# R-Process Abundances in the A=130 Region

B. Pfeiffer[1], K.–L. Kratz[1], and B.A. Brown[2]
[1] Institut für Kernchemie, Universität Mainz, Mainz, Germany
[2] Department of Physics and Astronomy, Michigan State University, East Lansing, USA

Using the proton-neutron formalism with the shell-model code OXBASH, calculations for the binding energies, level schemes and Gamow-Teller $\beta$-decay for very neutron-rich nuclei at N≃82 have been performed. A renormalized G matrix based upon the CD-Bonn potential has been used in a model space which contains 20 orbits (including all experimental knowledge) around the doubly closed shell nucleus $^{132}$Sn. Details about the model space and the effective interactions are described in [1].
The calculated $T_{1/2}$ and $P_n$ values were applied in our canonical r-process calculations to reproduce the A≃130 solar-system r-abundance ($N_{r,\odot}$) peak. This region is of particular importance for the understanding of the r-process: (i) it is around $^{132}$Sn that the heaviest isotopes directly lying **in** the r-process path are known experimentally, and (ii) this $N_{r,\odot}$ peak is the major bottle neck for the r-process matter flow to the rare-earth and actinide elements, up to the Th, U cosmochronometers. In the upper part of Fig. 1, the mass region around the A≃130 $N_{r,\odot}$ peak is displayed. The r-abundances in the rising wing of the peak are predicted far too low due to very short model-$T_{1/2}$ below $^{129}$Ag, which were calculated with the "optimized" OXBASH parameters prior to our recent experiments. As outlined in Refs. [1, 2], in order to describe the recently measured E($1^+$) excitation energy in $^{130}$In, the $\nu h_{11/2}$ orbital had to be shifted by 200 keV and the $[\pi g_{9/2} \otimes \nu g_{7/2}]$ matrix element had to be readjusted. As is shown in the lower part of Fig. 1, a recalculation of the r-abundances with this new data set for N=82 isotopes below Z=47 (OXBASH (B)) and experimental $T_{1/2}$ for $^{130}$Cd and $^{129}$Ag resulted in a considerably improved agreement with the $N_{r,\odot}$ observables. These results demonstrate that guidance from nuclear structure experiments is essential for reliable predictions from local shell-model calculations. Recently, other groups [3, 4] had presented results more in accordance with predictions from older OXBASH (A) parameters, and had drawn wide-ranging conclusions concerning the validity of the "waiting-point" concept in the A≃130 r-process peak region.

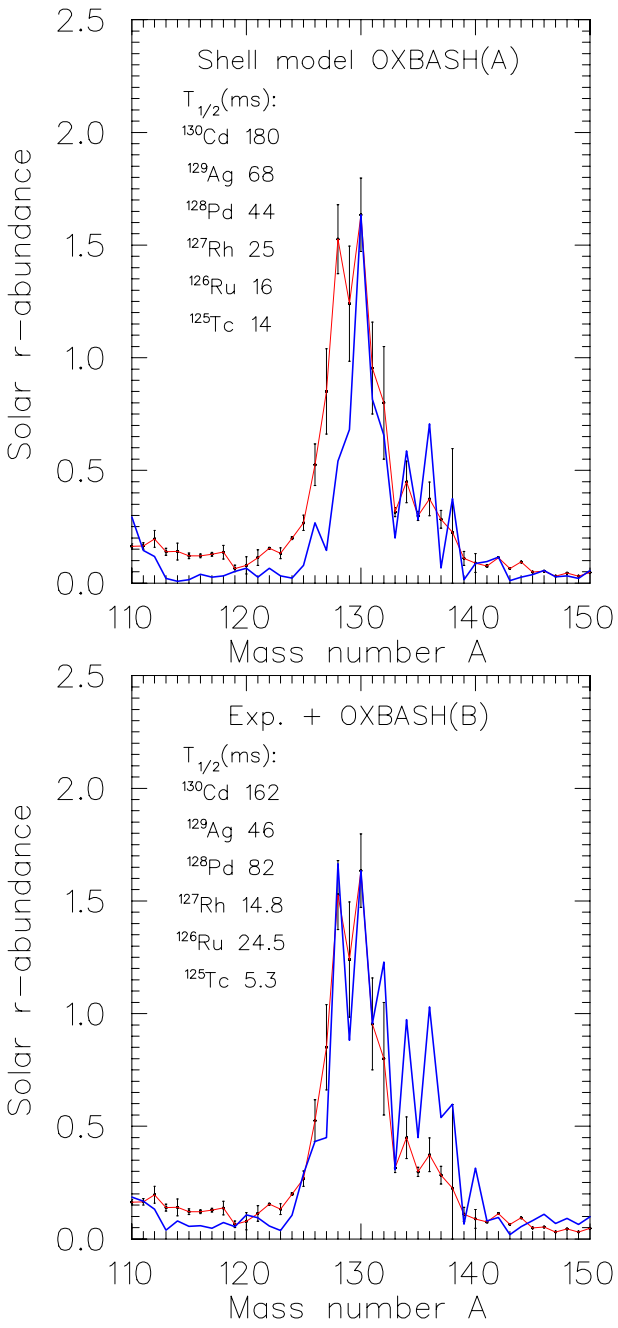


Figure 1: R-process abundances calculated with decay data from the OXBASH program. Data applied for the upper part were calculated prior to our experiments on $^{130}$Cd decay. Values obtained with readjusted interaction parameters give a much better agreement (see lower part).

References

[1] B.A. Brown et al., Proc. *Nuclear Physics in Astrophysics*, Debrecen 2002

[2] B.A. Brown, priv. comm.; and I. Dillmann et al., this report

[3] J. Engel et al., Phys. Rev. C60 (1999) 014320

[4] G. Martinez-Pinedo and K. Langanke, Phys. Rev. Lett. 83 (1999) 4502