

Correlation of flow coefficients measured in Au+Au collisions at 1.23 AGeV with HADES



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for the HADES-Collaboration

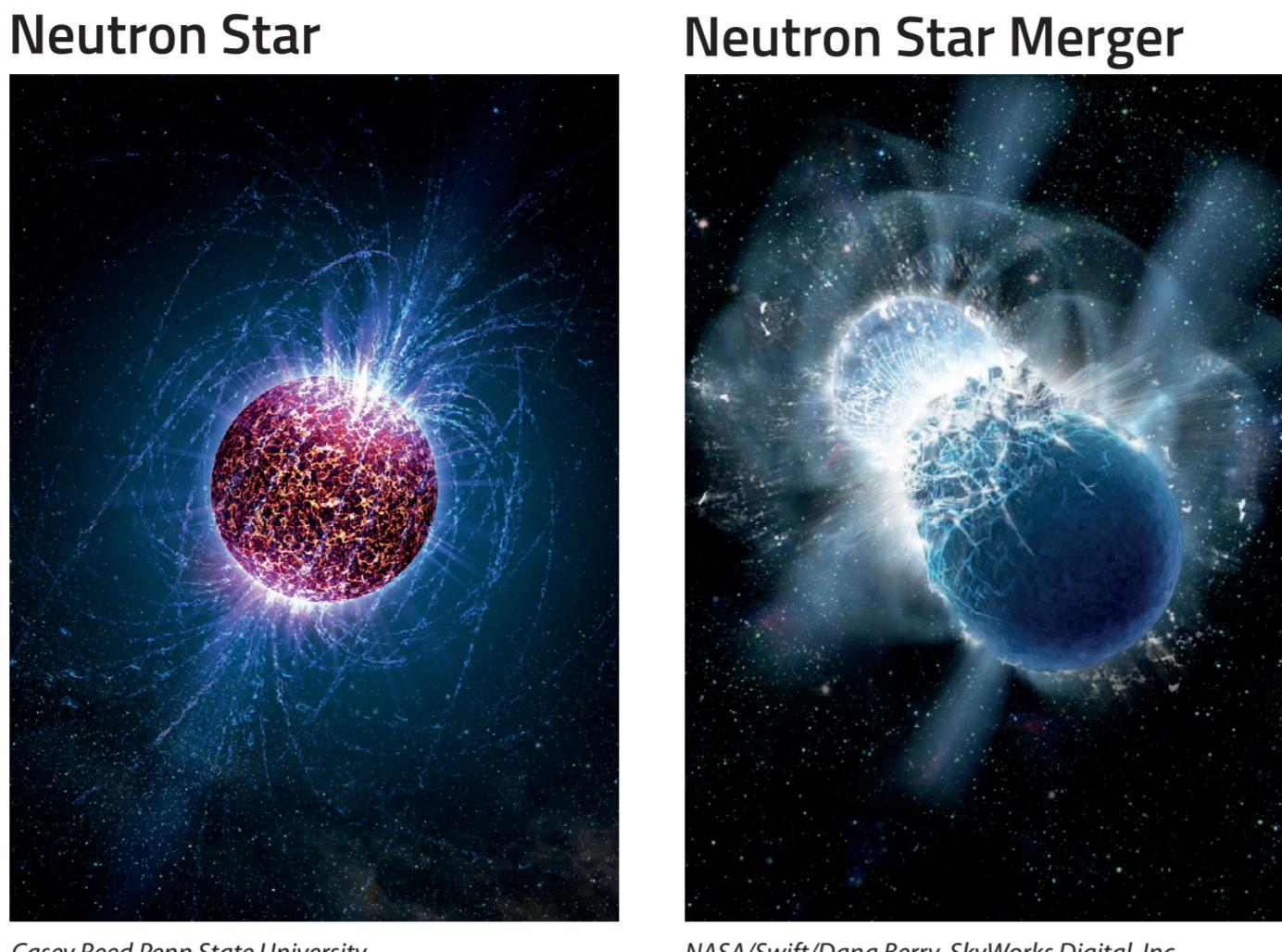
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Motivation

Heavy-ion collisions allow to investigate the properties of strongly interacting matter under extreme conditions, such as its equation-of-state (EOS).

Thus, they provide information which is also relevant for the understanding of neutron star mergers.

In particular the measurement of collective flow effects is decisive in this context.



Casey Reed/Penn State University



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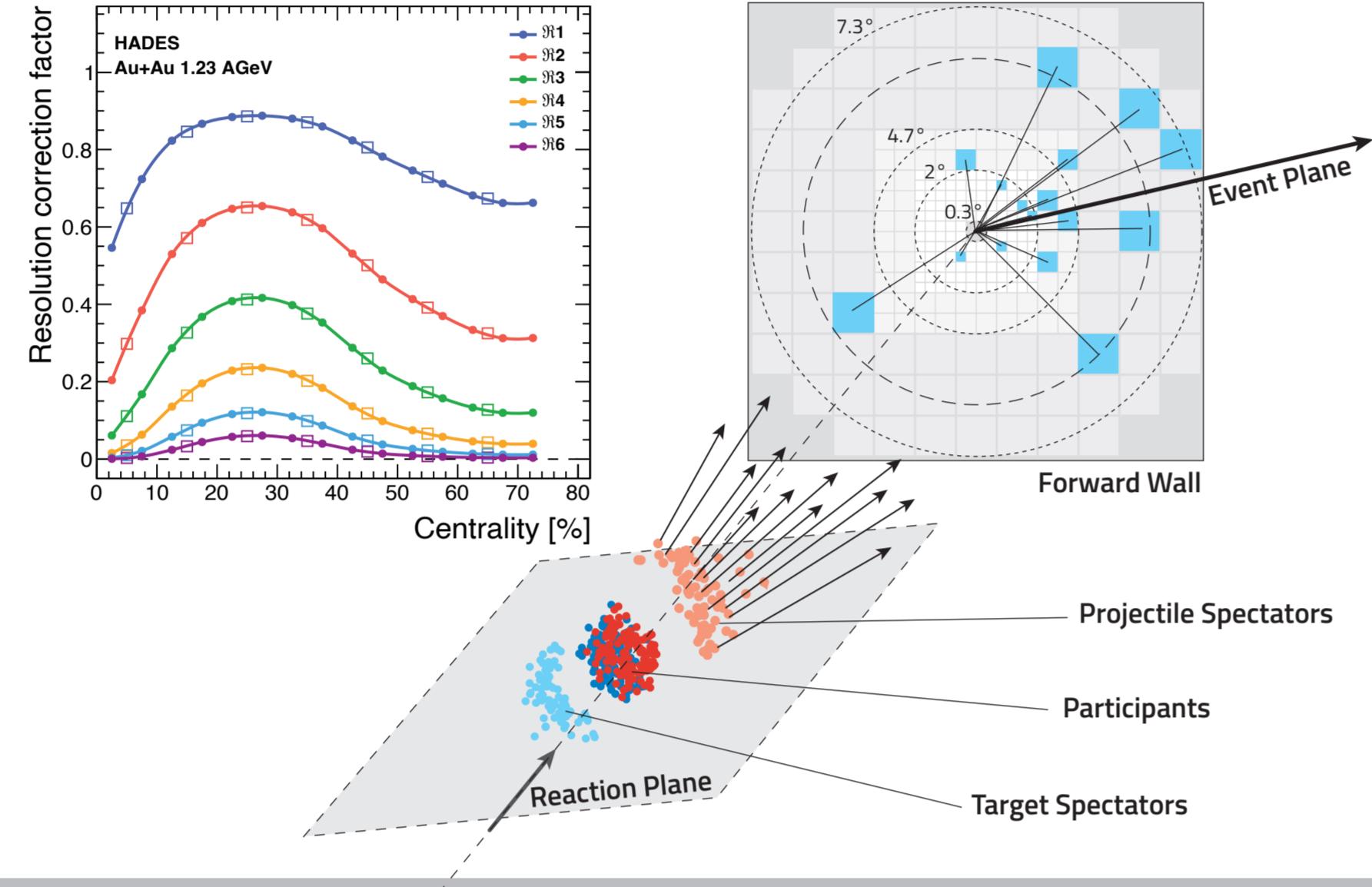
Method

