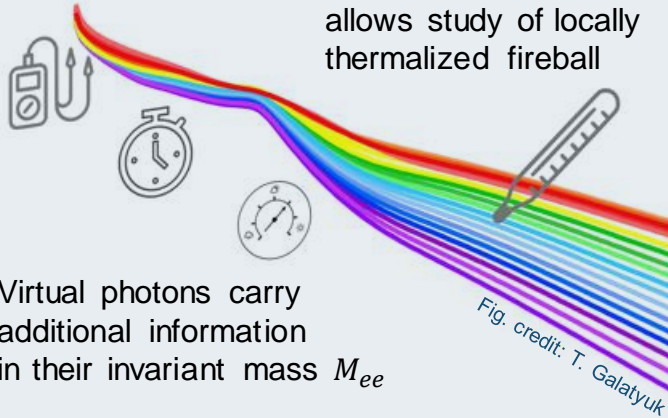


Centrality and system size dependence of the thermal dilepton excess yield in HADES

The promise of electromagnetic probes

Direct access to all stages in heavy-ion collisions

In particular: isolation of thermal contribution allows study of locally thermalized fireball



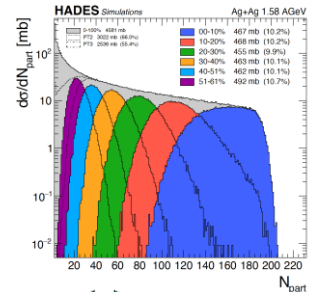
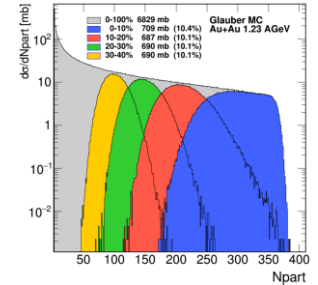
The experimental data

$3 \cdot 10^9$ Au+Au and $8 \cdot 10^8$ Ag+Ag selected collision events, both at $\sqrt{s_{NN}} = 2.42$ GeV:

Same energy

Overlapping centralities with same mean number of participants $\langle A_{part} \rangle$

Goal
Establish system size, centrality dependence of thermal dileptons



The High-Acceptance-Di-Electron-Spectrometer

HADES key facts

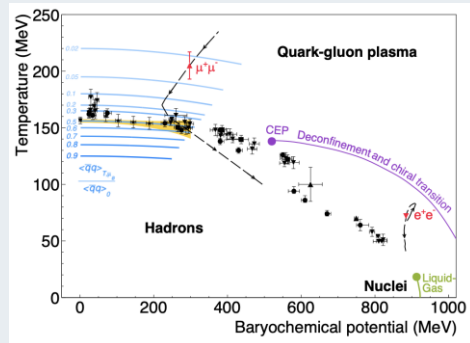
Explores region of high densities and moderate temperatures

Low-mass magnetic spectrometer

Fixed-target experiment for heavy-ion, p , d , π induced reactions in few GeV range

High rate (~ 50 kHz for pp , ~ 20 kHz for HIC)

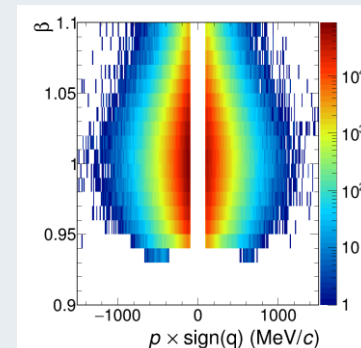
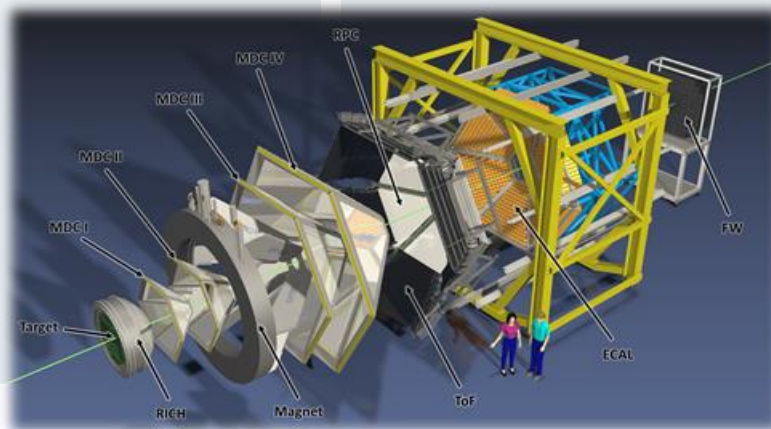
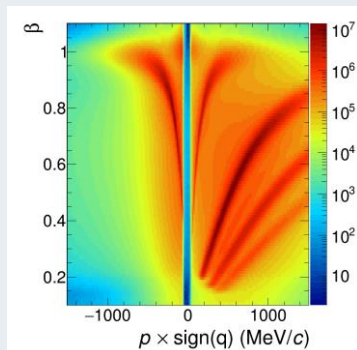
Large acceptance: $0^\circ < \varphi < 360^\circ$, $18^\circ < \theta < 85^\circ$



