



Game plan for transfer reactions Experiment (Sept-Dec 2007)

Expt 05133 Ar experiment

- $p(^{34}\text{Ar},d)^{33}\text{Ar}$ (70 hrs)
- $p(^{36}\text{Ar},d)^{35}\text{Ar}$ (24 hrs)
- $p(^{46}\text{Ar},d)^{45}\text{Ar}$ (70 hrs)

Expt 06035 Ni experiment

- $p(^{56}\text{Ni},d)^{55}\text{Ni}$ (48 hrs)
- $d(^{56}\text{Ni},^3\text{He})^{55}\text{Co}$ (144 hrs)
- $d(^{58}\text{Ni},^3\text{He})^{57}\text{Co}$ (24 hrs shake down)

Time line

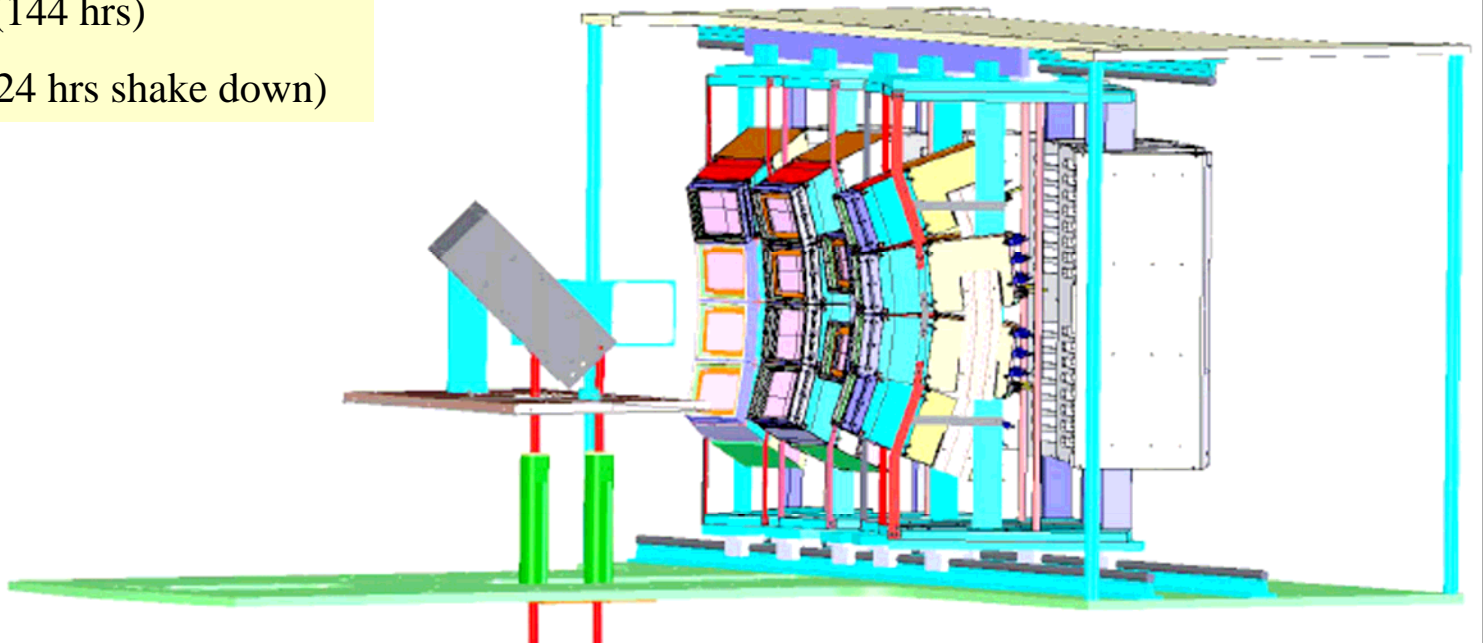
Sept 15 : chamber set up ready

Sept 17 : standby for S800 test run

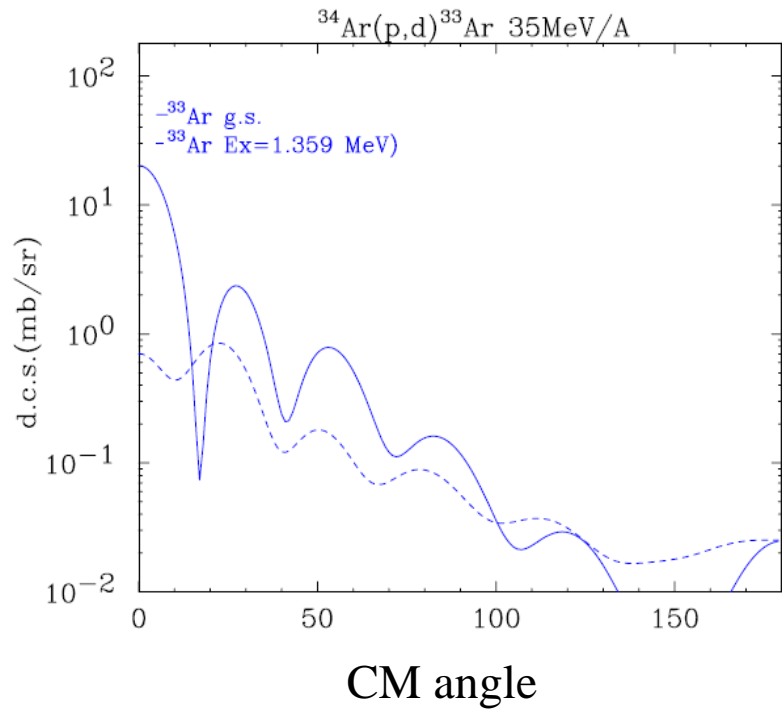
Sept 28 : HiRA+S800 test run

Oct 19-31 : Ar experiment

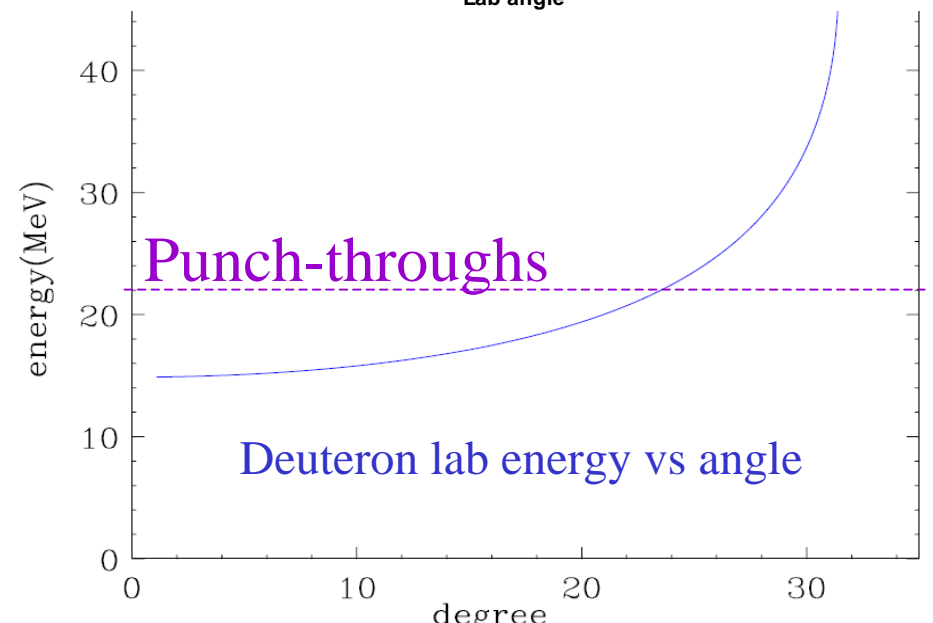
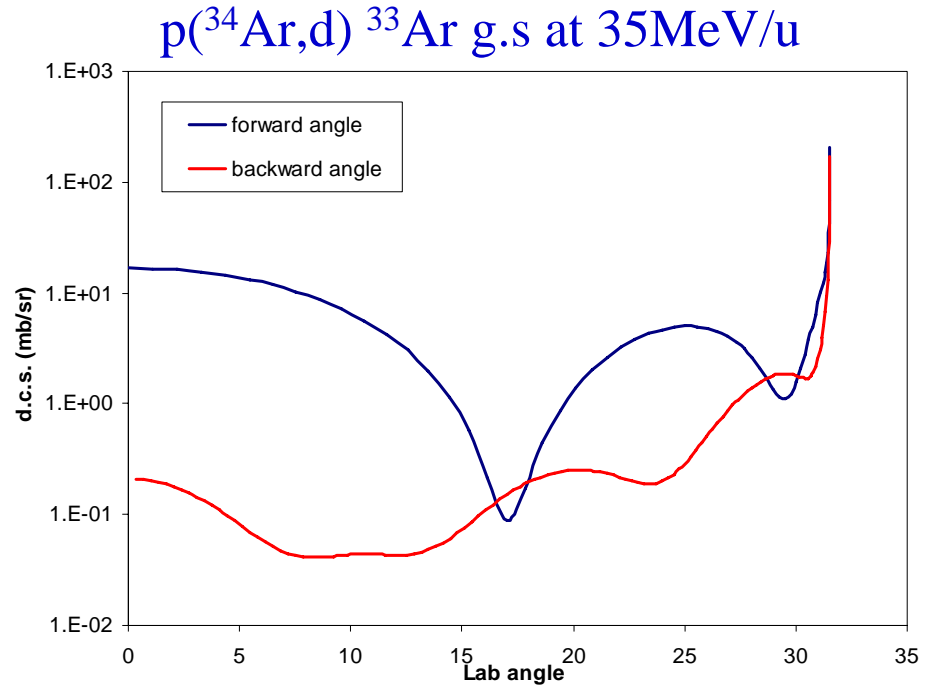
Nov 29-Dec 2: Ni(p,d) experiment



