

**A Measurement of the Neutron  
Asymmetry in  $d(\vec{\gamma}, n)p$  at Low Energies**

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## Experiment

$$d(\vec{\gamma}, n)p$$

$$E_{\gamma} = 6.0, 4.0, 3.5, 2.6 \text{ MeV}$$

## Why?

- Neutron asymmetry
- M1 contrib. to  $np$  capture cross section
- (Absolute cross sections ?)

## Where?

HI $\vec{\gamma}$ S

High Intensity Gamma Source

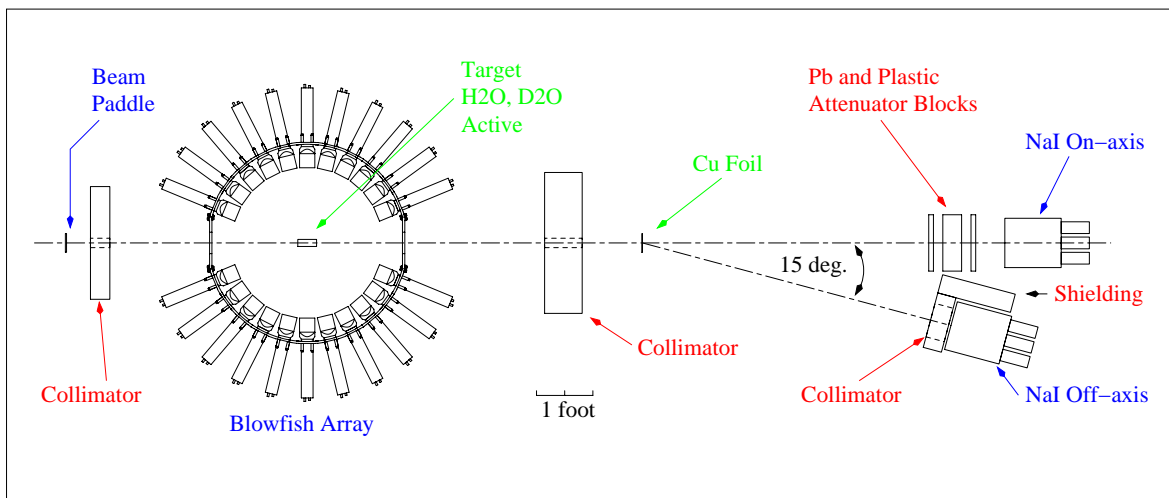
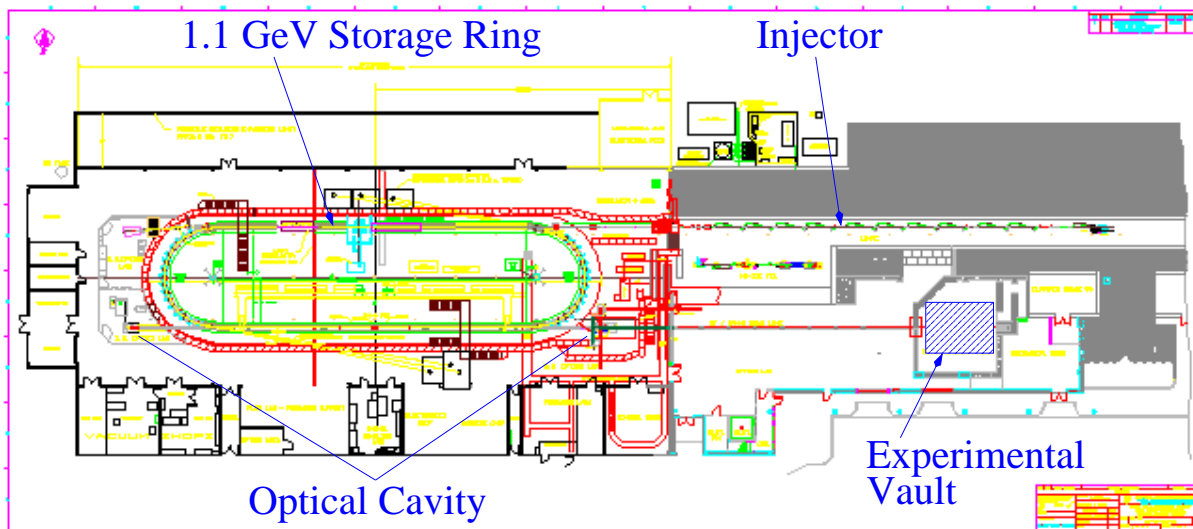
Duke University FEL

