

QCD PHENOMENOLOGY: FROM ICECUBE TO THE LHC AND BEYOND

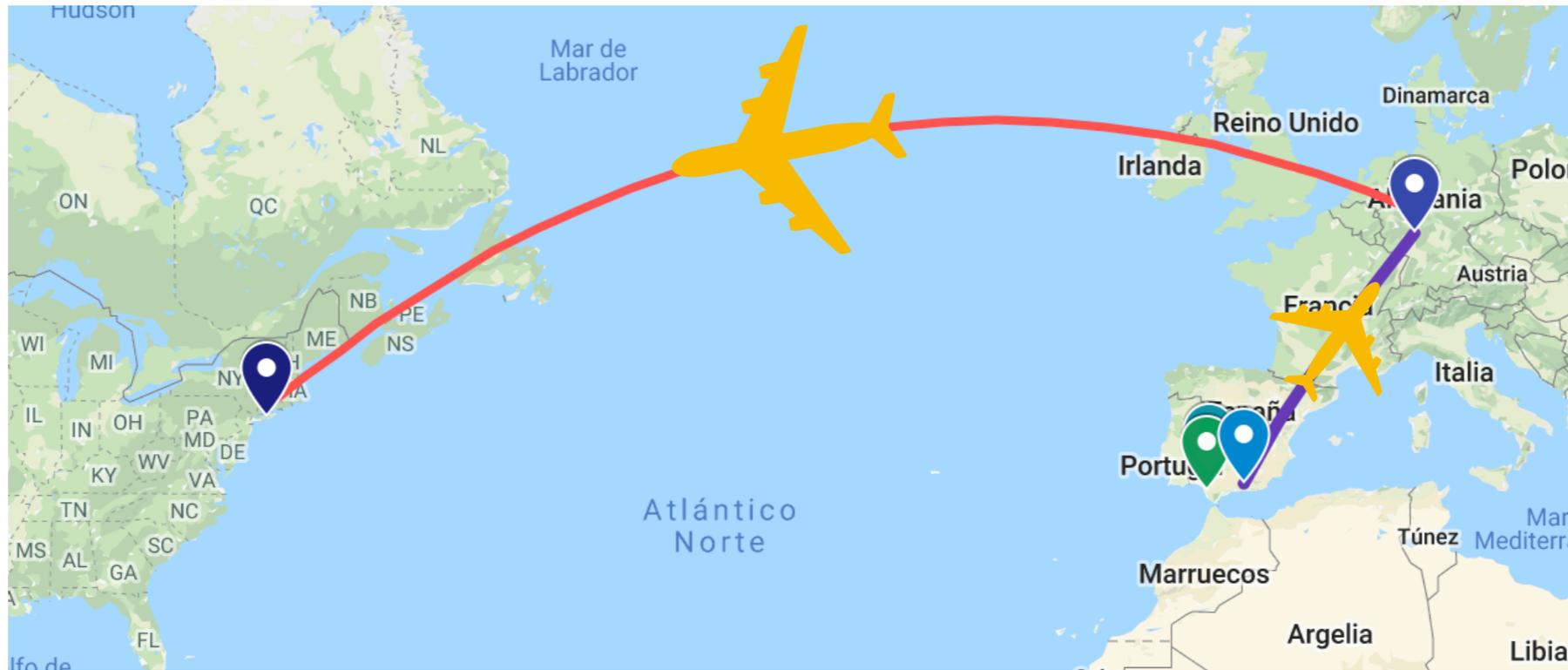
Alba Soto Ontoso

Inaugural Symposium of the Center for Frontiers in Nuclear Science

Stony Brook, 30th November, 2018



My education worldline



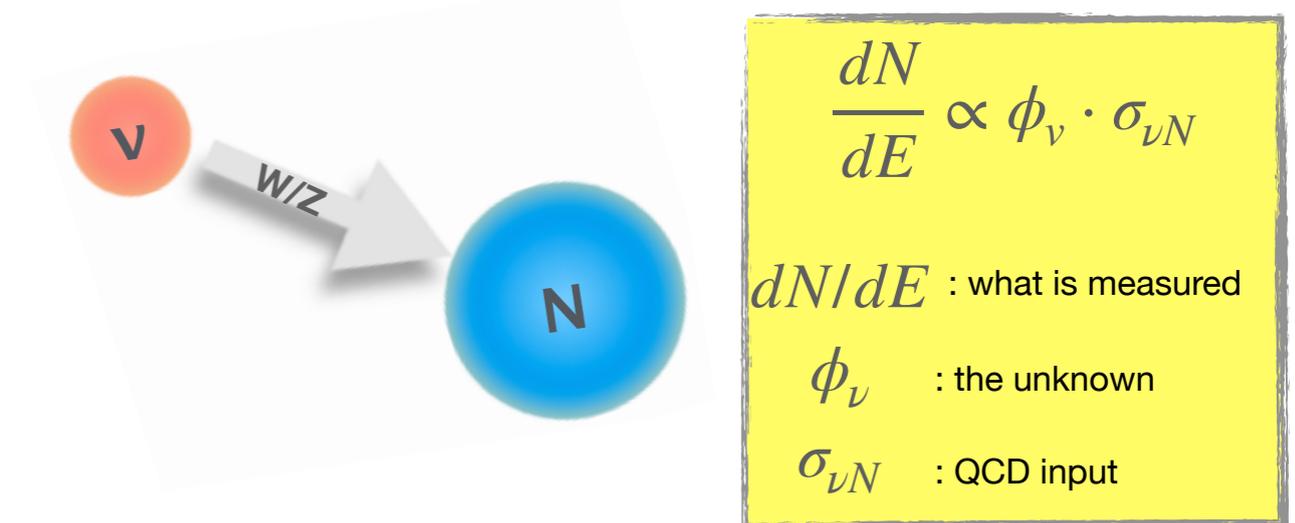
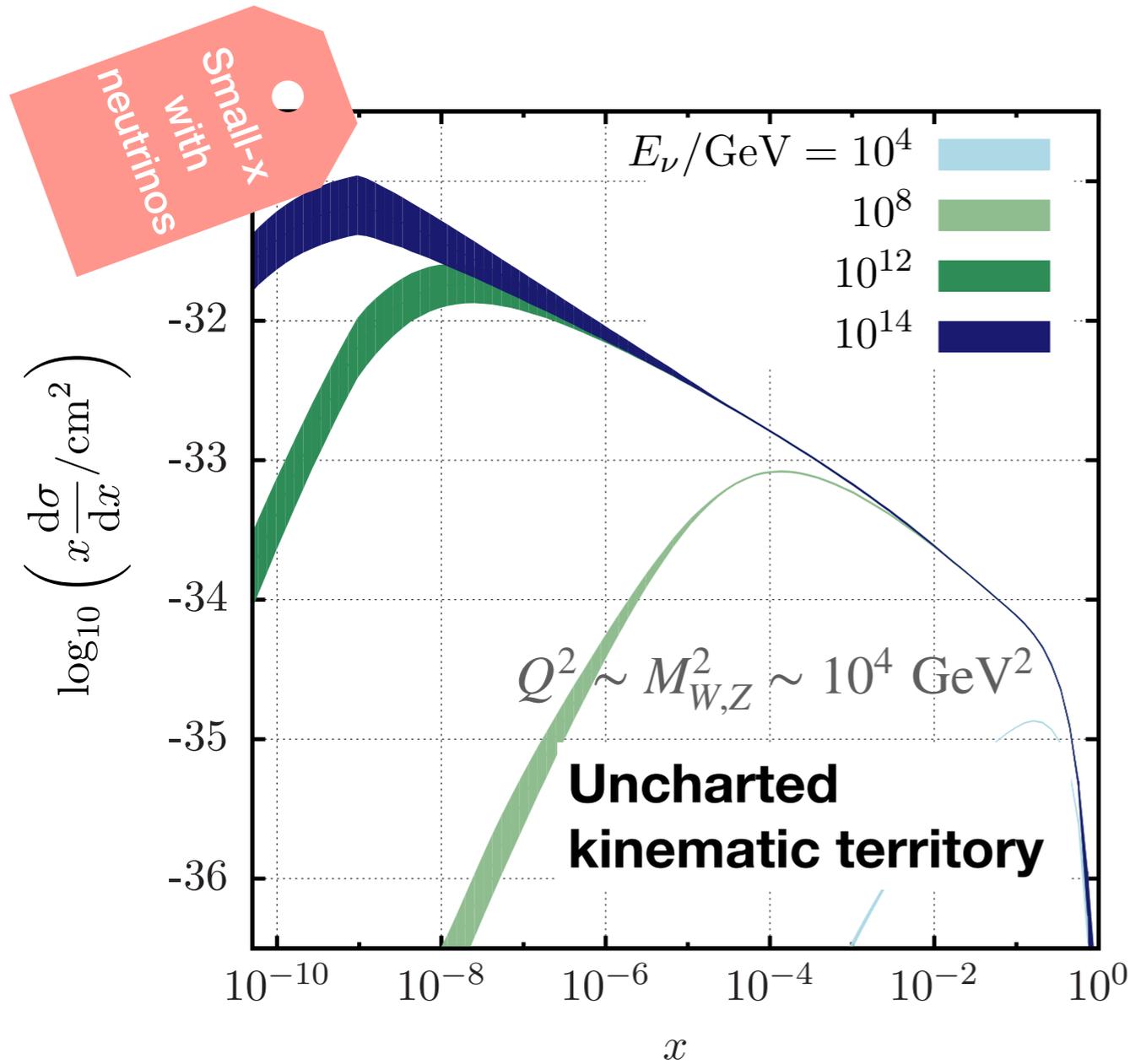
Sep 2010-June 2014, **BSc. Physics** @University of Sevilla + Granada (Spain)

