



High-precision mass measurements of neutron-rich krypton isotopes in $A=100$ region of deformation

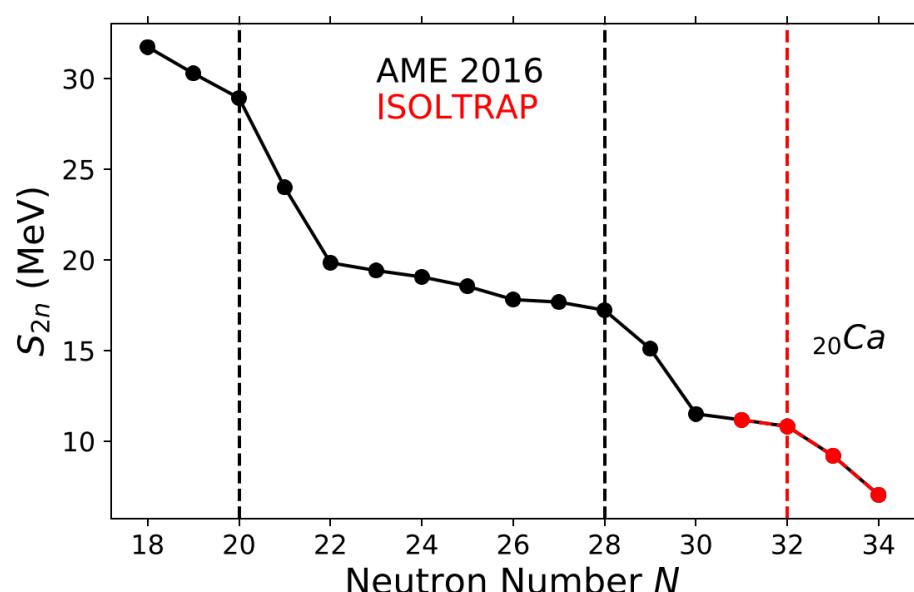
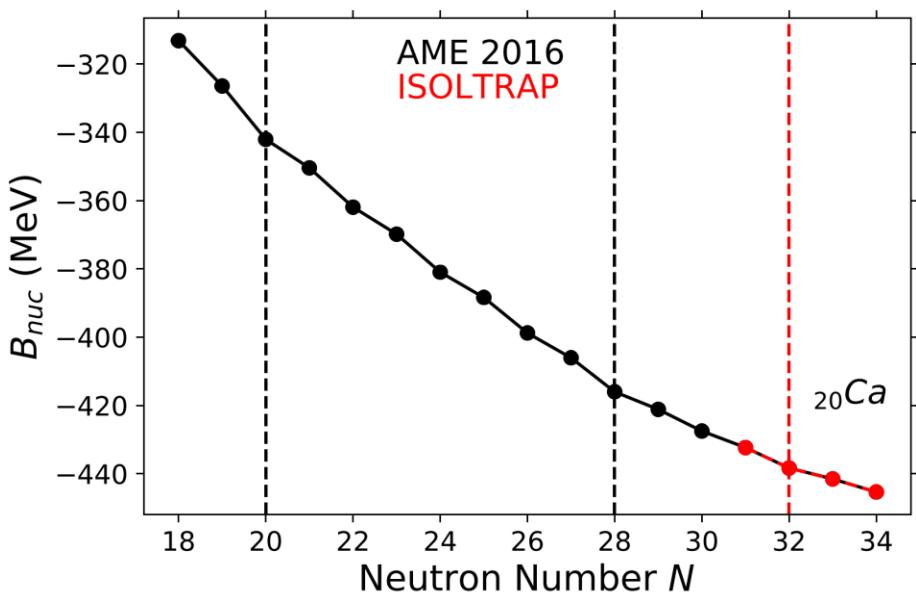
Ivan Kulikov

2020

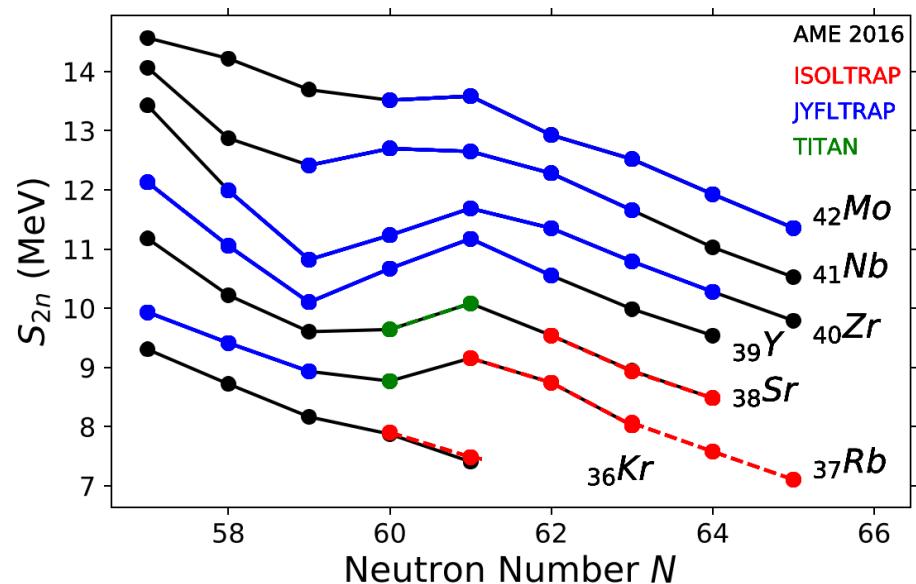
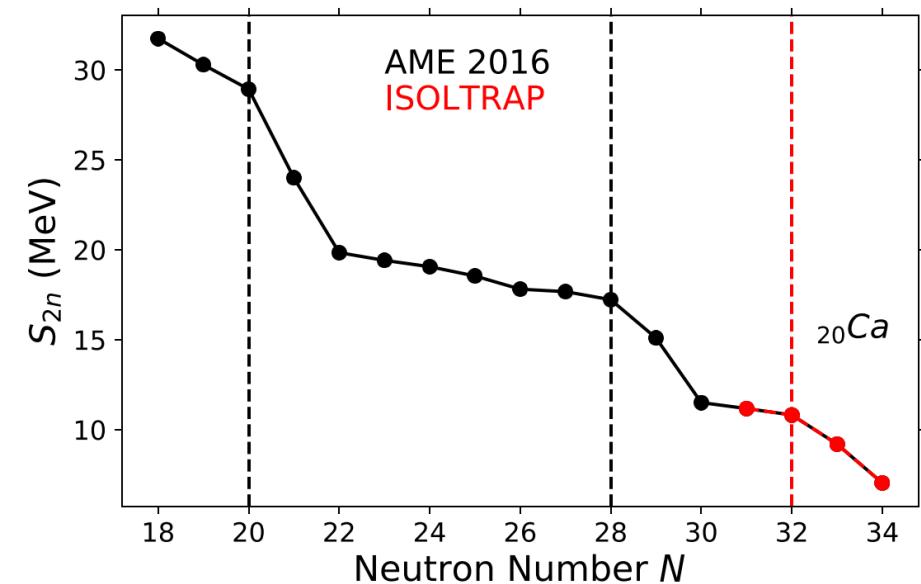
Motivation

