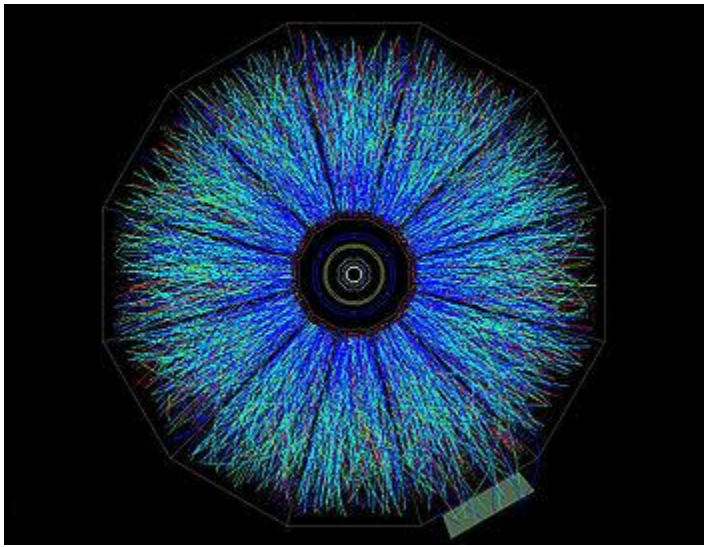
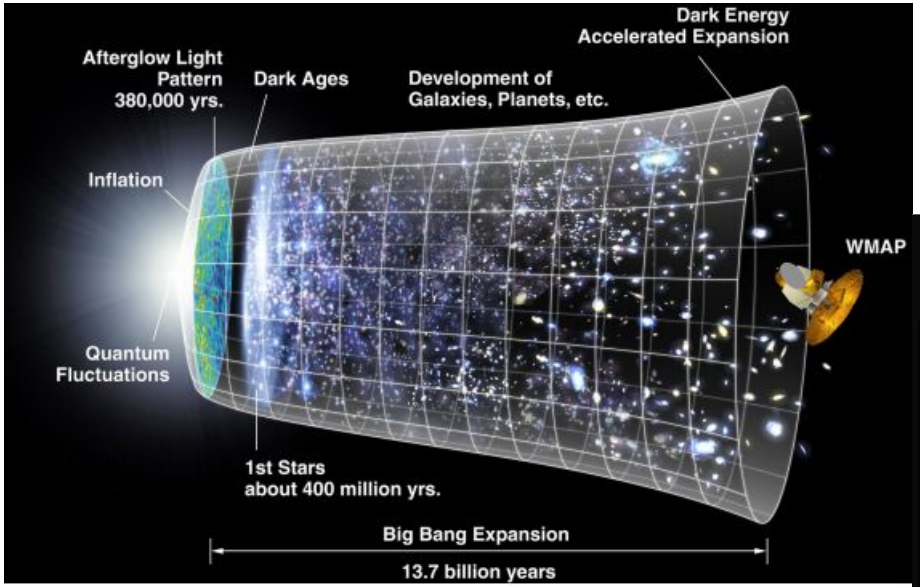
# The Little Bang of High Energy Heavy Ion Collisions

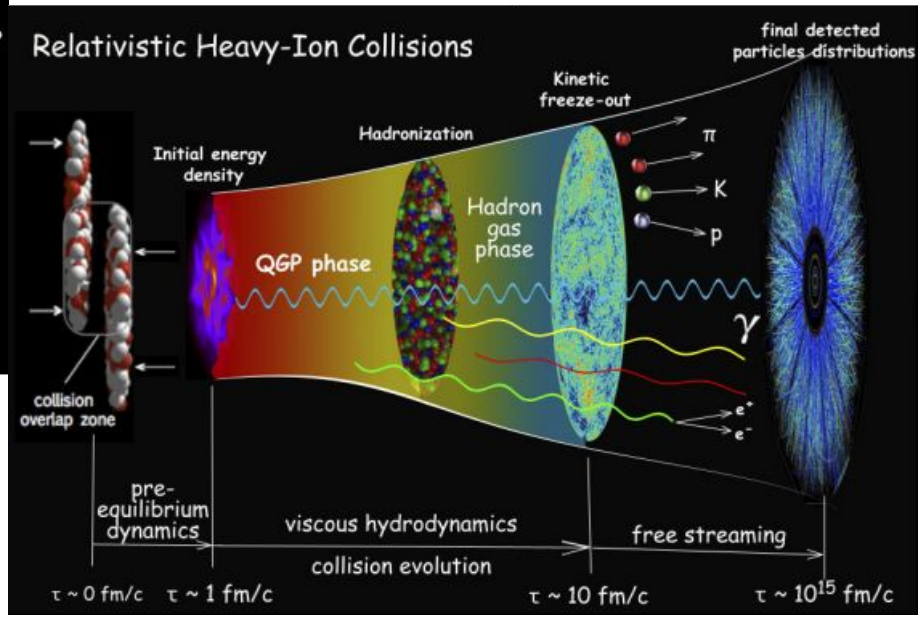


Meera Vieira Machado

Spåtind 2018

# Heavy-Ion collisions vs. Big Bang




**Artist's conception of the evolution of the Big Bang (top left - credit: NASA) and the Little Bang (bottom right - credit: Paul Sorensen and Chun Shen). Image extracted from arXiv:nucl-th/1304.3634.**

