Nonlocal Dielectric Mirror Paradox

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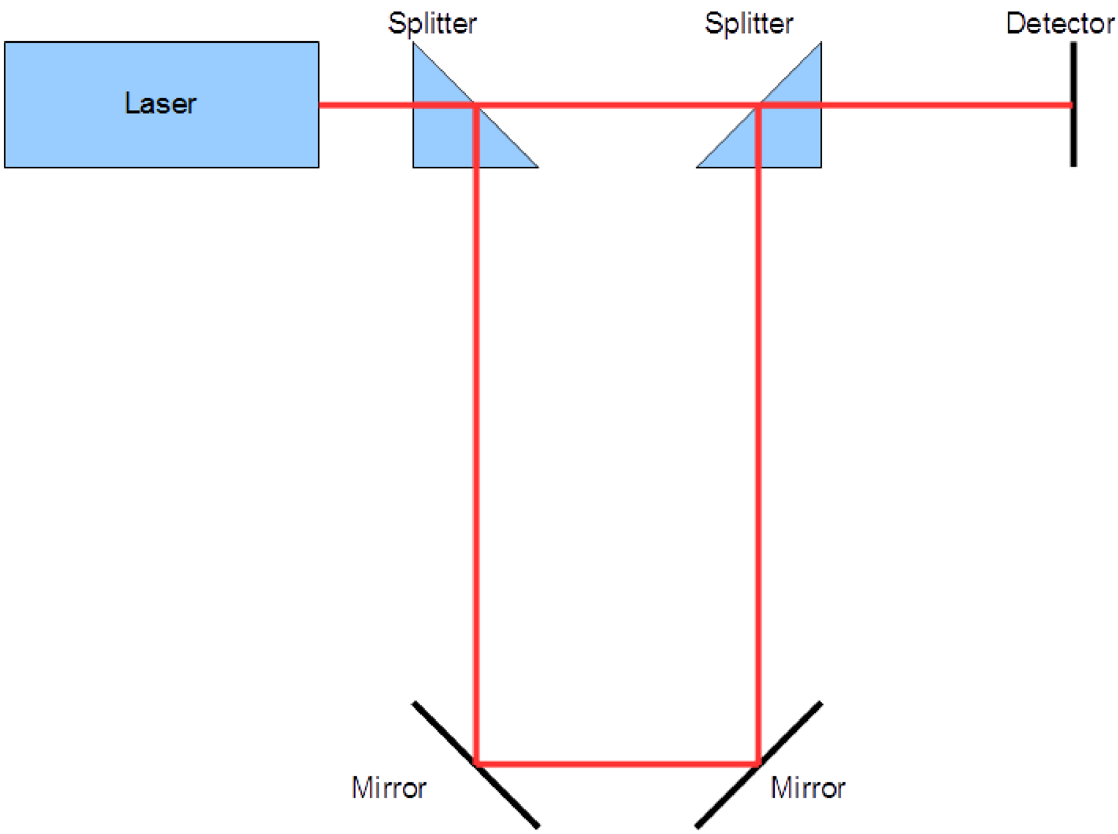
Abstract:

A simple thought experiment that can easily be performed in the laboratory that gives results that do not have an explanation.

Nonlocal dielectric mirror paradox:

A laser's beam is split and then recombined such that there is destructive interference at a detector, as shown here:



Such a setup is basically a dielectric mirror, and all the laser light is reflected back to the laser and none strikes the detector. In fact, you could simply look down the laser path and see your reflection--at least for the wavelength that destructively interferes.

Now let's also say that one of the two paths is very long such that there is a measurable time delay for that path.

Classically speaking, when you first turn on the laser the short path light makes it to the detector first and, since there is no long path light there yet, the detector is briefly illuminated by that short path light until the long path light also makes it to the detector, when we once again have destructive interference, and the detector is no longer illuminated.

However, quantum mechanically speaking every photon must experience destructive interference in this configuration. To measure it, we decrease the laser intensity until we can count individual photons and run the experiment again. When the laser is first turned on, is there a brief period that the detector is illuminated by these sparse individual photons? If so, then after the delay time what is it that stops these sparse individual photons from illuminating the detector? If there is no brief light pulse at the detector, then a bright beam will also not make a brief pulse of light on the detector when the laser first turns on, which opens the door to faster than light communication: Specifically, if the detector is illuminated it would indicate, without any time delay, that the long path is blocked, in spite of the fact that the blockage is far away (on the long path).