Wir schaffen Wissen – heute für morgen

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Diamond Detectors for Fast Transactinide Experiments

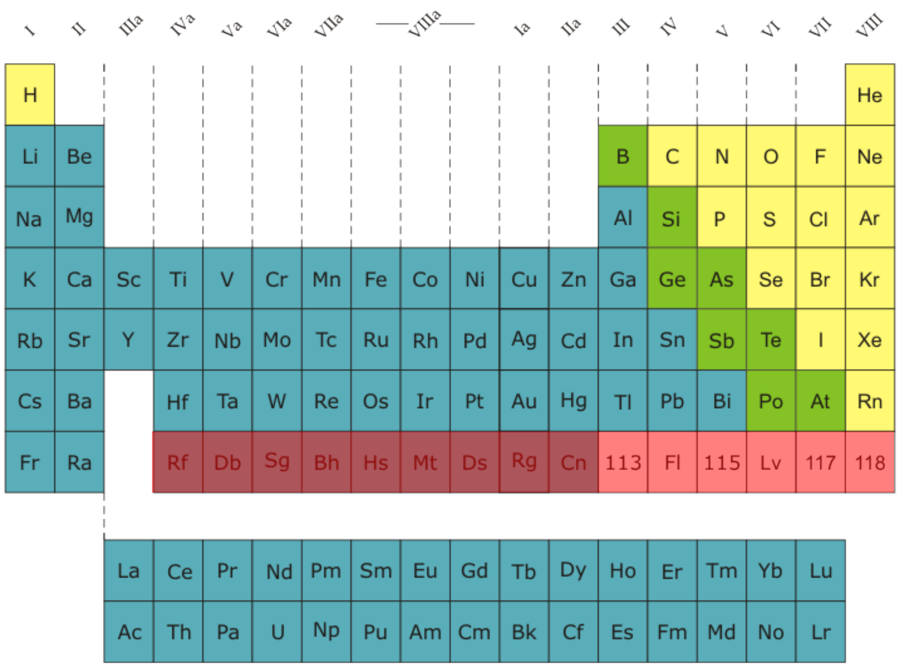
Outline

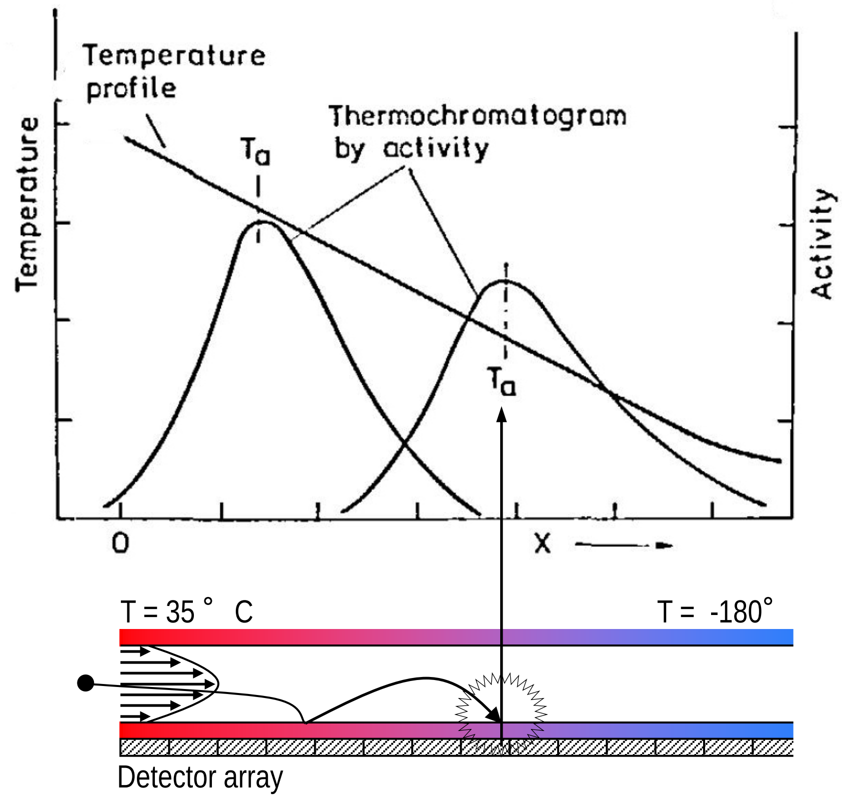
- Introduction to transactinide chemistry
- The COLD thermochromatography setup and resulting deposition patterns
- Detector heating experiments
- Problems with common Si PIN-diodes and diamond detectors in a future IVAC setup

Transactinide chemistry experiments

We are interested in the chemical properties of **transactinide elements** (Z > 103) with a special focus on the so-called superheavy elements (SHE).

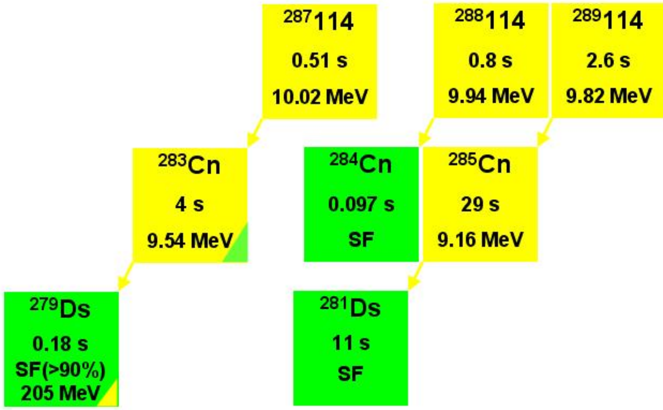
For instance, this is achieved by deducing adsorption enthalpies ($-\Delta H_{ads}$) using the **thermochromatography** setup with the Cryo – OnLine – Detector (COLD).



