

Chemical investigation of Element 114 @ DGFRS

Robert Eichler

*Laboratory for Radiochemistry and Environmental Chemistry
Paul Scherrer Institute and University of Bern*

for collaborations of



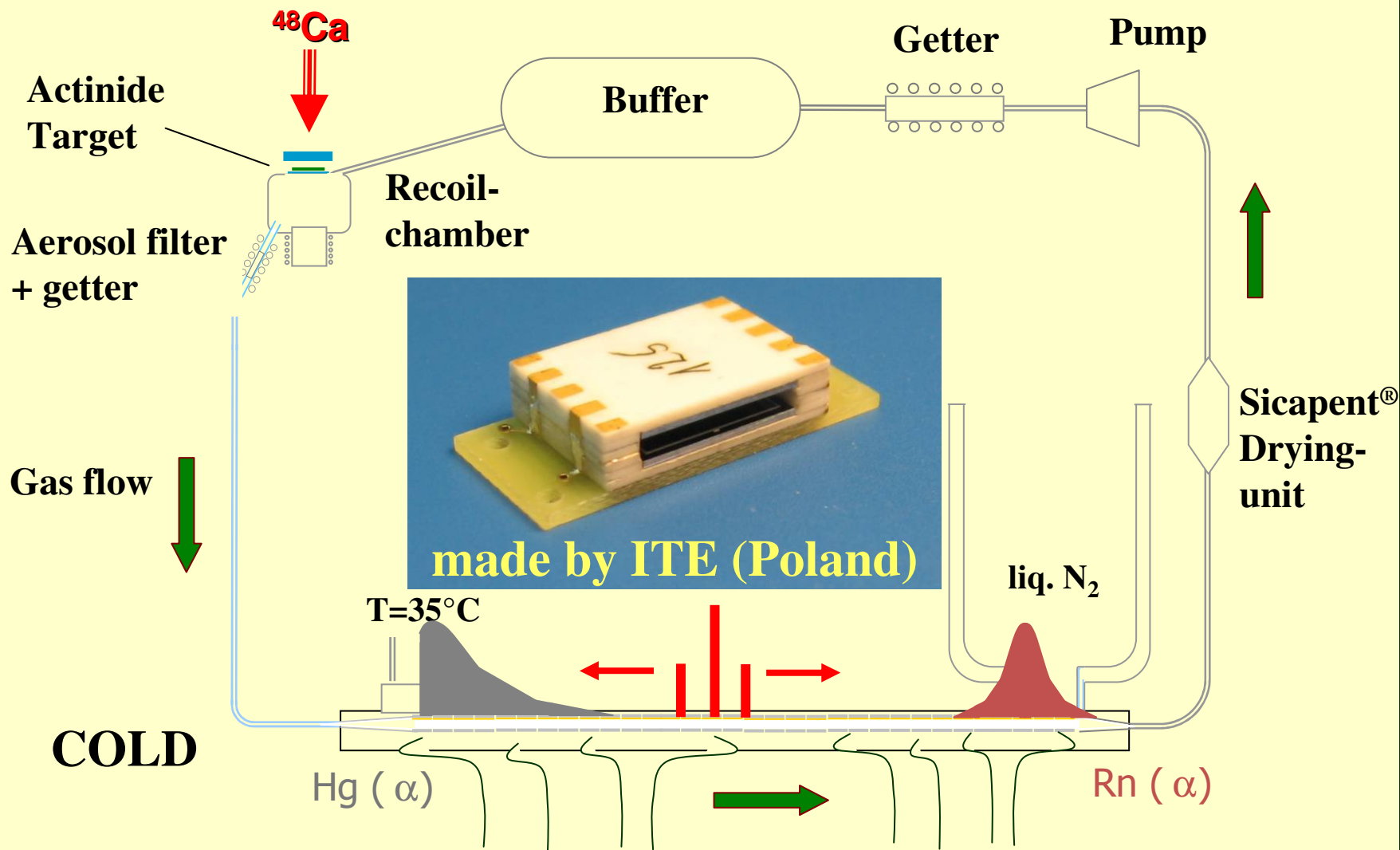
with





Thermochromatography of SHE

Experiments



Model experiments! S. Soverna et al. *Radiochim. Acta* 2005

Results

Dubna 2007

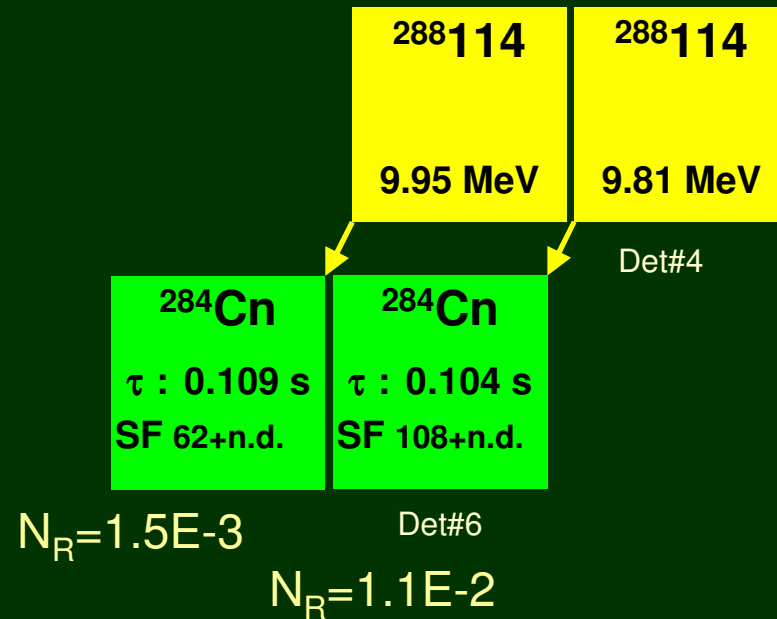
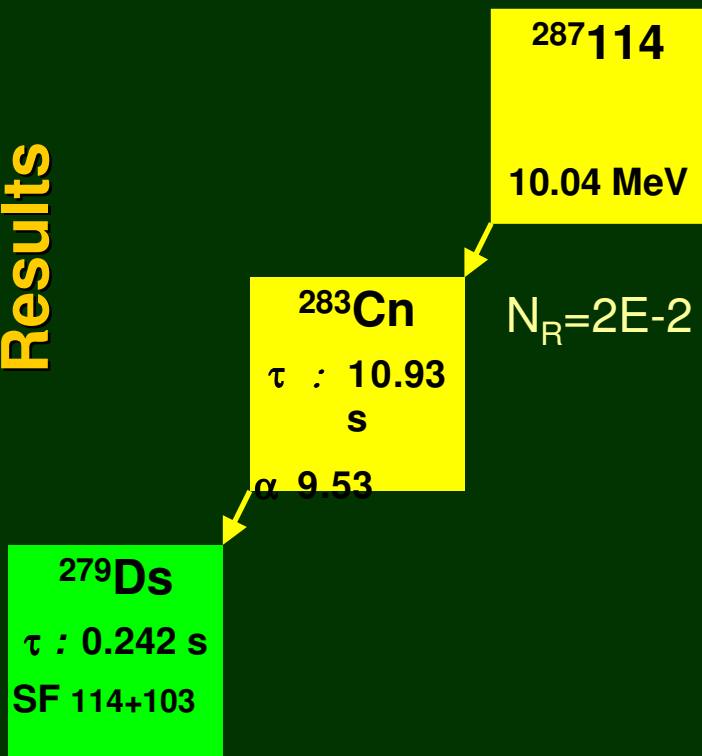
$^{242}\text{Pu} (^{48}\text{Ca}, 3\text{n}) ^{287}\text{114}$

$3.1 \cdot 10^{18}$ ^{48}Ca during 16 days

$^{244}\text{Pu}_{\text{LLNL}} (^{48}\text{Ca}, 3-4\text{n}) ^{288-289}\text{114}$

