



Direct virtual photon production in Au+Au collision at $\sqrt{s_{NN}} = 27$ and 54.4 GeV

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for the STAR collaboration

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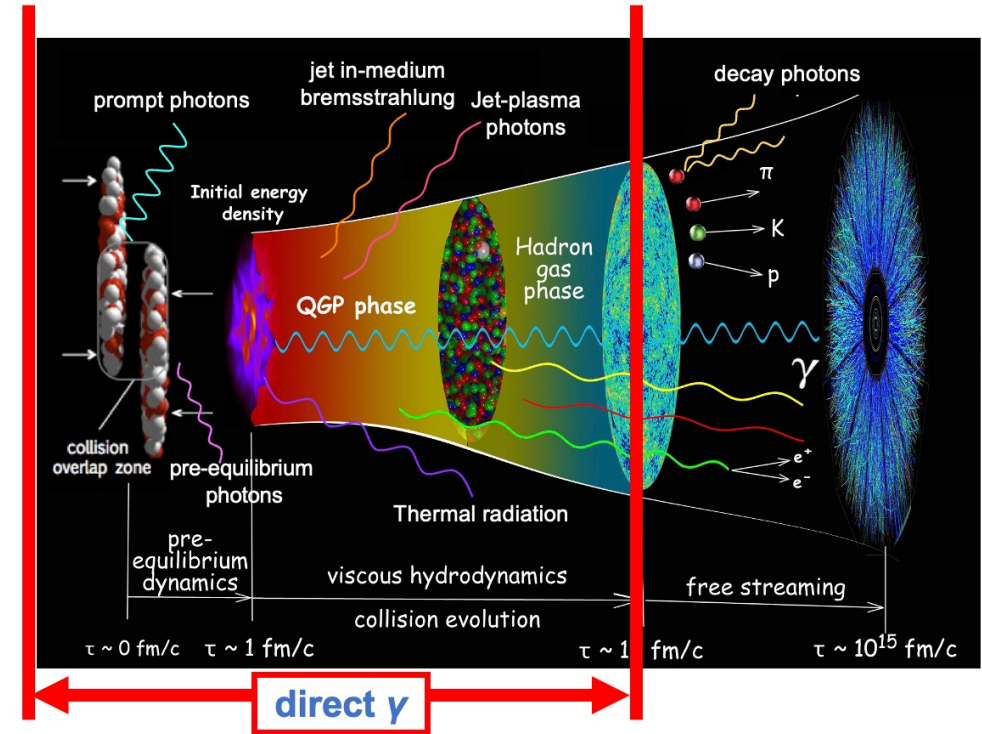
National Natural Science
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Why choose direct virtual photon?

- Do not participate in strong interaction
- Probe energy density, effective temperature, collective motion of QGP

What affect direct virtual photon yield?

- Evolution time: p_T integrated yield
- System size: $dN_{ch}/d\eta$
- μ_B and T : collision energy



| Au+Au collision at RHIC | | |
|---------------------------|-------|-------|
| $\sqrt{s_{NN}}$ (GeV) | 27 | 54.4 |
| μ_B (MeV) | 156 | 85 |
| Use events (minimum bias) | ~250M | ~430M |

