

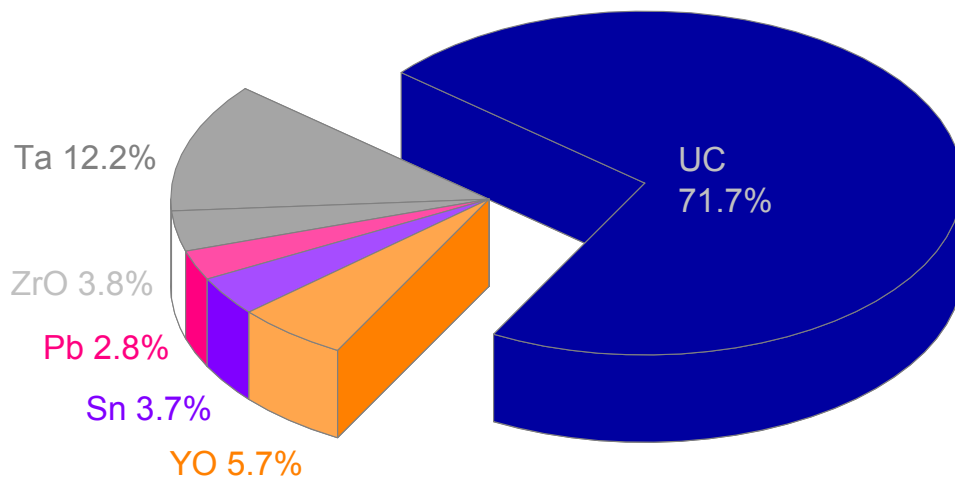
Uranium Carbide Material Developments at CERN-ISOLDE

Alexander Gottberg



Actinide targets in 2010 (2009)

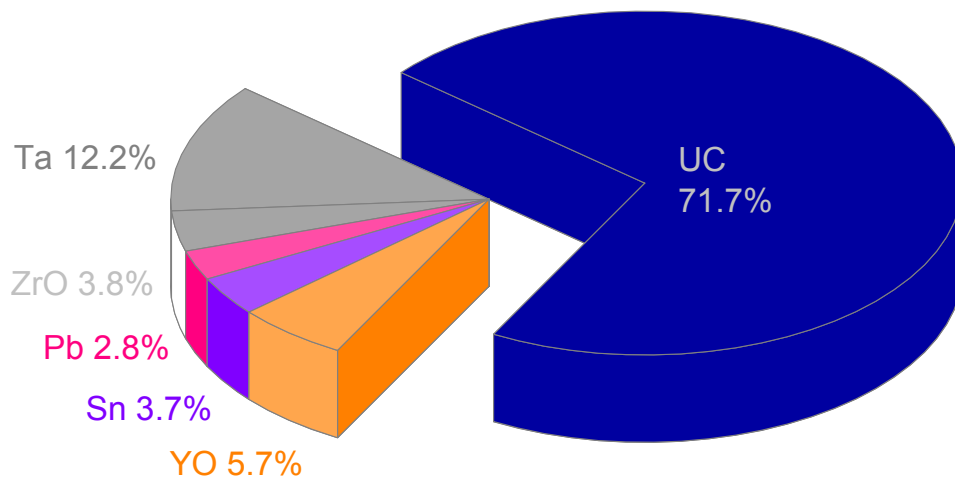
- 244 shifts out of 350 → 72% (282 → over 60% of total)
- 12 new and 2 old units (12 new)



