Charmonium in heavy ion collisions at LHCb in fixed-target configuration

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Why studying charmonium in heavy ion collisions ?

Charmonium: $c\bar{c}$ bound pair, such as J/ψ, ψ', χ_c
J/ψ, ψ', χ_c have different binding energies, different dissociation temperature / critical QGP temperature (T_d/T_c)

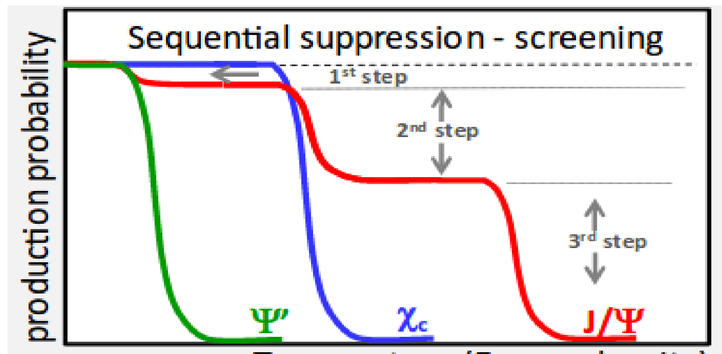
States	J/ψ	χ_c	Ψ'
T_d/T_c	2.10	1.16	1.12

[H. Satz, J. Phys. G 32 (2006)

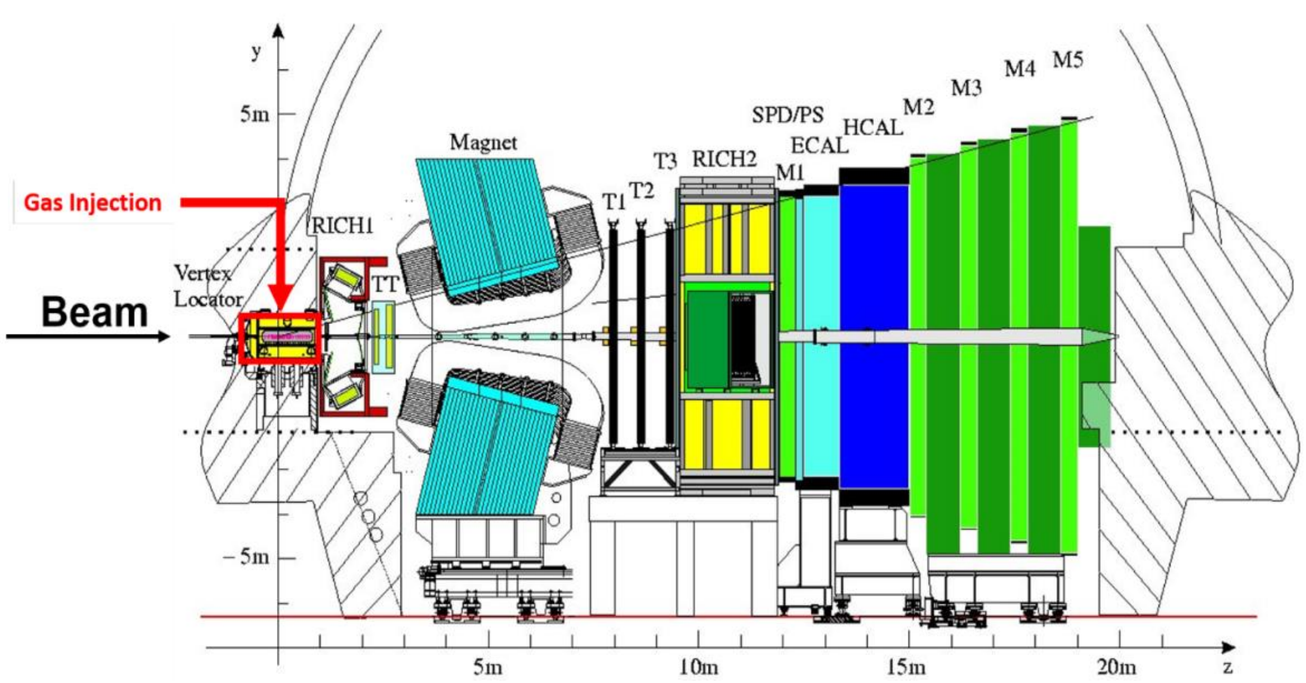
Aim: **characterize the transition from normal matter to deconfined matter** using charmonium suppression as a probe of the deconfinement

J/ψ production: 60% direct production, 30% from χ_c decays, 10% from ψ' decays
→ **J/ψ production probability should exhibit a step-by-step suppression pattern**

Experimentally: observation of J/ψ and ψ' suppression at experiments based at SPS, RHIC, and LHC
The full step-by-step suppression pattern has never been observed