Reactions in inverse kinematics (Two solutions in center-of-mass frame)



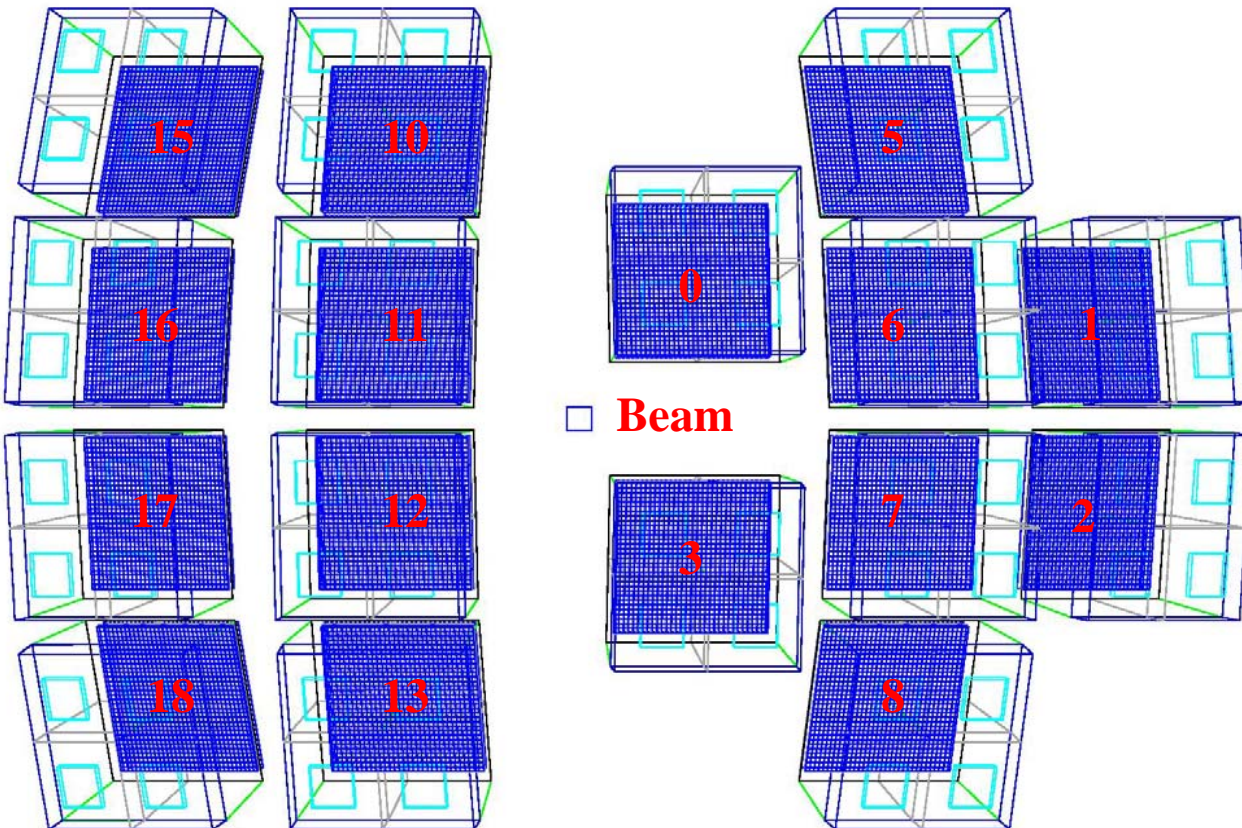
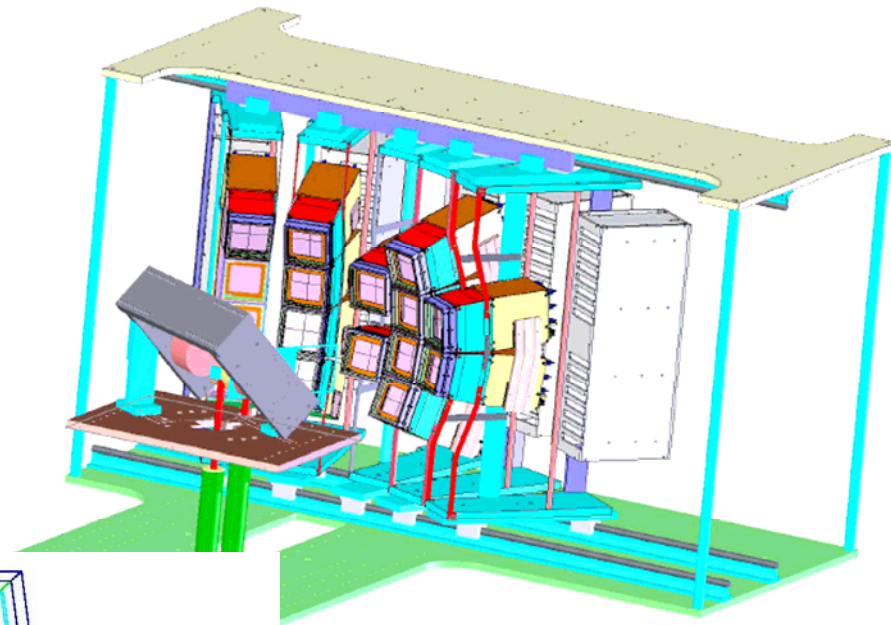
➤ Deuteron energy is calculated from the emitting angle and the kinematics of transfer reactions



