

Newtonian constant of gravitation workshop at NIST

The National Institute of Standards and Technology (NIST) held a workshop on the Newtonian Constant of gravitation, G , on October 9-10, 2014 as a follow-up to February 2014 Royal Society meeting in London. The NIST workshop was focused on determining a path forward and whether a consortium could provide a useful means to resolve the discrepancy. This document provide a brief summary of the conclusions of the workshop.

The workshop had 53 registered participants with 25 from outside of NIST. It included 13 invited talks, a panel discussion, and a summary discussion. Several of the talks were focused on new methods of measuring G , whereas the discussions and panel session were about how to address the situation of conflicting measurements of G .

The participants *unanimously recommended* that the community needed to respond to this situation. It was strongly felt that the primary value of the effort focused on G was more about resolving a discrepancy in science than the value itself. Given the news coverage and press around G it is clear that the public is interested, and since some of the future realizations of mass – *i.e.* the Watt Balance – depend on large mechanical instruments, there is value in understanding what has gone wrong with previous measurements of G . Due to both the difficulty of getting funding and to provide a scientific venue for discussions and advice during a measurement campaign, it was *recommended* that one or more organizations¹ act as a convening body for annual or biannual meetings focused on this specific topic and campaign. There was also strong consensus that in moving forward new measurements of G by new teams with existing apparatus that have led to some of the outliers would be very valuable in helping to resolve the discrepancy. Two such apparatus were offered pending discussions between the owners and the potential new teams. There was also strong consensus that additional new approaches would be very important in helping to resolve the discrepancy and several such approaches, including atom interferometers, were discussed at the meeting.

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Both the International Committee on Weights and Measures (CIPM) and a working group of the International Union of Pure and Applied Physics (IUPAP) were discussed as possible convening bodies and both provide clear benefits to the broader community. The former for the National Measurement Institutes in particular and the latter to the broader physics community.

The issue of a consortium had moderate support and was viewed as a means of providing some approaches with access to both expertise and independent measurements, traceability, or reduced uncertainty for key measurements. An additional benefit is that a consortium could provide National Measurement Institutes (NMIs) with a means of contributing support services such as precision length metrology to a local or regional participant. Finally in the case of an apparatus that can be easily relocated or moved, the consortium could provide an independent measurement by additional teams. This would lower overall cost of participation and provide additional means of looking for systematics. This concept, in part, was the basis for suggesting that new measurements be made with each existing apparatus that produced values of G that appear to be outliers.

The most controversial discussion was around the value of blind measurements. While some people were for completely blind measurements, others supported limited blindness to help in more efficiently searching for systematics. No final decision or recommendation was made on this topic, and it will probably be left to the individual teams or consortia to determine how best to proceed.

In summary the community believes that a convening body can contribute to creating a close community that can support those wishing to help resolve this discrepancy, and that in some situations teaming or a consortium can further enhance the likelihood of success in what is seen as a very difficult measurement, but one that is important scientifically to resolve. G remains one of the oldest of the fundamental constants that has such low precision.

Followup actions

Since the workshop, the proposal for a Working Group of the IUPAP, to function as an advisory body for work on the Newtonian constant G , was approved at the IUPAP General Assembly in Singapore on Friday November 7, 2014.

A proposal has been submitted to the CIPM to approve of an advisory committee and endorse further work on experiments to determine Big G .