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Exploring dense baryonic matter with the CBM experiment at FAIR

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Substantial experimental and theoretical efforts worldwide are devoted to explore the phase diagram of strongly interacting matter. At top RHIC and LHC energies, the QCD phase diagram is studied at very high temperatures and very low net-baryon densities. These conditions presumably existed in the early universe about a microsecond after the big bang. For larger net-baryon densities and lower temperatures, it is expected that the QCD phase diagram exhibits a rich structure such as a critical point, a first order phase transition between hadronic and partonic or quarkyonic matter, and the chiral phase transition. The experimental discovery of these prominent landmarks of the QCD phase diagram would be a major breakthrough in our understanding of the properties of nuclear matter.

The Compressed Baryonic Matter (CBM) experiment will be one of the major scientific pillars of the future Facility for Antiproton and Ion Research (FAIR) in Darmstadt. The goal of the CBM research program is to explore the QCD phase diagram in the region of high baryon densities using high-energy nucleus-nucleus collisions. This includes the study of the equation-of-state of nuclear matter at neutron star core densities, and the search for the deconfinement and chiral phase transitions. The CBM detector is designed to measure both bulk observables with large acceptance and diagnostic probes such as multi-strange hyperons, charmed particles and vector mesons decaying into lepton pairs. Most of these probes of dense matter will be measured for the first time with the CBM experiment in the FAIR energy range. The layout, the physics performance, and the status of the proposed CBM experimental facility will be discussed.