Macroscopic quantum shell effects in submicron hemispherical clusters

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The existence of macroscopic shell structure of submicron metal clusters is known for several decades [1]. Since the most studies provide theoretical analysis for clusters of spherical shape, the electron density inhomogeneities caused by shell effects [2] are spherically symmetric and do not provide long range electrostatic fields. However, similar shell structure should exist in a hemispherical cluster which conserves the closed periodic orbits of electrons, but not the spherical symmetry of electron distribution. As a result, we demonstrate that a strong electrostatic field exists in the vicinity of the flat surface of an isolated, uncharged metal nanocluster of hemispherical shape using modern approaches for electronic structure evaluation. This physical phenomenon is a consequence of the large-scale spatial inhomogeneity in distribution of electrons related to quantum shell effects in submicron metal clusters, which may find numerous applications in various fields of science and technology.

[1] Brack M 1993 *Rev. Mod. Phys.* **65** 677
[2] Kuratov S E, Shidlovski D S and Blinnikov S I 2019 *Physics of Plasmas* **26** 022709