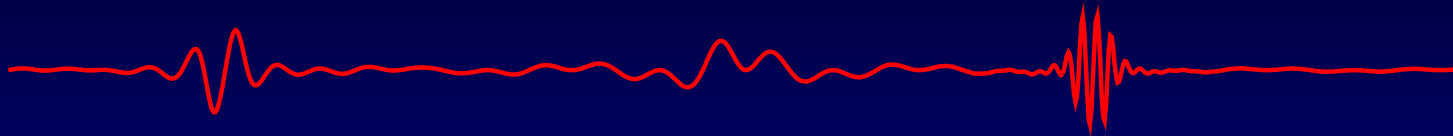


IR multipolar correction for the LHC upgrade



R. Tomás, M. Giovannozzi & R. de Maria

Thanks to S. Fartoukh and T. Risselada

IR'07, November 2007

Motivation for a new correction package

Large spectrum of LHC upgrade options:

- Dipole first, quadrupole first, D0, Q0, crab, etc.

We need an IR multipolar correction package that:

- is optics/layout independent
- is corrector order/type independent
- can deal with one or two beams indistinctly

→ We propose a correction algorithm based on the map coefficients from MADX-PTC

The map & the observable

$$\vec{x}_f = \sum_{jklmn} \vec{X}_{jklmn} x_0^j p_{x0}^k y_0^l p_{y0}^m \delta_0^n$$

To assess how much two maps, X and X' deviate from each other the following quantity is defined:

$$\chi^2 = \sum_{jklmn} \|\vec{X}_{jklmn} - \vec{X}'_{jklmn}\|$$

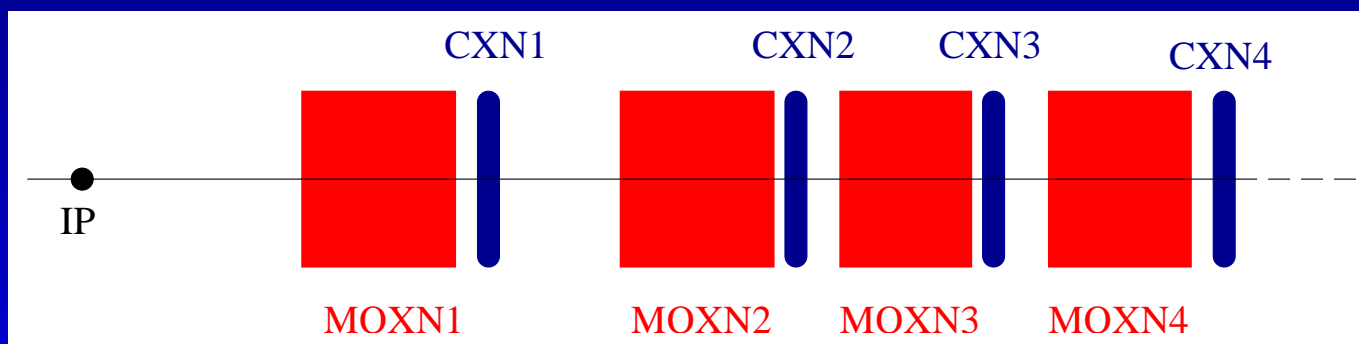
Weighting can be implemented. To disentangle the contribution of the different orders on χ^2 :

$$\chi_q^2 = \sum_{j+k+l+m+n=q} \|\vec{X}_{jklmn} - \vec{X}'_{jklmn}\|$$

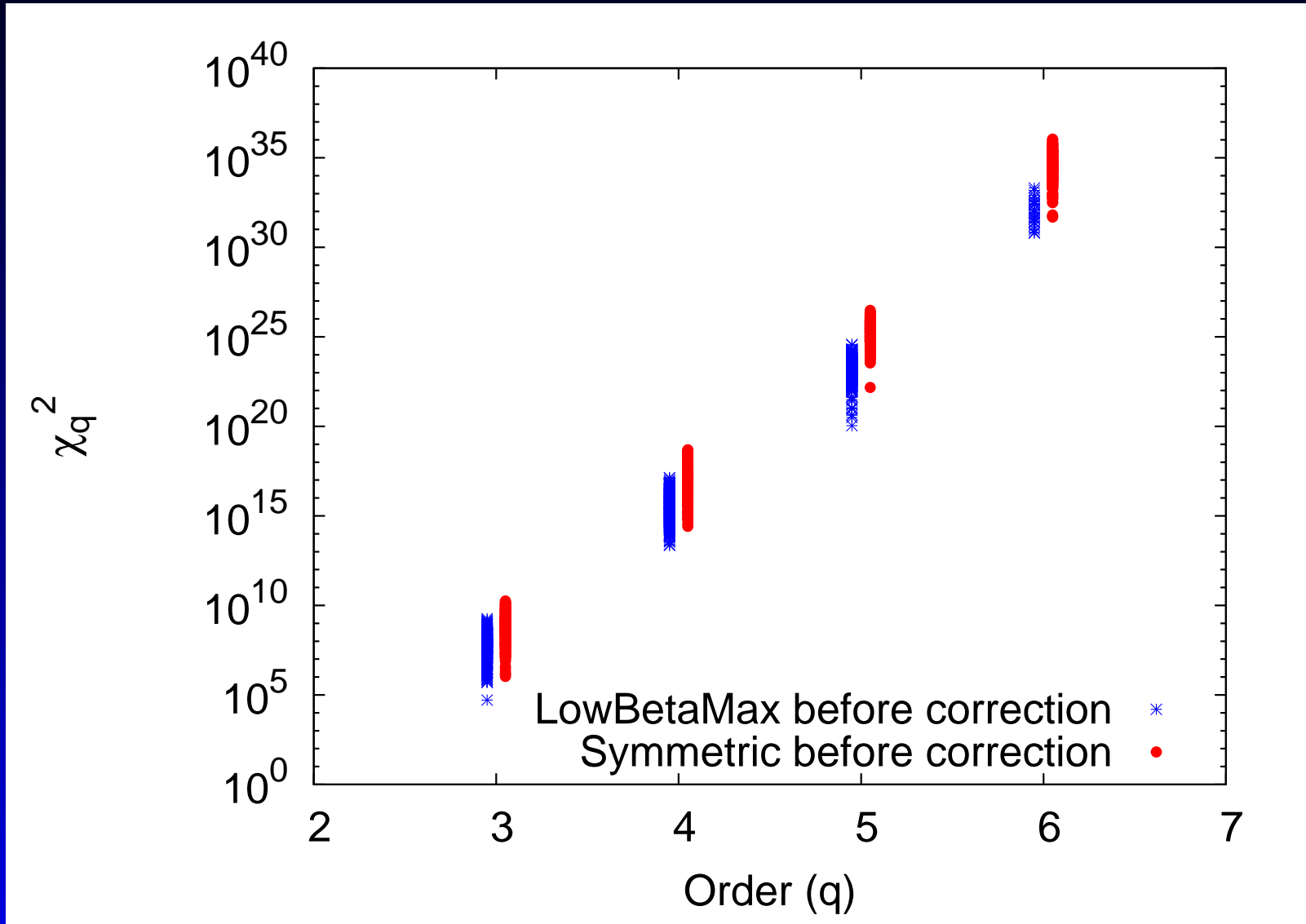
This is computed with the Python code `MAPCLASS`.

