Azimuthally-sensitive two-pion interferometry in U+U collisions at STAR
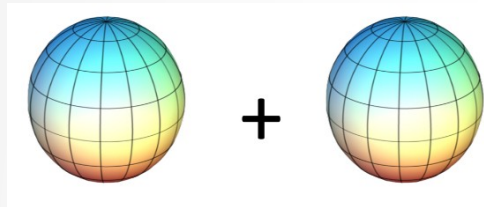
John Campbell – OSU
Midwest Critical Mass – 3/8/14

Overview
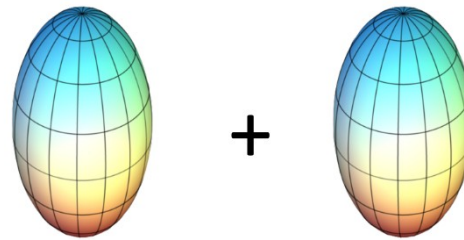
- Why Uranium?

- 2nd Order Azimuthal Femtoscopy

- Data Set and Cuts

- Correlation Functions

- Radius Oscillations

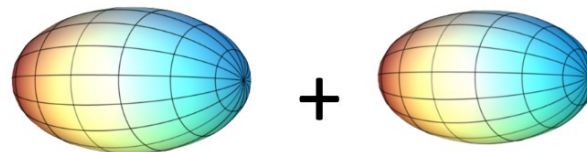- Conclusions and Next Steps

Why U+U for Azimuthal Femtoscopy?

- Au+Au: spherically symmetric nucleus

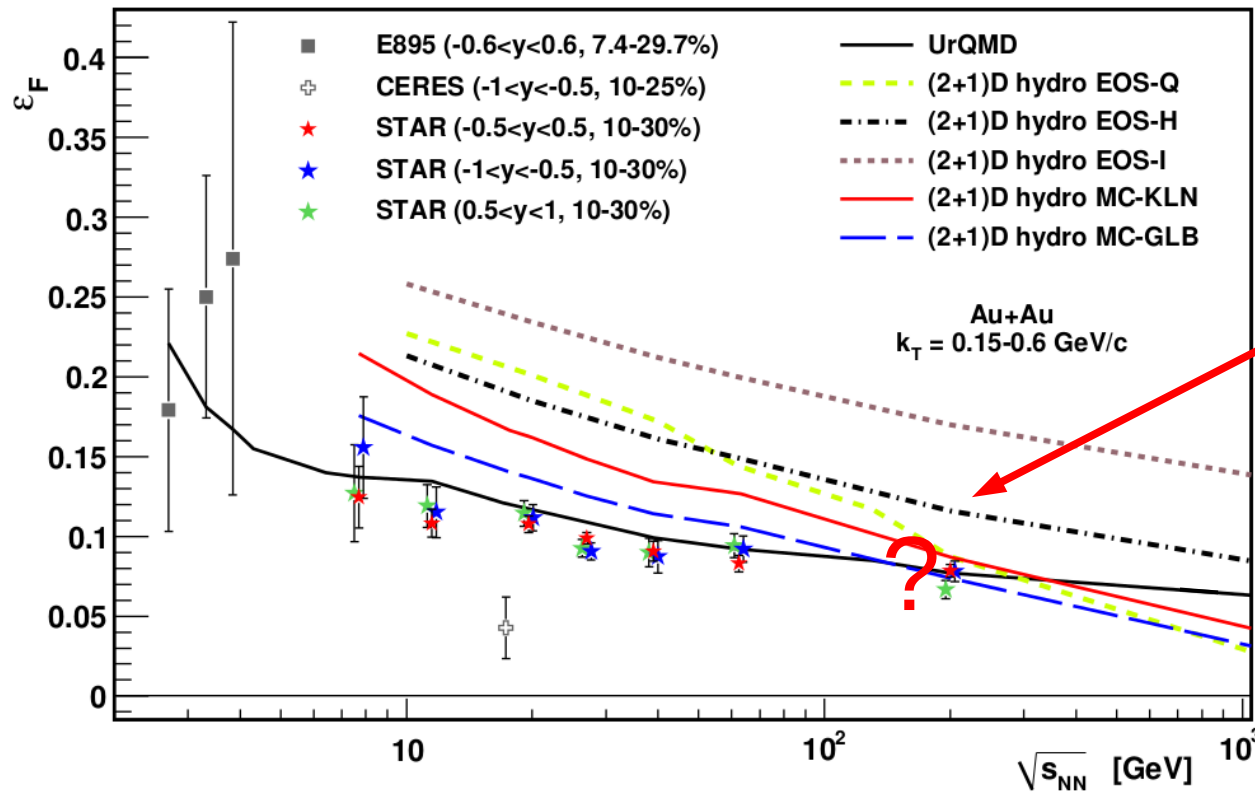- U+U can give *full overlap*, but with many different orientations
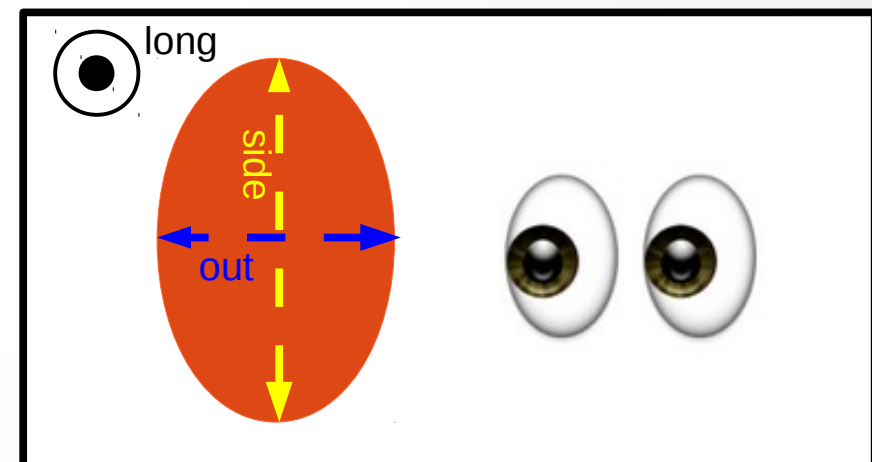
2nd order Femtoscopy

Can we use U+U to get a point at 193 GeV?

