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Ion acceleration with gaussian and vortex laser beam

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Developing compact 'all-optical'ion accelerators using high-power lasers has attracted significant interest due to their broad applicative potential in science, industry, and healthcare. Most research on ion acceleration has focused on the Target Normal Sheath Acceleration (TNSA) and the Radiation Pressure Acceleration (RPA) mechanisms using the typical Gaussian laser beam TEM00. Although the Gaussian beam provides the highest peak intensity, its intensity profile generates a ponderomotive force that pushes charged particles outwards, increasing the ion beam divergence, thus reducing the density. Laguerre-Gaussian (LG) laser beams are an interesting alternative to the Gaussian beam. Such beams exhibit a doughnut-intensity shape that has a component of the ponderomotive force pushing inwards, along with a helical phase that generates an orbital angular momentum (OAM). The properties of the LG beams have been theoretically investigated for decades, but experiments with such laser beams have been happening only recently as creating vortex beams, especially with high topological OAM orders, is challenging. A novel method for generating a high-order LG pulse with a PW-class laser beam and the latest experimental results on ion acceleration will be presented. Additionally, 3D PIC simulations will be compared with the experimental results.

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