

Status of precise measurements of electron-beam polarization changes during long term operation

Preparation of photocathodes with nitrogen trifluoride



JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Jennifer Groth Institut für Kernphysik 20th September 2022



Review

1 Motivation



3 Experimental Setup

Based on a ${\ensuremath{{\mbox{\sc b}}} T_E\!X}$ template by S. Friederich

Jennifer Groth

EWPAA 2022



JG U Mainz Energy-recovering Superconducting Accelerator (MESA)



Review

JG U How to generate polarized electrons



Band structure

Band splitting in heavy and light hole band due to spin orbit coupling.

Review

JGU How to generate polarized electrons



Band structure

Band splitting in heavy and light hole band due to spin orbit coupling.

Molecular structure

Momentum transfer from photon to electron enables polarized electron emission.



JGU Negative electron affinity NEA



Review

JG U Negative electron affinity NEA



Positive Electron Affinity

Jennifer Groth

EWPAA 2022

Review

JG U Negative electron affinity NEA



JG U Motivation

With cesium and oxygen preparation the polarization of the electrons change over time.



Source: V. Tyukin, K. Aulenbacher, PoS 2020, PSTP2019, 1-10

Review



With cesium and oxygen preparation the polarization of the electrons change over time.



Source: V. Tyukin, K. Aulenbacher, PoS 2020, PSTP2019, 1-10

Jennifer Groth

EWPAA 2022

Review

JG U Why using different oxidants?



Review

JG U Why using different oxidants?



NEA: negative electron affinity

JG U Stability of QE



Review

adapted N. Chanlek, PhD thesis, University of Manchester, 2011

ConclusionQuestionPreparation with NF3 allows more
activation cycles with stable QEIs longevity also visible with the ESP?

Jennifer Groth

EWPAA 2022



JG U Properties of NF₃ activation

Stability



with O_2

Handling

Since both compounds are gaseous, handling is the same.

Chemical properties

Review



May hint to no chemical bonding between Cesium and Fluorine indicated in PES.

Comparable with O_2

Starting QE and ESP are the same. W. Liu, PhD thesis, University of Chinese Acadamy of Sciences, 2017

Jennifer Groth

EWPAA 2022

JGU

Experimental setup





Ĥ

R

Review



The cathodes work in reflection mode.

Author	Year	QE	λ
Chanlek	2011	5.5 %	632 nm
Liu	2017	9.5 %	700 nm
This work	2022	7.3 %	674 nm

 $P_{Laser} = 100 \,\mu W$ heavy p-doped bulk $Zn_xGa_{1-x}As$

Review

N. Chanlek, PhD thesis, University of Manchester, 2011 W. Liu, PhD thesis, University of Chinese Acadamy of Sciences, 2017



EWPAA 2022

JG U Further preparing measurement



Preliminary measurement of the asymmetry.

Preliminary measurement of time developement of the asymmetry, needs to be investigated further. U Progress

Review



EWPAA 2022





Jennifer Groth

EWPAA 2022



JGU

Thank you very much for your attention!



Precision Physics, Fundamental Interactions and Structure of Matter



JG U Stability



Source: N. Chanlek, J. D. Herbert, et al., Journal of Physics D: Applied Physics 2015, 48, 375102

Jennifer Groth

EWPAA 2022

JG U Stability



Source: Z. Liu, Y. Sun, et al., Applied Physics Letters 2008, 92, 241107

EWPAA 2022

JG U Further into the time development



Appendix