Test of the Gravitational Inverse-Square-Law at the Sub-millimeter Range with larger test masses and 32-fold symmetric attractor

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Since a lot of speculations predict the violations of the gravitational Inverse-Square Law (ISL) at the short range, it is important to test the ISL with high presion expriments. We have been testing the ISL since 2000 [1–3], and gave a strongest limit at 70–300 μm range with dual modulation and compensation in HUST-2016. To improve the experiment result further more, we have designed new torsion pendulum and attractor, as shown in Fig. 1, and hope to give a stronger limit on α at the sub-milimiter range.

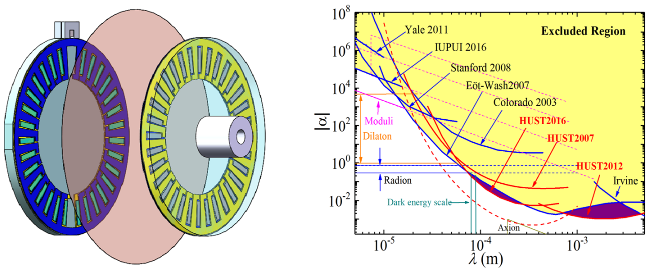

FIG. 1. The left figure shows the new design of the pendulum and attractor. The right figure shows the experiments constraints on Yukawa violation of the Newtonian $1/r^2$ law. The shaded region is excluded at a 95% confidence level; the dashed red line shows the target of this work; light lines show various theoretical predictions summarized in [4].

The most important improvement is that the design of new torsion balance with "disk-shaped", which has larger area and thicker test masses. The Yukawa force between test masses and source masses is 10 times larger than HUST-16. Then we increase the attractor from 8-fold to 32-fold azimuthal symmetry. The signal frequency is farther away from the fundamental frequency of the rotary stage in HUST-16. We also add compensation masses below the test masses and source masses to achieve a "null" experiment.

Our target is shown in Fig. 1, and we expect to give a more stringent limit on α at the range of 30–800 μm , and improve the previous bounds by up to a factor about 20 at the length scale of 70 μm.

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