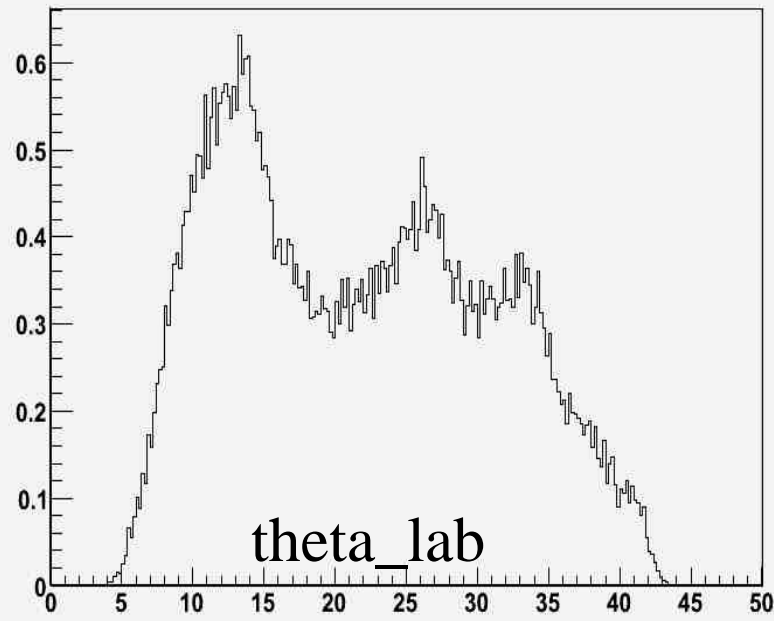
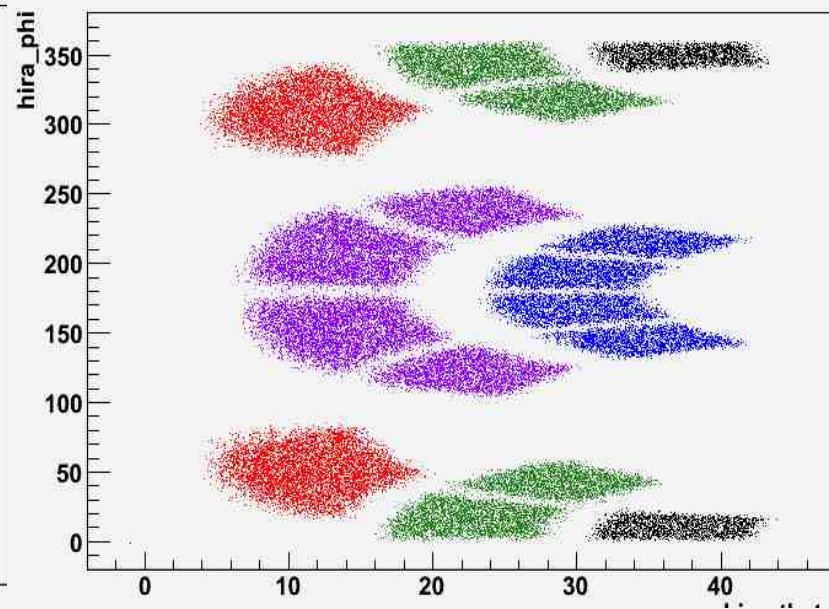
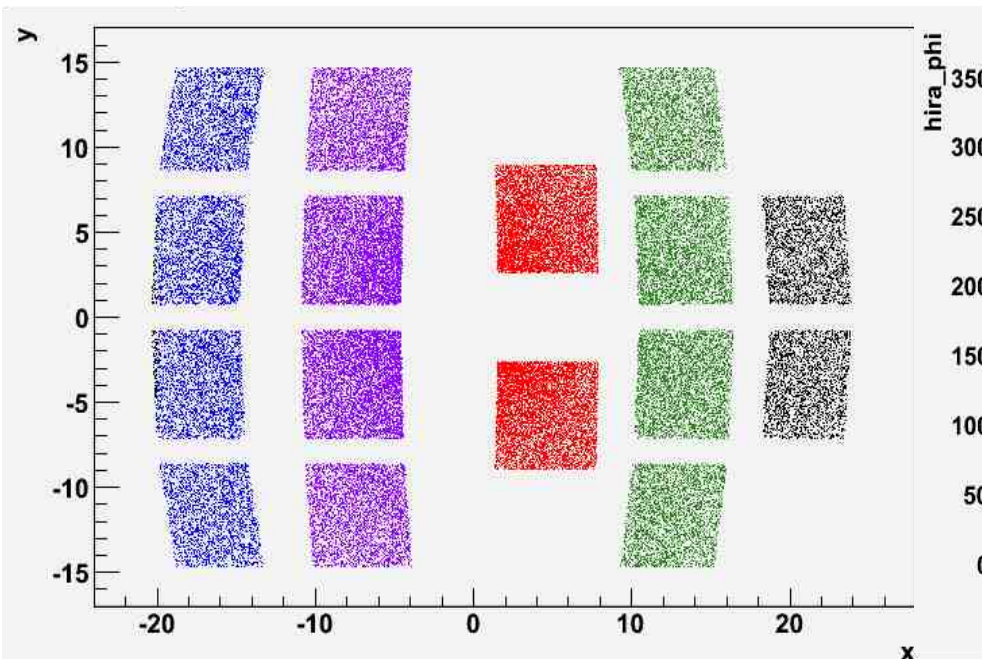
HiRA set up

Angles for the Towers (05133 Ar expt)

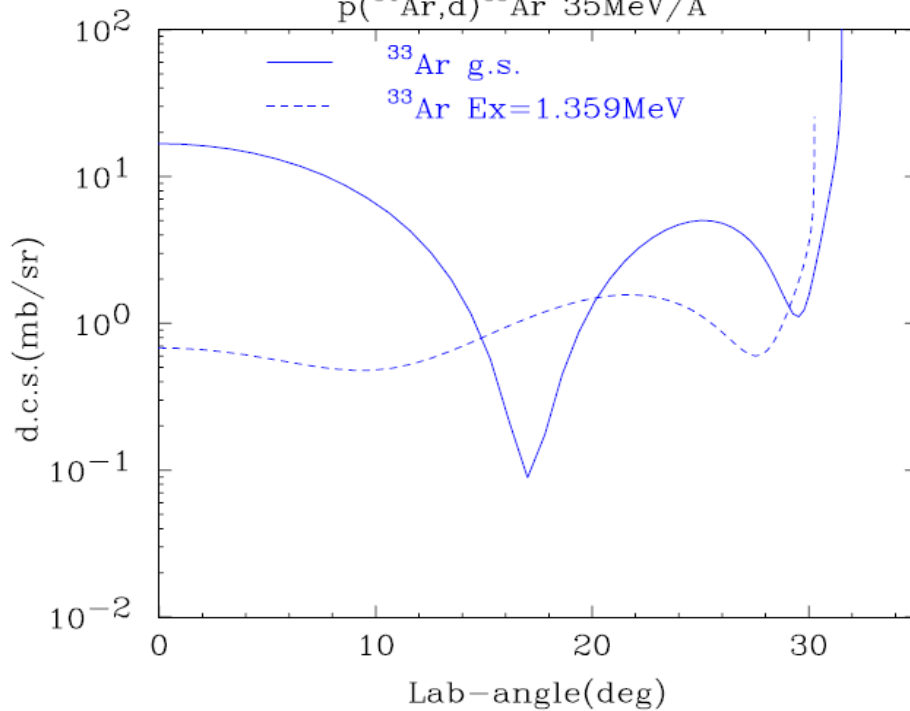
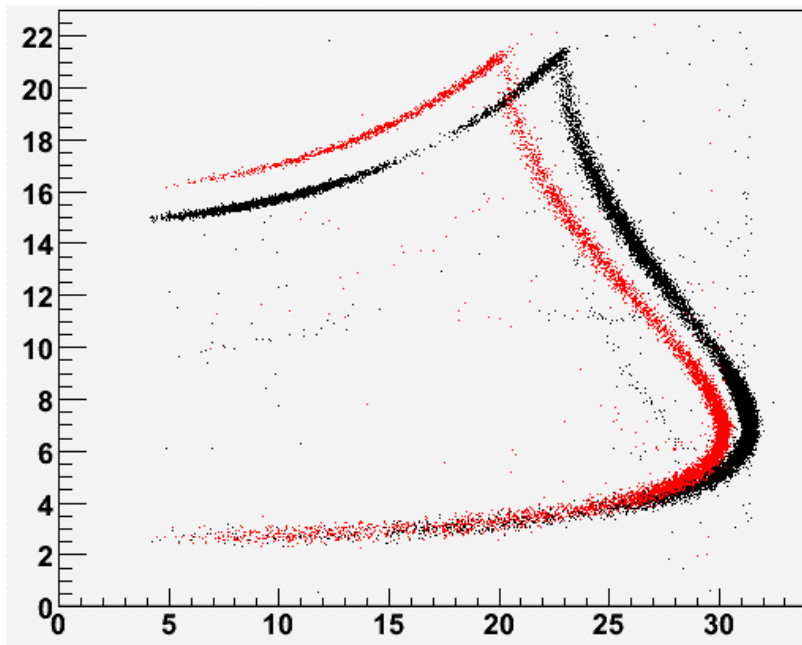
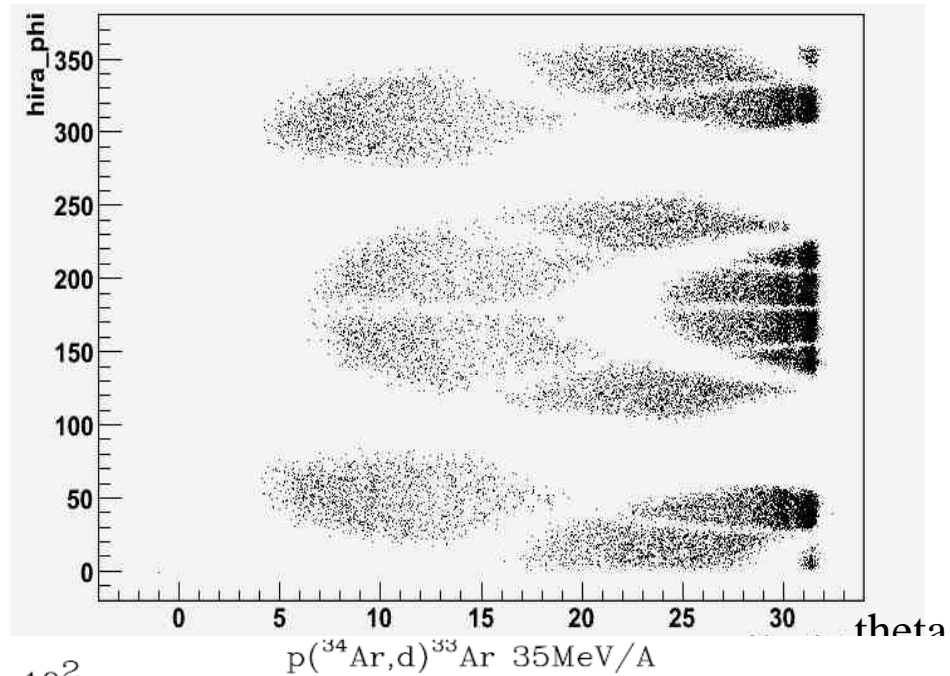
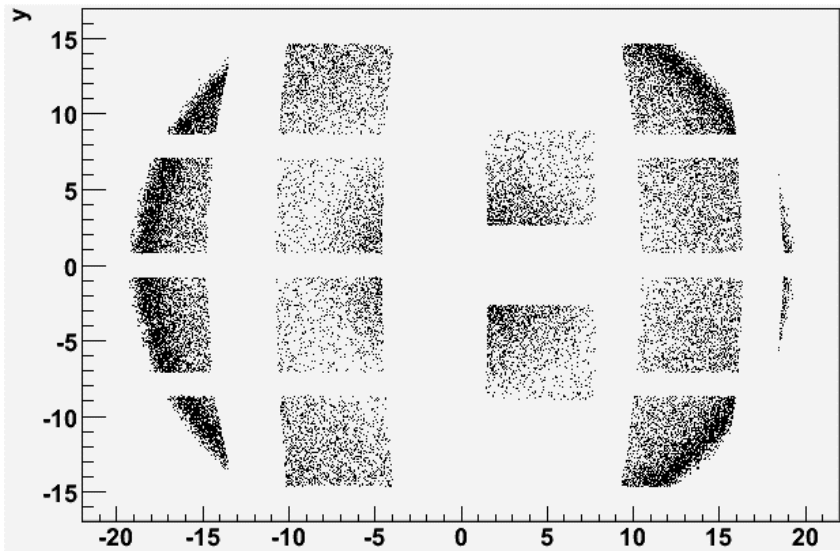
A	B	C	D	E
-29.5	-12.5	7.6	22.1	36.6



