Is H_0 Well Defined?

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As moderator, I very much enjoyed the high level of scientific discussion and wondered if the residual disagreement might be caused by different operational definitions of H_0.

I have just a few comments to make on the debate.

Most importantly, I think the level of scientific discussion was very high; both of the protagonists (Gustav Tammann and Sidney van den Bergh) presented convincing material in a clear and persuasive way. I was impressed by the erudition, the facts, the insight, and the logic of their arguments. Moreover, the introductory discussions were very enlightening.

I also had a lot of fun. Although the subject is of great importance, the significance of the scientific issues did not interfere with the good nature with which the participants presented their analyses.

The biggest surprise for me in listening to the debate was to learn about the great amount of precision data regarding ordinary stars, supernovae, galaxies, and galaxy clusters that is being obtained in order to determine H_0. These data are providing new discoveries and deep insights into many astrophysical problems. It is almost worth having a big controversy just to stimulate the enormous research activity that is motivated by a desire to measure the Hubble constant. On the long term, it could turn out that the incidental results obtained from the Hubble-constant controversy are even more important than the precise value of H_0.

There was, in the actual discussion, much less disagreement than I had anticipated. The two preferred values for H_0 almost overlap when systematic uncertainties are added to the statistical uncertainties. After much careful work and critical evaluation, we no longer have a disagreement by a factor of two. This is great progress!

I was, however, struck by the lack of a clear path to a final consensus. I had hoped that the participants in the debate would agree on some measurement, or set of measurements, the results of which would be decisive. Instead, there were, as is perhaps appropriate for a debate, a number of arguments given to show that the evidence presented by the other side was biased or not sufficient for the conclusions being advanced. This lack of consensus about what is to be measured was particularly clear with respect to the Virgo Cluster of galaxies. There were forceful arguments presented about whether individual objects were, or were not, members of the Virgo cluster and about the extent and composition of the cluster. As someone not familiar with the subject, I was confused by the fact that measurements made on nearby clusters were being compared with measurements made on more distant clusters, when there was not agreement on how membership in a galaxy cluster was to be defined in a distance–independent way.

In the question period, I asked the participants if they would supply me with a general algorithmic definition of a galaxy cluster, or of the Virgo cluster in particular, in order that I could use, impartially, computer files accessible via the internet to determine membership. This request elicited the only consensus of the debate: disdain for algorithmic definitions.

In a similar vein, I tried to suggest that both sides agree on appropriate criteria to use in selecting a supernova sample for applications to determining H_0, or, at the very least, that they analyze each other's data. But, this proposal met with, at best, amused tolerance for my naivete.

I did not succeed in getting agreement about what needs to be done to determine, with widespread consensus, a more accurate value of H_0. In my eyes, I therefore failed in my primary goal as a moderator. Moreover, I did not hear discussed a particular measurement, or set of measurements, the results of which would be so persuasive that everyone would say: "That is so simple and clear, it must give the correct value of H_0." I therefore had to struggle to prevent myself from asking what I am sure everyone present would have regarded as a silly question, namely: Is the value of H_0 that is being debated operationally well defined?