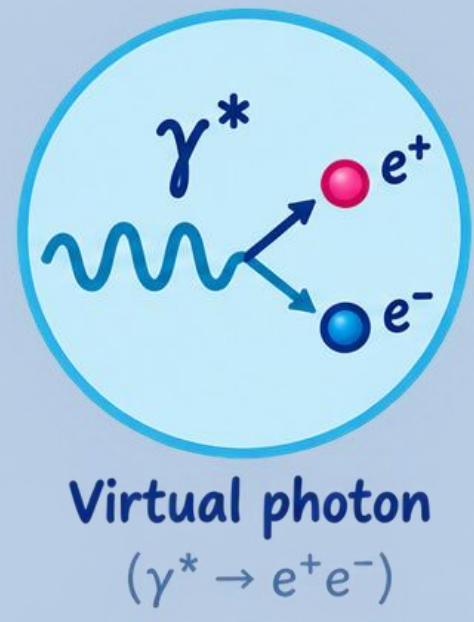
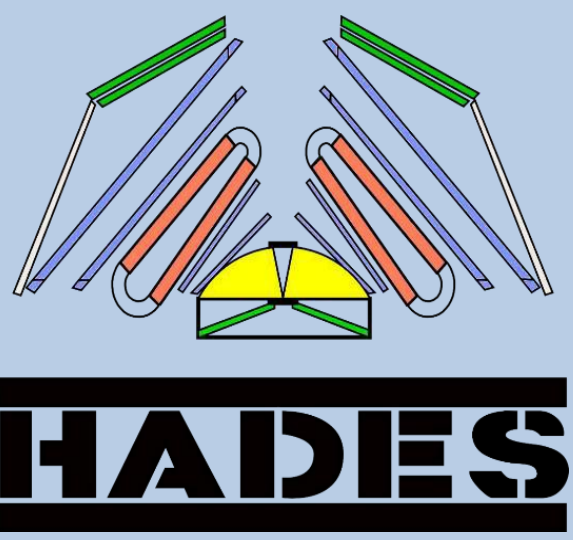


Virtual photons from hot and dense matter at HADES

30



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for the HADES Collaboration

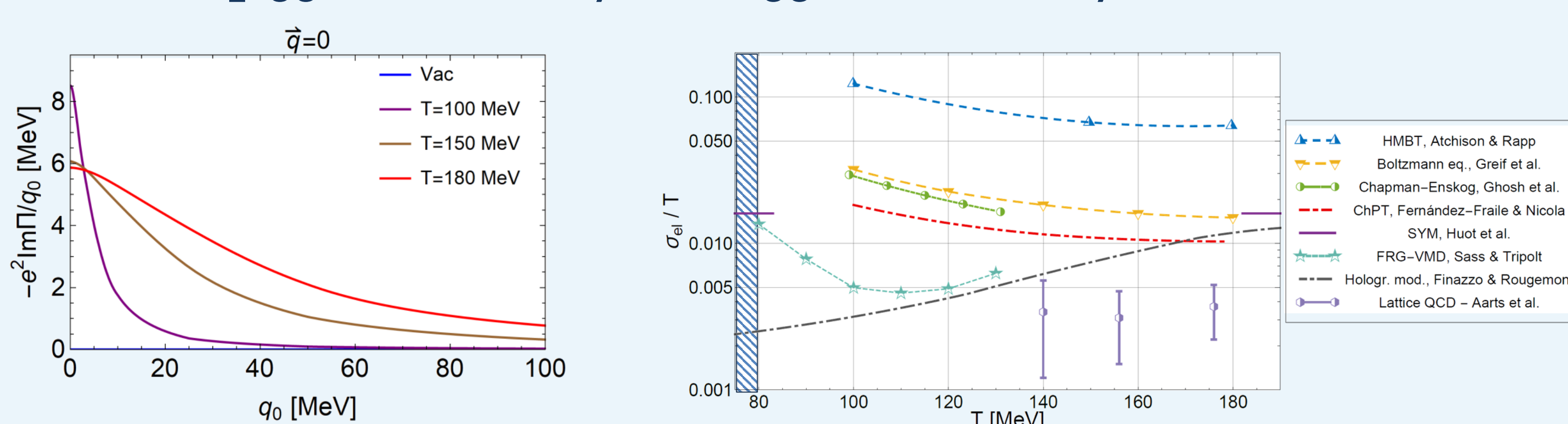


I. Motivation

- Study the phase structure of QCD
- Explore the high baryon density regime
- Extract transport properties: electrical conductivity

