

First Chemical Experiments with Element 112

A.B. Yakushev

for collaboration:

FLNR:

A.V. Belozerov
G.V. Buklanov
M.L. Chelnokov
V.I. Chepigin
S.N. Dmitriev
V.A. Gorshkov
V.Ya. Lebedev
O.N. Malyshev
Yu.Ts. Oganessian
A.G. Popeko
E.A. Sokol
A. Svirikhin
S.N. Timokhin
A. B. Yakushev
A.V. Yeremin
I. Zvara

PSI:

B. Eichler

Uni Bern:

S. Soverna

FZ Rossendorf:

S. Hübener

TU München:

A. Türler

IFJ Cracow:

Z. Szeglowski

Is element 112

Hg

like?

Rn

Hg

Rn

Very volatile

Inert gas

Very low adsorption enthalpy on inert surface (quartz, PTFE)

For quantitative adsorption very low temperature is needed

High adsorption enthalpy on some metals (Pd, Au, Pt, Cu...)

Adsorption enthalpy on some metals is higher than on quartz

Chemical separation:

- in atomic state in gas flow

Adsorption:

- on metals due to forming intermetallic bonds or
- adsorption on quartz surface at low temperature

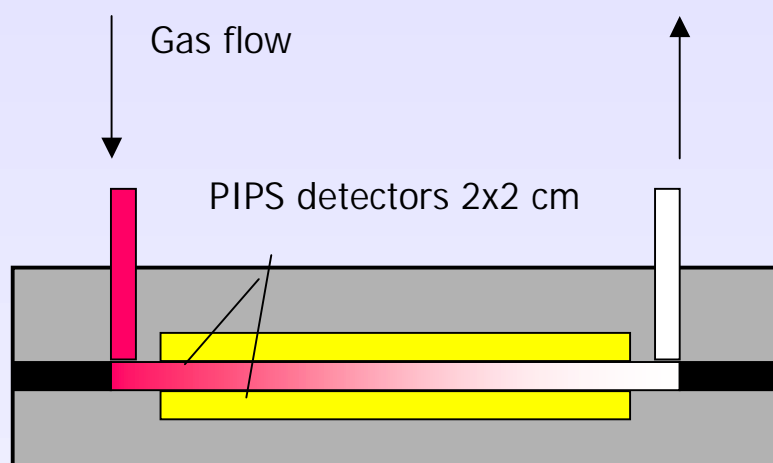
Detection:

- Si detectors (on SiO₂ and metal surfaces)
- in gas phase

Physical and Adsorption Properties of Hg and Rn

	Hg	Rn
Melting point	-38.87 °C	-71 °C
Boiling point	356.58 °C	-61.8 °C
Temper./1mm Hg	127°C	-144.2 °C
$\Delta H_{\text{ads}}/\text{quartz}$ (V.Pershina)	-26 kJ/mol	-20 kJ/mol
$T_{\text{ads}}/\text{quartz}$ (exp.)	≤ -150 °C	≤ -200 °C
T_{ads}/Au (exp.)	> 100 °C (S.Soverna)	≤ -150 °C (R.Eichler)
$T_{\text{ads}}/\text{Au,Pd,Pt}$ (exp.)	$-??$ °C $< T < 200$ °C	

Chemisorption of Hg on Au/or Pd surface



Efficiency of Hg chemisorption in one chamber

Gas flow	500ml/min	1000ml/min
	Detection temperature 25°C	
Ar/Au	60%	40%
He/Au	95%	80%
He/Pd	95%	80%
	Detection temperature -30°C	
He/Au	50%	

