A New Interface for Heavy Element Studies at the Berkeley Gas-filled Separator

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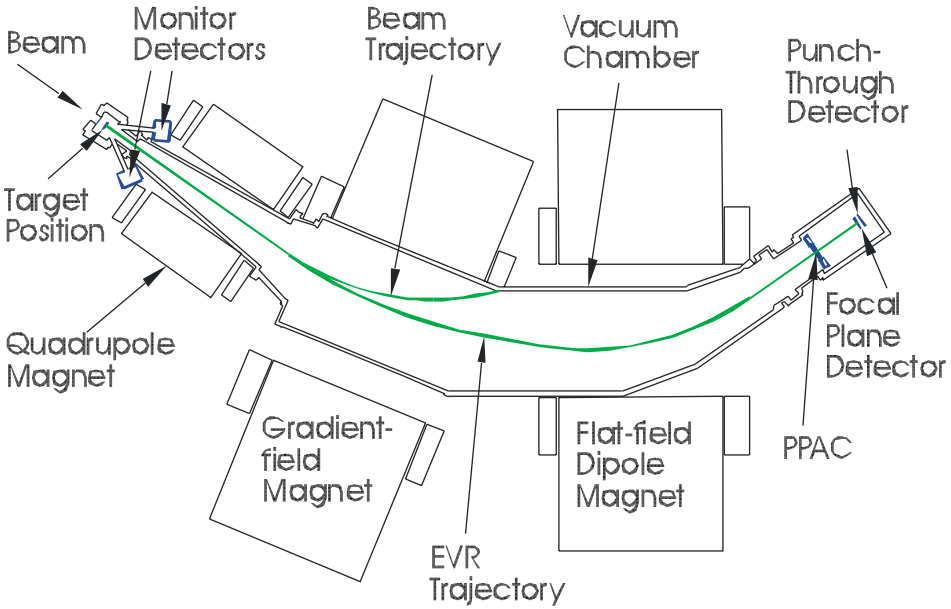
The Berkeley Gas-filled Separator

- Construction "completed" fall 1999
- Recycled Bevalac magnets
- Innovative design gives Ω=45msr
- 70º bend gives superior separation
- ~1 mBar He fill gives full momentum and charge acceptance



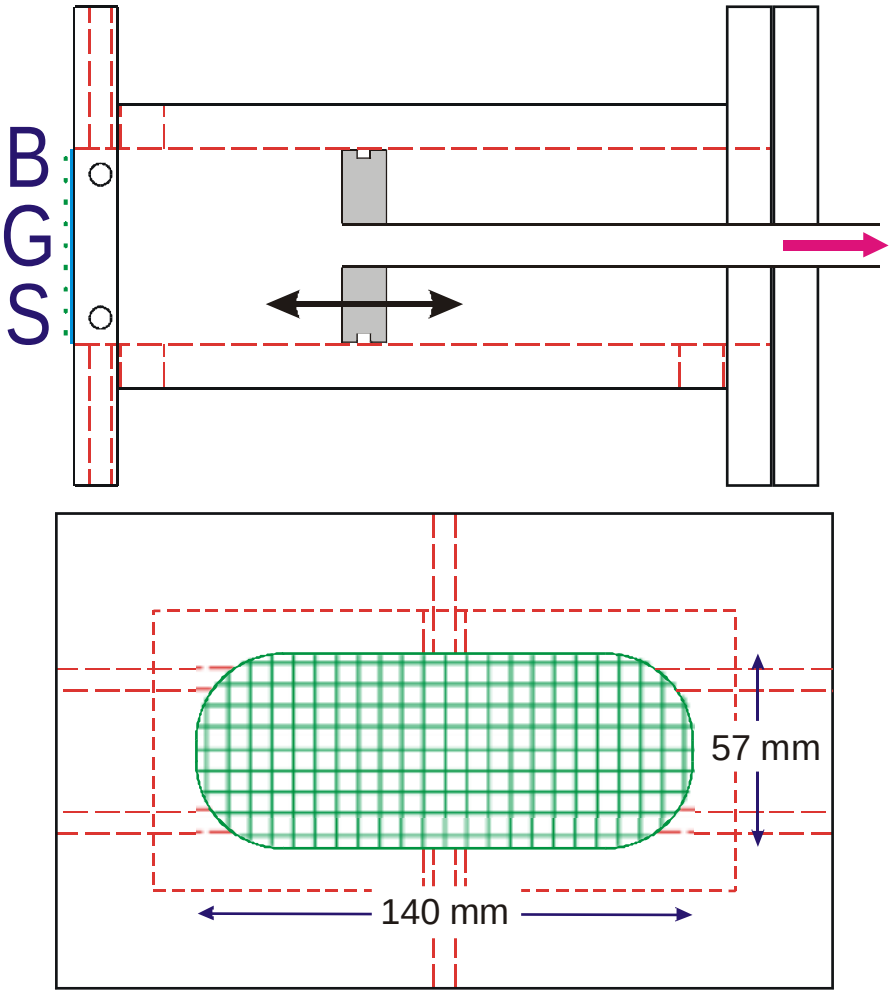
- Beam rejection up to 10^{15}
- Transit time ~μs
- Rotating target allows beam intensities up to pμA range
- Beam intensity, target thickness, and efficiency give 1 event/(picobarn*week)

