D-meson production in Pb-Pb collisions with ALICE at the LHC

Stefano Trogolo

University and INFN - Padova

on behalf of the **ALICE Collaboration**

UNIVERSITÀ DEGLI STUDI DI PADOVA

INFN PADOVA

Istituto Nazionale di Fisica Nucleare

Sezione di Padova

Quark Matter

Wuhan 4-9 November, 2019

Heavy flavours in the QGP

- Heavy flavours (i.e. **c** and **b** quarks) mainly produced in *hard-scattering process* on short time scale (~ 0.02—0.1 fm/c) in the early stage of the collision → probe the full evolution of the QGP
- With the latest (2018) Pb-Pb data sample ALICE measured **prompt D-meson** R_{AA} :

  → with **higher precision**

  → **extending** the low-p_T reach

D-meson reconstruction

$$D^0 \to K^-\pi^+ \,(BR = 3.89\%) \qquad D^{*+} \to D^0(\to K^-\pi^+)\pi^+ \,(BR = 67.7\% \times 3.89\%)$$

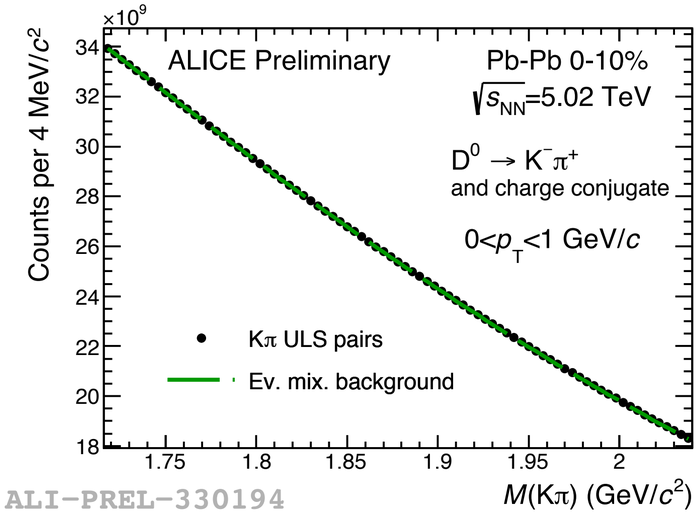
$$D^+ \to K^-\pi^+\pi^+ \,(BR = 9.46\%) \qquad D_s^+ \to \phi(\to K^+K^-)\pi^+ \,(BR = 2.27\%)$$

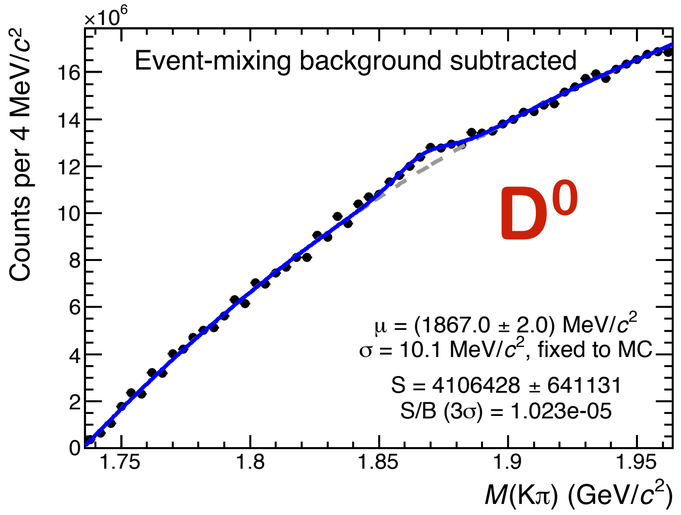
- **Reconstruction** of decay vertices **displaced ~100 *μ*m** from primary vertex combining pairs/triplets of tracks
- **Particle identification** (PID) of decay tracks and **geometrical selection** of displaced decay-vertex topology
- **Efficiency correction** with Monte Carlo simulations [1,2] and **beauty feed-down** subtraction based on FONLL pQCD calculations [3]

