Subject: Re: Questions
Date: 11/5/07 10:44:07 AM
From: "Peter J. Mohr" <mohr@nist.gov>
To: rf17@mail.gatech.edu
Cc: barry.taylor@nist.gov, hilltp66@charter.net

Ron,

Answers are given below.

Peter

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On Mon, 29 Oct 2007, rf17@mail.gatech.edu wrote:

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Dear Peter,

Thanks for your reply - we realize you must be very busy.

Ted and I reread Richard Davis's 2005 article in Phil Trans R Soc A to better understand the processes.

Perhaps Ted's questions were not clear - what we meant to ask was

1. What are the VALUES for N_A and N~_A? (Not what are the definitions)
To clarify, N_A and N~_A are both defined to the number of entities in a mole. What changes is the definition of the mole. N_A is the number of particles in the mole as currently defined. N~_A is the number of particles in the possibly redefined mole. If the mole is redefined, the definition will be done so that the number of entities in a mole is the same, to the best of our knowledge, for either definition, at that time. Now, the definition is that the number of entities in a mole is the same as the number of carbon atoms in 0.012 kg of carbon, neglecting binding energy, which is negligible at the precision needed. After the redefinition, the mole will be just a certain number of entities, with no reference to the kilogram.

After the redefinition, N~_A will never change, because by definition, it is the number of entities in the newly defined mole which is now just a certain number. However, N_A, which is the number of particles in the mole as previously defined will reflect any changes in our knowledge. In particular, the number of entities in 0.012 kg of carbon may become better known than it is at the time of the redefinition, since with the old definition, it is a number that depends on the results of experiments. It may even eventually disagree with the value at the time of the redefinition. The main point is that the old definition does not tell us the actual number of particles in a mole, but only gives us a way to find the number experimentally.

You can work out for yourself the consequences for kappa, which was simply introduced for convenience and should not be allowed to cloud ones thinking.

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As a concrete example, if your fix-five proposal is adopted in 2011, what will the values of N_A, N~_A, and kappa be on January 1, 2012, or in 2050 for that matter?

(In your2006 Metrologia article (p 241), you write that (1 + kappa) "will initially be equal to one", not that it will be one forever, so it certainly appears that kappa will change with time, as Barry first wrote. Thus, what is kappa after 2011? or after 2050?)

2. How and from which data were the 2006 CODATA recommended value and uncertainty for N_A calculated?
The 2006 value was calculated in essentially the same way as the 2002 value. Please read Rev. Mod. Phys. 77, 1 (2005), which explains the 2002 determination in detail. The only difference for the 2006 value is the inclusion of a new watt balance result, and a reduction of the uncertainty expansion factor of 2.325 to 1.5 because of the new result.

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In particular, how were the results from the Avogadro Project incorporated? Ted thought you said on the phone that you used results from both the Avogadro Project and the Watt-balance-obtained estimates of Planck's constant, and that since the results of both experiments were combined, that made the uncertainty higher than it would have been had you used only the Watt-balance Planck's constant results alone. Is that correct?
Yes, the results were averaged, and a decision was made to increase the uncertainty because of the disagreement. However, the uncertainty was not automatically higher since the results were combined, as your statement suggests.

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Thanks again - it is a fascinating class of problems.

Ron

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