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U.S. DEPARTMENT OF
ENERGY

Element 114 produced in $^{48}\text{Ca} + ^{242}\text{Pu}$ at LBNL

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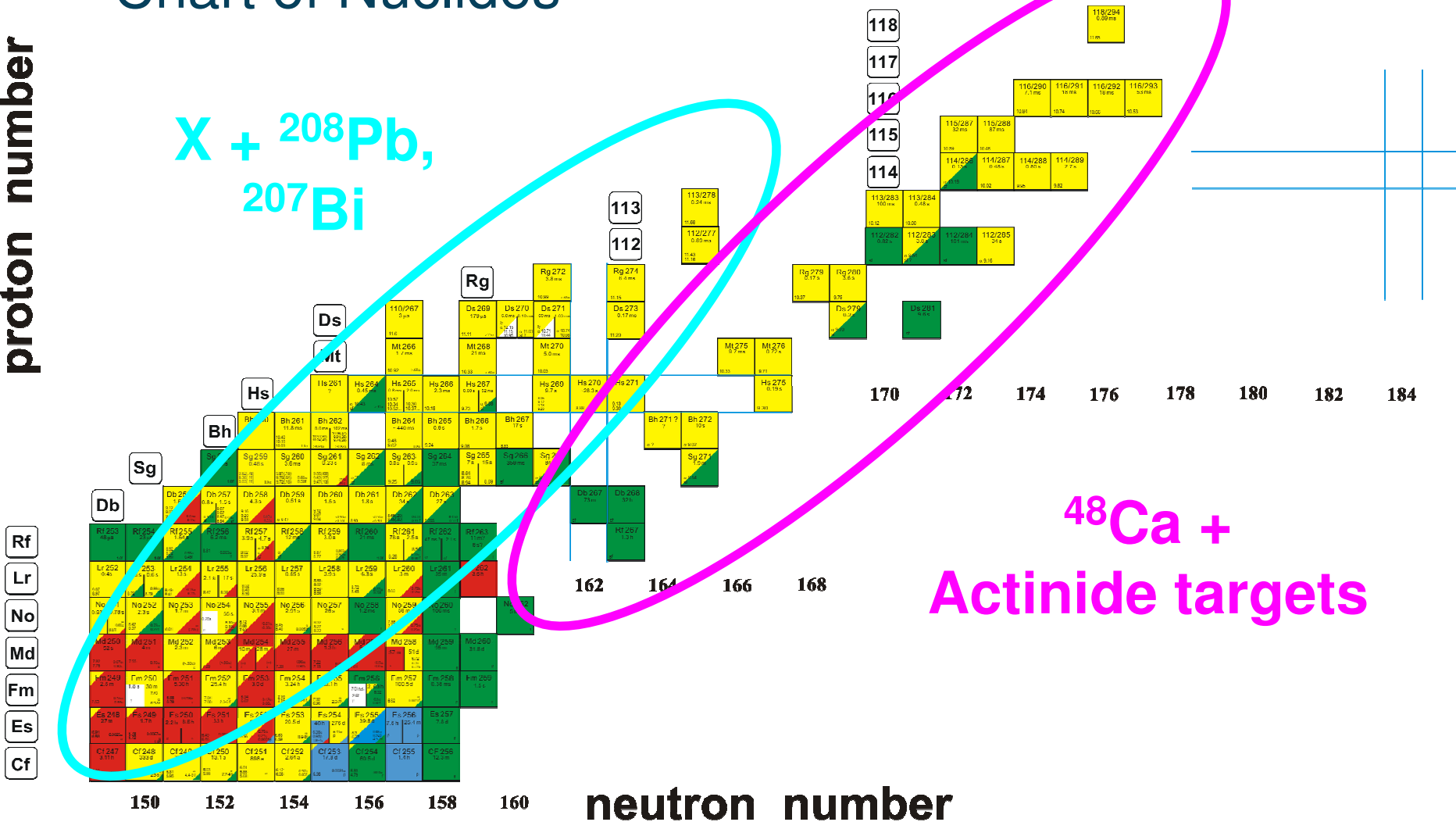
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Chart of Nuclides

