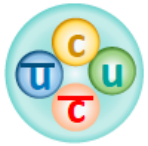
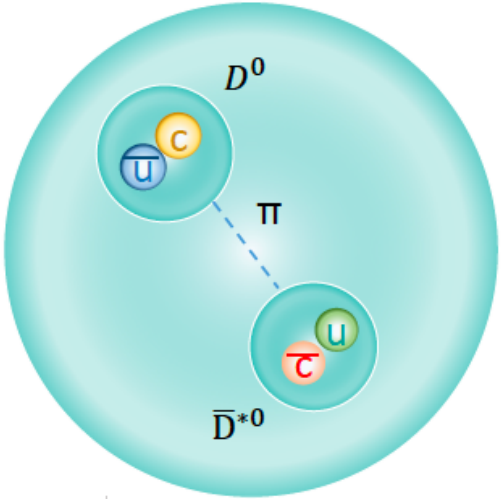
Deciphering Exotic Hadron Structures with Heavy Ion Collisions

What is the intrinsic structure of X3872 (and many other exotic states)?

Compact tetra quark? R ~ 0.5 fm





Hadron molecule? R ~ 5 fm

Despite nearly 20 years past its discovery, we still could not settle on its basic features by an order of magnitude!

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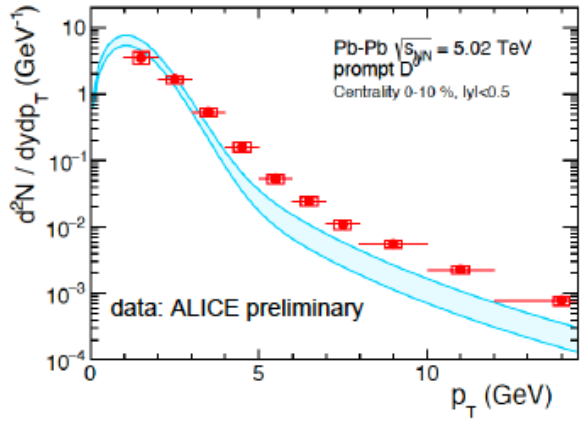
Indiana University, Physics Dept. & CEEM

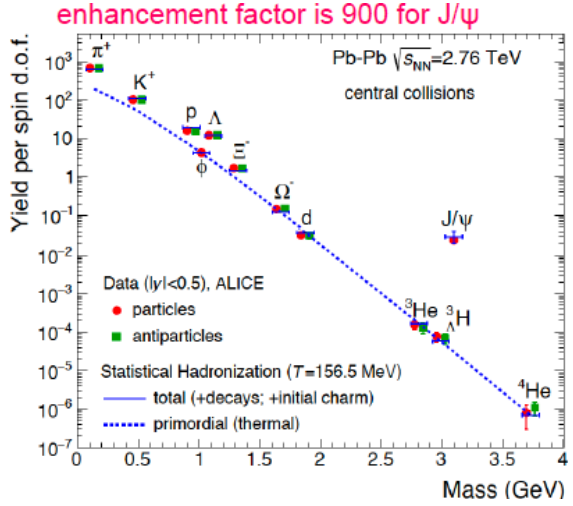
Can We (Heavy Ion Collisions) Help?

We have a nice bowl of MANY charms + numerous light quarks

enhancement factor is 30 for D^0



enhancement factor is 900 for J/ψ



The QGP produced @ LHC O(~1000) GeV collisions, is a "charming" soup, with a "large" (~100/event) number of charms
—> ideal environment for massive production and study of heavy exotics!!!

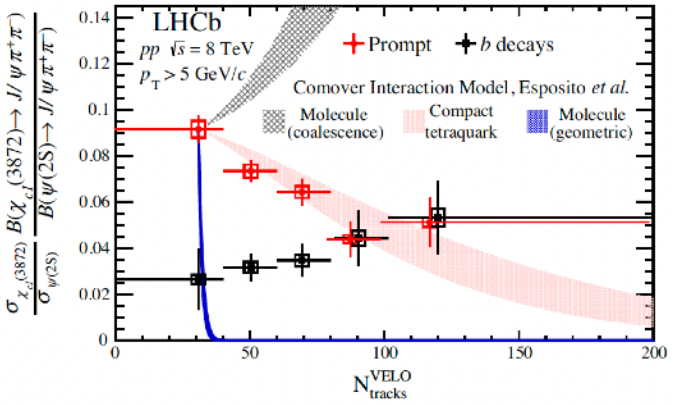
Hunting for X in Nuclear Collisions

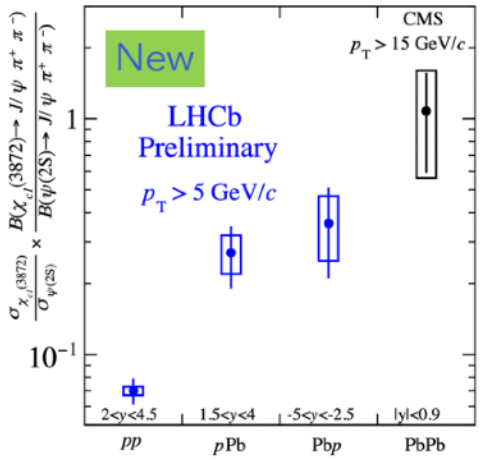
First set of X-measurements from CMS and LHCb since 2019

