# $^{249}$Bk target production and control

J. Runke[1], H. Brand[1], Ch.E. Düllmann[1,2,3], K. Eberhardt[2,3], E. Jäger[1], J. Khuyagbaatar[1,3], B. Kindler[1], J. Krier[1], B. Lommel[1], C. Mokry[2], J.B. Roberto[4], K.P. Rykaczewski[4], M. Schädel[1,5], P. Thörle-Pospiech[2], T. Torres[1], N. Trautmann[2], A. Yakushev[1]

[1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany
[2]Johannes Gutenberg-Universität, Mainz, Germany
[3]Helmholtz-Institut Mainz, Germany
[4]Oak Ridge National Laboratory, Oak Ridge, TN, USA
[5]Japan Atomic Energy Agency, Tokai, Japan

# Deposition of $^{249}$Bk by Molecular Plating


**3.17 mg $^{249}$Bk in form of the nitrate in glass vials covered with a Teflon septum**

↓

**Transfer 100 µl 0.1 M $HNO_3$ via a syringe into the vial to dissolve the nitrate**

↓

**Transfer the solution to the plating cell**

↓

**Wash glass vial with 3 x 300 µl isopropanol and transfer it to the cell**

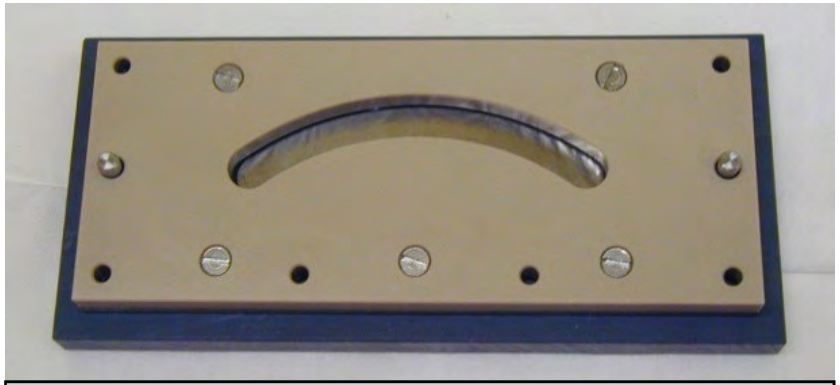
↓

**Fill the cell with isobutanol (51 ml)**

# Deposition of $^{249}$Bk by Molecular Plating

Target-segment with 2.3 µm Ti-backing-foil and Viton-O-ring

Target-segment on cathode-plate (Ti) with distance frame (Ti)

