# Core-breaking and octupole low-spin states in $^{207}$Tl

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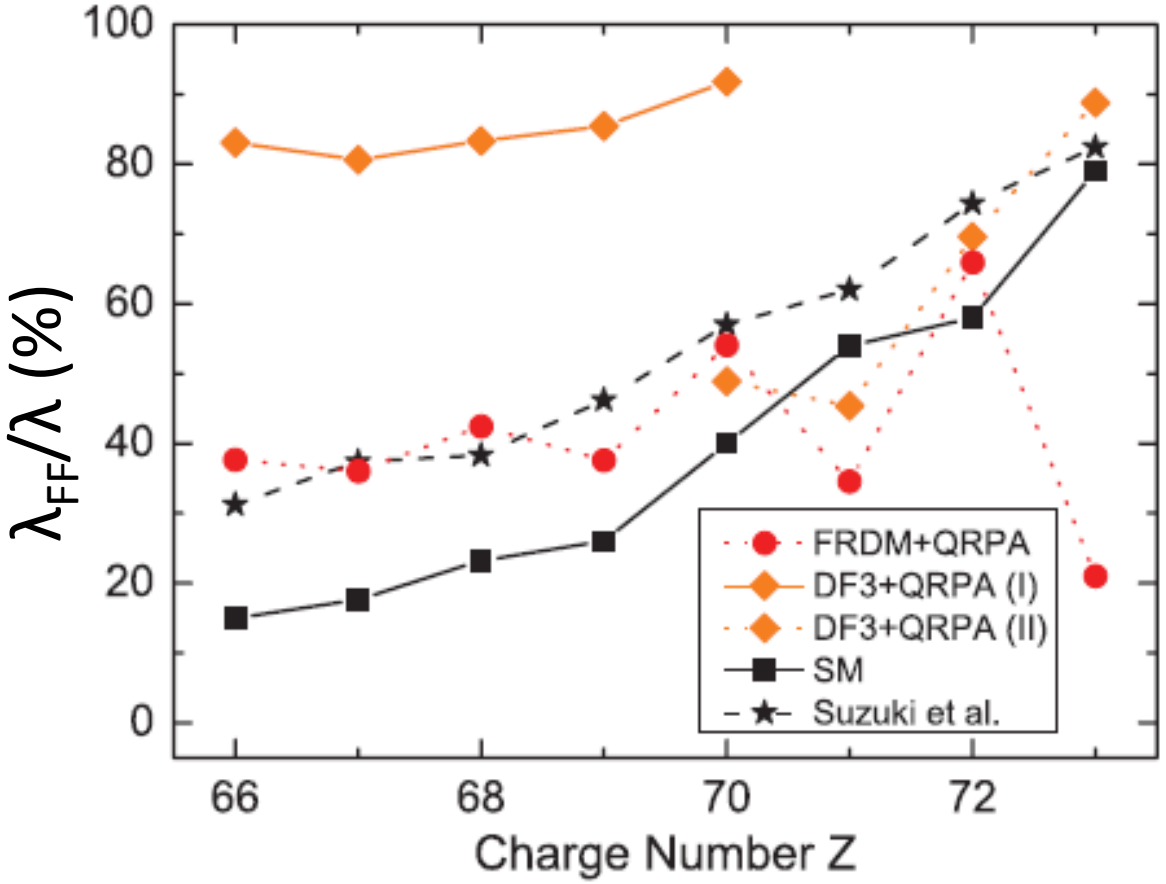
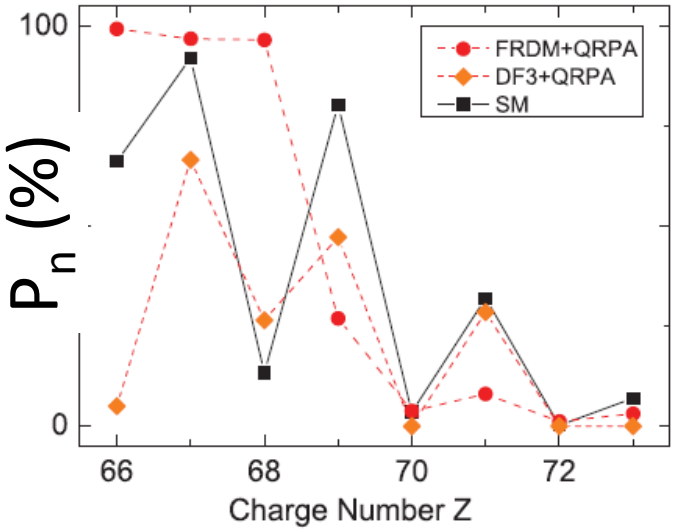
# What do we know?

| | | | | |
|---|---|---|---|---|
| **208Pb** Core | **209Pb** Yrast + ~3 | **210Pb** Yrast + ~4 | **211Pb** see Benzoni | **212Pb** see Benzoni |
| **207Tl** g.s. ½+ Yrast~35/2 | 208Tl g.s. (5+) | 209Tl gs.(1/2+) | 210Tl g.s. (5+) | 211Tl |
| **206Hg** Yrast till (13-) | 207Hg gs.(9/2+) | | | |
| **205Au** yrast | | | | |
| **204Pt** yrast | | | | |
| **203Ir** yrast | | | | |

Decay of 207Hg:
core-excitations => size of shell gap
coupling of 3- (structure of 3- ?)
ideal for studying fist-forbidden transitions;
crucial for heavy nuclei r-process;

Beta-decay studies (into 208Pb, 209Pb, 207Tl) performed at least 30 years ago
Only structure discussion (not decay)



