

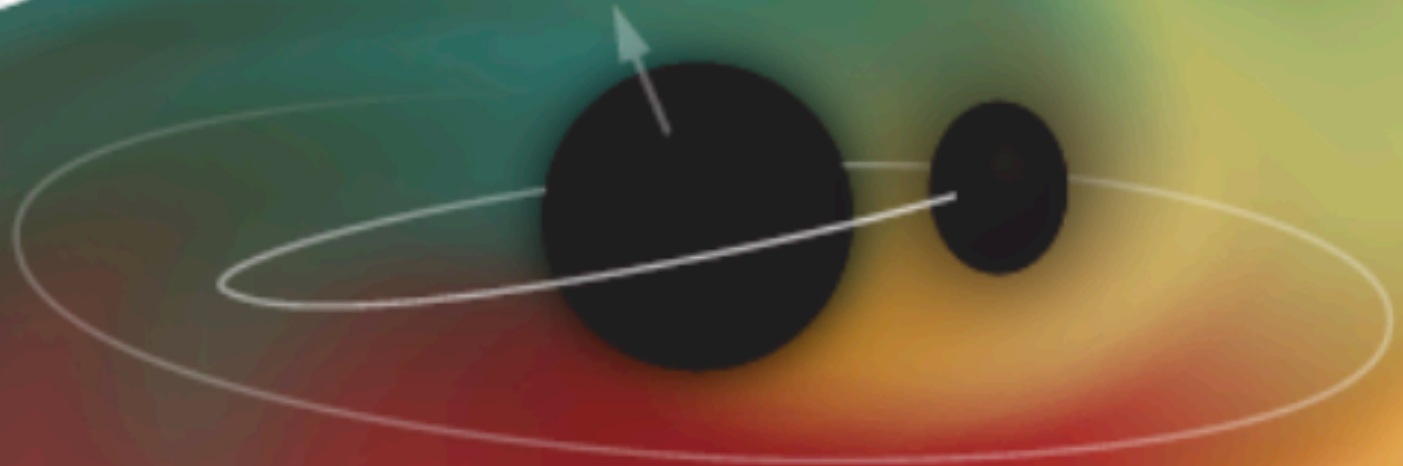
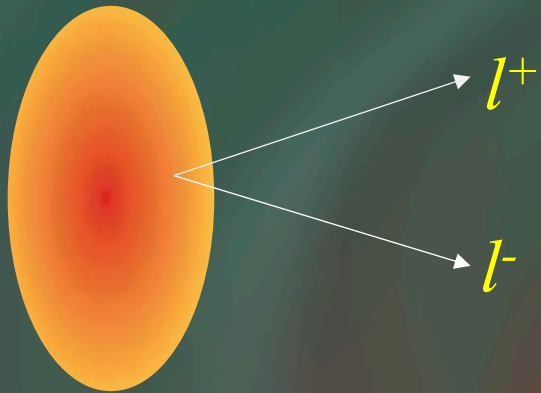
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Prospects of Dielectron Measurements with STAR BES-II

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for the STAR Collaboration

Q2020 quarks cosmos



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Dilepton as a penetrating probe of the collision system

