PROPOSAL OF STUDYING THE SYMMETRY ENERGY OF ASYMMETRIC NUCLEAR MATTER AT SUPRA-SATURATION DENSITIES ON THE COOLING STORAGE RING AT LANZHOU, CHINA

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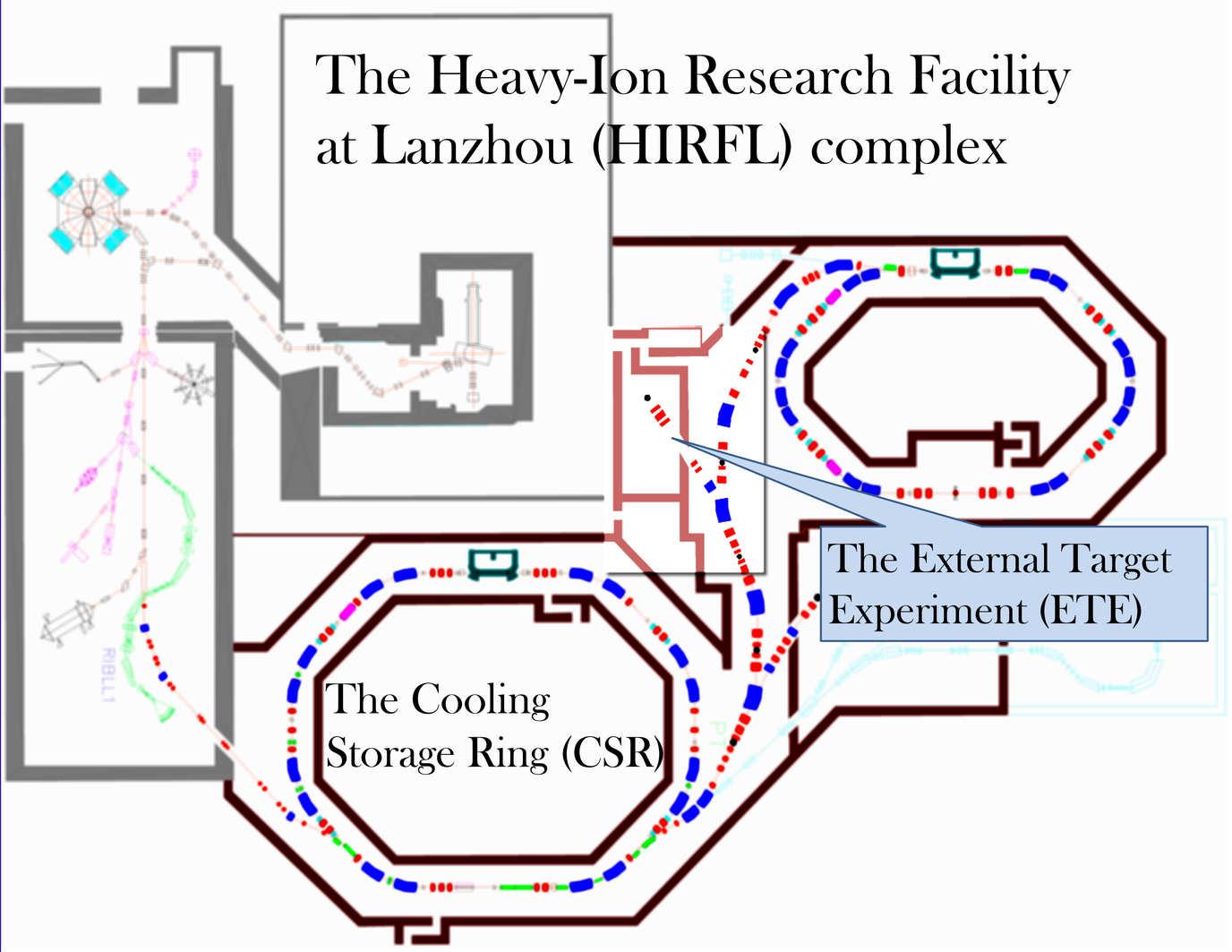
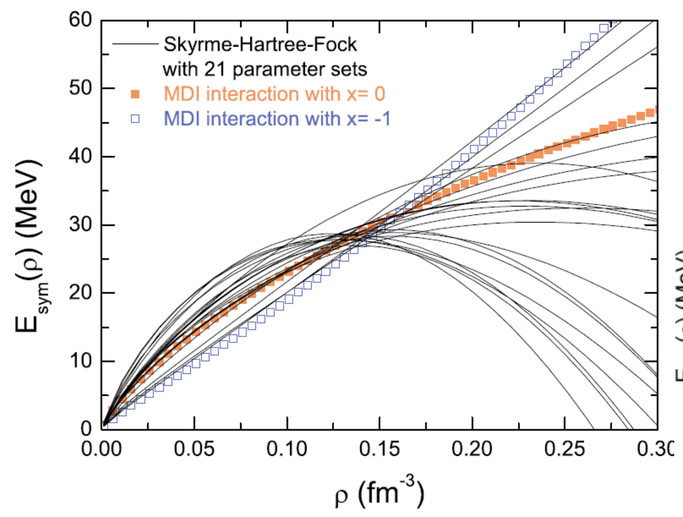
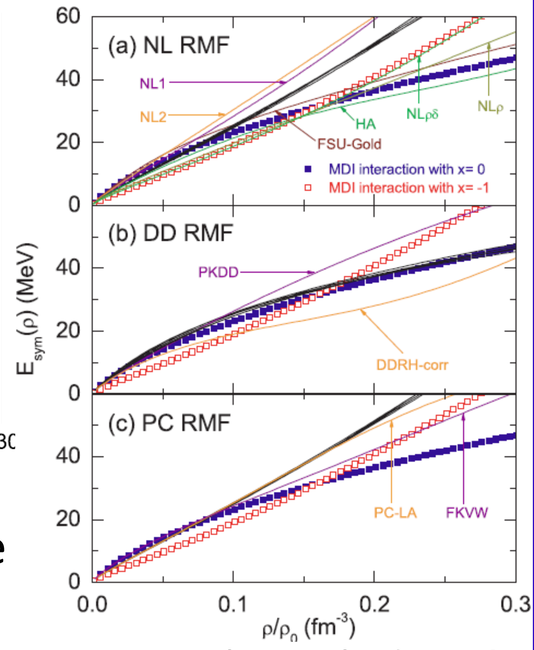
Abstract: The Cooling Storage Ring (CSR) at Lanzhou, China is a heavy-ion facility that can accelerate nuclei up to ^{238}U with a kinetic projectile energy of several hundred MeV to GeV. By utilizing the CSR heavy-ion beam on an external target, dense QCD matter can be created. The equation of state (EOS) of the strongly coupled matter can be studied via properly chosen physical observables, among which the π^-/π^+ production ratio probes the symmetry energy, $E_{sym}(\rho)$, of the asymmetrical nuclear matter at high densities. An External Target Experiment (ETE) is currently proposed for this study based on first-stage simulation and experimental work. To provide precise measurements and solid constraint to theory and models, experiment design and systematic requirements must be carefully studied.



