Trapping Energy Traps: mass spectrometry of nuclear isomers

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This talk will discuss the measurement of nuclear isomers in storage-rings; it will concentrate on methods of data analysis, particularly the unique properties of single ions for extracting lifetime and excitation energies.

The storage ring is powerful in its ability to resolve nuclear isomeric states from the corresponding ground states at the single-ion level. For low-lying isomers ($E < 400$ keV) it can be impossible to resolve both the ground state and isomer when both are measured in the same injection. By imposing a criterion that only when a single-ion is measured (in a particularly frequency region) the event is accepted into data analysis, clean spectra may be extracted [1]. A number of examples will be shown where this technique has been used.

Another method will be presented that uses the technique shown by Schmidt et al. [2] but is extended to the problems associated with single-ion storage-ring data. These developed procedures are applied to real experimental data for the ground state of $^{193}$Re.

An example of where employing lifetime measurements to exciting new physical phenomena is the metastable nuclear state of Os-192 in a hydrogen-like charge state. Single-ion analysis shows that the lifetime of the state is considerably longer than that of the neutral ion [3]. This hindrance of the lifetime is attributed to the diminishing level of internal conversion in the hydrogen-like atom. Calculations have been performed to estimate the lifetime, and the result has been compared with that measured experimentally.