Experiment 03045:

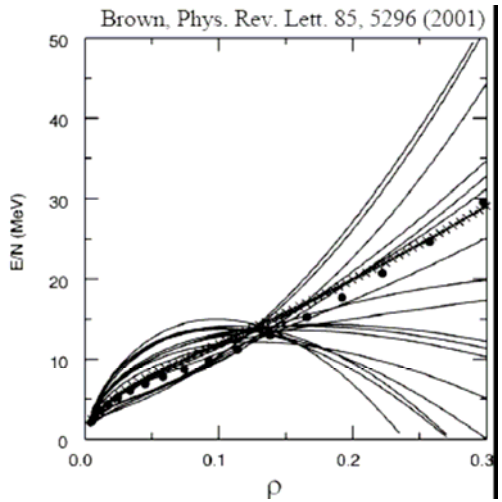
Two particle correlation functions and isospin effects in nuclear reactions

Vladimir Henzl

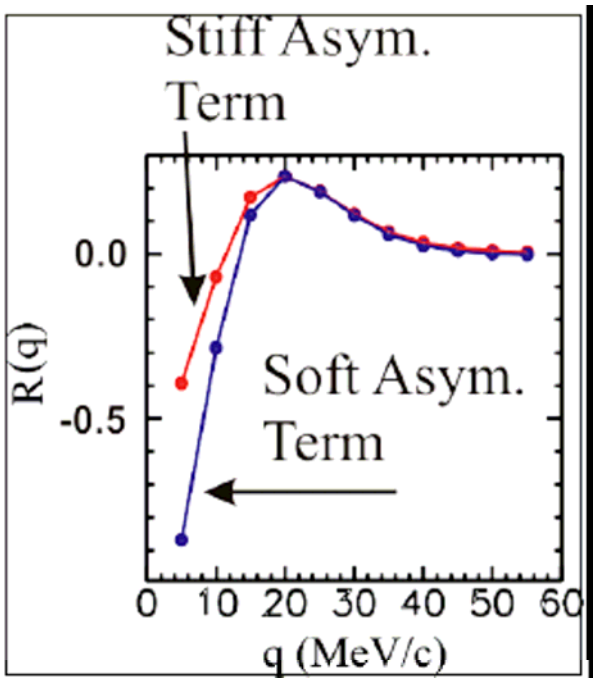
for HiRA collaboration

Motivation I

• investigation of density dependence of the symmetry energy, $E_{sym}(\rho)$ in the equation of state



two-proton correlation functions



greatest sensitivity to $E_{sym}(\rho)$ at low relative particle momenta q<15MeV/c

• stiff $E_{sym}(\rho)$:

=> earlier, more correlated pre-eq. emission

=> emitting source less expanded in space

=> larger radii of neutron stars

Experimental idea

- **4pi detector provides impact parameter selection and reaction plane reconstruction**

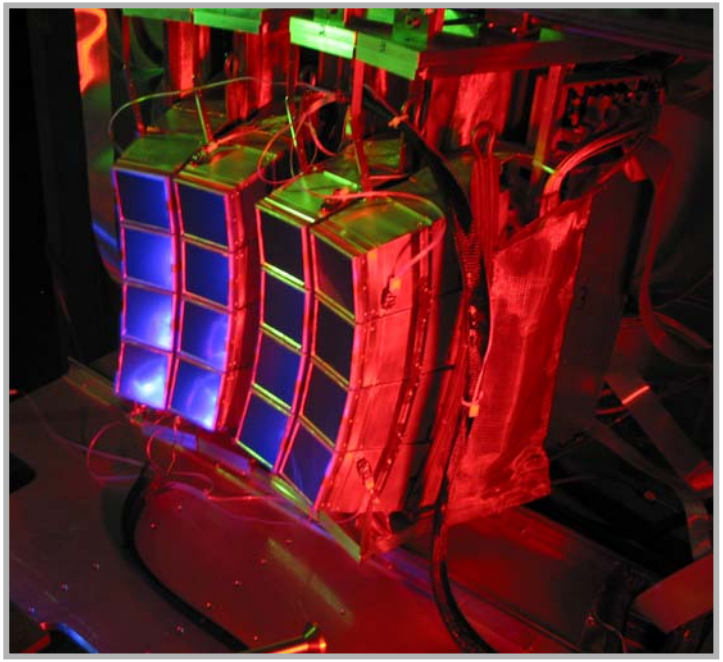
- **Light charge particle correlations detected by HiRA are sensitive to *N*/*Z* content of the initial systems.**

- **Reaction systems:**

  ^{40}Ca + ^{40}Ca at 80 *A* MeV
  ^{48}Ca + ^{48}Ca at 80 *A* MeV

Experimental challenge *(op.I)*

How to combine HiRA and 4pi detector ?



