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Precise wavelength measurements of middle-Z elements He- and Li-like satellites in a laser plasma of mineral targets.

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The atomic models of high-Z deeply charged ions are extremely complex and require experimental validation. One of the approaches is to measure the wavelengths of resonance transitions in He- and Li-like ions, while the spectral lines from H-like ions can be modelled with outstanding precision and, accordingly, can be used as a references in the spectra. However, already for the elements with Z around 15 and above it is quite difficult to create so hot and dense plasma providing a large concentration of H-like charge states. To mitigate the issue, we suggest particular minerals to be used as laser targets composed of average (Z from 15 to 30) and low (less than 15) Z elements, when the emission from the later will deliver perfect reference lines over a whole range of He-and Li-like average-Z emission under examination. As an example, several experimental configurations are described to measure the emission of highly charged K, Ca, Cl ions with the reference to a well-known Mg, Al, Si, P spectral lines. The resulting precision of the wavelength measurements is expected to be better than 0.1 mÅ. The requirements on pumping laser parameters are also discussed.

The X-ray spectroscopy diagnostics is one of a few methods suitable for inertial thermonuclear plasma investigations. It is necessary to know a variety of multicharged ions spectroscopic parameters to make this diagnostic tool applicable. Wavelengths of radiative transitions are the most important among them. Such spectroscopic properties are an attribute of an isolated multicharged ion so these values can be applied not only for the ICF investigations, but also across a range of fields both fundamental (atomic physics, quantum electrodynamics, laboratory astrophysics) and applied (X-ray lithography, radiography for medical and biological purposes etc.)

Approximate approaches are implemented to obtain spectroscopic characteristics of ions with two and more electrons. Such calculations are usually based either on variational methods or the perturbational theory. *A priory* accuracy estimations for both cases are unavailable, so the only one implementable way to estimate their precision is comparison of energetic levels structure obtained by means of a particular method for a particular ion with experimentally measured wavelengths of spectral lines emitted by this ion.

Precise measurements of the spectral lines wavelengths emitted by multicharged ions in the X-ray range has been carried out since the 70th of the last century. Plasma heating and multicharged ions creation in these experiments had been mainly providing via laser facilities able to generate pulses with energy of several tens joules and intensities up to 10^{14} W/cm^2. As a result, sufficiently detailed information has been obtained about properties of multicharged ions with not so high ionization potentials, which exists in a plasma with the sub-keV temperature (see, for example, SPECTR-W3[1]). Significantly more powerful kJ laser facilities had been required for shifting to investigations of heavy ions. Most of them have become available for spectroscopists only recently

Obviously, it is necessary to know all about a dispersion curve of an applied spectrometer to provide the high-accuracy measurements of the wavelengths. The curve can be obtained by observation of spectral lines with well-known wavelengths, so-called reference lines. Spectral lines of H-like ions are the best candidates for that. Wavelengths of these lines calculated analytically considering quantum electrodynamics effects (see, for example [2]) are known with a precision better than the best experimentally achievable. He-like ions spectrum lines also could be ideal reference lines, because such ions exist in rather wide range of the plasma electron temperature, but their wavelengths should be measured preliminary with the high accuracy, for example, on the base of H-like ions reference lines positions.

In the presentation it is shown how to determine with the high accuracy a radiative spectrum of the He-like K, Ca, Cl ions, including dielectronic satellites arises due transitions in the Li-like ions of the same element using spectral lines of Mg, Al, Si and P H-like ions as a source of reference lines. This approach, of course, can be implemented for many others He-like ions. Moreover, the precisely measured positions of He-like ions lines can be used as a reference for investigations of ions with more complicated energy levels structure with ground states corresponding to partially filled L- and M-shells.

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