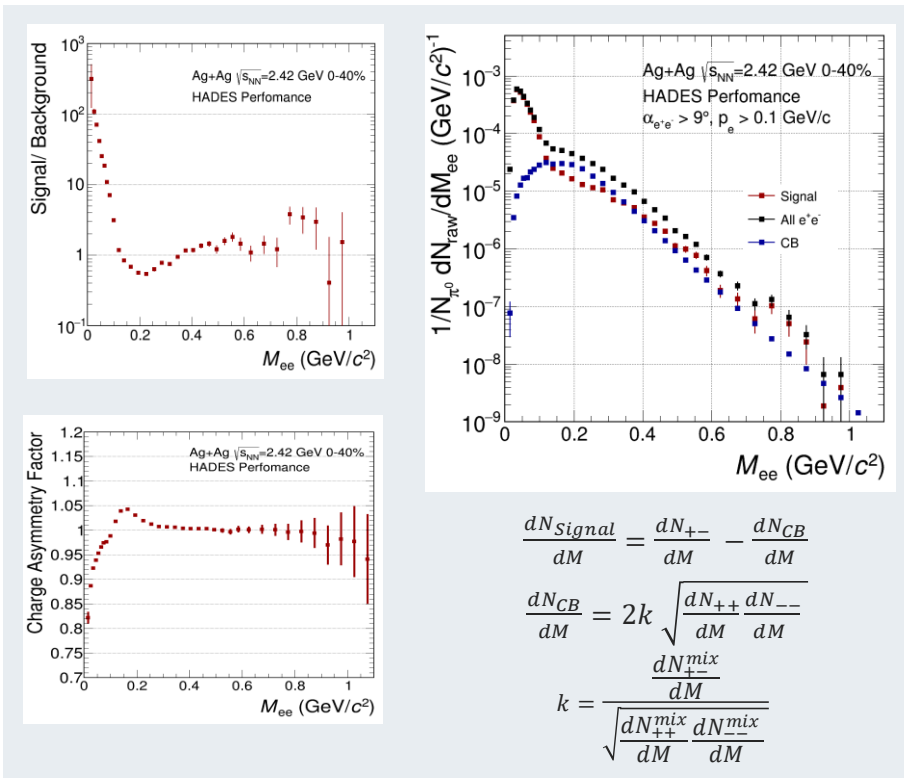
Particle identification

Dedicated detector components provide multiple e^\pm selection criteria:

- Electromagnetic Calorimeter
- Ring-Imaging-Cherenkov detector (RICH)
- Velocity β