Correction

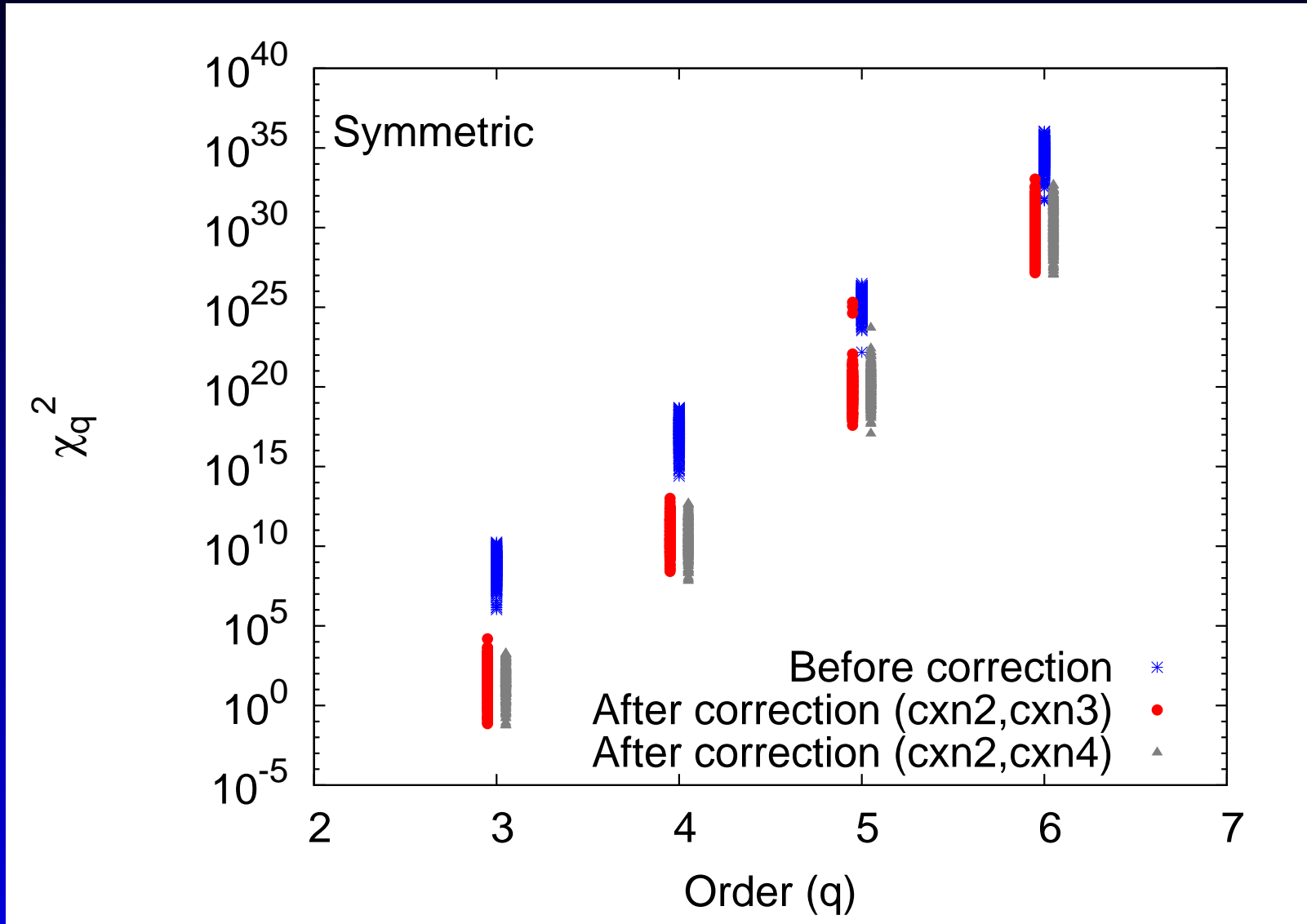
- MADX provides \vec{X}_{jklmn} to arbitrary order.
- \vec{X}_{jklmn} is the IR transfer map without errors
- \vec{X}'_{jklmn} is the IR transfer map with errors
- Correction of order q is achieved by minimizing χ_q^2 using $2q$ -pole correctors.



