Measurements with AC dipoles

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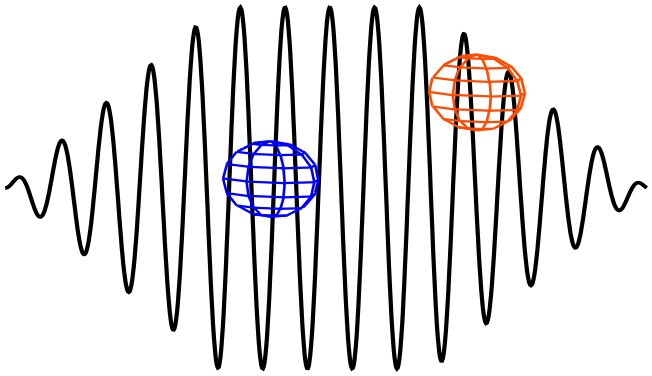

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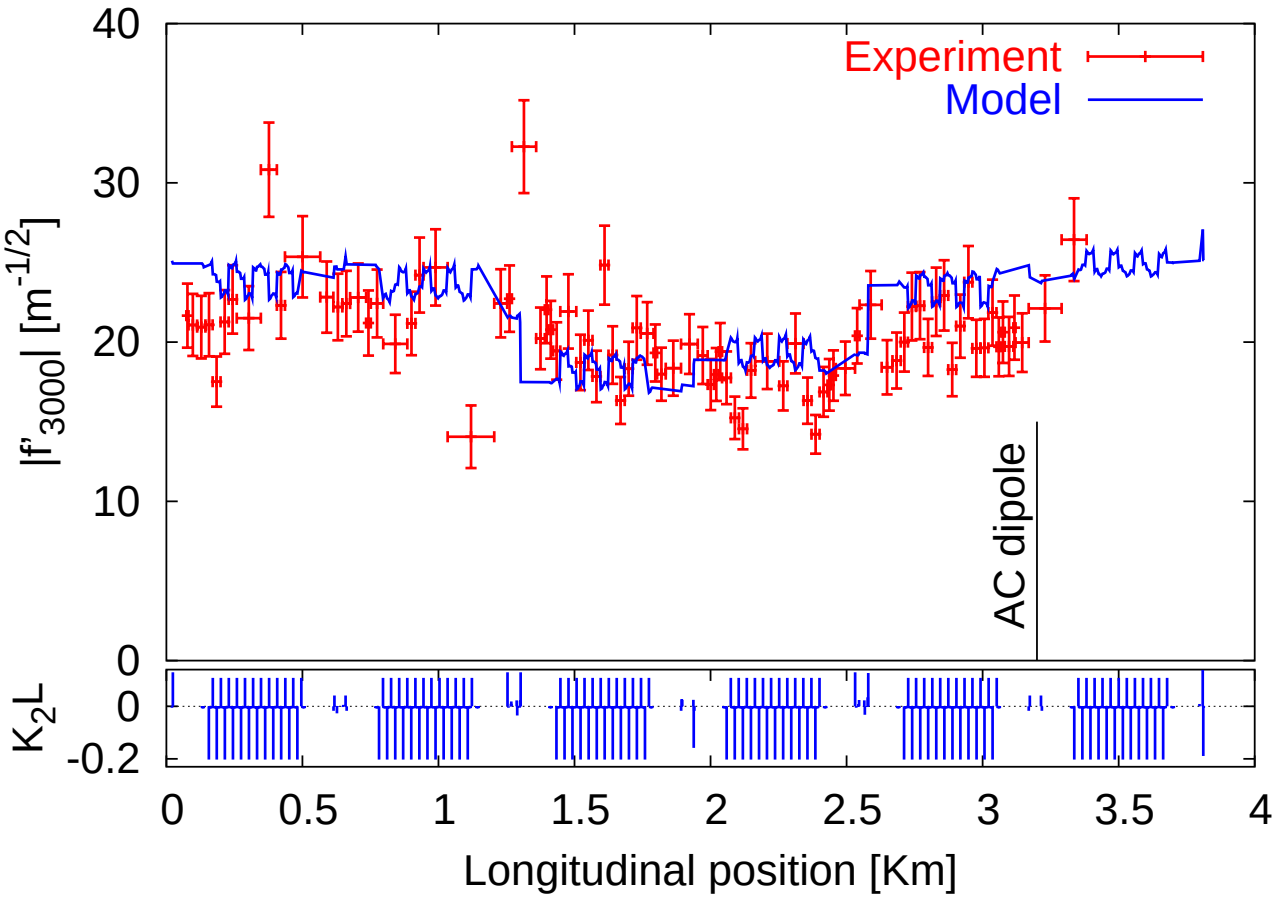
In presence of an AC dipole the particle motion is:

$$x_1(N) \propto \Re\{\sqrt{2I_x}e^{i\psi_x} - 2i\sum_{jklm} j f'_{jklm}(2I_x)^{\frac{j+k-1}{2}}(2I_y)^{\frac{l+m}{2}} \times e^{i[(1-j+k)\psi_x+(m-l)\psi_x]}\}$$

where f'_{jklm} tends to f_{jklm} close to the resonance.

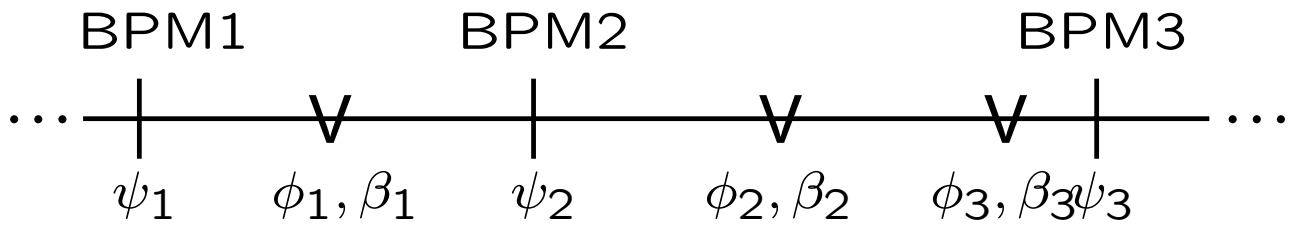
$\Rightarrow$ The resonance terms f'_{jklm} are computed from the FFT of two adjacent BPMs.

Sextupolar resonance driving terms II



$\longrightarrow$ First measurement ever of $|f'_{3000}|$ using an AC dipole !!!

Local sextupolar resonance terms I



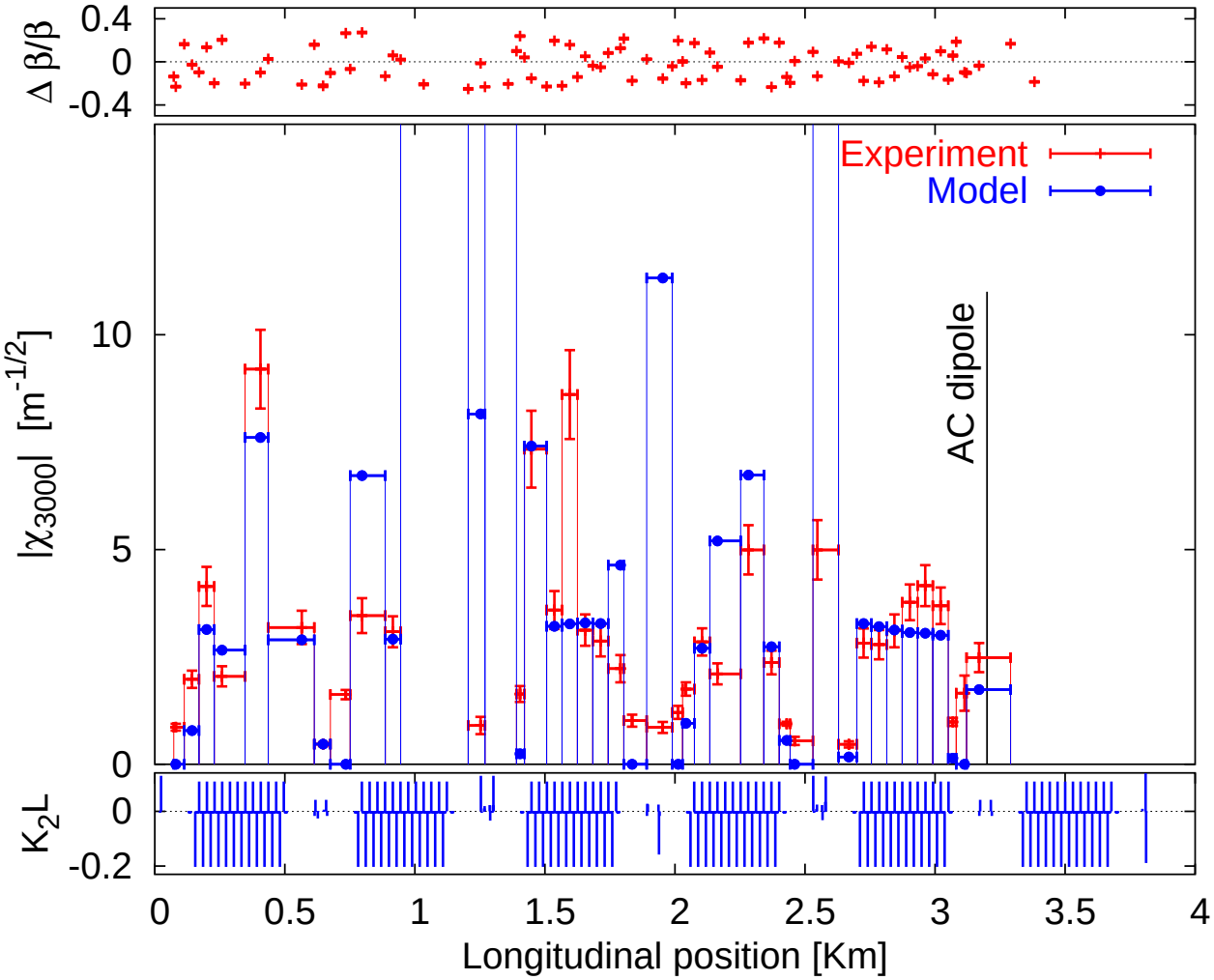
$$\psi_2 - \psi_1 = \pi/2 + \delta_1 \ , \qquad \psi_3 - \psi_2 = \pi/2 + \delta_2$$