Reconstructing the dilepton signal

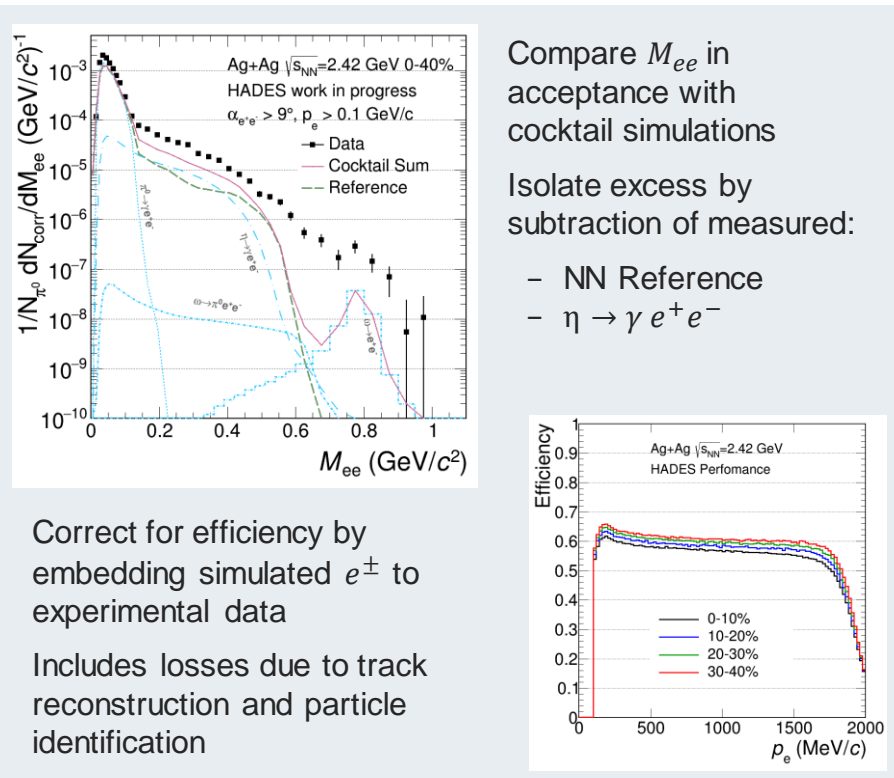


$$\frac{dN_{Signal}}{dM} = \frac{dN_{+-}}{dM} - \frac{dN_{CB}}{dM}$$

$$\frac{dN_{CB}}{dM} = 2k \sqrt{\frac{dN_{++}}{dM} \frac{dN_{--}}{dM}}$$

$$k = \frac{\frac{dN_{mix}}{dM}}{\sqrt{\frac{dN_{++}^{mix}}{dM} \frac{dN_{--}^{mix}}{dM}}}$$

The mass spectrum in acceptance



Compare M_{ee} in acceptance with cocktail simulations

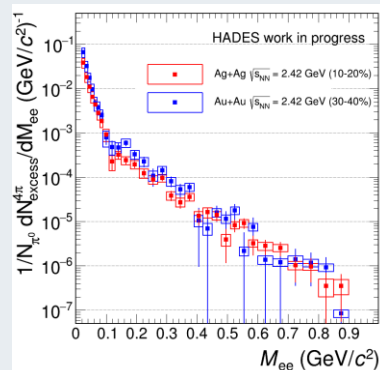
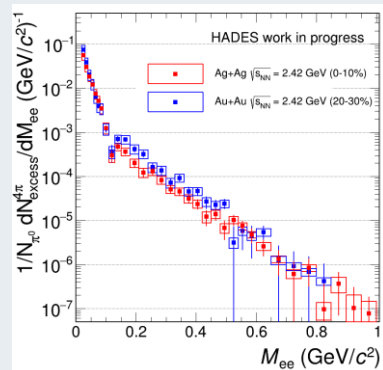
Isolate excess by subtraction of measured:

- NN Reference
- $\eta \rightarrow \gamma e^+e^-$

Correct for efficiency by embedding simulated e^\pm to experimental data


Includes losses due to track reconstruction and particle identification

Acceptance corrected excess yield




Extract observables in dominant mass region of in-medium ρ

Chronometer

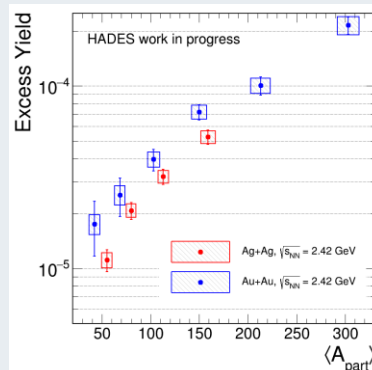
$$N_{\text{excess}} = \int_{0.3 \text{ GeV}/c^2}^{0.7 \text{ GeV}/c^2} \frac{dN}{dM} dM$$


