Amplitudes_2Pi	code/init/lowPhoton/twoPi_production/Amplitudes.f90		
inMedium_delta_width	logical	.false.	turn of the in-medium-width of the delta
inMedium_delta_potential	logical	.false.	turn of the in-medium-potential of the delta
inMedium_nucleon_potential	logical	.false.	turn on the in-medium-potential of the nucleon
inMedium_pion_potential	logical	.false.	turn on the in-medium-potential of the pion
buuPotential	logical	.true.	use buu potentials, else constants

AnalyzeSpectra	code/analysis/analyzeSpectra.f90		
realID	logical, dimension(1:122)	.false.	Switch on/off the output for specific particle IDs from the real particles vector
pertID	logical, dimension(1:122)	.false.	Switch on/off the output for specific particle IDs from the pert particles vector

angular_distribution	code/collisions/phaseSpace/winkelVerteilung.f90		
deltaPWave	logical	.true.	Switch for P-Wave decay of delta in pion nucleon Only relevant for deltas which are produced in pion-nucleon collisions. → see also master_2body Values: • .false.= isotropic in CM-Frame • .true. = 1+3*cos(theta)**2 in CM Frame (theta is angle of producing pion to outgoing pion)
pionNucleon_backward	logical	.true.	Switch for backward peaked pion nucleon cross section: • .true.= use backward peaked distribution • .false.= isotropic
pionNucleon_backward_exponent	real	26.5	Exponent for backward peaked pion nucleon cross section. Distribution=(coeff-cos(theta))**exponent*(pole-sqrt(s)/pole) Only used if pionNucleon_backward=.true. .
pionNucleon_backward_coeff	real	1.9	Exponent for backward peaked pion nucleon cross section. Distribution=(coeff-cos(theta))**exponent*(pole-sqrt(s)/pole) Only used if pionNucleon_backward=.true. .

rho_pipi_nonIsotropic	logical	.true.	Switch for non-isotropic rho → pi pi decay: • .false.= isotropic in CM-Frame • .true. = non-isotropic
NNisotropic	logical	.false.	if .true.: set isotropic nucleon-nucleon elastic cross section
iParam_gammaNVN	integer	3	for gamma N → V N events, this parameter is given to the routine vecmesa and selects there, how dsigma/dt is calculated. Only if iParam_gammaNVN >= 0 the default value of that routine is overwritten. Possible values: • 0: 'old' parametrisation for gammaN→VN (cf. Effenberger PhD): dsigma/dt ˜ exp(Bt). Slope paremeter B according ABBHHM collab, PR 175, 1669 (1968). • 1: Pythia parametrisation: Slope parameter B=2*b_p+2*b_V+4*s**eps-4.2 • 2: 'Donnachie, Landshoff' Select t according dsig/dt as given by VecMesWinkel/dsigdt, not by a given slope parameter • 3: as 1, but for rho and W<ˆ6GeV slope parameter adjusted according CLAS experimental data [Morrow et al, EPJ A39, 5 (2009)] • 4: Muehlich PhD, Appendix E • 5: Rho0 Toy Init • 6: Rho0 Toy Init: Fit to PYTHIA-VMD • 7: Flat (not exp.) cf. VecMesWinkel/vecmesa for a detailed description.
NN_NR_noniso	logical	.false.	If .true., use non-isotropic angular distr. for NN → NR, according to dsigma/dt = b/t**a.

annihilation	code/collisions/twoBodyReactions/annihilation/Annihilation.f90		
model	integer	2	Switch between the models of annihilation: • 1 – string based model, • 2 – statistical model

position_flag	integer	1	Switch between the choices of position of outgoing mesons: • 1 – at the c.m. of the baryon and antibaryon, • 2 – at the antibaryon position

barAntiBar_input	code/collisions/twoBodyReactions/baryonBaryon/barAntiBar.f90		
fact_LambdaBar	real	1.	Enhancement factor of pbar p → Lambda LambdaBar cross section (for larger statistics)
fact_JPsi	real	1.	Enhancement factor of pbar p → J/Psi cross section (for larger statistics)
fact_JPsi_width	real	1.	Enhancement factor of the J/Psi total width (for larger statistics)
useAnni	logical	.true.	Flag whether to perform Baryon-Antibarion annihilation or not at all

barBar_barBar	code/collisions/twoBodyReactions/baryonBaryon/barBar_barBar.f90		
mat_NR	real, dimension(Delta:F37_1950)	...	Squared matrix elements M**2/16pi for N N → N R. See http://arxiv.org/abs/1203.3557.
mat_DR	real, dimension(Delta:F37_1950)	(/210., ...	Squared matrix elements M**2/16pi for N N → Delta R. See http://arxiv.org/abs/1203.3557.
icugnon	integer	1	Switch for nucleon nucleon → nucleon nucleon cross sections: • 0=old parametrization • 1=new parametrization (Alexej Larionov, Cugnon)
use_ND_ND_model	logical	.false.	Switch for delta nucleon → delta nucleon cross sections: • false=old parametrization • true =one pion exchange model (Effenberger, Buss)
new_NR_NR	logical	.true.	• .false.= Switch off the NR→ NR improvement (improvement= better NN↔NN fit is being used) • only for debugging or comparing
NR_NR_massSHIFT	logical	.false.	• .true.= Shift the srts in NR→ NR elastic collisions.
oldOset_treatment	logical	.false.	• .true.= Use the old treatment for the Oset Delta width: Put everything into 3-body. • only for debugging or comparing

etafac	real	6.5	Parameter for enhancement of p n → N*(1535) N, relative to p p → N*(1535) N, in order to enhance eta production in pn collisions. See Calen et al., PRC 58 (1998) 2667.
rhofac	real	1.	Parameter for enhancement of p n → N*(1520) N, relative to p p → N*(1520) N, in order to enhance rho production in p n collisions.
neufac	real	1.	Parameter for enhancement of p n → N R, relative to p p → N R, affecting all resonances.
neufac_roper	real	2.	Parameter for enhancement of p n → N N*(1440), relative to p p → N N*(1440). See http://arxiv.org/abs/1203.3557.

barBar_barBarMes	code/collisions/twoBodyReactions/baryonBaryon/barBar_barBarMes.f90		
NNpi_BG	integer	2	Switch for the N N → N N pi background: • 0 = no BG • 1 = BG according to Teis • 2 = BG according to Buss (improves threshold behavior, default) • 3 = BG according to Weil
NNV_BG	logical	.true.	Incude a N N → N N V background term, where V=omega,phi (in addition to possible resonance contributions).
isofac_omega	real	1.	Isospin enhancement factor for p n → p n omega, relative to p p → p p omega. Data indicate that this is around 2, while theory predicts even larger values (up to 5). Reference: Barsov et al., EPJ A21 (2004) 521-527.
isofac_phi	real	1.	Isospin enhancement factor for p n → p n phi, relative to p p → p p phi. Theory predicts values of 3-4, cf.: Kaptari, Kaempfer, Eur.Phys.J. A23 (2005) 291-304.

BarBar_to_barBar_model	code/collisions/twoBodyReactions/baryonBaryon/barbar_to_barbar_model.f90		
couplings_switch	integer	2	Possible values: • 1 = use couplings according to Dmitriev • 2 = use couplings according to Pascalutsa (default)

lambda_cutoff	real	0.6	Cutoff parameter in the form factor for ND→ND Possible values: • 0.6 (Dmitriev, default) • 1.2 (Doenges)

baryonPotential	code/potential/baryonPotential.f90		
EQS_Type	integer	5	Switch for equation of state for nucleon resonances with spin 1/2. Parameters for nucleon potentials: • 0 = nucleon potential is set to zero • 1 = soft, momentum dependent, lambda = 2.130 (Teis PhD, K = 215 MeV) • 2 = hard, momentum dependent, lambda = 2.126 (Teis PhD, K = 380 MeV) • 3 = soft, momentum independent (Teis PhD, K = 215 MeV) • 4 = hard, momentum independent (Teis PhD, K = 380 MeV) • 5 = medium, momentum dependent, lambda = 2.130 (Teis PhD, K = 290 MeV) • 6 = LDA potential (Birger Steinmueller) • 7 = Deuterium potential Argonne V18 (not usable for eventtypes 'heavyIon' and 'hadron') • 8 = LDA Potential Welke • 9 = Buss PhD, Set#1 (K = 220 MeV, momentum dependent) • 10 = Buss PhD, Set#2 (K = 220 MeV, momentum dependent) • 11 = Buss PhD, Set#3 (K = 220 MeV, momentum dependent) • 12 = Shanghai meeting 2014 (soft, momentum independent, K = 240 MeV) • 13 = slightly modified Cooper potential, central depth = - 67.5 MeV at p=0 (see #14) • 14 = Potential fitted by Cooper et al, Fig. 6 in PRC 47 (1993) 297 • 98 = use pre-stored values • 99 = variable Skyrme : E_bind, p_0, U_0, rho_0 must be defined! NOTES References: • for 1-5, see the PhD thesis of S. Teis, chapter 3.3.2 / table 3.1 • for 9-11, see the PhD thesis of O. Buss, chapter 7.2.3 / table 7.1

DeltaPot	integer	1	Switch for potential of spin=3/2 resonances: • 0 = no potential • 1 = nucleon (spin=1/2) potential times 2/3 [according to Ericson/Weise book] • 2 = 100 MeV * rho/rhoNull • 3 = nucleon (spin=1/2) potential
HypPot	integer	1	Switch for potential of hyperons: • 0 = no potential • 1 = nucleon (spin=1/2) potential times (3+S)/3 (i.e. according to the share of the light quarks) • 2 = nucleon (spin=1/2) potential
symmetryPotFlag	integer	0	Switch for the asymmetry term in the nucleon potential. NOTES Possible values: • 0 = none (default) • 1 = linear (strength given by 'dsymm') • 2 = stiffer, Esym=Esym_rho_0*U^gamma=31.*U^gamma, gamma=2 • 3 = stiff, linear increasing Esym=Esym_rho_0*U=31.*U • 4 = soft, U_c=3, can give negative Esym=Esym_rho_0*U*(U_c-U)/(U_c-1)
symmetryPotFlag_Delta	logical	.false.	Switch for the asymmetry term in the Delta potential. NOTES If .true., a symmetry potential will be used also for the Delta (but only if symmetryPotFlag>0). It is closely related to the symmetry potential of the nucleon.
noPerturbativePotential	logical	.false.	Switch for potential of perturbative particles. If .true. then perturbative baryons feel no potential.
rho_0	real	0.16	Nuclear matter density for EQS_Type=99 NOTES • Units : fm^-3

p_0	real	0.8	momentum for which U(p_0,rho=rho_0)=0 for EQS_Type=99 NOTES • Units : GeV
U_0	real	0.075	U(p=0,rho=rho_0) for EQS_Type=99 NOTES • Units : GeV
bindingEnergy	real	0.016	Nuclear matter binding energy for EQS_Type=99 NOTES • Units : GeV
compressibility	real	0.290	Nuclear matter compressibility for EQS_Type=99 NOTES • Units : GeV
SurfacePotFlag	logical	.false.	Switch for the surface term in the nucleon potential. NOTES • Do not use it together with yukawa!
nLoopReAdjust	integer	10	number of iterations, if density is readjusted (cf. type(nucleus)%ReAdjustForConstBinding) NOTES It is necessary to reiterate (at least for momentum dependent potentials), since we calculate the potential for a given pF and then calculate for the radjusting a new pF.
dsymm	real	0.03	Parameter for symmetry potential in GeV. NOTES Value is only used for symmetryPotFlag = 1

BaryonWidth	code/width/baryonWidth.f90		
readTable	logical	.true.	There is a tabulation of the widths saved in buuinput which is used to initialize ('baryonWidthVacuum.dat.bz2'). If you don't want to use this pre-tabulated input, then you can set "readTable=.false". This is useful for runs on a cluster where you want to minimize input/output. Also it is necessary if the decay channels have been modified (cf. DecayChannels.dat).
writeTable	logical	.false.	This flag determines whether we write out a new tabulation of the widths ('baryonWidthVacuum.dat.bz2'). It will only have an effects if readTable == .false. or reading of the tabulation file fails for some reason.

BaryonWidthMedium_tables	code/width/baryonWidthMedium_tables.f90		
minRes	integer	-1000	Read the data table starting at this minimal resonance ID. ONLY FOR TESTING!!!
maxRes	integer	1000	Read the data table up to a maximum resonance ID. ONLY FOR TESTING!!!
inMediumParameterset	integer	2	chooses the parameters for the inMediumWidth (1 electron, 2 neutrino)
onlyNucleon	logical	.false.	Only for debugging: only nucleon width is read in.
deltaOset	logical	.false.	Use delta width according to Oset et al. NPA 468 (1987)
extrapolateAbsP	logical	.false.	if(true) then set absP to maxAbsP if absP is larger

BaryonWidthVacuum	code/width/baryonWidthVacuum.f90		
use_cutoff	logical	.true.	• Switch on and off the use of cut off parameters. • These cut-offs are necessary when working with dispersion relations to deduce the real part.
deltaRho_cutoff	real	0.85	• Cut off parameter for the decay of a resonance into delta rho. • Units of GeV
baryon_cutoff	real	2.0	• Cut off parameter for the decay of a resonance into an unstable baryon and a meson. • Units of GeV
meson_cutoff	real	1.6	• Cut off parameter for the decay of a resonance into a baryon and an unstable meson. • Units of GeV
Delta_width	integer	1	Select a parametrization for the Delta width: • 1 = Manley (GiBUU default, cf. Manley/Saleski, Phys. Rev. D 45, 1992) • 2 = Dmitriev (Dmitriev/Sushkov/Gaarde, Nucl. Phys. A 459, 1986) • 3 = Moniz (Koch/Moniz/Ohtsuka, Ann. of Phys. 154, 1984) • 4 = Verwest (Phys. Lett. B 83, 1979) • 5 = UrQMD (Bass et al., Prog. Part. Nucl. Phys. 41, 1998)

BB_BYK	code/collisions/twoBodyReactions/baryonBaryon/barBar_BarHypKaon.f90		
enable	logical	.true.	Enable the production of BB → B Hyperon Kaon channels. B=Nucleonˆ0,1,Deltaˆ-,0.+,++; Hyperon=Lambdaˆ0,Sigmaˆ0,-,+; Kaon=Kˆ+,0
parameter_set	integer	2	Select a particular parameter set for BB→BYK collisions. Possible values: • 1 = original Tsushima model: Tsushima et al., PRC59 (1999) 369 • 2 = extended/adjusted model, fitted to HADES data: Agakishiev et al., arXiv:1404.7011 • 3 = custom parameters based on Tsushima values (as given by the array 'a' in the jobcard; those values not given in the jobcard are adopted from Tsushima, i.e. parameter set 1) • 4 = custom parameters based on HADES values (as given by the array 'a' in the jobcard; those values not given in the jobcard are adopted from HADES, i.e. parameter set 2)
a	real, dimension(1:Nch)	-1.	This array contains the "a" parameters (in microbarn) for the 30 primary channels, see: • Tsushima et al., PRC59 (1999) 369, table III • Agakishiev et al., arXiv:1404.7011, chapter IV Note: The values given in the jobcard are only used for parameter_set = 3 and 4.

Box	code/init/initBox.f90		
thermalInit	logical	.false.	flag how to initialize
nDens	real	1.0	particle density [fmˆ-3]
ChargeSelection	integer	0	define the type of the charge selection: • 0: only pi0 • 1: 50% pi+, 50% pi- • 2: 33% for +,0,-
pInit	real	0.5	initial momentum of particles [GeV/c]
BoostZ	real	0.0	additional boost for all particles in z-direction
Temp	real, dimension(1:122)	0.0	for thermal init: temperature of every meson species in GeV, if larger than 0. otherwise this species is not initialized

Fugacity	real, dimension(1:122)	1.0	for thermal init: fugacity of every hadron species.
correctMovingBox	integer	1	switch to indicate, whether a correction of the momenta after initialization should be done to enforce vanishing 3-momenta. possibilities are: • 0 : no correction • 1 : global correction • 2 : per ensemble correction

BoxAnalysis	code/analysis/BoxAnalysis.f90		
do_Tmunu	logical	.false.	Switch for Tmunu output. default: Only one file for all ensemble! you may change this with the flag perEnsemble_Tmunu
perEnsemble_Tmunu	logical	.false.	Switch for Tmunu output. One file per ensemble! NOTES this may slow down the execution dramatically, since huge output to the hard drive is induced. You may observe this, if e.g the cpu load drops permanently to 30%. Thus: switch it on, only if you want it!
do_P	logical	.false.	Switch for dN/pˆ2 dp output
do_velrel	logical	.false.	Switch for calculating velrel
do_Cumulants	logical	.false.	Switch for calculating cumulants
useSet			

Checks	code/run/checks.f90		
Do_CheckDensity	logical	.false.	Flag to indicate whether the density check routine should be called.
Do_CheckCoulomb	logical	.false.	Flag to indicate whether the Coulomb check routine should be called.
Do_CheckFermiSurface	logical	.false.	Flag to indicate whether the Fermi-surface check routine should be called.
Do_CheckRadius	logical	.false.	Flag to indicate whether the radius check routine should be called.
Do_CheckMomentumDensity	logical	.false.	Flag to indicate whether the momentum-density check routine should be called.
Do_CheckEnergyLDA	logical	.false.	Flag to indicate whether the local density approximation check routine should be called.
Do_OccupiedReal	logical	.false.	Flag to indicate whether the occupation check routine for the real particle vector should be called.

