Novel interferometer for cold neutrons using a pair of etalons

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A new type of cold-neutron interferometer based on a pair of etalons coated with multilayer mirrors has been developed.
Neutron interferometry is of great importance for fundamental physics as an investigative technique into the influence of nuclear force, gravity, magnetic interaction, and various small interaction upon neutron wave function, and also into topological effects of them. A large dimensional interferometer for long wavelength neutrons has the advantage to increase the sensitivity to small interactions. That kind of interferometer was partially realized by using multilayer mirrors[1], however, the range of experimental application was limited due to the small spatial separation between the two coherent beams.
We used *etalons* in order to enlarge the spatial separation between two parallel waves in *neutron spin interferometer*[2]. An etalon consists of two parallel planes which are finished with high precision. By depositing neutron multilayer mirrors on the parallel planes of an etalon we can produce an optical component which divides the incident neutrons into two parallel paths. And then the two paths are recombined after the reflection off the second etalon (Figure 1). The experiment was performed using the cold neutron beam line 'MINE' at the JRR-3M reactor in JAERI. The beam had a wavelength of 8.8Å and a bandwidth of 2.4% in FWHM. Using etalons with an air gap of 9.75μm in spacing we have observed interference fringes with the contrast of 60%. This spacing of the gap is ten times as large as the limit of conventional one.
The present results have paved the way for the development a cold neutron interferometer with a large path separation. The enlargement of the path separation enables us to carry out high precision measurements and new types of experiment. We will describe the system of the present interferometer and results in detail, and also discuss possible application of this type of interferometer.

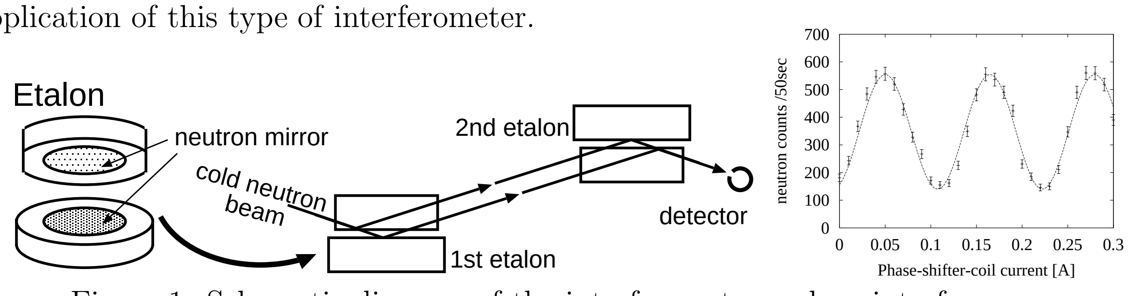

Figure 1: Schematic diagram of the interferometer and an interferogram. Neutron counts vary with the relative phase between the two paths which is produced by phase-shifter-coil. Magnetic components are omitted in the schematic diagram.

References

[1] H. Funahashi et al., Phys. Rev. **A54** (1996) 649.
[2] T. Ebisawa et al., Phys. Rev. **A57** (1998) 4720.