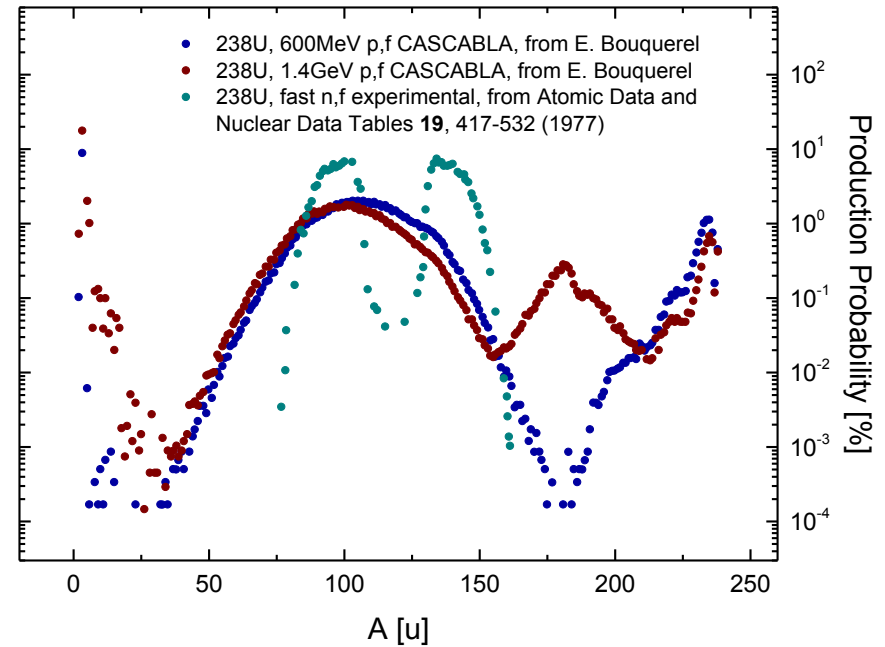
Numbers from M. Kowalska

Actinide targets in 2010 (2009)

- 244 shifts out of 350 → 72% (282 → over 60% of total)
- 12 new and 2 old units (12 new)



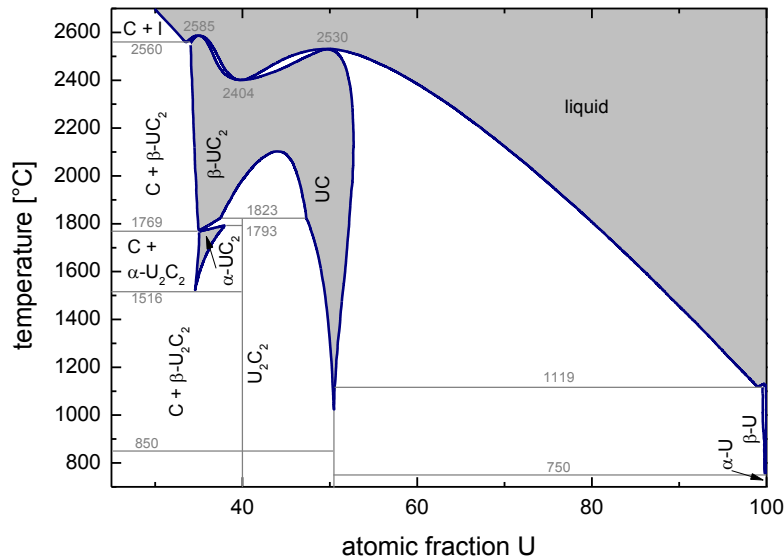
Numbers from M. Kowalska





Production Process:

