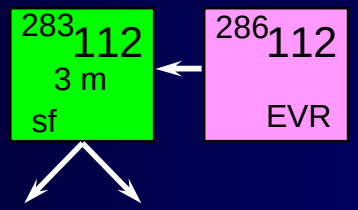
Status of the element 112 experiment

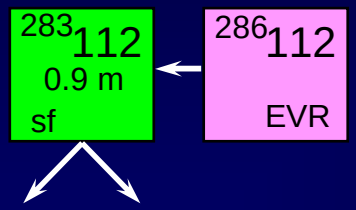
H.W. Gäggeler

For a GSI, PSI, Uni Bern, TU Munich, Uni Mainz, LBNL, FLNR collaboration

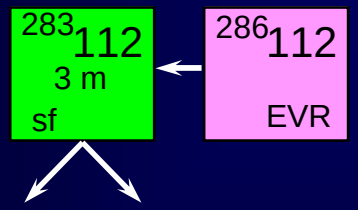
$^{238}U(^{48}Ca,3n)^{283}112$

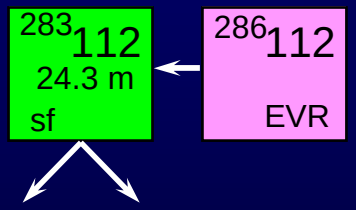
VASSILISSA





E* 33 MeV





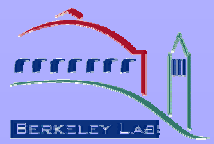
E* 35 MeV

Oganessian et al., 1999 & 2004

Periodic table of the elements

1																	18
1 H	2											13	14	15	16	17	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	3	4	5	6	7	8	9	10	11	12	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba		72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra		104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Uuu	112 Uub	113 Uut	114 Uuq	115 Uup	116 Uuh		

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr


S. Soverna
January 2004

Predictions for element 112

Relativistic

K.S. Pitzer, *J. Chem. Phys. 63*, 1032 (1975)

V. Pershina et al., *Chem. Phys. Lett.*, 365, 176 (2002)

Noble gas like

Volatile metal

Extrapolations

B. Eichler, *Kernenergie 10*, 307 (1976)

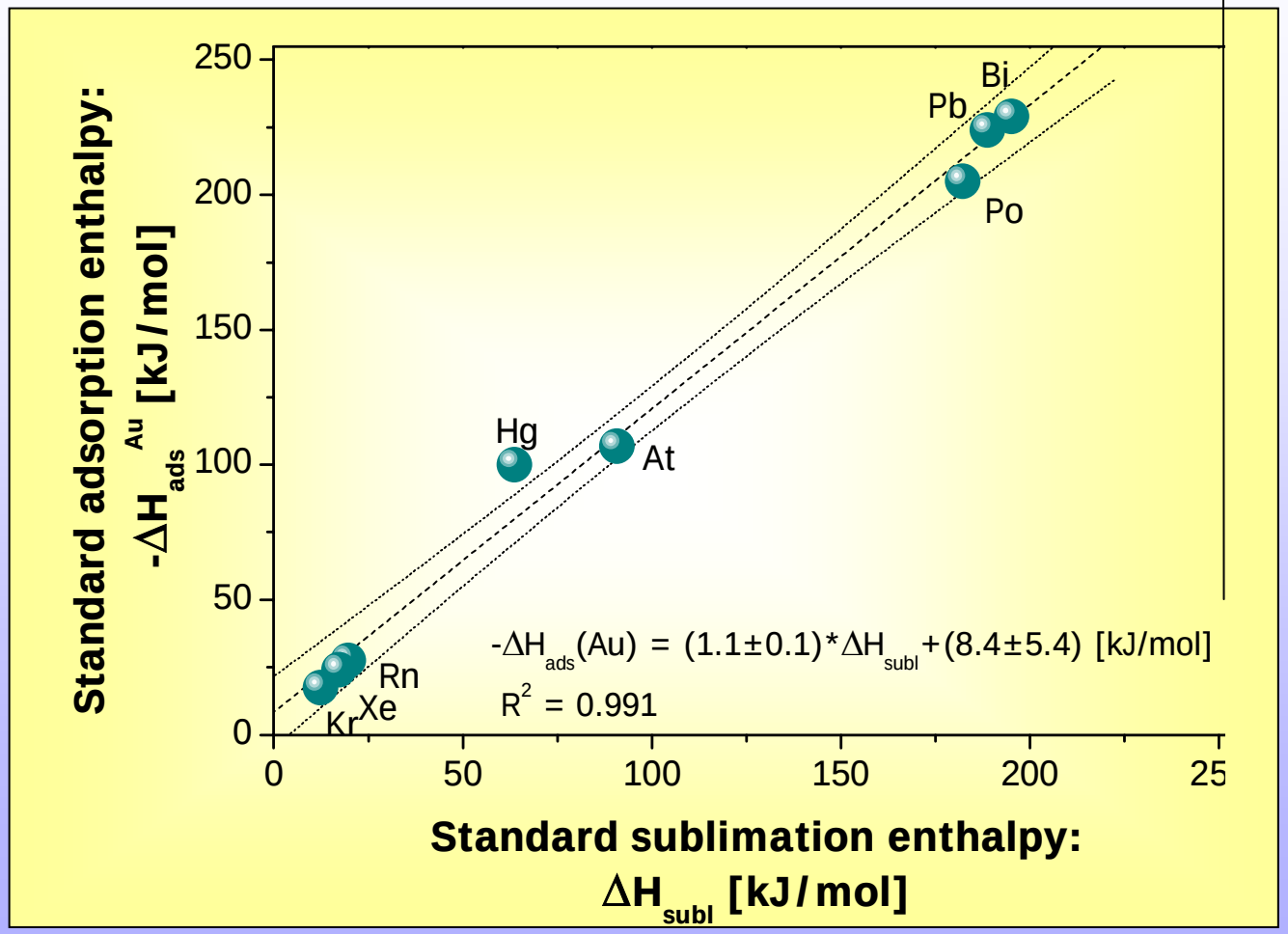
B. Eichler, *PSI Report 03-01*, Villigen (2000)

