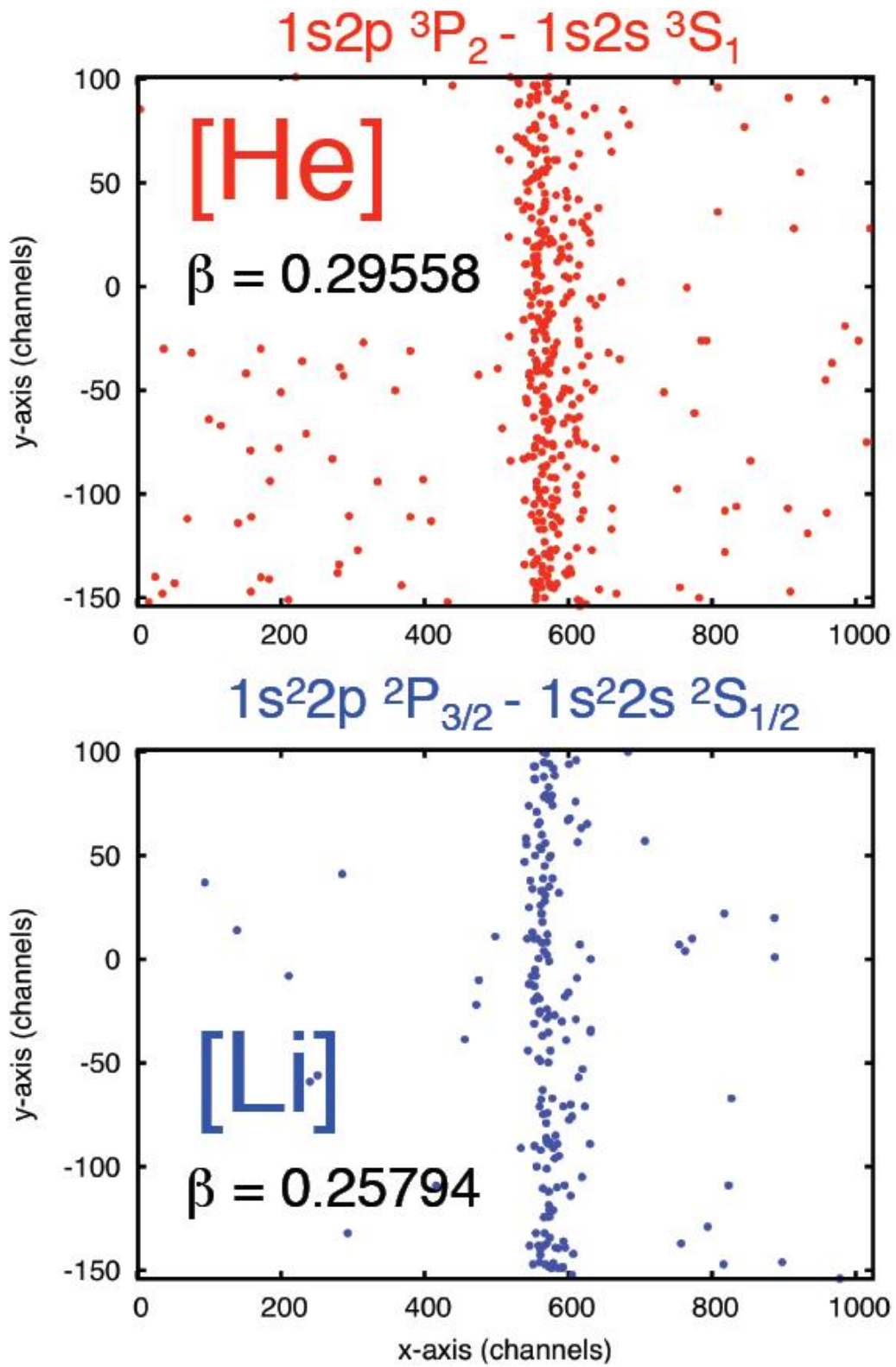


Strong-Field QED in Two-Electron Systems via Doppler-Assisted Bragg Crystal Spectrometry at the ESR

He-like ions are the simplest multi-body atomic systems. Investigations of these ions up to the heaviest species with the highest nuclear charge uniquely probe our understanding of correlation, relativistic, and Quantum Electrodynamics (QED) effects. In the high-Z region, the nuclear Coulomb-field strength and electron velocity, both proportional to $Z\alpha$, are very high resulting in an emphasis of these effects. In theory, benchmark calculations have been reported where even second order QED effects were considered in a rigorous way for both the ground state as well as for the first excited states. However, for the *excited* levels at high-Z virtually no experimental data on binding or transition energies are available. Besides the general importance of such data for atomic structure investigations, the great interest in accurate information about the excited levels in high-Z He-like ions is motivated by their relevance for the study of the influence of the electroweak interaction on the atomic structure. Since many years, high-Z He-like ions are under the discussion as ideal candidates for the study of atomic parity-violation effects. The ability to observe parity-violating transitions critically depends on the relative binding energies of the excited states. However, a benchmark experimental test of the atomic structure theory for the excited states in He-like ions is still pending.

We present the first observation of the $1s2p\ ^3P_2 \rightarrow 1s2s\ ^3S_1$ transition in He-like uranium. The experiment was performed at the internal gas-jet target of the ESR storage ring at GSI. Using the $1s^22p\ ^2P_{3/2} \rightarrow 1s^22s\ ^2S_{1/2}$ transition in Li-like uranium as reference and the deceleration capabilities of the ESR storage ring, we obtained the first evaluation of the energy of an intra-shell transition for a He-like heavy ion. The focussing Bragg crystal spectrometer used in the measurement serves as an accurate wavelength comparator in a narrow wavelength interval. The present measurements allow for an unambiguous identification of the spectral lines observed plus a first determination of the transition energy. The picture shows the spectral lines of the intra-shell transitions of He- and Li-like ions, respectively, as recorded by the position-sensitive CCD detector of the spectrometer. The lines appear Doppler shifted in the same narrow wavelength region when choosing the ion-beam velocity β accordingly.

see the recent publication: <http://www.iop.org/EJ/abstract/0295-5075/87/6/63001>



Observation of the $2p_{3/2} \rightarrow 2s_{1/2}$ intra-shell transition in He-like uranium