

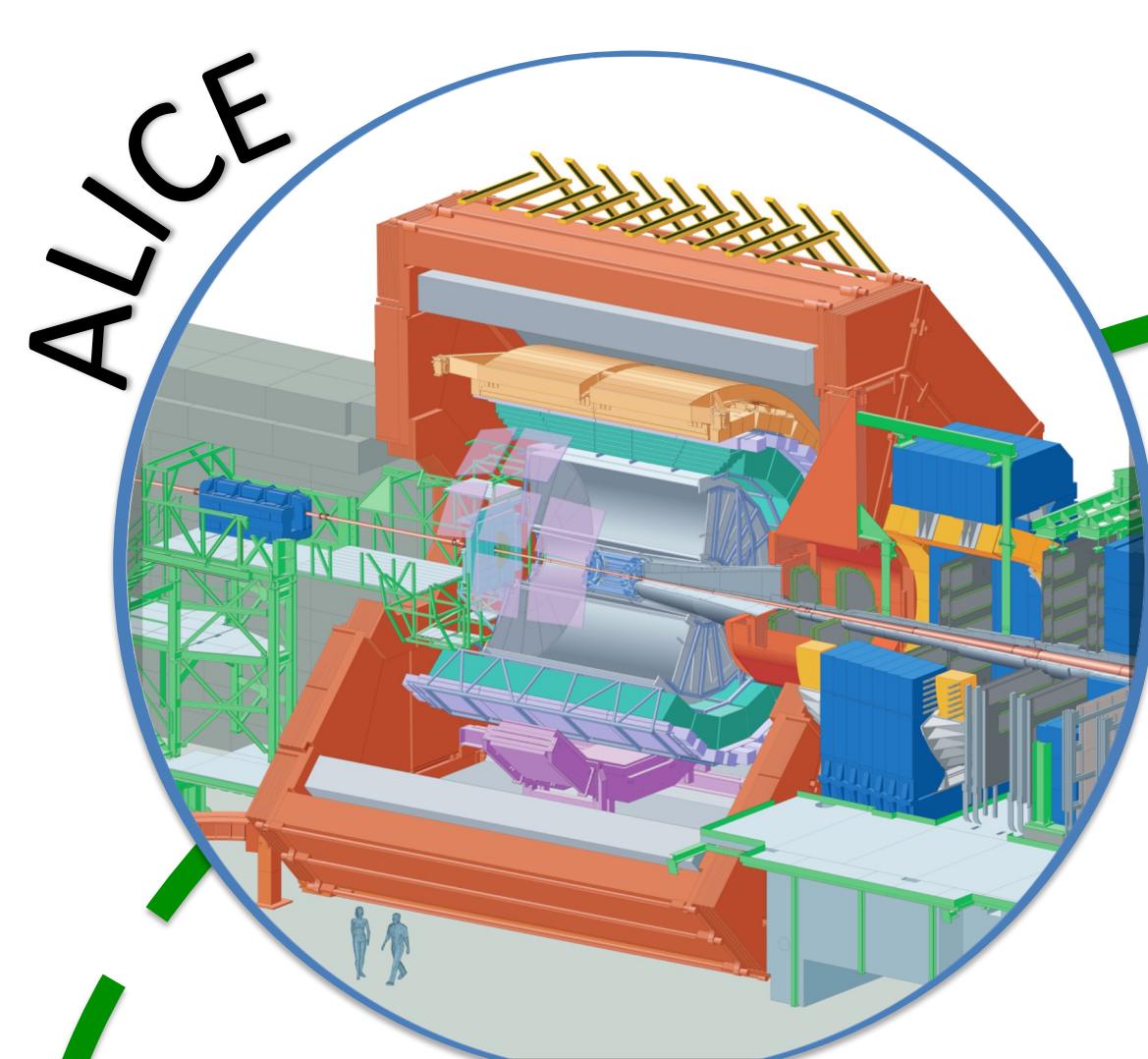
Controlling Volume Fluctuations in Nuclear Collisions