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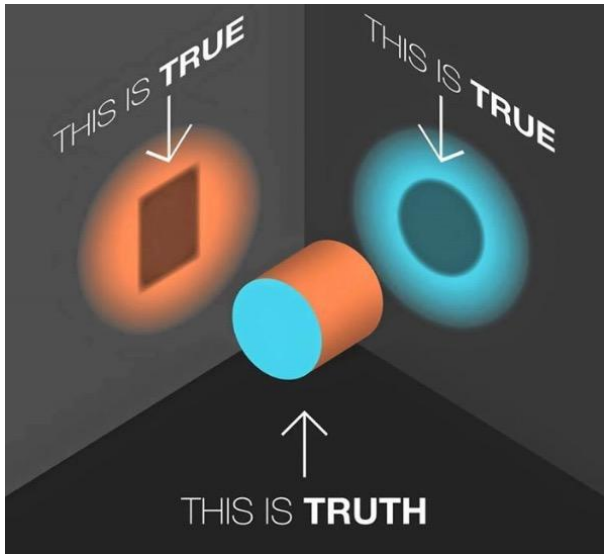
How about a new perspective?



# Map of a single HI event

- **0-5%** centrality, at **5.02 TeV** for pseudorapidity range of $|\eta| < 0.8$;
- $\eta = -\ln\left[\tan\left(\frac{\theta}{2}\right)\right]$;

