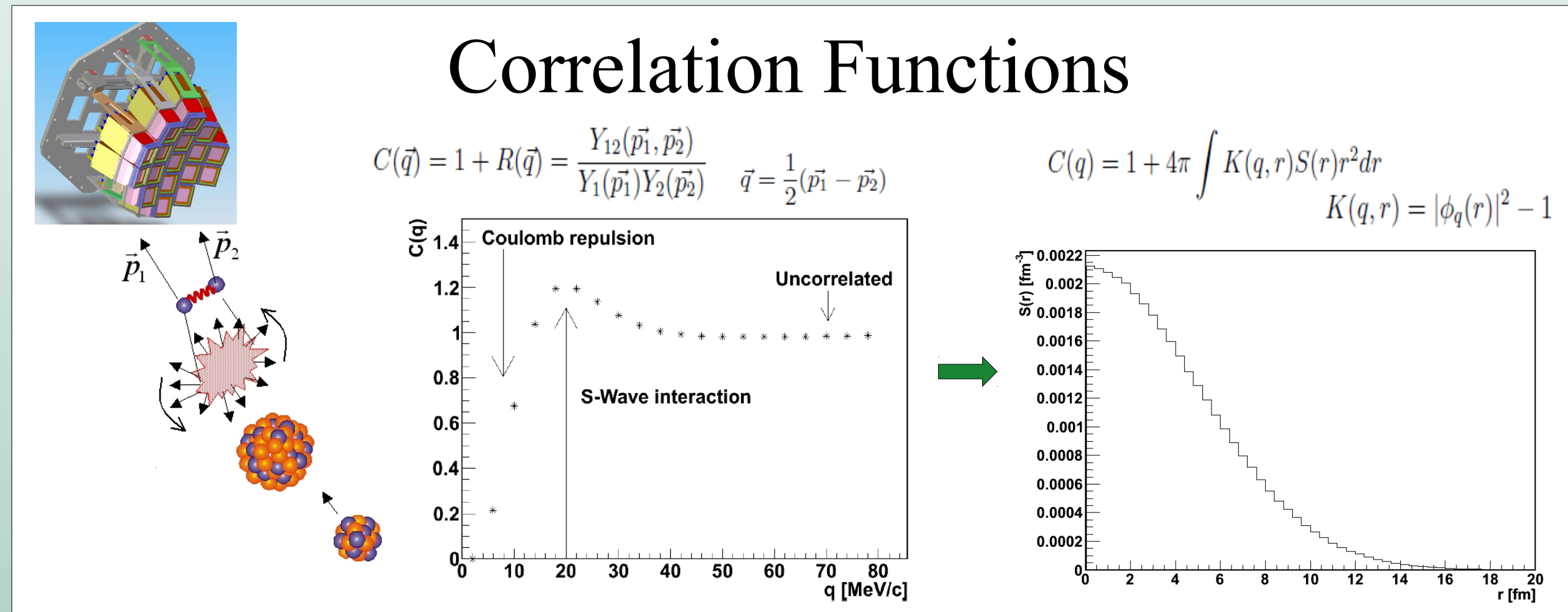


pp Correlation Functions as a Probe to the Density Dependence of the Symmetry Energy

