Dynamical Thermalization in Heavy-Ion Collisions

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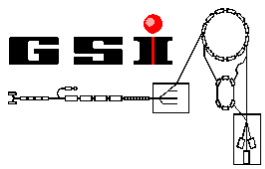
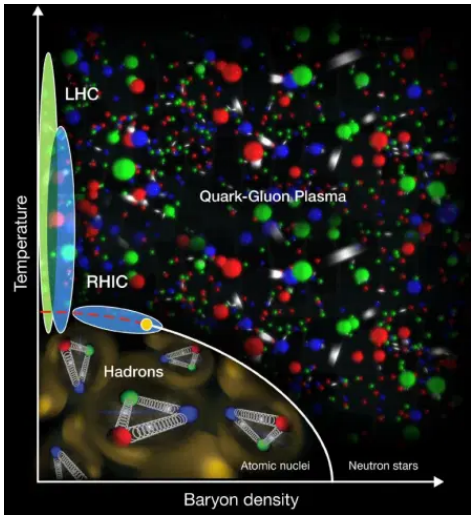
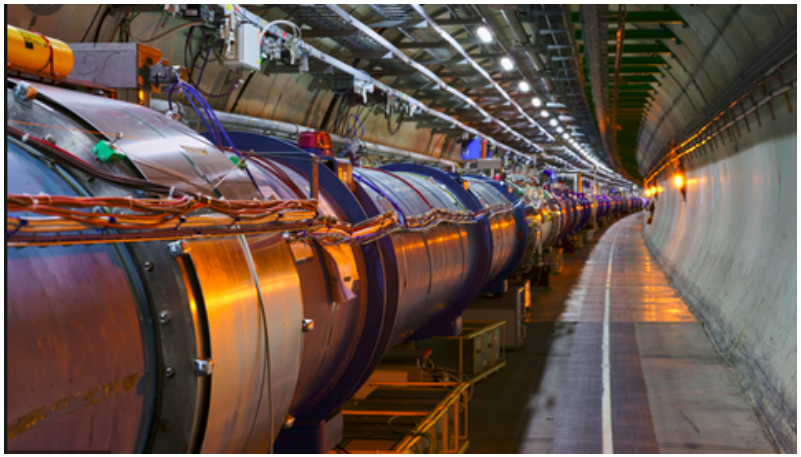


- Introduction
  - QGP, Particle accelerators
- Heavy-ion collision Models
  - EPOS & PHSD
- EPOS2PHSD interface
- Results
  - Particle Production, Elliptic Flow, Transverse Momentum, Transverse Mass
- Conclusion and outlook
- References

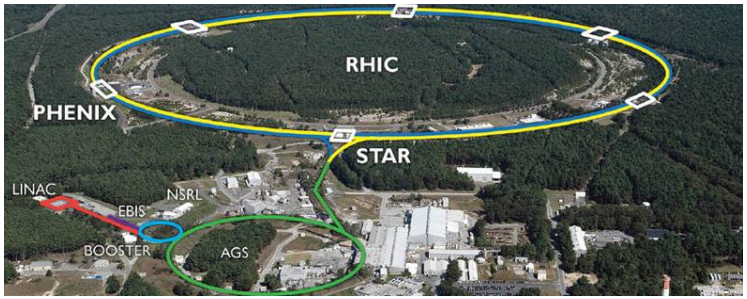
Quark-Gluon Plasma, Particle accelerators



Phase diagram of nuclear matter [1]



