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ΓΝΩΣΗ ΚΑΙΝΟΤΟΜΙΑ ΠΟΛΙΤΙΣΜΟΣ

From detector development to exploring dense QCD matter with CBM



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The Compressed Baryonic Matter (CBM) experiment is a fixed-target heavy-ion experiment under construction at the Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany, designed to explore strongly interacting matter at high net-baryon densities. SIS100 will provide gold beams at kinetic energies of 2–11 AGeV, light-ion beams, and proton beams up to 29 GeV. Complementing the heavy-ion programs at Brookhaven National Laboratory and CERN, CBM will investigate the QCD phase diagram and constrain the equation of state of dense matter through high-precision measurements of rare probes. Its program encompasses multi-strange hyperons, hypernuclei, dileptons, collective flow, and event-by-event fluctuations, alongside proton-beam studies of hadron physics and reference measurements. Designed for interaction rates up to 10 MHz, CBM combines slowly extracted beams with free-streaming, triggerless readout and online reconstruction. Silicon tracking detectors are complemented by ring-imaging Cherenkov, transition-radiation, and time-of-flight detectors for particle identification. The modular setup accommodates configurations optimized for electron or muon measurements. Following extensive prototyping, major detector systems have entered series production, with components being manufactured, qualified, and assembled. Several beam campaigns with the mini-CBM demonstrator at SIS18 have successfully demonstrated high-rate operation using a common free-streaming data-acquisition chain. Lambda-baryon reconstruction in Ni+Ni collisions provides a proof of concept for the integrated detector and reconstruction capabilities. Complementary simulation-based feasibility studies assess signal reconstruction, background rejection, and the expected precision of key physics measurements. A broad international collaboration shares responsibility for detector construction, computing, and physics analysis across institutes in multiple countries. These coordinated efforts are preparing CBM for the FAIR physics program, with first SIS100 beams anticipated in 2028.

Dr Maksym Teklishyn is a staff physicist at the GSI Helmholtz Centre for Heavy Ion Research in Darmstadt, Germany. He obtained his PhD from Paris-Sud University in 2014, studying charmonium production with the LHCb experiment at CERN. His research focuses on silicon tracking detectors for particle and heavy-ion physics. He contributes to the construction and integration of the Silicon Tracking System for the CBM experiment at FAIR and coordinates the collaboration's Tracker Upgrade task force. Previously, he worked on the CMS Tracker Phase II Upgrade at Université catholique de Louvain. He also supervises student research, including a recent project with Aristotle University of Thessaloniki on the feasibility of upgrading the CBM tracker.

