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1 Electron channel

The analysis follows what has already been published [1][2] and is schematically described in the following.

The preselection requires events with a charged multiplicity ≥ 8 (except if the recoiling system from the electron candidate pair is made of two jets, each with a charged multiplicity lower than or equal to 3 and with a mass below 2 GeV), a total energy above 0.12 $\sqrt{s}$ and a pair (at least) of electron candidates above 10 GeV. In addition, in order to reduce the Bhabha contamination, events where one electron has energy above 65 GeV and is below 25° to the beam axis or where both electrons are above 40 GeV and their acoplanarity below 3° are rejected.

After this preselection step, progressive cuts are applied. First a "tight" electron selection is applied, that is at most one electron candidate is allowed in the insensitive calorimeter regions and the electron candidates must have opposite charge. The energy of the slower/faster electron is required to be above 15/20 GeV. Electron isolation angles with respect to the closest jet are required to be more than 20° for the most isolated electron and more than 8° for the other. Global kinematic fits [18] are performed, imposing energy and momentum conservation, and loosely constraining the invariant mass of the e^+e^- system to m_Z; for details see [2]. As the search is restricted to high mass Higgs bosons produced in association with a Z particle, the sum of the masses of the electron pair and of the recoiling system as given by the kinematic fit is required to be above 150 GeV/c^2 and the difference in the range from -100 GeV/c^2 to 50 GeV/c^2. The fitted recoil mass and the global b-tagging variable x_b are used for the two-dimensional calculation of the confidence levels.

Table 1 shows the effect of the cuts on data, simulated background and signal events for the different cuts (including a final cut on x_b that is not used for the confidence levels calculations since x_b is one of the variables entering in the two-dimensional method). Data taken at different energies (and the corresponding simulations) at are shown separately. There is generally an excess of real data at preselection level. A significant fraction of this excess is associated to low charged multiplicities as shown in Figure 1. This means that a spill from leptonic events, produced by fake tracks, is not completely reproduced by the simulations. The remaining excess is not peaked in any observed variable. The next selection, i.e. the stronger requirement on the electron identification, rejects the spurious events and at that level the Monte Carlo expectations are in good agreement with the data. The general agreement between data and background simulation is illustrated at preselection level in Figure 2 and in Figure 3 for data at 196 and 200 GeV respectively. These show the distributions of the main analysis variables, namely, the electron energies, the fitted mass of the jet system, the probability of the kinematical fit, the electron isolation angle and the global event b-tagging variable x_b.

Table 2 shows the selection efficiency for different Higgs boson masses.

Among the events selected in data, three have a high x_b value; their masses are respectively 92.8, 91.7 and 88.2 GeV/c^2, so well compatible with Z pair production.

Selection	Data	Total background	$q\bar{q}(\gamma)$	$e^+e^-q\bar{q}$	other 4 fermion	$\gamma\gamma$
		Electron channel at 192 GeV 25.9 pb^{-1}				
Preselection	202	205.6$\pm$ 3.1	150.3	3.00	45.4	2.02
e^+e^-id.	48	45.3$\pm$ 1.4	24.1	2.17	16.0	0.90
Electr.energy	28	17.0$\pm$ 0.9	7.3	1.87	6.1	0.22
5C fit prob.	5	6.43$\pm$0.48	3.02	1.38	1.72	0.11
Electron isol.	1	2.41$\pm$0.27	0.50	1.26	0.44	0.00
Mass selection	0	1.58$\pm$0.14	0.30	1.03	0.25	0.00
B tagging	0	0.56$\pm$0.06	0.05	0.38	0.13	0.00
		Electron channel at 196 GeV 76.9 pb^{-1}				
Preselection	627	552.6$\pm$ 5.2	389.0	8.77	134.6	5.99
e^+e^-id.	145	129.2$\pm$ 2.8	66.6	6.35	47.6	2.66
Electr.energy	59	49.0$\pm$ 1.9	19.6	5.47	18.9	0.67
5C fit prob.	23	16.9$\pm$ 0.9	6.98	4.03	5.02	0.33
Electron isol.	9	5.96$\pm$0.62	0.43	3.70	1.26	0.00
Mass selection	5	4.06$\pm$0.17	0.34	3.01	0.70	0.00
B tagging	2	1.40$\pm$0.07	0.00	1.11	0.30	0.00
		Electron channel at 200 GeV 84.3 pb^{-1}				
Preselection	625	588.1$\pm$ 4.8	405.7	9.50	151.5	6.70
e^+e^-id.	122	140.6$\pm$ 2.7	70.5	6.92	53.8	2.98
Electr.energy	58	53.5$\pm$ 1.9	20.1	6.06	22.1	0.74
5C fit prob.	16	18.9$\pm$0.88	7.50	4.54	5.85	0.37
Electron isol.	7	7.24$\pm$0.65	1.08	4.18	1.36	0.00
Mass selection	4	4.83$\pm$0.18	0.66	3.43	0.74	0.00
B tagging	1	1.78$\pm$0.10	0.16	1.32	0.30	0.00
		Electron channel at 202 GeV 41.1 pb^{-1}				
Preselection	322	278.9$\pm$ 2.8	189.6	4.61	74.1	3.27
e^+e^-id.	71	68.1$\pm$ 1.6	33.7	3.34	26.6	1.45
Electr.energy	32	27.2$\pm$ 1.1	10.6	2.92	11.2	0.36
5C fit prob.	7	9.08$\pm$ 0.5	3.62	2.24	2.69	0.18
Electron isol.	3	3.74$\pm$0.34	0.55	2.06	0.83	0.00
Mass selection	1	2.52$\pm$0.12	0.33	1.72	0.47	0.00
B tagging	0	1.04$\pm$0.07	0.16	0.66	0.22	0.00