1. Blending UO_2 and carbon powder
2. Cold pressing into pills
3. Carbothermal reduction of UO_2

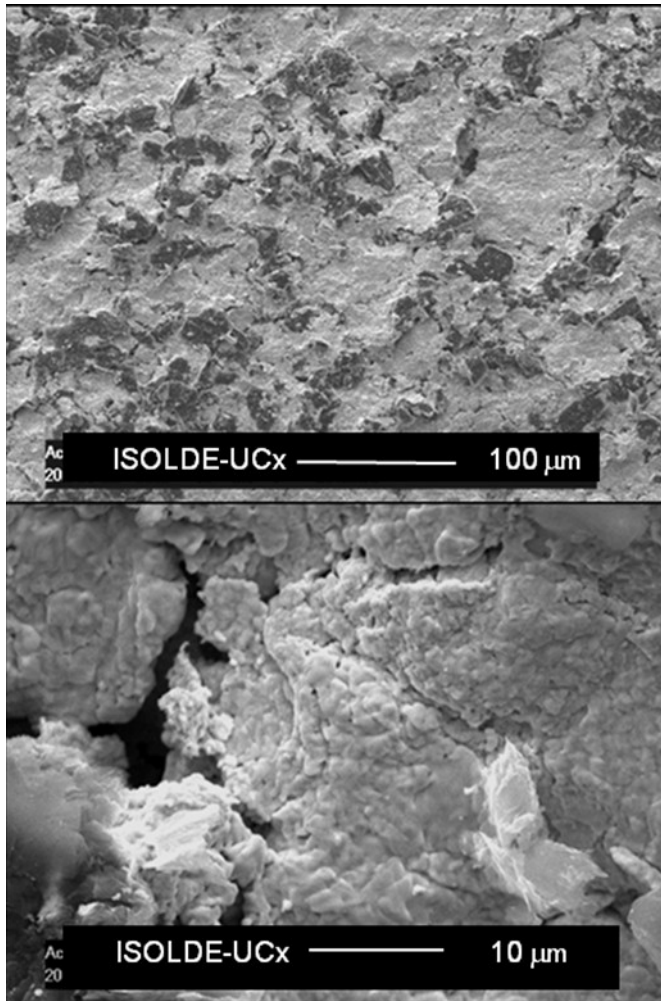


P.Y. Checalier *et al.*, J. Nuc. Mat. 288 (2001) 100-129

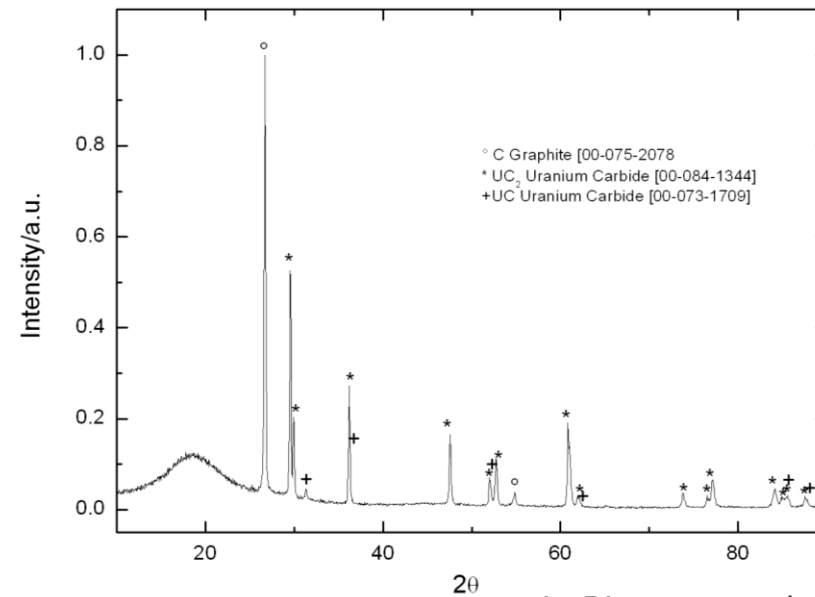


conventional UC pills used at ISOLDE,
 3.5g/cm^3 , grain size $3\ \mu\text{m}$ to $50\ \mu\text{m}$, high porosity





$\rho_{\text{bulk}} = 3.5 \text{ g/cm}^3$



L. Biasetto et al.





Task 1: Synthesis of new actinide targets (CERN, INFN, IPNO)

Subtask 1: Sol-gel synthesis in complex fluids

Subtask 2: Nanostructures

Task 2: Characterization of actinide targets (CERN, INFN)

Subtask 1: Microstructure, porosity, specific surface, crystalline phase

Subtask 2: Emissivity, thermal conductivity at high temperature

Task 3: Actinide targets properties after irradiation (CERN, PSI)

Subtask 1: Post-irradiation examination of target prototypes

Task 4: Online tests of actinide targets (CERN, GANIL, IPNO)

Subtask 1: Impact of pulse time structure on release and ageing properties

Subtask 2: Analysis of the results-effusion and diffusion phenomena

High Density UC Target at CERN



Importation from Russia of HD-UC pellets to CERN & online tests in Nov. 2010:



