Quantum Gravimeter Based Internal Structure Prediction Algorithm

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This study sought to explore the possibilities and limitations of internal structure prediction using quantum gravimeters. Quantum gravimeters are gravimeters(machines that measure the magnitude of gravitational field) whose accuracy is approximately 10^-9. Simulation using Wolfram Mathematica was implemented in order to test the potential possibility and deviations of prediction using such gravimeters. Since the cubes - they are easier to generate data than spheres - don't generate rotation-symmetric gravitational field, the structure of cubes can be more easily determined by measuring the gravitational field at locations around it.Gravitational field data was generated by gathering the magnitudes of gravitational field vectors. Once the dataset containing location of measurement and magnitude of gravitational field of unit density cube(s) was generated, an algorithm using FindFit function (non-linear, multidimensional curve fitting algorithm) of Mathematica was developed to find the condition that satisfies the given data with minimum error. Unlike the cases when there were only one cube, when the number of cubes were increased to two, the accuracy decreased as the mass difference between the two cubes increased and as the distance between them decreased. For cases where the distance between the blocks is longer than three times the longest edge, the error of center position was 0.00599; the error was increased to 0.02082 when the multiplied number decreased to two; when there was no filter applied, the error increased to 0.096018. Because predicting the internal structure can be separated into several fitting-to-two-cubes steps, the results of this research signifies that quantum gravimeter can predict the internal structure of an object with less than 25% of error.

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