BROOKHAVEN NATIONAL LABORATORY

Superconducting Magnet Division

Magnet Note

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RHIC SEXTUPOLES AT LOW EXCITATION

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Production measurements of the sextupoles were made at 10A and higher currents, both polarities. At + 10A, the fractional difference between the transfer functions measured on the up and down ramps, averaged over the magnets tested cold, is (0.82 ± 0.25)%. The estimated persistent current effect is half the difference, 0.41%. The –10A difference is essentially the same.

The integrated sextupole field at 10A (up ramp), 2.5 cm reference radius, is

$8954 \text{ T/m/kA} \times (0.01 \text{ kA}) \times (0.025 \text{ m})^2 = 5.596 \times 10^{-2}$ T.m.

The estimated persistent current sextupole field at low currents is

$0.41\% \times 5.596 \times 10^{-2}$ T.m $= 2.29 \times 10^{-4}$ T.m.

It is useful to scale this to the arc dipole at injection (470A), where the integral field is about 6.67 T.m/kA $\times$ 0.47 kA = 3.135 T.m. On this scale, the persistent current sextupole is ~ 0.7 units.

The sextupole generated by 0.5 A of transport current (the geometric sextupole) in the sextupole magnet is

$(8954 + 9028)/2 \times 0.025^2 \times 0.5 \times 10^{-3} = 2.810 \times 10^{-3}$ T.m.

This is about 10 times larger than the persistent current value or, equivalently, about 9 units of sextupole in the arc dipole at injection current.

(Saturation: the magnet begins to saturate at 30A. By 50A, the transfer function has dropped almost 10%. The first allowed term, the 18-pole, has a geometric value of –93 units. By 50A, it has increased in amplitude to –99 units – a 6% change.)