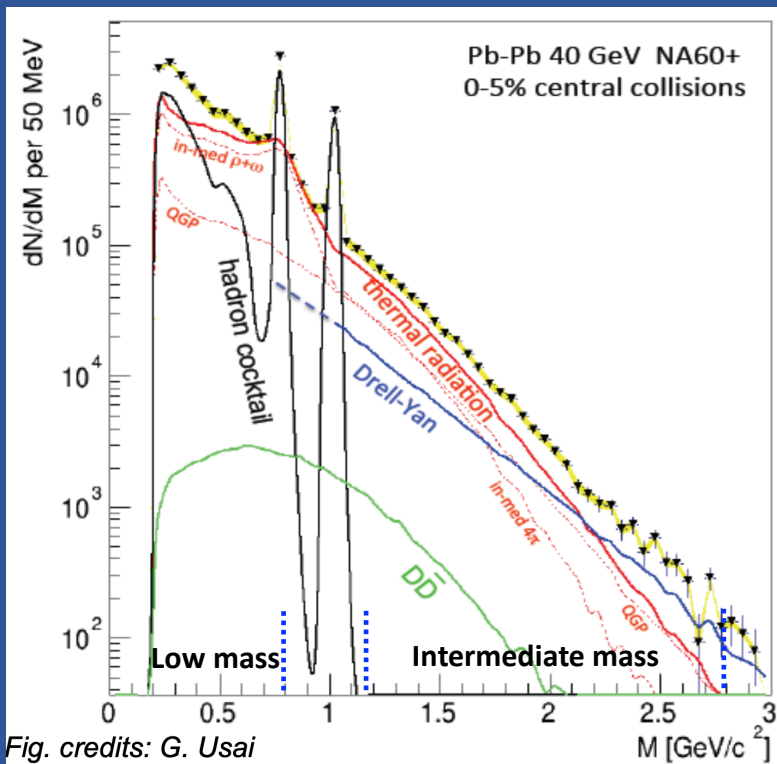
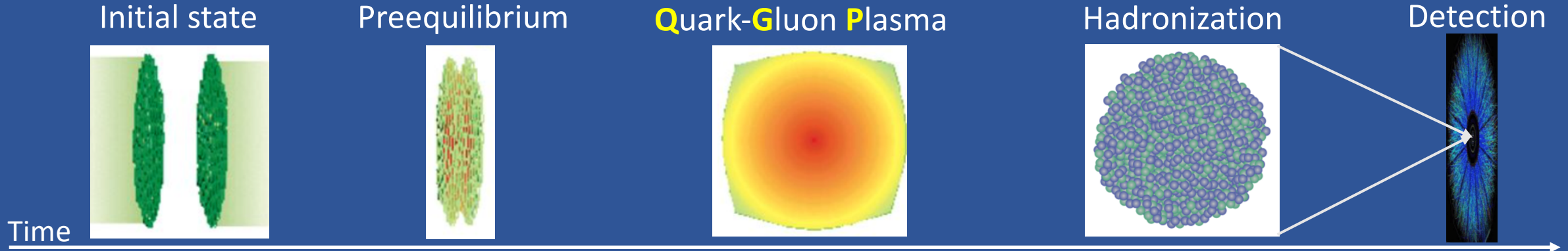
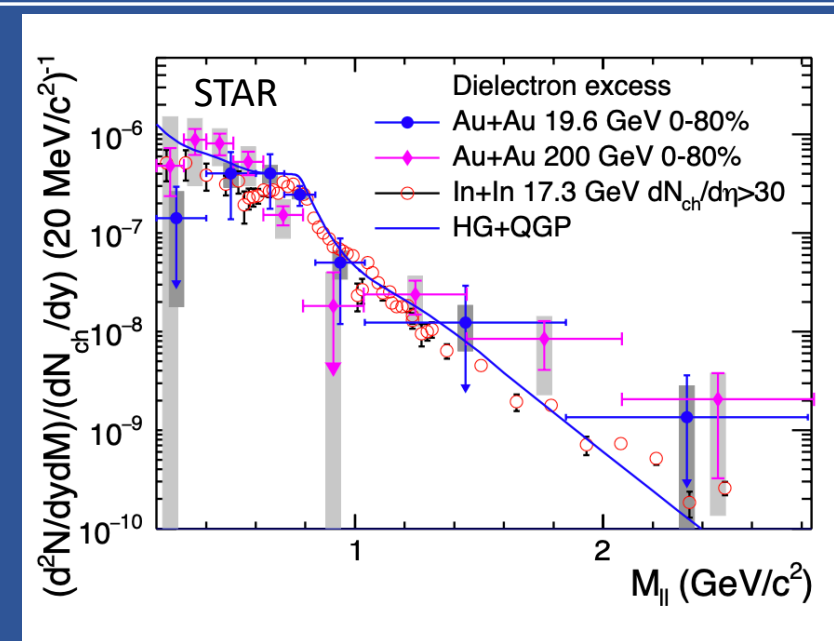
