Probing Charm Production in Cold Nuclear Matter with the CBM Proton Beam Program

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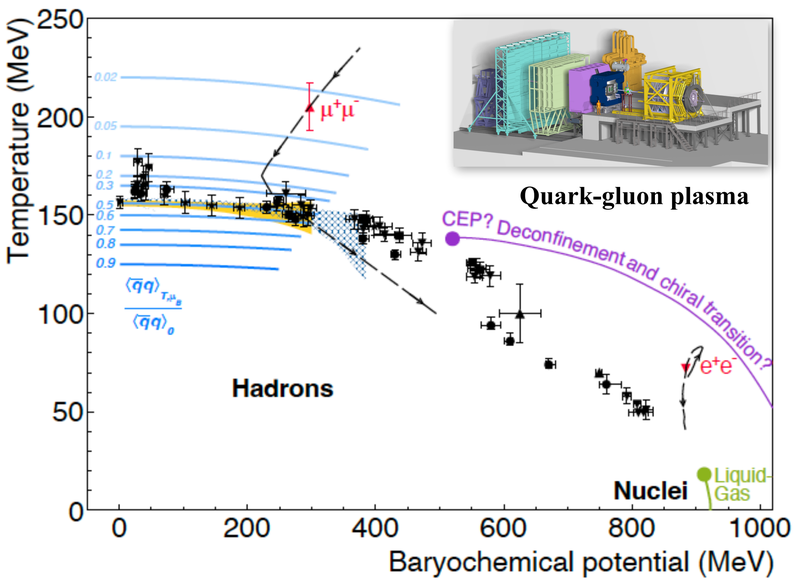
Mapping the phase diagram of strongly interacting matter in the region of high baryon density



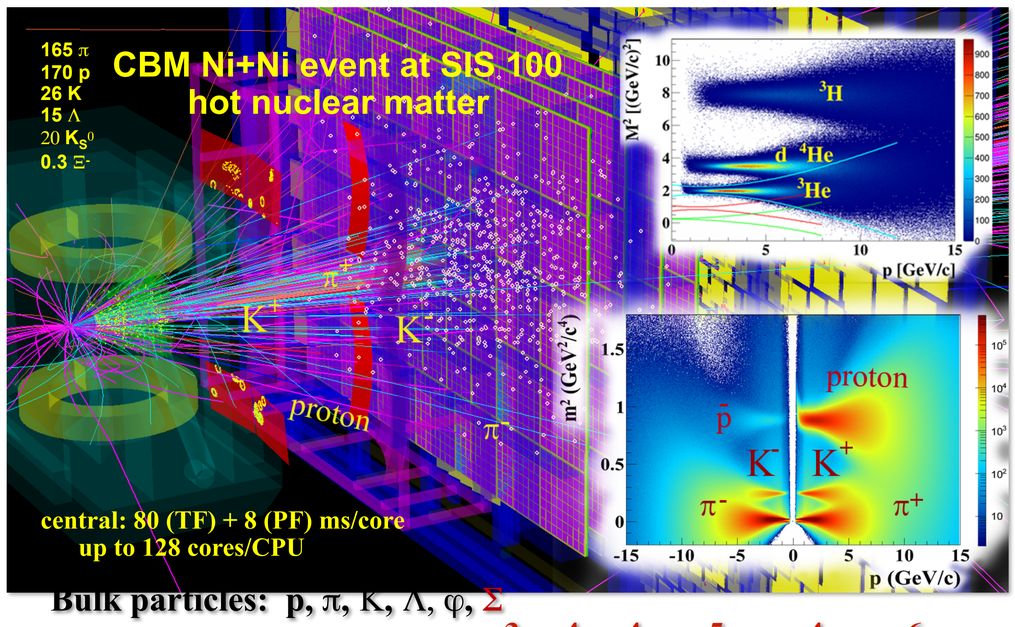
The CBM experiment at FAIR aims to study the properties of dense nuclear matter in the region of the quark-gluon plasma phase transition.

This extreme environment offers a unique opportunity to study hyperon-nucleon and hyperon-hyperon interactions through the production and decay of multi-strange particles and hypernuclei.