Recoil Transfer Chamber

- EVRs pass through thin MYLAR foil at BGS focal plane position
- Stop in gas at 2 atm
- Attach to aerosols
- Capillary transport to chemical separator or detector system

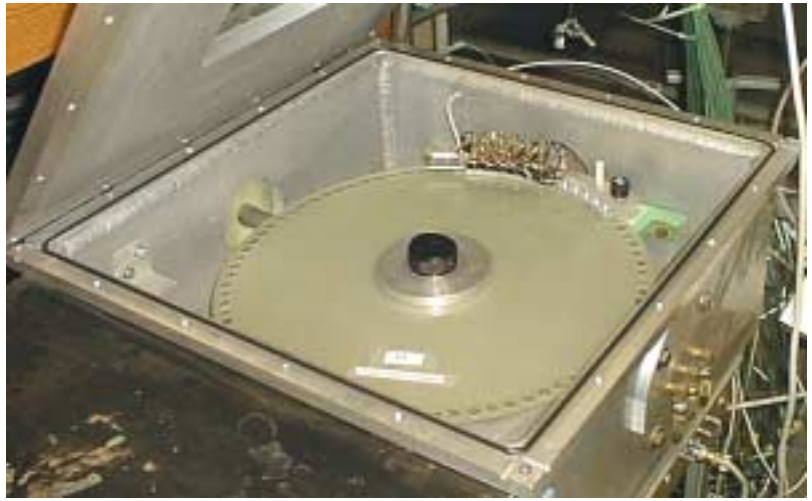
RTC Schematic

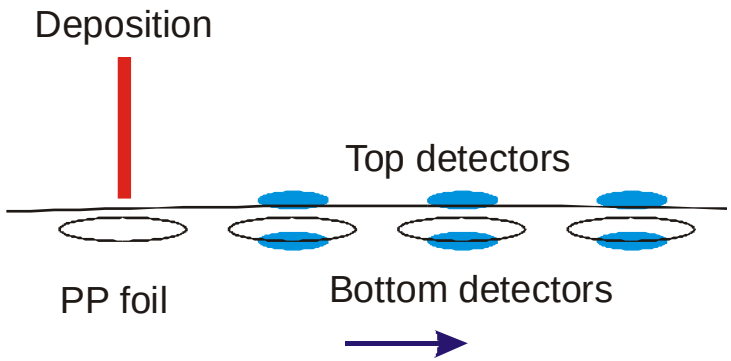
- Stainless steel chamber
- BGS & RTC are separated by a thin Mylar foil window (down to 1.5 µm)
- Supporting wire grid (94% transparency)
- Movable piston for different stopping ranges