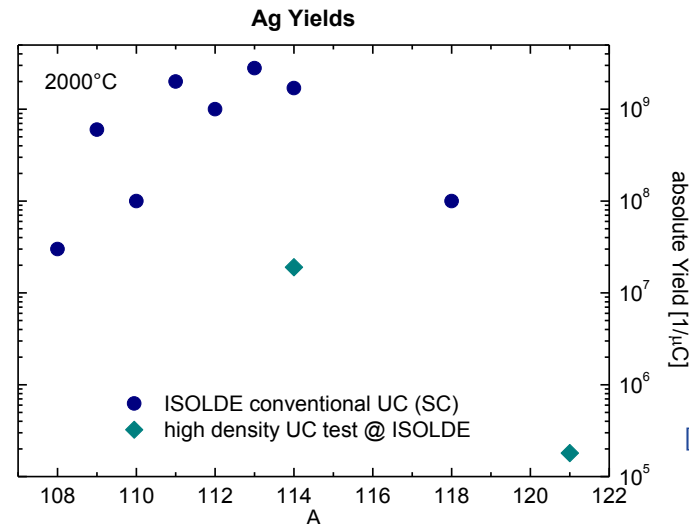
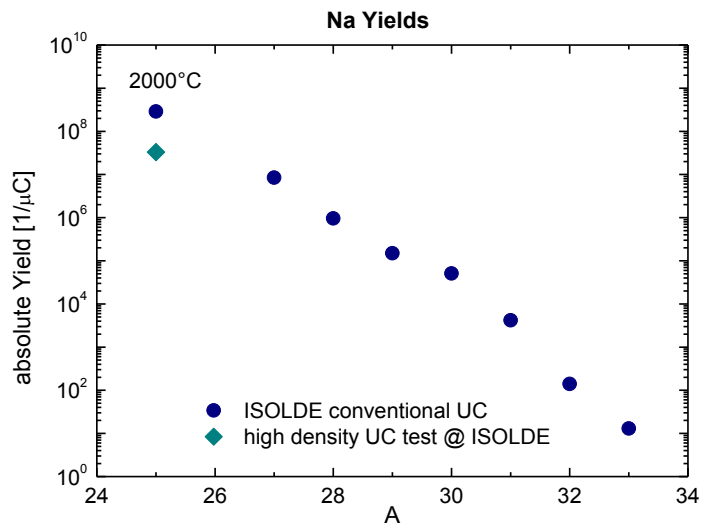
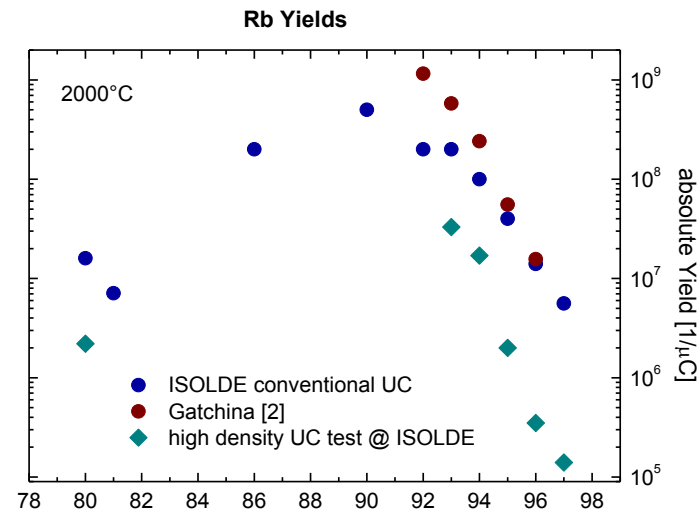
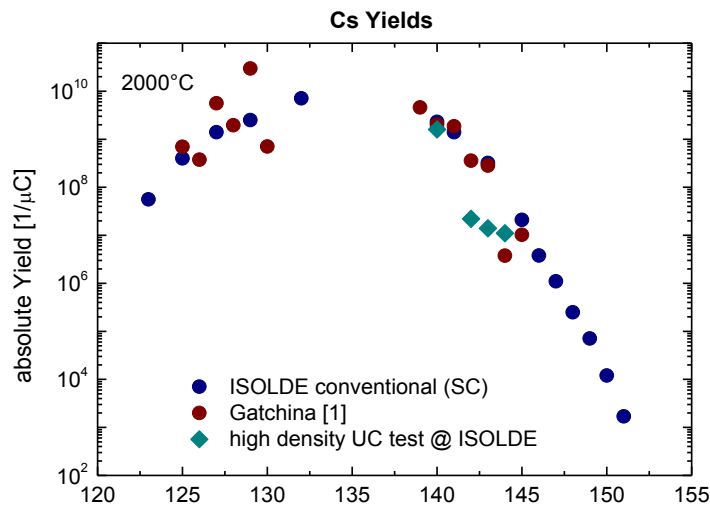
Set 1: 100 pills

