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Letter of Clarification
for proposal CERN-INTC-2007-013 INTC-P-226 to the INTC Committee

Approaching the r-processs "waiting point" nuclei below ^{132}Sn: quadrupole collectivity in ^{128}Cd

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Abstract: Proposal CERN-INTC-2007-013 INTC-P-226 aims at the investigation of the nucleus ^{128}Cd neighbouring the r-process "waiting point" ^{130}Cd. Recently, contradicting experimental findings for ^{130}Cd have been reported. These results led consequently to contradicting theoretical interpretations. In particular, a suprisingly large quadrupol deformation for neutron-rich Cd isotopes has been predicted by modern beyond-mean-field calculations. Therefore, we propose to measure the reduced transition strength $B(E2)$ between ground state and first excited 2^+-state in ^{128}Cd applying γ-spectroscopy with MINIBALL after "safe" Coulomb excitation of a post-accelerated beam obtained from REX-ISOLDE. The result from the proposed measurement will be complementary to those from other experiments at ISOLDE and will add valuable information to a consistent understanding of this region which is of particular interest for both nuclear astrophysics and nuclear structure.

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^{128}Cd yield measurement

The physics case of the proposal presented to the INTC during the meeting on May 21, 2007 has already been endorsed. However, before being recommended to the Research Board the INTC asked for a yield mesasurement for ^{128}Cd to be reported in the following meeting of the INTC. Due to technical problems with the RILIS this measurement originally scheduled for autumn 2007 could be performed only in May 2008.
The yield measurement has been performed with the target UC362 equipped with an improved version of the quartz transfer line. In the run of experiment IS411 in 2006, this quartz transfer line turned out to be the essential development for the suppression of isobaric contaminants in the beams of neutron-rich Cd isotopes. The proton beam was sent onto the neutron converter. The measured yield was $1.3 \cdot 10^4$ μC^{-1} for ^{128}Cd at the tape station [1]. The only isobaric contaminant in the beam was ^{128}In with a measured yield of $1.6 \cdot 10^2$ μC^{-1} already comprising In produced by the decay of Cd. These values remained stable during the irradiation with ca. $8 \cdot 10^{17}$ protons. A test without the neutron converter has been regarded as useless because of the expected overwhelming amount of isobaric Cs contamination making even a descent injection into REX impossible.
Taking into account a proton beam intensity of 2 μA, hence the production rate for ^{128}Cd is $2.6 \cdot 10^4$ s^{-1}. With an efficiency of REX of 7%, this value has been achieved during the run of experiment IS411 measuring ^{126}Cd, the expected rate on target will be 1800 s^{-1}. It has to be mentioned that due to the shorter half life of ^{128}Cd ($T_{1/2} = 280$ ms) compared to ^{126}Cd ($T_{1/2} = 515$ ms) more beam will be lost by decay, hence for the same setting of REX the efficiency will be lower. However, the long breeding time of 284 ms used in 2006 for ^{126}Cd may be decreased. In 2004 the same charge state of 31^+ has been reached with a breeding time of 148 ms, but as no quartz transfer line has been used at this time the obtained efficiencies of 2-3% are not completely comparable. Alternatively, the breeding time can also be reduced using a lower charge state of 30^+ [2]. Conclusively, we expect that at least half of the produced ^{128}Cd will decay before it reaches the target.
The rate estimate and the beam time request presented in the proposal were based on a little more pessimistic estimate for the ^{128}Cd intensity of 500 s^{-1} on target. Based on our experience from former experiments, always losses in beam time because of problems of the accelerators, both PS Booster and REX, have to be expected. Furthermore, fluctuations in the intensity due to the properties of the ISODLE target as well as its degradation during a one week run have to be considered too.
We conclude that our original estimate was obviously very realistic and we are confident that the aim of the experiment can be achieved within the **24 shifts** of beam time we have requested.
We retain our request for in total 24 shifts (8 days).

References

[1] T. Stora et al., private communication.

[2] F. Wenander et al., private communication.