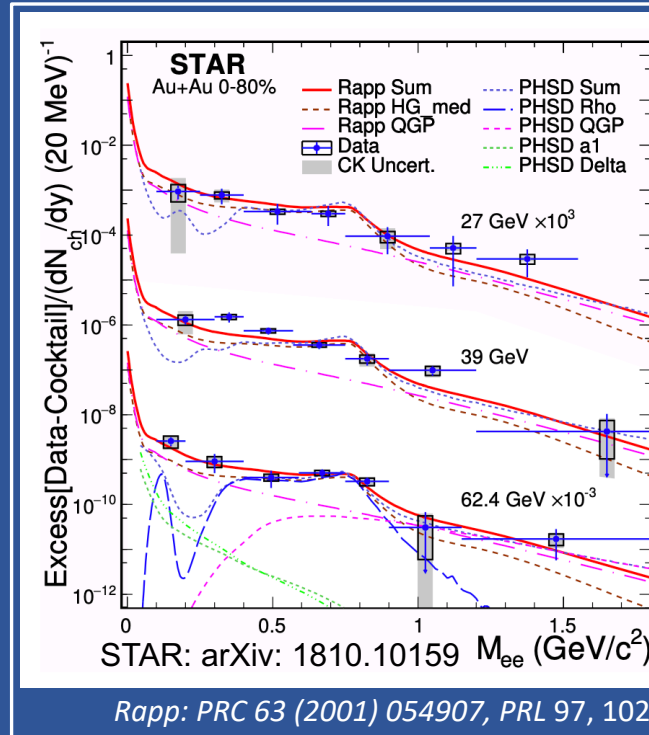
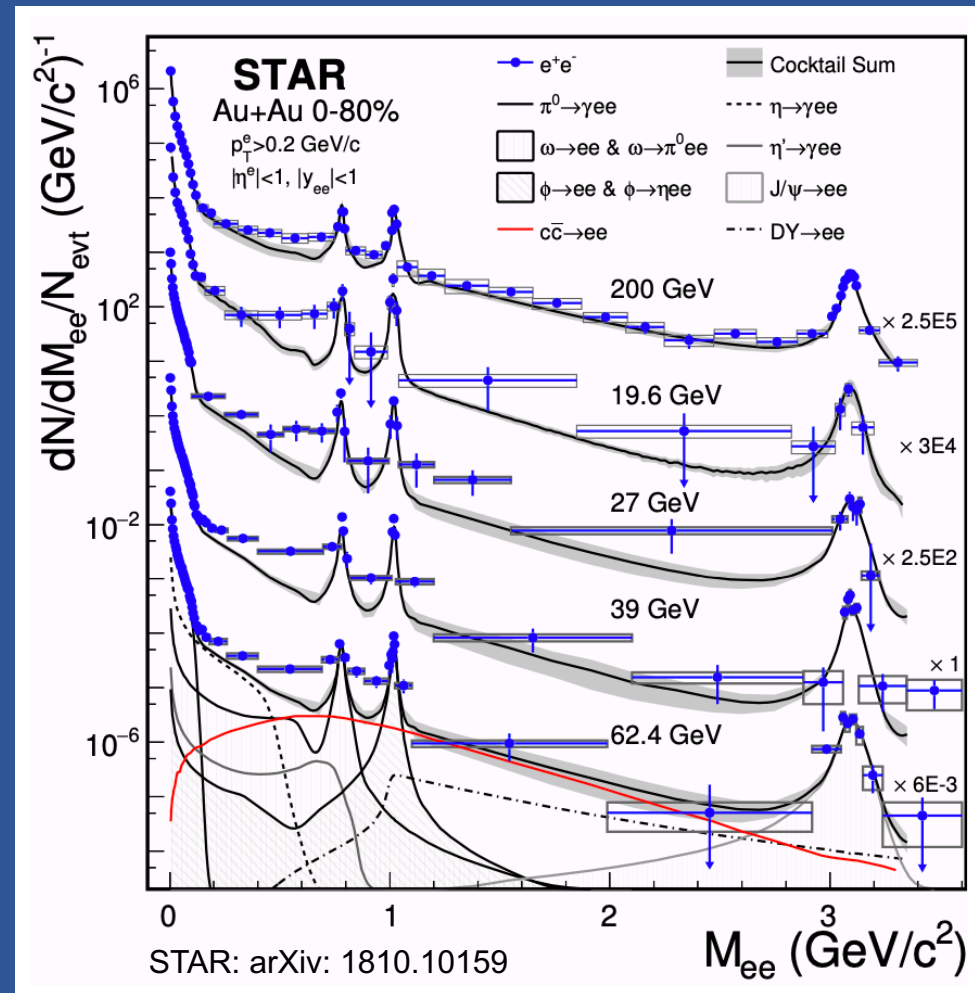


