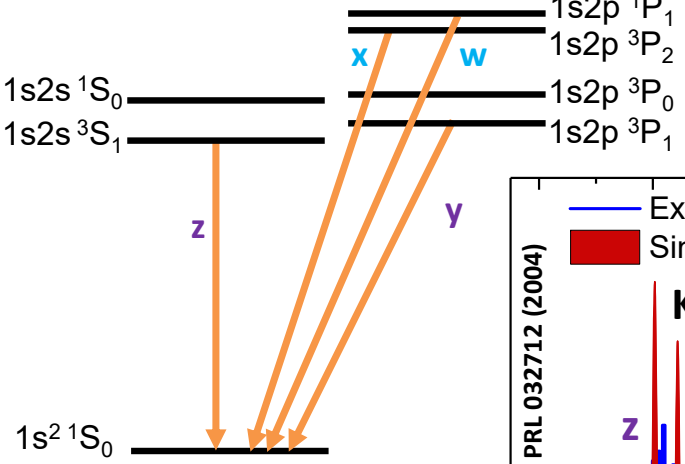
High-Resolution Spectroscopy of X-Ray Transitions in He-like Uranium at CRYRING@ESR

He-like Uranium

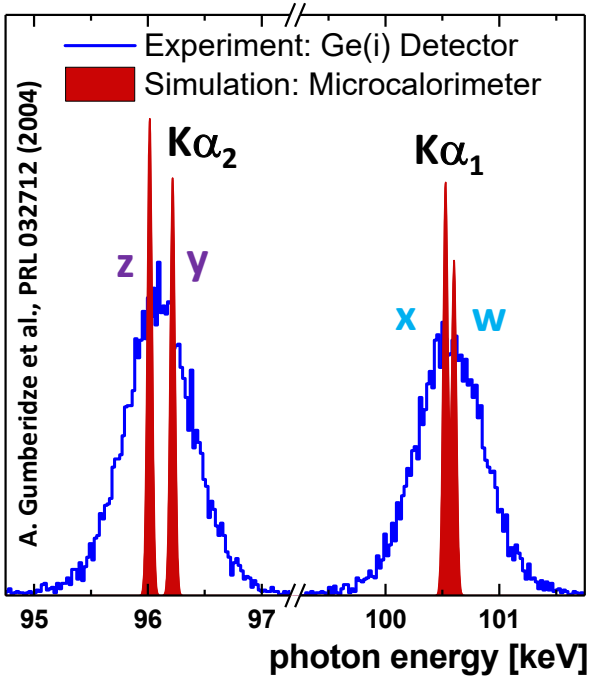


No precision data available for $Z > 54$

$\Delta(w\text{-}x) = 74$ eV

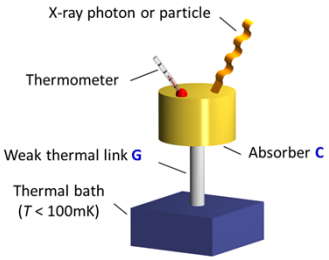
$\Delta(y\text{-}z) = 142$ eV

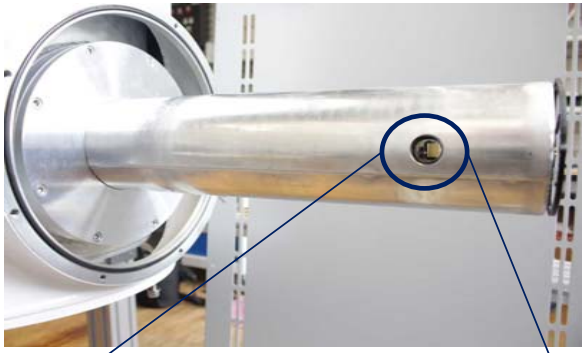
Y. S. Kozhedub et al., Phys. Rev. A 100, 062506 (2019)

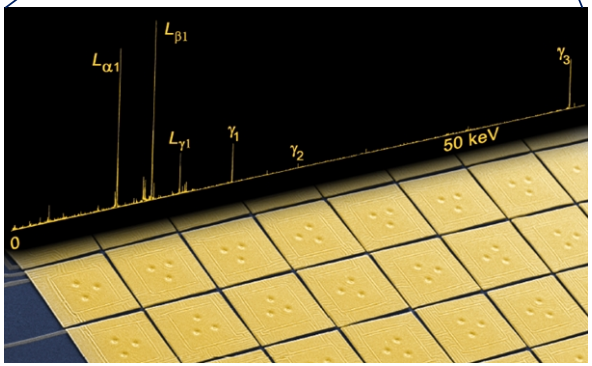


High spectral resolution of <100 eV FWHM is necessary to resolve the n=2 level structure and benchmark state-of-the-art theory.

