



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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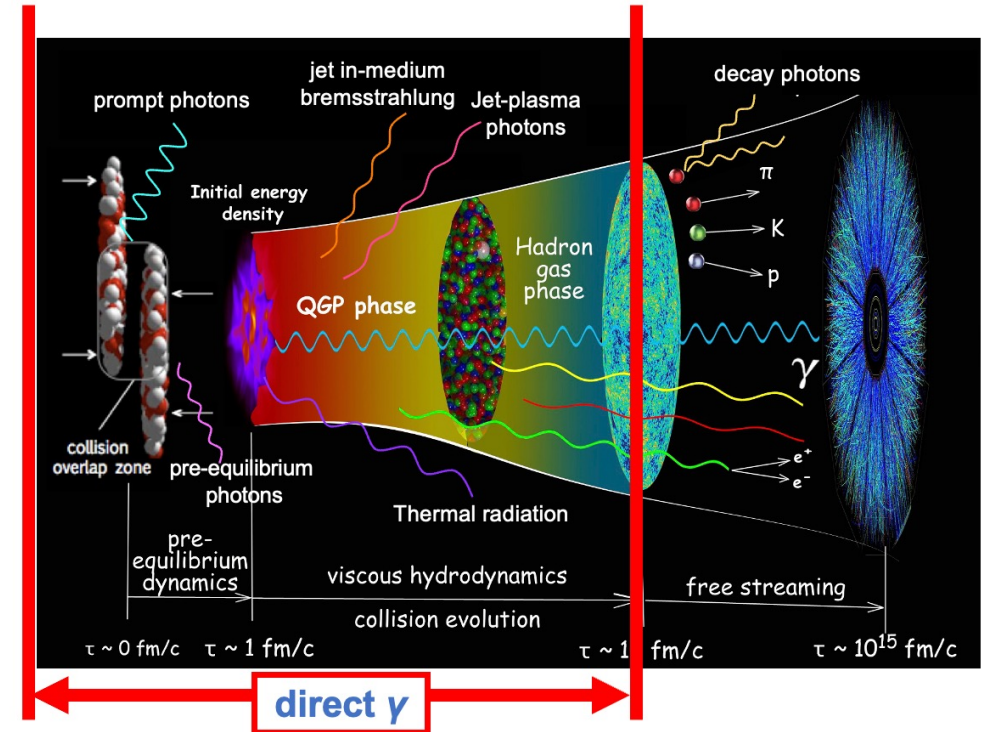
National Natural Science
Foundation of China

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?

- Emission time
- Volume $\propto dN_{ch}/dn$
- Temperature and total chemical potential