Fig. credits: G. Usai

- Dilepton spectra represent the spacetime integral of EM radiation
 - Mass dependent production allows separation of collision stages
 - Drell-Yan
 - Heavy flavor decay
 - Final state decays
 - Medium radiation
 - In-medium ρ (link to chiral symmetry restoration)
 - QGP (thermal meter of QGP)
 - ...
- } Cocktail from known sources

Dielectron measurements with STAR BES-I



STAR: PLB750 (2015) 64, NA60: EPJ C 59 (2009) 607
 Rapp: PRC 63 (2001) 054907, PRL 97, 102301 (2006) ; PHSD: Phys. Rep. 308, 65 (1999), NPA 831, 215 (2009)

STAR BES-I:

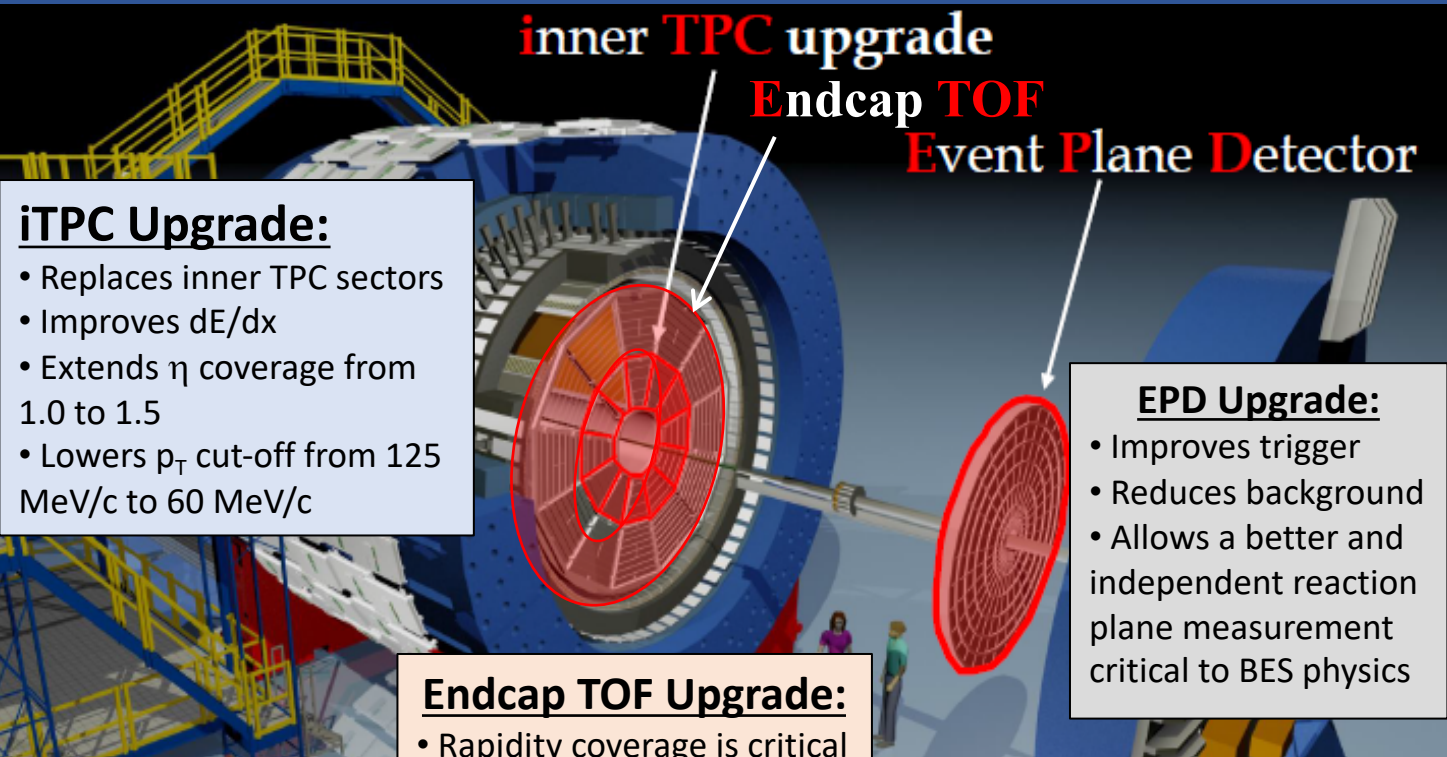
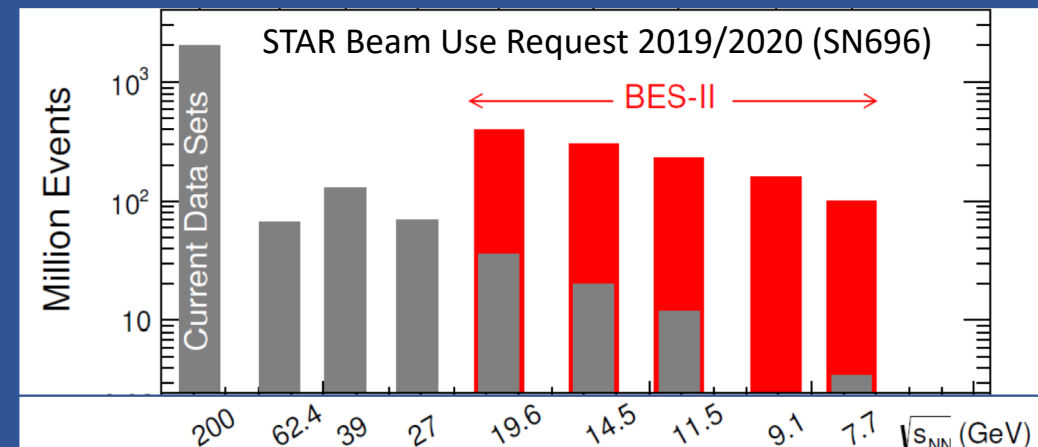
- Can be well described by theoretical calculations considering the broaden ρ + QGP emission
- Lack of precision to constrain on model assumptions
- Does not allow the temperature measurement at IMR

BES-II upgrades

What iTPC will help:

- Improve dielectron acceptance
- Reduce systematic uncertainties of dielectron excess yield by a factor of 2
 - Hadron contamination
 - Cocktail subtraction
 - Acc. diff. btw. unlike and like sign pairs
 - Efficiency corrections

RHIC LEReC upgrade improve luminosity for low energy beams



iTPC Upgrade:

- Replaces inner TPC sectors
- Improves dE/dx
- Extends η coverage from 1.0 to 1.5
- Lowers p_T cut-off from 125 MeV/c to 60 MeV/c

EPD Upgrade:

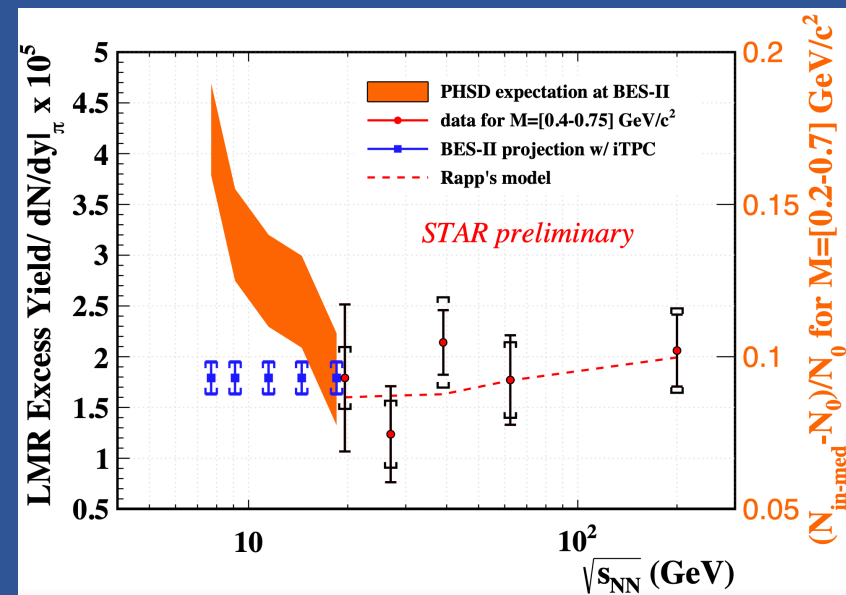
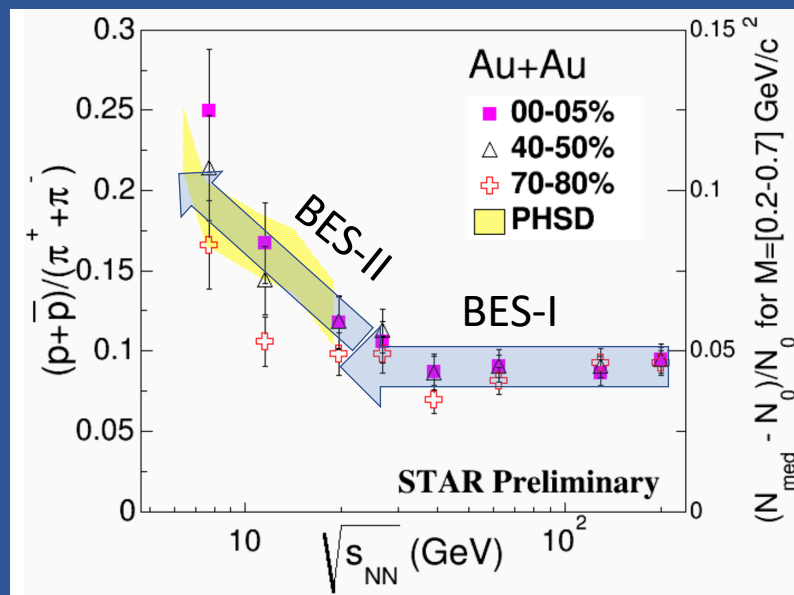
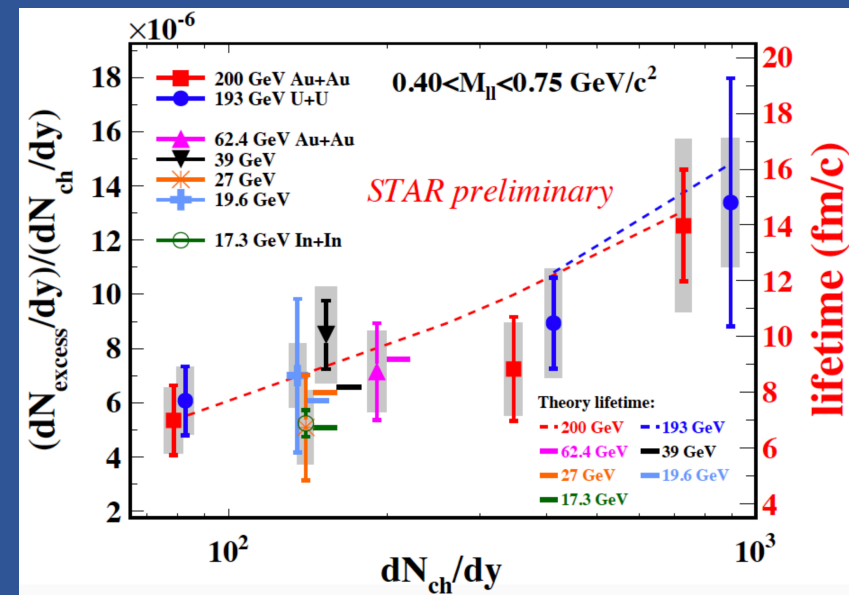
- Improves trigger
- Reduces background
- Allows a better and independent reaction plane measurement critical to BES physics