Sep 2014-June 2015, **Msc. Particle Physics** @University of Granada (Spain)

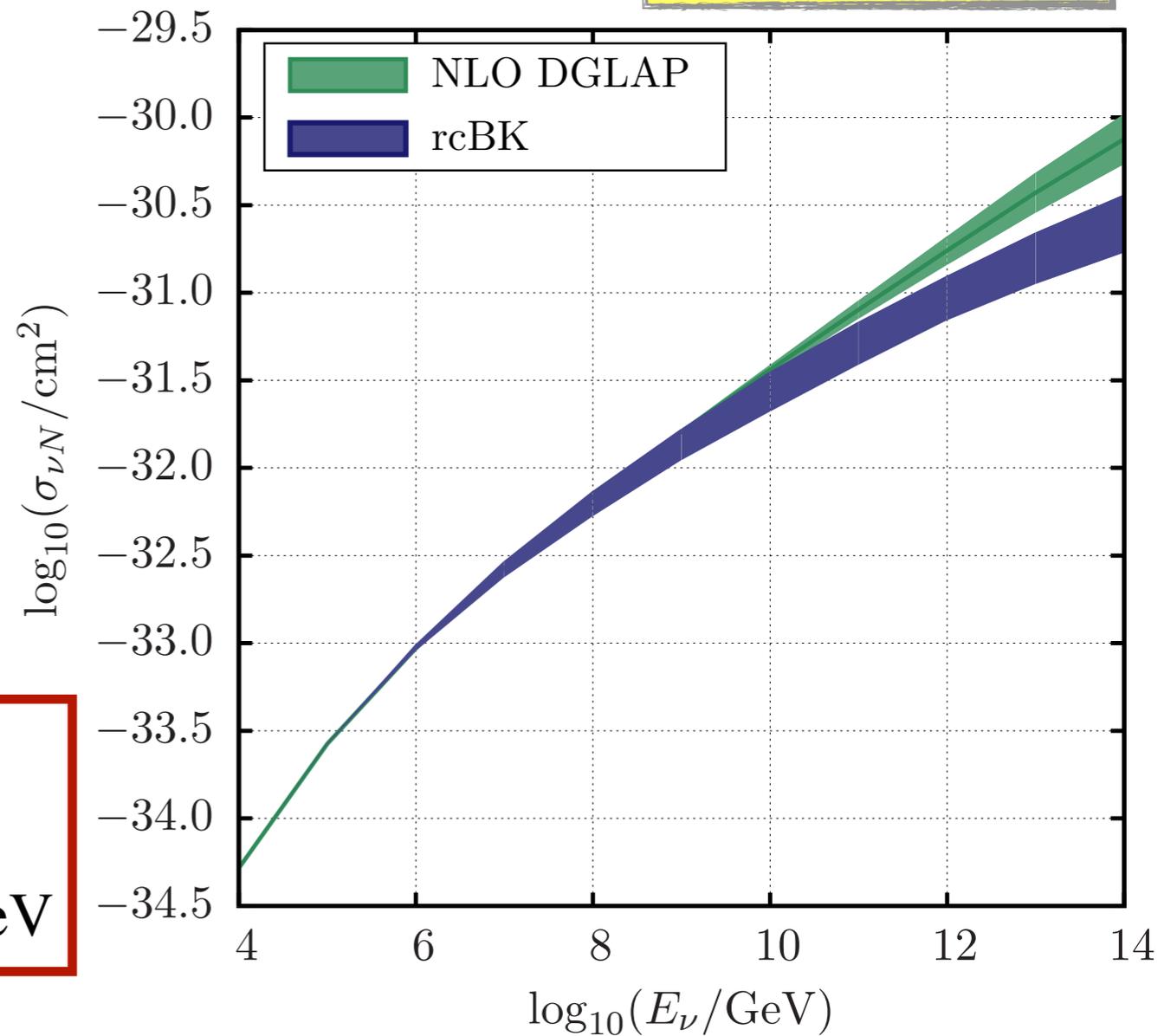
Sep 2015-June 2018, **Ph.D “Initial state structures and final state correlations in heavy ion collisions”** @University of Granada (Spain) + Goethe University (Germany)

Oct 2018-present, **Research Associate** @Brookhaven National Lab (USA)

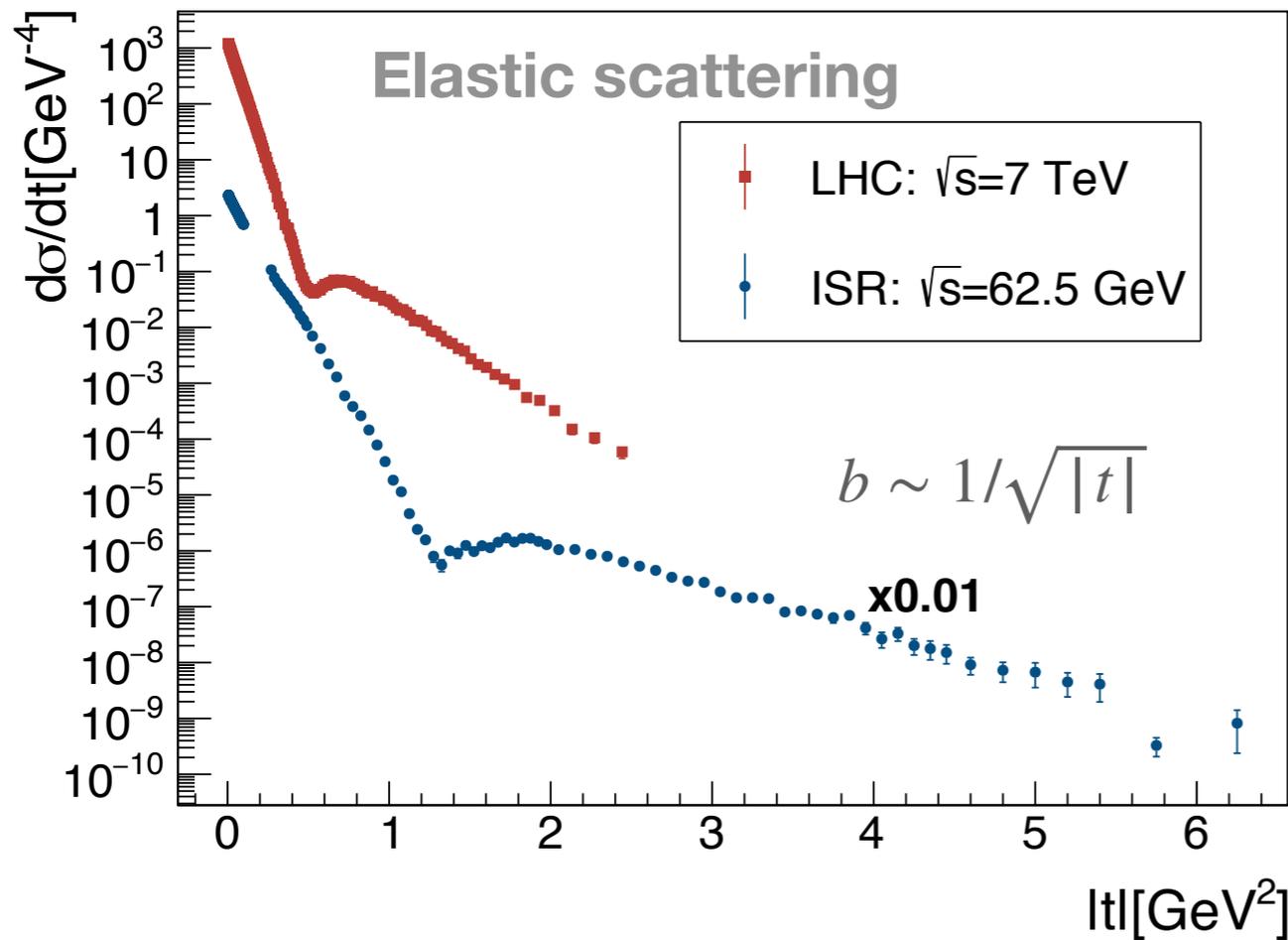
My research timeline: past [JL Albacete, JI Illana, ASO, Phys.Rev. D92 (2015) no.1, 014027]



