

Supplementary material for LHCb-PAPER-2016-011

Table 1: The measured cross-sections for Wj production in four bins of η^μ . The uncertainties shown are statistical, systematic and due to the luminosity determination.

η^μ	σ_{W+j} [pb]	σ_{W-j} [pb]
2.0 – 2.5	$22.24 \pm 0.15 \pm 2.07 \pm 0.26$	$10.16 \pm 0.10 \pm 1.09 \pm 0.12$
2.5 – 3.0	$18.09 \pm 0.12 \pm 1.68 \pm 0.21$	$9.53 \pm 0.09 \pm 1.08 \pm 0.11$
3.0 – 3.5	$11.29 \pm 0.10 \pm 0.96 \pm 0.13$	$7.39 \pm 0.08 \pm 0.74 \pm 0.09$
3.5 – 4.5	$6.07 \pm 0.08 \pm 0.46 \pm 0.07$	$6.29 \pm 0.08 \pm 0.72 \pm 0.07$

Table 2: The measured cross-sections for Wj production in four bins of η^{jet} . The uncertainties shown are statistical, systematic and due to the luminosity determination.

η^{jet}	σ_{W+j} [pb]	σ_{W-j} [pb]
2.2 – 2.7	$24.25 \pm 0.15 \pm 2.18 \pm 0.28$	$15.25 \pm 0.12 \pm 1.56 \pm 0.18$
2.7 – 3.2	$17.93 \pm 0.13 \pm 1.53 \pm 0.21$	$10.29 \pm 0.10 \pm 1.09 \pm 0.12$
3.2 – 3.7	$10.67 \pm 0.10 \pm 0.97 \pm 0.12$	$5.60 \pm 0.07 \pm 0.66 \pm 0.06$
3.7 – 4.2	$4.04 \pm 0.06 \pm 0.53 \pm 0.05$	$1.97 \pm 0.04 \pm 0.33 \pm 0.02$

Table 3: The measured cross-sections for Wj production in five bins of p_T^{jet} . The uncertainties shown are statistical, systematic and due to the luminosity determination.

p_T^{jet} [GeV]	σ_{W+j} [pb]	σ_{W-j} [pb]
20.0 – 25.0	$17.25 \pm 0.12 \pm 1.44 \pm 0.20$	$10.81 \pm 0.10 \pm 1.07 \pm 0.13$
25.0 – 30.0	$11.28 \pm 0.10 \pm 1.14 \pm 0.13$	$6.62 \pm 0.08 \pm 0.75 \pm 0.08$
30.0 – 40.0	$12.67 \pm 0.11 \pm 1.16 \pm 0.15$	$7.45 \pm 0.08 \pm 0.79 \pm 0.09$
40.0 – 50.0	$6.67 \pm 0.08 \pm 0.70 \pm 0.08$	$3.86 \pm 0.06 \pm 0.44 \pm 0.04$
50.0 – 100.0	$8.18 \pm 0.09 \pm 1.01 \pm 0.09$	$3.96 \pm 0.06 \pm 0.63 \pm 0.05$

Table 4: The measured cross-sections for Zj production in four bins of y^Z . The uncertainties shown are statistical, systematic and due to the luminosity determination.

y^Z	σ_{Zj} [pb]
2.0 – 2.5	$1.09 \pm 0.03 \pm 0.06 \pm 0.01$
2.5 – 3.0	$2.44 \pm 0.04 \pm 0.12 \pm 0.03$
3.0 – 3.5	$1.81 \pm 0.04 \pm 0.10 \pm 0.02$
3.5 – 4.5	$0.43 \pm 0.02 \pm 0.03 \pm 0.01$

Table 5: The measured cross-sections for Zj production in four bins of η^{jet} . The uncertainties shown are statistical, systematic and due to the luminosity determination.

η^{jet}	σ_{Zj} [pb]
2.2 – 2.7	$2.43 \pm 0.04 \pm 0.12 \pm 0.03$
2.7 – 3.2	$1.83 \pm 0.04 \pm 0.09 \pm 0.02$
3.2 – 3.7	$1.05 \pm 0.03 \pm 0.05 \pm 0.01$
3.7 – 4.2	$0.39 \pm 0.02 \pm 0.04 \pm 0.00$

Table 6: The measured cross-sections for Zj production in bins of $p_{\text{T}}^{\text{jet}}$. The uncertainties shown are statistical, systematic and due to the luminosity determination.