ALICE point @ 2.76 TeV

(added here by hand)

Find eccentricity with Fourier moments of R$_{side}$
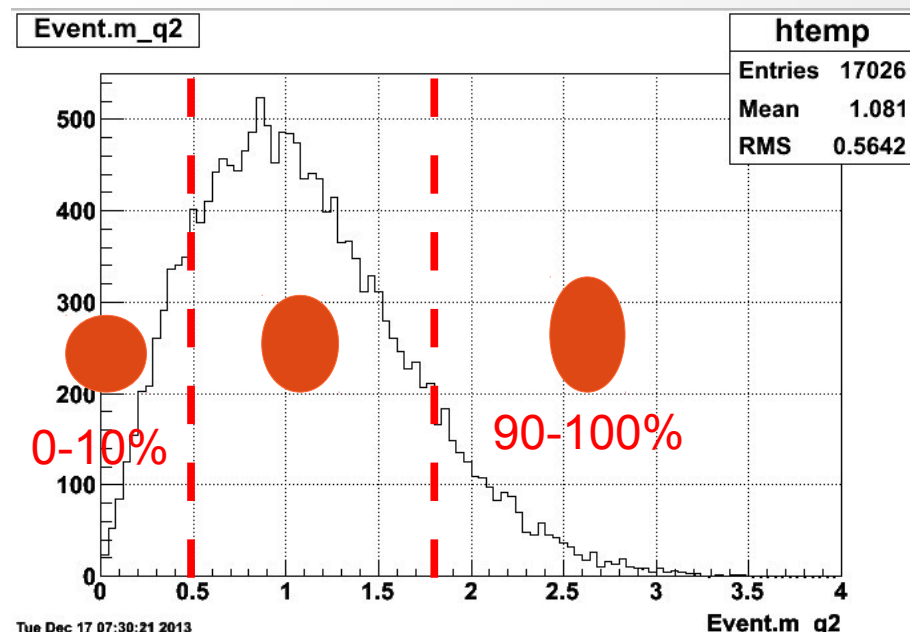
$$\varepsilon \approx 2 \frac{R^2_{s,2}}{R^2_{s,0}}$$

Data Set

- U+U, $\sqrt{s_{NN}} = 193\,GeV$

- ~13 Million Events from 1% ZDC trigger

- ~ 1.1 Million BB events (after cuts)

$$q_{n,x} = \frac{1}{\sqrt{M}} \sum_{i=1}^{M} \cos(n\varphi_i)$$

$$q_{n,y} = \frac{1}{\sqrt{M}} \sum_{i=1}^{M} \sin(n\varphi_i)$$

0-10%   90-100%

Event Cuts		Track Cuts		Pair Cuts + Binning	
$|V_z|$	< 30.0 cm	$|\eta|$	< 0.5	k_T	(0.15 GeV, 0.60 GeV)
V_r	< 2.0 cm	p_T	(0.15 GeV, 0.80 GeV)	φ	8 Bins
q_2	>1.8 (top 10% BB)	$|N\sigma_{pion}|$	< 2	Ψ_{EP}	16 Mixing Bins
$N_{ch,TPC}$	<1000	N_{Hits}	> 15	V_z	12 Mixing Bins
		DCA	< 3 cm		