Do_OccupiedPert	logical	.false.	Flag to indicate whether the occupation check routine for the perturbative particle vector should be called.
Do_CheckEnergy	logical	.false.	Flag to indicate whether the energy check routine should be called.
Do_TachyonsReal	logical	.false.	Flag to indicate whether the tachyon check routine for the real particle vector should be called.
Do_TachyonsPert	logical	.false.	Flag to indicate whether the tachyon check routine for the perturbative particle vector should be called.
TachyonIsBlocking	logical	.false.	Select whether the occurrence of a 'tachyon' in the check routines will stop the code or not (error messages will hopefully occur later in the code).
Do_CheckPertFlag	logical	.true.	Flag to indicate whether the flag '%perturbative' is set correctly in the particle vectors
Do_CheckConservation	logical	.false.	Flag to indicate whether conservation of energy/momentum, baryon number and strangeness between time steps for the real particles should be checked

coll_BaB	code/collisions/twoBodyReactions/HiEnergy/DoColl_BaB.f90		
iset	integer	1	Switch to choose an initialization of jets: • 1: phase space distribution, also the charge is conserved (new prescription) • 2: first jet along inPart(1) momentum, 3-d jet opposite, others orthogonal, charge is not conserved (old prescription)

coll_Manni	code/collisions/twoBodyReactions/HiEnergy/DoColl_Manni.f90		
angDistribution	integer	2	Switch to select the angular distribution: • 1: isotropic • 2: diquark/quark aligned like baryon/meson
itry_max	integer	10	maximum number of tries

collCriteria	code/collisions/twoBodyReactions/collisionCriteria.f90		
kodama_evalFrame	logical	.false.	Set to .true., this logical will cause the kodama criterion to be evaluated in the laboratory/evaluation frame, not CM frame.

collHistory	code/storage/CollHistory.f90		
DoCollHistory	logical	.false.	Flag to switch on/off the whole Collision History machinery. You may set this variable via your jobcard, namelist "collHistory"

collisionterm	code/collisions/collisionTerm.f90		
oneBodyProcesses	logical	.true.	Switch on/off one-body-induced processes.
twoBodyProcesses	logical	.true.	Switch on/off two-body-induced processes.
threeBodyProcesses	logical	.true.	Switch on/off three-body-induced processes.
threeMesonProcesses	logical	.false.	Switch on/off three-meson-induced processes. These are the backreactions for e.g. omega → pi pi pi etc.
threeBarMesProcesses	logical	.false.	Switch on/off baryon-meson-meson induced processes. These are the backreactions for e.g. N pi → N pi pi etc.
twoPlusOneBodyProcesses	logical	.false.	Switch on/off 2+1 body processes (two really colliding particles plus one nearby).
twoBodyProcessesRealReal	logical	.true.	Switch on/off two-body-induced processes between two real particles.
twoBodyProcessesRealPert	logical	.true.	Switch on/off two-body-induced processes between a real and a perturbative particle.
oneBodyAdditional	logical	.true.	Switch on/off additional Pythia one-body-induced processes.
doForceDecay	logical	.true.	switch on/off the forced decays at the end of the simulation NOTES • Do not touch, unless you know what you are doing! • You may set this to .false., if you are e.g. running box calculations with excited states. Decaying all these particles would need a much larger particle vector...
energyCheck	real	0.01	Precision of energy check for each collision in GeV.
maxOut	integer	100	Maximal number of produced particles in one process. Must not be smaller than 4. NOTES • When using annihilation, must not be smaller than 6 • If using FRITIOF or PYTHIA, should probably larger than 6 • Code stops with an error message, if value chosen too small

collisionProtocol	logical	.false.	Write a protocol of all real-real collisions to the file 'fort.990'. Includes the time, IDs, charges, invariant masses and 3-momenta of both collision partners and an indicator for Pauli blocking.
printPositions	logical	.false.	Switch on/off output of positions in real-pert collisions. Produces statistical output.
useStatistics	logical	.false.	Generate statistical information using the module statistics.
noNucNuc	logical	.false.	Switch on/off perturbative NN reactions.
storeRho0Info	logical	.false.	Flag whether in a rho0 decay the particle numbers of the resulting charged pions are stored or not.
storeRho0InfoOnlyDifr	logical	.false.	Flag, whether the flag storeRho0Info is valid for all decays or only for rho0, which are marked to be diffractive.
DoJustAbsorptive	logical	.false.	If this flag is true, then: for perturbative simulations all final state particles in a collision are set to zero; for real simulations %event index of incoming hadron is changed in the case of collision, but actual collision is not simulated. This is a way to mimick Glauber like calculations. NOTES The "absorption" is done with sigmaTot, not just by sigmaInEl.
annihilate	logical	.false.	If this flag is true, then an annihilation of the antibaryons with the closest baryons will be simulated (by hand) starting from annihilationTime.
annihilationTime	real	1000.	Time moment (in fm/c) when the annihilation will be started. NOTES This flag has an influence only when annihilate = .true. Before annihilationTime all the collision processes are not activated. They start to act (if the corresponding switches oneBodyProcesses,twoBodyProcesses etc. are .true.) only after annihilationTime.
justDeleteDelta	logical	.false.	Deletes final-state products in Delta N N $\rightarrow$ NNN and Delta N $\rightarrow$ N N. NOTE: Only for testing and comparing with the old Effenberger code! DO NOT USE OTHERWISE: Violates energy conservation! This switch is meant to simulate the treatment of the Delta in the old code. Only implemented for perturbative runs.
noRecollisions	logical	.false.	Outgoing particles of collisions are inserted somewhere in the particle vector. Due to implementation issues, these outgoing particles may interact during the same timestep. Setting this flag to true, the parameter '%lastCollisionTime' is checked against the actual time variable and collisions of these particles are excluded.

collReporter	code/collisions/collisionReporter.f90		
UseCollReporter	logical	.false.	Enable or disable the collision reporter.
cR_sizeT	integer	200	Number of timestep bins.
cR_sizeE	integer	100	Number of sqrt(s) bins.
cR_DeltaT	real	0.1	Size of timestep bins.
cR_DeltaE	real	0.1	Size of sqrt(s) bins.

ColStat	code/collisions/twoBodyReactions/twoBodyStatistics.f90		
flag_sqrts	logical	.false.	If .true., then the calculation and output of the sqrts distributions from subroutine sqrts_distribution will be done
flag_rate	logical	.false.	If .true., then the calculation and output of the collision rates from subroutine rate will be done
flag_varirate	logical	.false.	If .true., then the calculation and output of the collision rates from subroutine varirate will be done
sqrts_mode	integer	1	This flag determines the way how sqrt(s) is calculated (if flag_sqrts = .true.). 1 = use vacuum sqrt(s) 2 = use in-medium, i.e. full sqrts
varirate_chargeZero	logical	.true.	If .true., then all charge states are combined together
varirate_size	integer	100	size of array to hold all rates
varirate_filterPhi	logical	.false.	If .true., then only channels involving a phi meson are reported

coulomb	code/potential/coulomb/coulomb.f90		
coulombFlag	logical	.false.	Switch to turn on/off the Coulomb potential. If turned on, also 'symmetryPotFlag' (in namelist 'baryonPotential') needs to be turned on.
magnetFieldFlag	logical	.false.	Switch to turn on/off elm. vector potential. NOTES The vector potential is not yet fully implemented! Please do not use this option.

cutMomentumPotential	real	0.025	If larger than 0, the coulomb potential is set to zero for all particles with momentum larger than minmass**2/(2*cutMomentumPotential) The cut-off is smeared out, if cutMomentumWidth>0 This cut is needed in non-RMF mode since ¡pre¿ m_effˆ2 = (sqrt(mˆ2+pˆ2)+U_C)ˆ2-pˆ2 can become smaller than zero for ¡pre¿ p > U_C/2 - mˆ2/(2*U_C). In this case we have a 'tachyon'. NOTES • for RMF mode you do not need this cut • This value should correspond to the maximum vale of the Coulomb potential. Therefore you should readjust this for every nucleus. • For the pion, we take the mass (0.138) instead of minmass, since here minmass is zero!
cutMomentumWidth	real	0.100	If cutMomentumPotential>0 and cutMomentumWidth>0, then the cut-off is smeared by some linear interpolation: ¡pre¿ (At-Width) = 1.0 ... (At+Width) = 0.0 with At = minmass**2/(2*cutMomentumPotential) and the width given here in GeV. This width is introduced in order to destroy numerical problems due to sharp edges.

DecayChannels	code/database/decayChannels.f90		
rhoDelta_is_sigmaDelta	logical	.false.	If true, the rho-Delta decay channel will be replaced by sigma-Delta. For discussion, see e.g. Effenberger PhD, chapter 6.3.2.

deltawidth	code/width/deltaWidth.f90		
deltaSwitch	integer	3	Switch for different prescriptions for the delta width. NOTES • 1 = use Oset self energies+BUU input • 2 = Spreading potential • 3 = use Oset self energies • 4 = density dependent with BUU input

detailed_diff	code/analysis/neutrinoAnalysis.f90		
EkinMin	real	0.	if detailed_diff_output is TRUE: Maximal kinetic energy for dsigma/dEkin for hadrons
EkinMax	real	2.	if detailed_diff_output is TRUE: Maximal kinetic energy for dsigma/dEkin for hadrons
dEkin	real	0.01	if detailed_diff_output is TRUE: Delta(eKin) for dsigma/dEKin for hadrons
forPion	logical	.true.	If .true. then also the detailed output of differential cross sections is produced
forEta	logical	.false.	If .true. then also the detailed output of differential cross sections is produced
forKaon	logical	.false.	If .true. then also the detailed output of differential cross sections is produced
forKaonBar	logical	.false.	If .true. then also the detailed output of differential cross sections is produced
forDmeson	logical	.false.	If .true. then also the detailed output of differential cross sections is produced
forDbar	logical	.false.	If .true. then also the detailed output of differential cross sections is produced
forDs_plus	logical	.false.	If .true. then also the detailed output of differential cross sections is produced
forDs_minus	logical	.false.	If .true. then also the detailed output of differential cross sections is produced
forNucleon	logical	.true.	If .true. then also the detailed output of differential cross sections is produced
forLambda	logical	.false.	If .true. then also the detailed output of differential cross sections is produced
forSigmaResonance	logical	.false.	If .true. then also the detailed output of differential cross sections is produced
forXi	logical	.false.	If .true. then also the detailed output of differential cross sections is produced
forOmegaResonance	logical	.false.	If .true. then also the detailed output of differential cross sections is produced

deuteriumFermi	code/init/deuterium.f90		
waveFunction_switch	integer	1	Possible values are: • 0 – No Wave functions! Pointlike Deuterium • 1 – Wave functions according to Bonn potential • 2 – Wave functions according to Argonne V18

iParam	integer	1	Choose parameterization of momentum distribution when using the Bonn potential. Possible values: • 1 – Full Bonn (MaH87) • 2 – OBEPQ (MaH87) • 3 – OBEPQ-A (Mac89) • 4 – OBEPQ-B (Mac89) • 5 – OBEPQ-! (Mac89) • 6 – OBEPR (MaH87) self-made • 7 – Paris References: MaH87: R. Machleidt et al. Phys. Rep. 149, 1 (1987) Mac89: R. Machleidt, Advances in Nucl. Phys. Vol 19
pMax	real	0.5	Cut-off parameter for Fermi momentum
scaleMomentum	real	1.0	The selected momentum is multiplied by this factor afterwards, i.e. some rescaling is done

DileptonAnalysis	code/analysis/DileptonAnalysis.f90		
Enable	logical	.false.	If .true. the dilepton analysis will be performed, otherwise not.
Extra	logical	.false.	If .true. an extended analysis will be performed, writing out many extra histograms (beyond the basic ones: mass, pT and rapidity).
DeltaDalitz	integer	2	Choose between different parametrizations of the Delta Dalitz decay width (Delta → N e+e-): • 1 = Wolf, http://inspirehep.net/record/306273 • 2 = Krivoruchenko (default), http://inspirehep.net/record/555421 • 3 = HadronTensor • 4 = Ernst, http://inspirehep.net/record/452782

DeltaDalitzFF	integer	1	Choose a parametrization of the electromagnetic N-Delta transition form factor for the Delta Dalitz decay (only used for DeltaDalitz = 2): • 1 = constant (default) • 2 = Dipole • 3 = MAID 2005 • 4 = simple VMD • 5 = Wan/Iachello, Int. J. Mod. Phys. A 20 (2005) 1846, http://inspirehep.net/record/689265 • 6 = Ramalho/Pena, Phys.Rev. D85 (2012) 113014, http://inspirehep.net/record/1114321
omegaDalitzFF	integer	1	Choose between different parametrizations of the omega Dalitz decay (omega → pi^0 e+e-) form factor: • 0 = constant • 1 = Effenberger/Bratkovskaya (default) • 2 = standard VMD • 3 = Terschluesen/Leupold
b_pi	real	5.5	This constant represents the b parameter in the form factor of the pi0 Dalitz decay (in GeV^-2), cf. Effenberger Diss. eq. (2.141). Originally taken from L.G. Landsberg, Phys. Rep. 128, 301 (1985).
lambda_eta	real	0.716	This constant represents the Lambda parameter in the form factor of the eta Dalitz decay in GeV. Values: • L.G. Landsberg, Phys. Rep. 128, 301 (1985): Lambda = 720 MeV • HADES pp@2.2, B. Spruck, Diss. (2008): Lambda = 676 MeV • NA60, Arnaldi et al, PLB 677 (2009): Lambda = 716 MeV (default) • CB/TAPS, Berghuser et al, PLB 701 (2011): Lambda = 722 MeV

etaPrimeDalitzFF	integer	0	Choose between different parametrizations of the eta' Dalitz decay (eta' → e+e- gamma) form factor: • 0 = constant (default) • 1 = eta FF (cf. lambda_eta) • 2 = generic VMD • 3 = Genesis / Lepton-G • 4 = standard VMD (Terschluesen)
angDist	integer	1	This switch determines the angular distribution of the pseudoscalar Dalitz decays P → e+ e- gamma (with P=pi0,eta,etaPrime): • 0 = isotropic decay • 1 = anisotropic decay according to 1 + B*cos**2(theta) with B=1 • 2 = the Dalitz decays of pi0 and eta will be done via Pythia.
brems	integer	1	This switch determines how the bremsstrahlung contribution is obtained: • 0 = none • 1 = soft-photon approximation (SPA) • 2 = according to the one-boson-exchange (OBE) model by R. Shyam (for NN bremstrahlung only, no em. form factors) • 3 = as 2, but with pion em. form factor (for pn) • 4 = as 3, but times correction factor (for pn), see arXiv:2009.11702
nEvent	integer	10	Number of events to generate for each dilepton decay (to enhance statistics).
nEvent_BH	integer	1000	Number of events for Bethe-Heitler simulation. BH typically needs a lot more statistics than the other dilepton channels. Therefore nEvent_BH should be much bigger than nEvent.
kp_cut	logical	.false.	Perform a cut on (k*p) in the dilepton analysis, where k is the photon 4-momentum, and p is the electron or positron 4-momentum. This is useful for suppressing the BH contribution. Cf. "kp_min".
kp_min	real	0.01	If kp_cut=.true. a cut on (k*p) is performed. kp_min determines the position of this cut. Only events with (k*p)>kp_min are taken into account.
binsz	real	0.01	This determines the bin size of the dilepton mass spectrum in GeV. Default is 10 MeV.

filter	integer	0	If filter is nonzero, a filtering algorithm will be applied to the dilepton pairs, otherwise they will be written to the histograms unfiltered. For details on the filtering parameters see routine 'CS'. Choices: • 0 = no filter • 1 = DLS • 2 = HADES (simple cuts on polar angle, absolute momentum and opening angle) • 3 = HADES (full acceptance filter, using pair acceptance) • 4 = HADES (full acceptance filter, using single-particle acceptance) • 5 = g7/CLAS @ JLab • 6 = KEK E325 (cuts on rapidity, transverse momentum and opening angle) • 7 = JPARC E16 NOTES For filtering modes 3 and 4, the file containing the acceptance matrices must be specified (cf. hadesFilterFile).
hadesFilterFile	character(len=1000)	" "	This character string determines the location of the file containing the HADES acceptance matrices (filename with absolute or relative path). It has to be set for filtering modes 3 and 4.
WriteEvents	integer	0	This switch decides whether we write out the simulated events. Possible values: • 0: Don't write events (default). • 1: We write out only the lepton pair information (including charge, four-momentum, perturbative weight, source channel and filter result). All of this will be written to a file called 'Dilepton_Events.dat'. • 2: As 1, but only writing exclusive events (NN→NNe+e-). • 3: We write out all produced particles in the event (including the lepton pair) to a file called 'Dilepton_FullEvents.dat'. • 4: As 3, but only writing exclusive events (NN→NNe+e-). • 5: As 4, but only writing out R→Ne+e- events (with R=N*,Delta*).
p_lep_min	real	0.	This switch sets a lower bound on the lepton momentum. Only leptons with momenta larger than this threshold will pass the filter. This switch is only used for filtering mode 5 (JLab).

beta_gamma_cut	real	1.25	This is an upper bound on the beta*gamma value of the lepton pair. Since beta*gamma = p/m, it cuts on slow pairs.
massBinning	real, dimension(1:4)	(/ 0.150, 0.550, 9.999, 9.999 /)	We produce several histograms (e.g. p,pT,mT,y,theta_cm) not only for the full mass range, but also for (up to 5) different mass bins. The borders of these bins are given by this array.
particle_source	logical	.true.	This switch determines whether the mass spectrum will contain separate channels for different sources of particles, such as decays (R→rho N) or collisions (pi pi → rho, K K → phi). Currently this is only done for the rho and phi mesons. Note: If using this switch, the "sum" channel in the mass histogram should not be used, since the rho and phi contributions will enter twice.

elementary	code/init/initElementary.f90		
impactParameter	real	-1.	• >=0: this is the actual impact parameter • <0 : Impact parameter integration up to an automatically determined b_max. The actual impact parameter is randomly sampled in the interval [0.,b_max] with a proper geometrical weight.
particleId	integer, dimension(2)	(/1,1/)	Id of particles
particleAnti	logical, dimension(2)	(/.false.,.false./)	if .true. then particles are antiparticles
particleCharge	integer, dimension(2)	(/0,0/)	Charge of the particles
srtsRaiseFlag	logical	.false.	• if .true. then the srts stepping is done • if .false. then the ekin_lab stepping is done
ekin_lab	real	1.	kin. energy of first particle in the rest frame of second particle (starting value for the energy scan: the number of different energies is set by parameter num_Energies in the namelist "input")
delta_ekin_lab	real	0.03	kin. energy step for energy scan
srts	real	3.	invariant energy (starting value for the energy scan)
delta_srts	real	1.	srts step for srts scan

Elementary_Analysis	code/analysis/ElementaryAnalysis.f90		
DoOutChannels	logical	.false.	switch on/off: reporting of all final state channels
DoH2d	logical	.false.	if .true. than make output of 2-dimensional histograms (they could produce files of size 240 mb)
Do45ForAllEvents	logical	.false.	flag to decide, whether DoElementaryAnalysis4(5).dat is written for all events or just for events, where the output channel consist of pions
DodNNbar	logical	.false.	
DoPanda	logical	.false.	if .true., elementary analysis for channels with S = -2 and -3 (Xi, Omega)
Dodsigdt	logical	.false.	
Do2Part	logical	.false.	

eN_Event	code/init/ElectronGenerator/eN_event.f90		
selectFrame	integer	2	select frame, in which the calculaton of W_free is done: • 0 = doNOT — do NOT remove • 1 = CM • 2 = CALC • 3 = THRE prescription from correct threshold behaviour, used in heavy ion collisions • 4 = NucleonRest : boost nucleon in the rest frame, set free mN, recalculate boson momentum • 5 = THRE2 threshold with mˆ2: sfree=s+mˆ2-m*ˆ2
restingNucleon	logical	.true.	if this flag is .false., we use the momentum of the target nucleon in the calculation of the flux

EventOutput	code/analysis/EventOutputAnalysis.f90		
WritePerturbativeParticles	logical	.false.	Flag to write out the perturbative particle vector to an output file. The switch 'EventFormat' determines which format is used.
WriteRealParticles	logical	.false.	Flag to write out the real particle vector to an output file. The switch 'EventFormat' determines which format is used.

