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A Large-N Expansion for Minimum Bias

Wednesday 8 September 2021 13:18 (18 minutes)

Despite being the overwhelming majority of events produced in hadron or heavy ion collisions, minimum bias events do not enjoy a robust first-principles theoretical description as their dynamics are dominated by low-energy quantum chromodynamics. In this talk I will present a novel expansion scheme of the cross section for minimum bias events that exploits an ergodic hypothesis for particles in the events, and events in an ensemble of data. This expansion is entirely defined in terms of observable quantities, in contrast to models of heavy ion collisions that rely on unmeasurable quantities like the number of nucleons participating in collision. The expansion parameter that is identified is the number of detected particles N, and as $N \to \infty$ the variance of the squared matrix element about its mean, constant value on phase space vanishes. With this expansion, I will show that the transverse momentum distribution of particles takes a universal form that only depends on a single parameter, with fractional dispersion relation, and agrees with data in its realm of validity. Further I will show that the constraint of positivity of the squared matrix element requires that all azimuthal correlations vanish in the $N \to \infty$ limit, as observed in data. This approach enables unified treatment of small and large system collective behaviour, for instance being equally applicable to collective behaviour in heavy ion collisions and pp collisions. I will also briefly comment on power counting and symmetries for minimum bias events in other collider environments and show that a possible "ridge"in e+e− collisions is highly suppressed as a consequence of its symmetries.

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