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VIRTUAL PHOTONS FROM HOT AND DENSE MATTER AT HADES

MEET HADES



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<https://www.worldhistory.org/image/778/statue-of-hades-and-cerberus/>

Maybe not this one..

MEET HADES



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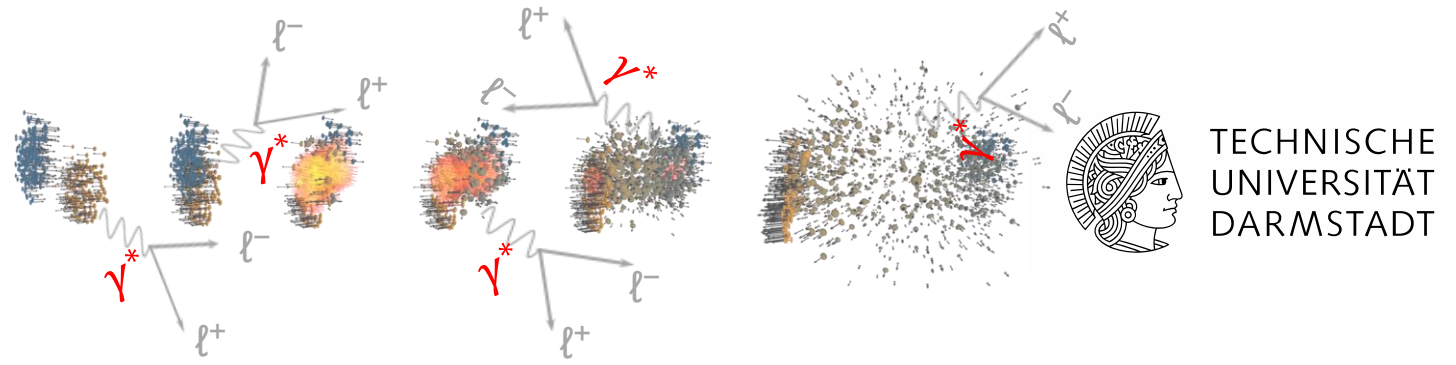


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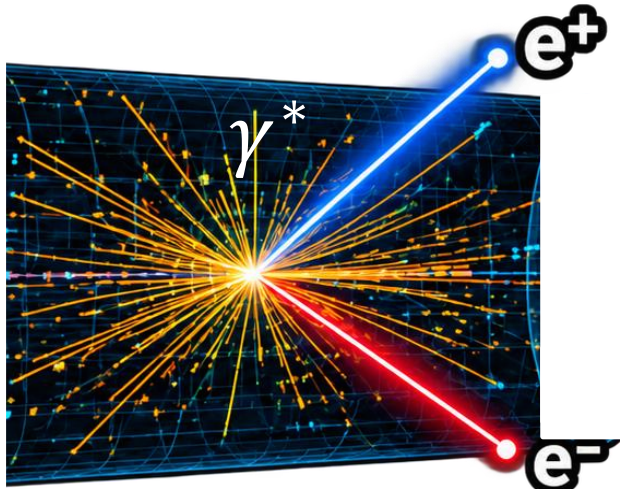


- PhD student in Darmstadt
- RG Prof. Galatyuk
- Focus on dilepton physics
- Exploring the QCD matter

VIRTUAL PHOTONS PROBE OF FIREBALL

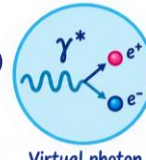


- In a heavy-ion collision, a hot and dense fireball is created
- Photons emitted from the fireball decay into a dilepton pair (e^+e^-)
- Dileptons act as an X-ray of the fireball
- Dileptons (e^+e^-) are **clean** : no further strong interaction

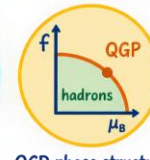


MOTIVATION

WHY VIRTUAL PHOTONS?



