A Study of the Dependence of the Jet Algorithms on the Minimum Transverse Energy

DØ Note 1557

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This note describes a study done using Monte Carlo data to determine the dependence of the jet cone algorithm on the minimum transverse energy (ETMIN) that the reconstructed jets (RECO jets) must have in order to be kept. The quantities measured were the number of reconstructed jets found, the number of these which were isolated, combined, or split, and the number of parton jets (PJET) that matched the RECO jets. Four different dijet Monte Carlo data runs generated using ISAJET with 200 events each were analysed and the ETMIN was varied from 4 GeV to 30 GeV. The range of the final-state jet momenta for the four runs was $20-40, 40-80, 80-160, 160-240$ GeV/c. The reconstructed jet and parton jet cone sizes were fixed at 0.7, the E_T splitting fraction, which is the fraction of transverse energy two RECO jets must share before they're combined into one jet, was fixed at 0.5, and the minimum matching distance between the PJET and RECO jet was fixed at 0.15 in η, ϕ space. The minimum transverse energy of the PJETs was held fixed at 15 GeV.

The results of the study are given below in Tables 1 through 4 for the four runs. Figures 1 through 3 show the number of RECO jets, the number of PJETs and RECO jets that match, and the fraction of RECO jets that are isolated, split and combined versus the minimum RECO jet E_T over the entire $20-40$ GeV/c run. The same quantities are shown in figures 4-6, 7-9, and 10-12 for the other momentum ranges. Statistical errors are shown on the figures. For the $20-40$ GeV/c run, it is somewhat meaningless to ask for a RECO jet with ETMIN greater than 15 GeV, therefore the number of matched jets in this lowest run should not be given the same significance as in the other runs. The number of PJETs in each run is constant, but the number of RECO jets changes with ETMIN and also with the momentum range For further information on jet algorithms, see DØ notes 904, 905, 1037 and 1472.

TABLE 1

Monte Carlo data, dijet momentum range 20 - 40 GeV/c							
RECO jet ETMIN	# RECO jets	# isolated	# combined	# split	# split & combined	# PJETs	# jets matched
4	701	461	73	148	19	345	273
8	500	362	66	64	8	345	275
15	295	252	41	2	0	345	229
20	133	115	18	0	0	345	117
30	14	12	2	0	0	345	12

TABLE 2

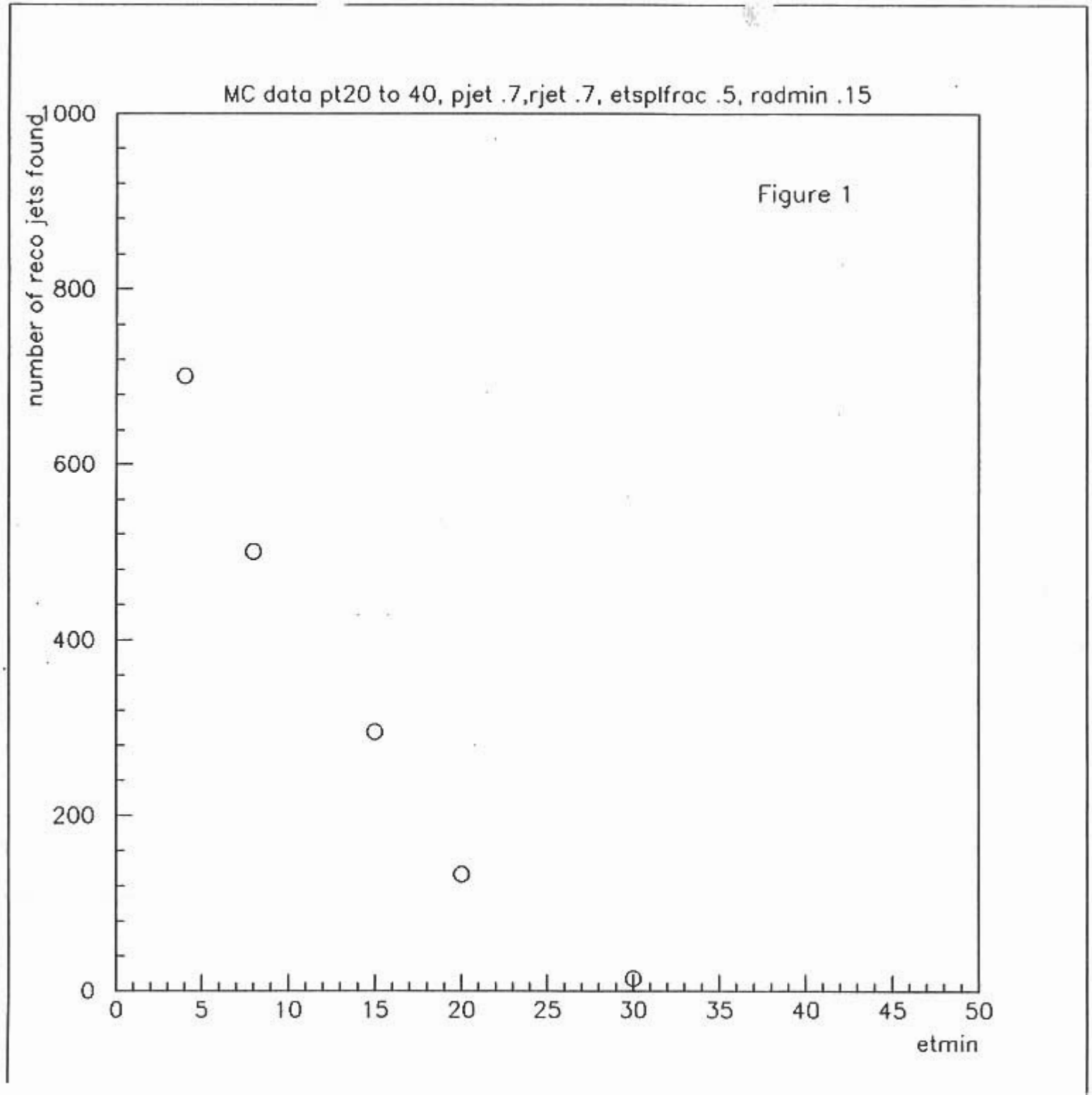
Monte Carlo data, dijet momentum range 40 - 80 GeV/c							
RECO jet ETMIN	# RECO jets	# isolated	# combined	# split	# split & combined	# PJETs	# jets matched
4	818	494	62	235	27	496	433
8	617	417	62	117	21	496	432
15	467	362	52	45	8	496	416
20	410	343	49	15	3	496	374
30	291	261	28	2	0	496	275

