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Low-energy, precision experiments with ion traps: mass measurements and decay spectroscopy

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The atomic mass is a unique identifier of each nuclide, akin to a human fingerprint, and manifests the sum of all interactions among its constituent particles. Hence it provides invaluable insights into many disciplines from forensics to metrology. At TRIUMF Ion Trap for Atomic and Nuclear science (TITAN), Penning trap mass spectrometry is performed on radioactive nuclides, particularly those with half-lives of as short as 9 ms. The TITAN mass values of Mg-20 and Mg-21 have been used to test the isobaric multiplet mass equation (IMME), revealing its dramatic breakdown. On the other side of the valley of stability, the increasingly detailed mass survey in the island of inversion on nuclides has exposed the lowest shell gap of any magic nucleus and the first crossover in the two-neutron separation energy. At heavier masses, neutron-rich Rb and Sr isotopes have been charge bred and their masses measured to probe the r-process, which is believed to be responsible for the production of roughly 50% of the abundance of elements heavier than Fe. A highlight of recent results and an overview of the advanced ion-manipulation techniques used will be presented.

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