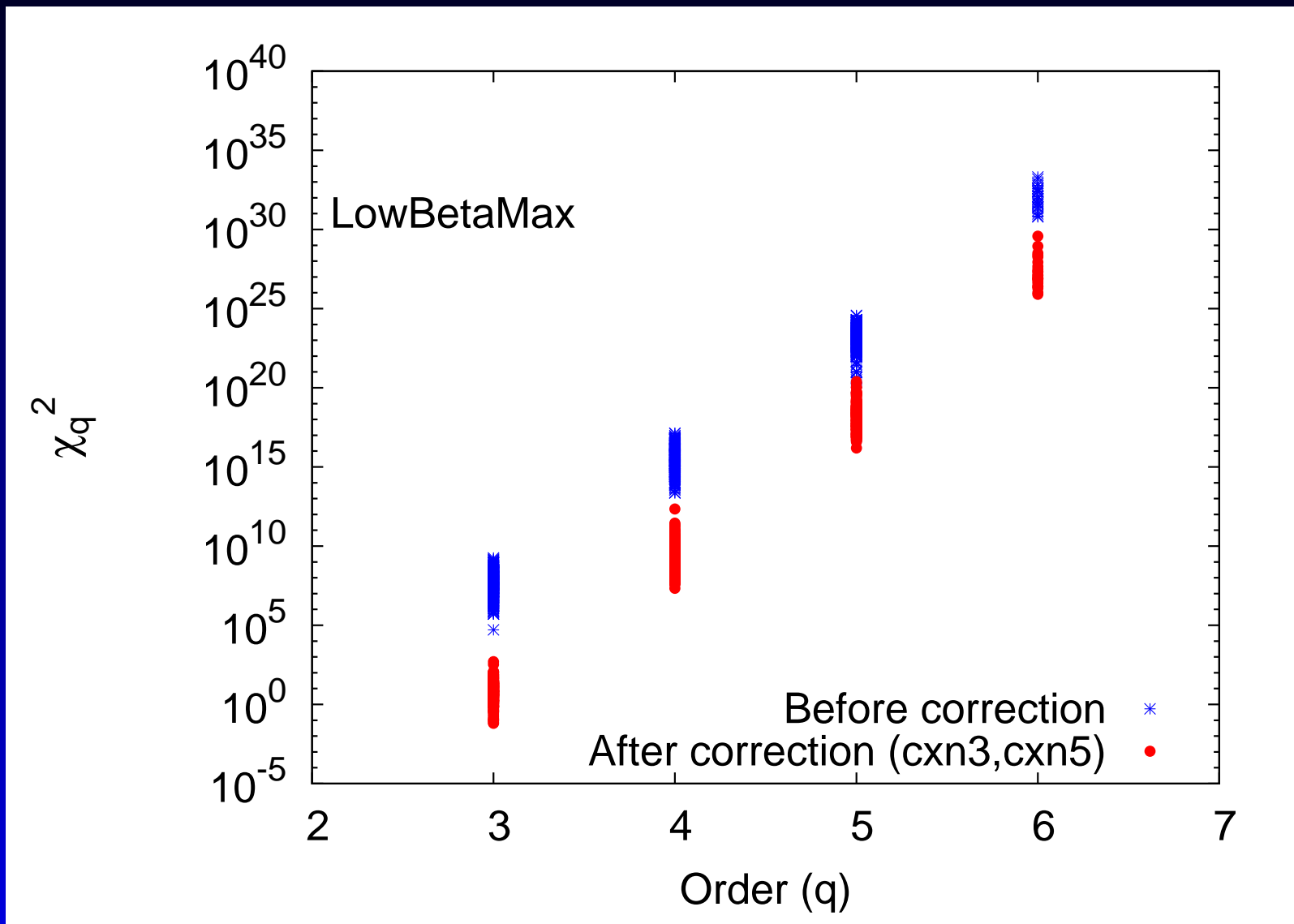
χ_q^2 for LowBetaMax and Symmetric



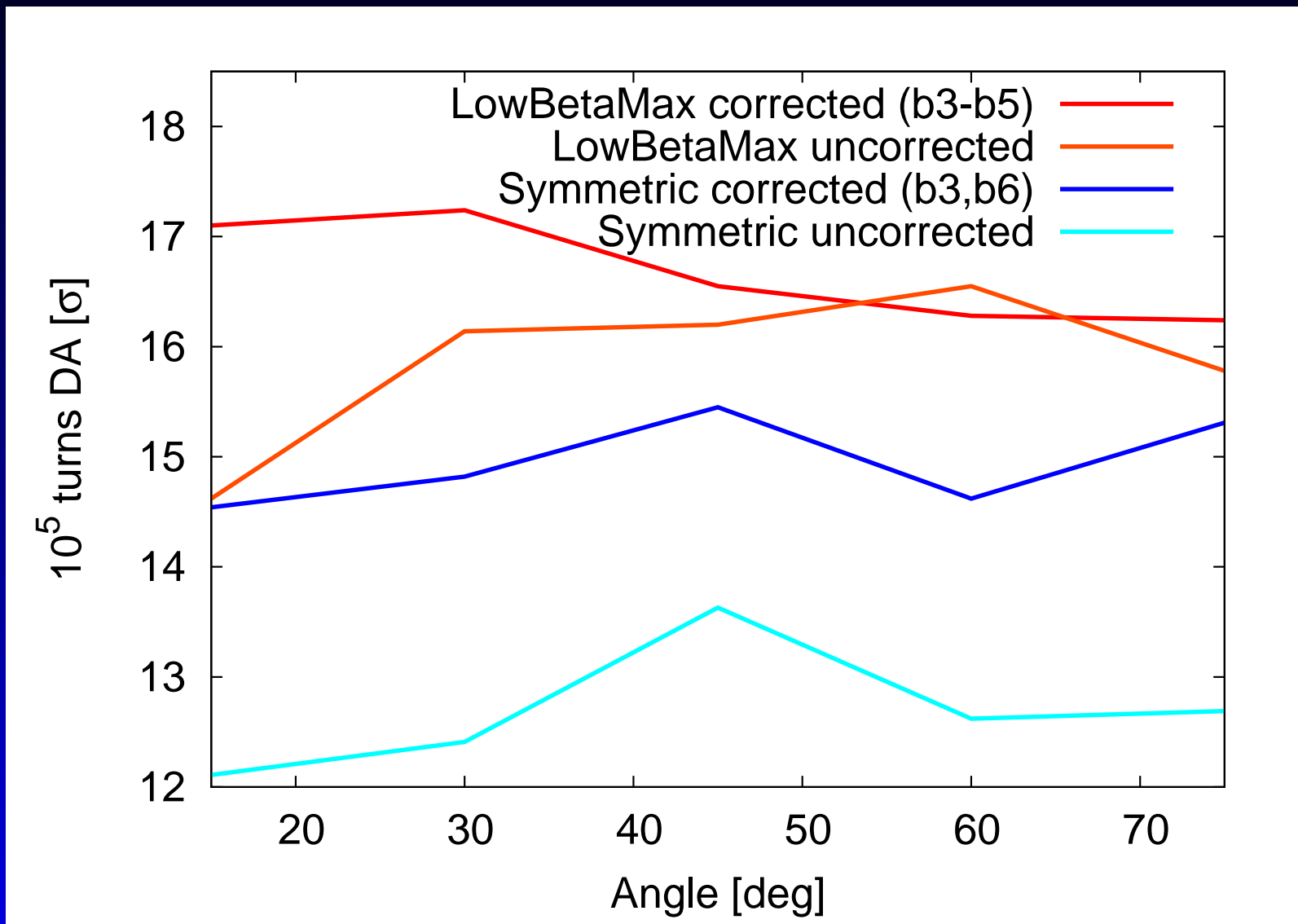
Correction illustration: Symmetric



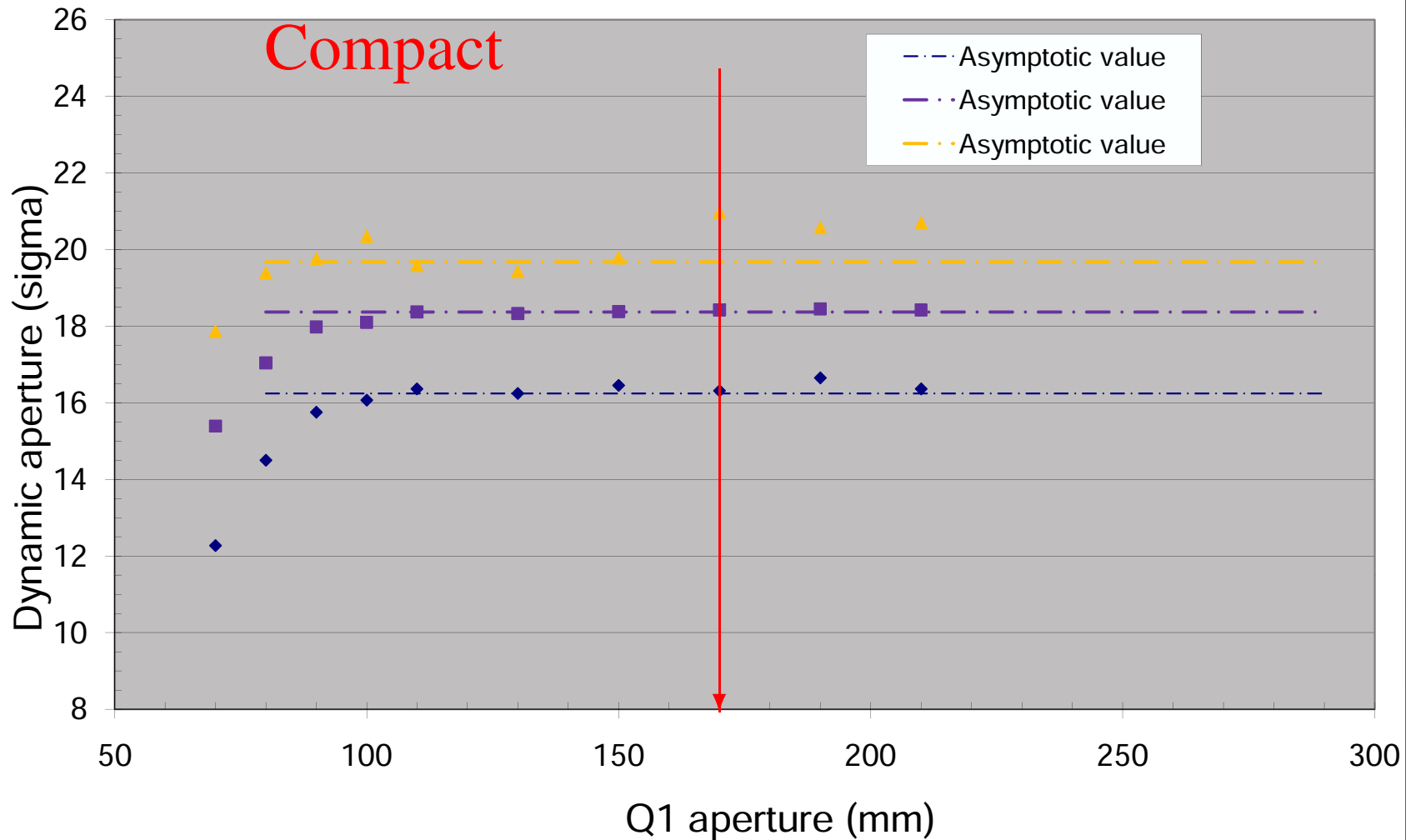
Correction illustration: LowBetaMax



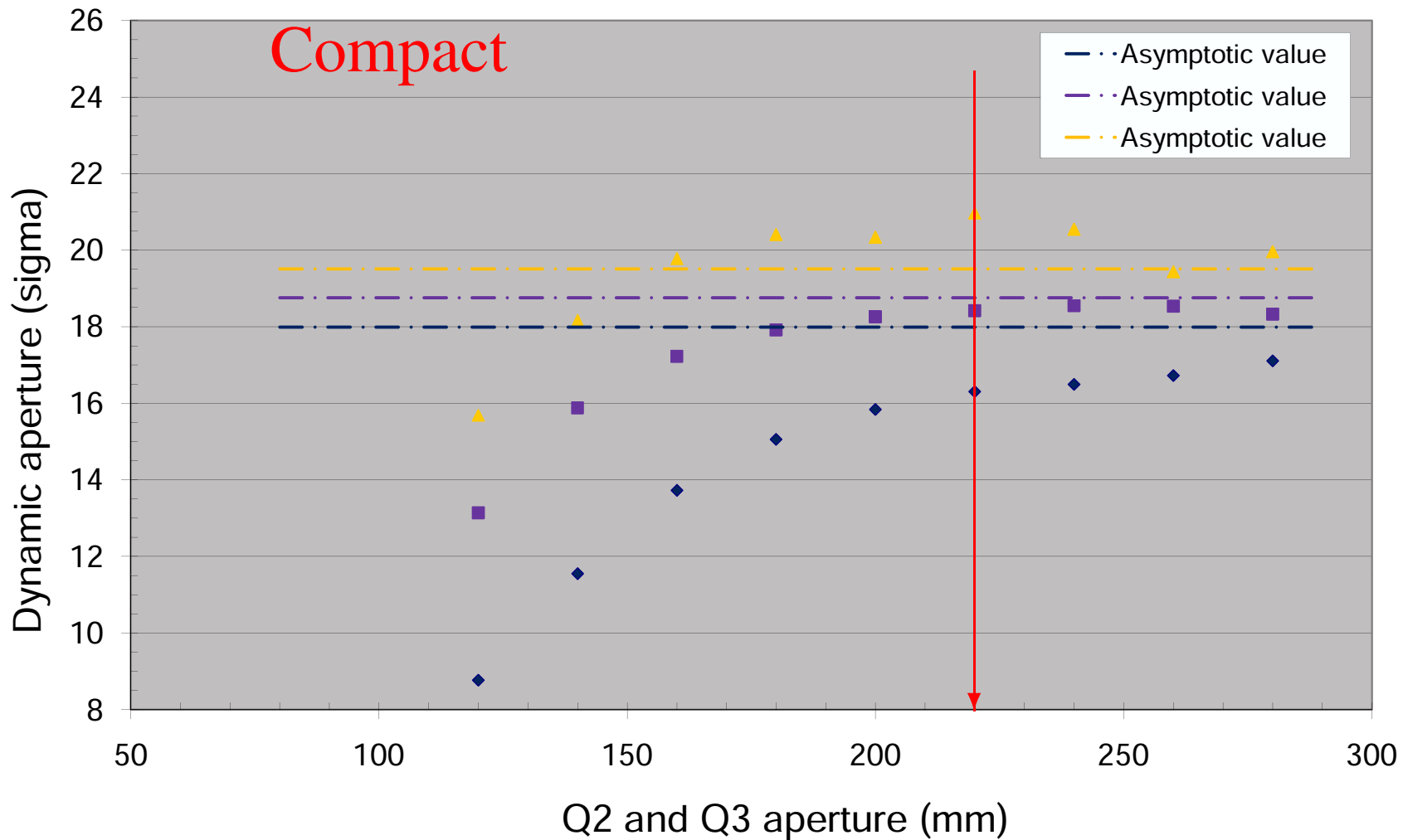
DA after correction



