

# The Production and Angular Correlations of the $b\bar{b}$ Dijet in Pb+Pb collision at LHC

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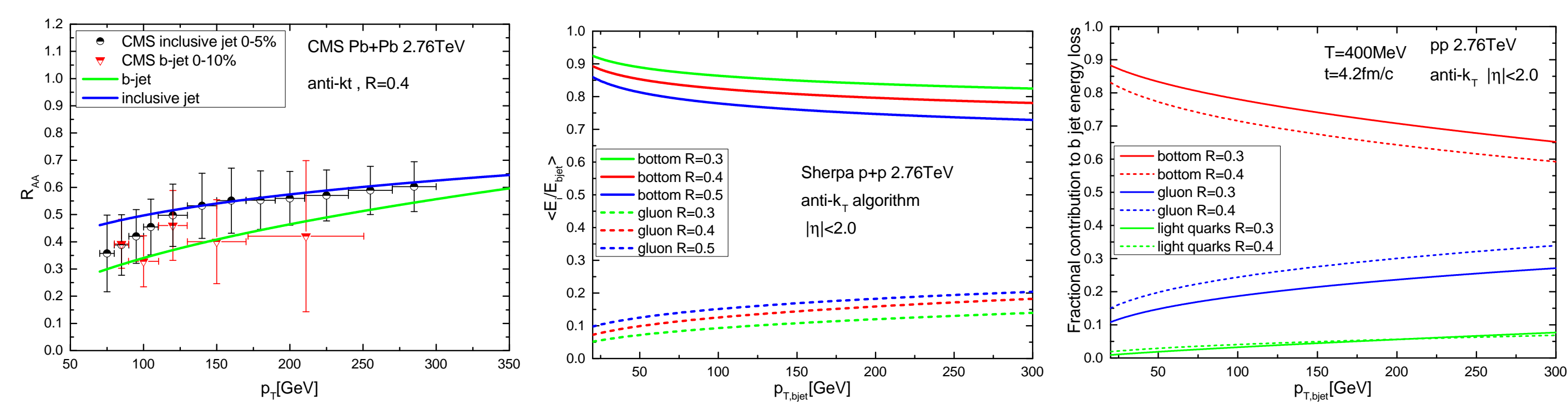
## Abstract

In this work, an MC simulation which describes the heavy quark and the light quark in-medium evolution simultaneously has been performed to investigate the  $b\bar{b}$  dijet productions in Pb+Pb collisions. NLO+parton shower MC events provided by SHERPA has been employed to give a nice p+p baseline. We first prove the framework valid for both inclusive jet and inclusive b-jet  $R_{AA}$ , then we confront our prediction of the momentum balance of the  $b\bar{b}$  dijet at 5.02 TeV in Pb+Pb collisions with the recent CMS data for the first time. A similar trend has been observed for both inclusive dijet and  $b\bar{b}$  dijet, the distribution shifted to smaller  $x_J$ . The prediction of the normalized azimuthal angle distribution of the  $b\bar{b}$  dijet in Pb+Pb collisions has also been presented at both 2.76 and 5.02 TeV. The in-medium effects of the  $b\bar{b}$  dijet will overall suppress its production, but the correlation at the near side suffers more suppression than that at the away side, therefore lead to suppression on the near side and enhancement on the away side in the normalized azimuthal angle distribution.

## MC Simulation Framework

- We employ MC@NLO generator SHERPA which combines NLO matrix elements with matched resummation of parton shower to produce the pp event for the initial input of our simulation. SHERPA could give a very nice description of the angular distribution of  $b\bar{b}$  dijet.
- For the in-medium parton evolution: a discrete Langevin equation is used to simulate heavy quarks propagation and the higher-twist scheme is used for the implementation of the gluon radiation of light partons as well as heavy quarks.
- The bulk medium evolution is provided by the Event-By-Event Viscous Israel Stewart Hydrodynamics.