PHYSICAL REVIEW LETTERS **126,** 092001 (2021)

Observation of Multiplicity Dependent Prompt $\chi_{c1}(3872)$ and $\psi(2S)$ Production in pp Collisions

R. Aaij *et al.**
(LHCb Collaboration)

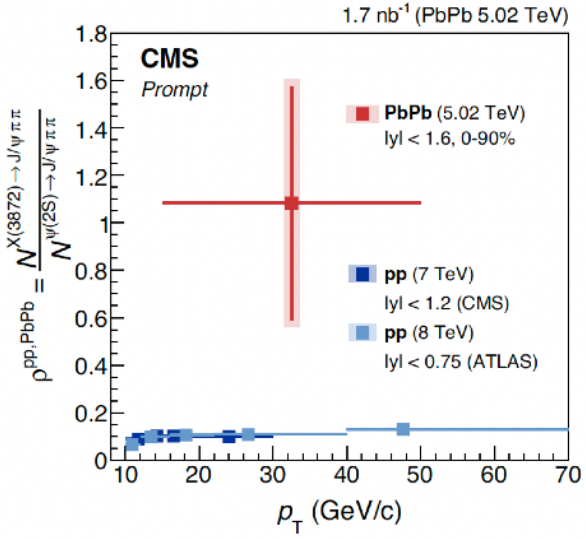




PHYSICAL REVIEW LETTERS **128,** 032001 (2022)

Evidence for X(3872) in Pb-Pb Collisions and Studies of its Prompt Production at $\sqrt{s_{NN}} = 5.02$ TeV

A. M. Sirunyan *et al.**
CMS Collaboration



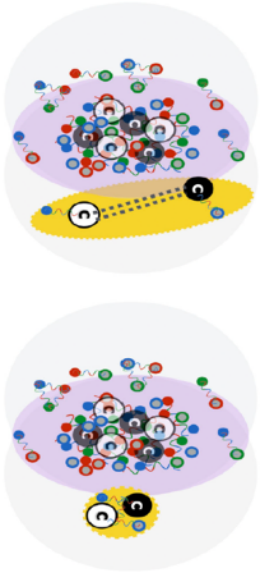
QM2022

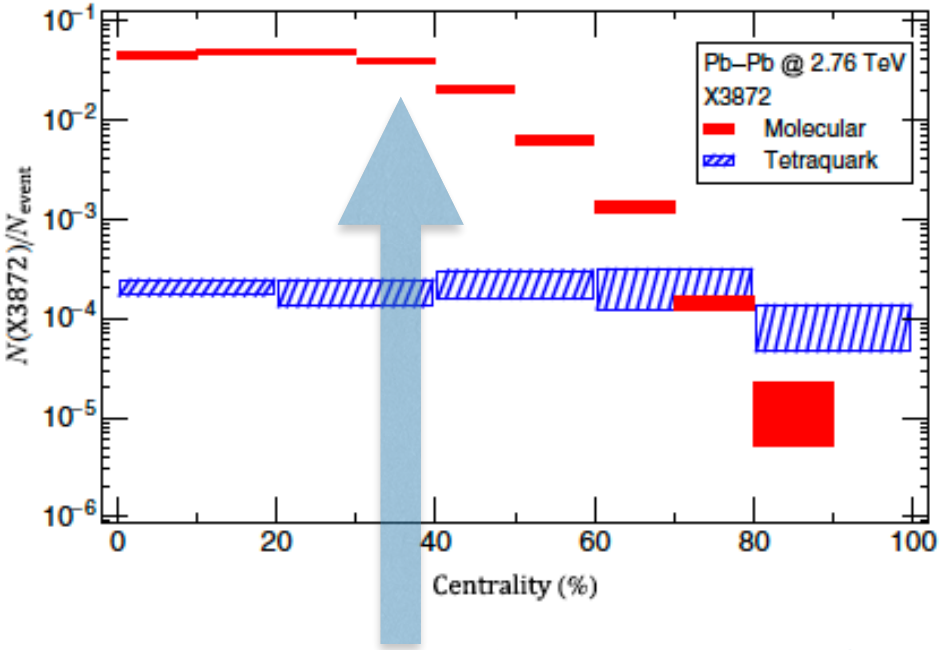
Measurements already hint at partonic medium effect on the X production!

How Can We Help?

More and better measurements are badly needed.

Interesting theoretical ideas have started floating around.
Strong theoretical efforts would be crucial and should be encouraged.





Details in PRL126(012301)2021;

Similar effect found for the doubly charmed Tcc: PRD104(L111502)2021.

Fireball size serves as a "meter stick" for nailing X size!

It's an emerging opportunity at the intersection of HOT&COLD QCD for doing exciting physics to help unravel a long-standing mystery!