

# Twisted Electrons Planning Discussion

April 1, 2015

Joe Grames

## ➤ Goals

- ✓ A big success to demonstrate modified Mott cross-section
- ✓ Even more success learning how making twisted electrons from GaAs
- ✓ Ground-breaking success demonstrating spin-polarized twisted-electrons
- ✓ Exceeding success if demonstrated with a GaAs-tip

## ➤ Step 1 – U. of Oregon Tests

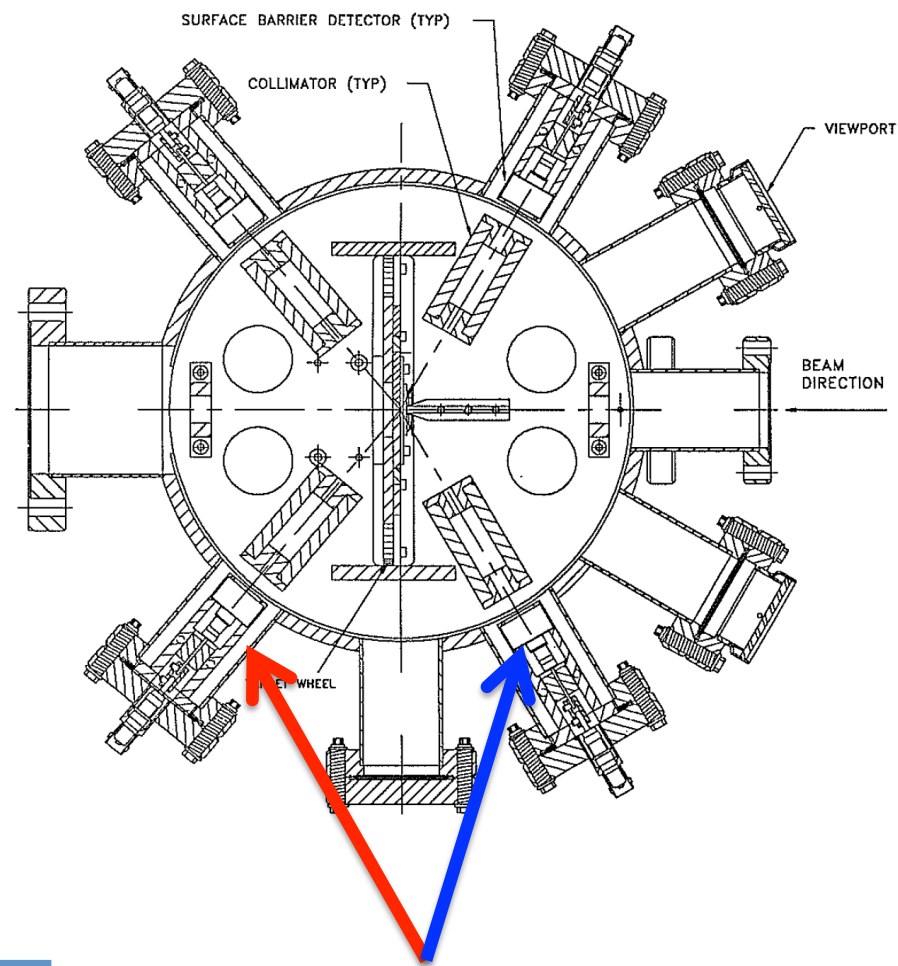
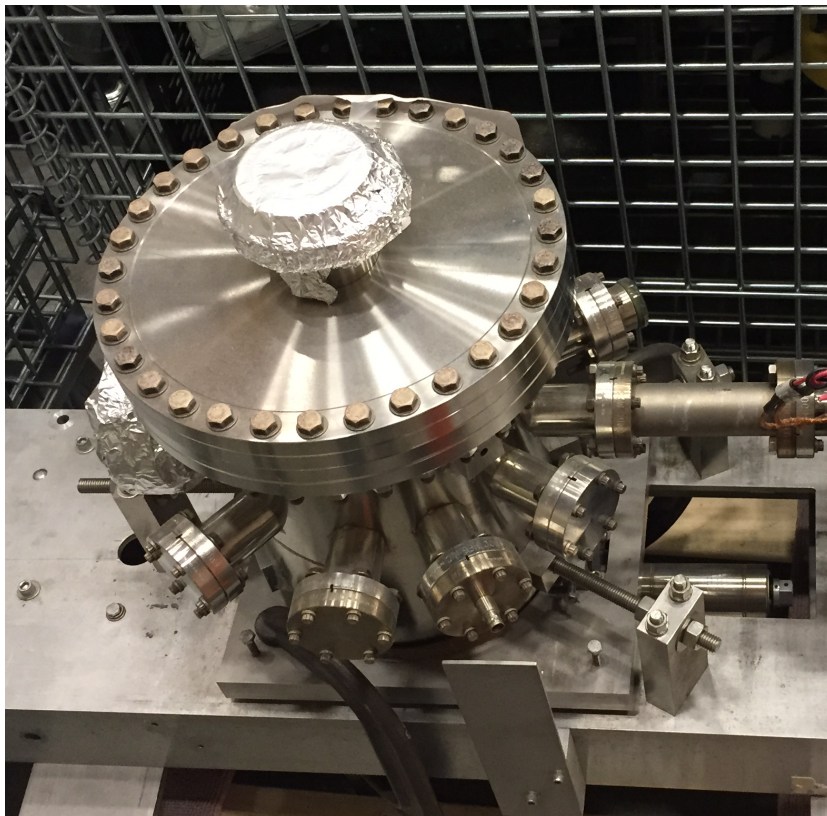
- ✓ Learn if/how Ben's electron gun can accept Mott style detector
- ✓ Test Dipangkar's modified Mott cross-section w/ and w/o twisted electrons