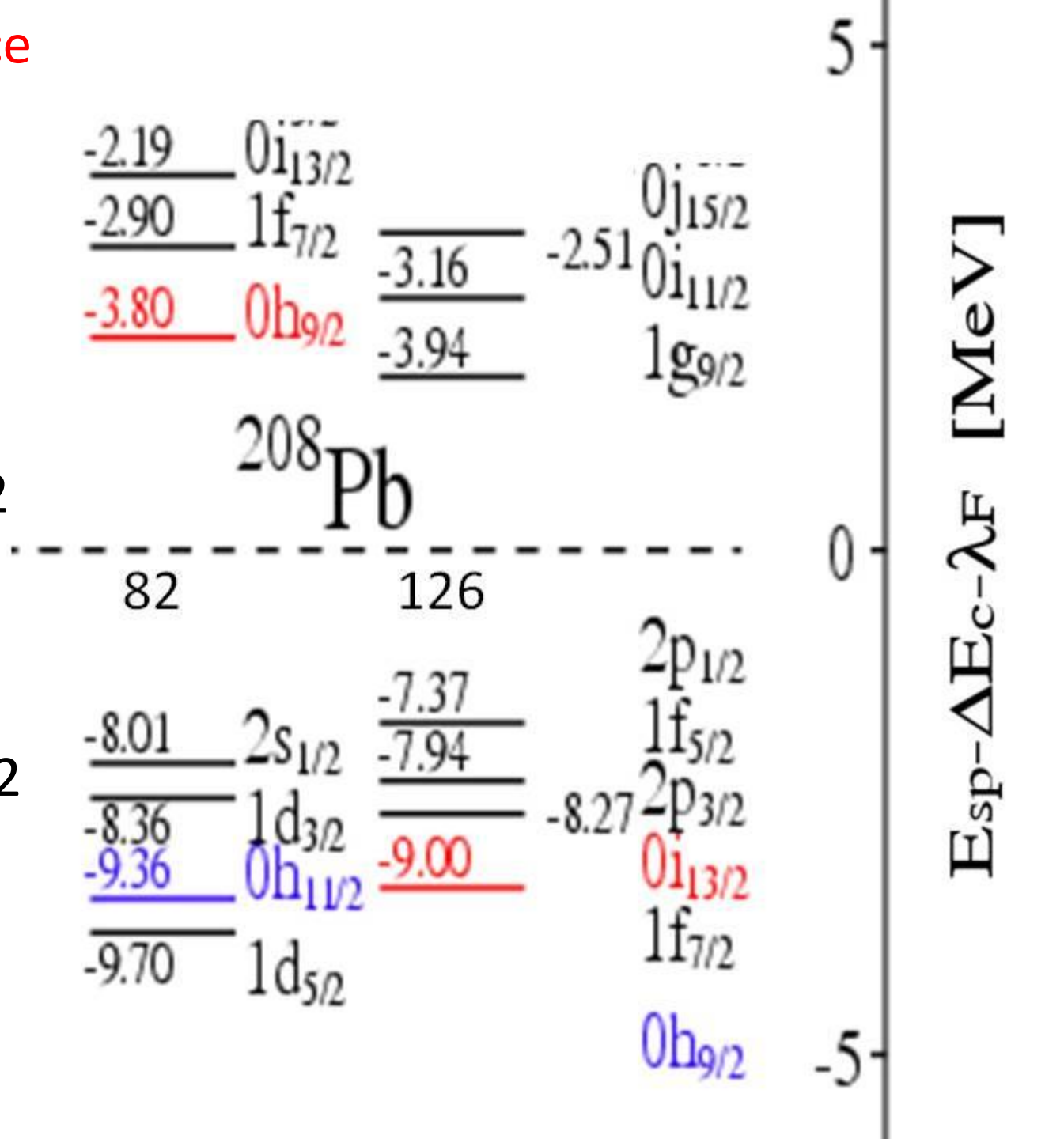




Q. Zhi, E. Caurier, J.J. Cuenca-Garcia, K. Langanke, G. Martinez-Pinedo, K. Sieja, Phys. Rev. C 87, 025803 (2013)

# Shell model space

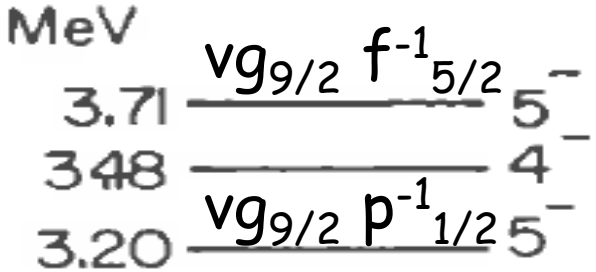
Allowed GT:
νh9/2 -> π h11/2

First-forbidden:
νp1/2->πd3/2