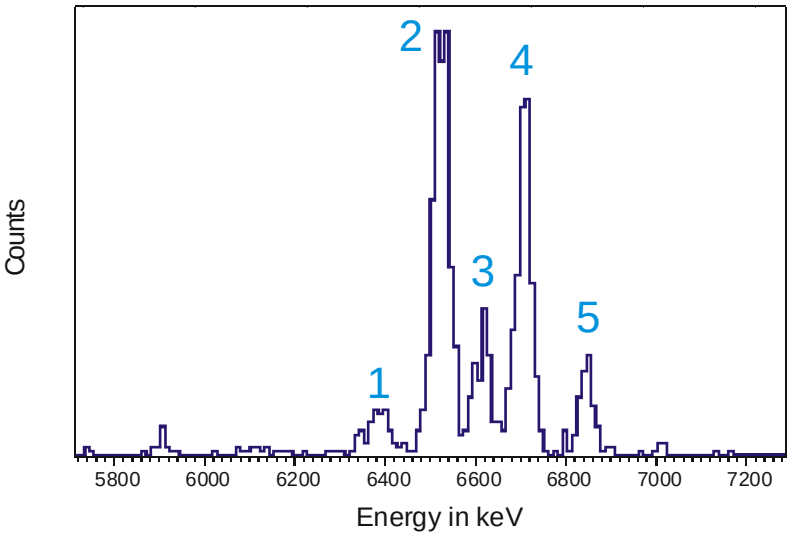
RTC efficiency experiment

- **Activity transport to the rotating wheel detection system (MG) via KCl/He gas-jet system using a 22 m long PE capillary (2 mm I.D.)**
- **Determination of the efficiency using EVRs with E_{kin}/A (≅ 215 and 51 keV/amu)**
- **Comparison of the activity measured in the MG with activity measured in the BGS focal plane detector**

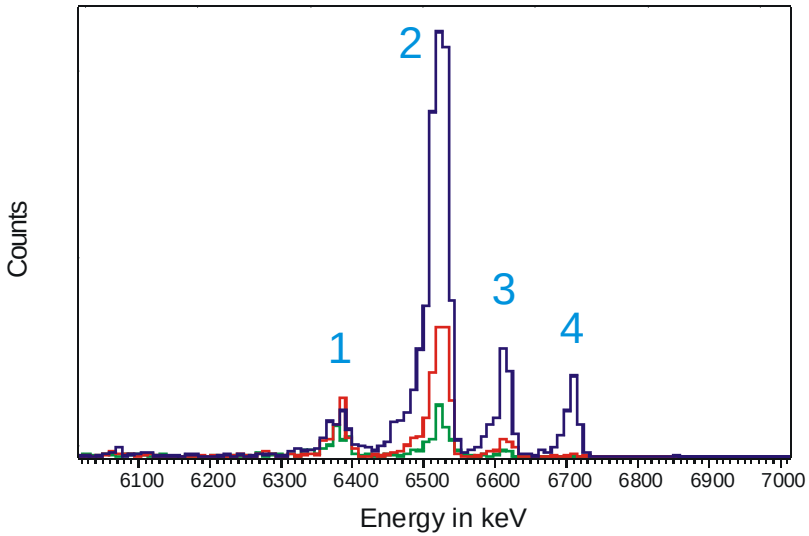




^{nat}Dy (^{40}Ar,xn) $^{201, 202...-n}$Po, EVR E_{kin}/A ≅ 215 keV/amu



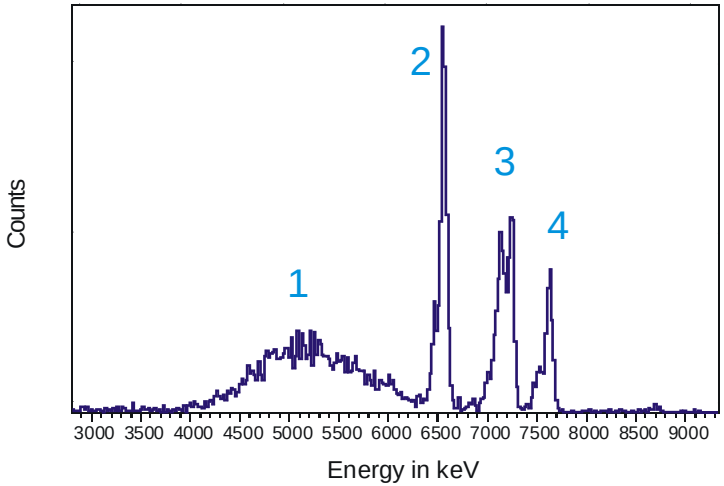
BGS focal plane detector



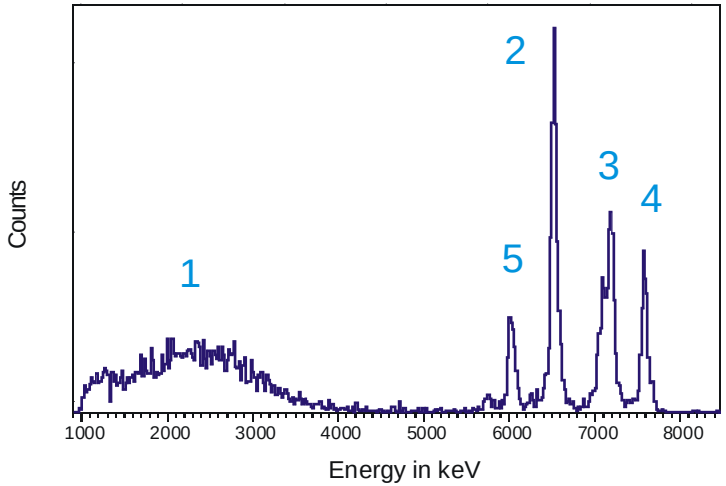
First, second, and third top detectors in the MG, stepping time 5 s