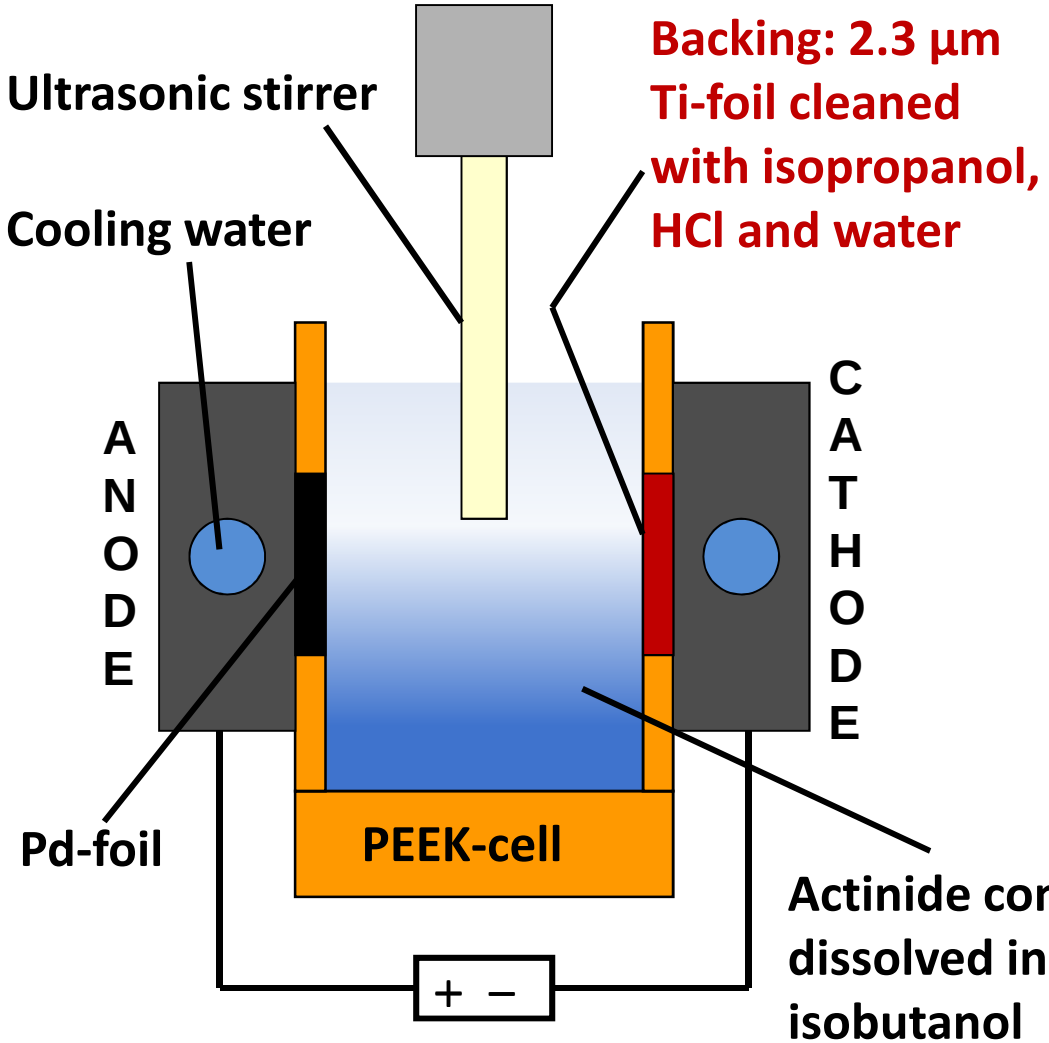


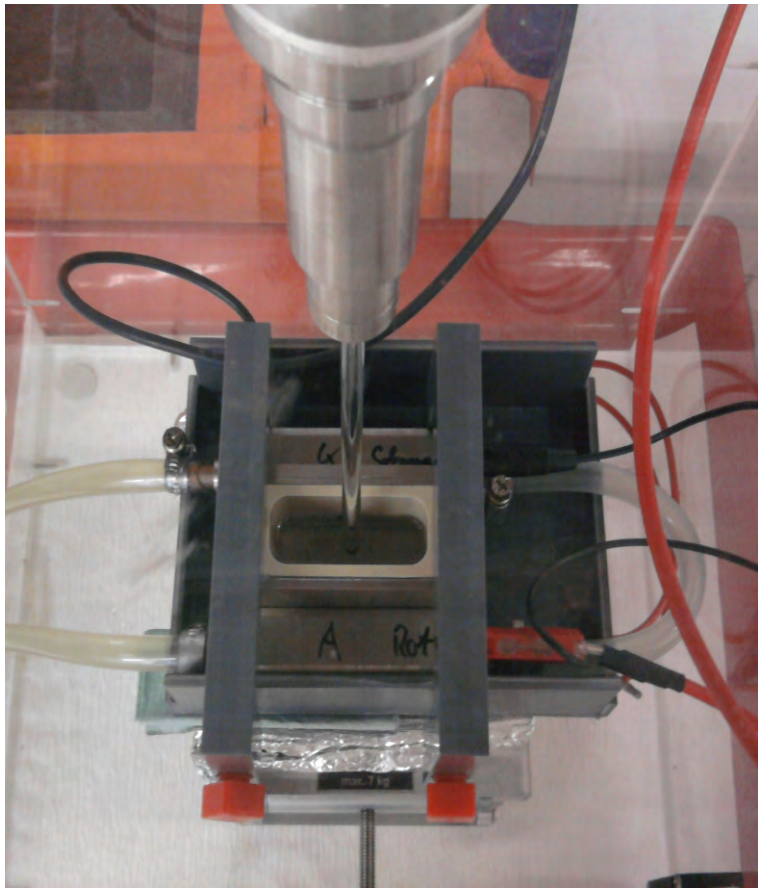
Complete Target-assembly with PEEK-cover

Molecular Plating cell with Ti-foil as cathode and Pd-foil as anode

Cell design according to H. Haba [RIKEN]