proton number

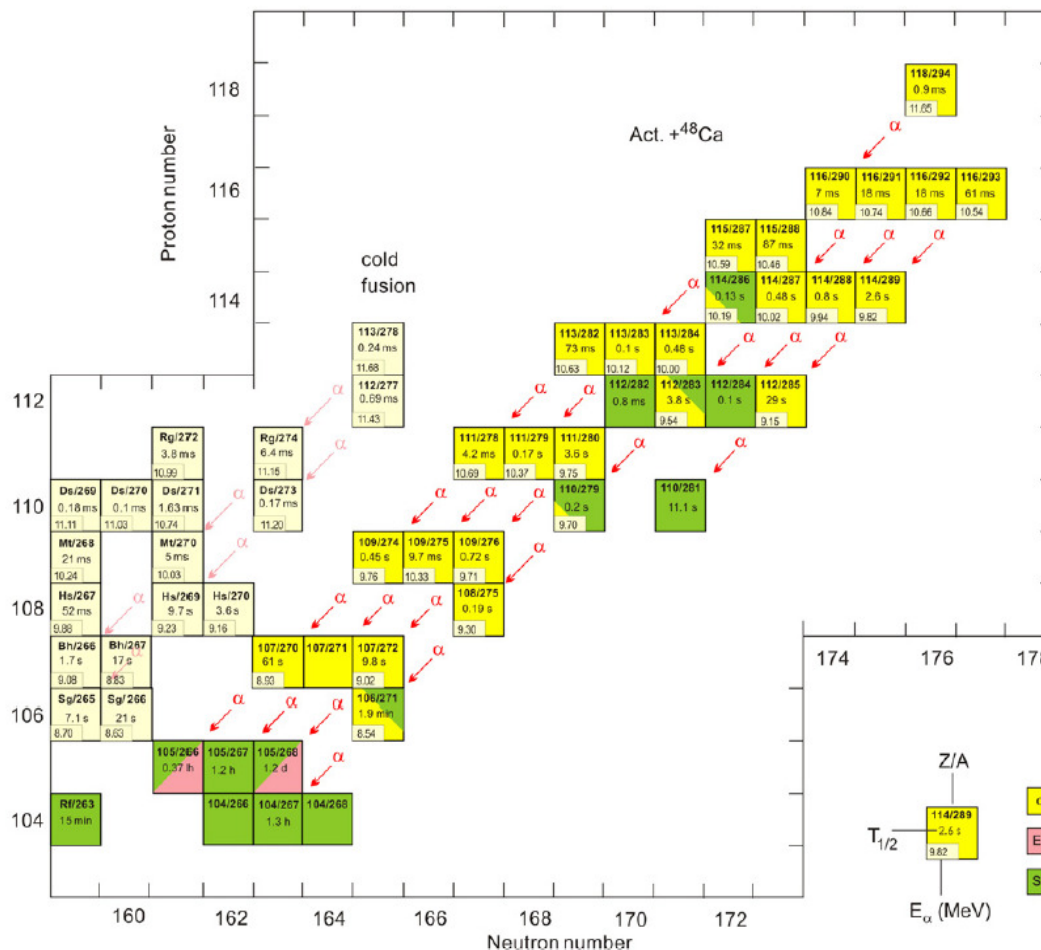
$X + {}^{208}\text{Pb},$
 ${}^{207}\text{Bi}$