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

- Probe the electrical conductivity through low-mass dileptons
- The yield at $p_{ee} = 0 \text{ MeV}/c$, $M_{ee} \rightarrow 0 \text{ MeV}/c^2$



II. Why are dileptons special?



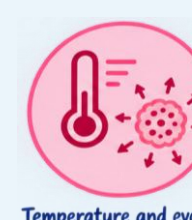
Clean messengers

They leave the medium without further strong interaction.



Full collision history

They reflect the whole history of the collision, not just freeze-out.



Probe the temperature and evolution of the medium

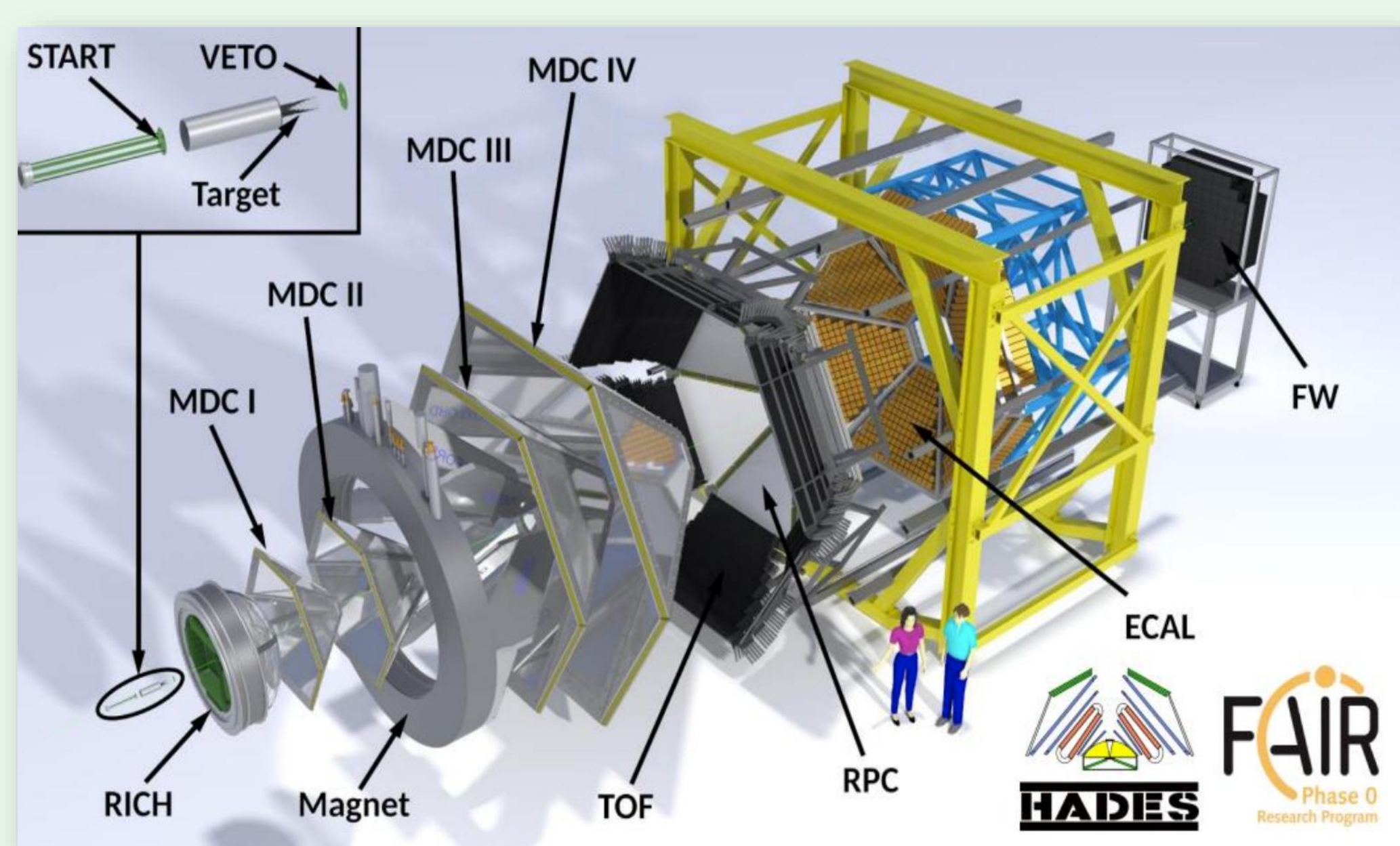
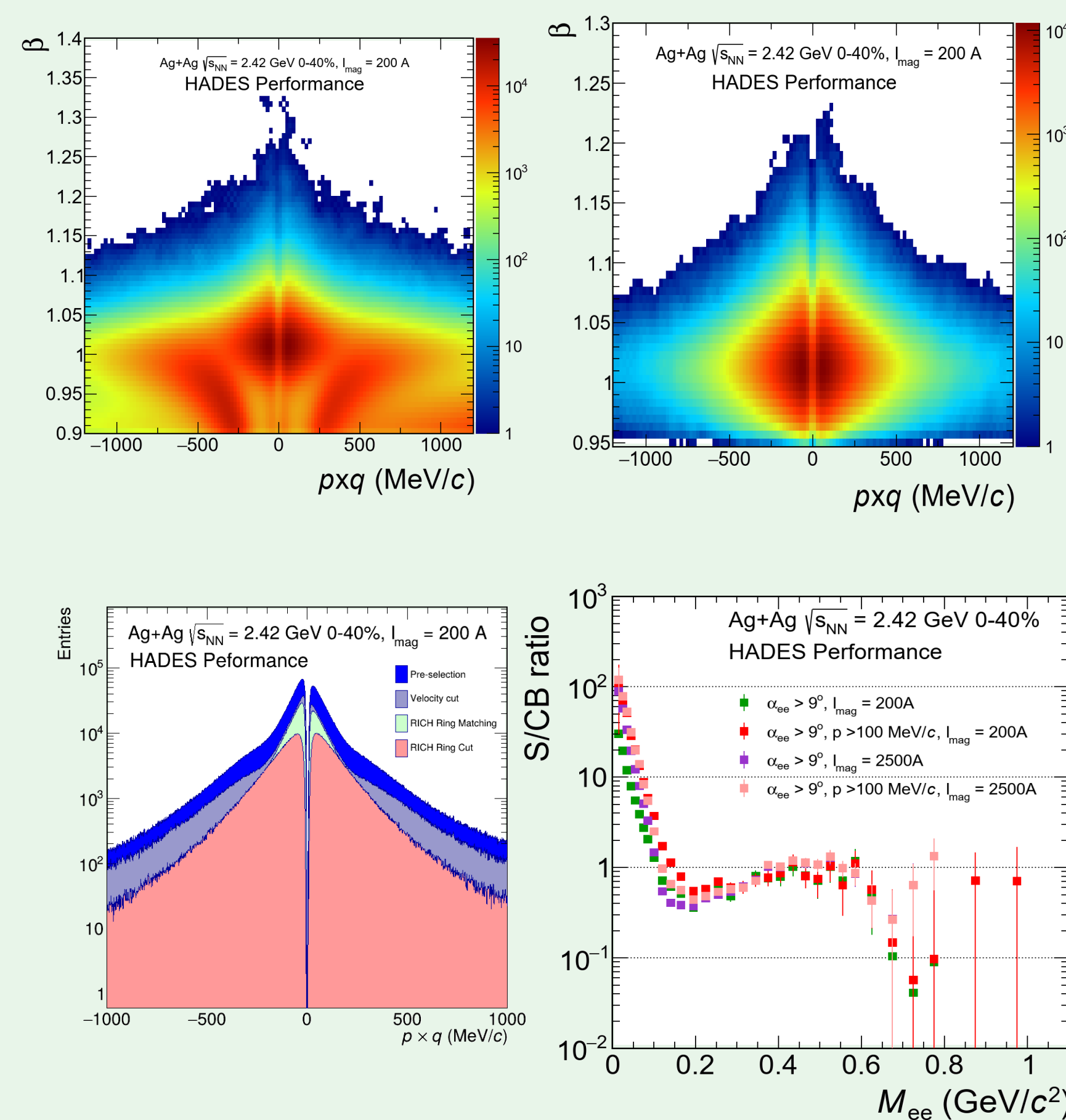


