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In-beam and decay spectroscopy of ^{251}Md

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Experiments on the heaviest nuclei are addressing the fundamental issue of the maximum limits of nuclear mass and charge. The difficulty of producing such exotic nuclei, however, creates an inherent challenge for elucidating the detailed structure of these extreme nuclear systems. By contrast, nuclei in the vicinity of $Z = 100$ and $N = 152$ may be studied in much greater detail, and yet they involve intrinsic excitations of the same single-particle orbits that lie close to the Fermi surface of the spherical superheavy nuclei~[1]. In particular, the structure of the low-lying energy levels in odd-mass transfermium nuclei is dominated by the unpaired particle, which gives direct information about the orbitals involved. The odd-Z nucleus ^{251}Md has recently been the subject of considerable interest in this regard, with the observation of states based on the $\frac{1}{2}^-$[521] Nilsson level~[2], the $\frac{7}{2}^-$[514] Nilsson level~[3], as well as a high-K isomer~[4]. These experiments are expanding our view of not only the transfermium region, but the superheavy nuclei as well.

We have performed a new experiment to study ^{251}Md via both in-beam and decay spectroscopy. The ^{205}Tl(^{48}Ca,2n) fusion-evaporation reaction was used to populate excited states in ^{251}Md. The newly commissioned Argonne Gas-Filled Analyzer (AGFA) was used to separate the unreacted beam and the ^{251}Md recoils, which were implanted into a 160×160 pixel silicon double-sided strip detector (DSSD) at the focal plane of AGFA. Prompt γ rays were detected with Gammasphere and correlated with ^{251}Md based on their time-of-flight and implantation energy in the AGFA focal plane. Long-lived isomers were detected by the observation of bursts of conversion electrons in the same DSSD pixel as an implantation event, and delayed γ rays emitted after isomer-decay events were detected with the X-array, which was arranged around the DSSD. With this setup, we have observed many new transitions in both the prompt and the delayed γ spectra, including transitions above the isomeric state. These results and their implications for the structure of ^{251}Md will be presented.

[1] R.-D.~Herzberg \textit{et al.}, Nature 442, 896 (2006)\\
[2] A.~Chatillon \textit{et al.}, Phys. Rev. Lett. 98, 132503 (2007)\\
[3] R.~Briselet \textit{et al.}, Phys. Rev. C 102, 014307 (2020)\\
[4] T.~Goigoux \textit{et al.}, Eur. Phys. J. A 57, 321 (2021)\\

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