# Deposition of $^{249}$Bk by Molecular Plating



Deposition time: 3-4 hours

Courtesy A. Vascon

# Deposition of $^{249}$Bk by Molecular Plating

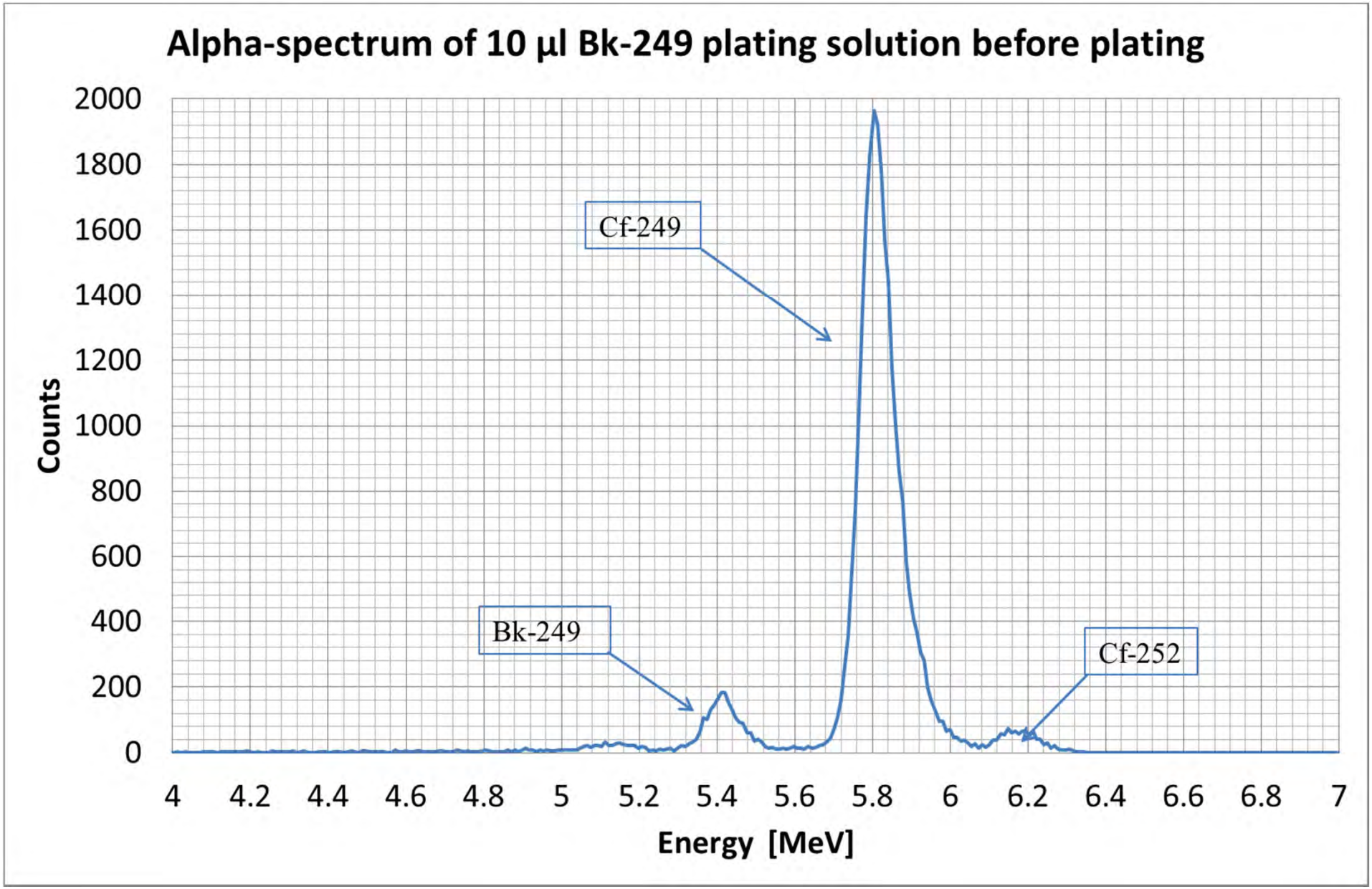
# Determination of the plating yield

**1. Gamma spectrum of $^{249}$Cf (388 keV and 333 keV) of the $^{249}$Bk sample in the vial was compared with those of the supernatant solution after the molecular plating procedure.**

**2. Before the plating procedure and then every 1 h 10 µl of the plating solution were taken out and measured by α-spectroscopy to determine the $^{249}$Bk and $^{249}$Cf content.**

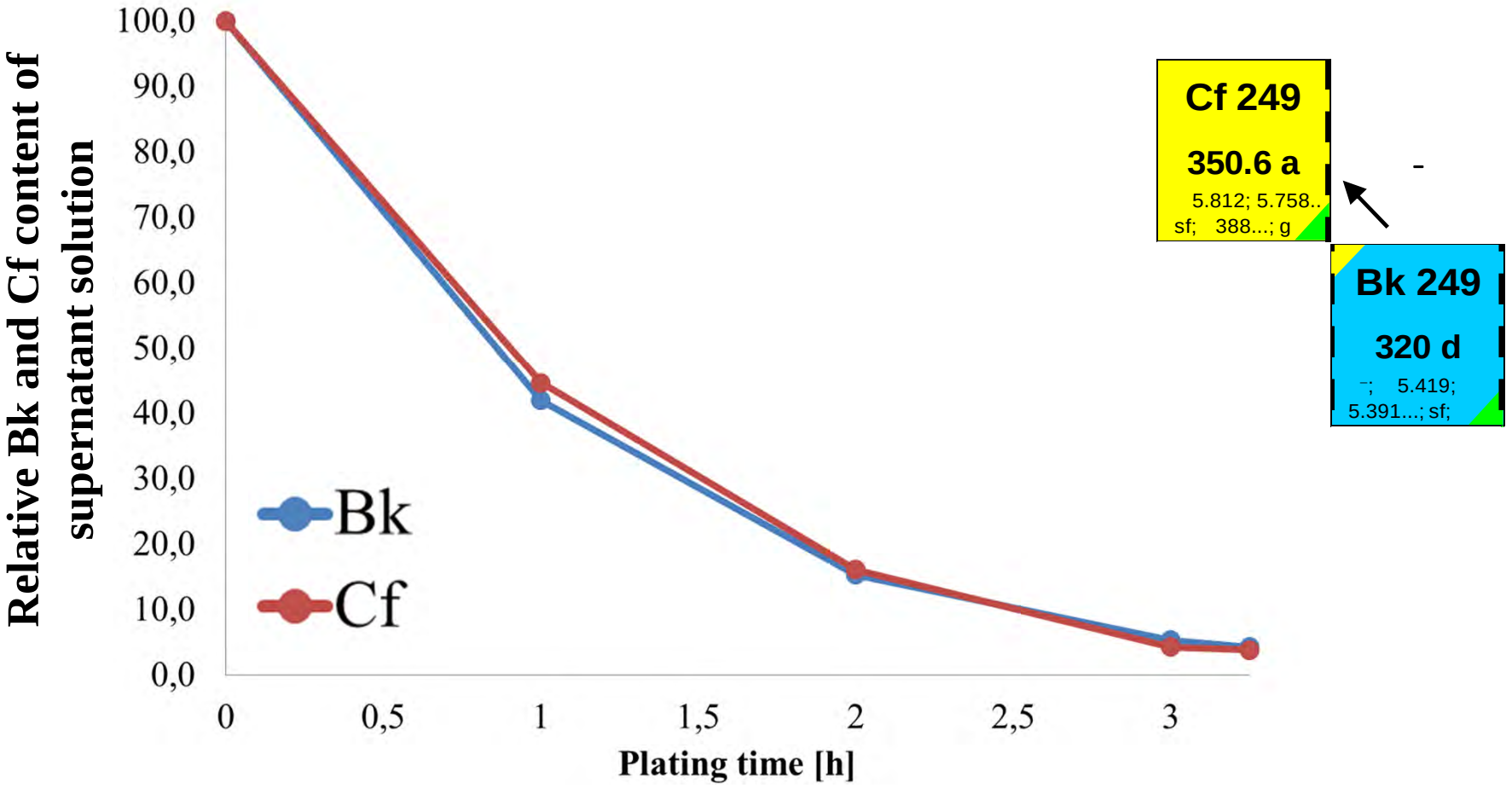
**From the decrease of the $^{249}$Bk and $^{249}$Cf α-activity the deposition yield was calculated in dependence of the plating time.**