## Simultaneous Description of Inclusive Jet and Inclusive b-jet

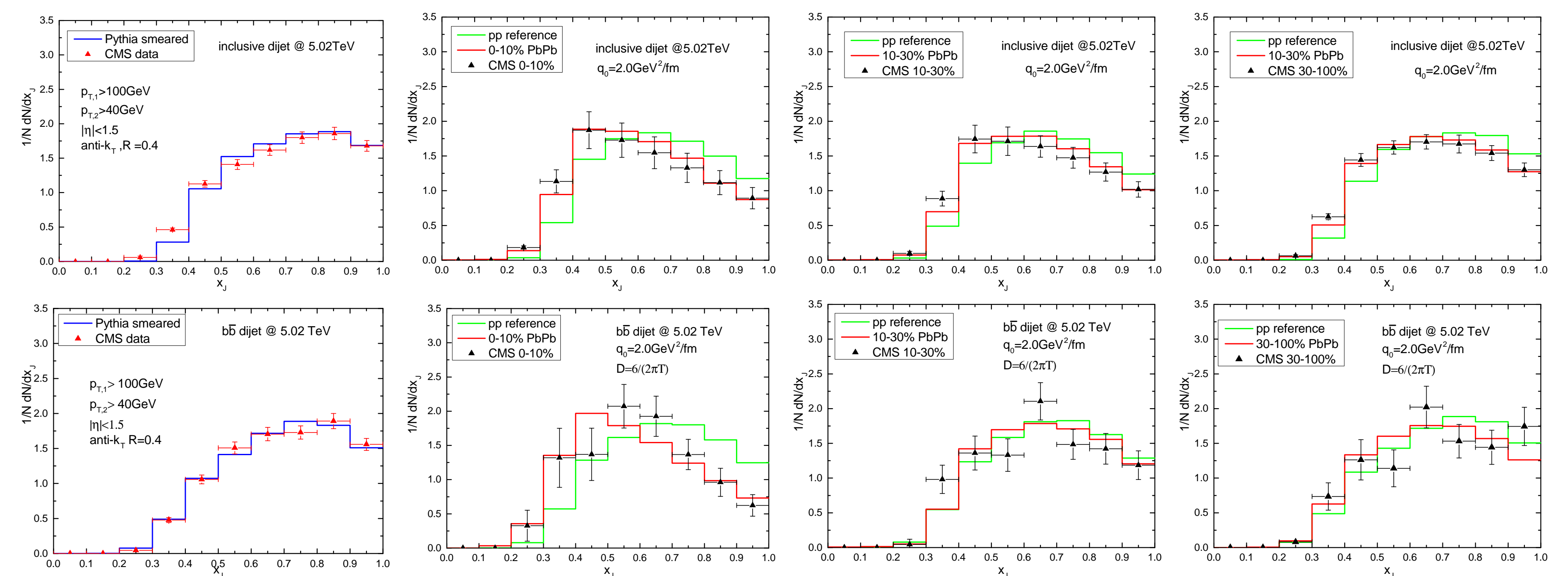


- The framework proved to be valid for describing the inclusive jet and inclusive b-jet  $R_{AA}$  at the same time.
- The  $R_{AA}$  of the inclusive jet and inclusive b-jet approach at the larger  $p_T$  region, reflect the mass effect of the heavy quark E-loss disappearing at large  $p_T$  region.
- The energy of a b-jet is dominated by b quark, and the E-loss of a b-jet is mostly contributed by the E-loss of the b quark.

