Three-nucleon forces in medium mass nuclei near N = 32 investigated through precision mass measurements at TITAN

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The Penning trap mass spectrometer at TRIUMF's Ion Trap for Atomic and Nuclear science (TITAN) is a precision device for providing mass measurements on short-lived singly and highly-charged ions. Nuclear masses are well established for studying nuclear structure. Through systematic examination of the mass surface important deviations from the shell model in nuclei far from the valley of stability have been found, for example, the discovery of the new magic number N = 16 and in understanding the island of inversion [1-3]. Recently, the region near N = 32, 34 [4] has been of great interest for nuclear structure because of the prediction of the emergence of new sub-shell closures. To test these predictions TITAN has undertaken a precision mass measurement campaign in the region of doubly-magic $^{48}Ca_{28}$, in which the magic number N = 28 is not reproduced in theoretical predictions employing nucleon-nucleon (NN) only forces. New calculations in a chiral effective field theory (EFT) with three nucleon (3N) forces, which have already shown its success in explaining the oxygen anomaly [5], have been completed for the Ca isotopes. Here we present results of the mass measurements of $^{49-52}$Ca and $^{47-51}$K measured with the Penning trap at TITAN [6-7]. The predicted two-neutron separation energies with 3N forces agree well with the new measured values, and also reproduce other measured observables in the Ca isotopes [4], which deviate greatly from the tabulated values in the 2003 Atomic Mass Evaluation.

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