DA versus quadrupole aperture I



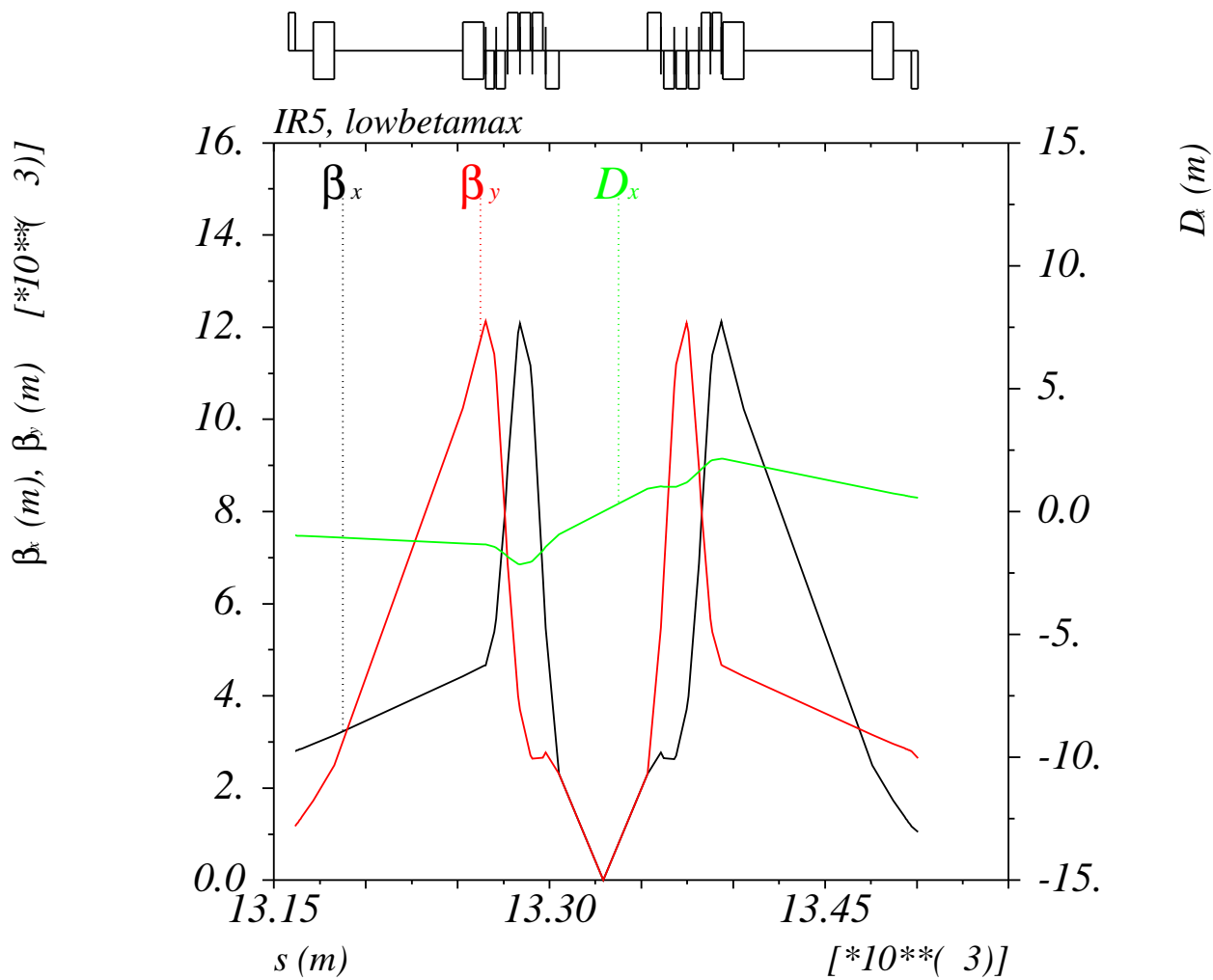
DA versus quadrupole aperture II



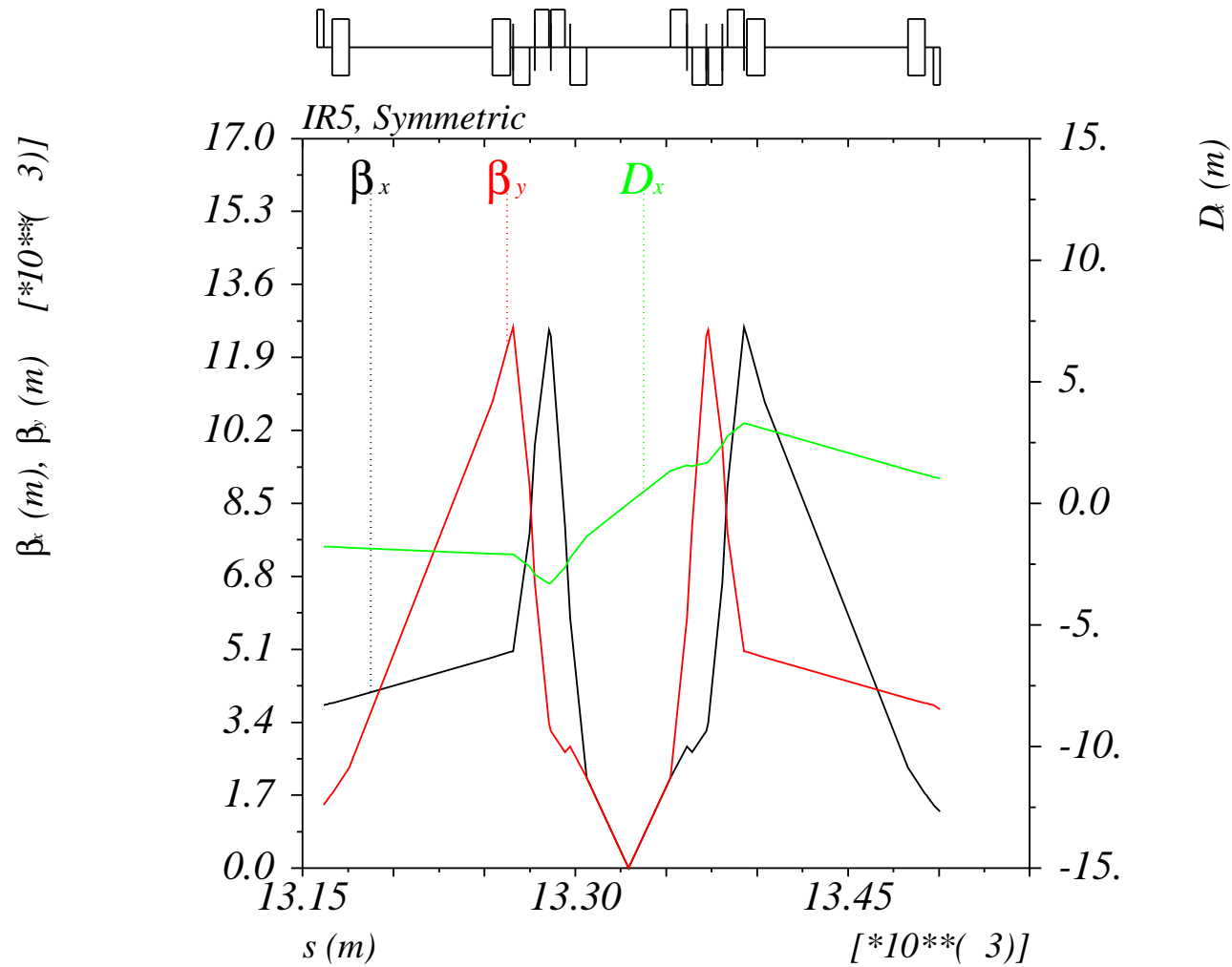
Conclusions

- A general correction package has been developed based on the computation of map coefficients
- It works for any option:
 - LowBetaMax: MDA from 14.5σ to 16.0σ
 - Symmetric: MDA from 12.0σ to 14.5σ
 - Old modular: MDA from 12.0σ to 14.5σ
- Compact needs no correction, thanks to the large aperture. Limits assessed with scans.
- Still to do:
 - include weights to select resonances
 - test performance with 2 beams