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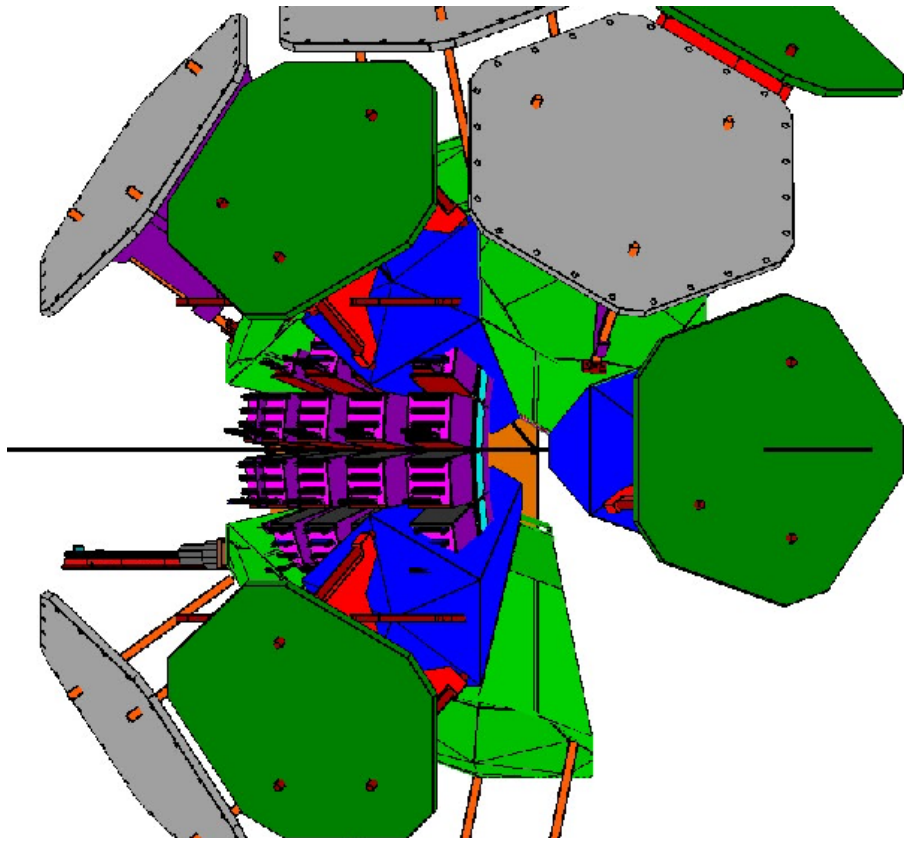
Experimental challenge *(op.II)*

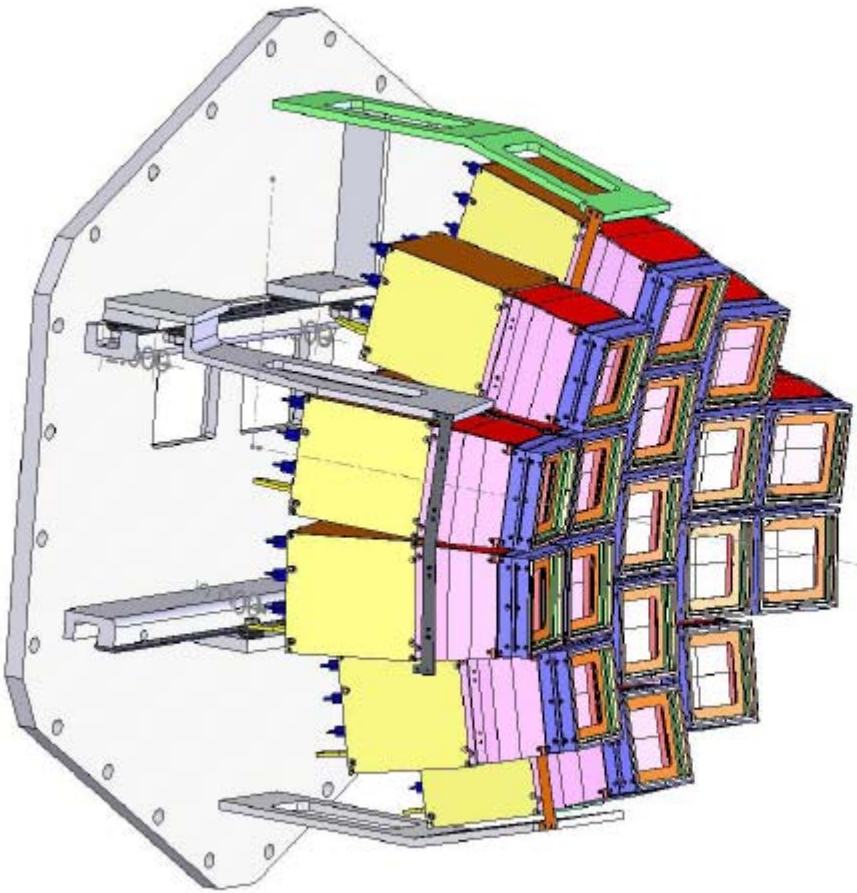
How to combine HiRA and 4pi detector ?