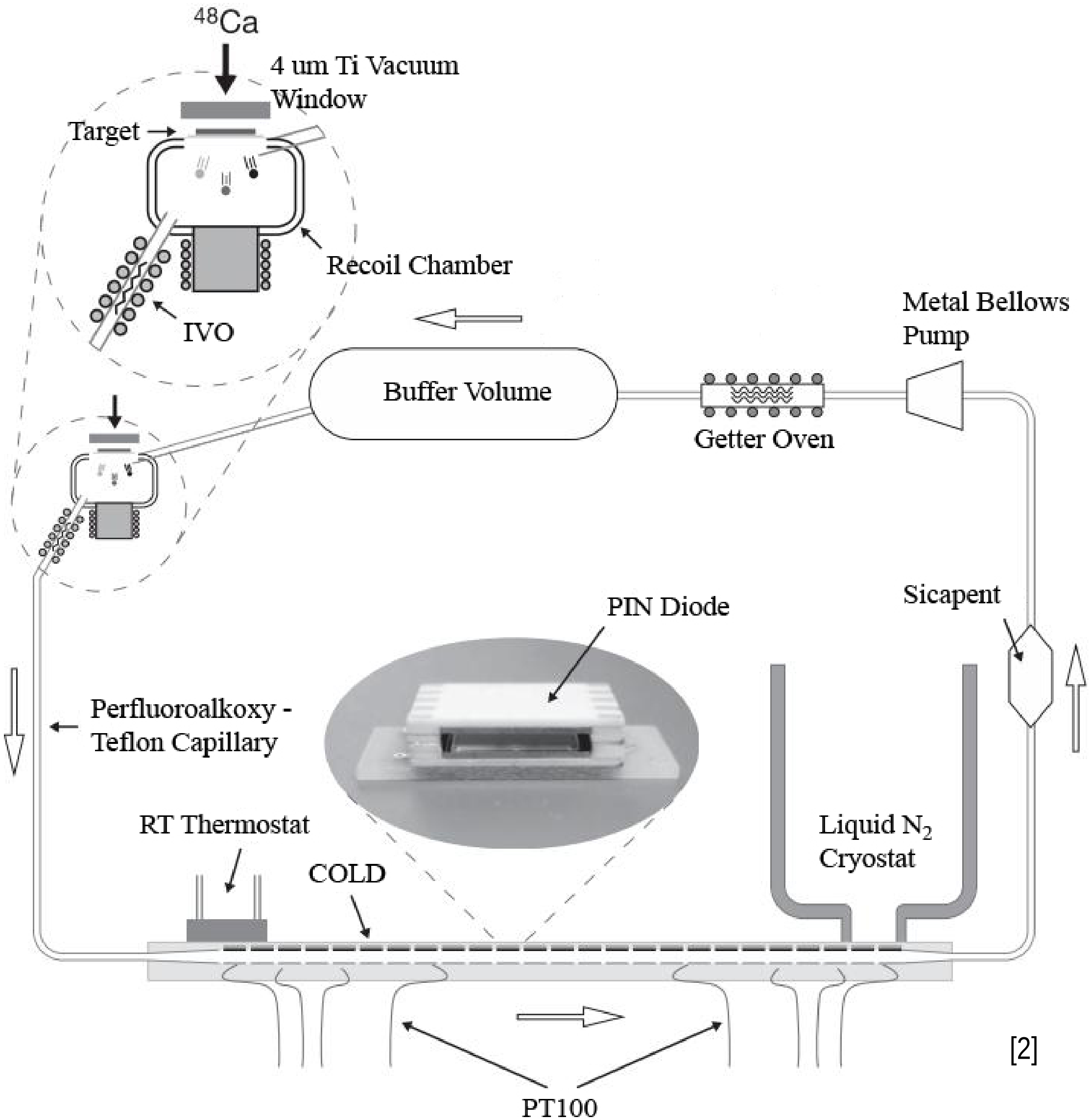


I. Zvara, *Isotopenpraxis* 26 (1990) 6, pp. 251 – 258

Schematic experimental setup



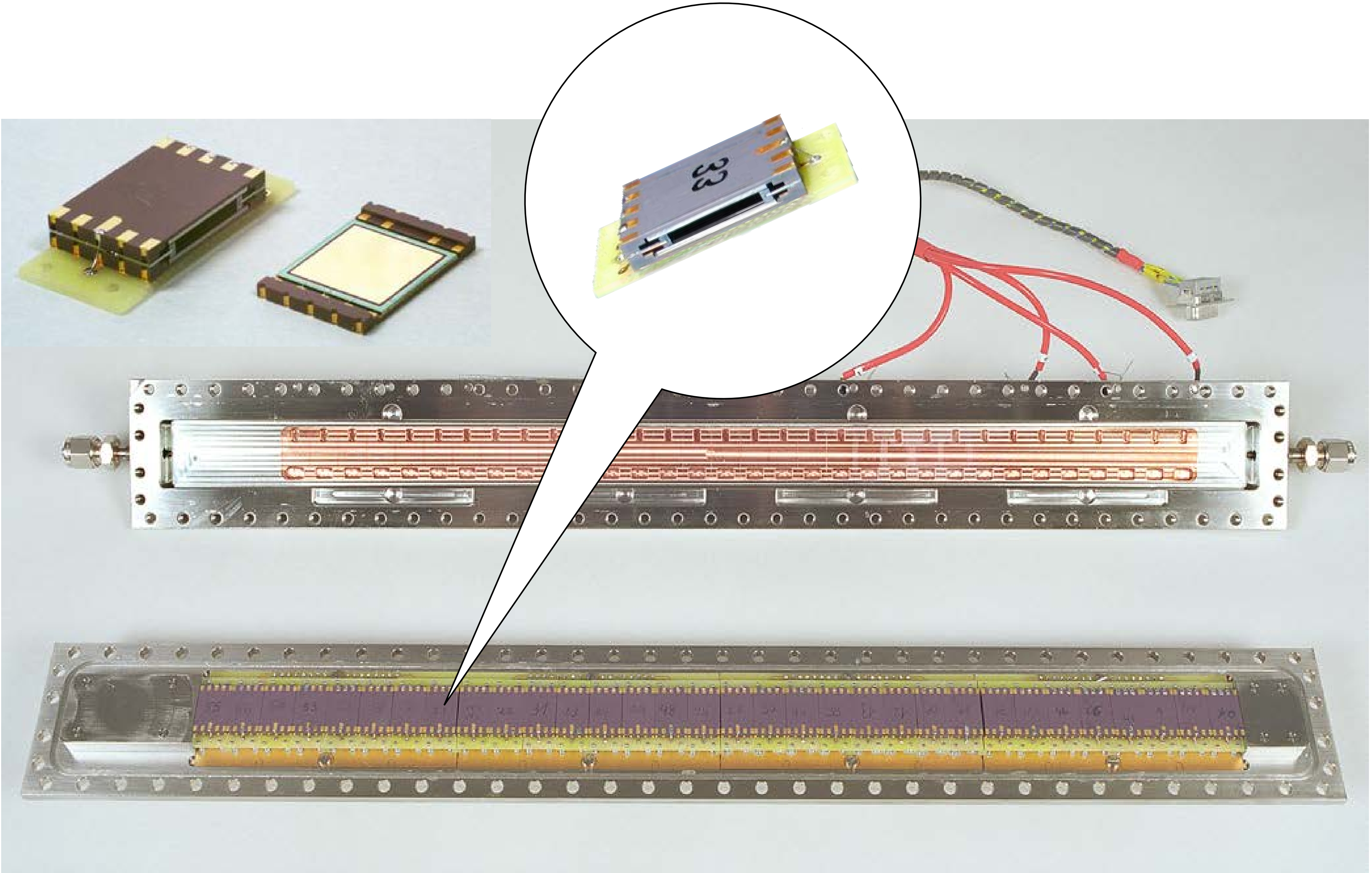