# Deposition kinetics of $^{249}$Cf and $^{249}$Bk



# Deposition kinetics of $^{249}$Cf and $^{249}$Bk

**Prior to deposition and in 1-h steps 10 µl aliquots of the $^{249}$Bk-solution were evaporated to dryness for α-particle spectroscopy**




⇒**identical plating behavior of both elements**

# Determination of the plating yield

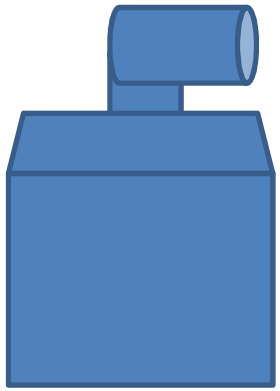
**1. Gamma spectrum of $^{249}$Cf (388 keV and 333 keV) of the $^{249}$Bk sample in the vial was compared with those of the supernatant solution after the molecular plating procedure.**

**2. Before the plating procedure and then every 1 h 10 µl of the plating solution were taken out and measured by α-spectroscopy to determine the $^{249}$Bk and $^{249}$Cf content.**

**From the decrease of the $^{249}$Bk and $^{249}$Cf α-activity the deposition yield was calculated in dependence of the plating time.**

**3. The γ-lines of $^{249}$Cf of five targets were compared with each other at the same measuring time (one target as reference standard).**