## ➤ Step 2 – Evaluate path forward

## ➤ Step 3 – JLAB Tests

- ✓ Test if GaAs makes twisted electrons using holographic filter + imaging
- ✓ If GaAs unsuccessful consider adding FE-source
  - Learn how to fabricate and operate (HV or light)
  - Characterize beam brightness vs. GaAs (how different?)
  - What are the limitations
- ✓ Test Dipangkar's modified cross-section w/ and w/o twisted electrons

# 100 keV Mott Scattering Chamber



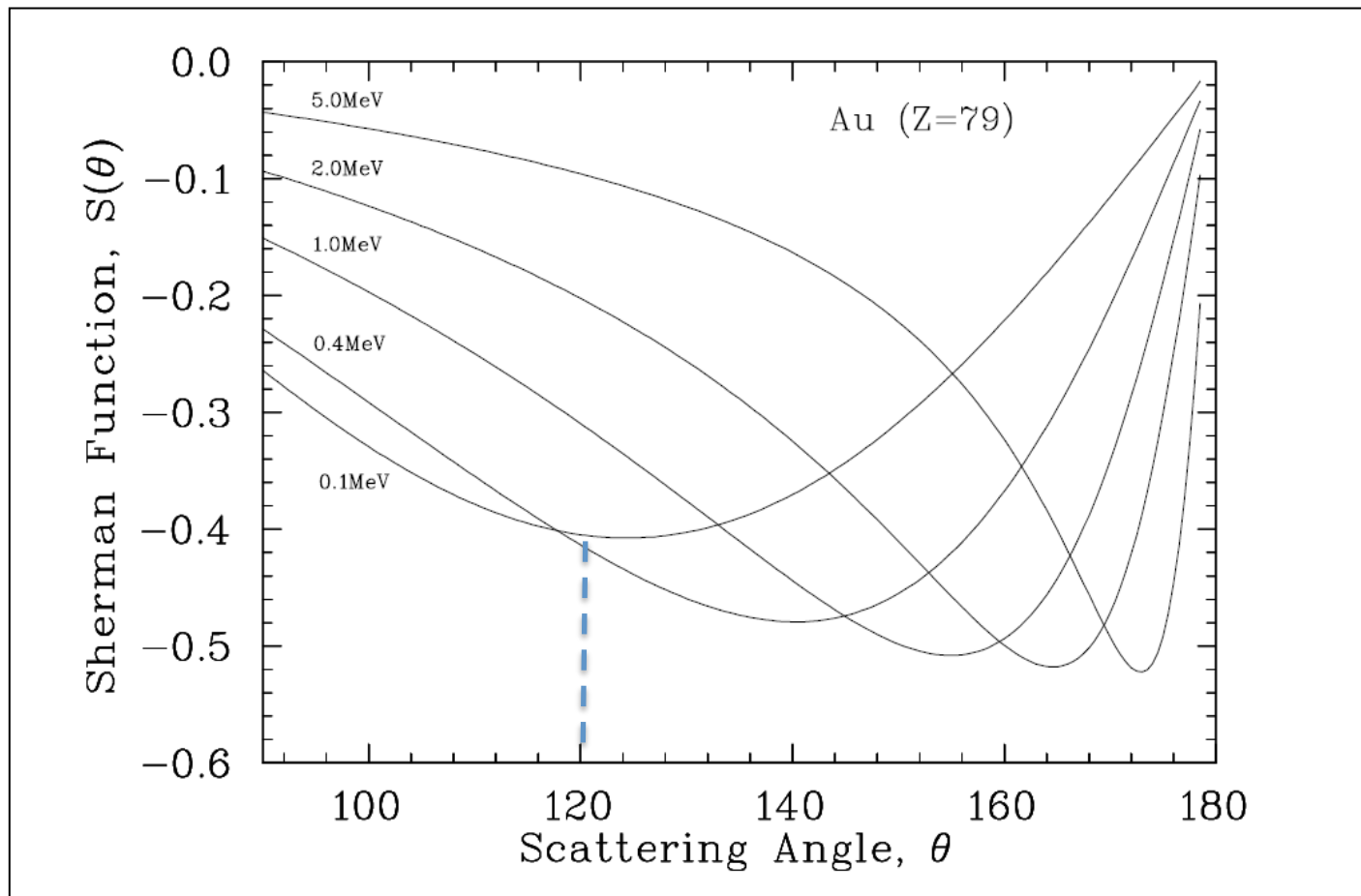
NH-016-050-300-S  
SILICON SURFACE  
BARRIER DETECTOR  
ORTEC

| Port     | Angle           | Solid Angle (sr)     |
|----------|-----------------|----------------------|
| Forward  | $\pm 50^\circ$  | $5.1 \times 10^{-5}$ |
| Backward | $\pm 120^\circ$ | $5.5 \times 10^{-4}$ |

# Maximum Analyzing Power vs. Kinetic Energy

Polarized cross-section :  $\sigma(\theta, \phi) = I(\theta)[1 + S(\theta)\vec{P} \cdot \hat{n}]$

