Simulations of thermal dielectrons for the CBM experiment

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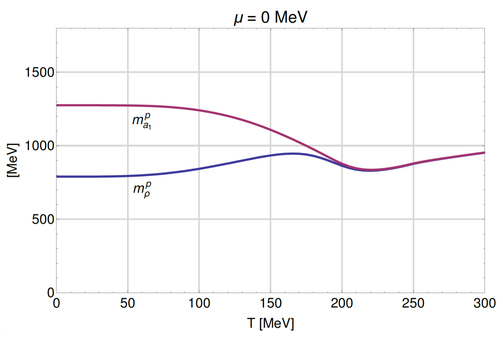
CBM at FAIR

Compressed Baryonic Matter experiment

Motivation

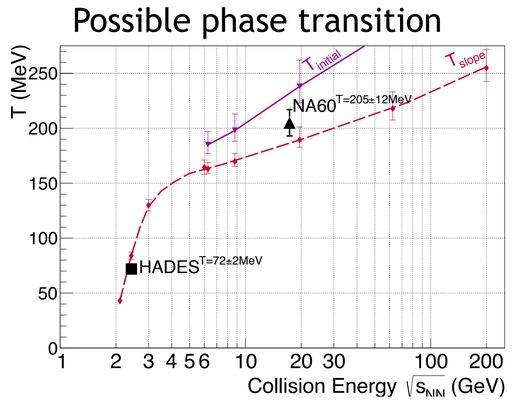
- In nature chiral symmetry is spontaneously broken
  - A measurement of it's restoration would be a breakthrough
  - Manifests in mixing of chiral pairs
  - Dileptons give direct access to the chiral mixing
- Is there a first order phase transition?
  - No measurements in the respective energy regime
  - Dielectrons can be used as thermometer of the emitting source
  - They can also be used as chronometer and barometer
  - They carry information about the early phases of the fireball

Chiral mixing



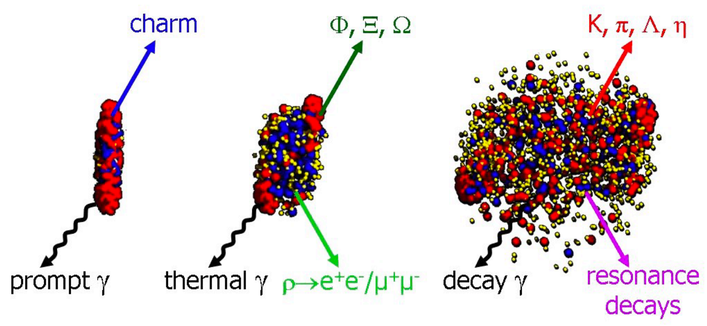
*C. Jung, F. Rennecke, R.-A. Tripolt, L. v. Smekal, J. Wambach, Phys. Rev. D 95, 036020 (2017)

Possible phase transition



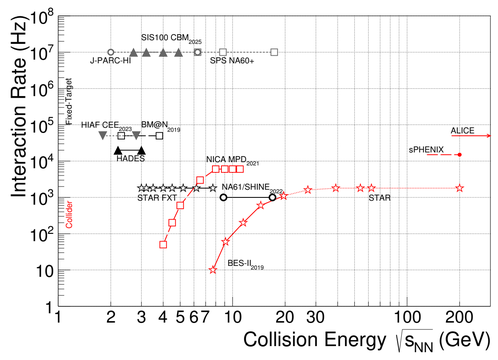
*R. Rapp, H. van Hees, PLB 753 (2016) 586
T. Galatyuk *et al.*: EPJA 52 (2016) 131

Fireball development in a heavy ion collision

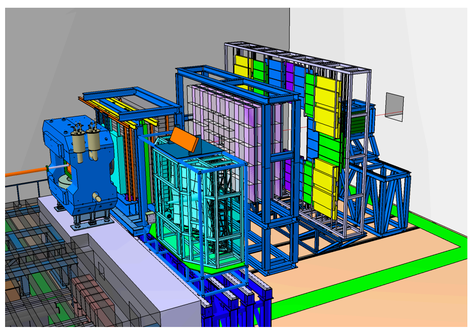


The CBM experiment

- Unmatched interaction rates at moderate energies
  - Investigation of rare processes
- Interchangable detector configurations
  - Specified for electron / muon / hadron measurements



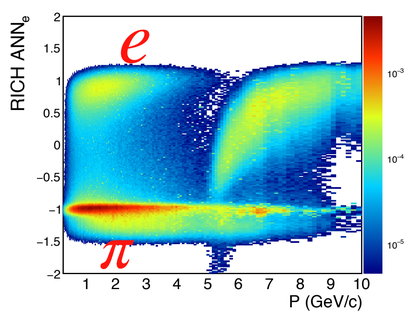
*T. Galatyuk., Nucl.Phys. A982 (2019) 163-169

