Progress in PHSD+FRIGA simulation

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Last datasets (summer 2016)

PHSD 3.3 + FRIGA:

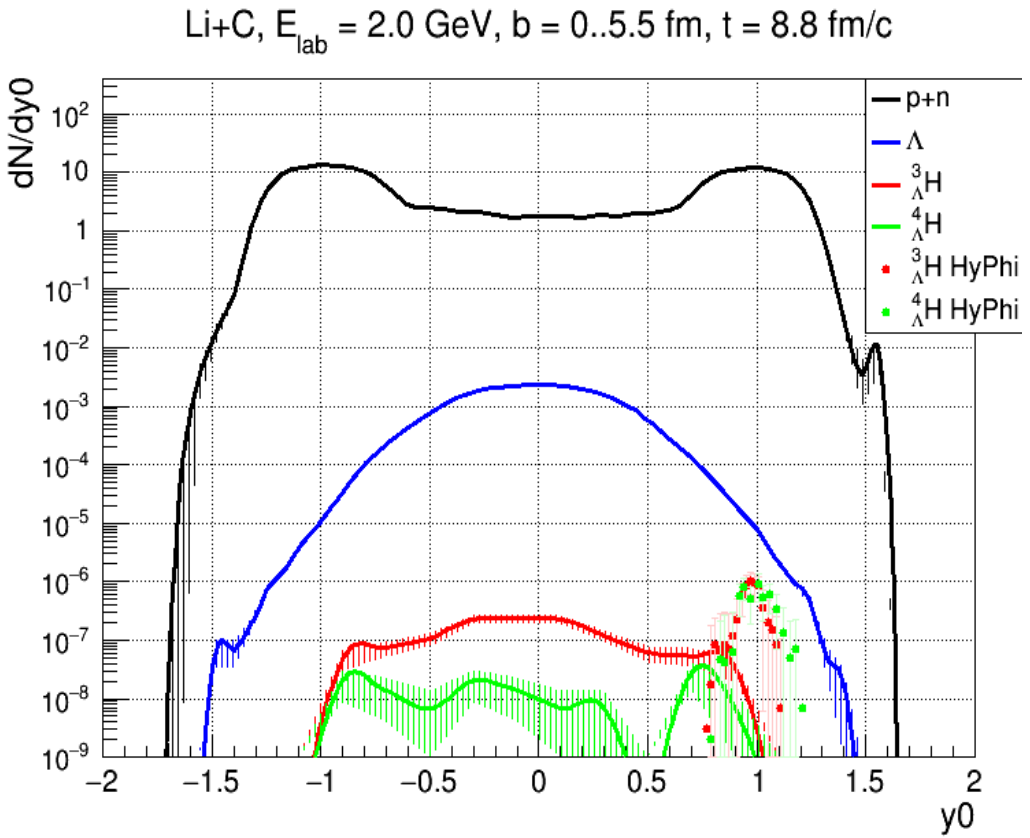
Li+C, E_{lab} = 2 GeV, b = 1..5.5 fm

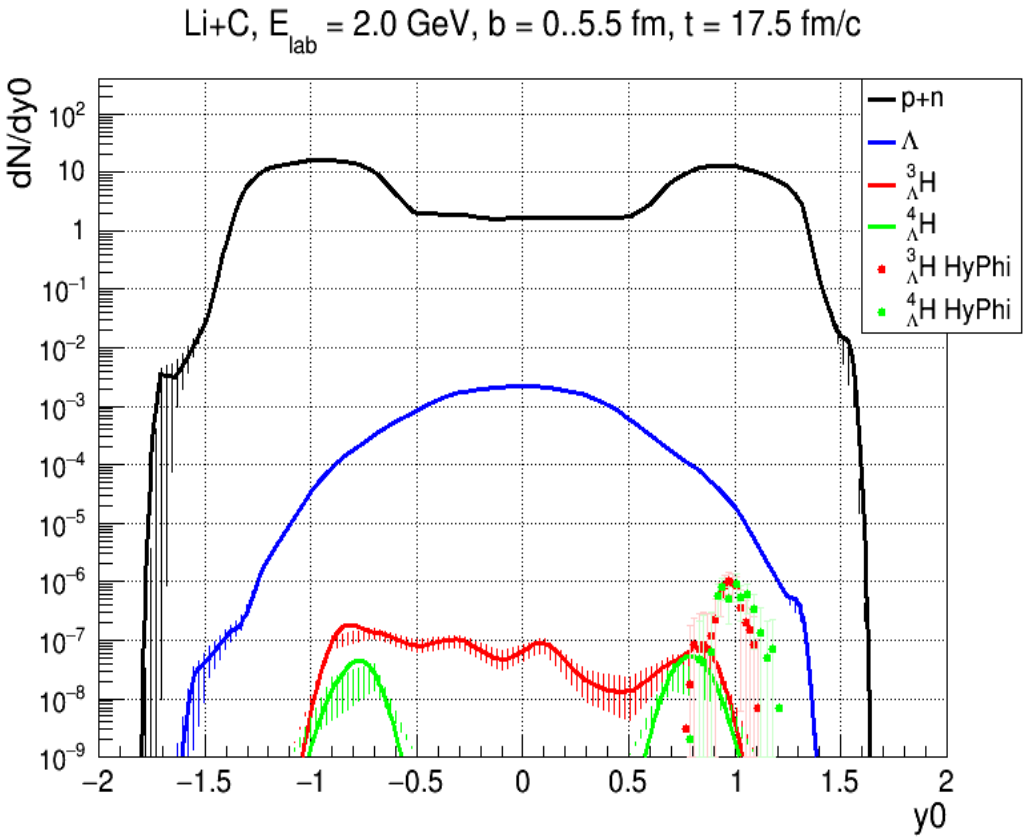
Au+Au, E_{lab} = 2, 6, 11.45, 20 GeV, b = 1..11 fm