- Monochromatic beam ( $\frac{\Delta E}{E} \approx 2-3\%$ )
- 100% linear polarized
- High intensity ( $10^6 \gamma/\text{sec}$ )

# HI $\gamma$ S

## High Intensity Gamma Source

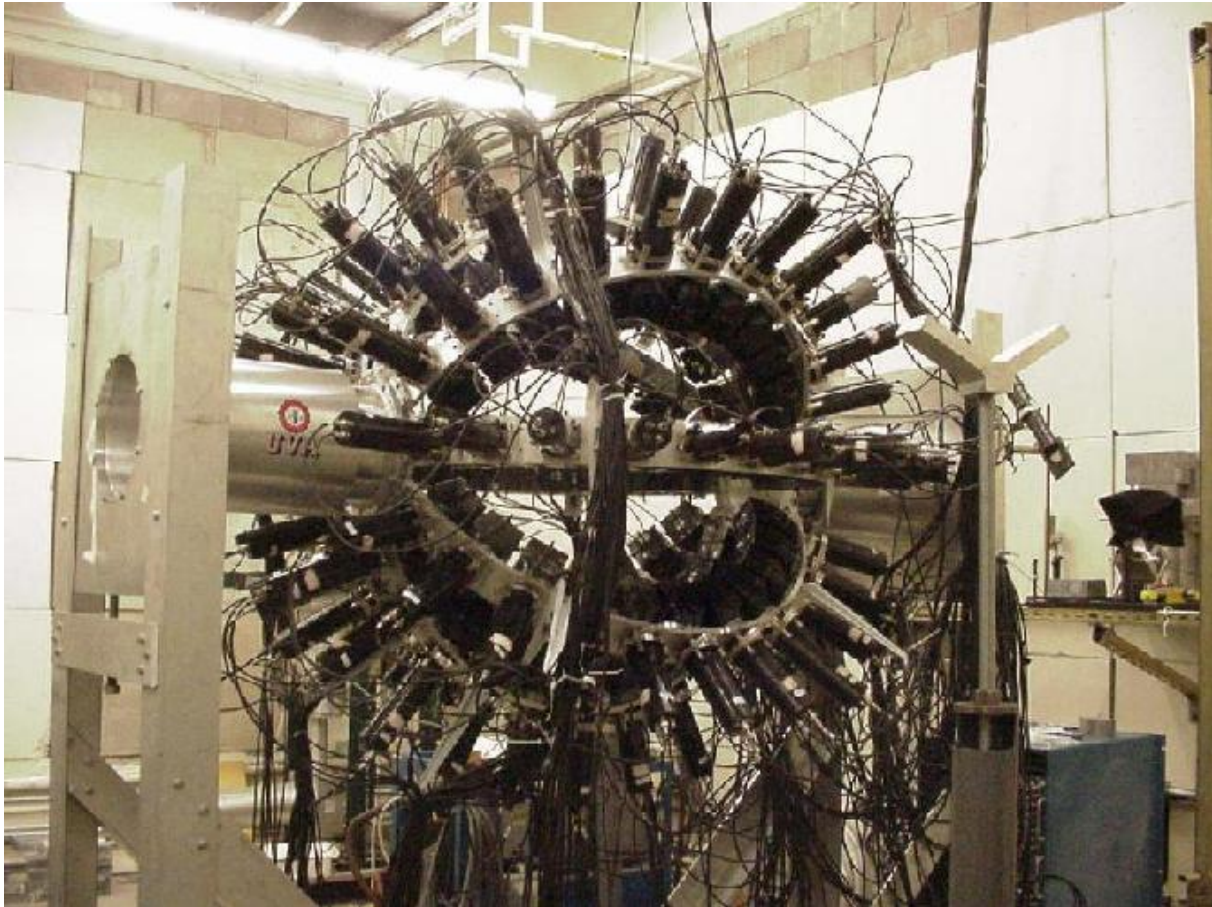
### Duke University FEL



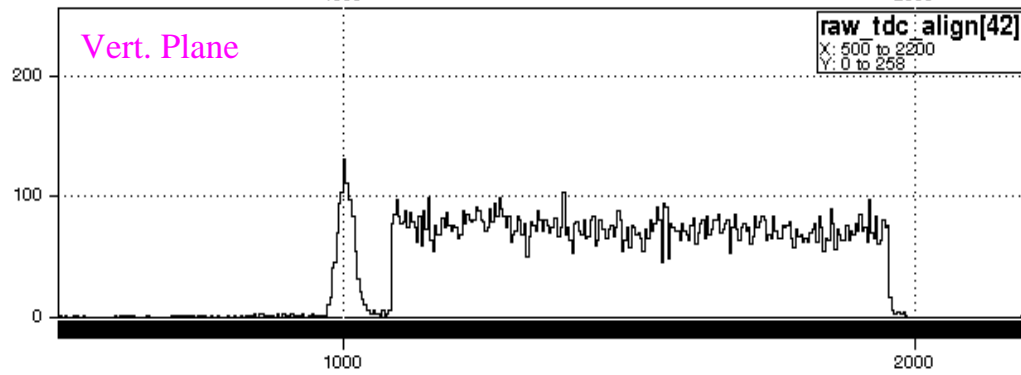
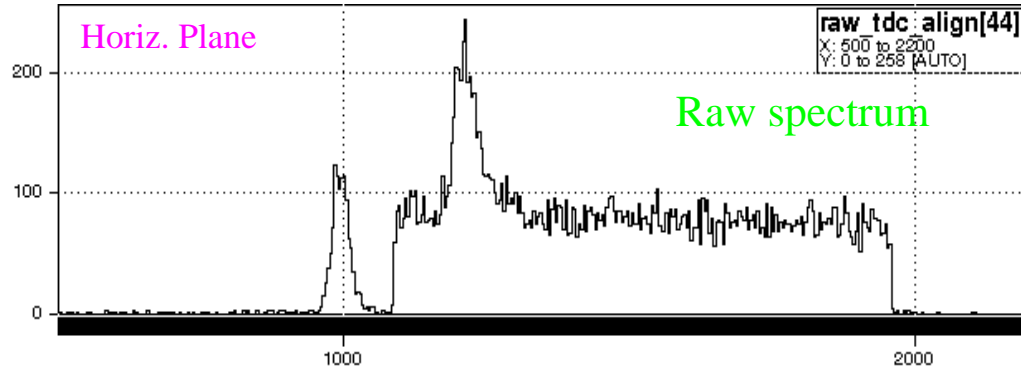
Experimental Vault