$$m_{nuc}(Z, N) = Nm_n + Zm_p + B_{nuc}(Z, N)/c^2$$

$$S_{2n} = B_{nuc}(Z, N - 2) - B_{nuc}(Z, N)$$



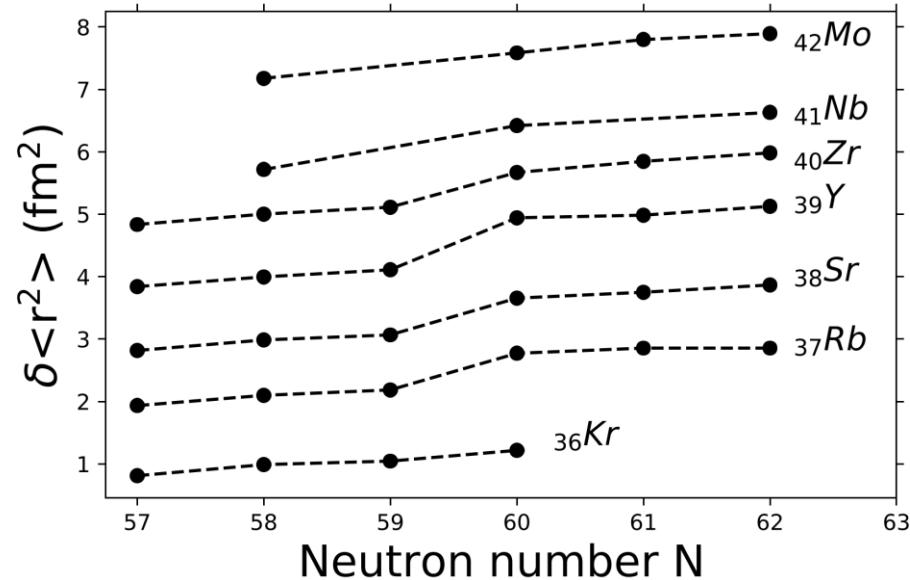
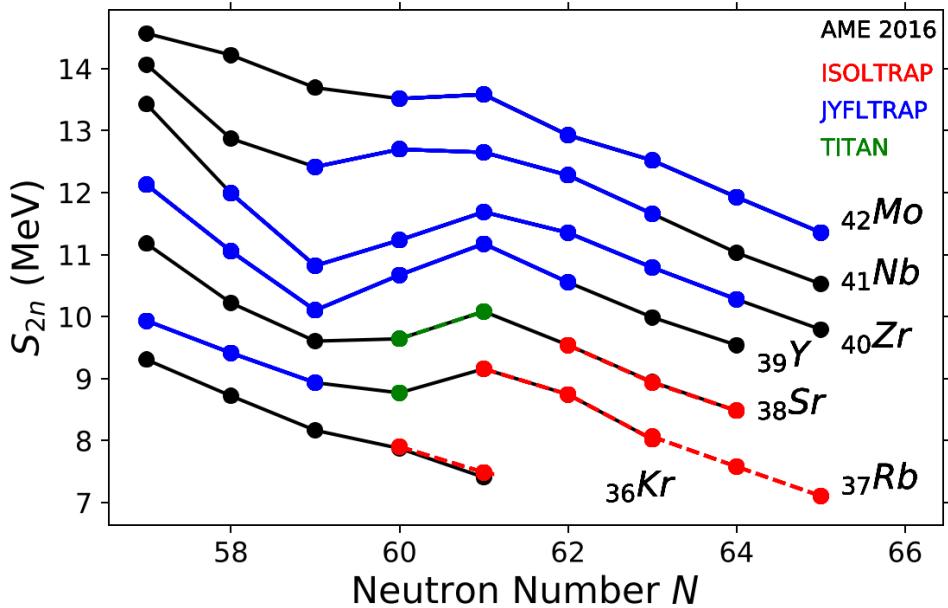
Nuclear structure effects



U. Hager *et al.*, Nuclear Phys A 793 (2007)
V. V. Simon *et al.*, PRC 85 (2012)
A. De Roubin *et al.*, PRC 96 (2017)

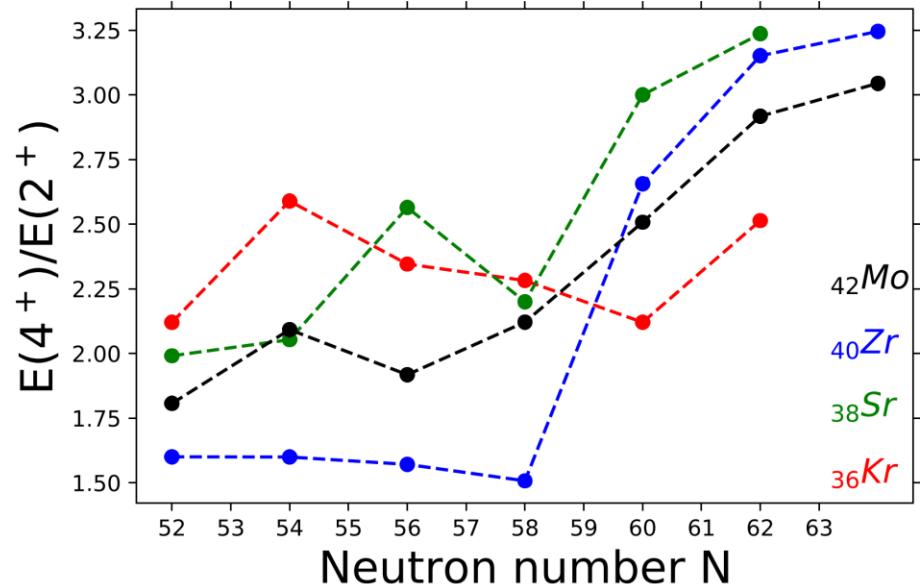
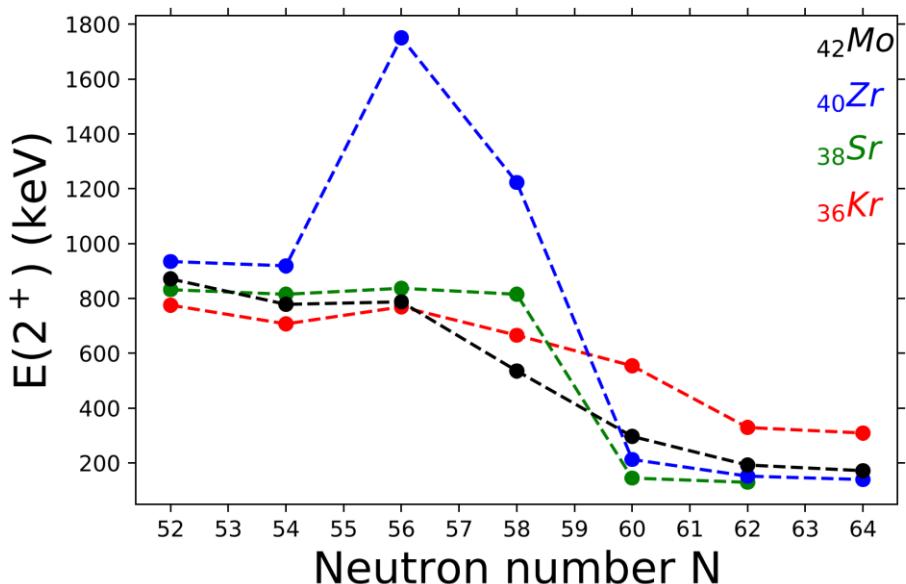
S. Naimi *et al.*, PRL 105 (2010)
V. Manea *et al.*, PRC 88 (2013)