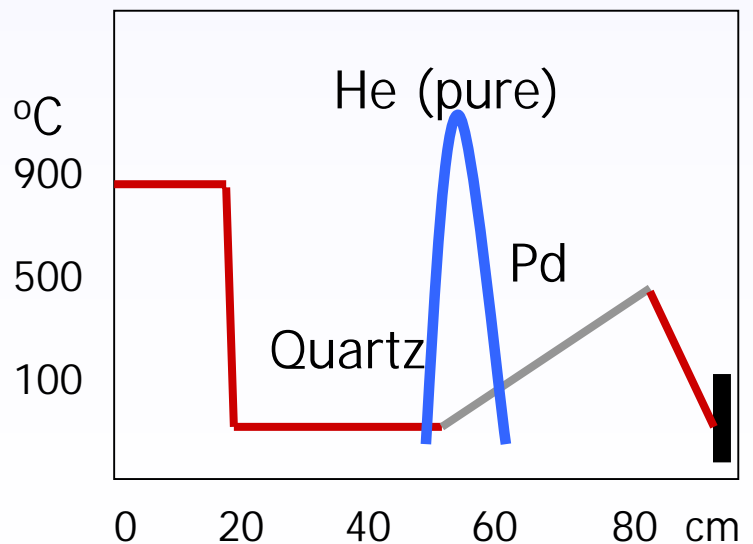
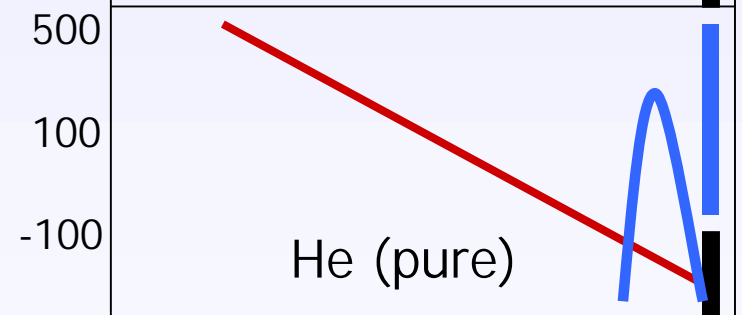
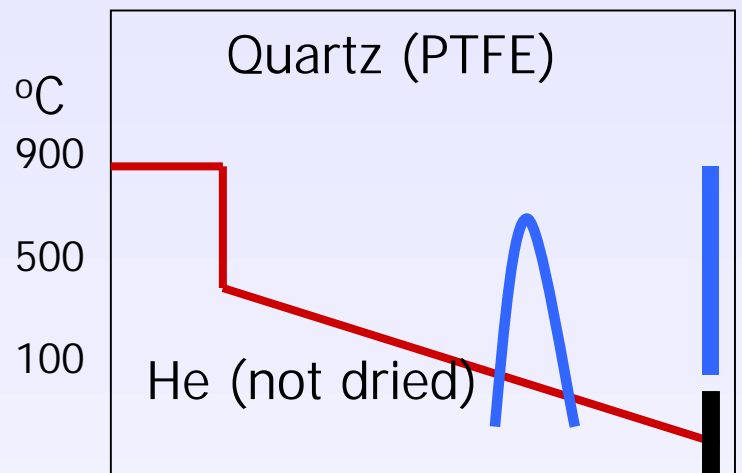
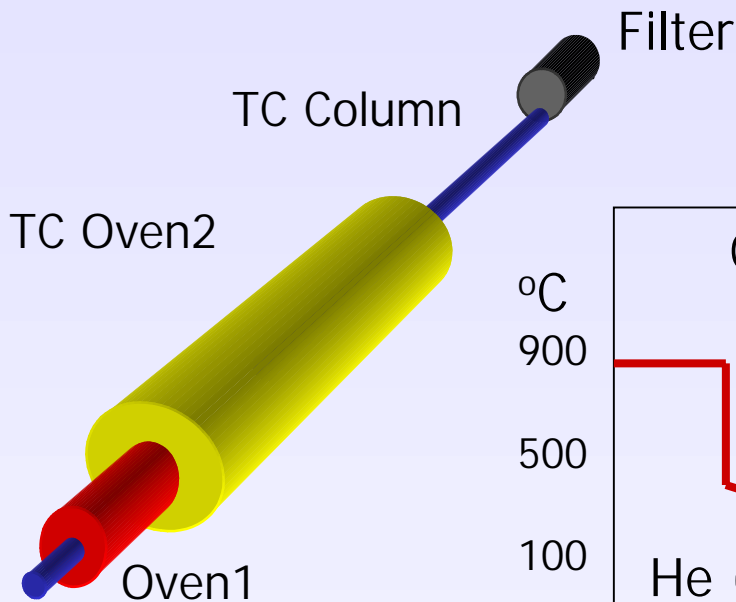
Adsorption of Hg, Rn and Element 112