LHC, CERN, Switzerland

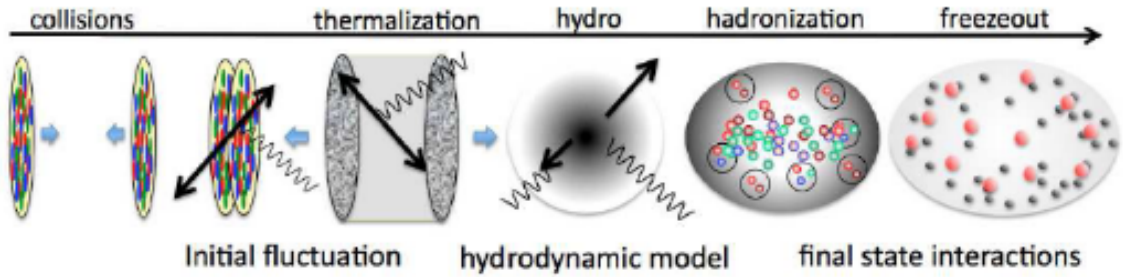


RHIC, Brokhaven, New York

Future accelerators:

- FAIR, Frankfurt, Germany
- NICA, Dubna, Russia

Heavy-Ion Collisions
Bjorken Scenario

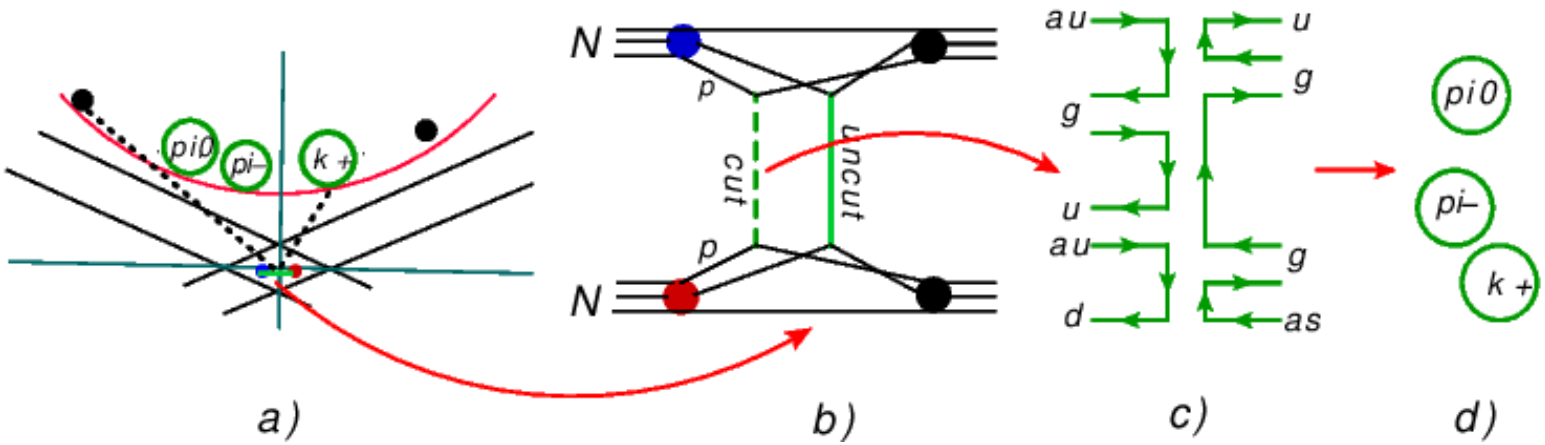


EPOS → *Primary Scattering*, *Hydrodynamical evolution*, *Hadronization*

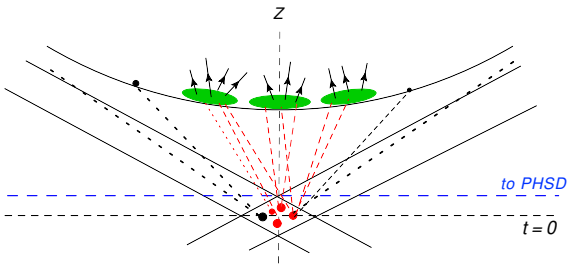
PHSD → *Primary Scattering done by PYTHIA* → *Space-time evolution*