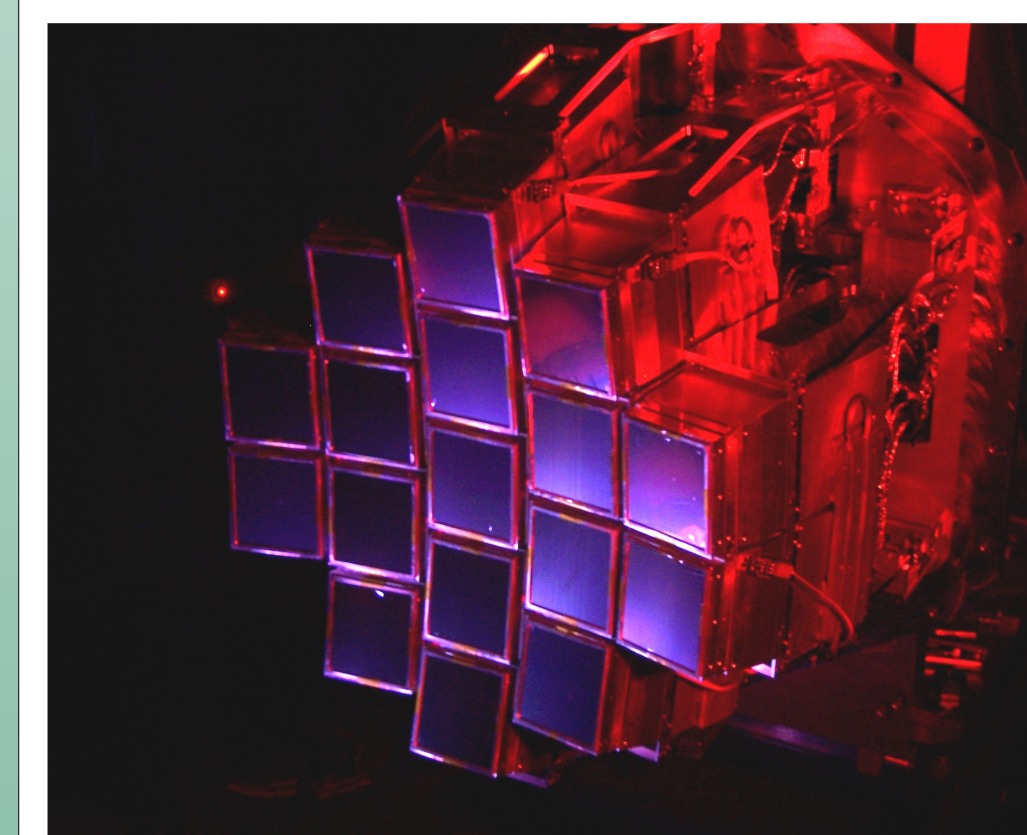
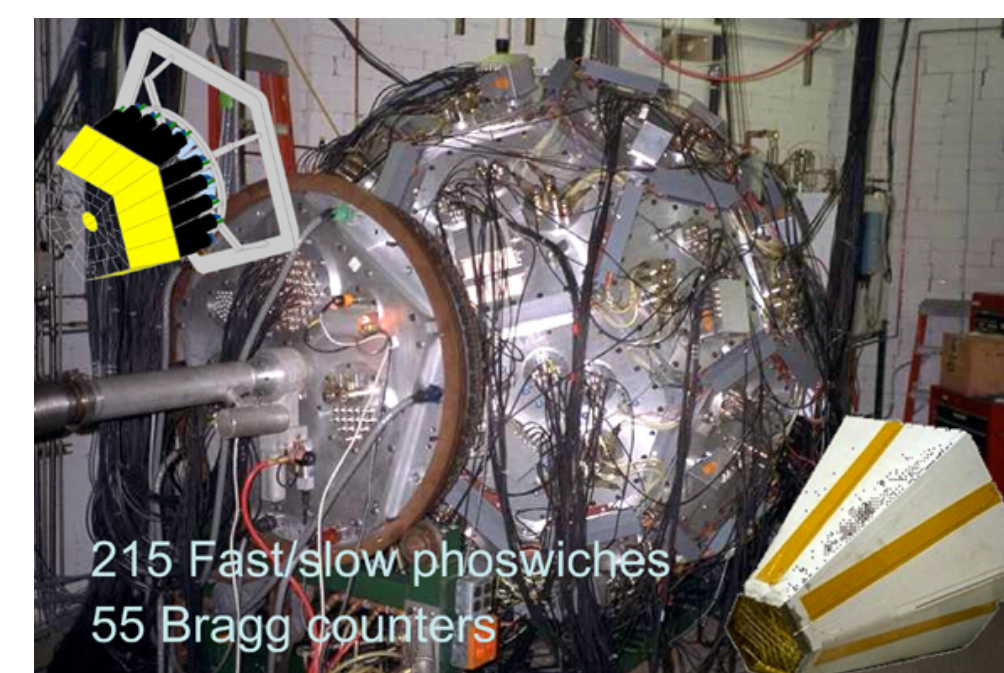
M. Kilburn, V. Henzl, D. Henzlova, Z. Chajecski, P. Danielewicz, W. Lynch, G. Verde



NSCL Exp. 03045: HiRA+4π

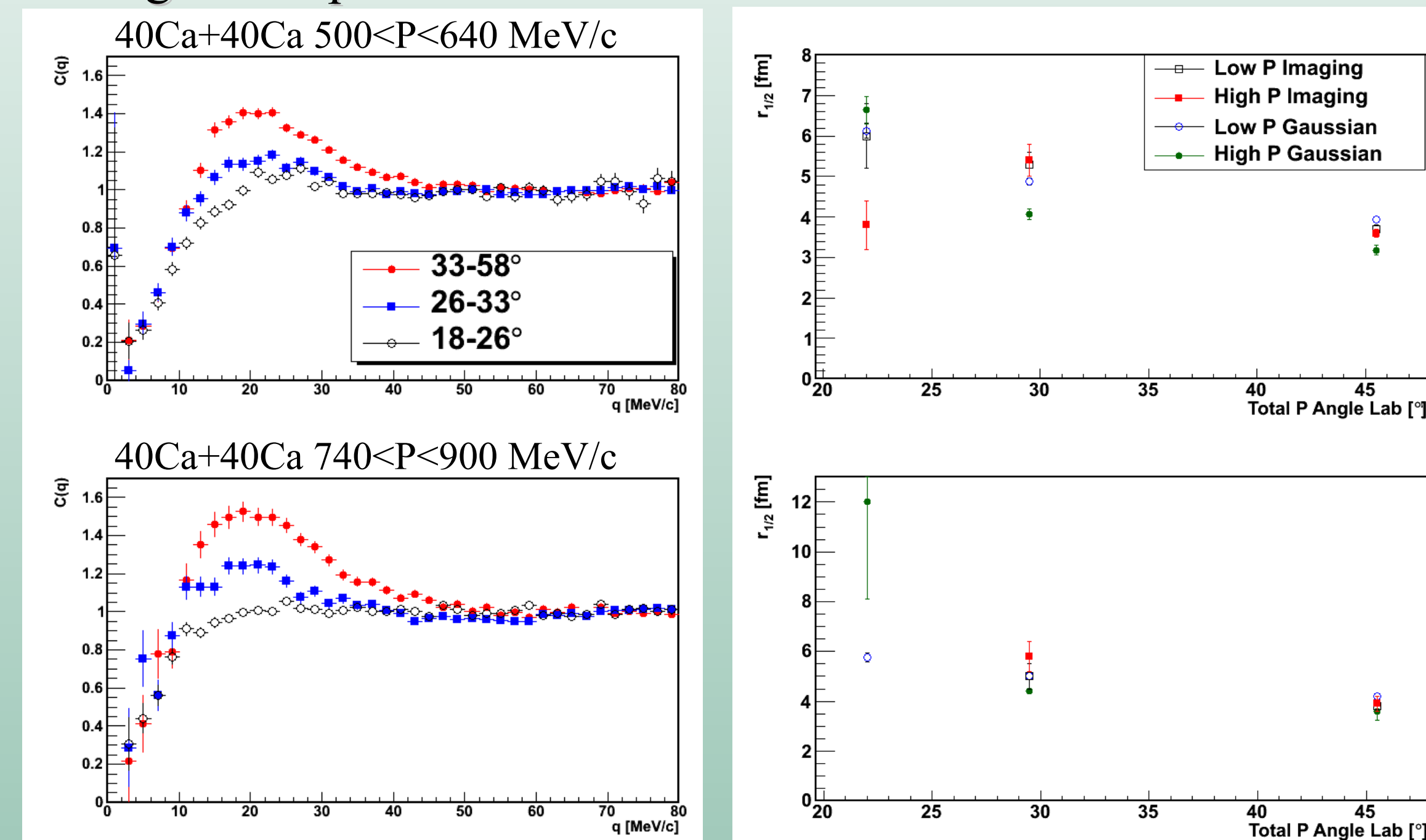
Reaction systems:
 $^{40}\text{Ca} + ^{40}\text{Ca}$ at 80 MeV/A N/Z=1
 $^{48}\text{Ca} + ^{48}\text{Ca}$ at 80 MeV/A N/Z=1.4

