Emissivity of Baryon-Rich Matter – Dilepton Spectroscopy in CBM

Etienne Bechtel[1], Tetyana Galatyuk[2], Christoph Blume[1]
for the CBM collaboration

[1] IKF – Goethe Universität, Frankfurt, Germany, [2] IKP – Technische Universität, Darmstadt, Germany

CBM

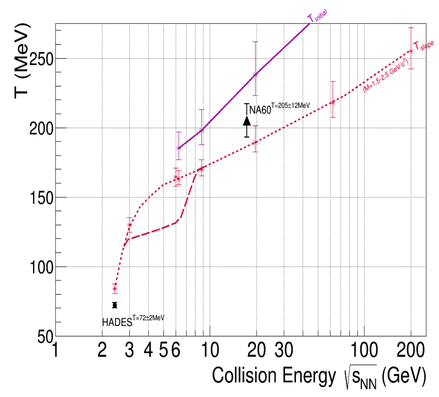
Compressed Baryonic Matter experiment at FAIR

Motivation

Explore QCD phase structure

Phase transition(s) and critical point
- Measure caloric curve for the hadron-QGP phase

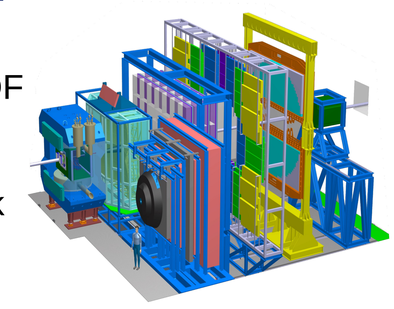
Chiral Symmetry restoration
- Measure in-medium ρ spectral function ($\rho - a_1$ chiral mixing)

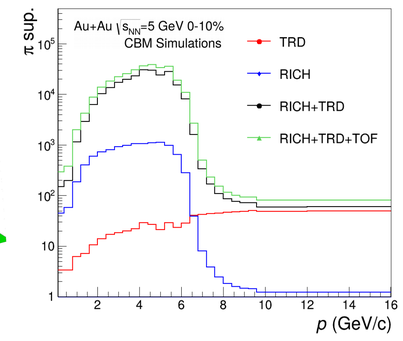


Electron identification

Particle tracking:
- STS (in dipole magnet) + TRD + TOF

Particle identification (PID):
- RICH → Artifical Neural Network
- TRD → Likelihood method
- TOF



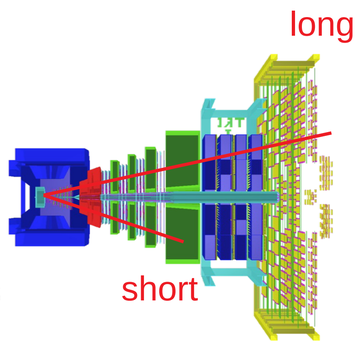


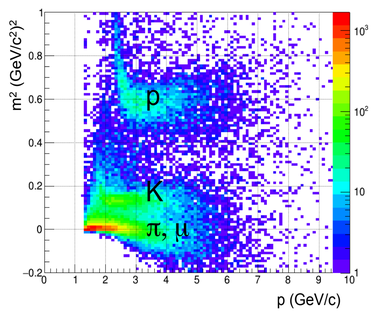
Muon identification

Exchange RICH by MUCH

Instrumented absorbers:
60 cm C + (20+20+30+100) cm Fe

Track topology of muon track candidates

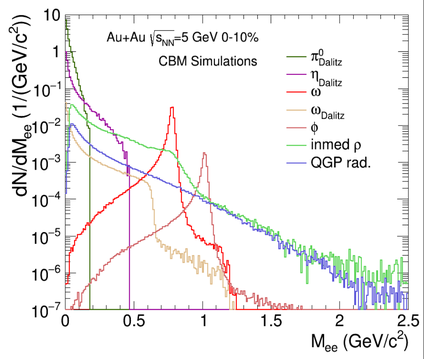




Simulation input

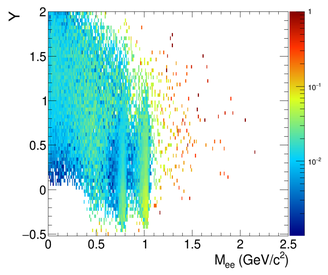
Background events:
- 5 million UrQMD events

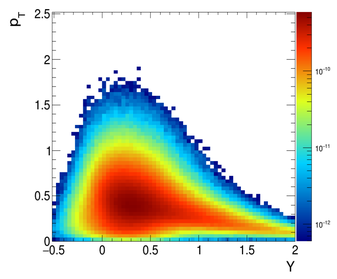
Signals:
- A cocktail of low mass vector mesons
  (W. Cassing et al., Nucl. Phys. A691 (2001) 753)
- Thermal radiation
  (T. Galatyuk et al., Eur. Phys.J. A52 (2016) 131)