Metallic Magnetic Microcalorimeter (MMC) Detectors



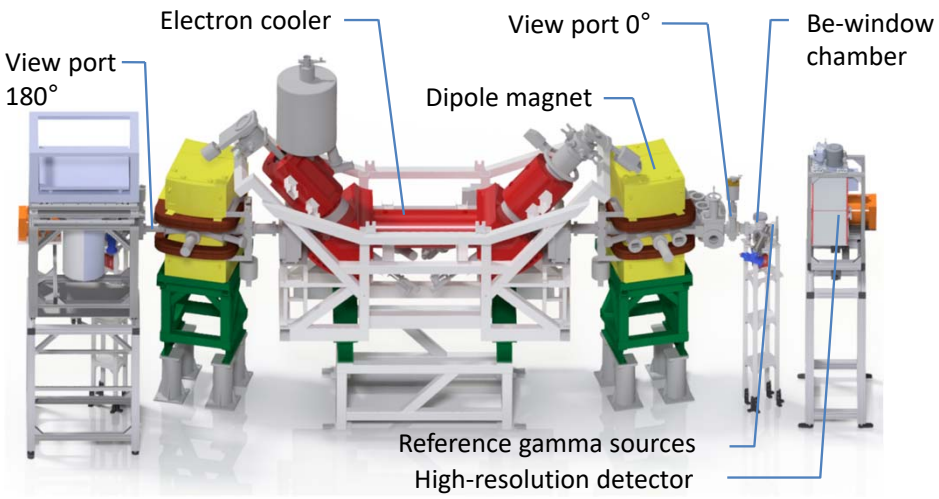


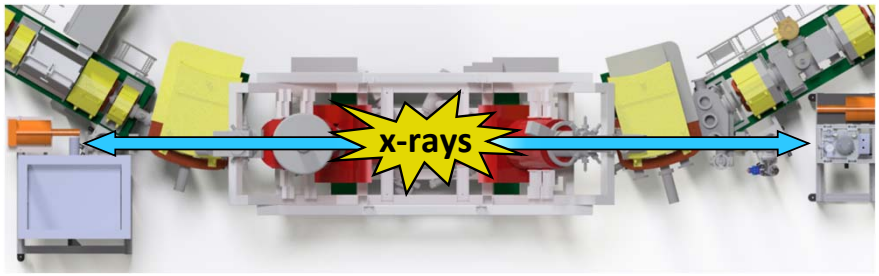


Combination of high spectral resolution and broad bandwidth acceptance offers unique possibilities.

Preceding Experiment E138: Setup and Spectra

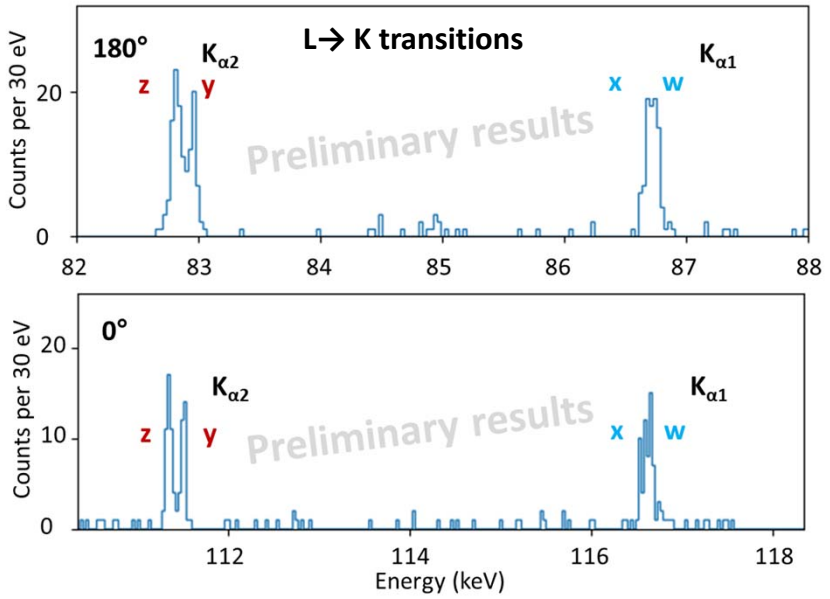
Experimental Setup with truly co-axial geometry

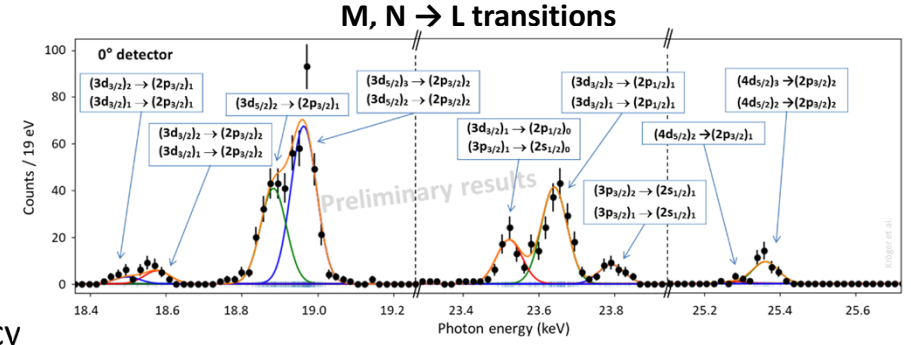




- ✓ insensitive to geometric misalignments
- ✓ combining 0° and 180° provides unique redundancy
- ✓ coincidences between x-rays and down-charged ions

Spectra obtained during recent beam time





First well-resolved K_α spectra ere recorded for a high-*Z* system.