Simulations with isotropic distributions

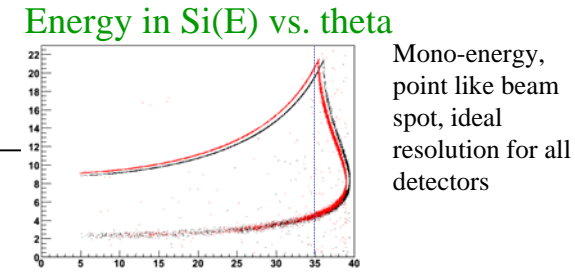
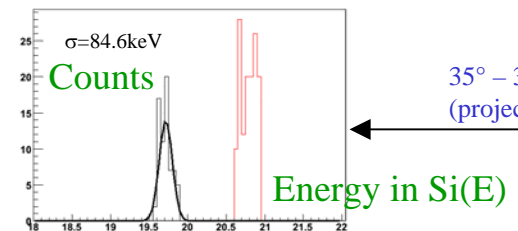


^{34}Ar with 35cm setup



HiRA Resolutions

$p(^{46}\text{Ar},d)^{45}\text{Ar}$ at 35cm
 $E_x = 0.532\text{MeV}$



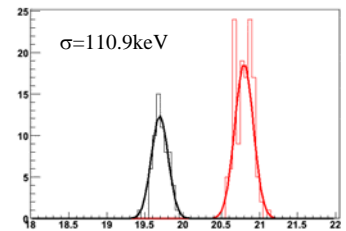
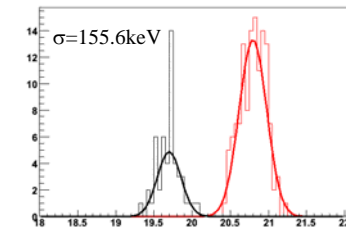
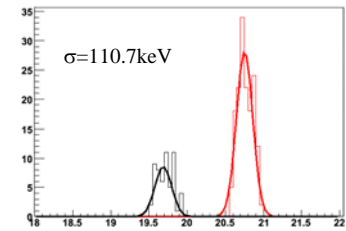
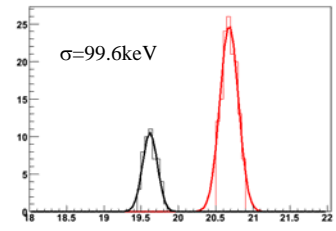
$35^\circ - 35.2^\circ$
 (projection)

Target Thickness
 20 um (CH_2)_n

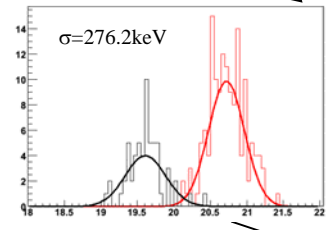
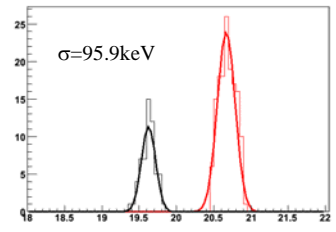
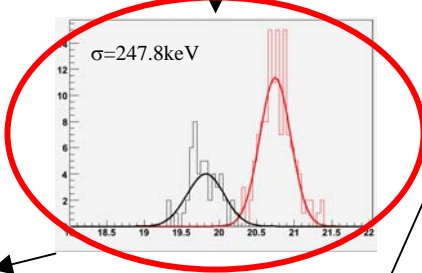
Beam energy 1MeV/A

Pixel
 0.33°

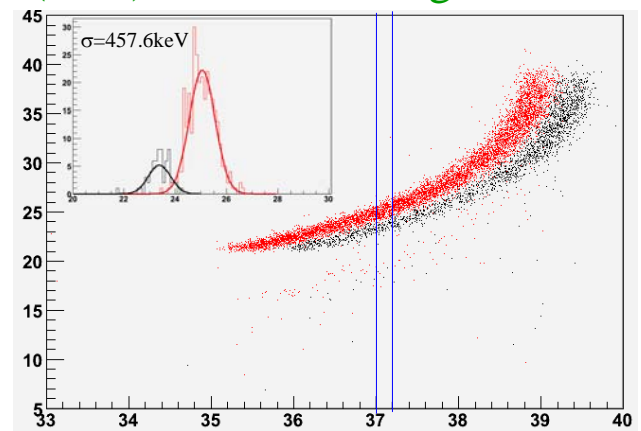
Detector resolution
 100 keV



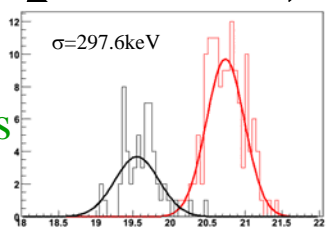
Target position 1.5 mm



E(total) vs. theta with gate on CsI

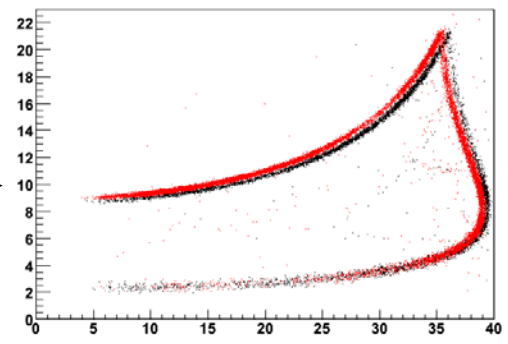


Counts



Energy in Si(E)