Experimental evidences



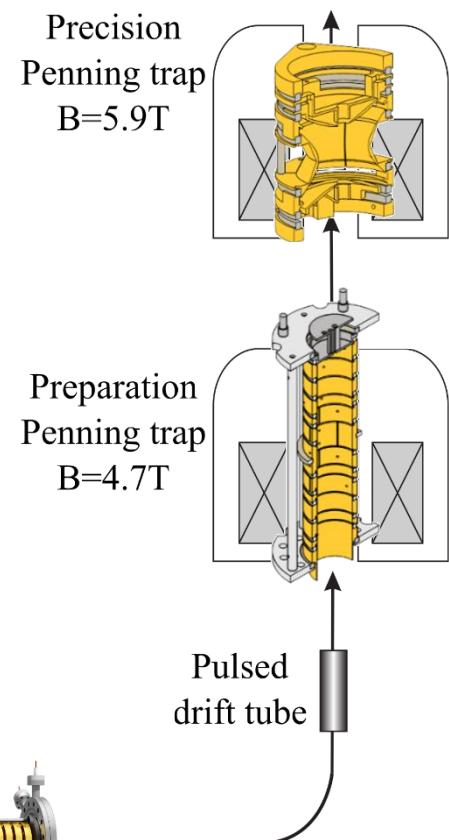
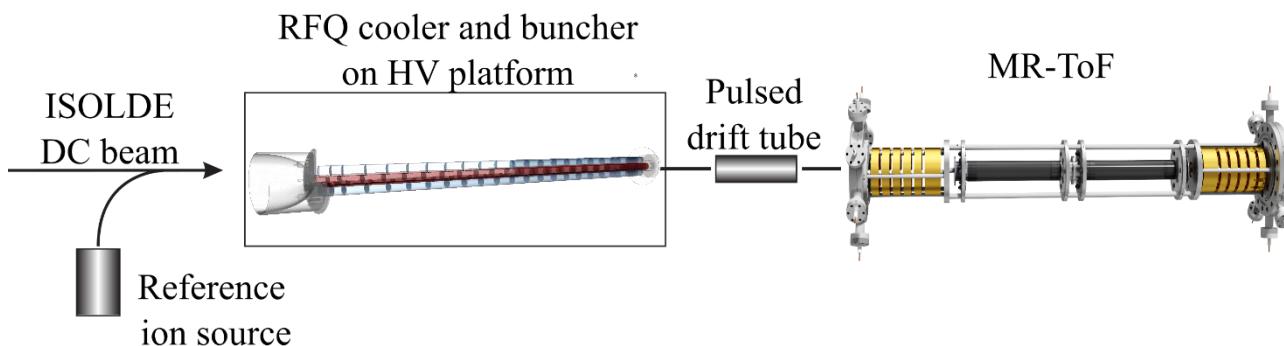
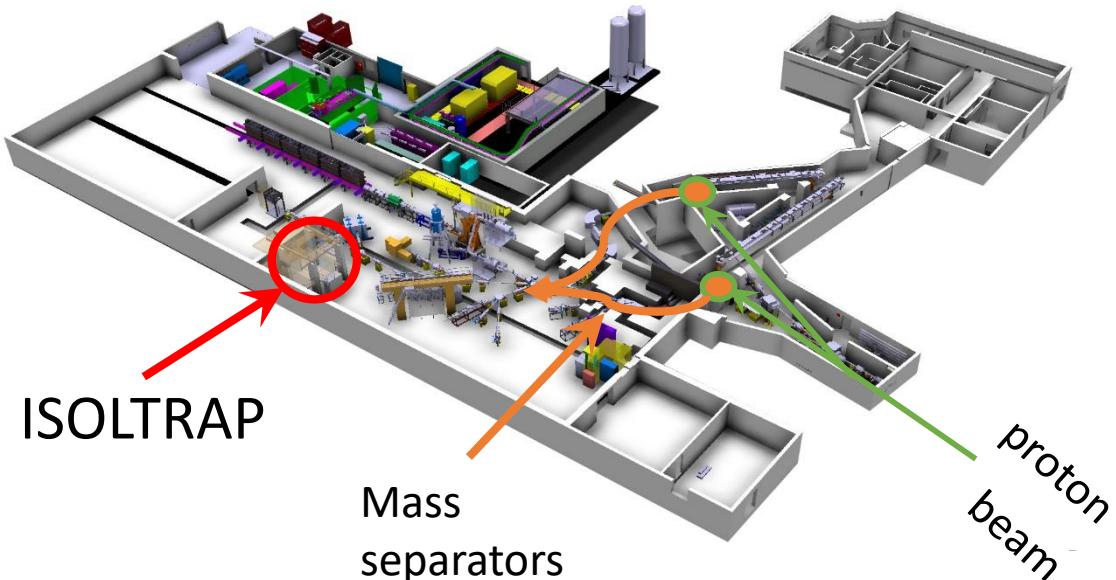
$N=60$ is the region of deformation for ^{37}Rb , ^{38}Sr , ^{39}Y , ^{40}Zr , ^{41}Nb isotopes

Experimental evidences

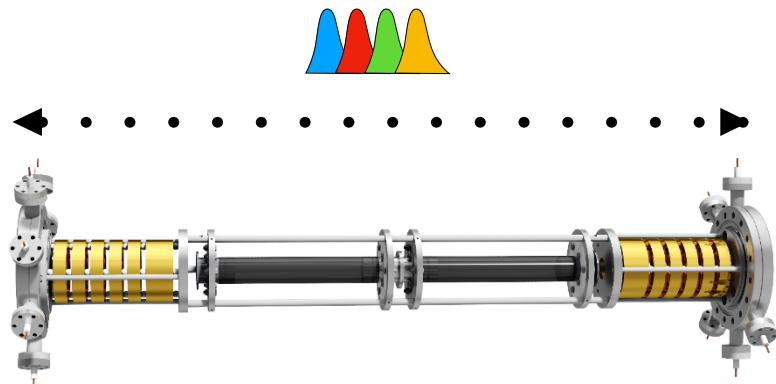


γ -spectroscopy concludes:
The shape transition happens at ^{98}Kr isotope !

ISOLTRAP

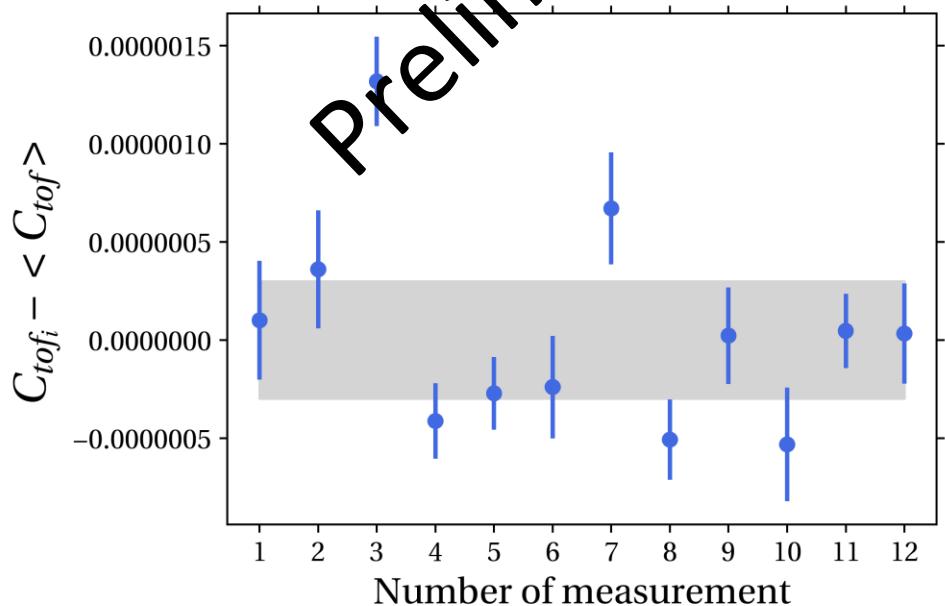
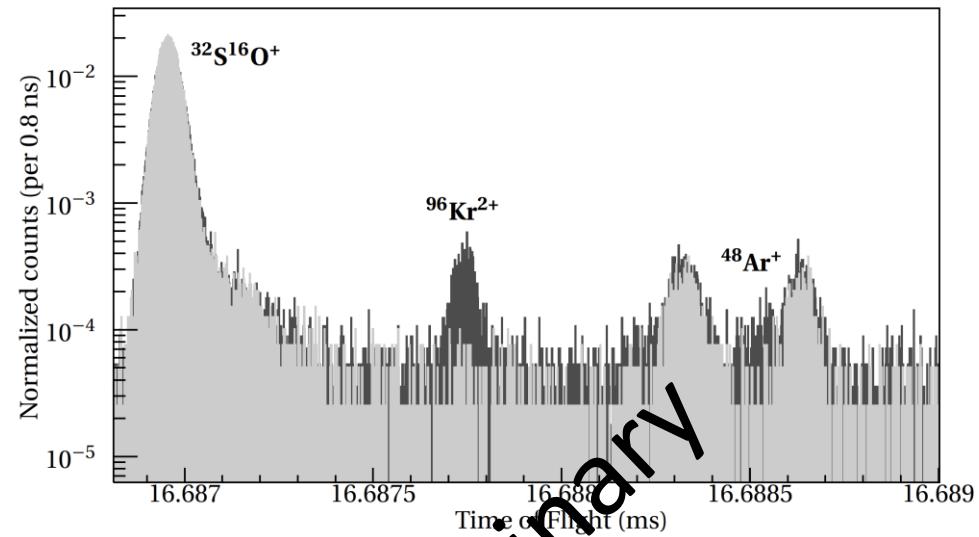


