Proposal of testing Newtonian inverse-square law in space

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Motivated by extra dimensions theories that predict new effects, a space proposal of experimental searching for the deviation from Newtonian gravitational inverse-square law (ISL) in short-range is presented, the basic idea of which is to adopt an electrostatic space accelerometer to test ISL at the separation of bodies close to 10μm. Two flat gold foils will act as test and source masses face to face in order to increase signals of assumed new force, and the test mass will also act as the inertial test mass of the electrostatic suspension accelerometer. The separation between the two flat gold foils is changed periodically by a piezoelectric driver. Besides the natural conditions in space such as microgravity, high vacuum and low noises, this scheme incorporates the improvement of the high sensitive space accelerometer and the larger effective force. Several systematic uncertainties, including spurious force due to the Casimir force, electrostatic force, and various sources of random uncertainty due to patch field and detector noise, are discussed seriously. Our analysis suggests that on microgravity, drag-free satellite, the proposed experiment will improve the current constraint on the possible new forces by 3 to 4 orders of magnitude, and the final result will provide the strongest experimental test of large extra-dimensional theories at corresponding scales.