A. Rustamov, R. Holzmann, J. Stroth

Quark Matter 2023, Houston, USA

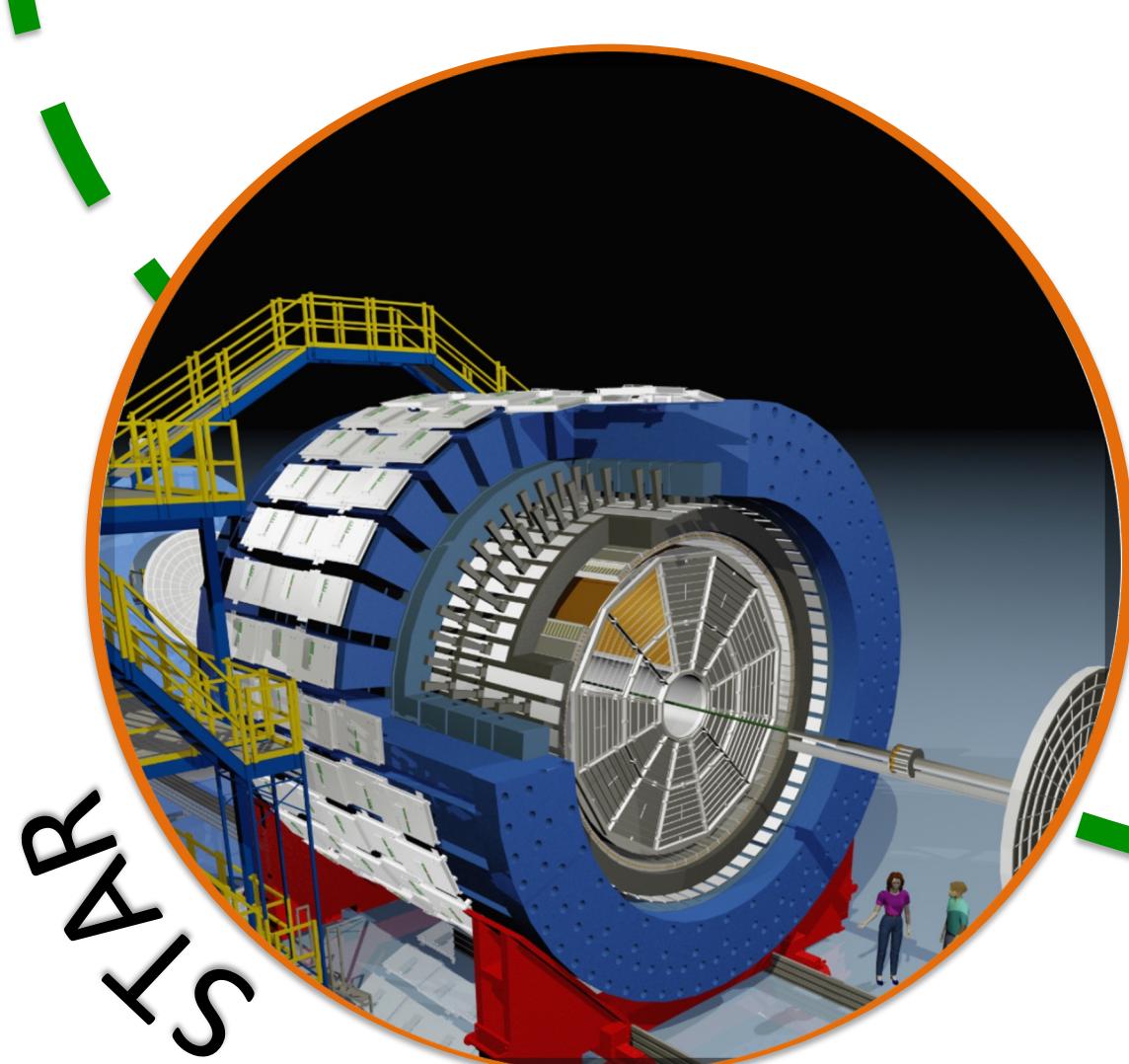
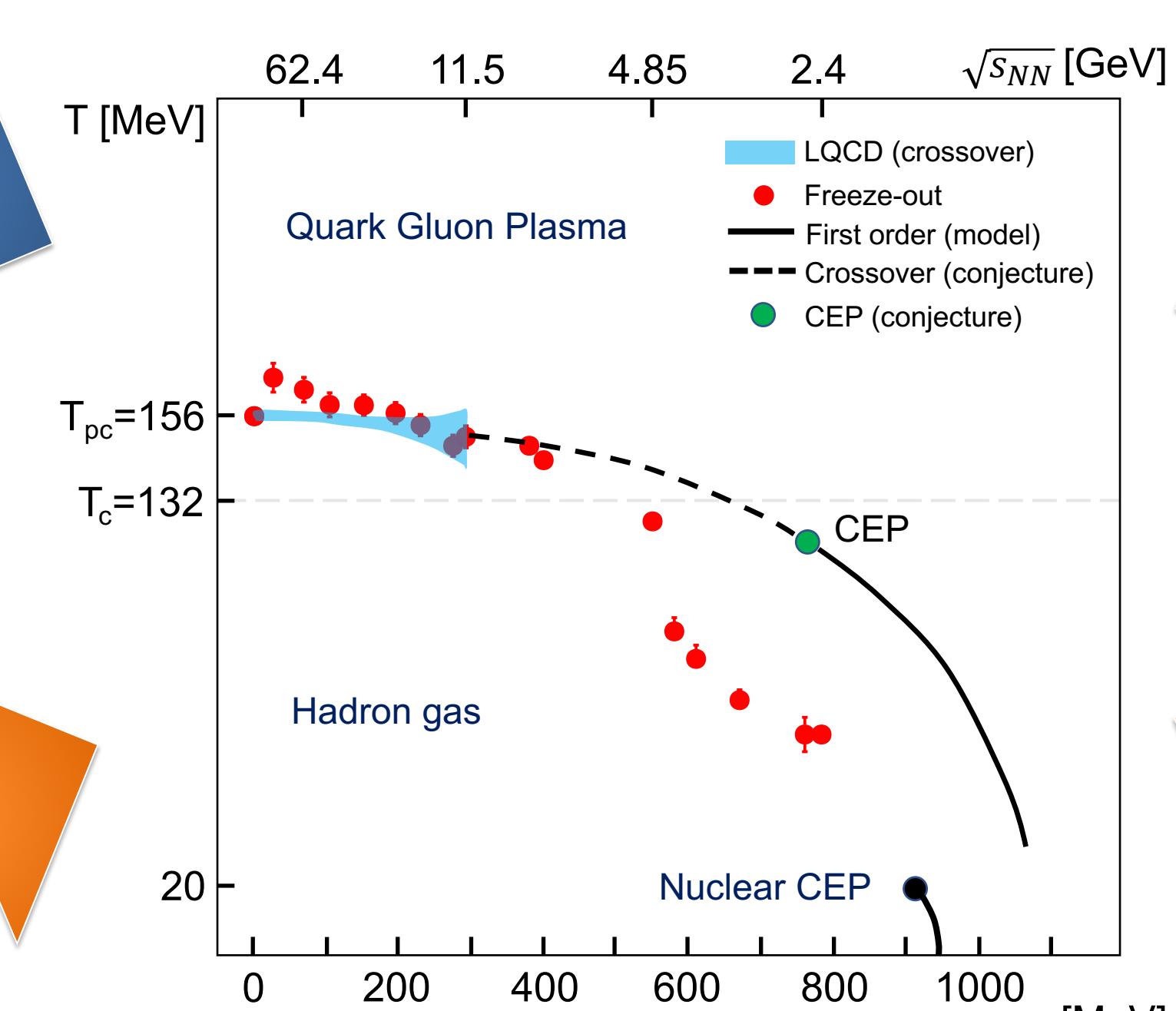
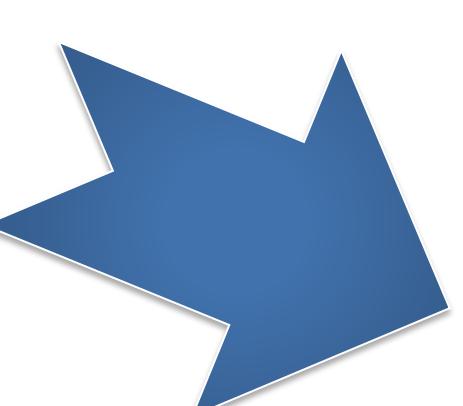


