^{72}Kr beam development for Shape determination in Coulomb excitation of ^{72}Kr

(CERN-INTC-2007-016/P-228)

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CERN-INTC-2008-042 / INTC-CLL-004
06/10/2008

A proposal, CERN-INTC-2007-016/P-228:' Shape determination in Coulomb excitation of ^{72}Kr, was submitted to the INTC aiming to determine the "Shape of ^{72}Kr nucleus". Intensities of 800 pps at the MINIBALL target position were requested for ^{72}Kr that should be sufficient to carry out the measurement comfortably. On the other hand a meaningful analysis can be performed with somewhat lesser intensities e.g. with 200 pps.

In the minutes of the INTC session of May 2007 (CERN/INTC 2007-024), priority has been requested for the development of ^{72}Kr beam which matches the needs of the proposal. This request has consequently been set as the first priority in the session of the Standing Group for the ISOLDE upgrade in November 2007.

The present ^{72}Kr beam development has benefitted from the past and the ongoing TISD activities linked to the development of new target materials and new ion sources such as a "MINIMONO" 1^+ ECRIS and 1^+ FEBIADs [1,2].

Several offline and online tests in 2008, in particular with the YO371MiMo and Nb380 units, have given appropriate improvements to achieve the present goal.

The reference figure of 2e3/μC 72Kr quoted in the ISOLDE Yield database, obtained with a ZrO2-MK7 FEBIAD unit, is not sufficient to reach the requested 800 pps at Miniball. Based on an overall 5% REX efficiency [3], this requires an improvement of at least a x4 factor, providing a yield of 8e3/μC ^{72}Kr.

Tests performed on Nb380 with a new FEBIAD ion source provided ^{72}Kr yields of 5e3/μC with a measured 12% ion source efficiency. The latest developments have provided Kr ion source efficiencies of 38%, a x9 improvement over the 4.3% for ISOLDE standard MK7 [4]. This new version was used online this year on the UC385 unit for Rn production. While experiencing some Fluorine contamination and somewhat not optimal ionization efficiency, it anyhow allowed the identification of a new Rn isotope.

We therefore can deliver 1.5e4/μC ^{72}Kr yields with the last FEBIAD version coupled via a cold transfer line to standard Nb foils targets.