^{96}Kr

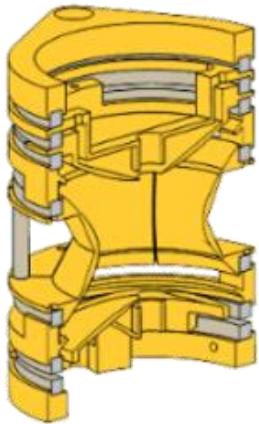


$$t = \alpha\sqrt{m/q} + \beta$$

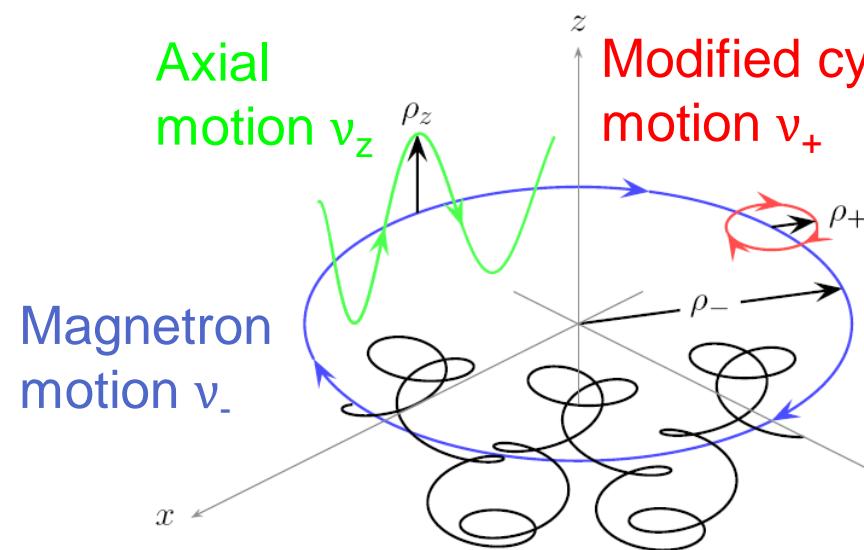
$$\sqrt{m/q} = C_{tof} * \Delta_{ref} + \frac{1}{2}\Sigma_{ref}$$



^{97}Kr

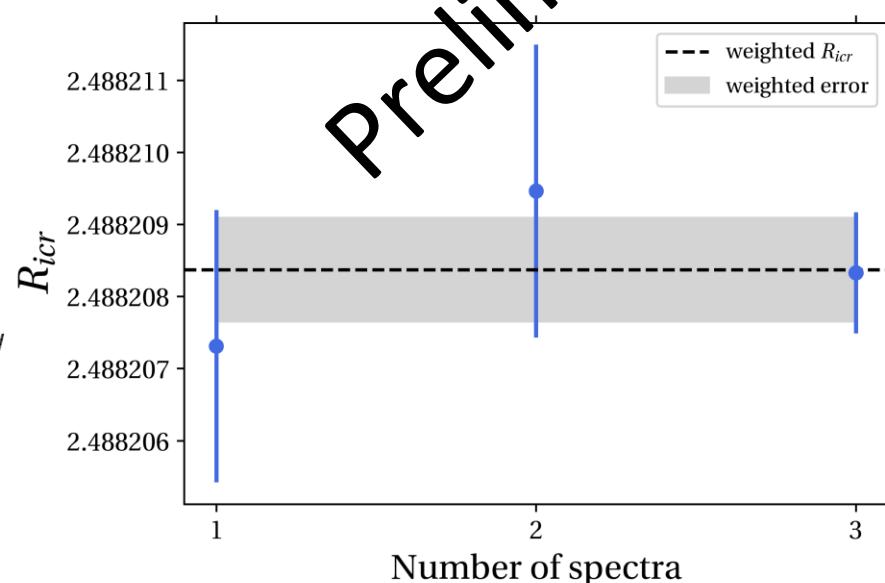
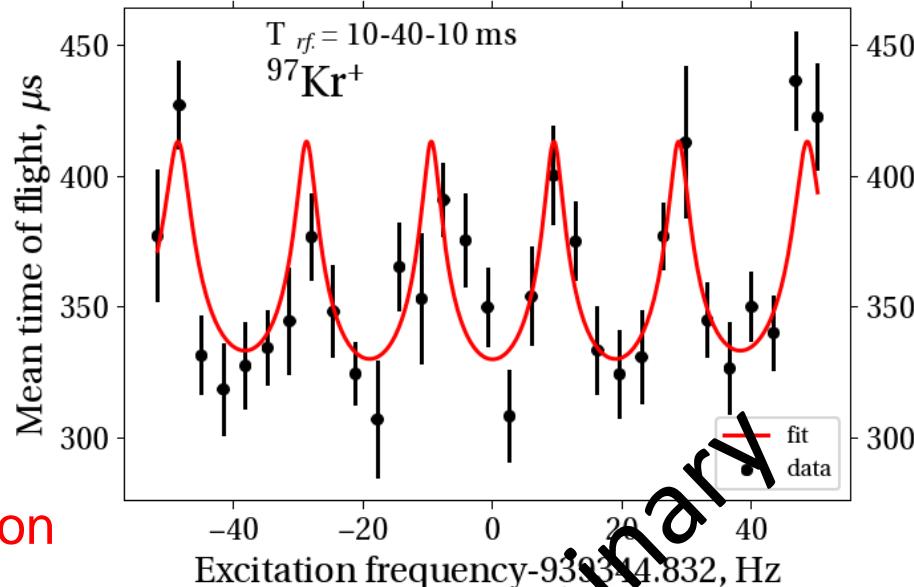


