Transient field g(2_1^+) measurements in nuclei near *A*=100

S.K. Chamoli[1,2]*, A.E. Stuchbery[2], R.F. Leslie[2], P.T. Moore[2], A. Wakhle[2], M.C. East[2], T. Kibédi[2], S. Frauendorf[3], Jie Sun[3], and Y. Gu[3]

[1]*Department of Physics, Birla Institute of Technology and Science, Pilani- 333031, Rajasthan, INDIA.*
[2]*Department of Nuclear Physics, Australian National University, Canberra, ACT0200, AUSTRALIA.*
[3]*Department of Physics, University of Notre dame, Notre Dame, IN 46556, USA.*
* *email: cylab123@gmail.com*

Introduction

The *g* factors of collective nuclear states measure the fraction of the total angular momentum carried by the protons, and hence provide a unique probe of nuclear collective excitations. In the region of *A = 100* a number of *g* factors have been measured for the first 2^+ states in neutron-rich nuclei produced as fission fragments. Reduced *g* factors, implying a reduced role for protons compared with neutrons, are observed for many, but not all, of the neutron-rich isotopes [1]. A holistic interpretation of this behavior is yet to be found. Recently, however, Frauendorf et al. [2] have introduced a version of the cranking model applicable to this region, in which the yrast states are treated as quadrupole waves running over the nuclear surface like a tidal wave over the ocean's surface. To test this model, improved experimental *g* factors for the stable isotopes are required. With this motivation, in the present work we report the new transient field *g*-factor measurements on 2_1^+ state of even-even stable Pd, Ru and Cd isotopes in inverse kinematics. For Cd isotopes, the measurements were also done in the conventional kinematics. To draw the nuclear structure information, the experimental *g*-factors are also being compared with *g*-factor values obtained with the tidal wave model calculations.

Experimental Details

The experiment was done with the 14 UD Pelletron accelerator facility at the Australian National University (ANU), Canberra. For the conventional kinematics run, the 2_1^+ states in $^{106-116}$Cd were Coulomb excited with a ^{32}S beam at a lab energy of 95 MeV falling on a multi-layer (Ag/Cd/Fe/Cu/) target of thickness (0.05/0.98/2.64/5.5) mg/cm^2. The backscattered ^{32}S ions were detected with a pair of silicon photodiode detectors (size 10.1 x 9.2 mm^2) symmetrically placed on either side of the beam axis in a vertical plane. On the other hand, in the inverse kinematics runs, beams of ^{102,104,106,108,110}Pd (@ 245 MeV), ^{96,98,100,102,104}Ru (@ 240 MeV) and ^{106,108,112,114}Cd (@ 240 MeV), were allowed to fall on a multi-layer (C/Cu/Gd/Cu) target of thickness (0.42/0.04/6.12/5.5) mg/cm^2. In both cases the target was mounted in the ANU Hyperfine Spectrometer [3] and maintained at ~ 6 K to reduce the effect of beam heating. The forward scattered Carbon ions were detected with an array of three silicon photo diode detectors (size 10.1 x 9.2 mm^2) downstream from the target. One particle detector was centered on the beam axis with the other two placed symmetrically above and below it in a vertical plane. To avoid the high energy heavy beam hitting the central particle detector, the beam is completely stopped in the target by putting an additional Cu sheet of thickness ~ 4.5 mg/cm^2 behind the target. For the conventional kinematics run, the emitted γ-rays, were detected with two HPGe detectors in the forward direction (50 % rel. eff.) and two HPGe detectors in the backward direction (20 % rel. eff.). A pair of 5" × 5" NaI detectors replaced the 20% HPGE detectors in the inverse kinematics measurements. The target-detector distances were set so that the detector crystals all subtended a half angle of 18^0. To polarize the ferromagnetic layer of the target perpendicular to the γ-ray detection plane, namely Fe (conventional kinematics) and Gd (inverse kinematics), an external magnetic field of 0.09 T is provided by an electromagnet. This field was periodically reversed, about every 15 minutes, to minimize systematic errors in the measurement of precession angles. For data collection particlegamma coincidences were recorded in the event by event mode.

The results of these measurements, in which the relative *g* factors are typically determined with a precision of the order of 5% or better, will be presented and compared with theory. With the improved precision, the *g* factor data for this region tell a different story, displaying sensitivity to the underlying shell structure, particularly the location of the proton Fermi surface between the Z = 40 and Z = 50 shells.

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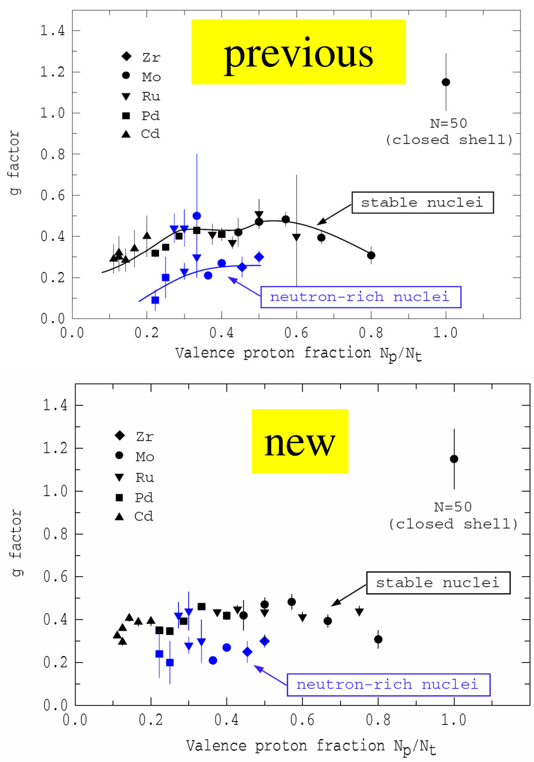
Figure 1: Comparison of the *g* (2_1^+) values in even-even stable Pd, Ru and Cd-isotopes. Previous data are shown in the top panel [1,4]. The lower panel includes the new results, measured with both conventional and inverse kinematics.



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