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

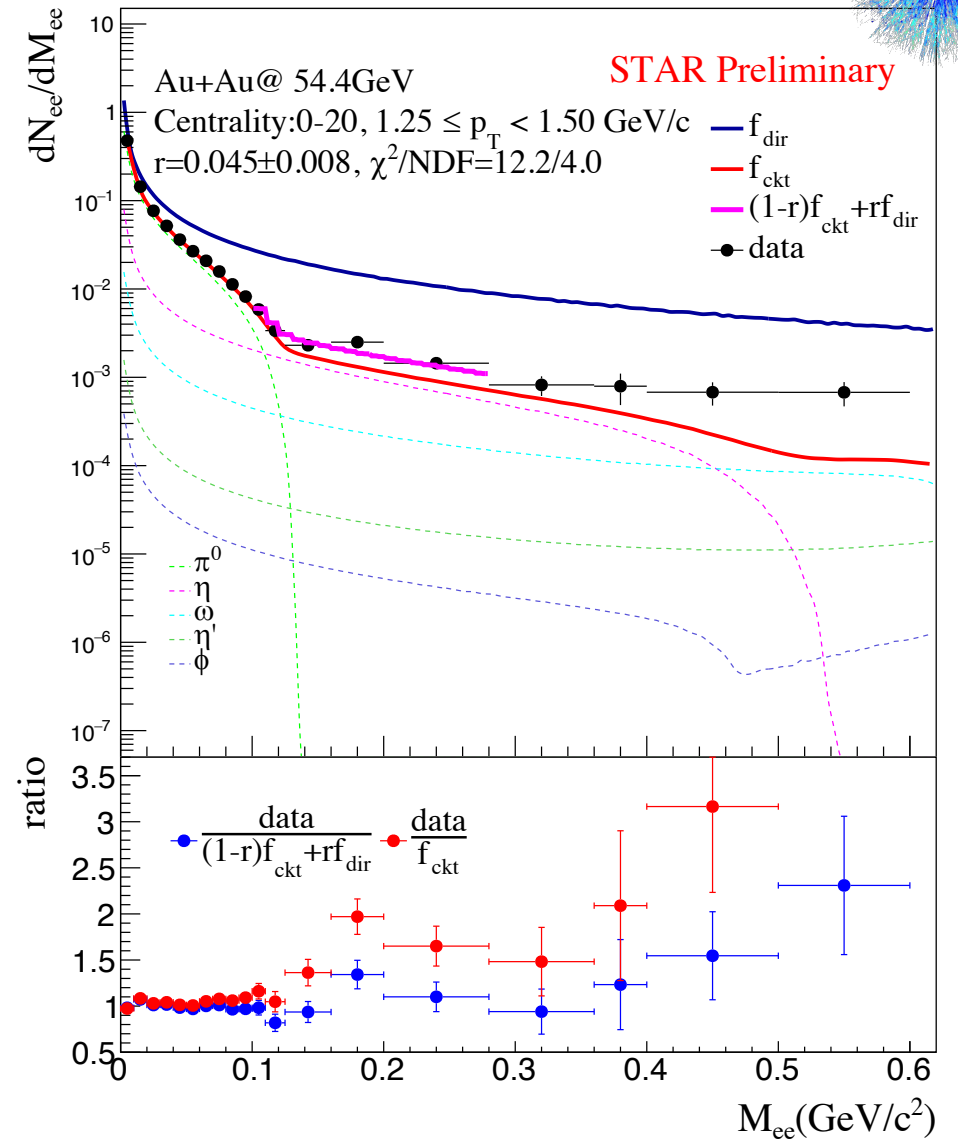
Direct virtual photon extraction

Dielectron signal and cocktail simulation

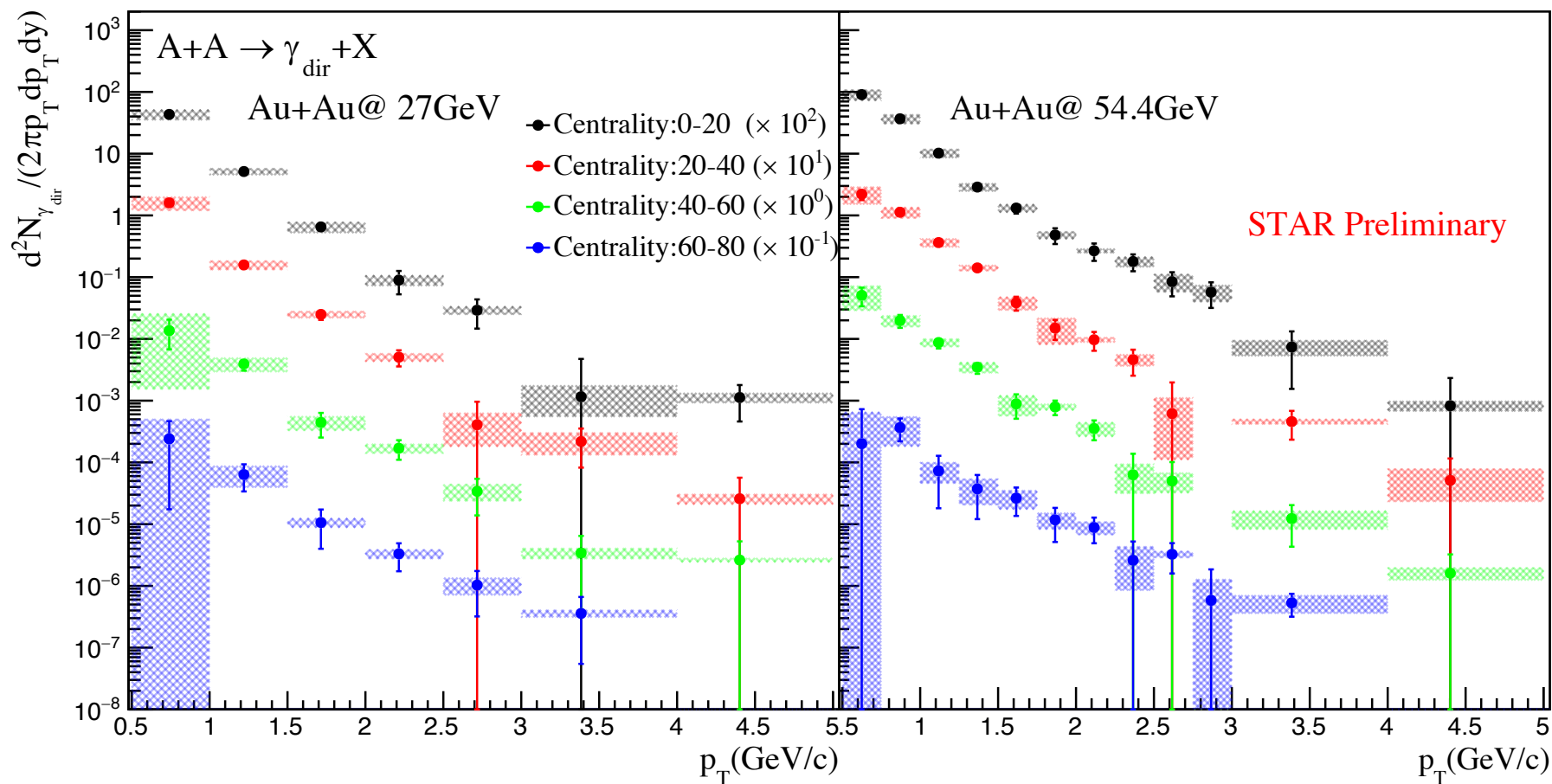
- Dielectron signal is consistent with cocktail at π^0 mass region
- η/π^0 are parametrized using Tsallis blast-wave function and constrained by world wide data at high p_T