The flow coefficients v_n of protons [1,2] are defined relative to event plane angle of the first order:

$$v_n^{obs} = \langle \cos[n(\varphi - \psi_{EP})] \rangle$$

They are corrected for the corresponding event plane resolution:

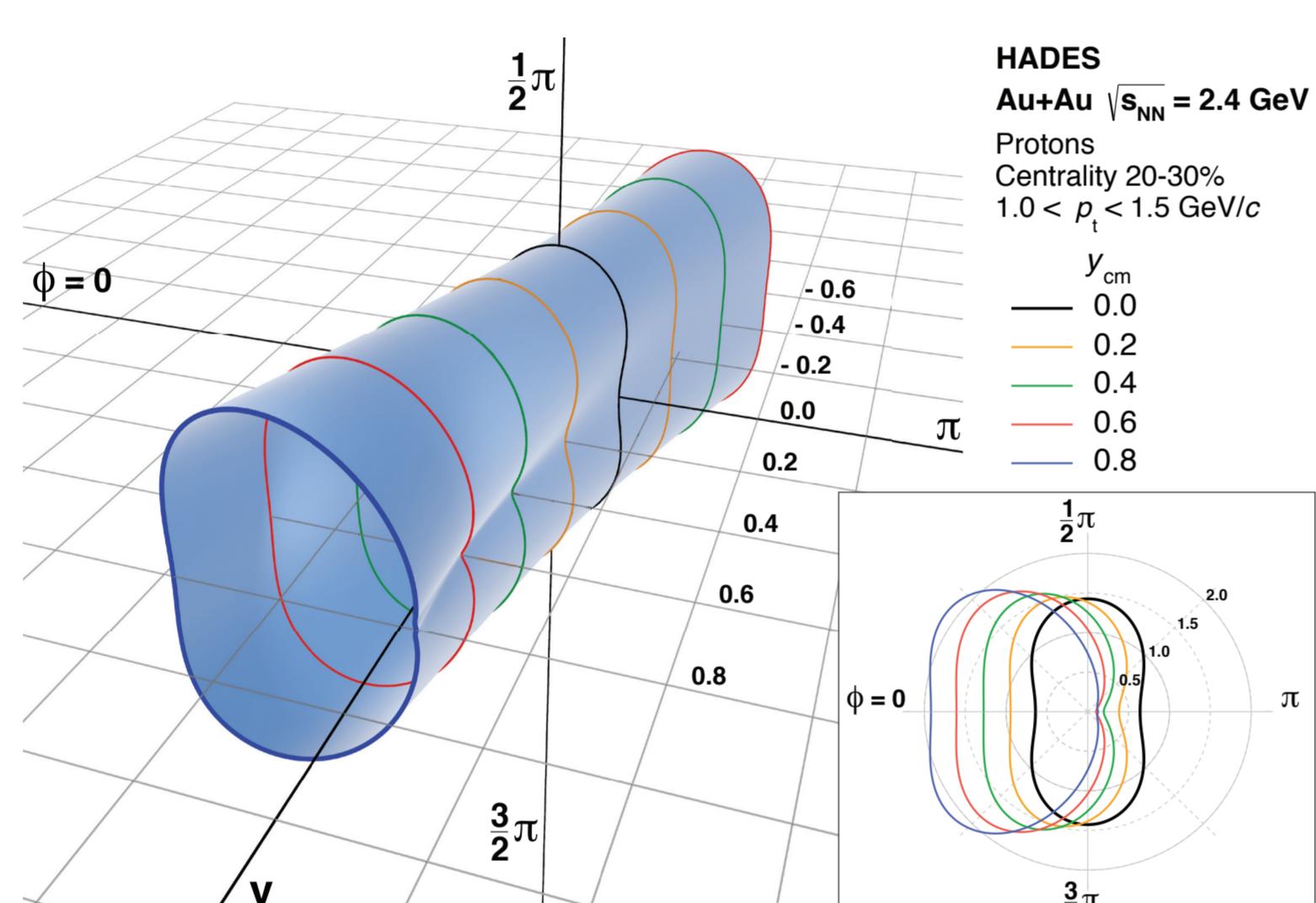
$$v_n = v_n^{obs} / \Re_n$$



Multi-differential Flow Analysis

The high event statistics collected for Au+Au at 1.23 AGeV allows for a multi-differential analysis of flow coefficients of the orders $n = 1 - 6$, covering a large region of phase space and for several intervals of reaction centrality.

This provides the possibility to characterize the particle production in heavy-ion collisions as a full 3D-picture in momentum space [2].