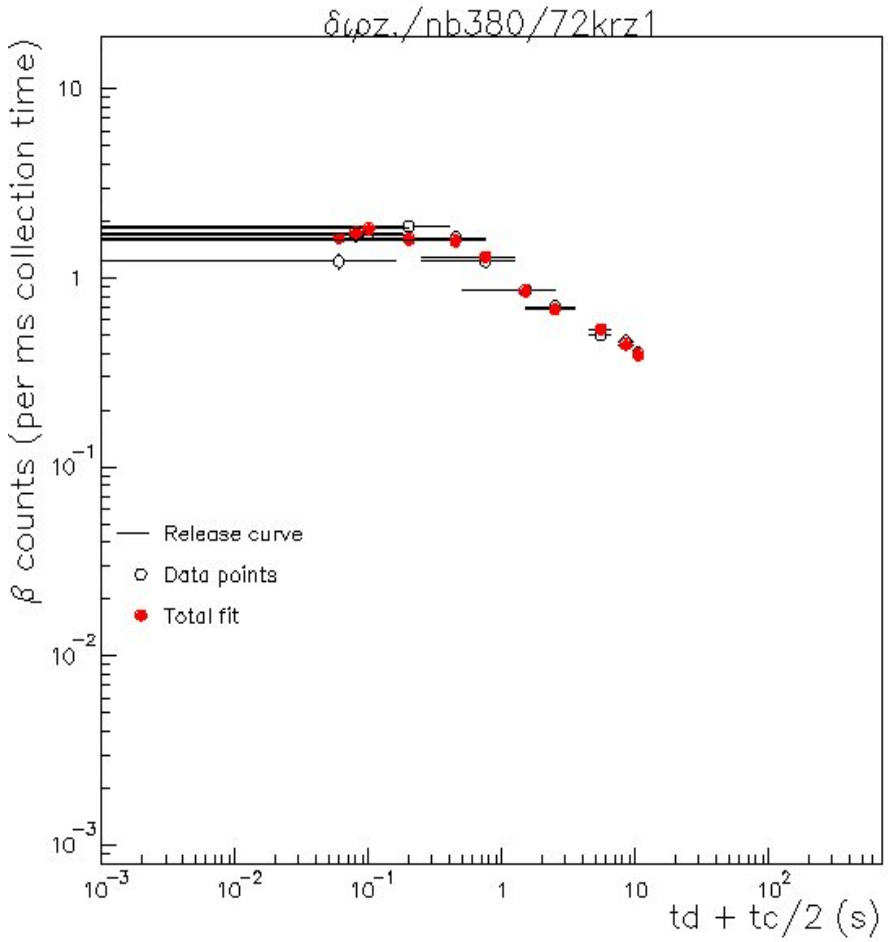

Figure 1: Release curve of ^{72}Kr obtained with the Nb380 unit. Yields of 5e3/μC were obtained.

A x2 yield improvement is quoted when using ZrO2 felts instead of Nb foils [5]. Similarly, we observed fast and high production rates of Kr isotopes on the YO371MiMo unit, Figure 2. Some extra gain is therefore to be expected if the last Y2O3 target material is used instead of the Nb foils. It is however difficult to precisely estimate the gain to be expected.

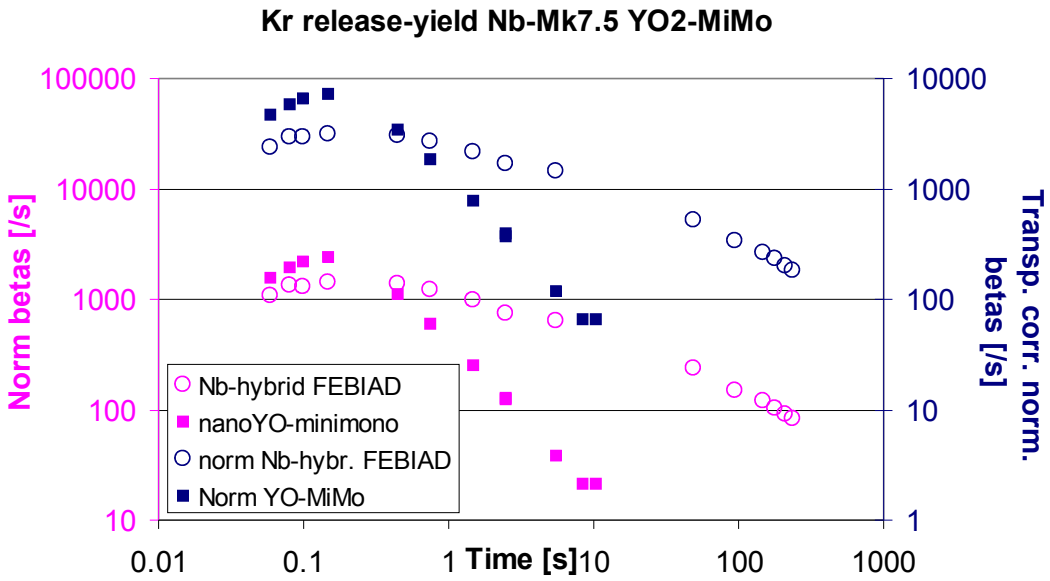

Figure 2: Comparison of release characteristics of Kr isotopes between Nb foils and Y2O3 target materials.

We can conclude that yields of 1.5e4/μC of ^{72}Kr can now be achieved at ISOLDE, leading to 1500 ^{72}Kr/s at MINIBALL with 2μA proton intensity delivered by PSBooster [1]. We confirm that this intensity for the ^{72}Kr beam should be sufficient to carry out the proposed experiment.

References:

[1] F. Wenander et al., Nuclear Physics A746 (2003), 659.
[2] L. Penescu et al., to be published.
[3] F. Wenander, private communication.
[4] U.C. Bergmann et al, NIM B204 (2003) 204.
[5] http://www.cern.ch/isolde, 2008

[1] An extra setup time of 1 shift is requested by F. Wenander in order to achieve 1500 ^{72}Kr/s with 2μA proton intensity and 5% REX efficiency.