Decay properties of SHE Fl (114) (observed at FLNR in 2004 [1])



[1] Y. Oganessian et al., *Phys. Rev. C* 70 (2004)

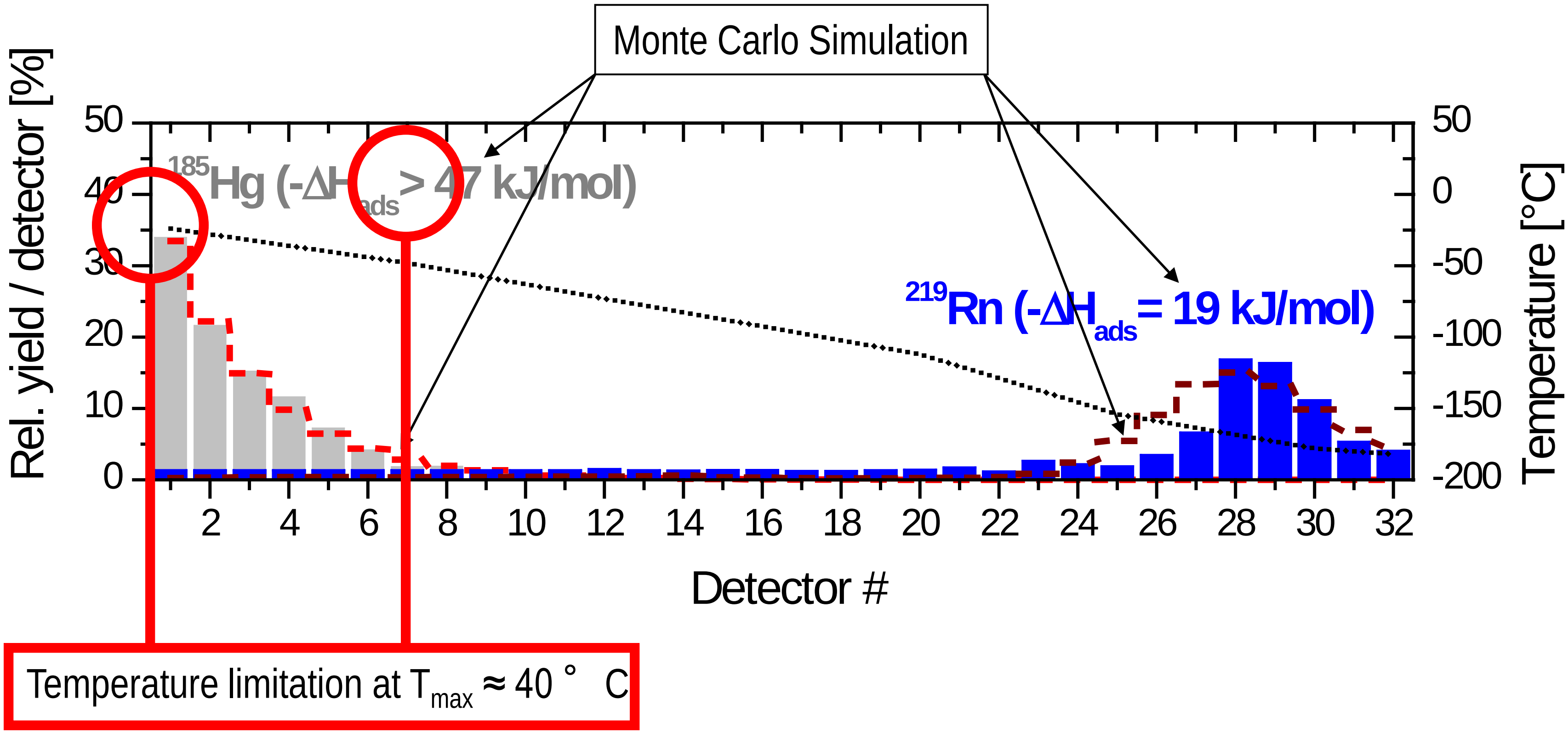
[2] R. Eichler et al., *Nature* 447 (2007), pp. 72 – 75