Event Plane Flattening

Raw EP vs. Flat EP - q$_2$ Bin: 10

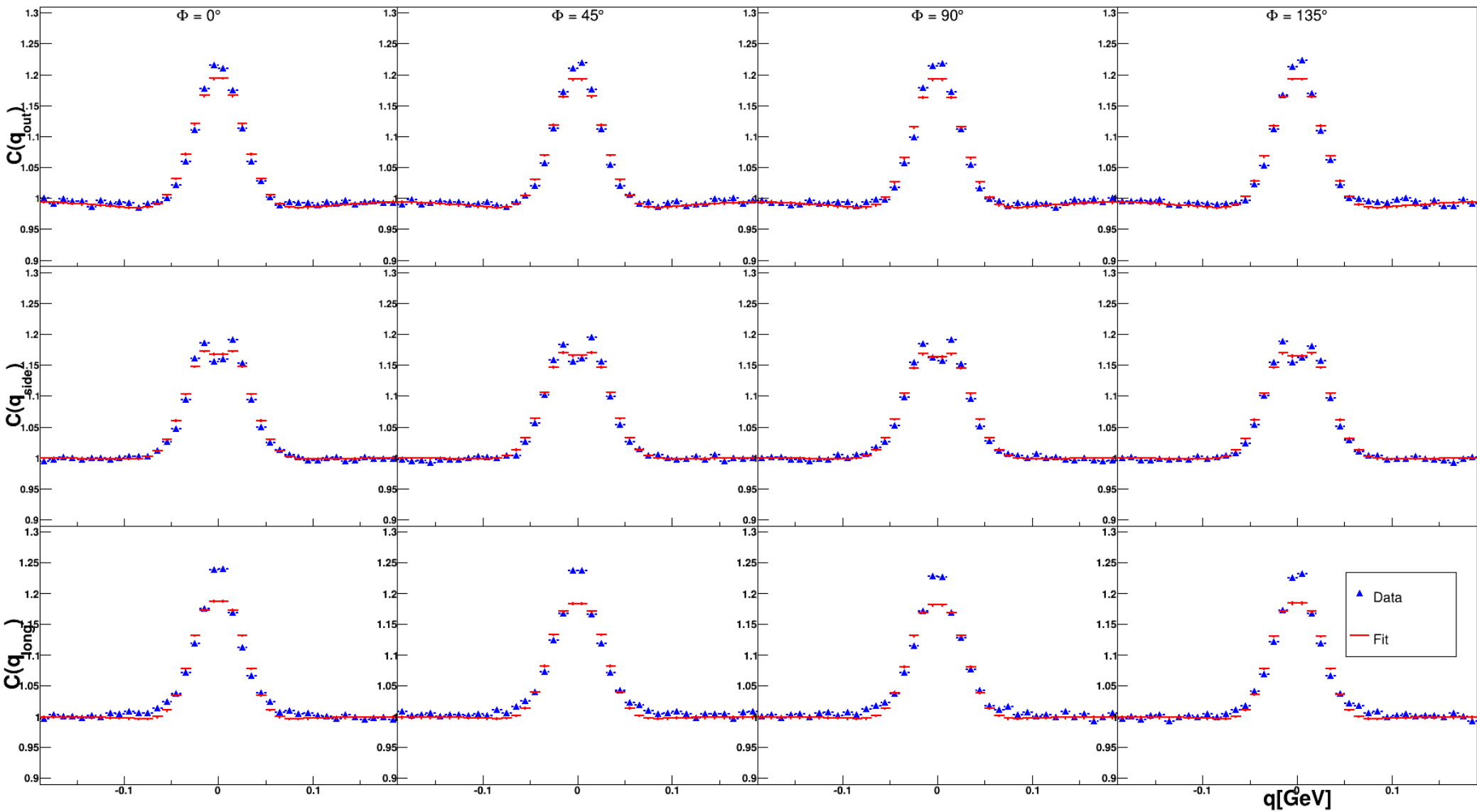| rawFlatEPCorr_11_py	
Entries	632966
Mean	1.22
RMS	0.5745