$4.5 \cdot 10^{18}$ ^{48}Ca during 16 days

Results



$$\sigma_{\text{e estimated}} = 3.7 \text{ pb}$$

Results

Dubna 2007

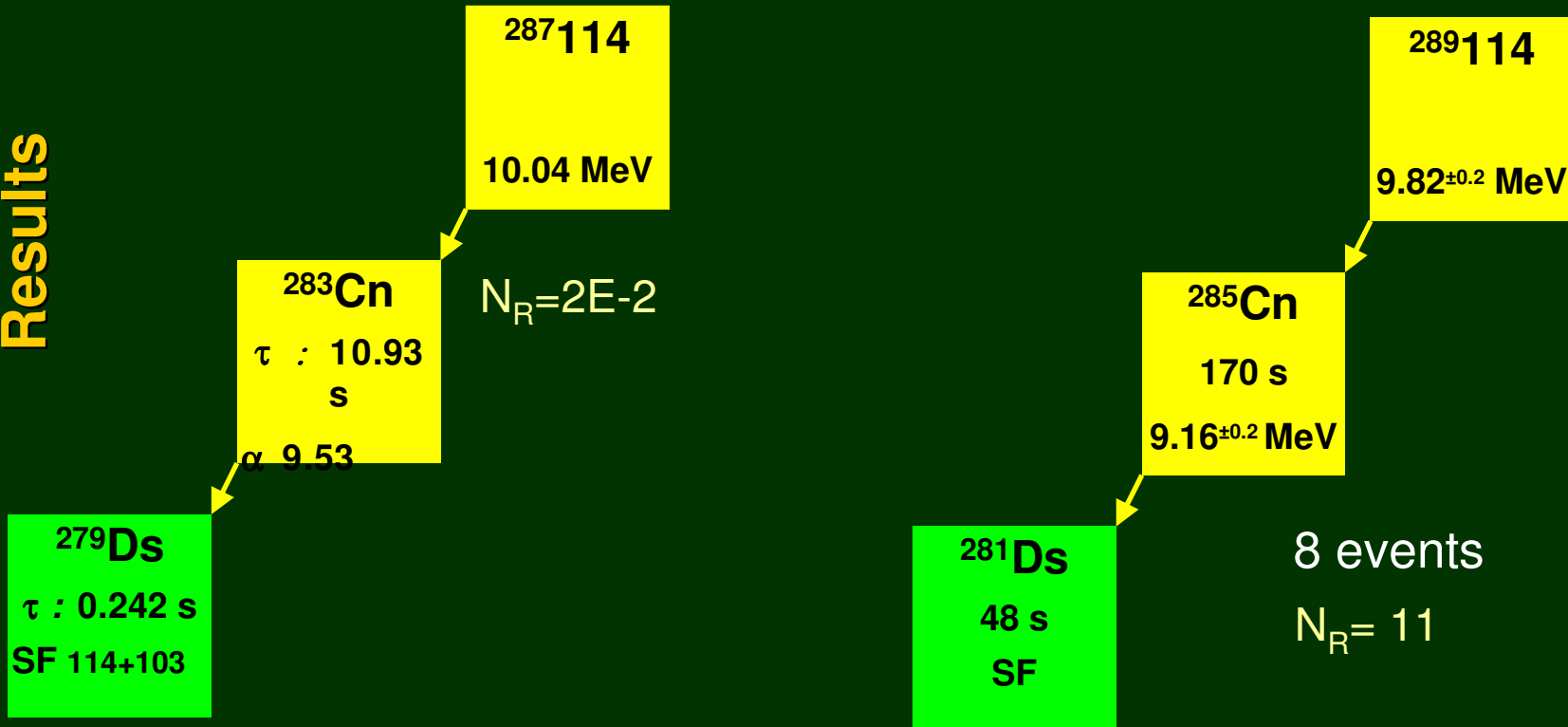


$3.1 \cdot 10^{18}$ ^{48}Ca during 16 days

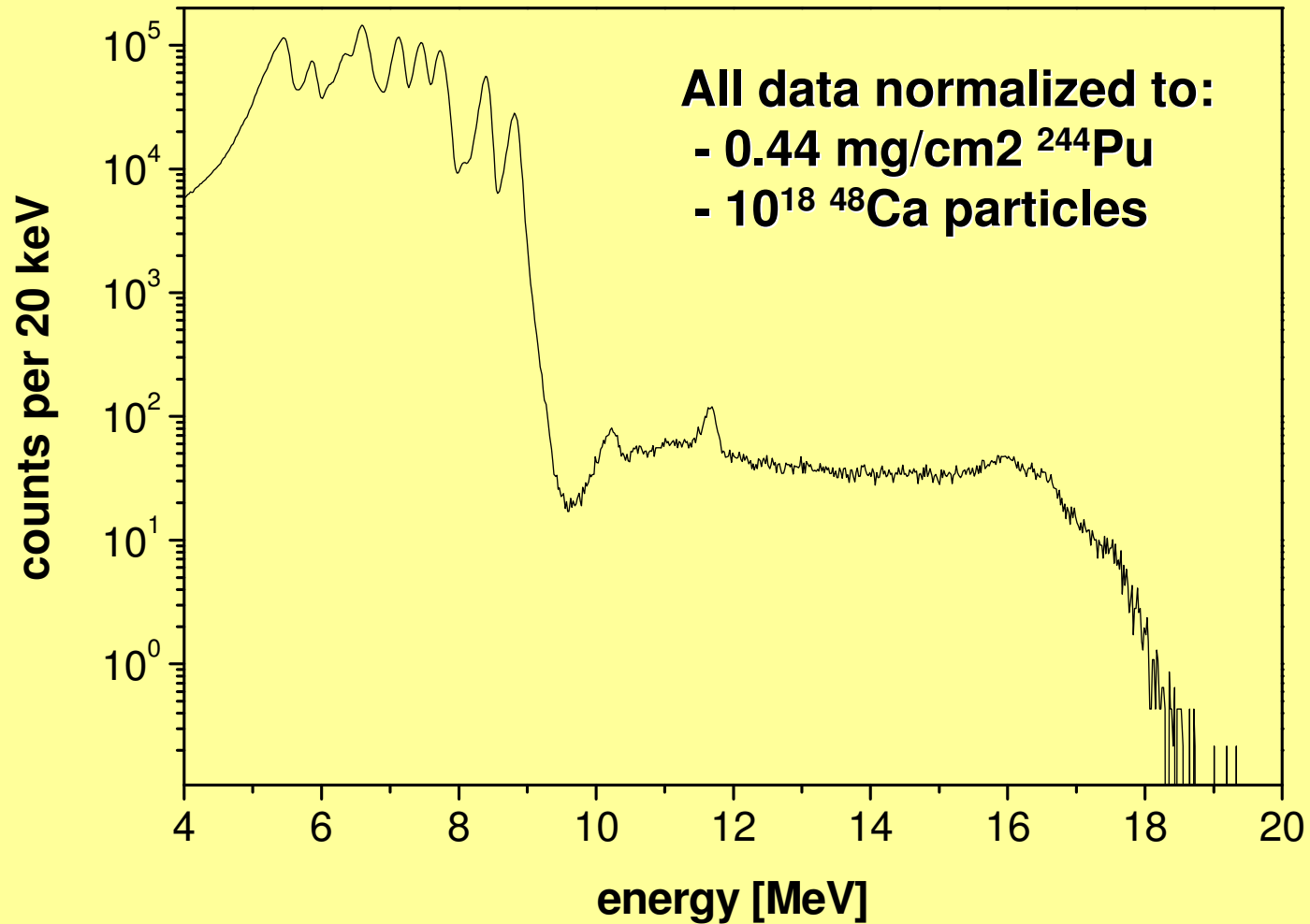


$4.5 \cdot 10^{18}$ ^{48}Ca during 16 days

Results



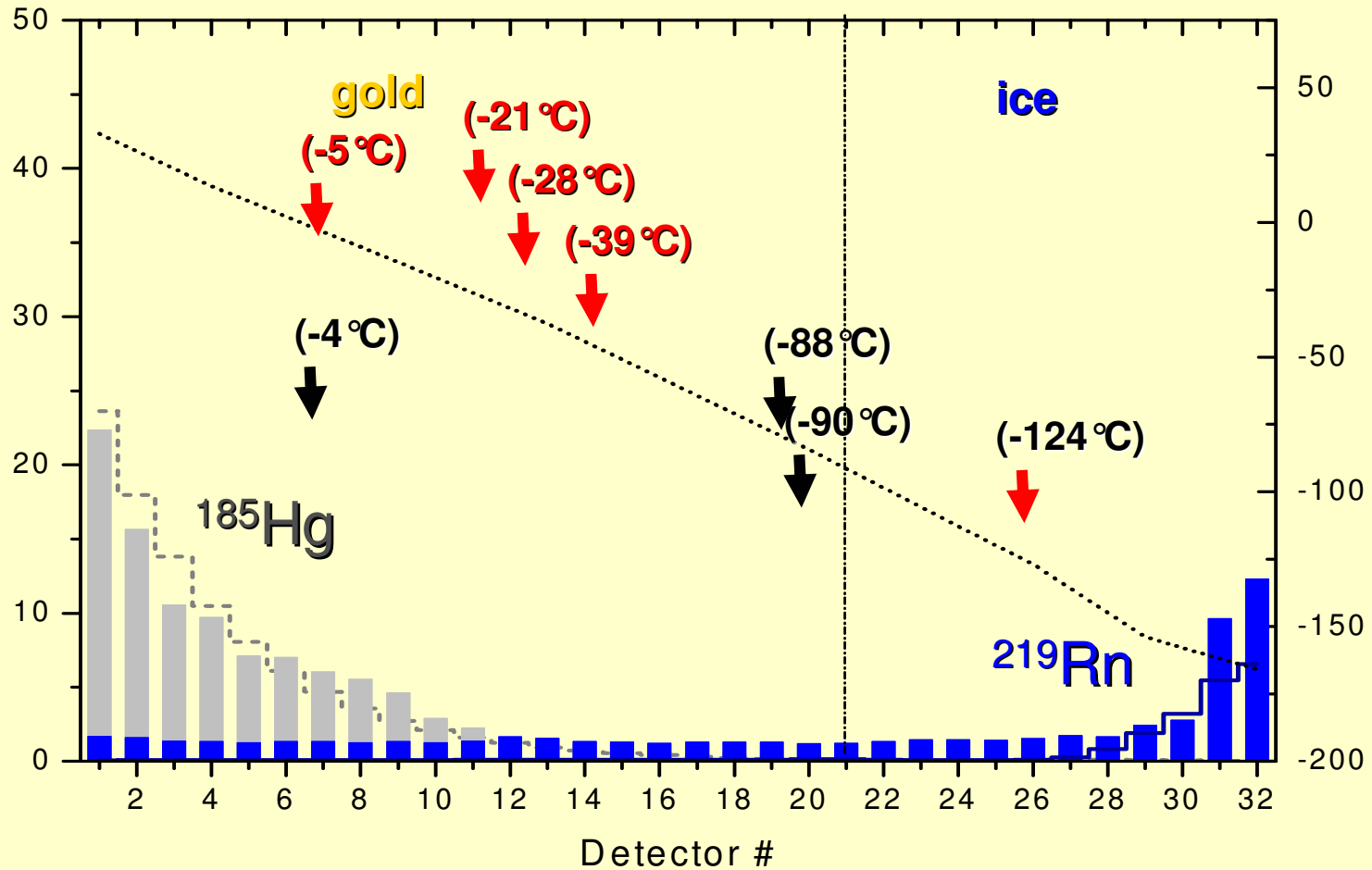
Sum Spectrum Dubna 2007



Results (2007)