Internal conversion method: two-component fit

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



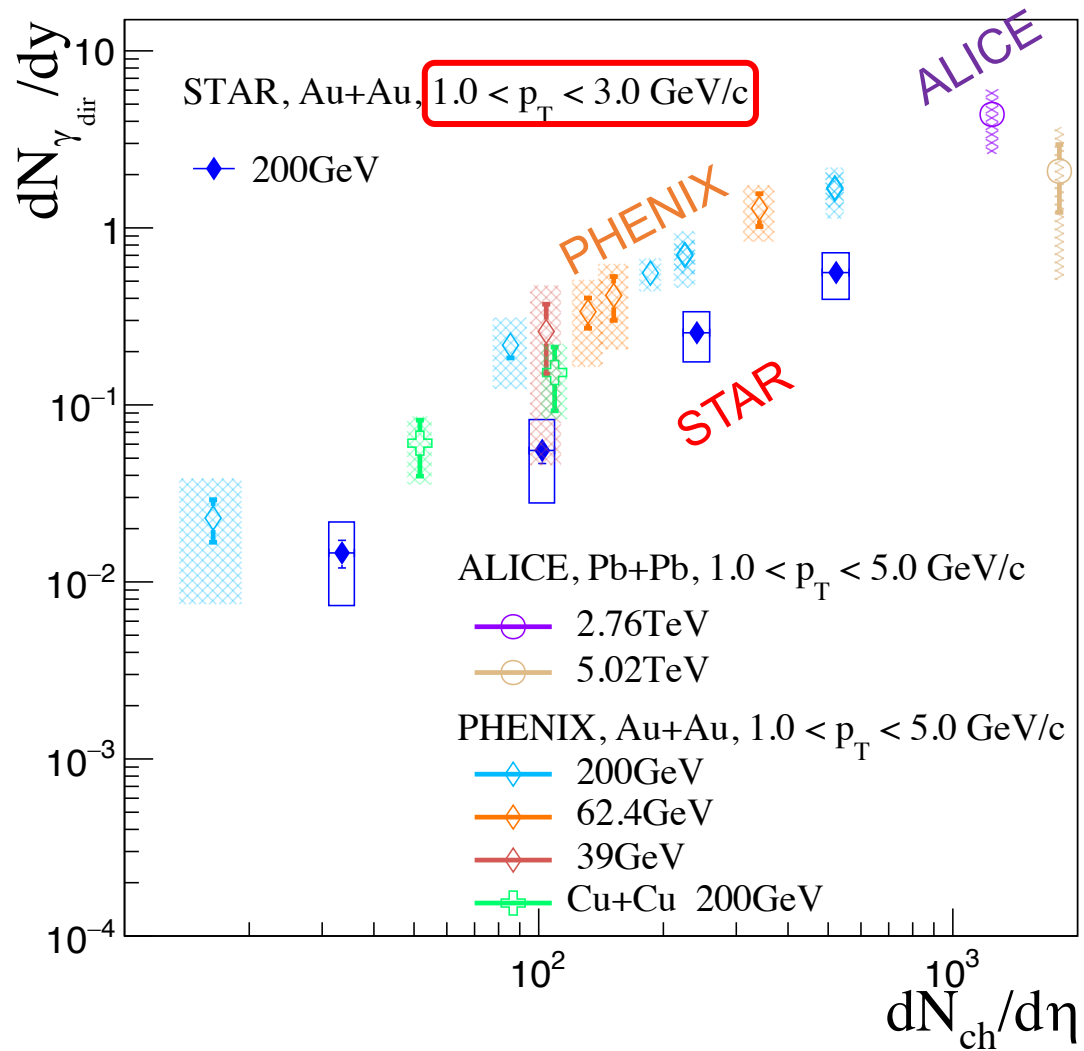
Direct virtual photon p_T spectrum



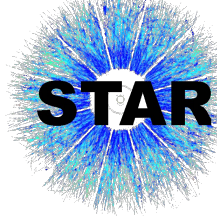
First direct virtual photon measurements in Au+Au collisions at $\sqrt{s_{NN}} = 27, 54.4$ GeV