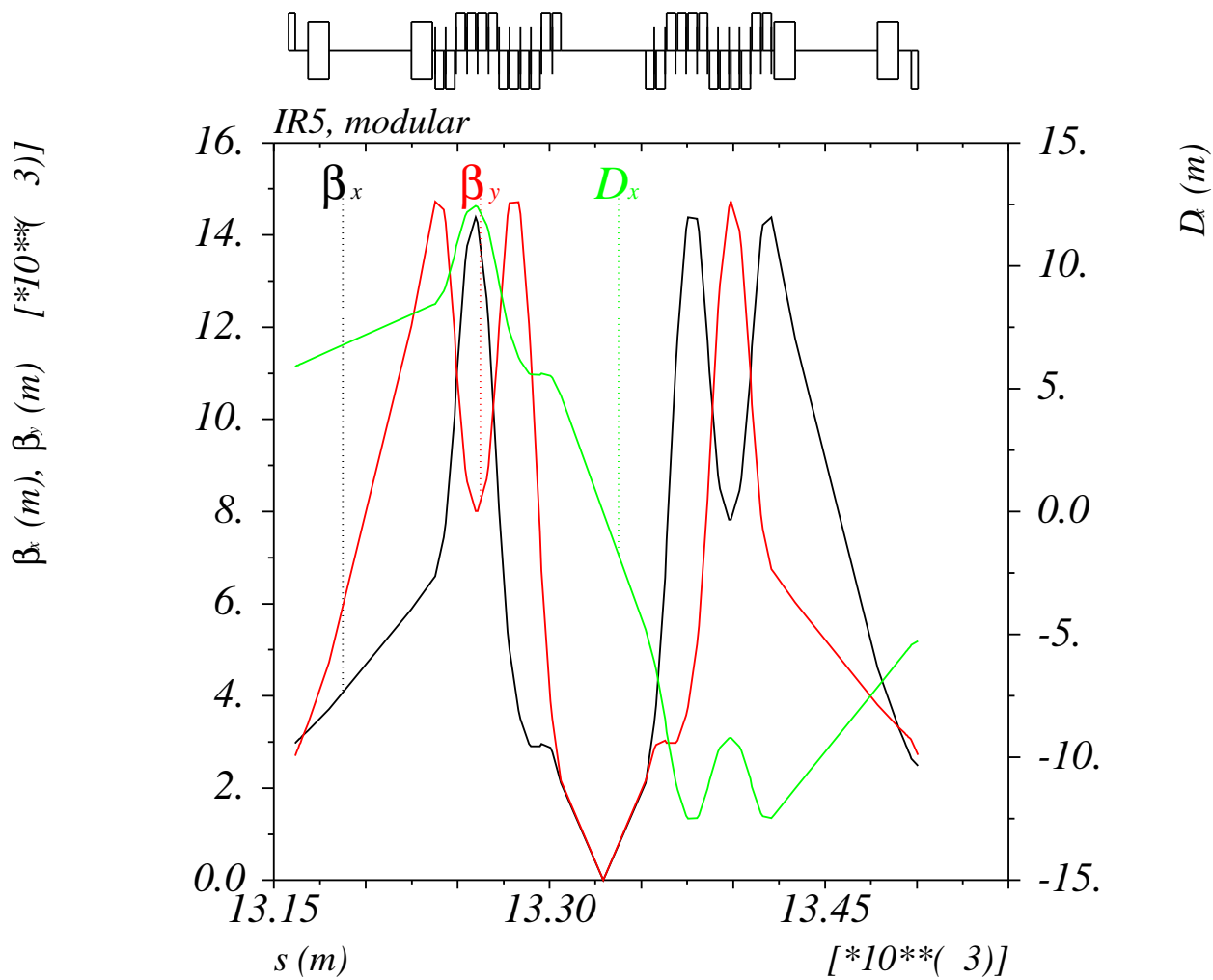
Optics: LowBetaMax



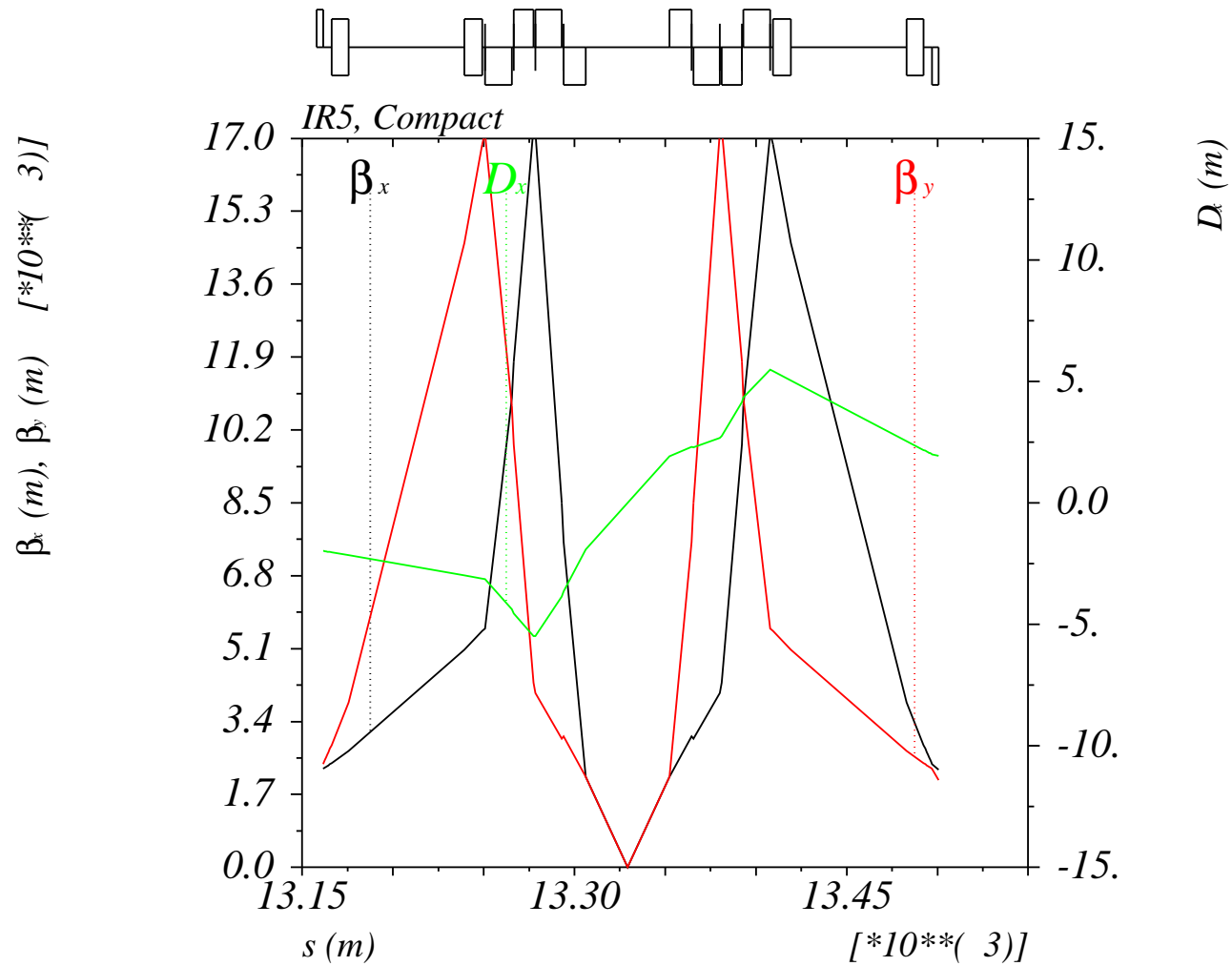
Optics: Symmetric