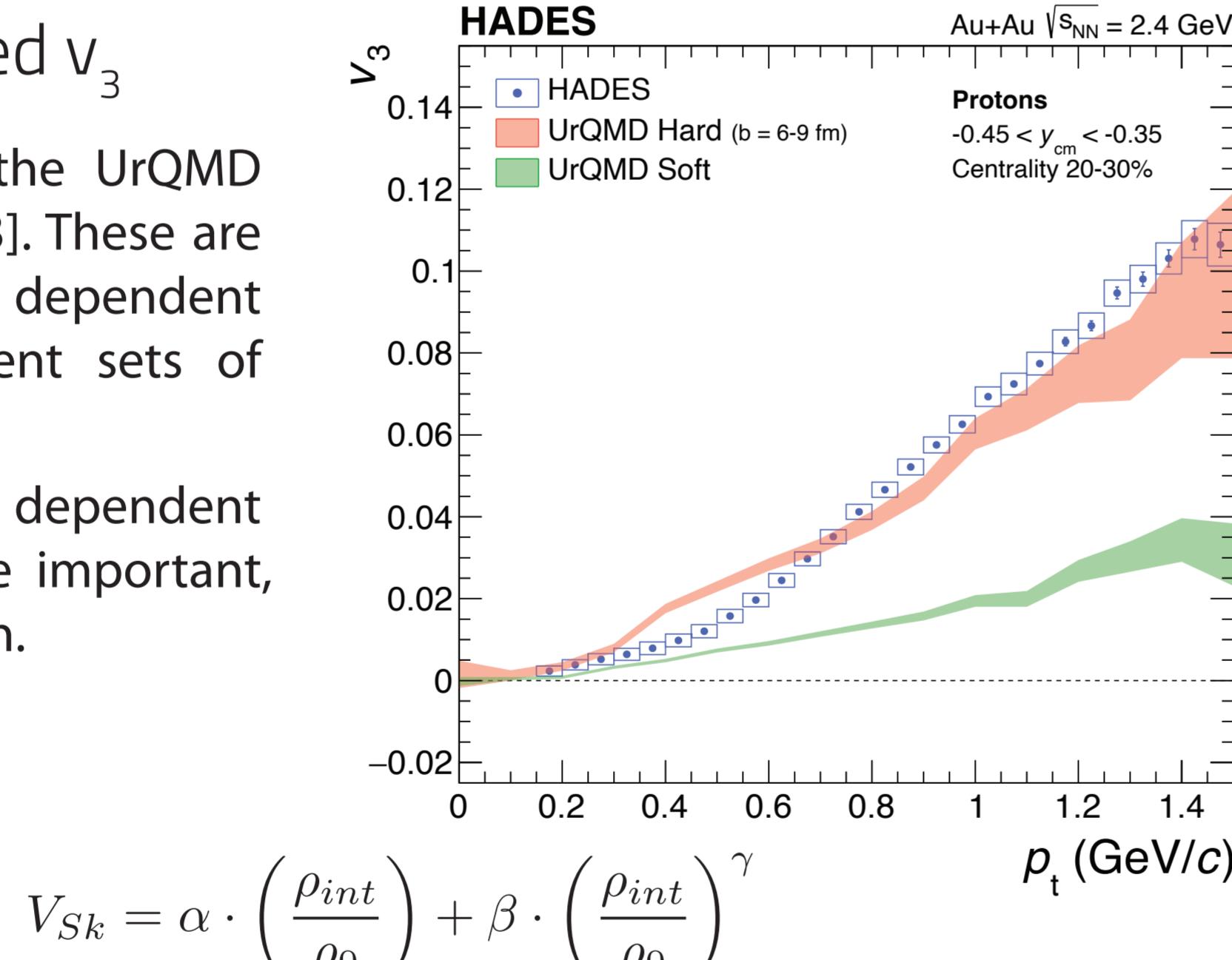


Model comparison integrated v_3

Comparisons with predictions by the UrQMD model based on two different EOS[3]. These are implemented via a baryon density dependent Skyrme-potential using two different sets of parameters.

Effects of momentum and isospin dependent potentials are, which might also be important, not included in this model calculation.

Parameters	Hard	Soft
α [MeV]	-124	-356
β [MeV]	71	303
γ	2.00	1.17



Conclusion

- Correlations between the flow coefficients v_1 , v_3 and v_4 and the event-wise v_2 have been studied.
- The triangular flow exhibits a high sensitivity to the equation-of-state of dense nuclear matter.

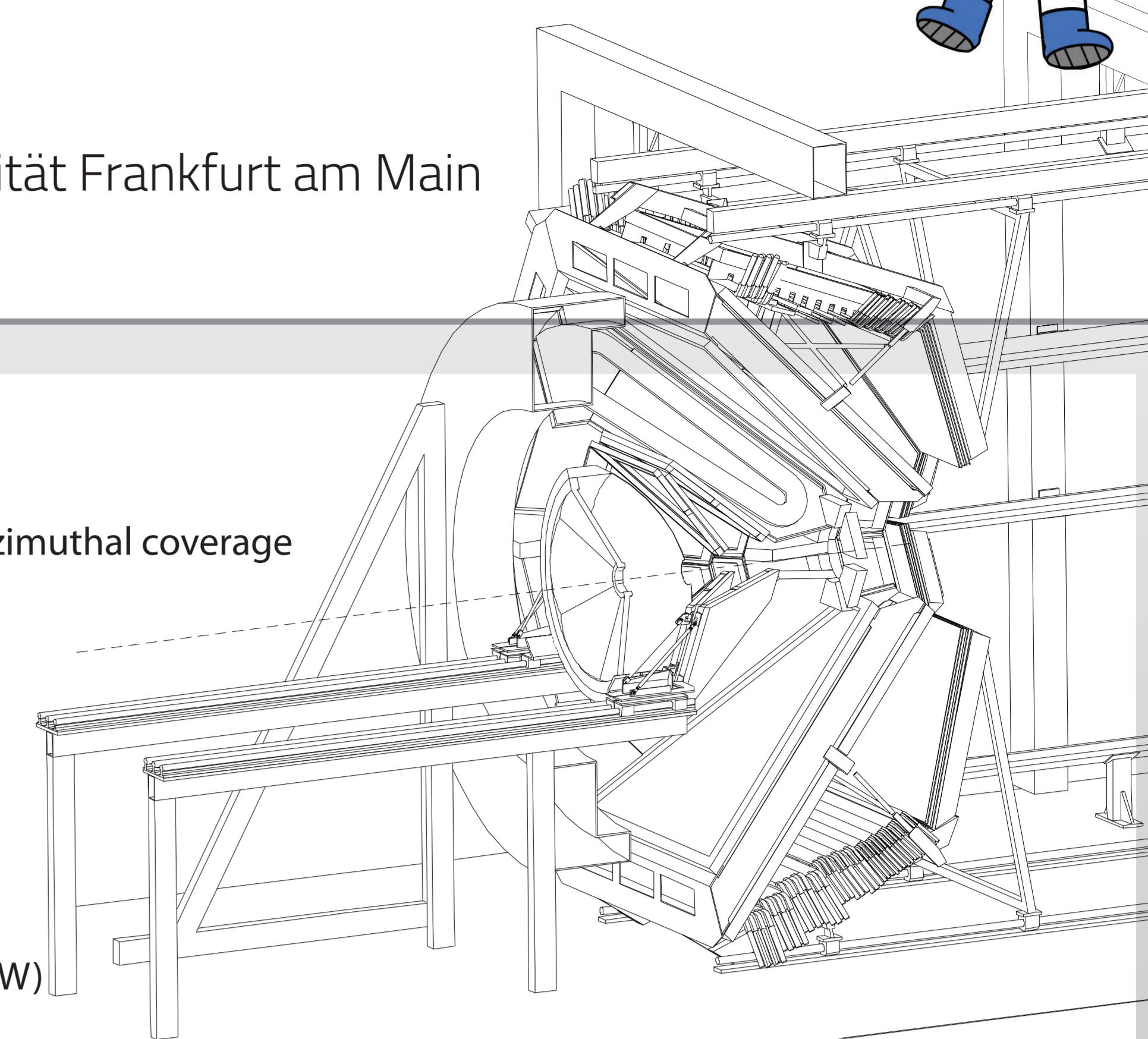
- Investigation of proton-multiplicity dependent systematic effects to be done.
- The analysis of Ag+Ag data at $\sqrt{s_{NN}} = 2.55$ GeV is on-going.