Call for theoretical calculations on thermal photons

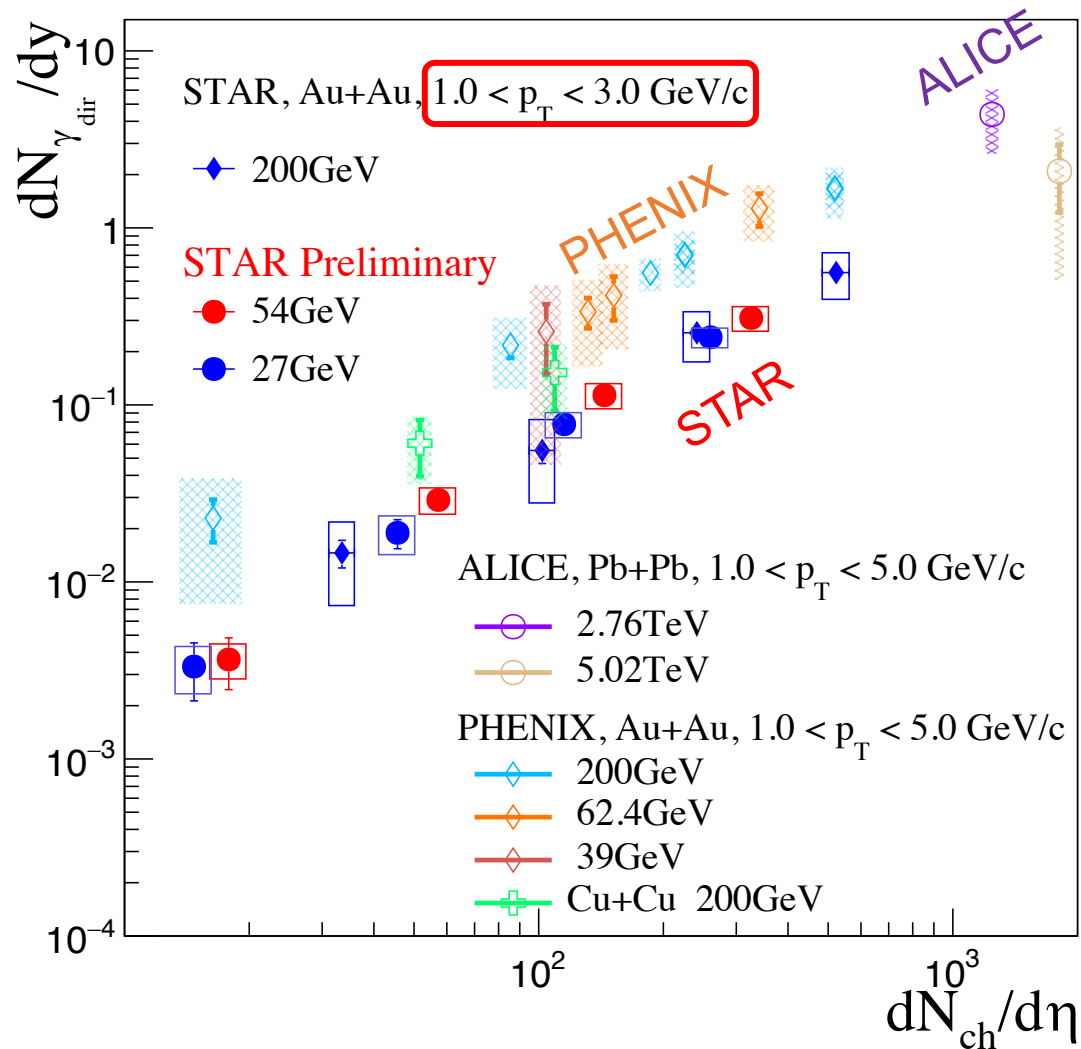
The scaling behavior in $dN_{\gamma_{\text{dir}}}/dy$ vs. $dN_{\text{ch}}/d\eta$