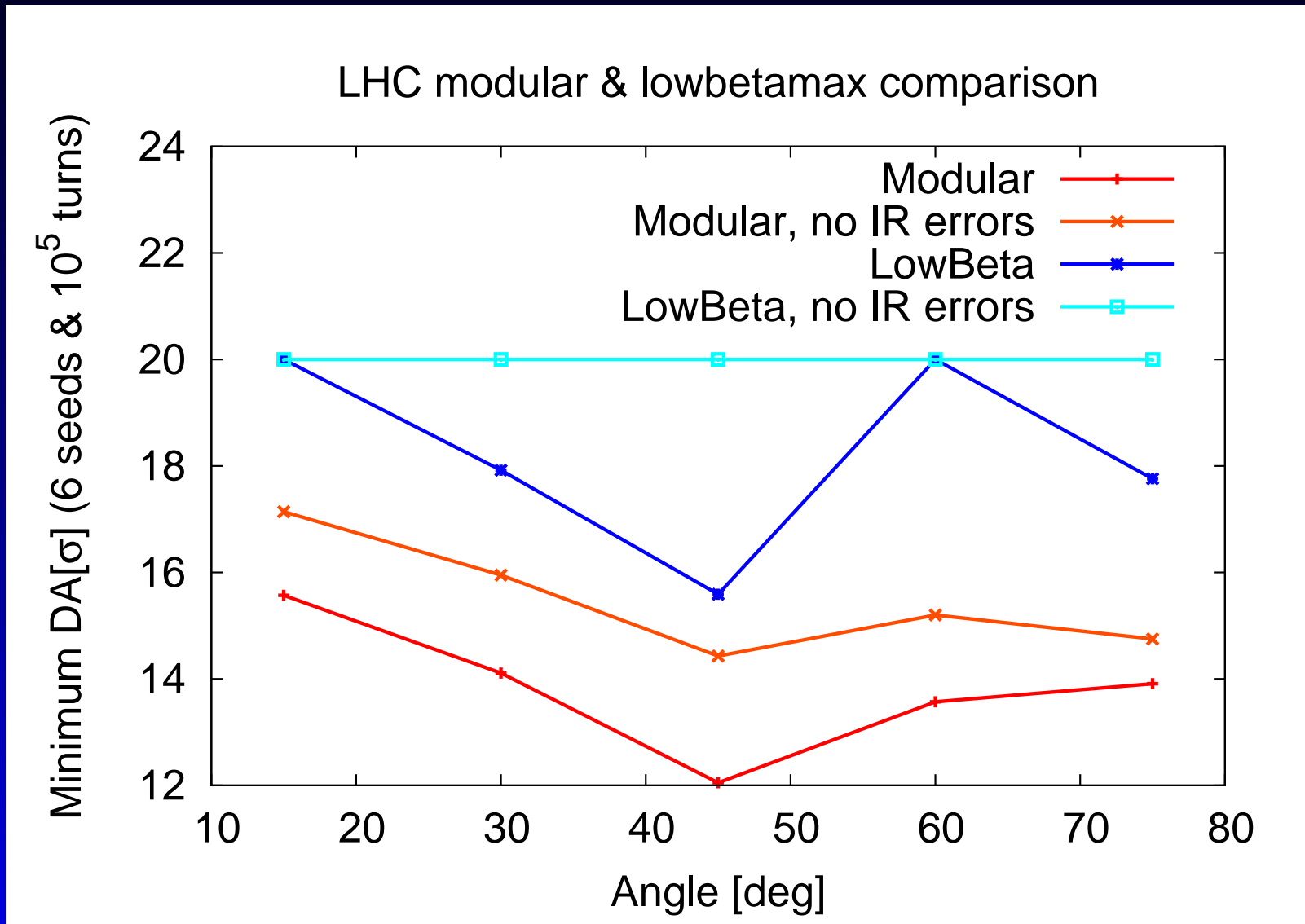
Optics: Modular



Optics: Compact

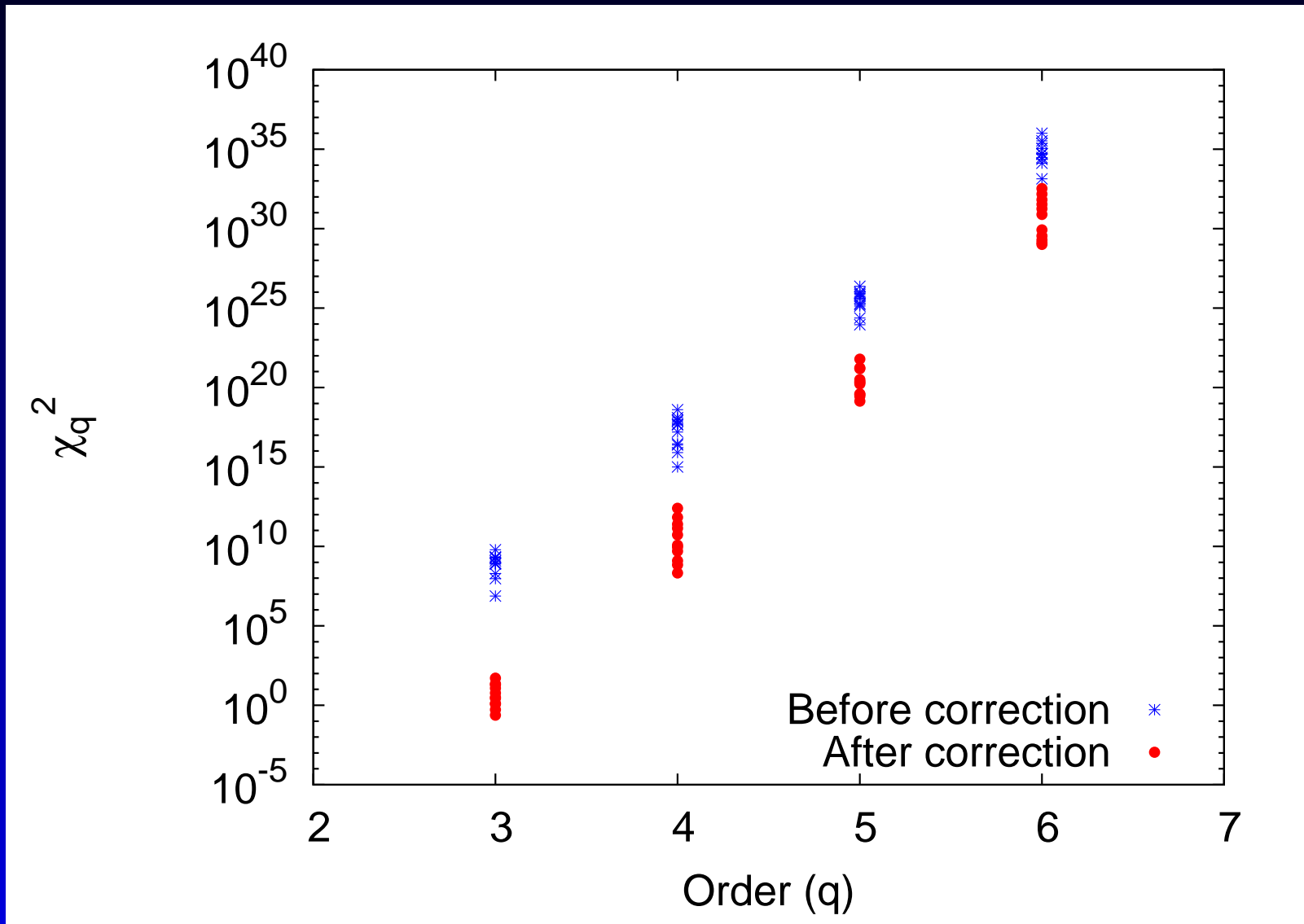


DA comparison: modular & lowbeta

