IRIS & ISOLDE: laser ion source

Исследование сосуществования форм
в области свинца (ядра висмута и ртути)
(ИРИС, ПИЯФ — ISOLDE, CERN)

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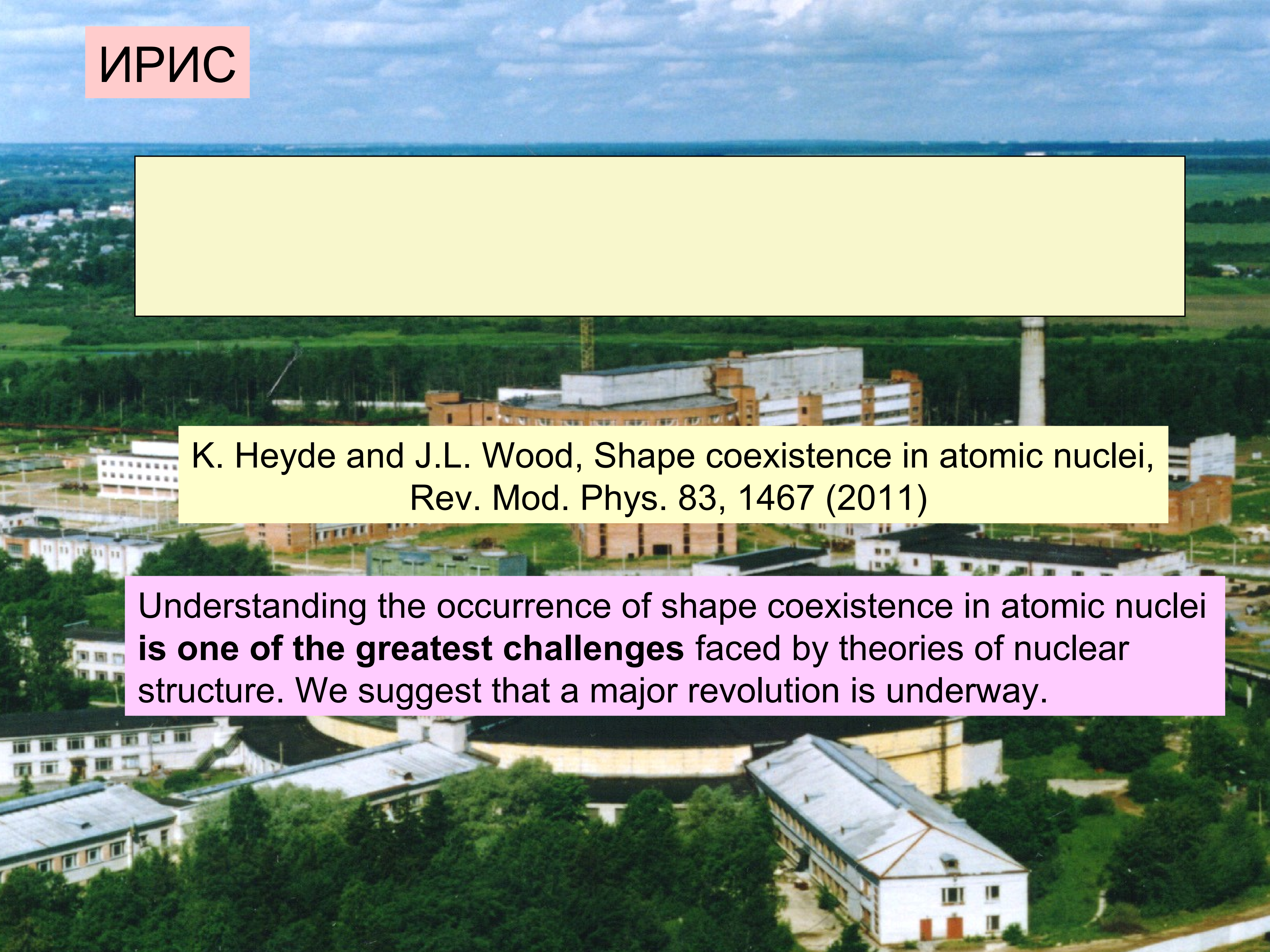
IS 598:
Laser spectroscopy and shape-coexistence studies
with radioactive $_{80}$Hg beams

MR-TOF@ISOLTRAP collaboration
PNPI, Gatchina, Russian Federation
RILIS and ISOLDE, CERN, Switzerland
SCK-CEN, Mol, Belgium
The University of Manchester, United Kingdom
The University of York, United Kingdom
University of Liverpool, United Kingdom
University of the West of Scotland, United Kingdom

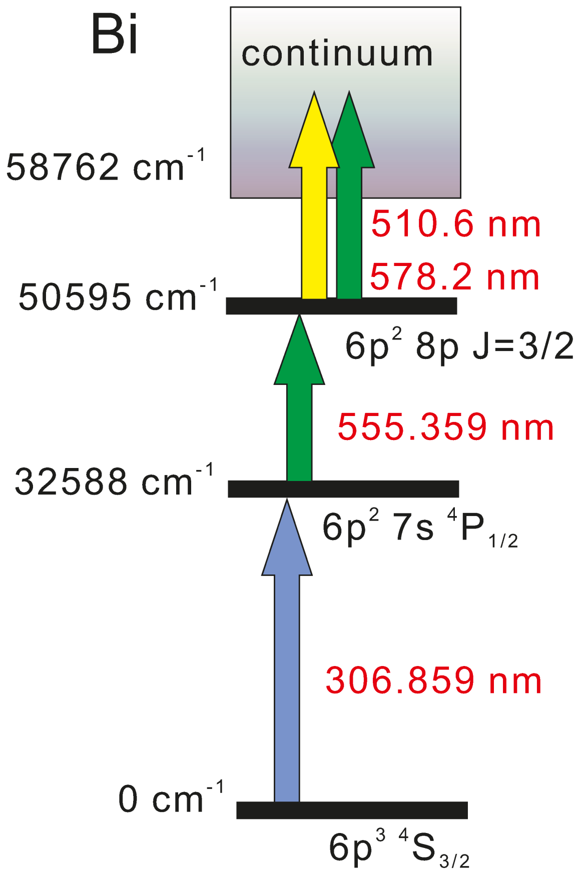
ИРИС



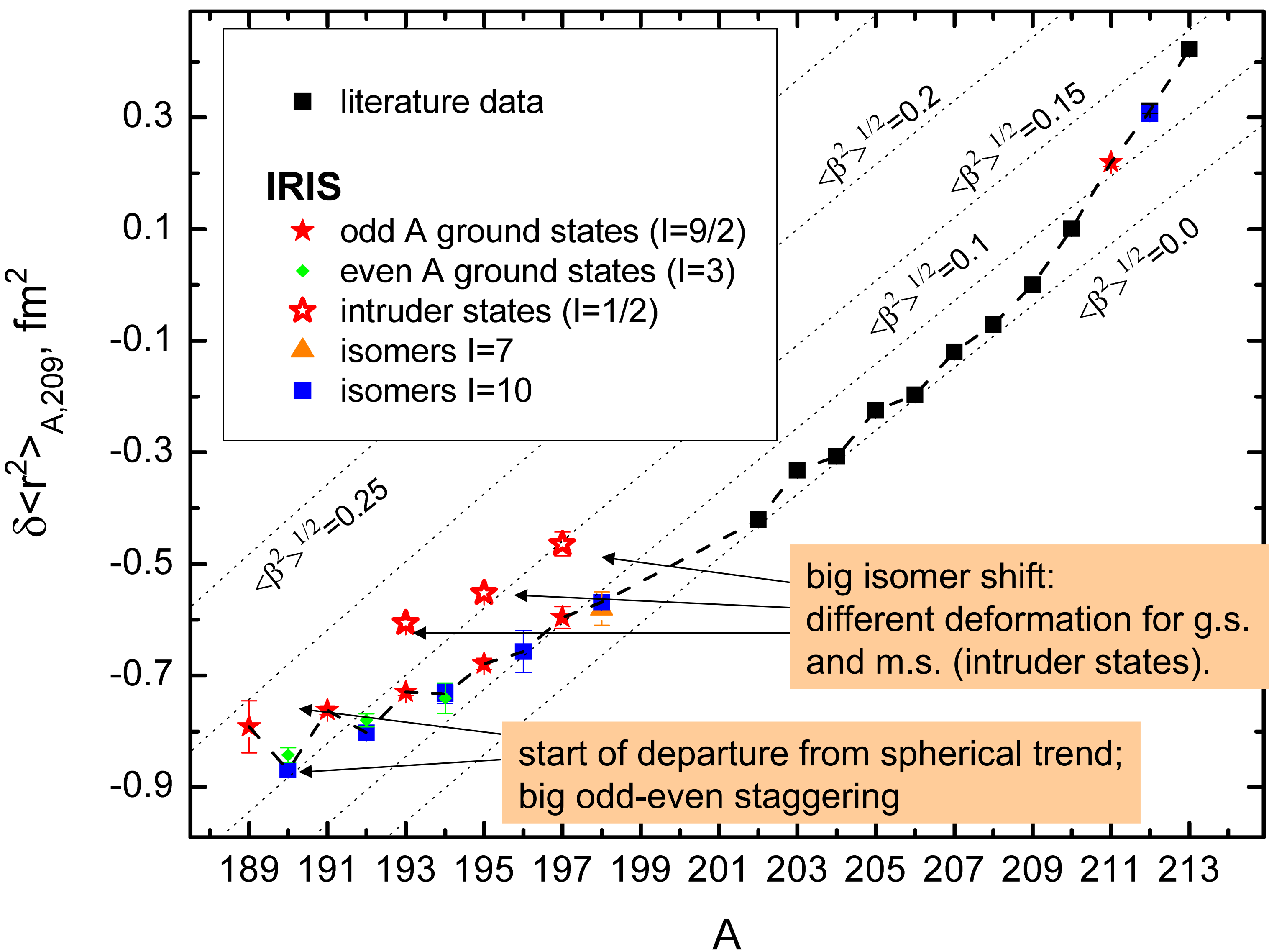
K. Heyde and J.L. Wood, Shape coexistence in atomic nuclei, Rev. Mod. Phys. 83, 1467 (2011)

