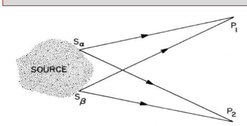
Upgrade to the FAUST array to obtain Correlation Functions as a probe of the Asymmetry Energy

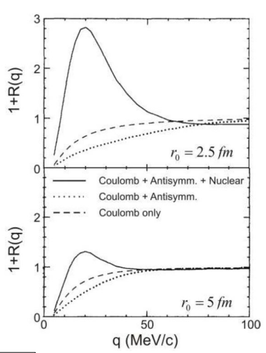
Lauren Heilborn
Cyclotron Institute, Texas A&M University

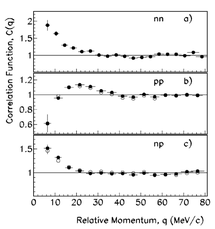
Abstract/Motivation

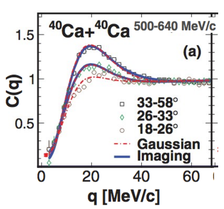
Proton-proton correlation functions are known to be a powerful probe of the spatial and temporal distribution of the hot emitting source in heavy-ion reactions. Theoretical calculations have shown that the nuclear equation of state influences the general shape of these correlation functions. Experimentally, the position and energy resolution of the protons from each nuclear collision needs to be very precise in order to extract spatial and temporal information on the source. To that end, new position-sensitive detectors are being implemented in an upgrade of the Forward Array Using Silicon Technology. The upgraded array will be utilized for obtaining correlation functions from ^{48}Ca on ^{58}Ni and ^{64}Ni. Constrained Molecular Dynamics (CoMD) is a theoretical code from which such functions can be extracted. CoMD runs with three distinct nucleon-nucleon interactions, which results in three different equations of state. Correlation functions can be extracted from neutron-poor and neutron-rich reaction systems of isotopically pure calcium and nickel, for three different formulations of the equation of state.

Proton-Proton Correlation Functions





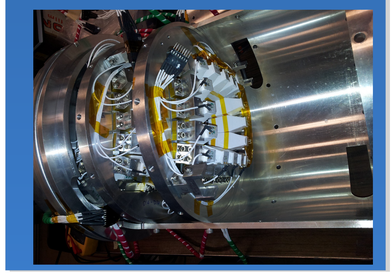




- Interferometry, patterns in the relative proton momenta, due to the interactions between any two protons in the same event.
- Correlation function sensitive to the asymmetry energy.
- Direct interaction between the two protons in the reaction.
- Good angular resolution important

$$|\vec{q}_{Rel}| = \frac{1}{2}|\vec{p}_1 - \vec{p}_2|$$

$$C(q_{Rel}) = N\frac{Y_c(q_{Rel})}{Y_{nc}(q_{Rel})}$$



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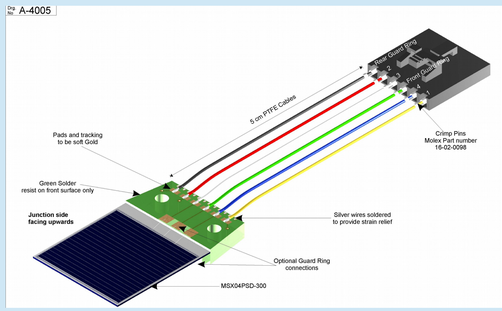
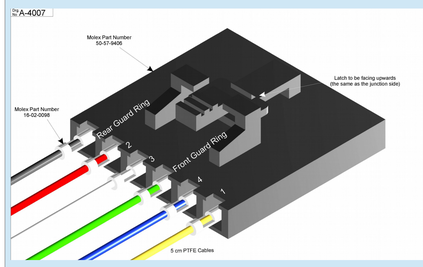
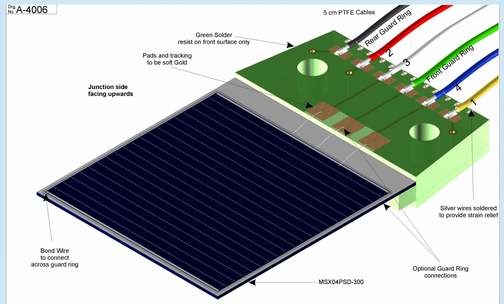
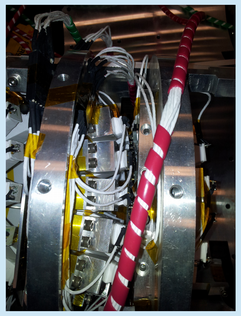
Array Upgrade