${}^{48}\text{Ca} +$
Actinide targets



SHE synthesized in $^{48}\text{Ca} + \text{X}$ at JINR in last 10 years

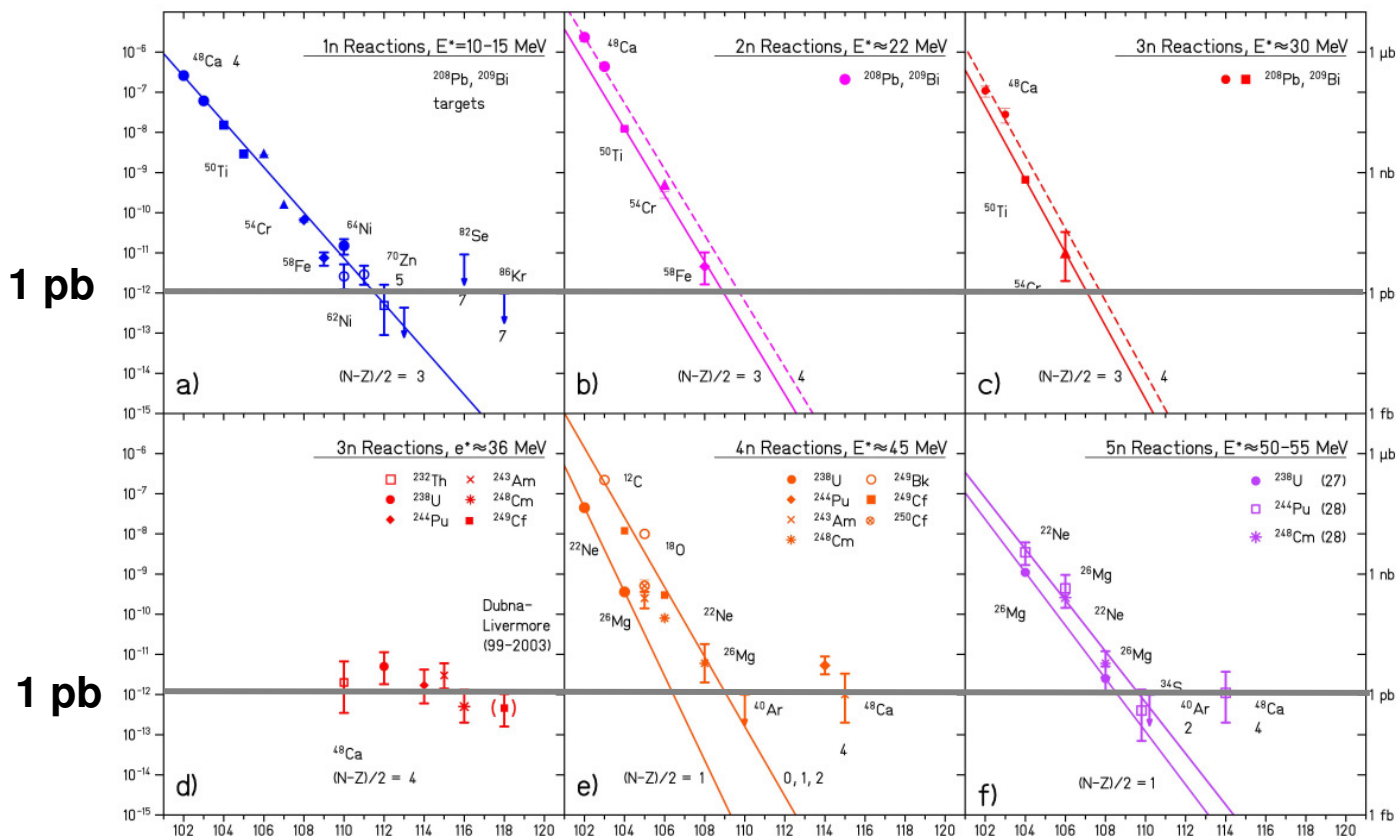
Decay chains finished with SF
 \rightarrow separated from the known nuclei



Oganessian *et al.*, Journal of Physics G: Nuclear and Particle Physics, **34**, R165-R242 (2007)

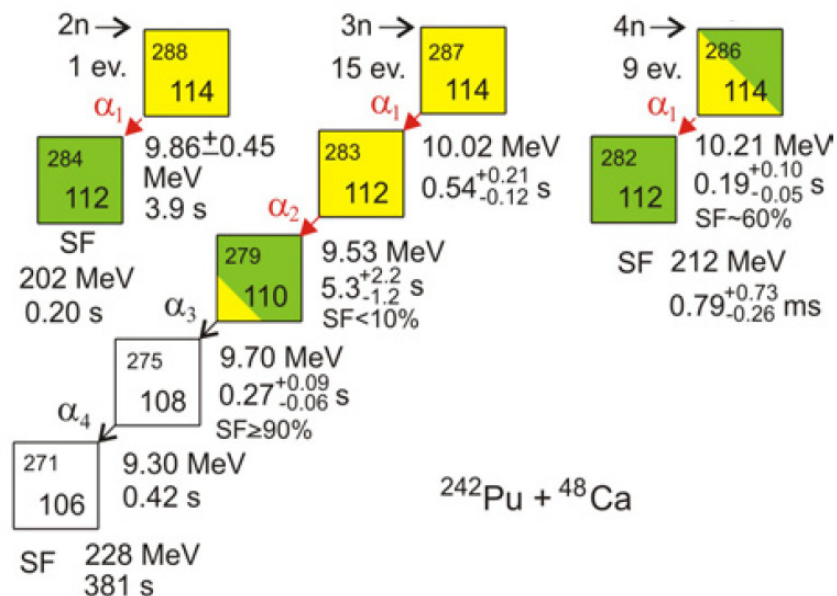
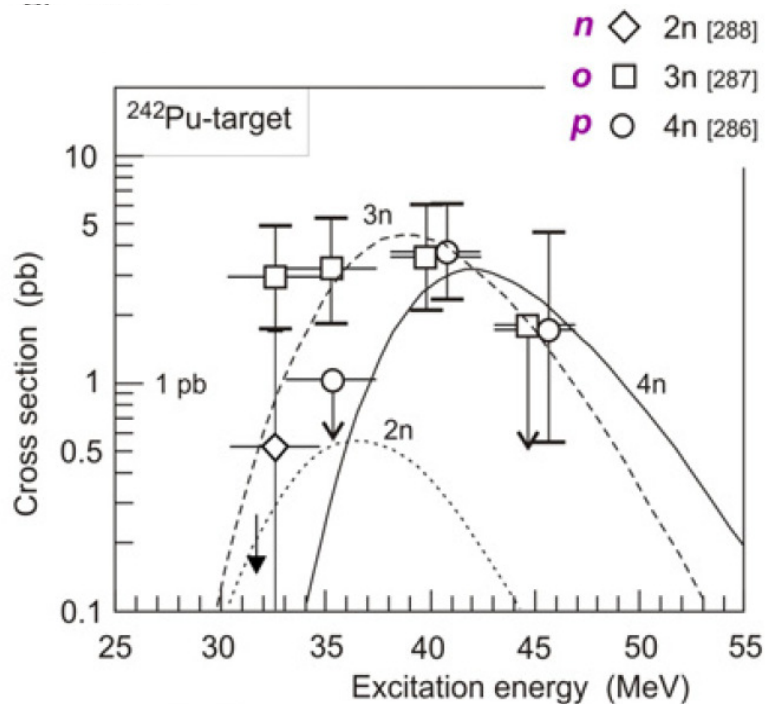
Comparison of σ of Cold / Hot fusion reactions