PHQMD 3.3 + FRIGA:

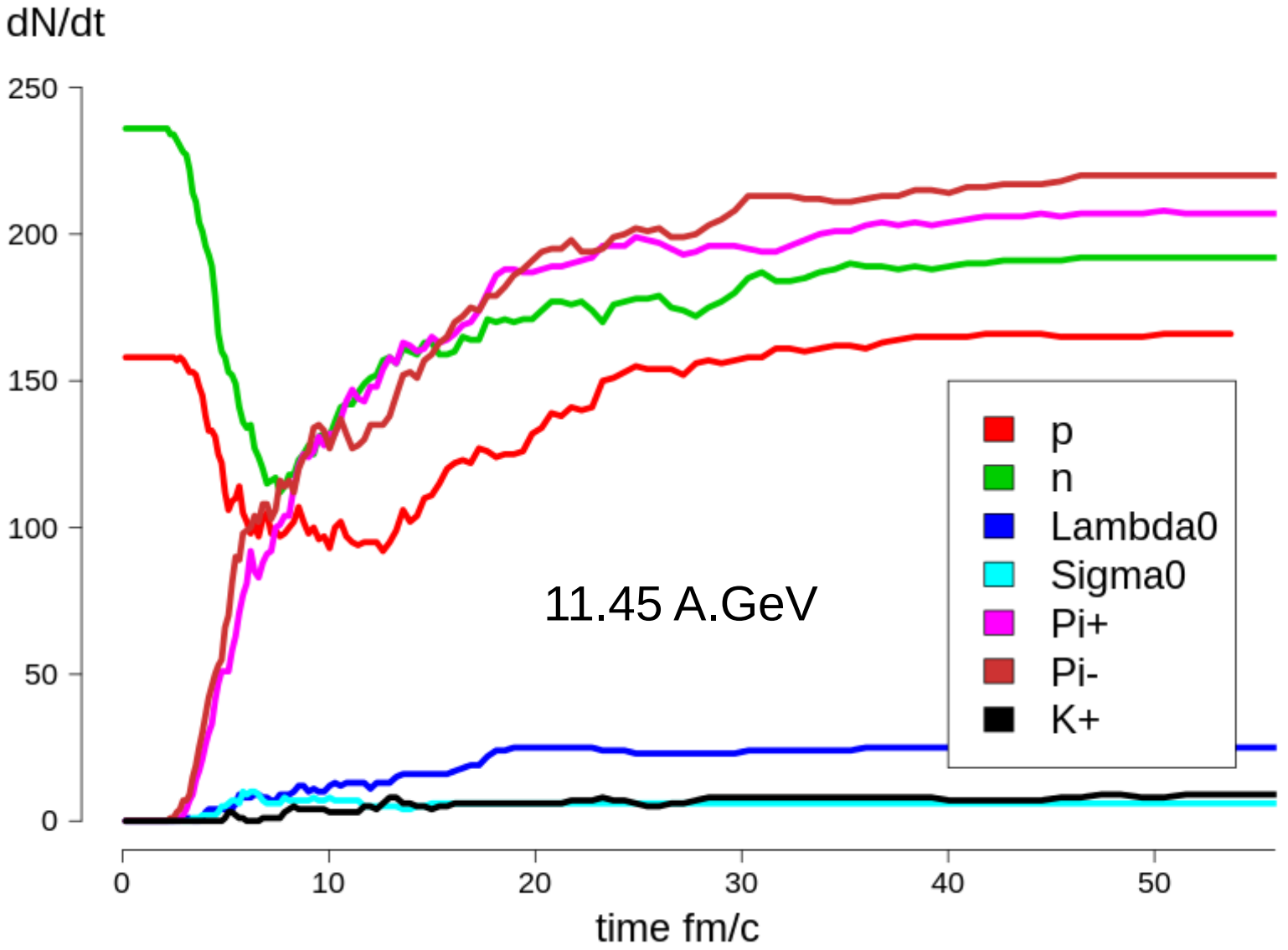
Au+Au, E_{lab} = 2, 6, 11.45, 20 GeV, b = 1..11 fm