Endcap TOF Upgrade:

- Rapidity coverage is critical
- PID at $h = 1.1$ to 1.5
- Improves the fixed target program
- Provided by CBM at FAIR

BES-II have $\sim x10$ times of BES-I data size

Low mass dielectron at BES-II



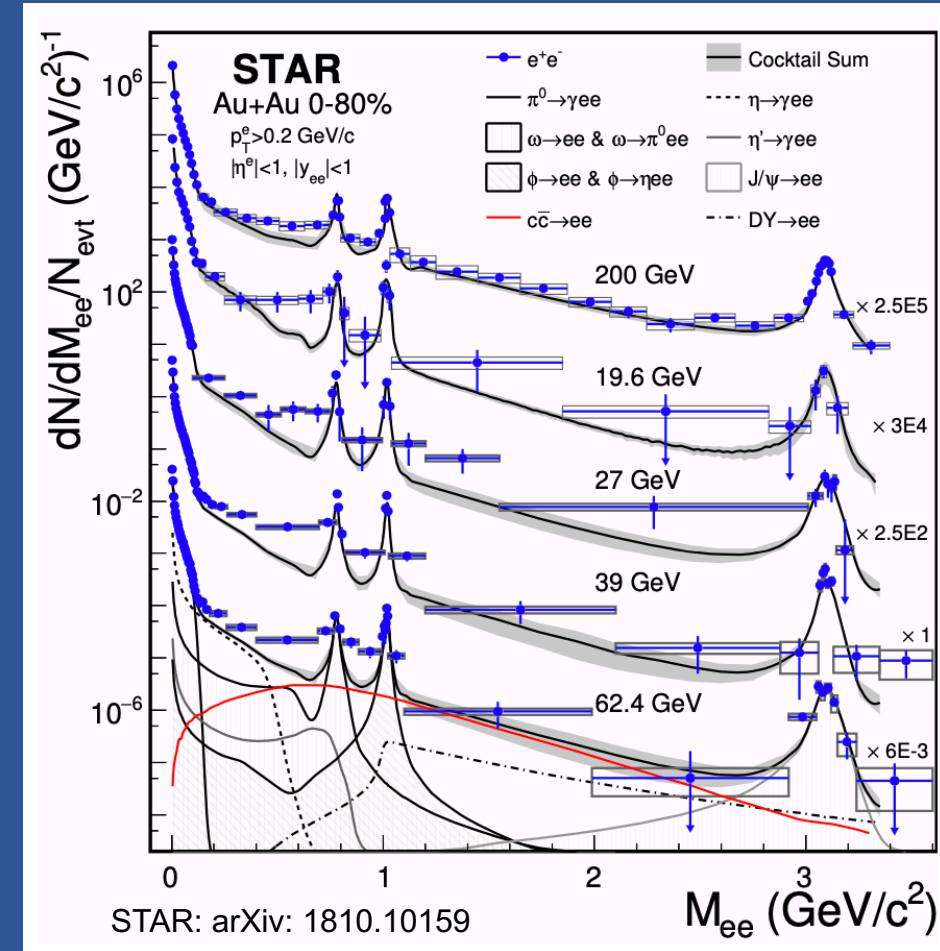
Rapp: PLB 753, 586 (2016); PHSD: Phys. Rep. 308, 65 (1999), NPA 831, 215 (2009)

- In-medium ρ is expected to depend on T , total baryon density and medium lifetime
- dN_{ch}/dy normalized broaden ρ yield is found $\propto \tau_{\text{med}}$ at BES-I \leftarrow the total baryon density is nearly a constant and the emission rate is dominant around T_c
- BES-II provides a unique opportunity to quantify the **effects of total baryon density** on the ρ broadening, will help understand the broadening mechanism