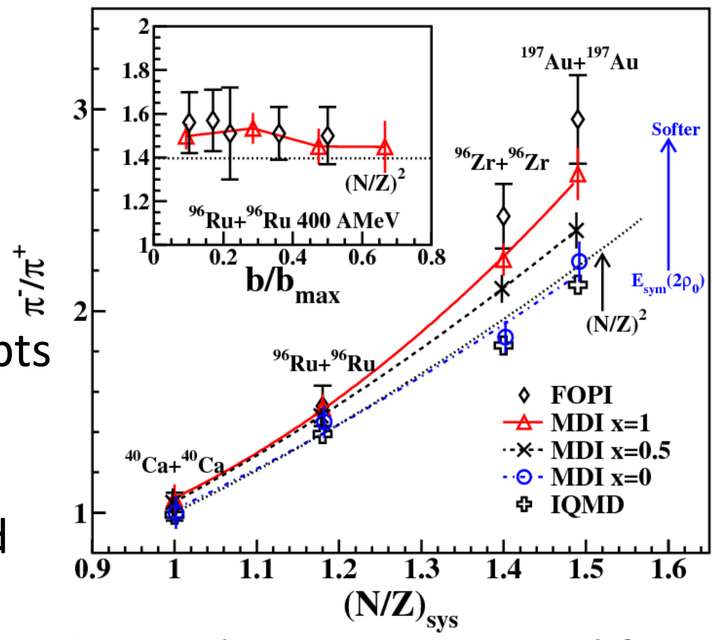
The Cooling Storage Ring (CSR) at Lanzhou has the ability of accelerating heavy-ion, from Helium to Uranium, to a kinetic energy of around 0.5-1GeV [1,2].



