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Evidence for top quark production in nucleus-nucleus collisions with the CMS experiment

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Evidence for the production of top quarks in heavy ion collisions is reported in a data sample of lead-lead collisions recorded in 2018 by the CMS experiment at a nucleon-nucleon center-of-mass energy of $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV, corresponding to an integrated luminosity of $1.7 \pm 0.1\,\mathrm{nb}^{-1}$. Top quark pair ($\mathrm{t\bar{t}}$) production is measured in events with two opposite-sign high-p_{T} isolated leptons ($\ell^{\pm}\ell^{\mp} = \mathrm{e}^{+}\mathrm{e}^{-}$, $\mu^{+}\mu^{-}$, and $\mathrm{e}^{\pm}\mu^{\mp}$). We test the sensitivity to the $\mathrm{t\bar{t}}$ signal process by requiring or not the additional presence of b-tagged jets, and hence demonstrate the feasibility to identify top quark decay products irrespective of interacting with the medium (bottom quarks) or not (leptonically decaying W bosons). To that end, the inclusive cross section ($\sigma_{\mathrm{t\bar{t}}}$) is derived from likelihood fits to a multivariate discriminator, which includes different leptonic kinematic variables with and without the b-tagged jet multiplicity information. The observed (expected) significance of the $\mathrm{t\bar{t}}$ signal against the background-only hypothesis is 4.0 (5.8) and 3.8 (4.8) standard deviations, respectively, for the fits with and without the b-jet multiplicity input. After event reconstruction and background subtraction, the extracted cross sections are $\sigma_{\mathrm{t\bar{t}}} = 2.03^{+0.71}_{-0.64}$ and $2.54^{+0.84}_{-0.74}\,\mu$b, respectively, which are lower than, but still compatible with, the expectations from scaled proton-proton data as well as from perturbative quantum chromodynamics predictions. This measurement constitutes the first crucial step towards using the top quark as a novel tool for probing strongly interacting matter.

Primary author: CMS

Presenter: ALCERRO ALCERRO, Luis (The University of Kansas (US))

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