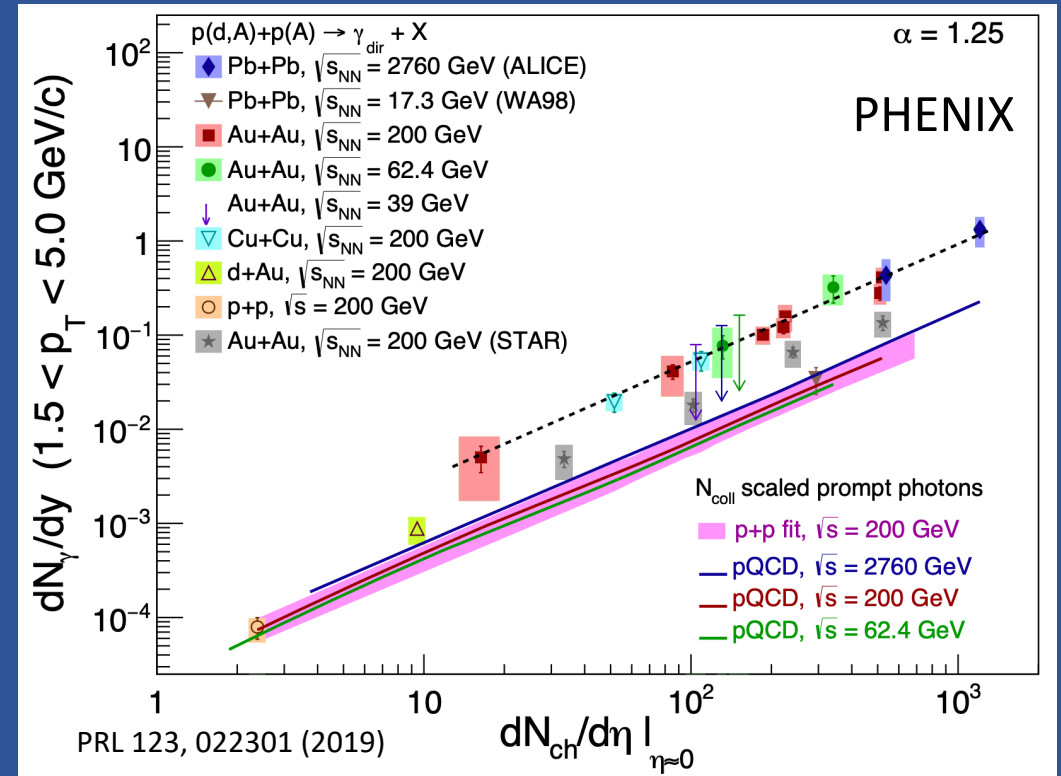
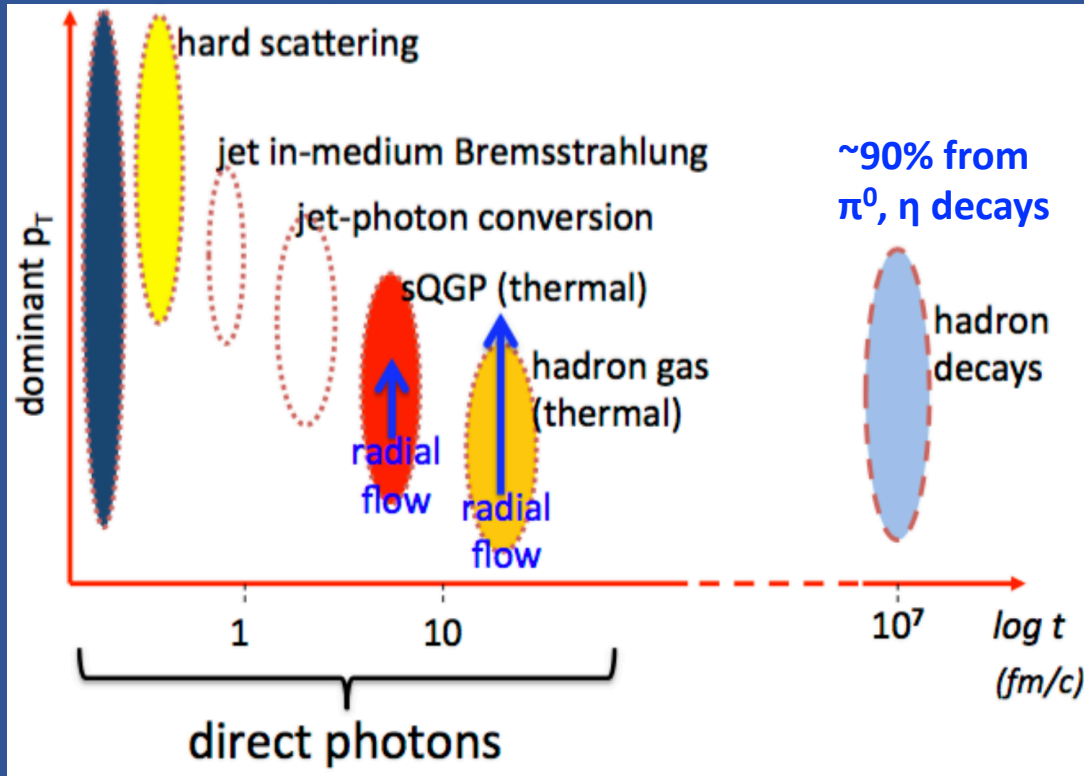
Intermediate mass dielectron at BES-II

Excess from **thermal radiation** in IM region can serve as the QGP thermometer:

- $dN/dM_{ee} \sim M_{ee}^{3/2} \exp(-M_{ee}/T_{med})$
- Main challenges at RHIC:
 - At top energy, open charm meson decays dominate
 - At low energy, suffer from low statistics
- STAR BES-II with x10 larger datasets \rightarrow first true temperature measurement at RHIC