νi13/2 -> π h11/2



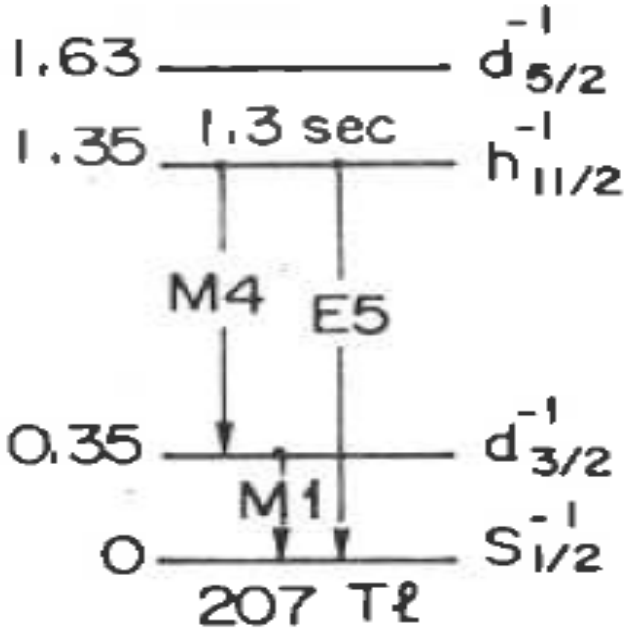
Single-proton hole states


Core excitations



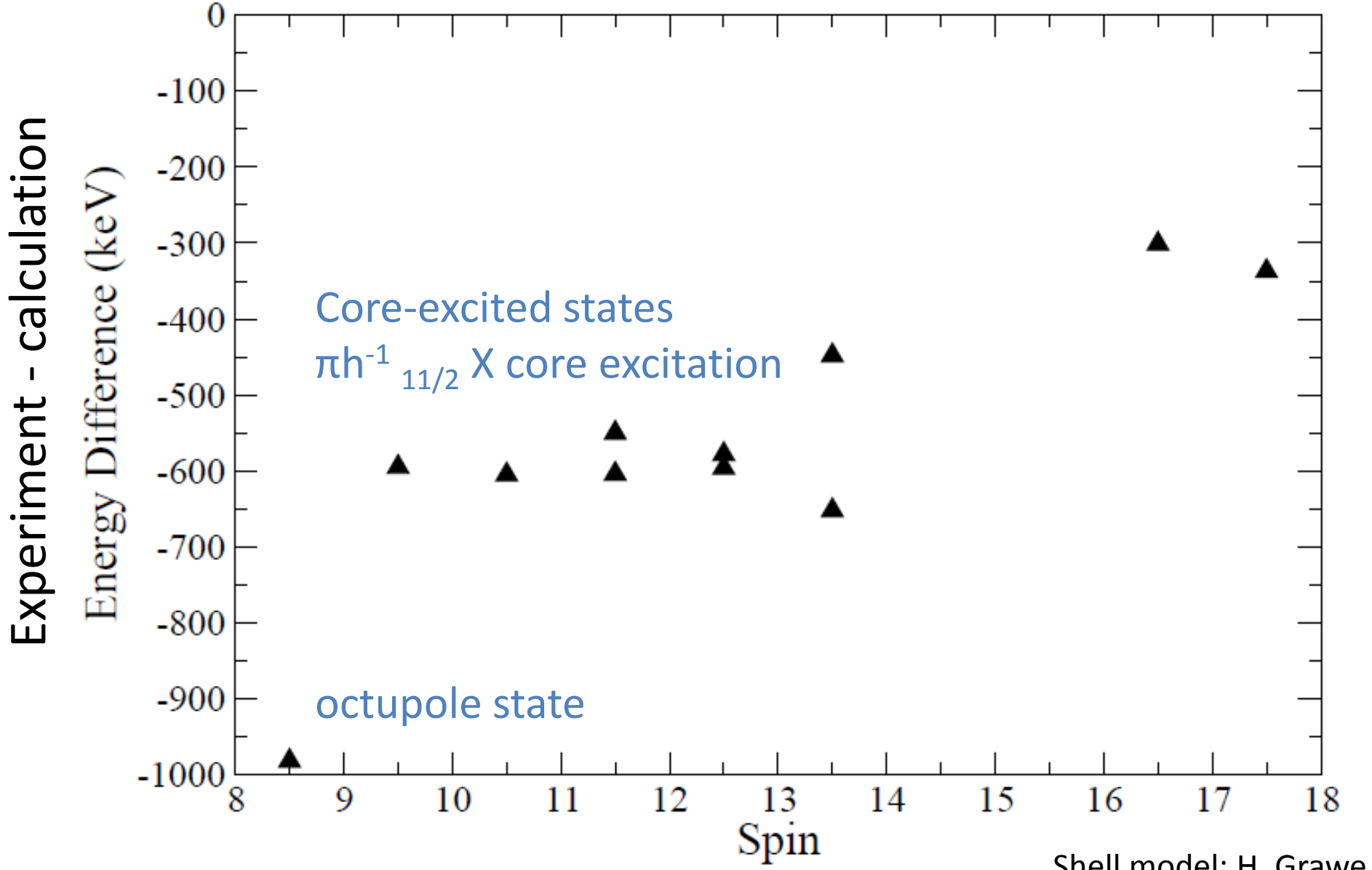


Octupole state




# $^{207}$Tl: yrast states

Yrast states populated in $^{208}$Pb+$^{208}$Pb at Gammasphere (to be published)




