Measurements of 1/4 Cell Assembly: Issues

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Desirable Measurements

- **"Mere Presence" Effect**
  (Change in transfer function or harmonics due to proximity of an unpowered magnet)
- **"Adjacent Powered Magnet" Effect**
  (Change in transfer function or harmonics of one magnet, when the adjacent magnet(s) is(are) powered.

“Mere Presence” Effect

- This effect is relatively easy to measure, because the perturbation of additional magnets on the *measurements* is expected to be small. (The perturbation on the field may be large.)
- If a long coil is used for measurements, one has to worry about only the addition of remnant field from the unpowered magnet. The measurements are unaffected as long as the remnant fields are small.

“Mere Presence”: Correctors on 21Q40

- Integrated quadrupole field in 21Q40 at the lowest current of interest (400 A, say) is 0.1 T.m at 80 mm.
- Typical remnant quadrupole field from 27CDM30 correctors is ~1×10^{-5} T.m. The error in transfer function measurement is therefore ~0.01% or less. OK.
- Typical remnant *Sextupole* field from 21CS26 corrector sextupoles is ~ 2×10^{-4} T.m. **This is 20 units of Sextupole for the 21Q40 !**
- The remnant sextupole also produces a quadrupole field by feed down, if the coil is not well centered. The error in 21Q40 ITF for **well aligned coil** (~mm) is negligible.

“Mere Presence”: Effect on 21CS26

- Integrated sextupole field in 21CS26 at the lowest current of interest (4 A, say) is ~ 8×10^{-3} T.m at 80 mm.
- Typical remnant sextupole field from 27CDM30 correctors is ~2×10^{-6} T.m. The error in transfer function measurement is therefore ~0.03% or less. OK.
- Typical remnant sextupole field from 21Q40 is ~3.3×10^{-6} T.m. The error in transfer function measurement is therefore ~0.04% or less. OK.
- The remnant quadrupole field from 21Q40 is ~3.6×10^{-4} T.m. This amounts to a centering error of ~2 mm for 21CS26. One may ignore this centering error for other harmonics.

"Mere Presence": Effect on 27CDM30

Field Type	27CDM30 at 4A (T.m at 80 mm)	Remnant field from	
		21Q40 (T.m at 80 mm)	21CS26 (T.m at 80 mm)
Dipole	2.7×10^{-3}	4.2×10^{-5}	4.6×10^{-5}
Quadrupole	6.8×10^{-4}	3.6×10^{-4}	1.0×10^{-5}
Sextupole	1.3×10^{-4}	3.3×10^{-6}	2.0×10^{-4}

As can be seen, the error due to remnant field may be at several percent level for the measurement of integral transfer function in the 27CDM30 corrector elements.

The remnant sextupole in 21CS26 is stronger than the sextupole in 27CDM30 !!

“Adjacent Powered Magnet”

- When two adjacent magnets (or all three magnets) are powered together, the effects of one on another is considerably more complex.
- In general, the effect on a given magnet would depend on the excitation level of each of the magnets. This enormously increases the parameter space that must be measured.
- Given the fact that even some of the remnant field issues can pose significant problems in the data analysis, the analysis becomes even more difficult when other magnets are powered.
- All potential analysis issues are not apparent at this time.