Spectral resolution of 70 – 80 eV FWHM @ 100 keV was achieved.

First exploitation of microcalorimeter timing capabilities with Δt_{FWHM} < 400 ns.

But: low statistics, mainly due to outages and underperformance of the accelerator during the first week of beam time.

Preceding Experiment E138: Preliminary Results

E138 Preliminary Results

$K_{\alpha 2}$ Splitting

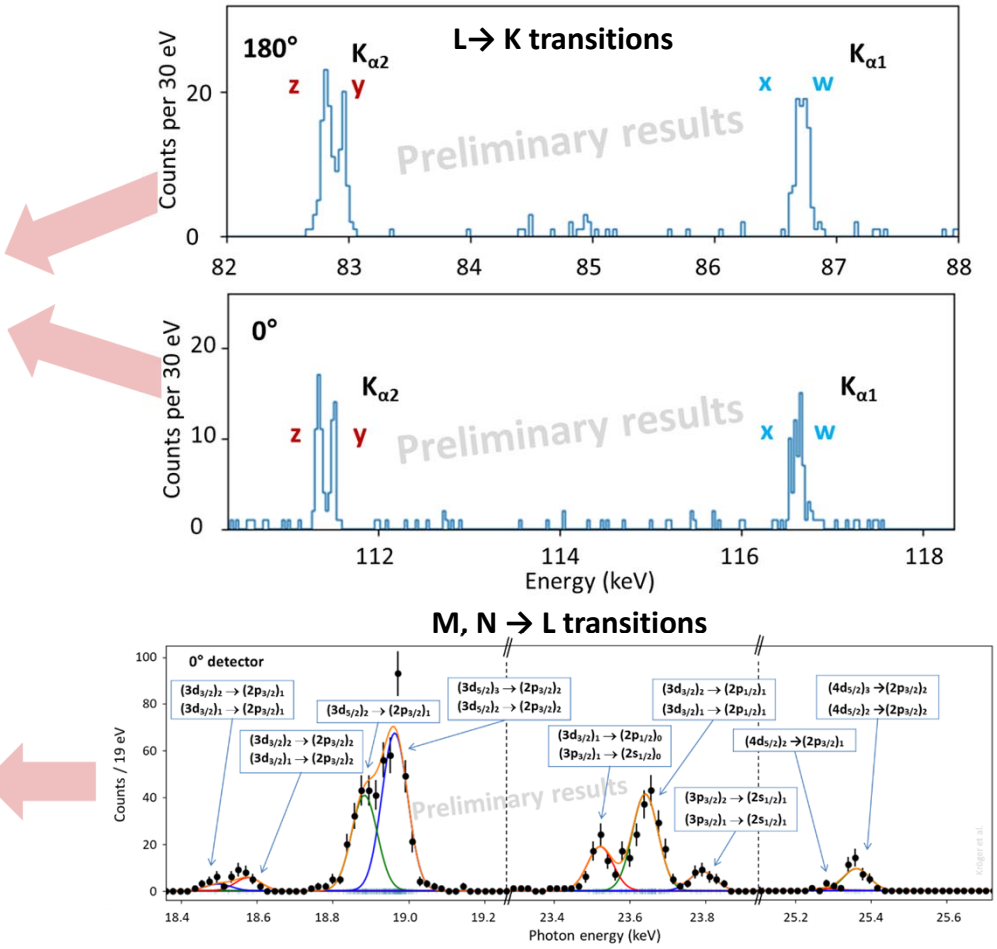
Experiment	Theory
138.6 eV ± 4.5 eV	141.7 eV

K_α @ 0° → 142 events
K_α @ 180° → 184 events

Effective Cooler Voltage

From Line Positions of M, N → L Transitions	Voltage Divider + Space Charge Potential
5602 V ± 6 V	5609 V

Spectra obtained during recent beam time



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New Experiment Proposal

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Proposal for a follow-up experiment

	180°	0°
Ions per injection	2.0E+06	
Measurement cycle in s	55	
RR fraction of beam loss	0.65	
Branching to K_α	0.9	
Efficiency Particle Detector	0.95	
$\Delta\Omega$ coverage	6.5E-07	5.0E-07
Lorentz transformation	0.75	1.34
Stopping Power (100 µm)	0.75	0.47
Escape Event Fraction (100 µm)	0.3	0.3
Photons per hour	**18.6**	**16.0**
Photons after 5 days	**2233**	**1914**

Goal: To increase the statistics by roughly a **factor of 10**, thus reducing the statistical uncertainty towards the **1 eV level**.

Requirement: 9 shifts (accelerator preparation and tuning) + 21 shifts (data taking).

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