^{244}Pu (^{48}Ca , 3-4n) $^{288-289}\text{114}$

$0.98 \cdot 10^{19}$ ^{48}Ca during 35 days

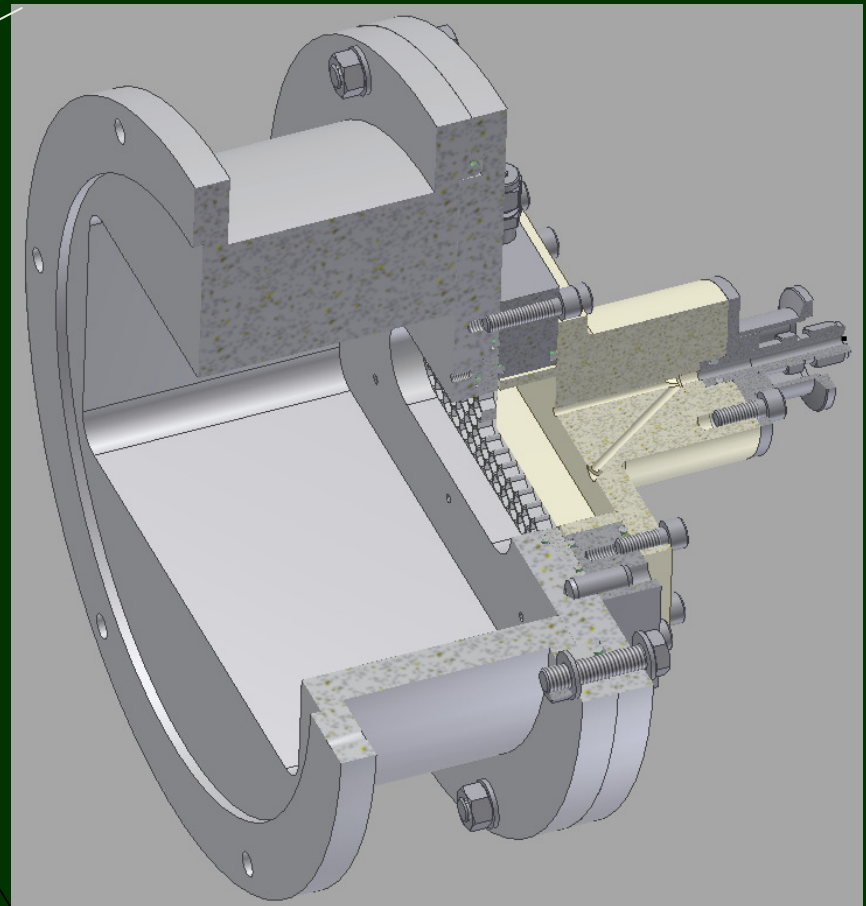
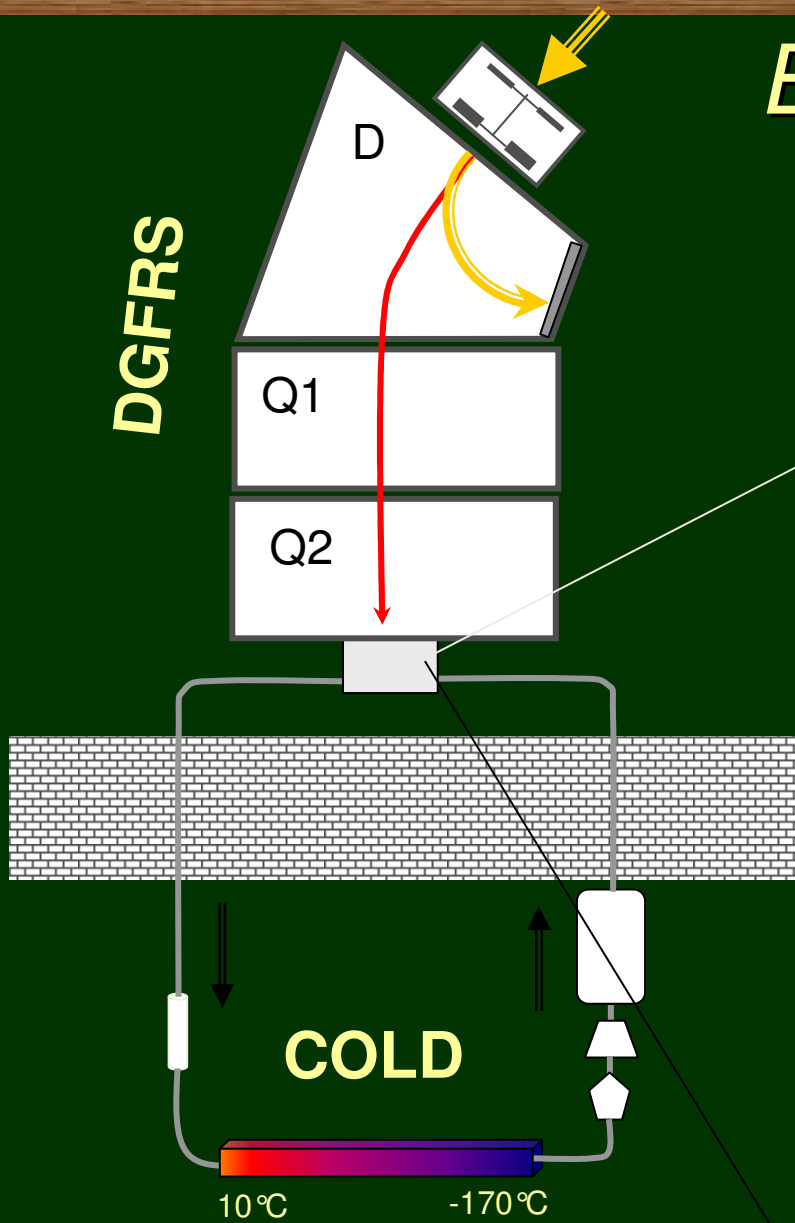


Results

Experiment (2008)

^{244}Pu (^{48}Ca , 3-4n) $^{288-289}\text{114}$

DGFRS

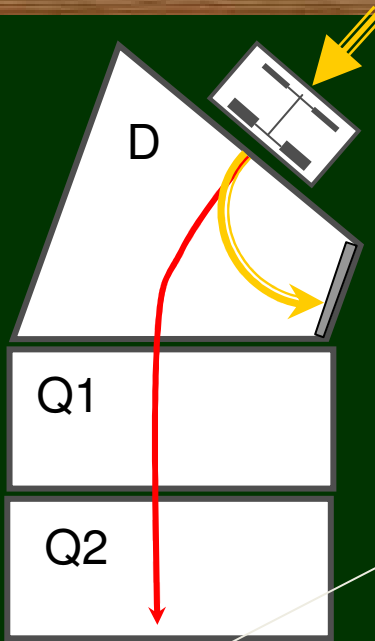


Results

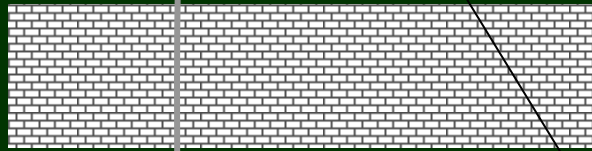
Experiment (2008)