Encode information on matter properties

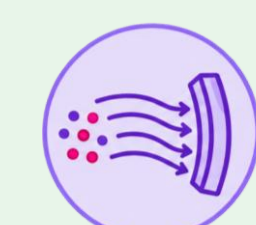
The low-energy electromagnetic response can constrain electrical conductivity

III. High Acceptance Di-Electron Spectrometer

- Heavy-ion beams $\sqrt{s_{NN}} \sim 2 - 3 \text{ GeV}$
- Field-free target region
- High geometrical acceptance
- Perfect for low momentum studies

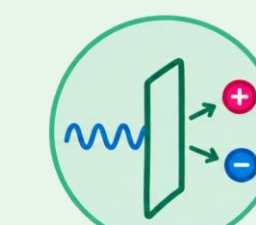


Why HADES?



High-rate capability

Dileptons are penetrating but rare probes (BR $\sim 10^{-5}$)



Low material budget

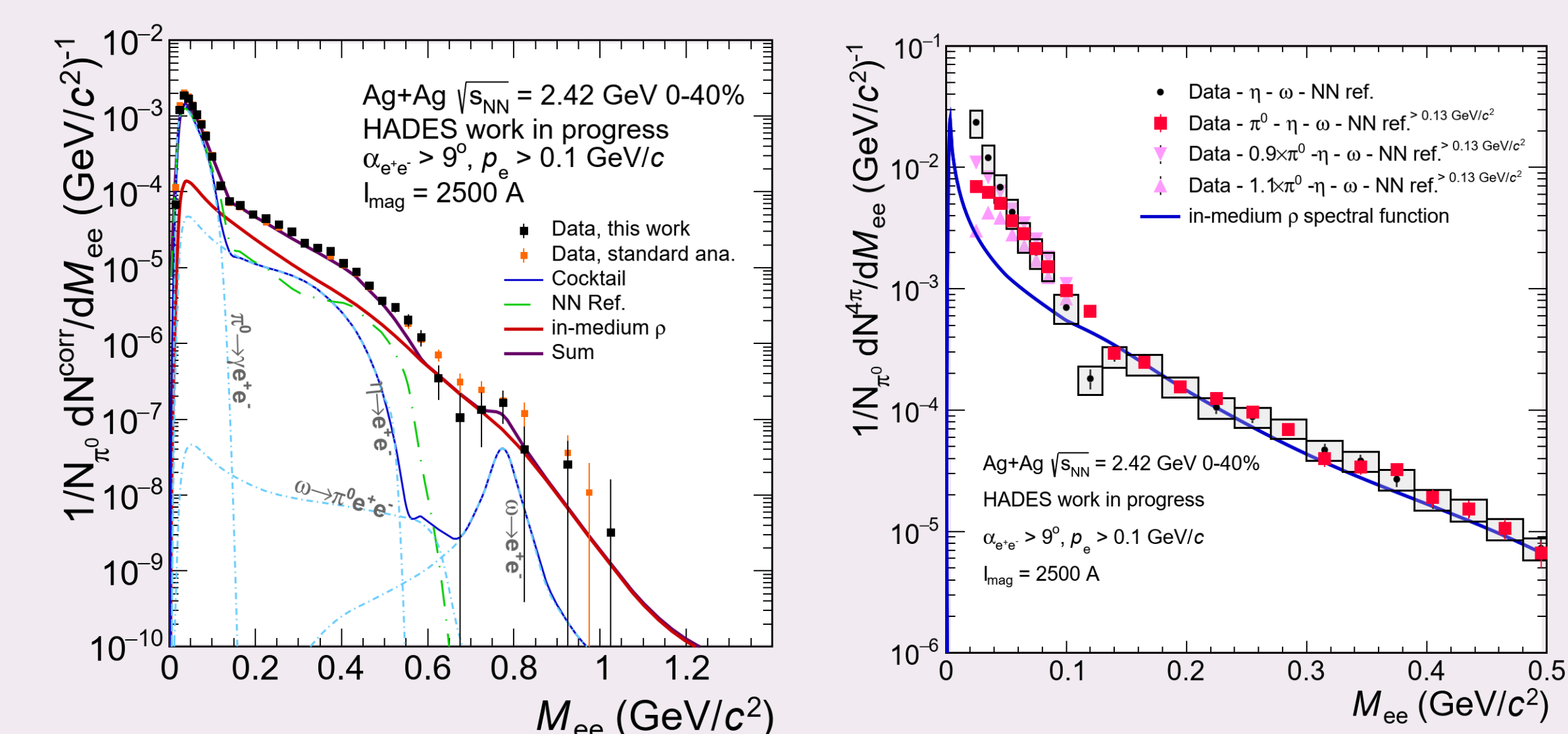
To reduce conversion



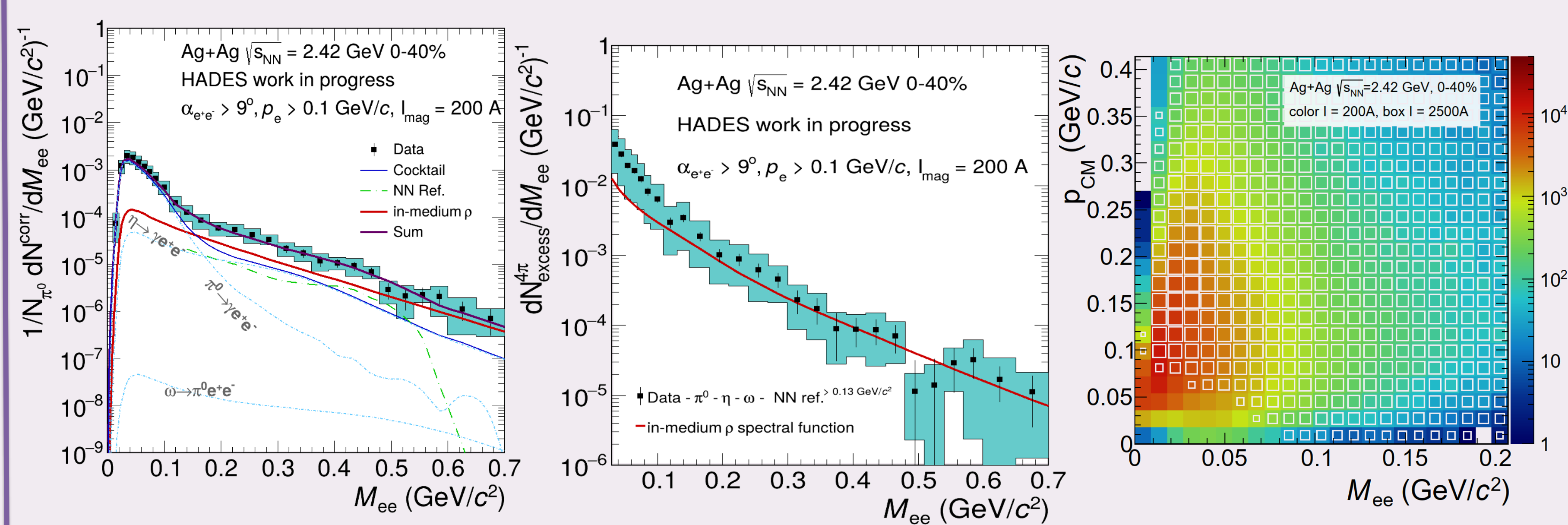
Dedicated run with a reduced magnetic field (6% x I_{max})
Excellent pion separation

IV. Results Ag+Ag at $\sqrt{s_{NN}} = 2.42 \text{ GeV}$

a. $I_{mag} = 2500 \text{ A}$ (78% x I_{max})



b. $I_{mag} = 200 \text{ A}$ (6% x I_{max})



- Two independent analyses: agreement of better than 95%
- Isolation of excess radiation by subtracting known sources
- Acceptance corrected spectra
- Efficiency corrected spectra
- NN reference applied for $M_{ee} > 0.13 \text{ GeV}/c^2$
- Excess extracted for the first time for small M_{ee}
- 2D analysis on the way



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[2] Atchison et al., PLB 858 (2024) 139024
[3] Atchison and Rapp, NPA 1037 (2023) 122704