Understanding the occurrence of shape coexistence in atomic nuclei **is one of the greatest challenges** faced by theories of nuclear structure. We suggest that a major revolution is underway.

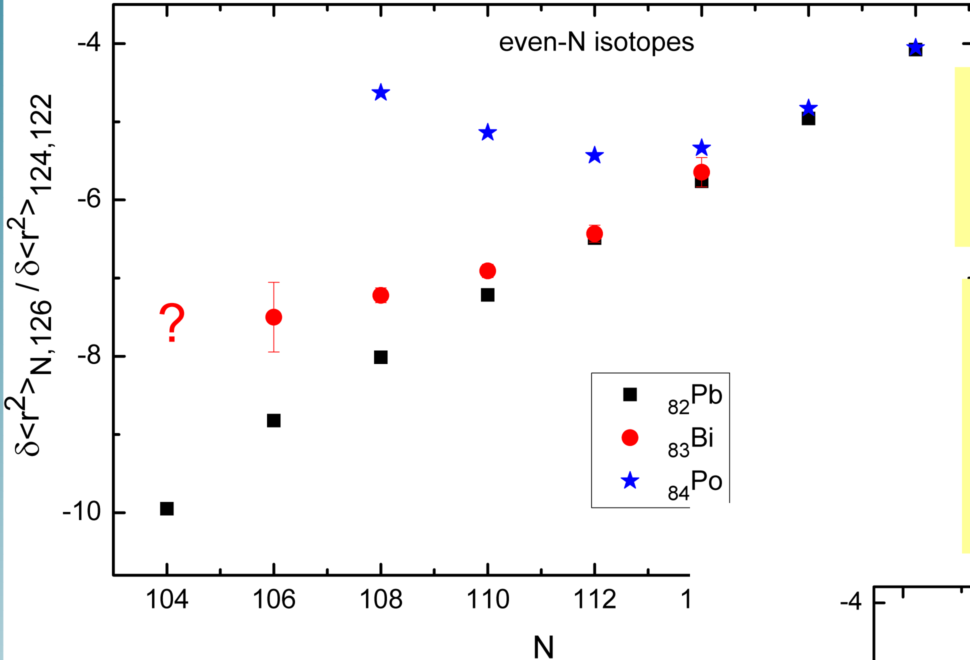
IRIS: laser ion source



IRIS, Bi: radii



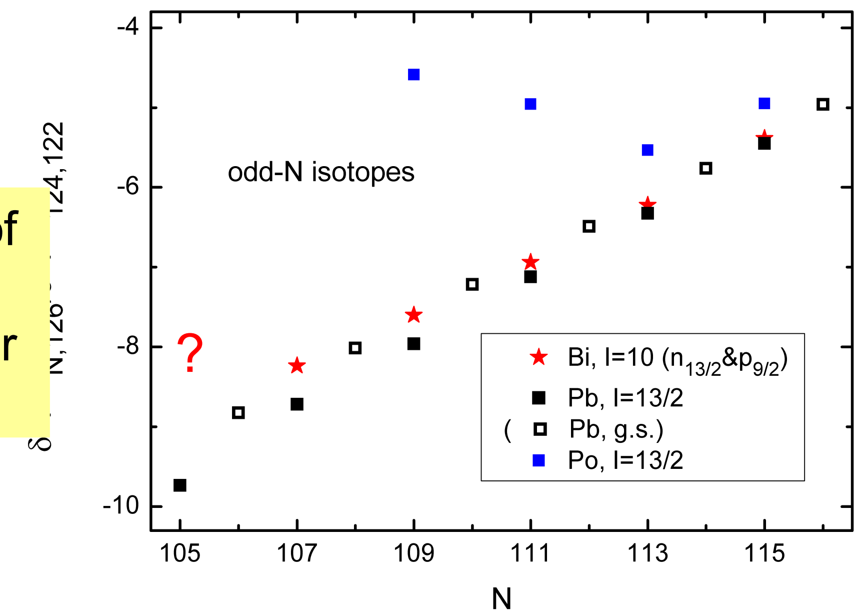
IRIS, Bi: relative radii



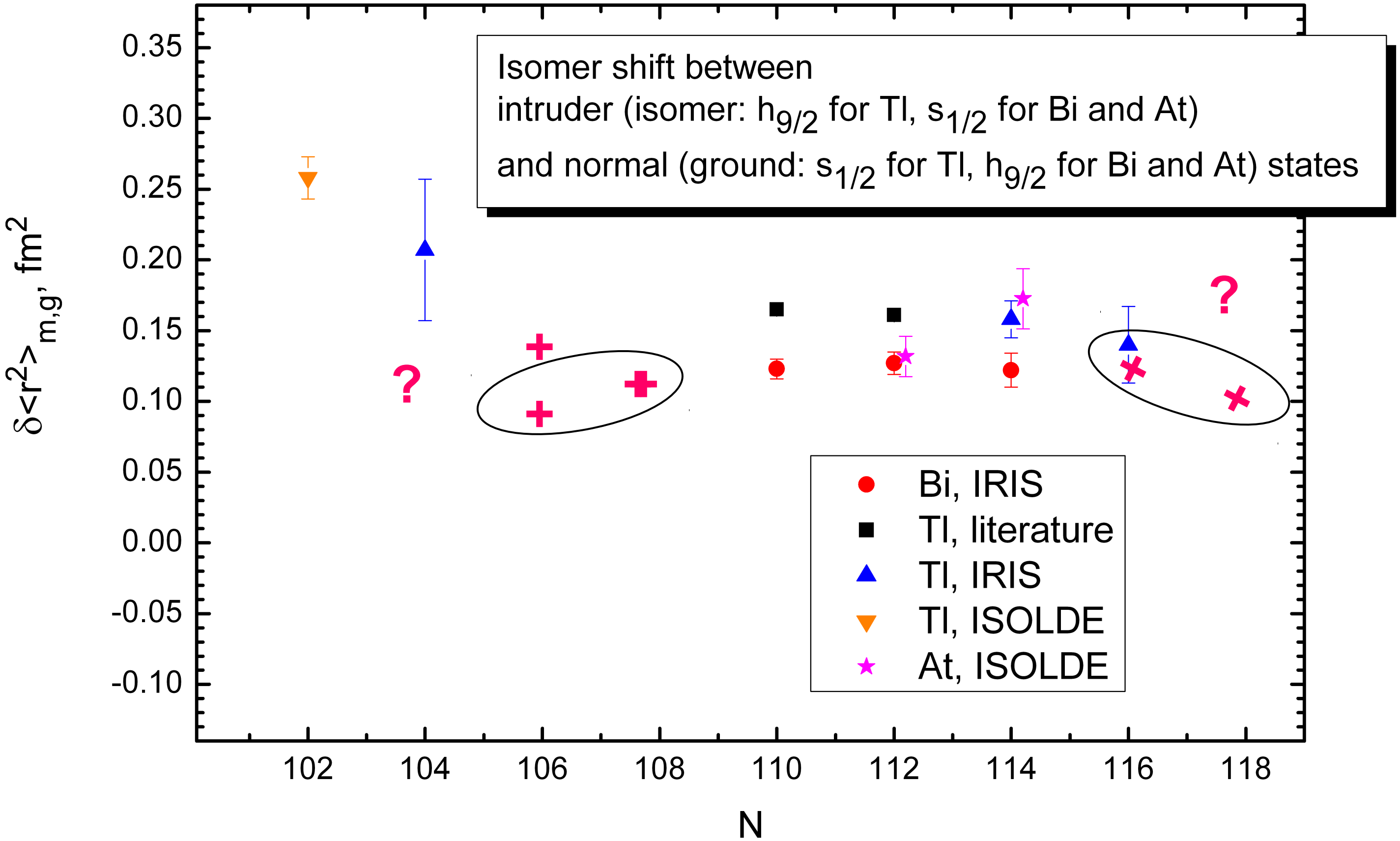
Deformation change for even-neutron Bi isotopes is “intermediate” between the ones for $_{82}$Pb и $_{84}$Po.