Shell model: H. Grawe

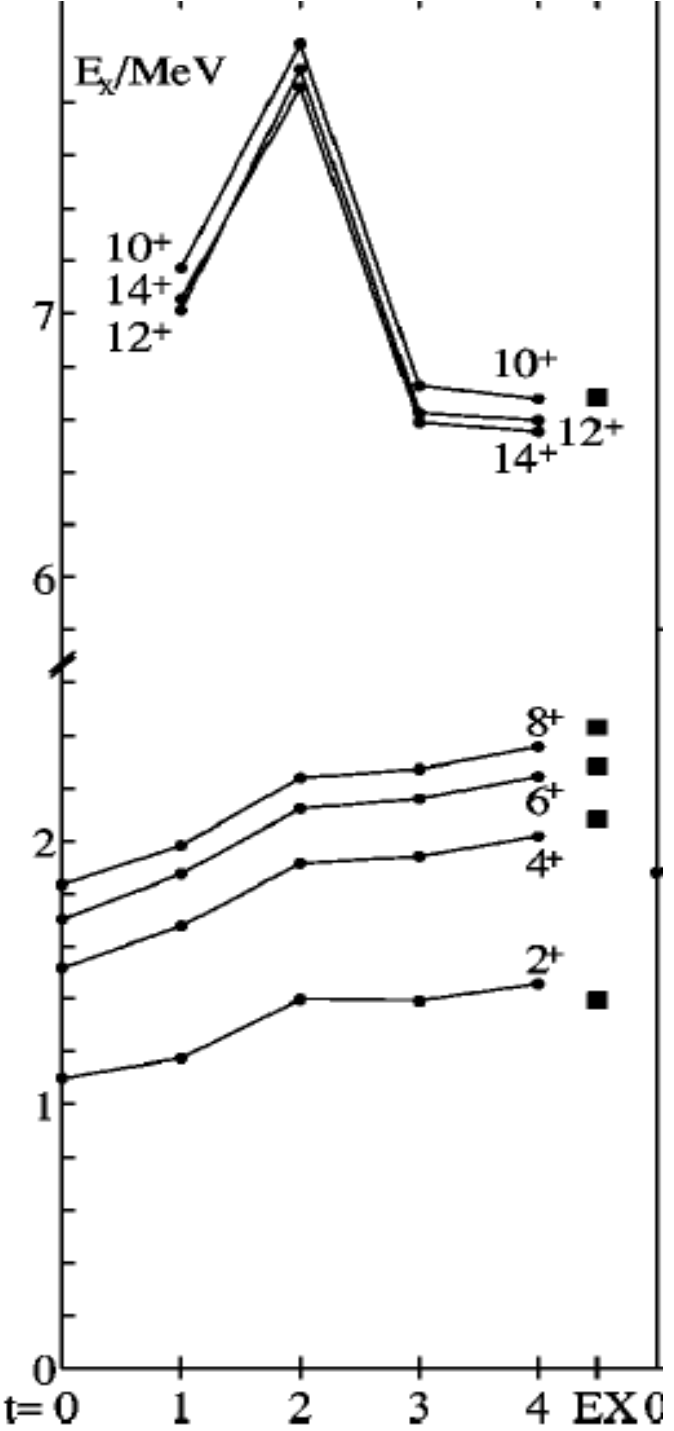
# $^{98}$Cd

t=number of core-excitations

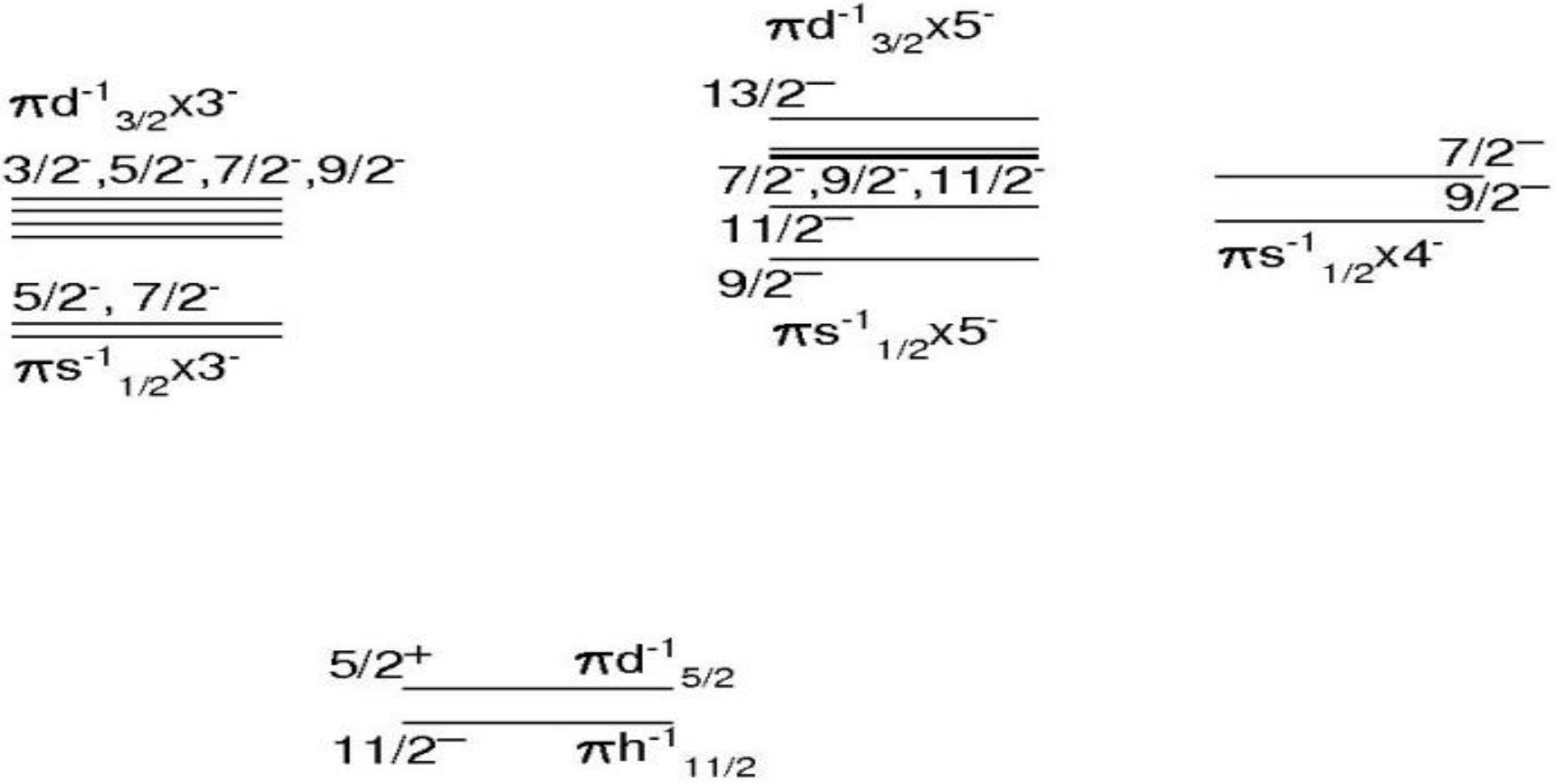
$^{207}$Tl discrepancy:

-from not considering t=3

-problem with interaction




A. Blazhev et al., Phys. Rev. C 69, 064304 (2004)
calculations by E. Caurier, F. Nowacki

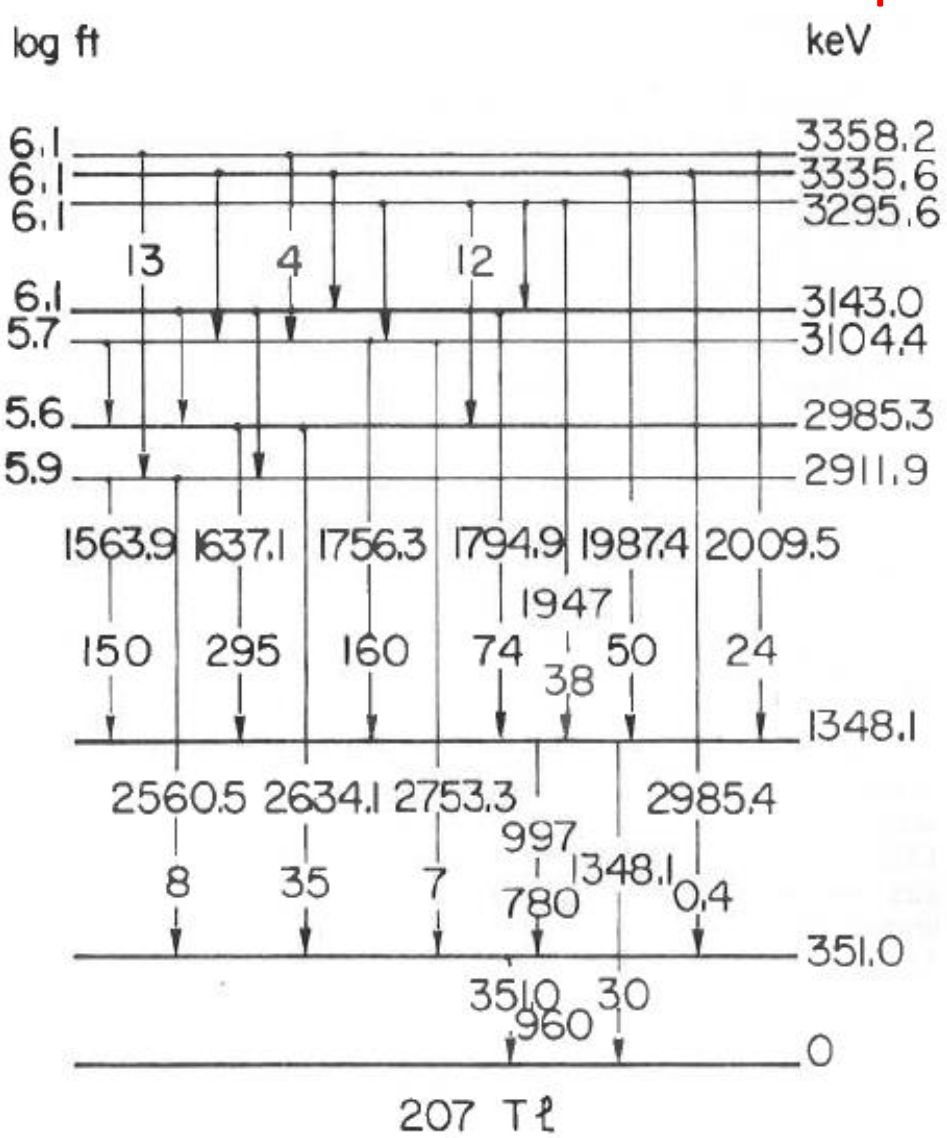


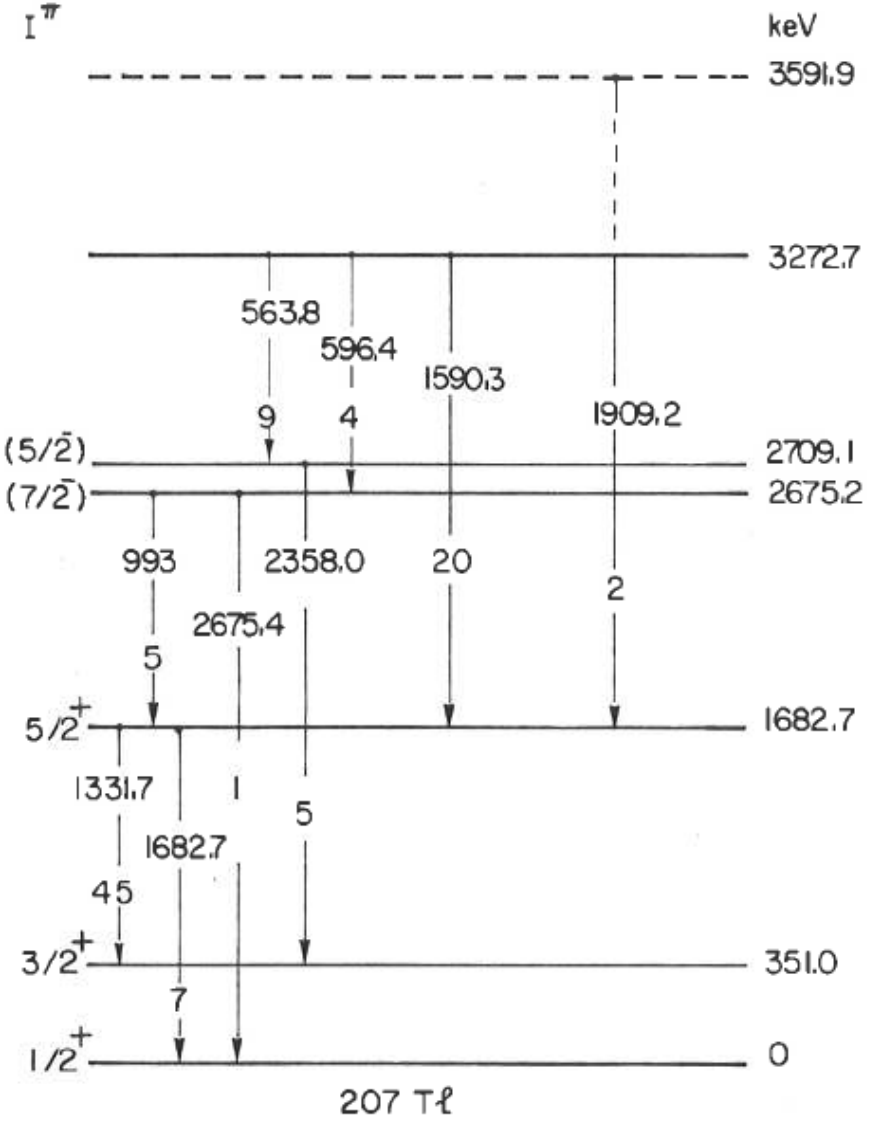

$^{207}$Tl

Shell model calculations: H. Grawe
excitation across N=126 and Z=82

(modified:
core-excitation -600 keV;
octupoles 'by hand')

# Former experiment




B. Jonson, O.B. Nielsen, J. Zylicz, CERN-81-09 (1981)
(Proc. Int. Conf. Nuclei far from stability, Helsingor, Denmark. Vol.2 p.640 (1981))

Nucl. Data Sheets 112, 707 (2011): 'incomplete and unbalanced'; e.g.20% feeding to the g.s.

# Where can we do better?

Higher statistics:

- 207Hg beam intensity
- gamma detection efficiency

$\Rightarrow$spin-parity determination:

- angular correlation
- weak gammas
- log ft values

State-of-the-art shell model treatment

- structure
- reaction

# $^{207}$Hg beam

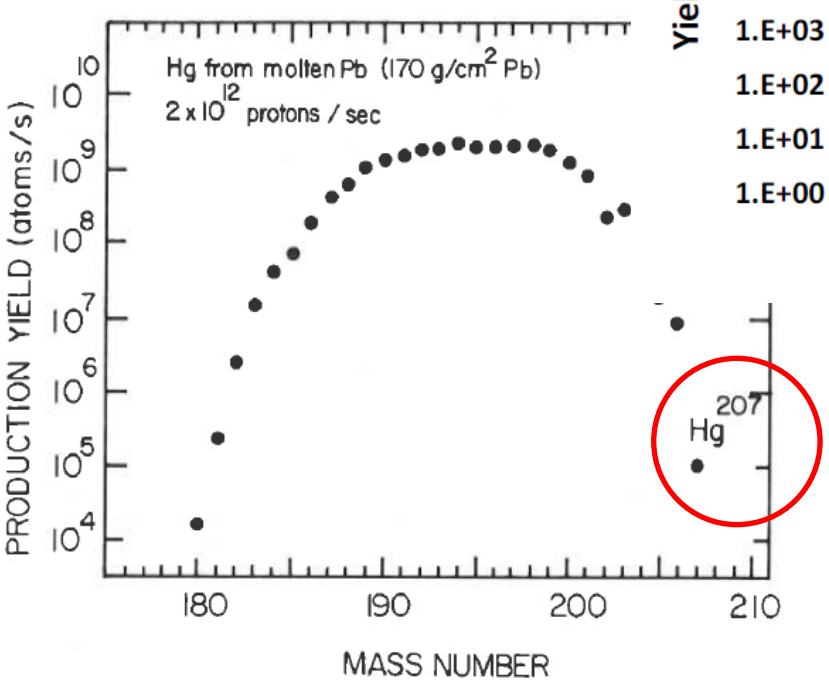
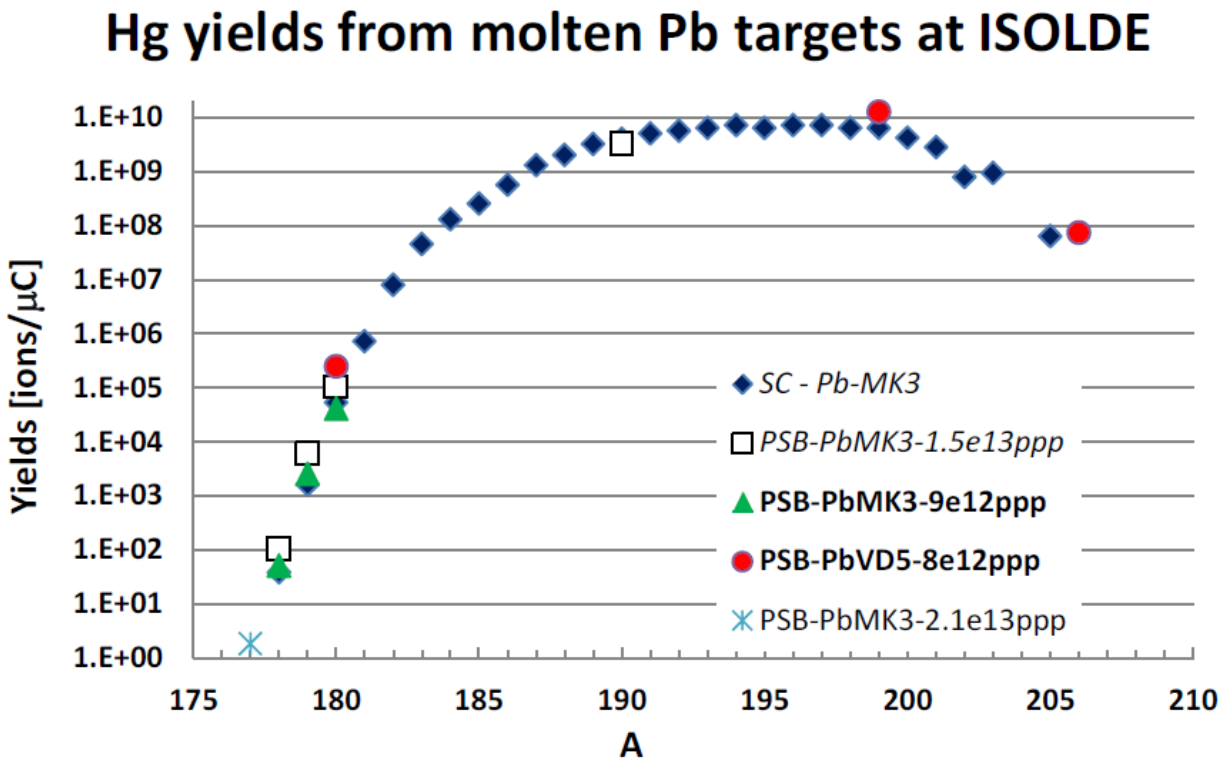


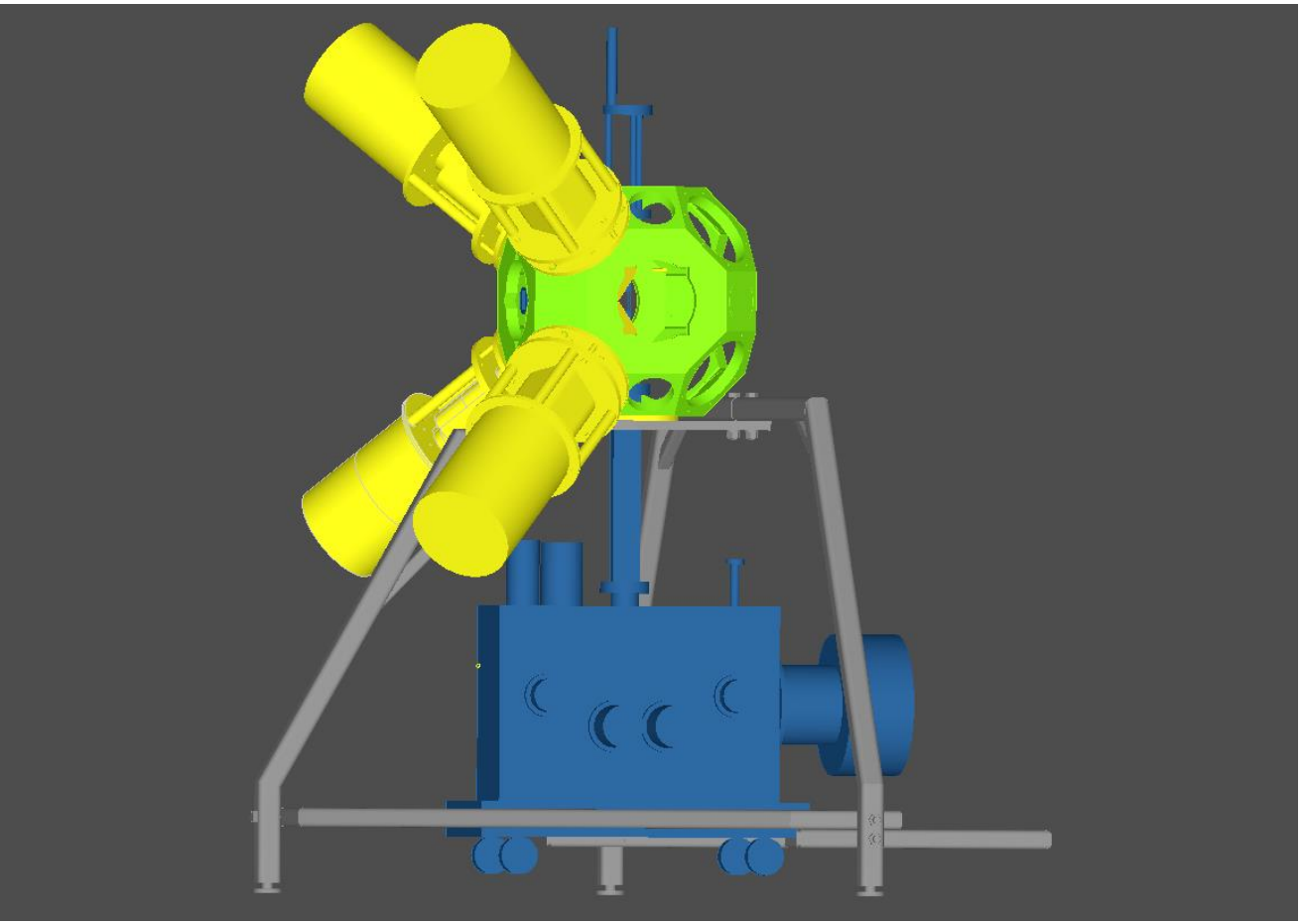

Fig. 1 Production yield in the ISOLDE facility of the mercury isotopes, including $^{206}$Hg and $^{207}$Hg.