Table 1: *Effect of the selection cuts on data and simulated background.*

Selection	$m_{\mathrm{H}} = 85$ GeV	90 GeV	95 GeV	100 GeV	105 GeV	110 GeV	115 GeV
			Electron channel efficiency at 192 GeV				
Presel.	0.807±0.009	0.804±0.009	0.804±0.009	0.790±0.009	0.818±0.009	-	-
e^+e^-id.	0.693±0.010	0.683±0.010	0.693±0.010	0.685±0.010	0.710±0.010	-	-
El.ene.	0.672±0.011	0.663±0.011	0.668±0.011	0.656±0.011	0.676±0.010	-	-
Fit prob.	0.641±0.011	0.626±0.011	0.621±0.011	0.621±0.011	0.631±0.011	-	-
El.isol.	0.613±0.011	0.604±0.011	0.594±0.011	0.578±0.011	0.604±0.011	-	-
Mass sel.	0.601±0.011	0.594±0.011	0.587±0.011	0.571±0.011	0.587±0.011	-	-
B tag	0.530±0.011	0.519±0.011	0.511±0.011	0.498±0.011	0.516±0.011	-	-
			Electron channel efficiency at 196 GeV				
Presel.	0.824±0.009	0.806±0.009	0.818±0.009	0.824±0.007	0.795±0.009	-	-
e^+e^-id.	0.718±0.010	0.688±0.010	0.717±0.010	0.712±0.008	0.691±0.010	-	-
El.ene.	0.692±0.010	0.665±0.011	0.694±0.010	0.690±0.008	0.660±0.011	-	-
Fit prob.	0.649±0.011	0.630±0.011	0.641±0.011	0.650±0.009	0.618±0.011	-	-
El.isol.	0.626±0.011	0.597±0.011	0.614±0.011	0.614±0.009	0.589±0.011	-	-
Mass sel.	0.620±0.011	0.595±0.011	0.610±0.011	0.609±0.009	0.584±0.011	-	-
B tag	0.550±0.011	0.529±0.011	0.533±0.011	0.536±0.009	0.508±0.011	-	-
			Electron channel efficiency at 200 GeV				
Presel.	0.793±0.013	0.796±0.009	0.814±0.009	0.811±0.009	0.794±0.007	0.811±0.009	0.807±0.009
e^+e^-id.	0.668±0.015	0.695±0.010	0.707±0.010	0.691±0.010	0.684±0.008	0.691±0.010	0.687±0.010
El.ene.	0.644±0.015	0.677±0.010	0.686±0.010	0.671±0.011	0.655±0.009	0.660±0.011	0.647±0.011
Fit prob.	0.608±0.015	0.636±0.011	0.643±0.011	0.631±0.011	0.611±0.009	0.612±0.011	0.590±0.011
El.isol.	0.578±0.016	0.614±0.011	0.616±0.011	0.601±0.011	0.575±0.009	0.577±0.011	0.558±0.011
Mass sel.	0.569±0.016	0.610±0.011	0.612±0.011	0.598±0.011	0.573±0.009	0.572±0.011	0.550±0.011
B tag	0.494±0.016	0.531±0.011	0.533±0.011	0.517±0.011	0.493±0.009	0.487±0.011	0.476±0.011
			Electron channel efficiency at 202 GeV				
Presel.	0.811±0.009	0.820±0.009	0.816±0.009	0.831±0.008	0.807±0.007	0.796±0.009	0.841±0.008
e^+e^-id.	0.714±0.010	0.707±0.010	0.710±0.010	0.725±0.010	0.697±0.008	0.693±0.010	0.729±0.010
El.ene.	0.697±0.010	0.687±0.010	0.690±0.010	0.700±0.010	0.673±0.009	0.664±0.011	0.695±0.010
Fit prob.	0.652±0.011	0.646±0.011	0.649±0.011	0.660±0.011	0.626±0.009	0.624±0.011	0.630±0.011
El.isol.	0.630±0.011	0.622±0.011	0.619±0.011	0.628±0.011	0.594±0.009	0.589±0.011	0.601±0.011
Mass sel.	0.627±0.011	0.616±0.011	0.616±0.011	0.625±0.011	0.592±0.009	0.586±0.011	0.592±0.011
B tag	0.568±0.011	0.534±0.011	0.553±0.011	0.546±0.011	0.511±0.009	0.503±0.011	0.513±0.011