Shape evolution in the Bi and Tl isotopic chains markedly differs from each other, although these chains are “mirror” in respect to the filled proton shell (Z=82)

At the same time the radii trend of the odd-neutron Bi isotopes does not deviate from the radii trend for Pb

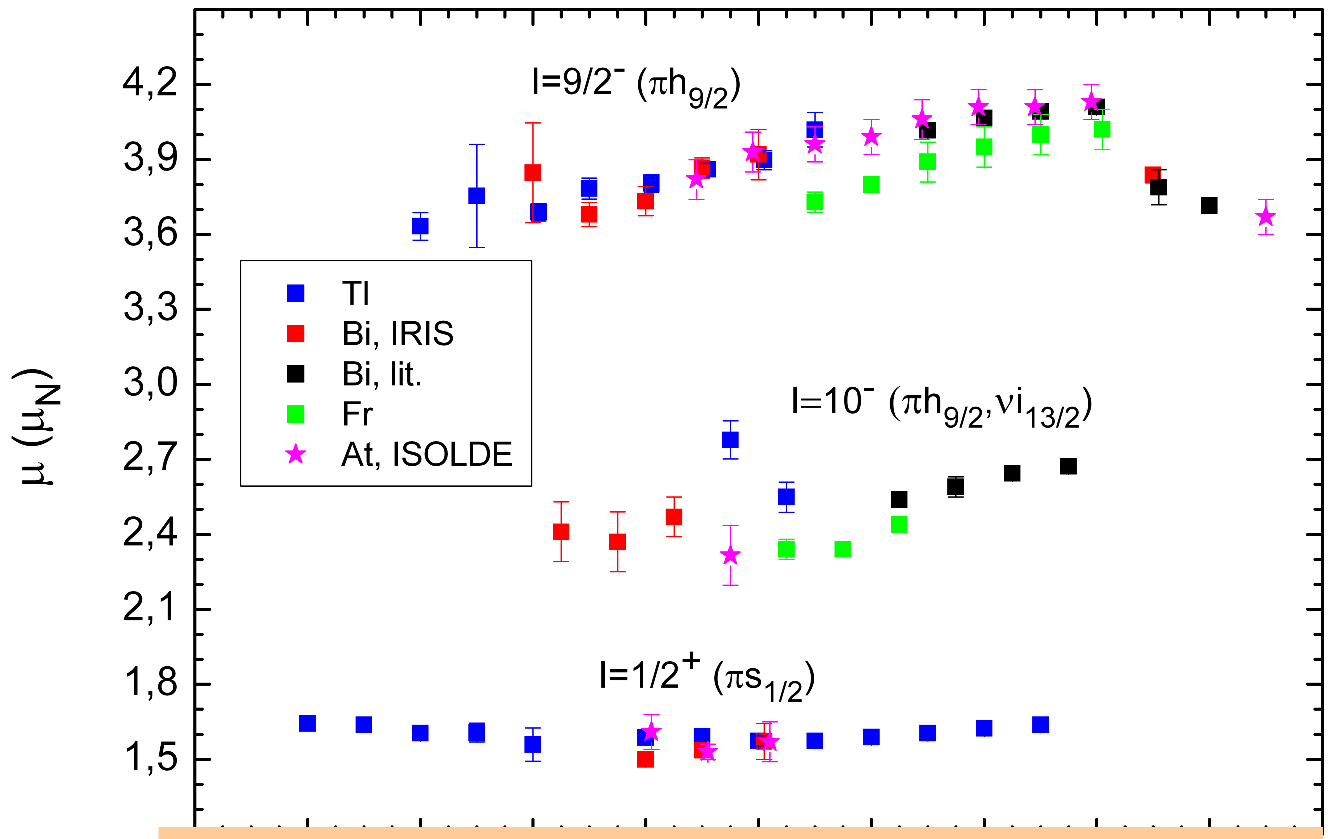


Bi, ISOLDE&IRIS: isomer shift



Isomer shift is nearly constant at 106<N<116 and independent (in the limit of present errors) on the nature of intruder state (1p2h for Tl, 2p1h for Bi, 4p1h for At)

IRIS&ISOLDE: μ's for intruder and normal states

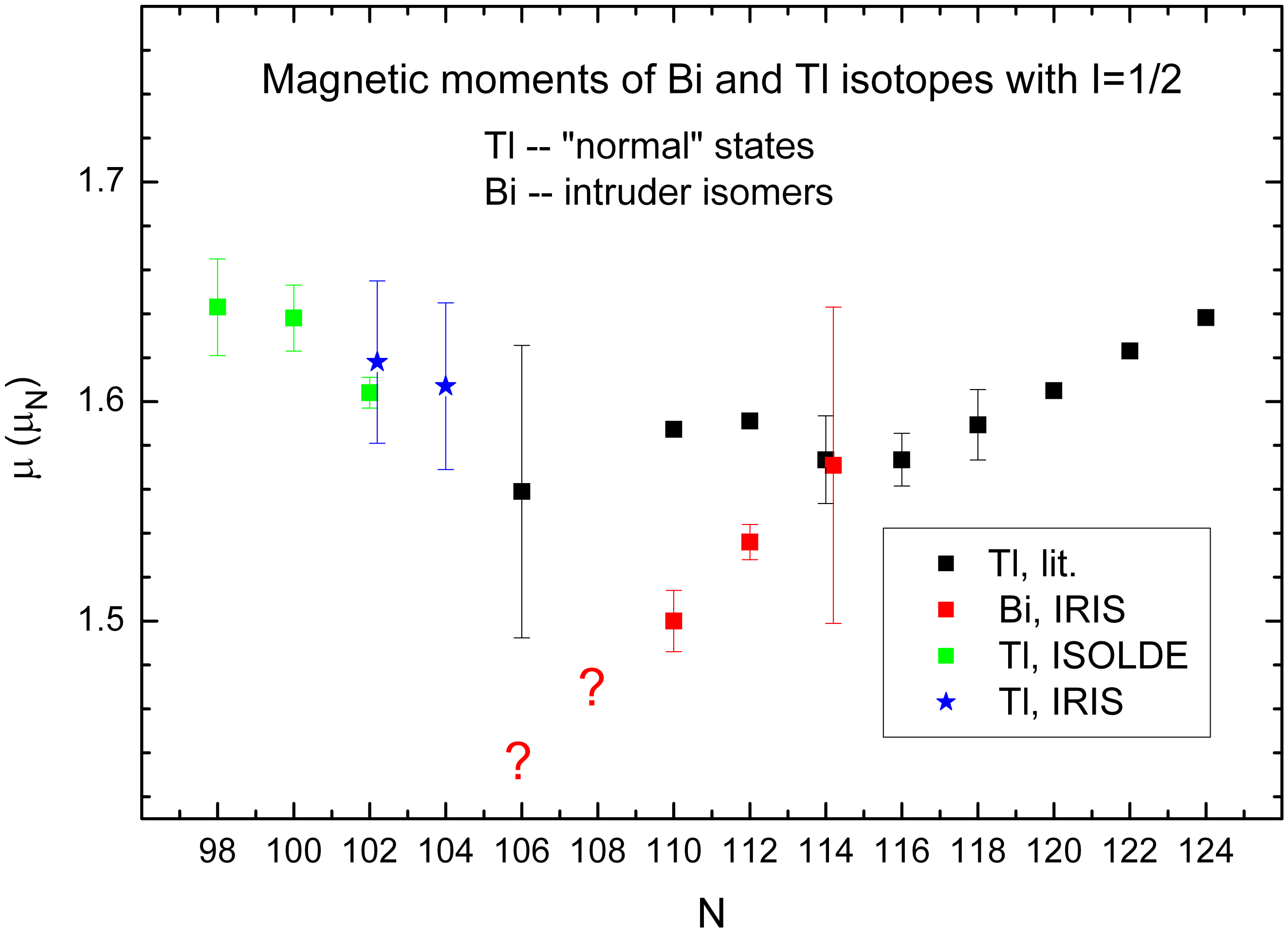


No marked difference between μ's for intruder and normal states with the same spin