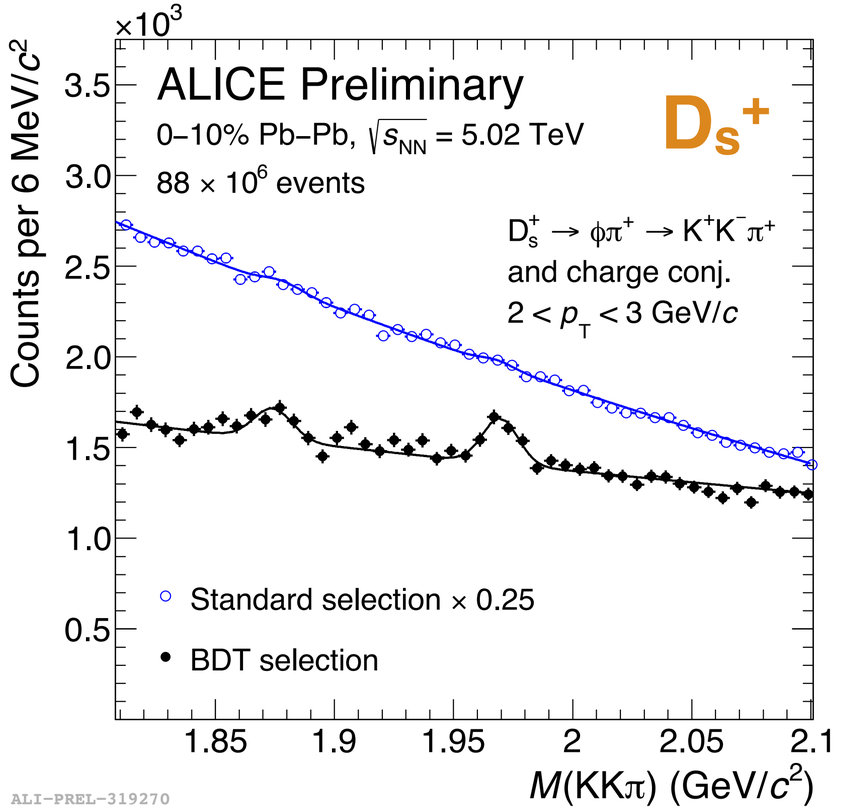
Highlight from D-meson reconstruction

- Data sample: Pb-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV **collected in 2018**

  → $\mathscr{L}_{int} \approx 114\ \mu b^{-1}$ (0-10%) and $\mathscr{L}_{int} \approx 49\ \mu b^{-1}$ (30-50%)