The 4π Array provides impact parameter selection for comparison to theory. Charged particle multiplicity and transverse energy can be used.



High Resolution Array replaced one of the hexagonal modules in the 4π. It was placed near 90° in the center of mass frame. High angular and energy resolution allowed us to measure the correlations with the necessary precision in low relative momentum.

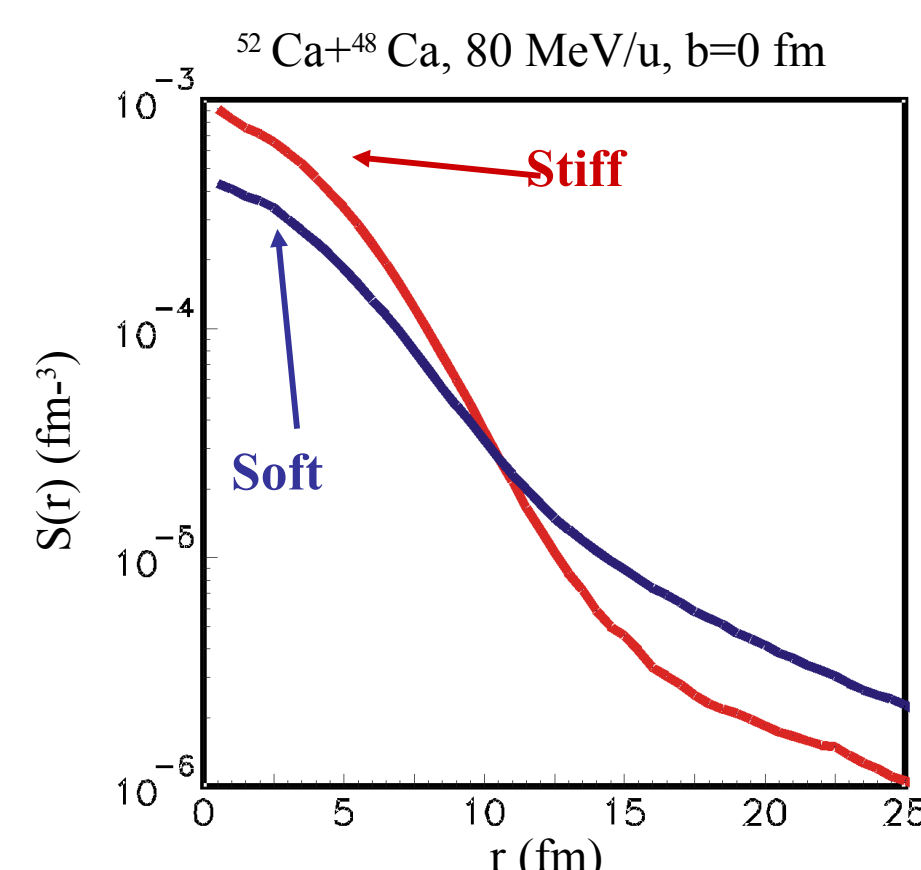
Angular Dependence of Correlation Functions and Source Size



