Dielectron production in RHIC at STAR

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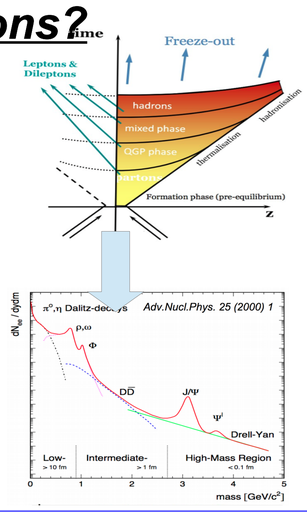
Abstract

This poster reviews the dielectron production measurement in RHIC at STAR. The following results are showed : the dielectron continuum measurement as a function of centrality, invariant mass and traverse momentum for Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV; the dielectron continuum measurement as a function of invariant mass for minimum-bias of Au+Au collisions at $\sqrt{s_{NN}}$ = 19.6, 27, 39, 62.4 ; and the acceptance-corrected dielectron excess measurements of Au+Au collisions at $\sqrt{s_{NN}}$ = 19.6, 27, 39, 62.4, and 200 GeV collisions. The connection between the measured dielectron excess yields and the lifetime of the hot, dense medium is discussed.

Why dileptons?

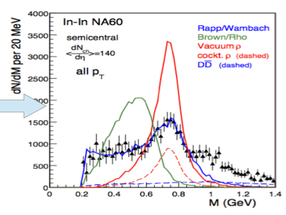
- **Dileptons – a bulk penetrating probe:**
  - Do not suffer strong interaction, penetrating the medium without final state effect.
  - Produced in all stages of the system evolution.
  - Provide direct information of medium.
  - Additional kinematic information (mass vs p_T), sensitive to different dynamics.
- **Challenges:**
  - Production rate is low, especially in higher mass region (M_{ee}>1GeV/c²).
  - Integrate over time and over many background sources.



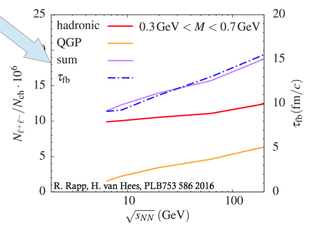
Interesting topics:

Low mass region (LMR):

- in-medium modifications of vector meson.
  - → Modification on spectral function ~ a broadened ρ spectral
  - → hint for chiral symmetry restoration.



- Theory calculations suggest that LMR "excess" is proportional to system life time

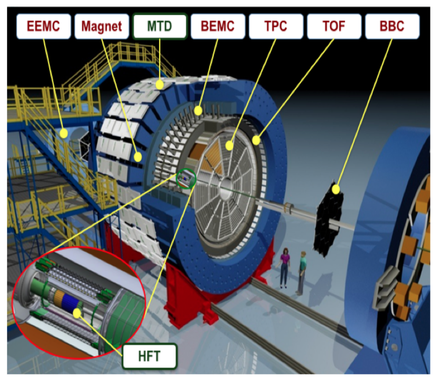


Intermediate mass region (IMR):
QGP thermal radiation.
semi-leptonic decays of correlated charm : possible charm de-correlation in Au+Au.

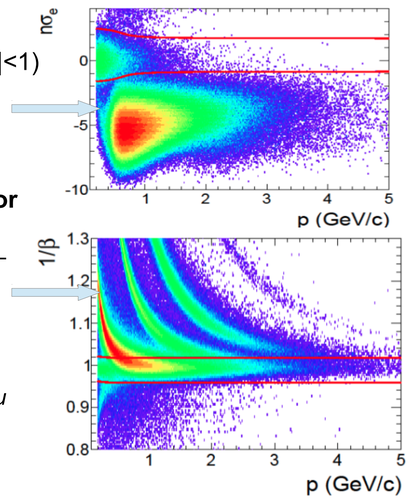
High mass region (HMR):
heavy quarkonia.
Drell-Yan process.

How to find them?