Energy in Si(E) vs. theta



Simulations on HiRA experiment for Transfer Reactions (p,d) with beams at 35MeV/A in *inverse kinematics* (Cross section measurement)

Expt 05133 Ar experiment

$p(^{36}\text{Ar},d)^{35}\text{Ar}$ (24 hrs)

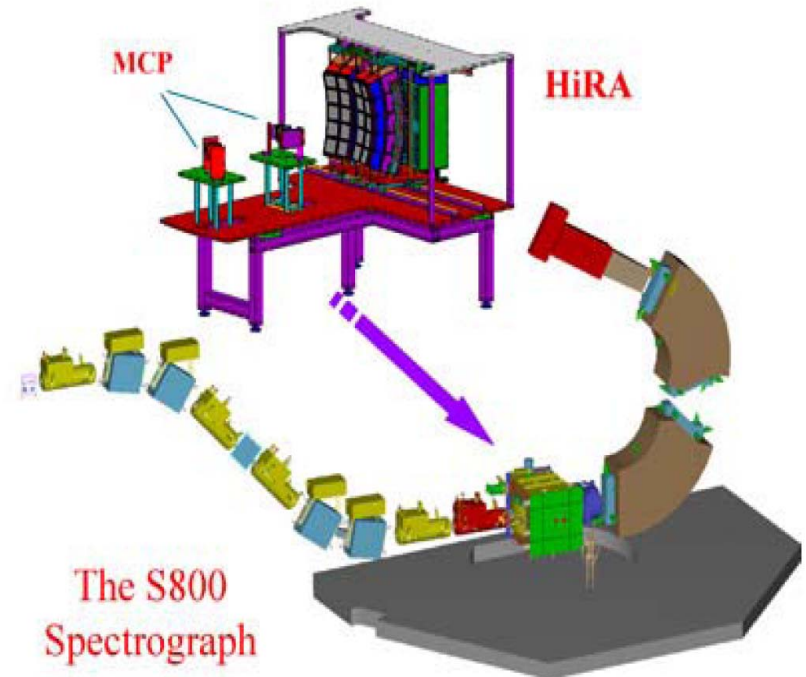
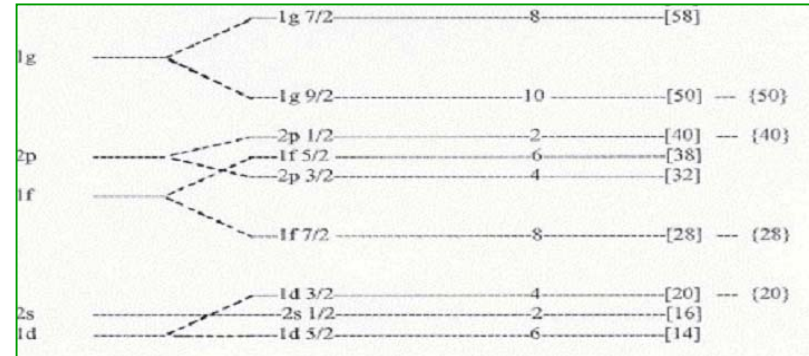
[g.s. – 1 d_{3/2} e.x. – 2 s_{1/2}]

$p(^{34}\text{Ar},d)^{33}\text{Ar}$ (70 hrs)

[g.s. – 2 s_{1/2}, e.x. – 1 d_{3/2},]

$p(^{46}\text{Ar},d)^{45}\text{Ar}$ (98 hrs)

[g.s. – 1 f_{7/2} e.x. – 2 p_{3/2}]



Calibration with stable beam $p(^{36}\text{Ar},d)^{35}\text{Ar}$ (24 hrs)

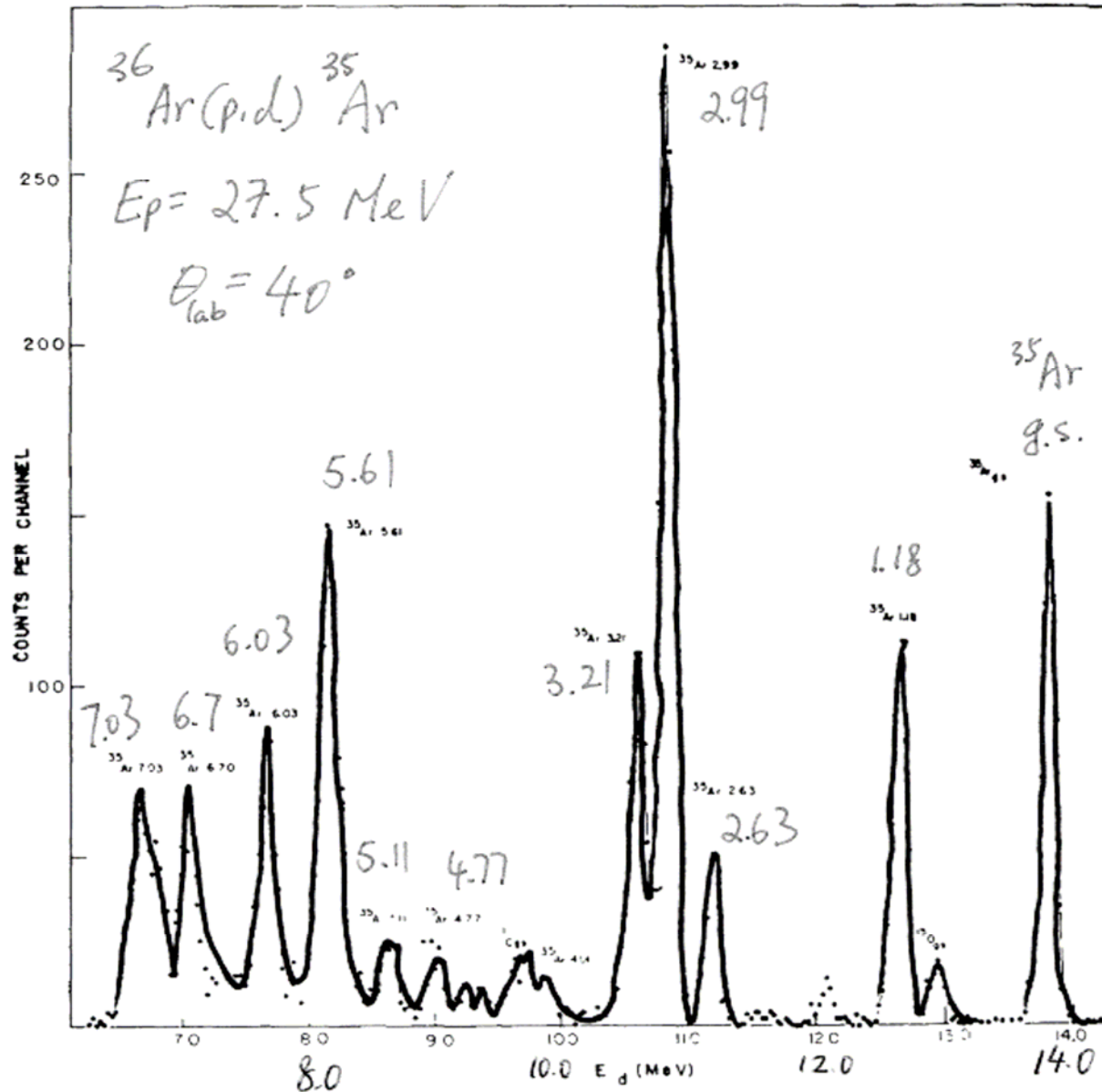
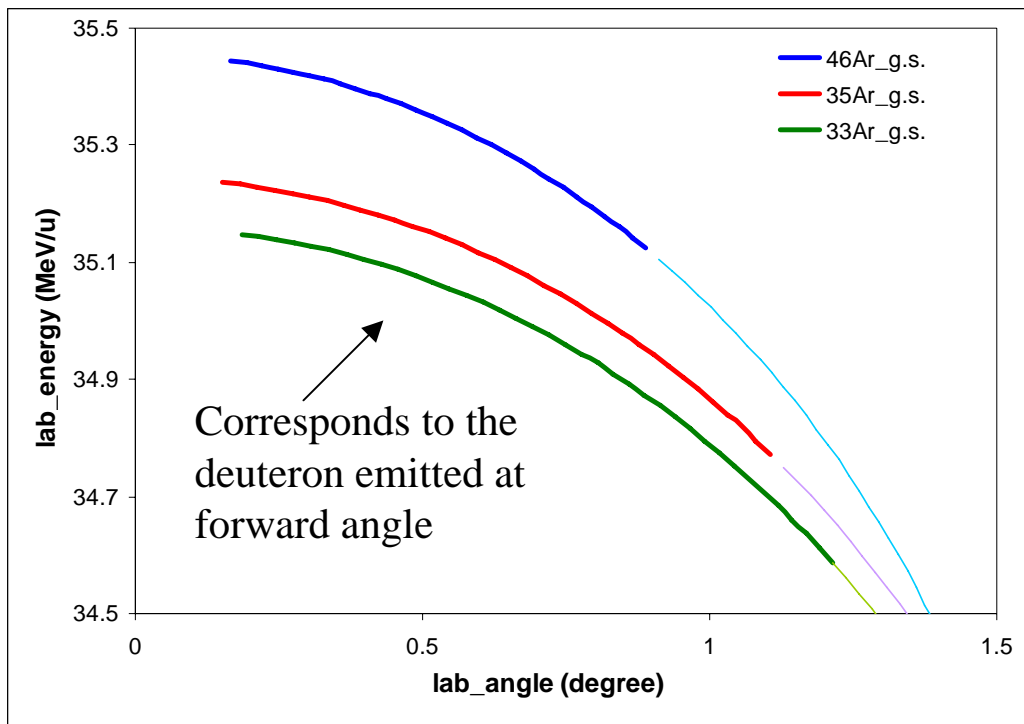
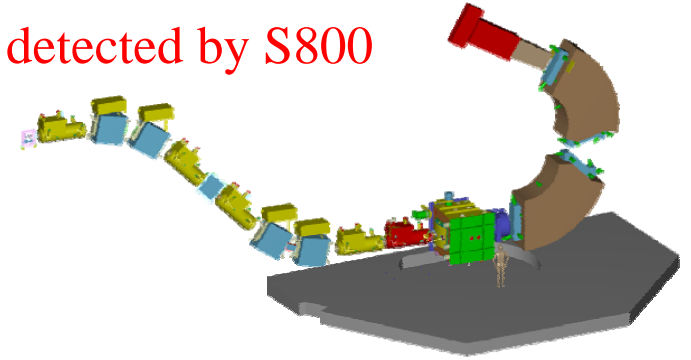