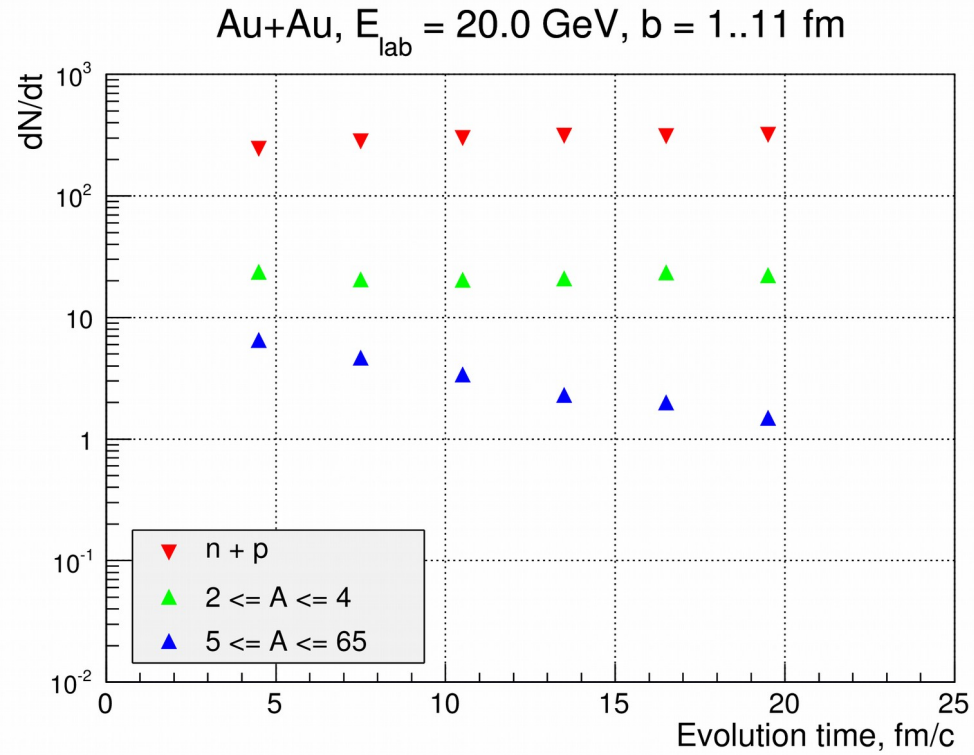
Low energies

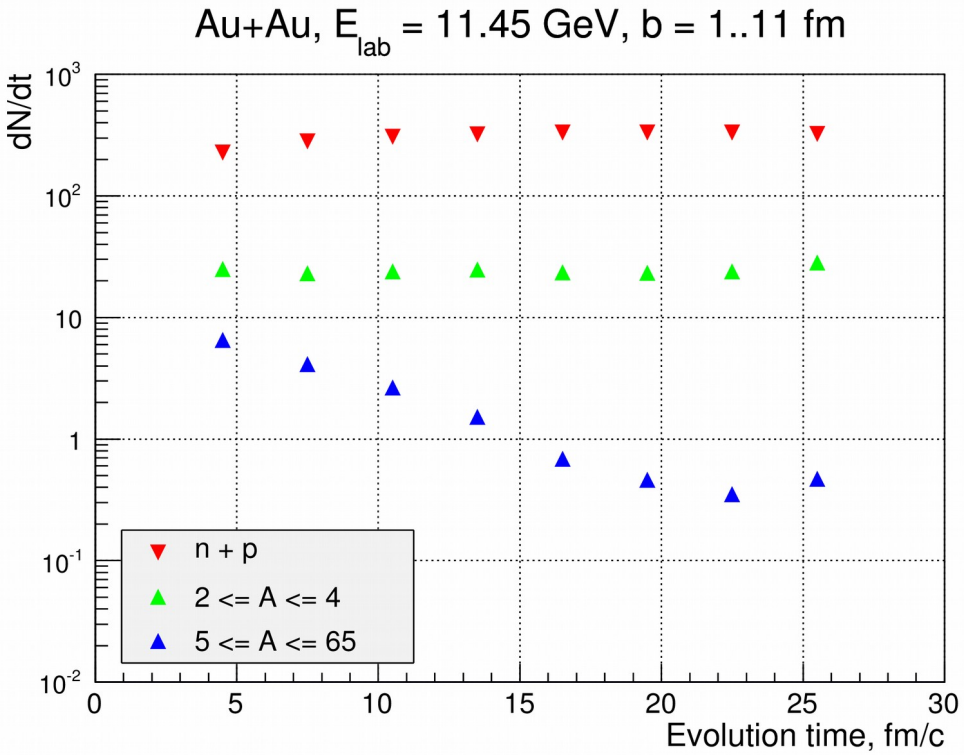


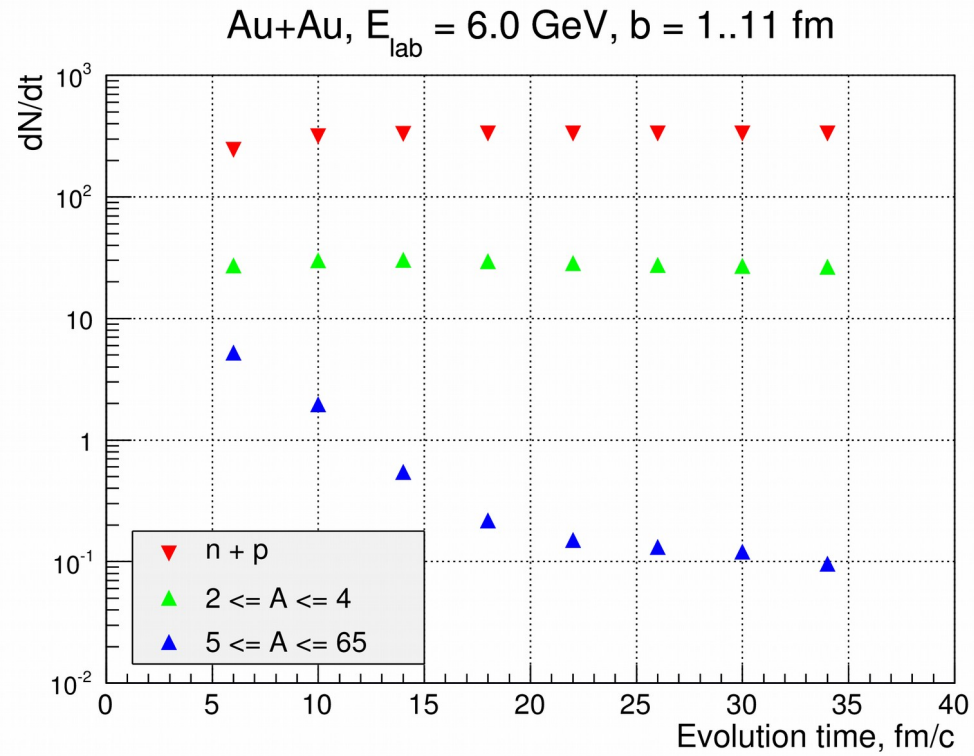