Understanding these interactions is critical for describing the nuclear equation of state at high densities and the structure of neutron stars.

Key observables: yields and distributions of particles including
- **Charm, multi-strange hyperons (Λ, Σ, Ξ, Ω) and Hypernuclei**

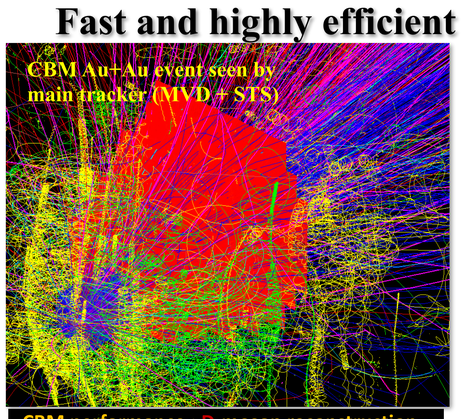
Interaction rates up to 10^7 collisions/sec
700 charged particles/collision, baryon density ~ 5 ρ_0

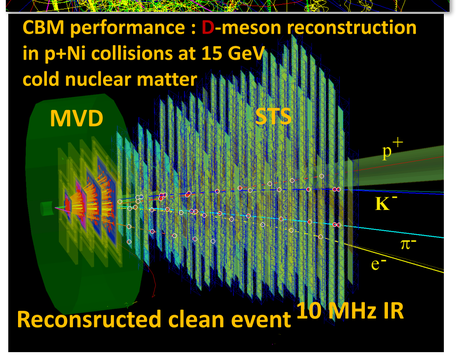


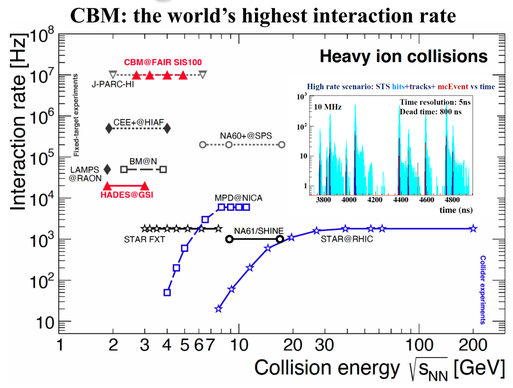
Bulk particles: p, π, K, Λ, φ, Σ

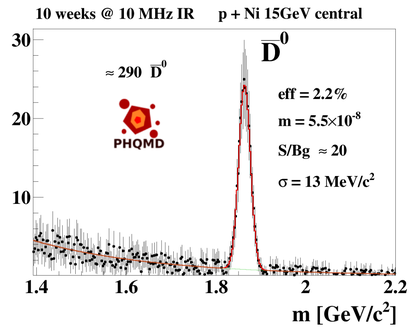
Rare probes: D⁰, D±, Λ_c; Ξ, Ω; ${}^{3}_{\Lambda}$H, ${}^{4}_{\Lambda}$H, ${}^{4}_{\Lambda}$He, ${}^{5}_{\Lambda}$He; ${}^{4}_{\Lambda\Lambda}$He, ${}^{6}_{\Lambda\Lambda}$He