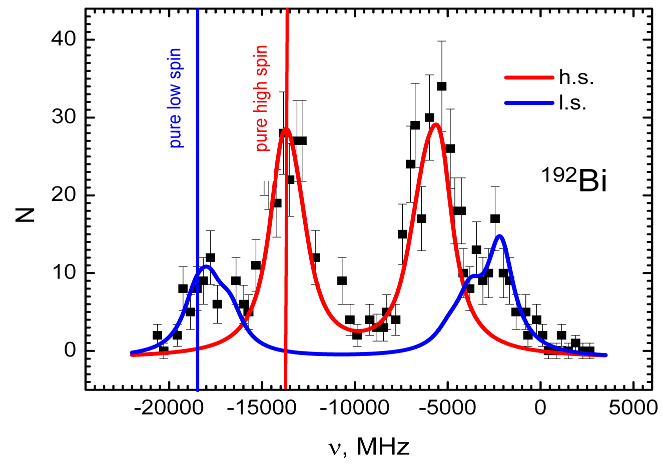
$\pi h_{9/2}$: Tl — intruder isomers
Bi, At, Fr — "normal" states

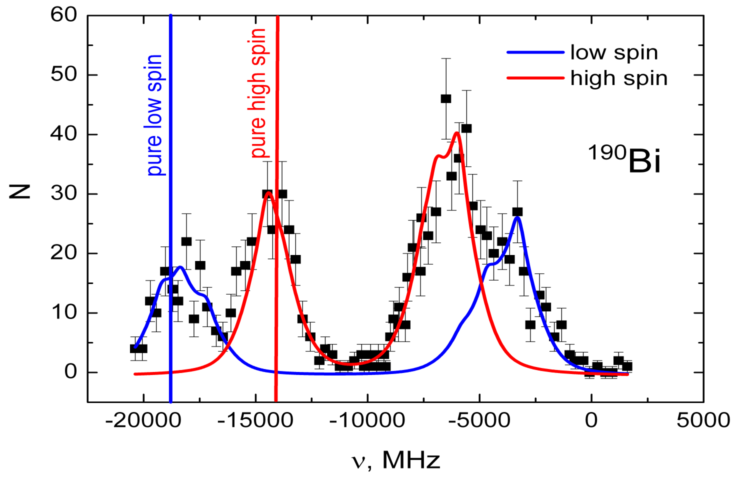
$\pi s_{1/2}$: Tl — "normal" states
Bi, At — intruder isomers

IRIS&ISOLDE: isotopes/isomers with I=1/2+



IRIS&ISOLDE: isomer selectivity ($I=10^{-}$&3^{+})

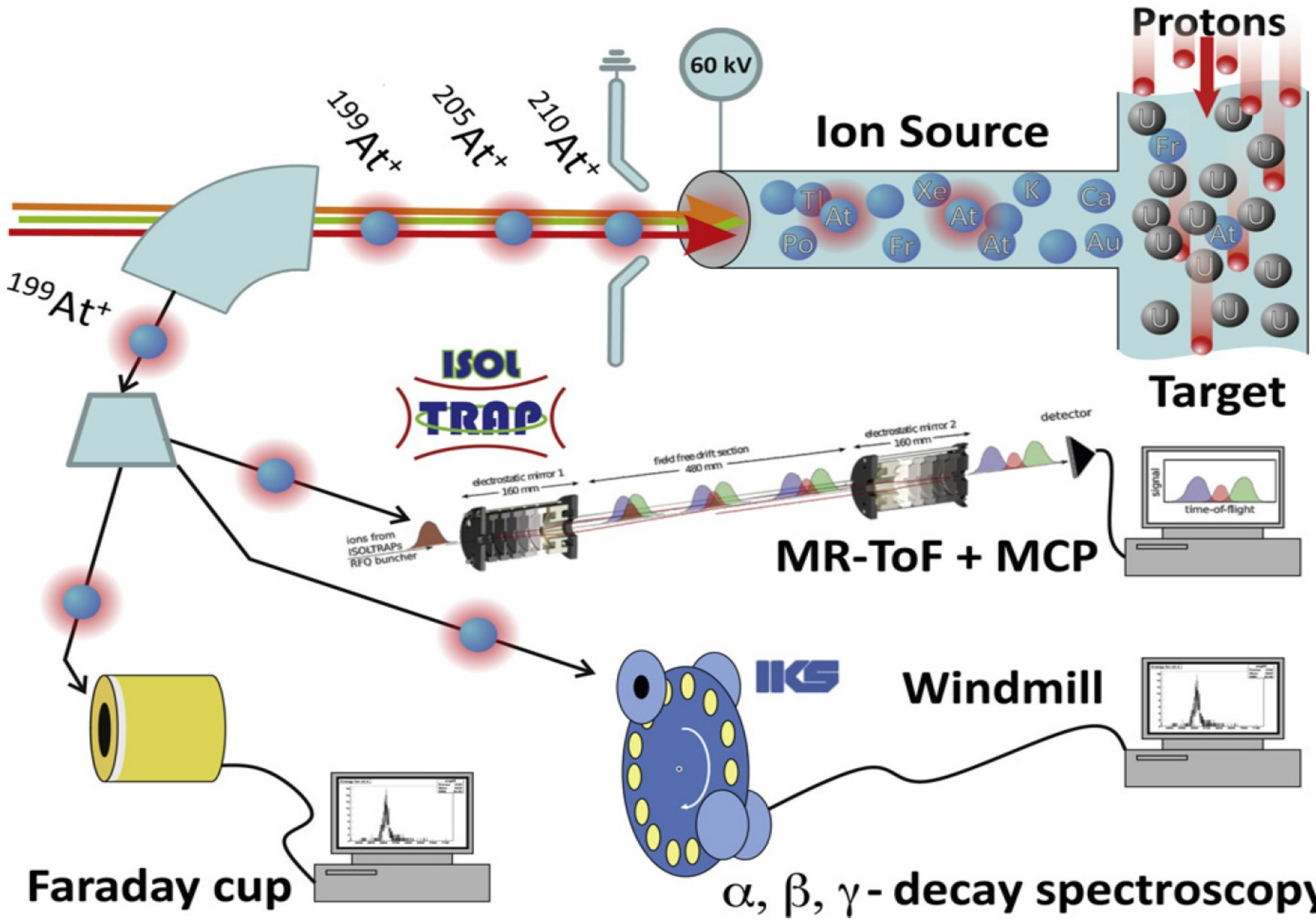




Hfs spectra for two isomers in ^{190,192}Bi. Vertical lines mark the frequency positions for the narrow-band 1st step laser with the pure low-spin (blue) or high-spin (red) isomer production.