- UC (^{235}U :0.38%), 13.2mm diam., 1mm thick, 12.3g/cm³, avg. grain 10 μm , UC₂<4%

Set 2: 300 pills

- UC (^{235}U :0.38%), 13.2mm diam., 1mm thick, 12.7g/cm³, avg. grain 6 μm , UC₂<4%

Yields from HD UC

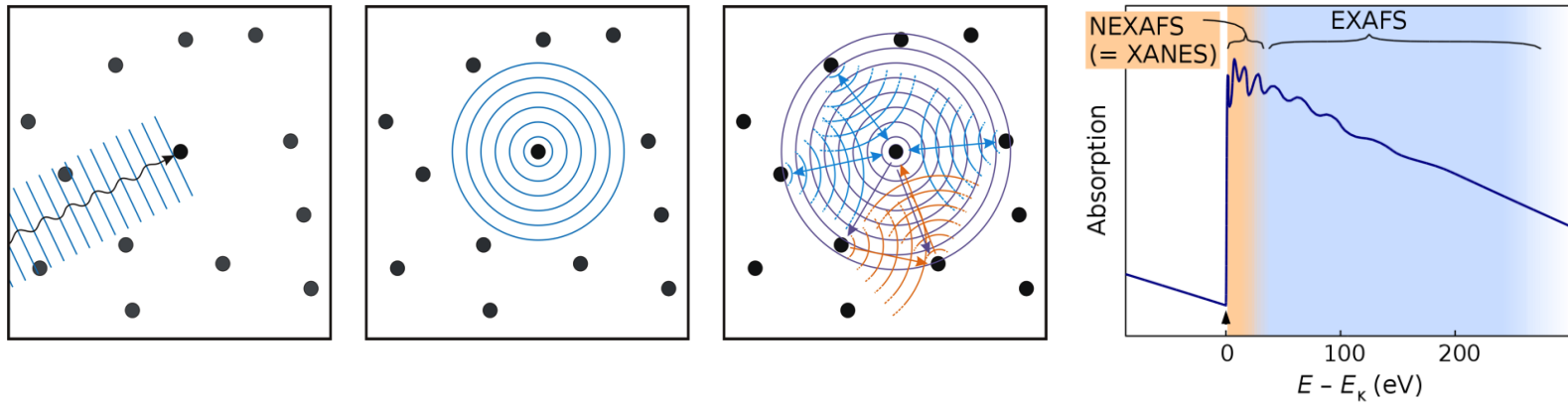


[1] V. N. Panteleev, et al.,
Eur. Phys. J. A **42**,
495-501 (2009)

- Comparable absolute yields (Gatchina 91g/cm², conventional ISOLDE \approx 45g/cm²)
- HD absolute yields @ ISOLDE (241g/cm²) x2 to x10 lower than from conventional UC targets

Beamline X05LA @ SLS, PSI offers: $h\nu = 5 - 20 \text{ keV}$, $\Delta E/E = 2 \cdot 10^{-4}$, $1 \times 1 \mu\text{m}^2$