1 ^{197m}Po, 26 s
2 ^{196}Po, 5.5 s
3 ^{195}Po, 4.5 s
4 ^{195m}Po, 2.0 s
5 ^{194}Po, 0.41 s

$^{197}Au\,(^{22}Ne,\,xn)\,^{219\text{-}n}Ac$, EVR $E_{kin}/A \cong 51$ keV/amu

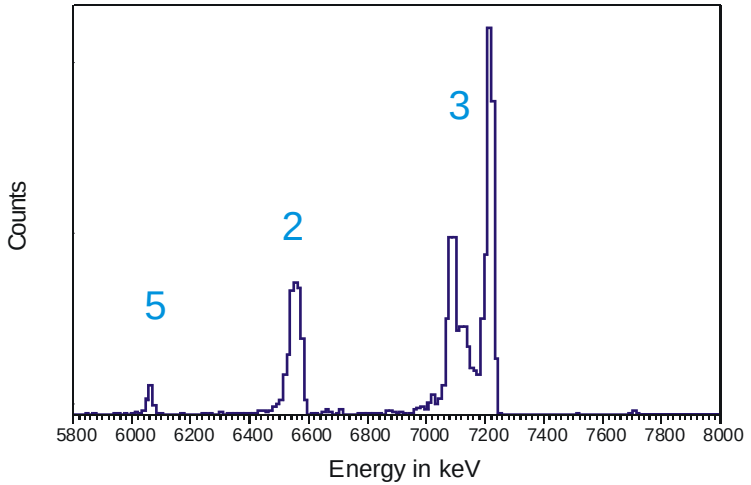


BGS focal plane detector



PIN diode in RTC

1 implanted EVR
2 ^{210}Fr, 3.2 min
3 ^{214}Ac, 8.2 s
4 ^{215}Ac, 0.17 s
5 ^{210}Rn, 2.4 h

