# Argument for implementing skew quadrupole correctors

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## 1 Necessity of skew correctors

Random rotation of normal quadrupoles of average zero and standard deviation of $\sigma_\theta = 5 \times 10^{-4}$ radians will create skew quadrupoles around the machines with random fluctuation of standard deviation equal to $\sigma_{j_1} = 2 \times 10^{-4}$ $\mathrm{m}^{-2}$. There errors excites the resonances $Q_x + Q_y = N$ and $Q_x - Q_y = M$. In simulations [1], the resonance $2Q_x + 2Q_y = 37$ have been found in and compensated. Next is a list of reasons to control these two resonances:

1 The resonance $Q_x+Q_y = 37$ becomes a barrier to a change of tunes. In case of necessity of moving the working point, the periodic resonance crossing of this skew resonance becomes an intensity limiting factor.

2 The resonance $Q_x - Q_y = 0$ overlaps with the Montague resonance and it may enhance (or not) the space charge driven stop-band forcing to move the working point to lower $Q_y$. This, however, would require a reduction of beam intensity for not crossing $Q_x + Q_y = 37$.

3 Linear coupling control is useful for emittance equilibration for mitigating space charge detuning. It may become useful for operations if needed.

## 2 Number and strength of the skew correctors

In a working diagram there are only two resonances of concern, which requires 4 skew correctors + other 2 for safety. This leads to 6 skew correctors. **The natural choice is to have one skew quadrupole corrector per**

**period, the strength of these elements should be the same as for the normal correcting quadrupoles**.

## References

[1] G. Franchetti and S. Sorge, Proc. of IPAC2013, pag. 1556(2013)