

Soft photon measurement

~present and future~

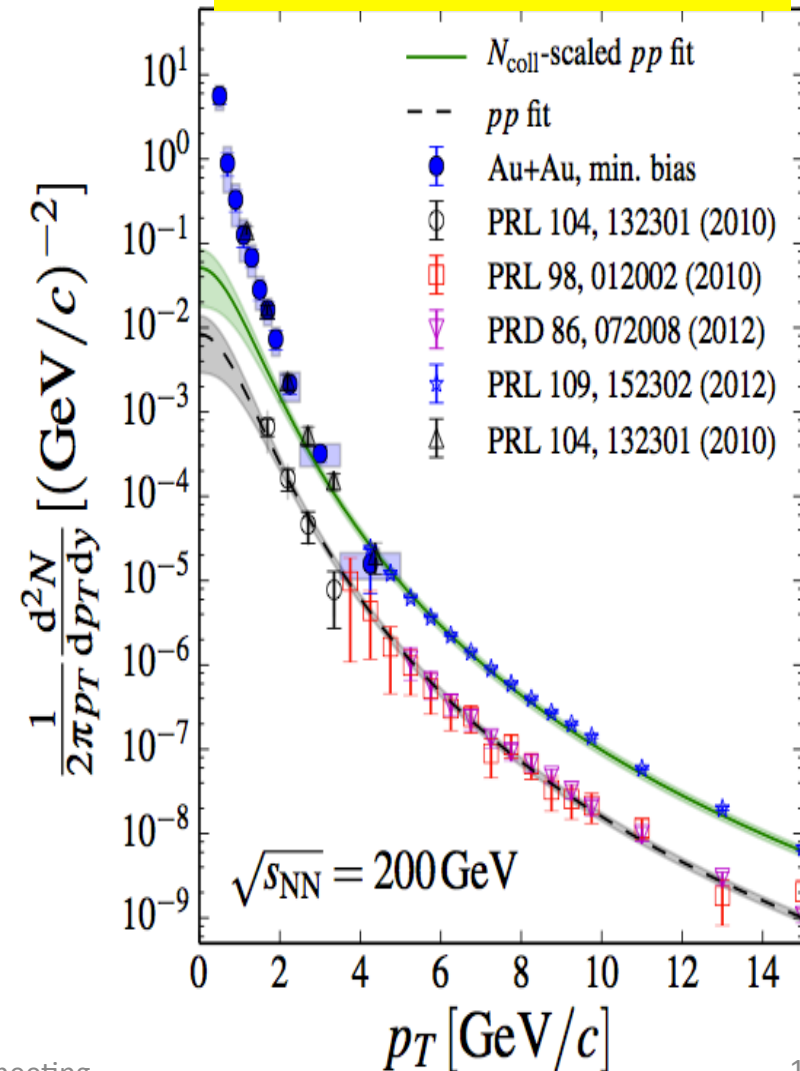
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with Gabor David, Ralf Rapp and Lijuan Ruan

- Soft photons = photons not from decay from hadrons or hard scattering
 - Emission strength (rate) reaches to the heart of the microscopic interactions in the medium
 - inverse slope closely related to temperature profile and radial flow
- Provide unique information but historically always took significantly longer time to measure than other QGP signals
- Measurement methods
 - Calorimetric measurement of real photons
 - Limited precision at low p_T
 - e+e- external conversion
 - Precise down to very low p_T , but requires huge statistics
 - Only proven way to access yield/flow below 1GeV/c
 - e+e- internal conversion
 - important cross-check, but needs statistics and has an irreducible lower limit in p_T