Exploring the Phase Structure of QCD

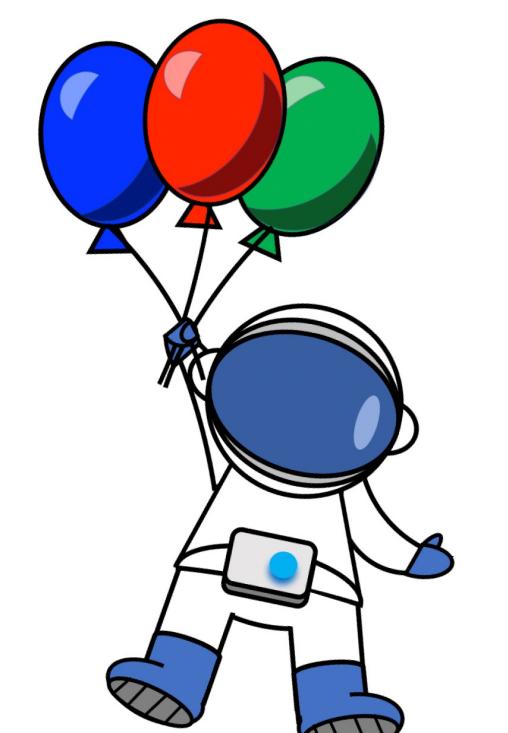
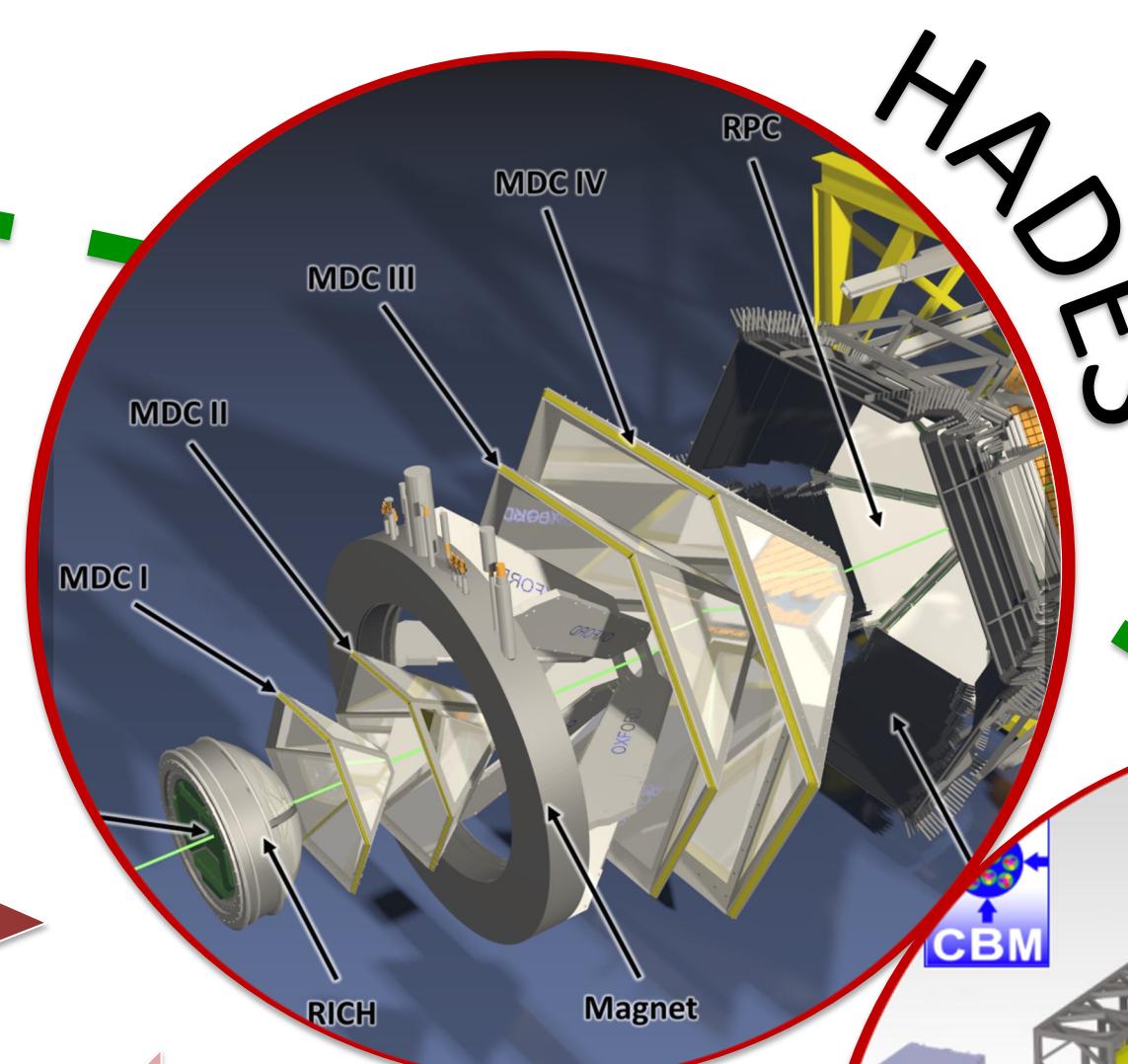