# Yield determination by γ-spectroscopy



γ-Detector

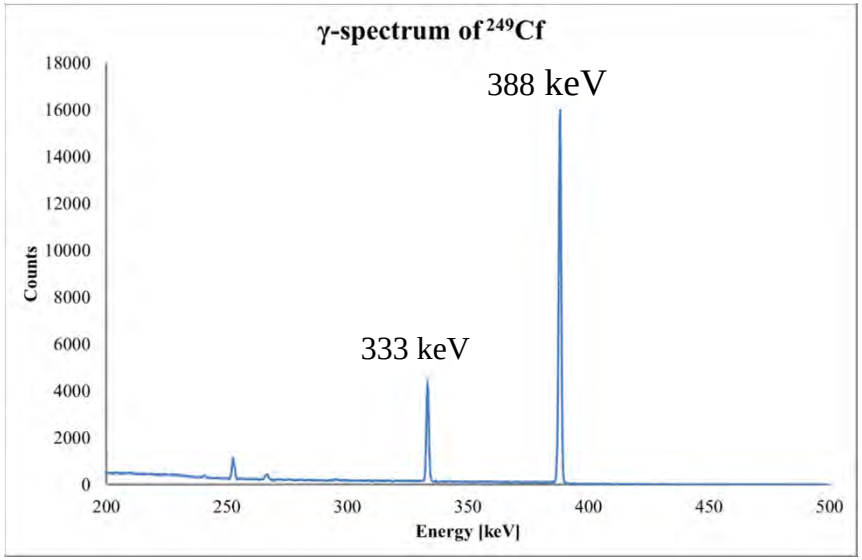
3 m

Measuring time: 5 min
Dead time: ~ 5 %

$^{249}$Bk target
used as reference

**$^{249}$Cf**
350.6 a
5.812, 5.758
γ 388, 333

**$^{245}$Cm**
8500 a
5.361, 5.304
γ 175, 133



# Amount of $^{249}$Bk on the targets (reference date 27.02.2012)

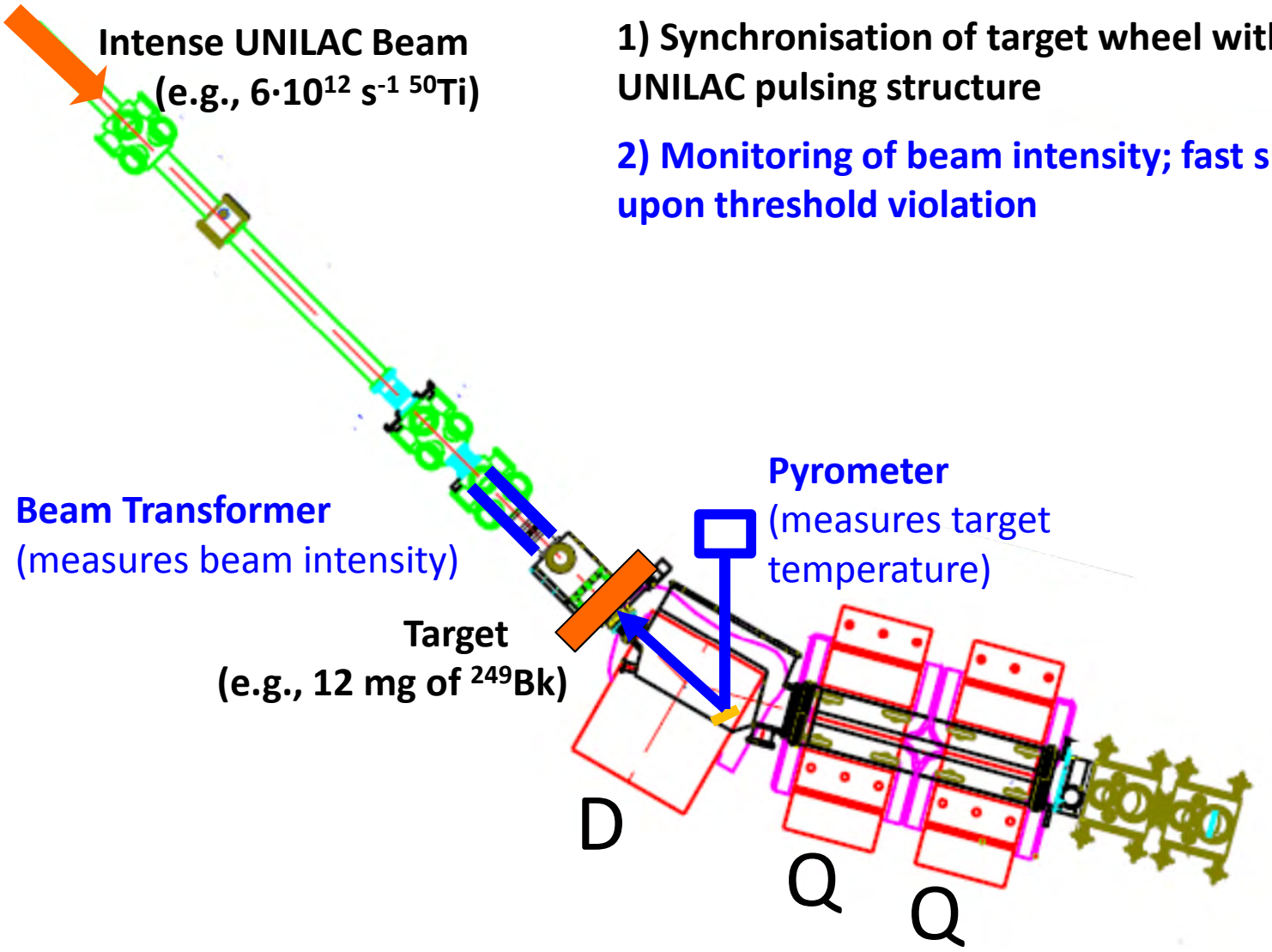
| | Target thickness | Total amount of $^{249}$Bk |
|---|---|---|
| **Target 1** | **154 µg/cm²** | **0.924 mg** |
| **Target 2** | **354 µg/cm²** | **2.124 mg** |
| **Target 3** | **505 µg/cm²** | **3.030 mg** |
| **Target 4** | **508 µg/cm²** | **3.048 mg** |
| **Target 5** | **484 µg/cm²** | **2.904 mg** |