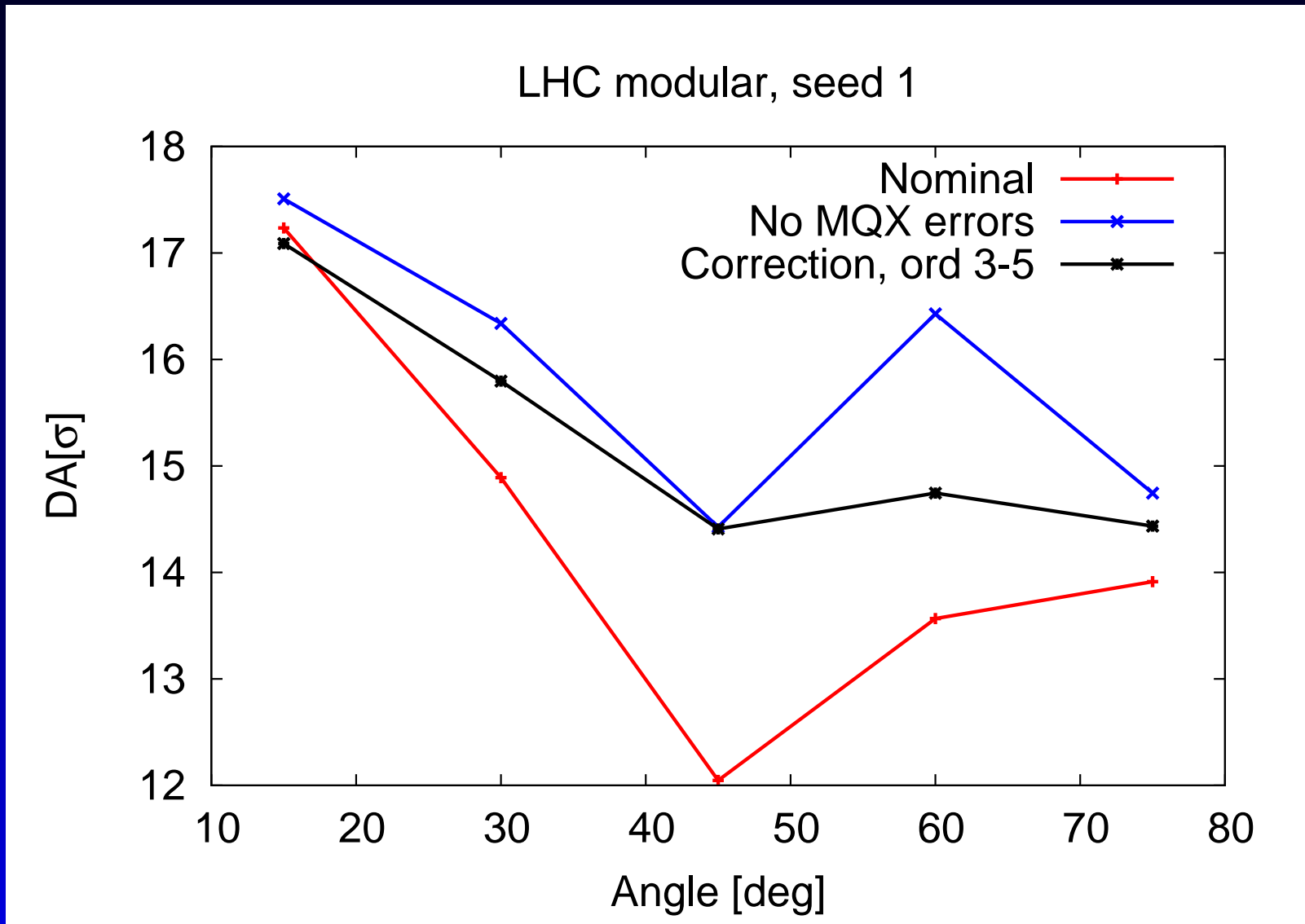


Old LowBetaMax!

Correction: χ_q^2 for the modular



Correction versus angle



Correction versus seed