References
[1] HADES, Eur.Phys.J.A 59 (2023) 4, 80
[2] HADES, Phys.Rev.Lett. 125 (2020) 262301

[3] P. Hillmann et al. (UrQMD), J.Phys. G45 (2018) no.8, 085101
[4] T. Reichert et al. (UrQMD), EPJ C 82 (2022) 510
[5] T. Reichert et al. (UrQMD), Phys.Lett.B 841 (2023) 137947

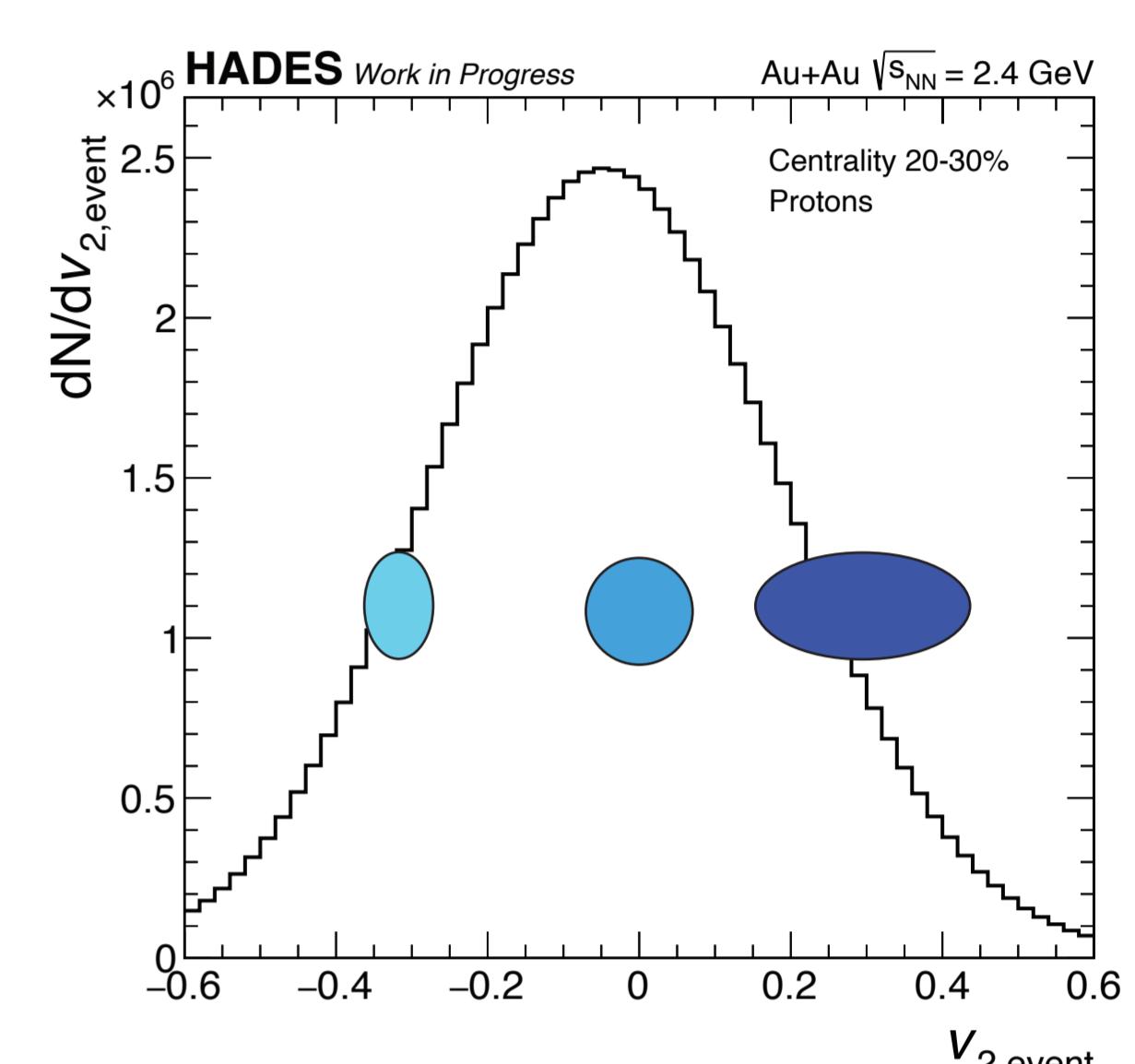
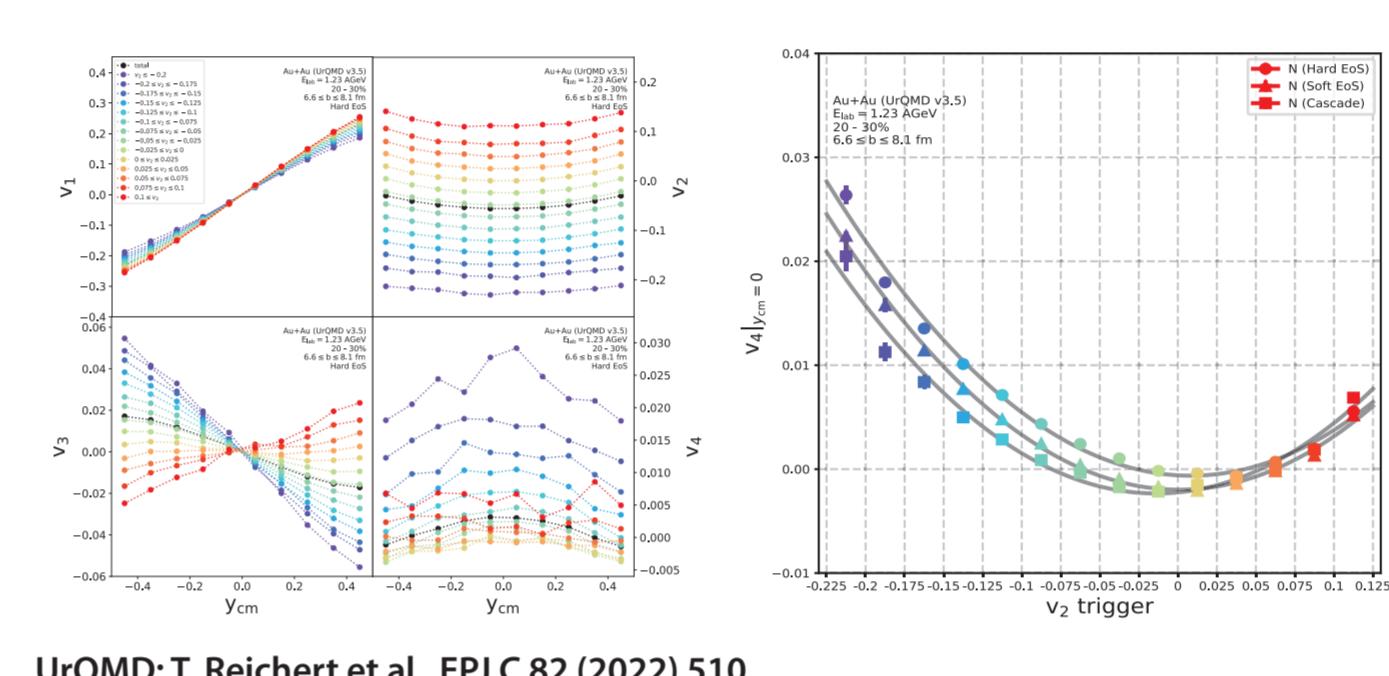
HADES - Detector