With the STAR Detector

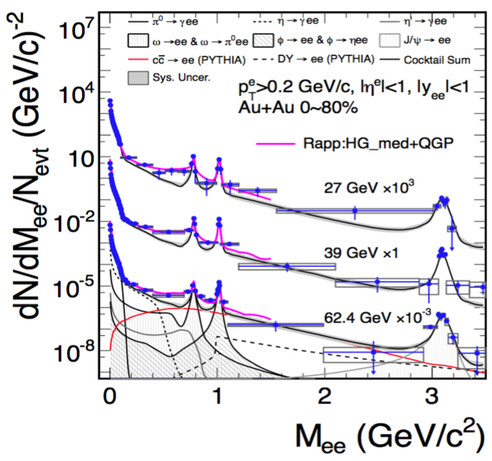


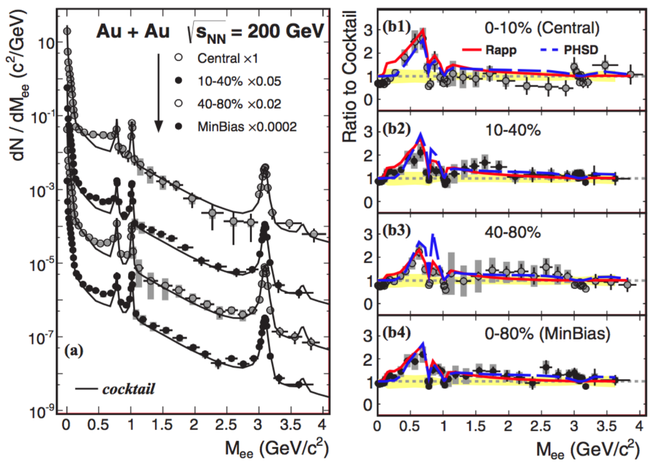
- **Time Projection Chamber** (0<Φ<2π, |η|<1)
  Tracking – momentum
  Ionization energy loss
- *– dE/dx (PID)*
- **Time Of Flight detector** (0<Φ<2π, |η|<1)
  Time resolution < 100ps – crucial for PID at the intermediate p_T region
- *Purity of electron sample:93~95% in Au+Au collisions.*

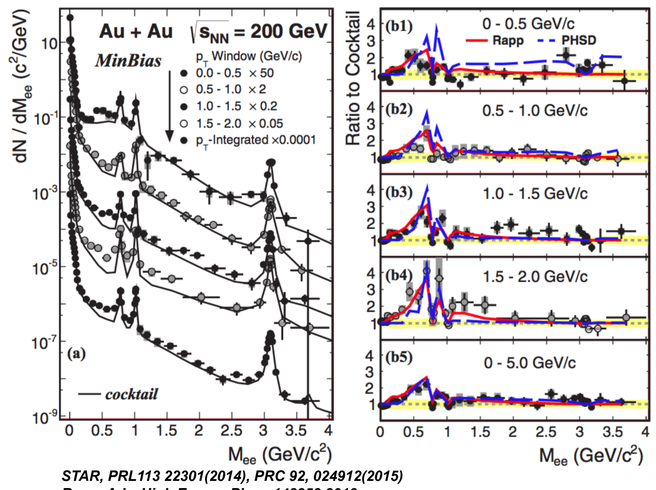


What we learned

Dielectron mass spectra







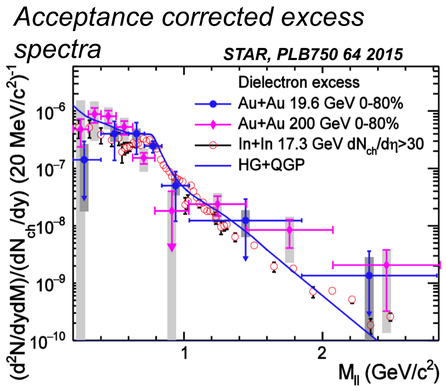
Model calculations with broaden ρ spectra function robustly describe the data from 200 to 20 GeV in Au+Au collisions.

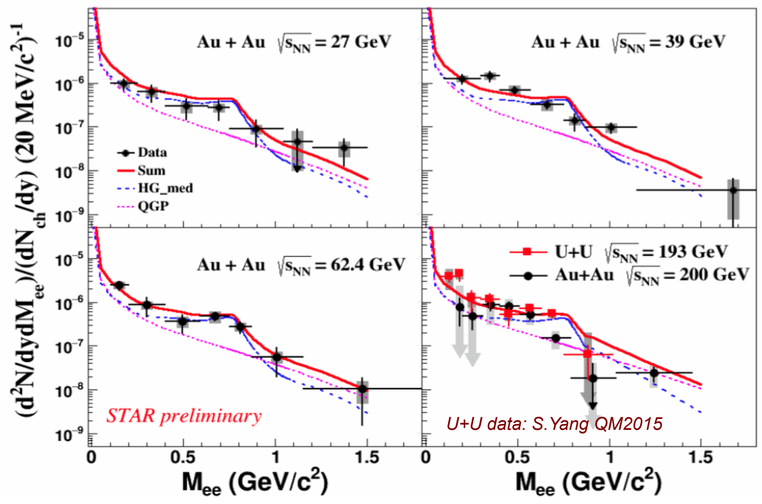
In these models, the excess dielectron yield is strongly determined by the correlations between vector mesons and baryons.

