

Precision Measurements of Asymmetry in Photocathodes for Po- larised Electron Beam Experiments

Preparation of photocathodes with nitrogen trifluoride



JOHANNES GUTENBERG
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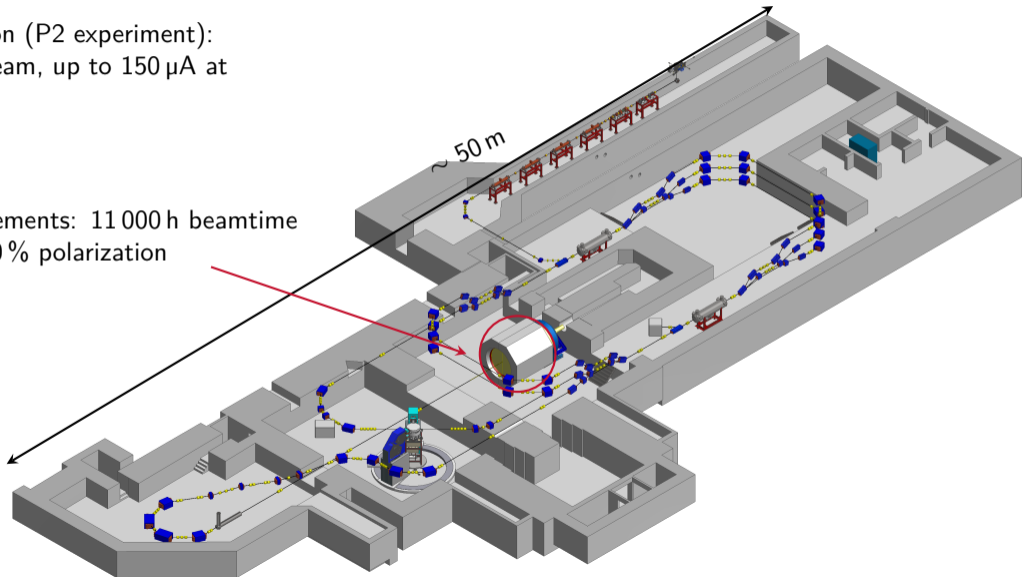
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26th September 2024



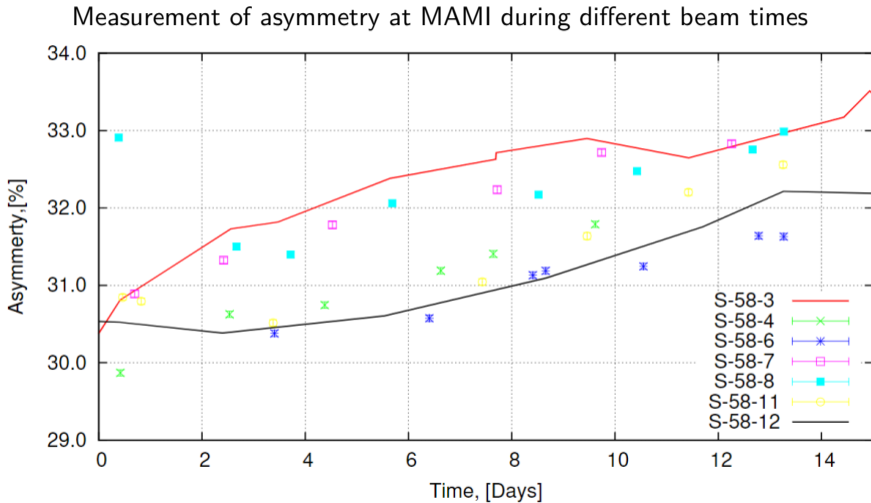
Mainz Energy-recovering Superconducting Accelerator (MESA)

EB-operation (P2 experiment):
polarized beam, up to $150\ \mu\text{A}$ at
 $155\ \text{MeV}$