Cold fusion (GSI)
based on
Pb and Bi targets



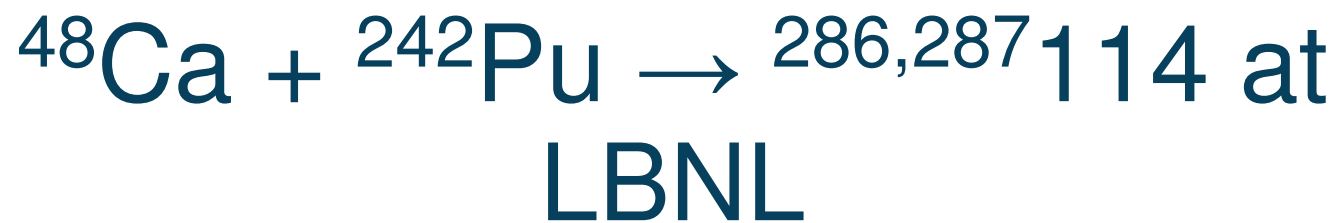
S. Hofmann

Dubna results of $^{242}\text{Pu}(^{48}\text{Ca}, 2-4n)^{288-286}114$



Oganessian *et al.*, J. Phys. G **34**, R165 (2007)

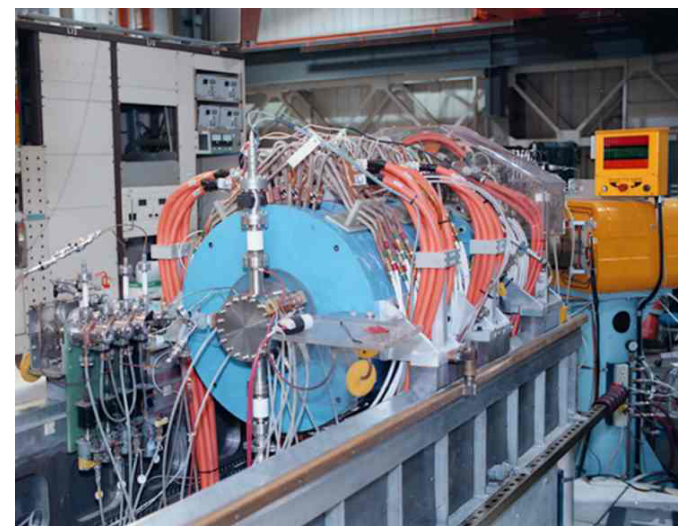
- 24 decay chains in 2-4n channels
- $\sigma_{3n} = 3.6 \text{ pb}$, $\sigma_{4n} = 4.5 \text{ pb}$ @ $E_{\text{LAB}} = 244 \text{ MeV}$ / $E^* = 41 \text{ MeV}$



