

To: Prof. Dr. Mark Huyse, Chairman  
To: INTC ISOLDE, CERN

October 1<sup>st</sup> 2008

Dear Professor Huyse and INTC members

**LETTER OF INTENT:**  
“g-factor measurements at REX-ISOLDE”

With this Letter of Intent we are asking for a provisional approval to build an experimental set-up and perform experiments to measure g factors of isomeric states in exotic nuclei utilizing post-accelerated ISOL beams after REX-ISOLDE. This possibility has been discussed within the Miniball collaboration and has been considered positively. The Miniball Steering Committee has suggested that this set up should be built at a beam line different than the one used by the Miniball. Recently we have acquired an electromagnet with the corresponding controller and power supply. We have built a support table, which can hold the electromagnet and the gamma-ray detectors, which should be positioned in a horizontal plane in this case. We have provided the ISOLDE Committee of the Experimental Hall Extension with information for the requirements of cooling water, electricity and space for the electronic equipment for the electromagnet.

Nuclear electromagnetic moments are sensitive probes to the properties of individual nuclear states, e.g. magnetic dipole moments reflect the single-particle components of the nuclear wave function. Thus, they turn out to be key experimental observables, which are needed to test nuclear structure models. With the development of radioactive beams, studies of neutron-rich nuclei became possible. In a number of cases the shell structure changes drastically away from the valley of  $\beta$ -stability, where the standard nuclear shell models have been developed. This results in erosion of normal shell closures, leading to new regions of deformation and collectivity. Experimentally such effects can be verified through studies of nuclear moments.

In order to perform such experiments with post-accelerated ISOL beams we have studied the possibility to populate isomeric states in transfer reactions in inverse kinematics and have carried out a series of experiments with stable beams in order to master the experimental techniques, e.g. see Ref. [1-3].

Exotic nuclei can be produced either by projectile fragmentation, or by the ISOL (Isotope Separation On-Line) method, the latter case being realized at ISOLDE. At present the REX-ISOLDE facility provides unique opportunities to perform experiments in transfer reactions in inverse kinematics with post-accelerated beams of a great variety of neutron-rich isotopes which we seek to exploit. The spin ensemble of the post-accelerated ISOL beams is completely randomly oriented. However, if nuclear reactions are performed, the reaction residues could be obtained in a spin-oriented manner. One such possibility is to utilize one-particle transfer reactions in inverse kinematics on deuterated targets. In such a case it is possible to populate isomers in  $N+1$  nuclei ( $N$  is the neutron number of the

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projectile), thus making a step towards more exotic nuclei. The main advantage of such a technique is the possibility to populate short-lived isomers in the nanosecond region, which is impossible to study with in-flight techniques, where the flight time through the separator is a major limitation. In this way, the successful realization of this technique will open an avenue to a large class of experiments, which are not possible with other techniques and at other facilities. Another option is to explore multi-nucleon transfer reactions for the population of exotic nuclei. This would not lead to any significant modifications of the suggested set up.

For the practical realization of the project will be necessary to build an experimental set up at a beam line different than the present Miniball beam line. This beam line needs to be equipped with beam monitoring detectors and devices. The experimental set up would include an electromagnet (~500 kg) with a controller and power supply. The gamma-ray detectors will be mounted on a support table ( $\varnothing \approx 150$  cm). For the measurement of the  $\gamma$  rays we intend to use four Miniball detectors and the corresponding electronics. A test of the set up using stable beam is of crucial importance and needs to be done before a radioactive beam experiment is proposed.

In summary, we believe that the opportunities provided by REX-ISOLDE are unique and g-factor measurements at this facility are timely and very significant for the physics of nuclei at the limits. Of course, we realize that the quality of such experiments needs to be scrutinized fully by the INTC. However, by this letter we ask for provisional approval to build an experimental set up, to enable us to begin a detailed planning process, aiming at a first physics experiment in 2009-2010.

Yours sincerely,

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References:

[1] G. Georgiev et al, EPJ **A30**, 351 (2006)

[2] D.L. Balabanski, AIP Conference Proceedings **899**, 7 (2007)

[3] E. Fiori, M.S. Thesis, University of Camerino, 2007 (unpublished)