$$\sigma_{\nu N}^{\text{DGLAP}} \sim 4.5 \times \sigma_{\nu N}^{\text{rcBK}} \quad \Big| \quad E_\nu = 10^{14} \text{ GeV}$$



My research timeline: past [JL Albacete, ASO, Phys.Lett. B770 (2017) 149-153]

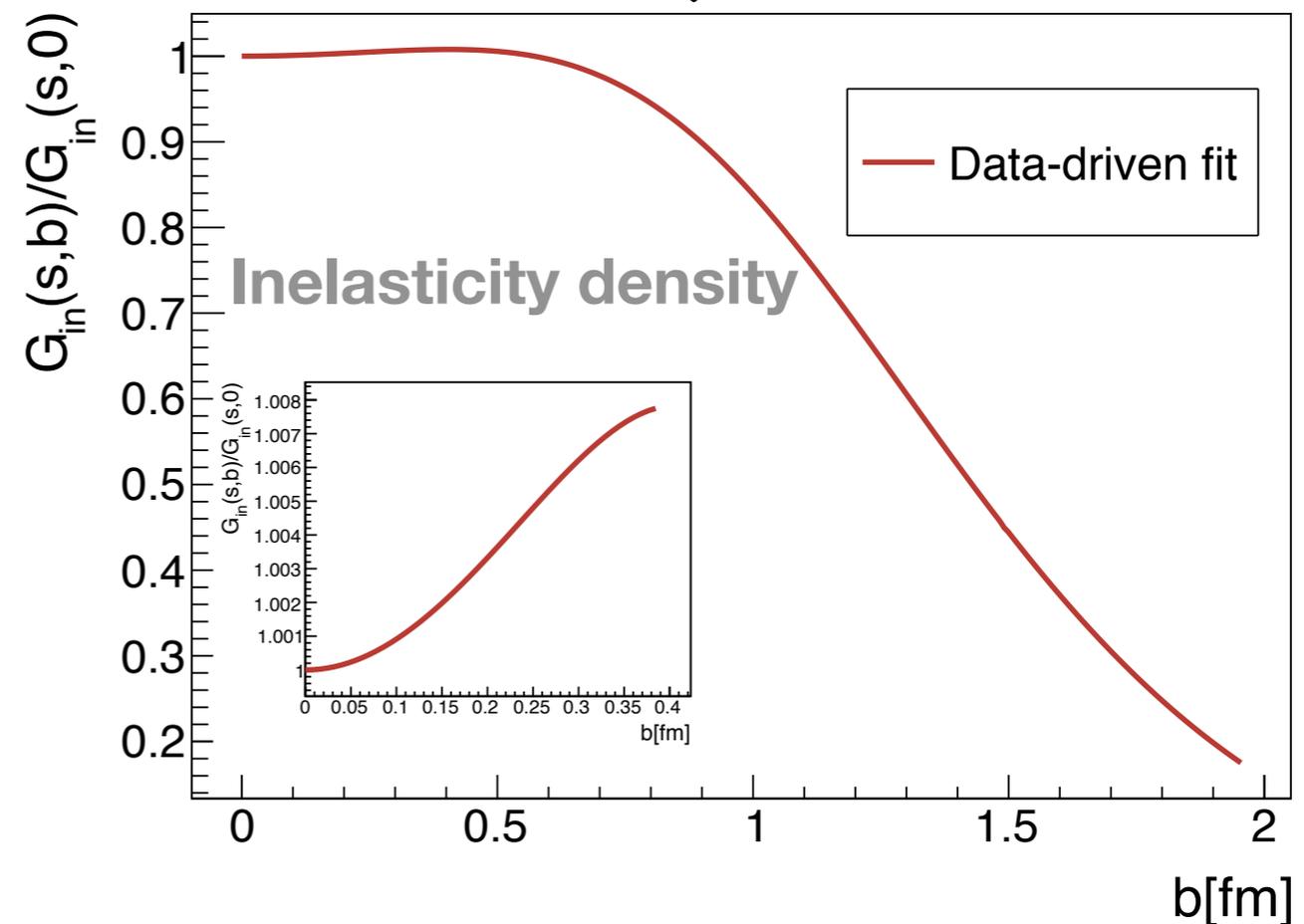


$$\frac{d\sigma_{el}}{dt} \propto |T_{el}(s, t)|^2$$

↓
Unitarity condition +
Fourier Transformation

$$G_{in}(s, b) \equiv \frac{d^2\sigma_{inel}}{d^2b} = 2\text{Im}T_{el}(s, b) - |T_{el}(s, b)|^2$$

↓



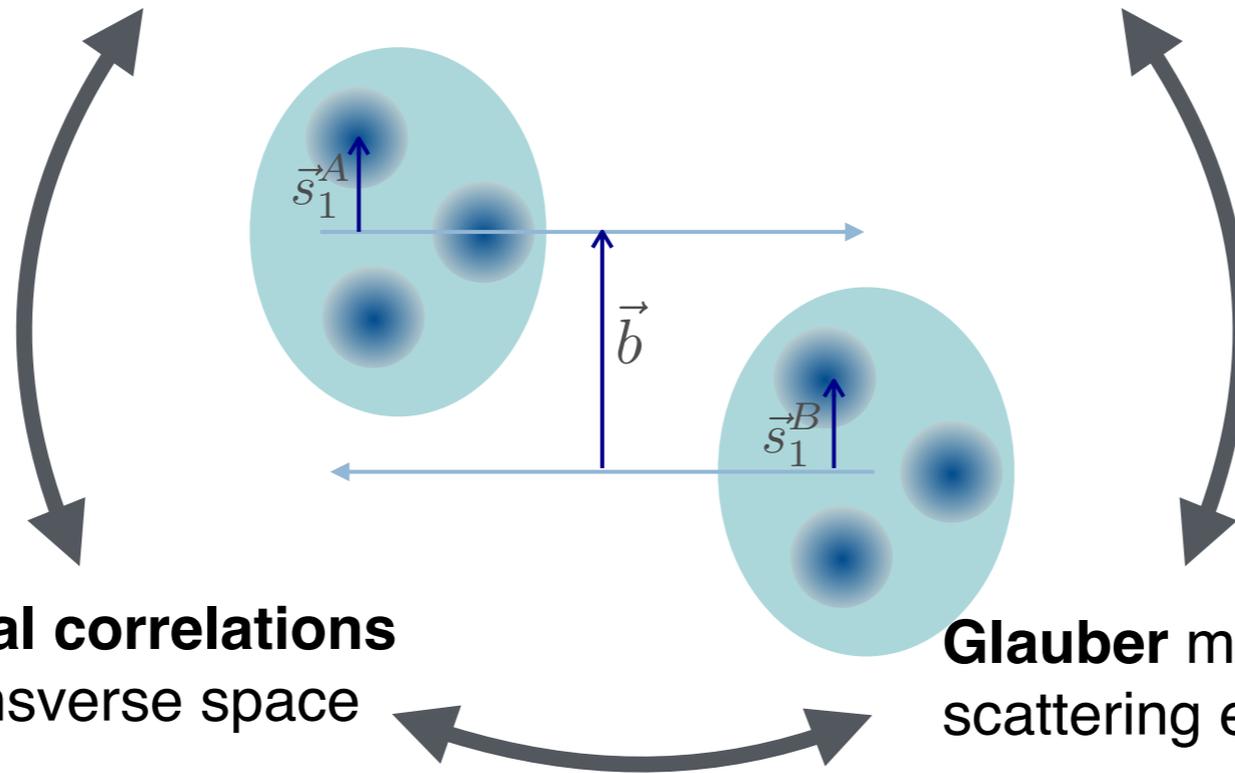
- **STRIKING** growing behaviour at low impact parameter
- Not observed at **ISR** energies
- Peripheral collisions contribute more to σ_{inel} than central ones