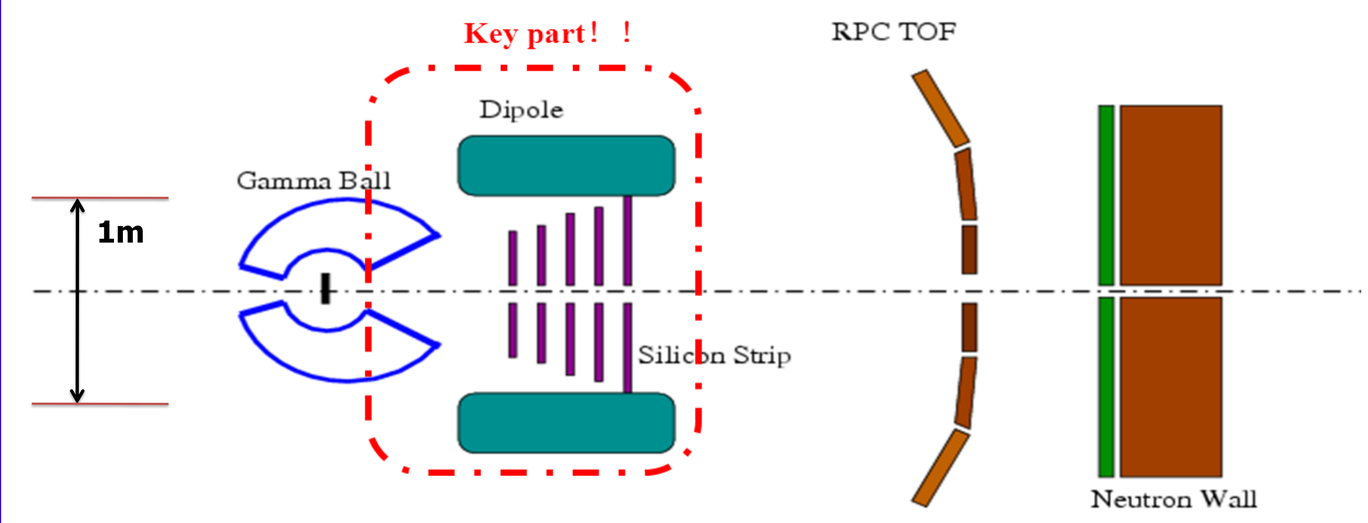


The symmetry energy of the asymmetrical nuclear matter at high densities provides important knowledge in understanding the Equation of State (EoS) of the strongly-interacting matter, as well as the evolutional properties of neutron stars. Predictions from current models differs significantly at this region [3].