^{244}Pu (^{48}Ca , 3-4n) $^{288-289}\text{114}$

DGFRS



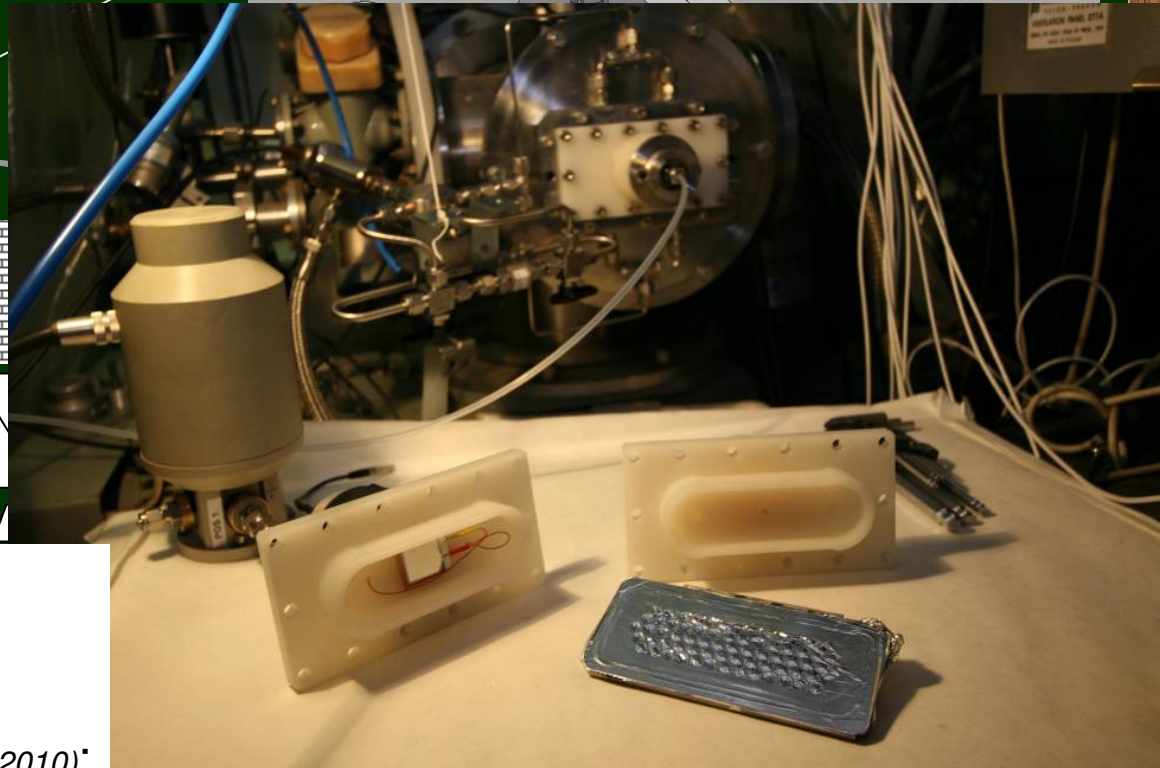
Results



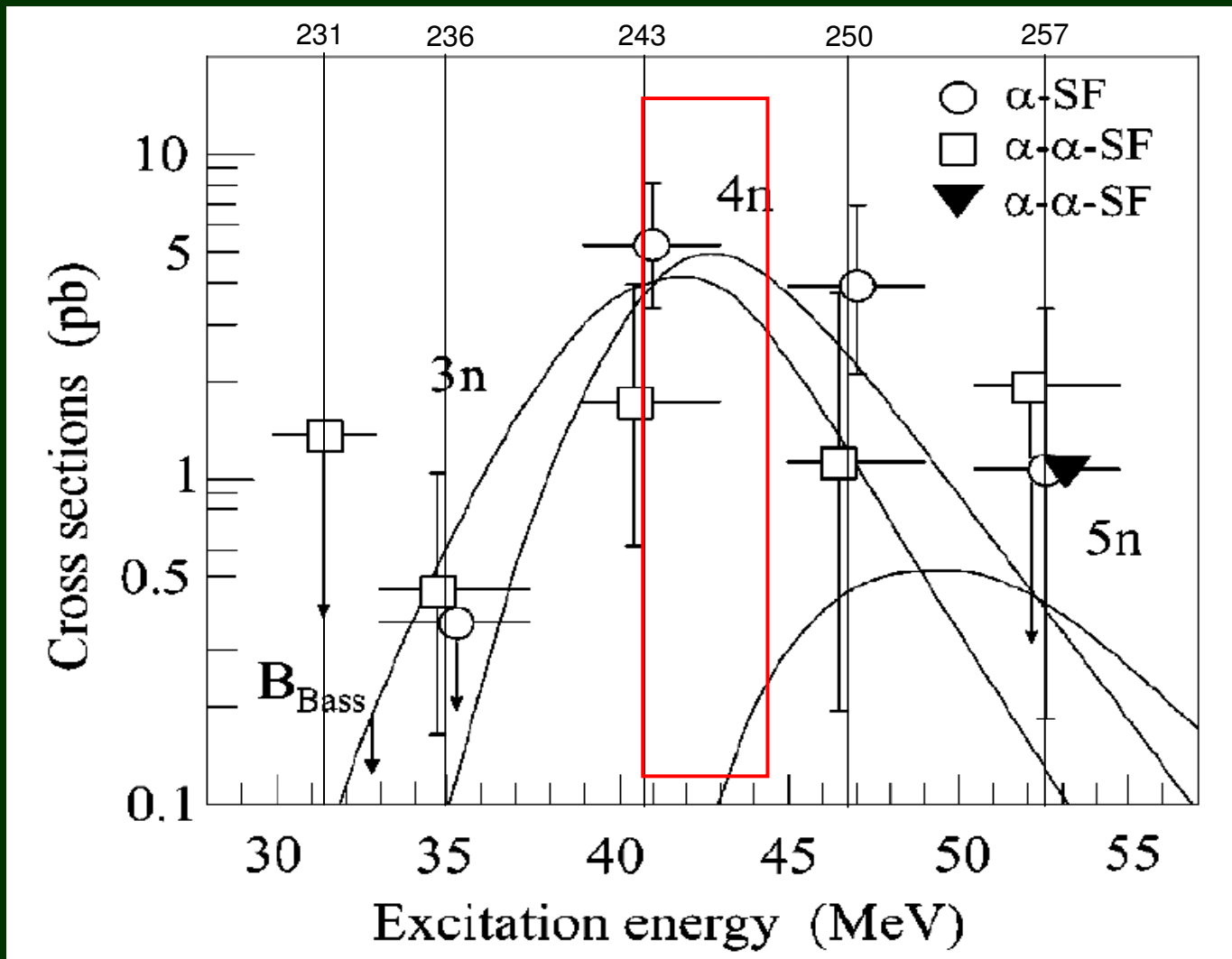
GOLD

Recoil ranges tested:
 ^{206}Rn , ^{185}Hg , ^{254}No

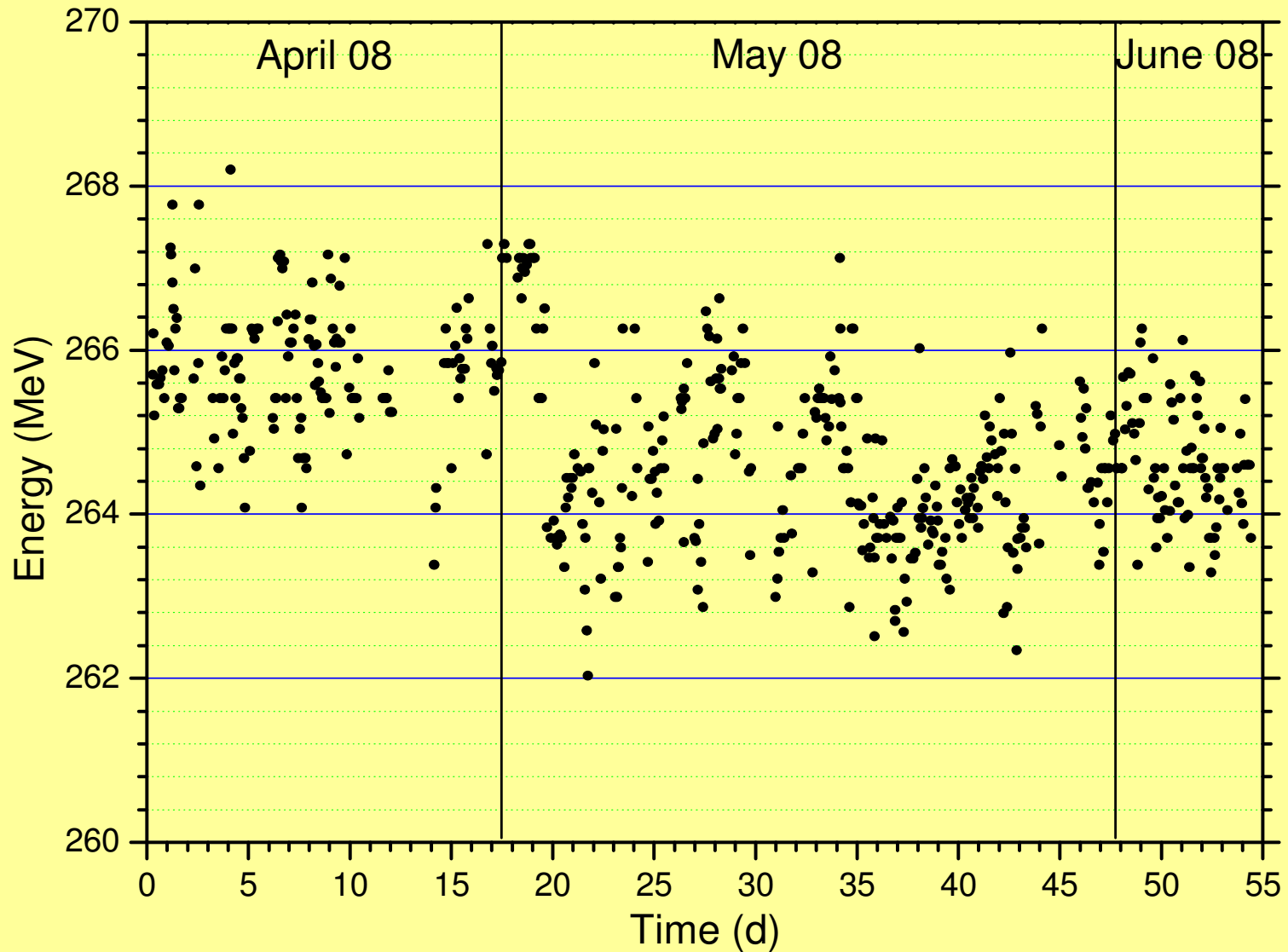
Reliable design (*Wittwer et al NIM B, 2010*):
3 μm , 1.5 cm Ar (1 bar)