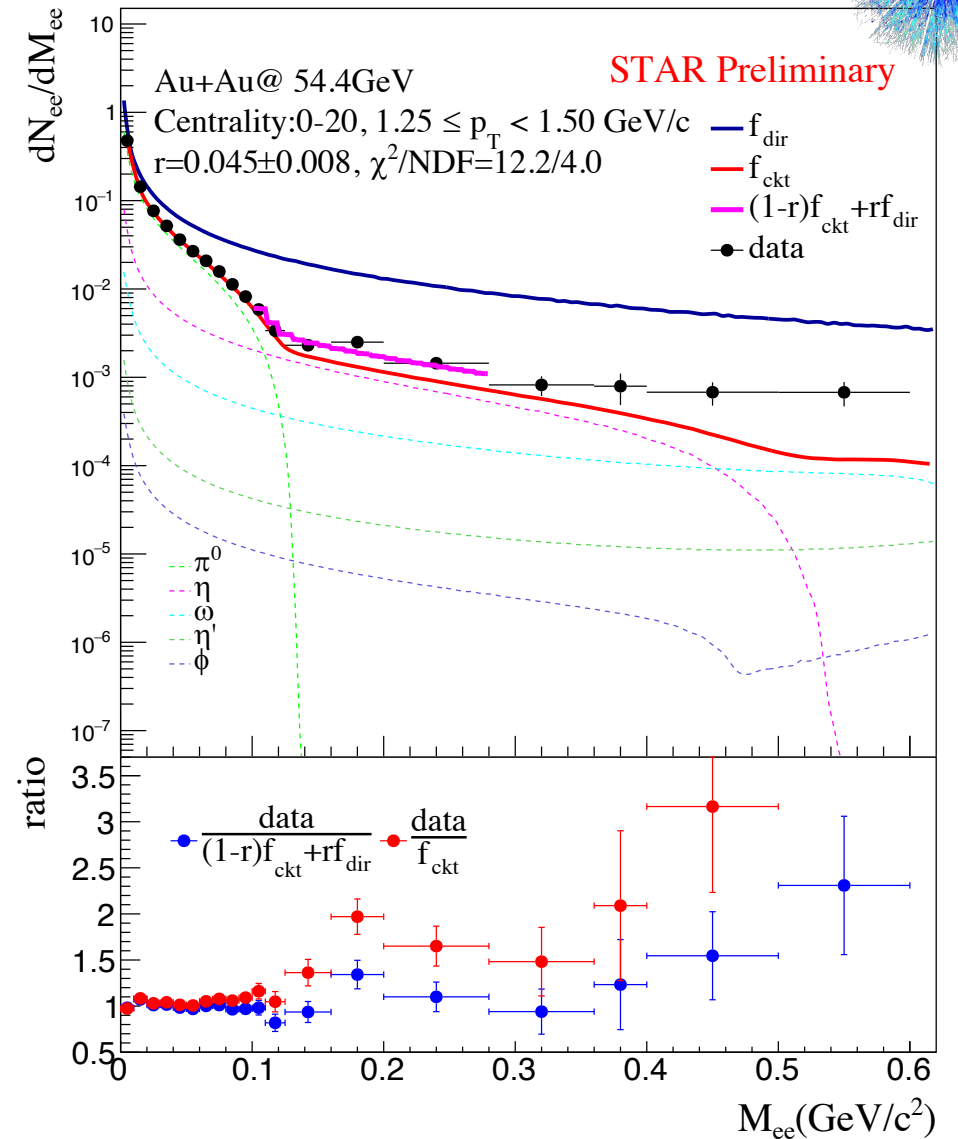
Direct virtual photon extraction

Dielectron signal and Cocktail simulation

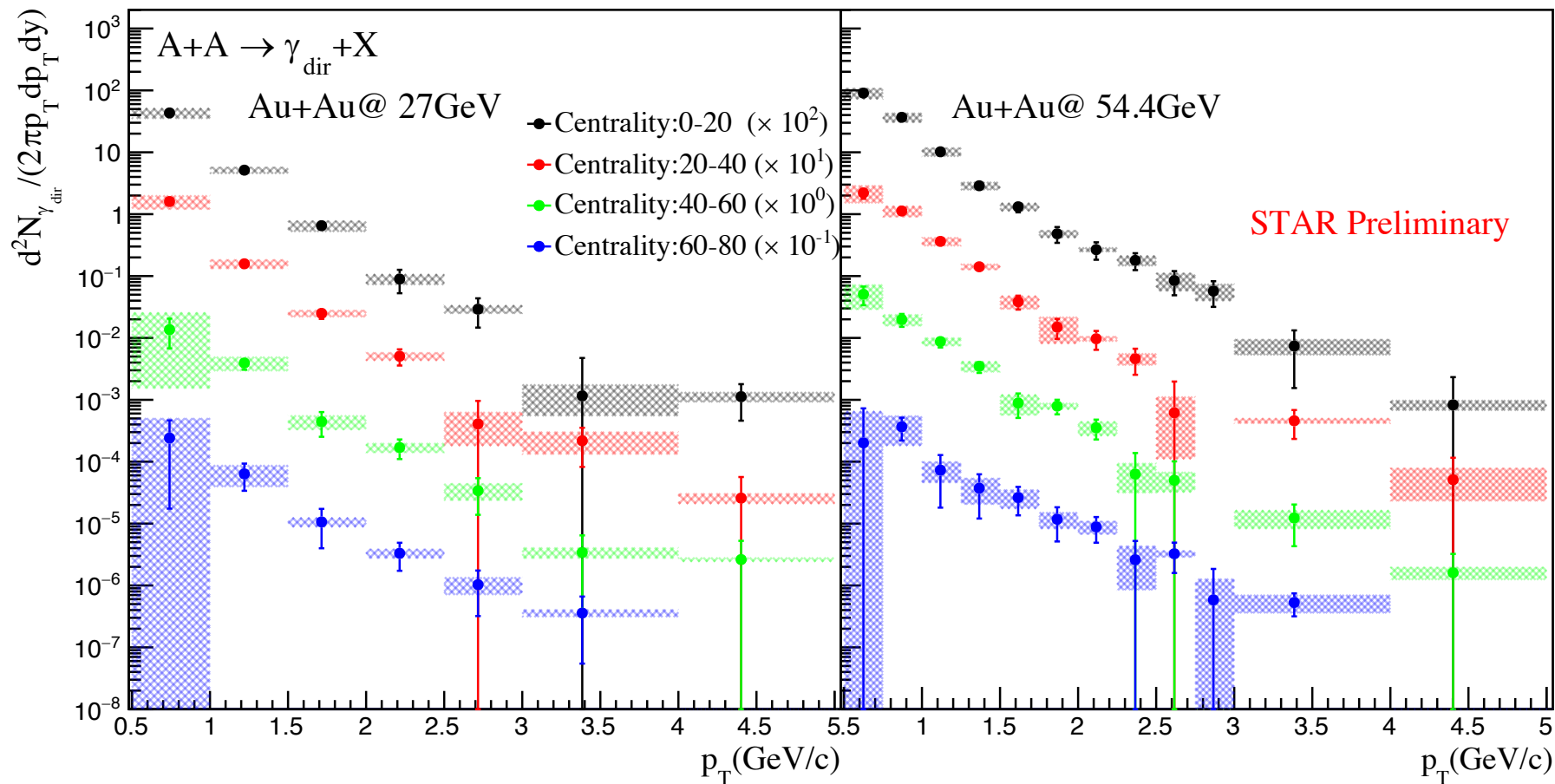
- Dielectron signal is consistent with Cocktail at π^0 mass region
- η/π^0 are parametrized using Tsallis blast-wave function and constrained by world wide data at high p_T

Internal conversion method: two-component fit

$$\frac{d^2 N_{ee}}{dM} = r * f_{dir} + (1 - r) * f_{cocktail} \quad r = \frac{\gamma^{direct}}{\gamma^{inclusive}}$$