$p_{\text{T}}^{\text{jet}}$ [GeV]	σ_{Zj} [pb]
20.0 – 25.0	$1.80 \pm 0.04 \pm 0.09 \pm 0.02$
25.0 – 30.0	$1.13 \pm 0.03 \pm 0.06 \pm 0.01$
30.0 – 40.0	$1.25 \pm 0.03 \pm 0.09 \pm 0.01$
40.0 – 50.0	$0.67 \pm 0.02 \pm 0.04 \pm 0.01$
50.0 – 100.0	$0.78 \pm 0.02 \pm 0.07 \pm 0.01$

Table 7: The measured cross-sections for Zj production in bins of $|\Delta\phi|$. The uncertainties shown are statistical, systematic and due to the luminosity determination.

$ \Delta\phi $ [rad]	σ_{Zj} [pb]
0.0 – 0.5	$0.14 \pm 0.01 \pm 0.01 \pm 0.00$
0.5 – 1.1	$0.17 \pm 0.01 \pm 0.02 \pm 0.00$
1.1 – 1.6	$0.20 \pm 0.01 \pm 0.02 \pm 0.00$
1.6 – 2.1	$0.37 \pm 0.02 \pm 0.03 \pm 0.00$
2.1 – 2.6	$0.94 \pm 0.03 \pm 0.06 \pm 0.01$
2.6 – 3.1	$3.80 \pm 0.05 \pm 0.16 \pm 0.04$

$$\begin{bmatrix} 1.000 & 0.971 & 0.956 & 0.897 \\ 0.971 & 1.000 & 0.957 & 0.901 \\ 0.956 & 0.957 & 1.000 & 0.912 \\ 0.897 & 0.901 & 0.912 & 1.000 \end{bmatrix} \begin{bmatrix} 1.000 & 0.965 & 0.952 & 0.953 \\ 0.965 & 1.000 & 0.953 & 0.960 \\ 0.952 & 0.953 & 1.000 & 0.942 \\ 0.953 & 0.960 & 0.942 & 1.000 \end{bmatrix}$$

Matrix 1: The correlation matrix for the systematic uncertainties on the (left) W^+j and (right) W^-j production cross-section measurements presented in Table. 1 in bins of η^μ , where the rows and columns correspond to the individual bins.

$$\begin{bmatrix} 1.000 & 0.971 & 0.958 & 0.947 \\ 0.971 & 1.000 & 0.957 & 0.937 \\ 0.958 & 0.957 & 1.000 & 0.922 \\ 0.947 & 0.937 & 0.922 & 1.000 \end{bmatrix} \begin{bmatrix} 1.000 & 0.966 & 0.938 & 0.934 \\ 0.966 & 1.000 & 0.943 & 0.927 \\ 0.938 & 0.943 & 1.000 & 0.932 \\ 0.934 & 0.927 & 0.932 & 1.000 \end{bmatrix}$$

Matrix 2: The correlation matrix for the systematic uncertainties on the (left) W^+j and (right) W^-j production cross-section measurements presented in Table. 5 in bins of η^{jet} , where the rows and columns correspond to the individual bins.

$$\begin{bmatrix} 1.000 & 0.929 & 0.910 & 0.881 & 0.887 \\ 0.929 & 1.000 & 0.954 & 0.928 & 0.933 \\ 0.910 & 0.954 & 1.000 & 0.919 & 0.951 \\ 0.881 & 0.928 & 0.919 & 1.000 & 0.875 \\ 0.887 & 0.933 & 0.951 & 0.875 & 1.000 \end{bmatrix} \begin{bmatrix} 1.000 & 0.947 & 0.930 & 0.903 & 0.892 \\ 0.947 & 1.000 & 0.949 & 0.905 & 0.930 \\ 0.930 & 0.949 & 1.000 & 0.912 & 0.949 \\ 0.903 & 0.905 & 0.912 & 1.000 & 0.892 \\ 0.892 & 0.930 & 0.949 & 0.892 & 1.000 \end{bmatrix}$$

Matrix 3: The correlation matrix for the systematic uncertainties on the (left) W^+j and (right) W^-j production cross-section measurements presented in Table. 3 in bins of p_T^{jet} , where the rows and columns correspond to the individual bins.

$$\begin{bmatrix} 1.000 & 0.898 & 0.862 & 0.826 \\ 0.898 & 1.000 & 0.908 & 0.856 \\ 0.862 & 0.908 & 1.000 & 0.829 \\ 0.826 & 0.856 & 0.829 & 1.000 \end{bmatrix}$$

Matrix 4: The correlation matrix for the systematic uncertainties on the Zj production cross-section measurements presented in Table. 4 as a function of y^Z , where the rows and columns correspond to the individual bins.

$$\begin{bmatrix} 1.000 & 0.909 & 0.850 & 0.896 \\ 0.909 & 1.000 & 0.886 & 0.869 \\ 0.850 & 0.886 & 1.000 & 0.820 \\ 0.896 & 0.869 & 0.820 & 1.000 \end{bmatrix}$$

