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Generation of high-energy monoenergetic heavy ion beams by radiation pressure acceleration of ultra-intense laser pulses[1] B. QIAO, D. WU, C. MCGUFFEY, F.N. BEG, UCSD — Generation of high-energy monoenergetic heavy ion beams by radiation pressure acceleration (RPA) of intense laser pulses is investigated for the first time. Different from previously studied RPA of protons or light ions, the dynamic ionization of high-Z atoms can self-organize and stabilize the heavy ion acceleration. A self-organized, stable RPA scheme specifically for heavy ion beams is proposed, where the laser peak intensity is required to match with the large ionization energy gap when the successive ionization passing the noble gas configurations [such as removing an electron from the helium-like charge state $(Z\text{-}2)^+$ to $(Z\text{-}1)^+$]. Two-dimensional PIC simulations show that a monoenergetic Al^{13+} beam with peak energy 1.0GeV and energy spread only 5% can be obtained at intensity 7×0^{20}W/cm^2 through the proposed scheme. Heavier monoenergetic Fe^{26+} beam at peak energy 17GeV can be obtained by increasing the intensity to 10^{22}W/cm^2. Heavy ion acceleration with the designed laser conditions of Extreme Light Infrastructure (ELI) is also systemically investigated, where both ionization and radiation-radiation effects need to be taken into account.

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