Hollowness effect

My research timeline: past [JL Albacete, ASO, Phys.Lett. B770 (2017) 149-153]

Glauber scattering for p+p

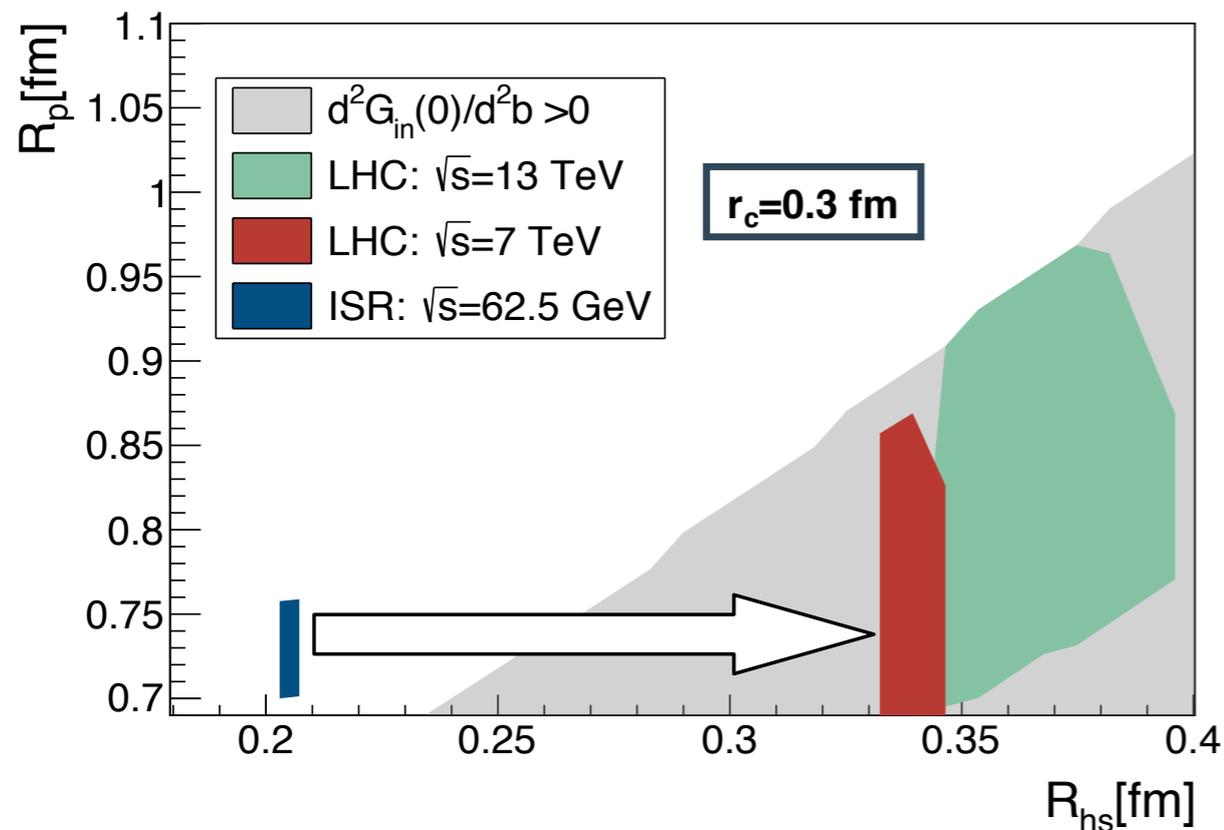
Gluonic hot-spots as effective d.o.f



Connection to GPDs

Spatial correlations in transverse space

Glauber multiple scattering expansion



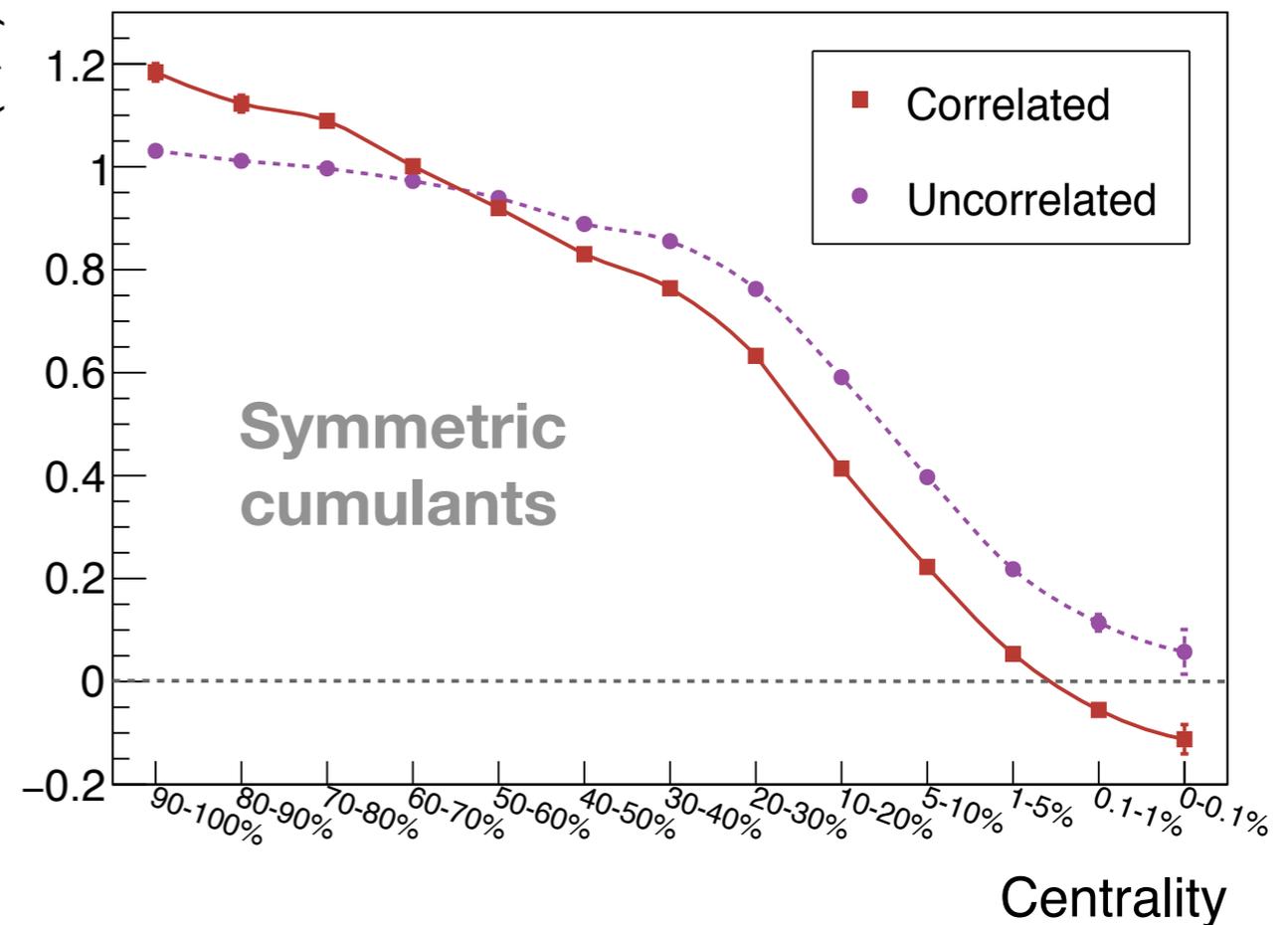
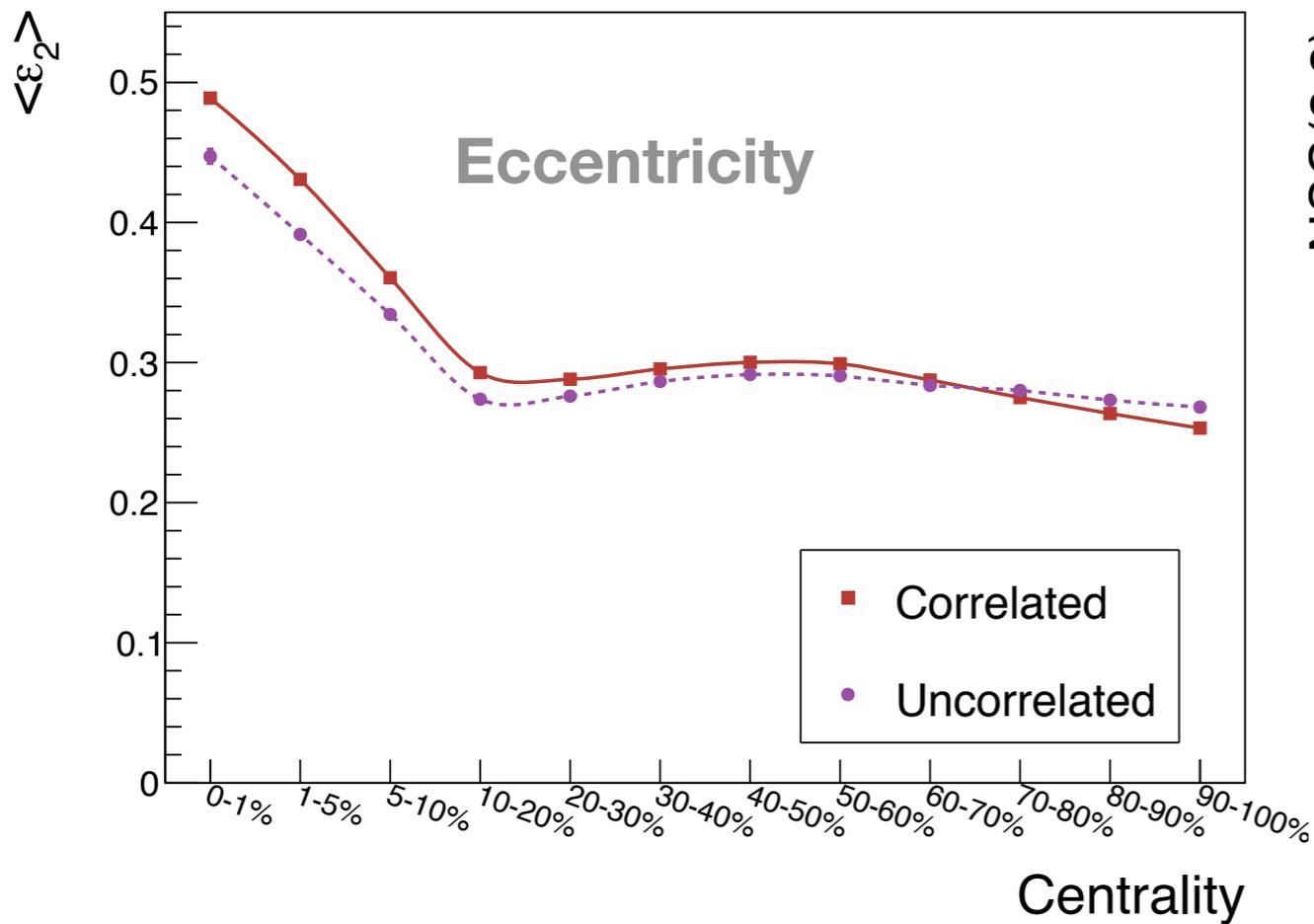
- $N_{hs} > 2$
- $r_c > 0$
- R_{hs} grows with \sqrt{s}