Motivation: IBUU Predictions

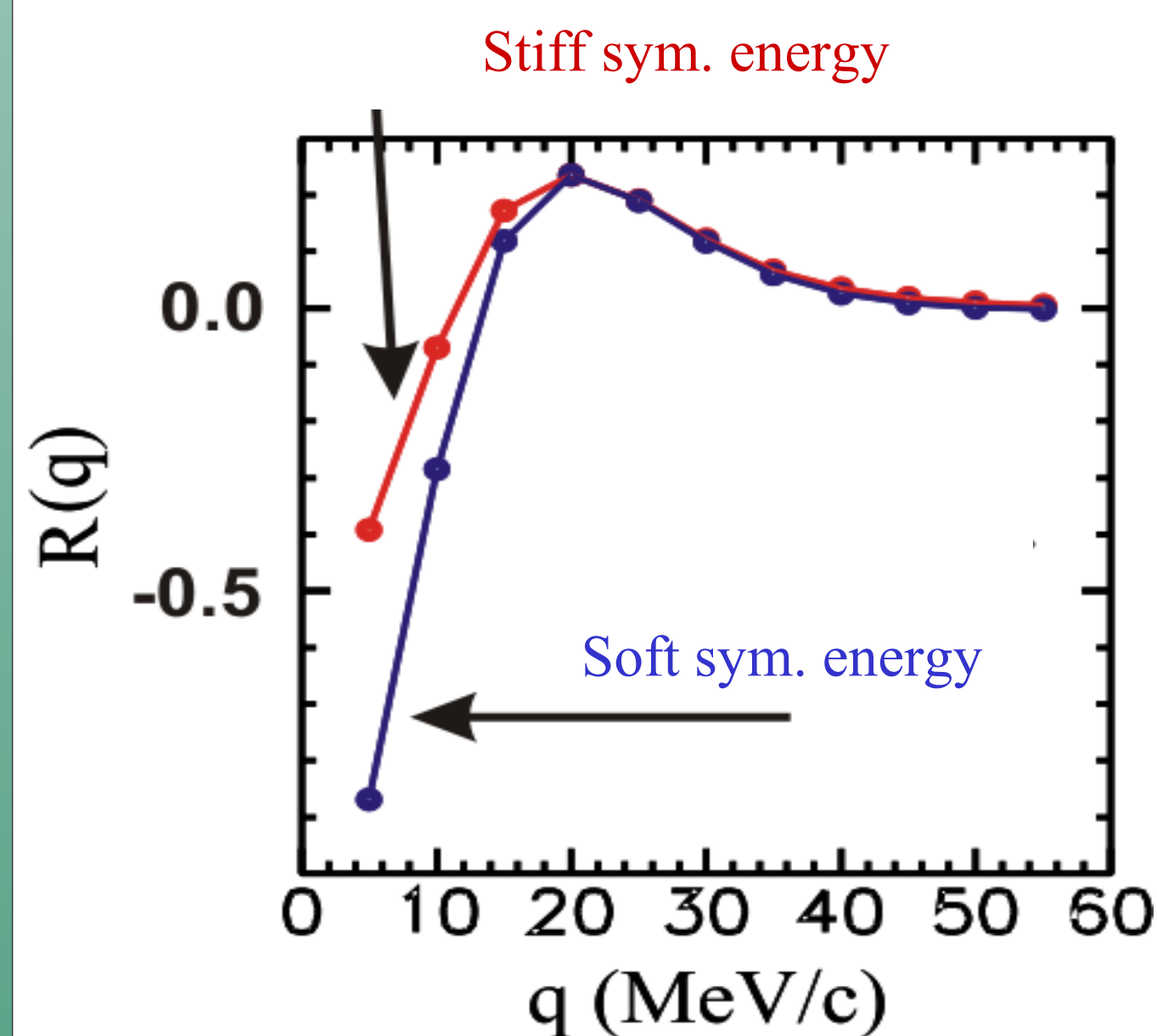
Particles with high momentum are emitted early while those with low momentum have long emission times.

The symmetry energy is attractive for protons. The soft symmetry energy has a mean field potential that retains the protons longer.