Axial motion v_z Modified cyclotron motion v_+

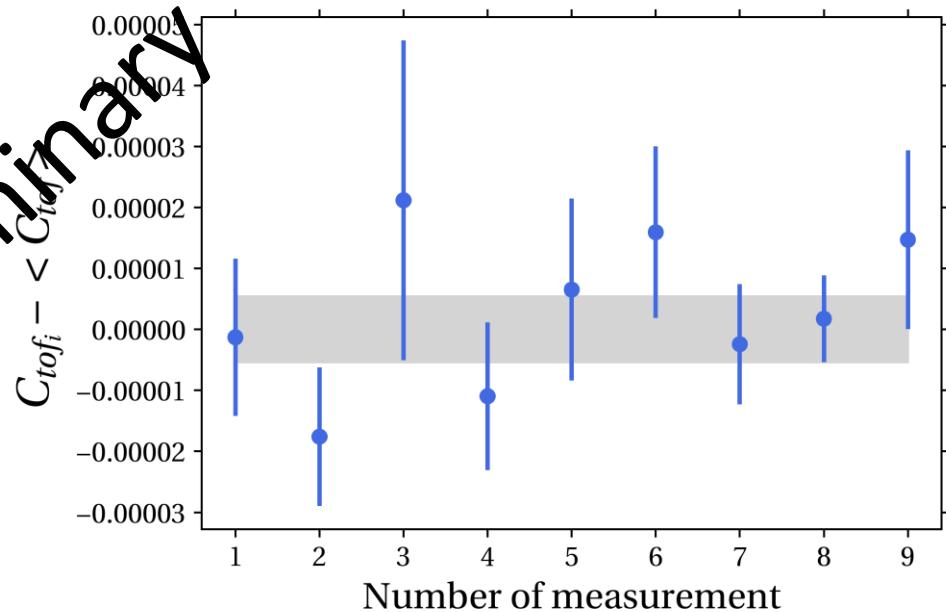
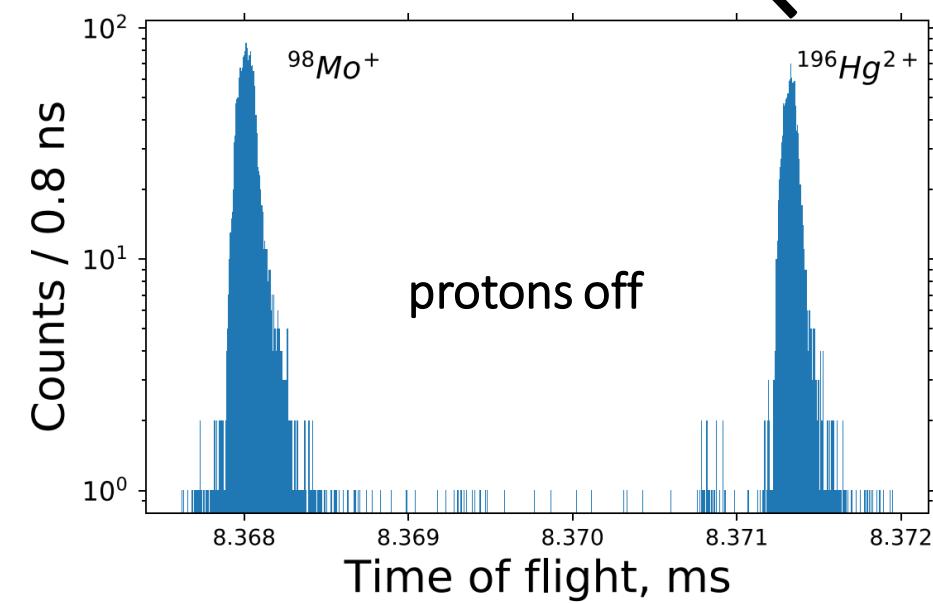
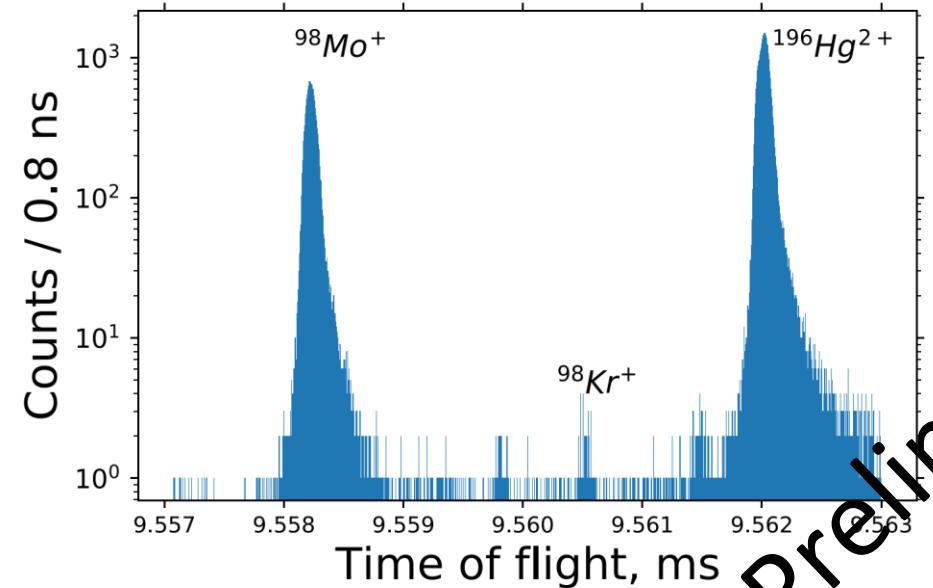


$$v_c = v_- + v_+ = \frac{B}{2\pi} * \frac{q}{m}$$

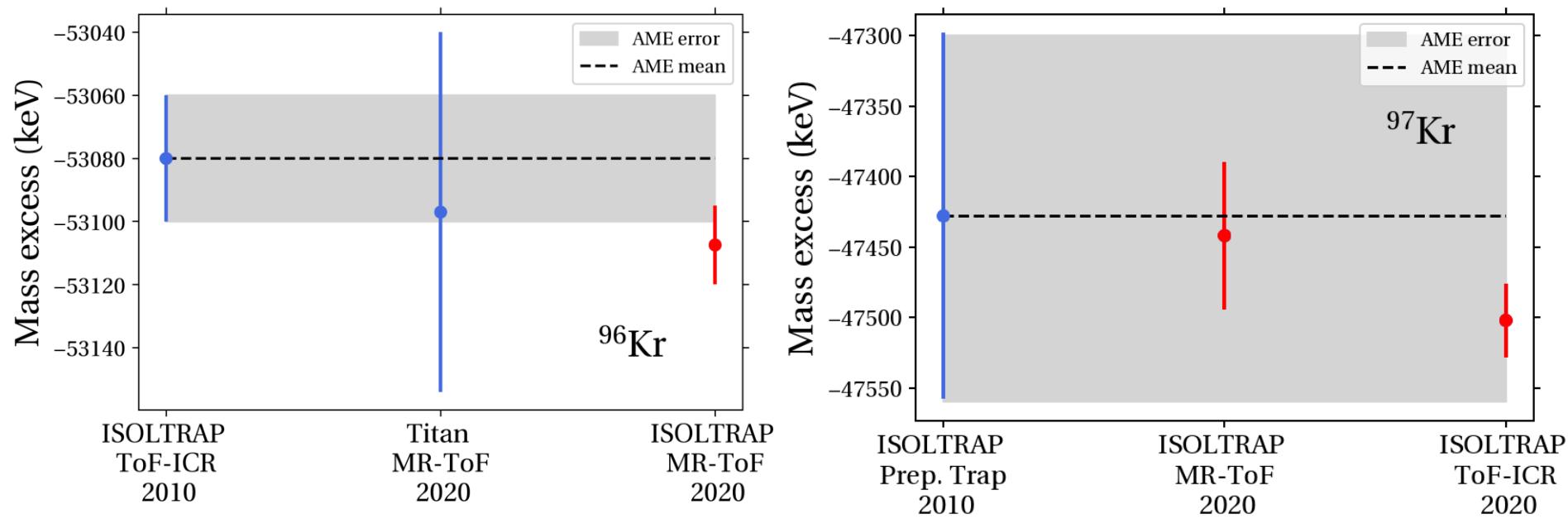
$$m = \frac{v_{c,ref}}{v_c} * (m_{ref} - m_e) + m_e$$