Beam Energy Dubna 2008

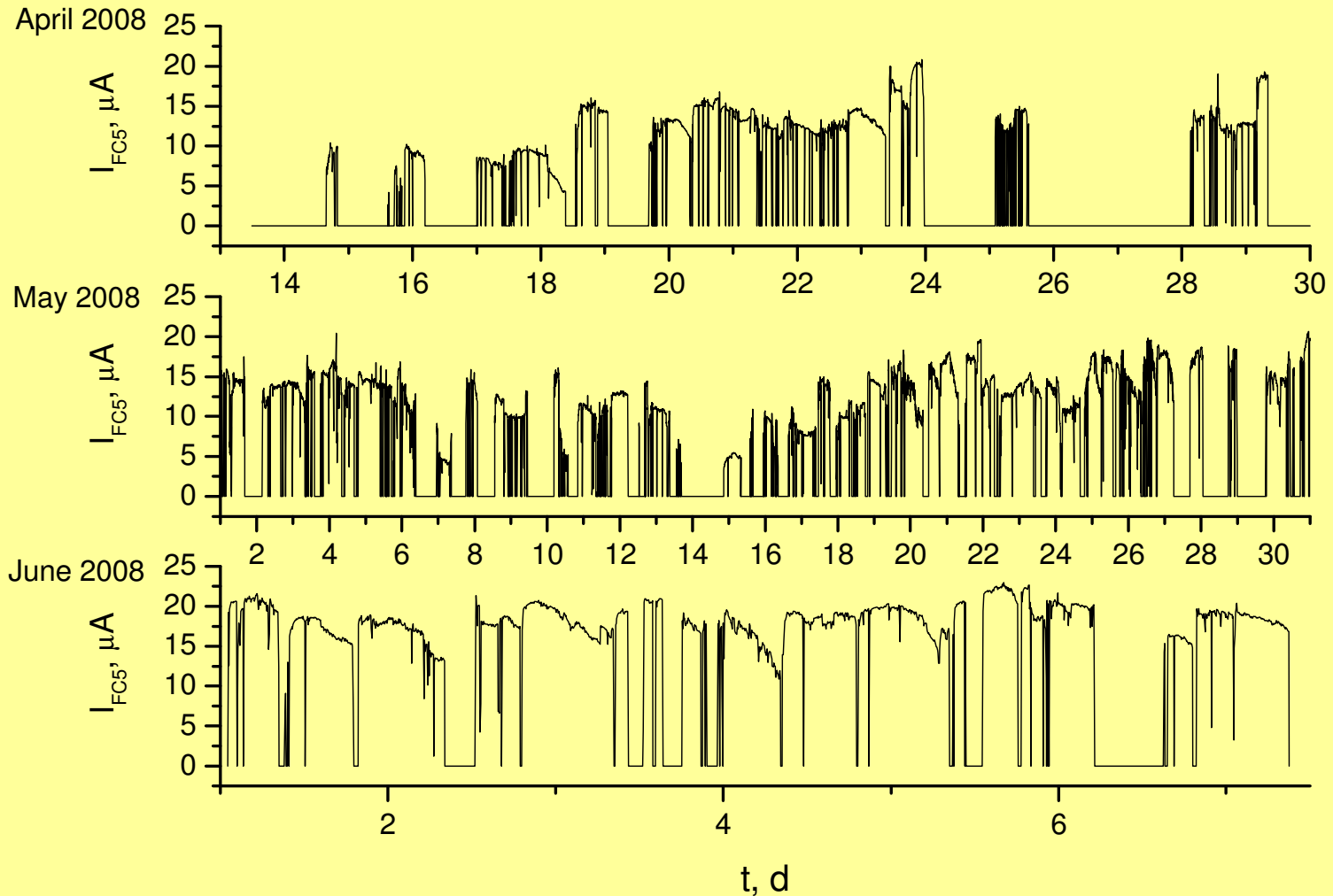


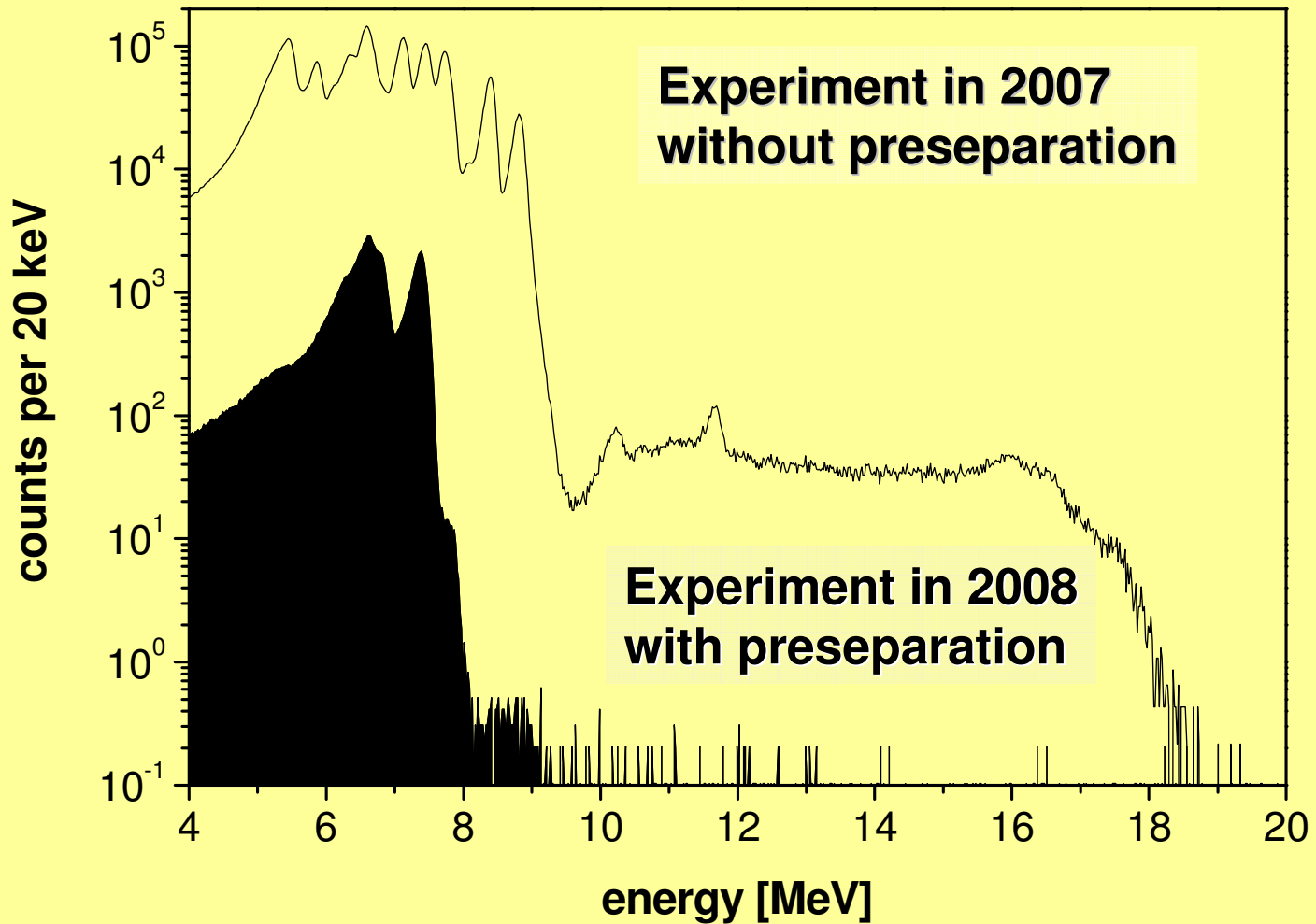
Beam Energy Dubna 2008



Beam Intensity Dubna 2008

Beam on on-line Experiment





Same gas flow conditions

All data normalized to:

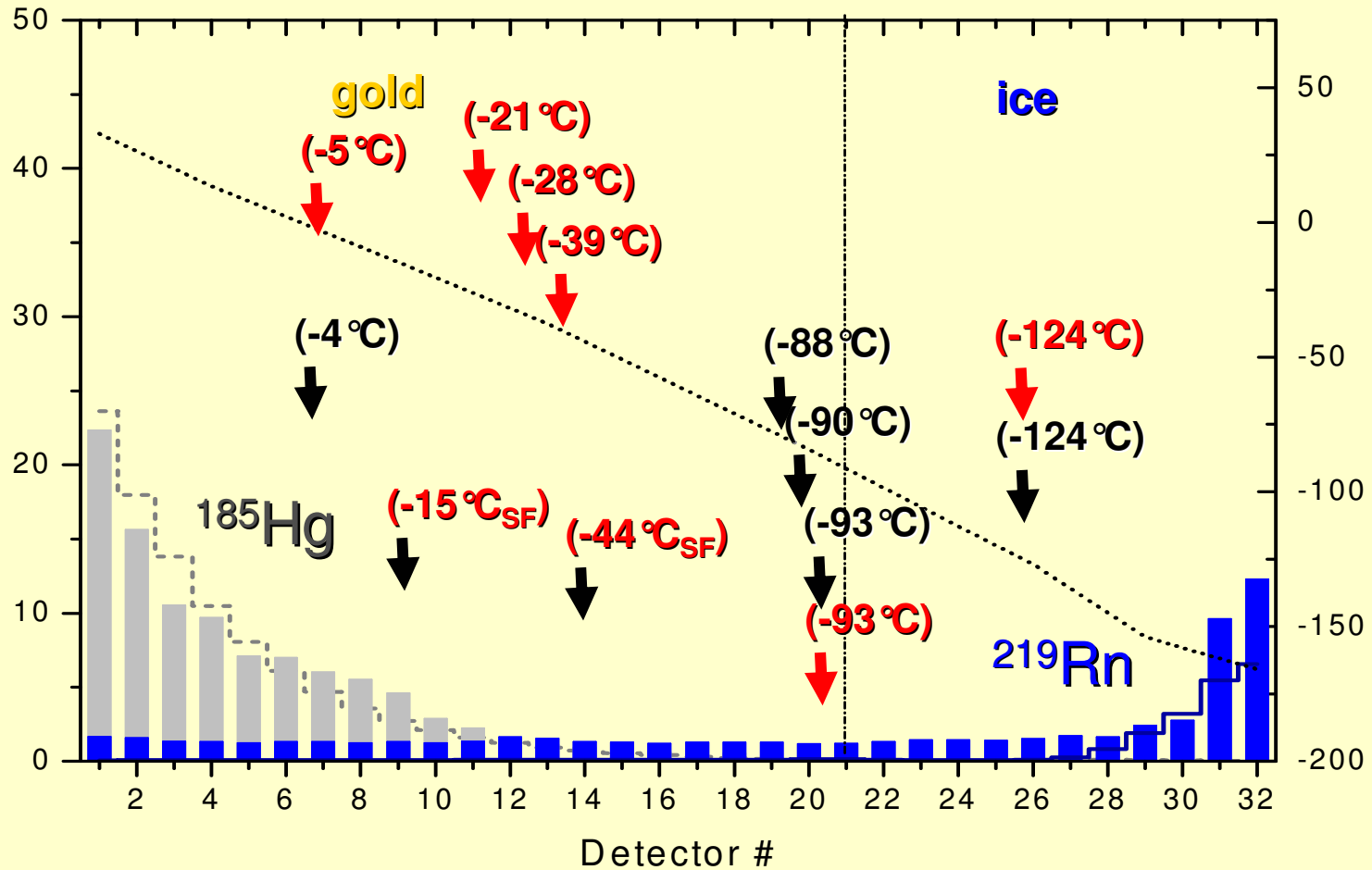
- 0.44 mg/cm² ²⁴⁴Pu

- 10¹⁸ ⁴⁸Ca particles

Results (2007-2008)

^{244}Pu (^{48}Ca , 3-4n) $^{288-289}\text{114}$

$0.98 \cdot 10^{19}$ ^{48}Ca during 35 days



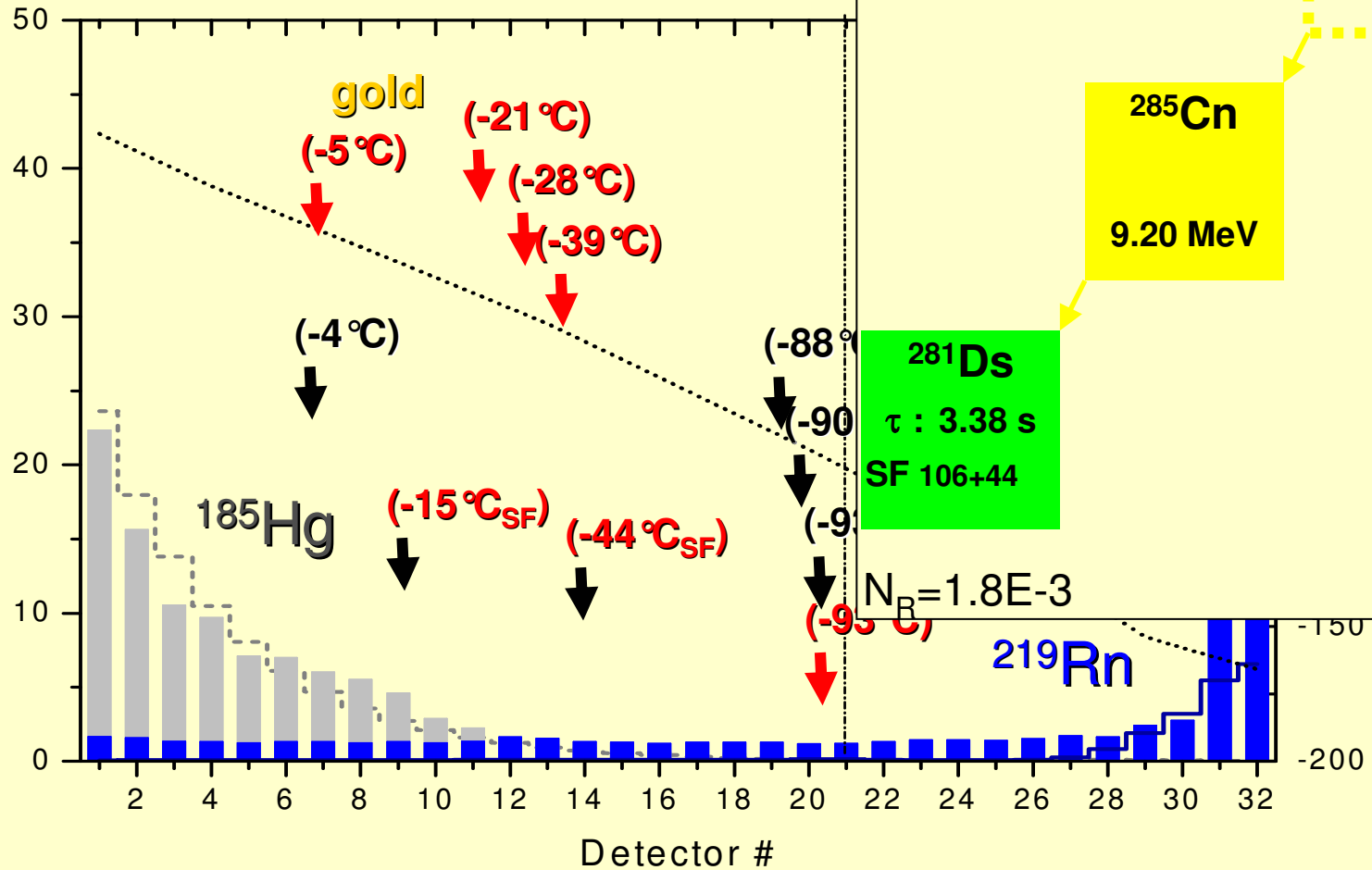
Results

Results (2007-2008)