- Large acceptance with almost full azimuthal coverage
- Polar angle coverage: $18^\circ - 85^\circ$
- Low-mass drift chambers (MDC)
- Superconducting toroidal magnet
- CVD diamond START detector
- Ring imaging Cherenkov detector
- Time-of-flight walls (TOF and RPC)
- Small angle spectator hodoscope (FW)

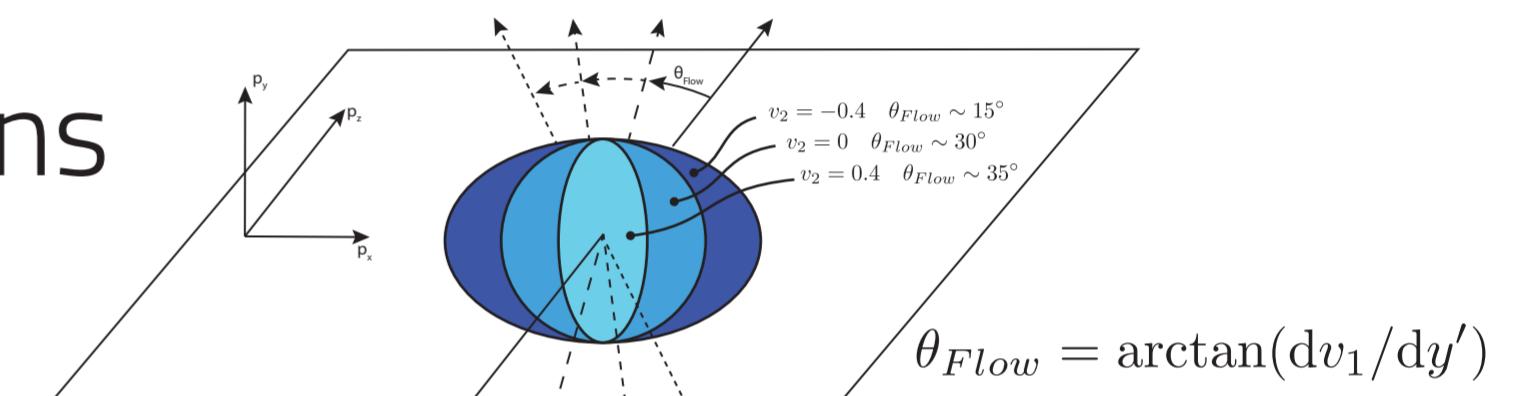


Event Ellipticity Classes

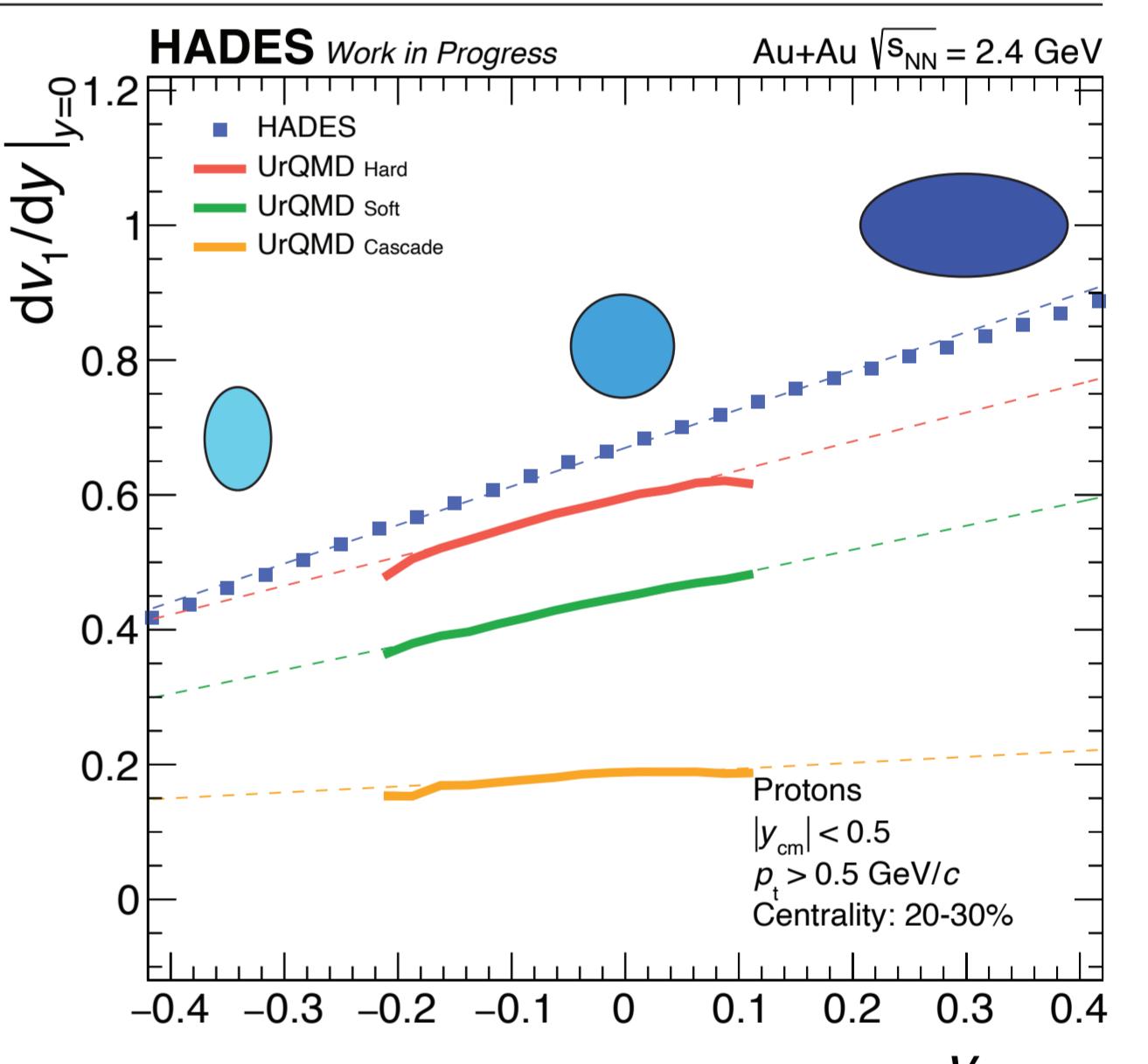
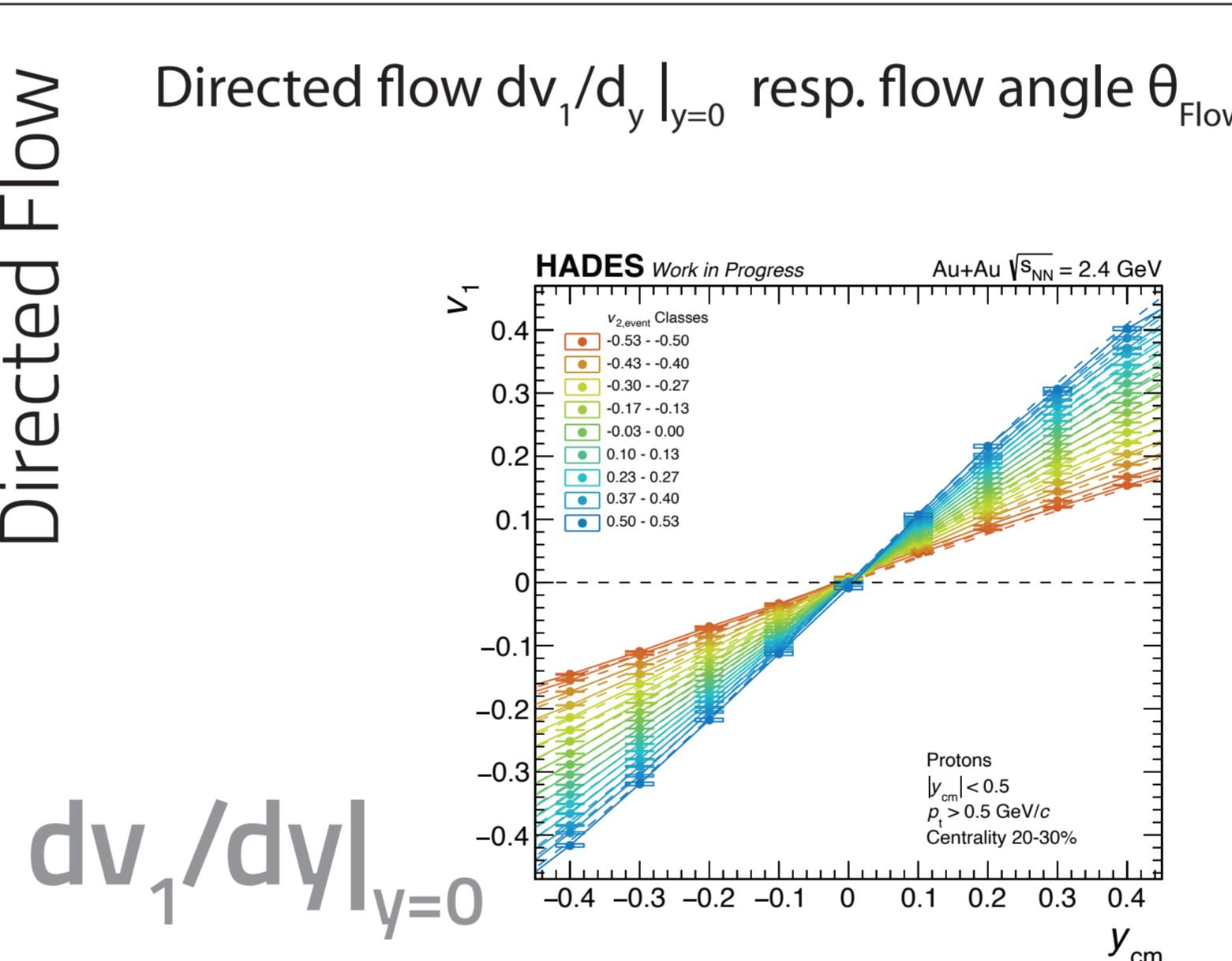
The events can further be selected according the event-wise magnitude of the elliptic flow $v_{2,\text{event}}$ as proposed in Ref. [4,5].



