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Probing deconfinement and related phenomena from small to large systems with Υ˜meson measurements with the CMS experiment

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One of the most unanticipated findings of the LHC heavy ion program is the observation of stronger suppressions of the excited Υ states compared to the lower $\Upsilon(1S)$˜state in \mbox{proton-lead} collisions, with the same hierarchy as seen in the larger \mbox{lead-lead}˜(PbPb) collision events. Together with other observations of signatures of quark-gluon plasma formation in “small systems”, this feature raises the question of whether a hot medium can be produced in such systems and motivates studies for ions with different sizes. At the same time, polarization observables remain to be investigated since the observed suppression patterns could be caused (to a large extent) by variations in quarkonium polarization rather than by changes in a genuine medium-induced modification of the production yields.
We report the first measurement of Υ˜mesons in \mbox{oxygen-oxygen} and \mbox{neon-neon} collisions and the observation of stronger suppression for the excited states. The yield ratios relative to the $\Upsilon(1S)$ production rate are compared with similar results from other collision systems as well as with models describing the nuclear modification of quarkonium production in (deconfined) media. In addition, we present a measurement of $\Upsilon(1S)$ polarization in PbPb collisions in the helicity and Collins-Sopper frames. These measurements represent important steps in establishing a comprehensive picture of quarkonium dynamics from small to large collision systems.

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