My research timeline: past

[JL Albacete, H Petersen, ASO, Phys.Rev. C95 (2017) no.6, 064909
Phys.Lett. B778 (2018) 128-136]



Access to event-by-event fluctuations of the initial state profile



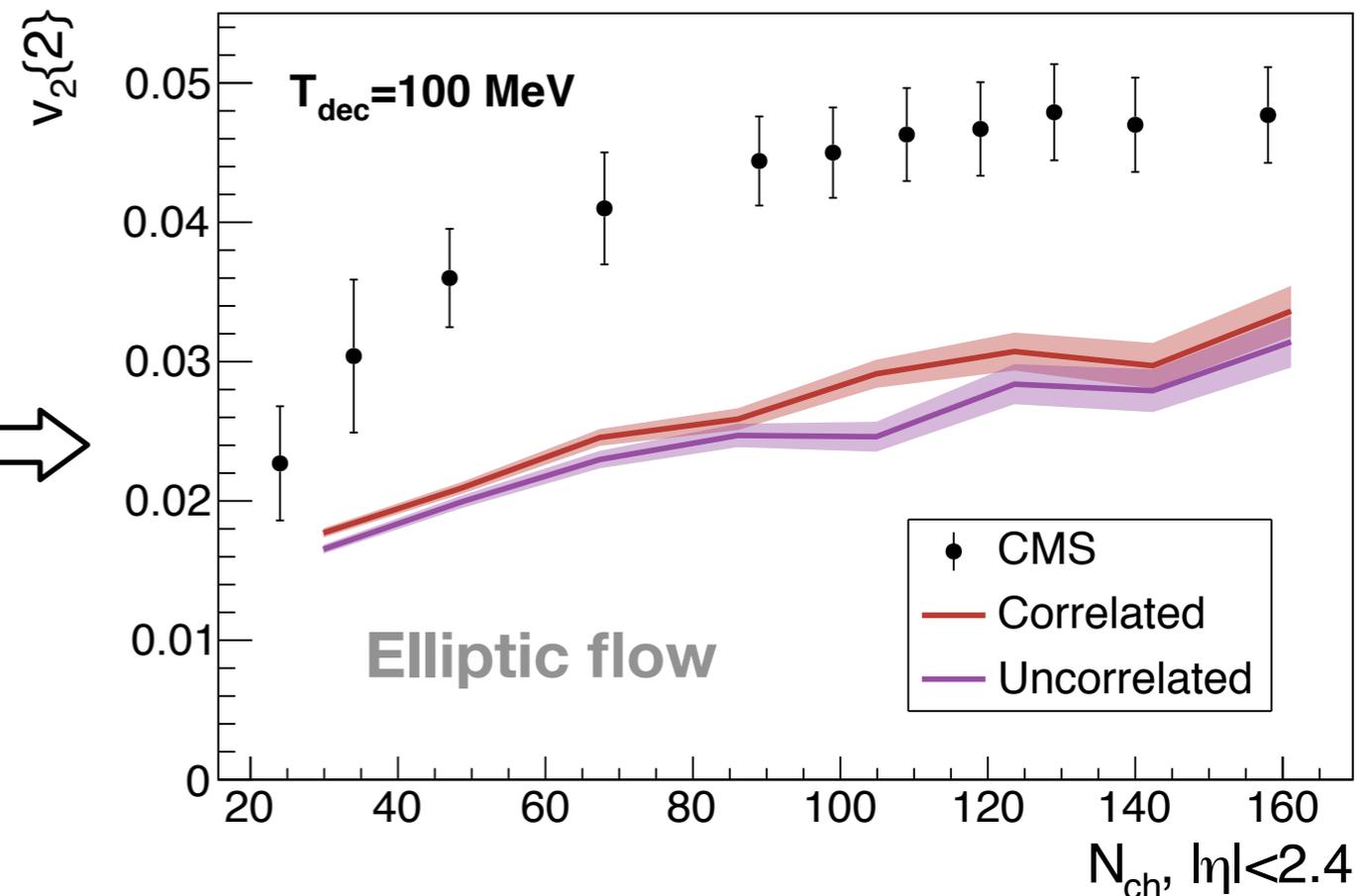
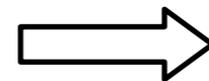
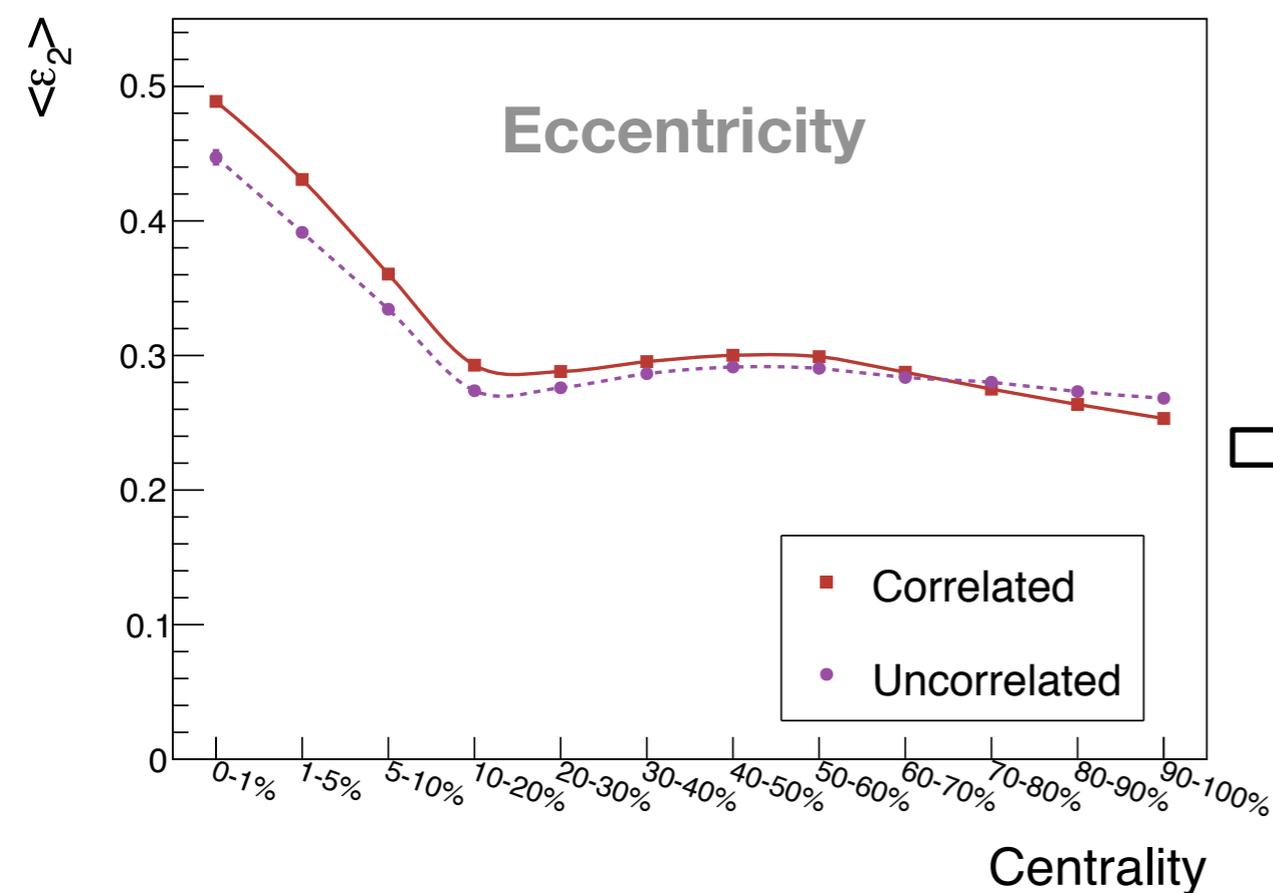
Repulsive correlations make $\varepsilon_{2,3}$ in ultra-central collisions