Requirements: 11 000 h beamtime
with 80 % polarization

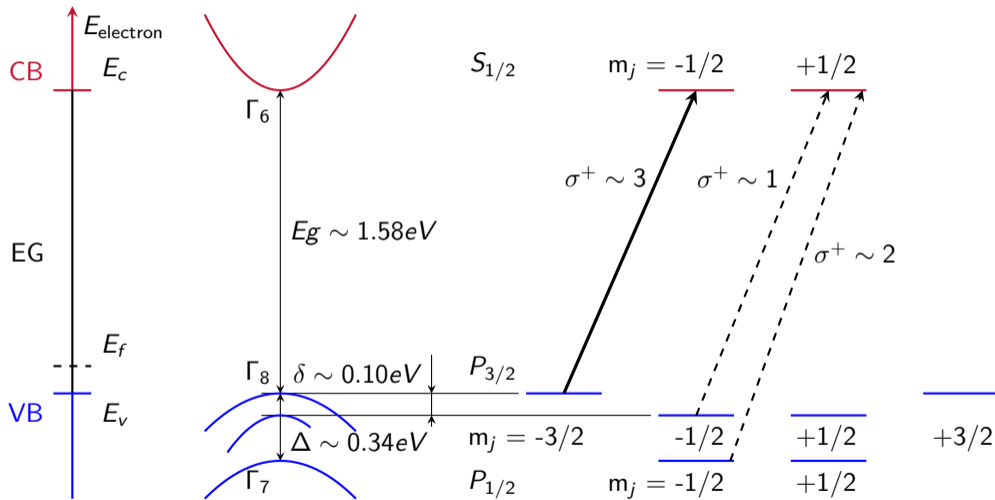


Asymmetry changes over time



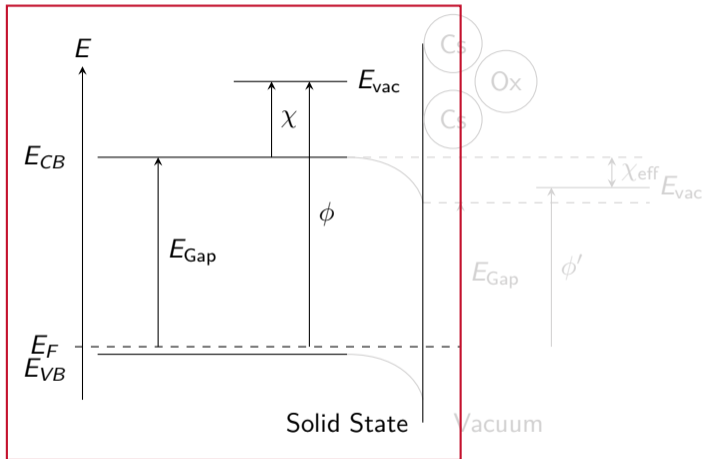
Source: V. Tyukin, K. Aulenbacher, *PoS 2020, PSTP2019*, 1–10, DOI 10.22323/1.379.0005