21-30. January 2009

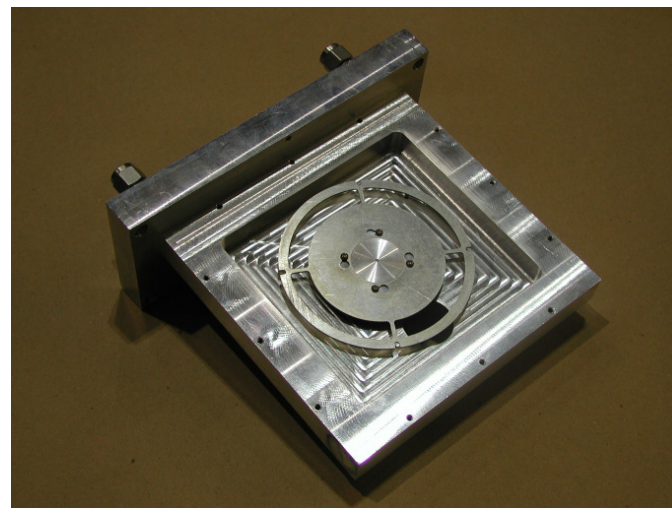
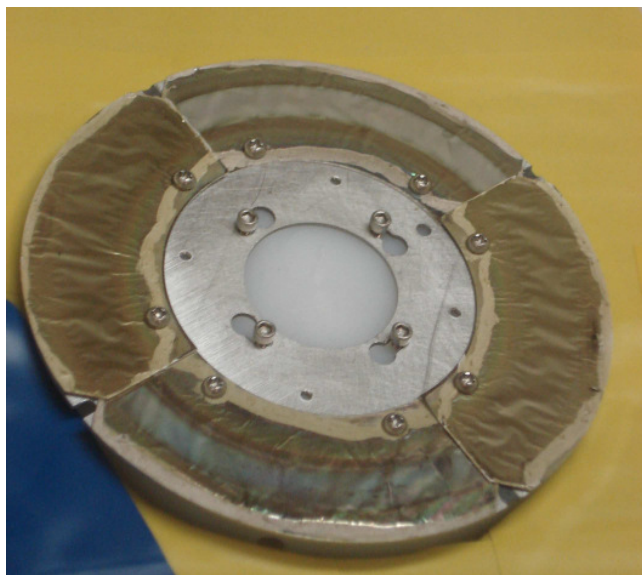
^{48}Ca beam at 88" cyclotron at LBNL

- 8 days of $^{48}\text{Ca}^{11+}$ beam from AECR source
- Average intensity $I=300\text{-}400$ pA,
- Energy in the center of the target
 $E_{\text{LAB}} = 244$ MeV, $E^* = 41$ MeV
- Beam intensity and target integrity controlled online by Rutherford detectors



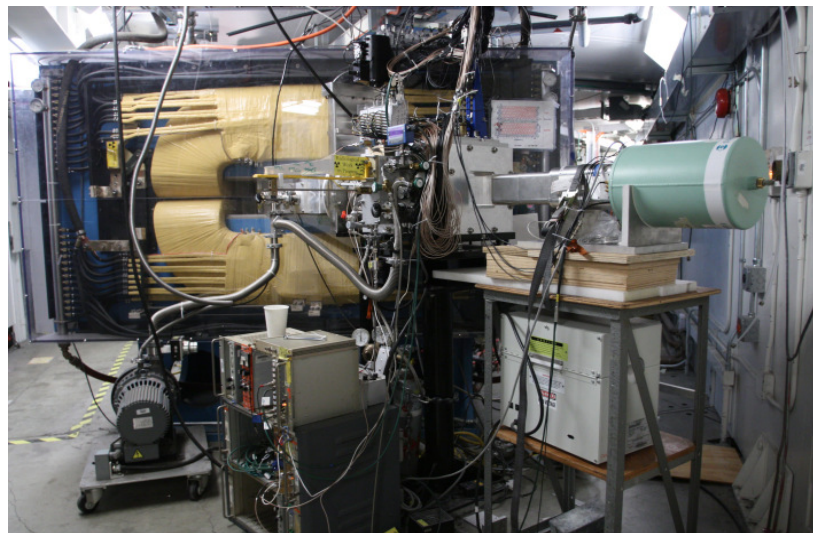
^{242}Pu targets

- 4 segments with 440, 340, 320, and 270 $\mu\text{g}/\text{cm}^2$ of PuO_2 (>99.9% ^{242}Pu)
- 2.4 μm Ti backing