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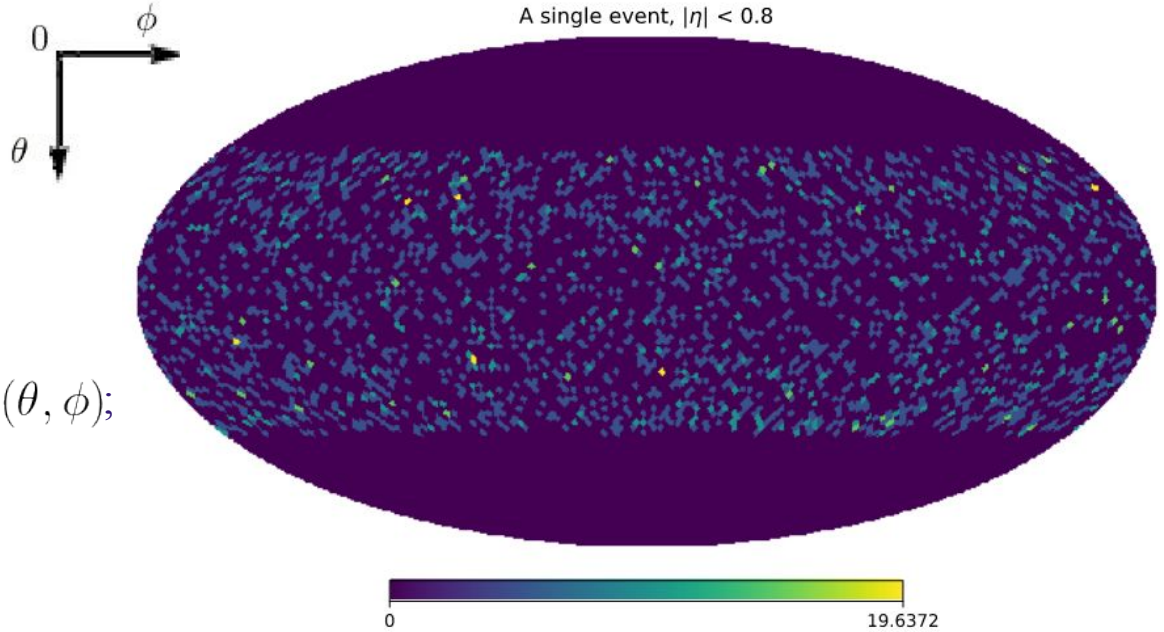
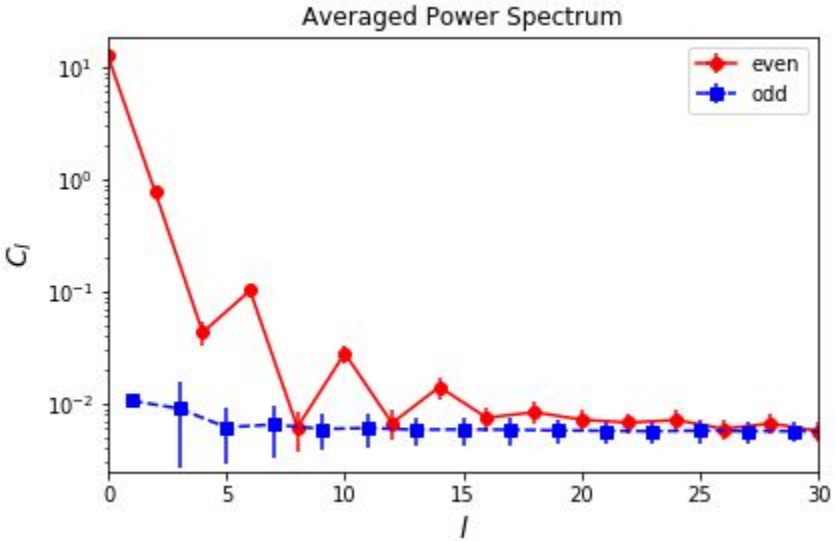
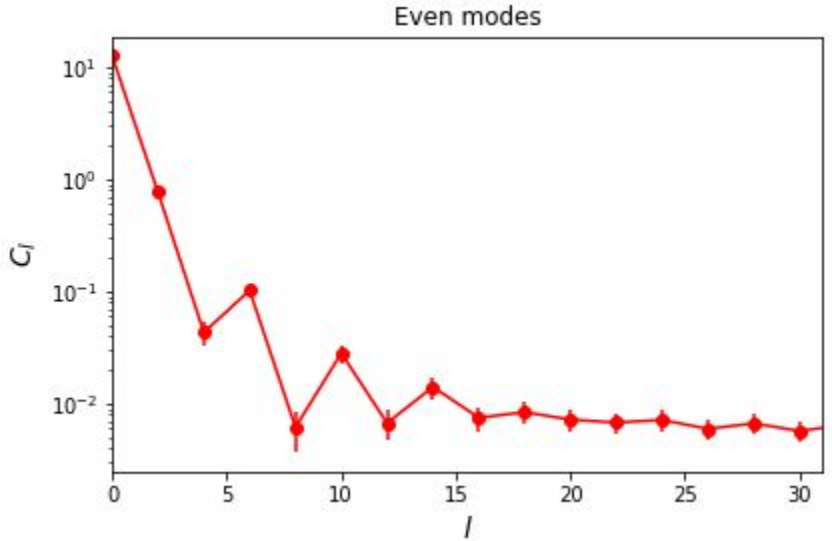
- $\eta = -\ln\left[\tan\left(\frac{\theta}{2}\right)\right]$;
- $f(\theta,\phi) = \sum_{l=0}^{l_{max}} \sum_{m=-l}^{m=l} a_{l,m} Y_{l,m}(\theta,\phi)$;