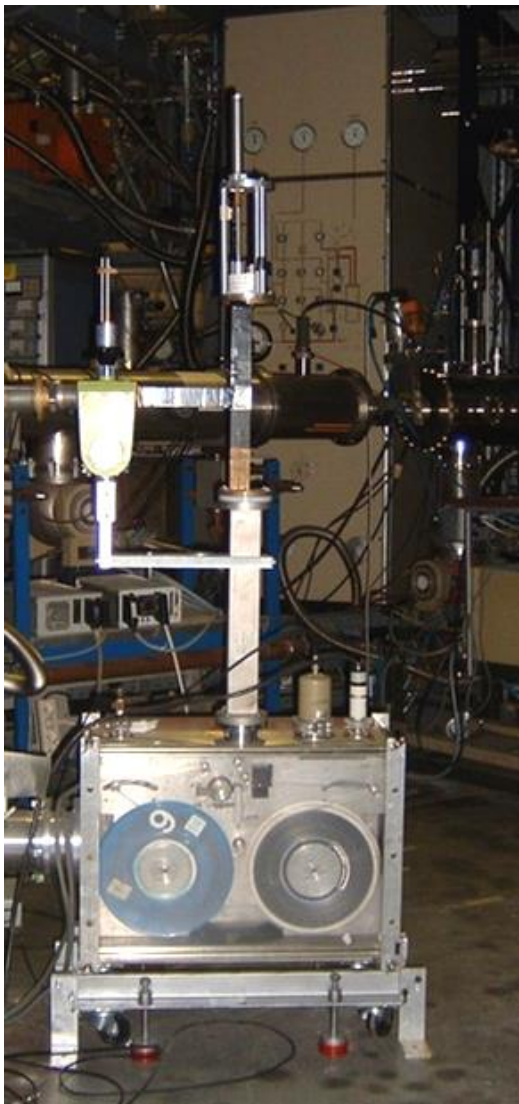



T. Stora, EURISOL town meeting, Oct. 2012

B. Jonson, O.B. Nielsen, J. Zylicz, CERN-81-09 (1981)
(Proc. Int. Conf. Nuclei far from stability, Helsingor, Denmark. Vol.2 p.640 (1981))

# ISOLDE Decay Station





Frame from Osiris IFIN Bucharest

Tape station from KU Leuven

2 clovers from IFIN Bucharest

2 clovers from KU Leuven

# Yield calculations

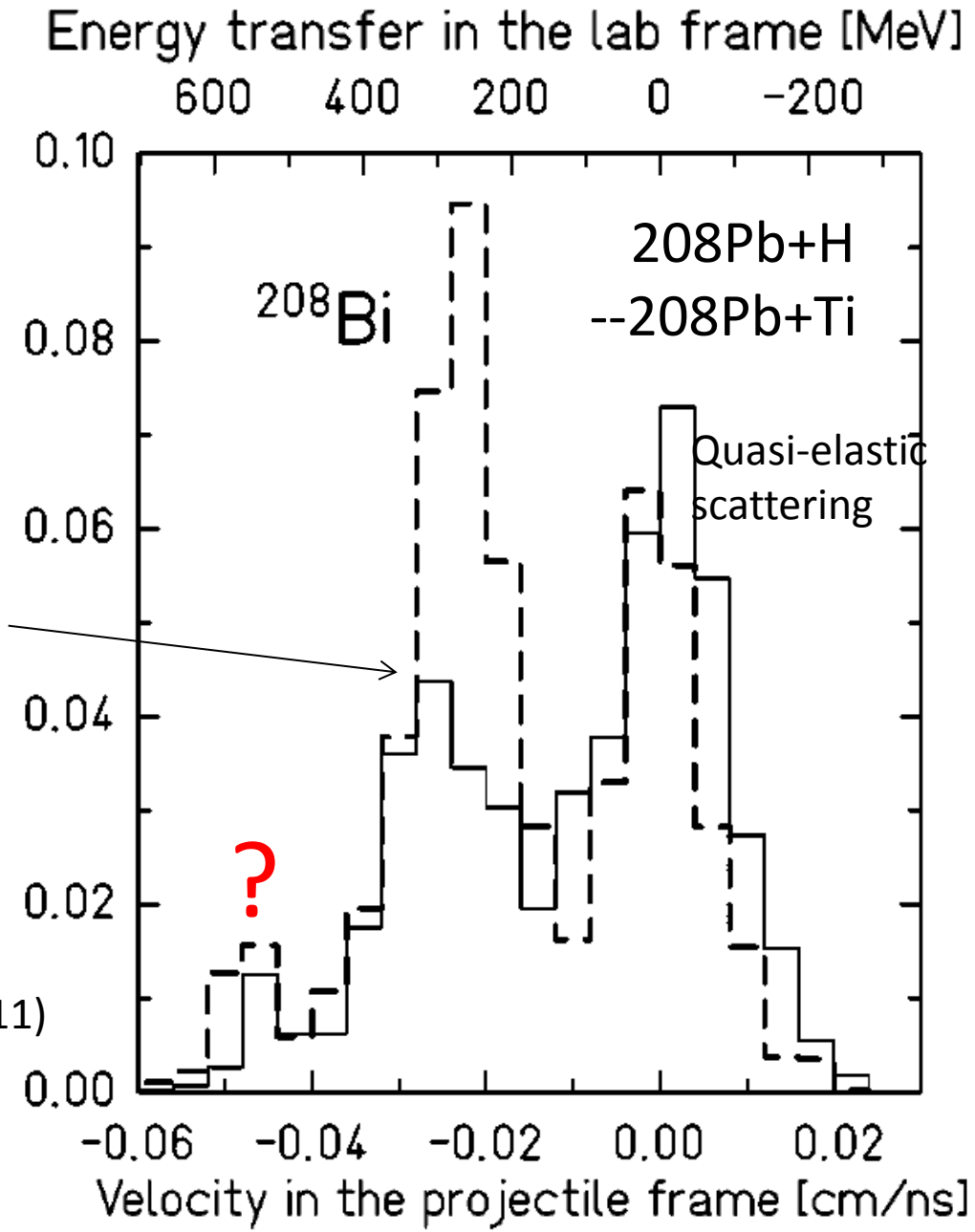
Beam: $^{207}$Hg +$^{207}$Pb (stable)
$^{207}$Hg yield: ~$10^6$ pps from target => ~4x$10^5$ pps on tape
(in the 1981 report: $10^5$ pps)

$^{207}$Hg (T1/2=2.9(2) min. -> $^{207}$Tl (T1/2=4.77(3) min -> $^{207}$Pb (stable)
Efficiency: gammas ~5%; beta ~60%
Beta-branch: $10^{-4}$ (needed!)