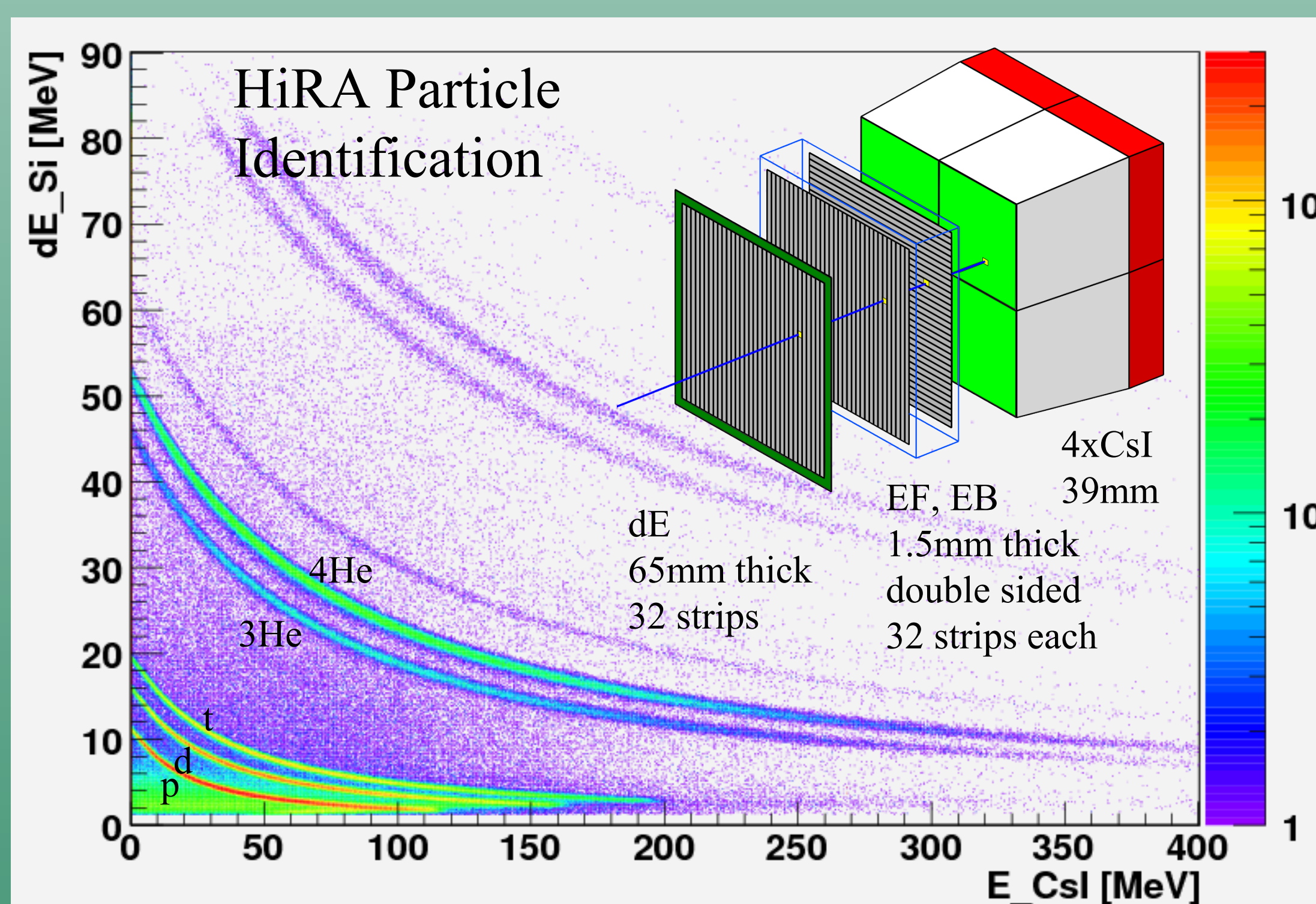
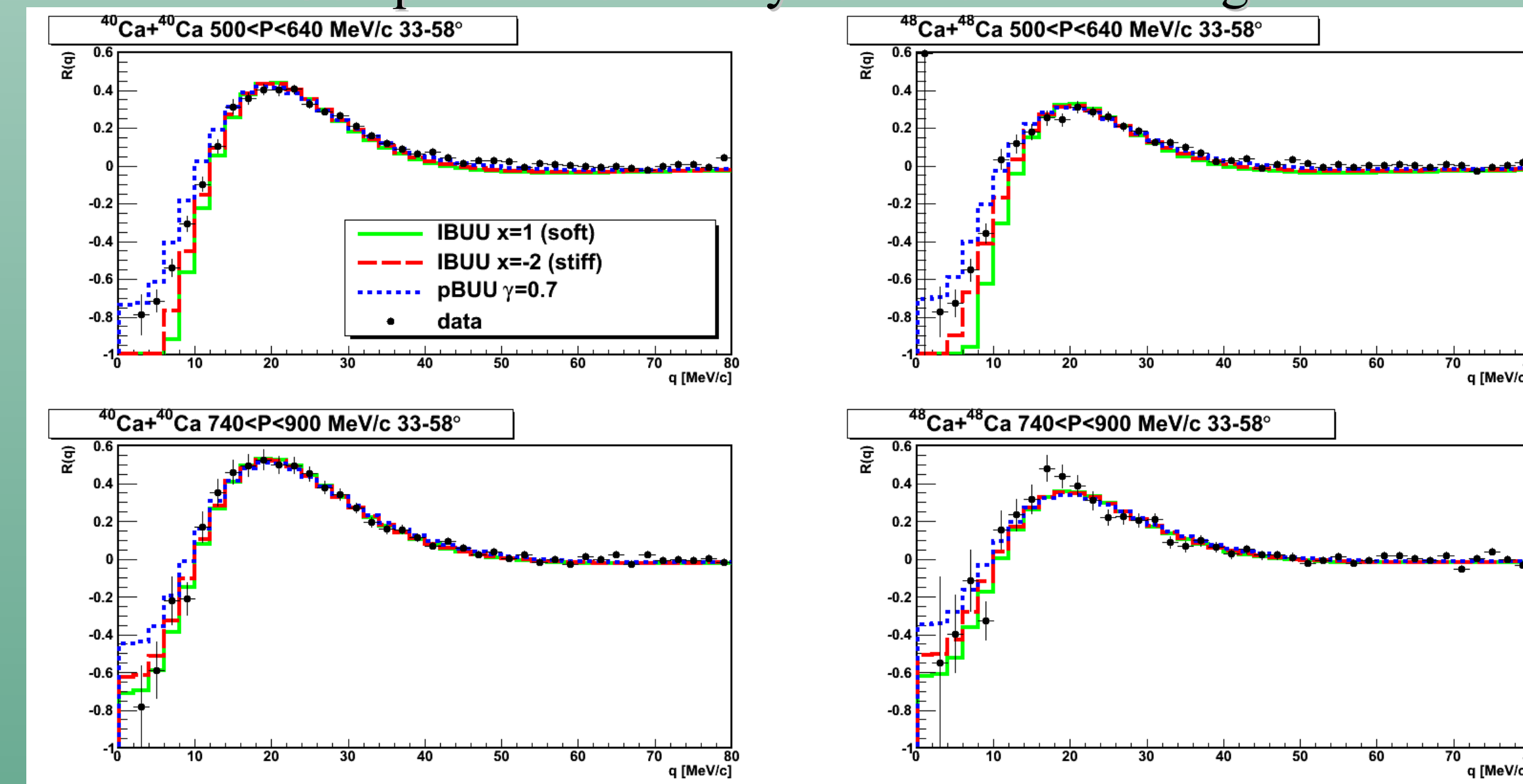


The stiff symmetry energy, with the more localized source has a larger and wider correlation function. When the correlation functions are normalized, it's clear that the main difference due to the symmetry energy is seen at low relative momentum.