# Power Spectrum

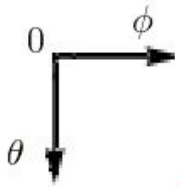


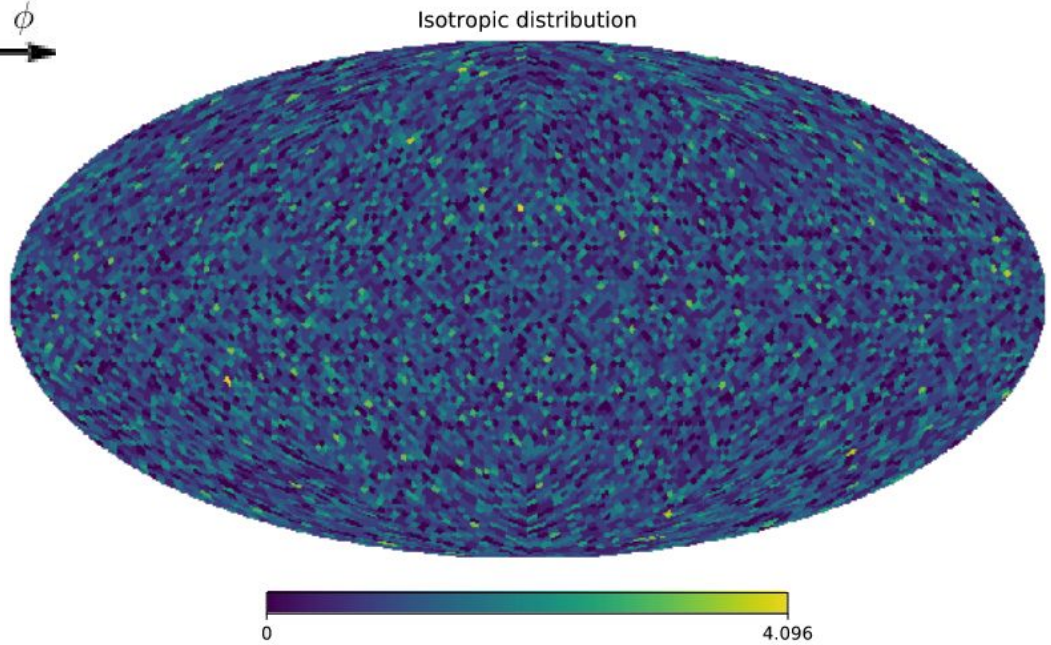



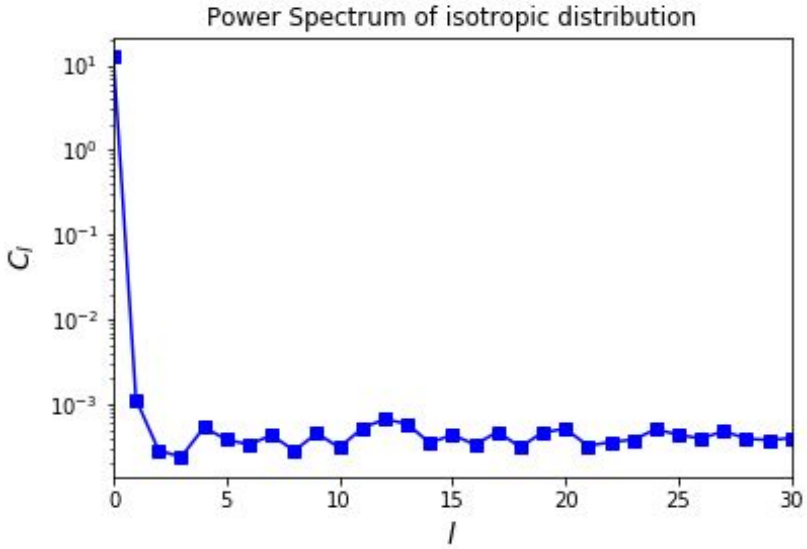

$$C_l = \frac{1}{2l+1} \sum_{m=-l}^{m=l} |a_{l,m}|^2$$

- Averaged over ~4000 events;
- Not enough particles to compute over $l \sim 30$;

# What are the cut effects?



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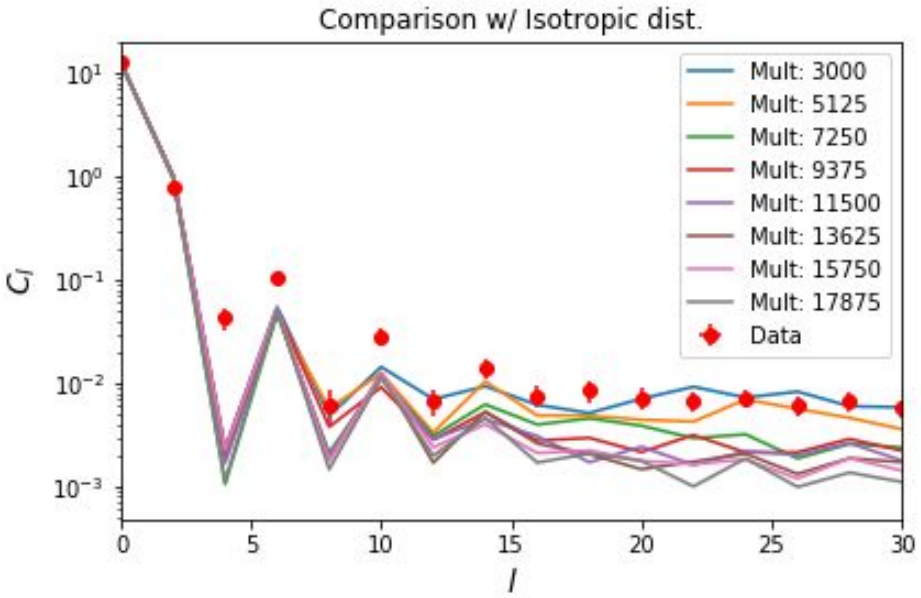
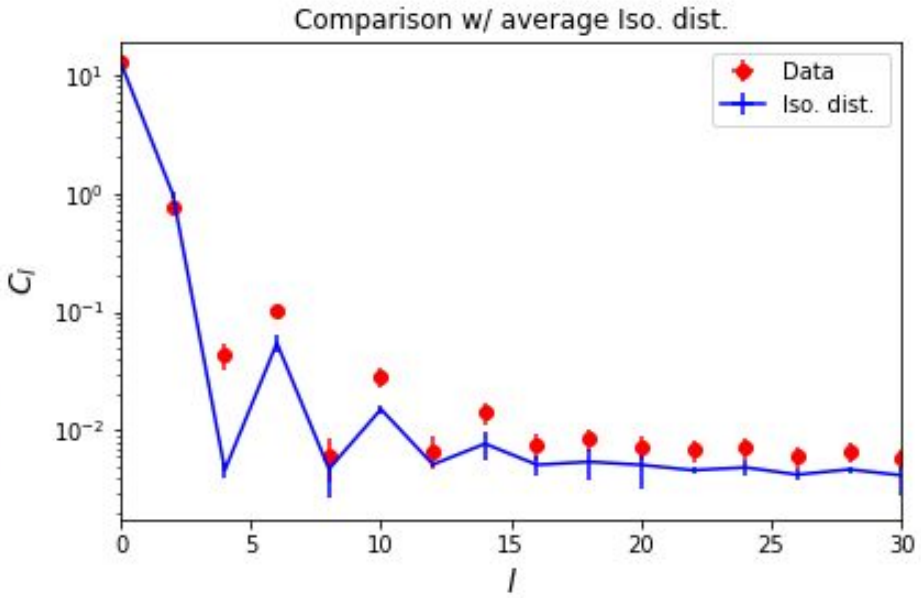
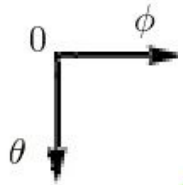