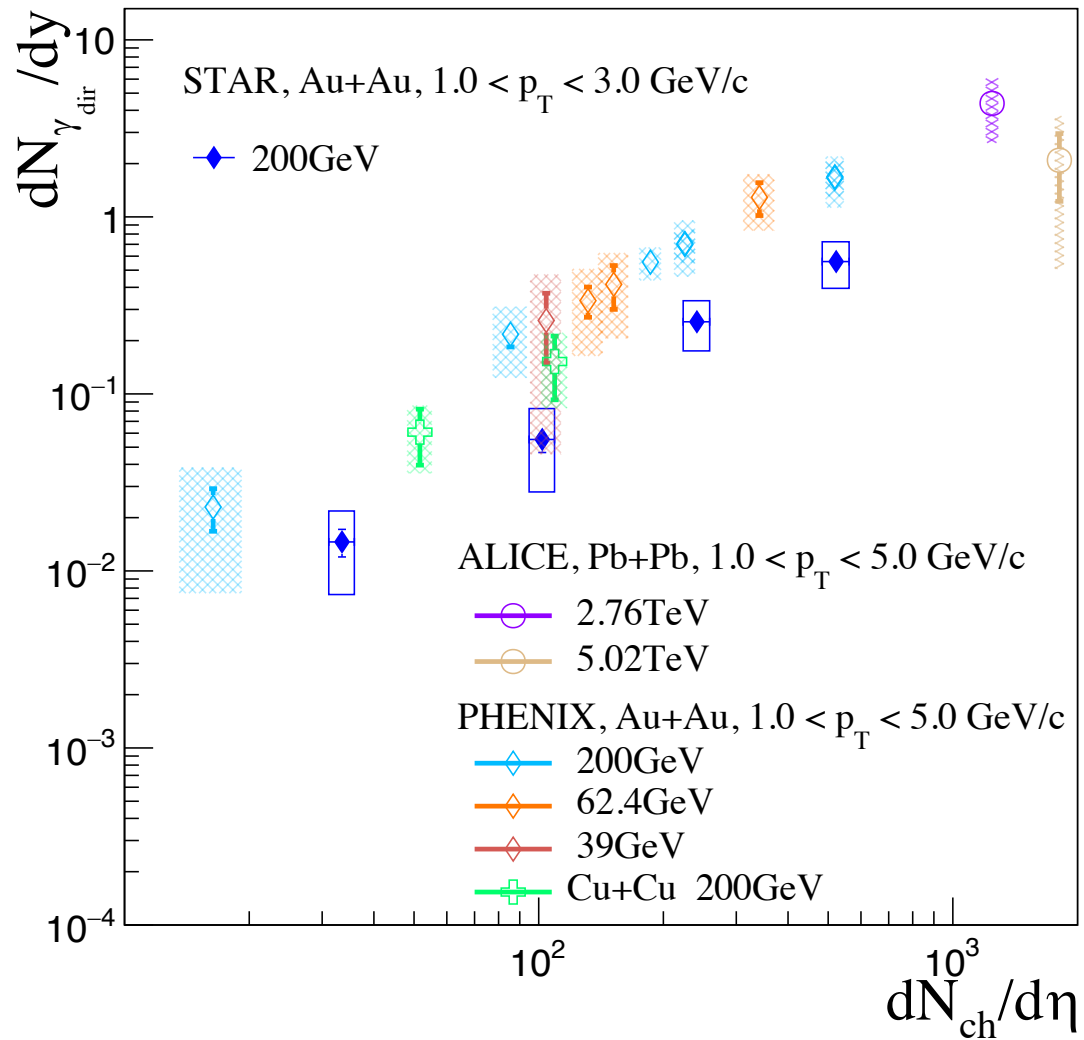
Direct virtual photon p_T spectrum



First direct virtual photon measurements in Au+Au 27 and 54.4 GeV

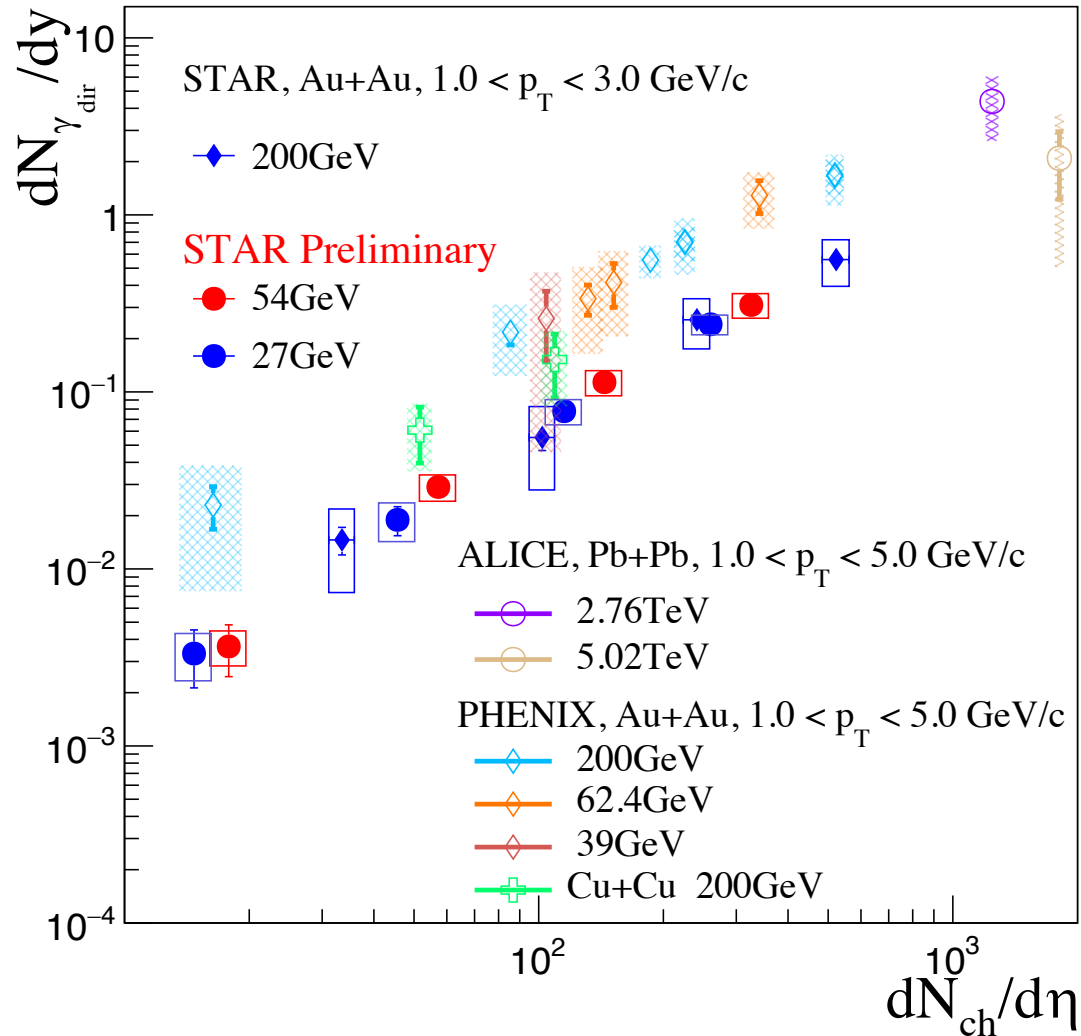
Call for theoretical calculations on thermal photon

The scaling in dN/dy vs. $dN_{ch}/d\eta$



STAR Collaboration, *Phys.Lett.B* 770 (2017) 451-45
 PHENIX Collaboration, *Phys.Rev.Lett.* 123 (2019) 022301
 ALICE Collaboration, *arXiv*: 2308.16704