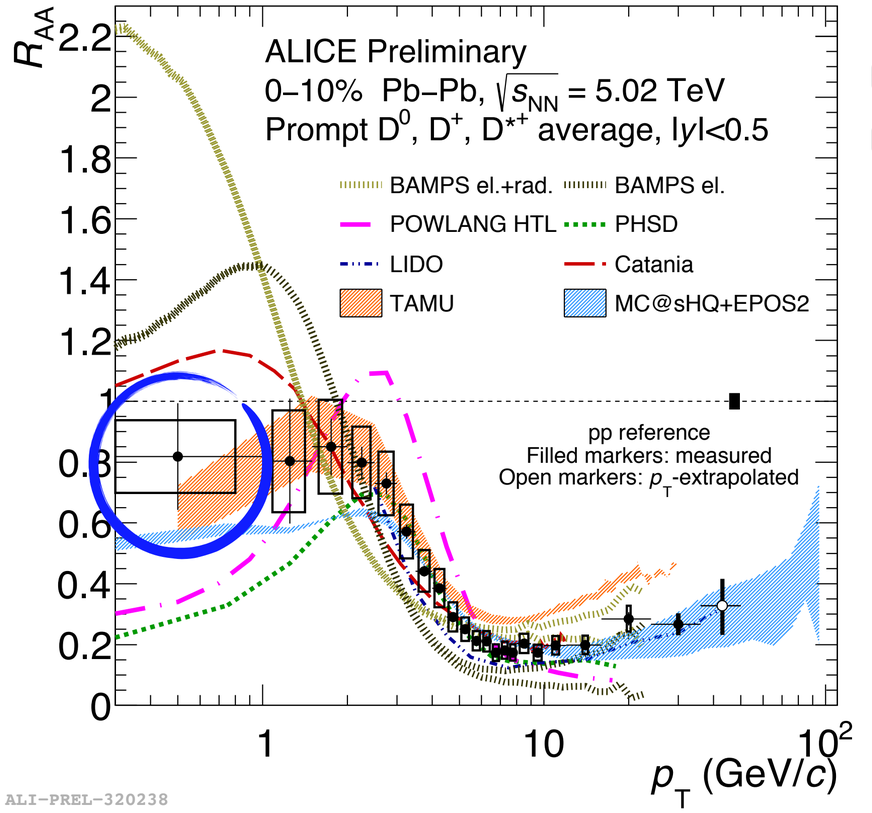




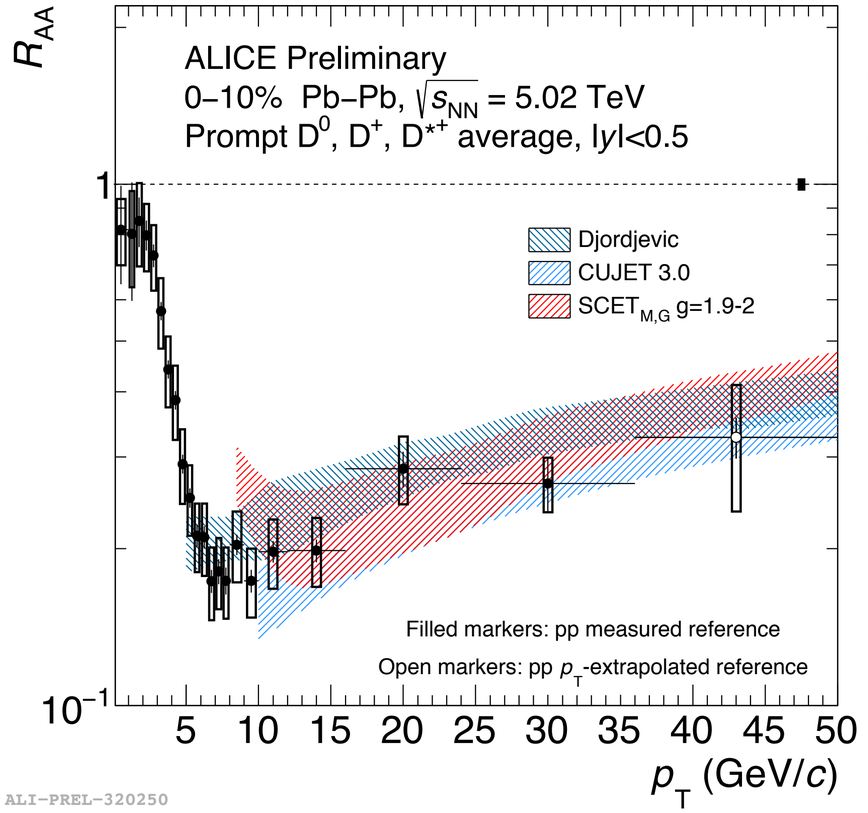
- **NEW: D^0** down to **zero p_T** (0-10%) selected w/o vertexing and by exploiting only the PID capabilities

- **NEW: D_s^+**-signal extraction optimized with ML techniques for:
  - **low-p_T: 2-3 GeV/c** (0-10%, 30-50%)
  - **high-p_T: > 36 GeV/c** (0-10%) and **p_T > 24 GeV/c** (30-50%)