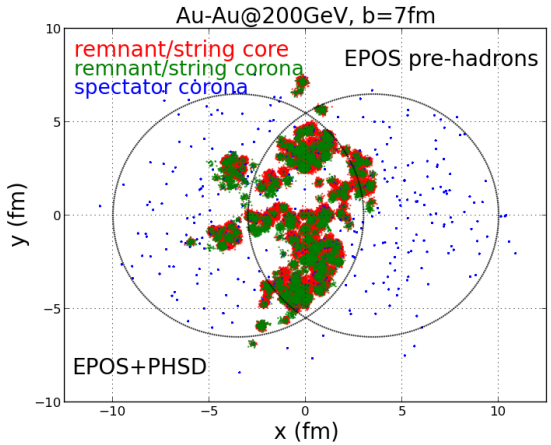
EPOS: Energy conserving multiple scattering Partons, parton ladder and strings Off-shell remnantes Saturation [2, 3].(PBGRT,EOS,Cooper-Frye procedure, UrQMD)

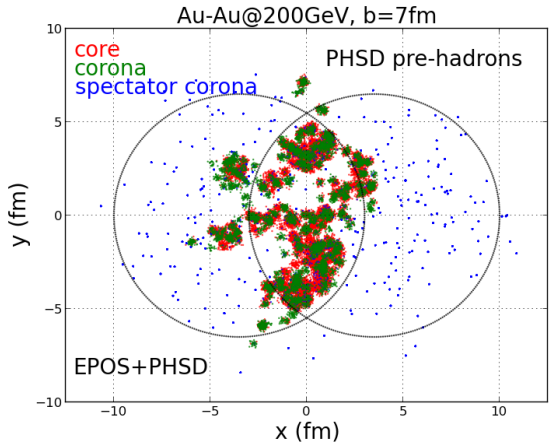
PHSD: Parton Hadron String Dynamics [4, 5, 8].(DGPM, Kadanoff-Baym equation, HSD)



Initial Condition in EPOS based on PBGRT [6, 7]





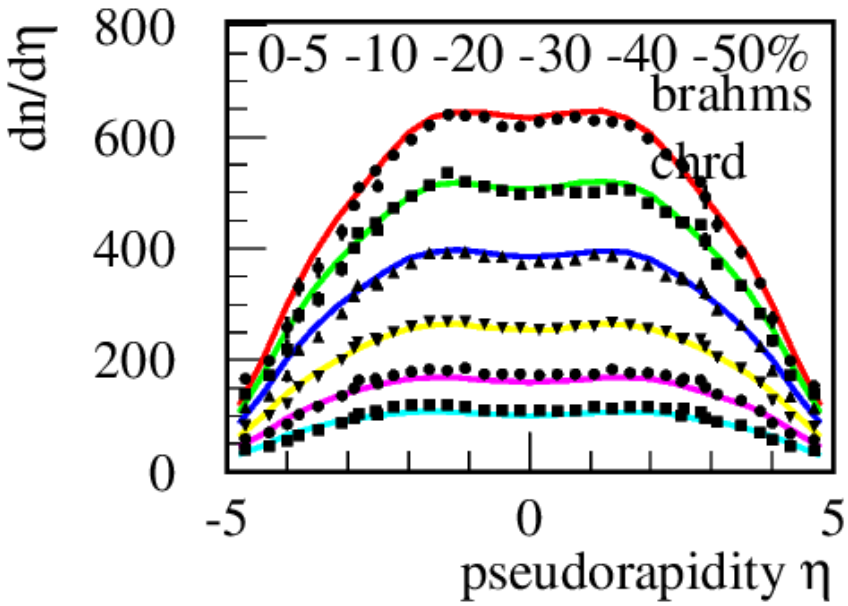


From participants (in EPOS) to core/corona pre-hadrons (in PHSD)