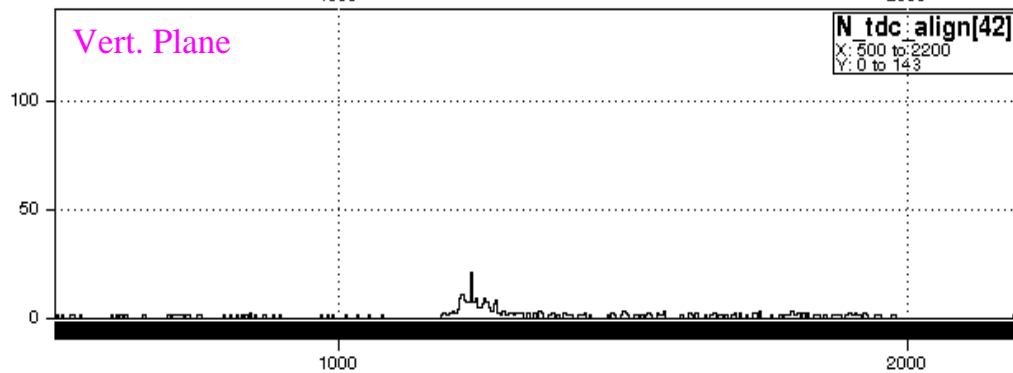
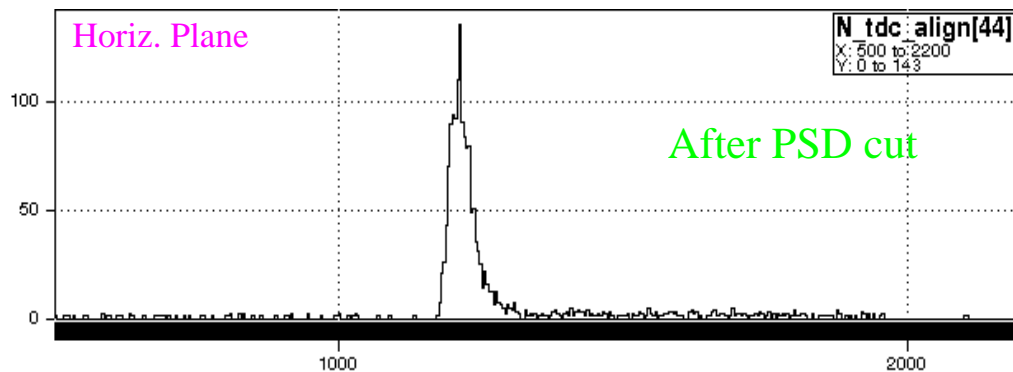
## The Blowfish Array

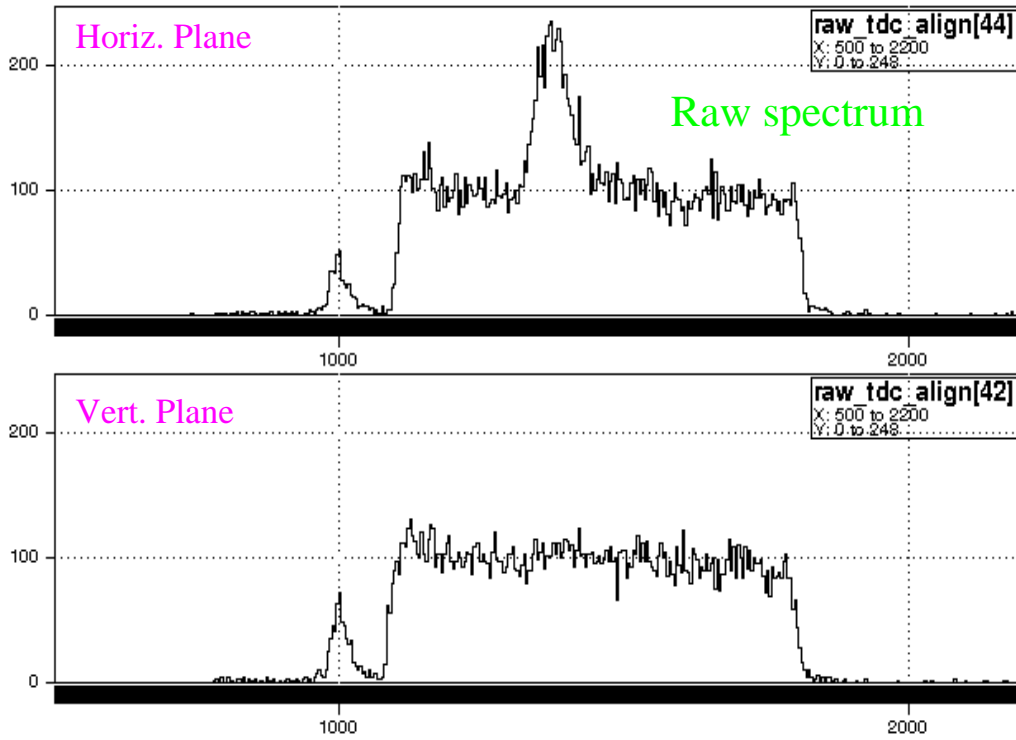


- 88 BC-505 cells
- 11 bites in  $\theta$
- 8 bites in  $\phi$
- $\approx \frac{1}{4}4\pi$  coverage