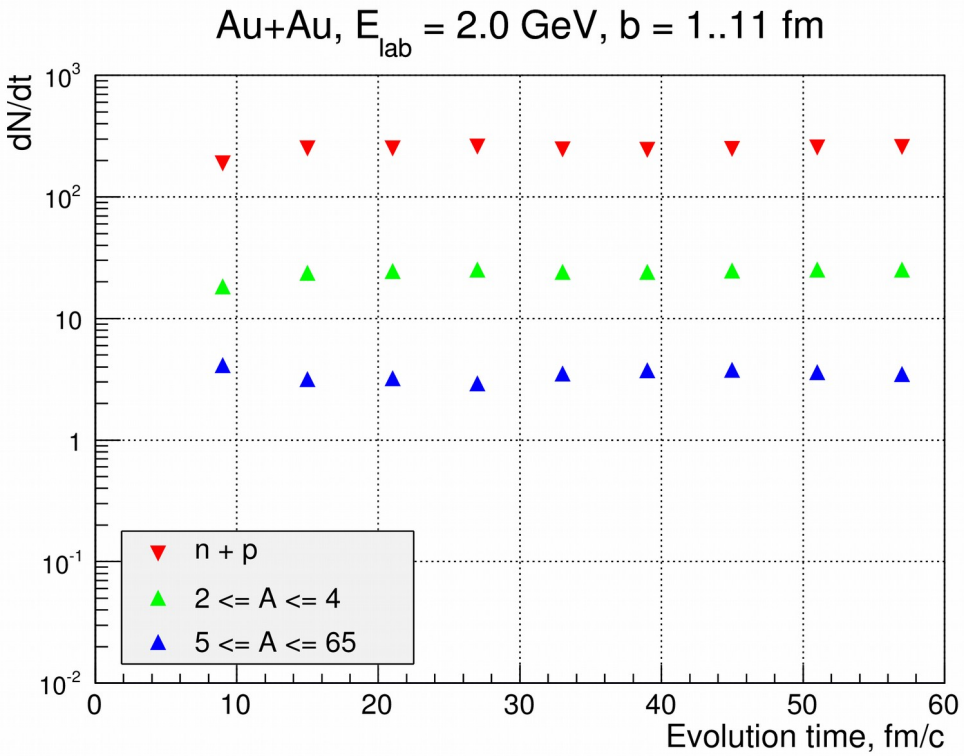
NICA/MPD energies



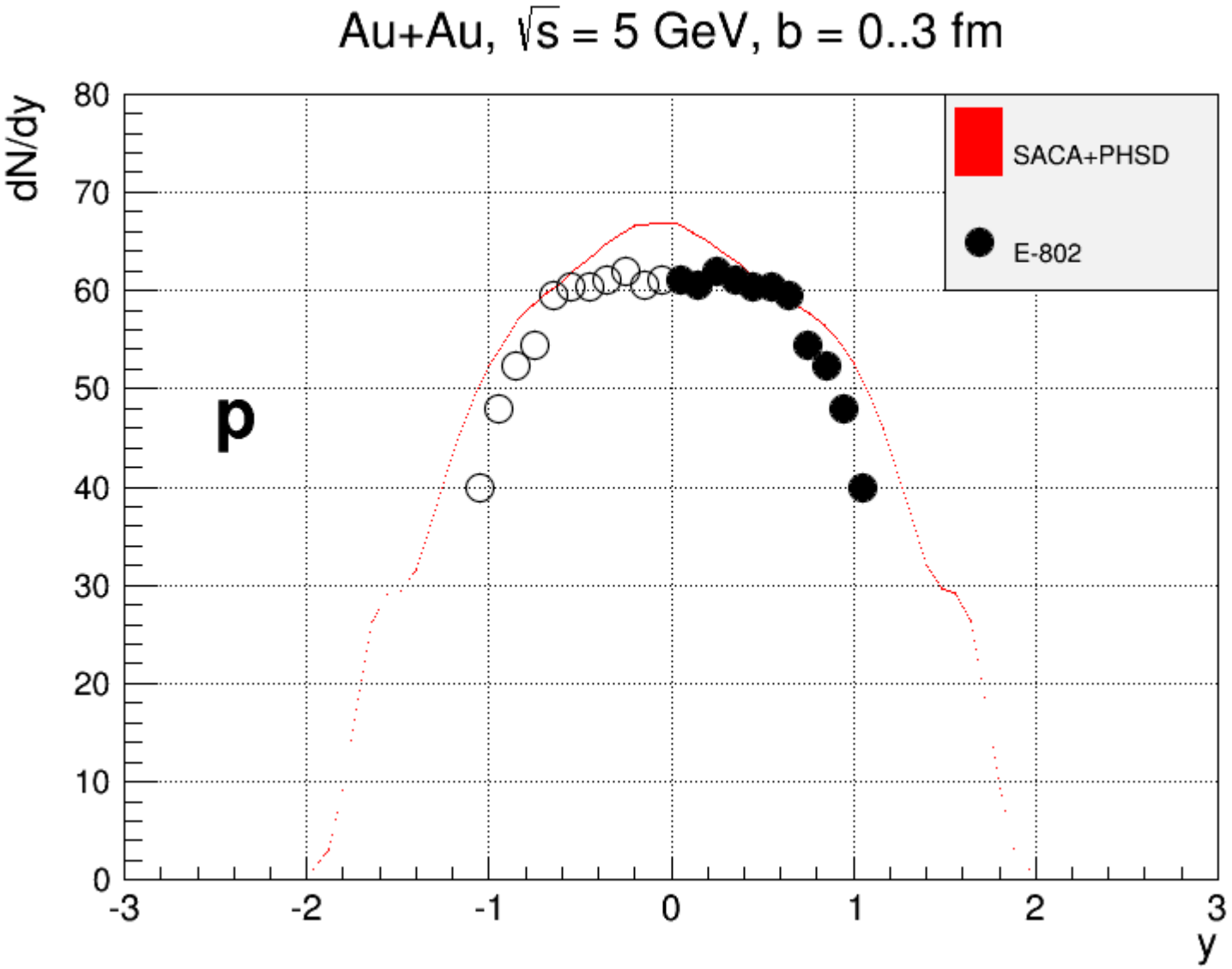

Au+Au, E_lab = 20.0 GeV, b = 1..11 fm
dN/dt
Evolution time, fm/c
n + p
2 <= A <= 4
5 <= A <= 65


Au+Au, E_lab = 11.45 GeV, b = 1..11 fm
dN/dt
Evolution time, fm/c
n + p
2 <= A <= 4
5 <= A <= 65