BGS

- First rigidity guess $B \rho = 2.18$ Tm, later changed to $B \rho = 2.24$ Tm,
- Transmission efficiency $\sim 60\%$
- Focal plane detector covers 9% in $B \rho$
- Ge clover detector behind BGS



Results – 2 decay chains observed + 2 SF-like events

Strip 14

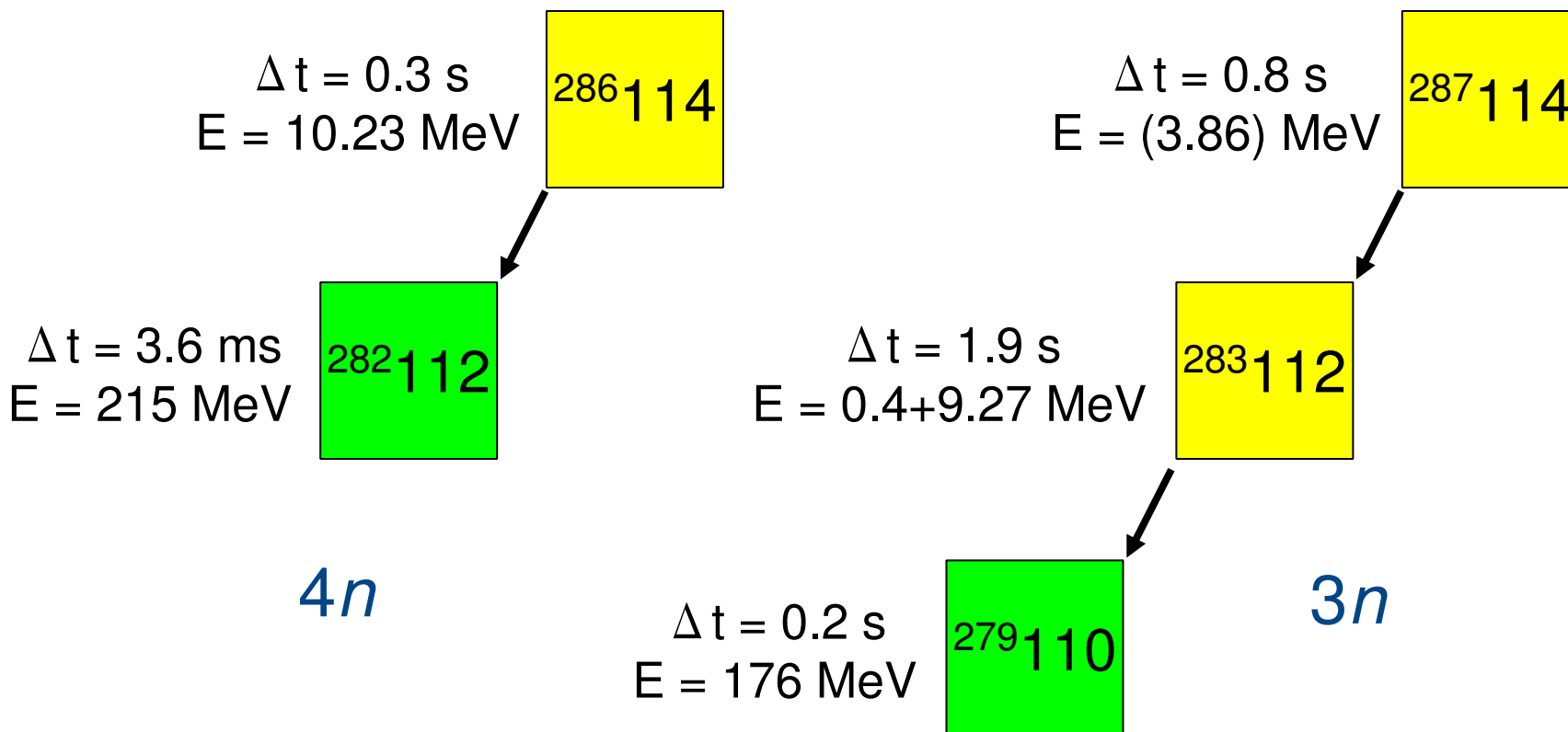
$$E_{\text{EVR}} = 11.55 \text{ MeV}$$

$$B_{\rho} = 2.28 \text{ Tm}$$

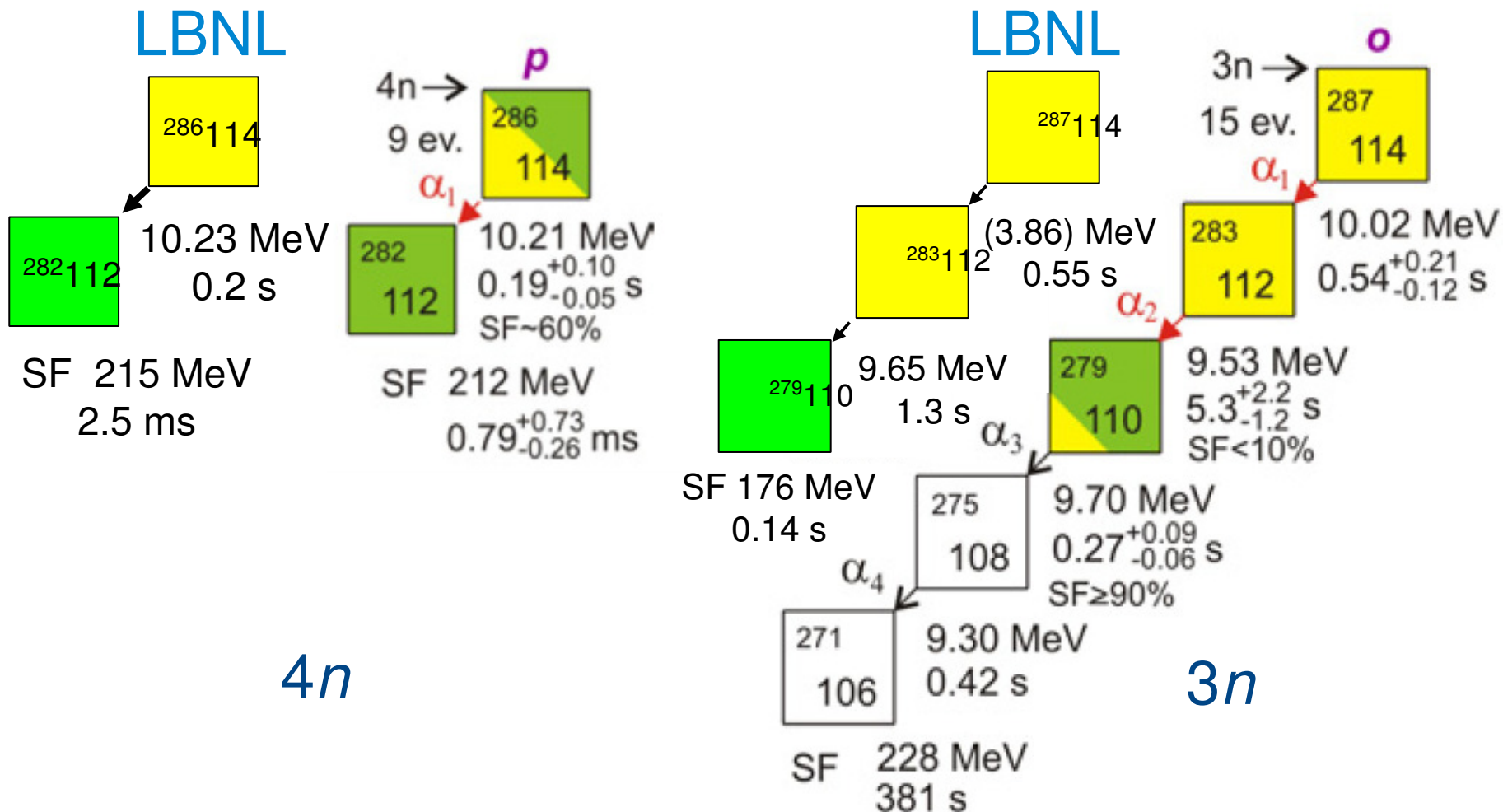
Strip 7

$$E_{\text{EVR}} = 7.73 \text{ MeV}$$

$$B_{\rho} = 2.25 \text{ Tm}$$



Comparison with Dubna chains



Random rates

TABLE III. Expected numbers of random correlations for sequences: EVR-like event followed by SF, α -SF, and α - α -SF, for the two parts of the experiment, referred to by the magnetic settings of the separator. The evaluated random rates are calculated for a ± 1.5 -mm vertical position window and a time window of 20 seconds.

