# The GiBUU transport tutorial (part 3)

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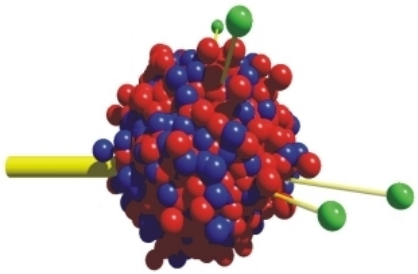

GiBUU
The Giessen Boltzmann-Uehling-Uhlenbeck Project

# NOW: HEAVY IONS

- get to the real 'meat': nuclear reactions / heavy-ion collisions
- learn more input parameters
- initializing a nucleus-nucleus collision
- setting up projectile & target nucleus
- example simulation: Ca+Ca at 2 GeV

# Basic input for a heavy-ion collision

```
&input
  eventtype     = 1           ! heavy-ion collision
  numEnsembles  = 100         ! number of ensembles
  delta_T       = 0.2         ! time step size in fm/c
  numTimeSteps  = 100         ! number of time steps
  num_runs_SameEnergy = 1     ! number of runs per energy
  num_energies          = 1   ! number of energies
  length_real = 500           ! length of real. par. vector
  path_To_Input = '/home/janus/GiBUU/buuinput'
/
```

- use less ensembles than before, because each ensemble will contain two big nuclei
- we need a large number of time steps now to do the full time evolution of the collision

# Setting up the kinematics

```
&heavyIon
  impact_parameter     = 0.    ! impact parameter in fm
  ekin_lab_Projectile = 2.    ! kin. energy of proj. in GeV/nucleon
  cmsFlag              = F    ! do collision in center-of-mass frame?
  adjustGridFlag       = T
/
```

- projectile nucleus gets 2 GeV/nucleon kinetic energy
- target nucleus stays at rest
- impact parameter is zero here ('central collision'), but will be varied later

# Defining projectile and target nucleus

```
&projectile
  projectile_Z = 20  ! Ca
  projectile_A = 40
/

&target
  target_Z = 20  ! Ca
  target_A = 40
/
```

- choose two medium-size nuclei ($^{40}Ca$), by giving Z (nuclear charge) and A (mass number) for both

# Analysis Flags

```
&LesHouches
  LesHouchesFinalParticles_Real = T    ! print out real part.
/

&HICanalysis_input
  pionAnalysis = .true.       ! produce some pion spectra
/
```

- the first one we know already, generates LesHouches event output
- the second one will produce additional output ('Pion*.dat')

# Exercises

1. perform a collision of two $^{40}$Ca nuclei with a beam energy of $E_{kin} = 2\,\mathrm{AGeV}$ (and fixed target), using the provided jobcard 'CaCa.job', but choose some impact parameter $0 \leq b \leq 6\,\mathrm{fm}$
2. determine the number of charged pions ($\pi^+$ and $\pi^-$) per event
3. produce $p_T$ and rapidity spectra of the charged pions (either using ROOT, or: directly use the histograms written to PionPt.dat and PionY.dat)
4. produce rapidity spectra of the nucleons (protons and neutrons)