# High intensity target wheel at TASCA

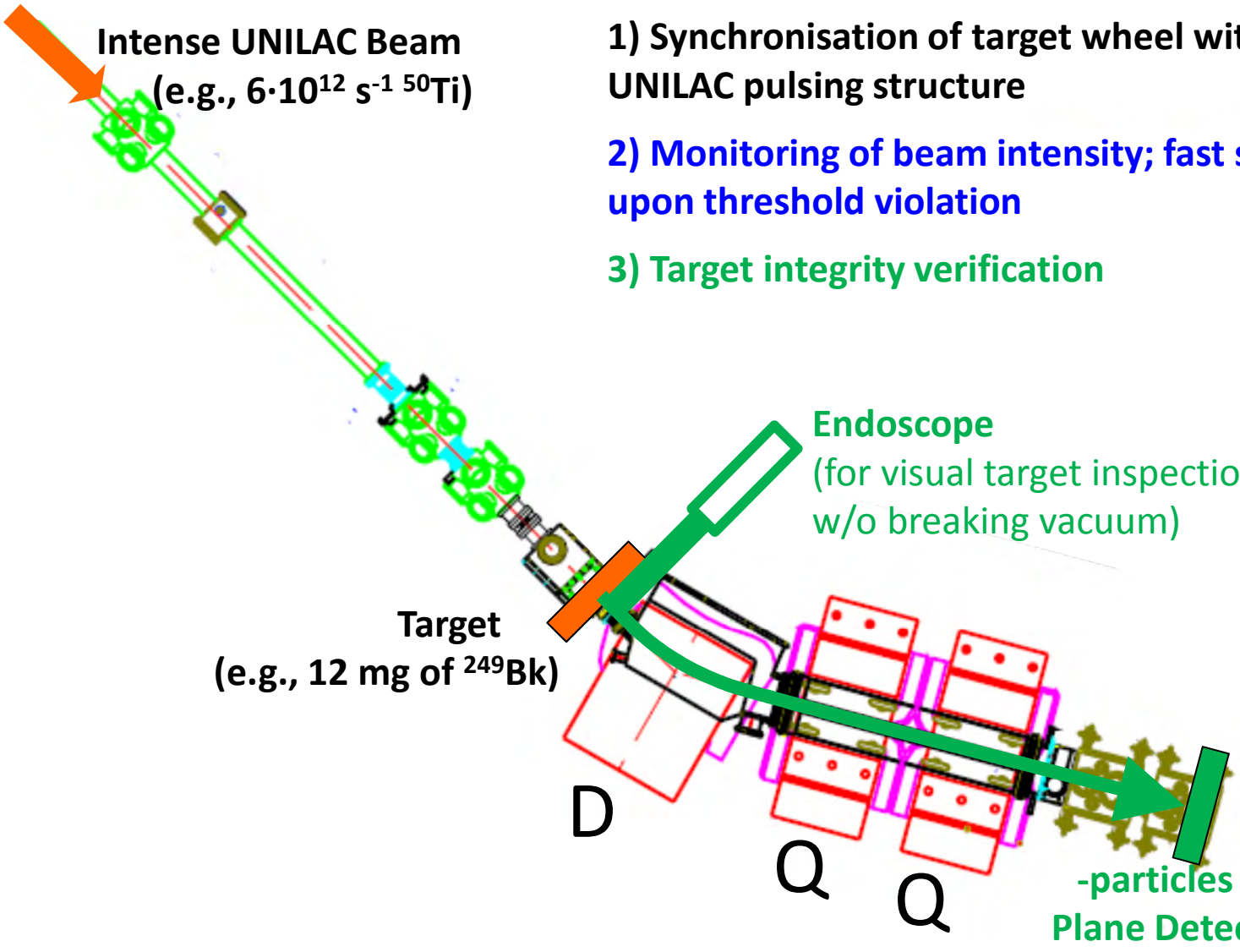
## Target wheel protection and monitoring tools

- Beam current intensity control
- Temperature control via pyrometer
- Off-line measurement of ingrowing $^{249}$Cf via alpha spectroscopy
- Visual inspection of target wheel with endoscopes