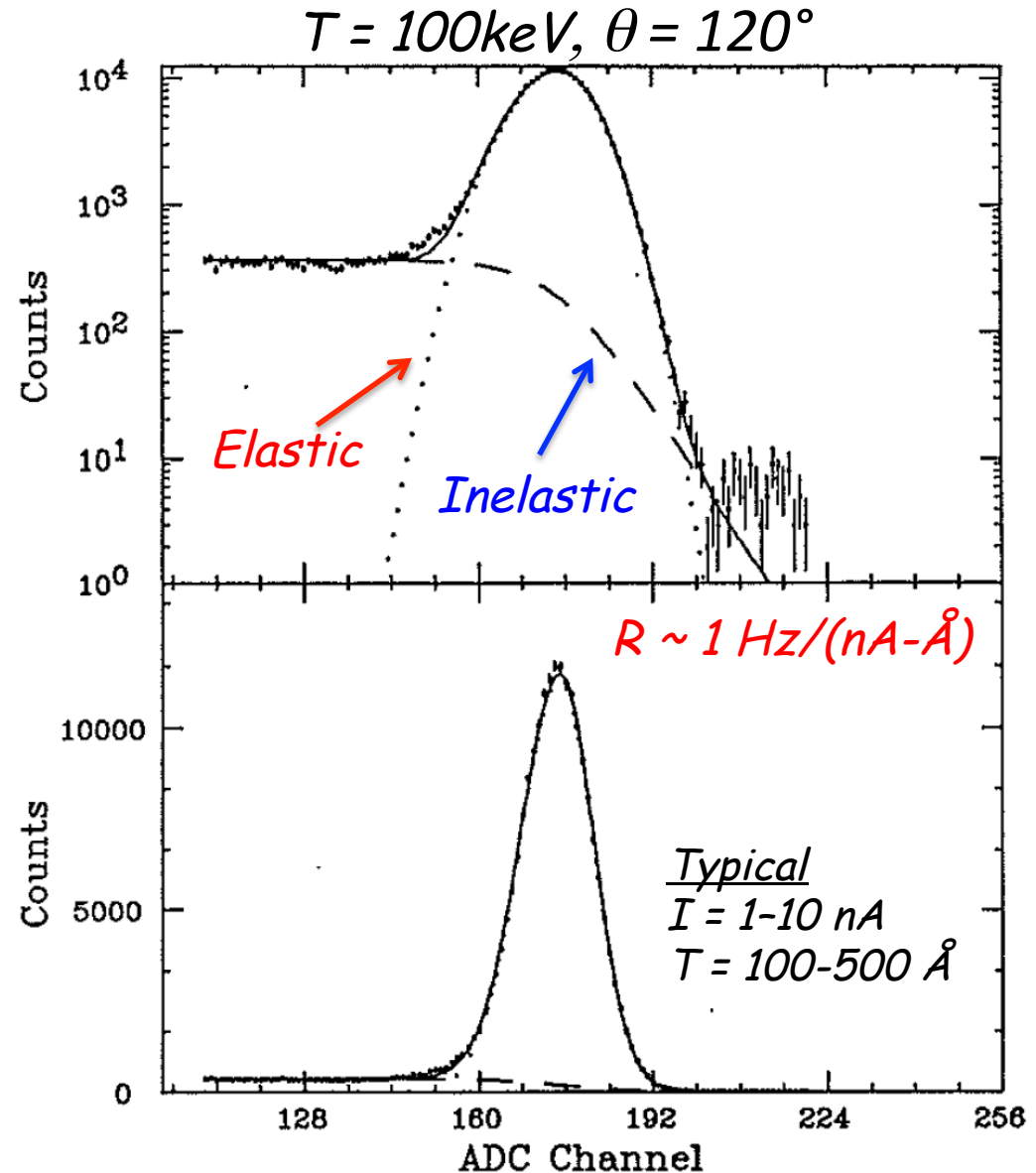
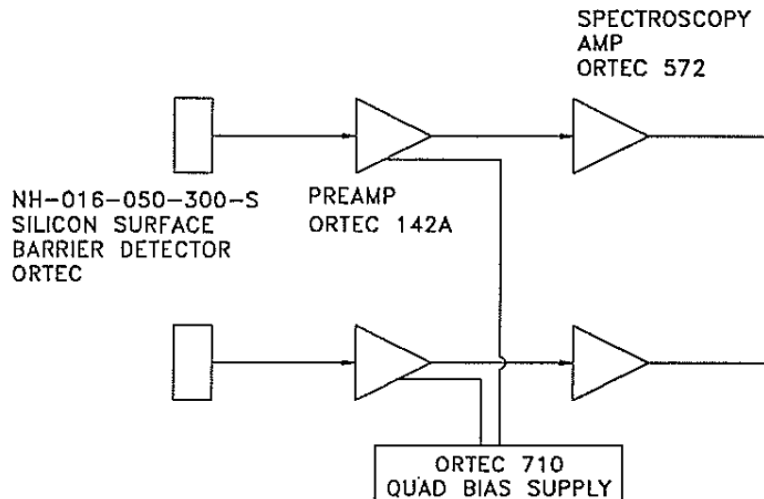
Unpolarized cross-section :  $I(\theta) = \frac{Z^2 e^4}{4m^2 \beta^4 c^4 \sin^2(\theta/2)} [1 - \beta^2 \sin^2(\theta/2)] (1 - \beta^2)$