<u>Au surface</u>	Hg	112	Rn
ΔH_{ads} , kJ/mol (calc)	- 92	-45 (B. Eichler)	-35.4
(exp)	-114	$-55 < \Delta H_{ads} < -38$	-36
T_{ads} , °C	+115	< +12	-115
Ref.	(S. Soverna)	(this work)	(R. Eichler)

<u>Quartz surface</u>	Hg	112	Rn
ΔH_{ads} , kJ/mol (calc)	-26 (V.Pershina)	-23	-20 (V.P.)
(exp)	<-27		
T_{ads} , °C	<-150	-167(calc)	-181
Ref.	this work	B. Eichler	R. Eichler

Thermochromatographic experiments with Hg

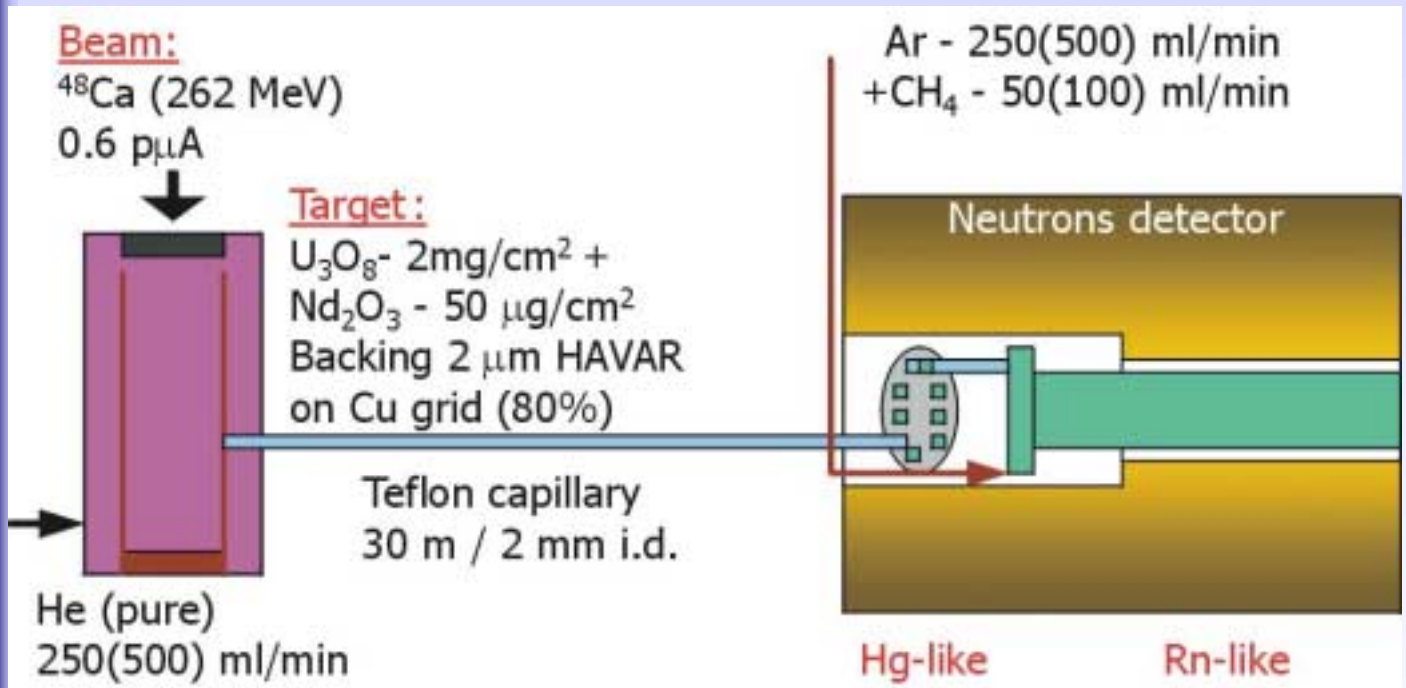
Pt(α, xn)^{195,197}Hg U200 cyclotron (Dubna) E _{α} =35 MeV