The COLD Array

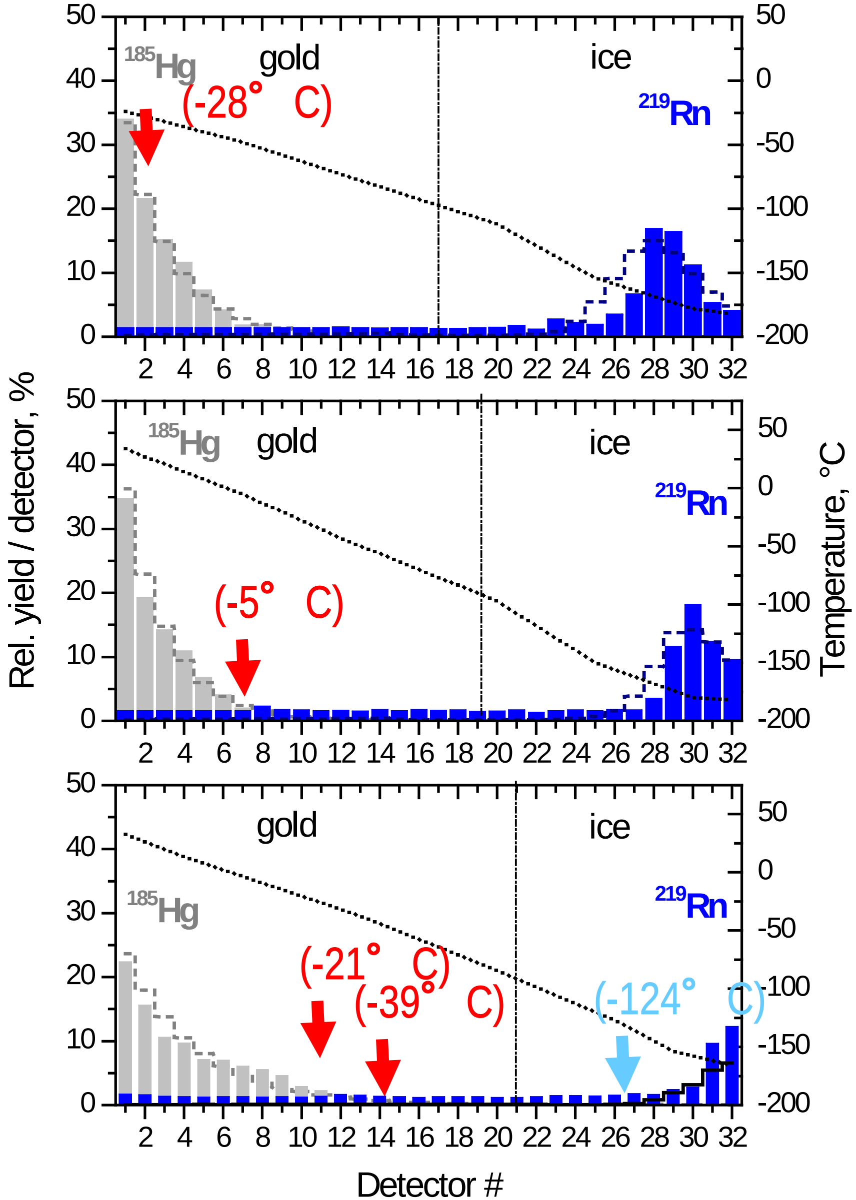


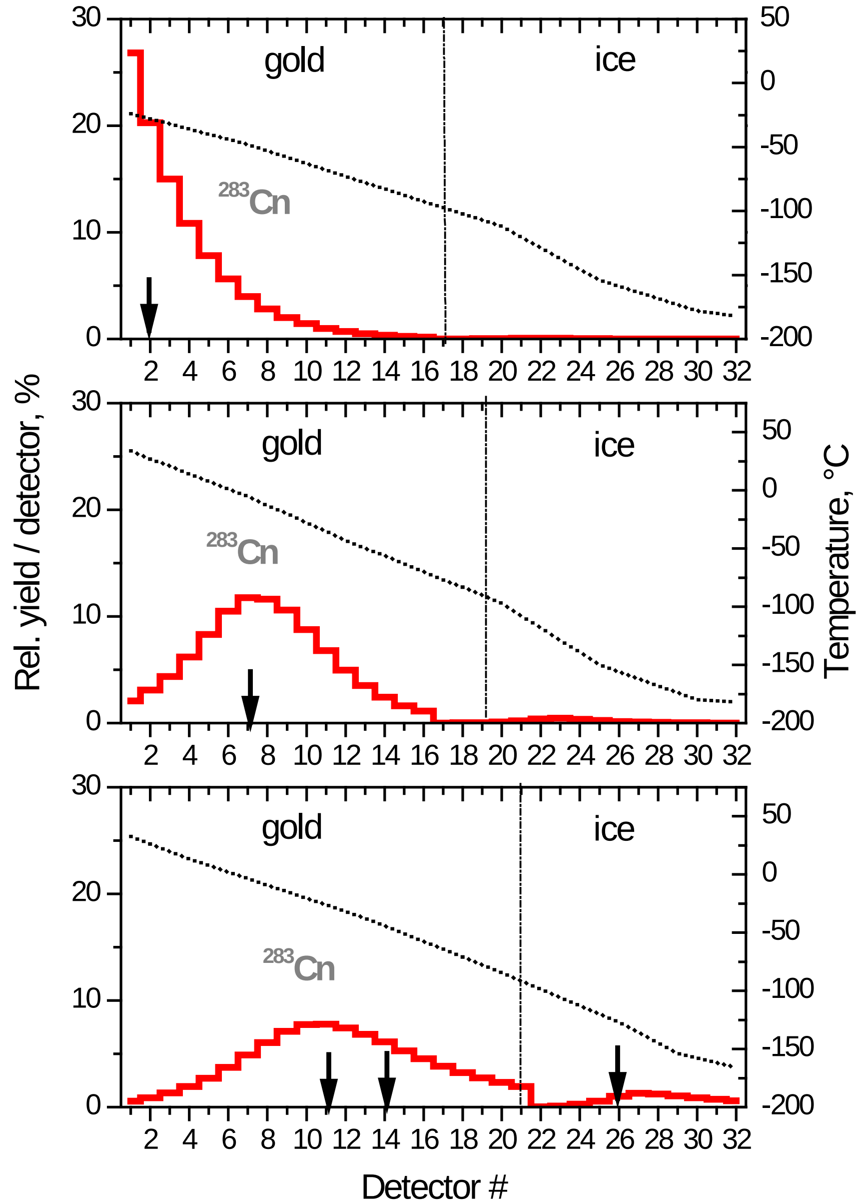
Deposition of ^{185}Hg and ^{219}Rn along COLD

Higher temperatures would enable the determination of adsorption enthalpies of elements with even higher adsorption characteristics on gold (e.g. 113, Tl, Hg, Pb, etc. → e.g. 8 diamond sandwich detectors in the COLD array for the „hot region").