Matrix 5: The correlation matrix for the systematic uncertainties on the Zj production cross-section measurements presented in Table. 5 as a function of η^{jet} , where the rows and columns correspond to the individual bins.

$$\begin{bmatrix} 1.000 & 0.894 & 0.882 & 0.807 & 0.892 \\ 0.894 & 1.000 & 0.909 & 0.851 & 0.892 \\ 0.882 & 0.909 & 1.000 & 0.880 & 0.935 \\ 0.807 & 0.851 & 0.880 & 1.000 & 0.848 \\ 0.892 & 0.892 & 0.935 & 0.848 & 1.000 \end{bmatrix}$$

Matrix 6: The correlation matrix for the systematic uncertainties on the Zj production cross-section measurements presented in Table. 6 as a function of $p_{\text{T}}^{\text{jet}}$, where the rows and columns correspond to the individual bins.

$$\begin{bmatrix} 1.000 & 0.469 & 0.560 & 0.509 & 0.615 & 0.663 \\ 0.469 & 1.000 & 0.601 & 0.602 & 0.712 & 0.688 \\ 0.560 & 0.601 & 1.000 & 0.651 & 0.775 & 0.767 \\ 0.509 & 0.602 & 0.651 & 1.000 & 0.777 & 0.760 \\ 0.615 & 0.712 & 0.775 & 0.777 & 1.000 & 0.896 \\ 0.663 & 0.688 & 0.767 & 0.760 & 0.896 & 1.000 \end{bmatrix}$$

Matrix 7: The correlation matrix for the systematic uncertainties on the Zj production cross-section measurements presented in Table. 7 as a function of $|\Delta\phi|$, where the rows and columns correspond to the individual bins.

1.000	0.971	0.956	0.897	0.961	0.955	0.952	0.933
0.971	1.000	0.957	0.901	0.958	0.968	0.947	0.940
0.956	0.957	1.000	0.912	0.932	0.927	0.935	0.901
0.897	0.901	0.912	1.000	0.860	0.853	0.851	0.837
0.961	0.958	0.932	0.860	1.000	0.965	0.952	0.953
0.955	0.968	0.927	0.853	0.965	1.000	0.953	0.960
0.952	0.947	0.935	0.851	0.952	0.953	1.000	0.942
0.933	0.940	0.901	0.837	0.953	0.960	0.942	1.000

Matrix 8: The correlation matrix for the systematic uncertainties on the W^+j and W^-j production cross-section measurements presented in Table. 1 in bins of η^μ . The first four rows/columns correspond to the W^+j cross-section in bins of η^μ and the second four rows/columns correspond to the W^-j cross-section in bins of η^μ . The matrix is used to calculate the ratio and asymmetry of W^+j and W^-j production as a function of η^μ .

1.000	0.971	0.958	0.947	0.957	0.927	0.915	0.903	0.670	0.710	0.715	0.674
0.971	1.000	0.957	0.937	0.948	0.939	0.921	0.903	0.639	0.702	0.691	0.645
0.958	0.957	1.000	0.922	0.926	0.912	0.928	0.893	0.603	0.643	0.671	0.607
0.947	0.937	0.922	1.000	0.927	0.894	0.883	0.916	0.704	0.732	0.725	0.765
0.957	0.948	0.926	0.927	1.000	0.966	0.938	0.934	0.650	0.699	0.712	0.665
0.927	0.939	0.912	0.894	0.966	1.000	0.943	0.927	0.569	0.645	0.649	0.587
0.915	0.921	0.928	0.883	0.938	0.943	1.000	0.932	0.535	0.572	0.595	0.550
0.903	0.903	0.893	0.916	0.934	0.927	0.932	1.000	0.613	0.633	0.623	0.669
0.670	0.639	0.603	0.704	0.650	0.569	0.535	0.613	1.000	0.909	0.850	0.896
0.710	0.702	0.643	0.732	0.699	0.645	0.572	0.633	0.909	1.000	0.886	0.869
0.715	0.691	0.671	0.725	0.712	0.649	0.595	0.623	0.850	0.886	1.000	0.820
0.674	0.645	0.607	0.765	0.665	0.587	0.550	0.669	0.896	0.869	0.820	1.000

Matrix 9: The correlation matrix for the systematic uncertainties on the W^+j , W^-j and Zj production cross-section measurements presented in Tables 2 and 5 in bins of η^{jet} . The first four rows/columns correspond to the W^+j cross-section in bins of η^{jet} , the middle four correspond to the W^-j cross-section in bins of η^{jet} and the final four correspond to the Zj cross-section in bins of η^{jet} . The matrix is used to calculate the ratios of Wj to Zj production and the charge ratio and asymmetry of Wj production in the total fiducial region.