Giorgadze, G.; Khimshiashvili, G.
Triangles and electrostatic ion traps. (English) Zbl 07353630

Summary: We consider the equilibrium points of the electrostatic potential of three mutually repelling point charges with Coulomb interaction placed at the vertices of a given triangle $T$. It is proven that for each point $P$ inside the triangle $T$, there exists a unique collection of positive point charges, called stationary charges for $P$ in $T$, such that $P$ is a critical point of the electrostatic potential of these point charges placed at vertices of $T$ in a fixed order. Explicit formulas for stationary charges are given, which are used to investigate the existence and geometry of stable equilibria arising in this setting. In particular, symbolic computations and computer experiments reveal that for an isosceles triangle $T$, the set $S(T)$ of points $P$ that are stable equilibria of their stationary charges is a non-empty open set containing the incenter of a triangle $T$. For a regular triangle, using symbolic computations, it appears possible to verify that the formulas for stationary charges define a stable mapping in the sense of Whitney having a deltoid caustic with three ordinary cusps. An interpretation of our results in terms of electrostatic ion traps is also given, and several plausible conjectures are presented.

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MSC:
78A37 Ion traps
78A30 Electro- and magnetostatics
68W30 Symbolic computation and algebraic computation

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References:

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