Structure of neutron-rich N=126 closed shell nuclei

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A series of experiments devoted to the study of the neutron-rich N~126 region have been performed at GSI, Darmstadt, within the Rare Isotopes Investigations at GSI (RISING) project. Exotic nuclei were synthesised using relativistic projectile fragmentation of ^{208}Pb provided by the SIS synchrotron. The fragments produced were separated and identified event-by-event using the GSI FRagment Separator (FRS). The final reaction products were stopped in layers of plastic, copper, or double-sided-silicon-strip detectors [1] at the final focal point of the FRS and viewed by the high-efficiency, high granularity Stopped RISING gamma-ray spectrometer [2], consisting of 15 Euroball cluster Ge-detectors. Time-correlated gamma decays from individually identified nuclear species have been measured, allowing the clean identification of isomeric decays (passive stopper), and beta and conversion electron decays (active Si stopper).

The highlights of the experimental results from these highly successful experiments include the first observation of excited states in three neutron-rich N=126 closed shell nuclei:
(i) In ^{205}Au$_{79}$ the conversion electron decay of the $\pi h_{11/2}^{-1}$ seconds lived isomeric state into the $\pi d_{3/2}^{-1}$ ground-state has been observed [3]. In addition the yrast structure has been established up to spin-parity (19/2$^+$) via the observation of the decay of in isomeric state with configuration $\pi(h_{11/2}^{-1})_{10}s_{1/2}$;
(ii) In ^{204}Pt$_{78}$, the yrast sequence has been observed following the internal decay of I^π=(5$^-$), (7$^-$) and (10$^+$) isomeric states [4];
(iii) In ^{203}Ir$_{77}$ excited states have been observed following the decay of an isomeric state with structure similar to that in its ^{205}Au isotone.

Shell model calculations have been performed in order to get a deeper understanding of the structure of these N=126 nuclei. It was found that in order to get a good description for all available information on the N=126 isotones below lead, both on excitation energies and transition strengths, small modifications of the standard two-body matrix elements [5] were required. The possible consequences of these modifications on the structure of the more exotic N=126 nuclei as approaching the r-process waiting points is investigated.

Experiments, results, comparison with theoretical calculations and future plans will be discussed.

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