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Extraction and emittance characterization of high-intensity ion beams from a laser ion source

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To enhance the matching efficiency between the laser ion source and the subsequent RFQ accelerator with the direct plasma injection scheme or other schemes, the characteristics of the ion beams extracted from the laser ion source was investigated. For this purpose, a three-electrode extraction system and a Pepperpot emittance meter equipped with an intensified imaging system were developed. Comprehensive investigations were conducted on the beam extraction performance and the corresponding beam quality. Stable extraction of carbon and nickel ion beams with peak currents exceeding 100 emA was demonstrated at an extraction voltage of 55 kV. With the help of the dedicated intensified imaging system of the Pepperpot, the emittance of the extracted beam can be measured for only one beam pulse. By optimizing the extraction voltage and electrode gap, a normalized RMS emittance of approximately 0.17 π·mm·mrad was achieved for the carbon ion beam with a peak current of 8 emA.

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