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Spectroscopy of TaN in Support of Fundamental Physics[1]
RICHARD MAWHORTER, DAVID SHARFI, YONGRAK KIM, Pomona College, DAMIAN KOKKIN, JACOB BOUCHARD, TIMOTHY STEIMLE, Arizona State University — Tantalum nitride, TaN, has been recently identified as a leading candidate for extending the study of T, P-odd effects in the nuclear realm to include proton, neutron, and quark electric dipole moments (EDM) and beyond. This is primarily due to enhancements in the interaction of electrons with the nuclear magnetic quadrupole moment (MQM) and the resulting parity-violating effects. Study of the dispersed laser induced fluorescence resulting from the excitation of the 17570.80 (Ω =0^+), 18427.38 (Ω =0^+), 19216.80 (Ω =1), and 19396.78 (Ω =1) bands above the $X^1\Sigma^+$ (v=0) ground state of TaN near 569 nm, 543 nm, 520 nm, and 515 nm has enabled a determination of the branching ratios and transition dipole moments of all 4 states. Radiative lifetimes of 454(32) ns, 479(12) ns, 333(4) ns, and 480(17) ns respectively were measured from an analysis of the fluorescence decay curves, and potential optical pumping approaches for both populating and detecting the parity-violation sensitive $^3\Delta_1$ state are proposed. Further experiments using CW laser excitation have enabled the observation of the hyperfine structure of several bands in the gateway 18427.38 (Ω =0^+) to $X^1\Sigma^+$ (v=0) transition, and analysis of these complex spectra is underway.

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