## Reference

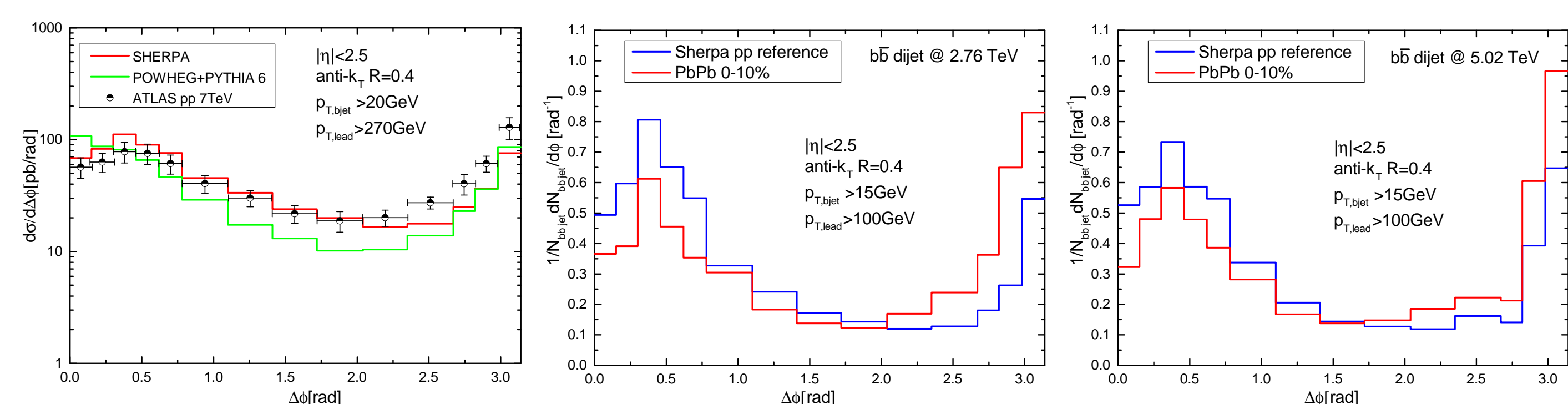
- [1] M. Gyulassy and M. Plumer, Phys. Lett. B **243** (1990) 432. X. N. Wang and M. Gyulassy, Phys. Rev. Lett. **68** (1992) 1480.
- [2] S. Cao, G. Y. Qin and S. A. Bass, Phys. Rev. C **88** (2013) 044907
- [3] B. W. Zhang, E. k. Wang and X. N. Wang, Nucl. Phys. A **757** (2005) 493
- [4] R. B. Neufeld, Phys. Rev. D **83** (2011) 065012
- [5] C. Shen, Z. Qiu, H. Song, J. Bernhard, S. Bass and U. Heinz, Comput. Phys. Commun. **199** (2016) 61
- [6] T. Sjostrand, S. Mrenna and P. Z. Skands, JHEP **0605**, 026 (2006)
- [7] S. Frixione, P. Nason and C. Oleari, JHEP **0711**, 070 (2007)
- [8] V. Khachatryan *et al.* [CMS Collaboration], Phys. Rev. C **96** (2017) no.1, 015202
- [9] S. Chatrchyan *et al.* [CMS Collaboration], Phys. Rev. Lett. **113** (2014) no.13, 132301 Erratum: [Phys. Rev. Lett. **115** (2015) no.2, 029903]
- [10] T. Gleisberg, S. Hoeche, F. Krauss, M. Schonherr, S. Schumann, F. Siegert and J. Winter, JHEP **0902**, 007 (2009)
- [11] A. M. Sirunyan *et al.* [CMS Collaboration], JHEP **1803** (2018) 181
- [12] M. Aaboud *et al.* [ATLAS Collaboration], Eur. Phys. J. C **76** (2016) no.12, 670

## Preliminary Prediction for the Transverse Momentum Balance of $b\bar{b}$ Dijet



- Our simulation can fairly describe the CMS data, the momentum balance of the  $b\bar{b}$  dijet is similar to dijet
- The normalized distribution in A+A collisions are shifted to smaller  $x_J$ , the enhancement at the smaller  $x_J$  and suppression at larger  $x_J$  are observed.

## Angular Correlations of $b\bar{b}$ Dijet in Pb+Pb Collision



- Two peaks are observed in the azimuthal angle distribution of the  $b\bar{b}$  dijet. The peak at the away side mainly originates from the flavour-creation process, and the peak at the near side largely originates from the gluon-splitting process which is closely related to the parton shower effect. With matched resummation of parton shower, SHERPA could give a nice description for ATLAS  $b\bar{b}$  angular correlation data in pp collision at 2.76 TeV.
- The prediction of the normalized azimuthal angle distribution of the  $b\bar{b}$  dijet in Pb+Pb collisions has been presented at both 2.76 and 5.02 TeV. The in-medium effect of the  $b\bar{b}$  dijet will overall suppresses its production, but the correlation at the near side suffers more suppression than away side, therefore lead to suppression on the near side and enhancement on the away side in the normalized azimuthal angle distribution.