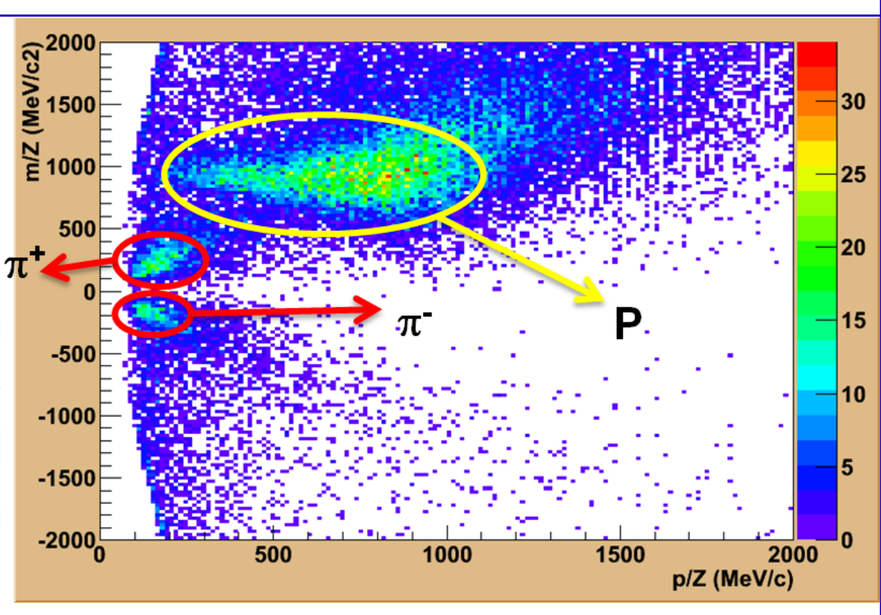
Systematic data on pion emissions at sub GeV HICs have been published by FOPI Collaboration [4], arousing many attempts in constraining the $E_{sym}(\rho)$. But no firm conclusion is achieved so far [5,6,7].

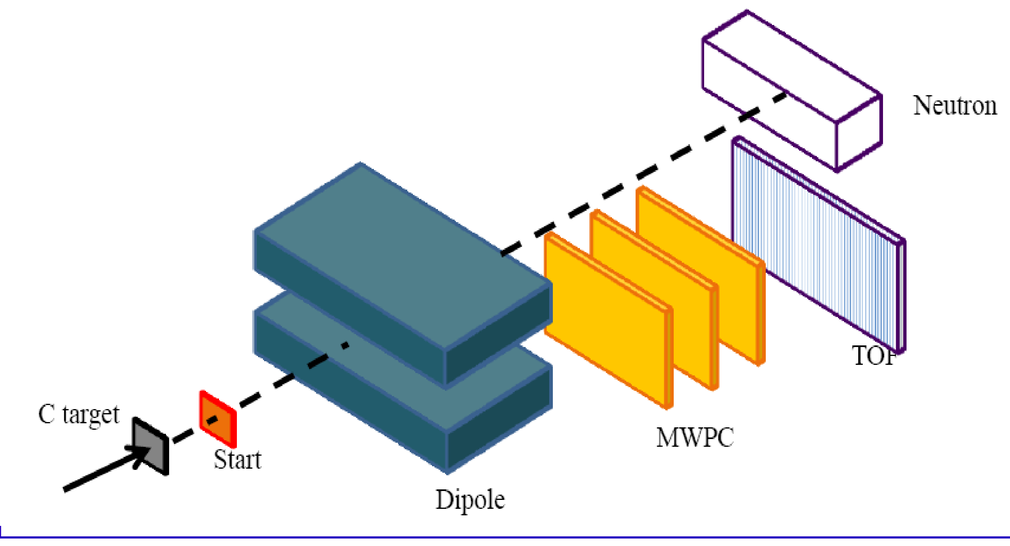


More dedicated experimental inputs are crucial for stimulating and constraining models.



An external target experiment is proposed to constrain the symmetry energy of the asymmetrical nuclear matter at high densities created in HICs at CSR by systematic measurement of the π^-/π^+ production ratio.





The feasibility of such a proposal was studied by Monte Carlo simulation, then checked by a pre-stage experiment, with smaller acceptance and simpler tracking. Preliminary results on π^-, π^+ and proton identification were obtained. Further studies based on both MC and experiment are undergoing.

[**References**]
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