Non-strange D mesons



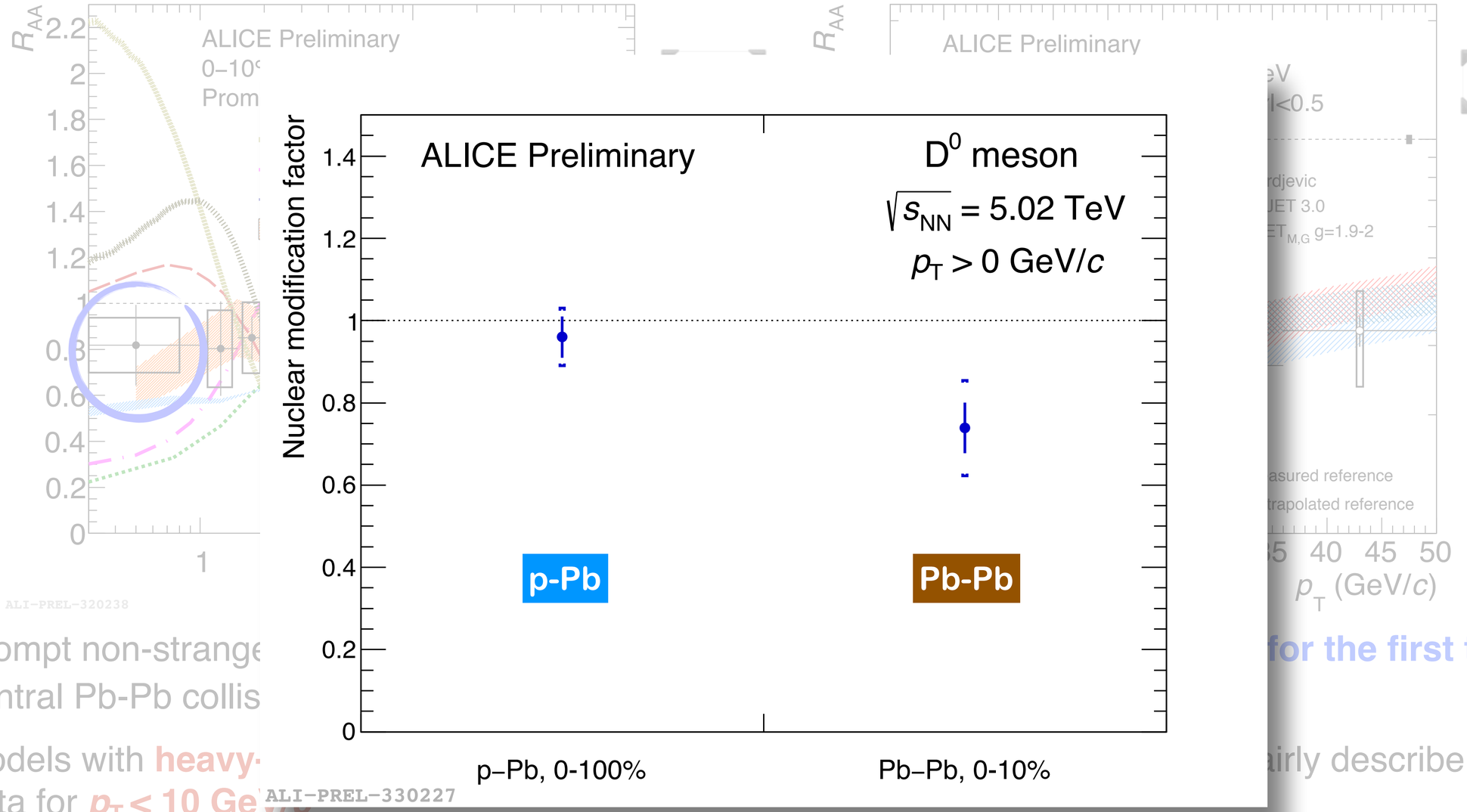
NEW



NEW

- Prompt non-strange D-meson R_{AA} measured in **finer p_T bins** and **down to zero p_T for the first time** in central Pb-Pb collisions
- Models with **heavy-quark transport in medium** [7-13] and realistic evolution can fairly describe the data for **p_T < 10 GeV/c**
- Models based on **pQCD** [14-16] provide a good description of the data for **p_T >10 GeV/c**

