The Critical Strain Angle in the Neutron Star Crust

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The critical strain angle in the Coulomb crystal in the neutron star crust is estimated on the assumption that this dimensionless number is of the order of the ratio of the Coulomb potential energy to the kinetic energy of the relativistic electrons, $\theta_{cr} \sim E_C/E_K$. This estimate scales with the fine structure constant, the charge Z, and microscopic length scales. The scaling also depends on the dimensionality according to the shapes of the nuclear clusters in various pasta geometries (i.e. spherical, rod, slab) in the inner crust. It is found that $\theta_{cr} \sim 10^{-1}$ in the outer crust, in agreement with the numerical results of [1], while it reduces to $10^{-2} - 10^{-3}$ in the inner crust where the lower dimensional rod and slab configurations prevail. Calculating the maximum quadrupole moment with varying critical strain throughout the crust, we predict the strain amplitude of gravitational waves for a maximally deformed crust and compare these with the observational upper limits from LIGO, recently updated by [2].

References

[1] C. J. Horowitz & K. Kadau, *Phys. Rev. Let.* 102, 191102 (2009)

[2] B. P. Abbott et. al. *arXiv:1701.07709* (2017)

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