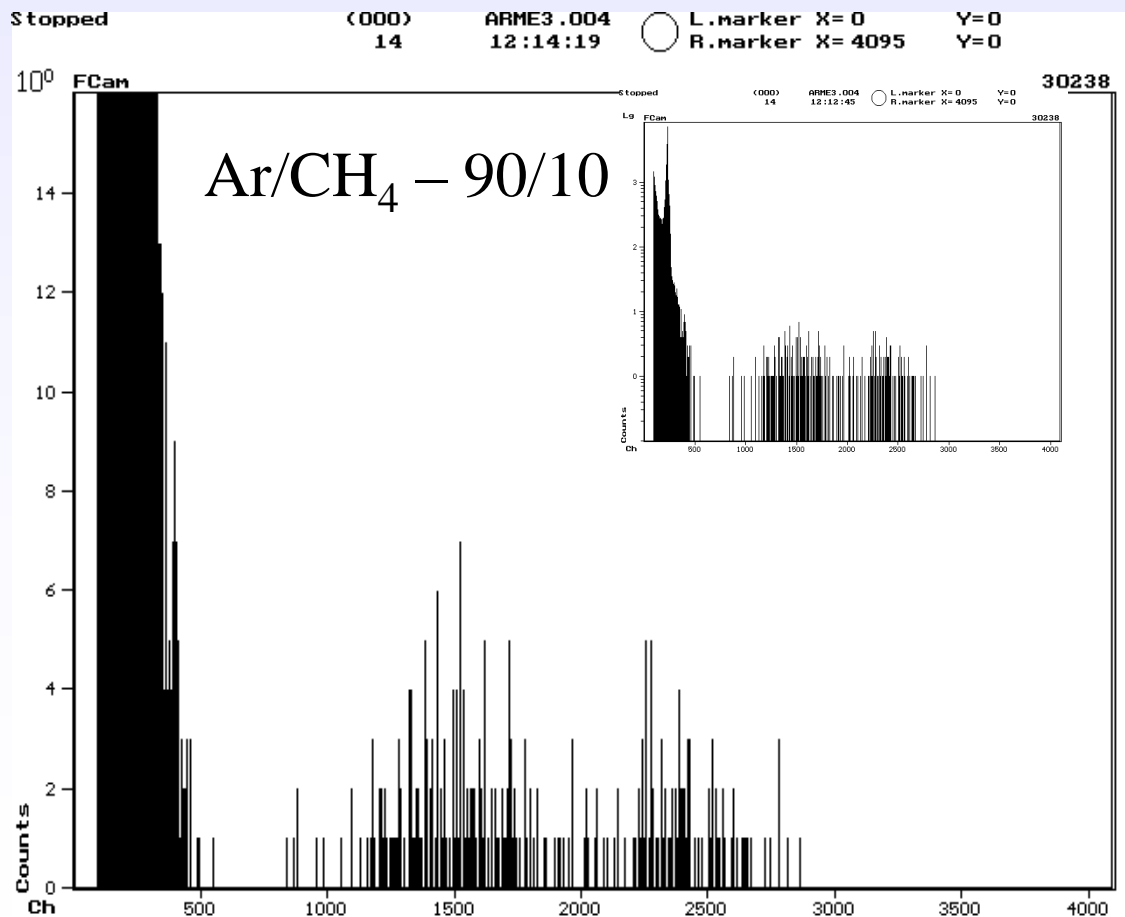
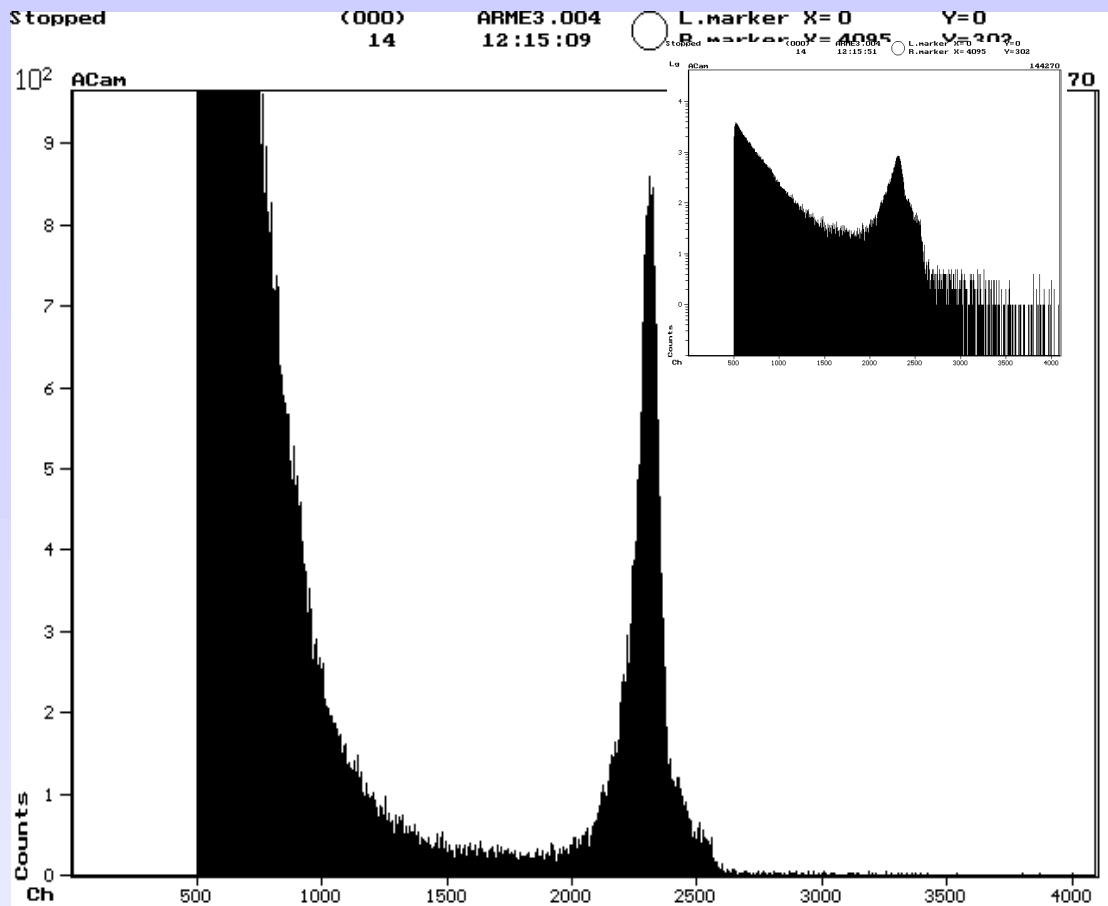
Experiment	T _{ads} /Yield	Filter/%
He(unpur.) /quartz	150°C /50%	50%
He(pure) /quartz	-150°C /50%	50%
He(pure) /Teflon	-150°C /50%	50%
He(pure) /Au, Pd	30°C /100%	