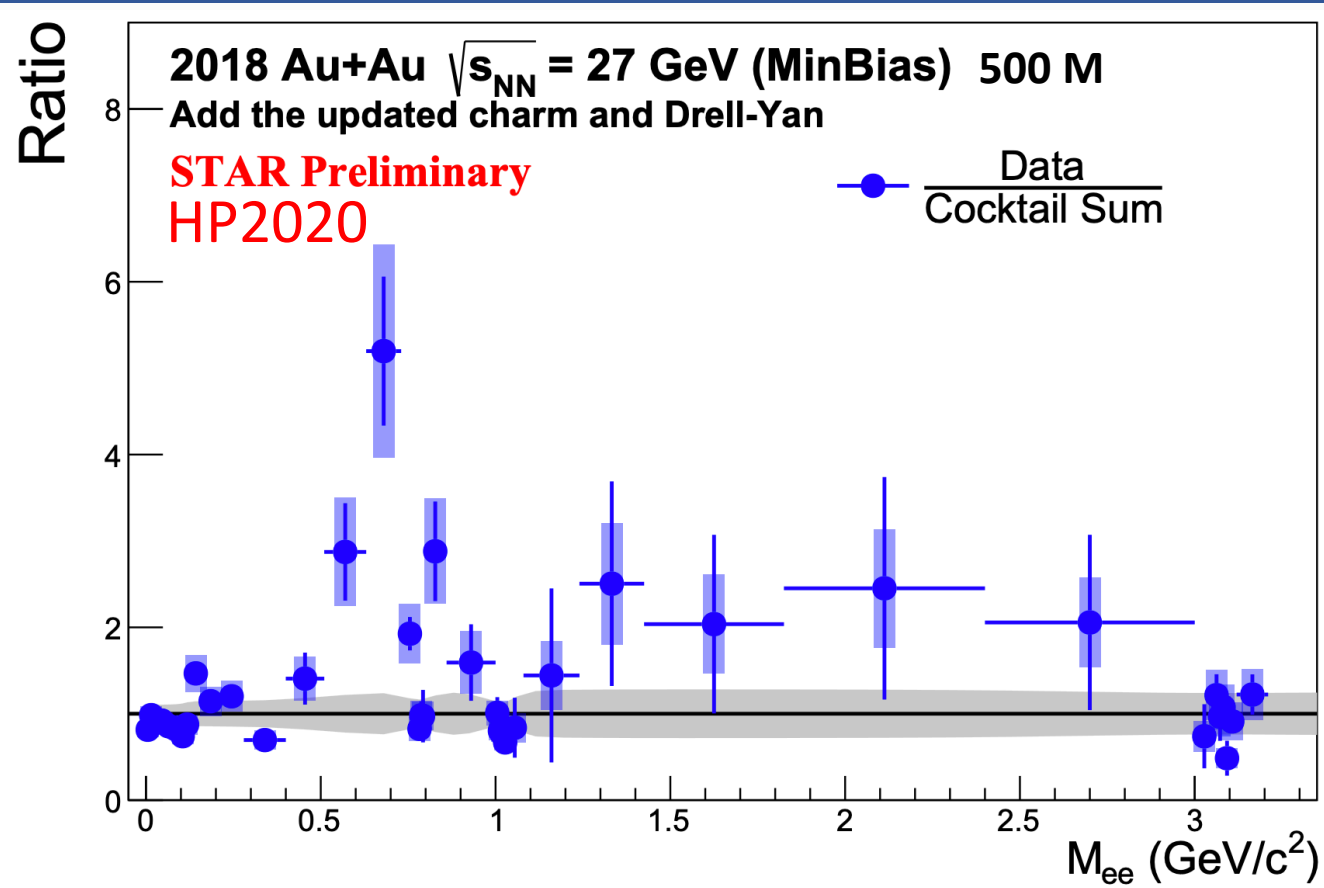


Direct virtual photon (very low mass dielectron) at BES-II



- Direct photon yields show a **common scaling**: $dN/dy \sim (dN_{ch}/d\eta)^{1.25}$
- STAR data show similar scaling but at a different magnitude
- STAR BES-II will explore towards lower energy Au+Au collisions (7.7, 9.2, 11.5, 14.5, 19.6 GeV)
 - Will the different magnitude and scaling still hold at lower energies?

Preliminary results with 2018 27 GeV Au+Au



2018 27 GeV data (no iTPC):

- Large data set
- Significant enhancement at the low mass region
- Excess in the intermediate mass region may allow the first T measurement
- Analysis is still on-going, improved and more physics results will come soon

More new results from STAR BES-II are on the way!

Summary

- BES-II with x10 times of larger data size than BES-I
- Reduce both statistical and systematic uncertainties
- Explore total baryon density effects on the in-medium ρ production
- Measure the hot medium temperature with the thermal dielectron
- Study direct virtual photon production at lower collision energies

THANK YOU