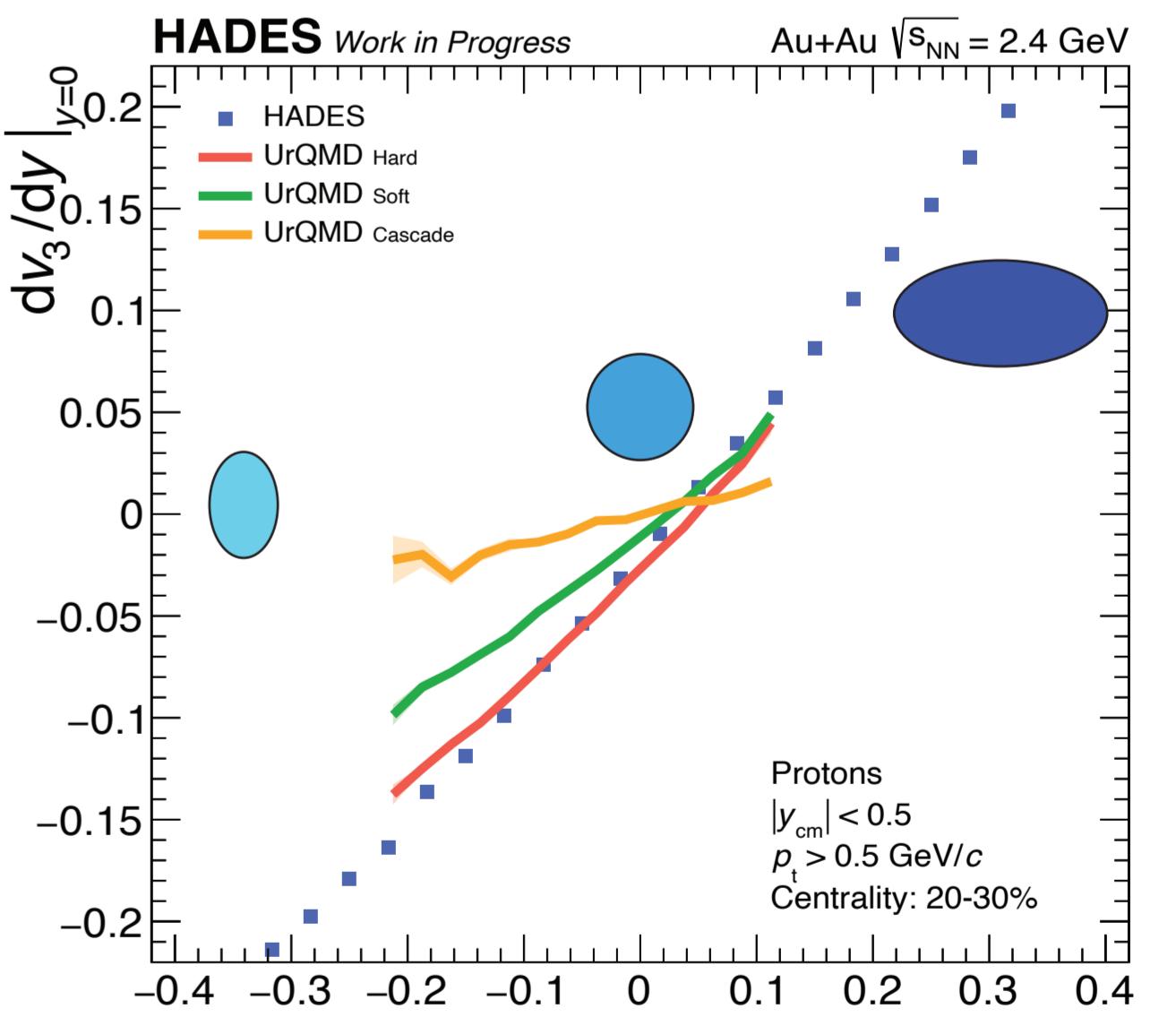
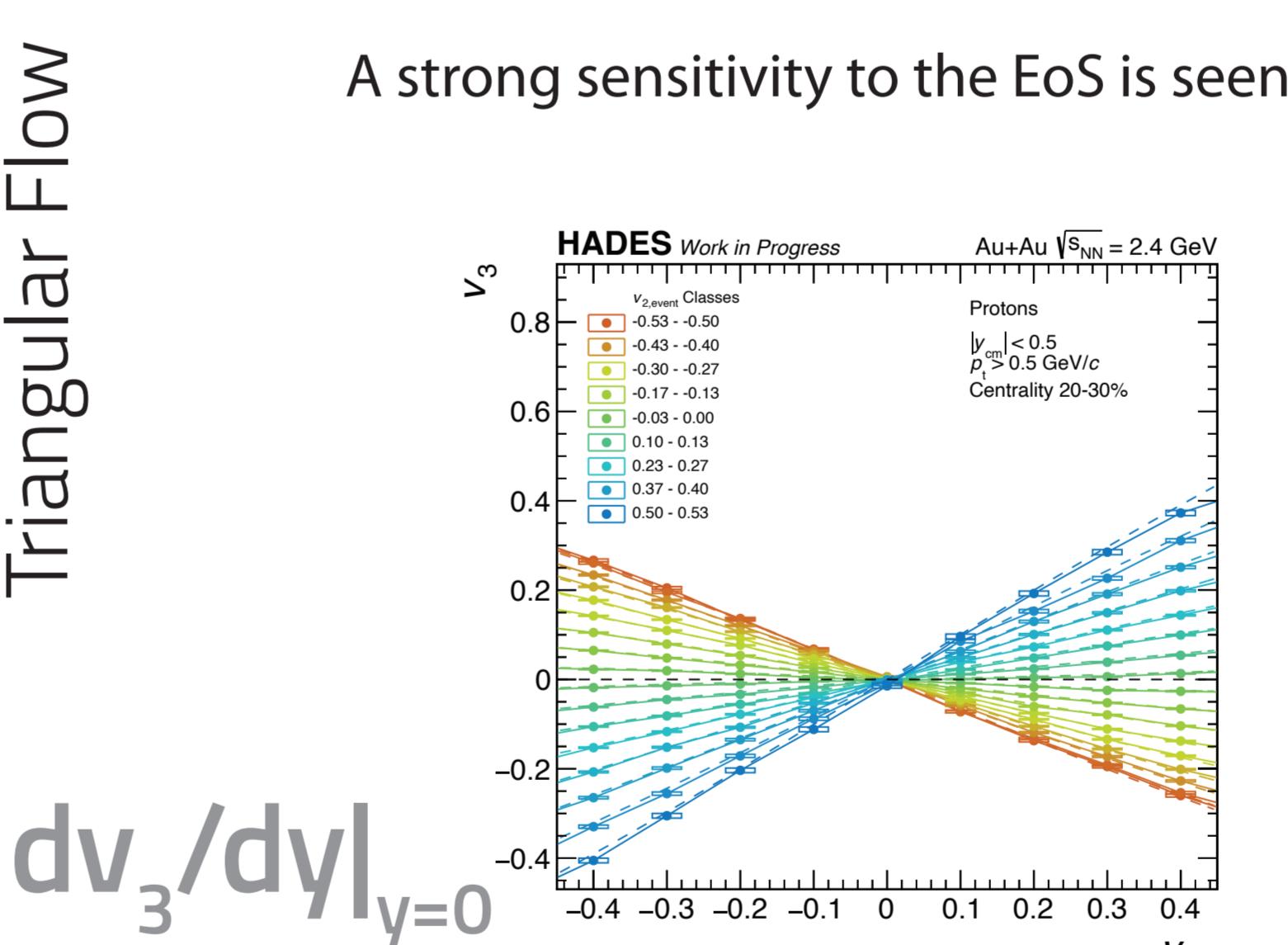
Event-wise v_2 Correlations



