

# Simulation study of three new quadrupole ion funnels to improve low-mass ion transmission

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## Abstract

**Rationale:** By applying RF (radio frequency) and DC (direct current) voltages to corresponding ring electrodes, ion funnel (IF) can efficiently focus and transmit ions. However, IF has an inherent mass discrimination problem that will greatly limit ion focusing and transmission. In order to improve the transmission efficiency (TE) of the IF and remove this limitation, this paper explores the new quadrupole ion funnel (QIF). **Methods:** Computer simulations of the potential field distributions of QIF and conventional IF were performed to assess their focusing characteristics. To compare the TE, using the ion optics simulation programmes SIMION and AXSIM, a series of simulations were carried out. Toroidal, cylindrical and hyperbolic configurations are used to improve ion TE. And compare transmission and focus performance with conventional IF. **Results:** By simulating the trajectories of low  $m/z$  ions in the IF with SIMION and AXISM software, in this paper, the optimum electrical parameters for three new QIFs are obtained, and compared them with the conventional IF, which can improve the TE of  $m/z < 100$  by about 16%, 20% and 13%, respectively. **Conclusions:** The results indicate that the study of these three new configuration IF has great research significance for improving the sensitivity of low  $m/z$  ions in mass spectrometer instruments.

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