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



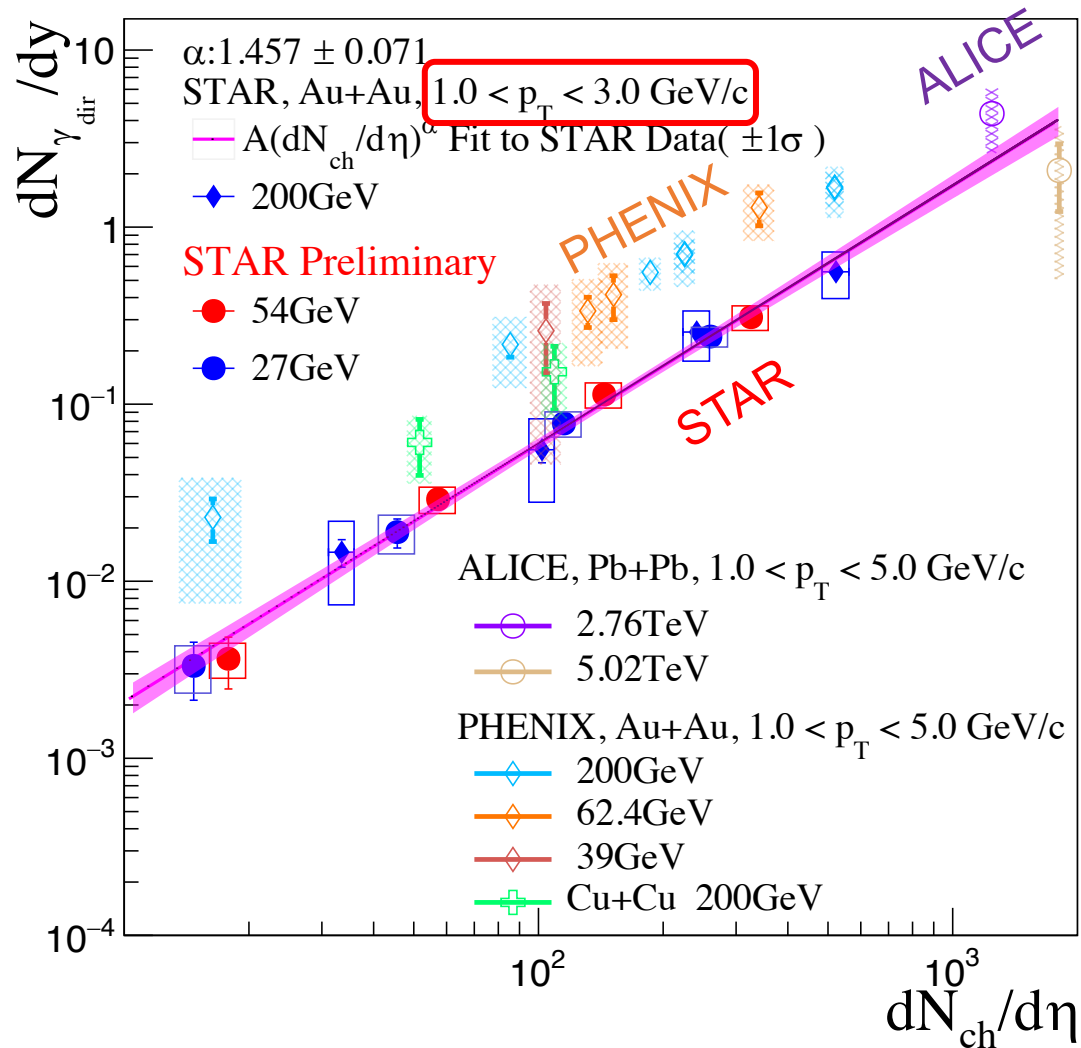
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- New measurements of $dN_{\gamma_{\text{dir}}}/dy$ at STAR
- Yield dominated by thermal photon
- Strong $dN_{\text{ch}}/d\eta$ dependence

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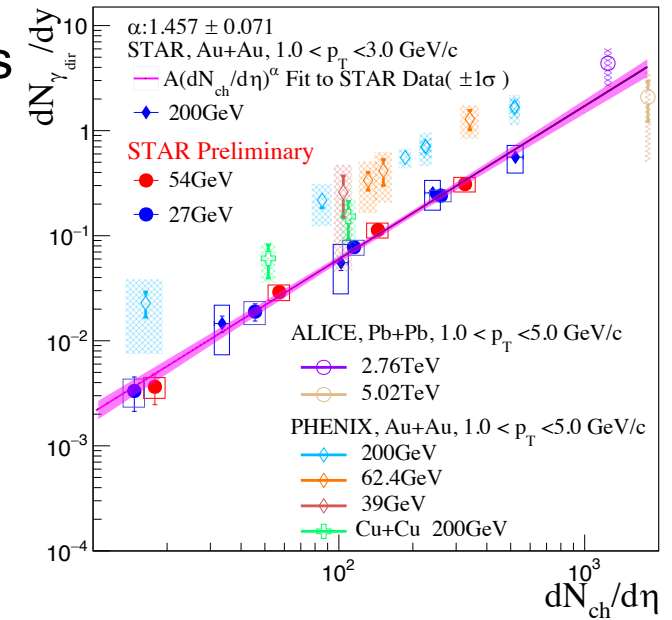