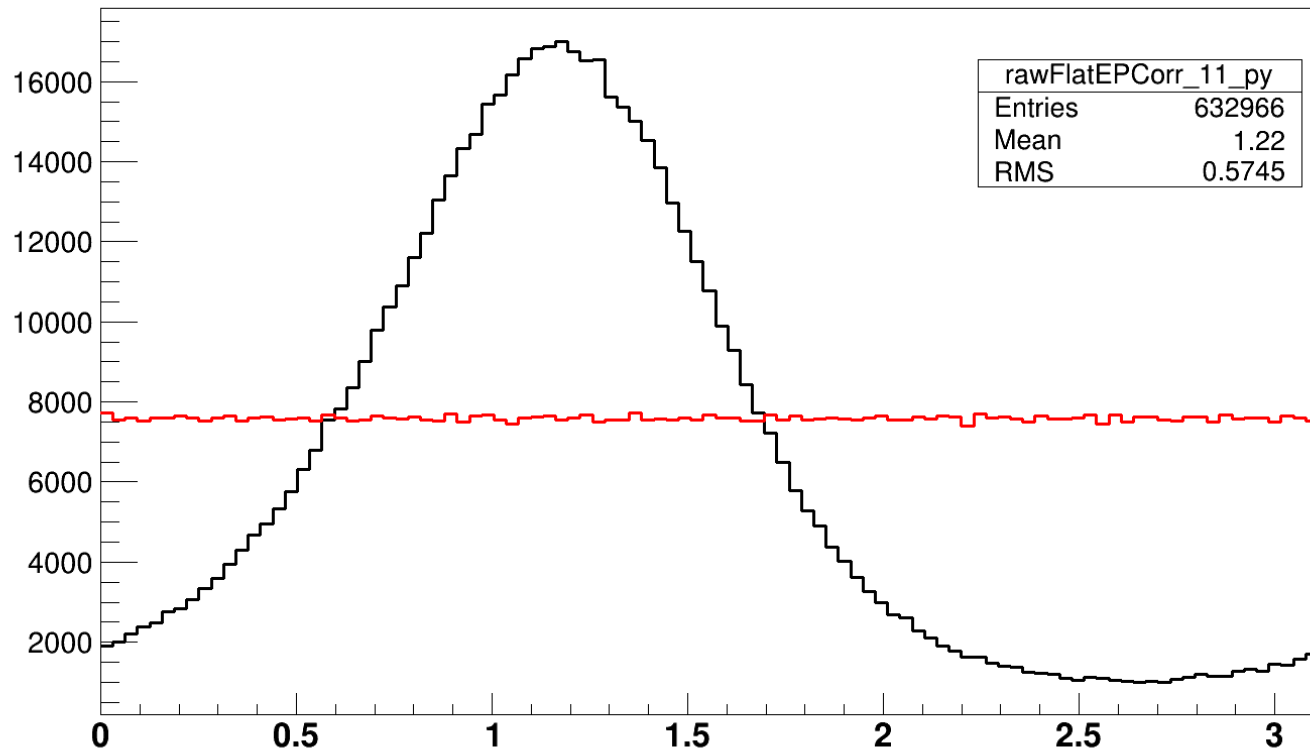
Correction Used: Psi Shift
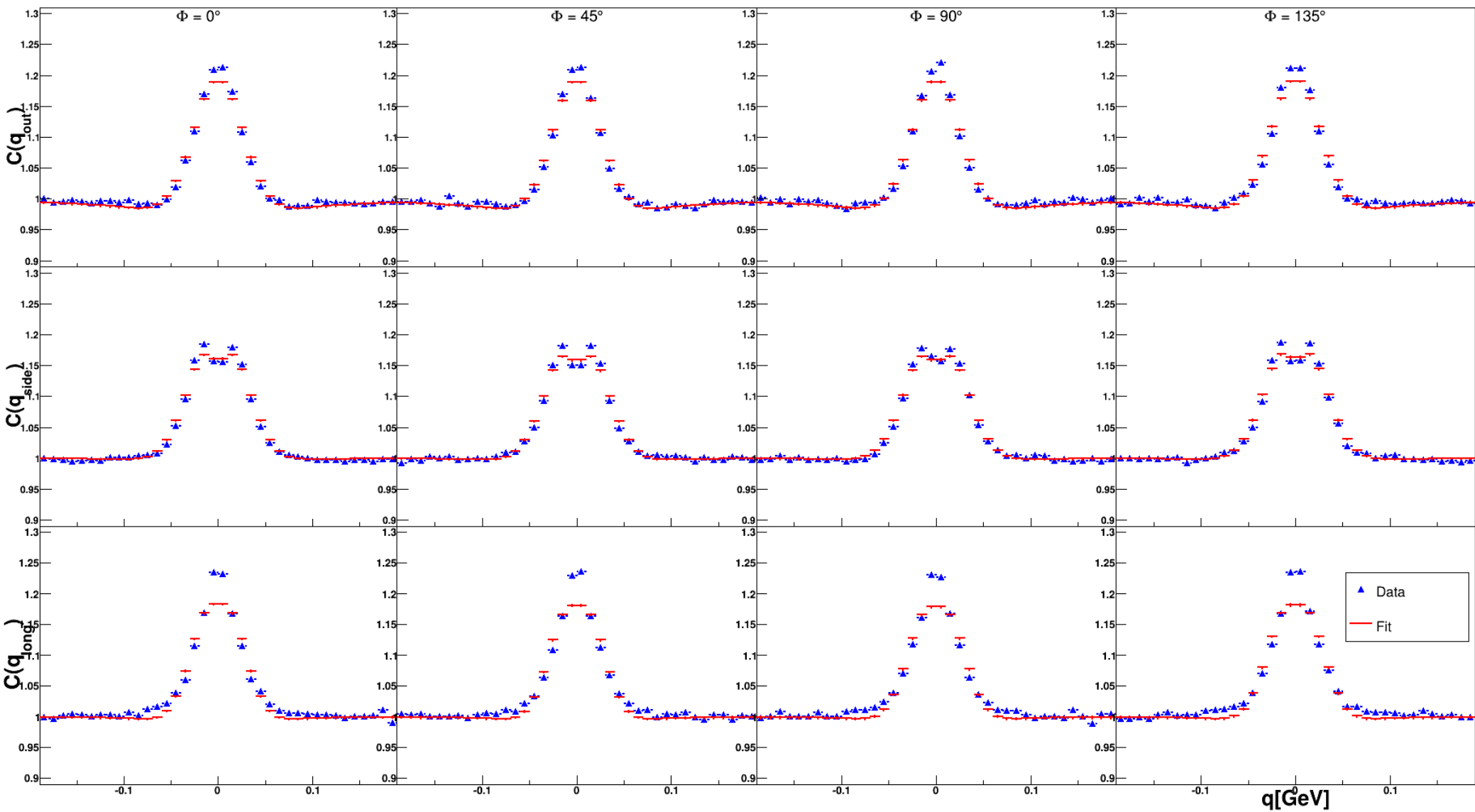
Not yet implemented:
Phi-weight, Recentering