EventFormat	integer	1	This switch determines the format of the event output files. Possible values: • 1 = Les Houches format (default) • 2 = OSCAR 2013 format • 3 = Shanghai 2014 format • 4 = ROOT NOTES • For Les Houches, the output will be written to files called EventOutput.Pert.lhe and EventOutput.Real.lhe. • For OSCAR, the output files are called EventOutput.Pert.oscar and EventOutput.Real.oscar. • For Shanghai, the output files are called EventOutput.Pert.dat and EventOutput.Real.dat. • For ROOT, the output files are called EventOutput.Pert.root and EventOutput.Real.root.
Interval	integer	0	Interval for event output, i.e. number of timesteps after which output is written. If zero, only final output at the end of the time evolution is produced.

externalSystem	code/init/initExternal.f90		
inputFile	character*1000	’./source.inp’	the absolute name of the input file with hadrons to be propagated. possible values: • if not set, default is ’./source.inp’ • if given, but does not contain ’/’: default is ’./[inputFile]’ • otherwise: filename is absolute, including path NOTE if you want to use the file ’XXX.inp’ in the actual directory, give it as ’./XXX.inp’
DoPerturbative	logical	.false.	if true, the particles will be inserted into the perturbative particle vector, the real particles have to be initialized via some nucleus definition

NumberingScheme	integer	1	The way, how particles%event will be numbered: • 1: event = iPart, i.e. the particle number in the ensemble (historical, but does not work for fullensemble) • 2: event = pert_numbering() or real_numbering() (good both for perturbative and real mode)
posSRC	logical	.false.	If true, the position vectors of the proton and neutron from SRC will be sampled by Monte-Carlo. Relevant when the target nucleus was initialized before calling initializeExternal and if there are only proton and neutron in the external source.
flagPH	logical	.false.	If true, a particle-hole excitation will be added to the target nucleus. The momentum of the particle is obtained by adding transverse momentum transfer along x-axis and from "-" momentum conservation.
pt	real	0.	Transverse momentum transfer to the struck nucleon (GeV/c). Relevant when flagPH=.true.

ff_QE	code/init/lepton/formfactors_QE_nucleon/FF_QE_nucleonScattering.f90		
parametrization	integer	3	• 0 = dipole approximation • 1 = BBA03 parametrization • 2 = BBBA05 parametrization • 3 = BBBA07 parametrization
MV2	real	0.71	vector mass squared in the dipole parametrization of the vector form factors
MA_in	real	1.0	axial mass (only if useNonStandardMA=.true.)
useNonStandardMA	logical	.false.	if one wants to use a specific axial mass, set this to true and choose value for MA_in
deltas	real	-0.15	strange contribution to the axial ff.
axialMonopole	logical	.false.	use axial ff. of Gari, Kaulfuss PLB 138 (1984)

FinalState_Full	code/collisions/phaseSpace/finalState_Full.f90		
maxbwd_scalingFactor	real	1.	• Rescales maxBWD
silentMode	logical	.true.	• Switches error messages off in massAss. Errors can still be seen looking at massAssStatus.dat

NYK_isotropic	logical	.false.	If .true., the angular distribution in Nucleon-Hyperon-Kaon production is assumed to be isotropic. If .false., a non-isotropic distribution is used, as described in Larionov/Mosel, Phys.Rev. C 72 (2005) 014901. See also momenta_in_3Body_BYK.

formfactors_pion	code/init/lepton/formfactors_pionProduction/formfactors_A_input.f90		
which_MaidVersion	integer	2	choice of MAID version: 1=2003, 2=2007

Freezeout	code/analysis/FreezeoutAnalysis.f90		
FreezeoutAnalysis_Pert	logical	.false.	Flag to do freeze out analysis for perturbative particles
FreezeoutAnalysis_Real	logical	.false.	Flag to do freeze out analysis for real particles
potThreshold	real	0.005	threshold value in GeV. If the absolute value of the potential is below this value, the particle is considered to be 'free', e.g. it 'escaped'

gamma_2Pi_Xsections	code/init/lowPhoton/twoPi_production/gamma2Pi_Xsections.f90		
experimentalXsections	logical	.true.	• If .true. then the Xsections are taken from the experiment • If .false. then the theoretical values are given

hadron	code/init/initHadron.f90		
impactParameter	real	0.	smaller 0: Impact parameter will be chosen randomly in the interval [0;abs(impactParameter)] (see subroutine setGeometry). It is recommended to take very large negative value of impactParameter in order to have good automatic random choice, e.g. impactParameter=-100.
bRaiseFlag	logical	.false.	if .true.: actual impact parameter will be raised by deltaB after nRunsPerB subsequent runs. Starting value is given by the impactParameter variable.
deltaB	real	0.	impact parameter step (relevant if bRaiseFlag=.true.)
nRunsPerB	integer	1	number of subsequent runs per impact parameter (relevant if bRaiseFlag=.true.)
perturbative	logical	.false.	if .true. then the hadron is a perturbative particle

numberParticles	integer	200	Number of projectile testparticles per ensemble in the case of a perturbative treatment
particleId	integer	1	Identity of the projectile hadron.
antiParticle	logical	.false.	if .true. then the hadron is an antiparticle
particleCharge	integer	0	Charge of the hadron
ekin_lab	real	1.	kinetic energy of the hadron in the rest frame of the target nucleus (GeV) NOTES If ekin_lab $< 0.$ — initialization according to the binding energy
E_bind	real	0.	binding energy of initialized hadron (GeV) NOTES Active for iniType= 0,2 if ekin_lab $< 0.$ is set.
iniType	integer	0	• 0: usual initialization for the hadron-nucleus collision • 1: position and momentum of the hadron is chosen according to the Gaussians centered, resp., at the centre of the nucleus and at zero momentum (impactParameter, distance and ekin_lab have no effect in this case) • 2: gaussian in coordinate space, but usual sharp momentum choice (impactParameter, distance and ekin_lab work as usual)
zChoice	integer	1	• 1: hadron is initialised at fixed distance delta from nuclear surface • 2: hadron is initialised at fixed z Relevant for iniType=0 or iniType=2.
delta	real	0.5	• for zChoice=1: distance from nuclear surface, at which the hadron is initialised [fm] • for zChoice=2: maximum distance from the edge of nucleus in transverse direction which restricts the choice of actual impact parameter for impactParameter < 0 (for impactParameter > 0 no restriction) Relevant for iniType=0 or iniType=2.
deltaZ	real	5.	z = -deltaZ - R_nucleus, where z is z-coordinate of the hadron Relevant for iniType=0,2 and zChoice=2.
width	real	1.	Width of a gaussian density profile [fm]. Only relevant for iniType= 1 and 2.

HadronAnalysis	code/analysis/hadronAnalysis.f90		
flagAnalysis	logical	.false.	If true, perform the output of a hadron at the latest time step before the hadron disappeared (file DoHadronAnalysisTime.dat). The output hadron has the same baryon/meson type and antiparticle-flag as the beam particle. In case if the hadron did not disappear, the output is done at the end of the time evolution. The output for the hadron is also done in three another files if its momentum becomes for the first time less than the cut values pCut1 and pCut2 (files DoHadronAnalysisTime1.dat and DoHadronAnalysisTime2.dat) and if it becomes bound (DoHadronAnalysisTime3.dat) NOTES Presently feasible only for real particle simulations.

hadronformation	code/collisions/twoBodyReactions/hadronFormation.f90		
tauProda	real	0.5	in formation time concept 2) and 3) for "error particles": production time of non-leading in rest frame of hadron (in fm)
tauForma	real	0.8	in formation time concept 1) and in concept 2),3) for "error particles": formation time in rest frame of hadron (in fm)
tauFormaFak	real	1.0	in formation time concept 1): scale factor for constituent quark model, rescales #(lead quarks)/#quarks
useJetSetVec	logical	.true.	Flag to select fragmentation time estimates: • false → old concept 1) • true → new concepts 2) and 3) NOTES select false in case of calculations on a nucleon (speed!).
powerCS	real	1.0	in formation time concept 2): power of 't' (constant, linear, quadratic)
useTimeFrom	integer	1	in formation time concept 2): encode time XS starts to evolve: 1: tP_min, 2: tP_max, 3: tF
useTimeTo	integer	3	in formation time concept 2): encode time XS stops to evolve: 1: tP_min, 2: tP_max, 3: tF
GuessDiffrTimes	logical	.true.	if true, then the times for diffractive particles are treated like them of all other particles, otherwise particles from "diffractive" events hadronize immediately.
useJetSetVec_Q	logical	.true.	if useJetSetVec, then also use Q2 as measure for XS-pedestal, i.e. select concept 3) instead of concept 2)
useJetSetVec_R	logical	.true.	if not useJetSetVec_Q, then use rLead as measure for XS-pedestal

pedestalCS	real	0.0	in formation time concept 2): encode time XS stops to evolve: 1: tP_min, 2: tP_max, 3: tF
useQDM	logical	.false.	If true, then use the quantum diffusion model of G.R. Farrar et al., PRL 61, 686 (1988). It means that the cross section grows as (t-t_int)**powerCS for t_int < t < t_form, where t_int is the interaction time (=0 for electron-nucleus case) and t_form= t_int + 2*p/dM2. So hadrons with equal momenta have equal formation times (lengths). Also allows to control the space-time scale of hadronization. Attention: setting useQDM = .true. overrides other switches of this module.
dM2	real	0.7	Mass denominator in the coherence length. Relevant only for quantum diffusion model (when useQDM =.true.)
use_pCut	logical	.false.	If true, then only particles with momentum p < pCut will interact.
pCut	real	1.	Momentum cutoff. Relevant only when use_pCut =.true.

HadronTensor_ResProd	code/init/lepton/hadronTensor_ResProd.f90	
speedup	logical	.true.

heavyIon	code/init/initHeavyIon.f90		
impact_parameter	real	0.	Impact parameter b [fm]. There are three options: • b>=0: The impact parameter is fixed to the given value. • -100<b<0: The impact parameter will be chosen randomly in each run between 0 and abs(b). • b<=-100: "Minimum bias". The impact parameter will be chosen randomly in each run (maximum = sum of radii plus twice the sum of surfaces).

impact_profile	integer	0	This switch provides impact-parameter distributions for trigger-biased setups. Only used for impact_parameter < 0. Possible values: • 0: minimum bias (default) • 1: HADES C+C at 1.00 AGeV • 2: HADES C+C at 2.00 AGeV • 3: HADES Ar+KCl at 1.76 AGeV • 4: HADES Au+Au at 1.23 AGeV (all) • 5: HADES Au+Au at 1.23 AGeV (0-10% central) • 6: HADES Au+Au at 1.23 AGeV (10-20% central) • 7: HADES Au+Au at 1.23 AGeV (20-30% central) • 8: HADES Au+Au at 1.23 AGeV (30-40% central)
distance	real	0.	Distance between centers of nuclei along z (i.e. beam)-direction [fm]. This will be readjusted automatically in case it is too small.
coulomb	logical	.false.	If .true., then a Coulomb propagation from coulombDistance = 10000 fm to distance is performed.
ekin_lab_Target	real	0.	Kinetic energy per nucleon of target nucleus in lab frame [GeV].
ekin_lab_Projectile	real	0.	Kinetic energy per nucleon of projectile nucleus in lab frame [GeV].
adjustGridFlag	logical	.false.	If .true., the grid spacing in z-direction will be readjusted.
cmsFlag	logical	.true.	If .true., the collision takes place in the CM frame of the two nuclei (default option). If .false., the collision takes place in the LAB frame (target at rest).

HICanalysis_Input	code/analysis/HeavyIonAnalysis.f90		
flag_outputReal	logical	.false.	If .true., then the output of the real particle vector will be written to the file 'DoHIA.dat'.
flag_outputPert	logical	.false.	If .false., then the output of the perturbative particle vector will be written to the file 'DoHIA_pert.dat'.

flag_outputDetailed	logical	.false.	Print out more detailed information at each time step from subroutine HeavyIon_evol: • rhorad_*.dat • rhoz_*.dat • rhozx_*.dat • Fields_*.dat • pauli_*.dat • dens_max.dat
pionAnalysis	logical	.false.	This flag generates various pion spectra (p_T, m_T, y, etc). The analysis operates under the assumption of a fixed target, and expects the collision to be performed in the CMS system (cf. cmsFlag in namelist /heavyIon/). The analysis matches the one applied to the HADES data in Agakishiev et al., Eur.Phys.J. A40 (2009) 45-49.
rapBinning	real, dimension(0:7)	(/ -0.75, -0.45, -0.15, 0.15, 0.45, 0.75, 1.05, 1.35 /)	Rapidity binning for the pion analysis (only used if pionAnalysis = .true.). The numbers represent the binning borders in y0. For each of the seven y0 bins, a separate mT spectrum will be generated.
KaonAnalysis	logical	.false.	This flag generates various Kaon spectra and Kaon-related analyses.
DensityPlot	logical	.false.	This flag select printing the density for several time steps
NucleonMassPlot	logical	.false.	This flag select printing the (invariant) mass of the nucleons for several time steps
do_Tmunu	logical	.false.	Switch for Tmunu output.
rotateZ_Tmunu	logical	.false.	select, whether the particles are first rotated to be aligned to the z-axis
correctPot_Tmunu	integer	0	select, whether the energy is corrected for the potential or not: • 0: no correction • 1: full potential added to p0 • 2: only U_b/2+U_r added to p0

HiGammaNucleus	code/init/ElectronGenerator/eventGenerator_eN_HiEnergy.f90		
DoLowEv	logical	.true.	If this flag is set true, then for W_free<HighEnergyThreshold we will call the low energy model routines.

DoTransEv	logical	.false.	flag: use transitionEvent in order to replace PYTHIA events by events where we give the cross section explicitely and do the remaining stuff by FRITIOF NOTES this replaces the flag "FRITIOF" in the namelists "HiLeptonNucleus" and "HiPhotonNucleus"
useHermesPythiaPars	logical	.false.	flag: Use "PYTHIA tuning done by HERMES collab"
DoDiffr	logical	.true.	flag: Generate diffractive events
PYTHIAthresh	real	2.0	Below this value for W, PYTHIA is not used to generate (G)VMD events NOTES This value is transferred to PyVP.f. you can access this value by the function "GetPYTHIAthresh()".
useVMD_VM	logical, dimension(4)	.true.	These flags can be used to switch on/off some VM in the VMD description of the events generated by "transitionevent" NOTES • The VMD events of PYTHIA are not affected. (We could change this!)
useRes	logical, dimension(2:nres+1)	.true.	Switch for including/excluding specific resonances
allowRes	logical	.true.	Switch for including/excluding resonance contribution. If this is set to .true., 1pion events will just be generated as for the background, but according the full MAID cross section (if at all)
allow1pi	logical	.true.	Switch for including/excluding 1pion contribution. Depending on the switch allowRes, 1 pion events will be done according the full cross section or just as a background.
allow2piBack	logical	.true.	Switch for including/excluding additional 2pion background.
allowDIS	logical	.true.	Switch for including/excluding DIS contribution
allowVMDrho	logical	.true.	Switch for including/excluding the VMD gamma N $\rightarrow$ rho0 N contribution
DoToyModel_pi	logical	.false.	flag: Use a Toy model instead of realistic event generation. Only a single pion is generated

DoToyModel_rho	logical	.false.	flag: Use a Toy model instead of realistic event generation Only rho0 N events are generated. Additional assumptions: (c.f.UseFormTime_ToyModel_rho) * tau_F = 0 * tau_F = m with t_F = E (boost according E/m, not E_string/M_string) In the latter case we suffer also the following simplifications: • no Q2 dependance • XS starts with n_L/n = 0.5 (should be 0.66 for the nucleon)
UseFormTime_ToyModel_rho	logical	.false.	flag: if .true., we set the formation times of the particles produced in the ToyModel_rho equals to the energy of the particle (t_f/fm=E/GeV) representing the assumption tau_f/fm = m/GeV plus a boost according E/m. (Otherwise the formation time is set to zero.)
DoExclPiModel	logical	.false.	flag: Use a model for exclusive pion production. Only those events are generated
ExclPiCharge	integer	1	variable to specify the charge of the pion produced, if DoExclPiModel is selected
flagTwoJets	logical	.false.	If .true. - the events without two jets with large transverse momentum are marked with XS_tot=100000 mub.