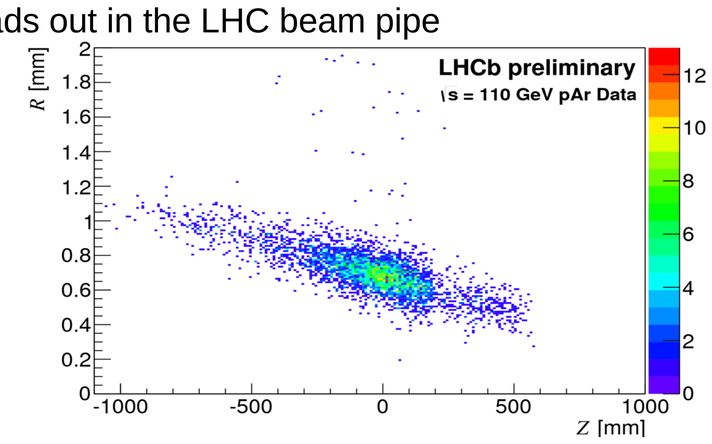
The LHCb detector and its fixed target system



LHCb detector: design to study proton-proton collisions at LHC

Unique opportunity at the LHC for a fixed-target experiment
→ originally design to do beam-gas imaging
→ optimal to test the charmonium step-by-step suppression pattern

During **dedicated runs**, **injection of a noble gas** (pressure ~10^{-7} mbar), which spreads out in the LHC beam pipe



Charmonium and open charm in proton-argon collisions

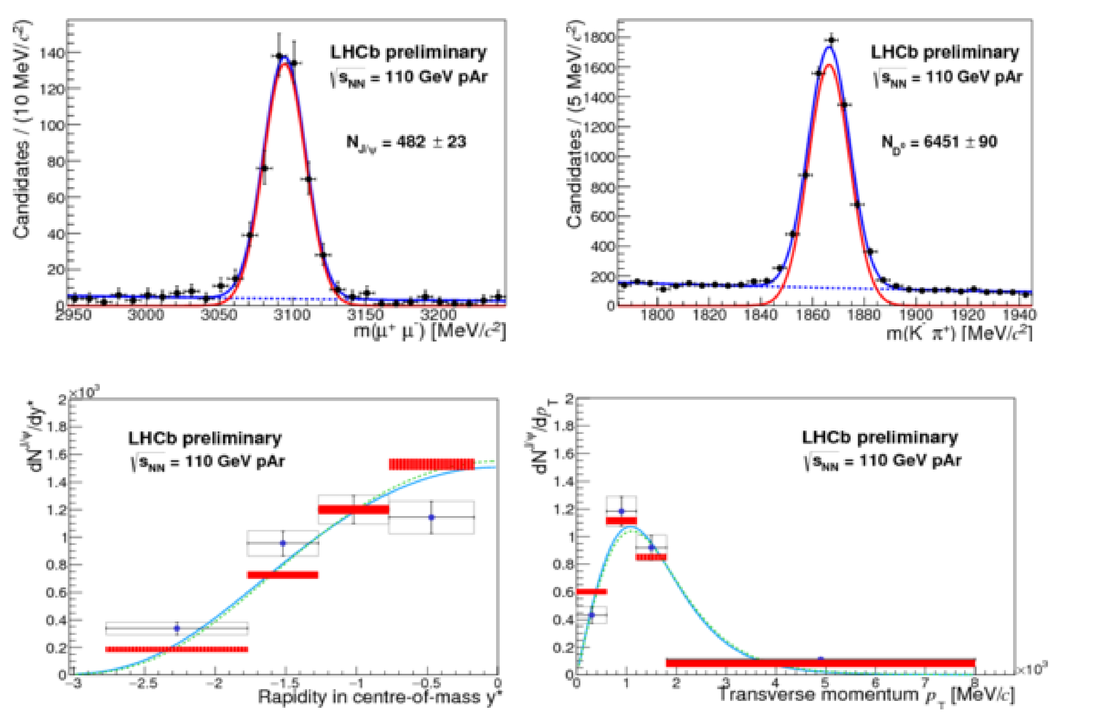
Proton-argon collisions collected during 18h in October 2015

First sample with enough statistics to study charmonium

Methodology:
1. Select events coming from a region where the detector performance is optimal
2. Select and extract J/ψ and D^0 signal (D^0 is the reference)
3. Evaluate and correct all the biases introduced by the data taking and analysis
4. Compare the corrected yields of J/ψ and D^0 signal with theoretical predictions

First charmonium analysis with LHCb in fixed-target configuration
[LHCb Collaboration, LHCb-CONF-2017-007]

→ **Prove the feasibility of the heavy flavour fixed-target program**



What's next ?

2015 - 2016: special protons-nucleus runs with limited beam intensity
→ **Analysis of proton-argon done**
→ **Analysis of proton-helium ongoing**

2017: First high-intensity SMOG run, with 2.5 TeV proton beam of nominal intensity on neon gas
→ **Next analysis**