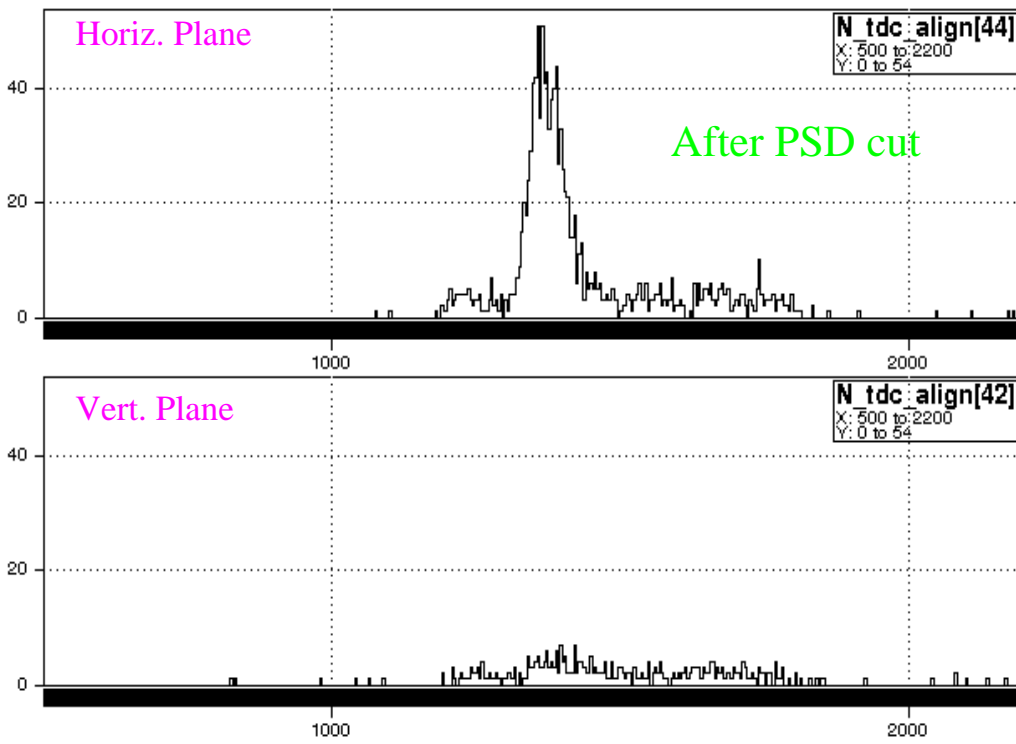


6.0 MeV





3.5 MeV



## Asymmetry

- Neut yield/cell =  $\Sigma(\text{neut cut}) - \Sigma(\text{bkgd wind})$
- $\text{Asym}(\theta) = \frac{\Sigma H(\theta) - \Sigma V(\theta)}{\Sigma H(\theta) + \Sigma V(\theta)}$