How to experimentally determine a metallic character at a single atom level?

→ Determine interaction energy (adsorption enthalpy) with (noble*) metals (e.g. Au)

** Easier to keep clean surface during experiment*

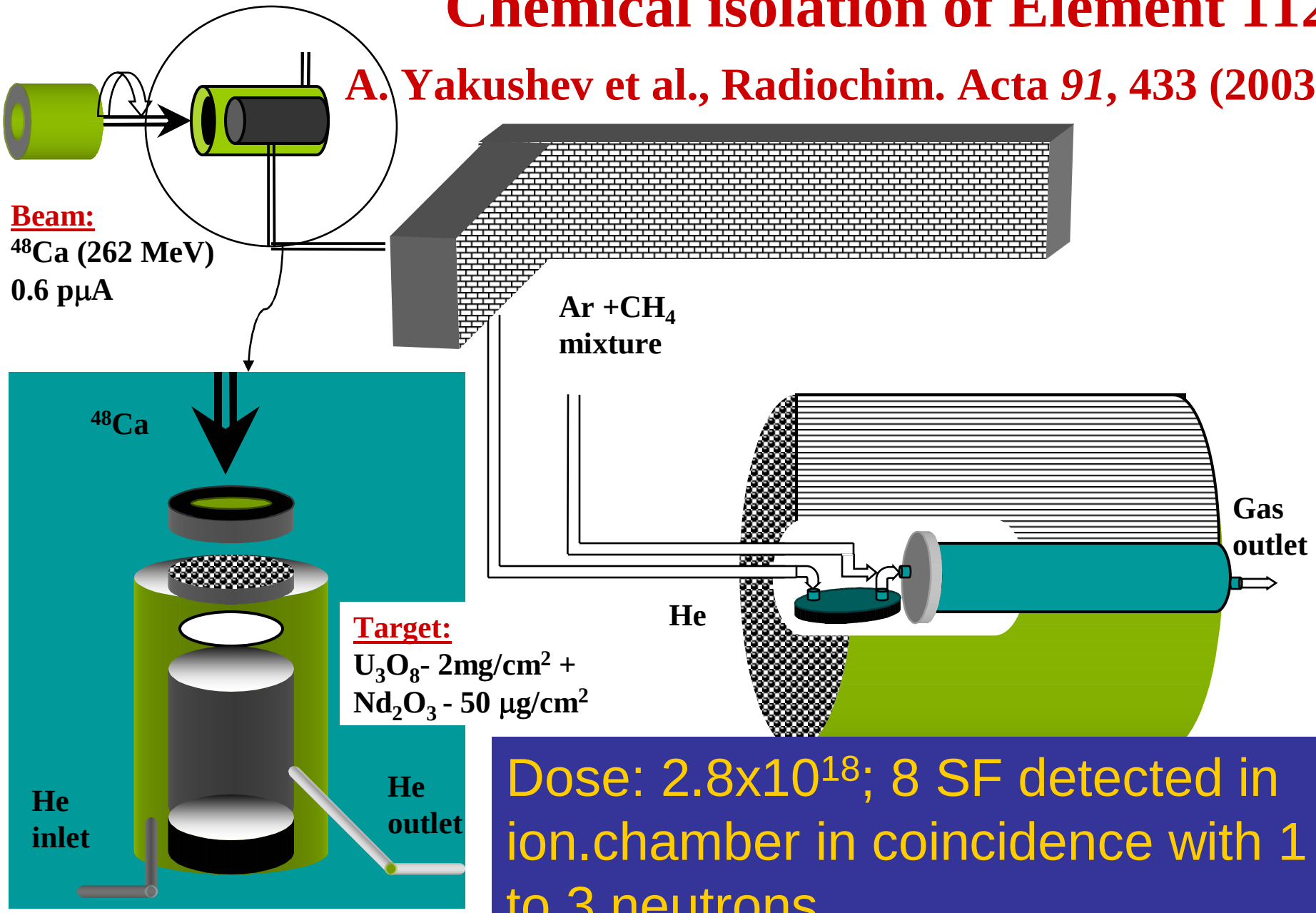
Correlation of $\Delta H_{ads}^{(Au)}$ with ΔH_{subl}