HiLepton_Analysis	code/analysis/HiLeptonAnalysis.f90		
DoTimes	logical	.false.	switch on/off: reporting of times
DoOutChannels	logical	.false.	switch on/off: reporting of all final state channels
DoInvMasses	logical	.false.	switch on/off: reporting of pairwise-invariant-masses
DoFindRho0	logical	.false.	switch on/off: reconstructing rho0 from final pions
DoClasie	logical	.false.	switch on/off: Do pion analysis as Clasie et al., arXiv:0701.1481
DoMorrow	logical	.false.	switch on/off: Do pion analysis as Morrow et al., Morrow:2008ek
DoBrooks	logical	.false.	switch on/off: Do pi+ pT2 spectra for Brooks delta pT2
DoMandelT	logical	.false.	switch on/off: Do pion analysis with Mandelstam t.
DoClassifyFirst	logical	.false.	Classifying 'FirstEvent' into some classes Needs DoEventAdd.
DoFSIsqrts	logical	.false.	switch on/off: Estimate potential/future final state interactions Plot the sqrt(s) distribution of potential final state interactions of perturbative particles with the nucleus (real) particles). (The interactions do not happen, this is calculated before every propagation.) In order to select the particle class for which one wants to report the FSI, please change directly the code.

DoCentralN	logical	.false.	switch on/off: Do centrality analysis with slow nucleons
DoLeptonKinematics	logical	.false.	switch on/off lepton kinematics output
DoHadronKinematics	logical	.false.	switch on/off hadron kinematics output
flagDoIt	logical	.true.	switch on/off using DoHiLeptonAnalysis

HiLeptonNucleus	code/init/initHiLepton.f90		
iExperiment	integer	0	choice of experiment, detector and energy possible values are: • 0: no experiment/fixed kinematics • 1: Hermes, 27GeV, D,N,Kr • 2: Hermes, 27GeV, Ne • 3: Hermes, 27GeV, H • 4: JLAB, 12GeV • 5: JLAB, 5GeV • 6: EMC, 100GeV • 7: EMC, 120GeV • 8: EMC, 200GeV • 9: EMC, 280GeV • 10: Hermes, 12GeV • 11: Hermes, 27GeV, arXiv:0704.3270 • 12: Mainz, Yoon: Ebeam=1.5GeV • 13: Hermes, 27GeV, arXiv:0704.3712 (pT-broadening) • 14: JLAB, 5GeV, rho0 experiment • 15: JLAB, 4GeV, rho0 experiment • 16: EIC, E_e and E_A given explicit (3+30,11+30,4+100) • 17: no detector, total cross section, Ebeam • 18: E665, 470GeV • 19: CLAS/JLAB, 12GeV RunGroupA optimized 10.6 GeV • 20: CLAS/JLAB, 12GeV RunGroupA theoterical please note: The entry "iExperiment == 0" replaces the old HiPhoton event type.
shadow	logical	.true.	flag: Consider shadowing or not
minimumMomentum	real	0.1	minimal momentum considered. (in GeV)

ModusCalcFluxNorm	logical	.false.	if this flag is true, than we do not really generate events. We only select nu and Q2 according an equal distribution and plot the flux (and the flux multiplied with AccWeight). Normally we choose nu and Q2 according flux*Accweight via von-Neumann- rejection method (where we loose access to the absolute normalisation).
iDetector	integer	-1	This sets the treatment of the detector: • -1 : not valid/not initialized/use default • 0 : no detector, as AccFlag=.false. • 1 : HERMES, full efficiency • 2 : EMC, full efficiency • 3 : CLAS, only cuts (th_e=12..50, th_hadron=6..143) • 4 : CLAS, full efficiency + cuts as for 5GeV • 5 : CLAS, electron: cuts (th_e=12..50), hadrons: efficiency+cuts as for 5GeV • 90 : full acceptance
EIC_Ee	real	-99.9	the electron beam energy, if iExperiment=EIC
EIC_EA	real	-99.9	the hadron beam energy, if iExperiment=EIC
realRun	logical	.false.	Flag to indicate, whether we produce real or perturbative particles. NOTES run with real particles untested !!!
DoStatistics	logical	.false.	switch on/off statistical output of init routines
user_numin	real	-99.9	user given value for numin, overrides default value if reasonable
user_numax	real	-99.9	user given value for numax, overrides default value if reasonable
user_costmin	real	-99.9	user given value for costmin, overrides default value if reasonable
user_costmax	real	99.9	user given value for costmax, overrides default value if reasonable
user_ymax	real	-99.9	user given value for ymax, overrides default value if reasonable
user_smin	real	-99.9	user given value for smin, overrides default value if reasonable
user_xBmin	real	-99.9	user given value for xBmin, overrides default value if reasonable
user_qsqmin	real	-99.9	user given value for qsqmin, overrides default value if reasonable
user_qsqmax	real	-99.9	user given value for qsqmax, overrides default value if reasonable
user_maxw	real	-99.9	user given value for maxw, overrides default value if reasonable

earlyPauli	logical	.false.	Flag to indicate, whether we should check Pauli blocking already during generation or only at the end. if .false. (default), events will be generated in a first stage without Pauli blocking. This is then tested afterwards. If the generated event is blocked, it will be redone! Thus Pauli blocking does *not* change the total cross section, only the relative strength will be reshuffled. if .true., then blocked events will be excluded from the Monte Carlo decision and the total cross section will be reduced. NOTES The behaviour, if no event at all is possible, is at the moment a little bit unpredictable ;)

HiPhotonKinematics	code/init/initHiLepton.f90		
nu	real	-99.9	Photon energy [GeV]
Q2	real	-99.9	transfer four momentum squared [GeV^2]
eps	real	-99.9	Photon polarisation [1]
srts	real	-99.9	sqrt(s) of electron nucleon system [GeV]
W	real	-99.9	sqrt(s) of photon nucleon system [GeV]
xBj	real	-99.9	Bjorken x [1]
Ebeam	real		electron beam energy [GeV]

HiPion_Analysis	code/analysis/HiPionAnalysis.f90		
Enable	logical	.true.	If .true. the HiPion analysis will be performed, otherwise not.
EnablePerTime	logical	.false.	If .true. the HiPion analysis per timestep will be performed, otherwise not.
DoSimpleKin	logical	.false.	switch on/off: Analysis for simple kinematics: pZ-, pT-spectra etc.
DoHarp	logical	.false.	switch on/off: Analysis for the HARP experiment
DoBlobel	logical	.false.	switch on/off: Analysis according Blobel et al.
DoInvMasses	logical	.false.	switch on/off: reporting of pairwise-invariant-masses
DoOutChannels	logical	.false.	switch on/off: reporting of all final state channels

HiPionNucleus	code/init/initHiPion.f90		
distance	real	15.	Distance in z-direction from the nucleus center in fm, where the projectiles are initialzed. If negative, the distance will be chosen automatically.
impact_parameter	real	0.	Impact parameter of the projectiles in fm. If positive (or zero), this fixed value is used for all projectiles. If negative, the impact parameter is chosen by Monte Carlo, so that the projectiles are distributed over a certain disk. Cf. 'setPosition'.
ProjectileCharge	integer	0	Charge of projectile particles.
ProjectileID	integer	pion	ID of projectile particles.
ProjectileAnti	logical	.false.	Antiparticle flag of projectile particles.
nTestparticles	integer	200	Number of projectile testparticles per ensemble.
ekin_lab	real	-99.9	Kinetic energy of projectile particles in lab frame [GeV].
p_lab	real	-99.9	Momentum of projectile particles in lab frame [GeV/c].
DoPerturbativeInit	logical	.false.	If this flag is set to .true., the first collision of the projectile particles with a nucleon in the target nucleus will be done in this init routine (at timestep 0). This enables you to treat the first (hard) collision different from those in the FSI. If this flag is set to .false., the projectile particles have to be propagated onto the nucleus as in the default trasport treatment. See documentation of 'initHiPionInducedCollide' and 'initHiPionInducedCollideFull' for further information.
DoOnlyOne	logical	.true.	If the first interaction of beam and target particles is treated already here in the init (cf. DoPerturbativeInit), you may select whether a beam particle may interact only once (flag set to .true.) or with all other target nucleons (flag set to .false.). See documentation of 'initHiPionInducedCollide' and 'initHiPionInducedCollideFull' for further information.
minimumMomentum	real	1.0	Minimal momentum of particles (in GeV) produced in the init routines. Only particles with an absolute momentum larger than this will be further propagated.
useHermesPythiaPars	logical	.false.	flag: Use "PYTHIA tuning done by HERMES collab"
NucCharge	integer	-1	Select charge state of nucleons to scatter on. If this value is >=0, then we only scatter on nucleons with the respective charge, i.e. only on neutrons if NucCharge==0 and only on protons if NucCharge==1. Useful e.g. for selecting only pn events in a pd collision.

History	code/collisions/history.f90		
IncGeneration_Decay	logical	.true.	This flag determines whether we will increase the stored 'generation' of the daughter particles in a resonance decay.
IncGeneration_Elastic	logical	.true.	This flag determines whether we will increase the stored 'generation' of particles in an elastic collision. Setting it to .false. will also prevent elastic collisions from showing up as parents in the history.

InABoxAnalysis	code/analysis/InABoxAnalysis.f90		
Enable	logical	.true.	Flag to enable or disable the box analysis alltogether.
Interval	integer	20	Interval for output, i.e. number of timesteps after which output is written.

initDatabase	code/database/particleProperties.f90		
propagationSwitch	integer	3	• 0 = propagate resonances with more than 1 star in their rating (irrespar=0 in old code) • 1 = propagate just the Delta (irrespar=2 in old code) • 2 = propagate no resonance (irrespar=3 in old code) • 3 = propagate all resonances (default)
usageForXsectionSwitch	integer	2	• 0 = use resonances with more than 1 star rating for cross sections • 1 = use all resonances for cross sections • 2 = use all resonances besides the 1* star I=1/2 resonances • 3 = use only the Delta
rho_dilep	logical	.false.	If .false. (default), the rho meson width will be exclusively given by the 2pi decay and its minmass will be 2m_pi. If .true., the dilepton width will be included in the width and spectral function of the rho, and the minmass will be 2m_e. This is important for dilepton spectra, in order to get contributions from the rho below the 2pi threshold.

FileNameDecayChannels	character(1000)”	The absolute filename of the file containing decay channel infos. possible values: • if not set, default is ’[path_To_Input]/DecayChannels.dat’ • if given, but does not contain ’/’: default is ’[path_To_Input]/[FileNameDecayChannels]’ • otherwise: filename is absolute, including path NOTE if you want to use the file ’XXX.dat’ in the actual directory, give it as ’./XXX.dat’

initDensity	code/density/density.f90		
densitySwitch	integer	1	This switch decides whether the density is static or dynamic during the run. (”Static” makes sense only for fixed target scenarios!) One can use a static density if the nucleus stays roughly in its ground state during the collision. possible values: • 0: Density is set to 0. • 1: Dynamic density according to test-particle distribution. • 2: Static density (not for heavy-ion collisions). • 3: Resting matter: Density is given by the two input parameters ”densityInput_neutron” and ”densityInput_proton”.
linearInterpolation	logical	.true.	If this switch is ’true’, then the dynamic-density mode uses linear interpolation to determine the density in between the gridpoints.
densityInput_proton	real	0.084	Assumed proton density if densitySwitch=3
densityInput_neutron	real	0.084	Assumed neutron density if densitySwitch=3
gridSize	real, dimension(1:3)	(/12.,12.,12./)	Size of density grid in fm.
gridPoints	integer, dimension(1:3)	(/30,30,30/)	Number of gridpoints in each space direction.
setnewsmearing	logical	.false.	Readjust the smearing to a different width if .true.
newsmearing	real	1.	Use a smearing width as in a grid wtih newsmearing times the gridspacing
numberLargePoints	integer	2	Number of points which are considered to the left and right to smear density on

initInABox	code/init/initInABox.f90		
proton_Density	real	0.084	• proton Density [fmˆ-3]
neutron_Density	real	0.084	• neutron Density [fmˆ-3]
fermiMotion	logical	.true.	• true = switch on Fermi motion • false = switch off Fermi motion
temp	real	0.	If fermiMotion is true, this switch determines the temperature (in GeV) used in the Fermi distribution.
energy_density	real	0.	Energy density in GeV/fmˆ3. If a finite positive number is given, the box will be boosted to a frame with the given energy density.
standing_wave_number	integer	0	If this number is larger than zero, the initial density distribution will not be uniform, but is modulated with a standing wave in z direction. The given number determines the number of oscillations throughout the box. The amplitude of the oscillations is currently fixed to be 20% of the (average) nucleon density.

initNbarN_to_NbarDelta	code/collisions/twoBodyReactions/baryonBaryon/NbarN_to_NbarDelta.f90		
delta_mass	real	0.01	• grid step on a delta mass (GeV)
maxPoints_mass	integer	150	• number of the grid points on the delta mass
delta_srts	real	0.01	• grid step on an invariant energy (GeV)
maxPoints_srts	integer	100	• number of the grid points on the invariant energy

InitNucleus_in_PS	code/init/initNucPhaseSpace.f90		
improvedMC	logical	.false.	• If this flag is set to .true. then we use the information of the already initialized nucleons to decide on the position of a nucleon which has to be initialized. • This prescription does only work properly if the smearing with is really small. Therefore it is switched off by default.
improvedMC_speedup	integer	500	• If improvedMC is set to .true. then this variable defines the speedup of the algorithm. • The number defines how often the density field is updated. • A large value of this parameter yields a less accurate test-particle distribution and a faster initialization.
HiTail	logical	.false.	If HiTail is set to .true., then a simple parametrization of n(p) is used to initialize the nucleon momenta (cf. function chooseAbsMomentum for details).

determine_Fermi_momentum_by_binding_energy	logical	.false.	If set to .true., the Fermi momentum will determined by E_B=p_f**2/(2m)+U(rho,p_F), where E_B is the binding energy per nucleon.
determine_Fermi_new_NucDLDA	logical	.false.	If set to .true., the Fermi momentum will be set to a value such that there are no unbound nucleons at the initialisation.
useEnergySF	logical	.false.	If set to .true., then a spectral function is used to choose the energy.
compressedFlag	logical	.false.	If set to .true., then a spherically deformed nucleus is initialized (isotropic compression/expansion; protons and neutrons in phase). This type of deformation corresponds to a giant-monopol resonance mode.
ScaleFactor	real	1.	If compressedFlag=.true., then rescale coordinates by ScaleFactor.
useCdA	logical	.false.	Instead of the usual momentum distribution according a fermi gas, use the momentum parametrizations as given in: • C. Ciofi degli Ati, S. Simula, PRC 53, 1689 (1996) These exist only for 2H,3He,4He,12C,160 40Ca,56Fe,208Pb
zeroNucleusMomentum	logical	.true.	Indicate whether a procedure should be called to try to find a momentum init where the sum of all nucleon momenta (per ensemble) is zero (or at least close to zero). At the moment, only a hill climbing algorithm is available, which changes the directions of the momenta randomly. The resulting averaged nucleus momentum is in the order of 10 MeV. Whitout that, the average nucleus momentum goes ˜0.17GeV*sqrt(A). (Applies only for A>2.)

initPauli	code/density/pauliBlocking.f90		
pauliSwitch	integer	1	• 0 : No Pauli blocking • 1 : dynamic Pauli blocking (use actual phase space densities) • 2 : analytic Pauli blocking (use ground state assumption) (not possible for Heavy Ions!)
densDepMomCutFlag	logical	.false.	if .true. - the radius in momentum space for selecting nucleons around given nucleon will depend on local Fermi momentum NOTES Used only for dynamic pauli blocking.
Gauss	real	1.0	Smearing for dynamic pauli blocking
cutGauss	real	2.2	Cutoff for gauss Smearing

cutMom	real	0.08	• for densDepMomCutFlag=.false. — radius of phase space box in momentum space • for densDepMomCutFlag=.true. — minimum radius of phase space box in momentum space
cutPos	real	1.86	Radius of phase space box in position space
nGridPos	integer	30	number of points in position space to save weights on
ensembleJump	integer	5	Parameter for speedup. Only every "ensemblejump"th ensemble is considered to evaluate the probability for pauli blocking.
DoHistogram	logical	.false.	if .true., a historgram is filled representing the blocking probability as function of the fermi momentum. You have to call 'WriteBlockMom' explicitely for writing the histogram

initRandom	code/numerics/random.f90		
Seed	integer	0	Random Seed (used to initialize the random number generator), accessible through the namelist 'initRandom'. If Seed is zero (default), then it is set via "SYSTEM_CLOCK()".
resetRandom	logical	.false.	Reread random generator, used by setRandom, useful for debugging.