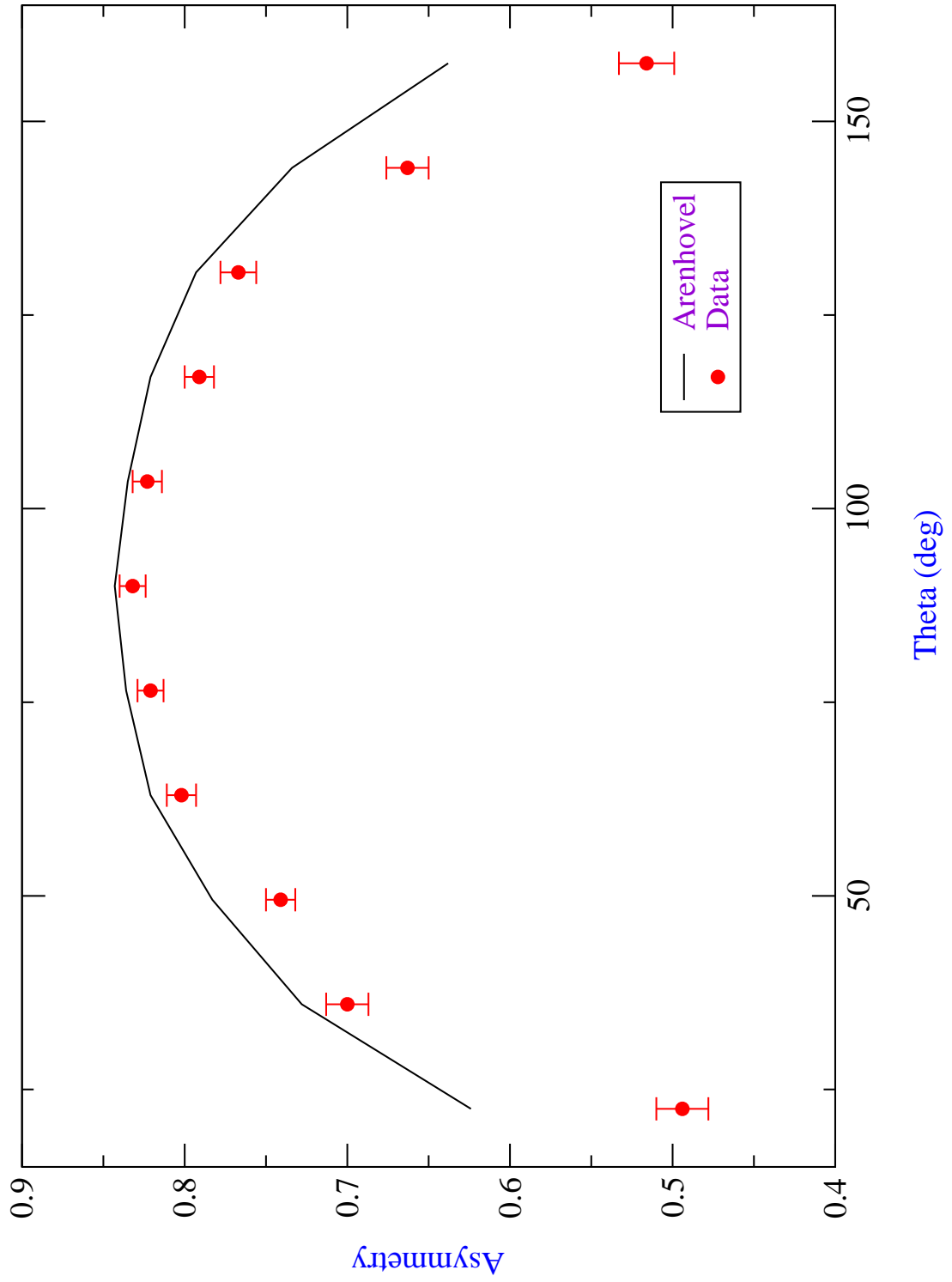
## Cross Check

- Repeat Asym calculation for other 4 arms
  - it should equal *zero*
  - but it did not!?