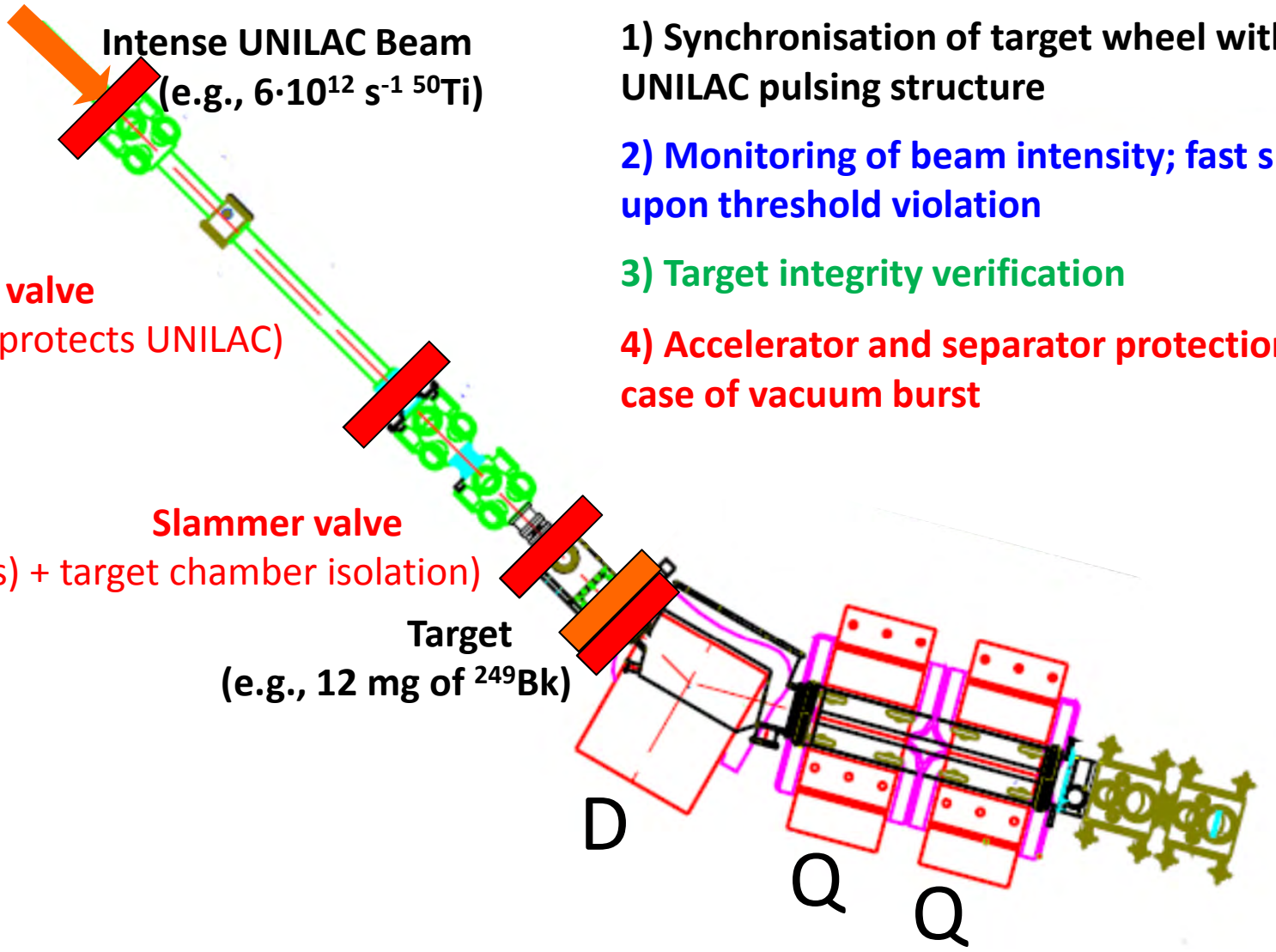
# The TASCA gas-filled separator facility at GSI



