Is communication via gravitational radiation possible?

Raymond Chiao

University of California at Merced, P.O. Box 2039, Merced, CA 945344, USA

There is a widely held belief in the general relativity community that generating gravitational radiation in the laboratory is, for all practical purposes, impossible. Hence communication via gravitational radiation, unlike the case of radio, is impossible. This belief is based on an orders-of-magnitude argument given by Misner, Thorne, and Wheeler (MTW), who, in their book, "Gravitation", in Chapter 36 on the generation of gravitational (or general relativistic (GR)) waves, concluded that GR waves could be generated with any significance solely by astrophysical sources, and that any laboratory sources of this kind of radiation would, for all practical purposes, be impossible.

MTW's argument begins with the fact that Einstein's field equation contains within its coupling constant only two of the fundamental constants of physics, viz., G, Newton's constant of universal gravitation, and c, the speed of light, but does not contain Planck's constant $\hbar$. By dimensional analysis, they showed that from G and c, one can form the quantity c^5/G, which has units of power, and which turns out to be an astronomically huge quantity. This indicates that the only place in the Universe where gravitational radiation can be generated with any significance is in astronomical sources, such as when two solar-scale masses orbit around each other near the speed of light in an extremely tight orbit, but not in laboratory sources.

However, one can think of at least four possible quantum loopholes in MTW's argument. These four loopholes are connected with the following four questions:

(I) Can Planck's constant alter MTW's argument?

(II) Can mesoscopic, Planck-mass-scale mirrors for gravitational radiation exist?

(III) Can effectively relativistic motions occur within the context of mesoscopic, Planck-mass-scale, opto-mechanical laboratory settings?

(IV) Can the amplification of gravitational waves occur, for example, by the stimulated emission of radiation, like in a laser?

Here we suggest affirmative answers to the above four questions based on some proposed, mesoscopic-scale quantum-gravitational experiments. (See arXiv:1301.4270, 1303.4020).