$$\chi(N) = \frac{\hat{x}_1(N)}{\cos\delta_1} + \hat{x}_2(N)(\tan\delta_1 + \tan\delta_2) + \frac{\hat{x}_3(N)}{\cos\delta_2} \ , \qquad (1)$$

$$\chi(N) = 2 \sum_{j>k,l>m} j|\chi_{jklm}|(2I_x)^{\frac{j+k-2}{2}}(2I_y)^{\frac{l+m}{2}} \times \qquad (2)$$
$$\cos\left(((1-j+k)\nu_x + (m-l)\nu_y)2\pi N + \psi_{jklm}\right)$$

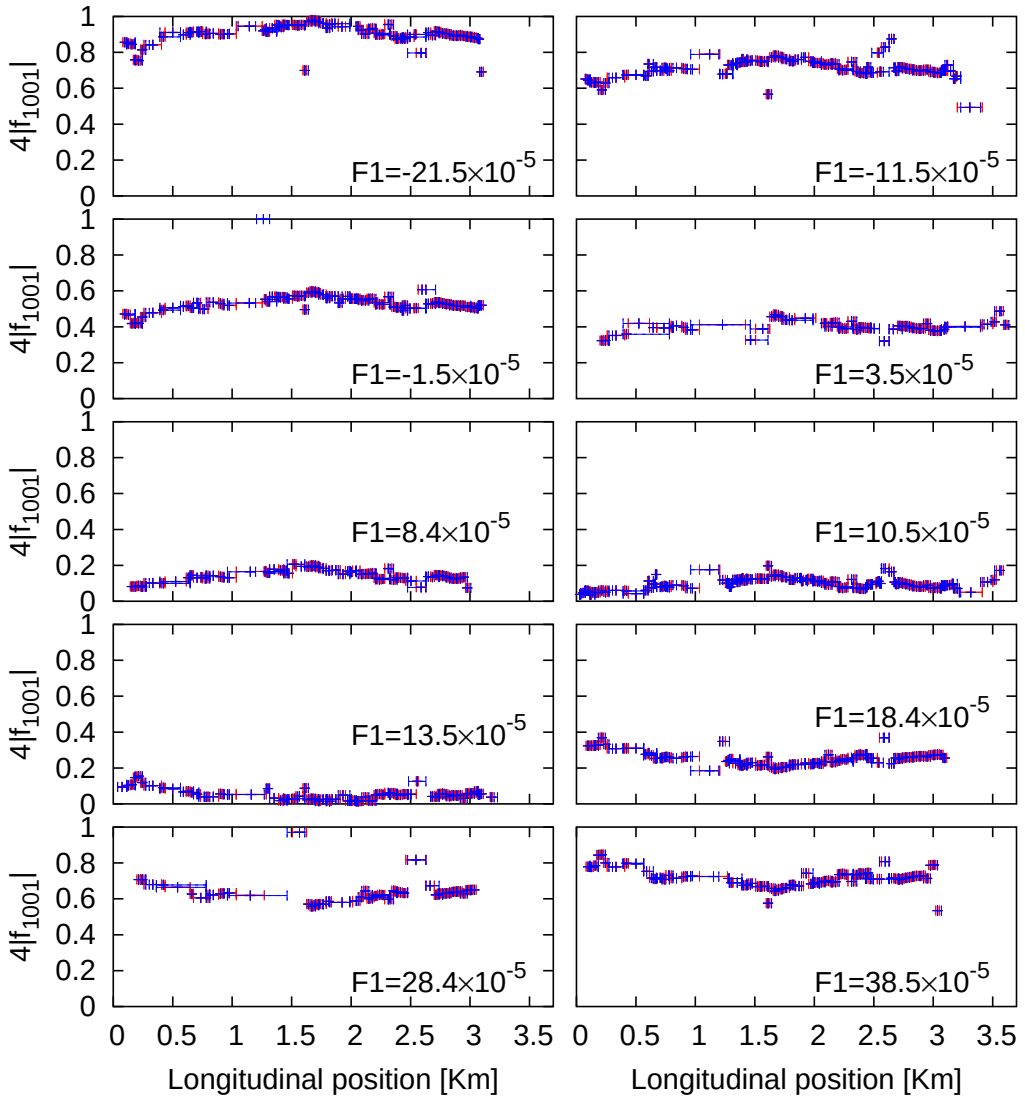
$\Rightarrow$ The terms χ_{jklm} are truely local and measurable

Local sextupolar resonance terms II



$\Rightarrow$ First measurement ever of χ_{jklm} !!