Chemical Identification of Element 112

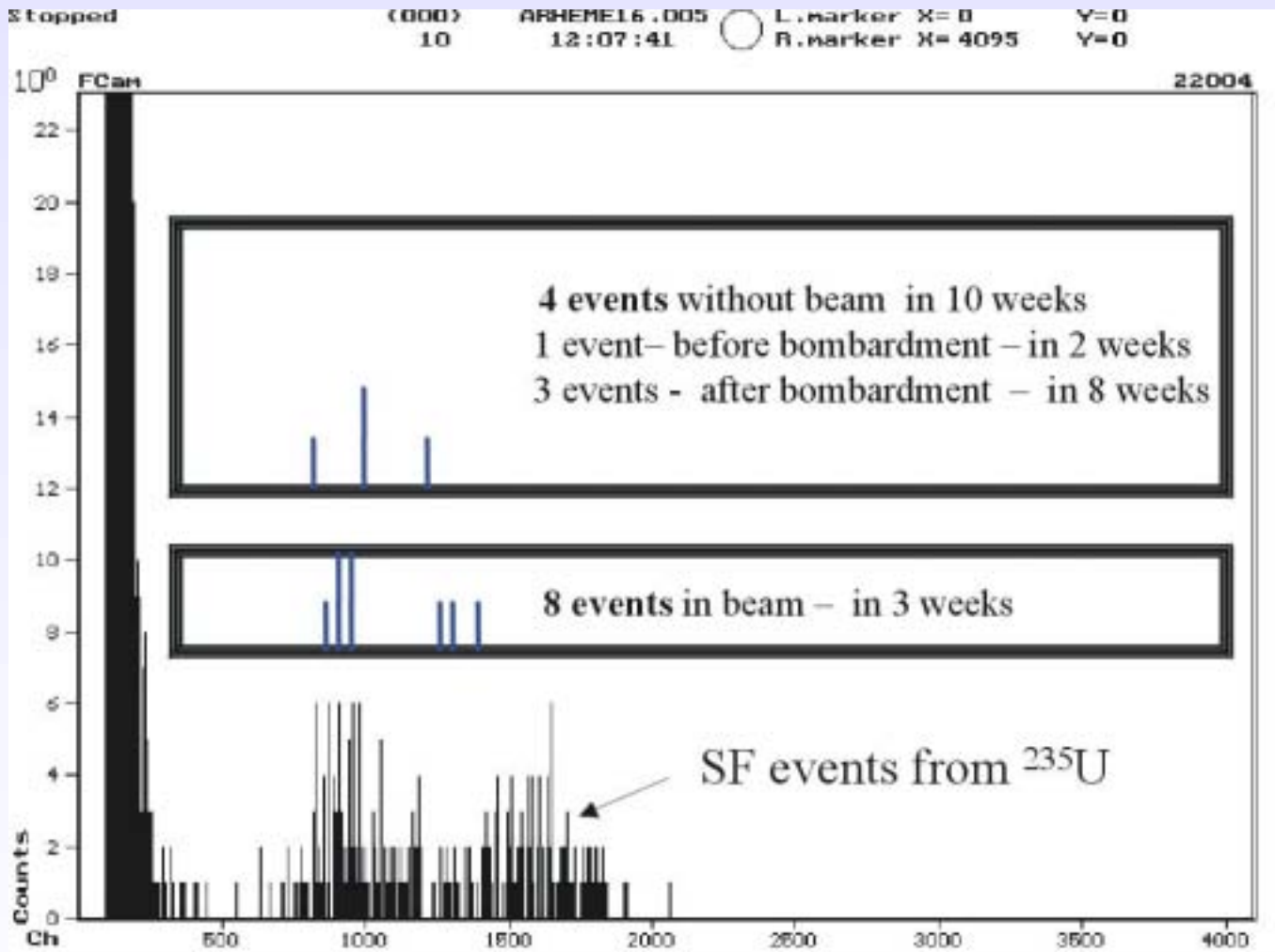
Nuclear reaction: $^{238}\text{U}(^{48}\text{Ca}, 3\text{n})$
 14.11-10.12.2001 / U-400 FLNR / Dubna