STAR, PRL113 22301(2014), PRC 92, 024912(2015)
Rapp: Adv. High Energy Phys. 148253 2013
PHSD: O. Linnyk et al., PRC 85 024910 2012

LMR "excess"

Acceptance corrected excess spectra

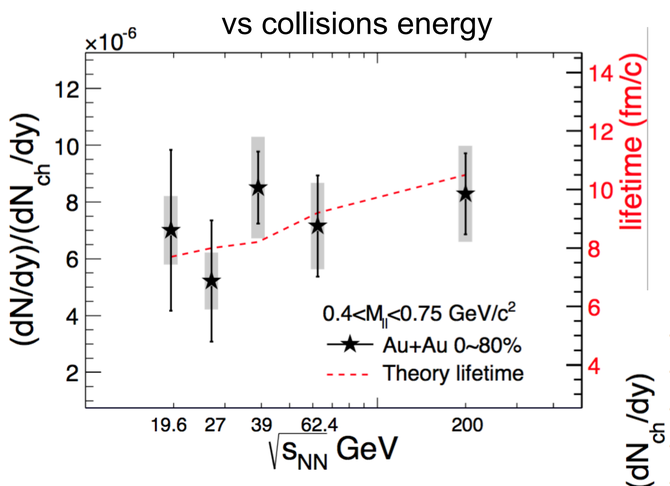


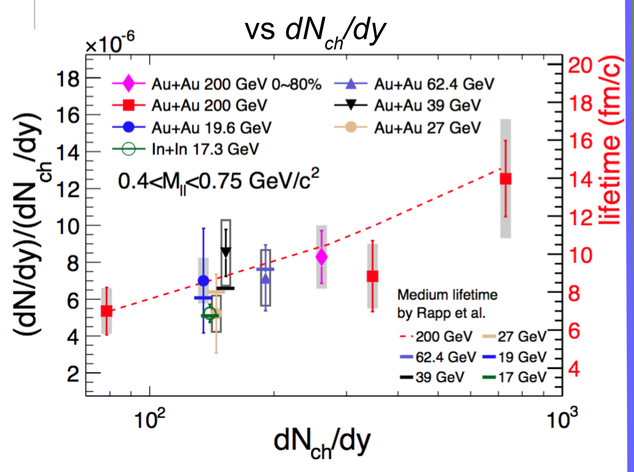


Different initial conditions ~ changing energy density (species+√sNN).

Models with a broaden ρ spectra function show good agreement with data.

Integral excess yields normalized by the charged particle multiplicity (dN_{ch}/dy)

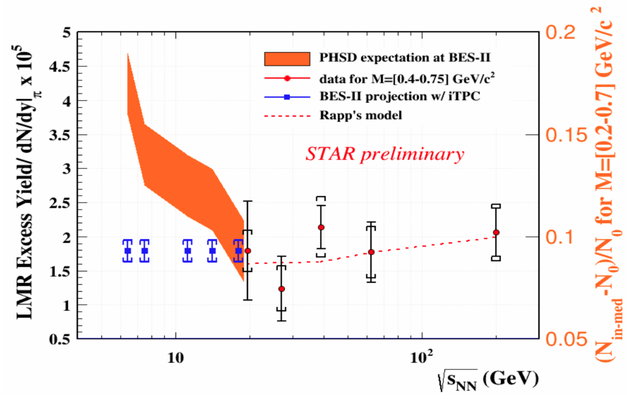




- **Model :**
  - Normalized yields are strongly correlated to system lifetime from $\sqrt{s_{NN}}$ = 17.3-200 GeV.
- **Data :**
  - yields show weak collision energy dependence in minimum bias Au+Au collisions.
  - higher yields in central collisions w.r.t peripheral collisions.
- **The measurements consistent with the expectation of theory calculations:**
  - low mass excess is determined by the total baryon density.
  - longer system lifetimes for more central collisions.

Future

- **HFT+MTD upgrade ~ dielectron in IMR:**
  - electron – muon correlation: clean study for the charm correlation.
  - dielectrons from thermal radiation.
- **BES II projection:**
  - push into lower collision energies
  - regions with an increasing total baryon density.
  - higher precision measurement with iTPC upgrade.



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