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## Heavy hadrons production in pp collisions - the importance of collectivity and correlations

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The creation of a quark-gluon plasma (QGP) is expected in heavy ion collisions. It came as a surprise that proton-proton collisions at ultrarelativistic energies show as well a “QGP-like” behavior and signs of the creation of a fluid, although the corresponding system size is not more than a few cubic femtometers. Even more surprisingly, also heavy flavor particles seem to be part of the fluid or at least interact with it. In this contribution, we will investigate in a quantitative way this “collective behavior” of heavy flavor, by employing the newly developed EPOS4HQ approach, which has proven to be compatible with basic experimental data of light flavor hadrons. We will investigate all observables, which may manifest collectivity, as particle spectra, elliptic flow, baryon-to-meson ratios, and two-particle correlations, and compare the results with experimental data. We will try to disentangle initial state effects, those being due to interactions between charm quarks and plasma partons, and final state effects (hadronization). We proceed then to the study of correlations between the produced heavy quarks which are caused by different pQCD production mechanisms. They do not only show up in the azimuthal correlations but also in the production of quarkonia. We show that even the open heavy meson spectra are a complicated superposition of these elementary processes.

### **session**

F. Heavy Flavor and Quarkonia

**Primary author:** AICHELIN, Joerg (SUBATECH)

**Presenter:** AICHELIN, Joerg (SUBATECH)

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