	2.18 Tm setting	2.24 Tm setting
EVR-SF	0.022	6.3×10^{-4}
EVR- α -SF	4.3×10^{-7}	3.7×10^{-8}
EVR- α - α -SF	1.0×10^{-10}	2.8×10^{-12}

Stavsetra *et al.*, Physical Review Letters, **103**, 132502 (2009)

Cross section

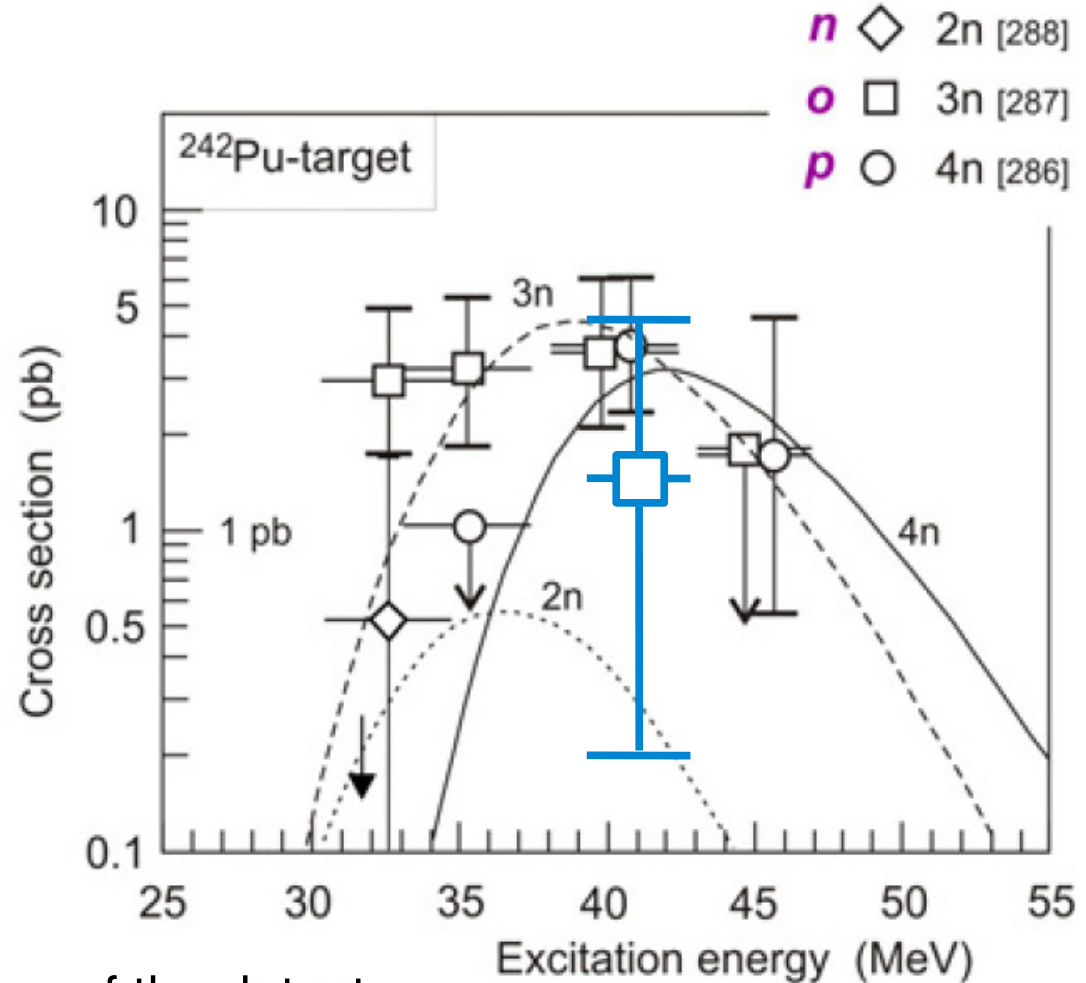
6 chains expected, got
2 (9% probability)



$$\sigma_{3n} = \sigma_{4n} = 1.4^{+3.2}_{-1.2} \text{ pb}$$

Note:

both events at high B_ρ edge of the detector
→ lower efficiency if the real $B_\rho > 2.3 \text{ Tm}$



Conclusion

- Element 114 produced in $^{242}\text{Pu}(^{48}\text{Ca},3-4n)^{287-286}114$ at LBNL
- Decay properties in agreement with those reported from Dubna
- Measured cross section lower than expected, but it can be a matter of statistics
- If you want to know more:

Stavsetra *et al.*, Physical Review Letters, **103**, 132502 (2009)



+ Liv Stavsetra

Thank you for your attention