Data (in terms of flow) indicate a transition to negative values of NSC(2,3) with increasing multiplicity. Repulsive correlations vital in our setup

My research timeline: present [JL Albacete, H Niemi, H Petersen, ASO, in preparation]

Viscous
hydro for
p+p

Perform hydrodynamic evolution of our initial state profiles



Repulsive correlations in the initial geometry seems to affect the elliptic flow. No fine tuning. More statistics (and work) needed!!

My research timeline: present [Y Mehtar-Tani, N Mueller, F Salazar-Wong, B Schenke, ASO, in preparation]

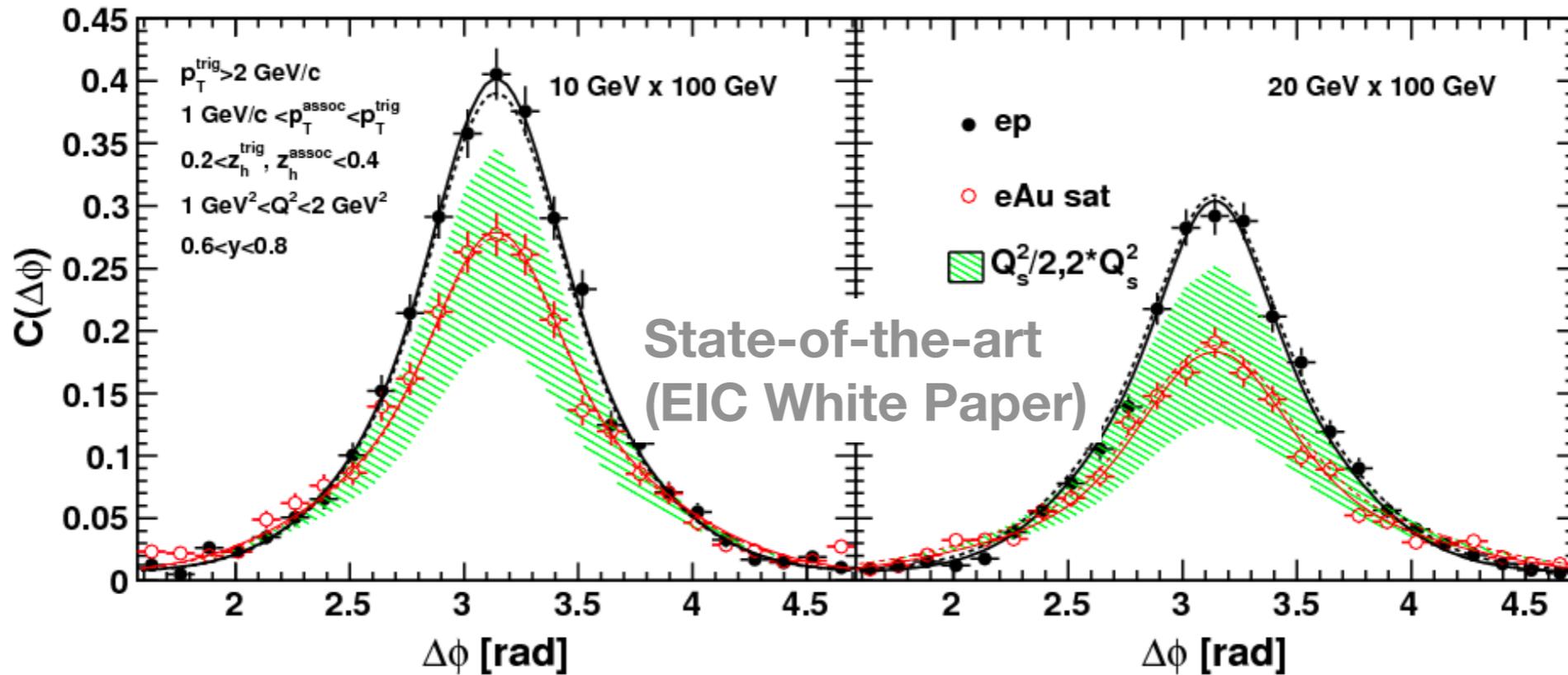
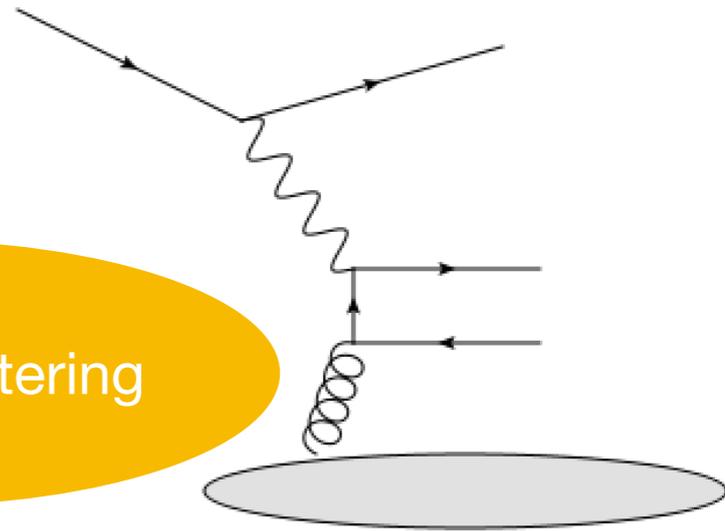
Small-x
with
dijets in
e+A