^{98}Kr



Results

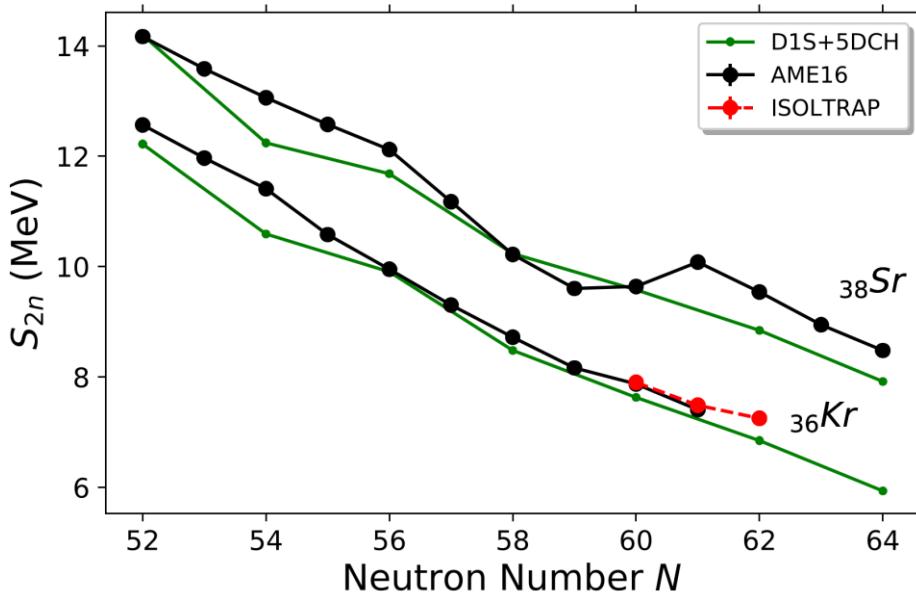
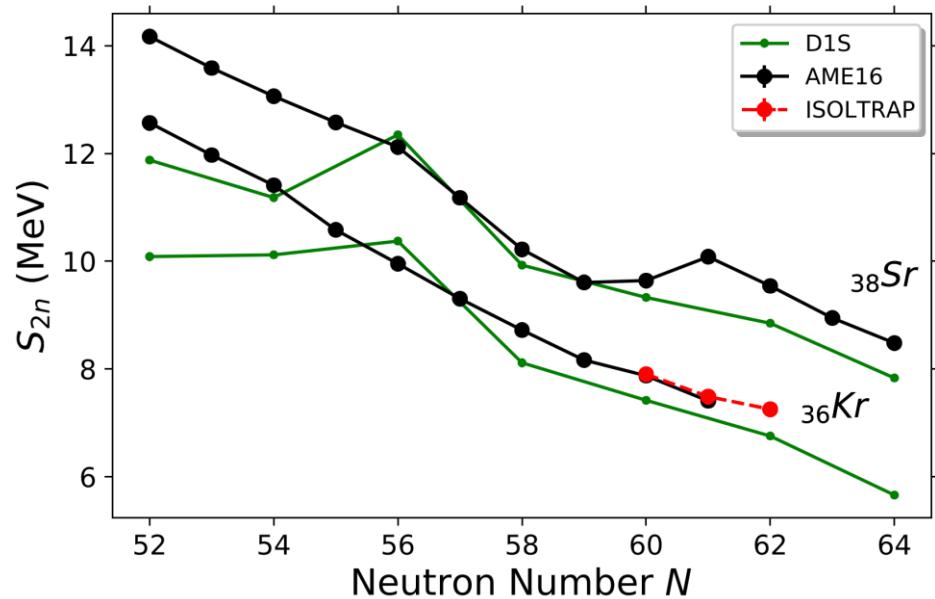
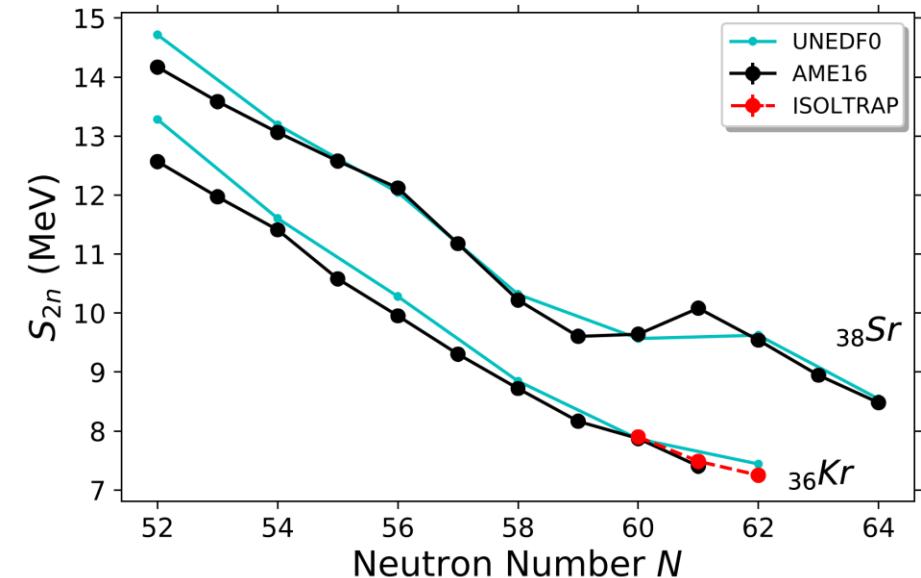


