A new helium chamber and a long collimator with a four-way guard slit for collecting X-ray diffraction data from very low to high resolution

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Bacterial flagellar filaments are supercoiled assembly of single protein flagellin. The filaments undergo dynamic transformation of its shape between left and right handed supercoiled forms, in order for bacterial cells to swim and tumble. To understand the structural mechanism of these dynamic transformation, we tried to collect fiber diffraction patterns from the two types of straight filaments. For fiber structure analysis, diffraction data at low resolution are as important as those at high resolution. However, the camera set up for protein crystallography at BL41XU consists of a large beam stop supported with a thick metal rod, and this hides a large area of diffraction pattern behind it. The camera also consists of a standard collimator with a guard slit of a fixed size, which tends to produce a streak scattering near the beam stop shadow. Therefore, we designed a new helium chamber to which a large mylar window is attached (top panel). A cylindrical beam stop of either 0.5 mm or 1 mm in diameter is attached on the mylar window, and the position of the beam stop can be adjusted by moving the window, so that the shadow of the beam stop is minimal. We also designed a longer collimator with a four way guard slit (middle panel) to eliminate the streak scattering as much as possible. Both the mylar window and the guard slit are remote controlled for easy optimization of their positions. We had these equipements made by Rigaku and Union Optics. An ion chamber was used to monitor the direct beam intensity while adjusting the positions of the beam stop and the four edges of the guard slit. The bottom panel is a diffraction pattern from the R-type flagellar filaments collected by using these equipements, with an X-ray wavelength of 1.0 Å, a specimen-detector distance of 430 mm, and an exposure time of 10 sec. The small beam stop hides only a small portion of the diffraction pattern very close to the direct beam.