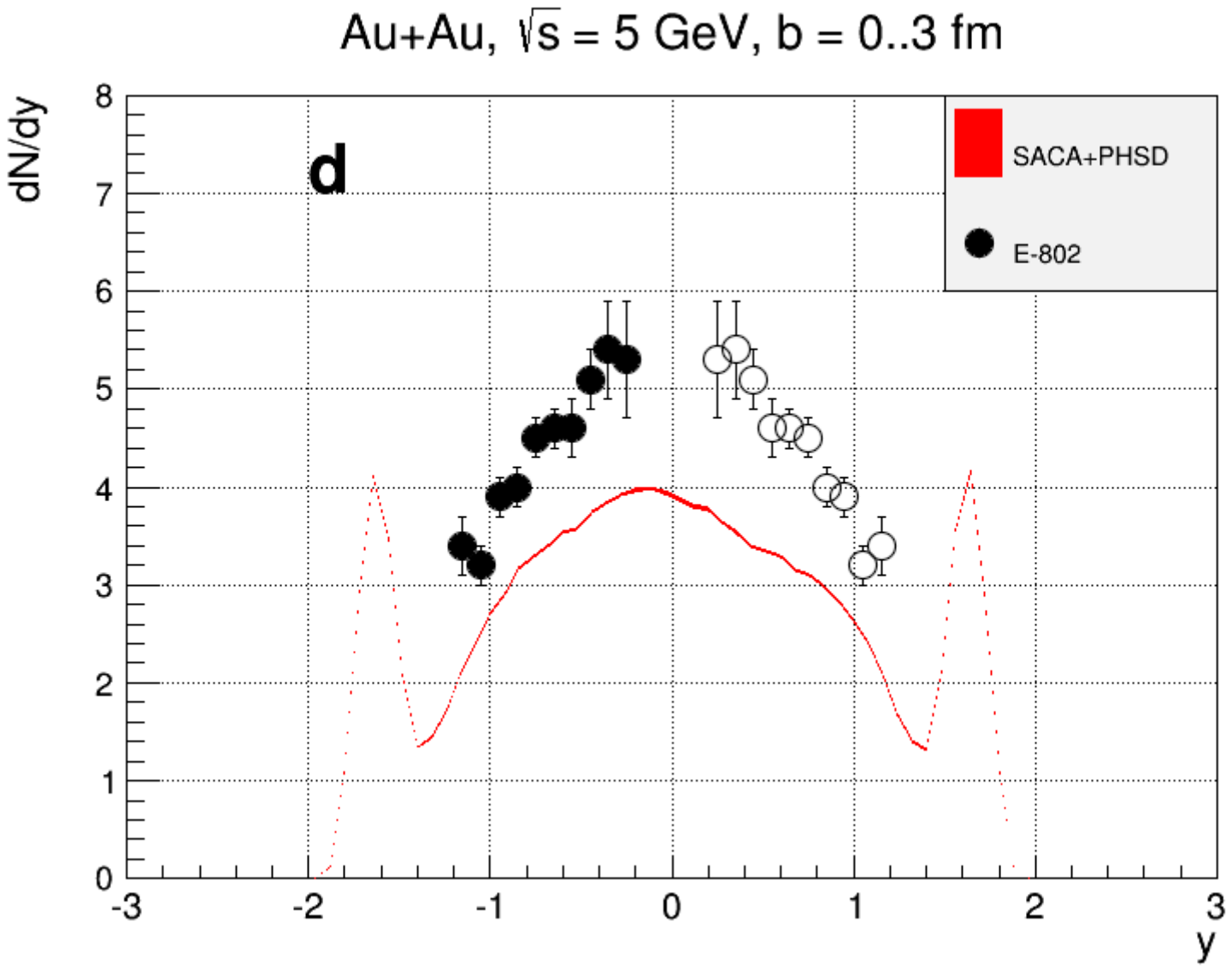

Au+Au, E_lab = 6.0 GeV, b = 1..11 fm
dN/dt
Evolution time, fm/c
n + p
2 <= A <= 4
5 <= A <= 65


Au+Au, E_lab = 2.0 GeV, b = 1..11 fm
dN/dt
Evolution time, fm/c
n + p
2 <= A <= 4
5 <= A <= 65