Thermometer

$$\frac{dN}{dM} \propto M^3 \exp\left(-\frac{M}{T}\right)$$


Before final: Investigate systematic uncertainties due to:

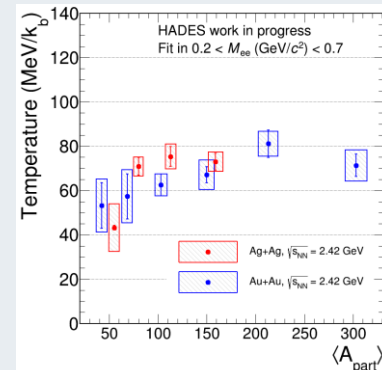
- Cocktail subtraction
- Possible carbon contamination from collisions with structure material around target in peripheral collisions



Current results indicate a consistently higher yield for the larger overall system

Fit $\propto \langle A_{part} \rangle^\alpha$ gives:

- $\alpha^{Au+Au} = 1.34 \pm 0.09$
- $\alpha^{Ag+Ag} = 1.42 \pm 0.14$



Ag+Ag temperatures still subject of systematic uncertainties

Dependence on $\langle A_{part} \rangle$ as well as overall system size is less pronounced

First Insights: Analysis of Dilepton Anisotropy and Flow Coefficients

High statistics data Ag+Ag $\sqrt{s_{NN}} = 2.55$ GeV allows for multidifferential flow analysis

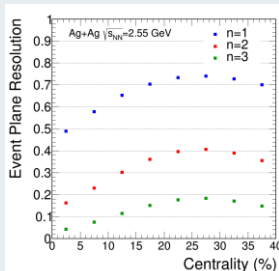
Opens possibility to study collective behavior



Analysis procedure

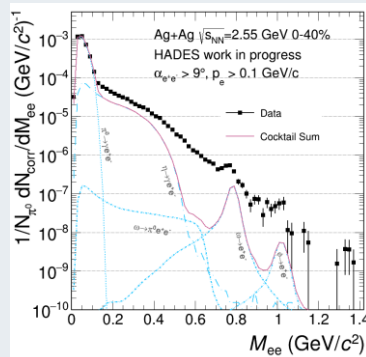
Event plane Ψ_{RP} reconstructed via modified total transverse momentum transfer technique [1]

Event plane resolution R_n estimated via Ollitrault method [2]

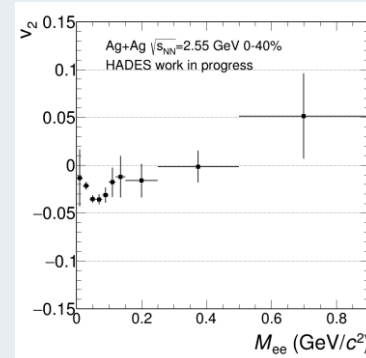
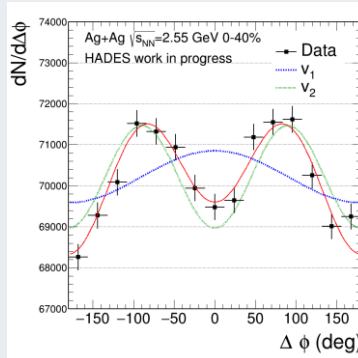


$$\frac{dN}{d\Delta\phi} \propto 1 + 2 \sum_{n=1}^{\infty} v_n \cos(n \Delta\phi)$$

$$\Delta\phi = \varphi_{ee} - \Psi_{RP} \quad v_n = \frac{v_n^{obs}}{R_n}$$



Elliptic flow



For $M_{ee} < 0.14$ GeV/c² dilepton signal is dominated by π^0 Dalitz decay $\rightarrow v_2(\pi^0)$ consistent with $v_2(\pi^{+/-})$

v_2 close to zero at higher masses \rightarrow supports the idea that dileptons serve as penetrating probes in the hot and dense medium

- Ongoing work**
- Isolation of thermal contribution
 - Determination of systematic uncertainties