Table 2: *Effect of the selection cuts on the signal efficiency for the different energies and masses.*

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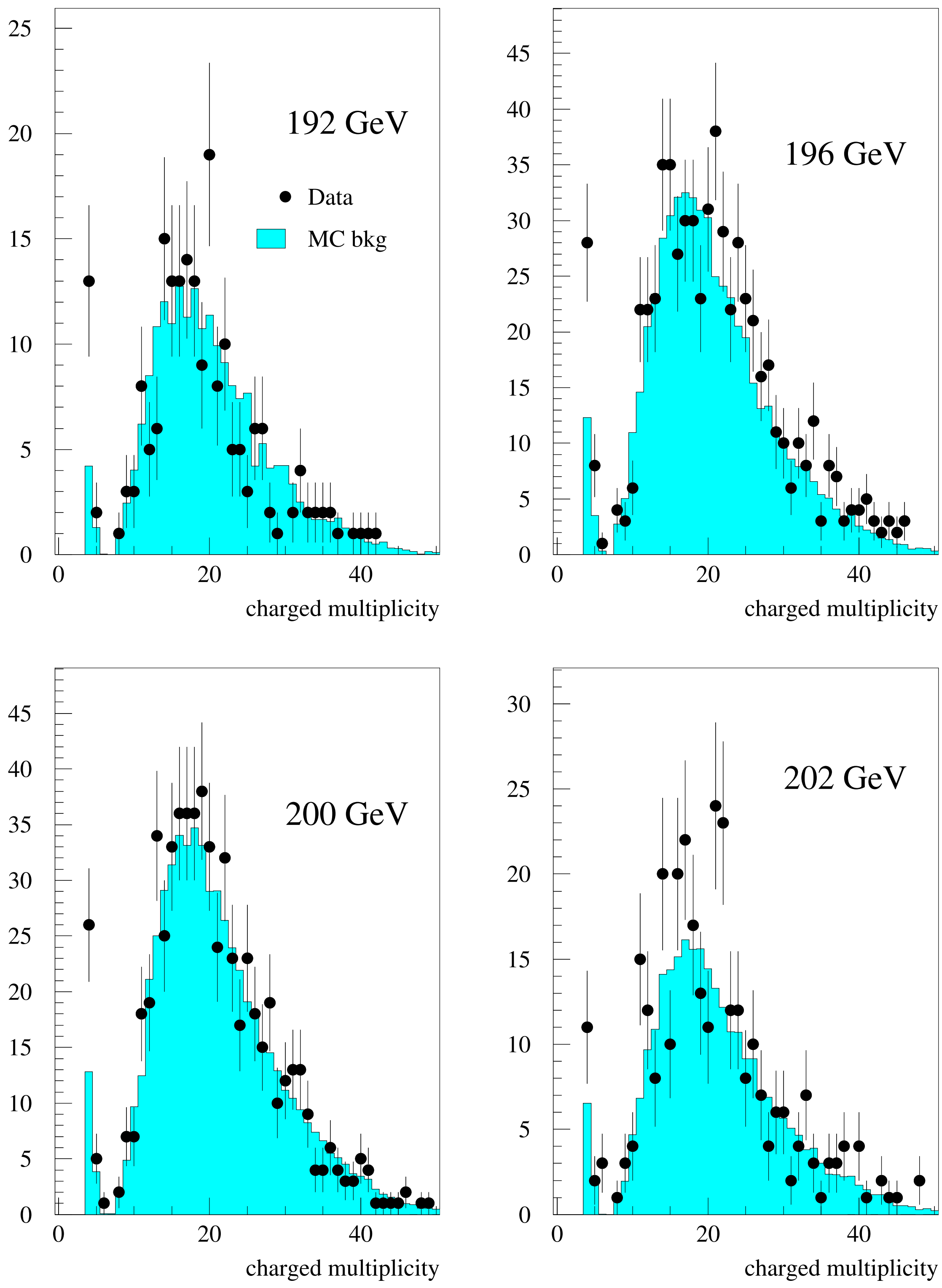