Coupling resonance driving terms



Also first measurement ever with an AC dipole !!

Failure in measuring coupling strenghts

y08-qs3 was set to -0.0006 and Andrea's measurement gave:

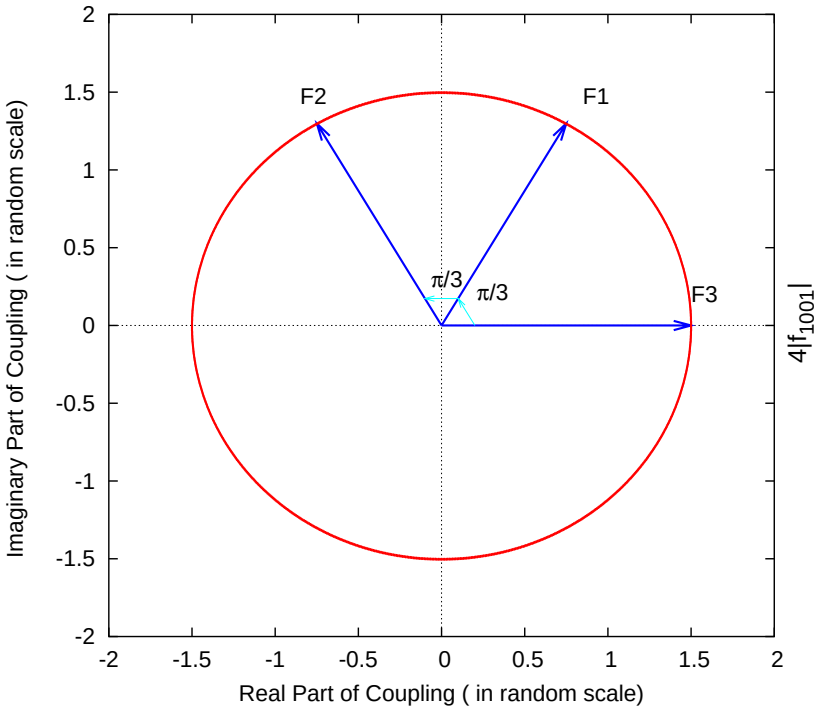
BPM	pos	from f1001	from f1010	# of SKEW	FILE
12	675	0.7219E-02	0.7036E-02	1	LC_49 plus
12	675	0.1585E-02*	0.9874E-02	1	LC_50 plus

The reason for the discrepancy has been identified:

• Unexpected coupling sources in between BPMs: D0 magnet multipoles and quad tilts.

