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Heavy flavour spectra in nucleus-nucleus collisions within a Langevin approach

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We present the outcomes of a theoretical study of heavy-flavour spectra in nucleus-nucleus (AA) collisions. The core of the analysis is represented by the study of the propagation of heavy (c and b) quarks in the Quark Gluon Plasma (QGP) formed in the relativistic AA collisions: their dynamics is described through a relativistic Langevin equation, whose transport coefficients are evaluated within a thermal-field-theory approach. Results obtained with lattice-QCD transport coefficients will be also shown. The Langevin approach, at variance with standard radiative energy-loss calculations, allows one to address more general situations, describing in particular the asymptotic relaxation of a heavy-quark sample to thermal equilibrium with the surrounding plasma. In facing the actual experimental situation, the numerical solution of the Langevin equation enters into a multi-step setup including:

- The initial hard production of the q-qbar pairs, given by the POWHEG-BOX event generator (based on NLO pQCD);
- In the AA case, the Langevin dynamics in the QGP, with the fireball evolution described by relativistic hydrodynamics;
- The hadronization stage according to the most up-to-date branching fractions and fragmentation functions;
- The final decays into the experimentally accessible channels (open charm hadrons, displaced J/psi, heavy-flavour electrons);
- The evaluation of the experimental observables: inclusive spectra (in pp and AA), R_AA and v_2 (in AA) and comparison with the most recent experimental results obtained in Pb-Pb collisions at the LHC at 2.76 TeV.

Our analysis represents an improvement of the calculations presented in Eur.Phys.J. C71 (2011) 1666., in particular

- for what concerns the simulation of the initial hard production, performed according to the most up-to-date QCD approaches, with NLO calculations interfaced with a parton-shower stage (measurements of exclusive open-charm spectra which became available at the LHC allowing one to fix the pp benchmark with tighter constraints);
- for the wider systematic study of the coupling of the heavy quarks with the QGP, with weak-coupling results compared to lattice-QCD findings.

Such a kind of transport study allows one to establish a link between what is possible to derive from the underlying microscopic theory (the transport coefficients) and the final experimental observables, enabling one to extract information on the properties of the produced medium.