^{244}Pu (^{48}Ca , 3-4n) $^{288-289}114$

$0.98 \cdot 10^{19}$ ^{48}Ca during 35 days

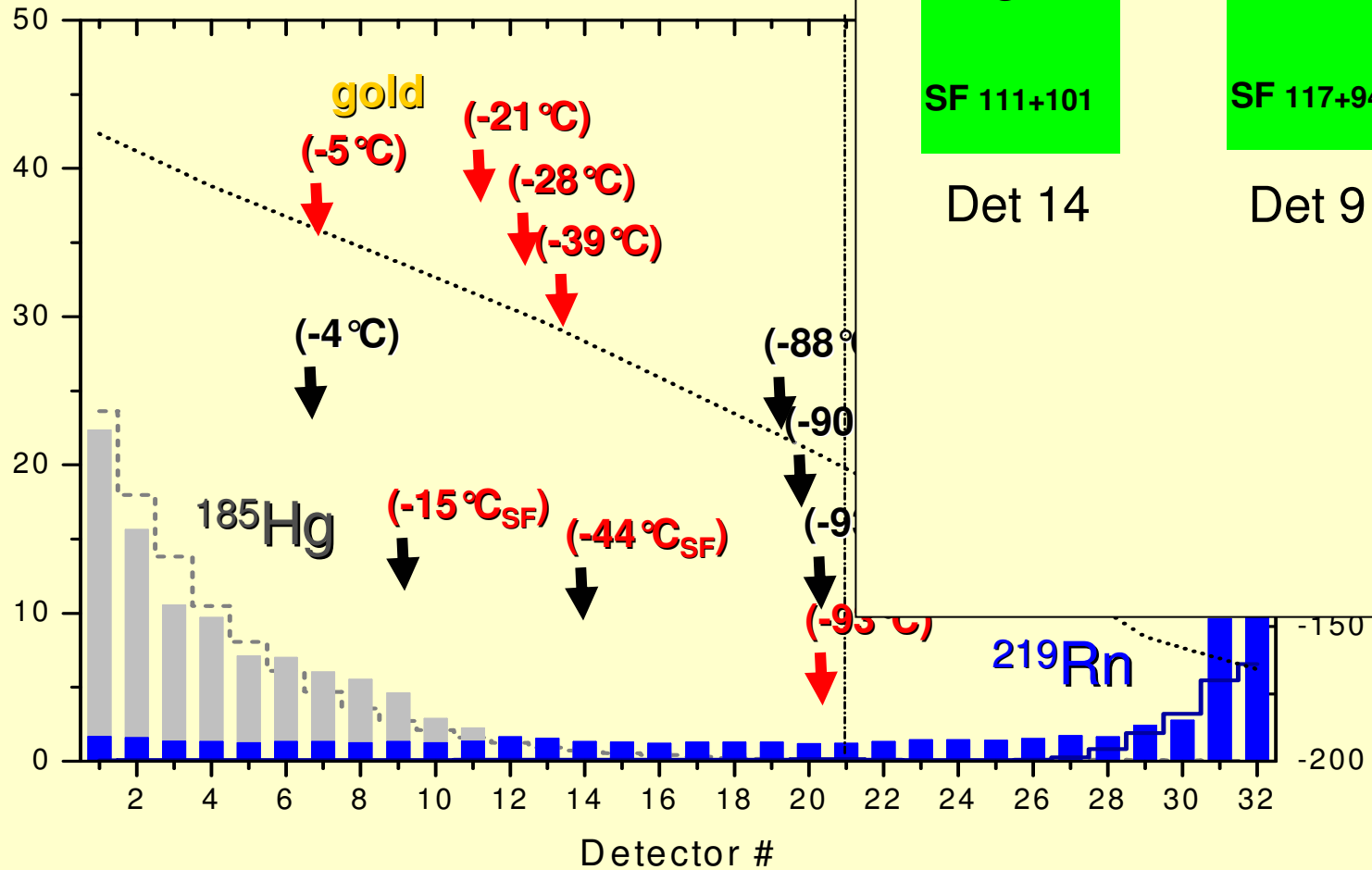
$^{289}114$



Results

Results (2007-2008)

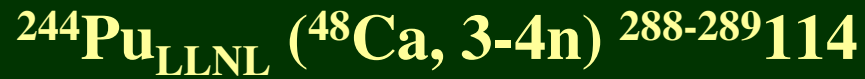
^{244}Pu (^{48}Ca , 3-4n) $^{288-289}114$



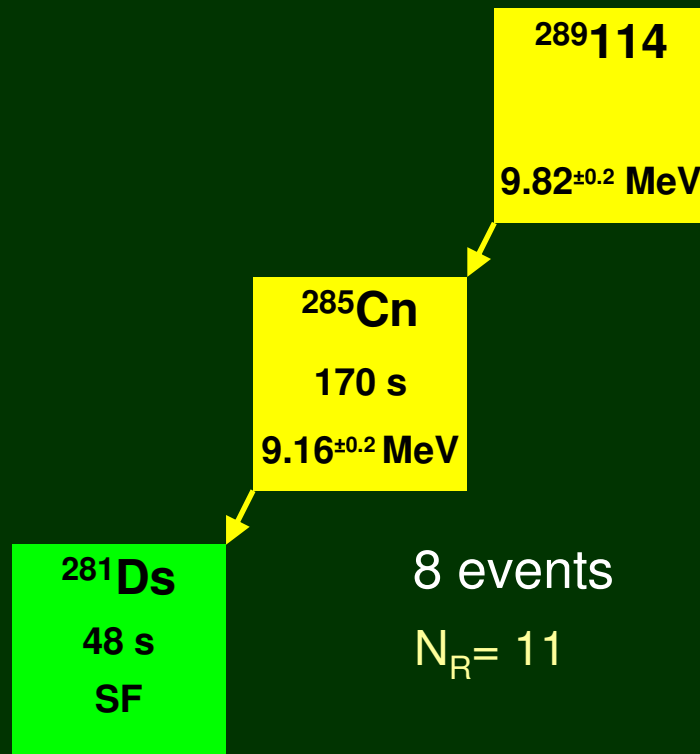
Results

Results

Dubna 2007



$4.5 \cdot 10^{18}$ ^{48}Ca during 16 days



Results (2007-2009)

Pb
~1000 °C

(\lll)

Hg
~ 200 °C

\ll

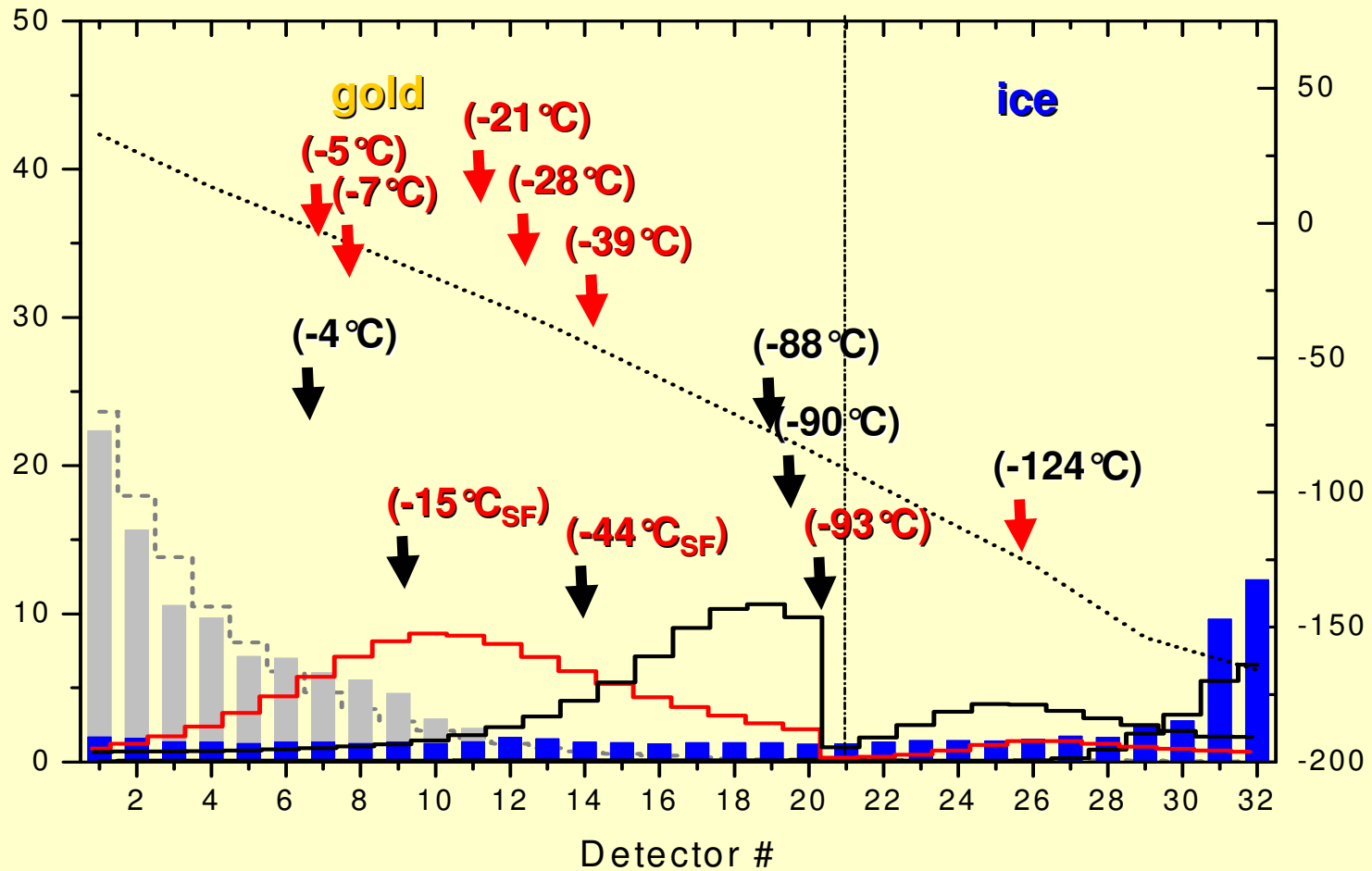
Cn
-25 °C

\lt

114
-90 °C

\lt

Rn
-170 °C



Dubna 2008

Efficiency and sensitivity estimations

	Efficiency $\epsilon_{\text{transp}} \cdot \epsilon_{\text{deposition}} \cdot$ $\epsilon_{\text{det}} \cdot \epsilon_{\text{Window}} \cdot$ $\epsilon_{\text{Separator}}$	$\Sigma^{244}\text{Pu}$ 0.3mg/cm2	$\Sigma^{48}\text{Ca}$ Sum(Integral)	1 event $\sigma[\text{pb}]$	2 event $\sigma[\text{pb}]$	3 event $\sigma[\text{pb}]$
alpha-SF						
285112	0.136	7.41E+17	9.72E+18	1.02	2.05	3.07
288114	0.025	7.41E+17	9.72E+18	5.46	10.91	16.37
284112	0.019	7.41E+17	9.72E+18	7.31	14.62	21.93
alpha-alpha-SF						
289114	0.085	7.41E+17	9.72E+18	1.64	3.27	4.91