1st attempt =>



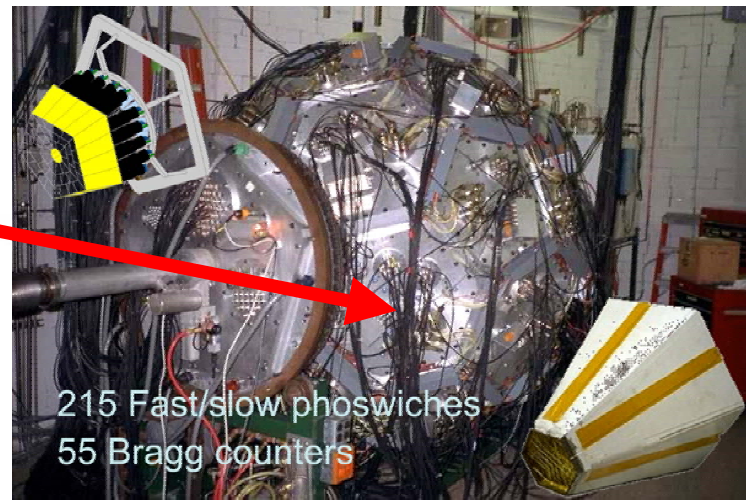
Experimental challenge *(op.III)*

How to combine HiRA and 4pi detector ?



