MLF Experimental Report	提出日 Date of Report August 20, 2010
課題番号 Project No. 2009A0065 実験課題名 Title of experiment Development of neutron beam focusing devices using large-m supermirror on precisely figured aspheric surfaces 実験責任者名 Name of principal investigator Dai Yamazaki 所属 Affiliation MLF Division, J-PARC Center, JAEA	装置責任者 Name of responsible person Fujio Maekawa 装置名 Name of Instrument/(BL No.) BL10 実施日 Date of Experiment 2010/5/14-2010/5/16

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)
Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.

No sample

2. 実験方法及び結果 (実験がうまくいかなかった場合、その理由を記述してください。)
Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

We examined the focusing performance of a 1-dimensional elliptic supermirror which has been developed by combining the high-performance supermirror deposition. and an ultra-precise surface figuring technique (numerically-controlled local wet etching (NC-LWE)). The mirror successfully focused wideband neutron beam ($\lambda > 3.5$ Å) into the size of 0.20mm with peak intensity gain of 52.

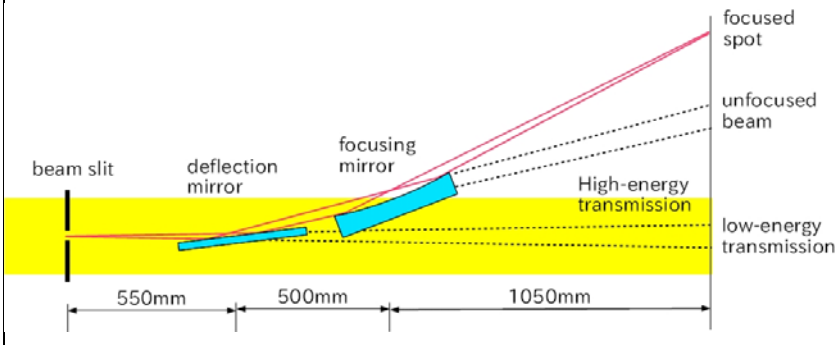

Fig.1 Beam line built at the BL10 instrument room.

The mirror is an m=4 NiC/Ti super-mirror for 1:1 beam focusing. (i.e. initial spot size = focused spot size). It is of 1-D elliptic shape, 400mm in length, and has a focal length of 2100mm. It was installed at the midpoint of the two focal points. Fig.1 shows the beamline build on the experimental bench. of BL10.

2. 実験方法及び結果（つづき） Experimental method and results (continued)

Incident beam was narrowed with a manual beam slit to form the first 1-dimensional "spot" of the ellipsoid. The beam, which diverges after the slit, is reflected by the elliptic mirror and goes into the second "spot". Neutrons are detected at the second "spot". Additionally, we installed a flat supermirror just after the manual slit in order to kick the beam out of the high-energy direct beam region and reduce background.

Figure2 shows images of the focused and unfocused beam with the slit width (the initial spot size) 0.10mm. They were taken by a same imaging plate (IP) for 400 seconds when beam source power was 120 kW. The 2-dimensional data was retrieved from the IP by the IP scanner owned by BL10 with following parameters: dynamic range L=4, Sensitivity $S=10^4$, pixel size = 50μm.

Figure3 shows horizontal intensity profiles extracted from the center of Fig.2.The intensities are expressed in units of PSL (photosimulated luminescence). The focused peak was 0.20mm in FWHM and 2.85 in height, while the average intensity of the unfocused beam was about 0.055, suggesting the peak gain 52. Integrated PSL values were 12.7 in the focused beam profile and 13.8 in the unfocused one, which demonstrate high efficiency focusing and transportation. In the above evaluations, backgrounds, which are estimated at 0.009 PSL/pixel in the focused beam profile and 0.012 PSL/pixel in the unfocused one, were subtracted. The mismatch of the initial "spot" size 0.10mm and the focused size could be attributed to the position alignment of the focusing mirror, particularly to tilt setting.

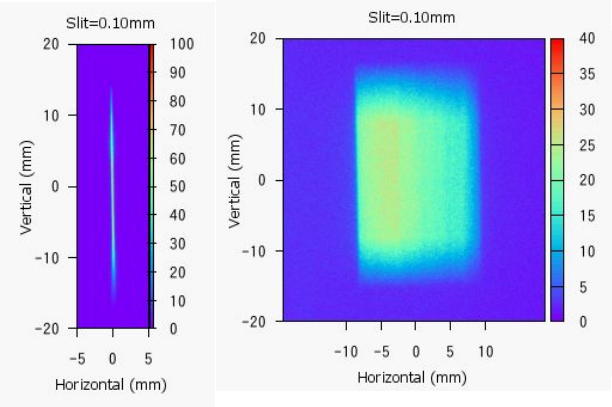

Fig2: 2-dimensional images of the focused beam(Left) and unfocused beam(Right).

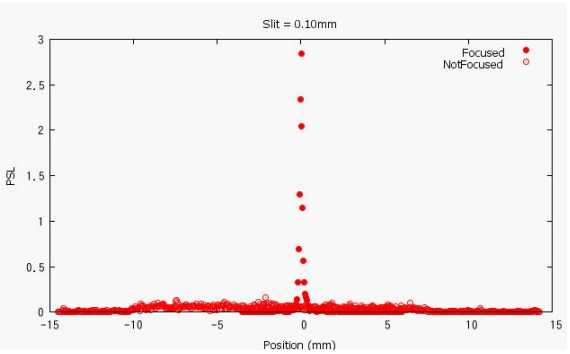

Fig3：Horizontal beam profiles of the focused and unfocused beam

Wavelength distributions of the focused and unfocused beam were also measured with a single 3He detector and the result is shown in Fig.4. The rising edge of the focused beam profile at 3.5Å corresponds to the critical reflection angle of the coated mirror $Q_c=0.088Å^{-1}$ (m=4), demonstrating that the mirror functions up to our expectation. It should be noted that comparing absolute values of the two profiles in the figure is nonsense because we could not measure the absolute value of the unfocused beam intensity due to the detector window smaller than the beam width. The intensities of the unfocused beam are multiplied by an arbitrary constant.

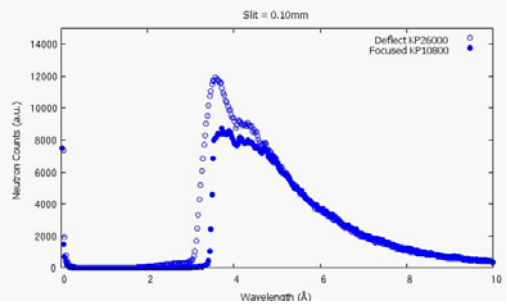

Fig4：Wavelength distribution profiles of the focused (solid circle)and unfocused beam (open circle)