e+A->dijet+X : test of saturation at the EIC

Sudakov radiation

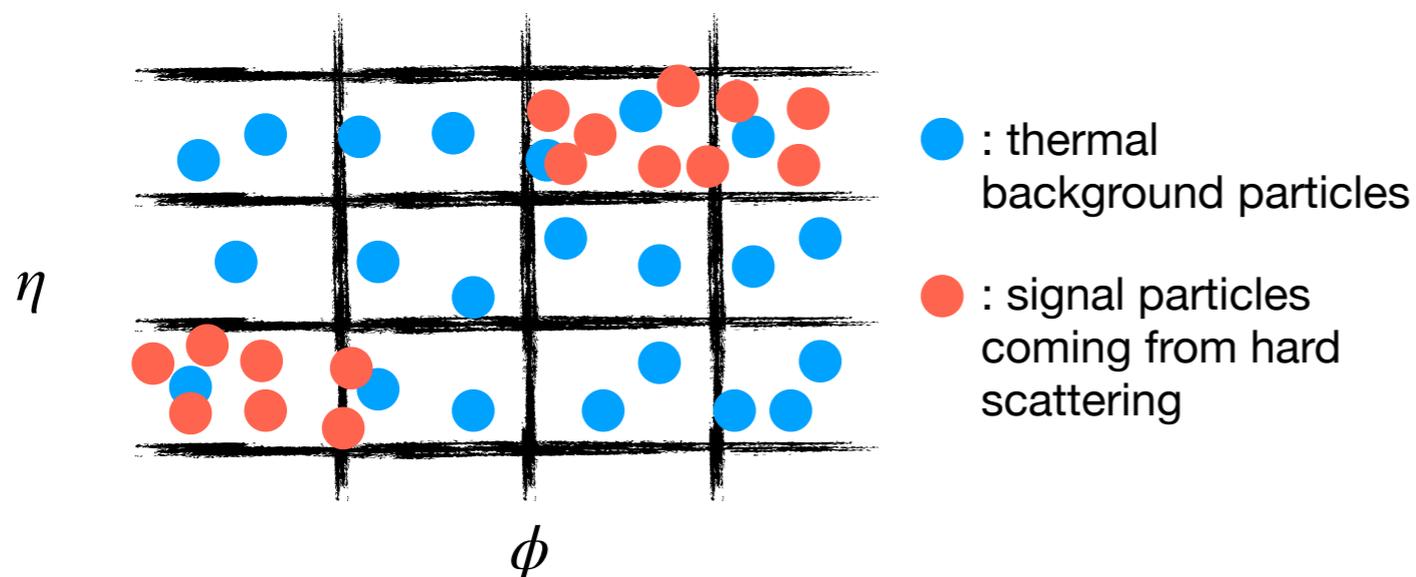
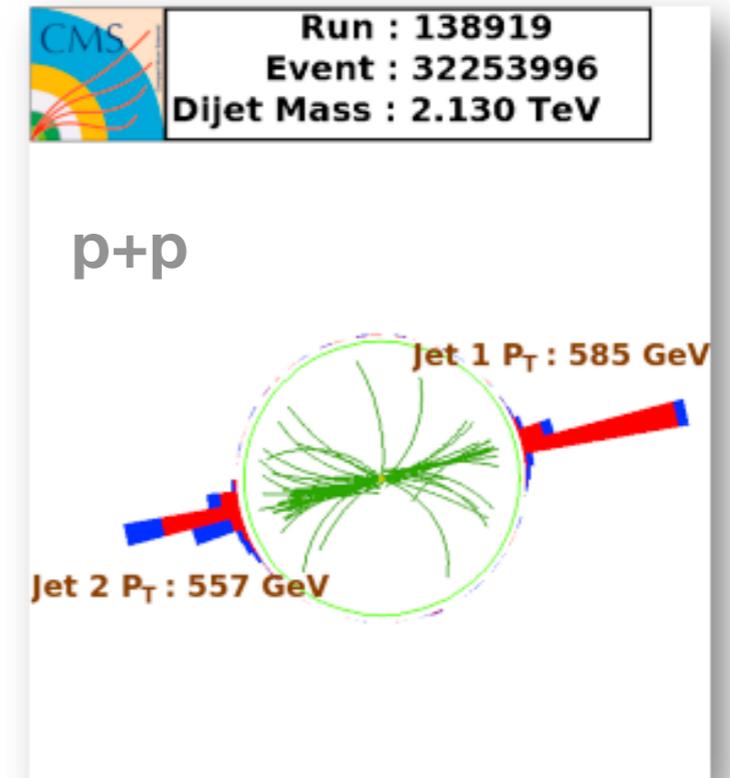
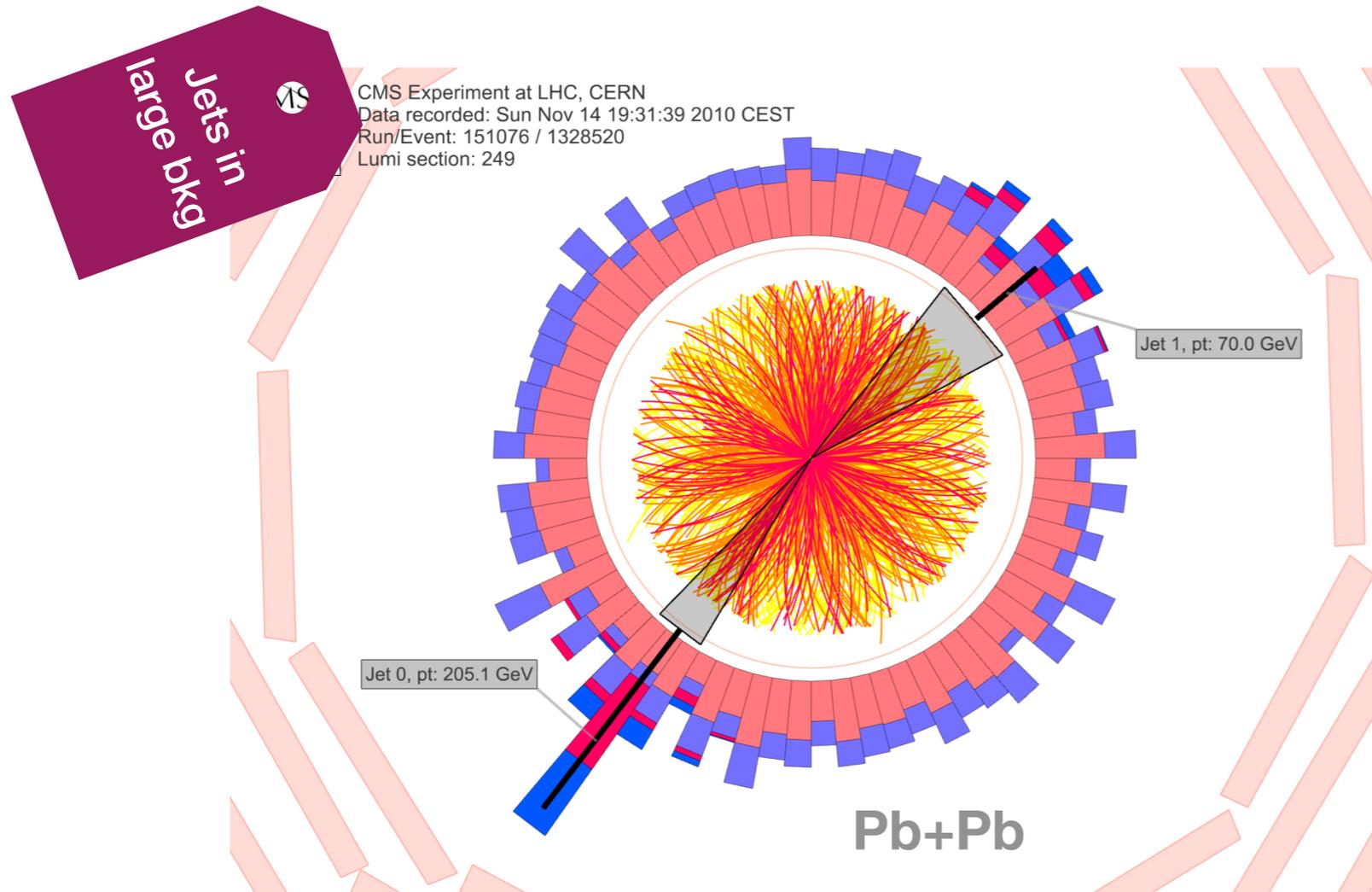
VS

Multiple scattering



Room for improvement: small-x evolution coming from rcBK/JIMWLK, include impact parameter dependence, linearly polarised gluon distribution...