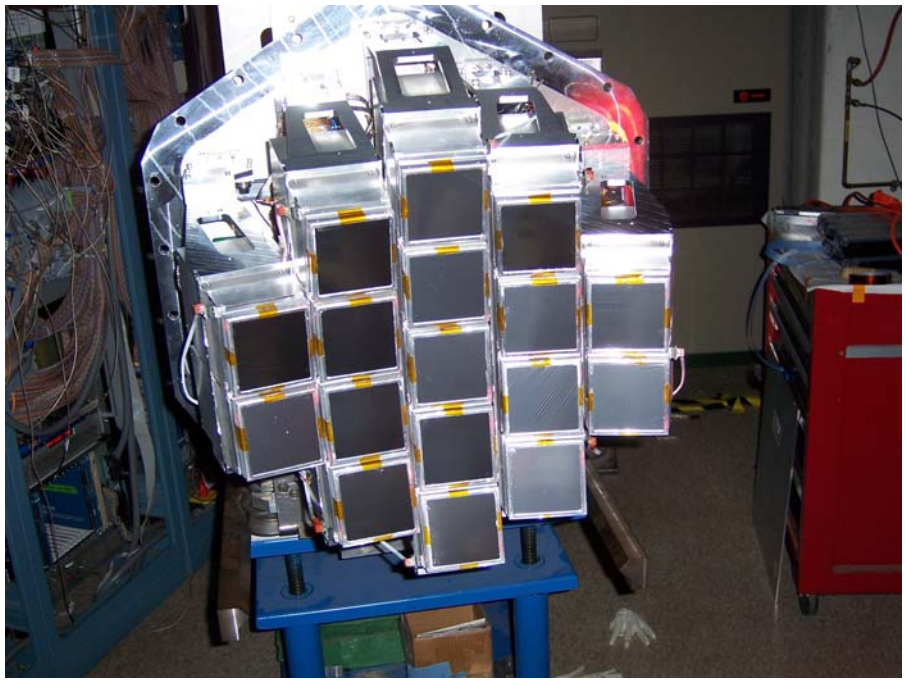
Design by Len Morris

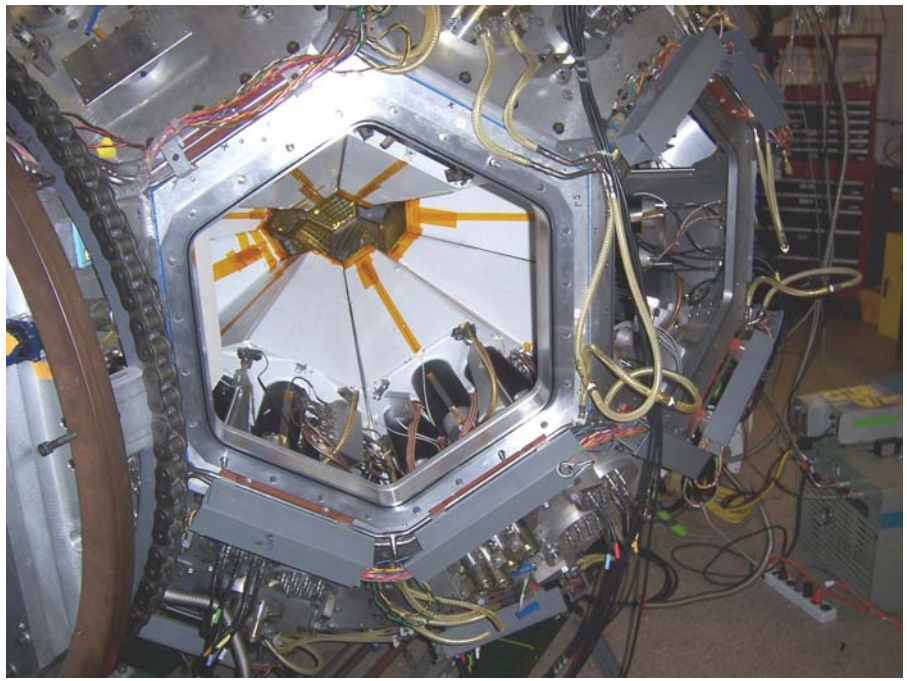
- 17 HiRA telescopes
- 63 cm from the 4pi center (i.e. target)
- 7.5-8° apart
- ang. Coverage 20-60 °