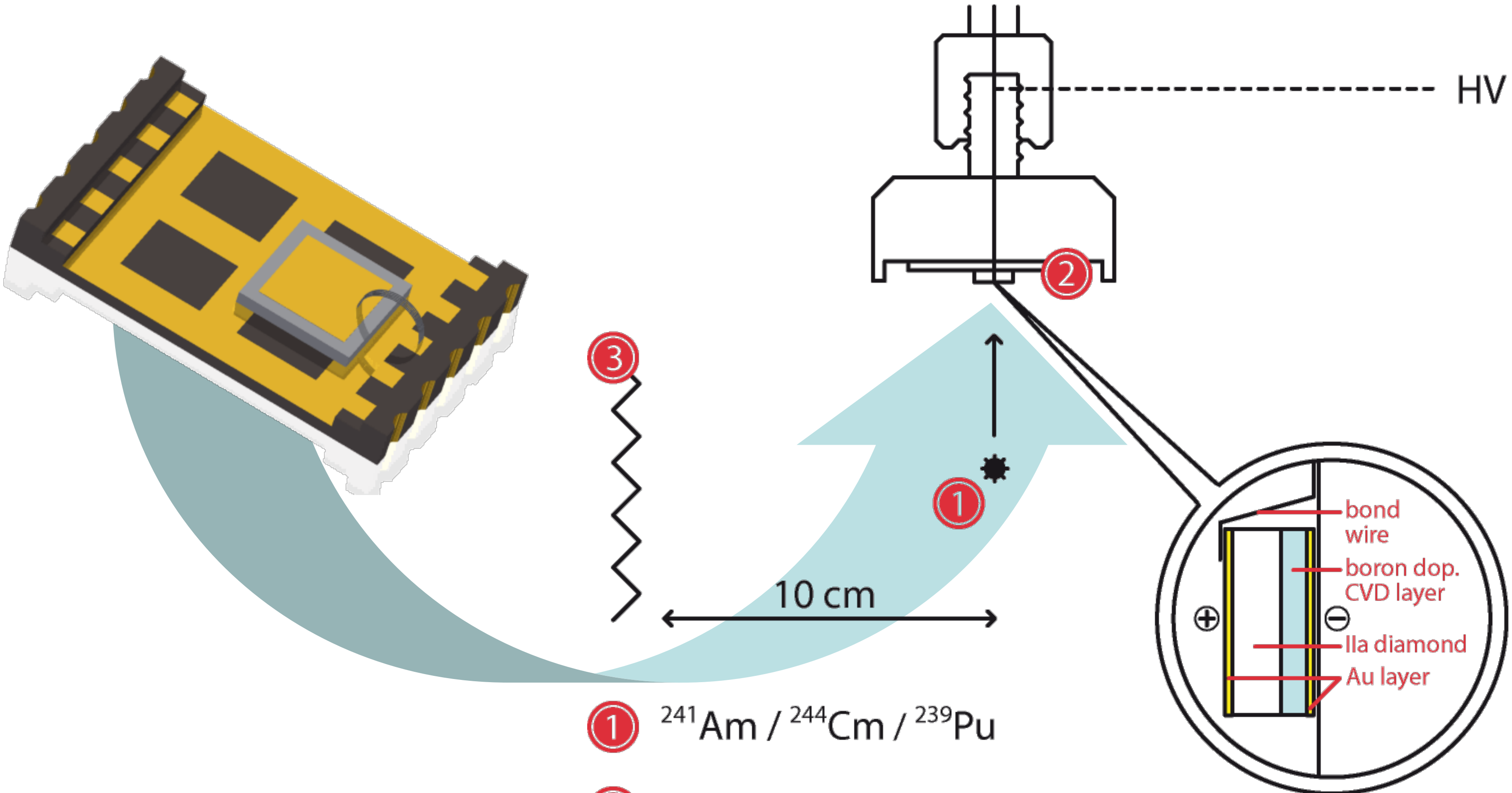


Deposition of Cn (Element 112)



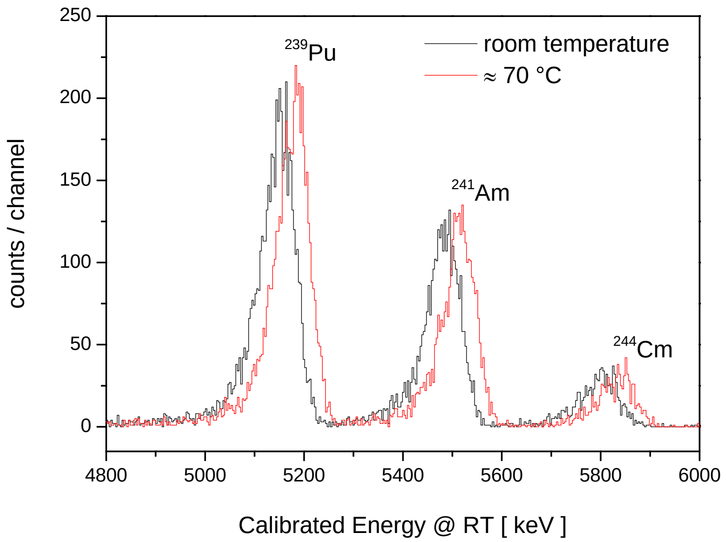


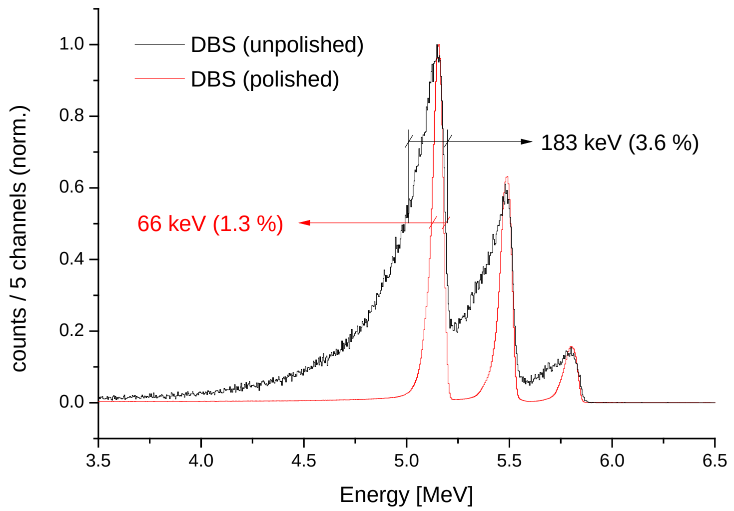
Detector under IR-“Irradiation“ (Joule Heating)



1. ^{241}Am / ^{244}Cm / ^{239}Pu
2. CVD diamond detector
3. Tantalum heating fillament (1000 °C)

Detector under IR-“Irradiation“ (Joule Heating)