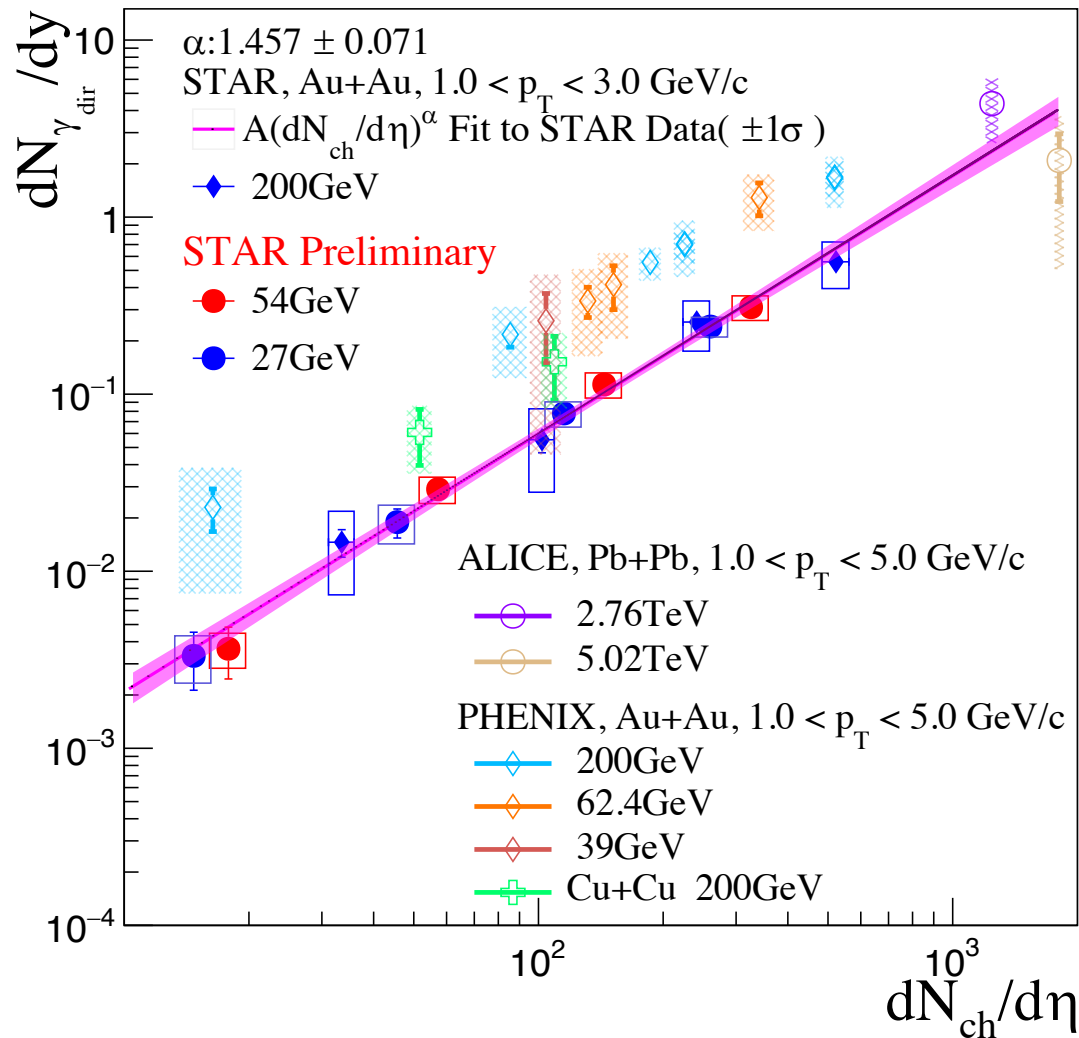
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- New measurements of $dN_{\gamma_{dir}}/dy$ at STAR
- Strong $dN_{ch}/d\eta$ dependence

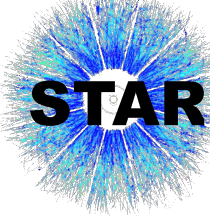
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The scaling in dN/dy vs. $dN_{ch}/d\eta$



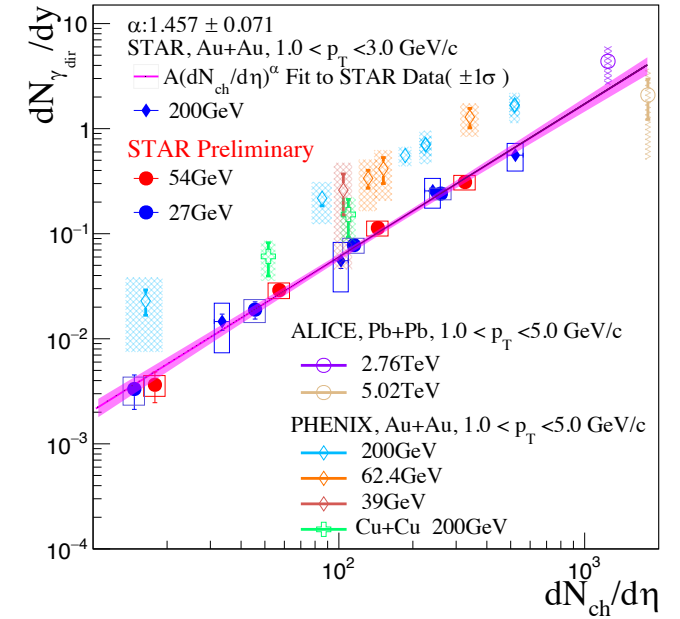
- New measurements of $dN_{\gamma_{dir}}/dy$ at STAR
- Strong $dN_{ch}/d\eta$ dependence
- The yields at $\sqrt{s_{NN}} = 27, 54.4$ and 200 GeV measured by STAR follow a common scaling, with $\alpha = 1.457 \pm 0.071$
- Dominated by thermal photon