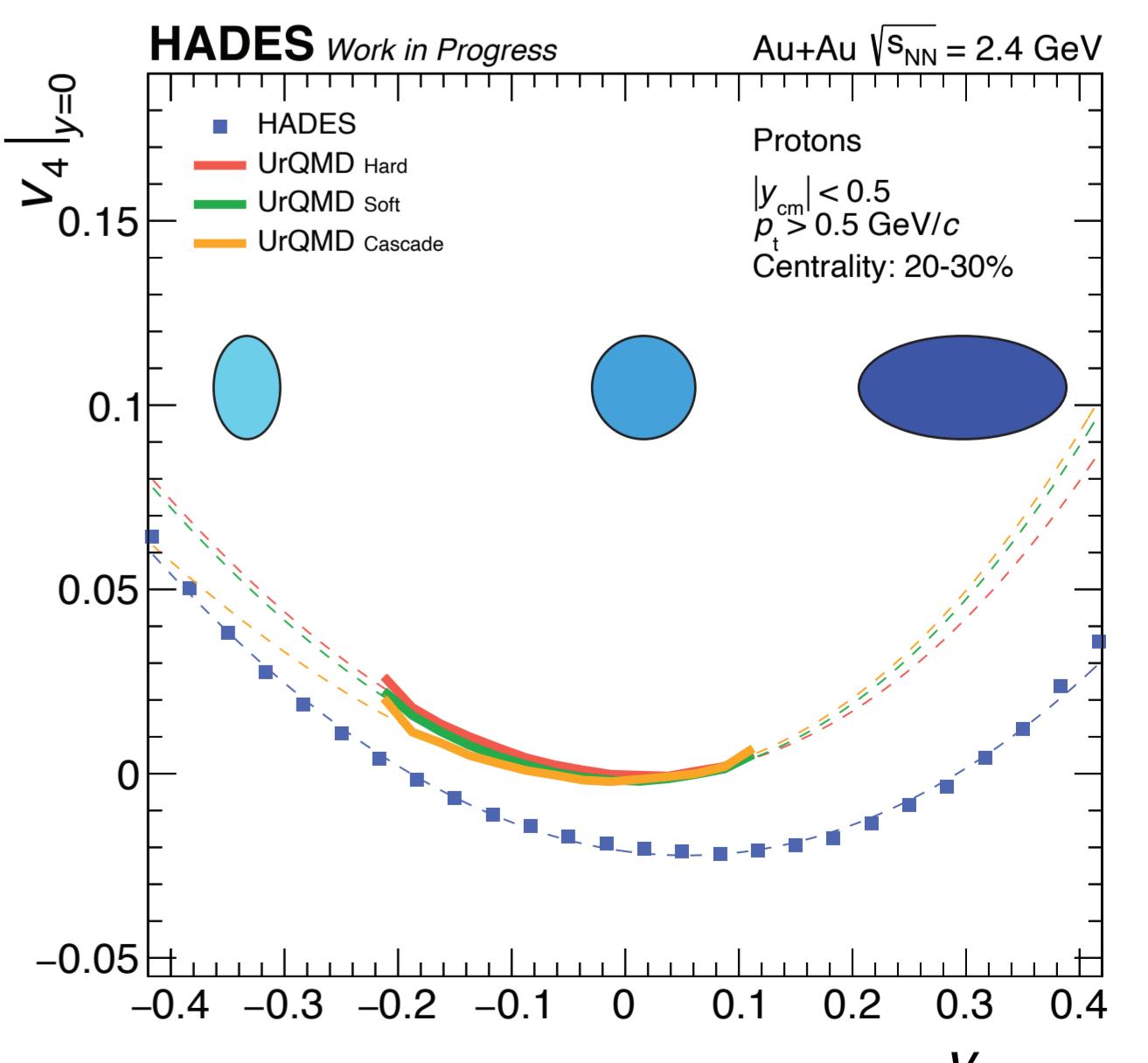
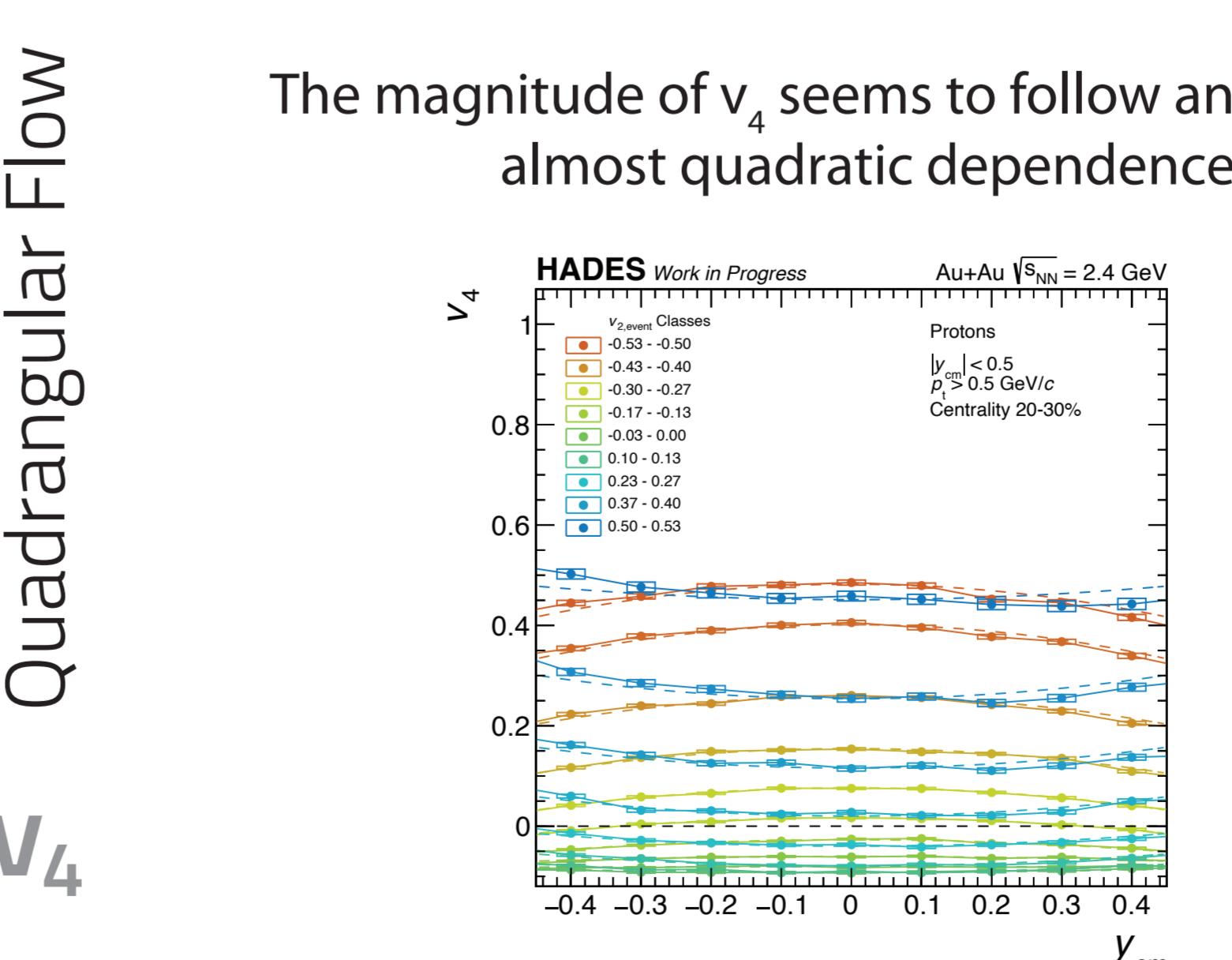
Directed Flow



Triangular Flow



v_4



The magnitude of v_4 seems to follow an almost quadratic dependence.

Contact

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