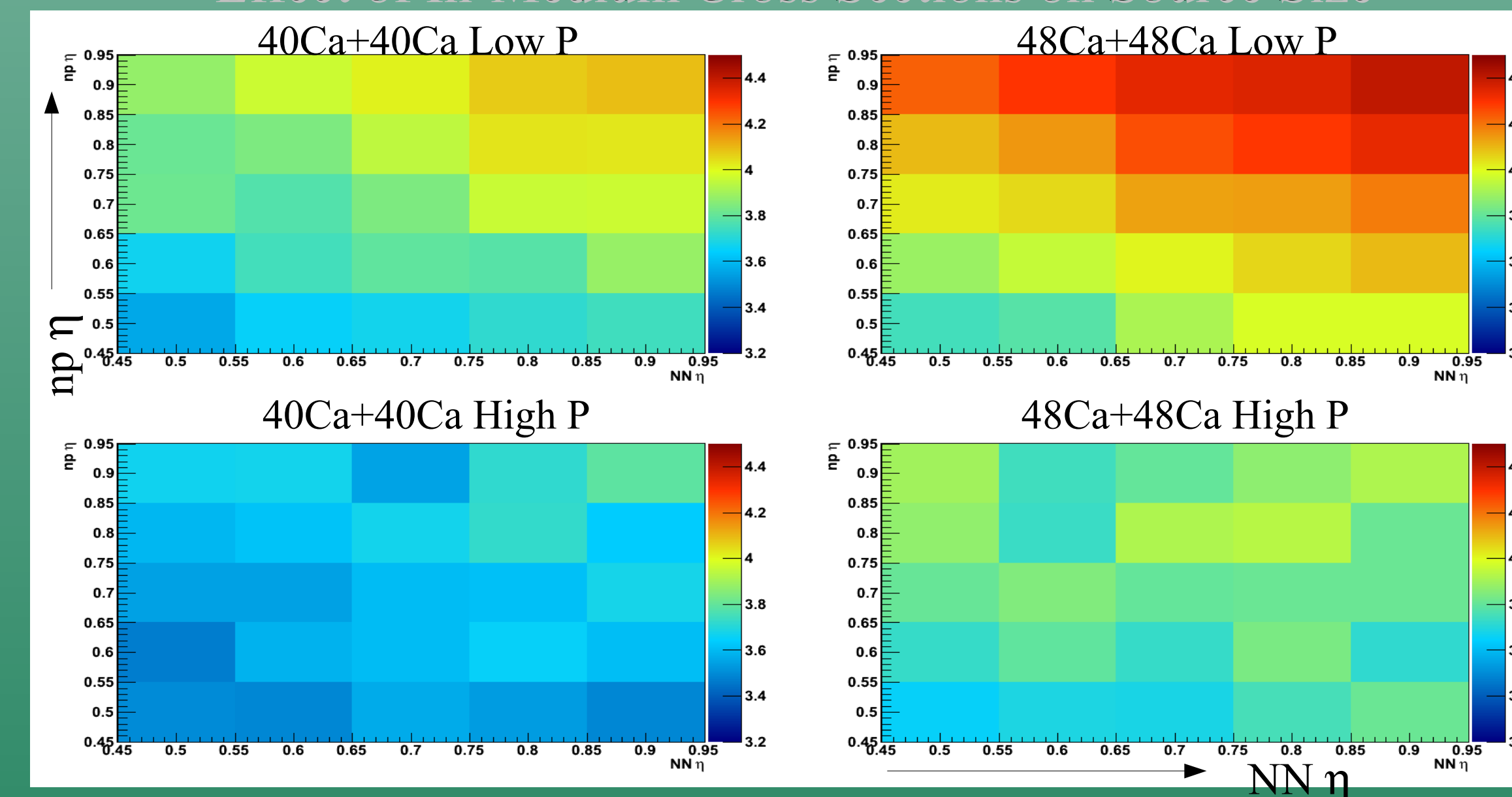
Chen, Li, et al Phys.Rev.Lett 90,162701



Comparison to Theory