⇒Coupling strenghts measurement in RHIC is out of scope for now

Plans for next run: coupling at store

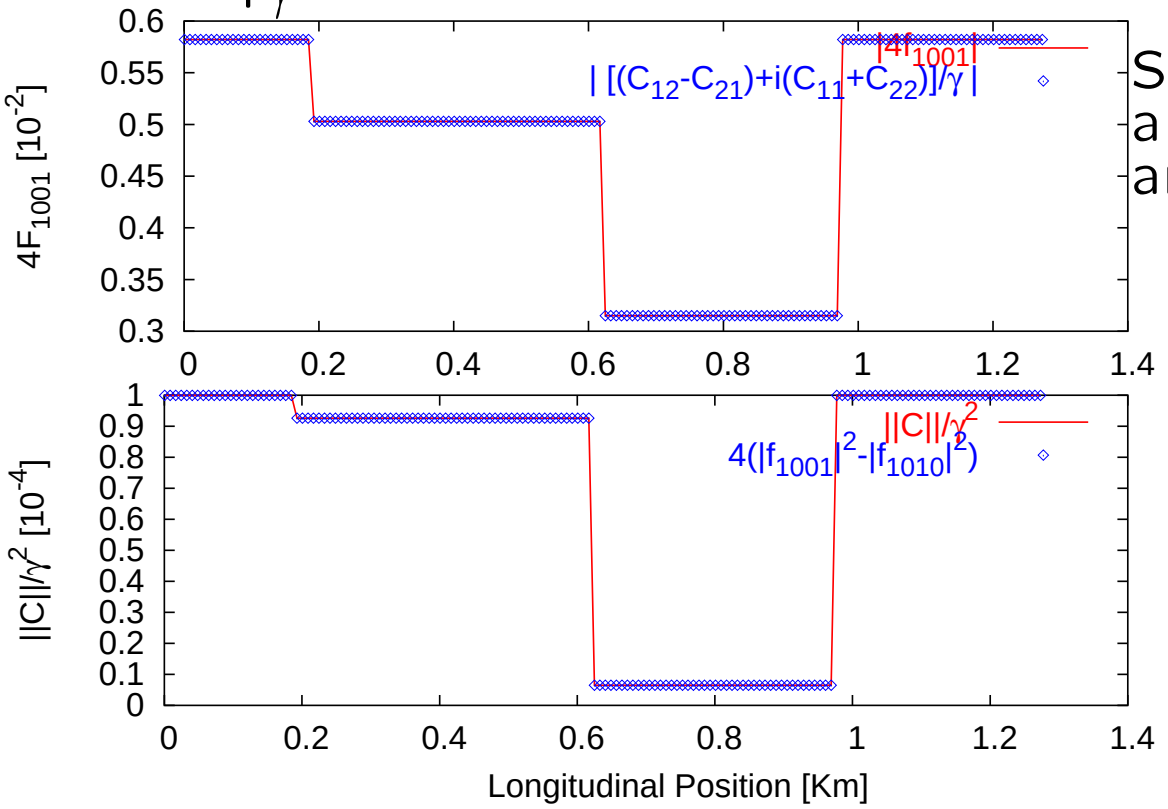


All cases same ΔQ_{min}

- Optimisation of the 3 families needs $|f_{1001}|$ measurement
- Measurement of $|f_{1001}|$ can also uncover local coupling sources
- Other goodies regarding the $\mathbf{C}$ matrix...

$$\frac{1}{2\gamma}\overline{C}^{12}_{21} = \mathcal{R}\{f_{1010} \pm f_{1001}\} \ , \quad \frac{1}{2\gamma}\overline{C}^{11}_{22} = \mathcal{I}\{f_{1001} \pm f_{1010}\} \ ,$$