^{96}Kr agrees with ToF-ICR and MR-ToF

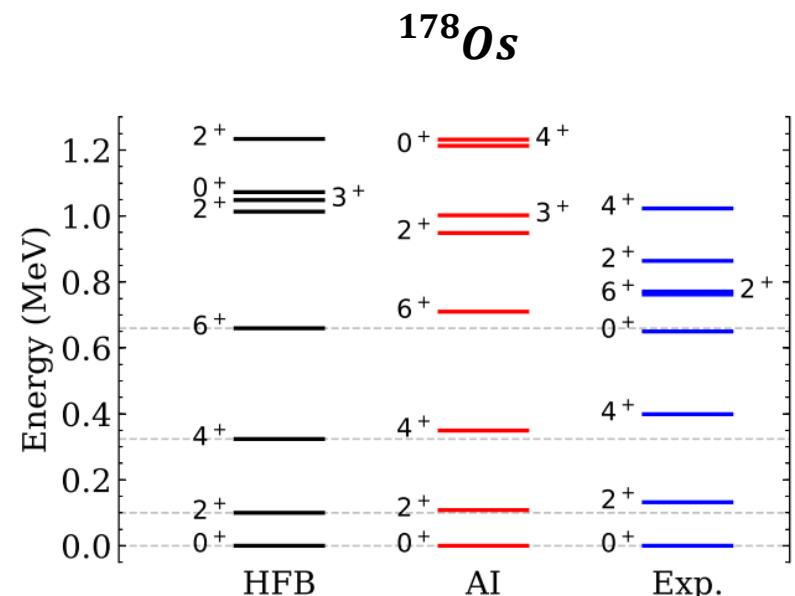
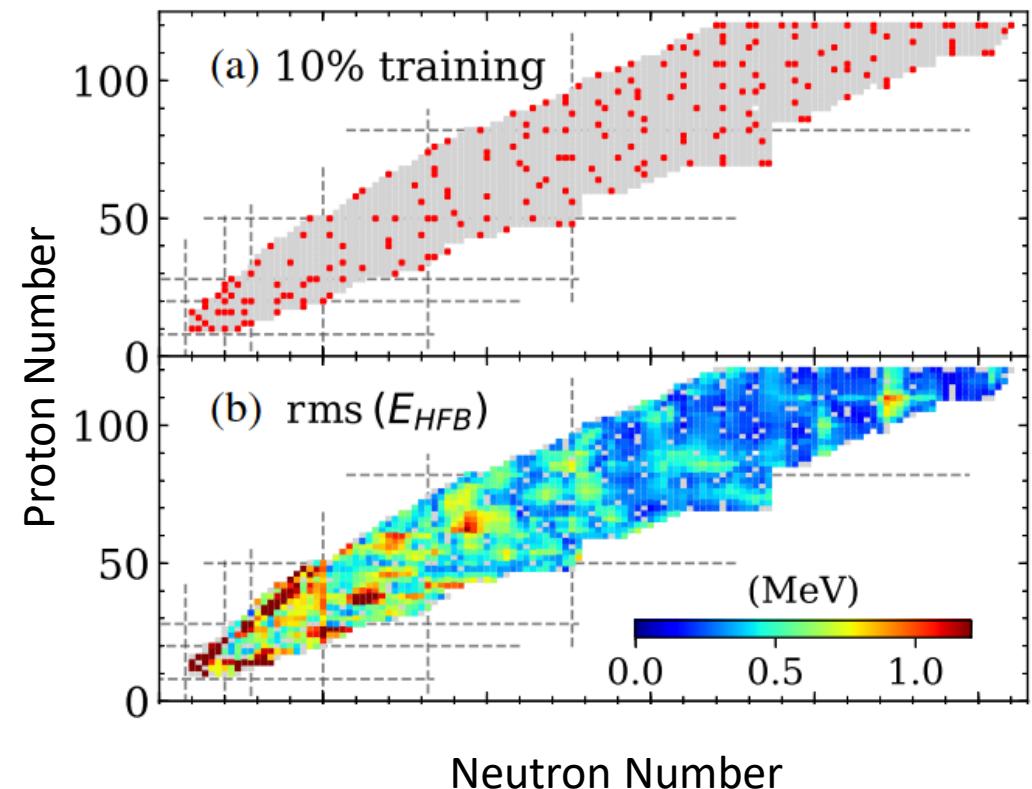
^{97}Kr agrees within different mass measurement techniques

^{98}Kr first ever time measured!

