First mass measurements at LHCb

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First mass measurements are performed using a sample of pp collisions at $\sqrt{s} = 7$ TeV, collected in 2010 with the LHCb detector and corresponding to an integrated luminosity of 35 pb^{-1}. $X(3872)$ and b-hadron candidates are fully reconstructed in final states with a $J/\psi \to \mu^+\mu^-$ decay (see Figs. 1 and 2). The $X(3872)$ selection does not include any impact parameter cut with respect to the primary interaction vertex, while the b hadron candidates are required to have a measured proper time larger than 0.3 ps. The mass resolution is improved by constraining, in the vertex fits, the J/ψ mass (and also the K_S^0 or Λ mass when applicable) to its known value.

A time-dependent momentum calibration is obtained from a large sample of $J/\psi \to \mu^+\mu^-$ decays, and checked using two-body decays of the $\Upsilon(1S)$, D^0 and K_S^0 mesons, as well as $\psi(2S) \to J/\psi\pi^+\pi^-$ decays. A relative error of 10^{-4} is assigned on the momentum scale and propagated to the mass measurements. Other systematic uncertainties include those associated to the energy loss correction in the track fitting, the alignment of the tracking devices and the fitting of the mass distributions.

The preliminary results [1] are shown in Table 1. While the $X(3872)$ mass result is still dominated by its statistical uncertainty, the b-hadron results already represent the most precise measurements to date.

Channel	Yield	Resolution [MeV/c^2]	Mass [MeV/c^2]
$X(3872) \to J/\psi\pi^+\pi^-$	585 ± 74	2.75 ± 0.54	$3871.96 \pm 0.46 \pm 0.10$
$B^+ \to J/\psi K^+$	11151 ± 115	10.50 ± 0.10	$5279.27 \pm 0.11 \pm 0.20$
$B^0 \to J/\psi K^{*0}$	3308 ± 65	7.73 ± 0.15	$5279.54 \pm 0.15 \pm 0.16$
$B^0 \to J/\psi K_S^0$	1184 ± 38	8.62 ± 0.26	$5279.61 \pm 0.29 \pm 0.20$
$B_s^0 \to J/\psi\phi$	816 ± 30	6.96 ± 0.25	$5366.60 \pm 0.28 \pm 0.21$
$\Lambda_b \to J/\psi\Lambda$	279 ± 19	9.00 ± 0.61	$5619.49 \pm 0.70 \pm 0.19$
$B_c^+ \to J/\psi\pi^+$	25.1 ± 6.6	13.9 ± 3.7	$6268.0 \pm 4.0 \pm 0.6$

Table 1: Signal yields, mass resolutions, and mass measurements. The first (second) quoted uncertainty is statistical (systematic).

References

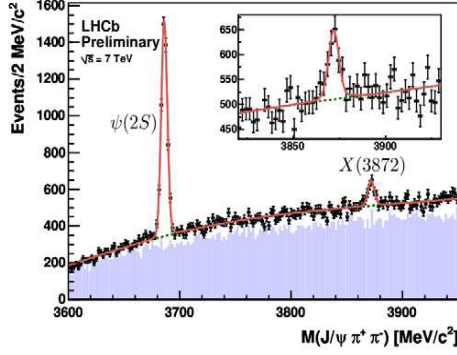[1] LHCb collaboration, LHCb-CONF-2011-027 and LHCb-CONF-2011-030.

Figure 1: Invariant mass distribution of $J/\psi\pi^+\pi^-$ (black points with errors bars) and same-sign $J/\psi\pi^\pm\pi^\pm$ (blue filled histogram) candidates. The red curve is the result of the fit to the $\psi(2S)$ and $X(3872)$ masses. The insert shows a zoom of the region around the $X(3872)$ mass.
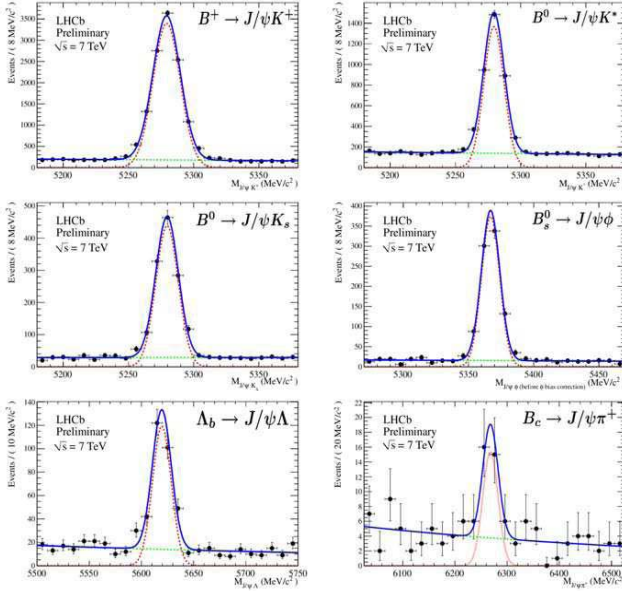

Figure 2: Invariant mass distributions of $B^+ \to J/\psi K^+$ (top left), $B^0 \to J/\psi K^{*0}$ (top right), $B^0 \to J/\psi K_S^0$ (middle left), $B_s^0 \to J/\psi\phi$ (middle right), $\Lambda_b \to J/\psi\Lambda$ (bottom left), and $B_c^+ \to J/\psi\pi^+$ (bottom right) candidates, with superimposed fits.