Initial conditions in high energy heavy ion collisions

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Abstract

Relativistic heavy ion collisions (HICs) at the modern accelerators like the Relativistic Heavy Ion Collider the Large Hadron Collider provide unique testing ground for Quantum Chromodynamics (QCD) at high energies. Experimental observation over the past decade indicates that the strong color fields produced at the initial stages of HICs, as consequence of non-linear interactions of QCD, eventually leads to the formation of a liquid-like matter that filled the microsecond-old universe. The quantum fluctuations in the early stages of HICs lead to ripples in such liquid that can be detected by studying the angular correlations of particles produced in such collisions [1,2,3]. In the same way, the primordial quantum fluctuations in the early universe after the Big Bang are detected through inhomogeneities in the observation of cosmic microwave background [4]. In this talk, I will discuss recent theoretical and experimental progress in understanding the initial conditions of HICs [5]. Interestingly, the early stages of HICs also generate the strongest known electromagnetic fields (10^{18} Gauss) in the universe [6]. The quantum fluctuations in the early stages of HICs can lead to a possible violation of P and CP symmetries of strong interactions. Such an effect is expected to manifest as an asymmetry between the production of positive and negative charged particle along the direction of the strong magnetic field produced in HICs. [6,7]. It is known that a similar mechanism in electroweak interaction led to the prevalence of matter over antimatter in the early universe. In this talk I will briefly discuss about the ongoing and future experimental efforts towards the search for any possible signature of strong local parity violation in the early stages of relativistic heavy ion collisions [8].

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