⟹ possibility of the first isomer selective βDf studies

ISOLDE: in-source spectroscopy

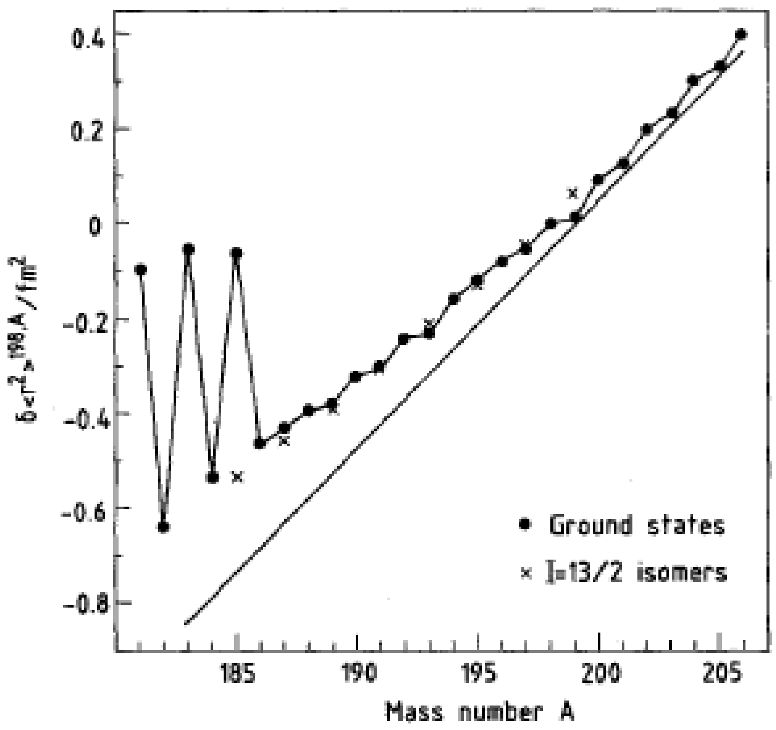


B. A. Marsh et al., 20013 EMIS conference, NIM B317, p.550 (2013)

WM: A.N. Andreyev et al, Phys. Rev. Lett 105, 252502 (2010)

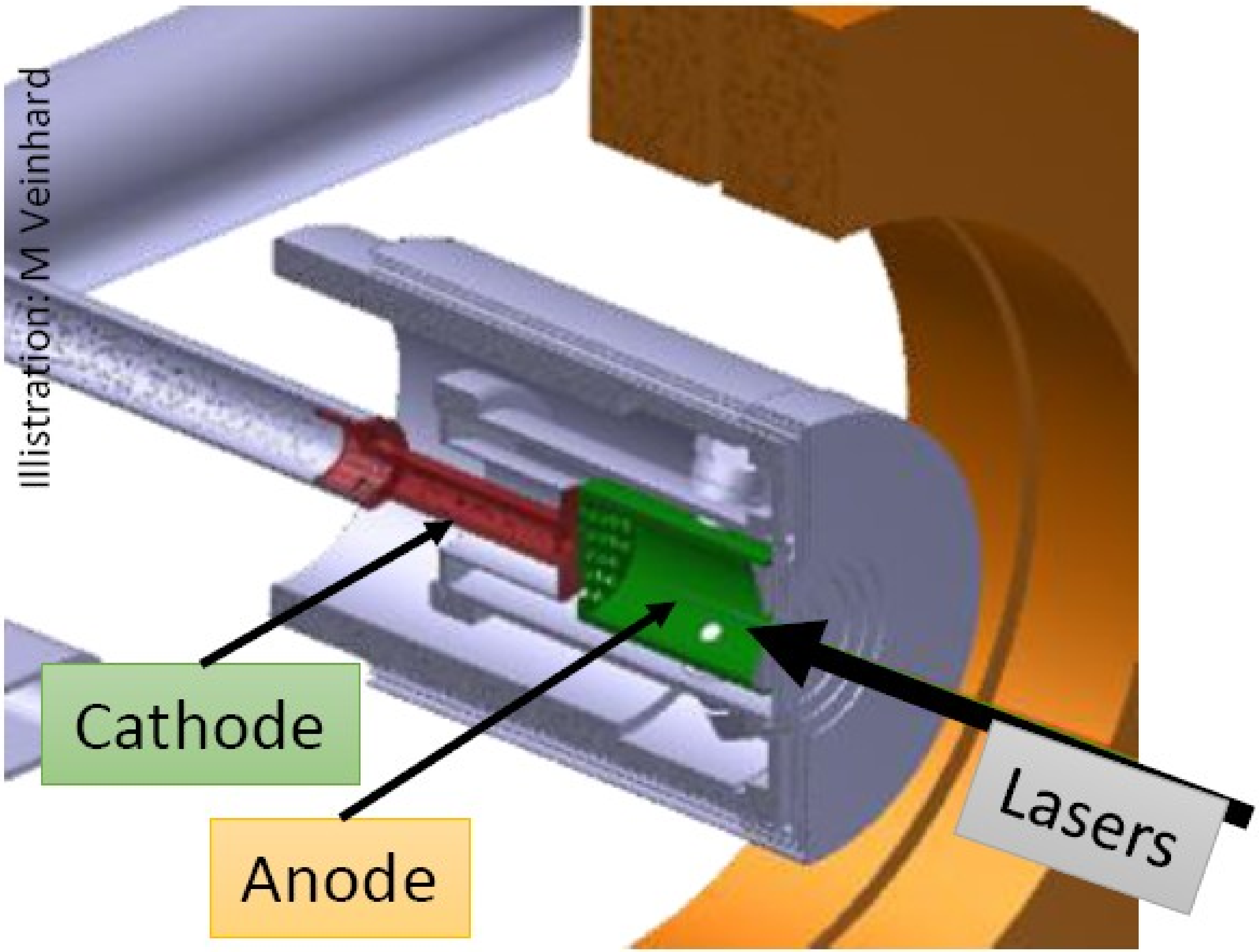
MR-ToF MS: R. N. Wolf et al, NIM, A686, 82 (2012)

ISOLDE: "Otten's effect"