Phase space

Phase space distribution of reconstructed ω signals and acceptance of the input



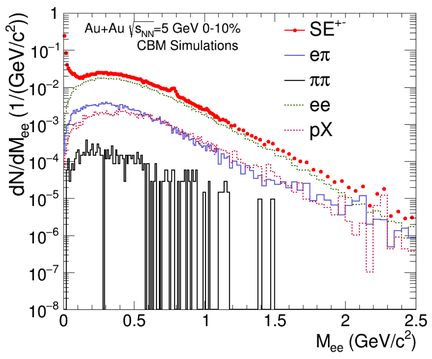


Invariant mass spectra

Dielectron Spectra

Combinatorial background at top right

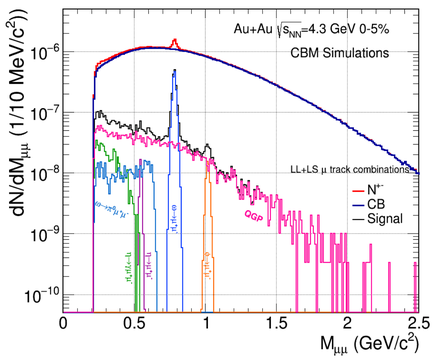
Reconstructed pairs of same events in red

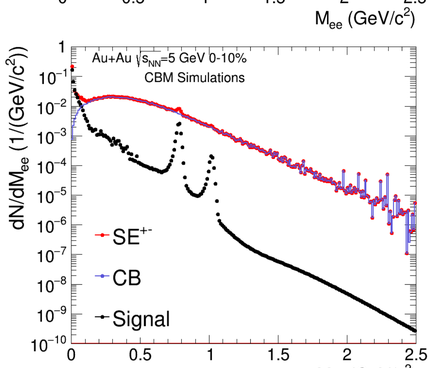


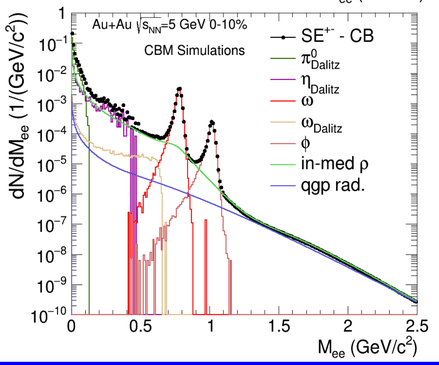
Dimuon Spectrum

Full scale simulation with 5 million events

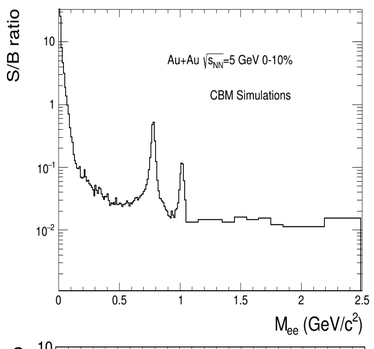
Background estimation via event mixing

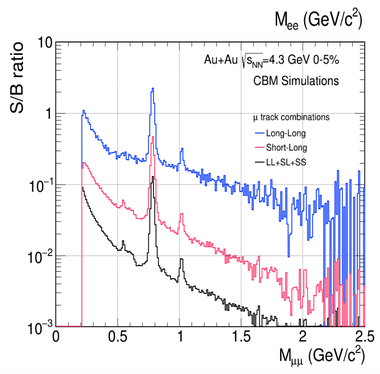






Signal-to-background





Dielectron ratio top

Dimuon ratio bottom

Signal to combinatorial background ratio above 10%

High S/B ratio in the region of π^0_{Dalitz}

Clear signal peaks for ω and ϕ

Sufficiently high S/B over the whole intermediate mass range

Thermal radiation

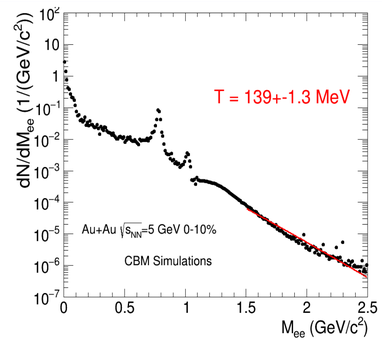
Access to thermal radiation at intermediate mass range

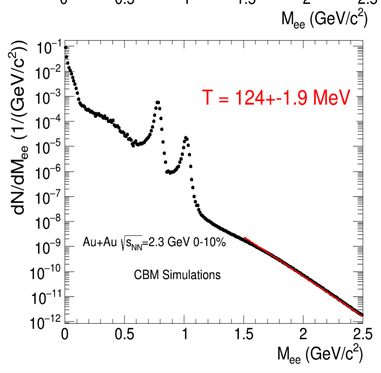
Signals are corrected for acceptance and efficiency

Fitfunction: $M^{\frac{3}{2}} \cdot e^{\frac{-M}{T}}$

The running day 1 scenario will be 4 weeks at 200 kHz interaction rate
- Later go to 1-10 MHz

Investigation of systematic errors in progress





FAIR
HIC for FAIR Helmholtz International Center
Bundesministerium für Bildung und Forschung
GOETHE UNIVERSITÄT FRANKFURT AM MAIN
HGS-HIRe for FAIR Helmholtz Graduate School for Hadron and Ion Research
TECHNISCHE UNIVERSITÄT DARMSTADT
GSI