$$\Psi \rightarrow \Psi' = \Psi + \delta(\Psi)$$

$$\delta(\Psi) \equiv \sum_{n=1}^{\infty} \frac{1}{n} [-\langle \sin n\Psi \rangle \cos n\Psi + \langle \cos n\Psi \rangle \sin n\Psi]$$
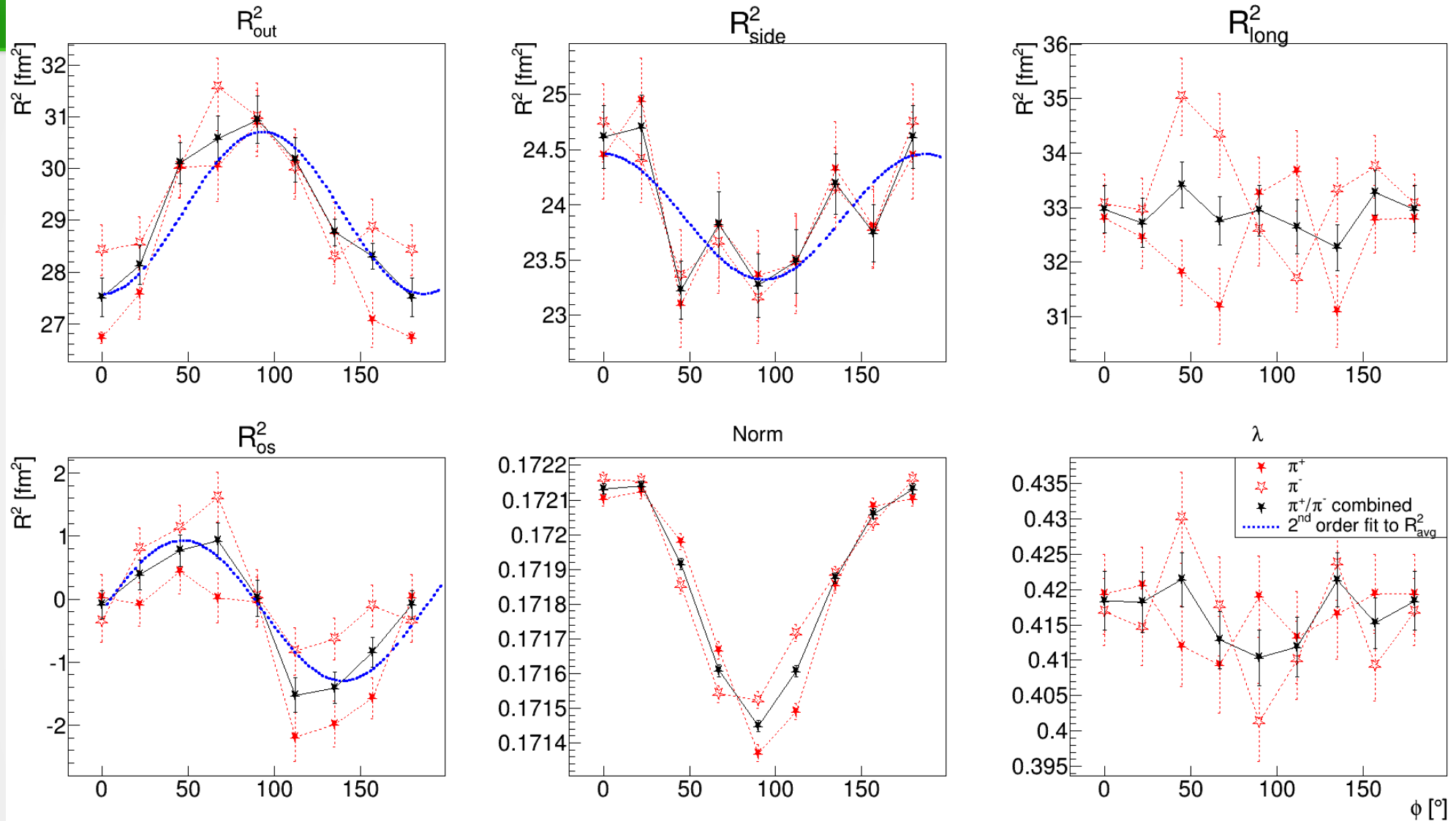
Correlation Functions – π⁺π⁺:90-100% q_2
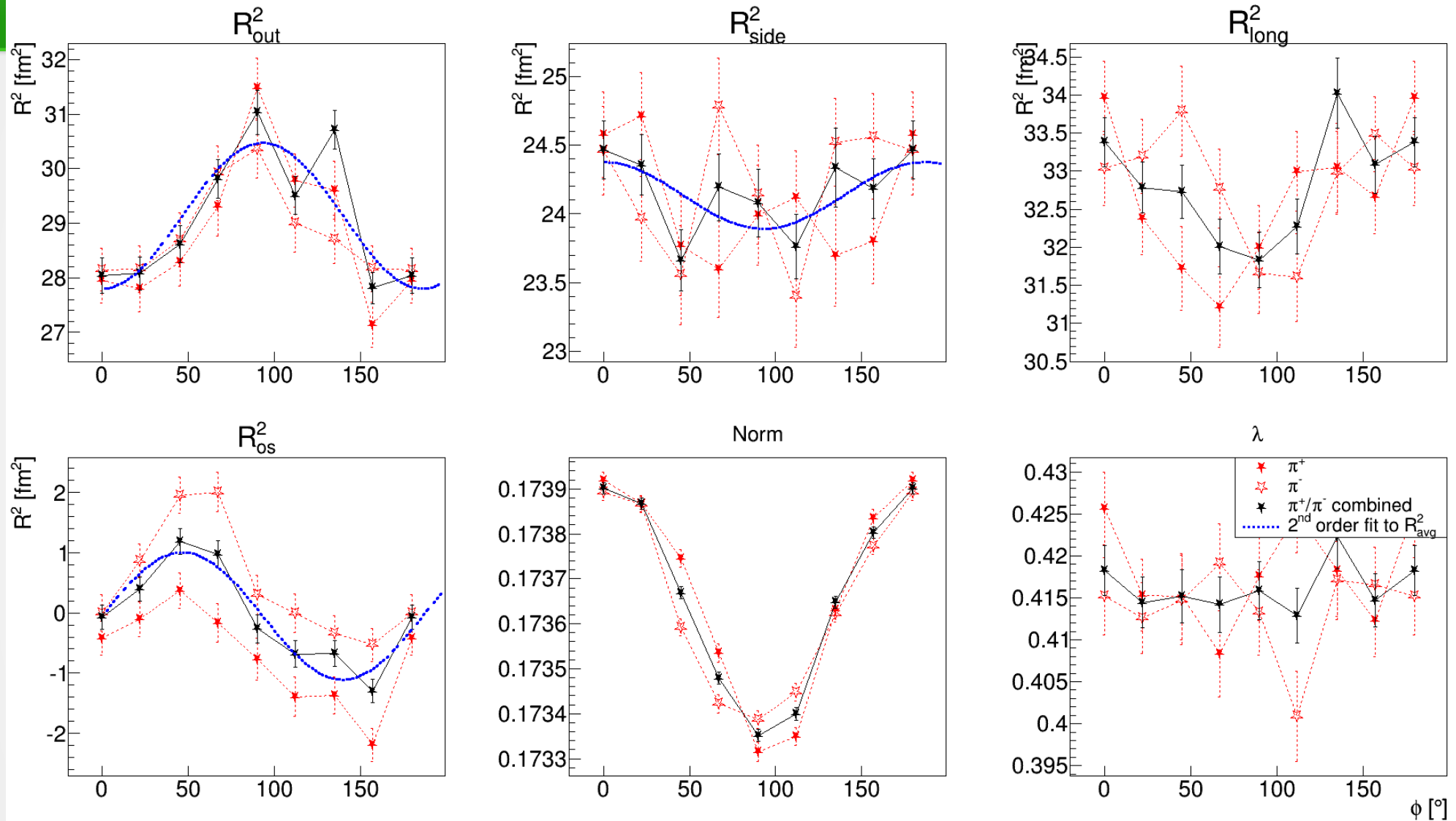
Correlation Functions – π⁻π⁻: 90-100% q_2

Radii are *not* corrected for detector resolution, which damps oscillations.