R. Eichler, to be published

Chemical isolation of Element 112

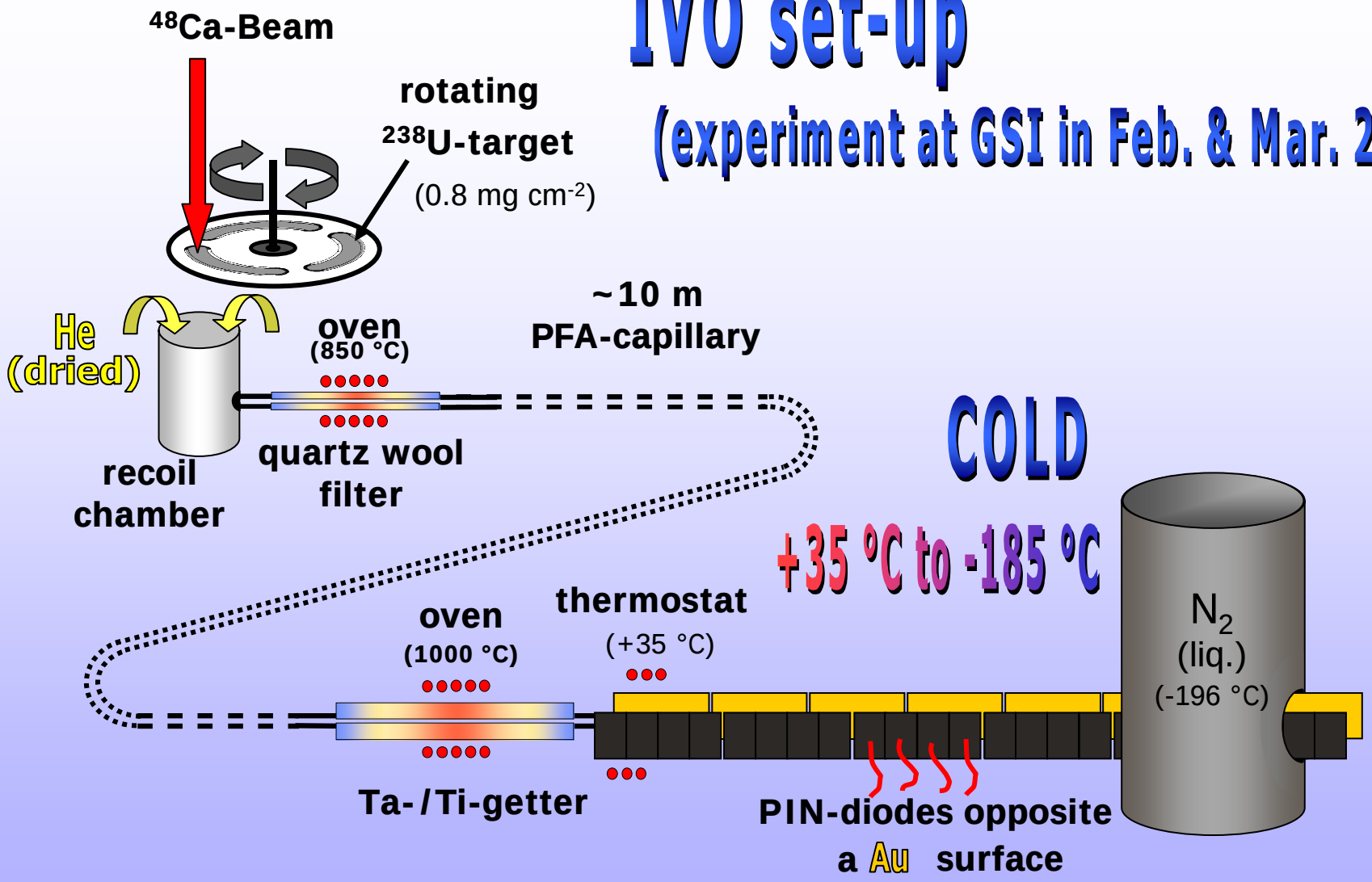
A. Yakushev et al., Radiochim. Acta *91*, 433 (2003)