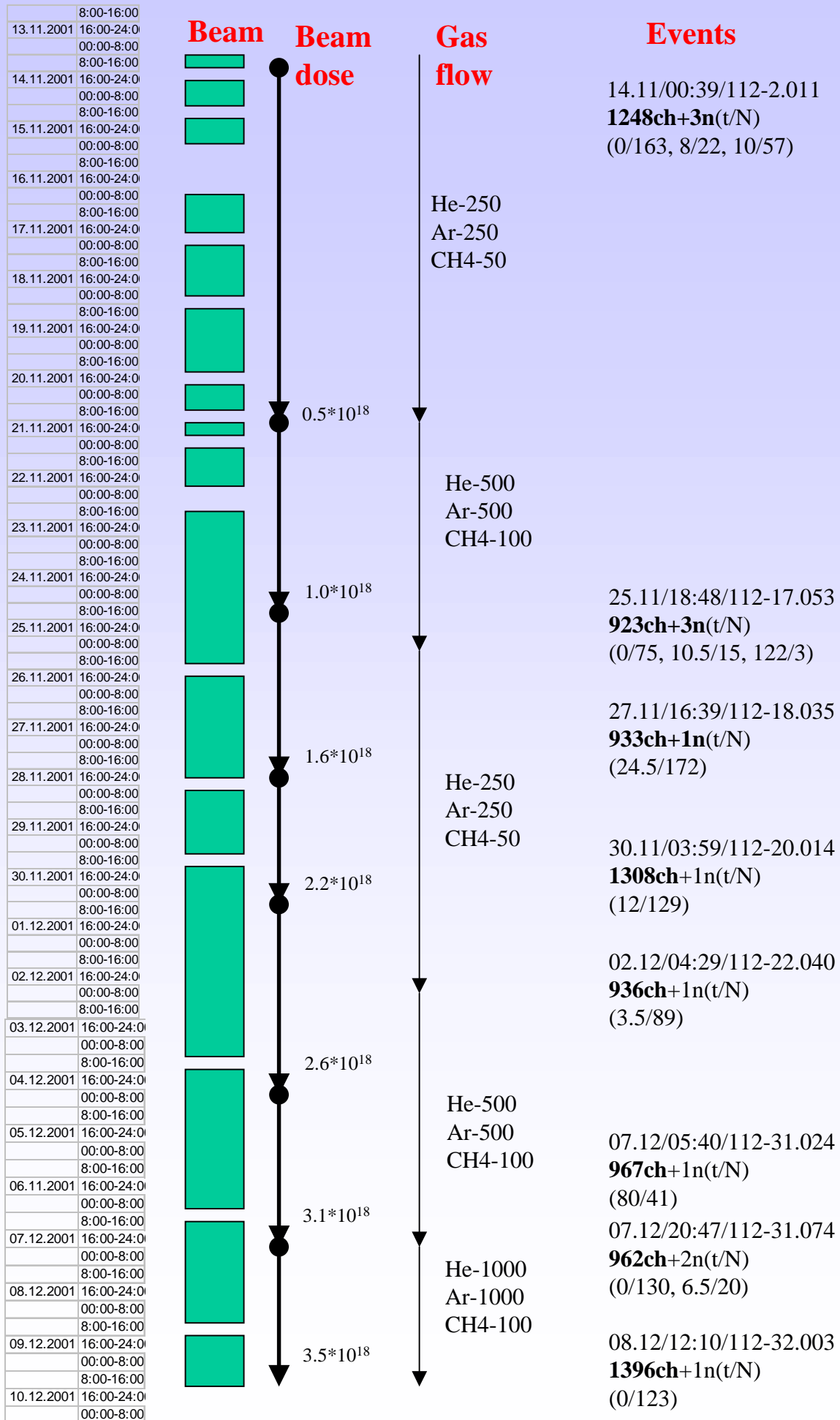


Apha- and SF spectra in ionization chamber



Registered SF events in ionization chamber





Outlook:

- Next experiment with element 112 using cryo detector (like COLD)
- Comparative study of Hg, Rn and element 112
- Experiments with alpha-decaying isotopes
- Rn background problem - chemical separator
- More beam intensity, more efficiency
- Chemistry and detection in vacuum