Beta-gamma-gamma rate: ~50 hour$^{-1}$

=> 15 shifts are requested +time to set up.

# $^{208}$Hg from $^{208}$Pb target?




Δ(1232) resonance excitation

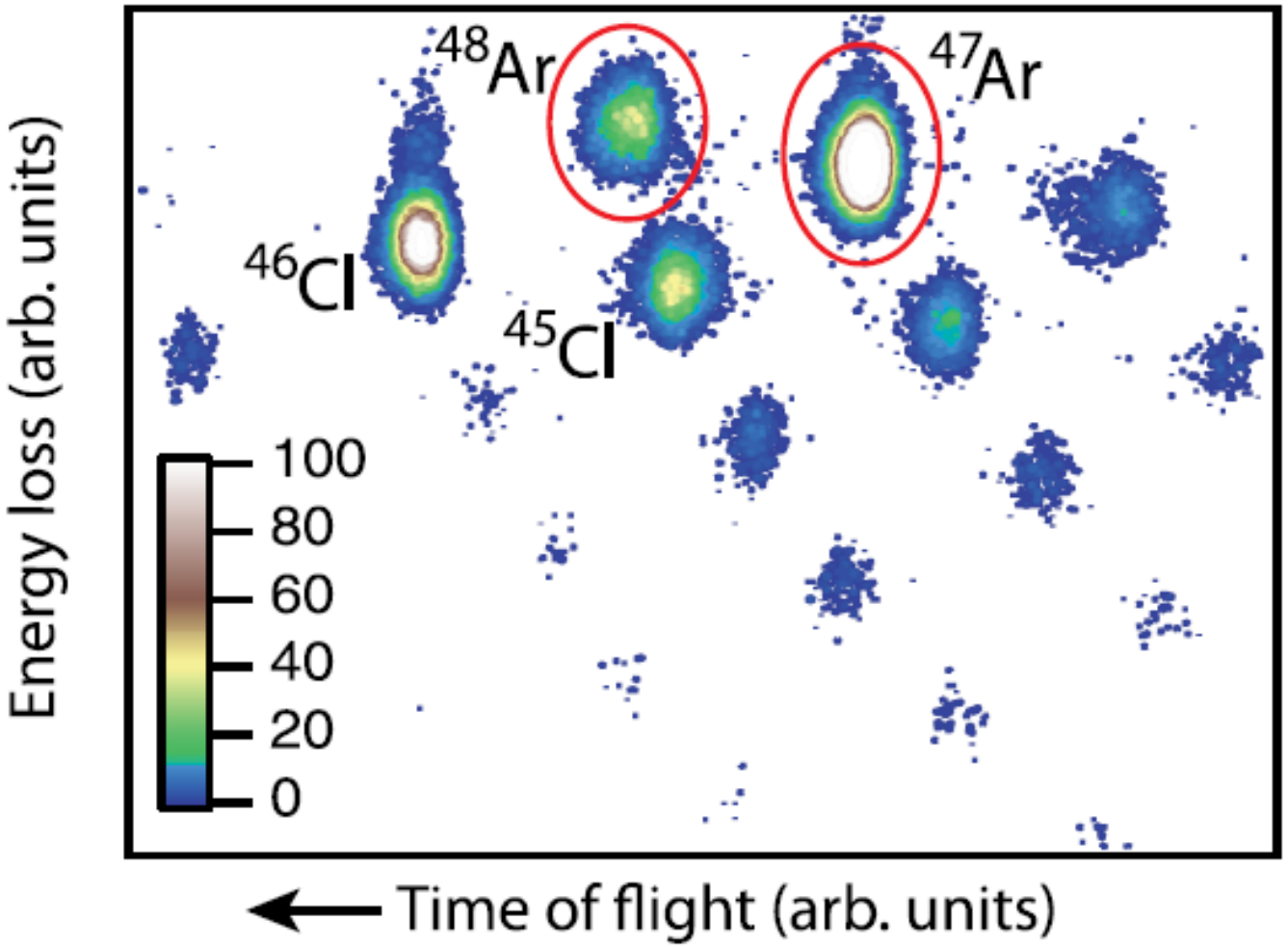
207Hg cross section measured
in 208Pb+9Be (from Δ resonance)
A. Morales et al., Phys. Rev. C 84, 011601(2011)

A. Kelic et al., Phys. Rev. C 70, 064608 (2004)

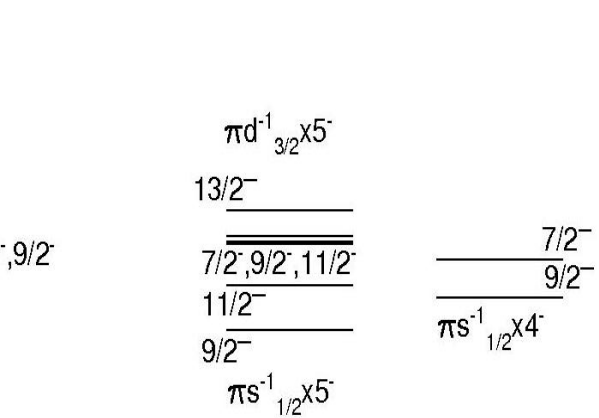
End

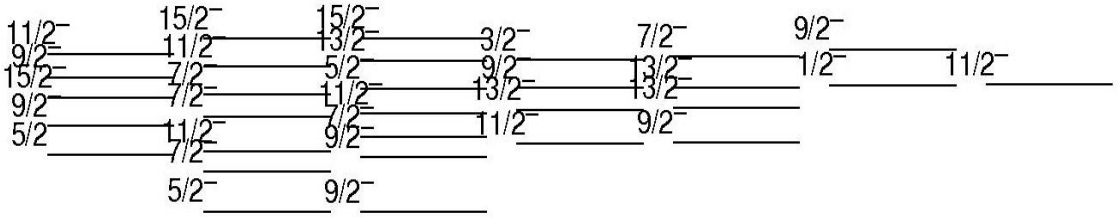
48Ca (140 MeV/u) +9Be -> 46Ar

Z=20 -> Z=18




R. Winkler et al., Phys. Rev. Lett. 108, 182501 (2012)




Shell model: H. Grawe