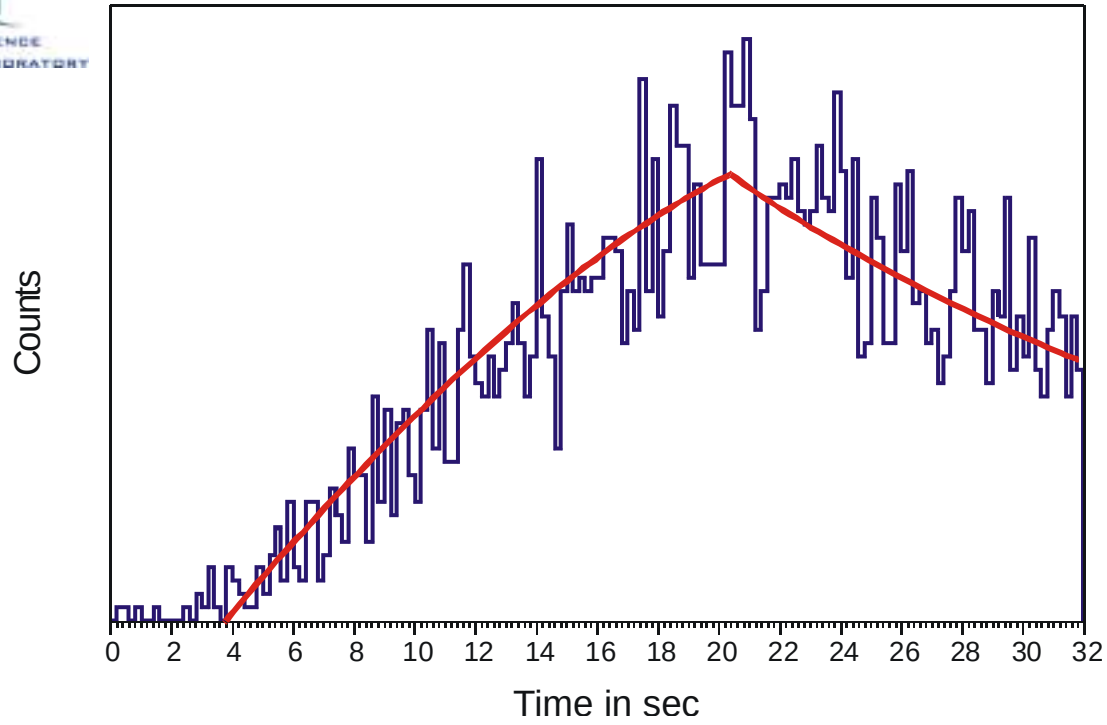


First top detector in MG

Experimental Results using RTC

E_{kin} of EVR	215 keV/amu	51 keV/amu
Total Efficiency	30%	15%
Mylar foil thickness	6 µm	1.5 µm
BGS pressure	1 Torr	0.1 Torr
RTC pressure	765 Torr	550 Torr,
	Window stable for days at 2 atm pressure differential	window failure after 30 min at 765 Torr
Distance of piston from window	65 mm	50 mm
Remarks		small KCl spots on the foils

Transport time measurement

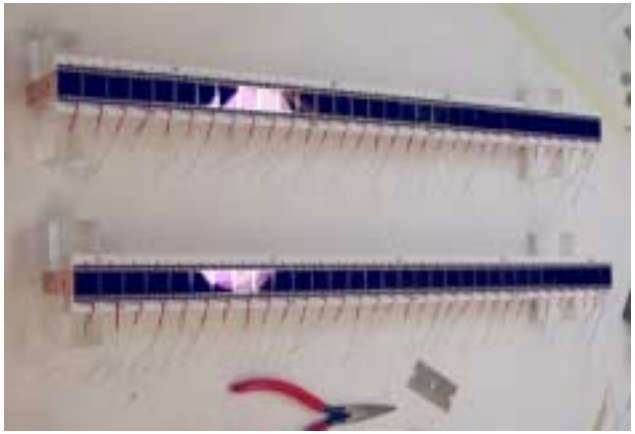


Pulse mode: 16 s on, 16 s off, stepping time 32 s,
Detector under collecting point

Transport time 4 ± 1 s

Cryogenic Thermochromatographic System (CTS) and Development of Chemical Separation for HsO_4

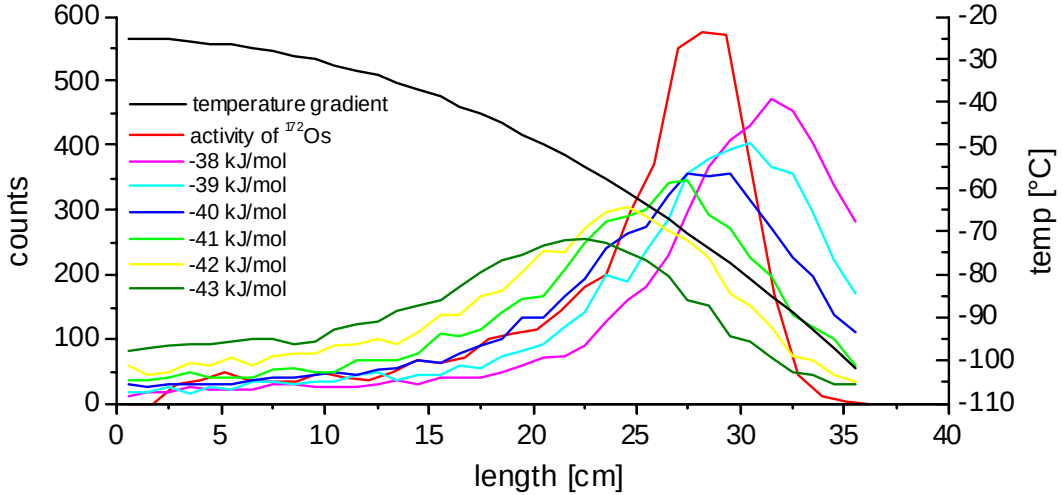
RTC on the BGS detector box



Columns of PIN diodes (SiO_2 adsorption surface & α-particle detectors) on Cu heat conductors

CTS nearing completion

OsO_4 Chemistry Result ΔH_{ADS}=-40 kJ/mol



BGS-RTC-SISAK

- $^{208}Pb(^{50}Ti,1n)^{257}Rf$ and $^{209}Bi(^{50}Ti,n)^{258}Db$ produce transactinide isotopes with ~4-sec halflives at rates of several atoms per hour
- Separation in BGS and transport via 20-meter capillary to SISAK
- Liquid-liquid extractions on a few-seconds timescale
- Detection by liquid scintillation α-particle pusle height analysis w/ continuously flowing liquid

- Exciting new capabilities for transactinide chemistry
- More experiments planned for summer 2002