Figure 1: Charged multiplicity distributions for data and simulations at the different energies.

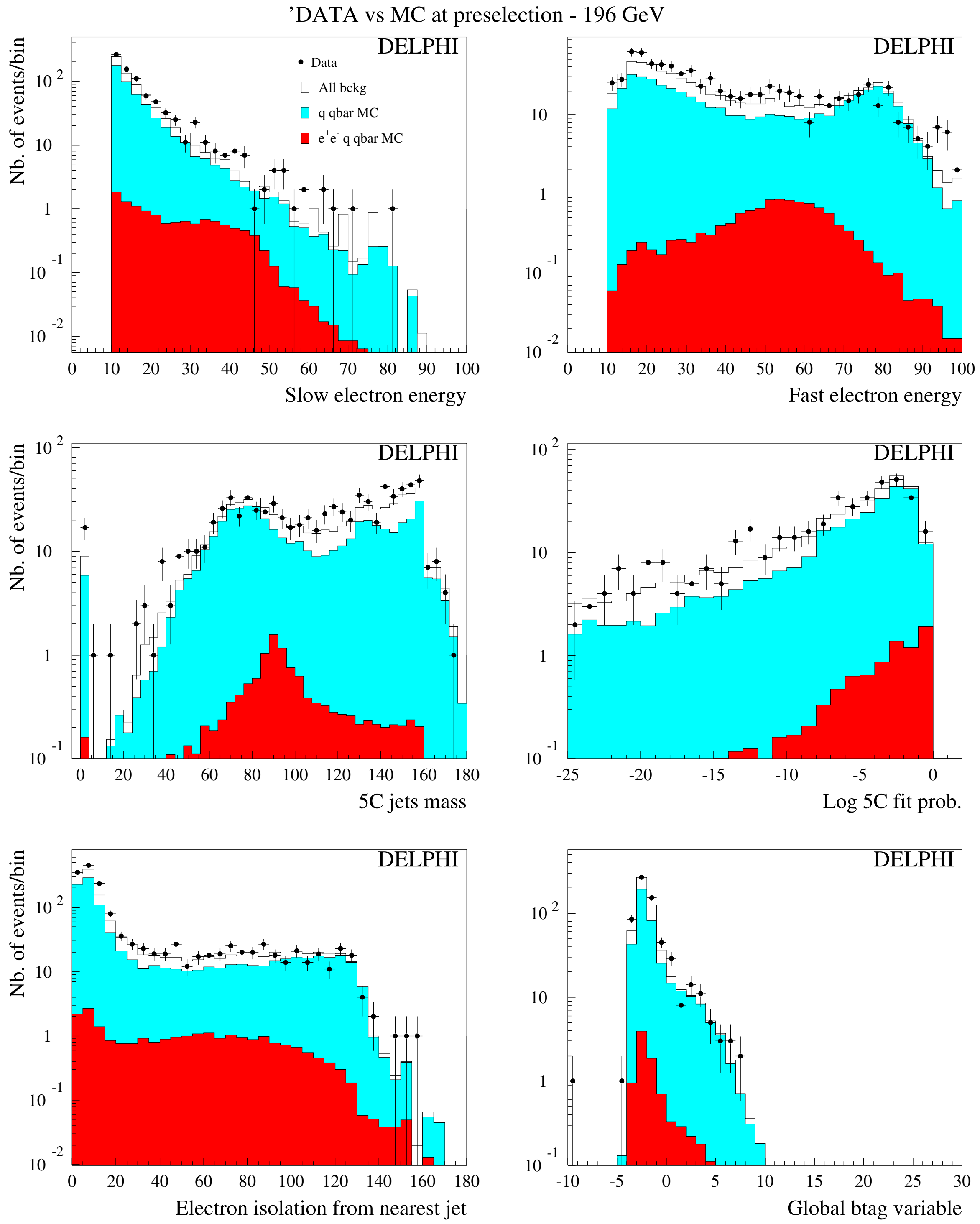

Figure 2: Distributions of some analysis variables, as described in the text, at 196 GeV.