for Backwards Angles

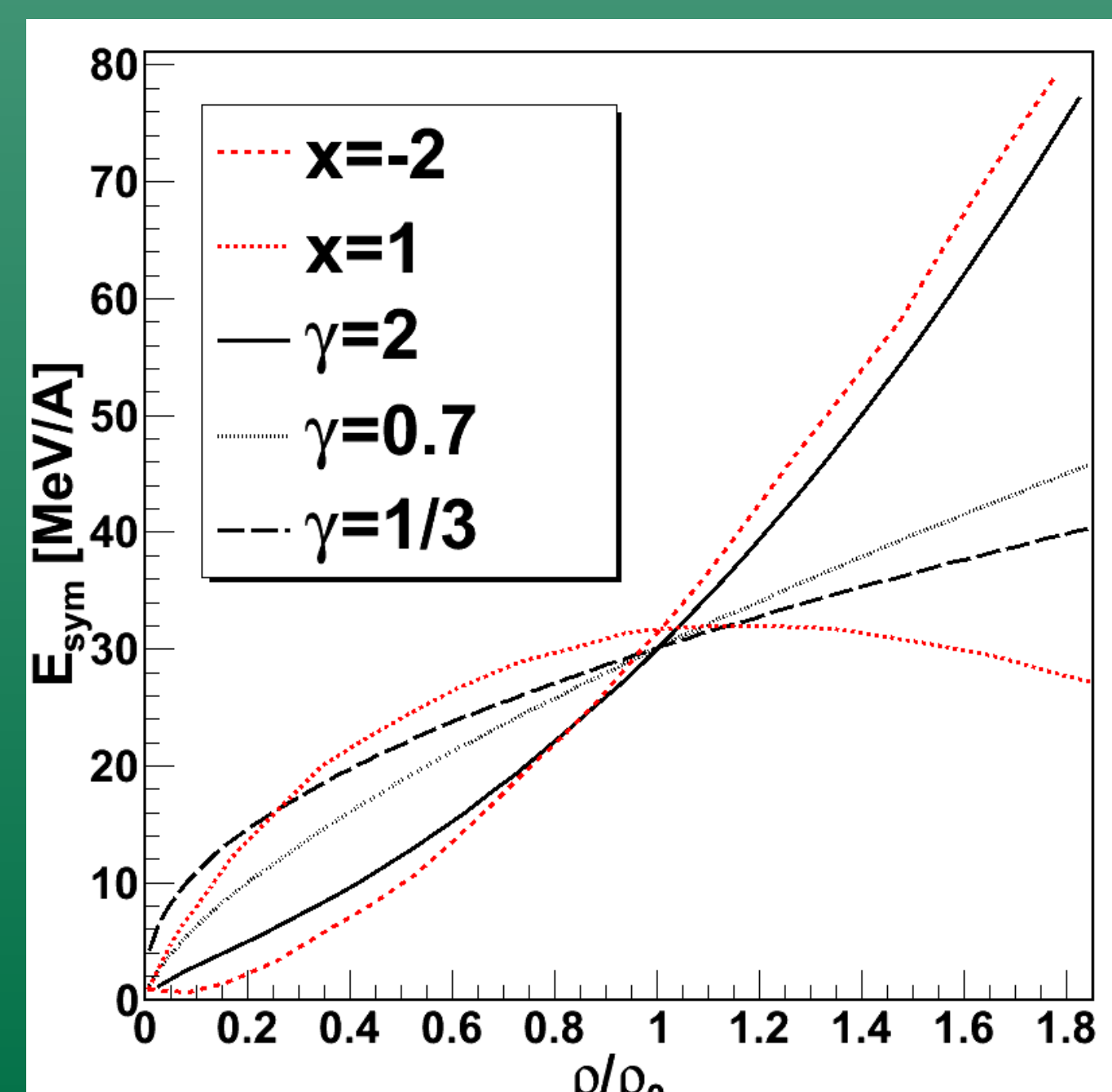
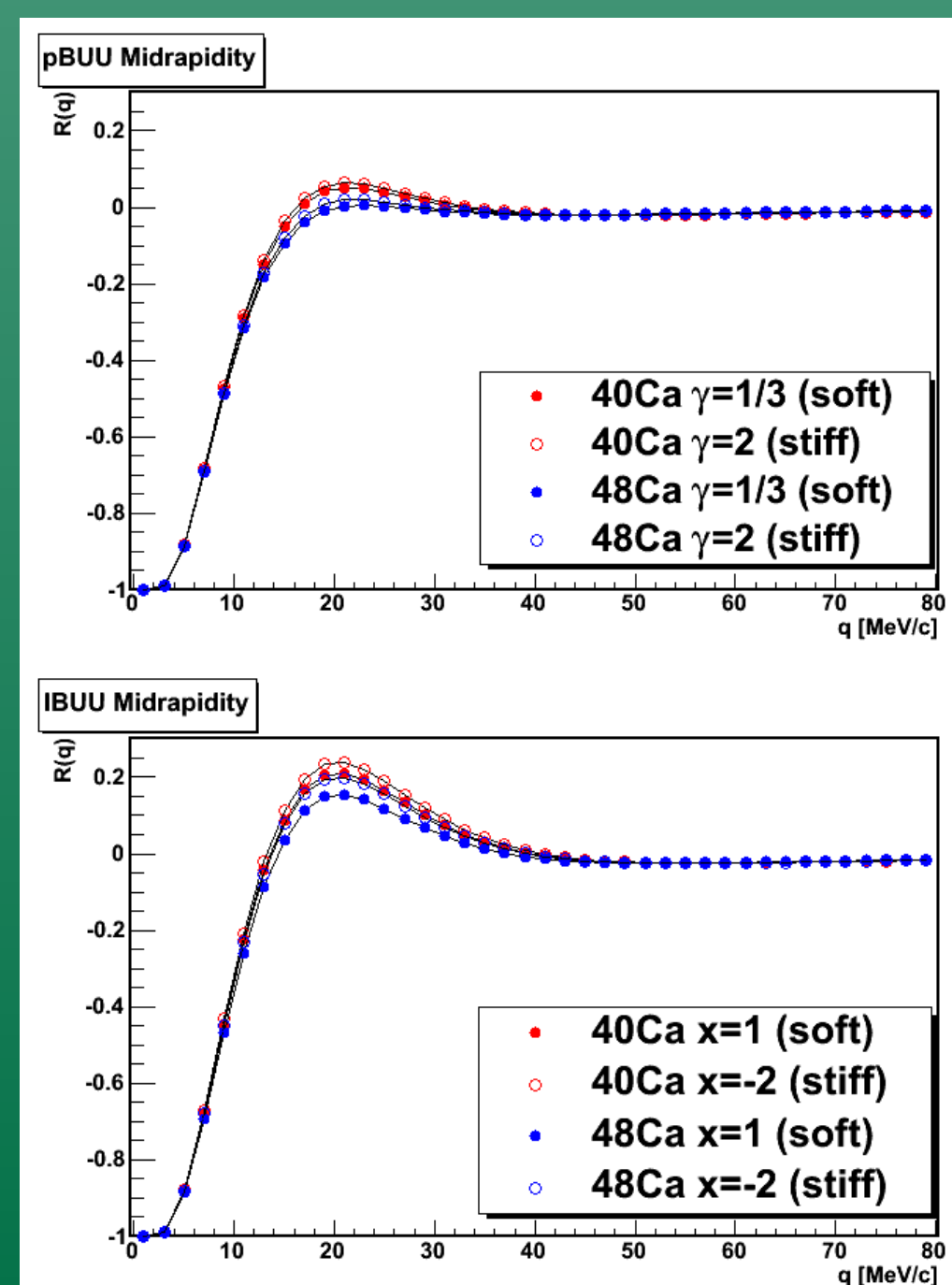