Dose: 2.8x10^{18}; 8 SF detected in ion.chamber in coincidence with 1 to 3 neutrons

IVO set-up

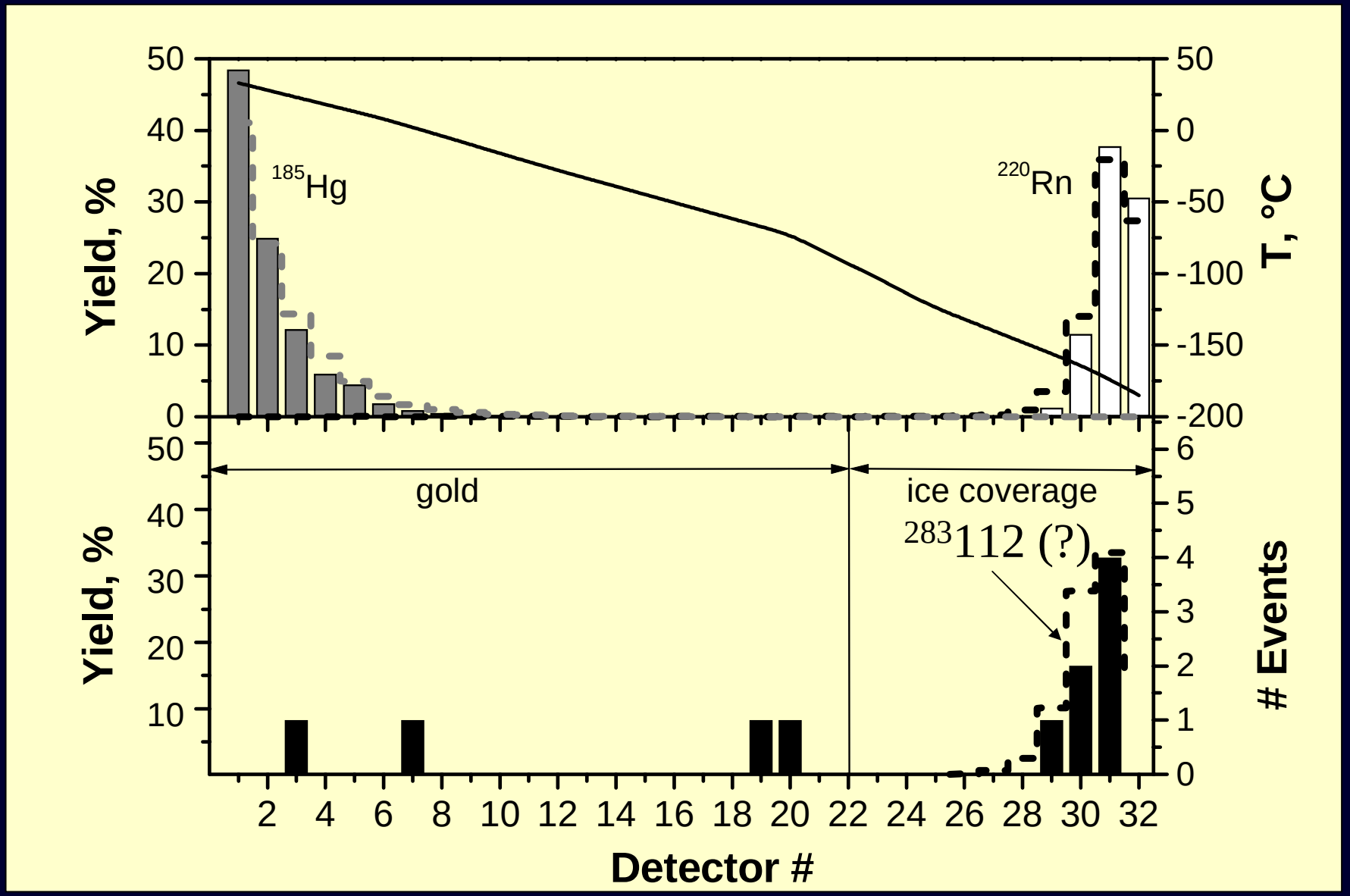
(experiment at GSI in Feb. & Mar. 2003)



