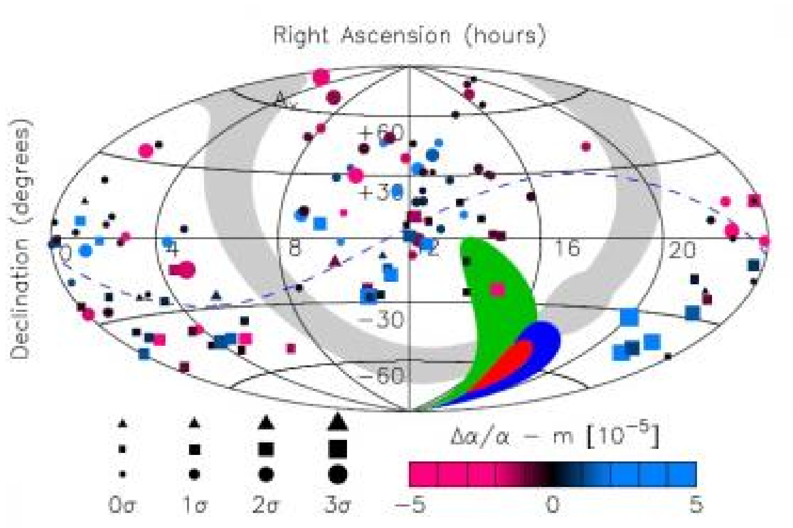
Taking a second look at evidence for the 'varying' fine-structure constant

October 21 2010, by Lisa Zyga



In this full-sky illustration of the quasar measurements, squares represent quasars observed by the Very Large Telescope, circles represent observations by the Keck telescope, and triangles represent observations by both telescopes. The data suggest that the fine-structure constant seems to be larger in the southern direction. Image credit: Webb, et al.

(PhysOrg.com) -- A few weeks ago, a group of scientists from Australia posted a study at arXiv.org that showed evidence that the fine-structure constant may not actually be a constant. If the fine-structure constant does vary throughout the universe as their data seems to show, it would mean that the laws of physics also vary throughout the universe, with huge implications. But over the past few weeks, a few blogs by physicists not involved in the study have offered some early criticism of the authors' results.

In their study, which has been submitted to Physical Review Letters, John Webb from the University of New South Wales in Sydney and coauthors used data from two telescopes facing different directions to show that the fine-structure constant seems to be slightly different in the northern hemisphere than the southern hemisphere. Peering at the light emitted by distant quasars 10 billion years ago, and analyzing how the light was absorbed by old gas clouds during its travels, the physicists seemed to be detecting a shift in the fine-structure constant across the universe.

In their blogs, physicists Chad Orzel of Union College and Sean Carroll of the California Institute of Technology scrutinized this claim from different perspectives. Orzel looked at Webb, et al.'s plot of the quasar sources in the sky (shown above). In the figure, the symbols' colors indicate the sign of the constant's shift and their sizes indicate the strength of the constant's shift. Also, the shapes of the symbols indicate the telescope used: circles refer to the Keck telescope in Hawaii and squares indicate the Very Large Telescope in Chile. Triangles indicate that both telescopes made observations, and so the triangles are mainly in the middle regions.

Orzel noticed that nearly all the triangles are black, indicating no shift for those regions. Although the regions with the triangles do make up the boundary region, Orzel finds it suspicious that they align so well with the locations of the specific telescopes. The idea is that the shift may be due to subtle differences in the two telescopes, in which one telescope's data set was slightly high and the other telescope's data set was slightly low, so that they canceled each other out when they overlapped.

Carroll takes an entirely different approach to the study. He looks at the fine-structure constant as a scalar field. He explains that, if the telescopes' observations are correct, and the fine-structure constant varies smoothly over the universe, then the scalar field must have a very small mass. However, previous research has shown that the mass is not likely to be extremely small.

Both of these scientists' early criticisms point to the fact that different techniques are needed to confirm or contradict the results, as Webb, et al., also concluded in their study.