Experimental challenge *(op.IV)*

HiRA ready for 4pi



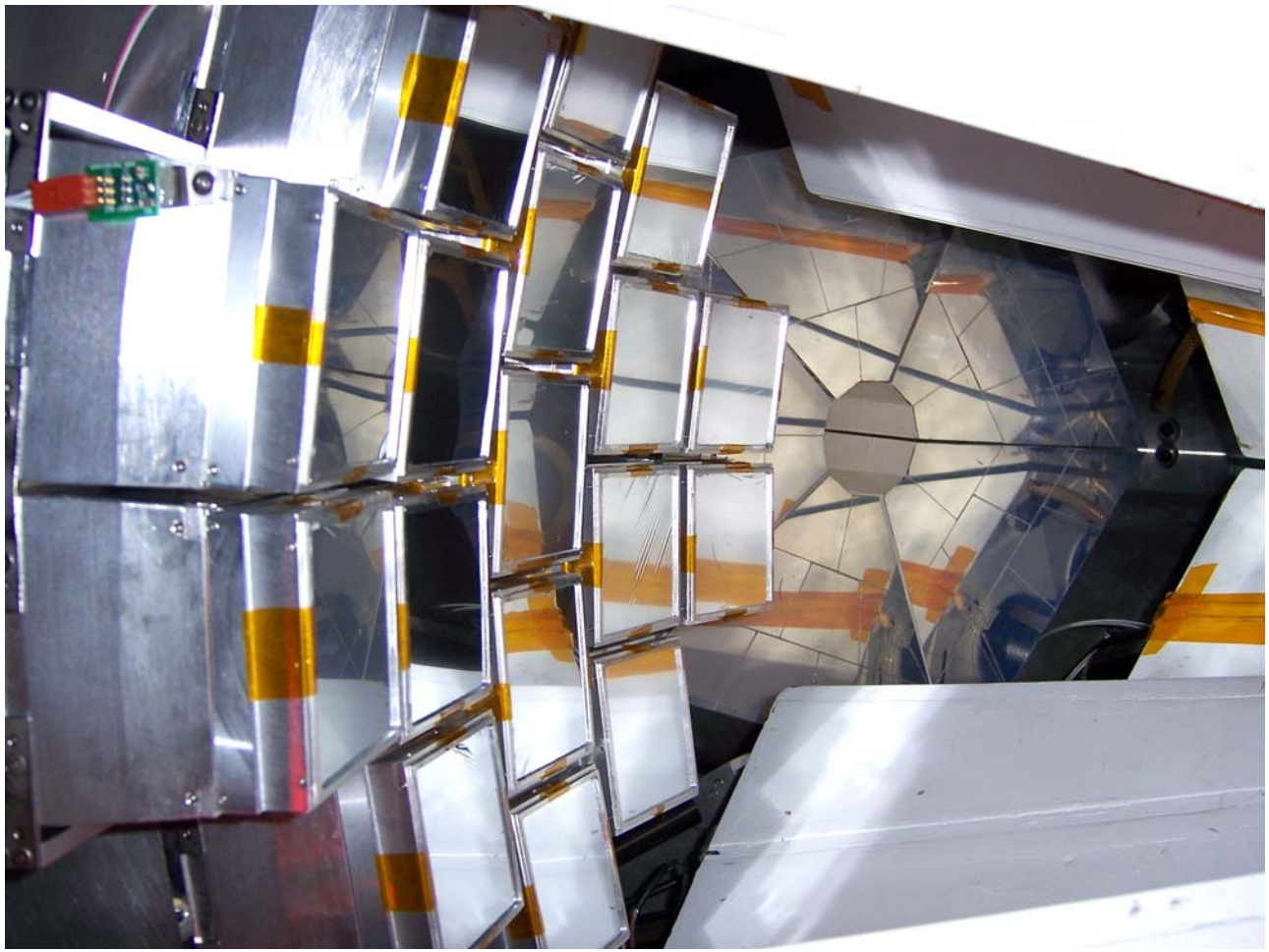


Fabrication:
Doug Miller, Jay Pline, Bob Weldon, …

4pi resurrection:
Skip Vander Molen, Daniela Henzlova

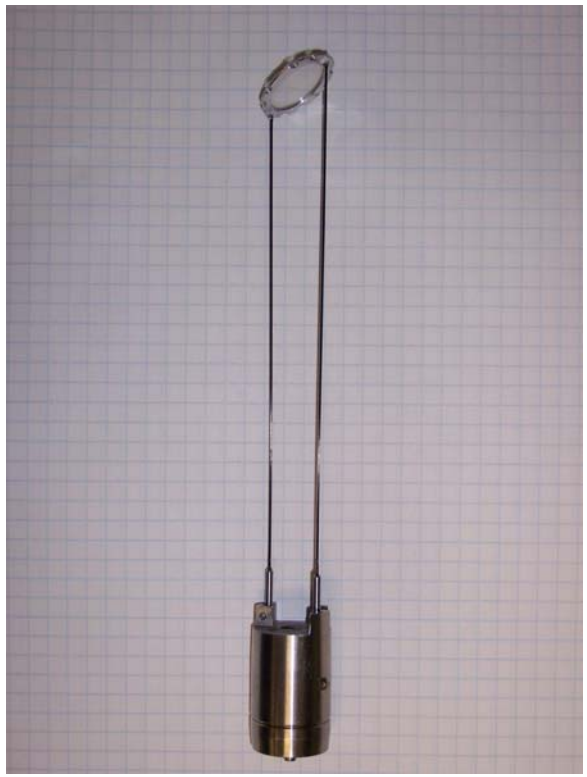
Experimental challenge *(op.V)*

HiRA inside 4pi:



Experimental challenge *(op. VI)*

Calcium targets:

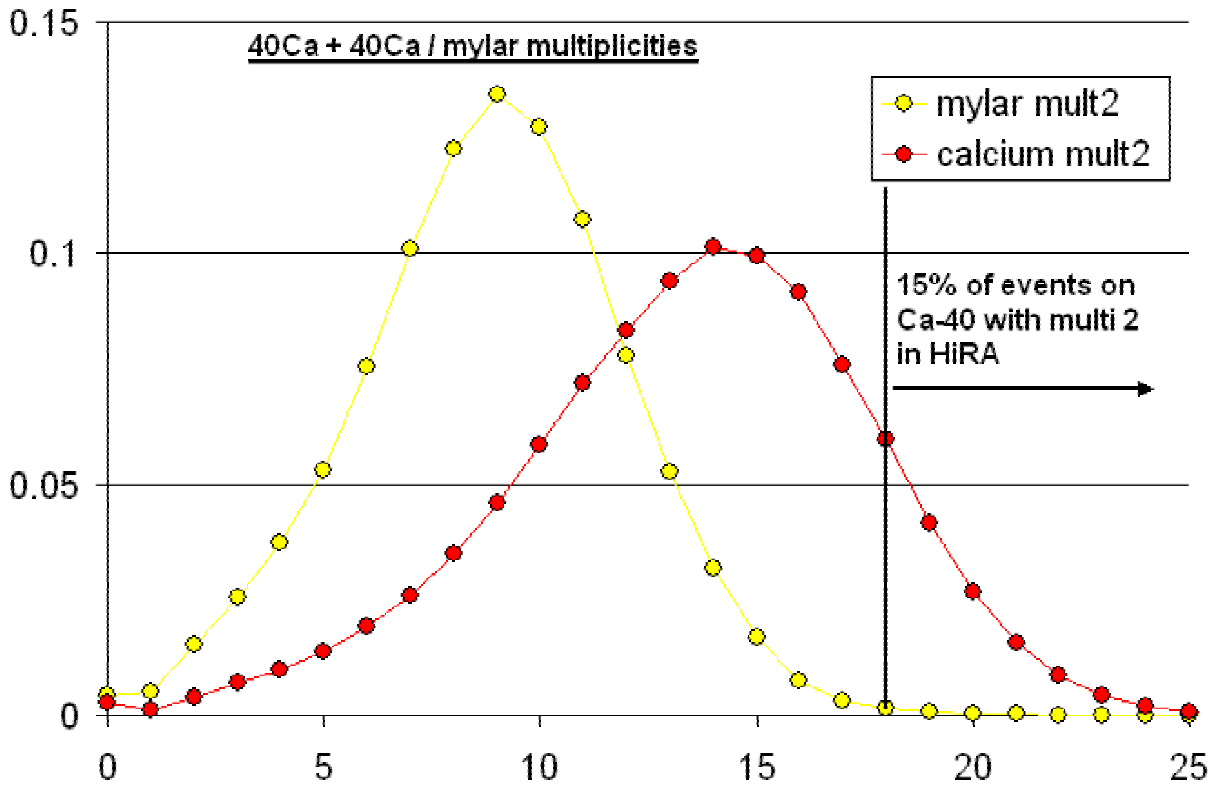


$\Rightarrow$ Calcium quickly oxidizes in air atmosphere (~ minutes)

$\Rightarrow$ All ^{40}Ca and ^{48}Ca targets rolled and assembled in argon atmosphere inside the glove box *(Sergei Lukyanov and Micha Kilburn)*

Preliminary results - multiplicities

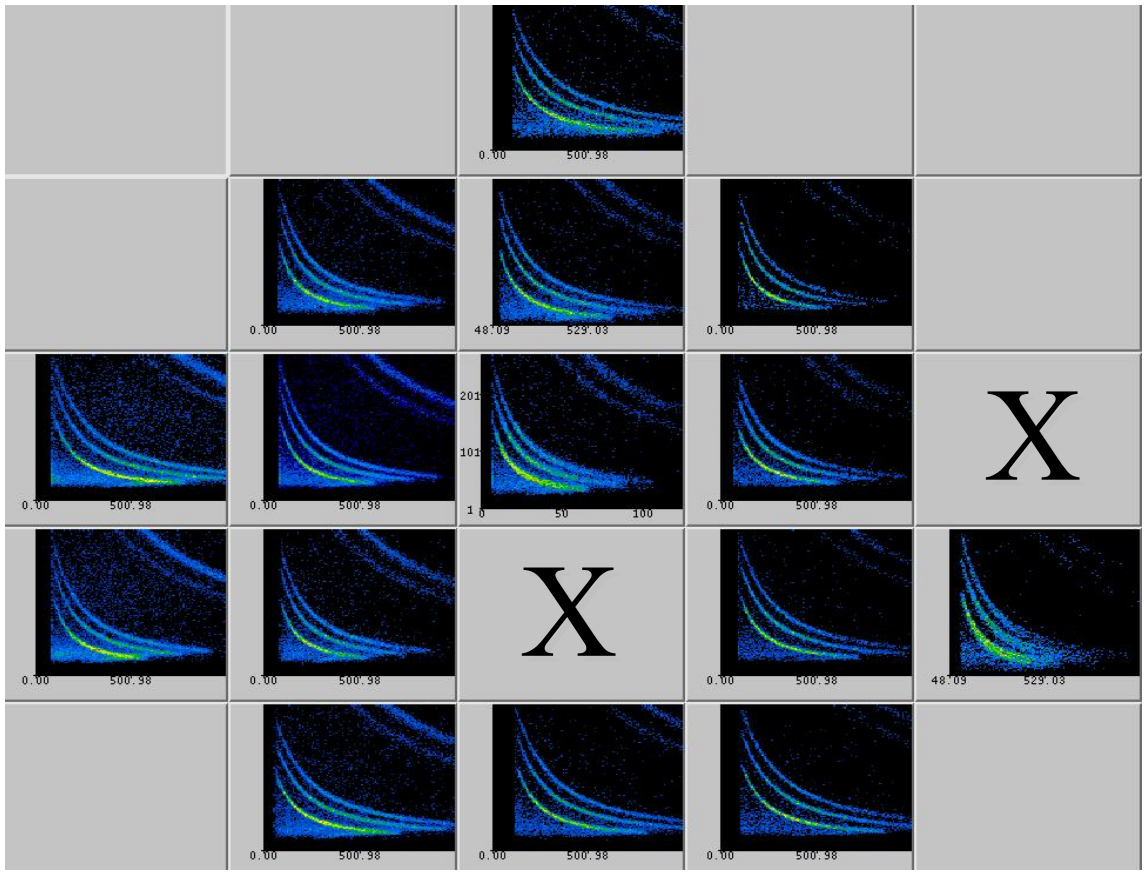
Event multiplicity in 4pi gated by mult ≥2 in CsI