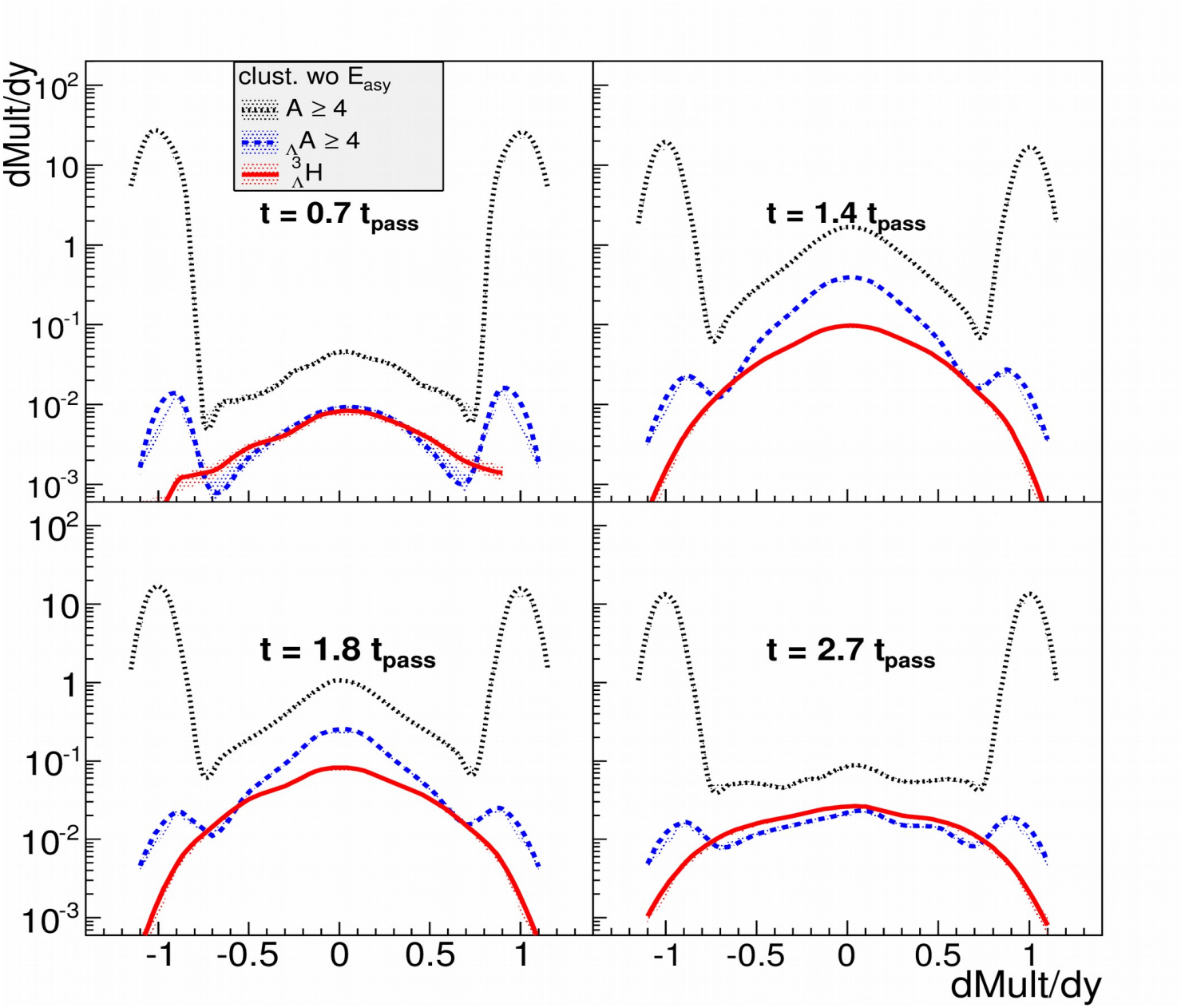
NICA/MPD energies



NICA/MPD energies



NICA/MPD energies



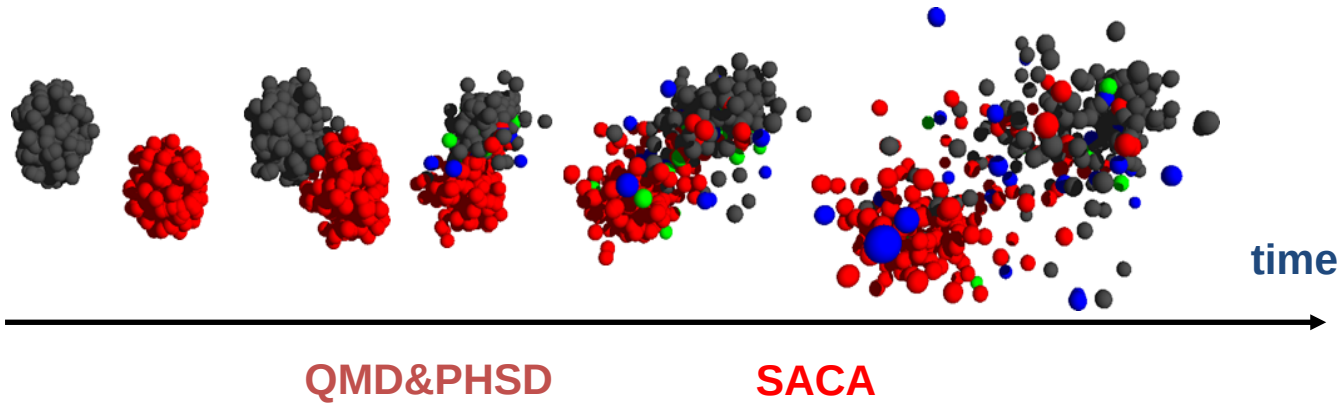
Modeling of fragment and hypernucleus formation

The goal: **Dynamical modeling of cluster formation by a combined model**
PHQMD = (QMD & PHSD) & SACA (FRIGA) *(presently under construction!)*

(GU & GSI & NANTES & JINR collaboration: **A. Le Fèvre, Y. Leifels, J. Aichelin, V. Kireev, E. Bratkovskaya)**

- **Parton-Hadron-Quantum-Molecular-Dynamics - a non-equilibrium microscopic transport model which describes n-body dynamics based on QMD propagation with collision integrals from PHSD (Parton-Hadron-String Dynamics) and cluster formation by the SACA model in comparison to the Minimum Spanning Tree model (MST). MST can determine clusters at the end of the reaction)**

- **Simulated Annealing Clusterization Algorithm – cluster selection according to the largest binding energy (extension of the SACA model -> FRIGA which includes hypernuclei). FRIGA allows to identity fragments very early during the reaction.**