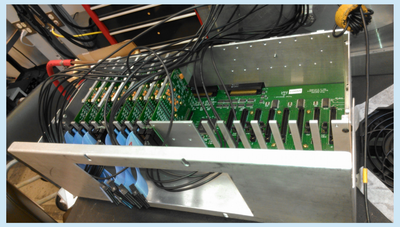
- DADL detectors, to add angular resolution to the experiment.
- Position Resolution: < 200 um
- Energy Resolution: < 2%

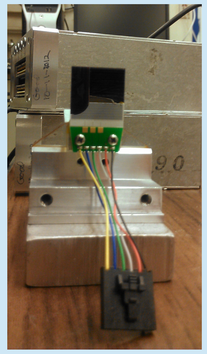




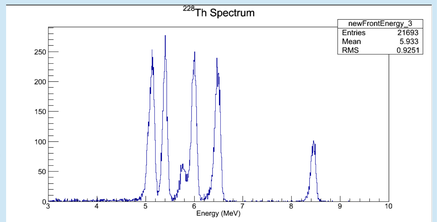


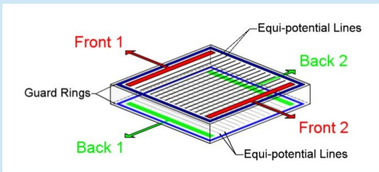






- Two signals off of each side of each of the 68 detectors in FAUST.
- Re-cabling, working with ASICS electronics to deal with extra signals (150% more signals)
- After digitalization, need to be Gain-Matched, for accurate Energy spectra.





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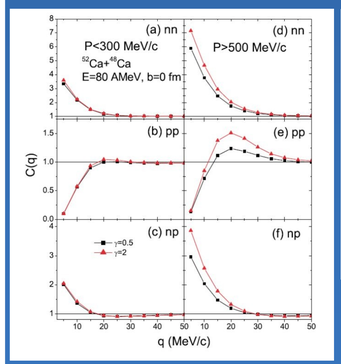
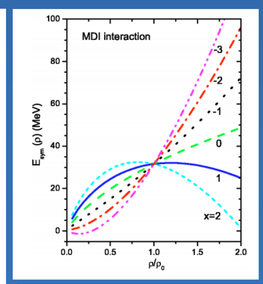
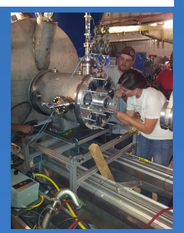
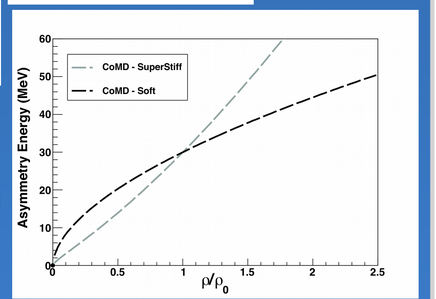
Simulations

- IBUU has been used in the past to investigate the shape and creation of the correlation function.
- iBUU will be run for the intermediate-energy Ca+Ni systems
- Constrained Molecular Dynamics (CoMD) is a molecular dynamics model, rather than a transport one.
- Simulations also used to set the magnets that follow the FAUST array in the beamline, to pick up any large residues.
- The triplet magnet and downstream detector can help with characterizing less violent events.









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Acknowledgments

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