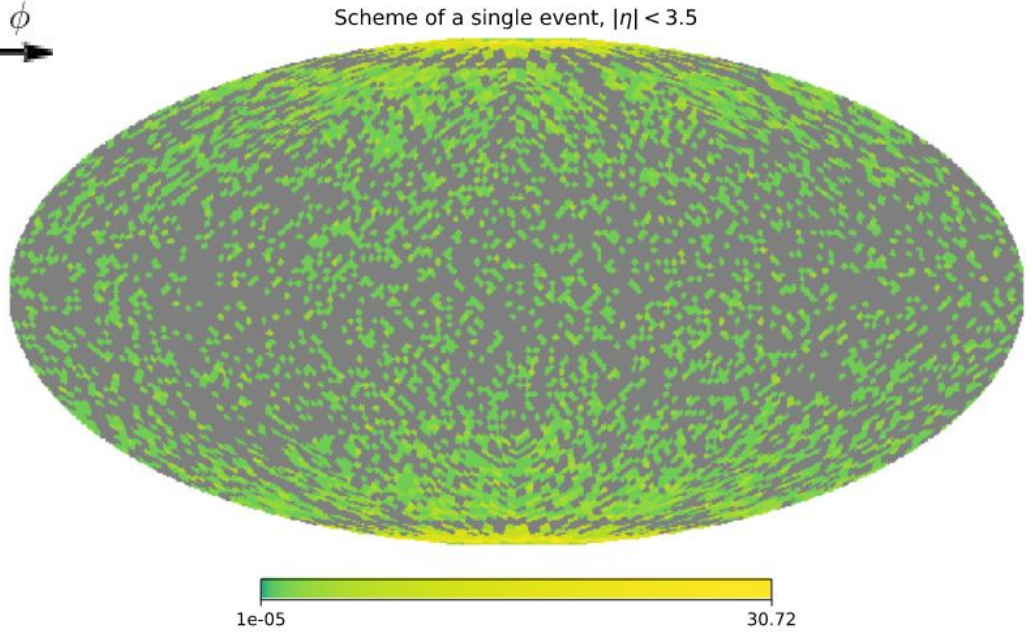



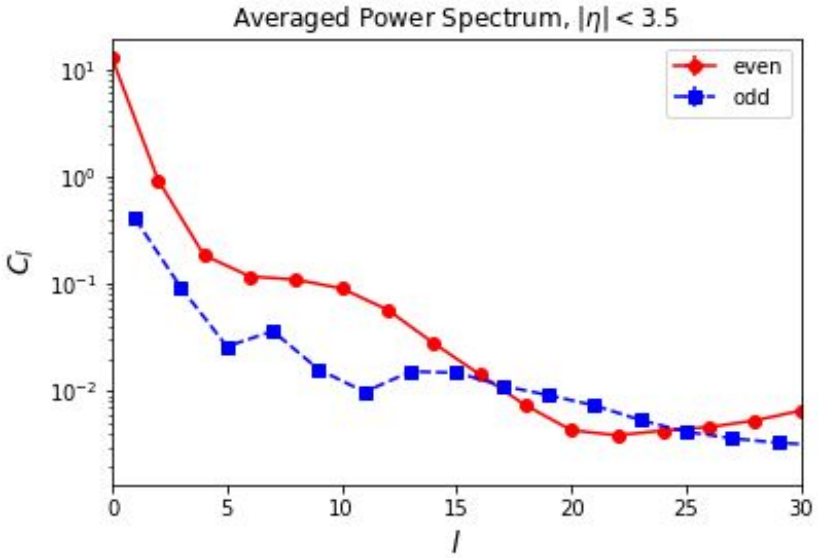

- Particle distributions of central most collisions seem to behave isotropically in the given range!?