S. Soverna
January 2004

Experiment GSI February-March 2003

$^{238}U(^{48}Ca, 3n)^{283}112$ (SF, 3min); Dose 2.8×10^{18}



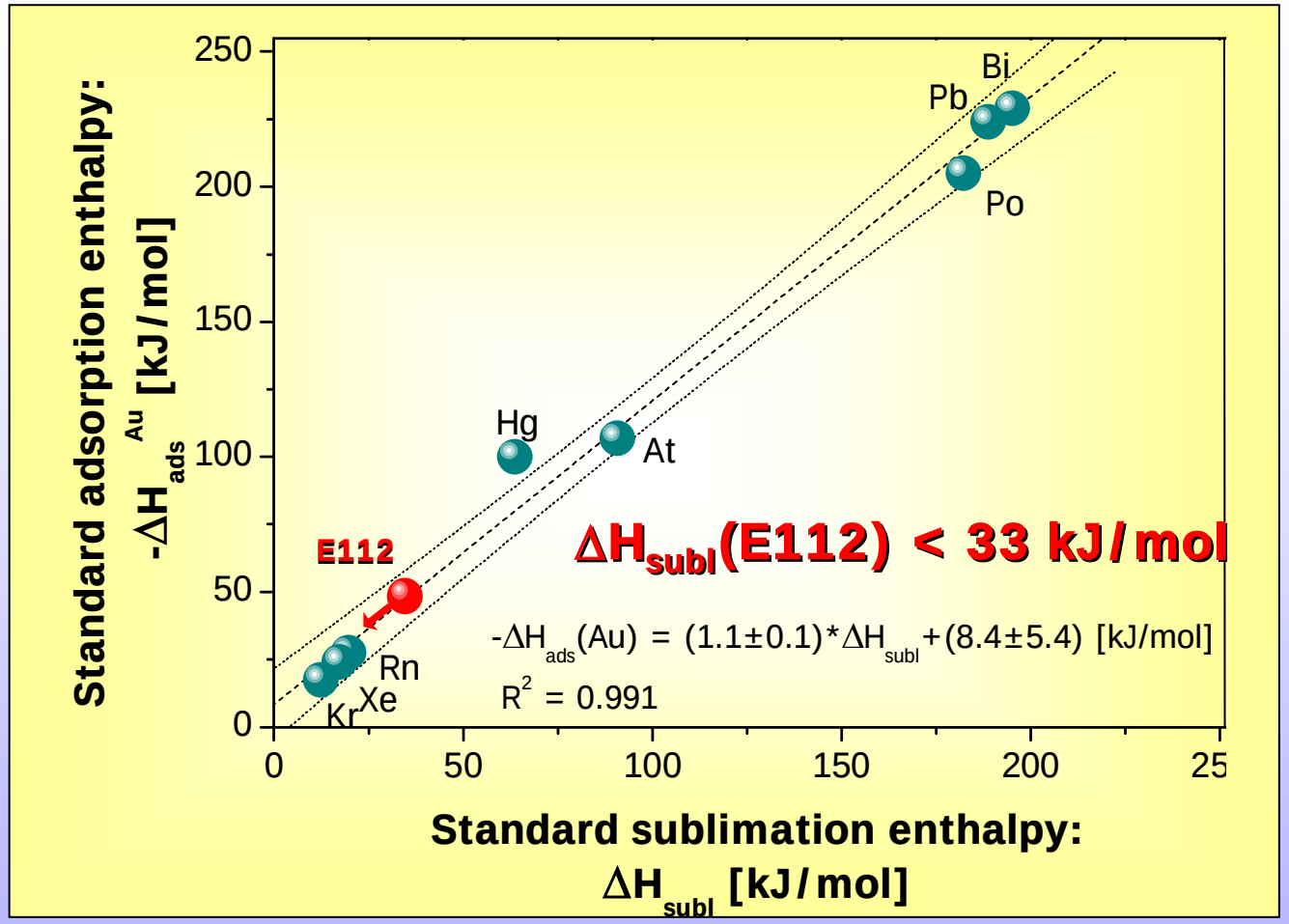
Current status on element 112 chemistry: Indication for

