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Novel idea of neutron polychromator and application for reflectometry and spectroscopy

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Historically, two methods are used to determine the wavelength of neutrons: one is a time-of-flight method separating the velocity of pulsed neutrons by the flight time, and the other is a method utilizing Bragg reflection by a monochromator such as a single crystal and multilayer mirror. The former cannot be applied for electromagnetic waves because the light velocity is constant and independent of wavelength, while "polychromators", such as a prism and grating, separating the wavelength utilizing chromatic dispersion are often used in the range from infrared to soft x-ray. Though the polychromators require collimated beams to separate the wavelength with the enough resolution, it does not matter especially for laser and synchrotron light because they are naturally collimated. On the other hand, collimating neutrons leads to the drastic decrease in the intensity because neutrons naturally diverge from the source. This is the reason why the use of polychromators for neutron scattering instruments are quite limited: the RAINBOWS reflectometer [R. Cubitt *et al.*, *J. Appl. Cryst.* **51** (2018) 257] is the only practical example as far as the author knows.
Here, we will propose a novel idea of a neutron polychromator utilizing an elliptic multilayered mirror, which can be applied for a wide beam with a large beam divergence. In the presentation, the principle of the polychromator and application examples for reflectometer and spectrometer will be shown.

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