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Recent developments in the Thomson Parabola Spectrometer diagnostic for laser-driven multi-species ion sources

Ongoing developments in laser-driven ion acceleration, in synergy with the currently available/upcoming multi-Petawatt laser facilities around the world, would foster in a near future the frontier of ion energies to multi-100 MeV range. Development of diagnostics to cope with such high-energy, multi-species ion sources is highly warranted and timely. Thomson Parabola Spectrometers (TPS) [1] have been widely used for spectral characterization of such ion sources. Although the TPS has the unique ability of dispersing ions simultaneously depending on their energy and charge to mass ratios (Z/A), it has several intrinsic limitations, such as (i) inability to discriminate between ions with same Z/A, for instance between D+ and C6+ ions while using deuterated plastic targets to study bulk acceleration, (ii) low resolution and overlapping of ion traces at high energies, (iii) single line of sight measurement, typically of extremely small solid angle (nSr-Sr). A review of recent (progressive) developments on the TPS diagnostic to deal with these shortcomings will be presented, such as (i) using differential filtering techniques [2] to retrieve spectra of ion species with the same Z/A ratio, (ii) extended, trapezoidal electric plates to achieve high energy-resolution at high energies without sacrificing the lower energy part of the spectrum [3,4], and further development into a novel multi-pinhole TPS design, that would allow angularly resolved, complete spectral characterization of the multi-species beam.

References

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