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Displacement-noise-free neutron interferometer for gravitational wave detection at low frequencies

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Improvement of the sensitivity of gravitational-waves (GWs) detectors at lower frequencies is still challenging on account of displacement noise sources, such as thermal noise, seismic noise, and radiation pressure noise. One of the solutions is the displacement-noise-free interferometer (DFI). At frequencies lower than 1Hz, however, the DFI has less sensitivity to GWs because the propagation time of light is much shorter than the period of the GWs. To resolve this problem, DFI with neutrons instead of laser, which is called a neutron DFI, was proposed. In a neutron DFI with neutrons propagating much more slowly than light, the neutron propagation time can be comparable to the period of GWs at lower frequencies. This enables us to cancel displacement noise without cancellation of the GW signals. Also, we proposed a simplification of the detector configuration by taking advantage of the ability to adjust the neutron speeds depending on the configuration. In our poster, we discuss the principle of the neutron DFI as well as a plan of the demonstration experiment.

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