3RD INTERNATIONAL CONFERENCE ON EXOTIC NUCLEI AND ATOMIC MASSES
July 2-7, 2001, Hämeenlinna, Finland

Mid-shell crisis and the pairing gap in neutron-deficient Hg isotopes

S. Henry, G. Audi and D. Lunney
Centre de Spectrométrie Nucléaire et de Spectrométrie de Masse (IN2P3-CNRS)
Université de Paris Sud, F-91405 Orsay, France

S. Schwarz and G. Bollen
National Superconducting Cyclotron Laboratory
Michigan State University, East Lansing MI 48824, USA

Many years ago, optical spectroscopy studies [1] revealed a dramatic odd-even staggering in the radii of the Hg isotopes located midway between the neutron shell closures at N=82 and N=126. The ensuing avalanche of theoretical work and nuclear spectroscopy studies all point to competition between different shape configurations at very nearly equal energies, otherwise known as shape coexistence.

The explanation is thought to be the neutron pairing energy that provides a stabilizing effect of nearly spherical shape until the number of neutrons becomes so small and this effect collapses into strong prolate deformation of the ground state.

Access to the binding energies necessary to evaluate the neutron pairing gap only became possible recently due the superior resolving power and high accuracy provided by the on-line Penning trap spectrometer ISOLTRAP [2]. Mass measurements of Hg isotopes were particularly challenging due to the existence of very low lying (100-300 keV) isomeric states.

It has been suggested [3] that the the odd-even staggering in masses has two components, one due to pairing and the other due to the (deformed) mean field. To probe this question, it is interesting to compare mass model predictions to the new measured values. Examination of these differences reveals an interesting fact: all the models considered (be they algebraic, microscopic or macro-micro) have a pronounced, residual odd-even effect.

Given that mass model predictions can be far from the absolute value, it is interesting to examine mass differences so that the nuclear structure content of the various model can be brought to the fore. What is perhaps more instructive is to directly examine the pairing energies determined from the odd and even sheets of the experimental mass surface [4].

This contribution will present the model differences mentioned above, the comparison of the neutron pairing gap as calculated by theory and the new experimental values, and will attempt to draw some conclusions about the impact of the pairing gap on the so-called mid-shell crisis of the competing shape personalities of the light Hg isotopes.

We are grateful for discussions with A. Lopez-Martens, J. Sauvage and D. Verney.

References

[1] E. Otten in "Treatise on Heavy-Ion Physics, Vol. 8" D.A. Bromley, ed. (Plenum Press, New York, 1989)
[2] S. Schwarz et al., Nucl. Phys. A (2001) in print
[3] W. Satula, J. Dobaczewski and W. Nazarewicz, Phys. Rev. Lett. 81 (1998) 3599
[4] S. Henry, Doctoral thesis, Université de Strasbourg - Louis Pasteur, 2001