Virtual photon
($\gamma^* \rightarrow e^+e^-$)



QCD phase structure
High μ_B , low T



Clean messenger
Weak final-state interactions



Collision history
Emitted throughout the evolution



Transport properties
Electrical conductivity



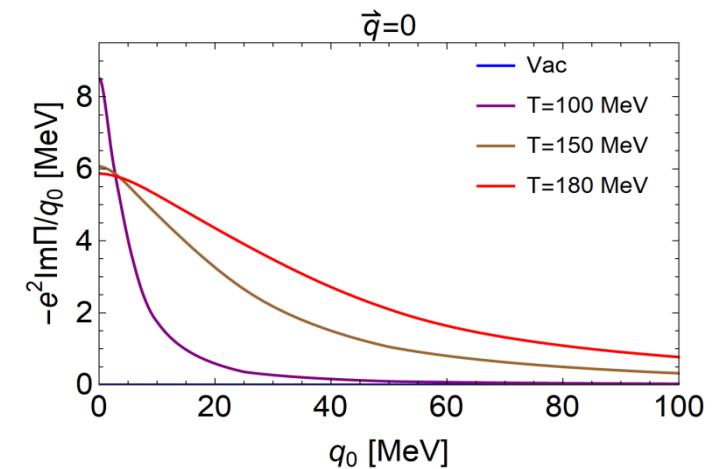
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Goal: study QCD phase structure at high baryon density

Target: transport properties, e.g. electrical conductivity σ_{el}

$$\sigma_{el}(T) = -e^2 \lim_{q_0 \rightarrow 0} \frac{\rho_{EM}(q_0, \vec{q} = 0, T, \mu_B)}{q_0}$$

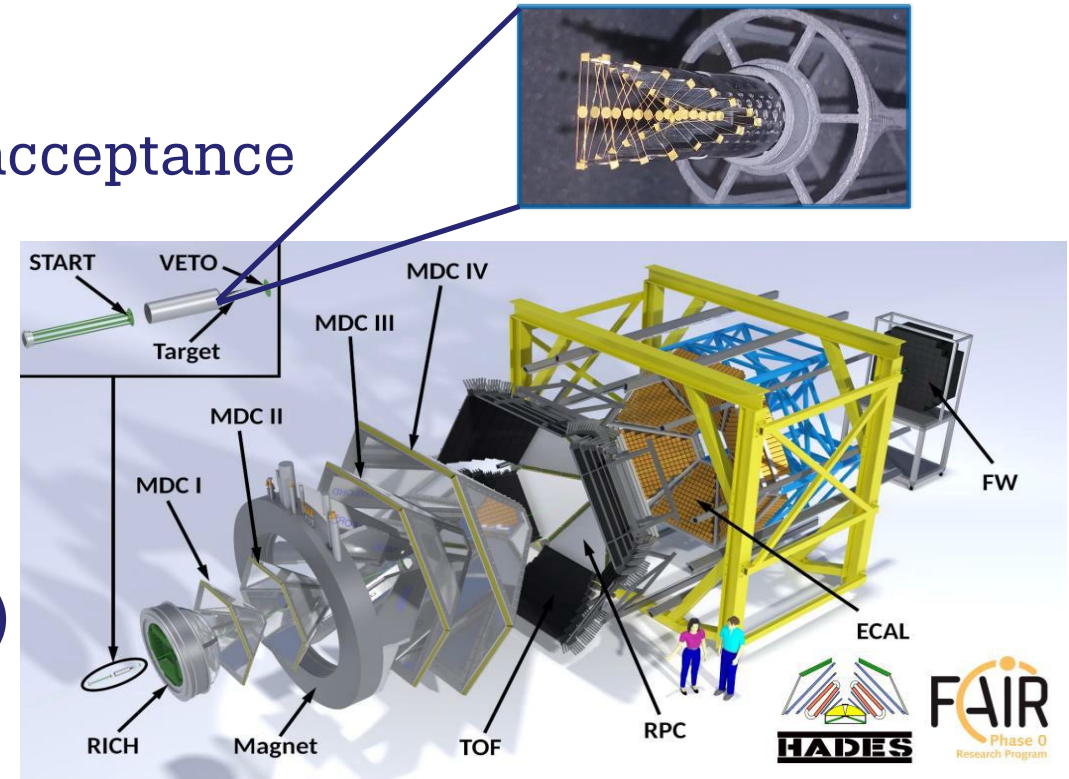
- σ_{el} is linked to the emission rate at $\mathbf{p}_{ee} \rightarrow 0, \mathbf{M}_{ee} \rightarrow 0$