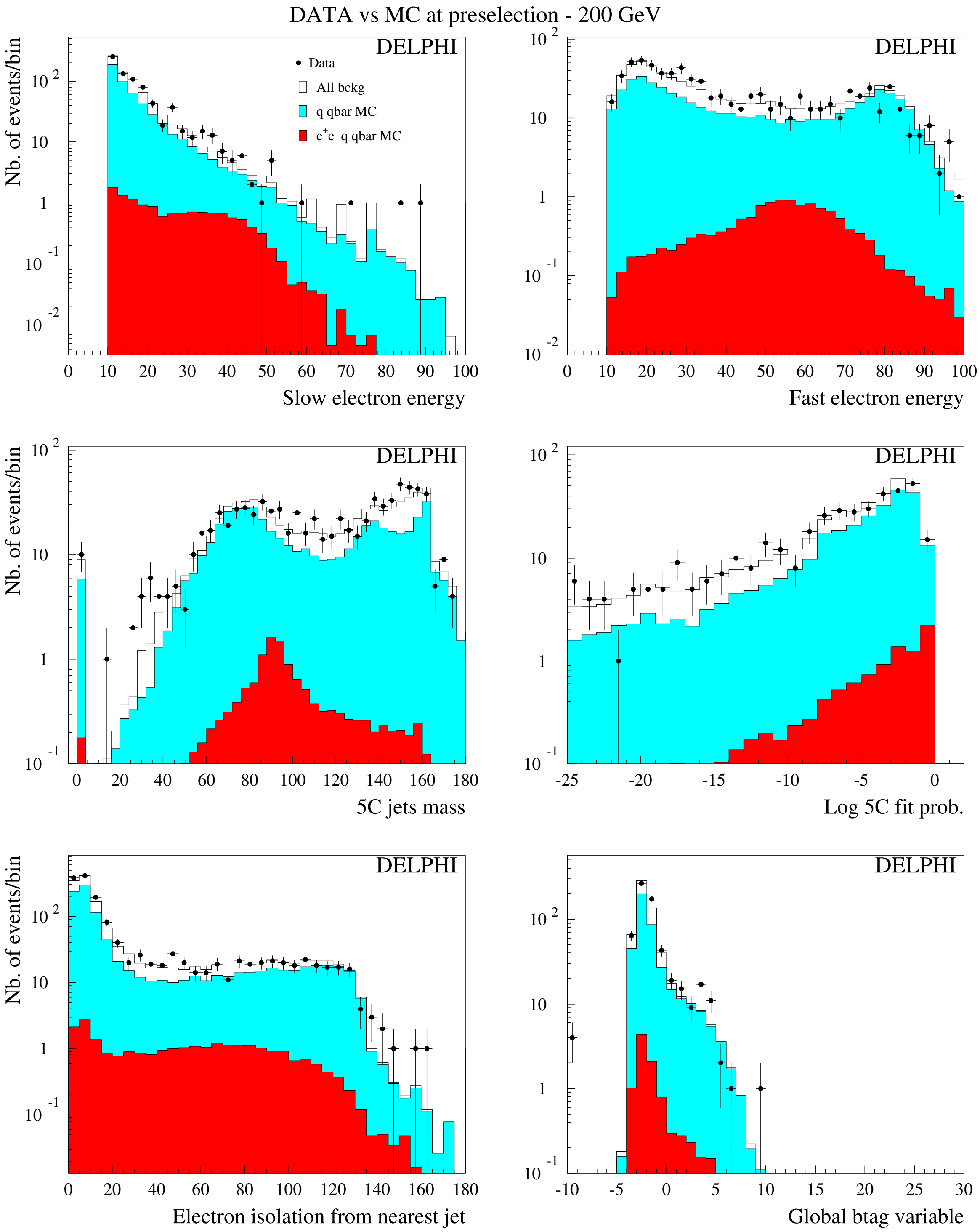

Figure 3: Distributions of some analysis variables, as described in the text, at 200 GeV.