How to generate polarized electrons



Courtesy: V. Tyukin

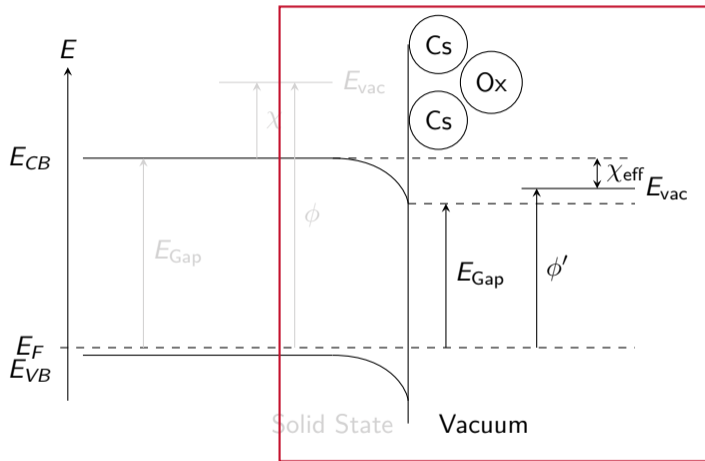
Negative electron affinity NEA



$$\chi = E_{vac} - E_{CB}$$

Positive Electron Affinity

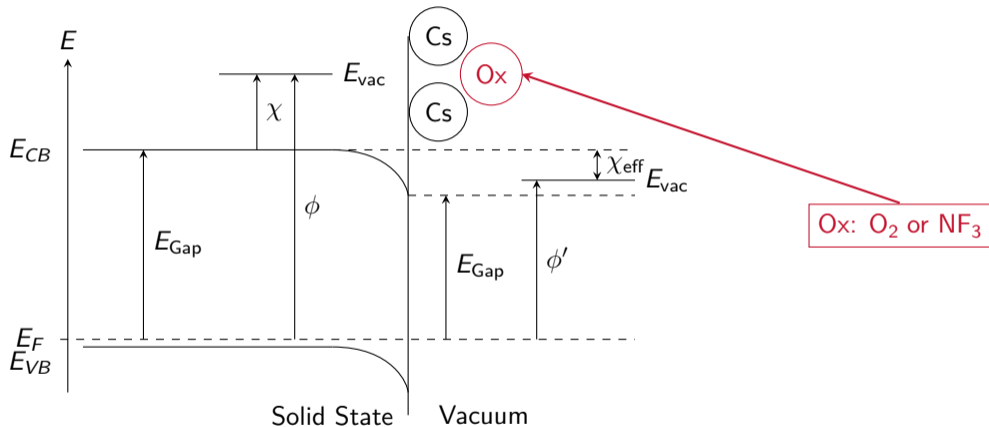
Negative electron affinity NEA



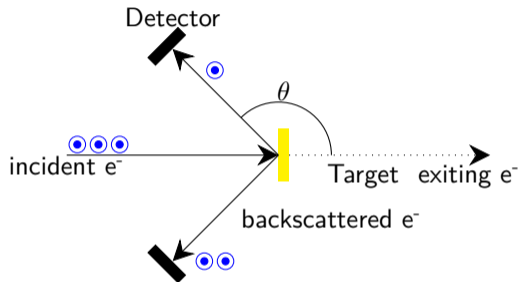
$$\chi_{eff} = E_{vac} - E_{CB}$$

Surface

Negative electron affinity NEA

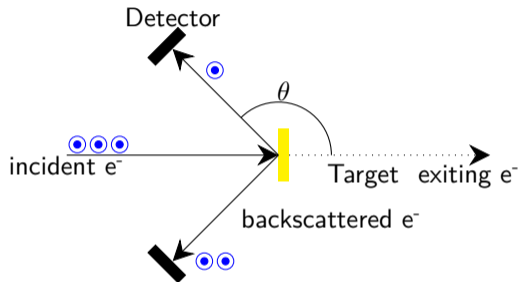


Mott polarimetry as measurement tool



$$A = S \cdot \vec{P}$$

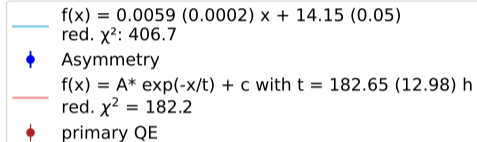
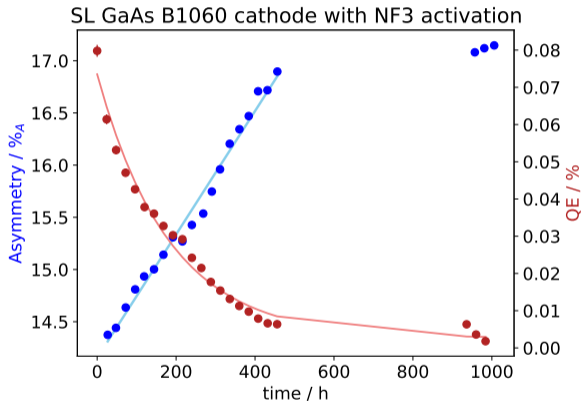
Mottpolarimetry as measurement tool

**Aim**

Measure the relative change in asymmetry over time.

