Supplementary material for LHCb-PAPER-2018-007

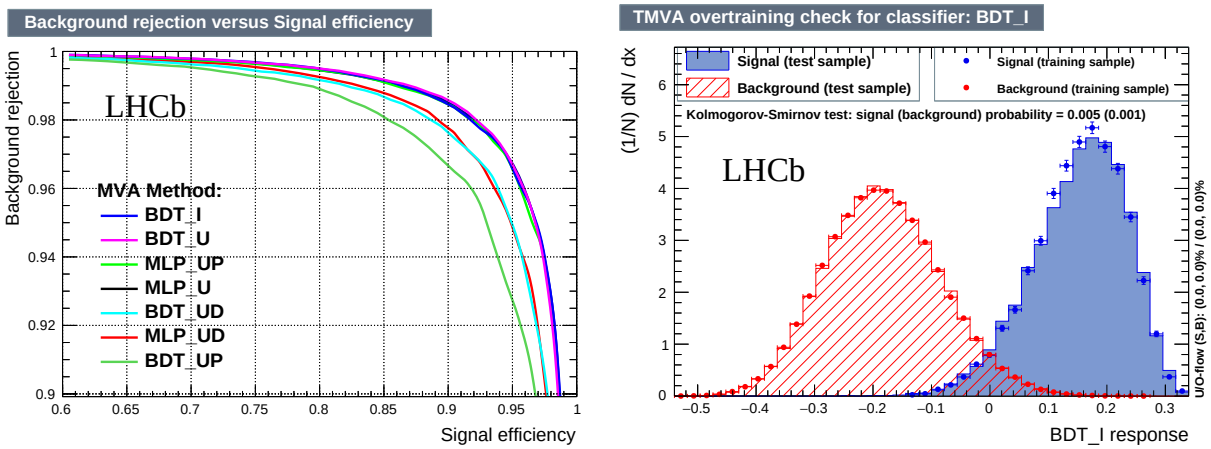

Figure 1: (left) Comparison of the performance of several classifiers, evaluated for the selection of $B^- \to D_s^- D^0$ decays, followed by $D^0 \to K^-\pi^+$. The two classifiers considered are boosted decision tree (BDT) and multilayer perceptron (MLP). Several transformations of the input variables are considered: I for identity (no transformation), U for uniform (transform such that the sum of signal and background distribution is uniform), P for principal component decomposition, and D for decorrelation. (right) Output distributions of the BDT for $B^- \to D_s^- D^0$ decays, followed by $D^0 \to K^-\pi^+$. Signal and background distributions are compared and the testing and training samples are overlaid.

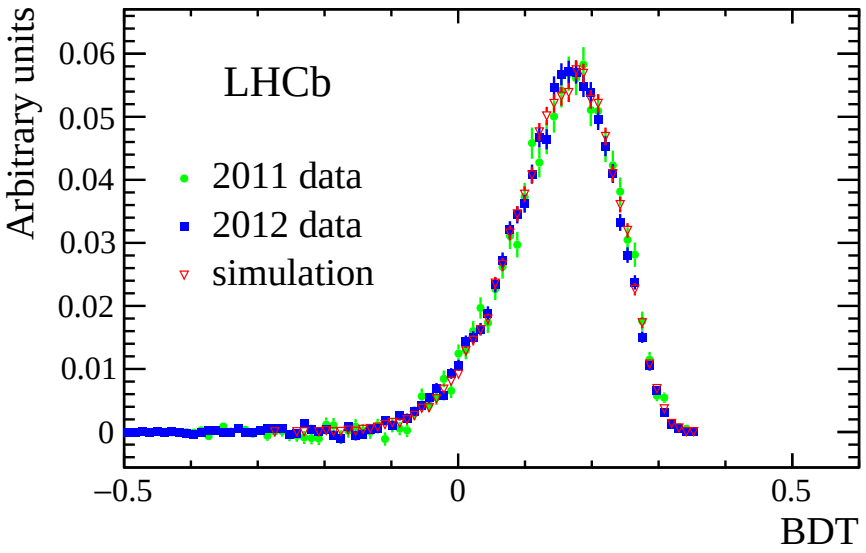

Figure 2: Comparison of the BDT response between data and simulation for $B^- \to D_s^- D^0$ decays, followed by $D^0 \to K^-\pi^+$. For the data, the background has been subtracted using sWeights, where the weight was determined from the reconstructed invariant mass of the B^- candidate.