$$\kappa_n(q) = VT^3 \frac{\partial^n \hat{P}}{\partial \hat{\mu}_q^n}$$

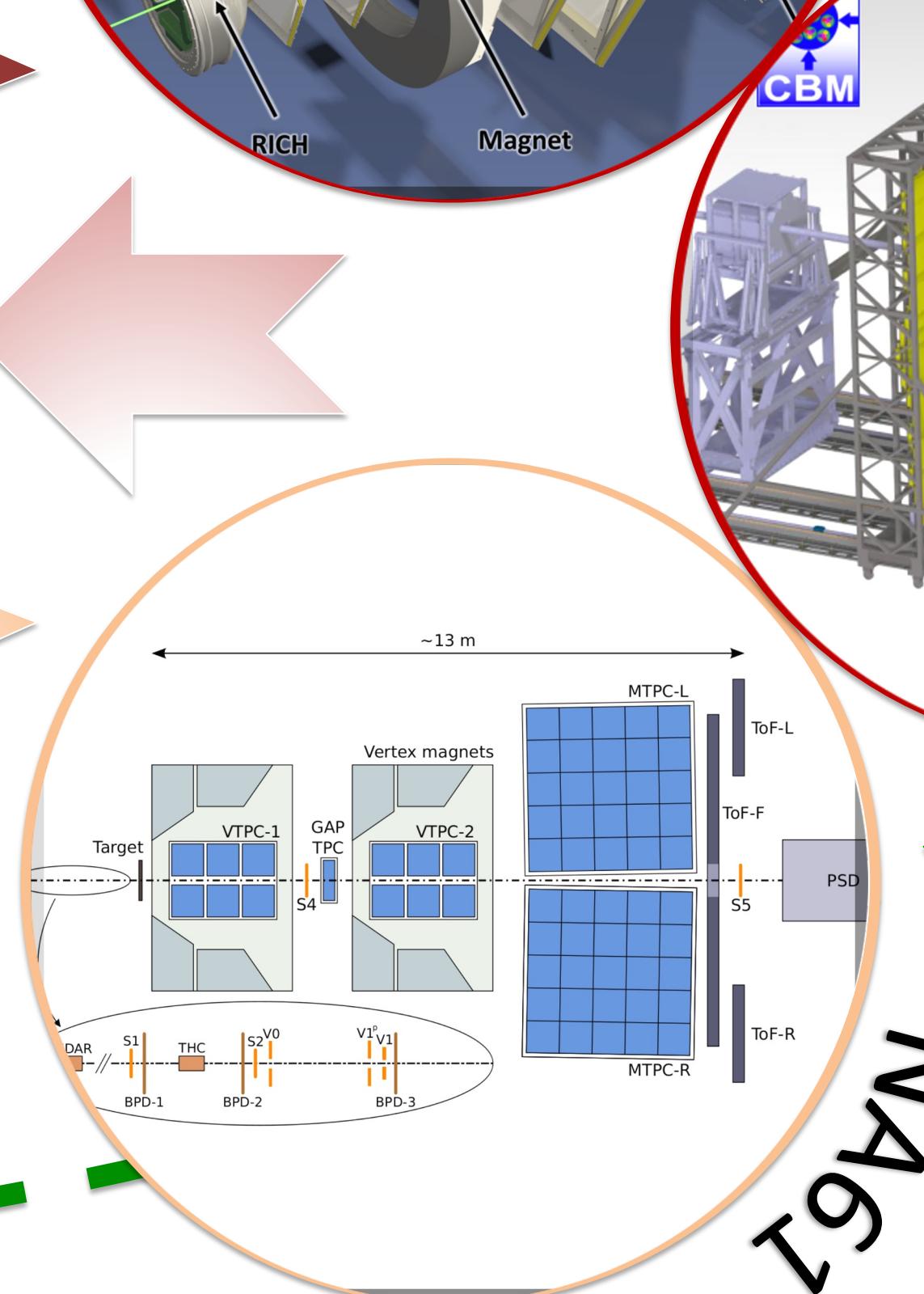
q - conserved charge



$$\kappa_2^{exp} = \langle N_W \rangle \kappa_2(q) + \langle q \rangle^2 \kappa_2(N_W)$$



