Structure effects in proton emission near the top of the N=Z line - the ^{116}La case

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The $T_Z = 1$ nuclide $^{116}_{57}La_{59}$, 23 neutrons away from the only stable lanthanum isotope $^{139}_{57}La_{82}$, has been synthesized in the fusion- evaporation reaction $^{58}Ni(^{64}Zn, p5n)^{116}La$ [1]. They lanthanum nuclei were identified via their proton radioactivity using the MARA mass spectrometer and associated focal plane detectors at the JYFL Cyclotron Accelerator Laboratory, Finland. Electromagnetic decays from isomeric states in ^{116}La and ^{117}La were also observed. Comparisons of the measured proton energy (E_p = 718(9) keV and half-life ($T_{1/2}$ = 50(22) ms with quantum tunneling calculations of the WKB type indicate that the proton is emitted with an orbital angular momentum $l = 2$. Applying the approach described in Refs. [2,3] the proton emission probability is calculated to be enhanced relative to its closest, less exotic, odd-even lanthanum isotope ($^{117}La_{60}$) while the proton-emission Q-value is lower. This interesting feature is discussed within the context of the pairing and spin degrees of freedom.

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*This work was supported by the Swedish Research Council under Grant No. 2019-04880; the United Kingdom Science and Technology Facilities Council (STFC) underGrants Nos. ST/P003885/1, ST/V001035/1, ST/P004598/1, and ST/V001027/1; the EU 7th Framework Programme, Integrating Activities Transnational Access, project No.262010 ENSAR; and the Academy of Finland under the Finnish Centre of Excellence Programme (Nuclear and Accelerator Based Physics Programme at JYFL).