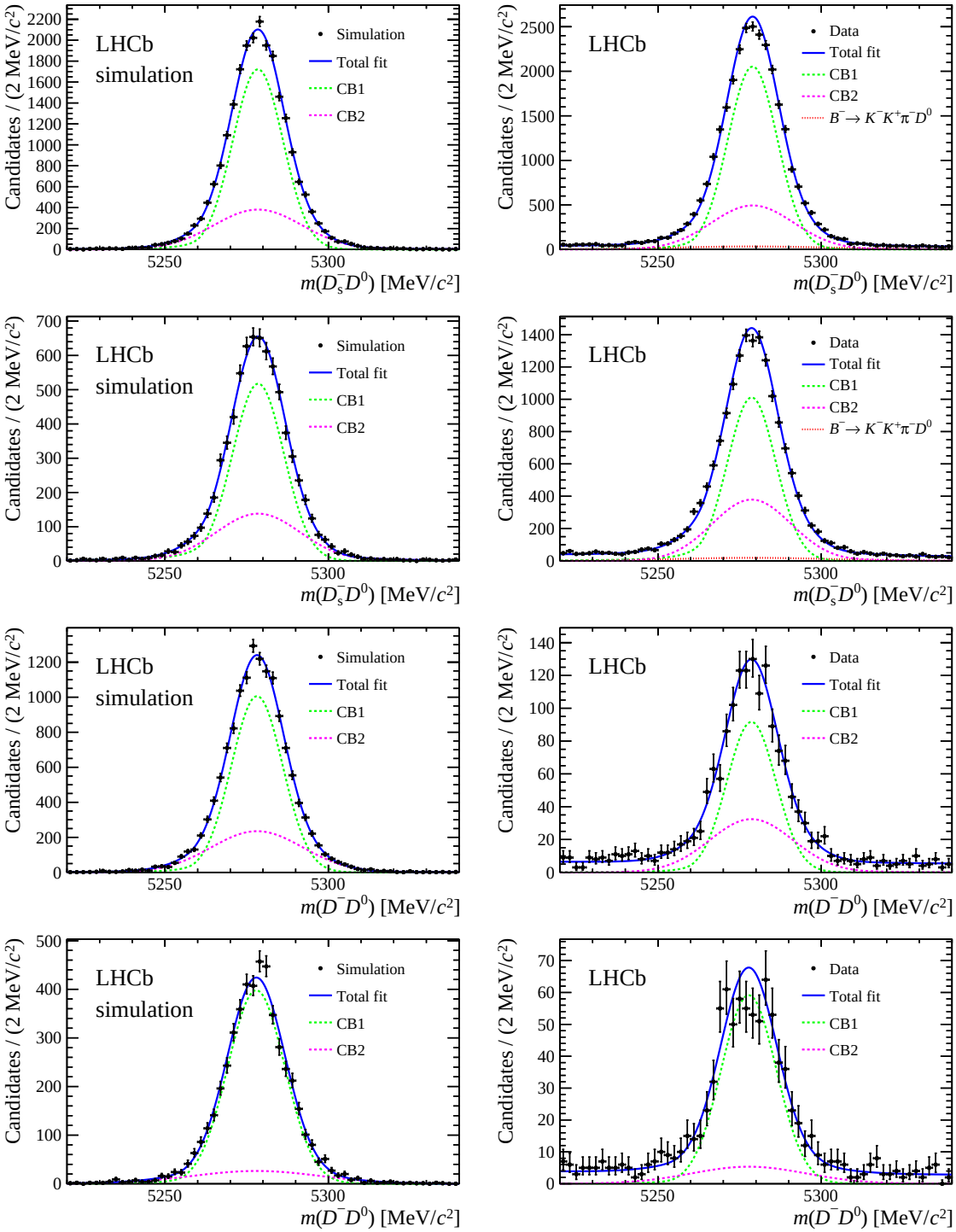

Figure 3: Reconstructed invariant-mass distributions of $B^- \to D^-_{(s)}D^0$ candidates; left are from simulation and right are from data. Top row are $D_s^-D^0$ with $D^0 \to K^-\pi^+$ final states, second row are $D_s^-D^0$ with $D^0 \to K^-\pi^+\pi^-\pi^+$, third row are D^-D^0 with $D^0 \to K^-\pi^+$ and on the bottom row are D^-D^0 with $D^0 \to K^-\pi^+\pi^-\pi^+$. Overlaid are fits to a sum of two Crystal Ball functions, CB1 and CB2, and a background component. For the simulation, the shape parameters are floating, while for the data all shape parameters have been fixed to the values obtained from the fit to the simulated events.