initThermoDynamics	code/density/thermoDyn.f90		
temperatureSwitch	integer	1	• 1=groundstate calculations (T=0,mu=E_F) • 2=the full procedure
linearExtrapolation	logical	.true.	• .true.= Use linear extrapolation for temperature between gridPoints • .false.= Do not use it

input	code/inputOutput/input.f90		
path_To_Input	character(1000)	'../../buuinput'	Path to input files. This switch needs to be set to the local path of the 'buuinput' directory, which contains various input files for GiBUU.
numEnsembles	integer	300	Number of parallel ensembles
eventtype	integer	3	Switch for the type of event possible values: see module eventtypes

fullEnsemble	logical	.false.	Switch for the type of simulation: • .false.=parallel ensembles • .true.=full ensemble See also "localEnsemble".
localEnsemble	logical	.false.	Switch for the type of simulation: • .false. = parallel or full ensembles (depending on the value of the fullEnsemble switch). • .true. = fullEnsemble with "local collisionCriteria", see Lang/Babovsky et al., J. Comput. Phys. 106 (1993) 391-396. Setting localEnsemble = .true. will implicitly set fullEnsemble = .true. (disregarding its value in the jobcard).
delta_T	real	0.2	time difference for time stepping
numTimeSteps	integer	100	Number of time steps
variableTimeStep	logical	.false.	Switch for using of variable time step: • .false.= use constant time step delta_T (see above). • .true.= use time step computed from the frequency of collisions. In this case the input delta_T is used as the maximum allowed time step.
time_max	real	30.	Maximum time until which the time evolution will be computed in the case of variableTimeStep = .true.
num_energies	integer	1	Number of different energies for energy scans
num_runs_sameEnergy	integer	1	Number of runs with the same energy in the initialization.
checkGridSize_Flag	logical	.false.	Switch for checking if particles escape out of grid. possible values: • .false.= no check. • .true. = check is performed, and a warning flag is printed out, in case that particles are outside of the grid. • check valid only for real particles.

continousBoundaries	logical	.false.	• Switch to turn on continous boundary conditions. • Implications for density and propagation. • This means that particles are propagated according to continous boundaries. A particle leaving the grid will move back in from the opposite side. The densities are carefully constructed such that places at the opposite side contribute to places on the near side. • What is still missing is the full implementation in collision criteria, this is not done yet for the two body collisions! Be careful therefore with the 2-Body-collisions at the edges. A particle at one edge does not see its scattering partner at the opposite edge.
FinalCoulombCorrection	logical	.false.	Switch for Coulomb correction at the end of each run of the outgoing particles
length_perturbative	integer	-1	Length of perturbative particle vector (per ensemble). If negative, it will be determined automatically by event type.
length_real	integer	-1	Length of real particle vector (per ensemble). If negative, it will be determined automatically by event type.
freezeRealParticles	logical	.false.	Switch for not propagating real particles
printParticleVectors	logical	.false.	Switch to turn on the printing of the particle vector at the start and end of a run.
printParticleVectorTime	logical	.false.	• Switch to turn on the printing of the particle vector as function of time. • Useful for event classes using real particles (HeavyIon,Hadron). • See also 'timeForOutput' and 'timeSequence'.
printParticleVectorsFormat	integer	1	Select the format for printing the particle vectors. Possible values are: • 1: ASCII • 2: binary
timeForOutput	real	50.	• Time (fm/c) after which the particle vector is printed during run (see also variable "timeSequence"). • valid only if printParticleVectorTime = .true.
timeSequence	real	10.	• Time sequence (fm/c) of time dependent printing of the particle vector • valid only if printParticleVectorTime = .true.
DoPrLevel			
povray_switch	logical	.false.	Switch for generating Povray-Output

LRF_equals_CALC_frame	logical	.false.	• Switch to turn on the assumption that calculation frame and LRF frame coincide • Only useful for reactions close to ground state !!!
DoFragmentNucleons	logical	.false.	• Switch to turn on/off adding of nucleons stemming from fragmentation of bound clusters.
PrintCollsionList			

input_FF_Delta	code/init/lepton/formfactors_Delta/FF_Delta_production.f90		
FF_Delta	integer	1	This switch decides whether the Paschos form factors (FF_Delta=1) or the Maid form factors (FF_Delta=0) are used. Default is FF_Delta=1.

input_FF_ResProd	code/init/lepton/formfactors_ResProd/formFactor_ResProd.f90		
FF_ResProd	integer	0	With FF_ResProd (namelist "input_FF_ResProd" in the Jobcard) one can choose how the form factors are calculated: • 0: MAID's helicity amplitudes (Luis' helicity expressions - CM frame) • 1: fit of Lalakulich (PRD 74, 014009 (2006)) • 2: MAID's helicity amplitudes (Lalakulich's helicity expressions - LAB frame)
aDelta	real	-0.25	fit parameter for C_5^A (Adler)
bDelta	real	0.04	fit parameter for C_5^A (Adler)
cDelta	real	3.	fit parameter for C_5^A (Paschos)
DeltaAxFF	integer	1	choose between different axial form factors for the Delta: • 1: Adler • 2: Paschos • 3: dipol
HNV_axialFF	logical	.false.	With .true. or .false. HNV_axialFF (namelist "input_FF_ResProd" in the Jobcard) one can choose which axial form factors to use for Delta-resonance: • .true. is Hernandez-Nieves-Valverde fit with C5A=0.867,MA=0.985 (PRD 76) • .false. is as it was used by Lalakulich et al in PRD 74

nenner_C5A_Lalakulich	real	3.0	Factor wich appear in the Lalakulich parameterization of the axial C_5^A form factor 3.0 was fitted to BNL and used in Lalakulich PRD71 and PRD 74 fit of ANL gave 0.5
refit_barnu_axialFF	logical	.false.	With .true. refit_barnu_axialFF (namelist "input_FF_ResProd" in the Jobcard) means that the axial form factors are refitted to explain the low value of antineutrino cross section (exper data Bolognese PLB81,393 (1979))
W_cutOff_lambda	real	1.071	Value for lambda in the W-dependent cut-off function.
W_cutOff_switch	logical	.false.	Switch to include a W-dependent cut-off function for the vector form factor of the Delta: • false = excluded • true = included
vector_FF_switch	logical	.true.	Switch to turn off the vector form factors: • false = off • true = on
axial_FF_switch	logical	.true.	Switch to turn off the axial form factors: • false = off • true = on
W_cutOff_switchAll	logical	.false.	Switch to include a W-dependent cut-off function for the vector and the axial form factor of all resonances: • false = excluded • true = included NOTES we assume the same dependence as for the Delta vector form factor
DeltaCouplrelErr	real	0.	error in percent for C_5^A(0) for the Delta
MA	real	0.95	delta resonance axial mass parameter.

insertion	code/collisions/insertion.f90		
minimumEnergy	real	0.005	Minimal kinetic energy in GeV for produced perturbative nucleons. If their energy is below this threshold, then they are not propagated, i.e. they are not inserted in the particle vector. NOTES This value was formerly given in the namelist "collisionterm".

propagateNoPhoton	logical	.true.	If .true. then we eliminate all photons, such that they are not propagated and do not show up in the particle vector. If .false. then photons are explicitly propagated.

Lepton2p2h	code/init/neutrino/neutrinoparms.f90			
ME_Version	integer	4		indicate the type of matrix element parametrisation NOTES possible values: • 1: const ME_Norm_XX ! const for CC fitted to MiniBooNE is 1.8e-6 • 2: constant transverse and decreasing with Enu • 3: "Dipole transverse" transverse, fall with Q2 as 4-th power • 4: MEC from E. Christy (8/2015), with parametrization for longitudinal • 5: MEC from Bosted arXiV:1203.2262, with parametrization for longitudinal • 6: MEC additional parametrization, with parametrization for longitudinal • not yet implemented
ME_Norm_QE	real, dimension(1:3)	(/1.0, 1.0/)	1.0,	Overall strength of 2p2h matrix element with 2N out for (EM,CC,NC) NOTES The value == 1 gives the coded strength
ME_Norm_Delta	real, dimension(1:3)	(/1.0, 1.0/)	1.0,	Overall strength of 2p2h matrix element with NDelta out for (EM,CC,NC) NOTES The value == 1 is a dummy value
ME_Mass_QE	real, dimension(1:3)	(/1.0, 1.0/)	1.0,	Cutoff-mass in some parametrizations of 2p2h matrix element for NN out for (EM,CC,NC) NOTES The value == 1 is a dummy value
ME_Mass_Delta	real, dimension(1:3)	(/1.0, 1.0/)	1.0,	Cutoff-mass in some parametrizations of matrix element for NDelta out for (EM,CC,NC) NOTES The value == 1 is a dummy value

ME_Transversity	real, dimension(1:3)	(/1.0, 1.0, 1.0/)	Parametrisation of structure functions for (EM,CC,NC) NOTES The value = 1 chooses structure function W2 so that 2p2h is pure transverse
ME_LONG	real, dimension(1:3)	(/0.0, 0.0, 0.0/)	Parametrization of structure functions for (EM,CC,NC) NOTES The value = 0 turns any additional longitudinal contribution to structure funct. W2 off
ME_W3	real, dimension(1:3)	(/0.,1.0, 1.0/)	Overall strength factor for structure function W3 only for (CC,NC) NOTES overall strength parameter for structure function W3
ME_ODW	integer	2	switch for choosing the connection between structure functions W1(electron) and W1(neutrino) and W3(neutrino): • 1: for expressions from Martini et al • 2: for expressions from O'Connell et al • 3: for expression with relativistic version of O'Connell only for (CC,NC) NOTES • O'Connell et al: PR C6 (1972) 719 • Martini et al: PR C80 (2009) 065501
inmedW	integer	1	Controls which inv mass W is used in parametrization of 2p2h W1 NOTES • 1: W = static inv. mass in 2p2h parametrization of W1 • 2: W = inv mass for Fermi moving nucleons in potential • 3: W = inv mass for Fermi moving nucleons without potential
T	real	99	target isospin, affects only neutrino 2p2h structure function NOTES • T = 0, 1 , ... • T = 99 gives T = (N-Z)/2

Adep	integer	2	Switch for A-dependence of 2p2h structure function NOTES • 1: A-dependence for zero-range force (Mosel, Gallmeister, 2016) • 2: linear A-dependence, normalized to C12

lepton_bin	code/init/neutrino/initNeutrino.f90		
cost_min	real	-1.0	if detailed_diff_output is TRUE: Minimal cos(theta) of outgoing leptons, used in 2D dsigma/dEdcos(theta) This cut affects *only* the outgoing lepton
cost_max	real	+1.0	if detailed_diff_output is TRUE: Maximal cos(theta) of outgoing leptons, used in 2D dsigma/dEdcos(theta) This cut affects *only* the outgoing lepton
delta_cost	real	0.1	stepsize of cos(theta) of outgoing leptons, used in 2D dsigma/dEdcos(theta)
Elept_min	real	0.0	stepsize of min. energy of outgoing leptons, used in 2D dsigma/dEdcos(theta)
Elept_max	real	2.0	if detailed_diff_output or printAbsorption are TRUE: stepsize of maximal energy of outgoing leptons, used in 2D dsigma/dEdcos(theta)
delta_Elept	real	0.01	if detailed_diff_output or printAbsorption are TRUE: stepsize of energy of outgoing leptons, used in 2D dsigma/dEdcos(theta)

low_photo_induced	code/init/lowPhoton/initLowPhoton.f90		
energy_gamma	real	0.	Energy of incoming photon in nucleus rest frame (in GeV).
delta_energy	real	0.	Increase of energy for energy scans.
energy_weighting	integer	0	Determines the relative weight of different photon energies in energy scans Possible values: • 0 = flat distribution (all energies are weighted equal) • 1 = exponential distr. (energies are weighted ˜ 1/E)

LowElectron	code/init/lowElectron/lowElectron.f90		
runType	integer	1	• If runType=1, then we make runs at some fixed angle defined by lowElectron/theta_lf. • If runType=2, then we make runs at some fixed QSquared defined by lowElectron/QSquared

inputType	integer	1	Decides which set of variables is used to determine the final electron energy energy_lf and the step size delta_energy_lf: • If inputType=1, then we use directly energy_lf and delta_energy_lf as input • If inputType=2, then we use W_min and W_max as input. For this we assume the nucleon to be at rest to calculate energy_lf out of W. • If inputType=3, then we use energy_lf_min and energy_lf_max as input.
theta_lf	real	10.	Theta scattering angle of outgoing electron with respect to the incoming one. Only relevant of runType=1.
phi_lf	real	-10.	Phi scattering angle of outgoing electron with respect to the incoming one. If less than 0, then we do a Monte-Carlo-Integration over phi!
energy_li	real	1.2	Energy of incoming electron in GeV.
energy_lf	real	0.8	Energy of final state electron in GeV. * Only used if inputType=1
energy_lf_min	real	0.1	Minimal energy_lf * Only used if inputType=3
energy_lf_max	real	0.1	Maximal energy_lf * Only used if inputType=3
delta_energy_lf	real	0.8	delta(Energy) of final state electron in GeV for energy scans. * Only used if inputType=1
W_min	real	0.9	Minimal W at the hadronic vertex assuming a resting nucleon * Only used if inputType=2
W_max	real	1.9	Maximal W at the hadronic vertex assuming a resting nucleon * Only used if inputType=2
QSquared	real	0.5	QSquared of virtual photon. Only relevant of runType=2.
Do_QE	logical	.true.	Switch for including or excluding Quasi-Elastic (QE) processes
Do_1Pi	logical	.true.	Switch for including or excluding direct Single pion production processes. If the resonances are included (Do_Res=.true.) then only the background part is included.
Do_Res	logical	.true.	Switch for including or excluding resonance production processes
Do_2Pi	logical	.true.	Switch for including or excluding direct Double pion production processes. If the resonances are included (Do_Res=.true.) then only the background part is included.
Do_DIS	logical	.true.	Switch for including or excluding deeply inelastic scattering (DIS) events. Only relevant for W>1.4-1.5 GeV.
Do_2p2hQE	logical	.false.	Switch for including or excluding event according gamma* N1 N2 → N1' N2'

Do_2p2hDelta	logical	.false.	Switch for including or excluding event according gamma* N1 N2 → N' Delta
minMass_QE	real	0.3	Minimal mass of a nucleon in QE event. Prevents super-luminous nucleons when embedded in a Skyrme potential.
minEnergy_1pi	real	0.16	Minimal q_0 such that pion production processes are considered.
onlyDelta	logical	.false.	Switch for including only delta resonance
nuclearTarget_corr	logical	.true.	• If the input is a nuclear targer, then the target nucleus is at rest and we calculate the cross section for nuclear target: use flux with respect to the nucleus. • Use .false. only for debugging.

lowElePhoto_Analysis	code/analysis/lowElectronAnalysis.f90		
dOmega_switch	logical	.false.	If .true. then also dSigma/dOmega is produced, if false not..
dE_switch	logical	.false.	If .true. then also dSigma/dE is produced, if false not..

lowPhotonAnalysis	code/analysis/LowPhotonAnalysis.f90		
outputEvents	logical	.false.	If .true. then all events are printed to file.
outputEvents_onlyFree	logical	.false.	If outputEvents=.true. then only particles which may leave the nucleus, i.e. may become "free", are printed to file.
KruscheOutput	logical	.false.	If .true. then we perform an analysis as in EPJA22 347-351 (2004)
KruscheAnalyse_cut	real	0.	Value of the cut for the deltaE cut in EPJA22 347-351 (2004).
FissumOutput	logical	.false.	If .true. then we perform an analysis as in PRC 53,#3 pages 1278 ff. (1996) Produces dsigma/dOmega/dT_pi for piˆ+
photonAnalyse	logical	.false.	Special analysis for final state photons
TwoPiOutput	logical	.false.	If .true. then we perform an analysis for 2pi production, including statistics for the mass of the pi-pi pair.
pi0gamma_analysis	logical	.false.	Do analysis of pi0 gamma pairs (dsigma/dm), to reconstruct invariant mass spectrum of omega mesons.
pi0gamma_momcut	real	0.5	Cut on the absolute omega three momentum in GeV, being applied to the pi0 gamma spectrum.

pi0gamma_masscut	real, dimension(1:2)	(/0.,2./)	Cuts on the pi0-gamma invariant mass in GeV, being applied to all pi0-gamma spectra (except the mass spectrum). First component is lower limit, second component is upper limit.
pi0gamma_mombin	real	0.050	Bin size for the pi0 gamma momenentum spectrum in GeV.
pi0gamma_massres_sigma	real	0.025	Sigma parameter for the exp. resolution smearing (width of the Gauss or Novosibirsk function in GeV). See also pi0gamma_massres_tau.
pi0gamma_massres_tau	real	-0.090	Skewness parameter tau of the Novosibirsk function (for exp. resolution smearing). See also pi0gamma_massres_sigma.
Ekin_pi0_cut	real	0.	Cut on the kinetic energy of neutral pions in the pi0gamma_analysis. Only pions with kinetic energies larger than this cutoff are used for the analysis.