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R² vs. Φ: 40-50%

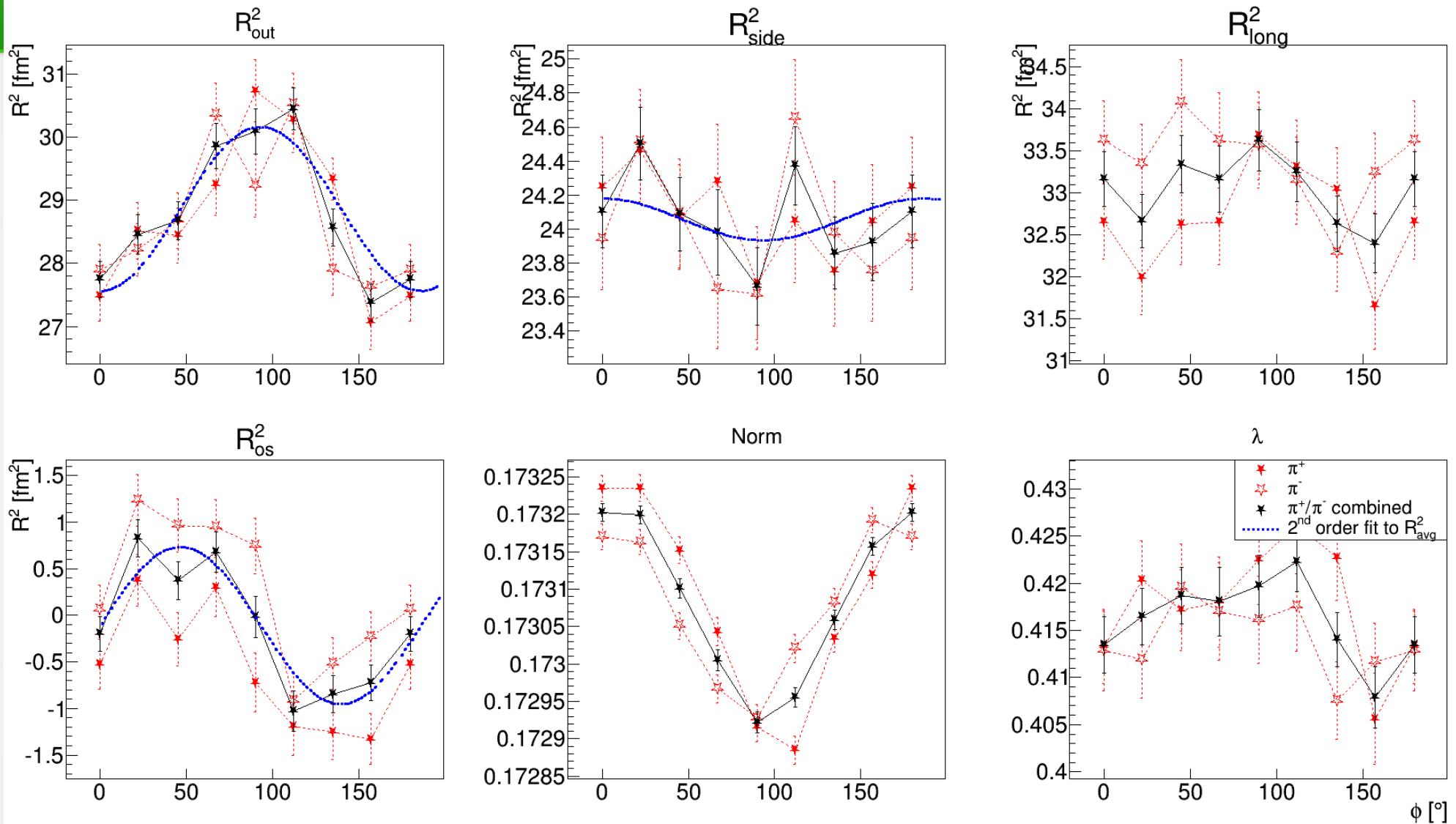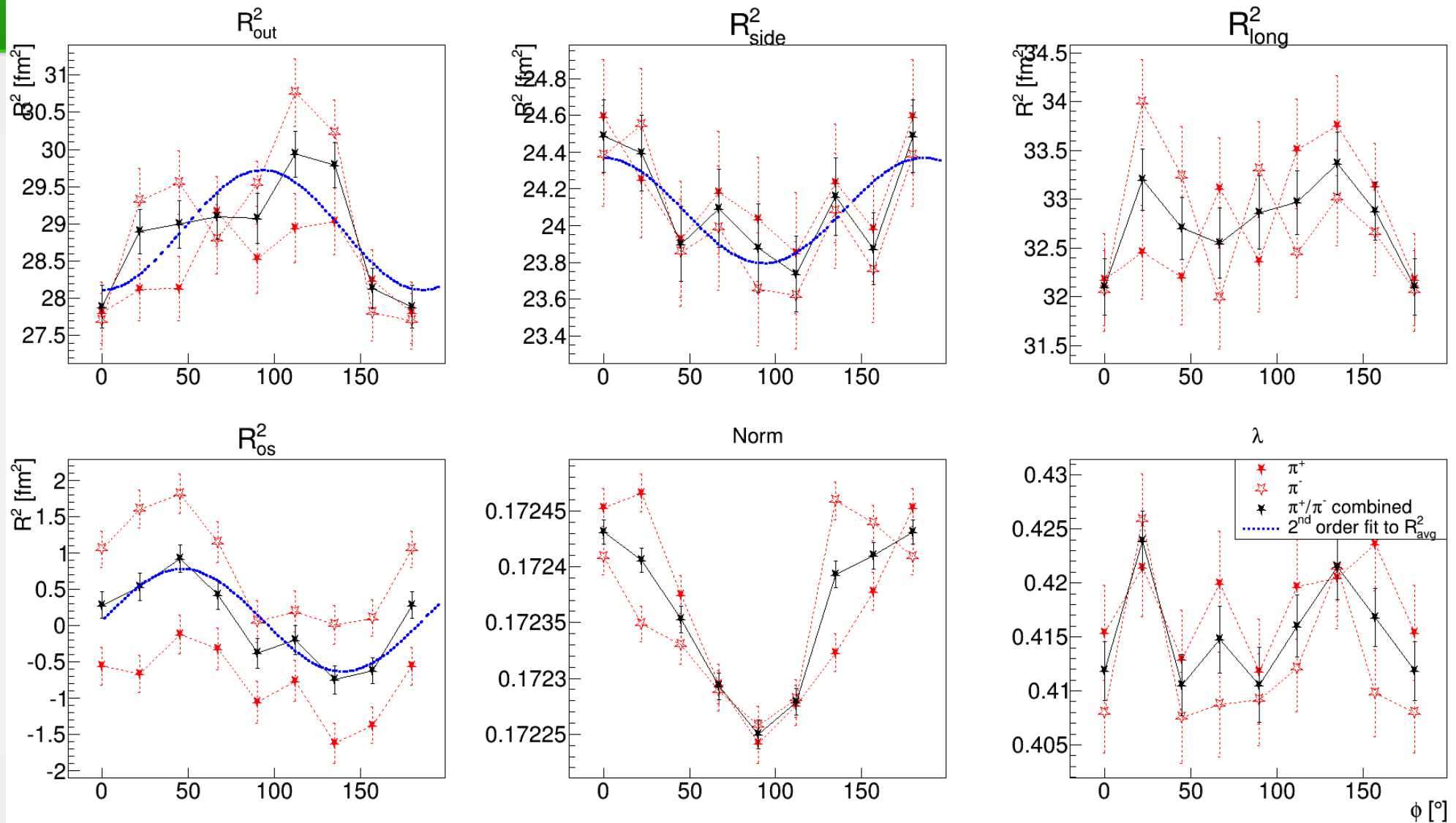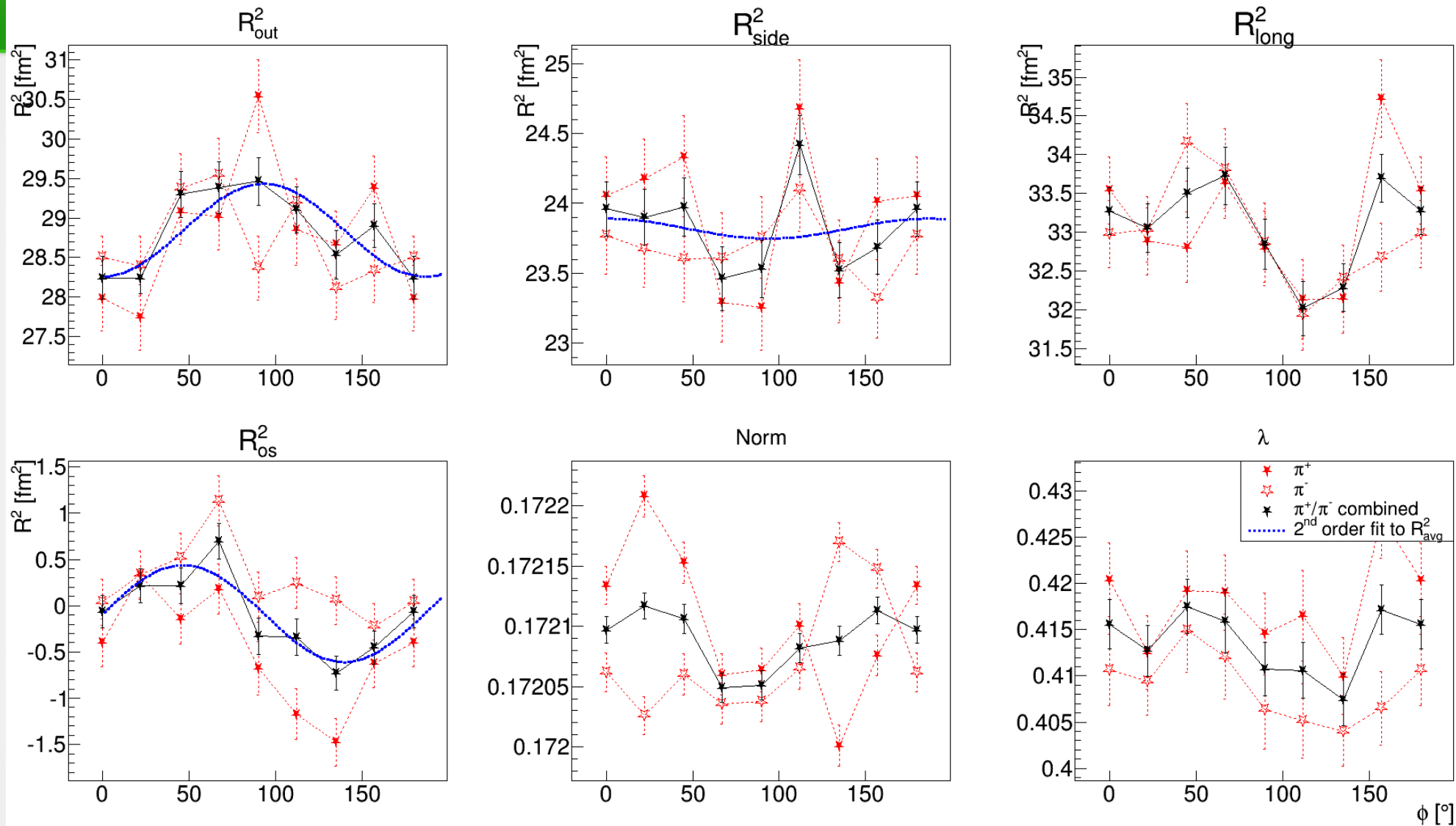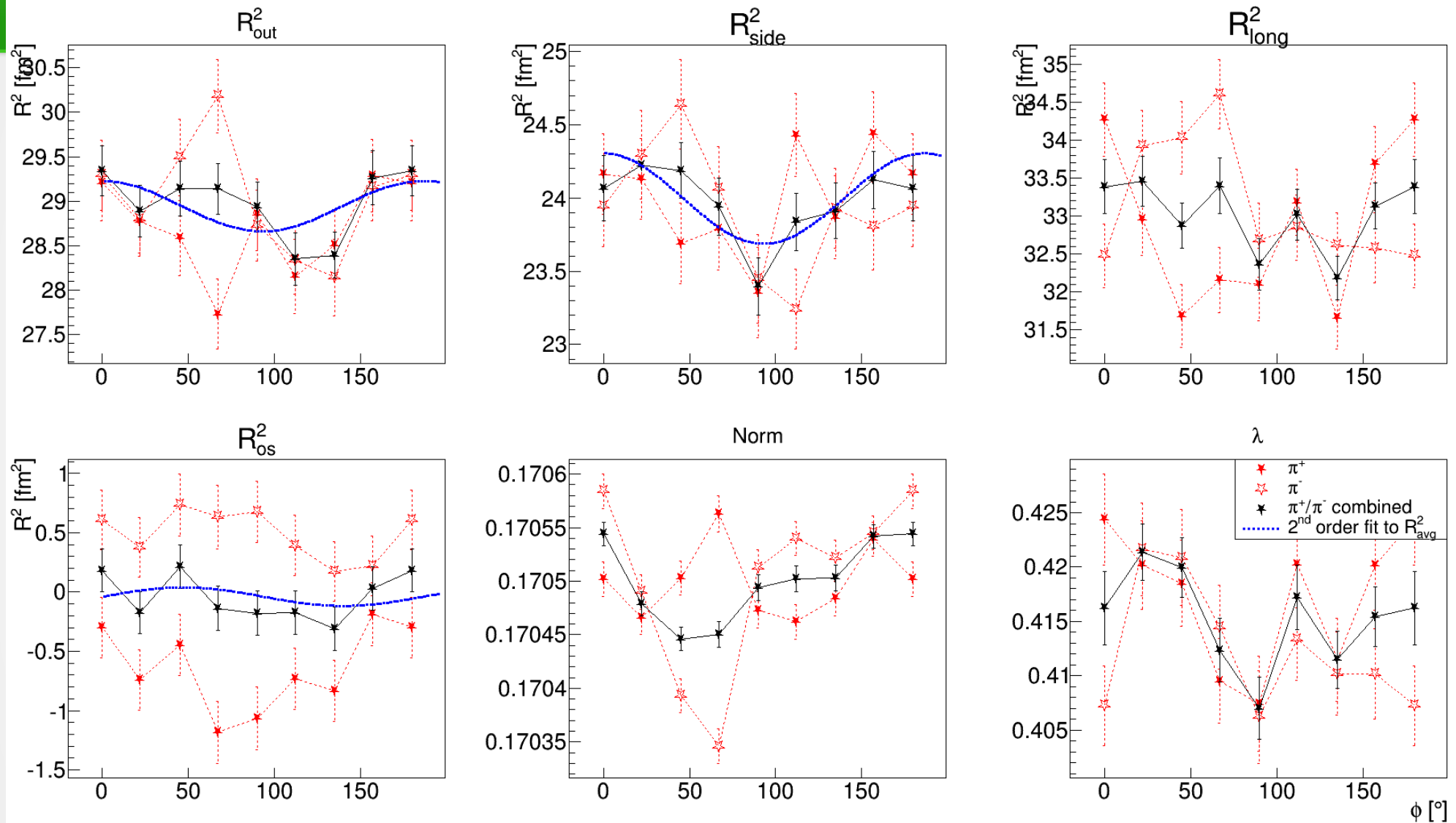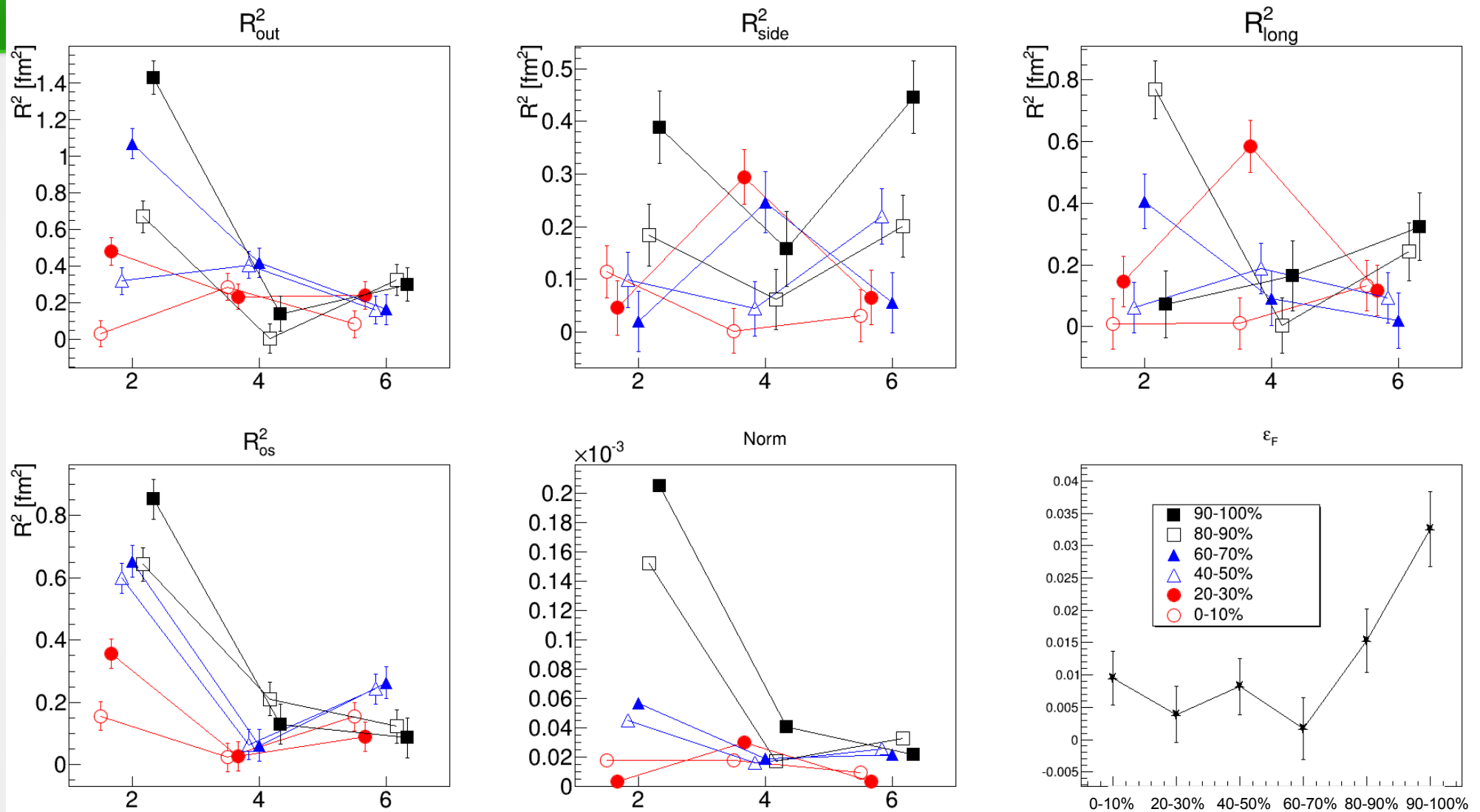Radii are *not* corrected for detector resolution, which damps oscillations.

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R^2 vs. Φ: 0-10%

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R^2(Φ) Fourier Components

Conclusions and Next steps

- Oscillation signal is there (R_{os}!)...

- ... but messy (R_s)

- Highest q_2 bin yields ε_f = 0.033 +/- 0.006 (which will likely increase)

- Corrections $\rightarrow$ Resolution, phi-weight, recentering

- Get/perform Glauber calculations of *initial shape*

- Encourage theorists to calculate predictions of the *final state* size and shape (interest from Heinz group)