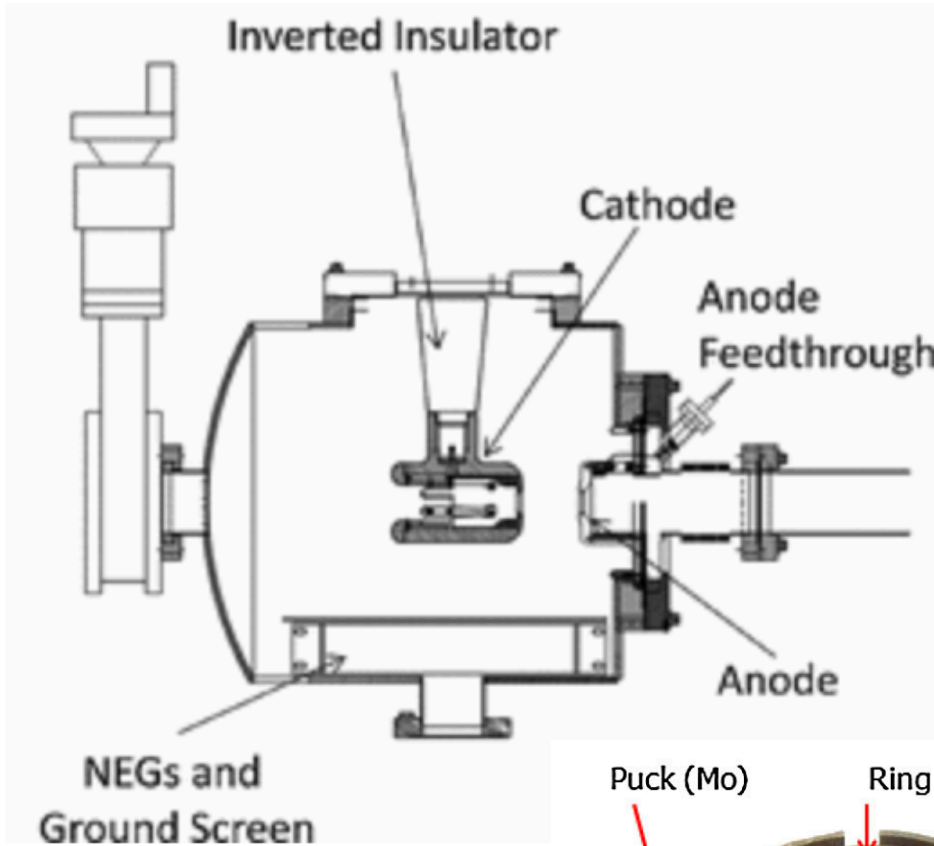
# 1990's Setup and Result

## Most equipment available

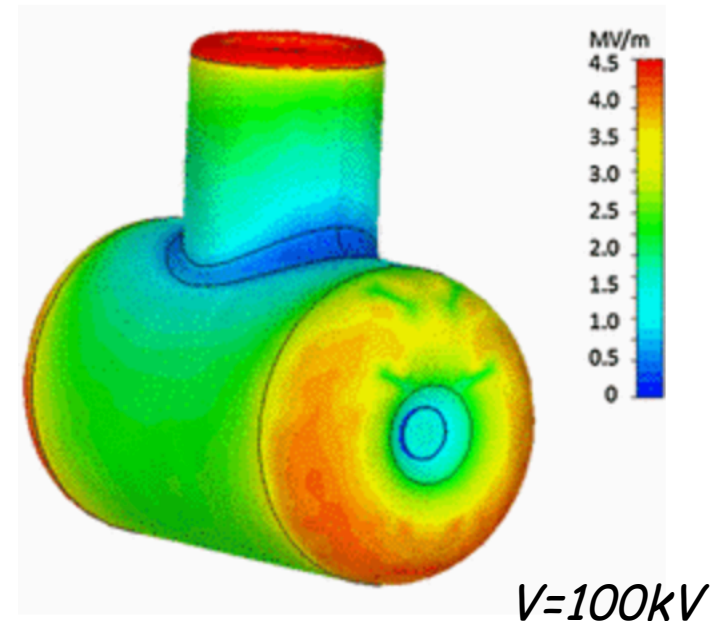
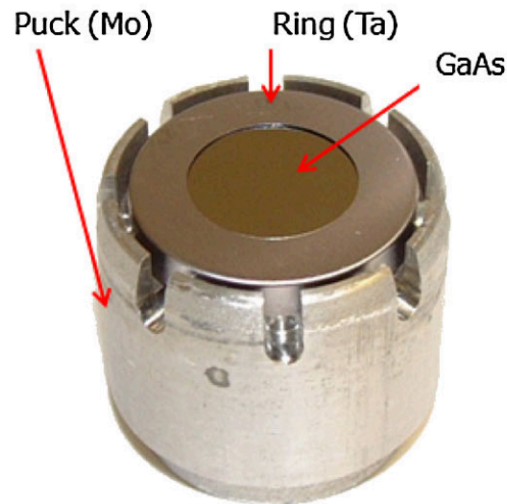
- CF mount surface barrier detector
- Mini NIM crate
  - Bias supply
  - Pre-amp to improve S/N
  - Amplifier
  - Pulse height analyzer/ADC



# Photo-Emission and? Field-Emission



1. Use HV to achieve FE
2. Use anode for control?
3. Photo-assisted FE?