TABLE 3

Monte Carlo data, dijet momentum range 80 - 160 GeV/c							
RECO jet ETMIN	# RECO jets	# isolated	# combined	# split	# split & combined	# PJETs	# jets matched
4	858	510	60	244	44	591	518
8	698	431	61	176	30	591	518
15	551	398	46	85	22	591	502
20	497	390	41	52	14	591	467
30	435	368	31	28	8	591	415

TABLE 4

Monte Carlo data, dijet momentum range 160 - 240 GeV/c							
RECO jet ETMIN	# RECO jets	# isolated	# combined	# split	# split & combined	# PJETs	# jets matched
4	883	459	40	332	52	670	574
8	745	425	40	234	46	670	574
15	616	395	28	159	34	670	563
20	569	386	25	135	23	670	534
30	504	373	27	87	17	670	484


MC data pt20 to 40, pjet .7,rjet .7, etsplfrac .5, radmin .15
Figure 1
number of reco jets found
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
45
50
etmin

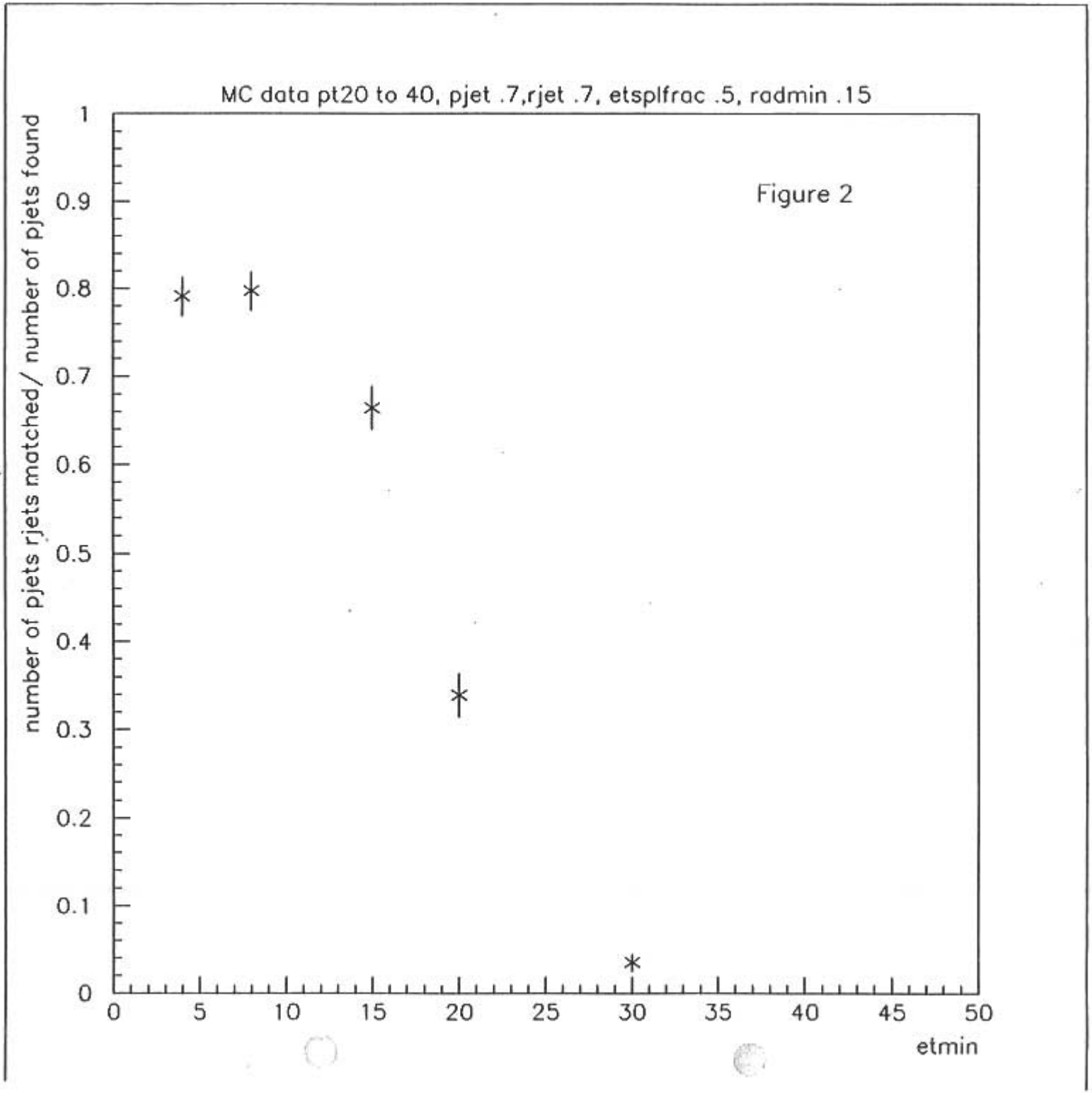

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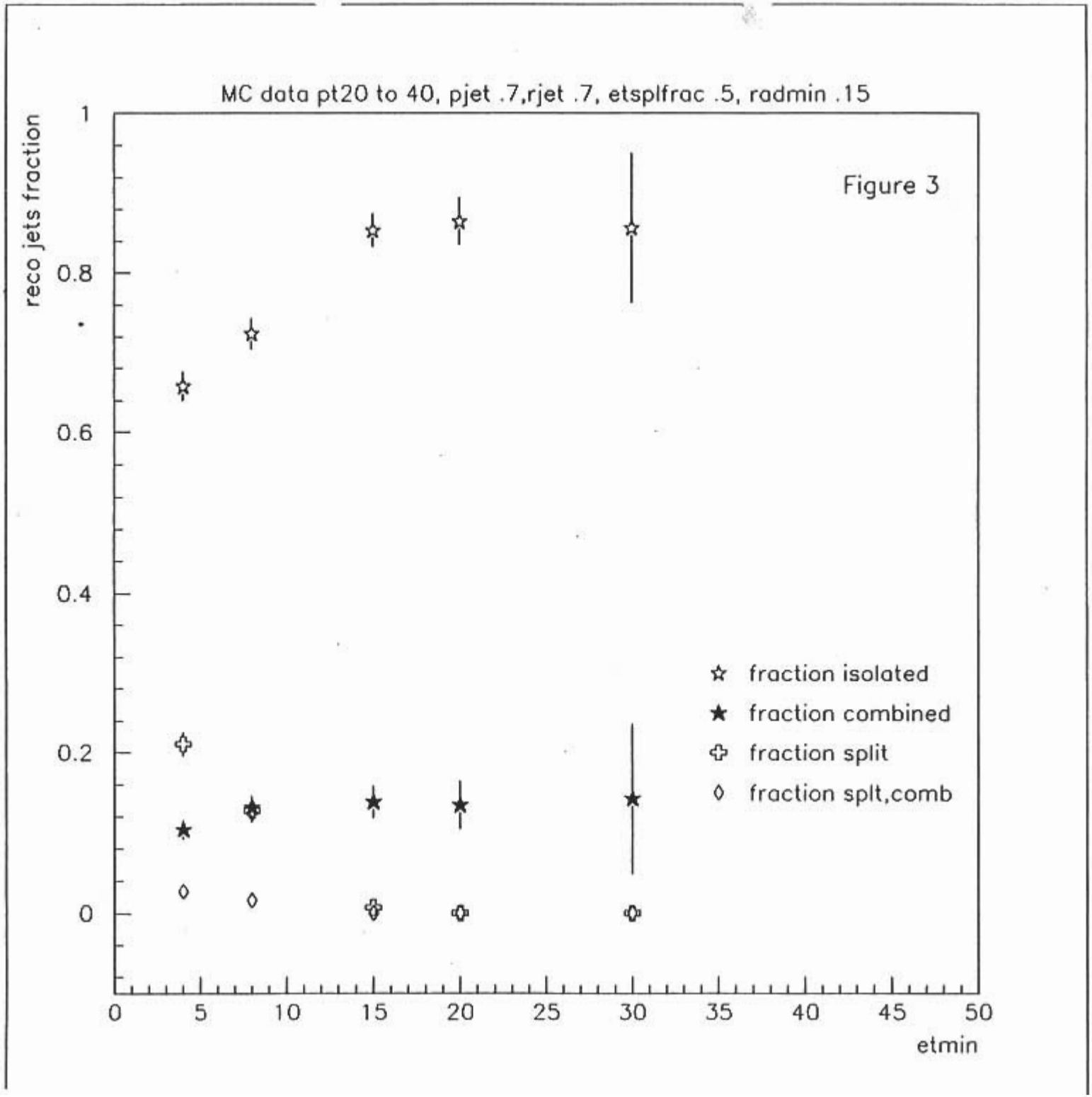
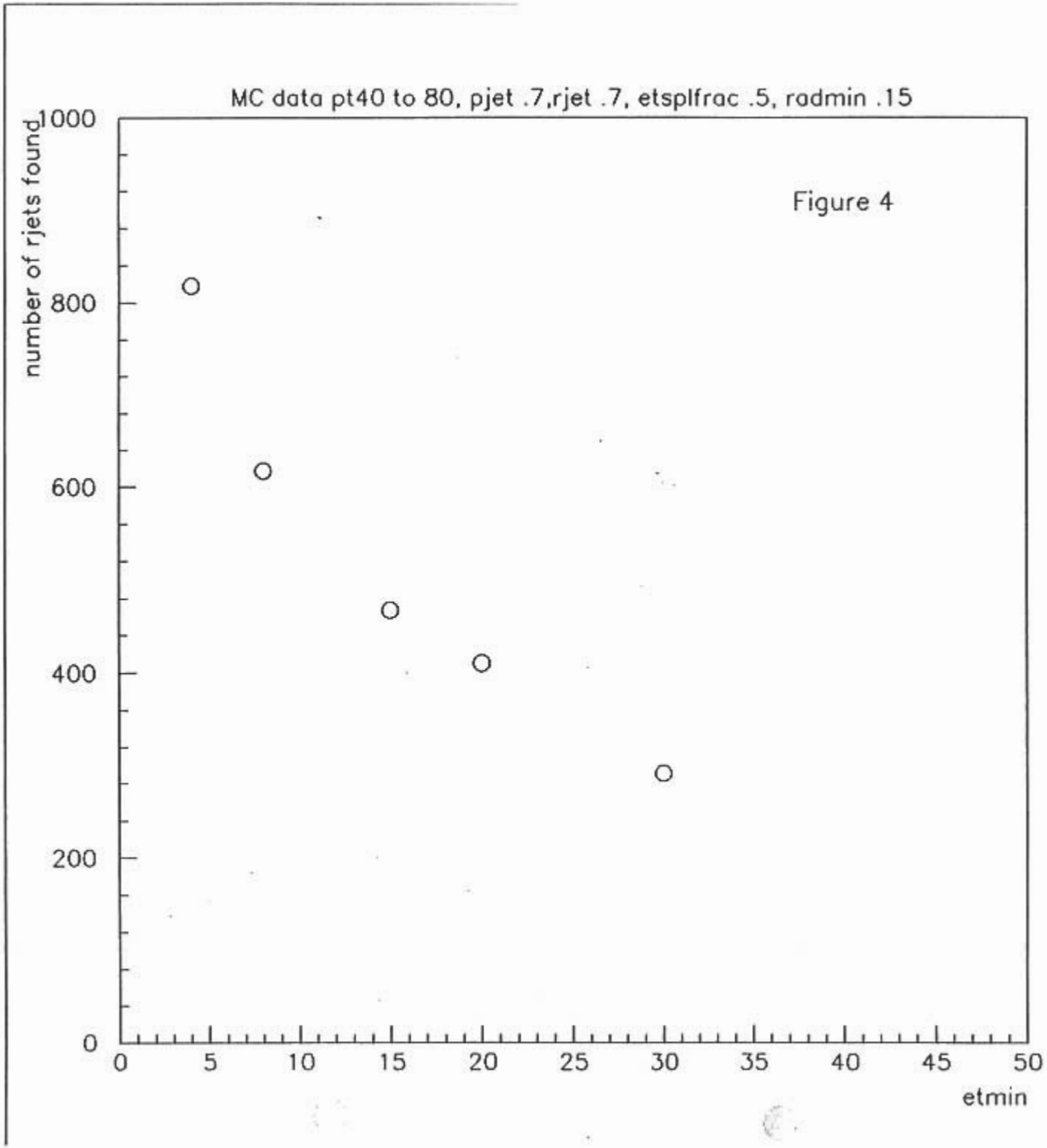
Figure 2
number of pjets rjets matched/ number of pjets found
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
25
30
35
40
45
50
etmin


