Proton Emission from Odd–Even and Odd–Odd Deformed Drip–Line Nuclei

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One of the most exciting subjects in contemporary nuclear physics is the search for the limits of stability of nuclei. Recent measurements on spherical [1] and deformed proton emitters, in the region of heavy nuclei with $50 < Z < 82$, make possible to define almost completely the borders of proton stability. Important aspects of nuclear structure can be learned from proton decay, since it is a probe for small components of the wave functions of the decaying states and helps to determine the deformation of nuclei and the angular momentum of the ground state [2]. The theoretical description of proton emission from spherical systems was studied by various authors [1,3], and the experimental results are well reproduced within these models. In the case of deformed nuclei, to study proton emission, one has to determine resonances in deformed system. The search of complex energy eigenvalues in a nonspherical system was solved only recently [4]. The Schrödinger equation was solved exactly [4] for a deformed Saxon–Woods potential with a deformed spin-orbit term, imposing outgoing wave boundary conditions. The states obtained with this procedure are the Nilsson bound states and resonances.

Assuming that the proton moves in a single particle Nilsson level, we have developed a model that leads to the exact evaluation of the half–life for the decay. The model was applied to all measured odd [2] and even [5] deformed decaying nuclei, considering deformed those systems where spherical calculations provide unreasonable spectroscopic factors.

The available data were accurately and consistently reproduced for all deformed proton emitters from the ground and isomeric states and the fine structure decay. The calculations provide information on the deformation and angular momentum J of the decaying nuclei, giving unambiguous assignments to the decaying states. This type of information might be difficult to extract using other probes in this unstable mass region. Our results support the nuclear structure predictions of ref. [6] for nuclei at the proton drip line.

[1] P. J. Woods and C. N. Davids, Annu. Rev. Nucl. Part. Sci. **47**, 541 (1997).
[2] E. Maglione, L. S. Ferreira and R. J. Liotta, Phys. Rev. Lett. **81**, 538 (1998); Phys. Rev. **C59**, R589 (1999).
[3] S. Åberg, P. B. Semmes and W. Nazarewicz, Phys. Rev. **C56**, 1762 (1997).
[4] L. S. Ferreira, E. Maglione and R. J. Liotta, Phys. Rev. Lett. **78**, 1640 (1997).
[5] L. S. Ferreira and E. Maglione, Phys. Rev. Lett. in press
[6] P. Möller, J. R. Nix, W. D. Myers and W. J. Swiatecki, At. Data Nucl. Data Tables **59**, 185 (1995).