Recombination of B_c-mesons in ultra-relativistic heavy-ion collisions

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The B_c meson, a bound state of a *b*-quark and *c*-antiquark, has been proposed as a valuable alternative probe of the Quark Gluon Plasma (QGP) in ultra-relativistic heavy-ion collisions (URHICs) [1], relative to the more "traditional" quarkonia of charm-anticharm and bottom-antibottom quarks. The binding characteristics specific to the B_c, as well as its regeneration through the recombination of a bottom and a charm quark, offer independent tests of their melting via the screening of the heavy-quark potential in the QGP and the kinetics of regeneration processes at lower temperatures [2]. Pioneering data [3] of B_c production in URHICs indicate an enhancement relative to expectations from pp collisions.

We employ the TAMU kinetic transport model [4-6] to compute the time evolution of B_c yields in a QGP fireball in Pb-Pb collisions at the LHC, accounting for both primordial and regeneration components [7]. The in-medium binding energies are taken from in-medium T-matrix calculations of B_c spectral functions in a strongly coupled QGP [8] with a potential constrained by thermal lattice-QCD data, cf. left panel of Fig. 1. Utilizing inelastic rates and equilibrium limits based on previously determined quasifree processes and heavy-quark fugacities, respectively, we predict the centrality and transverse-momentum (p_T) dependence of inclusive B_c production including feed-down contributions from excited states, see middle and right panels of Fig. 1.

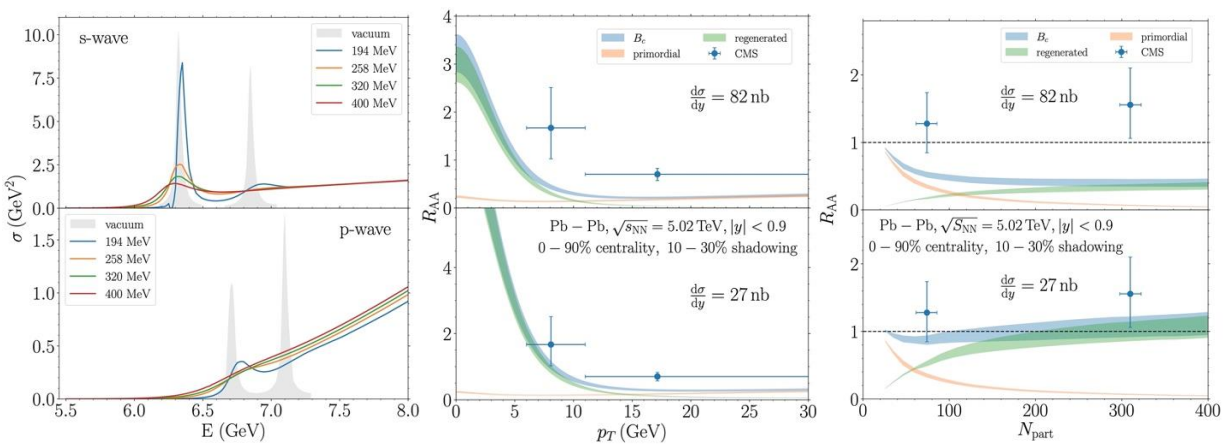

Fig. 1. Left panels: vacuum (gray band) and in-medium (solid lines) B_c spectral functions in the S- (upper panel) and P-wave (lower panel) channels (the vacuum masses are in fair agreement with experiment). Middle and right panel: p_T- and centrality-dependent nuclear modification factor, $R_{AA} = N_{Bc}^{AA} / N_{coll}\, N_{Bc}^{pp}$, of $\mathbf{B_c}$ production in minimum bias Pb-Pb (5 TeV) collisions, compared to CMS data (blue dots) [3]; shown are the primordial (orange lines) and regeneration (green lines) contributions, as well as their sum (blue lines; the bands represent the uncertainty in the nuclear shadowing of open-charm production); the upper (lower) panels are based on a B_c production cross section of $d\sigma^{pp}/dy$= **27** (82) nb figuring in the denominator of the R_{AA}. The centrality dependence in the right panels is for B_c mesons with a $p_T > 6$ GeV cut.

Our results suggest that the inclusive B_c yield in semi-/central Pb-Pb collisions is dominated by regeneration processes, while the precise value of the R_{AA} depends on the input cross section from pp collisions figuring in the denominator, which currently has a large uncertainty. The transverse-momentum

and centrality dependence of the R_{AA} from our calculation describe the experimental data better for smaller values of the cross section as shown in the lower middle and right panels.

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