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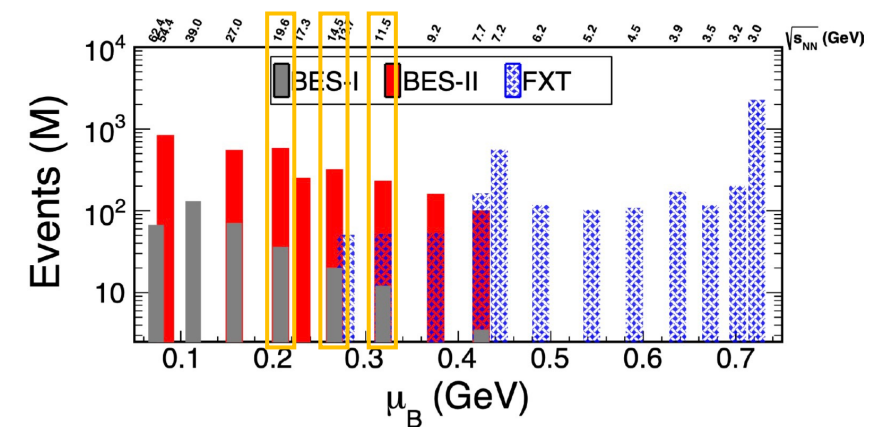
Summary

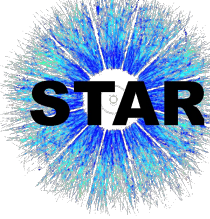
- New measurements of direct virtual photon in Au+Au collision at $\sqrt{s_{NN}} = 27$ and 54.4 GeV, firstly extended to BES-II region
- The yields at $\sqrt{s_{NN}} = 27, 54.4$ and 200 GeV measured by STAR follow a common scaling
 - Strong $dN_{ch}/d\eta$ dependence
 - Scaling power $\alpha = 1.457 \pm 0.071$



Outlook

- Extend the study to lower energies (e.g. $\sqrt{s_{NN}} = 11.5, 14.6, 19.6$ GeV), near possible CEP

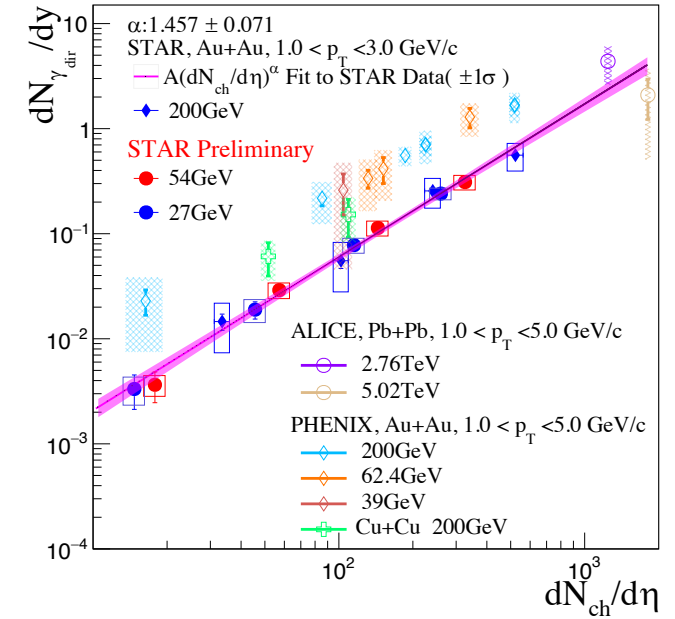




Summary

Thanks for attention!

- New measurements of direct virtual photon in Au+Au collision at $\sqrt{s_{NN}} = 27$ and 54.4 GeV, firstly extended to BES-II region
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