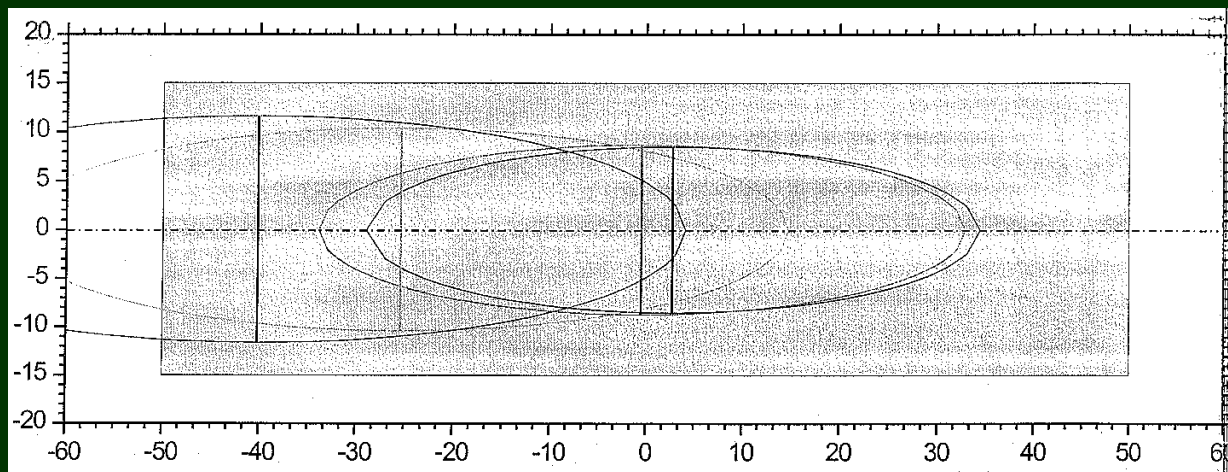
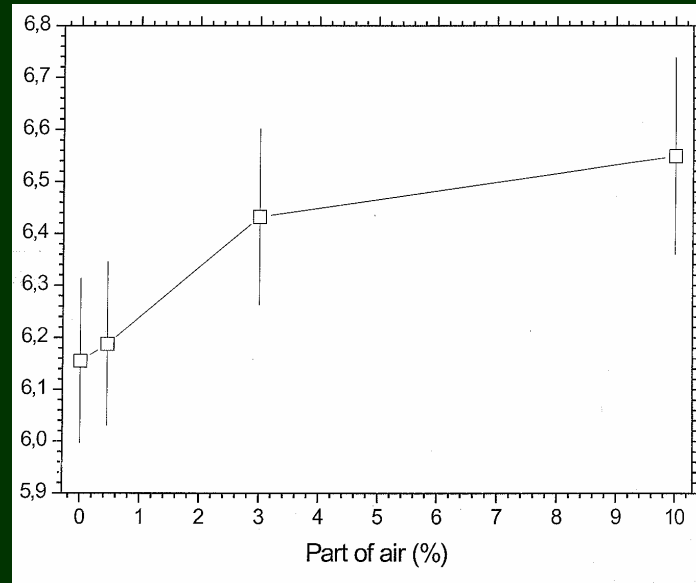
Changes for $^{288}\text{114}$ a lot if $T_{1/2}^{288}\text{114} = 0.47 \text{ s!}$

$$^{289}\text{114}: 0.6 \cdot 0.82 \cdot 0.71 \cdot 0.8 \cdot 0.3 = 0.085$$

$$^{285}\text{Cn}: 0.96 \cdot 0.82 \cdot 0.71 \cdot 0.8 \cdot 0.3 = 0.136$$

Dubna 2008

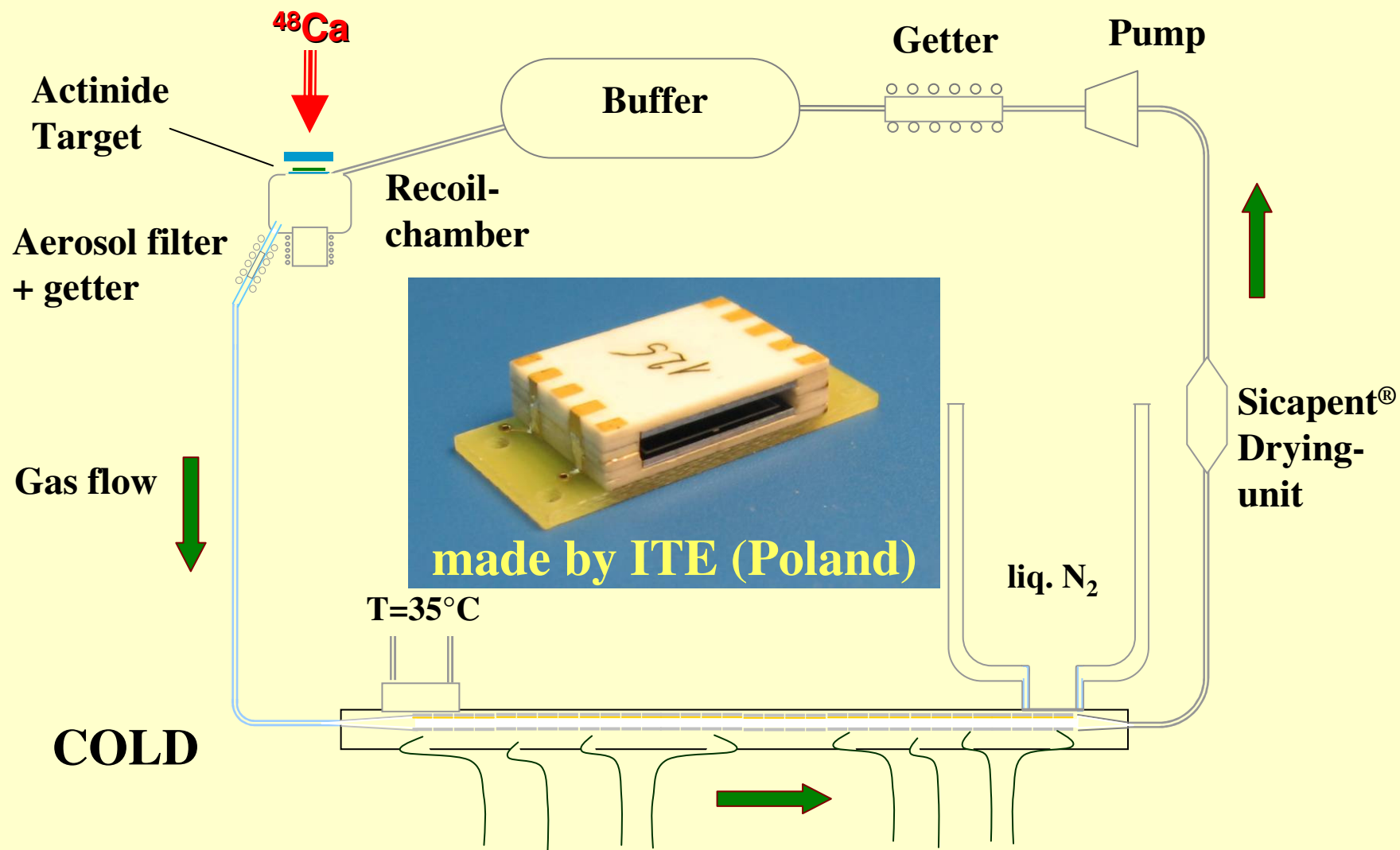
Charge states with leaking air



Near Future (Spring 2011)