Fig. 2. The deuteron energy spectrum of the reaction $^{36}\text{Ar}(p,d)^{35}\text{Ar}$ at $\theta_{\text{lab}} = 40^\circ$.



Recoil residue
detected by S800



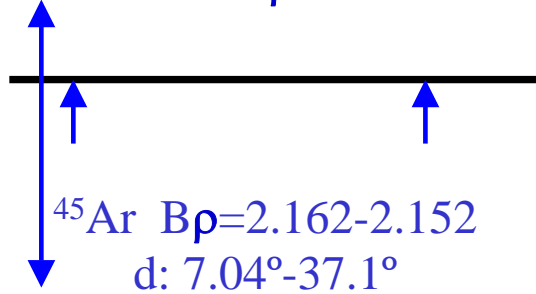
S800 Momentum acceptance = 5.8%

^{46}Ar beam : $^{45}\text{Ar} \rightarrow 0.46\%$ (range of $B\rho$)

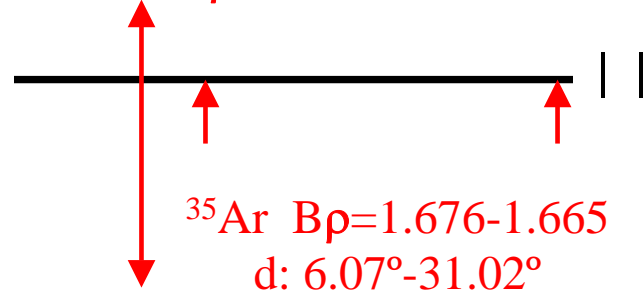
^{36}Ar beam : $^{35}\text{Ar} \rightarrow 0.66\%$

^{34}Ar beam : $^{33}\text{Ar} \rightarrow 0.83\%$

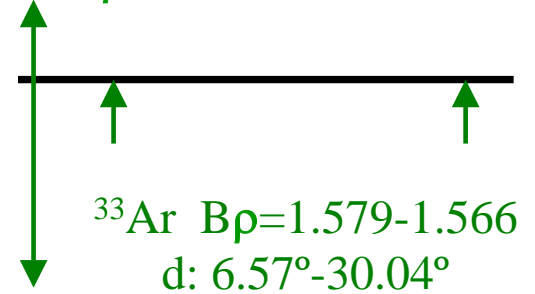
^{46}Ar beam: $B\rho=2.188$



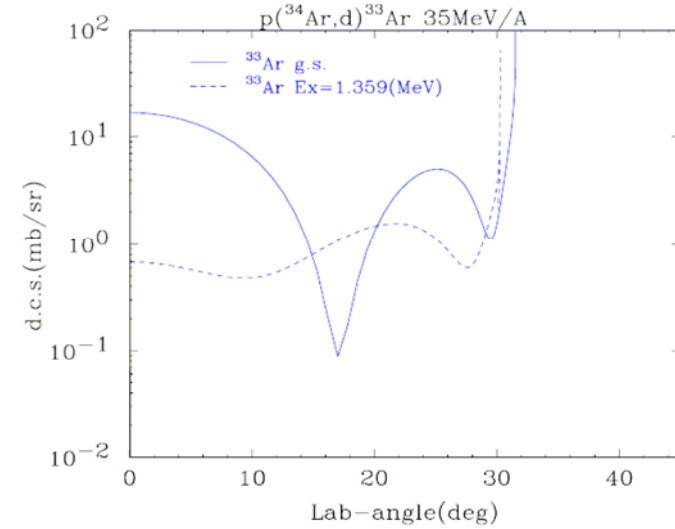
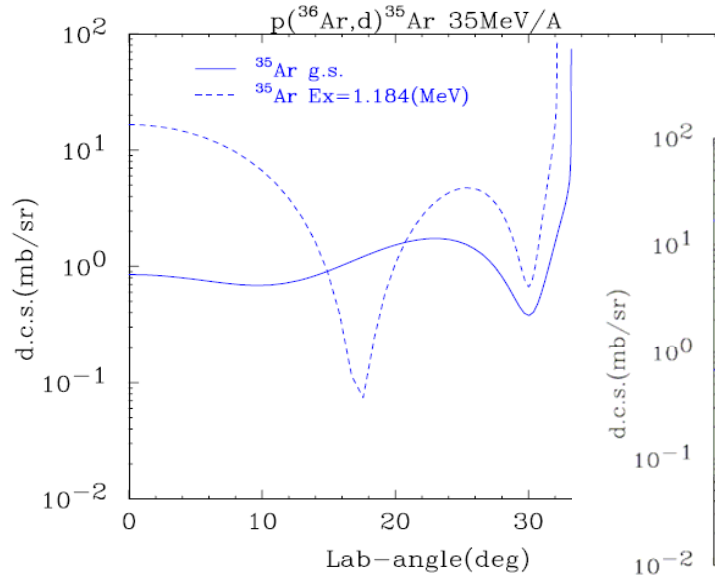
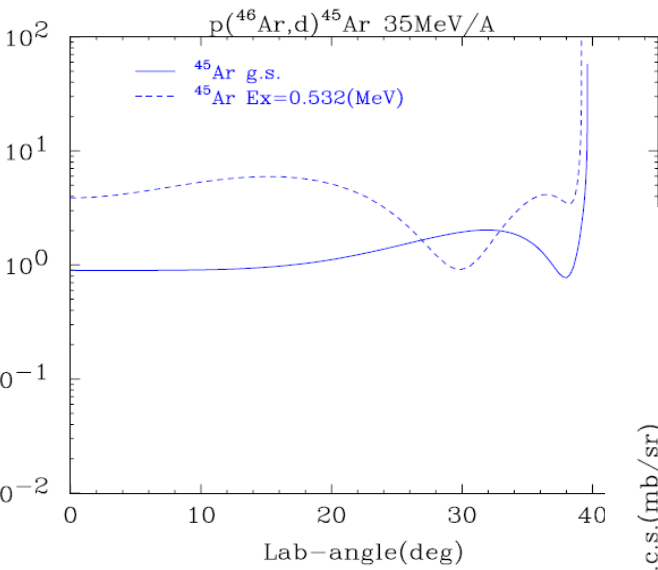
^{36}Ar beam: $B\rho=1.7101$