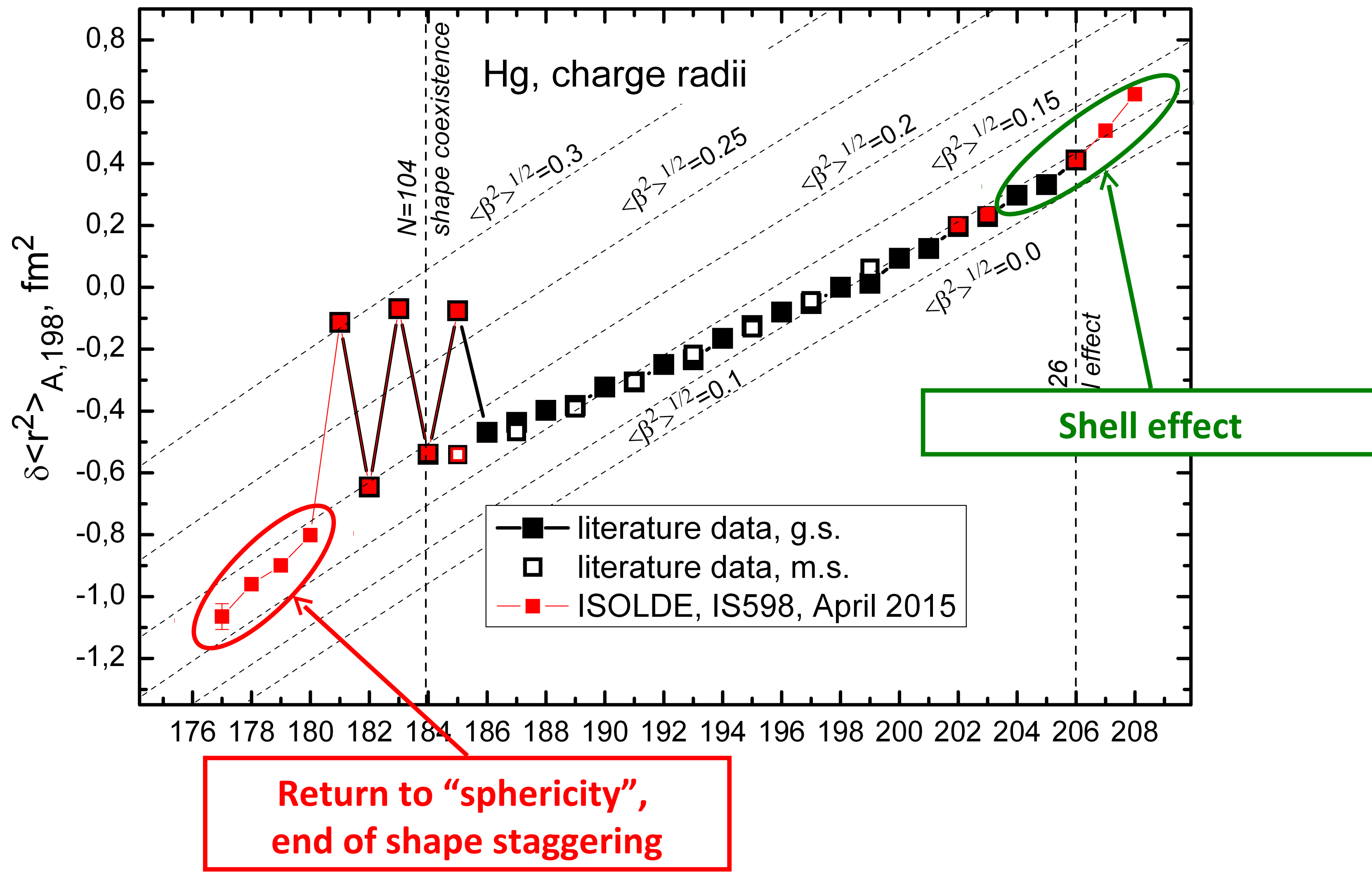


G. Ulm, S.K. Bhattacherjee, P. Dabkiewicz, et al., Z. Phys. A 325, 247-259 (1986)

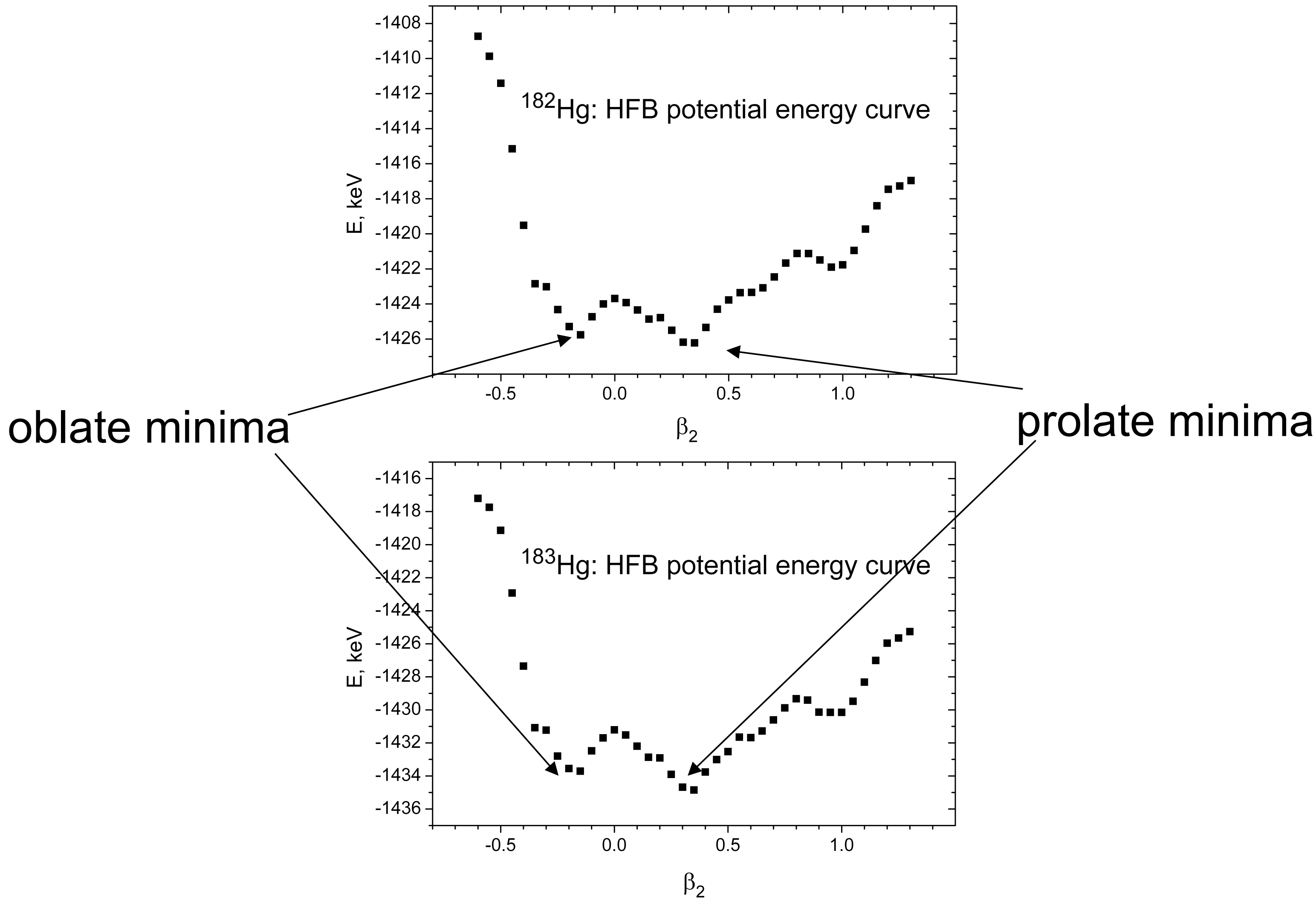
ISOLDE: VADLIS



ISOLDE, Hg: radii

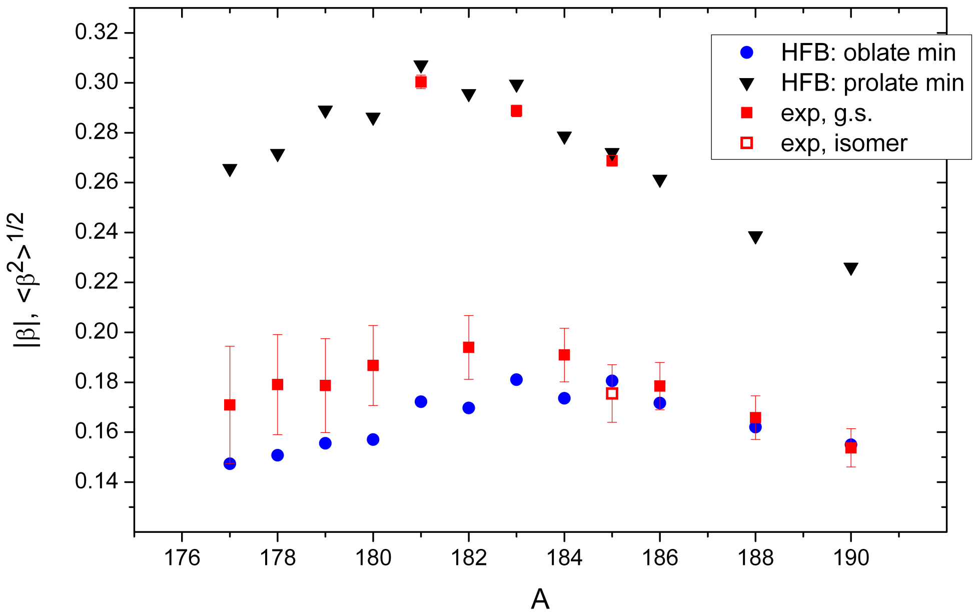


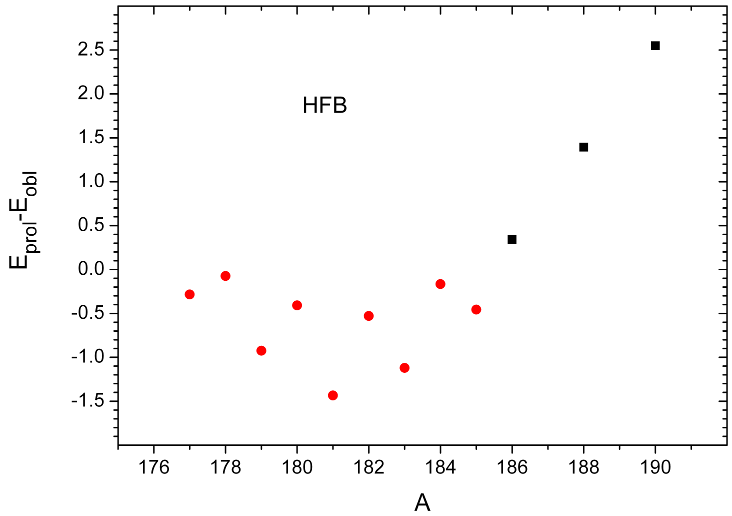
ISOLDE, Hg: theory



HFB: S. Hilaire, M. Girod, Eur. Phys. J. A 33, 237–241 (2007); http://www-phynu.cea.fr/HFB-Gogny eng.htm