# Oversimplified Test Stand Idea ?

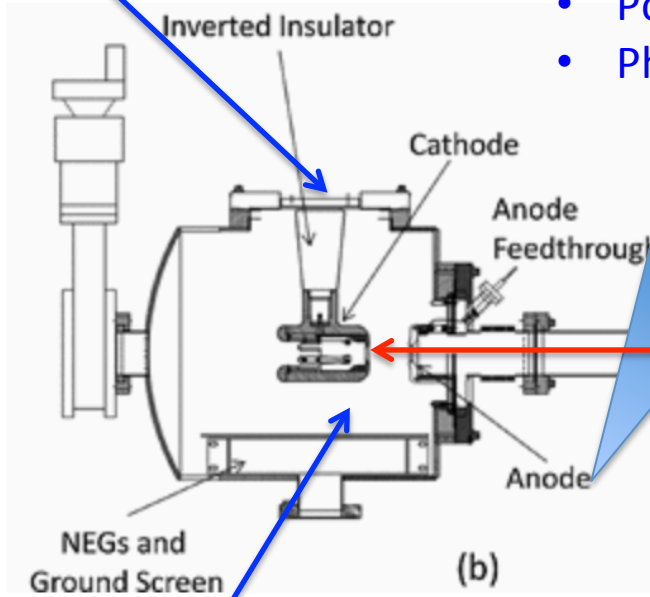
HV < 200 kV

Polarized Laser

- Polarized photoemission
- Photo-assisted FE???

Mott Polarimeter

- Entrance aperture
- Scattering 50, 120 deg
- Asymmetry measurement
- Current monitoring



Mount to standard moly puck

- GaAs photocathode
- FE emission tip

Intensity Control

- Slit/aperture
- Cup/Plate monitor

Twisted Generator Cross

- Grating
- YAG viewscreen/camera