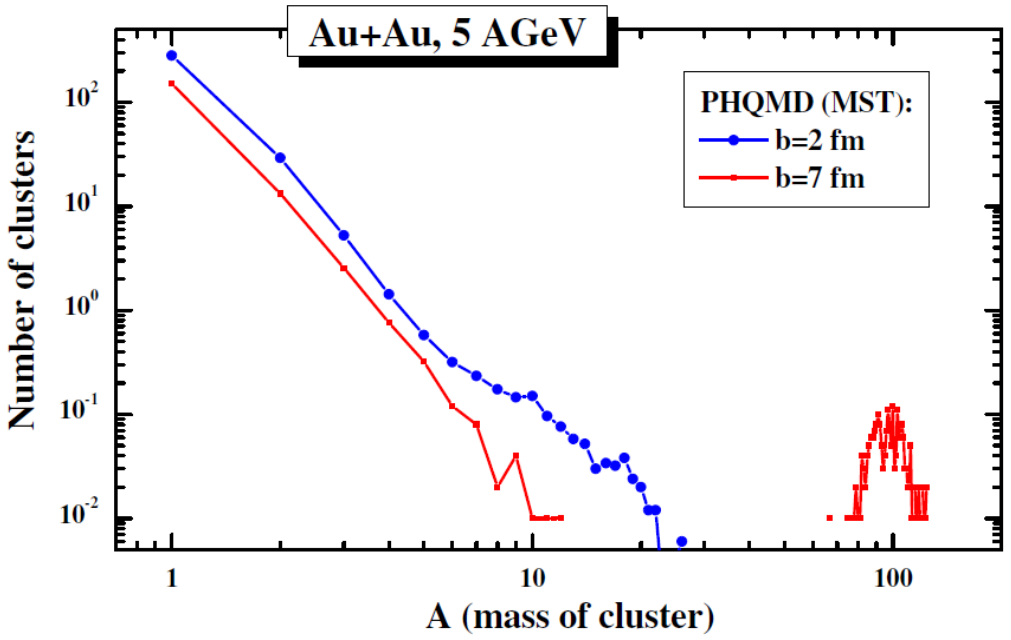
SACA: R. K. Puri, J. Aichelin, J.Comput.Phys. 162 (2000) 245-266
PHSD: W. Cassing, E. Bratkovskaya, PRC 78 (2008) 034919; NPA831 (2009) 215

PHQMD: fragment formation

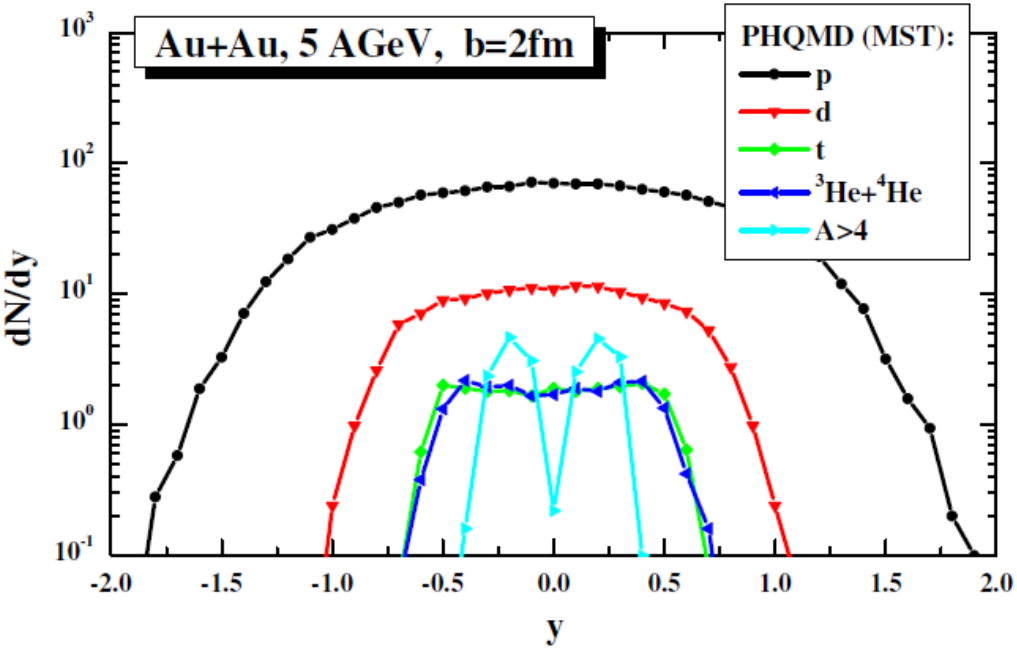
- **PHQMD with Minimum Spanning Tree model (MST) for clusters formation:**
  MST finds clusters at the end of the reaction

Au+Au @ 5 A GeV ***(preliminary results at NICA energies)***

- **Mass distributions of fragments for central and semi-peripheral collisions**



- **Rapidity distributions of fragments for central collisions**



- **Central collisions: light clusters;**
  semi-peripheral collisions: heavy clusters – remnants from spectators
- **Rapidity distribution becomes more narrow with increasing the cluster size**