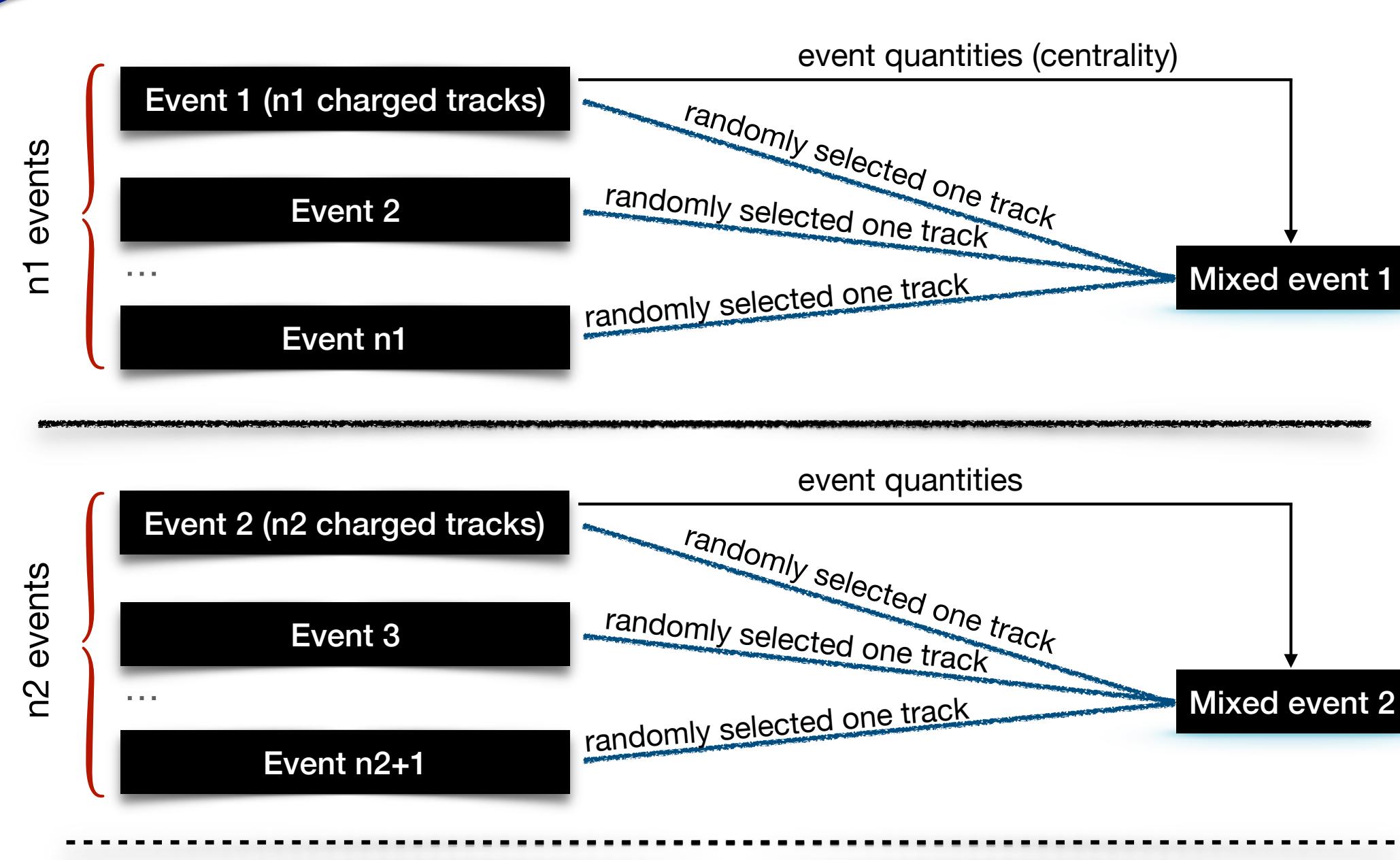
CBM



NICA

Fluctuations of net-particle numbers, encoded in cumulants κ_n , probe the phase structure of hadronic matter via derivatives of pressure \hat{P} with respect to the chemical potential $\hat{\mu}$. However, in experiments wounded nucleons (WN) also fluctuate e-by-e leading to non-vanishing $\kappa_n(N_W)$. Hence, fluctuations of N_W have to be accounted for in order to extract κ_n^{exp} from the measured κ_n .