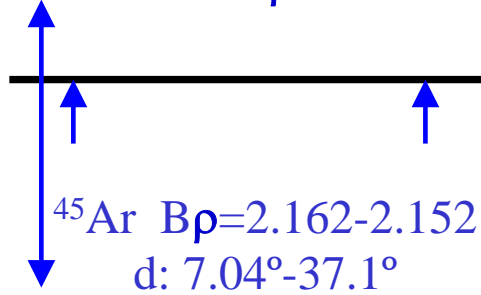
^{34}Ar beam: $B\rho=1.6152$



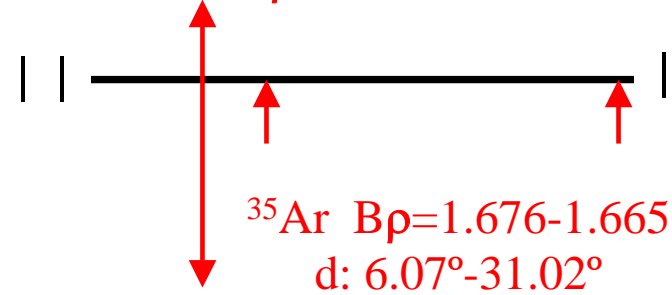
S800 Momentum acceptance = 5.8%



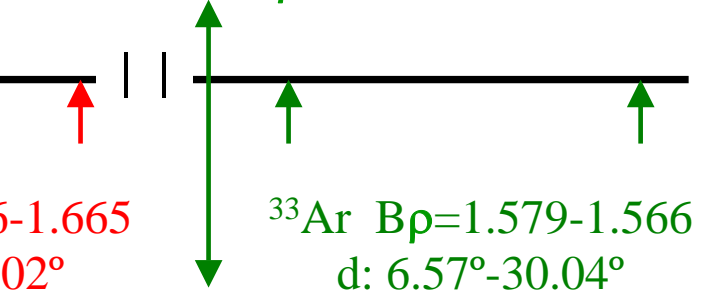
^{46}Ar beam: $B\rho=2.188$



^{36}Ar beam: $B\rho=1.7101$



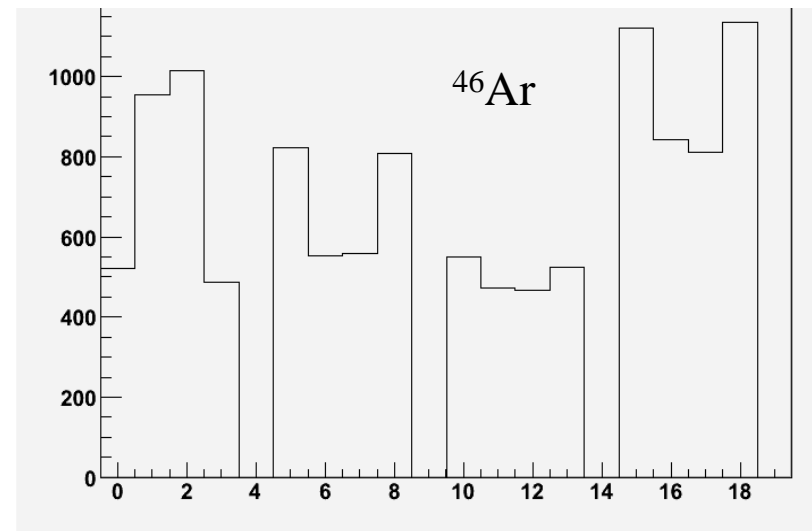
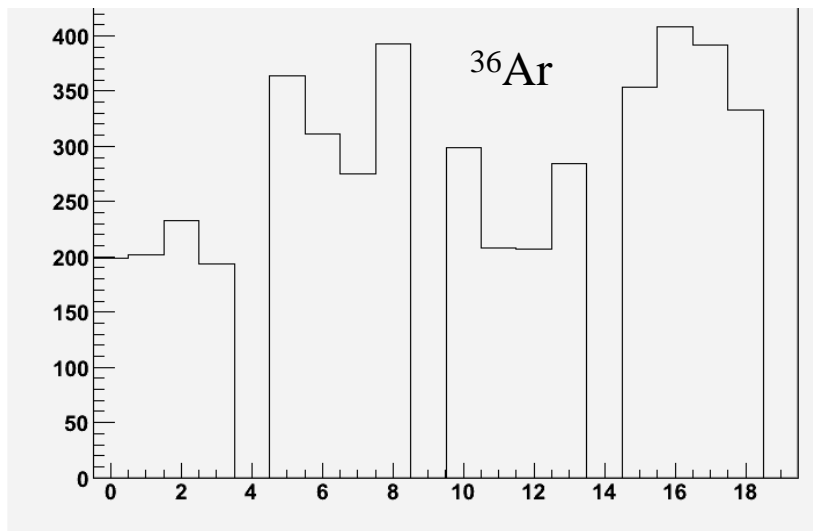
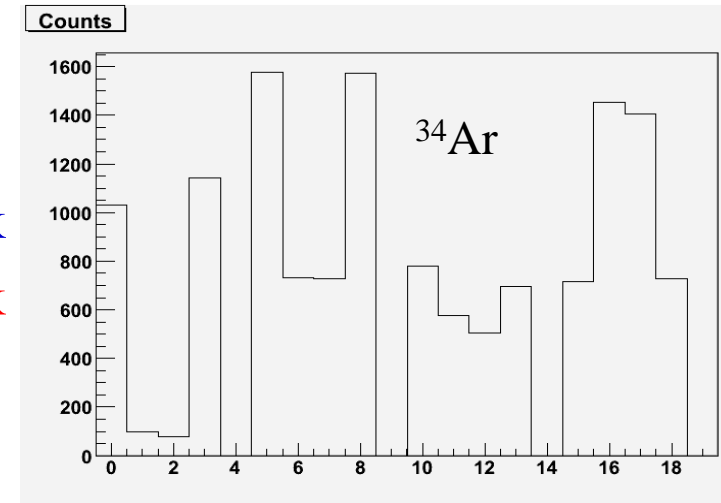
^{34}Ar beam: $B\rho=1.6152$



Estimated counts in HiRA

Cross-section (g.s., forward angle only, ADWA results)

- Events simulated with backward angles
- No efficiency considered
- 20 um CH₂ target => 2.8×10^{20} protons/cm²
- ⁴⁶Ar 2.1 mb + 98h(2×10^5 pps) => 42k => 11.5k
- ³⁴Ar 4.0 mb + 70h(2×10^5 pps) => 56k => 13.5k
- ³⁶Ar 1.3 mb + 24h(1×10^6 pps) => 31k => 11k