## Corrections

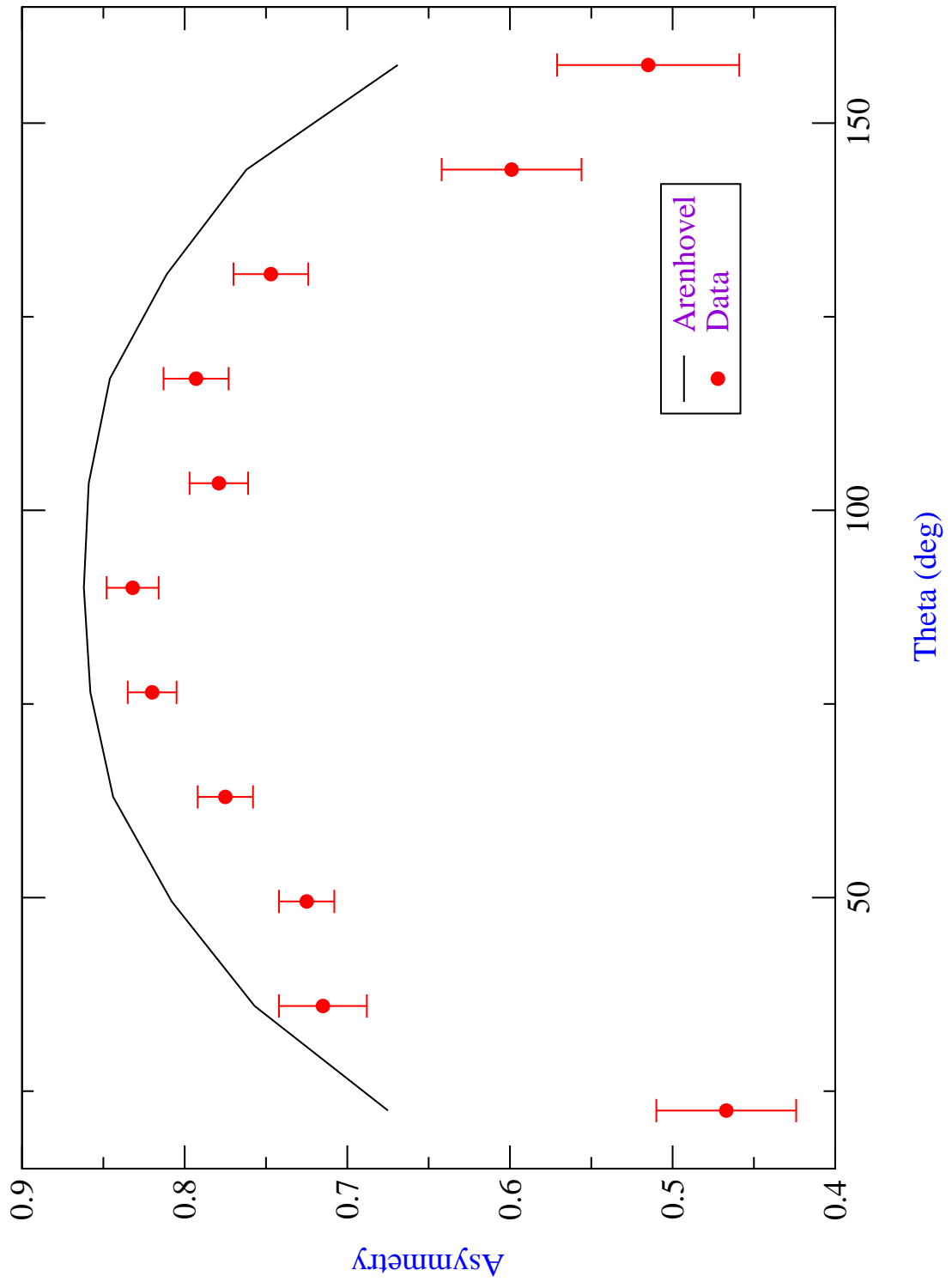
- Rotation of polarization plane
- Finite detector size/acceptance
- Neutron scatters in target