We propose a data driven event-mixing scheme to control the N_W fluctuations



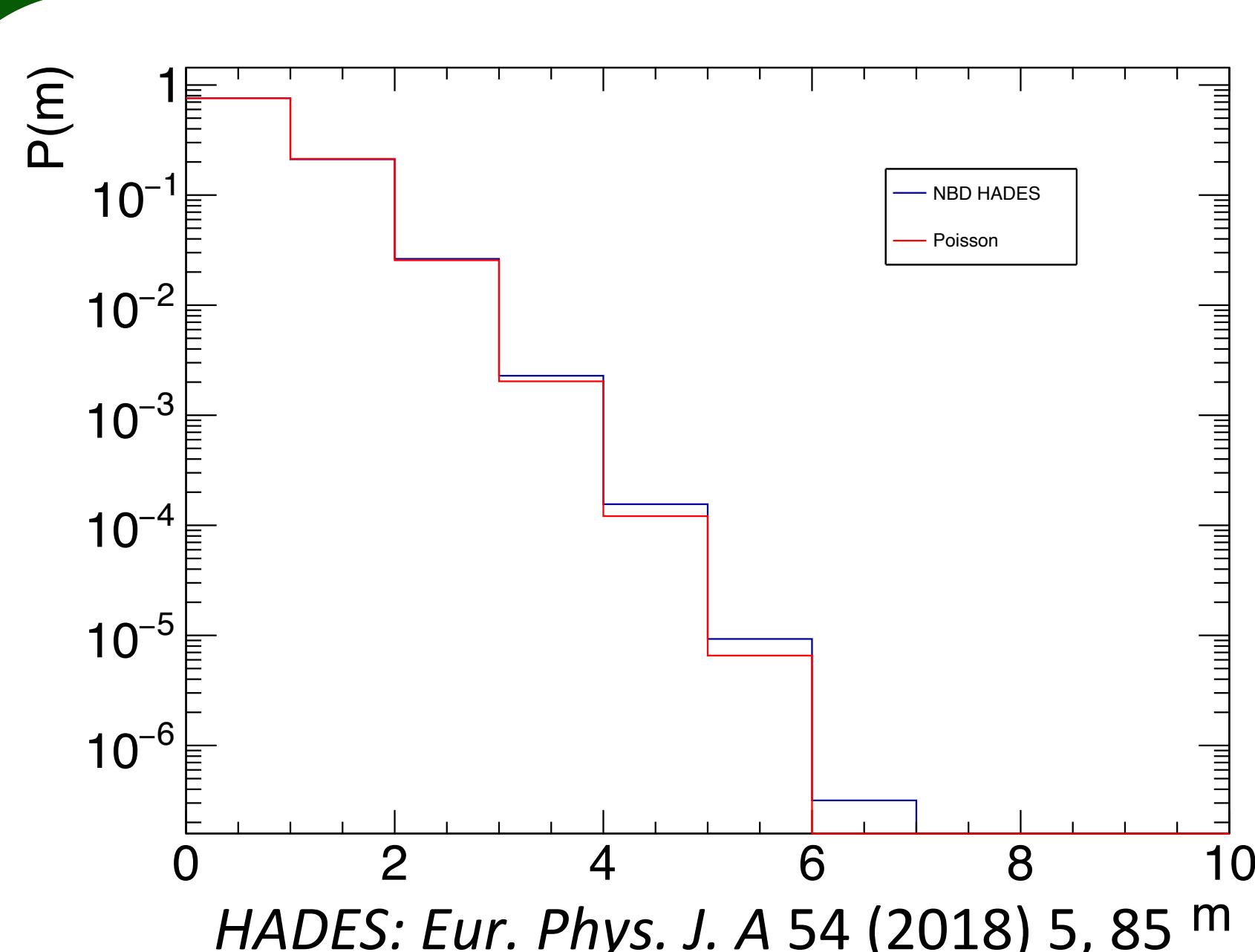
$$\frac{\kappa_2(N_W)}{\langle N_W \rangle^2} = \frac{\kappa_2^{mixed}(N_i)}{\langle N_i \rangle^2} - \frac{1}{\langle N_i \rangle} - \frac{1}{\langle N_W \rangle} \left[\frac{\kappa_2(m)}{\langle m \rangle^2} - \frac{1}{\langle m \rangle} \right]$$