MassAssInfo	code/typeDefinitions/MassAssInfoDefinition.f90		
UseMassAssInfo	logical	.true.	This switch indicates, whether we want to use the whole MassAssInfo machinery or stick to the old prescription of mass assignment. You may set this switch via the jobcard. Anyhow, if your selection of switches for baryon and medium switches leads to cases which are not yet implemented, this flag is set to false automatically.

master_1body	code/collisions/oneBodyReactions/master_1Body.f90		
correctEnergy	logical	.true.	Scale final state momenta to fulfill energy and momentum conservation. If .false. energy conservation is violated
StableInFormation	logical	.true.	Particles during its formation time are considered to be stable or not.
omegaDecayMediumInfo	logical	.false.	Write out information about all decaying omega mesons to a file called "omegaMediumInfo.dat" (decay point, momentum, density, etc).

omegaDecay_restriction	integer	0	This switch, like omegaDecayMediumInfo, helps to analyze omega → pi0 gamma decays. It will only have an effect for omegaDecayMediumInfo = .true. Possible values: • 0 = none (default) • 1 = vacuum (rho < 0.1 rho0) • 2 = medium (rho > 0.1 rho0) With the default value (0), all omega decays are carried out as usual. For the value 1, the decay products are only kept, if the decay happens in the vacuum (i.e. at rho < 0.1 * rho0). For the value 2, the decay products are only kept, if the decay happens in the medium (i.e. at rho > 0.1 * rho0). If the density does not meet these conditions, the decay products are simply removed and will not be put in the particle vector (and thus they will not appear in the analysis).

master_2body	code/collisions/twoBodyReactions/master_2Body.f90		
correctEnergy	logical	.true.	Scale final state momenta to fulfill energy and momentum conservation. If .false. energy conservation is violated
baryonBaryonScattering	logical	.true.	Switch to turn off baryon-baryon-Scattering
baryonMesonScattering	logical	.true.	Switch to turn off baryon-Meson-Scattering
mesonMesonScattering	logical	.true.	Switch to turn off meson-Meson-Scattering
usePythia	integer	1	This flag decides whether to use Fritiof or Pythia for high-energy collisions: • 0: use Fritiof • 1: use Pythia NOTES • This flag is not used in the baryon-antibaryon channel
usePythia_BaB	integer	0	This flag decides whether to use Fritiof or Pythia for high-energy baryon-antibaryon collisions: • 0: use Fritiof • 1: use Pythia
useHiEnergy	logical	.true.	Switch to turn HiEnergy on/off. Formerly known as "useFritiof". NOTES Please be very sure what you are doing when setting this parameter to .false.!

HiEnergyThresholdBarMes	real	2.2	Sqrt(s) threshold for HiEnergy in Baryon-Meson Reactions
HiEnergyThresholdBarMesDelta	real	0.2	width for the Sqrt(s) threshold for HiEnergy in Baryon-Meson Reactions
HiEnergyThresholdBarBar	real	3.4	Sqrt(s) threshold for HiEnergy in Baryon-Baryon Reactions
HiEnergyThresholdBarBarDelta	real	0.1	width for the Sqrt(s) threshold for HiEnergy in Baryon-Baryon Reactions
HiEnergyThresholdBarAntibar	real	2.38	Sqrt(s) threshold for HiEnergy in Baryon-Antibaryon Reactions
HiEnergyThresholdBarAntibarDelta	real	0.0	width for the Sqrt(s) threshold for HiEnergy in Baryon-Antibaryon Reactions
useManni	logical	.true.	Flag, whether to use meson-baryon annhilation as proposed by Markus Wagner (Diploma, Giessen 2004), but with some enhanced treatment
ElastAngDist	integer	3	Choice of angular distribution in (high-energy) elastic collisions (cf. DoColl_Elast): • 1 = isotropic • 2 = J. Cugnon et al., NPA 352, 505 (1981) • 3 = Pythia (default)
flagElastBB	logical	.false.	If .true., use a constant elastic baryon-baryon cross section of 40 mb and no inelastic baryon-baryon scattering.
coarse	real, dimension(1:3)	(/3.,4.,4./)	coarse maximal impact parameter (in fm)
bmax_nucleonNucleon	real	2.52	Real maximal impact parameter for nucleon-nucleon-scattering. Maximal crossection is ¡pre¿ bMax**2 * pi * 10 mb/fm**2 = (2.52**2*pi*10) mb = 199.5 mb
bmax_nucleonResonance	real	1.60	Real maximal impact parameter for nucleon-resonance scattering. Maximal crossection is ¡pre¿ bMax**2 * pi * 10 mb/fm**2 = (1.60**2*pi*10) mb = 80.4 mb
bmax_hyperonNucleon	real	2.52	Real maximal impact parameter for hyperon-nucleon-scattering. Maximal crossection is ¡pre¿ bMax**2 * pi * 10 mb/fm**2 = (2.52**2*pi*10) mb = 199.5 mb
bmax_baryonPion	real	2.52	real maximal impact parameter for baryon pion scattering
bmax_baryonMeson	real	2.52	real maximal impact parameter for baryon-Meson-scattering
bmax_mesonMeson	real	2.	real maximal impact parameter for meson-meson-scattering
correctEnergy_message	logical	.true.	Switch off error message for energy correction failures.

OverideSigma_PiN	real	-99.9	Parameter to replace the calculated cross section for pi+N collision by a fixed value (in mb). Only in use if >= 0. The elastic cross section is assumed to be 1/10 of the given value.
OverideSigma_RhoN	real	-99.9	Parameter to replace the calculated cross section for rho+N collision by a fixed value (in mb). Only in use if >= 0. The elastic cross section is assumed to be 1/10 of the given value.
OverideSigma_PiPi	real	-99.9	Parameter to replace the calculated cross section for pi+pi collision by a fixed value (in mb). Only in use if >= 0. We set sigma_elast = sigma_tot
Overide_PiPi_ResIsElast	logical	.false.	Flag to replace the calculated cross section for pi+pi collision; The calculated resonant cross section will be transformed into the elastic cross section. Thus no resonances will be propagated explicitely, but they show up in the cross section We set sigma_elast = sigma_Res, sigma_Res = 0, sigma_tot = sigma_elast please note: background processes as pi pi $\leftrightarrow$ K K$^{\sim}$ are *not* affected by this switch. You have to disable those additionally by hand, see mesMes_do2to2
omega_K_factor	real	2.	Modification factor for the inelastic omega-nucleon cross section. Necessary to describe transpacrency ratio data measured by CBELSA/TAPS, see: http://arxiv.org/abs/1210.3074
coulombCorrect	logical	.false.	Since the new particles are initialized at new positions, also the total coulomb energy might change. If .true. than this is taken into account and some correction to sqrt(s) is done. NOTES Should only be used if the new finalstate particles are initialized in the middle of the two initial state particles! According to OB, this parameter, which switches on/off the usage of the routine "CoulombDifference", has more or less some nostalgical reasons. Better not to use it nowadays anymore!
mesMes_do2to2	logical	.true.	flag whether to do m m' $\leftrightarrow$ K K$^{\sim}$, K K*$^{\sim}$ etc.
mesMes_useWidth	logical	.false.	flag whether to use the width in m m' $\leftrightarrow$ K K$^{\sim}$, K K*$^{\sim}$ etc. This is needed to enforce detailed balance. Otherwise only pole masses are used.
doScaleResidue	logical	.true.	scale the cross section of real-pert collisions by a factor N'/N or Z'/Z for a scattering on a neutron or proton, where N' and Z' are calculated via the residuum.

master_3body	code/collisions/threeBodyReactions/masterThreeBody.f90		
correctEnergy	logical	.true.	Scale final state momenta to fulfill energy and momentum conservation. If .false., energy conservation is violated.
radiusNukSearch	real	2.9	Radius for the search of nucleons, i.e. the radius in which nucleons shall be searched for at rho_0.
deltaThreeBody			
pionThreeBody	logical	.true.	Switch for the NNpion → NN processes (false=OFF).
positionNNpi	logical	.false.	This switch determines where the final state particles in NNpi→NN are positioned: • true: pion position • false: center of NNPi (default)

MatrixElementQE	code/init/lepton/matrixElementQE.f90		
useQEextraterm	logical	.true.	switch on/off an extra term appearing in the current due to different masses of in- and outgoing nucleons
useCorrelations	logical	.false.	switch on/off RPA correlations according to Nieves, Amaro, Valverde, PRC70, 055503 (2004)
nievesCorr_para	integer	2	if RPA correlations are switched on, this parameter decides which set of varibles to use: • 1: modified Nieves et al., PRC70, 055503 (2004) • 2: original Nieves et al., PRC70, 055503 (2004) • 3: Tselyaev, Speth et al., PRC75, 014315 (2007)
gp	real	0.63	vary gp if RPA correlations are switched on
withScalarInt	logical	.true.	switch on/off scalar interactions

MediumModule	code/density/medium.f90		
mediumCutOff	real	1.E-8	If the density is lower than this value, then we treat the medium like vacuum.

mesonPotential	code/potential/mesonPotential.f90		
pionPot_Switch	integer	0	Switch for pion potential: • 0 = no potential • 1 = Oset potential (NPA 554), which is valid up to 50 MeV kinetic energy • 2 = Kapusta suggestion for pion potential (rather unusual) • 3 = Delta-Hole potential, which is valid up to 130 MeV kinetic energy • 4 = Smooth spline transition between switch 1 and 3. NOTES Can be set in namelist mesonPotential.
noPerturbativePotential	logical	.false.	Switch for potential of perturbative particles. If .true. then perturbative mesons feel no potential. NOTES Can be set in namelist mesonPotential.
vectorMesonPot	integer	0	Switch for medium-modification of vector mesons: • 0 = no modification • 1 = Brown-Rho-Scaling • 2 = Brown-Rho-Scaling with momentum dependence according to Kondtradyuk (see page 162 in Effenberger's thesis). Currently not available! NOTES Can be set in namelist mesonPotential.
brownRho	real	0.16	Brown-Rho scaling parameter alpha.

MesonWidthVacuum	code/width/mesonWidthVacuum.f90		
omega_width	integer	1	Select a parametrization for the omega vacuum width: • 1 = GiBUU default (a la Manley) • 2 = Muehlich

ModifyParticles	code/database/particleProperties.f90	
mass	real, -1.0 dimension(1:pion+nMes-1)	Input array for modifications on the particle mass NOTES This array is intended to "input" values for the mass of the particles, which are different from the default. Therefore only entries, which are positive after reading the file are stored in the internal database.
width	real, -1.0 dimension(1:pion+nMes-1)	Input array for modifications on the particle width NOTES This array is intended to "input" values for the width of the particles, which are different from the default. Therefore only entries, which are positive after reading the file are stored in the internal database.
stabilityFlag	integer, -1 dimension(1:pion+nMes-1)	Input array for modifications on the particle stability NOTES This array is intended to "input" values for the stability of the particles, which are different from the default. Therefore only entries, which are >-1 after reading the file are stored in the internal database. The index of the array is the particle ID. The value encodes on a bitwise level, how the particle may decay (cf. also master_1Body): • 1: particle may decay during run, if Gamma > gammaCutOff • 2: particle may decay at the end of the run, if Gamma > 0. • 4: particle may decay at the end via Jetset, if there the parameters allow for a decay. The default values are one of the following: • 0: particle may not decay at all (i.e. it is stable) • 3: particle may decay both during run and at the end (combination of 1 and 2)

neutrino_induced	code/init/neutrino/initNeutrino.f90		
process_ID	integer	2	Determine the process (cf. module leptonicID): • 1 = EM • 2 = CC • 3 = NC • -1 = antiEM • -2 = antiCC • -3 = antiNC
flavor_ID	integer	2	Determine the lepton flavor: • 1 = electron • 2 = muon • 3 = tau

nuXsectionMode	integer	0	To choose which kind of Xsection is calculated. All values set in module neutrino_IDTable.f90 possible values: • 0 = integratedSigma: required input: enu • 1 = dSigmadCosThetadElepton: required input: enu, costheta, elepton • 2 = dSigmadQsdElepton: required input: enu, Qs, elepton • 3 = dSigmadQs: required input: enu, Qs • 4 = dSigmadCosTheta: required input: enu, costheta • 5 = dSigmadElepton: required input: enu, elepton • 6 = dSigmaMC: required input: enu • 7 = dSigmadW: required input: enu, W calculation for specific experiments taking into account the flux (choose your favorite experiment with flag nuExp): • 10 = EXP_dSigmadEnu • 11 = EXP_dSigmadCosThetadElepton • 12 = EXP_dSigmadQsdElepton • 13 = EXP_dSigmadQs • 14 = EXP_dSigmadCosTheta • 15 = EXP_dSigmadElepton • 16 = EXP_dSigmaMC • 17 = EXP_dSigmadW

nuExp	integer	0	• 0 = no specific experiment • 1 = MiniBooNE neutrino flux (in neutrino mode = positive polarity) • 2 = ANL • 3 = K2K • 4 = BNL • 5 = MiniBooNE antienutrino flux (in antineutrino mode = negative polarity) • 6 = MINOS muon-neutrino in neutrino mode • 7 = MINOS muon-antineutrino in neutrino mode • 8 = NOVA neutrino (medium energy NuMI, 14 mrad off-axis), FD • 9 = T2K neutrino off-axix 2.5 degrees (at ND280 detector) • 10 = uniform distribution from Eflux_min to Eflux_max (see namelist nl_neutrino_energyFlux in the module expNeutrinoFluxes) • 11 = MINOS muon-neutrino in antineutrino mode • 12 = MINOS muon-antineutrino in antineutrino mode • 13 = MINERvA muon neutrino, old flux • 14 = MINERvA muon antineutrino, old flux • 15 = LBNF/DUNE in neutrino mode • 16 = LBNF/DUNE in antineutrino mode • 17 = LBNO neutrino in neutrino mode • 18 = NOMAD • 19 = BNB nue BNB= Booster Neutrino Beam • 20 = BNB nuebar • 21 = BNB numu • 22 = BNB numubar • 23 = NOvA ND • 24 = T2K on axis • 25 = MINERvA, 2016 flux • 99 = user provided input file
includeQE	logical	.true.	include QE scattering

includeDELTA	logical	.true.	include Delta excitation
includeRES	logical	.true.	include excitation of higher resonances
include1pi	logical	.false.	include one-pion cross section see neutrinoXsection.f90 for details: there one might choose between different models and also whether it is taken as background or as total cross section
include2pi	logical	.false.	include 2 pion background channel
includeDIS	logical	.false.	include DIS contribution
include2p2hQE	logical	.false.	include 2p2h QE contribution
include2p2hDelta	logical	.false.	include 2p2h Delta contribution
sigmacut	real	10e-4	events with a cross section smaller than this value are skipped.
realRun	logical	.false.	Do not initialize the final state particles as perturbative particles but as real ones.
printAbsorptionXS	logical	.false.	flag to produce output about inclusive (absorption) cross sections
FileNameFlux	character(1000)”		The absolute filename of the file containing flux info, if user supplied possible values: • if given, but does not contain ’/’: default is ’[path_To_Input]/[FileNameFlux]’ • otherwise: filename is absolute, including path (’~’ is okay) NOTE if you want to use the file ’XXX.dat’ in the actual directory, give it as ’./XXX.dat’
storeNucleon	integer	2	indicate which kind of struck nucleon to save: • 1: free Nuecleon (i.e. potential removed) • 2: bound nucleon NOTES real check of energy and momentum conservation only possible with ’2’

neutrino_MAIDlikeBG	code/init/neutrino/singlePionProductionMAIDlike.f90		
b_proton_pinull	real	3.	strength of 1pi BG for CC, multiplies EM BG 3. is tuned to ANL, 6. is tuned to BNL
b_neutron_piplus	real	1.5	strength of 1pi BG for CC, multiplies EM BG 1.5 is tuned to ANL, 3. is tuned to BNL

neutrino_matrixelement	code/init/neutrino/matrixelement.f90		
which_resonanceModel	integer	0	to change between different realizations of the matrix elements: • 0 = with Fortran calculated matrix elements containing all resonances (default) • 1 = with Mathematica calculated matrix elements (only Delta) • 2 = Rein and Sehgals matrix elements

NeutrinoAnalysis	code/analysis/neutrinoAnalysis.f90		
detailed_diff_output	logical	.false.	If .true. then also the detailed output of differential cross sections is produced
include_W_dist	logical	.false.	If .true. then the invariant mass distributions for events with 1 pion and 1 nucleon in the final state are produced
kineticEnergyDetectionThreshold_lepton	real	0.0	kineticEnergyDetectionThreshold only lepton kinetic energies above this threshold can be detected This cut affects *all* events, not just the outgoing lepton!
AngleUpperDetectionThresholdDegrees_lepton	real	180.0	lepton angles up to this value can be detected This cut affects *all* events, not just the outgoing lepton!
kineticEnergyDetectionThreshold_nucleon	real	0.0	kineticEnergyDetectionThreshold lower detection threshold for nucleon kinetic energies
AngleUpperDetectionThresholdDegrees_nucleon	real	180.0	nucleon angles up to this value can be detected
kineticEnergyDetectionThreshold_chargedpion	real	0.0	kineticEnergyDetectionThreshold
AngleUpperDetectionThresholdDegrees_chargedpion	real	180.0	charged pion angles up to this value can be detected
kineticEnergyDetectionThreshold_neutralpion	real	0.0	kineticEnergyDetectionThreshold
AngleUpperDetectionThresholdDegrees_neutralpion	real	180.0	neutral pion angles angles up to this value can be detected
inclusiveAnalysis	logical	.true.	if flag "inclusiveAnalysis" is set to true, we keep all particles in FinalEvents.dat, independent of if they are bound or not
Fissum_analysis	logical	.false.	do analysis with cuts as needed for Fig 25 in Fissum et al, PRC 70, 034606 (2004)
ZeroPion_analysis	logical	.false.	produce output of xsec for various final states with 0 pions and 2 pions see file see sigma_0pions.dat for the list of the final states see files neutrino_0pions.dat, neutrino_0pions_QE.dat, neutrino_0pions_Delta.dat, ... for output
calorimetric_analysis	logical	.false.	do calorimetric energy-transfer and neutrino-energy reconstruction (for each QE, Delta, ...) as in the MINOS experiment

radialScale	real	1.5	If radial position of nucleon < radialScale*target radius, then the nucleon is assumed to be bound
reconstruct_neutrino_energy	logical	.false.	reconstruct neutrino energy for final state in "specificEvent_analysis" NOTES .true. must be combined with specificEvent_analysis=.true. and at least one specific event .true.
outputEvents	logical	.false.	If .true. then all events are printed to the file 'FinalEvents.dat'.
specificEvent_analysis	logical	.false.	do analysis for specific final states values can be changed in the namelist nl_specificEvent
Xsection_analysis	logical	.false.	If .true. then files "..._total_Xsection_..." and "..._dSigmadEkin_..." are printed.