MC data pt20 to 40, pjet .7,rjet .7, etsplfrac .5, radmin .15
Figure 3
reco jets fraction
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
30
35
40
45
50
etmin
fraction isolated
fraction combined
fraction split
fraction splt,comb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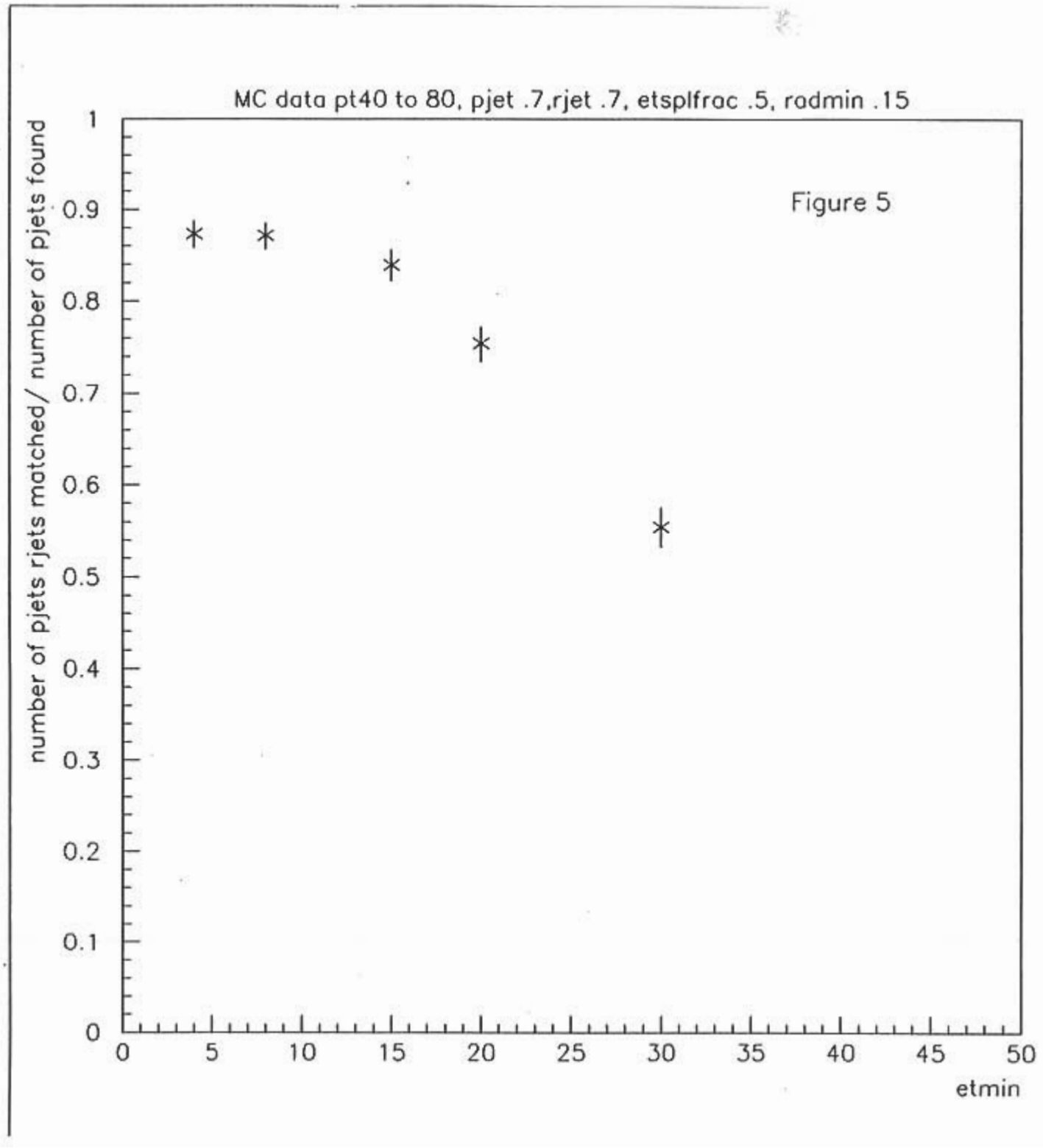
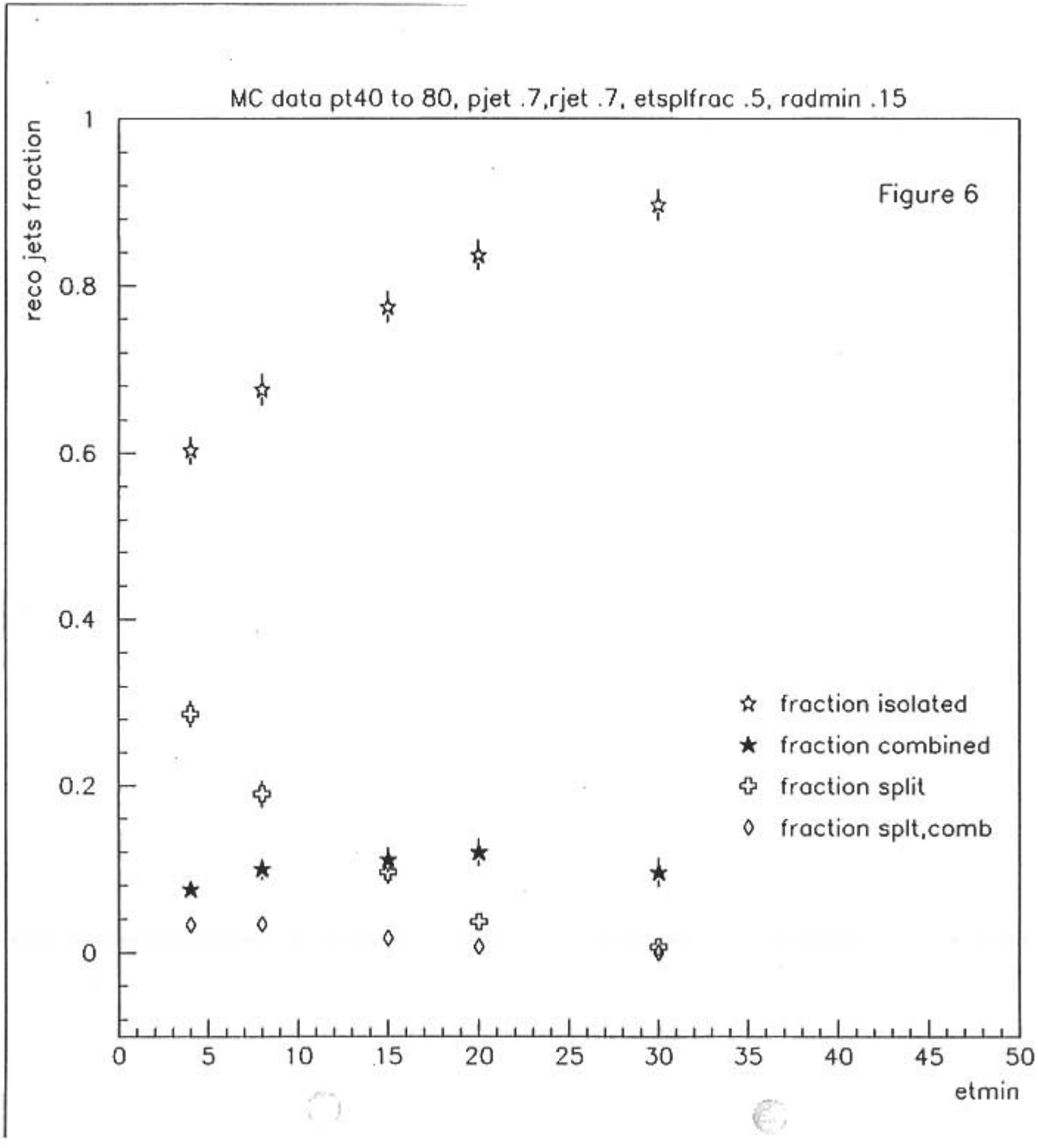
number of rjets found
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
45
50
etmin