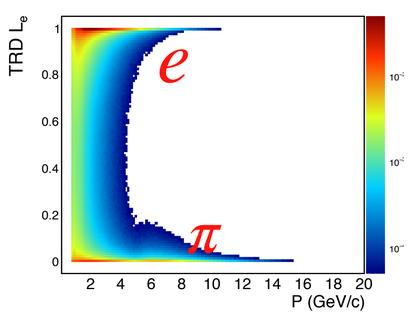


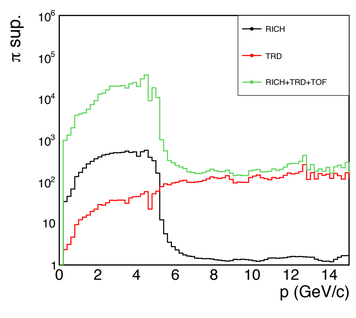
12 A GeV 10% most centr. Au+Au collisions

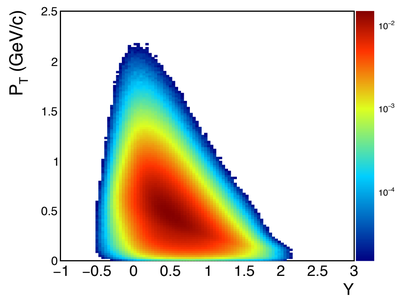
- New theory calculations for thermal radiation at 12 A GeV
  - Fireball model with a coarse-graining approach
- New filtering algorithm allowed larger simulations
  - Simulated 200 million thermal dielectron pairs

Particle identification with the sub systems

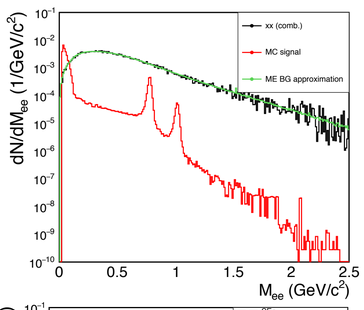




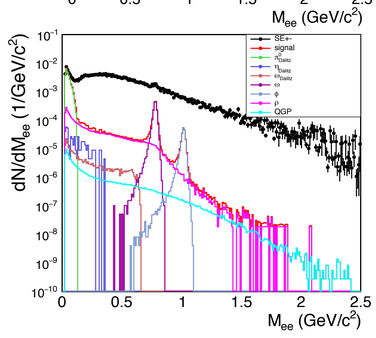




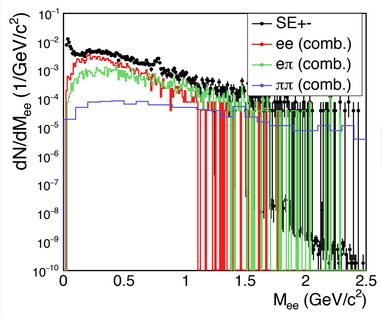
Event mixing describes the background very well

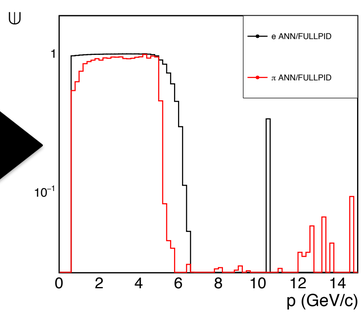


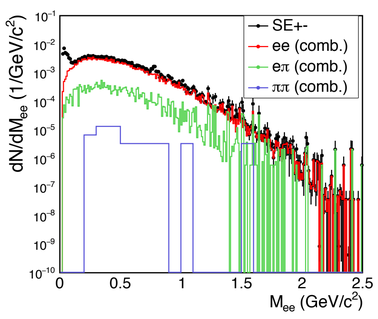
Thermal radiation is the only signal source above 1 GeV



- New challenges from software changes
  - Track selection with machine learning on global level

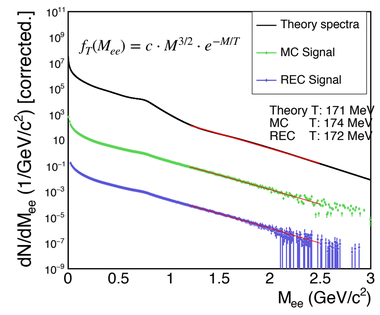






Extracted inverse slope parameter of thermal sources reproduced the theory values

→ Outlook: repeat analysis for 3 GeV



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