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- The yields at $\sqrt{s_{\text{NN}}} = 27, 54.4, 200 \text{ GeV}$ measured by STAR follow a **common scaling**, with $\alpha = 1.457 \pm 0.071$

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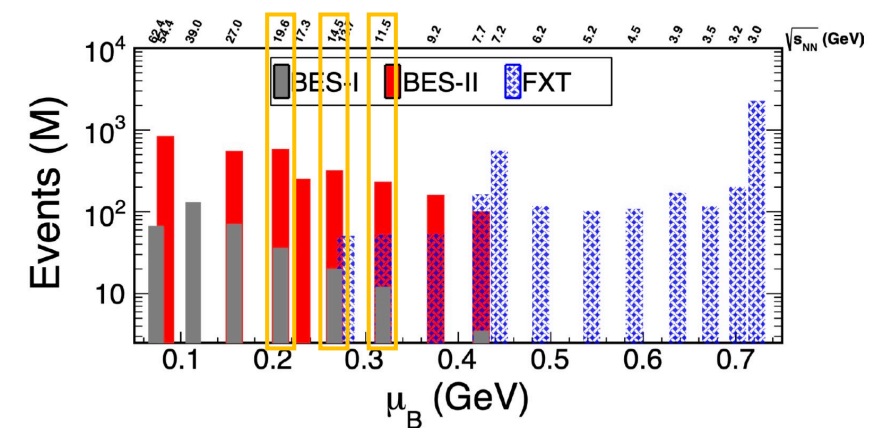
Summary

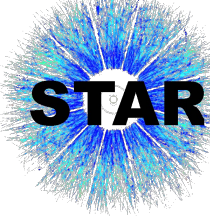
- New measurements of direct virtual photons in Au+Au collisions at $\sqrt{s_{NN}} = 27, 54.4$ GeV, firstly extended to BES-II region
- The yields at $\sqrt{s_{NN}} = 27, 54.4, 200$ GeV measured by STAR follow a **common scaling**
 - Strong $dN_{ch}/d\eta$ dependence
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Outlook

- Extend the study to the lower energies $\sqrt{s_{NN}} = 11.5, 14.6, 19.6$ GeV

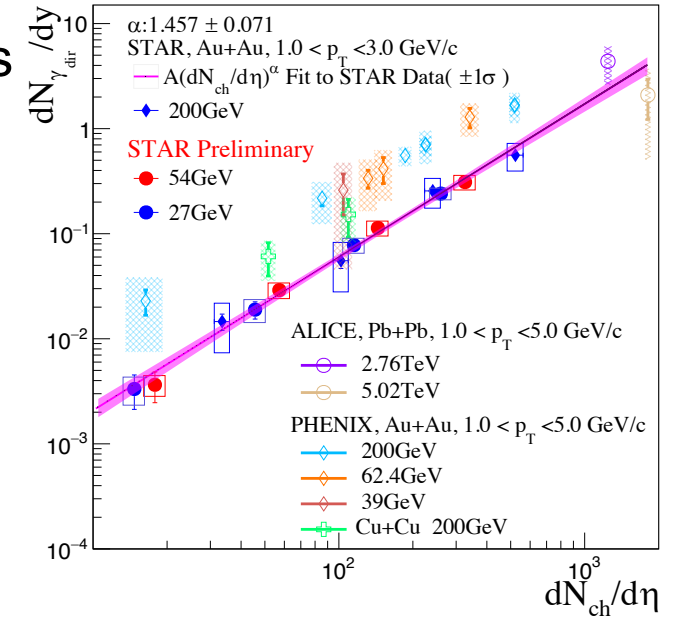




Summary

Thanks for attention!

- New measurements of direct virtual photons in Au+Au collisions at $\sqrt{s_{NN}} = 27, 54.4$ GeV, firstly extended to BES-II region
- The yields at $\sqrt{s_{NN}} = 27, 54.4, 200$ GeV measured by STAR follow a **common scaling**
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