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MORA project and optimization of transparent ion trap geometry

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The MORA (Matter's Origin from the RadioActivity of trapped and oriented ions) project [1] is part of the research on CP violation that could explain the matter-antimatter asymmetry observed in the universe, through the measurement of the so-called D correlation. MORA uses an innovative in-trap orientation method which combines the high trapping efficiency of a transparent Paul trap with laser orientation techniques. The MORA setup will permit to reach precision on D down to a few 10^{-5}, which allows to probe the Final State Interactions (FSI) effects for the first time.
Within the framework of this project, a three-dimensional Paul trap (MORATrap) geometry has been optimized to broad the quadrupolar region, where the contribution of higher order harmonics is reduced. MORATrap is composed of three conic ring pairs with a mid-plane symmetry, its geometry is inspired from the existing transparent Paul trap, LPCTrap [2]. Our trap optimization was carried out by minimizing high order harmonics and maximizing the quadrupolar term in the spherical harmonics expansion of the generated potential in the trap center. Our simulation is based on solving Laplace's equation with the AXIELECTROBEM software developed at LPC Caen coupled to some χ^2 minimization.

[1] P. Delahaye et al., arXiv:1812.02970, proceedings of the TCP 2018 conference, to appear in Hyp. Int.
[2] P.~Delahaye et al., arXiv:1810.09246 [physics.ins-det], submitted to EPJA.

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