# Wider $\eta$ coverage

- For $|\eta| < 3.5$ ($0.06 \lesssim \theta \lesssim 3.08$);



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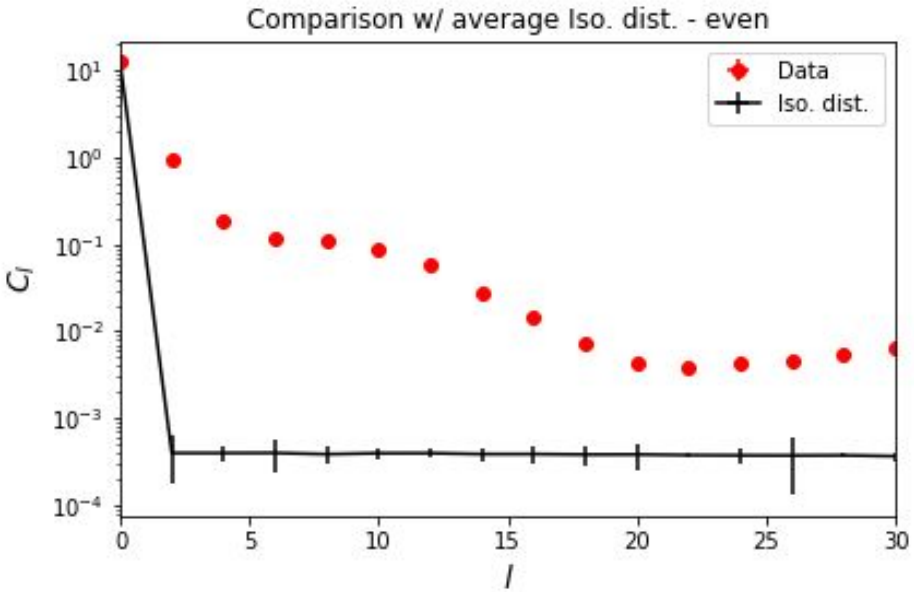
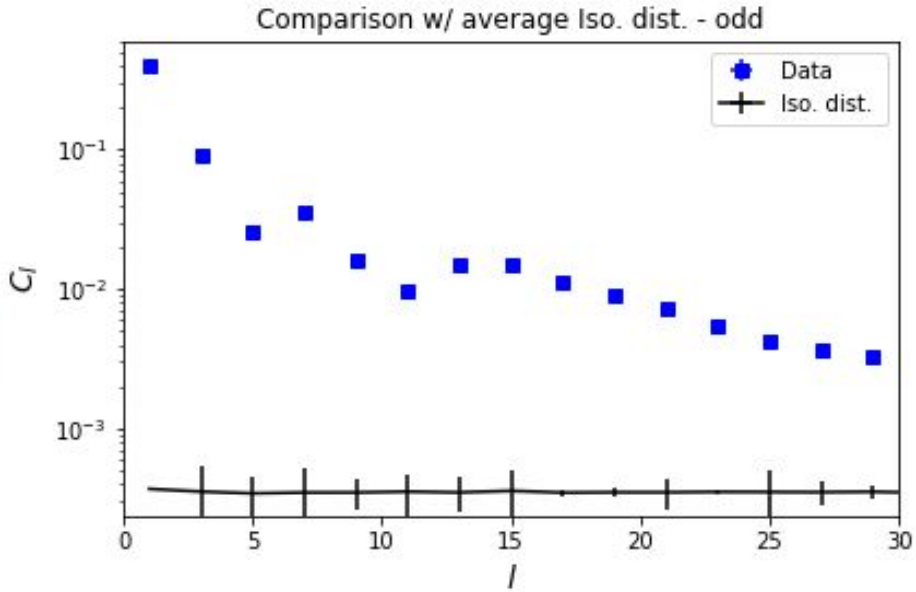