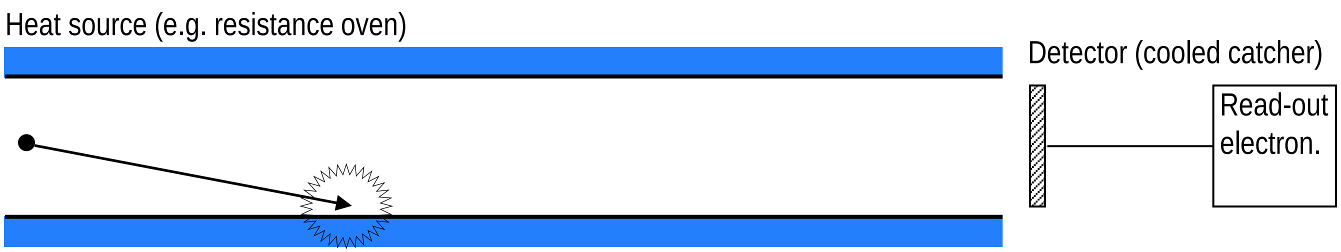




The shift to the right seems to be equidistant, which means that there must be an absolute charge amount in addition per incident particle. This can be either related to the **charge collection distance** or a **constant charge release at higher temperatures**. A spectrum of ^{148}Gd and ^{241}Am should give further insight in this effect (larger energy gap → equidistant shift?).

Vacuum chromatography

Since diamond detectors can be operated near a hot source (e.g. oven), they are perfectly suitable for **isothermal vacuum chromatography** experiments:



The transition from gas chromatography towards vacuum chromatography has the following advantages:

- **No aerosol transport** and therefore lower background (decreased random rate).
- Less pollutions (organic impurities, water, etc.) → **clean stationary surfaces.**
- **Better energy resolution** in case of vacuum chromatography.
- **Easy to simulate** with a MCS approach.

Vacuum chromatography

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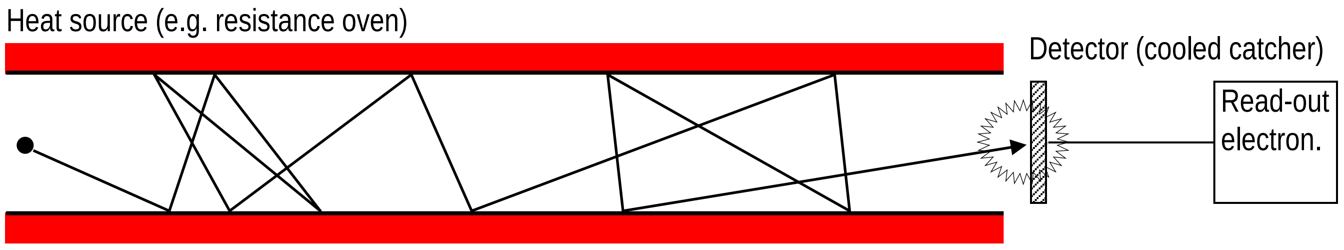
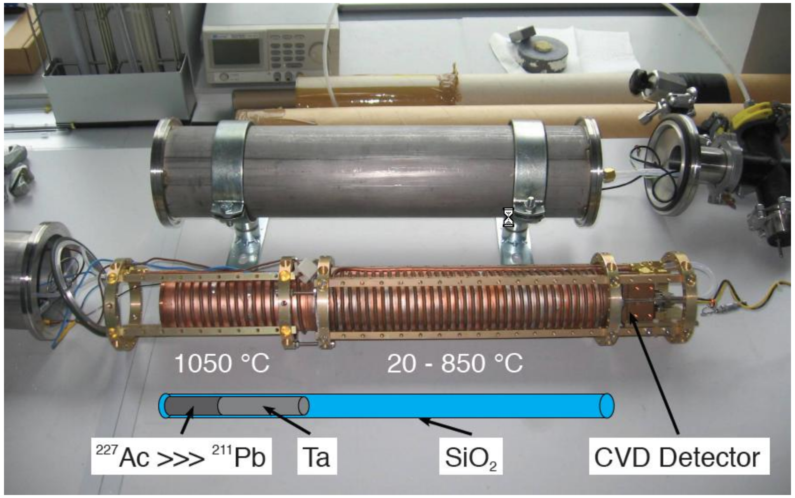


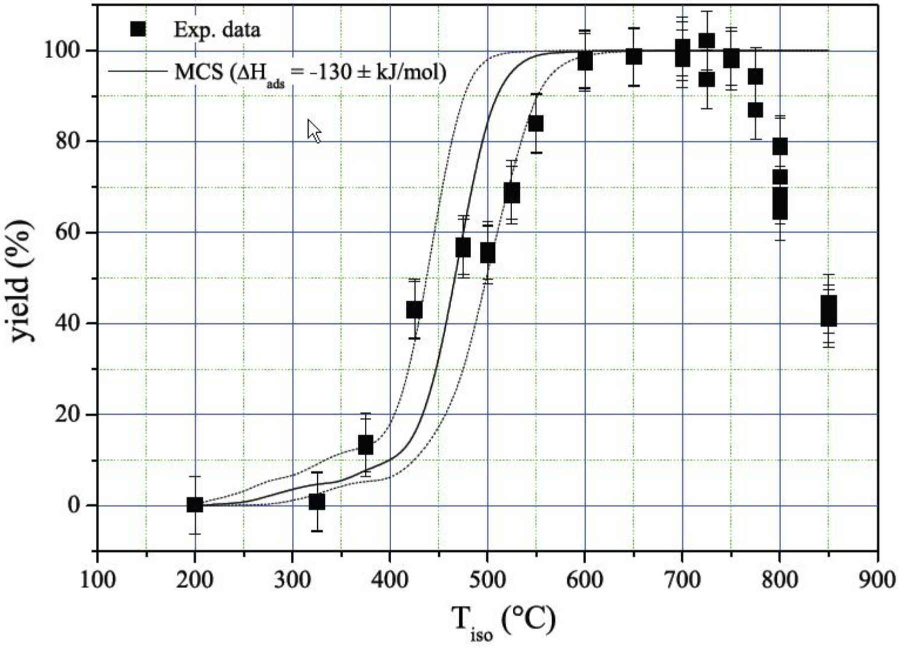
The transition from gas chromatography towards vacuum chromatography has the following drawbacks:

- **Less chromatographic resolution** due to random walk in comparison with a geometrically identical thermochromatography setup.
- **Complicated coupling to production device** (relative to the stopping; see thesis Dr. D. Wittwer).

The need of positioning the detector near an IR, UV or VIS source or the operation in the vicinity of an oven (see also thermal release experiments → T > 1200 °C) **excludes common Si-based detectors and demands for diamond used as detector material.**

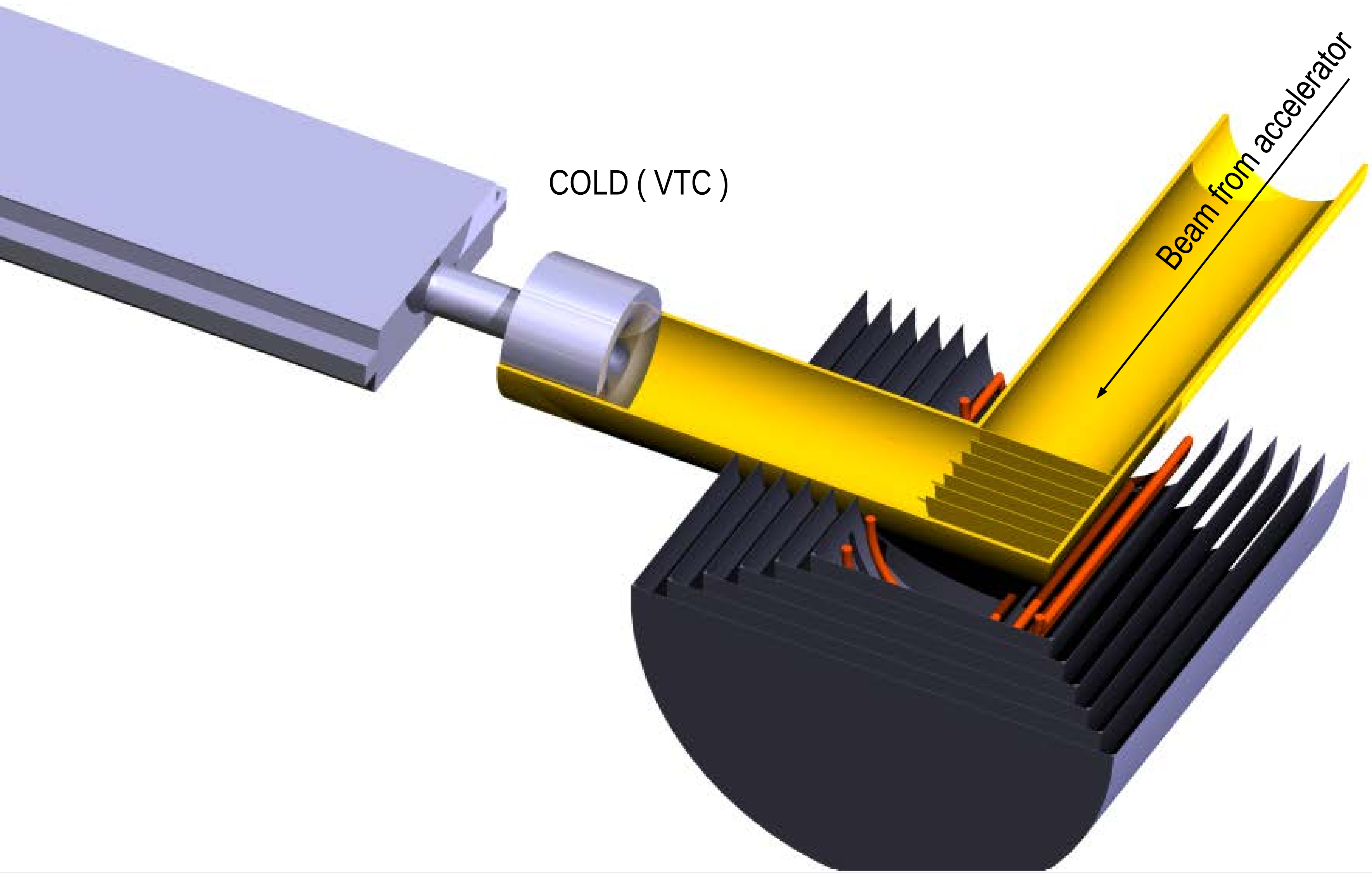
Isothermal Vacuumchromatography





http://www.cividec.at

To be continued…



Thanks to…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///    Erich Griesmayer     ///
///    Ilya Usoltsev        ///
///    Robert Eichler       ///
///    Rugard Dressler      ///
///    Silvan Streuli       ///
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Thank you for your kind attention!