nl_calorimetric_analysis	code/analysis/neutrinoAnalysis.f90		
numin	real	0.	for calorimetric analysis: values for transferred energy; only work if calorimetric_analysis is .true. set the min, max and bins for nu distributions
numax	real	10.0	for calorimetric analysis: values for transferred energy; only work if calorimetric_analysis is .true. set the min, max and bins for nu distributions
nubin	real	0.1	for calorimetric analysis: values for transferred energy; only work if calorimetric_analysis is .true. set the min, max and bins for nu distributions
Enumin	real	0.	for calorimetric analysis: values for neutrino energy; only work if calorimetric_analysis is .true. set the min, max and bins for nu distributions
Enumax	real	10.0	for calorimetric analysis: values for neutrino energy; only work if calorimetric_analysis is .true. set the min, max and bins for nu distributions
Enubin	real	0.1	for calorimetric analysis: values for neutrino energy; only work if calorimetric_analysis is .true. set the min, max and bins for nu distributions

nl_dSigmadcostheta	code/init/neutrino/neutrinoXsection.f90		
enu	real	-10.	neutrino energy, read in by namelist
costheta	real	-10.	cosine of the angle between the neutrino (z-direction) and the outgoing lepton
delta_costheta	real	-10.	value by which costheta is increased

nl_dSigmadCosThetadElepton	code/init/neutrino/neutrinoXsection.f90		
enu	real	-10.	neutrino energy, read in by namelist
costheta	real	-10.	cosine of the angle between the neutrino (z-direction) and the outgoing lepton
elepton	real	-10.	energy of the outgoing lepton
delta_elepton	real	-10.	value by which elepton is increased

nl_dSigmadElepton	code/init/neutrino/neutrinoXsection.f90		
enu	real	-10.	neutrino energy, read in by namelist
elepton	real	-10.	energy of the outgoing lepton
delta_elepton	real	-10.	value by which elepton is increased

nl_dSigmadQs	code/init/neutrino/neutrinoXsection.f90		
enu	real	-10.	neutrino energy, read in by namelist
Qs	real	-10.	momentum transfer squared
delta_Qs	real	-10.	value by which Qs is increased

nl_dSigmadQsdElepton	code/init/neutrino/neutrinoXsection.f90		
enu	real	-10.	neutrino energy, read in by namelist
Qs	real	-10.	momentum transfer squared
elepton	real	-10.	energy of the outgoing lepton
delta_elepton	real	-10.	value by which elepton is increased

nl_dSigmadW	code/init/neutrino/neutrinoXsection.f90		
enu	real	-10.	neutrino energy, read in by namelist
W	real	-10.	invariant mass defined as (p+q)^2
delta_W	real	-10.	value by which W is increased

nl_fluxcuts	code/init/neutrino/esample.f90		
Enu_lower_cut	real	0.	cut events with neutrino energy below Enu_lower_cut; for ANL experiment, for example, Enu_lower_cut=0.5 for some analysis of ppi+
Enu_upper_cut	real	200.	cut events with neutrino energy above Enu_upper_cut; for ANL experiment, for example, Enu_upper_cut=1.5 for ppi0 and npi+ final state, but 5.98 for ppi+
energylimit_for_Qsrec	logical	.false.	switch for using the energylimits Enu_upper_cut and Enu_lower_cut for the Qˆ2 reconstruction; values: .true. or .false. (default: .false.)

nl_integratedSigma	code/init/neutrino/neutrinoXsection.f90		
enu	real	-10.	neutrino energy, read in by namelist
delta_enu	real	-10.	value by which the neutrino energy is increased

nl_Neutrino2piBack	code/init/neutrino/neutrinoparms.f90		
Wtrans	real	3.0	W for transition from Bloom-Gilman Paramerization to PYTHIA DIS
Norm2pi	real	1.2	overall normalization factor for 2pi BG and Bloom-Gilman X-section
normRES	real	1.6	overall normalization factor for neutrino-induced resonance contributions beyond the Delta
normCB	real	2.0	overall normalization factor for neutrino-induced Christy-Bosted contributions between 2 GeV and DIS onset

nl_neutrino_energyFlux	code/init/neutrino/expNeutrinofluxes.f90		
Eb	real	0.034	contant binding energy used for energy and Q2 reconstruction based on QE scattering kinematics
Eflux_min	real	0.2	minimum energy for uniform flux distribution minimum and maximum energies for the uniform neutrino flux (nuExp=10 in the namelist neutrino_induced) can be changed in the namelist nl_neutrino_energyFlux
Eflux_max	real	2.5	maximum energy for uniform flux distribution minimum and maximum energies for the uniform neutrino flux (nuExp=10 in the namelist neutrino_induced) can be changed in the namelist nl_neutrino_energyFlux

nl_neutrinoxsection	code/init/neutrino/neutrinoXsection.f90		
integralPrecision	integer	3	precision for the Gauss integration (reduce it for nuXsectionMode.eq.0 (sigma) to e.g. 2)
integralPrecisionQE	integer	500	precision for the Gauss integration over the QE peak (reduce it for nuXsectionMode.eq.0 (sigma) to e.g. 300)
singlePiModel	integer	1	to change between different models for the pion nucleon cross section: • 0 = pi N according to Nieves et al (hep-ph/0701149) • 1 = MAID-like model
invariantMassCut	real	100.	cut events with invariant Mass above this value (in GeV); cut pion production from Delta and DIS on Wrec = Sqrt[Mˆ2 + 2*M*nu - Qˆ2]
invariantMassCut_BG	real	100.	cut MAID-like background events with invariantMass_BG above this value (in GeV); cut 1pi BG on Wrec = Sqrt[Mˆ2 + 2*M*nu - Qˆ2]
DIScutW	real	1.95	W-cut for sigmoid onset of DIS
DIScutwidth	real	0.1	width for sigmoid onset of DIS
REScutW	real	2.0	W-cut for sigmoid turn-off of resonances
REScutwidth	real	0.1	width for sigmoid turn-off or resonances
DISformfakEM	integer	2	Introduce an additional form factor for the DIS cross section, when processed via a photon: • 0: no form factor • 1: Qˆ2/(mcutDISˆ2+Qˆ2) • 2: Qˆ4/(mcutDISˆ2+Qˆ2)ˆ2 In case of electron induced events, we need choose 2 in order to be compatible with Pythia's electron machinery.
DISformfakNCCC	integer	1	Introduce an additional form factor for the DIS cross section, when processed via W or Z boson: • 0: no form factor • 1: Qˆ2/(mcutDISˆ2+Qˆ2) • 2: Qˆ4/(mcutDISˆ2+Qˆ2)ˆ2 In case of electron induced events, we need choose 2 in order to be compatible with Pythia's electron machinery.
mcutDIS	real	0.6	parameter to control Qˆ2 dependence of DIS

DISrespectHad	logical	.true.	Flag to indicate, whether hadronization failures should be respected and affect the overall DIS cross section Pythia is run to generate the DIS cross section. But not every of the generated events may lead to a correct hadronic final state.
DISdoMSTP23	logical	.true.	Flag to indicate, whether in Pythia for neutrino-DIS the value MSTP(23)=1 should be used or not
new2piBG	logical	.true.	Flag to turn on the new treatment of 2pi BG for electrons and neutrinos
indBG	integer	3	Index to choose Bloom-Gilman like BG parametrization 1 : original Bloom Gilman 2 : Niculescu fit 3 : nonresonant BG fit from Christy-Bosted

nl_NievesHadronTensor	code/init/neutrino/NievesHadronTensor.f90	
DeltaPole	logical	.true.
crossedDelta	logical	.true.
nucleonPole	logical	.true.
crossedNucleonPole	logical	.true.
contactTerm	logical	.true.
pionPole	logical	.true.
pionInFlight	logical	.true.

nl_SigmaMC	code/init/neutrino/neutrinoXsection.f90		
enu	real	-10.	neutrino energy, read in by namelist
MC_xmax	real	2.0	

nl_singlePionProductionNHVlike	code/init/neutrino/singlePionProductionNHVlike.f90		
integrate_over	integer	2	possible values: • 1 = costhetaPi • 2 = Epi • 3 = over cosThetaPi_star_qz in CM frame which 3-pl differential cross sectio to use for integration: • 1= dsigma/dcostheta/dElepton/dcosThetaPion was originally used and works for nuclei. disadvantage: for some cosThetaPion there are two solutions for Epi, this leads to fluctuations on the cross section • 2= dsigma/dcostheta/dElepton/dEPion has an advantage, that for a given pion energy there is only one solution for the angle between the resonance and pion momenta. so the integration is simpler and results should be smoother NOTES • for 1 : the only option checked for nucleus • for 2 : code works better and faster, gives significantly smoother results below Delta peak. disadvantage: now for the free nucleon only, TO DO : nuclei

nl_specificEvent	code/analysis/neutrinoAnalysis.f90		
no_pi	logical	.false.	do analysis for specific final states: specificEvent=1, no_pi (for example, for QE-like MiniBooNE) values can be changed in the namelist nl_specificEvent
p_Xn_no_pi	logical	.false.	do analysis for specific final states: specificEvent=2 values can be changed in the namelist nl_specificEvent
piplus	logical	.false.	do analysis for specific final states: specificEvent=3, 1 pi+ X nucleons mesons of other flavor values can be changed in the namelist nl_specificEvent
piplus_MULTI	logical	.false.	do analysis for specific final states: specificEvent=4 >=1 pi+ X other pions (incl pi+) X nucleons values can be changed in the namelist nl_specificEvent

pi0	logical	.false.	do analysis for specific final states: specificEvent=5, 1 pi0 X nucleons, plus mesons of other flavor values can be changed in the namelist nl_specificEvent
pi0_MULTI	logical	.false.	do analysis for specific final states: specificEvent=6, >=1 pi0 X other pions X nucleons, (pi0 K2K) values can be changed in the namelist nl_specificEvent
piminus	logical	.false.	do analysis for specific final states: specificEvent=7 1 pi- X other pions X nucleons values can be changed in the namelist nl_specificEvent
piminus_MULTI	logical	.false.	do analysis for specific final states: specificEvent=8 >=1 pi- X other pions X nucleons values can be changed in the namelist nl_specificEvent
pp_no_pi	logical	.false.	do analysis for specific final states: specificEvent=9 2 protons, X neutrons, 0 pions values can be changed in the namelist nl_specificEvent
pn_no_pi	logical	.false.	do analysis for specific final states: specificEvent=10 1 neutron, 1 proton, 0 pions values can be changed in the namelist nl_specificEvent
nn_no_pi	logical	.false.	do analysis for specific final states: specificEvent=11 2 neutrons, X protons, 0 pions values can be changed in the namelist nl_specificEvent
pp_Xn_no_pi	logical	.false.	do analysis for specific final states: specificEvent=12 2 protons, X neutrons, 0 pions values can be changed in the namelist nl_specificEvent
nn_Xp_no_pi	logical	.false.	do analysis for specific final states: specificEvent=13 2 neutrons, X protons, 0 pions values can be changed in the namelist nl_specificEvent
ppp_Xn_no_pi	logical	.false.	do analysis for specific final states: specificEvent=14 3 protons, X neutrons, 0 pions values can be changed in the namelist nl_specificEvent
pppp_Xn_no_pi	logical	.false.	do analysis for specific final states: specificEvent=15 4 protons, X neutrons, 0 pions values can be changed in the namelist nl_specificEvent
p_no_pi	logical	.false.	do analysis for specific final states: specificEvent=16 1 proton, 0 neutron, 0 pion values can be changed in the namelist nl_specificEvent

n_no_pi	logical	.false.	do analysis for specific final states: specificEvent=17 1 neutron, 0 proton, 0 pion values can be changed in the namelist nl_specificEvent
Xn_no_pi	logical	.false.	do analysis for specific final states: specificEvent=18, 0 proton, X neutrons, 0 pions values can be changed in the namelist nl_specificEvent
binsizeQ2	real	0.01	do analysis for specific final states: binning for reconstruction of Q2 and Enu values can be changed in the namelist nl_specificEvent
binsizeEnu	real	0.02	do analysis for specific final states: binning for reconstruction of Q2 and Enu values can be changed in the namelist nl_specificEvent
maxQ2	real	5.0	do analysis for specific final states: max values for reconstruction of Q2 and Enu values can be changed in the namelist nl_specificEvent
maxEnu	real	5.0	do analysis for specific final states: max values for reconstruction of Q2 and Enu values can be changed in the namelist nl_specificEvent
excl_hadron	logical	.false.	do analysis for specific final states: specificEvent=19,20,21 exclusive 1 pion, no other pions or other mesons of different flavor There could be still other mesons which are heavier than the D, Such events (very rare at DUNE energies) could be counted as exclusive single-meson cross section. This could be cured by extending the list of stable mesons value can be changed in the namelist nl_specificEvent
QEp	logical	.false.	if .true, do analysis for specific analysis for QE-like event with 1 mu, 0 pi, X p values can be changed in the namelist nl_specificEvent
full_incl	logical	.true.	do analysis for specific final states: specificEvent=22 fully inclusive event, all hadrons in final state value can be changed in the namelist nl_specificEvent

OffShellPotential	code/width/offShellPotential.f90		
useOffShellPotentialBaryons	logical	.false.	Switch on or off whether the offshellness should be used for baryons. NOTES • must be set to "TRUE" if mediumSwitch_coll (see module BaryonWidthMedium) is .true. • if .true. then delta_T (see module inputGeneral) must be <=0.05 AND delta_P (see module propagation) must be <=0.002; AND delta_E (see module propagation) must be <=0.002; slows down propagation by a factor of 10
useOffShellPotentialMesons	logical	.false.	Switch on or off whether the offshellness should be used for mesons.
extrapolateBaryonWidth	logical	.true.	Whether to extrapolate the baryon width below minimal mass or not.
max_offshellparameter	real	5.	The maximal value for the offshell parameter. Note: empirical value! This only applies to baryons. For mesons we have no restrictions on the offshell parameter.
relativistic	logical	.false.	• false: Use non-rel. off-shell parameter x=Delta m/Gamma, which obeys Stefan Leupold's non-rel. EOM. • true: Use rel. off-shell parameter x=Delta mˆ2/Gamma, which obeys Cassing's rel. EOM.
SetOffShellEnergyFlag	logical	.false.	• false: the energy of off-shell particle is constant during time evolution (static nucleus) • true: the energy of off-shell particle varies during time evolution (dynamic case, e.g. heavy ion collision)

paramEP	code/init/lowElectron/ParamEP.f90		
useParam	integer	2	select, which parametrization to use: • 1: Brasse • 2: Bosted

photonXS	code/collisions/twoBodyReactions/HiEnergy/photonXS.f90		
iParam	integer	2	Switch to select the kind of parametrization for gamma N → V N: • 1: "old parametrization", fit to experimental data, cf. Effenberger PhD, p.53 • 2: Pythia, cf. Friberg/Sjstrand hep-ph/0007314 • 3: Donnachie, Landshoff [citation needed]
omega_saphir	logical	.true.	If .true. an improved fit (to SAPHIR data) will be used for gamma N → omega N. cf. "calcXS_omega_saphir"

pionAnalysis	code/analysis/pionXsection.f90		
CMFrame	logical	.false.	If .true. Xsection is evaluated in CM-Frame of the incoming pion and a resting nucleon, else in calculation frame.
dsigma_dOmegadE_switch	logical	.false.	If .true. then dsigma/dOmega and dSigma/dOmega/dE are evaluated.
twoPi_switch	logical	.false.	If .true. then 2Pi output is evaluated.

pionNucleus	code/init/initPion.f90		
UseCoulomb	logical	.false.	if .true. then a Coulomb propagation from CoulombDistance to distance is performed
CoulombDistance	real	200.	distance from where the Coulomb propagation starts
distance	real	15.	initialization distance
impact_parameter	real	0.	impact parameter. If less than 0, than an impact parameter integration is performed
charge	integer	0	charge of pion
numberPions	integer	200	number of initialized pions per ensemble
ekin_lab	real	0.	kinetic energies of pions in lab frame.
delta_ekin_lab	real	0.01	step size for kinetic energies in energy scans

pn_medium	code/width/proton_neutron_width_medium.f90		
density_dependent	logical	.false.	the density of the spectral function
pn_medium_switch	logical	.true.	If .true. medium_modifications will be used

form_factor	logical	.true.	If .true. the form factor for the width is used

projectile	code/density/nucleus.f90		
Projectile_A	integer	0	Mass A of projectile nucleus (= number of nucleons). If zero, a default isotope is chosen for the given projectile_Z.
Projectile_Z	integer	20	Charge Z of projectile nucleus (= number of protons).
fermiMotion	logical	.true.	Determines whether particles in projectile nucleus feel Fermi motion or not.
densitySwitch_static	integer	3	This switch is important, because it decides, which static density is used to set up the testparticles in the nuclei before the first time-step. Possible values: • 0 : density=0.0 • 1 : Static density uses Woods-Saxon according to H. Lenske • 2 : Static density according to NPA 554 • 3 : Static density according to Horst Lenske, implements different radii for neutrons and protons • 4 : Static density according oscillator shell model • 5 : Density distribution is a sphere with density according to the input value of "fermiMomentum_input". • 6 : Static Density based on LDA, implemented by Birger Steinmueller • 7 : Static Density based on LDA + Welke potential • 8 : Static Density prescription according Relativistic Thomas-Fermi (Valid only in RMF-mode) Possible nuclei for the different prescriptions: • 1 : A > 2 (only A > 16 makes sense) • 2 : • 3 : 6→C(12), 8→O(16),O(18), 13→Al(27), 20→Ca(40),Ca(44), 79→Au(197) 82→Pb(208) • 4: 2→He(4), 4→Be(9), 5→B(11), 6→C(12), 8→O(16)
fermiMomentum_input	real	0.225	Input value of the fermi momentum for densitySwitch_static=5 (in GeV).