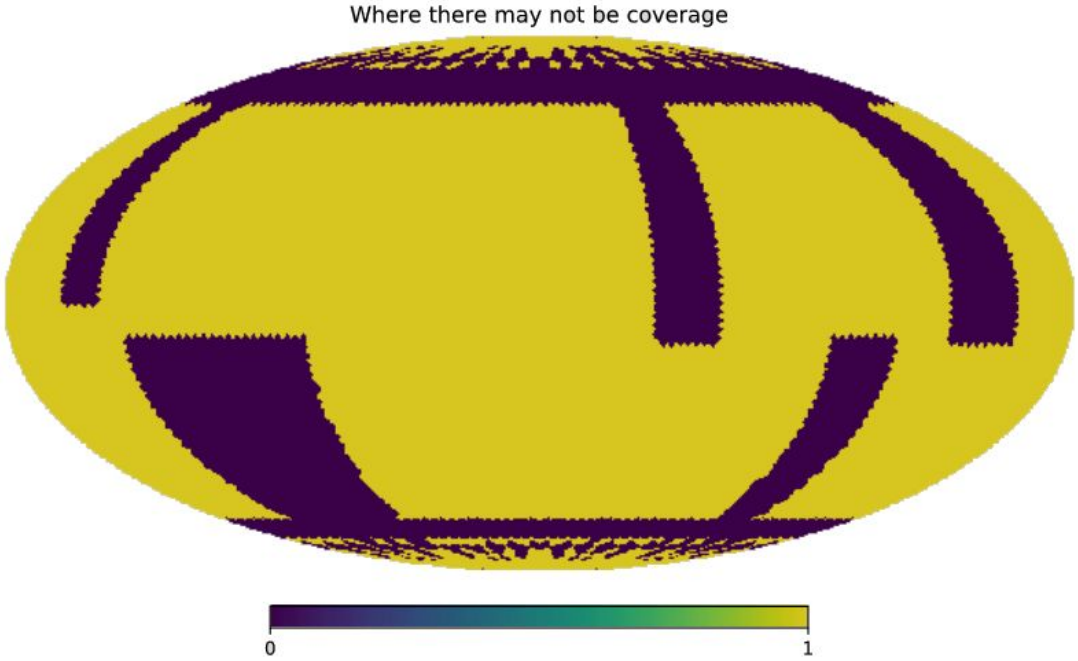




- Back to the comparison with isotropic distributions given $|\eta| < 3.5$;

# Additional effects

- Issue with secondaries (how they would affect the power spectrum?)

- Possible detector failures:
  - Create a mask that mimics possible spots where it might have occured;
  - Apply it to the isotropic distribution.



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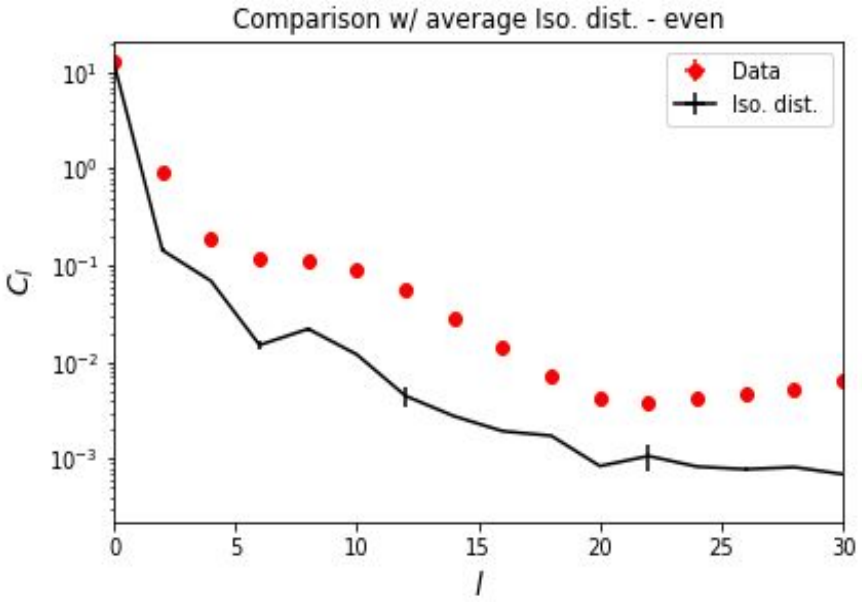