ISOLDE, Hg: theory vs experiment

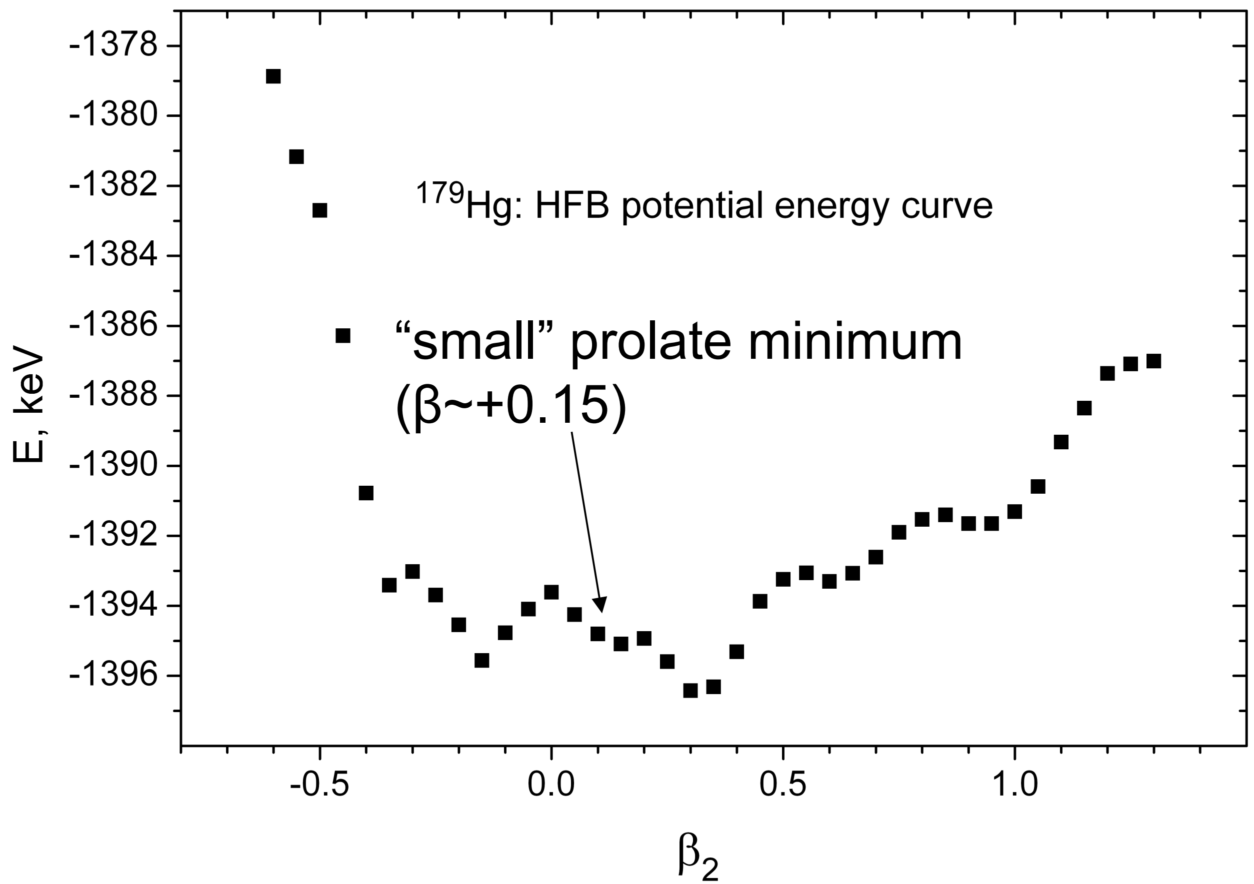




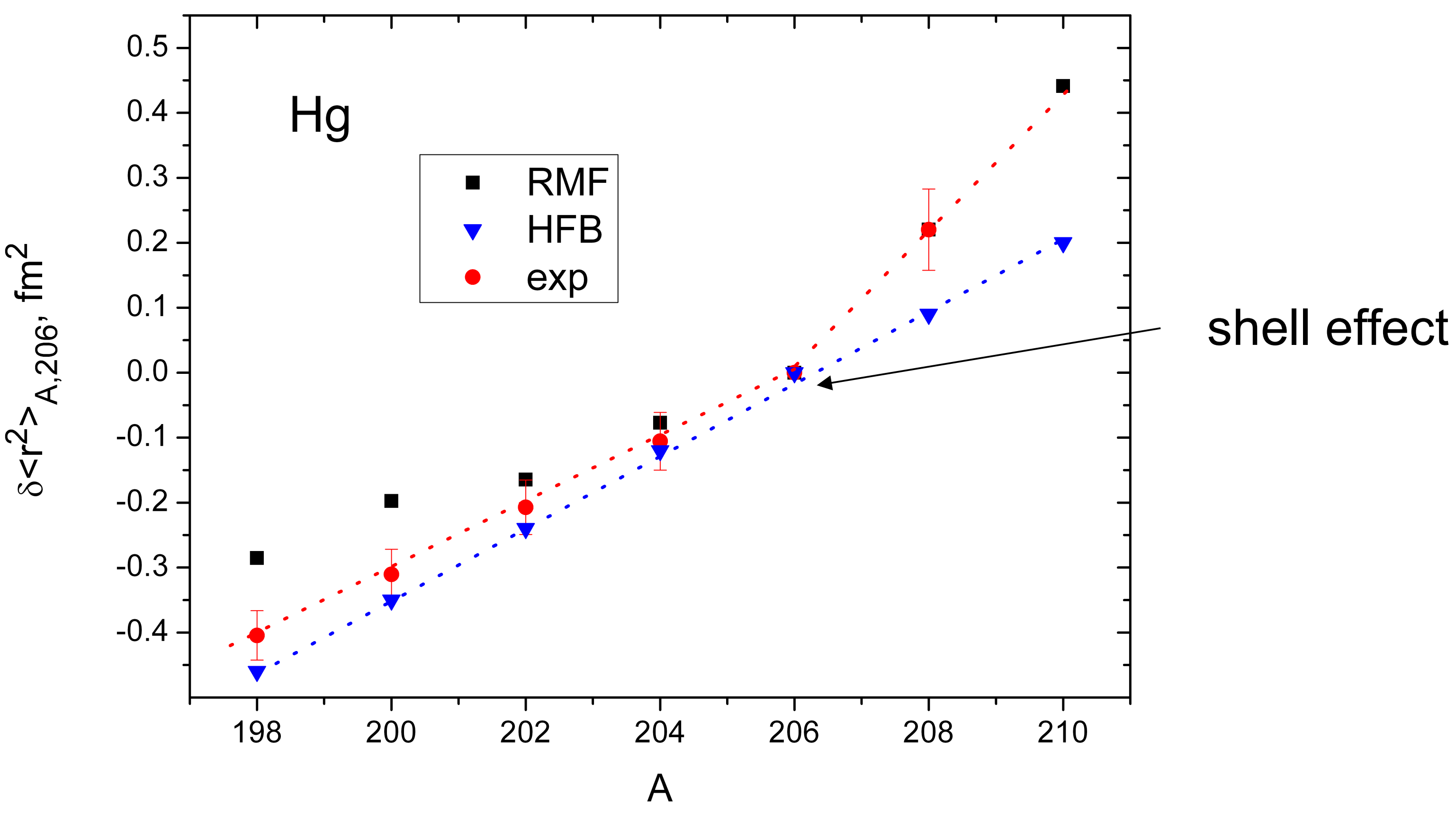
ISOLDE: unexpected μ's

I(^{179}Hg)=7/2, μ(^{179}Hg)=-0.95(2)n.m., Q (^{179}Hg)=0.7(3)b

may be explained only with β~+0.15



ISOLDE, Hg: shell effect



RMF: S. E. Agbemava, A. V. Afanasjev, D. Ray, and P. Ring, Phys. Rev. C 89, 054320 (2014)

Laser spectroscopy: other projects

SPES (Legnaro, Italy)

REVIEW OF SCIENTIFIC INSTRUMENTS **87**, 02B708 (2016)

First results on Ge resonant laser photoionization in hollow cathode lamp

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(Presented 27 August 2015; received 6 August 2015; accepted 19 October 2015; published online 12 November 2015)

In the framework of the research and development activities of the SPES project regarding the optimization of the radioactive beam production, a dedicated experimental study has been recently started in order to investigate the possibility of in-source ionization of germanium using a set of tunable dye lasers. Germanium is one of the beams to be accelerated by the SPES ISOL facility, which is under construction at Legnaro INFN Laboratories. The three-step, two color ionization schemes