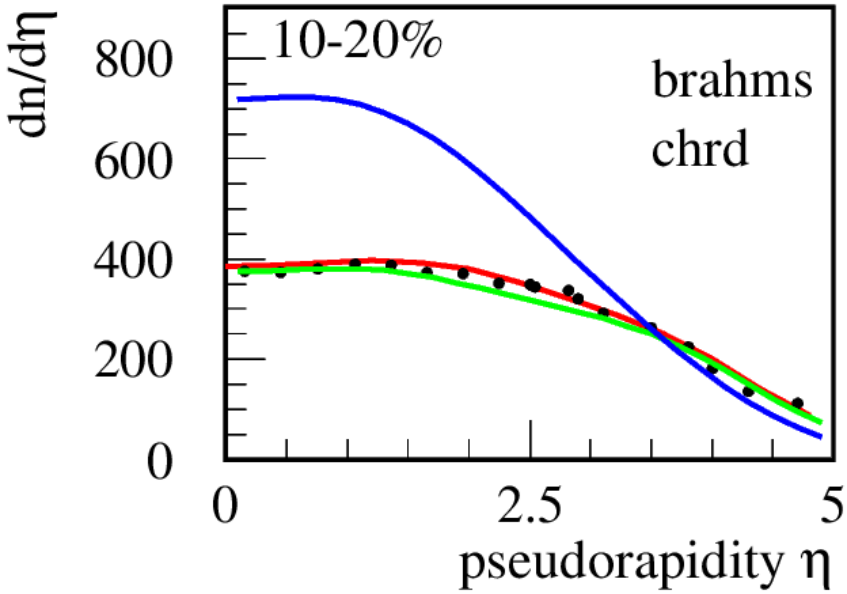
RESULTS

Comparing the
Particle Production, Elliptic Flow (v_2), Transverse Momentum (p_T)
and Transverse Mass (m_T) for Au-Au@200GeV
With different simulations:
EPOS+PHSD, EPOS+hydro, EPOS-hydro, pure PHSD

Particle Production:
Au-Au@200GeV



(a) EPOS+PHSD



(b) EPOS+PHSD, EPOS+hydro
EPOS-hydro

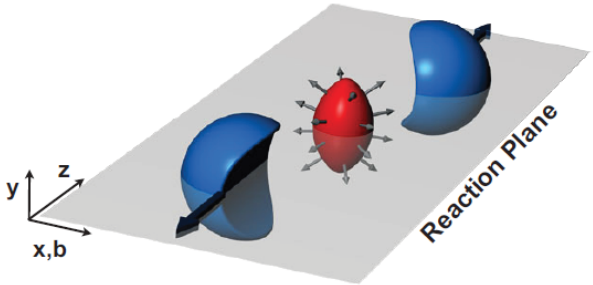
Good agreement to the real DATA ✓

Elliptic Flow v_2:

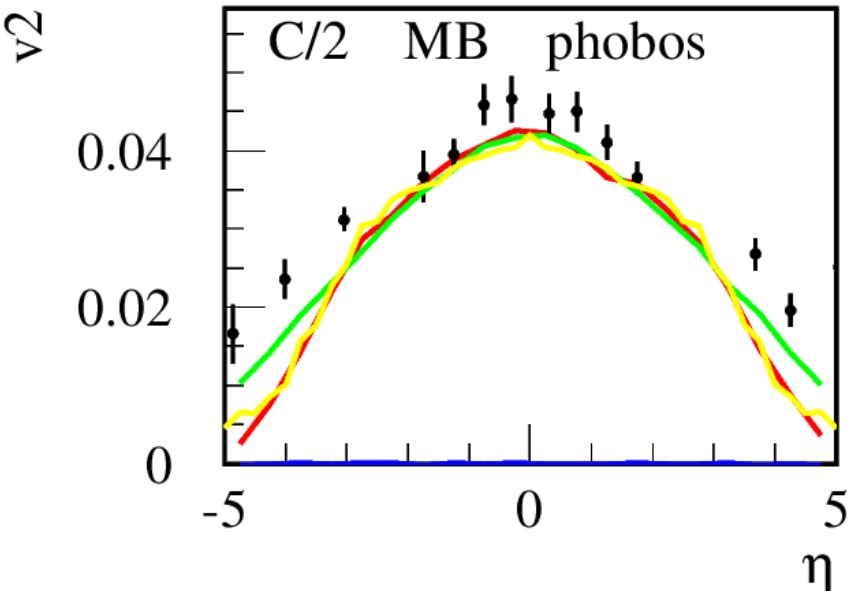
$E\frac{d^3N}{d^3p} = \frac{1}{2\pi}\frac{d^2N}{p_t dp_t dy}(1 + \sum_{n=1}^{\infty} 2v_n cos(n(\phi - \Psi_{RP})))$