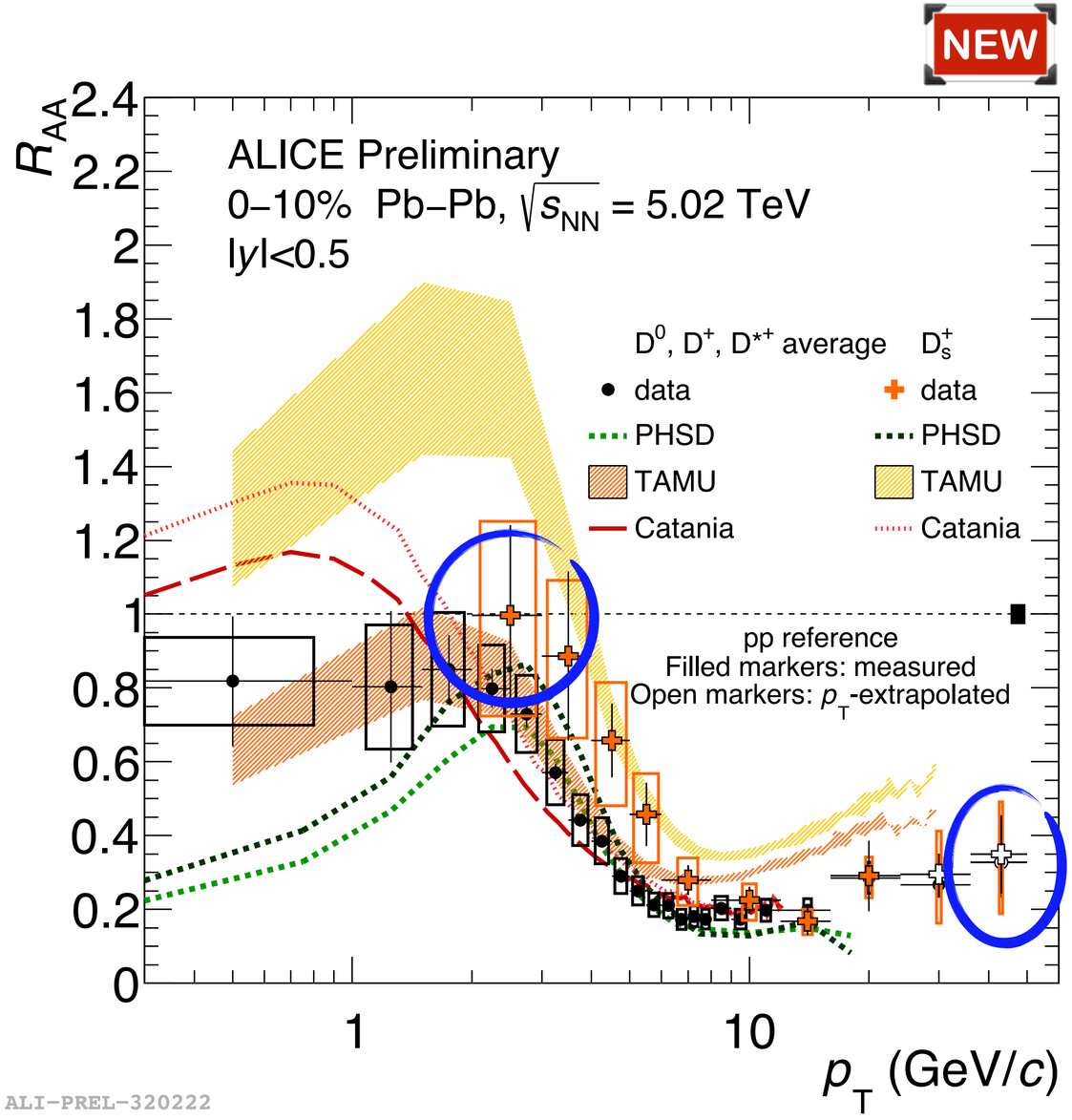
Non-strange D mesons



NEW

- Prompt non-strange … for the first time in central Pb-Pb collis…
- Models with heavy-… airly describe the data for $p_T < 10$ GeV/c
- Models based on pQCD [14-16] provide a good description of the data for $p_T > 10$ GeV/c

Charming strangeness



- D_s^+ R_{AA} extended down to p_T = 2 GeV/c and up to p_T = 50 GeV/c

  → going down in p_T provide a better constrain of theoretical models [7,8,13]

- D_s^+ vs non-strange D mesons

  → **sensitivity to hadronisation mechanism**

- Hint of larger D_s^+-meson R_{AA} w.r.t. that of non-strange D mesons for p_T < 10 GeV/c

  → expected in case of **hadronisation via coalescence** due to the enhanced production of s quarks in the QGP

- Run3: **larger data sample** and **improved precision**

  → **reduced uncertainties** and **better separation** between non-strange and strange D-mesons R_{AA}

Bibliography

1) *PRD* 44 (1991) 3501
2) *JHEP* 0605 (2006) 026
3) *JHEP* 9805 (1998) 007
4) *NPB* 483 (1997) 291
5) *PRD* 44 9 (1991) R2625
6) *JHEP* 10 (2018) 174
7) TAMU: *PLB* 735 (2014) 445
8) PHSD: *PRC* 92 (2015) 014910
9) POWLANG: *EPJC* 75 (2015) 121
10) MC@sHQ+EPOS: *PRC* 89 (2014) 014905
11) LIDO: *PRC* 98 (2018) 064901
12) BAMPS: *JPG* 42 (2015) 115106
13) Catania: *EPJC* 78 (2018) 348
14) DAB-MOD: *PRC* 96 (2017) 064903