Micha Kilburn, Betty Tsang

Preliminary results - PIDs

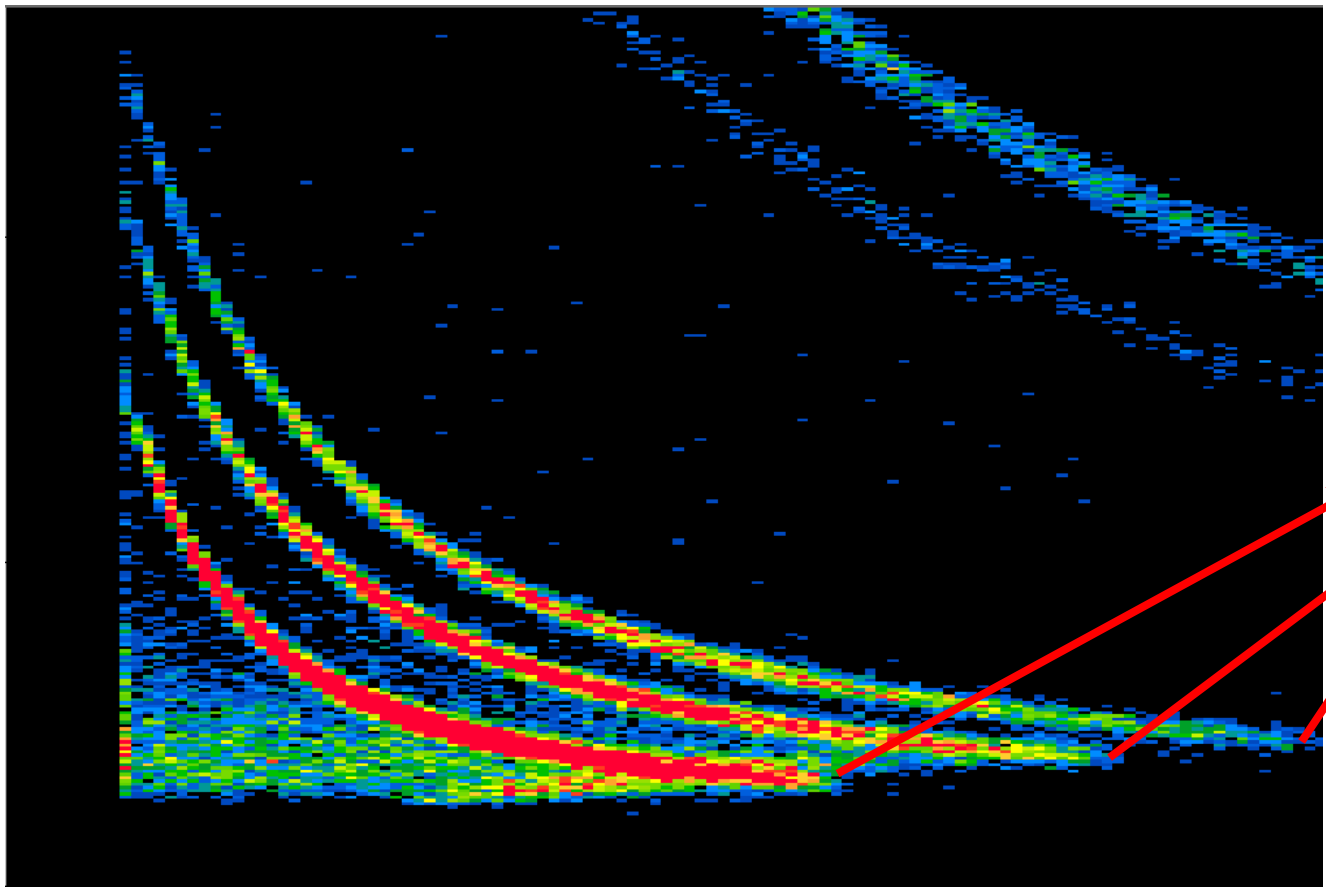
Energy loss in Si detector (1.5 mm) vs. energy in CsI (40 mm)