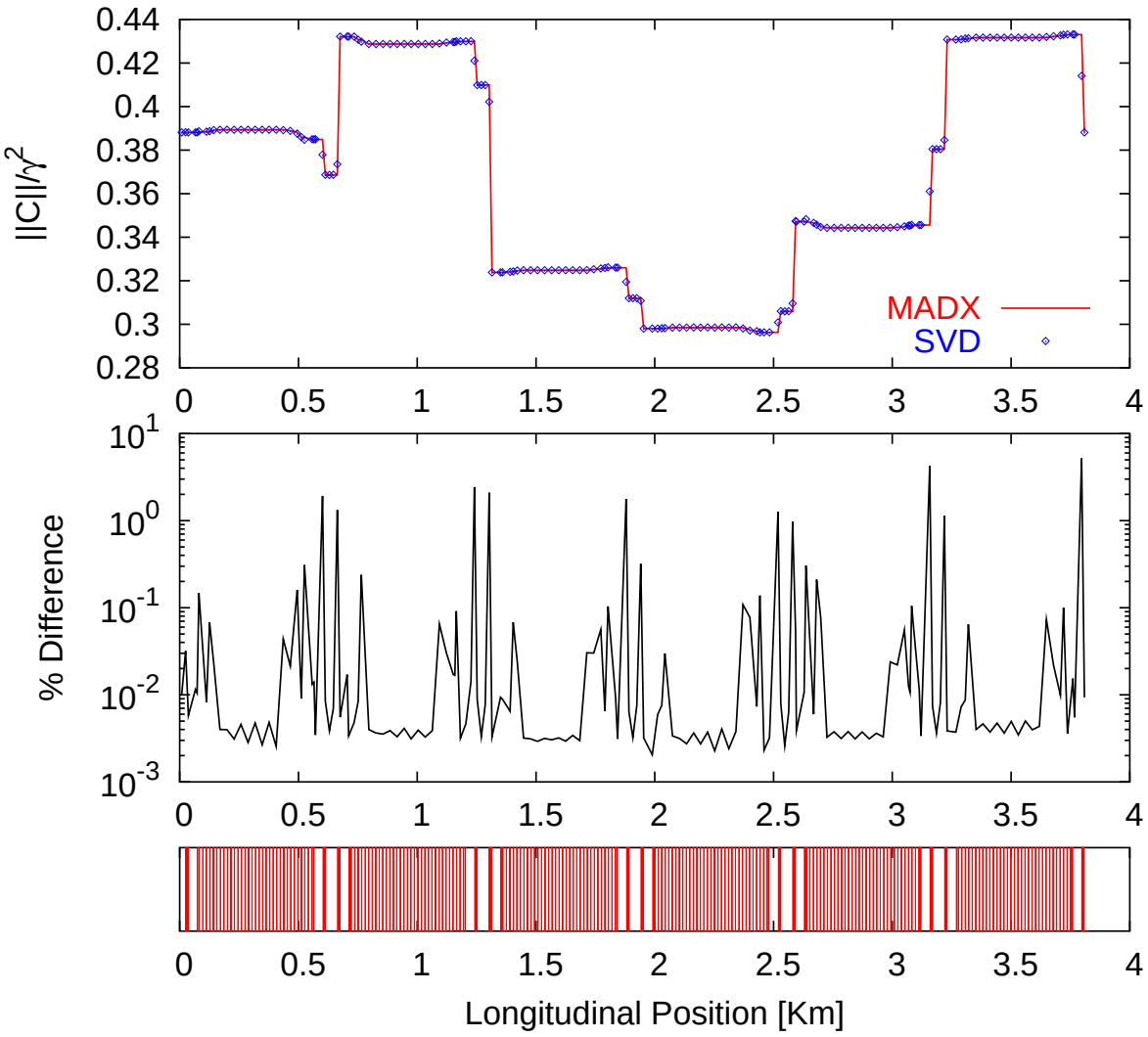
$$\frac{|\overline{C}|}{4\gamma^2} = |f_{1001}|^2 - |f_{1010}|^2$$



Simulation with a FODO lattice and 3 skew quads

Measurement of the $\mathbf{C}$ matrix

Ram's simulated measurement using a realistic RHIC lattice:



Conclusions

- Coupling and sextupolar resonance driving terms have been measured for the first time using AC dipoles
- Truely local non-linear observables have been defined and measured too
- A way to measure $\mathbf{C}$ has been developed
- Next natural target is store