IL NUOVO CIMENTO Vol. 34 C, N. 6 Novembre-Dicembre 2011
DOI 10.1393/ncc/i2011-11058-9

Colloquia: IFAE 2011

J/ψ production cross section and non-prompt fraction measurement with the ATLAS detector

N. Orlando on behalf of the ATLAS Collaboration
INFN Sezione di Lecce and Dipartimento di Fisica Università del Salento - Lecce, Italy

(ricevuto il 29 Luglio 2011; pubblicato online il 6 Dicembre 2011)

Summary. — This paper summarizes the first ATLAS results on inclusive J/ψ production cross section and the ratio between promptly and non-promptly produced J/ψ meson in pp collisions at $\sqrt{s} = 7\,\text{TeV}$.

PACS 13.85.-t – Hadron-induced high- and super-high-energy interactions.
PACS 14.40.Pq – Heavy quarkonia.

The early B-physics program [1] of the ATLAS experiment [2] starts with the studies of charmonium states, the most abundantly produced of which is the J/ψ meson.

The J/ψ production cross section and non-prompt ratio [3] exploits J/ψ observation through its decays in muon pairs because of the lower QCD background than in the electron channel. Events are selected on-line with single muon triggers by applying p_T thresholds increasing with the luminosity.

The integrated luminosity of the collected data sample for inclusive cross section measurement is $L = 2.27\,\text{pb}^{-1}$; the non-prompt ratio can benefit by a slightly larger luminosity of $2.44\,\text{pb}^{-1}$.

In the off-line two reconstructed muons with invariant mass in the J/ψ mass window are selected. Muon reconstruction generally requires a track in the inner tracking system (named Inner Detector), satisfying specific quality criteria, statistically compatible with a track reconstruction in the Muon Spectrometer. In order to increase the efficiency for low-p_T muons, one of the two muons is allowed to be reconstructed with loose criteria, *i.e.* by matching an Inner Detector track to a segment in the muon spectrometer. The two muons are required to have opposite charge. For non-prompt fraction measurement, to avoid ambiguity in vertex association, it is also required that the two muons are both associated with the same primary vertex; this last requirement rejects less than 0.2% of the events. At least one of the two selected muons must be spatially close to the fired trigger chamber. The cross section is given by the number of candidate J/ψ corrected for the weight $w^{-1} = \mathcal{A} \cdot \mathcal{M} \cdot \varepsilon_{trk}^2 \cdot \varepsilon_{\mu^+}(p_{T\,\mu^+}, \eta_{\mu^+}) \cdot \varepsilon_{\mu^-}(p_{T\,\mu^-}, \eta_{\mu^-}) \cdot \varepsilon_{trig}$ and normalized to data luminosity. The single track inner reconstruction efficiency ε_{trk} is evaluated to be $99 \pm 0.5\%$ from simulations, trigger efficiency ε_{trig} is measured by hybrid data-MC method [3] and the bin migration correction factor $\mathcal{M}$ that move the J/ψ transverse

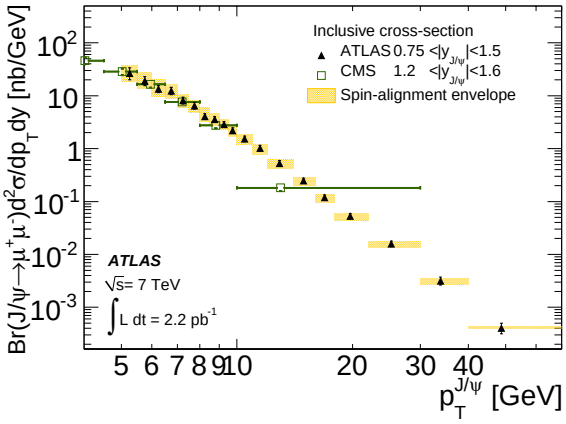

Fig. 1. – Inclusive J/ψ production cross section as function of $p_T(J/\psi)$ in the rapidity bin $0.75 < |y_{J/\psi}| < 1.5$.

momentum distribution observed in data back to the truth distribution is evaluated from simulations. The charge dependent muon reconstruction efficiency $\varepsilon_{\mu^\pm}(p_{T\,\mu^\pm}, \eta_{\mu^\pm})$ is measured with the tag-and-probe method [4] separately for negative and positive charged muons. The acceptance correction $\mathcal{A}$ is evaluated inside the fiducial volume defined by $|\overrightarrow{p}_\pm| > 3\,\text{GeV}$ and $|\eta_\pm| < 2.5$, to ensure that kinematic regions of very low trigger and reconstruction efficiency are rejected. As example in fig. 1 the results of the cross section measurement in the rapidity bin $0.75 < |y_{J/\psi}| < 1.5$ as function of the J/ψ transverse momentum are shown; the yellow bars represent the spin-alignment envelope, *i.e.* the theoretical uncertainty due to unknown polarization, and the CMS points [5] are also superimposed. The non-prompt fraction f_B is given by the fraction of J/ψ coming from B-hadrons decays. The measurement of f_B is performed by a likelihood fit to the 2-dimensional distribution given by pseudo-proper-time *versus* invariant mass [3] with a likelihood p.f.d. that includes a model for prompt and non-prompt component of the signal and a model for the prompt and non-prompt component of the background as well [3].

In conclusion, the inclusive J/ψ cross sections and the non-prompt fraction are measured with the ATLAS detector. Further studies on J/ψ polarization can be used in the future to improve the J/ψ cross section measurement.

* * *

I thank the IFAE 2011 organizing committee for support this work. I also thank G. Chiodini and S. Spagnolo for reading and comment the first version of this manuscript.

REFERENCES

[1] Rossi E., these proceedings.
[2] Aad G. *et al.* (ATLAS Collaboration), *JINST*, **3** (2008) S08003.
[3] Aad G. *et al.* (ATLAS Collaboration), *Nucl. Phys. B*, **850** (2011) 387.
[4] Aad G. *et al.* (ATLAS Collaboration), ATLAS-CONF-2011-021 (2011).
[5] Khachatryan V. *et al.* (CMS Collaboration), *Eur. Phys. J. C*, **71** (2011) 1575.