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Precisely Measuring the Potential of a Surface Electrode Ion Trap

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Accurately measuring the potential generated by electrode of a Paul trap is of great importance for either precision metrology or quantum computing using ions in a Paul trap. For a rectangular shaped electrode, we find a simple and highly accurate parametric expression of the spatial field distribution. Using this expression, a method based on multi-objective optimization is presented to accurately characterize the spatial field strength due to the electrodes and also the stray electric field. This method allows to utilize many different types of data for optimization, such as the equilibrium position of ions in a linear string, trap frequencies and the equilibrium position of a single ion, which therefore greatly improves the model accuracy. The errors of predicted secular frequencies and average ion position are less than 0.5 micron and 1.2 micron respectively, better than the ones predicted by existing method.

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