Betty Tsang

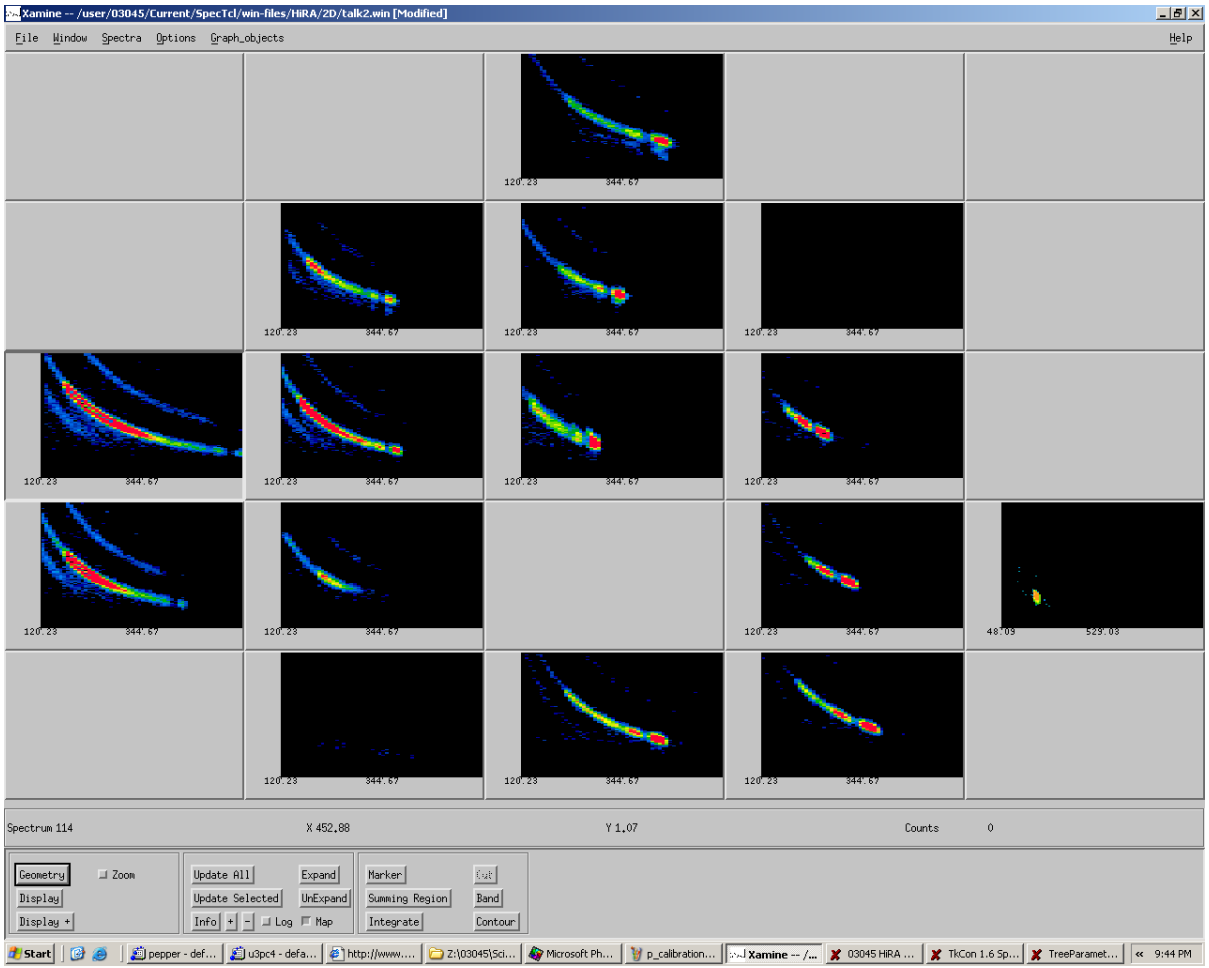
Preliminary results - PIDs

Detail of PID plot (energy in thick Si vs. energy in CsI)



Betty Tsang

Preliminary results – recoil p calib.



Calibration of CsI with recoil protons from $^{40}Ca + CH_2$ reaction