# 6 MeV - Preliminary Results

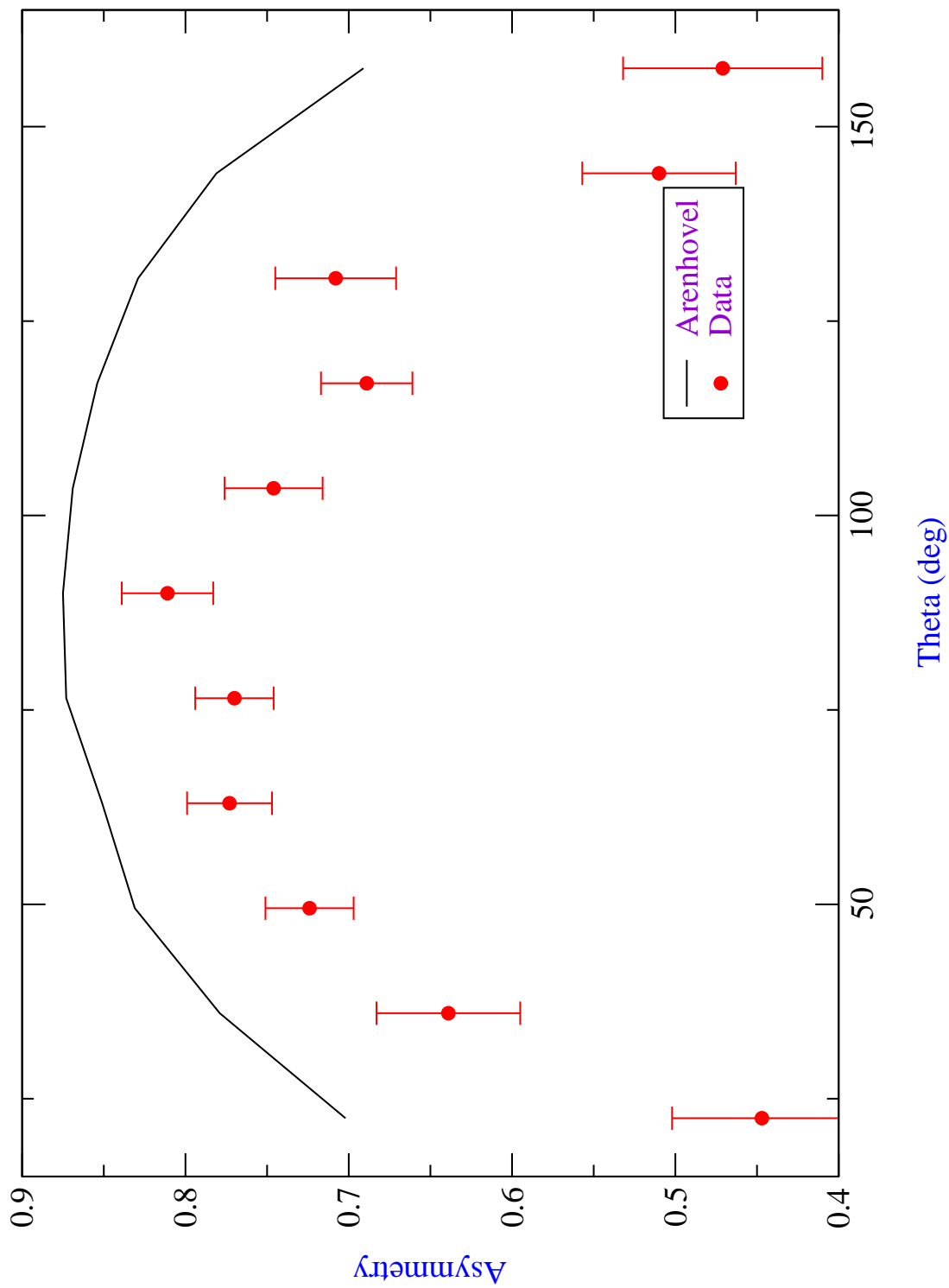




# 4 MeV - Preliminary Results



### 3.5 MeV - Preliminary Results



## Summary

- Completed  $d(\vec{\gamma}, n)p$  measurement at 6.0, 4.0, 3.5 and 2.6 MeV
- Excellent statistical precision
- Quality data

## Still to be done ...

- Shake-down and refine Monte Carlo simulation
- Extract E1/M1 ratio
- Absolute cross sections
  - ▷ Measure neutron detection efficiencies
  - ▷ Extract incident gamma flux

## Future plans ...

- $\vec{d}(\vec{\gamma}, n)$ 
  - ▷ **GDH Sum Rule**
  - ▷ Double polarization observables
  - ▷ Spin polarization observables ( $\gamma_i$ )
- ${}^3\text{He}(\vec{\gamma}, n), {}^7\text{Li}(\vec{\gamma}, n), {}^{17}\text{O}(\vec{\gamma}, n), \dots$