

Activities of the Working Group on the Newtonian Constant of Gravitation

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Introduction

The working group on the Newtonian Constant of Gravitation was created at the 28th General Assembly of IUPAP in November 2014. The purpose of this working group is to coordinate experimental efforts to measure the Newtonian constant or gravitation, G . This fundamental constant of nature describes the strength of gravity, the weakest of the four known fundamental interactions. The first laboratory measurement of the gravitational constant was carried out by Henry Cavendish at the end of the 18th century. In modern times, more than a dozen measurements have been described in the literature in the last 30 years. However, the agreement between the results is poor. The best results achieve relative standard uncertainties of about 20 parts in a million, but the relative difference between the largest and smallest value exceeds 500 parts per million. Clearly something is amiss. One task of the working group is to understand this problem.

Activities

The activities of the working group in the reporting period can be sorted in three broad categories.

Support of Experimental Work

In spring of 2016, a torsion balance that has been used by T.J. Quinn and collaborators at the Bureau International des Poids et Mesures (BIPM) to measure the gravitational constant was shipped to the National Institute of Standards and Technology. The idea behind this move is to repeat the experiment at a new site with different scientists. Being able to reproduce results is an important feature of the scientific method and it seems surprising that for big G measurements this has never been attempted before, especially since the results are discrepant. First result of the apparatus in the new location can be expected in 2017.

Currently some members of the working group are involved in securing another big G experiment. The apparatus used by Faller and Parks is at the Joint Institute for Laboratory Astrophysics in Boulder Colorado and is no longer in use. There is danger that the international community may lose this apparatus. To avoid this, the working group will move the apparatus to NIST. This move will allow for maintenance of the experimental equipment so that eventually this measurement can be repeated, too.

Communication and Outreach

The working group helped to organize an invited session on the measurement of the gravitational constant at the April Meeting of the American Physical Society in Salt Lake City. Three members of the working group gave invited talks on the subject. This event prompted several articles in the press, most notably an article by Adam Mann in the Proceedings of the National Academy of Sciences of the USA. The working group wrote an article for the IUPAP newsletter.

Providing expertise to scientists

The National Science Foundation held an Ideas Lab on the measurement of the gravitational constant. The goal of the Ideas Lab was to interest new groups in measuring big G and to come up with new techniques. The participants of the ideas lab were guided by mentors which were provided by the IUPAP working group on the gravitational constant.