Contribution ID: **59** Type: **Poster**

Fast beta-alpha-pile-up suppression electronics for super heavy element identification

Monday, 17 September 2012 17:30 (1h 30m)

The synthesis [1] and chemical [2] investigation of new elements are one of the most fascinating tasks in nuclear physics and radiochemistry. Especially for the investigation of their chemical properties the unam¬biguous identification of the decay of their isotopes is a very important prerequisite. The time-re¬solved spectroscopic recording of alpha particles emitted during the decay of an isotope as well as its con¬secutive decaying descendents gives the highest possible confidence to assign the observed event chain to the decay of the isotope of interest. However, the formation of unwanted by-products in the used nuclear reactions leads to large amounts of unwanted events in energy regions, where the decay of the inves¬tigated isotopes or their daughter nuclei is expected. Especially the beta-decay of Bi-212 and the following alpha-decay of Po-212 (half-life 0.3 us) might disturb the measurement due to the consecutive emission of a high energetic beta- and alpha-particle. The sum of the kinetic energies of both particles may exceeds 10.5 MeV if both hit the same detector within a short time period of typically less then 1 us. Conventional spectroscopy electronics can not resolve the consecutive hits of the beta- and alpha-particle in time. This leads to so called pile-up pulse height amplification. Also the separation power of high acceptance physical mass sepa¬rators like the Berkeley Gas-filled Separator (BGS at LBNL, USA) or the Trans Actinide Separator and Chemistry Apparatus (TASCA at GSI, Germany) are not able to suppress all of these beam-like by-products. It was shown in [3] that such pile-up events contribute two orders of magnitude more to the event budget in the region between 8.9 MeV and 9.5 MeV than all other possible events in the course of experiments synthesized 114 at the TASCA separator.
A new and fast spectroscopic detection system PURECOLD was designed and build-up to distinguish pile-up signals from real pure alpha-events at the same energy. This setup is able to record each 2 us a single event with overall event rates up to 12000 per sec and per spectroscopic channel. The discrimination of pile-up signals is based on the sampling of the leading edge of the independently amplified fast timing signal using sixteen consecutive fast voltage comparators (switching time 150 ps) with a time resolution of 0.5 ns. The spectroscopic part of PURECOLD consists of two independently acting amplifier chains each connected to a 500000 sample per second 16-bit analog digital converter to process events from 0 MeV to 30 MeV and from 0 MeV to 300 MeV, respectively. Furthermore, this system has the capability to measure time-wise very short consecutive alpha-decays, which appears to be increasingly important for the dis¬covery of new elements and new isotopes due to the possibility to convert a second signal arriving within the conversion time of the first one using the second amplifier chain and analog digital converter.

References:

[1] Yu.Ts. Oganessian, et al.: J. Phys. G: Nucl. Part. Phys. 34 (2007) R165
[2] H. W. Gäggeler: Radiochim. Acta 99 (2011) 503
[3] J. M. Gates, et al.: Phys. Rev. C 83, 054618 (2011)

Primary author: Dr DRESSLER, Rugard (Paul Scherrer Institut, Switzerland)

Co-author: Mr RASMUSSEN, Peter (Paul Scherrer Institut)

Presenter: Dr DRESSLER, Rugard (Paul Scherrer Institut, Switzerland)

Session Classification: Poster Session

Track Classification: Chemistry of radioelements and Super Heavy Elements research