arXiv:1405.3940

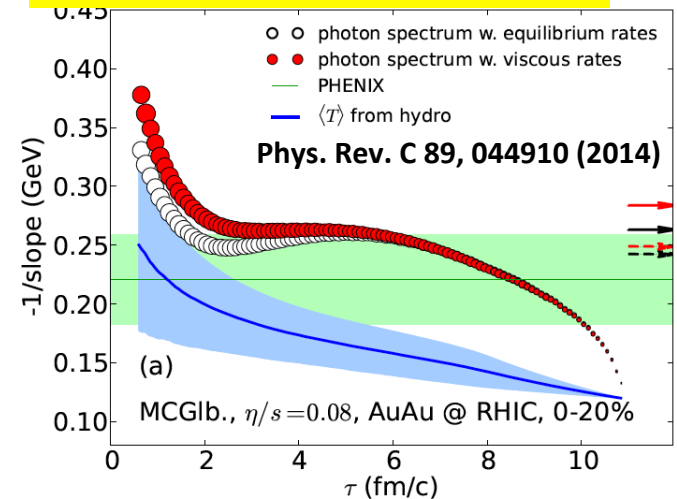
Direct photon spectra in Au+Au and p+p



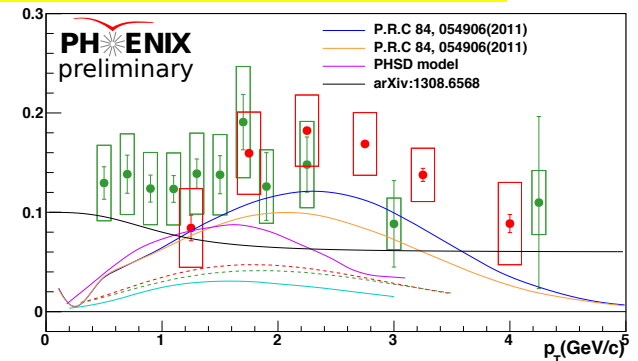
Recent status and results

- Experimental side
 - Measurement of spectra has been performed down to $p_T=0.5\text{GeV}/c$
 - Inverse slope of the spectra is 220MeV , which is consistent with virtual photon analysis
 - v_2/v_3 has been measured
 - v_3 is positive. Hydrodynamical process is dominant (magnetic field effect has $v_3=0$)
- Theoretical side
 - Large v_2 (build up in the later stage) has not been consistent with large yield (build up in early stage)
 - Recent works suggested that the high effective temperature come from around T_c plus blueshift.
 - Phys. Rev. C 84, 054906 (2011)
 - Phys. Rev. C 89, 044910 (2014)
 - Hadron-gas interaction is a non-negligible contributions to the rates
 - Maybe strongest emissivity around T_c
 - Yield/ v_2 puzzle is converging?

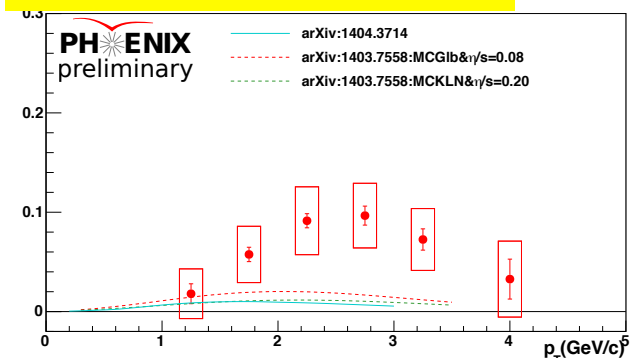
Inverse slope vs photon production time



Direct photon v_2 in Au+Au, 20-40%



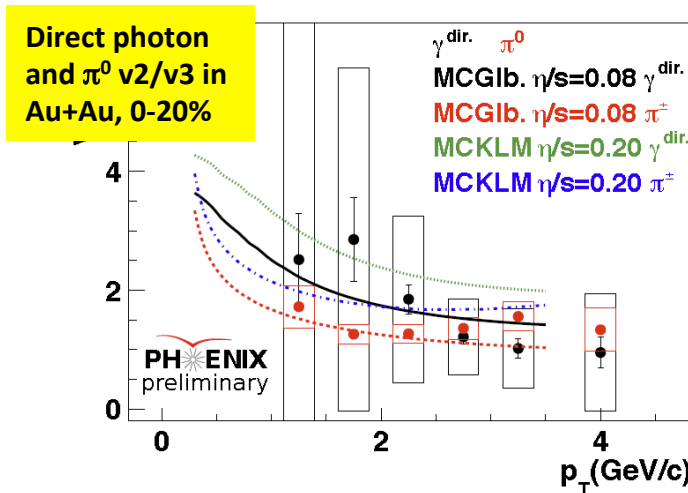
Direct photon v_3 in Au+Au, 20-40%



Future prospects and needs

- Precise measurement of both spectra and v_n are essential for understanding photons originating from the medium
 - e.g. recently it turned out that the v_n ratios help
- Future measurement
 - Temperature and flow from both photons and intermediate mass dileptons
 - Running at other cms energy may help (62GeV, etc.)
 - Rate and flow give another constraint to models
 - HBT: the only "foolproof" way to get pre-equilibrium size and shape, also (at lower q_T), the safest way to get the size of the medium
- Photon measurement is extremely difficult
 - Due to the experimental challenge, it took longer to meet the required precision (historically true for all photon-related experiments)
 - Need more time and detailed study of photon production \rightarrow should be carried onto the next generation research
- A theorist's comment: a realistic emissivity (rate) is certainly as important as a realistic space-time evolution.

Lines: arXiv:1403.7558 [nucl-th]



L. Ruan, TPD2014 workshop