Bias term, vanishes for Poisson P(m)

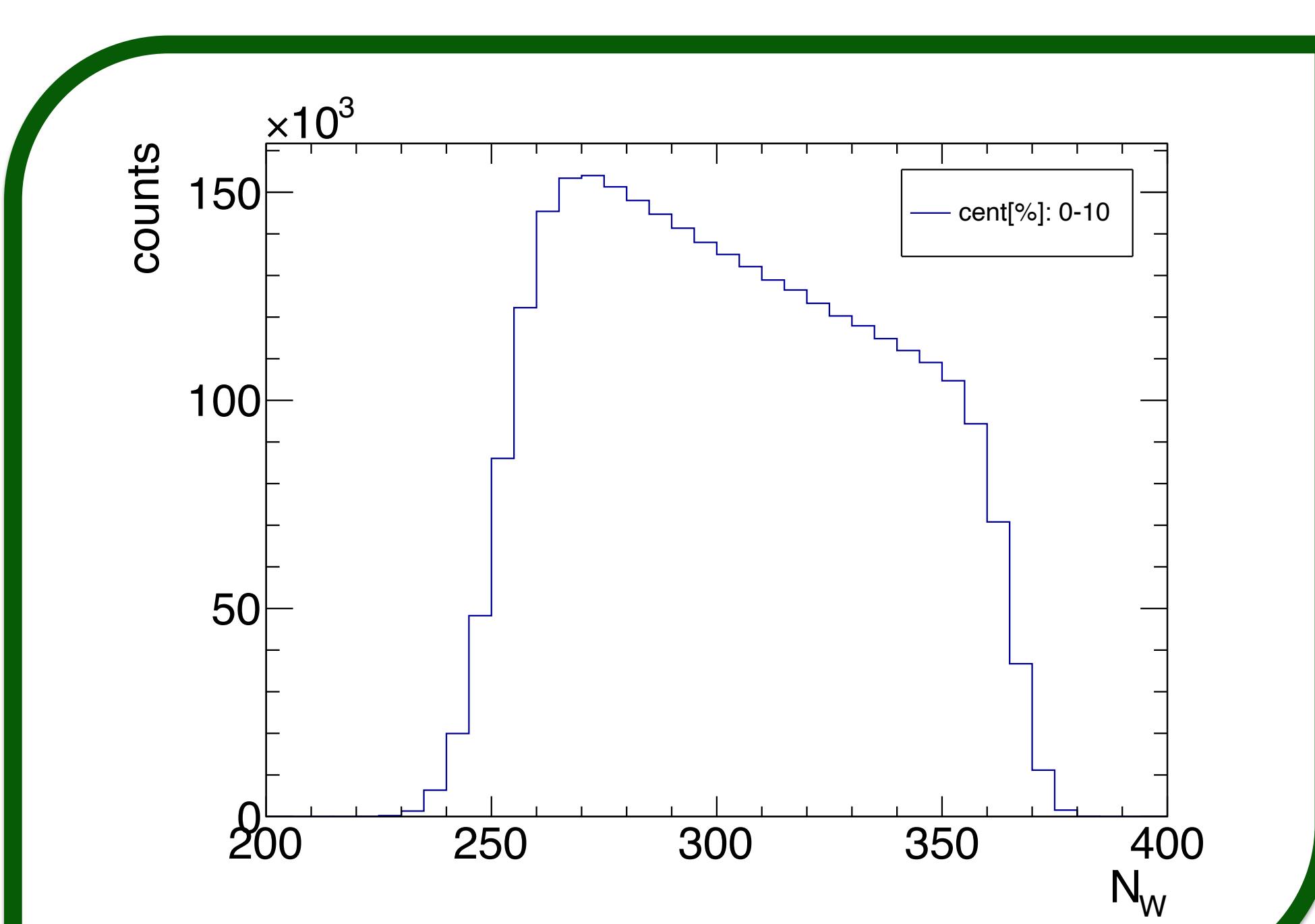
i - particle type, m - number of charged particles per WN
similar expressions for $\kappa_n(N_W)$ ($n = 3, 4 \dots$)