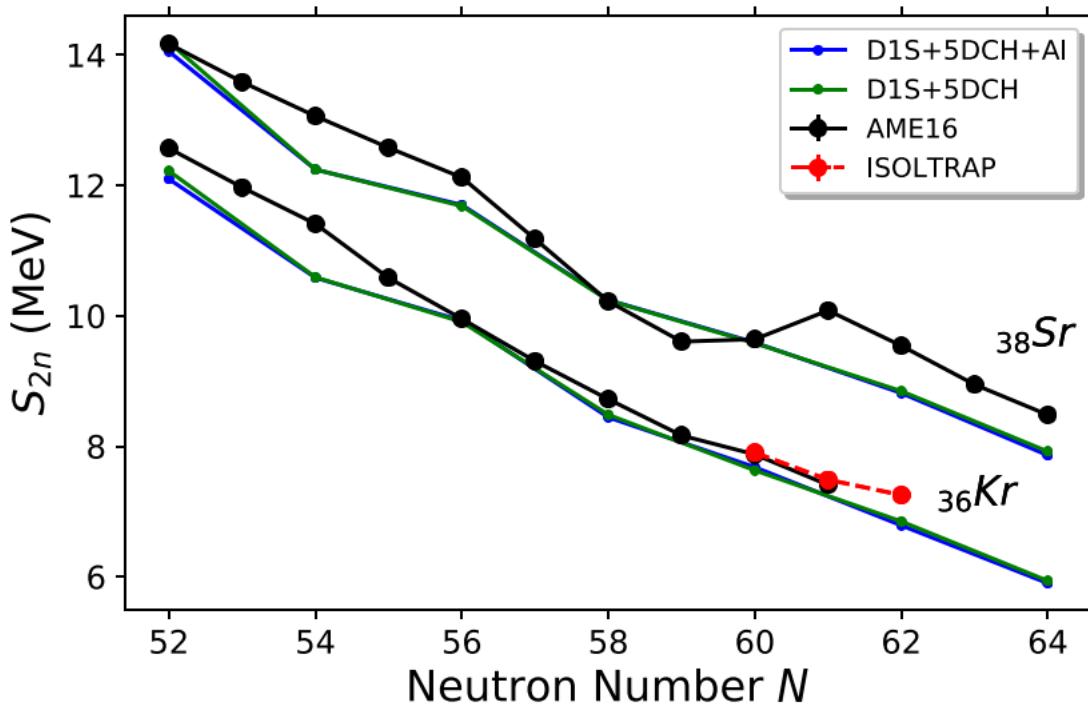
Mean-field approach



Artificial intelligence approach

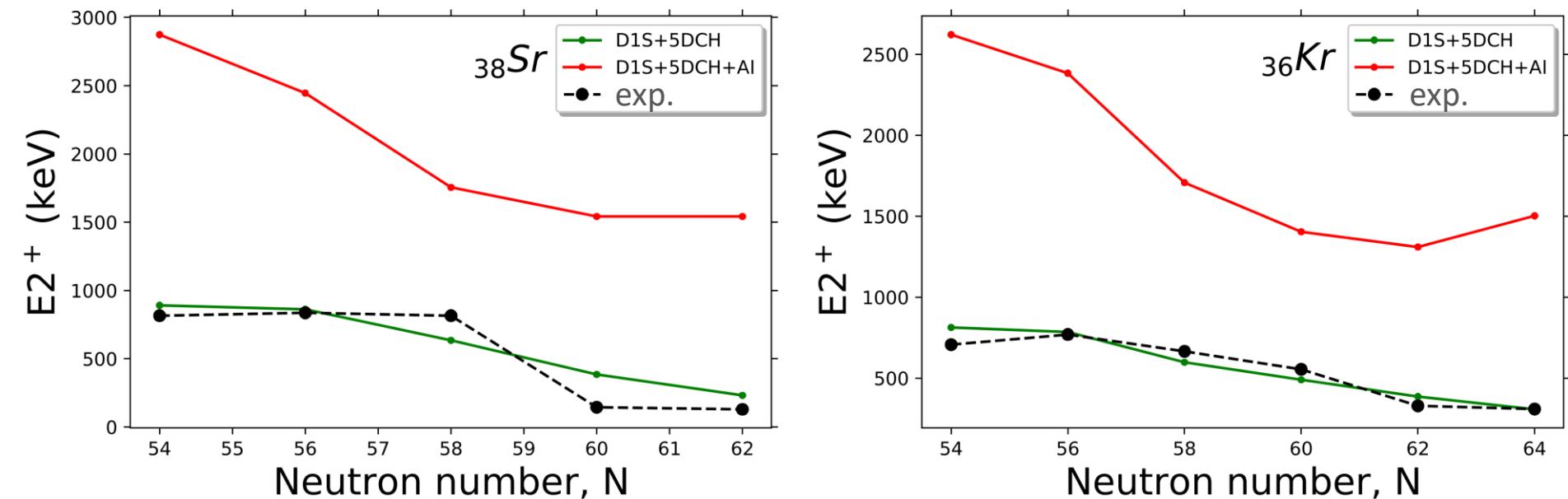


Artificial intelligence approach



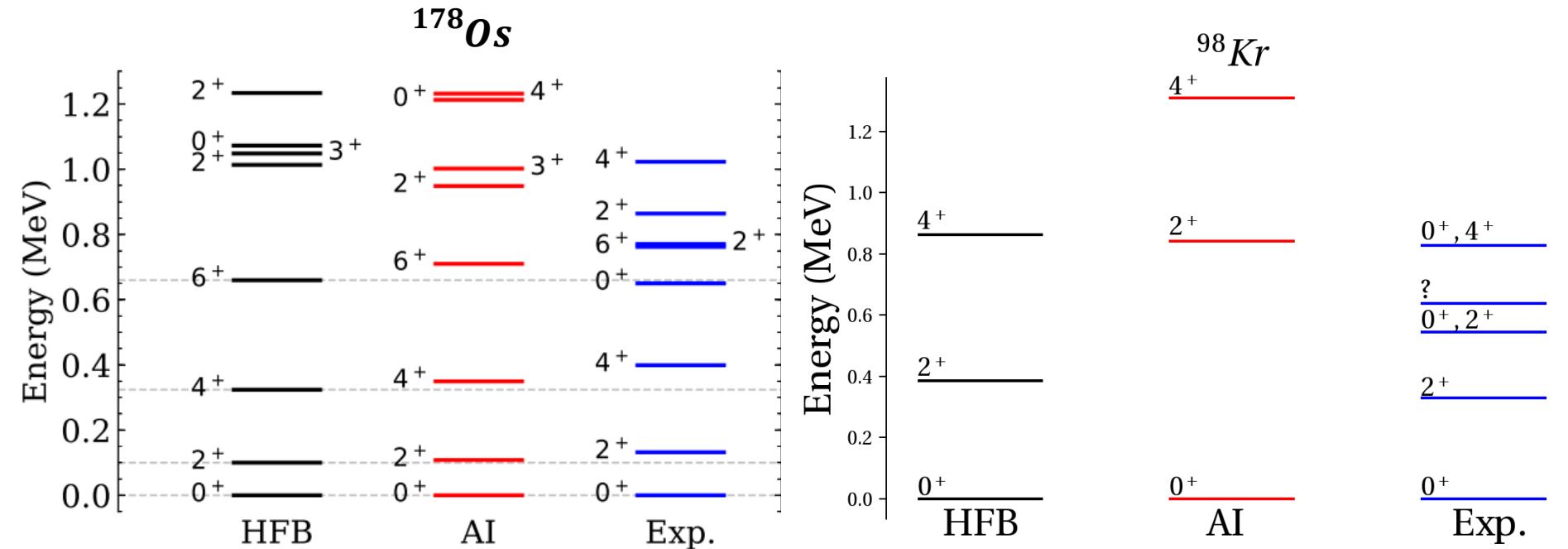
Does well compare to D1S+5DCH
In much shorter computation time!

Energy of 2+ state



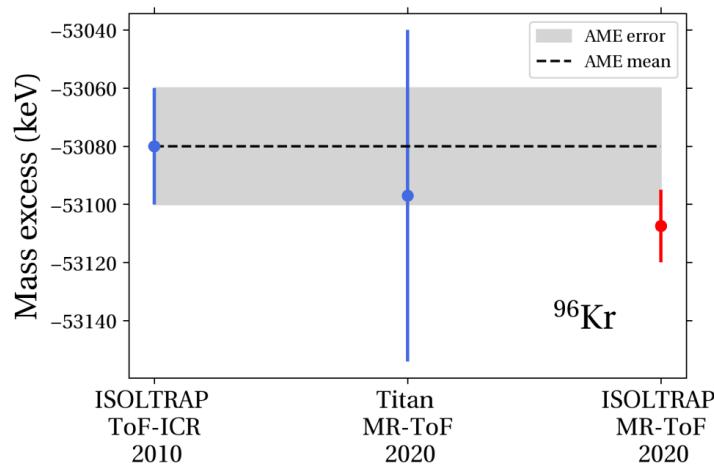
AI approach misses to predict the energy of 2+ state!

Energy levels



Maybe, the training set of the neural network does not capture enough information about nuclear deformation

Conclusion



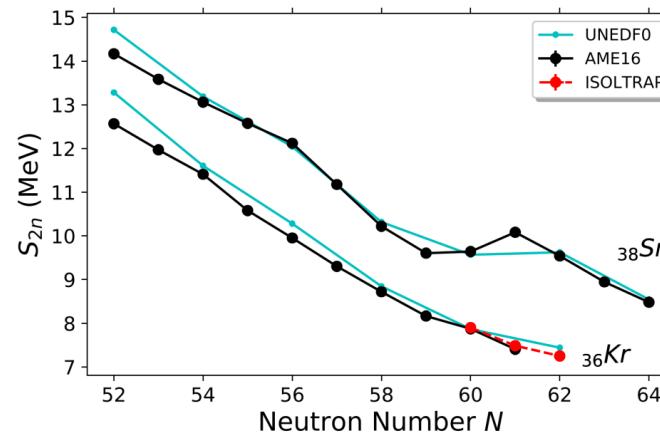
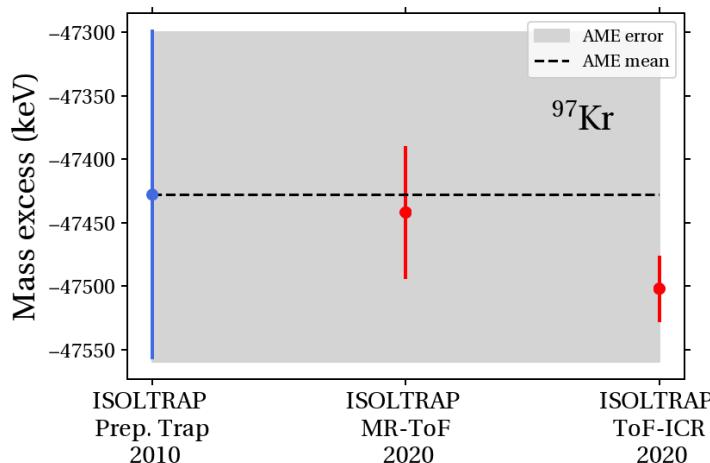
^{96}Kr agrees with ToF-ICR and MR-ToF

^{97}Kr agrees within different mass measurement techniques

^{98}Kr first ever time measured!

UNEDFO predicts the region the best

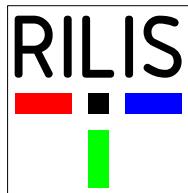
New approach based on Artificial Intelligence was done
predicts well the S2n energy
does not predict well the E2+ energy



Acknowledgements



P. Ascher, G. Audi, **D. Atanasov**, D. Beck, K. Blaum, G. Bollen, M. Breitenfeldt, R. B. Cakirli, T. Cocolios, S. Eliseev, S. George, F. Herfurth, A. Herlert, W. Huang , **J. Karthein**, **I. Kulikov**, J. Kluge, Yu. A. Litvinov, D. Lunney, **V. Manea**, E. Minaya-Ramirez, **M. Mousseot**, **L. Nies**, D. Neidherr, Ryan Ringle, M. Rosenbusch, A. de Roubin, L. Schweikhard, M. Wang, A. Welker, **F. Wienholtz**, R. Wolf, K. Zuber



*ISOLDE Target
and Technical Group*



MAX-PLANCK-INSTITUT
FÜR KERNPHYSIK



MAX-PLANCK-GESELLSCHAFT

ERNST MORITZ ARNDT
UNIVERSITÄT GREIFSWALD



Federal Ministry
of Education
and Research