$$A = S \cdot \vec{P}$$

Measurement - Example



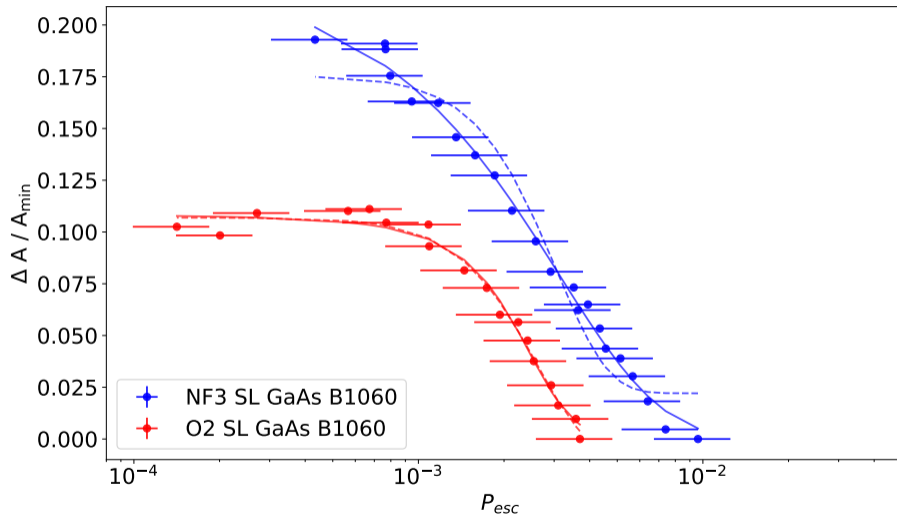
Benefits

Escape probability is used to describe QE by Spicer and Herrera-Gomez in 1993

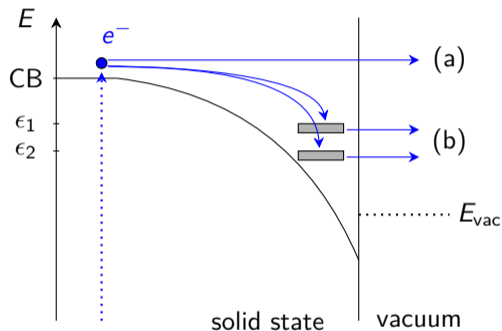
$$P_{\text{esc}} \approx QE$$

W. E. Spicer, A. Herrera-Gomez in SPIE's 1993 International Symposium on Optics, Imaging and Instrumentation, (Ed.: K. J. Kaufmann), 1993, p. 18, DOI 10.1117/12.158575

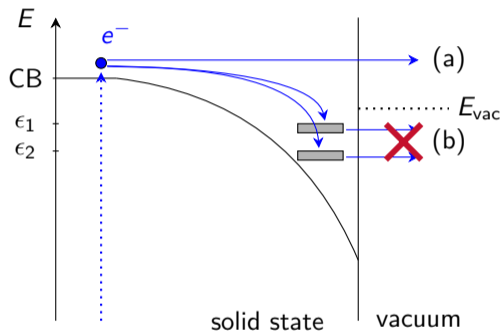
JGU | Correlation between asymmetry and escape probability



Filter mechanism explains increase of polarization



P_{esc}/ QE high



P_{esc}/ QE low

Key Insights



Asymmetry changes always if QE changes



Showcased the differences in asymmetry changes

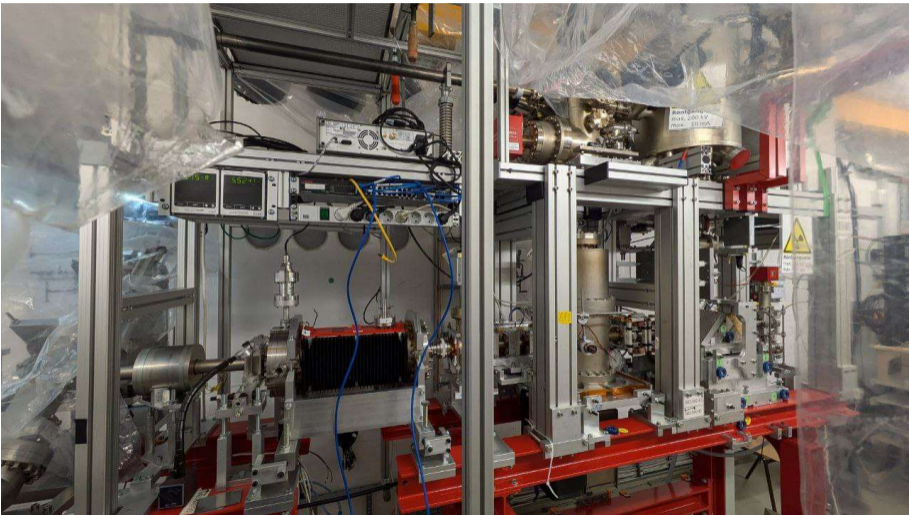


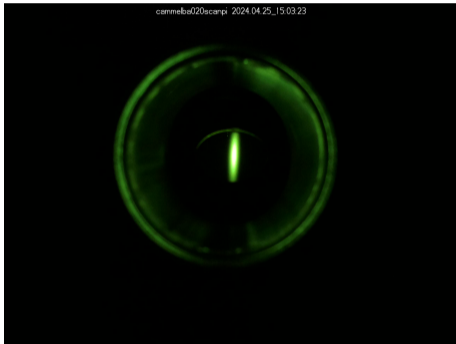
For polarization sensitive measurements, check changes in asymmetry regularly

Thank you very much for your attention!



MESA Status September 2024





Unnormalized Asymmetry

