The wire corrector on the analogy of multipole correctors was proposed by H. Ito [1]. Two-parallel line current (Fig. 1) makes the magnetic field similar to that of a quadrupole as shown in Fig. 2. When using two-parallel line current, the field cancels at the rotation symmetric axis and the two-parallel line current can generate quadrupole magnetic field because each magnetic field has opposite rotation direction of magnetic flux. The wire corrector is only arranged by parallel line currents without using any magnetic materials, so it can be easily and simply fabricated and arranged in comparison to a conventional multipole. Adverse effect of hysteresis of magnetic material does not exist and homogeneity of magnet property is not needed. Magnetic field can be controlled by superimposition of parallel line currents. In actual layout, the wire corrector is configured to a coil shape in addition to the parallel currents with infinite length, but the effect of a coil shape can be reduced by consideration of its shape. Applying constant current to a main coil, fine adjustment of magnetic field can be performed by applying current to a sub coil. The wire corrector is valuable to the aberration corrected electron optics with high precision alignment and reproducibility.

When using the wire corrector of N=2, the magnetic field is similar to quadrupole field but the magnetic field is expanded in a series which also contains octapole field as a higher order term, as shown in Eq.(1) inset of Fig.1. Due to the wire corrector has octapole component, the wire corrector has possibility of simultaneous correction of spherical aberration in addition to chromatic aberration. Symmetric curved ray optical system constituted by combining both components of a deflector and the wire corrector of N=2, is expected that chromatic and spherical aberration is potentially corrected in such configuration. The combination of the round lenses and the wire correctors of N=3 decreases the spherical aberration [2]. This shows the wire correctors of N=3 worked as a hexapole. The wire corrector has a potential of consisting an easy-to-use aberration corrector.


Acknowledgement: A part of this work of calculation was done by Dr. Eric Munro and Dr. John Rouse in Munro’s Electron Beam Software Ltd.
Fig. 1: The wire corrector consisting of two parallel line currents ($N=2$).

Fig. 2: Magnetic flux in the wire corrector ($N=2$).

\[ H(x, y) = \frac{2(y + ix)}{R^2 - (x - iy)^2} \]
\[ \approx \frac{2}{R^3} (y + ix) \]
\[ - \frac{2}{R^5} (y + ix)^3 + \cdots \quad (1) \]