Table 1: Yields and raw asymmetries for $B^- \to D_s^- D^0$ decays, split by D^0 decay mode, data taking year and magnet polarity.

Year	Magnet polarity	D^0	$N(B^-)$	$N(B^+)$	$A_{\rm raw}$
2011	*MagUp*	$D^0 \to K^-\pi^+$	1649 ± 45	1704 ± 46	$(-1.6 \pm 1.9)\%$
		$D^0 \to K^-\pi^+\pi^-\pi^+$	957 ± 35	978 ± 37	$(-1.1 \pm 2.6)\%$
		combined	2606 ± 57	2682 ± 59	$(-1.4 \pm 1.6)\%$
2011	*MagDown*	$D^0 \to K^-\pi^+$	2376 ± 54	2523 ± 55	$(-3.0 \pm 1.6)\%$
		$D^0 \to K^-\pi^+\pi^-\pi^+$	1321 ± 42	1304 ± 44	$(0.6 \pm 2.3)\%$
		combined	3696 ± 68	3828 ± 70	$(-1.7 \pm 1.3)\%$
2011	combined	$D^0 \to K^-\pi^+$	4024 ± 71	4231 ± 72	$(-2.5 \pm 1.2)\%$
		$D^0 \to K^-\pi^+\pi^-\pi^+$	2286 ± 55	2283 ± 57	$(0.1 \pm 1.7)\%$
		combined	6310 ± 90	6513 ± 92	$(-1.6 \pm 1.0)\%$
2012	*MagUp*	$D^0 \to K^-\pi^+$	4781 ± 77	5073 ± 79	$(-3.0 \pm 1.1)\%$
		$D^0 \to K^-\pi^+\pi^-\pi^+$	2738 ± 62	2958 ± 64	$(-3.9 \pm 1.6)\%$
		combined	7519 ± 99	8031 ± 101	$(-3.3 \pm 0.9)\%$
2012	*MagDown*	$D^0 \to K^-\pi^+$	4860 ± 77	4870 ± 78	$(-0.1 \pm 1.1)\%$
		$D^0 \to K^-\pi^+\pi^-\pi^+$	2696 ± 61	2711 ± 59	$(-0.3 \pm 1.6)\%$
		combined	7556 ± 98	7581 ± 98	$(-0.2 \pm 0.9)\%$
2012	combined	$D^0 \to K^-\pi^+$	9641 ± 108	9979 ± 111	$(-1.7 \pm 0.8)\%$
		$D^0 \to K^-\pi^+\pi^-\pi^+$	5430 ± 87	5660 ± 87	$(-2.1 \pm 1.1)\%$
		combined	15071 ± 139	15639 ± 141	$(-1.8 \pm 0.6)\%$
2011/12	*MagUp*	$D^0 \to K^-\pi^+$	6430 ± 89	6777 ± 91	$(-2.6 \pm 1.0)\%$
		$D^0 \to K^-\pi^+\pi^-\pi^+$	3702 ± 71	3943 ± 74	$(-3.1 \pm 1.3)\%$
		combined	10132 ± 114	10720 ± 117	$(-2.8 \pm 0.8)\%$
2011/12	*MagDown*	$D^0 \to K^-\pi^+$	7227 ± 94	7432 ± 102	$(-1.4 \pm 0.9)\%$
		$D^0 \to K^-\pi^+\pi^-\pi^+$	4019 ± 74	4012 ± 73	$(0.1 \pm 1.3)\%$
		combined	11246 ± 119	11444 ± 125	$(-0.9 \pm 0.8)\%$
2011/12	combined	$D^0 \to K^-\pi^+$	13659 ± 129	14209 ± 132	$(-2.0 \pm 0.7)\%$
		$D^0 \to K^-\pi^+\pi^-\pi^+$	7717 ± 103	7945 ± 104	$(-1.5 \pm 0.9)\%$
		combined	21375 ± 165	22153 ± 168	$(-1.8 \pm 0.5)\%$