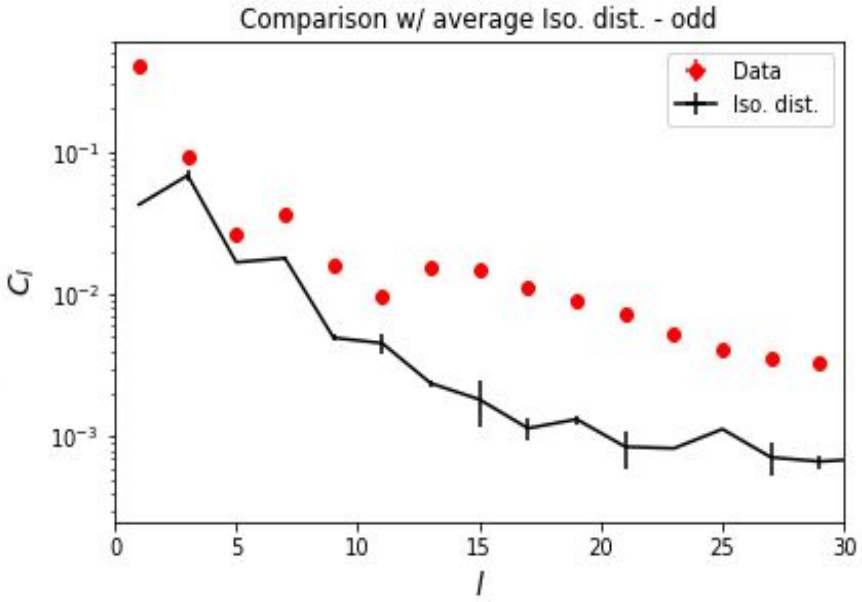


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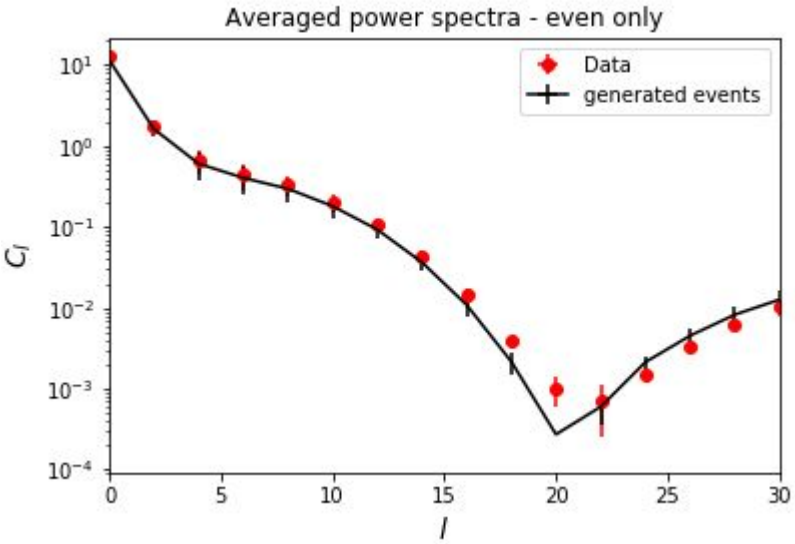


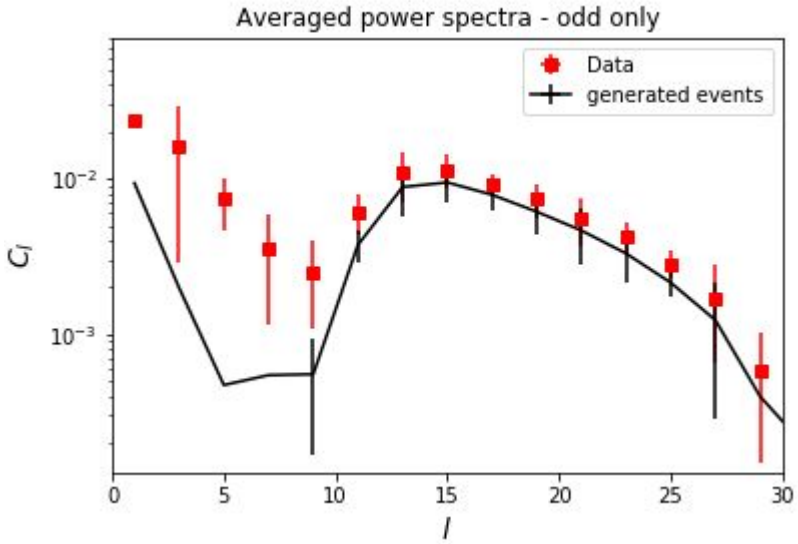


- Distribution in $\theta$ created based on data, whereas distribution in $\varphi$ is random;
- Created from few events;

# It is an ongoing investigation

- Maps and power spectra for other centralities;
  - Flow effects;
  - Event-plane issue;
- Methods for reconstruction of power spectrum (e.g. adaptive topological window);
- Effects of jets (require computation of $p_T$ maps);
- What can the “true” power spectrum tell us? Could we see turbulence?
- And even more...

# Thank you!

# References


- Title image: http://www.thefullwiki.org/QGP;
- Image about perspective: http://www.maggiehosmcgrane.com/2015/08/perspective-and-empathy.html;
- All data was provided by ALICE collaboration members.