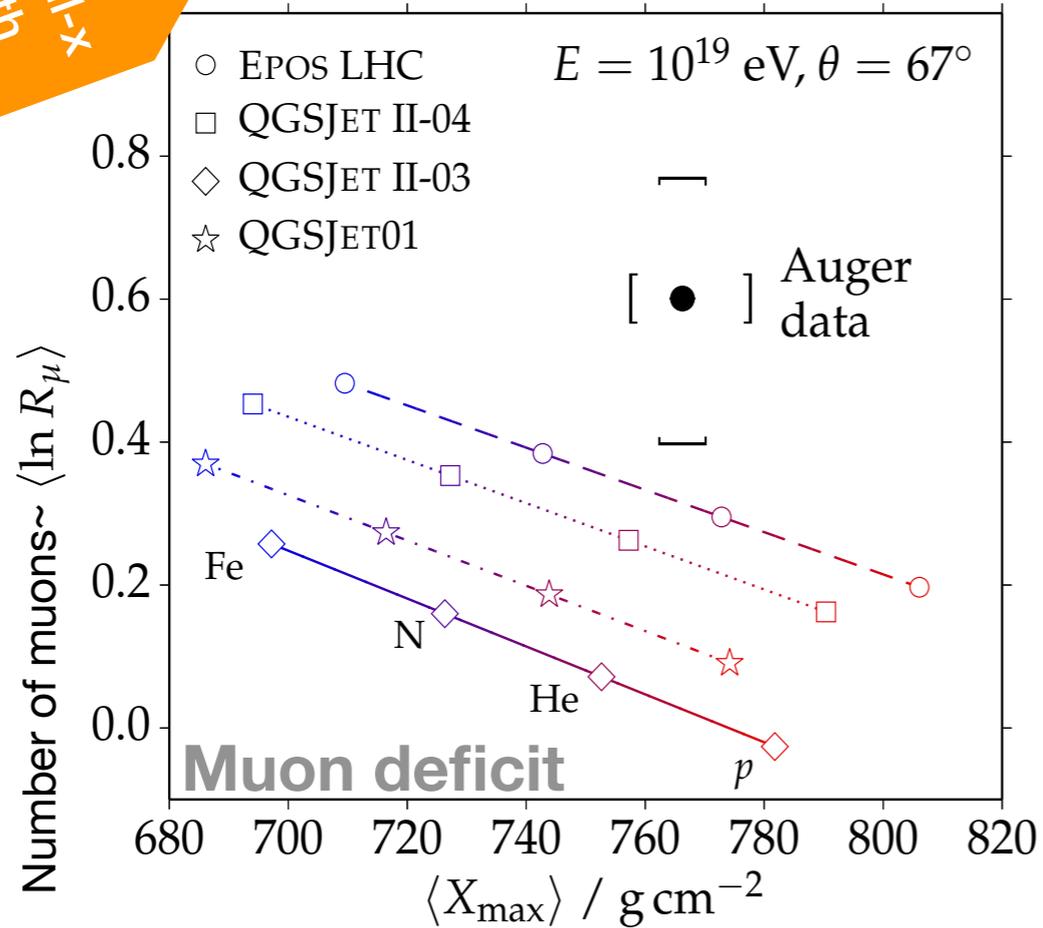
My research timeline: present [Y Mehtar-Tani, ASO, M Verweij in preparation]



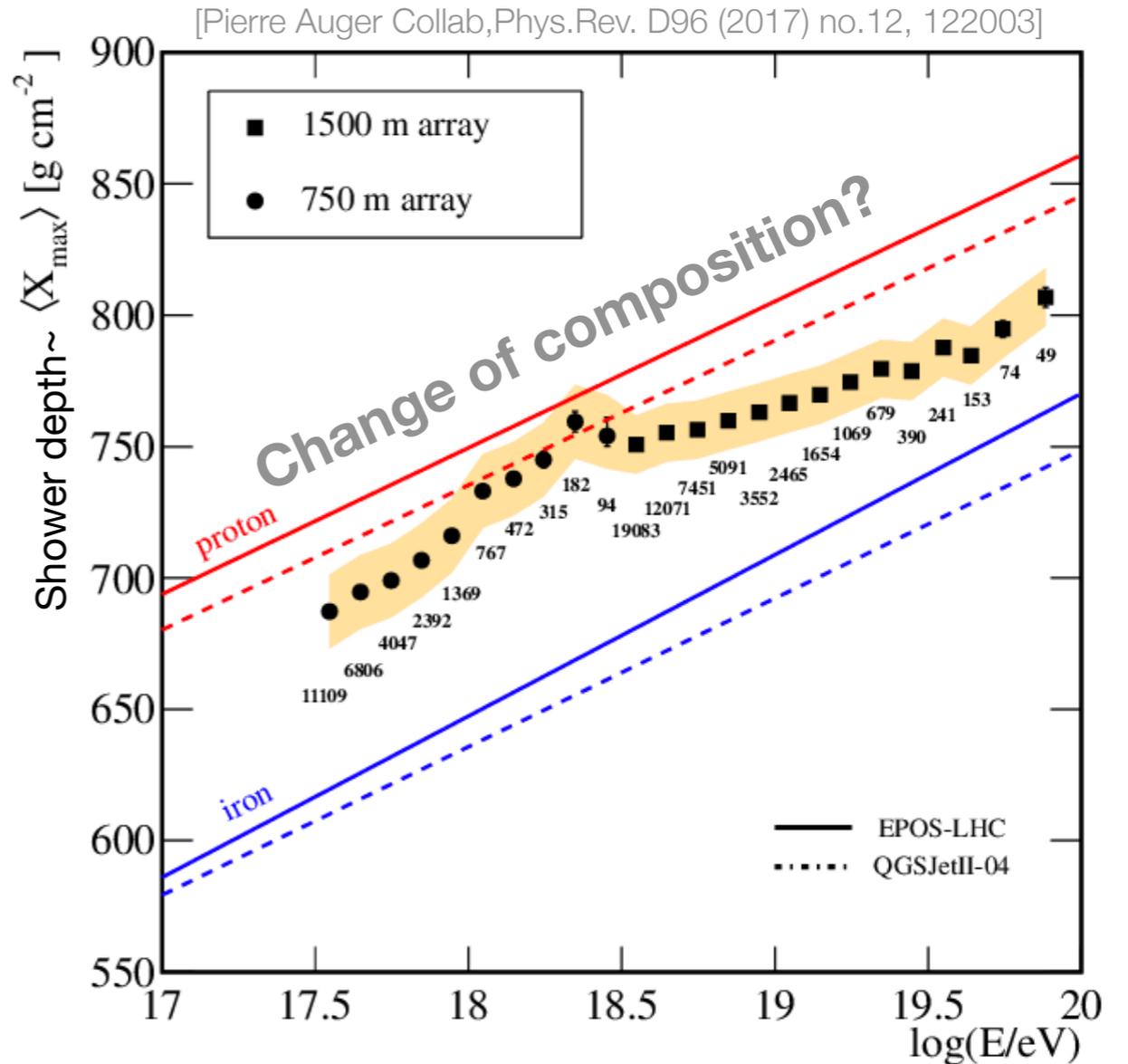
Goal: subtract uncorrelated background at the particle level for jet substructure studies

My research timeline: **future** [ASO + anybody who wants to join]

Small-x
with
cosmic
rays



[Pierre Auger Collab, Phys.Rev. D91 (2015) no.3, 032003]



Data-models tension realised in many observables. Dangerous extrapolation, up to 3 orders of magnitude higher in energy, with LHC-tuned MCs. Hints of *new* physics i.e. saturation phenomena?