At FLNR: Isothermal chromatography on Au:

E112 does not adsorb at room temp. $\Delta H_a < 60$ kJ/mol (A. Yakushev et al.)

At GSI: Thermochromatography: E112 does not deposit on Au down to -90 °C $\Delta H_a < 48$ kJ/mol (S. Soverna et al.)

Correlation of $\Delta H_{ads}^{(Au)}$ with ΔH_{subl}



If high energy events due to element 112, then it is most likely gaseous under standard conditions

Both experiments not conclusive, because

→ Detection of SF activity not specific to assign it to a given (isotope of an) element.

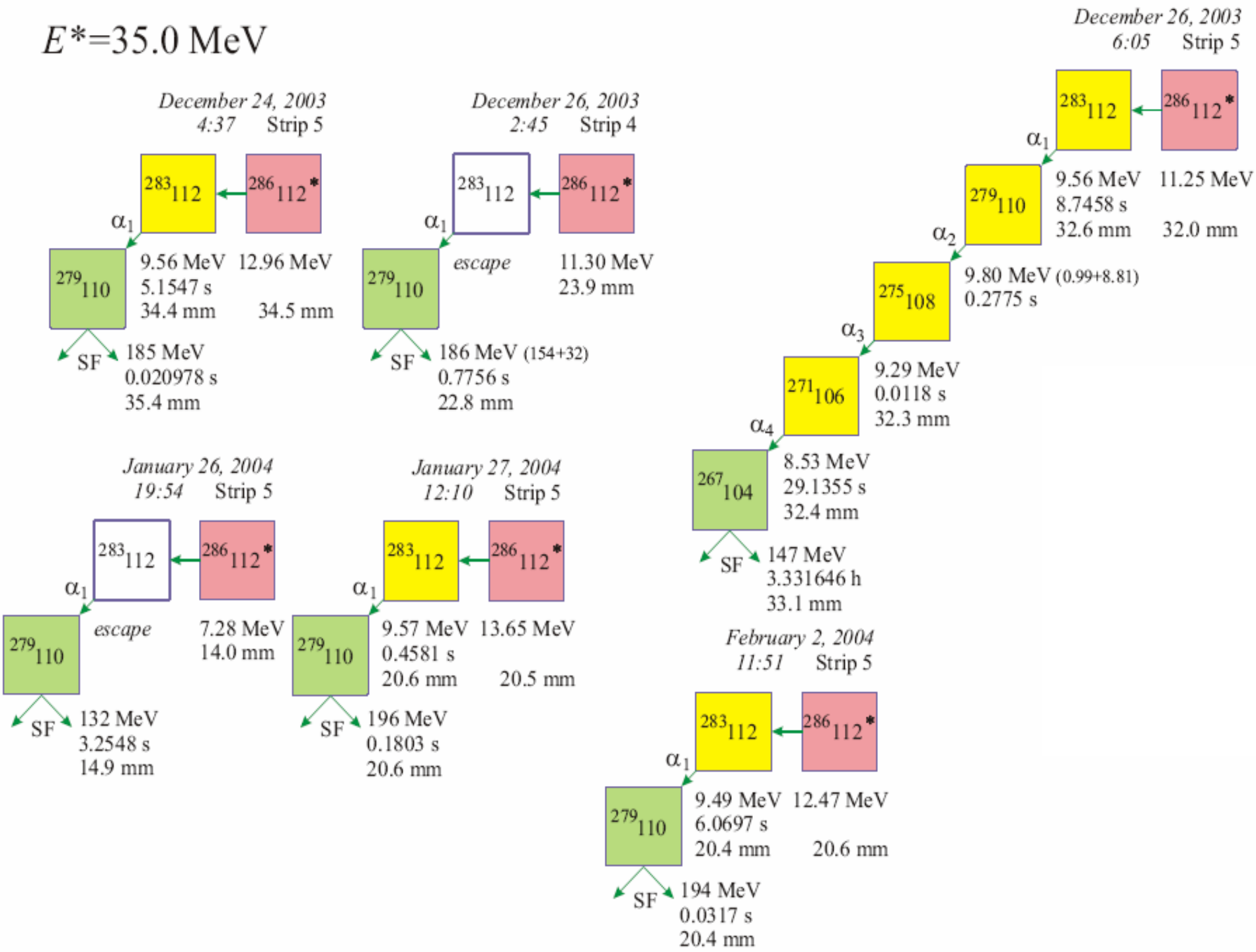
→ Fission fragment energies too low

(FLNR: ion. chamber; GSI: PIN-diodes)

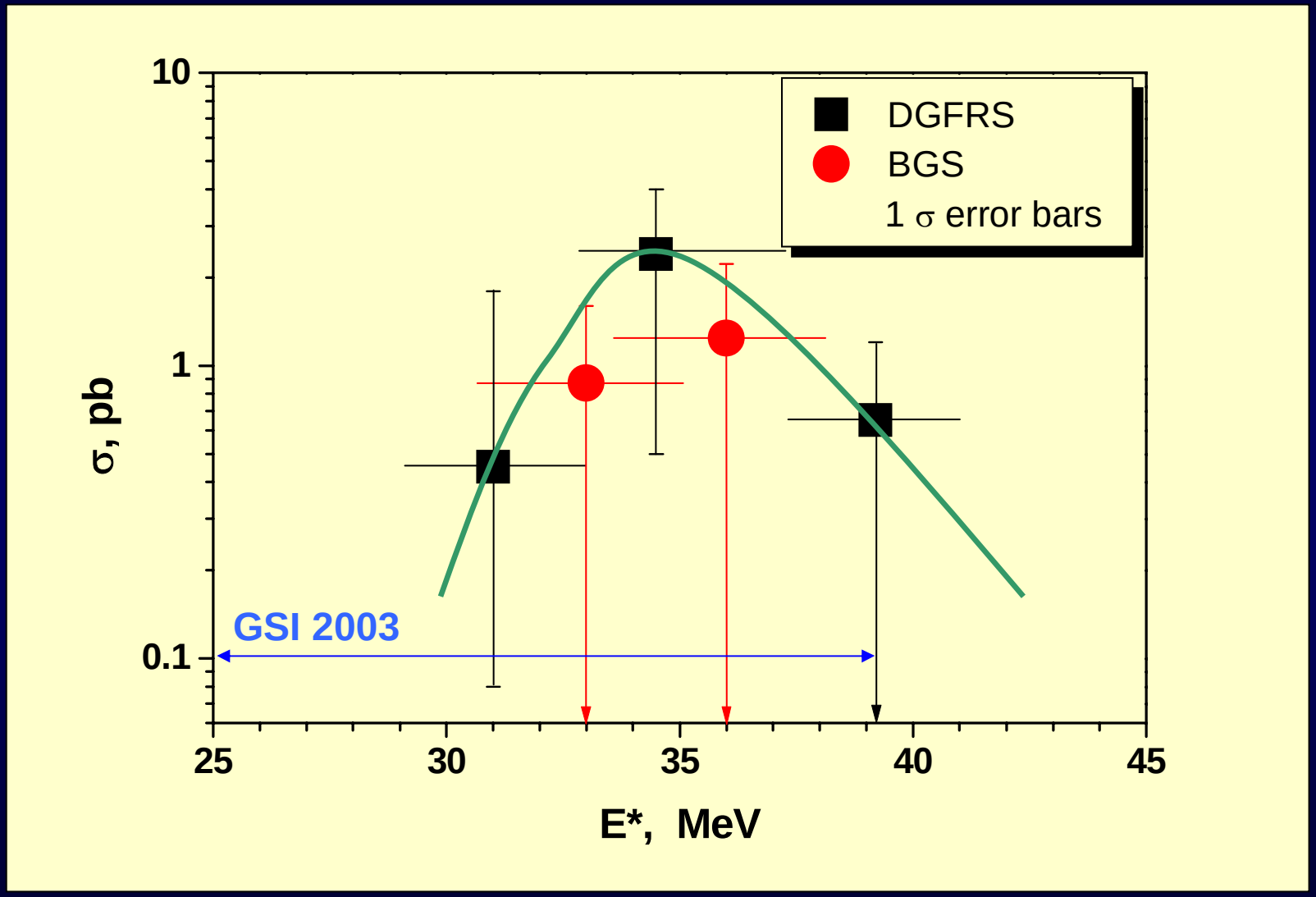
Even more concern:

- Several attempts to confirm Dubna findings failed at LBL (K.E. Gregorich at al): No observation of any evaporation residues using BGS at cross section limits being a factor of four below the claimed Dubna values
- Recent attempt to confirm the VASSILISSA result with DGFRS at FLNR failed also: no sf-activity was found but an α–decaying isotope discovered (Utyonkov, priv. comm.)

E^*=35.0 MeV


December 24, 2003
4:37 Strip 5
283112
286112*
α1
279110
9.56 MeV
5.1547 s
34.4 mm
12.96 MeV
34.5 mm
SF
185 MeV
0.020978 s
35.4 mm
December 26, 2003
2:45 Strip 4
283112
286112*
α1
279110
escape
11.30 MeV
23.9 mm
SF
186 MeV (154+32)
0.7756 s
22.8 mm
January 26, 2004
19:54 Strip 5
283112
286112*
α1
279110
escape
7.28 MeV
14.0 mm
SF
132 MeV
3.2548 s
14.9 mm
January 27, 2004
12:10 Strip 5
283112
286112*
α1
279110
9.57 MeV
0.4581 s
20.6 mm
13.65 MeV
20.5 mm
SF
196 MeV
0.1803 s
20.6 mm
December 26, 2003
6:05 Strip 5
283112
286112*
α1
9.56 MeV
8.7458 s
32.6 mm
11.25 MeV
32.0 mm
279110
α2
9.80 MeV (0.99+8.81)
0.2775 s
275108
α3
9.29 MeV
0.0118 s
32.3 mm
271106
α4
8.53 MeV
29.1355 s
32.4 mm
267104
SF
147 MeV
3.331646 h
33.1 mm
February 2, 2004
11:51 Strip 5
283112
286112*
α1
279110
9.49 MeV
6.0697 s
20.4 mm
12.47 MeV
20.6 mm
SF
194 MeV
0.0317 s
20.4 mm

$^{238}U(^{48}Ca,3n)^{283}112$



What‘s next ?

Repeat GSI experiment with improved set-up

September 2004

- 4π COLD
  higher detection efficiency: single α-decay: 88 %
  SF-decay: 76 % (coinc.)

- Faster transport time ≈ 2 s (sensitive to long-lived sf and short-lived α–emitters)

- Closed loop for the carrier gas (less water vapor)

3RD INTERNATIONAL CONFERENCE ON THE CHEMISTRY AND PHYSICS OF THE TRANSACTINIDE ELEMENTS

http://tan07.web.psi.ch

SEPTEMBER 23-28, 2007 DAVOS, SWITZERLAND

August 2004

The Third International Conference of the Chemistry and Physics of the Transactinide Elements (TAN 07) will be held September 23-28, 2007 in Davos, Switzerland. This conference is the continuation of TAN 03, the Second International Conference on the Chemistry and Physics of the Transactinide Elements that was held in Napa, California, USA during November 2003. Davos is located in a picturesque mountainous area in eastern Switzerland at an altitude of 1560 m asl.

Preliminary Schedule:

First Circular	September 2006
Deadline for Questionnaire	October 31, 2006
Second Circular and Call for Abstracts	December 2006
Deadline for Abstracts	February 28, 2007
Authors Notification and Deadline for Registration	April 30, 2007
Third Circular and Final Program	June 2007