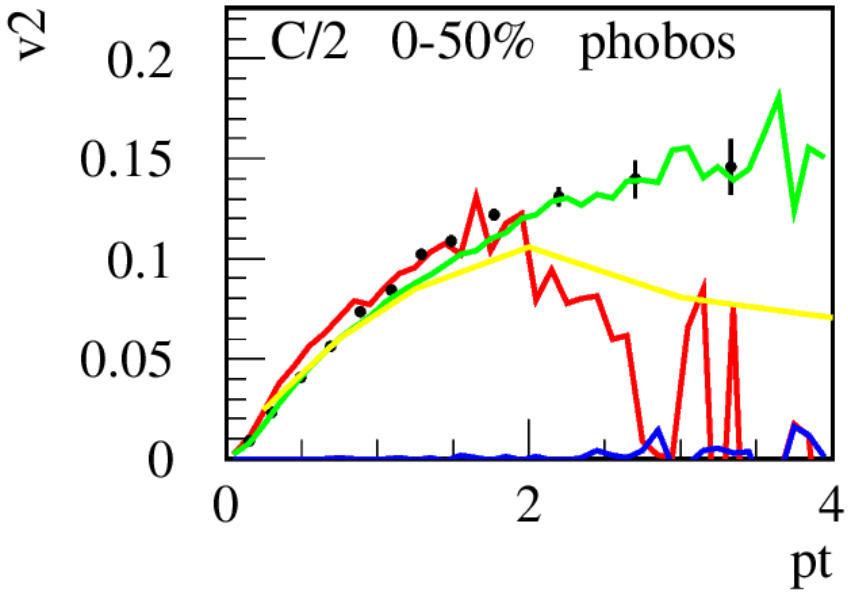
$v_n(p_t, y) =< cos(n(\phi - \Psi_{RP})) >$, v_2 = elliptic flow,

Ψ_{RP} =reaction plane angle [9].