# The TASCA gas-filled separator facility at GSI



# The TASCA gas-filled separator facility at GSI



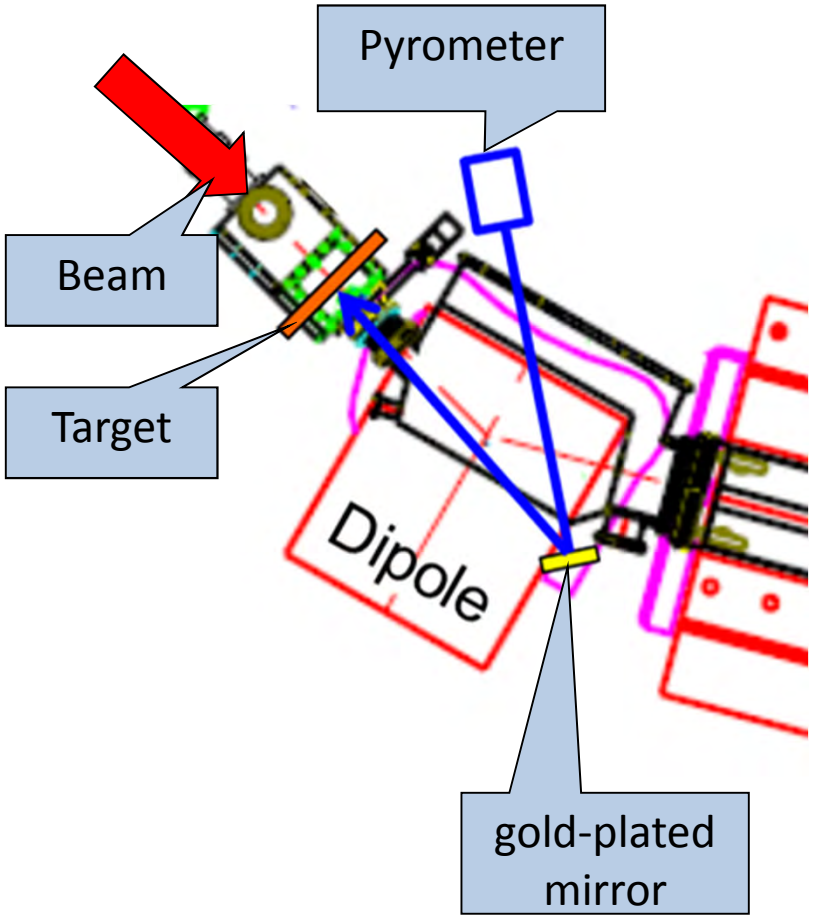

1) Synchronisation of target wheel with UNILAC pulsing structure

2) Monitoring of beam intensity; fast shut-off upon threshold violation

3) Target integrity verification

4) Accelerator and separator protection in case of vacuum burst

# TASCA beam control system
# Pyrometer: mechanical setup




UNILAC macropulse

Trigger

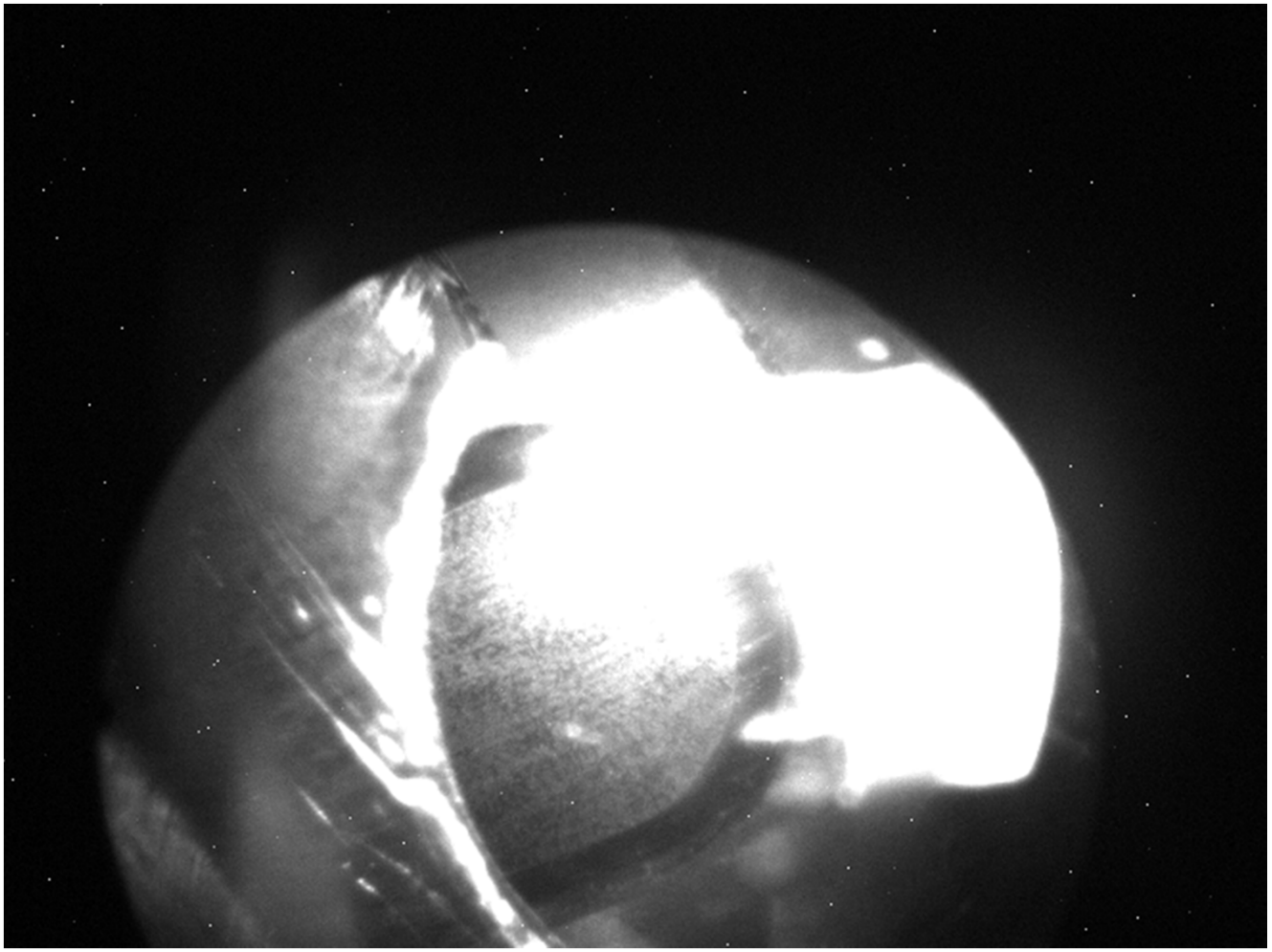


Temp. Range:
30-500 C



Fast beam shut-off upon threshold violation

# TASCA beam control system (off line)
# Image of Bk targets through endoscope



One segment of the target wheel shown in 8 positions through endoscope and CCD camera

# Summary

- Deposition of $^{249}$Bk by Molecular Plating
- Yield Determination: α-measurements
  γ-measurements
- Target wheel protection and monitoring tools

# Thanks to:

**The Target Laboratory at GSI for providing the Ti-backing foils**


**The Mechanical Workshop of the Institut für Kernchemie in Mainz for the construction of the deposition cells**


**….and you for your attention**