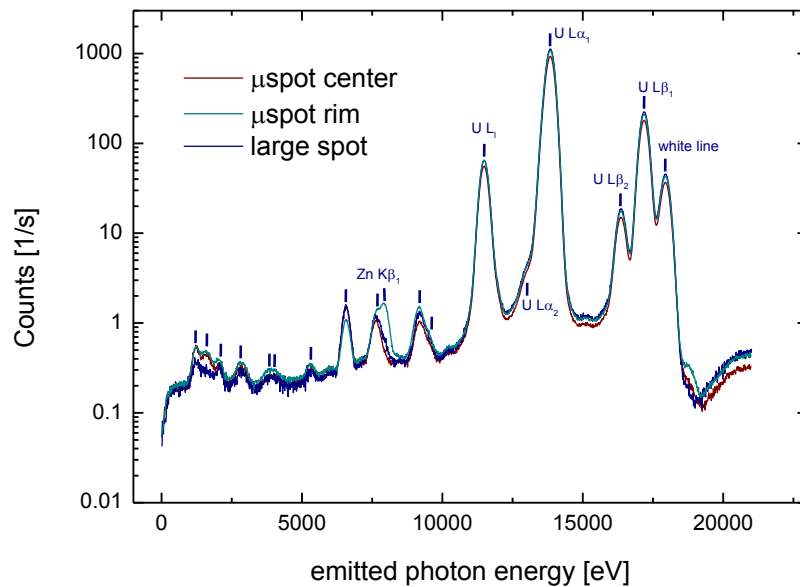
- XRD
- XFS
- X-ray absorption fine structure (XAFS, NEXAFS, EXAFS)



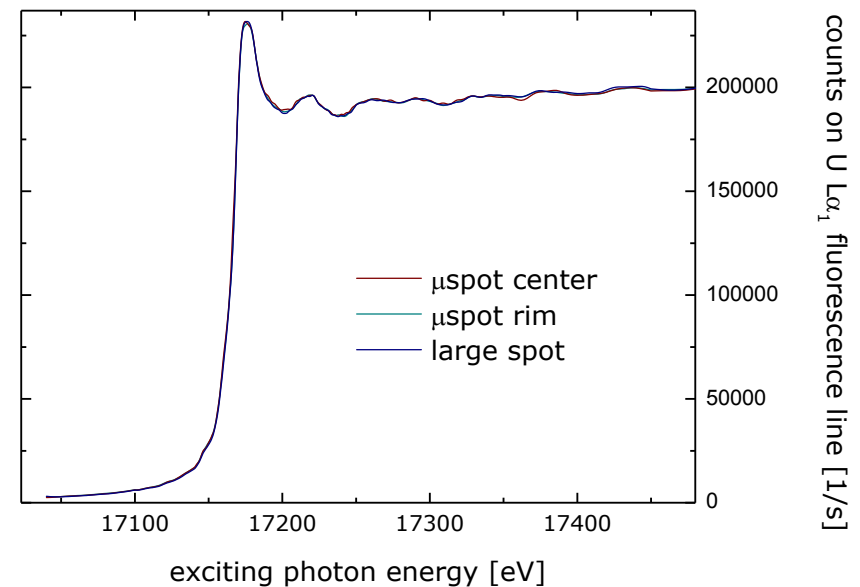
Beamline X05LA @ SLS, PSI offers: $h\nu = 5 - 20$ keV, $\Delta E/E = 2 \cdot 10^{-4}$, $1 \times 1 \mu\text{m}^2$

- XRD
- XFS
- X-ray absorption fine structure (XAFS, NEXAFS, EXAFS)

Fluorescence



EXAFS



Results from first X-ray absorption experiments on UC



Team:

- Richard Catherall
- Thierry Stora
- Tim Giles
- Pekka Suominen
- João Pedro Ramos
- Christoph Seiffert
- Bernard Crepieux
- Gunvor Koldste
- Marc Guichard

Thanks to:

- Daniel Grolimund (PSI)
- Claude Degueldre (PSI)
- Ines Günther-Leopold (PSI)

- Daniel Stracener (ORNL)
- Vladimir Panteleev (PNPI)

- Stefano Sgobba (EN-MME)

- Yorick Blumenfeld
- Magdalena Kowalska