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R. Holzmann, V. Koch, A. Rustamov, J. Stroth, under preparation

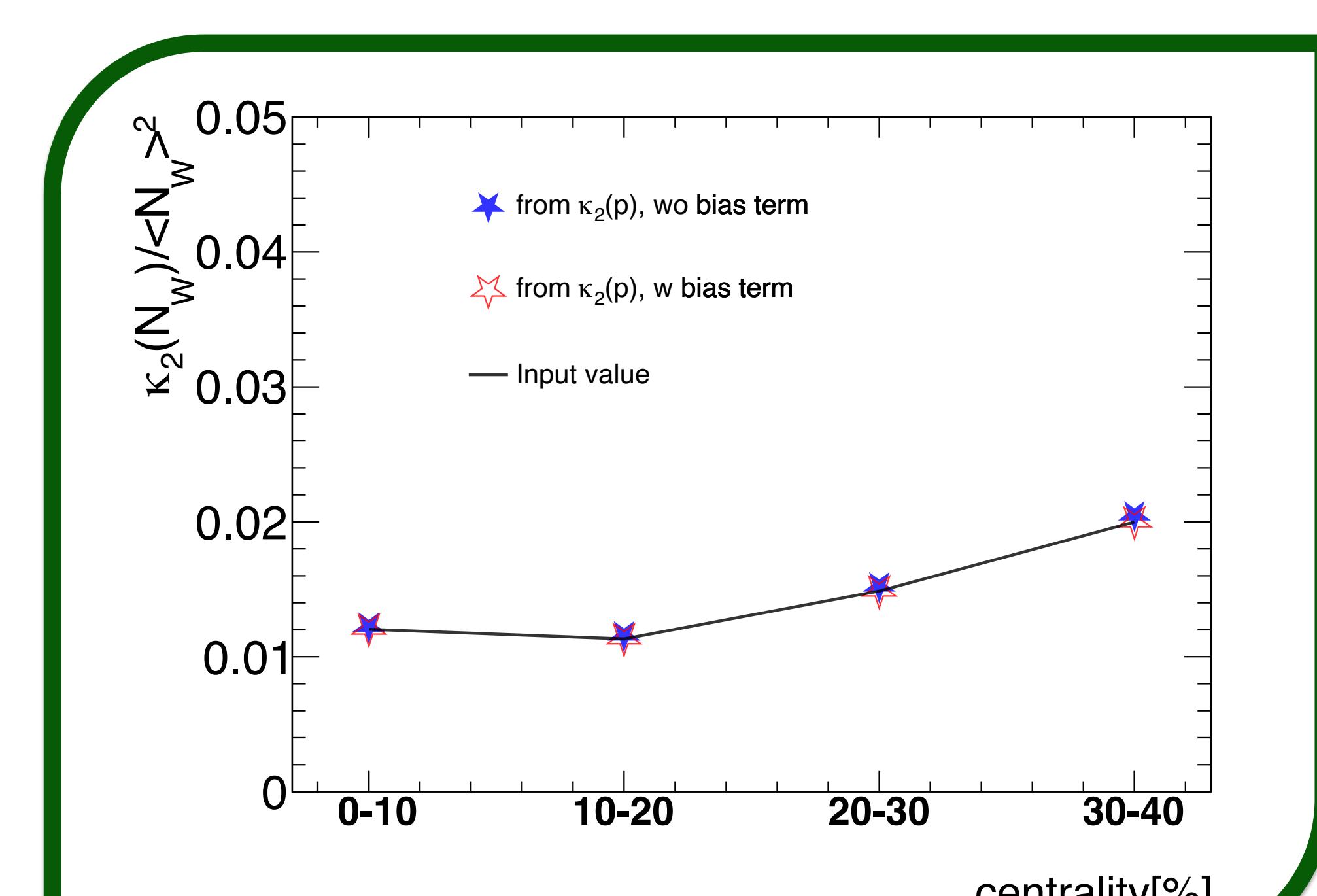
Verification of the method by proton emission in Au-Au simulations at $\sqrt{s_{NN}}=2.4$ GeV



Charged particle multiplicity per WN, input to simulations



Distributions of N_W , input to simulations, from Glauber MC



Fluctuations of N_W from mixed events vs. input values