Propagation	code/propagation/propagation.f90		
delta_P	real	0.01	Delta Momentum in derivatives
delta_E	real	0.01	Delta energy in derivatives
UseCoulombDirectly	logical	.true.	Whether to use coulomb force directly in propagation or not. (If switched off while coulomb is switched on in module coulomb, the effect of the coulomb potential comes in via the gradient of the potentials. With this flag you can not switch on/off coulomb, you just select, how it is treated.)
UseHadronic	logical	.true.	Whether to use hadronic potentials in propagation
FreezeNonint	logical	.false.	If switched on, the real particles which did not interact will have zero velocities, i.e. will be "frozen". This is important for stability of the nuclear ground state in real particle simulations. Note that this flag influences only when freezeRealParticles=.false.
RungeKuttaOrder	integer	1	Order of Runge-Kutta in derivatives: • 1 = first order Runge-Kutta • 2 = second order Runge-Kuttay
Mode	integer	2	define the type of propagation: • 0: Cascade • 1: Euler • 2: PredictorCorrector
dh_dp0_switch	logical	.true.	Switch which decides whether we use dh_dp0.
offShellInfoDetail	logical	.false.	print out detailed offShellInfo
tachyonDebug	logical	.false.	...

propagation_RMF_input	code/propagation/propagation_RMF.f90		
predictorCorrector	logical	.true.	Switch for predictor-corrector method in the propagation. If .false. then simple Euler method is used (i.e. only predictor step is done)

pythia	code/collisions/twoBodyReactions/HiEnergy/DoCollTools.f90	
MSEL	integer	Pythia variable

MSTU	integer, dimension(200)	Pythia array
MSTJ	integer, dimension(200)	Pythia array
MSTP	integer, dimension(200)	Pythia array
MSTI	integer, dimension(200)	Pythia array
PARU	real, dimension(200)	Pythia array
PARJ	real, dimension(200)	Pythia array
PARP	real, dimension(200)	Pythia array
PARI	real, dimension(200)	Pythia array
CKIN	real, dimension(200)	Pythia array
PMAS	real, dimension(500, 4)	Pythia array
MDCY	integer, dimension(500, 3)	Pythia array

residue_Input	code/analysis/sourceAnalysis/residue.f90		
DetermineResidue	logical	.true.	If .true., then the determination of target residue properties for every event will be done. Their output in file 'TargetResidue.dat' at the end of time evolution is called elsewhere. If nothing is stored, no output is generated.

mode	integer	1	select the mode, how the residue energy is determined (field res%momentum(0)): • 1: the sum of hole excitation energies • 2: the sum of energies of the removed particles (with minus sign)
switchOutput	integer	0	select the output * 1: write out TargetResidue.dat * 2: write out TargetResidue.Plot.dat * 3: write out both files

ResonanceCrossSections	code/collisions/twoBodyReactions/baryonMeson/resonanceCrossSections.f90		
fullPropagator	logical	.false.	Includes also the real parts in the resonance propagator. In former works (i.e. in the old Efffenberger code) this has been neglected. It should be set to .true. only if mediumSwitch_coll=.true. in the namelist width_Baryon.

RMF_input	code/rmf/RMF.f90		
RMF_flag	logical	.false.	If .true. then use relativistic mean fields.

N_set	integer	1	Select which parameter set to use: • 1 — NL1 from G.A. Lalazissis et al., PRC 55, 540 (1997), (K=211.29 MeV, m*/m=0.57) • 2 — NL3 from G.A. Lalazissis et al., PRC 55, 540 (1997), (K=271.76 MeV, m*/m=0.60) • 3 — NL2 set from A. Lang et al., NPA 541, 507 (1992), (K=210 MeV, m*/m=0.83) • 4 — NLZ2 set from M. Bender et al., PRC 60, 34304 (1999), (K=172 MeV, m*/m=0.583) • 5 — NL3* set from G.A. Lalazissis, private communication, (K=258.28 MeV, m*/m=0.594) • 6 — Same as N_set=3, but including the rho meson. • 7 — NL1 set from S.J. Lee et al., PRL 57, 2916 (1986), (K=212 MeV, m*/m=0.57) • 8 — NL2 set from S.J. Lee et al., PRL 57, 2916 (1986), (K=399 MeV, m*/m=0.67) • 9 — Set I from B. Liu et al., PRC 65, 045201 (2002), (K=240 MeV, m*/m=0.75) *31 — Parity doublet model Set P3 from D. Zschiesche et al., PRC 75, 055202 (2007)
grad_flag	logical	.false.	If .true. then include space derivatives of the fields.
lorentz_flag	logical	.true.	If .false. then the space components of the omega field are put to zero.
Tens_flag	logical	.false.	If .true. then compute the energy-momentum tensor and four-momentum density field (not used in propagation).
flagCorThr	logical	.false.	If .true. then the srtfree of colliding particles is corrected to ensure in-medium thresholds of BB $\rightarrow$ BB and MB $\rightarrow$ B
kaonpot_flag	logical	.false.	This switch turns on the Kaon potential in RMF mode.
fact_pbar	real	1.	Modification factor for the antiproton coupling constants.
fact_hyp	real	1.	Modification factor for the hyperon coupling constants.
fact_antihyp	real	1.	Modification factor for the antihyperon coupling constants.
fact_Xi	real	1.	Modification factor for the Xi and XiStar coupling constants.
fact_antiXi	real	1.	Modification factor for the antiXi and antiXiStar coupling constants.

fact_kaon	real	0.	Modification factor for the Kaon and antikaon coupling constants.

selfenergy_realPart	code/spectralFunctions/selfenergy_baryons.f90		
rel_accuracy	real	0.05	Relative accuracy for resonance self energy
intSolver	integer	1	Decide on the numerical package to be used for the Cauchy integral: • 1=quadpack routine • 2=cernlib routine
makeTable	logical	.true.	Switch on/off the usage of an input tabulation
noDispersion	logical	.false.	Switch on/off the usage dispersion relations
maxRes	integer	100	
minRes	integer	-100	
extrapolateAbsP	logical	.false.	if(true) then set absP to maxAbsP if absP is larger
writeLocal	logical	.false.	• Tables are outputted to local directory, not to buuinput

selfEnergyMesons	code/spectralFunctions/selfenergy_mesons.f90		
dispersion	logical	.false.	Use dispersive real parts of the self energy.

SMM_input	code/analysis/sourceAnalysis_Main.f90		
SMM_Flag	logical	.false.	if .true. then source analysis is switched on
rho_cutoff	real	100.	density cutoff (in units of the saturation density "rhoNull") which defines "emitting" particles
spectator_cutoff	real	1.	min. value of number of collisions which defines "spectator"-matter
A_cutoff	integer	2	min. value of the source mass number
SelectionMethod	integer	0	defines the selection method of spectators and fireball. Can be used in high energy Hadron-Nucleus events.
betaChoice	integer	0	Defines the way to calculate the source velocity in RMF mode. Has no influence in calculations with Skyrme potential.

MaxTimePrinting	integer	10	Indicates how many times the results are printed into files. NOTES Set MaxTimePrinting to a very big value, i.e. 1000, if you wish that the BUU-run developes until time=time_max.
DetailedHyperonOutput	logical	.true.	print more informations for Hyperons and pions.
hyperSource	logical	.false.	If true, the Lambda and Sigma0 hyperons will be included into source

spectralFunction	code/spectralFunctions/spectralFunc.f90		
which_nuclwidth	integer	1	This flag decides what is used for the nucleon width. Note: The correct normalisation has not been included here!! Choose between: • which_nuclwidth=1 - use constant width given in const_nuclwidth • which_nuclwidth=2 - use width increasing linear with density; Gamma=const*rho/rho0 with const given in nuclwidth_dens • which_nuclwidth=3 - use toy model (constant NN cross section) • which_nuclwidth=4 - use realistic width (cf. diploma thesis of D. Kalok) • which_nuclwidth=5 - use realistic width: width based on our collision term
nuclwidth	real	0.001	• if which_nuclwidth=1, nuclwidth gives the width used in the Breit-Wigner for the nucleon
nuclwidth_dens	real	0.006	• if which_nuclwidth=2, nuclwidth_dens gives the width used in density dependent width • 6 MeV are motivated in F. Froemel dissertation
nuclwidth_sig	real	5.5	• if which_nuclwidth=3, nuclwidth_sig gives the NN cross section in fmˆ2
relativistic	logical	.true.	• Use either relativistic or non relativistic spectral functions.

spectralFunctionMesons	code/spectralFunctions/spectralFunc_mesons.f90		
relativistic	logical	.true.	• Use either relativistic or non relativistic spectral functions.

target	code/density/nucleus.f90		
Target_A	integer	0	Mass A of target nucleus (= number of nucleons). If zero, a default isotope is chosen for the given target_Z.

Target_Z	integer	20	Charge Z of target nucleus (= number of protons).
fermiMotion	logical	.true.	Determines whether particles in projectile nucleus feel Fermi motion or not.
densitySwitch_static	integer	3	This switch is important, because it decides, which static density is used to set up the testparticles in the nuclei before the first time-step. Possible values: • 0 : density=0.0 • 1 : Static density uses Woods-Saxon according to H. Lenske • 2 : Static density according to NPA 554 • 3 : Static density according to Horst Lenske, implements different radii for neutrons and protons • 4 : Static density according oscillator shell model • 5 : Density distribution is a sphere with density according to the input value of "fermiMomentum_input". • 6 : Static Density based on LDA, implemented by Birger Steinmueller • 7 : Static Density based on LDA + Welke potential • 8 : Static Density prescription according Relativistic Thomas-Fermi (Valid only in RMF-mode) Possible nuclei for the different prescriptions: • 1 : A > 2 (only A > 16 makes sense) • 2 : • 3 : 6→C(12), 8→O(16),O(18), 13→Al(27), 20→Ca(40),Ca(44), 79→Au(197) 82→Pb(208) • 4: 2→He(4), 4→Be(9), 5→B(11), 6→C(12), 8→O(16)
fermiMomentum_input	real	0.225	Input value of the fermi momentum for densitySwitch_static=5 (in GeV).
ReAdjustForConstBinding	logical	.false.	If this flag is set to true, we use the selected density distribution only for a preliminary step, where we calculate the baryonic potential as function of r (which depends on the density distribution). From the condition, that the binding energy has to be constant, we deduce the distribution of the fermi momentum and thus the 'new' density distribution. The tabulated density distribution is replaced via the 'new' one and all behaviour is as usual.

ConstBinding	real	-0.008	if 'ReAdjustForConstBinding' equals true, we a trying to readjust the fermi momentum and the density such, we quarantee this value for the binding energy.

TransportGivenParticle	code/init/initTransportGivenParticle.f90		
particle_ID	integer	1	Determines what kind of particle is initialized (see idTable)
charge	integer	1	Determines what charge
position	real, dimension(1:3)	(/0.,0.,0./)	Determines the position.
threemomentum	real, dimension(1:3)	(/0.,0.,1./)	Determines the three-momentum.
mass	real	-1.	Determines the mass (if negative, choose mass according to spectral function).
maxmass	real	1.5	Determines the maximum mass (if mass is chosen according to spectral function).
perweight	real	1.	Determines the weight.
frequency	integer	10	after this amount of time steps a new output file is generated
initRandomRadiativeDelta	logical	.false.	intented use: radiativeDelta decay. chooses position,threemomentum,mass of Delta randomly; charge is choosen either 0 or 1

W_distributions	code/analysis/neutrinoAnalysis.f90		
dW_Npi	real	0.02	for dsigma/d(InvariantMass); only work if include_W_dist is .true. set the min, max and steps for various W-distributions
Wmin_Npi	real	1.08	for dsigma/d(InvariantMass); only work if include_W_dist is .true. set the min, max and steps for various W-distributions
Wmax_Npi	real	1.6	for dsigma/d(InvariantMass); only work if include_W_dist is .true. set the min, max and steps for various W-distributions
dW_mupi	real	0.04	only work if include_W_dist is .true. set the min, max and steps for various W-distributions
Wmin_mupi	real	0.24	only work if include_W_dist is .true. set the min, max and steps for various W-distributions
Wmax_mupi	real	1.2	only work if include_W_dist is .true. set the min, max and steps for various W-distributions
dW_muN	real	0.04	only work if include_W_dist is .true. set the min, max and steps for various W-distributions

Wmin_muN	real	1.04	only work if include_W_dist is .true. set the min, max and steps for various W-distributions
Wmax_muN	real	2.12	only work if include_W_dist is .true. set the min, max and steps for various W-distributions

width_Baryon	code/width/baryonWidthMedium.f90		
mediumSwitch	logical	.false.	Switch on and off the in-medium width of all baryons at once. If .false., the vacuum width are used.
mediumSwitch_Delta	logical	.false.	Only meaningful if mediumSwitch=.true.: Switch on and off the in-medium width of the Delta. (.false.=off) Note that in that case the Delta is treated specially: what is used for the in-medium width is determined by the flag in deltaWidth. This switch is not consistent with mediumSwitch_coll!
mediumSwitch_proton_neutron	logical	.false.	Only meaningful if mediumSwitch=.true.: Switch on and off the in-medium width of the proton and the neutron. (.false.=off) Note that in that case the nucleons are treated specially. This switch is not consistent with mediumSwitch_coll!
mediumSwitch_coll	logical	.false.	Only meaningful if mediumSwitch=.true.: Use in-medium width according to collision term. NOTES if set to TRUE, then also UseOffShellPotentialBaryons (see module offShellPotential) must be .true.
verboseInit	logical	.false.	switch on/off informational messages during initialization
verboseInitStop	logical	.false.	Stop after informational messages during initialization or not.

width_Meson	code/width/mesonWidthMedium.f90		
mediumSwitch	integer	0	Treatment of In-Medium Widths for mesons: • 0: Only vacuum widths are used. • 1: The collisional width is assumed to be constant (only density-dependent). • 2: The full tabulated in-medium width is used, as calculated via the collision term. Isospin asymmetry of nuclear matter included. Zero temperature assumed. All mesons are in-medium broadened. • 3: Same as 2 but for isospin symmetric nuclear matter at finite temperature. Only rho-meson is in-medium broadened. Other mesons not modified.
Gamma_coll_rho	real	0.150	Collisional width for the rho meson in GeV. Only used if mediumSwitch = 1.
Gamma_coll_omega	real	0.150	Collisional width for the omega meson in GeV. Only used if mediumSwitch = 1.
Gamma_coll_phi	real	0.030	Collisional width for the phi meson in GeV. Only used if mediumSwitch = 1.
verboseInit	logical	.false.	switch on/off informational messages during initialization
allowMix	logical	.false.	switch on/off linear interpolation between bins in density while returning the tabulated values for MassAssInfo.

XsectionRatios_input	code/collisions/phaseSpace/XsectionRatios.f90		
flagScreen	logical	.false.	• If .true. – in-medium screening is applied to the input cross section. • If .false. – no cross section modification.
ScreenMode	integer	1	possible values: • 1: in-medium screening of NN total cross section according to Li and Machleidt, PRC 48 (1993) 1702 and PRC 49 (1994) 566 • 2: in-medium screening of BB total cross section according to P. Daniewlewicz, NPA 673, 375 (2000); Acta. Phys. Pol. B 33, 45 (2002) NOTES relevant when flagScreen = .true.
flagInMedium	logical	.false.	• If .true. – In-medium ratios are used to decide whether an event is accepted or not. • If .false. – The event is always accepted

InMediumMode	integer	2	possible values: • 1: all events of the type BB → BB (+ mesons) are subject to in-medium reduction following Eqs.(194),(195) of GiBUU review paper [currently works in RMF mode only] • 2: NN → NN elastic scattering events are modified according to Li and Machleidt all other BB → BB events are subject to in-medium reduction according to Eq. (33) from T. Song, C.M. Ko, PRC 91, 014901 (2015) [works in all modes (Skyrme, RMF, cascade)] NOTES relevant when flaginMedium = .true.
alpha	real	1.2	Parameter which controls the density dependence of the NN ↔ N Delta cross section. for the density dependence from: Song/Ko, arXiv:1403.7363 (InMedium-Mode=2)
shift0	real	0.	Mass shift m-mˆ* (GeV) for using in elementary particle collision mode.

YScalingAnalysis	code/analysis/yScalingAnalysis.f90		
analyze	logical	.false.	Determines wether the y-scaling analysis is performed
optionalOutput	logical	.false.	Determines wether in addition to the standard 'scaling_analysis.dat' other histograms will be generated. E.g. * 'single_nucleon.dat' - a table for comparing nucleon-knockout with fully inclusive ¡pre¿ x sections * 'scaling_info.dat' - general parameters of the analysis, to be used for quick ¡pre¿ analyis * 'scaling_delta.dat' - output to be used for analyis of scaling function in ¡pre¿ resonance excitation region
variable	integer	1	determines which kind of scaling variable will be used (cf. Donnelly, Sick 1999): • 1) RFG full variable Psi • 2) RFG approximation Psi • 3) PWIA full Upsilon (y/kf) • 9) evaluation will be done for all variables, output written to seperate files

kFermi	real	0.2251	Nucleon Fermi momentum in nucleus. If none specified 0.2251 will be used, except if densitySwitch_static is set to 5, then fermiMomentum_input is used. The 0.225_1_ aims at preventing confusion whith delibaretely set differences between kFermi and fermiMomentum_input
E_shift	real	0.020	Energy correction to account for binding effects, otherwise neglected in RFG model

Yukawa	code/potential/yuka.f90		
yukawaFlag	logical	.false.	Switches Yukawa potential on/off
smu	real	2.175	Yukawa mass in fm**(-1). (range of potential)