Fast and highly efficient 4D tracking with STS detector



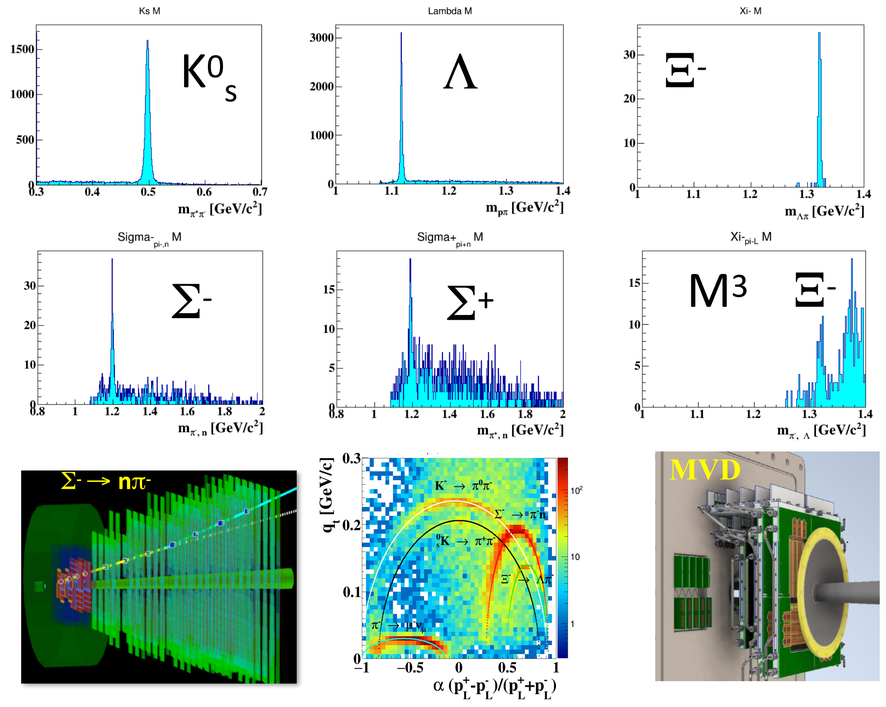




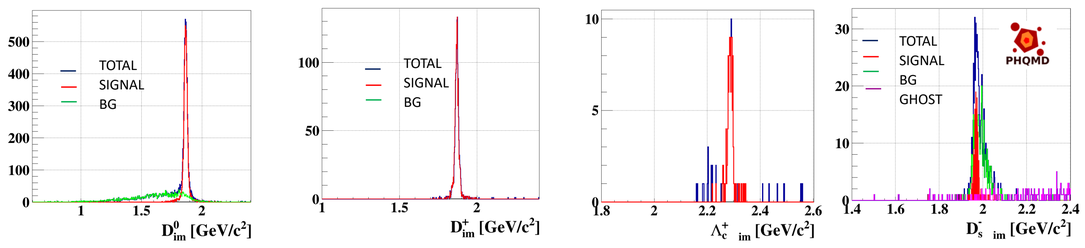


Strangeness: p +Be at 30 GeV (10^6 events 10 sec at day one)

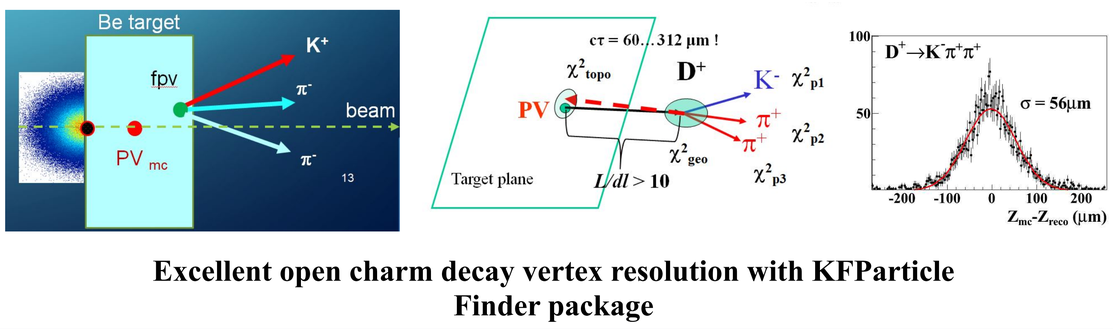
PHQMD



Open charm in CBM at SIS100 with p + Be at 30 GeV



1M simulated PHQMD events with charm trigger: CBM is sensitive to open charm particles within current PHQMD predictions of their multiplicities.



Excellent open charm decay vertex resolution with KFParticle Finder package

Summary

CBM@SIS100: Open charm production at threshold

Proton beams up to 30 GeV
- ➢ Excitation function of charm (production mechanism)
- ➢ Charm propagation in cold nuclear matter

  Light nuclei (Ni) beams up to 15 GeV
- ➢ Charm production & propagation in hot nuclear matter