Au-Au@200GeV

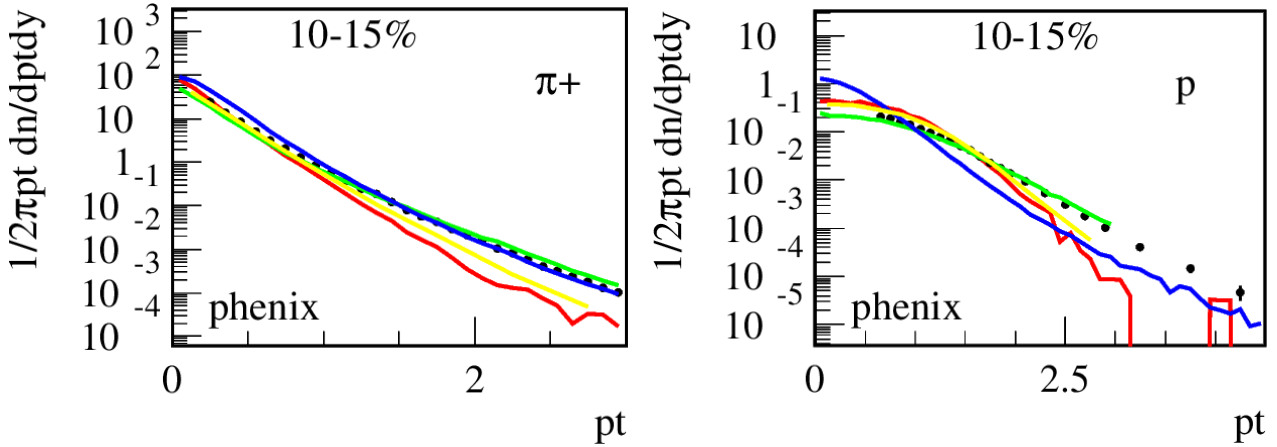




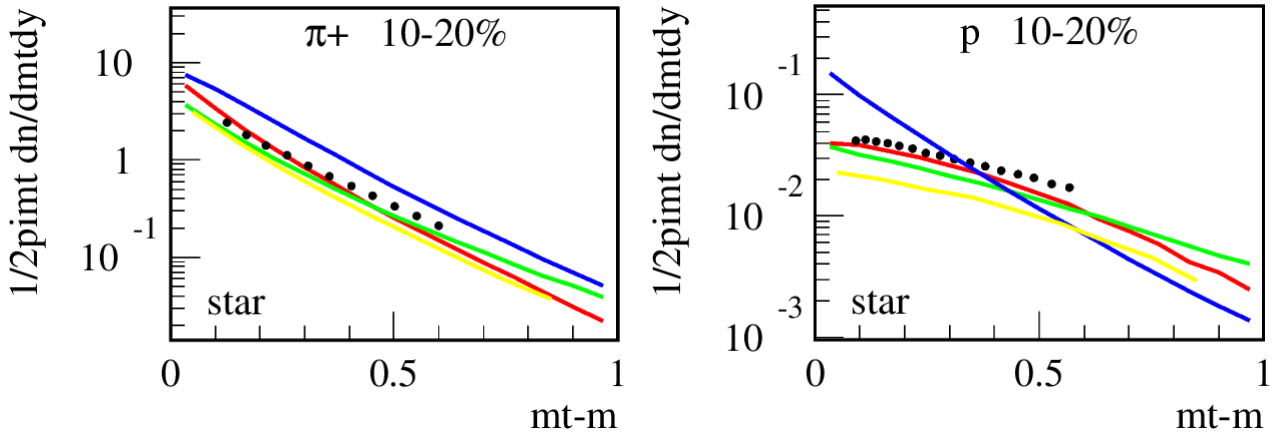
EPOS+PHSD, EPOS+hydro, EPOS-hydro, pure PHSD

NEAR TO THE THERMALIZATION ✓

Transverse Momentum and Transverse Mass: Au-Au@200GeV



EPOS+PHSD, EPOS+hydro, EPOS-hydro, pure PHSD



EPOS+PHSD, EPOS+hydro, EPOS-hydro, pure PHSD

Summary and Conclusion:

- The project done to merge the two models commenting the issue of different framework (Miles coordinates and Minkowski space-time).
- Comparison of space-time evolution by EPOS+PHSD with EPOS+hydro also EPOS-hydro and pure PHSD.
- Considering observables like charged particles production, v_2, p_T, m_T. p_T has not been improved yet by EPOS+PHSD.

Outlook:

- Comparison EPOS+PHSD with different range energies from RHIC to LHC for various systems like p-p and Au-Au collisions.
- Investigation of other "flow behaviors"; v_n =1; 3; 4; ...
- Investigation of electromagnetic probes, photon and dilepton production.
- Checking heavy flavor particles behavior


thanks for your time

References

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[2] K. Werner et al, "Parton ladder splitting and the rapidity dependence of transverse momentum spectra in deuteron-gold collisions at the BNL Relativistic Heavy Ion Collider", Phys. Rev. C 74 (2006) 044902.

[3] T. Pierog, K. Werner et al, "EPOS LHC: Test of collective hadronization with data measured at the CERN Large Hadron Collider", Phys. Rev. C 92 (2015) 034906.

[4] W. Cassing and E. L. Bratkovskaya, "Parton transport and hadronization from the dynamical quasiparticle point of view", Phys. Rev. C 78 (2008) 034919.

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[8] W. Cassing, "From Kadanoff-Baym dynamics to off-shell parton transport", arXiv:0808.0715 [nucl-th].

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