Atchison, Rapp, Nucl. Phys. A 1037 (2023) 122704

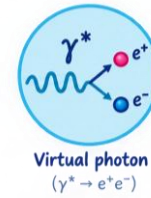
HADES BUILT FOR DILEPTONS

- Heavy-ion beams, $\sqrt{s_{NN}} \approx 2\text{--}3\text{ GeV}$
- Field-free target region and high geometrical acceptance
- High-rate capability
- Low material budget: less photon conversion
- **Dedicated run with reduced field (6% of I_{max})**



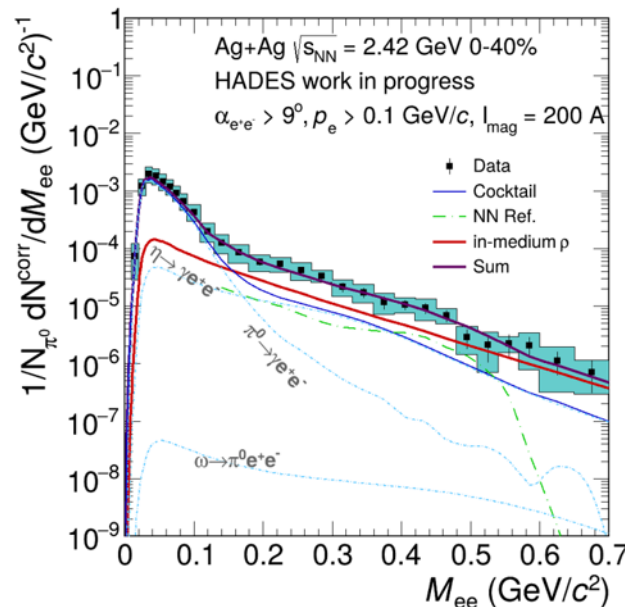
RESULTS

AG+AG AT $\sqrt{s_{NN}} = 2.42$ GEV

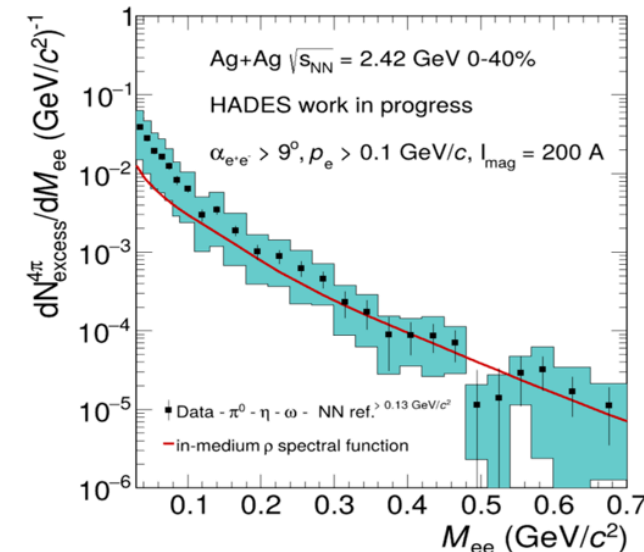


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- Excess radiation, reduced field ($I_{mag} = 200$ A)
- Acceptance-corrected spectra
- NN reference applied for $M_{ee} > 0.13$ GeV/c²
- **First extraction of the excess at very soft dilepton kinematics**
- Excess observed down to very low M_{ee} and p_{ee} , the region sensitive to σ_{el}



cocktail subtracted



OUTLOOK

Thermal radiation extraction

$I_{\text{mag}} = 200\text{A}$, lower momentum cut



Differential p_{CM} thermal spectra



Extrapolation to low-mass limit



Theory comparison

On-going work in the group

Thank you!

See you at poster no. 30!