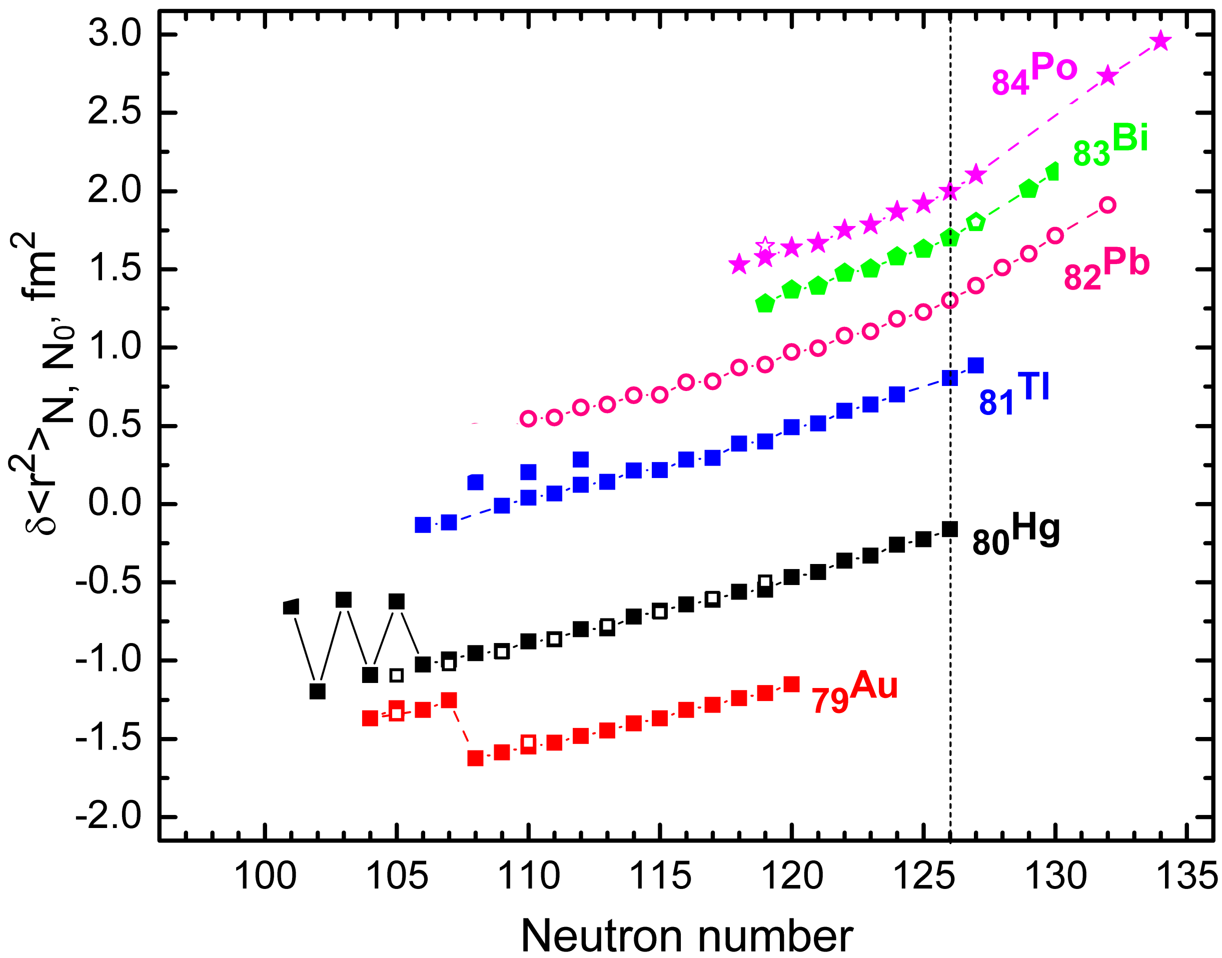
KU Leuven (Belgium)

Submitted to Nature Physics:

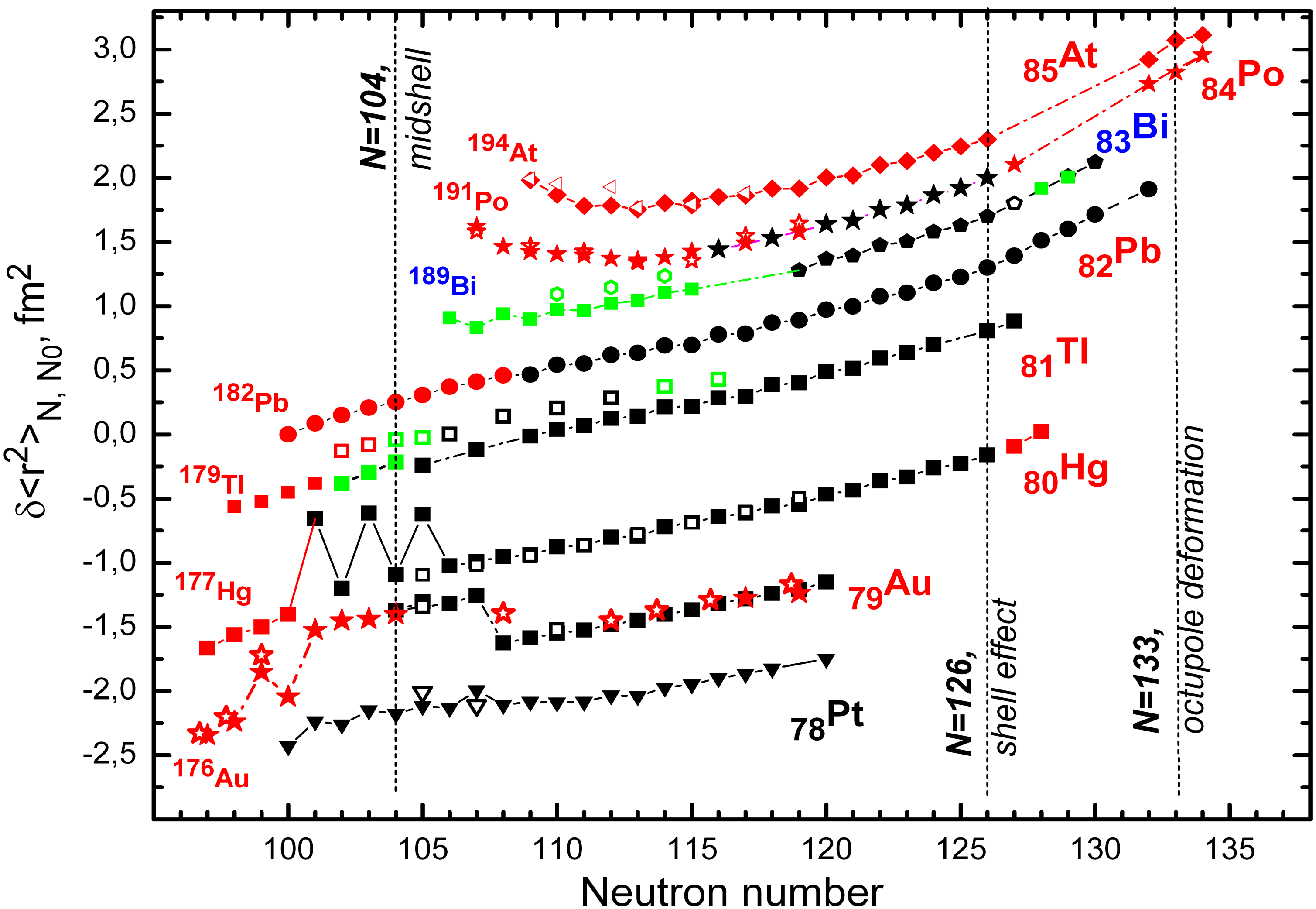
In-Gas Laser Ionization and Spectroscopy of Ac:
A quest for the atomic and nuclear structure of heavy elements

R. Ferrer, A. Barzakh, P. Creemers, R. de Groote, L.P. Gaffney, L. Ghys et al.

Pre-2012: Charge radii in the lead region



ISOLDE & IRIS (2015)



IRIS & ISOLDE: laser ion source — summary

1.Измерены изотопические сдвиги и сверхтонкое расщепление (*μ*, *Q*,

2.Измерены изотопические сдвиги и сверхтонкое расщепление (*μ*, *Q*,

3.Обнаружен оболочечный эффект в зарядовых радиусах Hg (N=126).