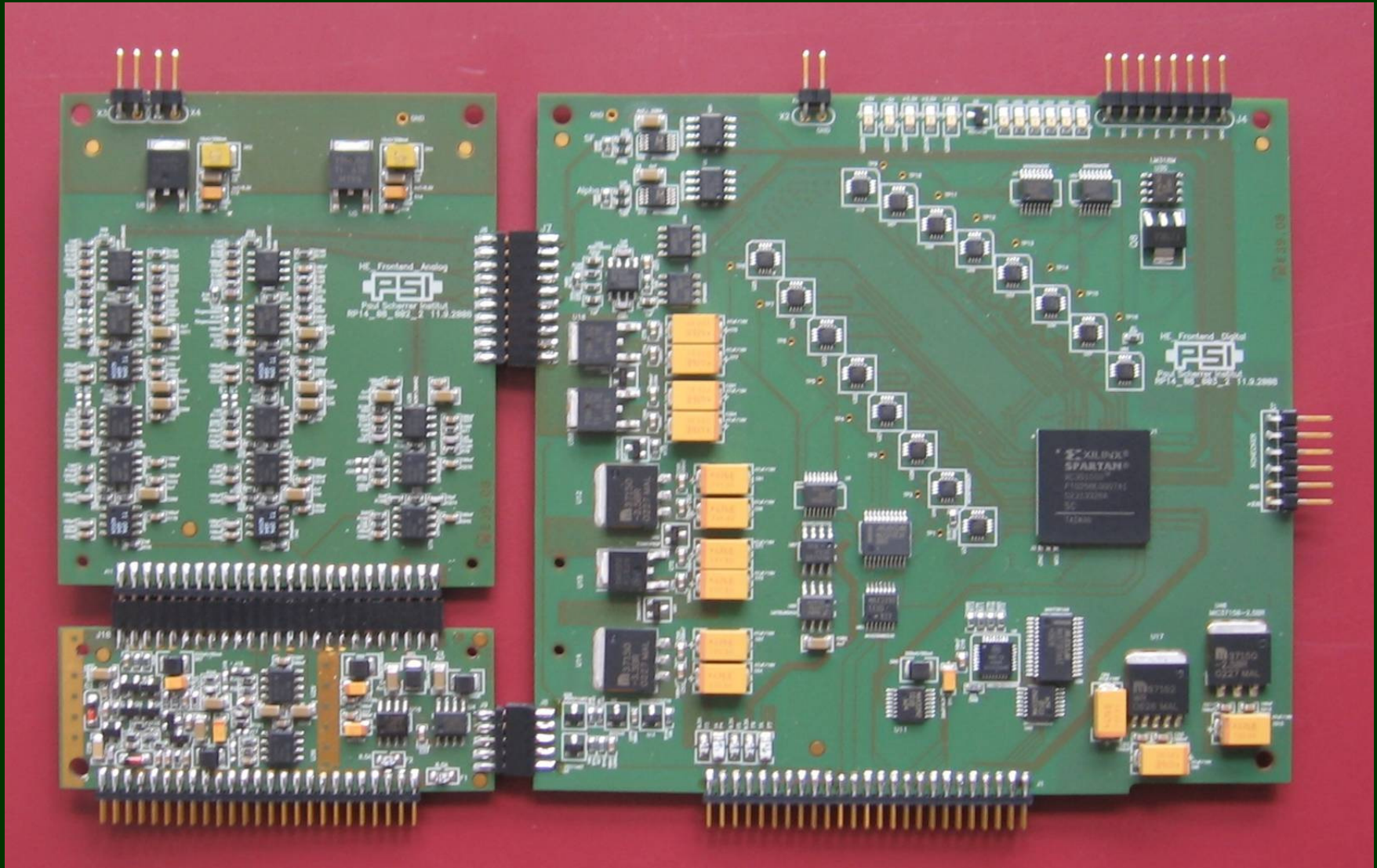
Thermochromatography of SHE

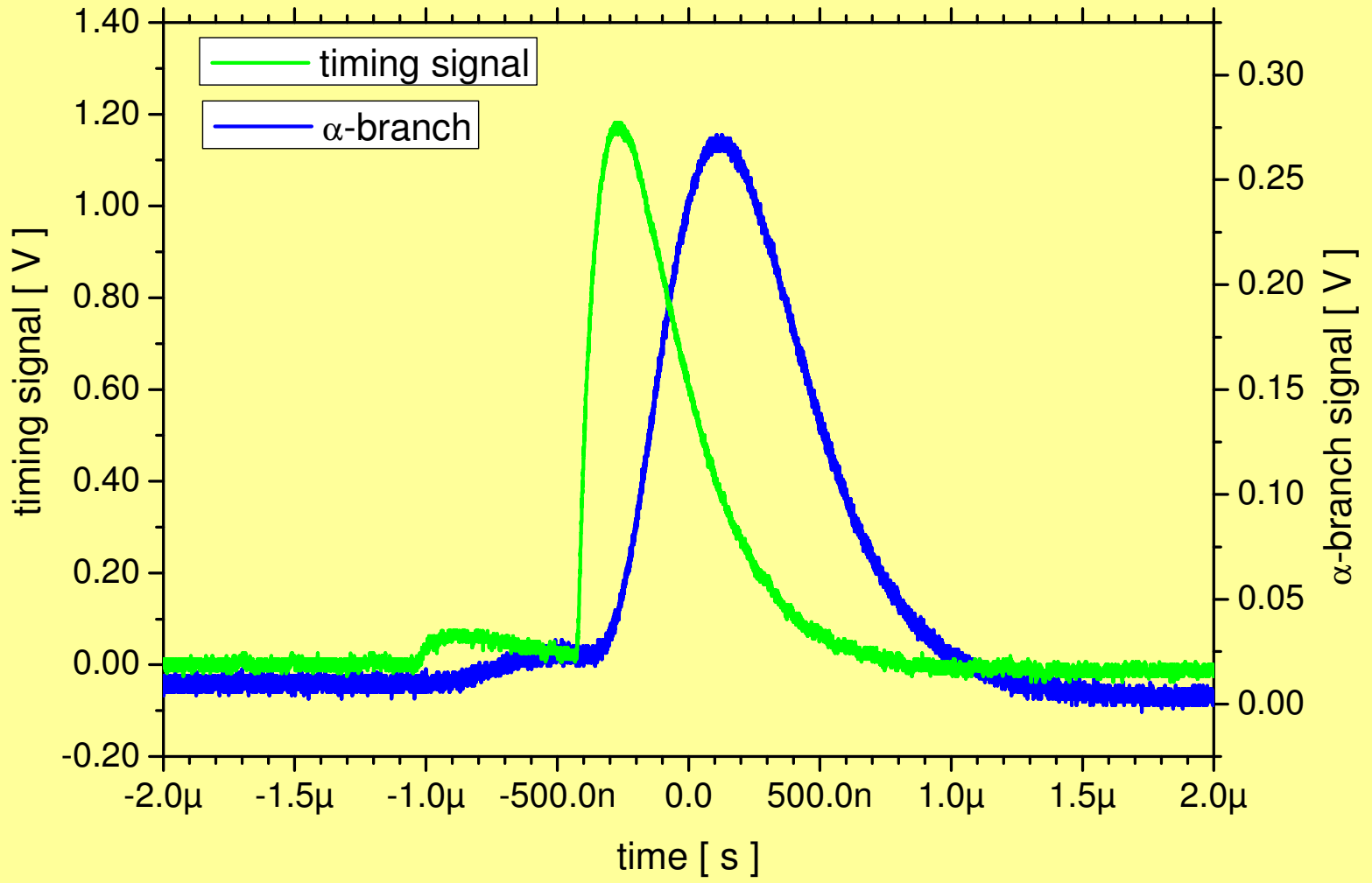
Experiments



pure COLD (running @ 64 channels)

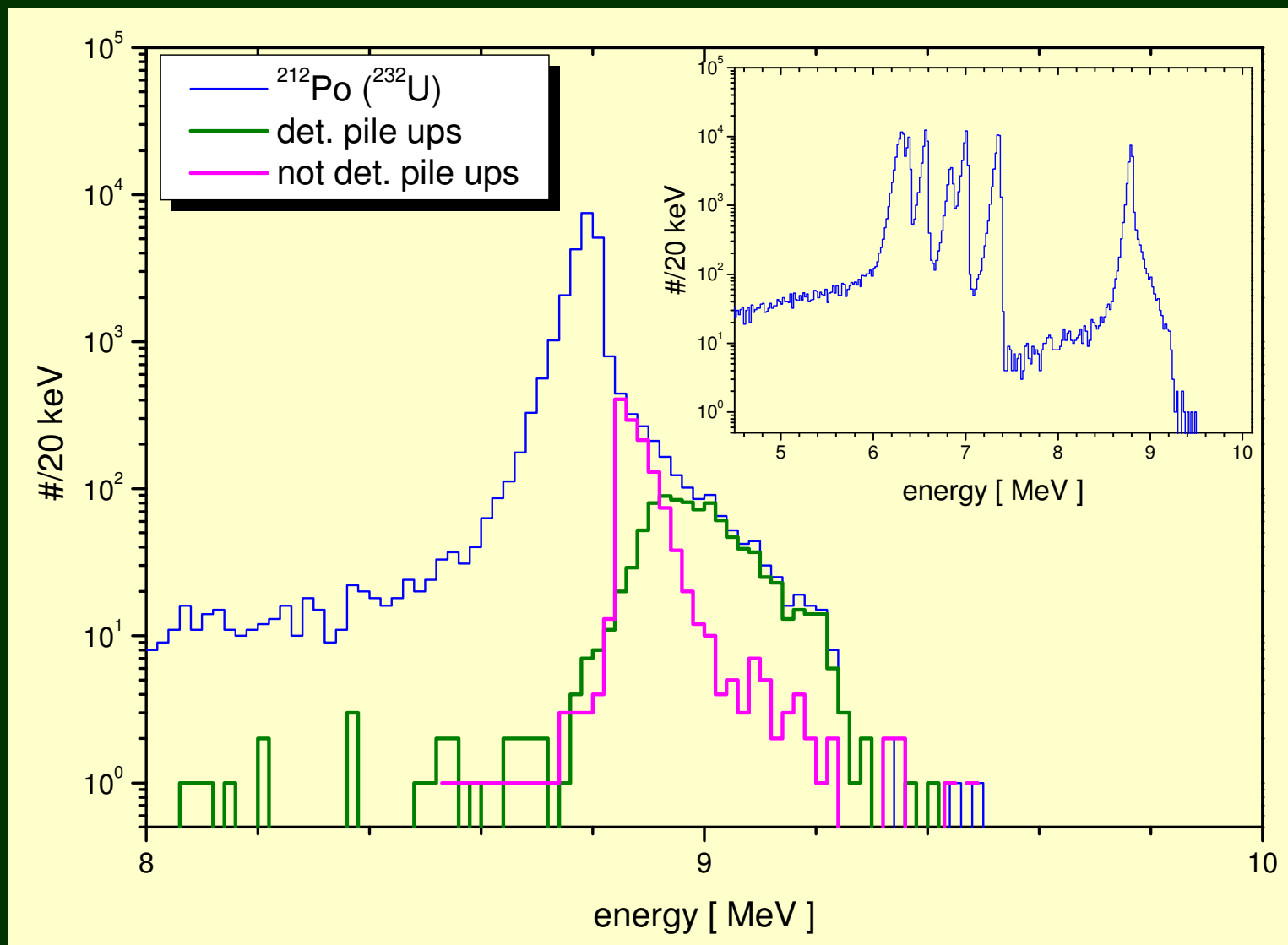
pile-up rejection DAQ electronics @ PSI





pure COLD (running @ 64 channels)

pile-up rejection DAQ electronics @ PSI



Acknowledgements



Accelerator and ECR crews:

U400, Philips cyclotron

LMN, Electronics group @ PSI

Tech-shops @ University Bern, PSI, FLNR

US Department of Energy (^{244}Pu)

U\$ Department of Energy

Ru\$\$\$ian Foundation for Ba\$ic Re\$earch

\$wi\$\$ National \$cience Foundation