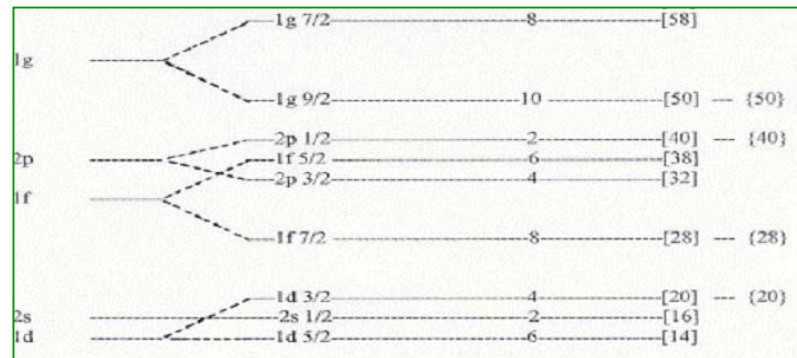


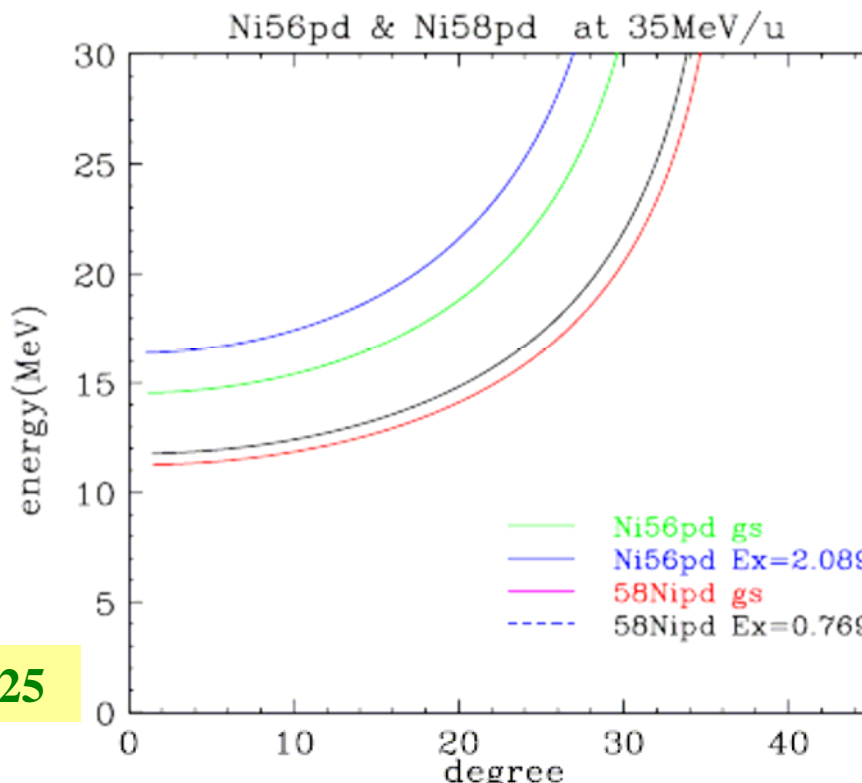
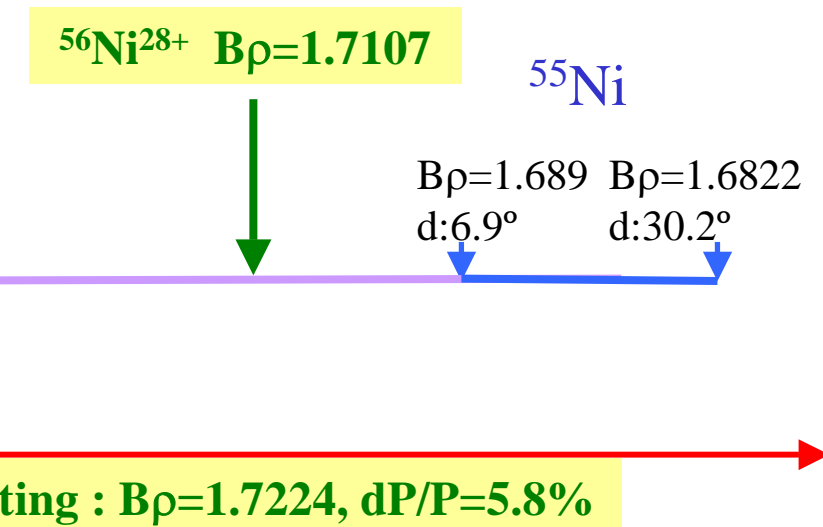
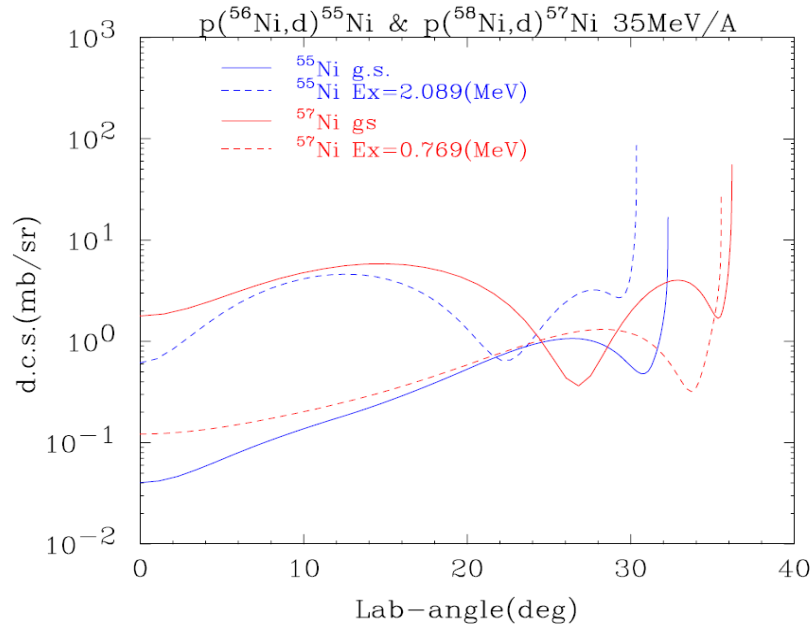
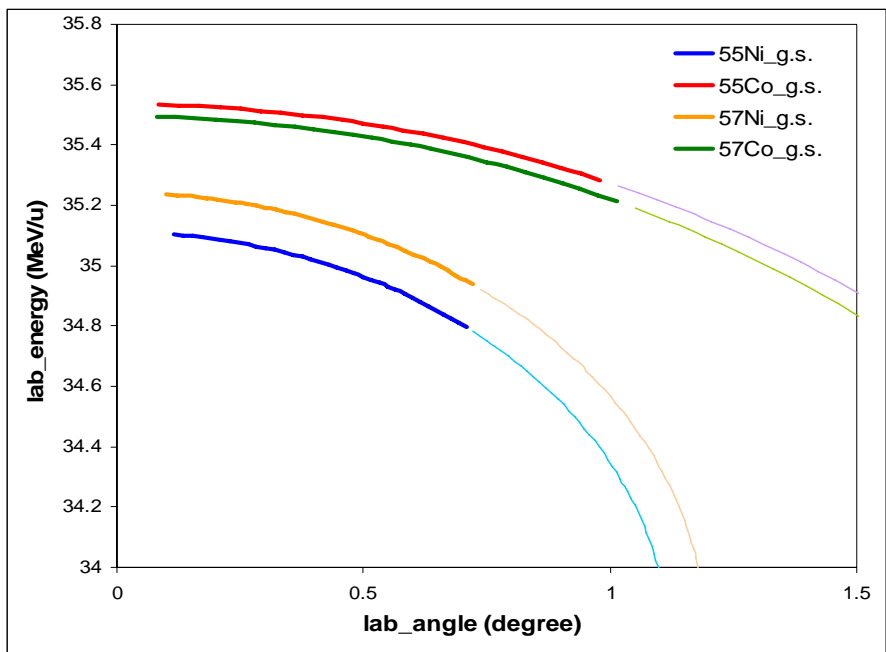
Experiment 06035 ‘Evolution of neutron and proton hole states at N=28 closed shell

Expt 06035 Ni experiment part 1

Nov 29, 2007

• $p(^{56}\text{Ni}, d)^{55}\text{Ni}$ (48 hrs) [g.s. – 1 $f_{7/2}$ e.x. – 2 $p_{3/2}$]





Estimated counts

- Cross-section (g.s., forward angle only, AWBA results)
- No efficiency considered
- *40 um CH₂ target => 1.4x10²⁰ protons/cm²*
- ⁵⁶Ni(p,d)⁵⁵Ni 0.62 mb + 32.6 hr(2x10⁵pps) => 8.4k => 2.4k



Time line

S800 test run: Remco, Daniel Bazin, Andy Rogers, Jenny, Sun?

Sept 17 : standby for S800 test run

Sept 28 : HiRA+S800 test run

Chamber set up: Vladimir (Andy and Brian from UT)

Electronics : Daniela (John Elson comes after test run)

Data acquisition: Daniela (Mike Famiano before test run and Oct expt)

MCP : Sun (Dan Shapira + Kyle Oct 14-)

Oct 19-31 : Ar experiment

Nov 28-Dec? – Sylvie Hudan, Bob Charity, Bill Peters (?),

Nov 29-Dec 2: Ni experiment

Dec 3- Dec 20:

- calibrations, change to Ni experiment configurations

- pulser calibrations for DE, E, and CsI

- alpha source calibrations for DE

- pin source calibrations for E

- alpha source calibrations for E

- laser calibrations

- change experiment configurations

- off line analysis (Giuseppe?)



Transfer reactions Experiment (Sept-Dec 2007)

Useful References:

S800: http://groups.nsl.mscl.msu.edu/s800/Users/User_frameset.htm

Setup of S800 without PPAC's.

HiRA detector and calibrations:

<http://groups.nsl.mscl.msu.edu/hira/minilectures.htm>

http://groups.nsl.mscl.msu.edu/hira/Publications%20and%20Theses/HiRA_paper.pdf

Don't forget the experiment websites:

<http://groups.nsl.mscl.msu.edu/hira/05133/index.htm>

<http://groups.nsl.mscl.msu.edu/hira/06035/index.htm>