Effect of In-Medium Cross Sections on Source Size

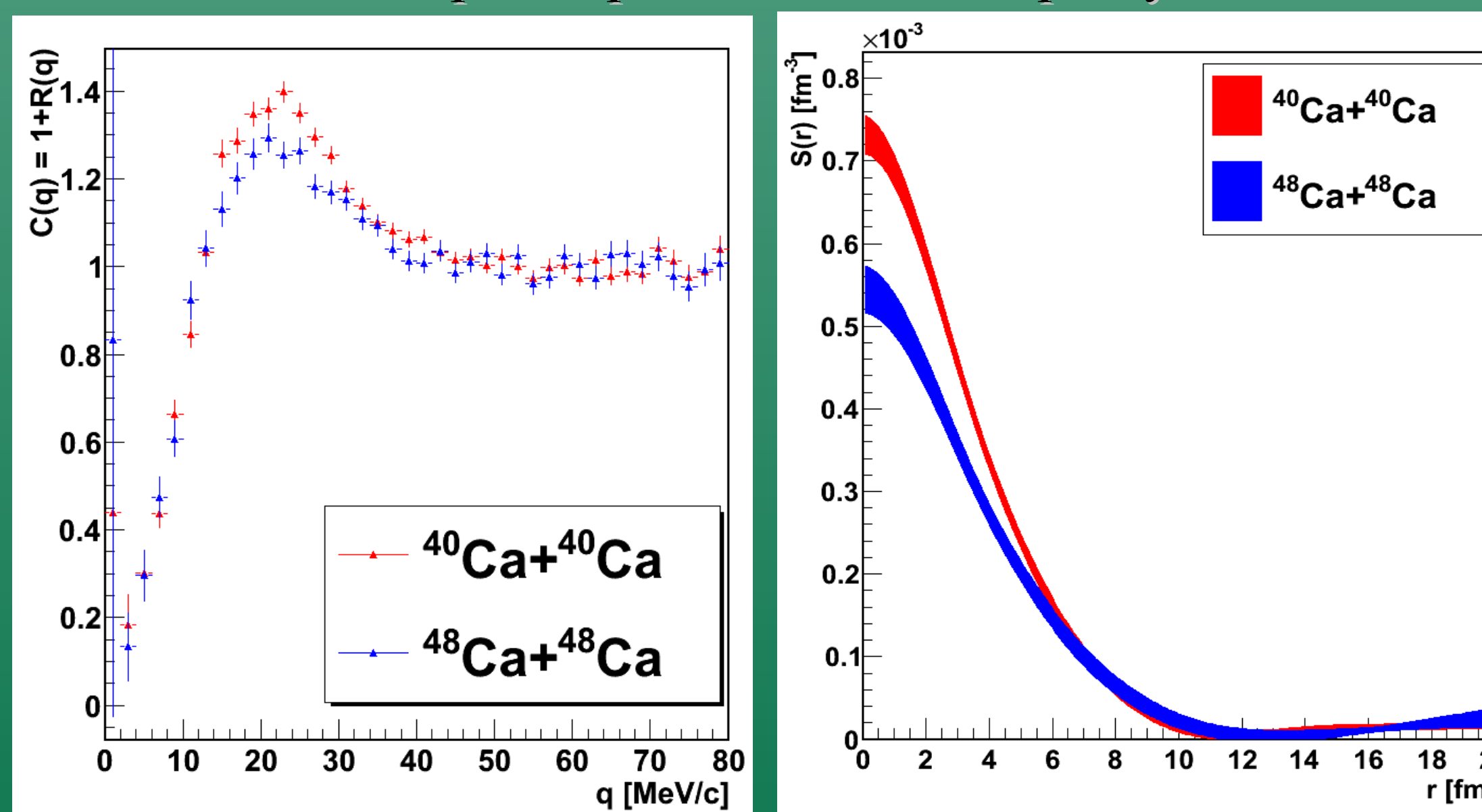


BUU Analysis

pBUU (Nucl. Phys. A, 533, 712) and IBUU04 (Phys. Rev. C, 44, 450) were used to explore the effects of many transport quantities on correlation functions. Shown here are the effects of changing the density dependence of the symmetry energy at midrapidity. Little sensitivity is seen to the correlation functions for pBUU and a slight sensitivity is seen for IBUU. To make a direct comparison between pBUU and IBUU04, a momentum dependent isoscalar mean field potential was employed as were free NN cross sections.



Isospin Dependence at Midrapidity



Conclusions

- The high resolution of HiRA allows for measurement of pp correlation to low q
- BUU calculations show only a slight sensitivity to symmetry energy
- Data shows interesting effects with angular cuts
 - Different angle cuts select different regions of the reaction
 - Higher momentum correspond to smaller source except in the case of very forward angles
- Other transport quantities effect the pp correlation functions more strongly than the symmetry energy
 - secondary decays
 - in-medium cross sections



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