Figure 4


MC data pt40 to 80, pjet .7,rjet .7, etsplfrac .5, radmin .15
Figure 5
number of pjets rjets matched/ number of pjets found
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
25
30
35
40
45
50
etmin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reco jets fraction
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
30
35
40
45
50
etmin
fraction isolated
fraction combined
fraction split
fraction splt,comb

Figure 6

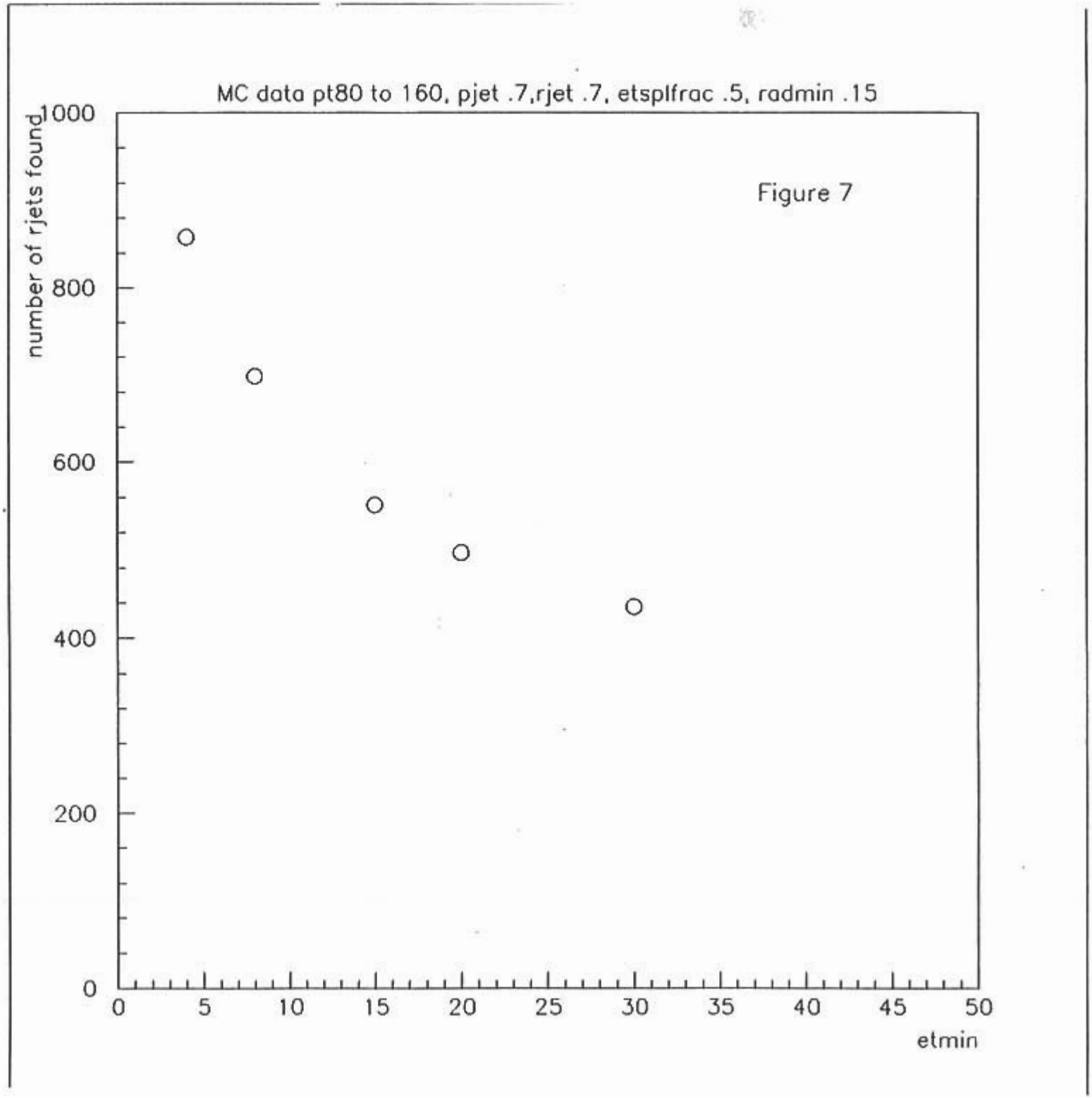
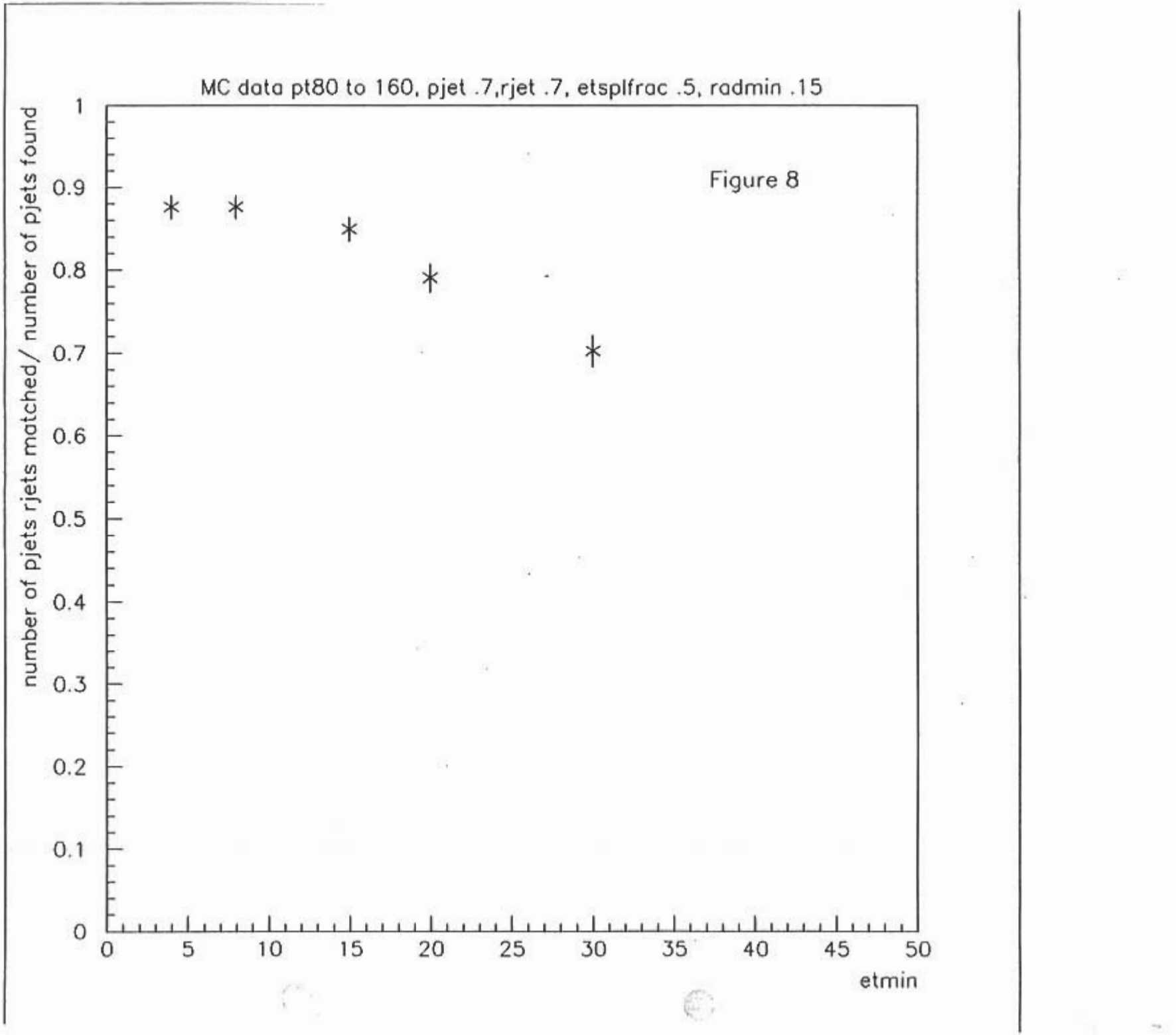
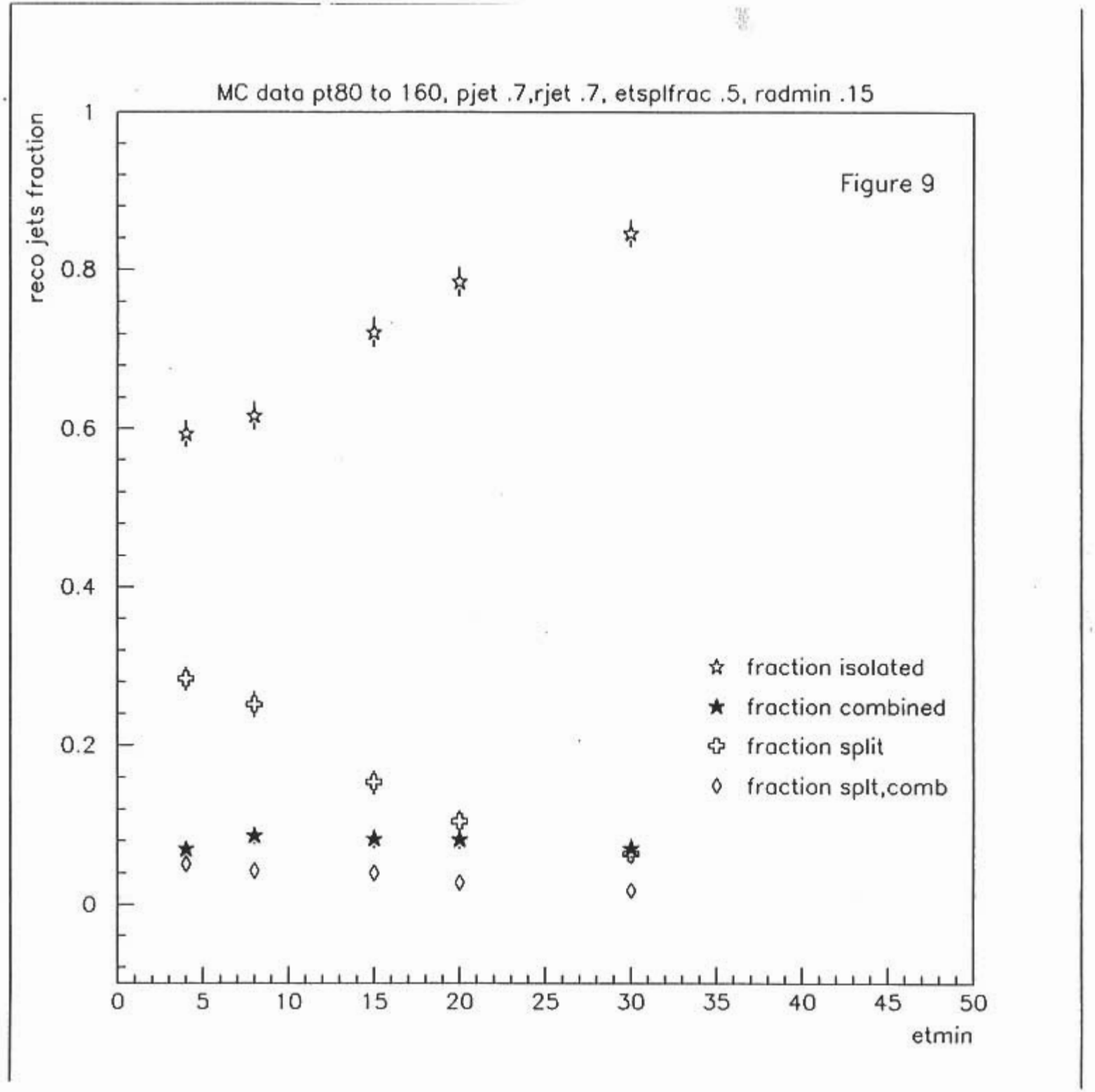

MC data pt80 to 160, pjet .7,rjet .7, etsplfrac .5, radmin .15
number of rjets found
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
45
50
etmin

Figure 7


MC data pt80 to 160, pjet .7,rjet .7, etsplfrac .5, radmin .15
Figure 8
number of pjets rjets matched/ number of pjets found
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
25
30
35
40
45
50
etmin


MC data pt80 to 160, pjet .7,rjet .7, etsplfrac .5, radmin .15
Figure 9
reco jets fraction
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
30
35
40
45
50
etmin
fraction isolated
fraction combined
fraction split
fraction splt,comb

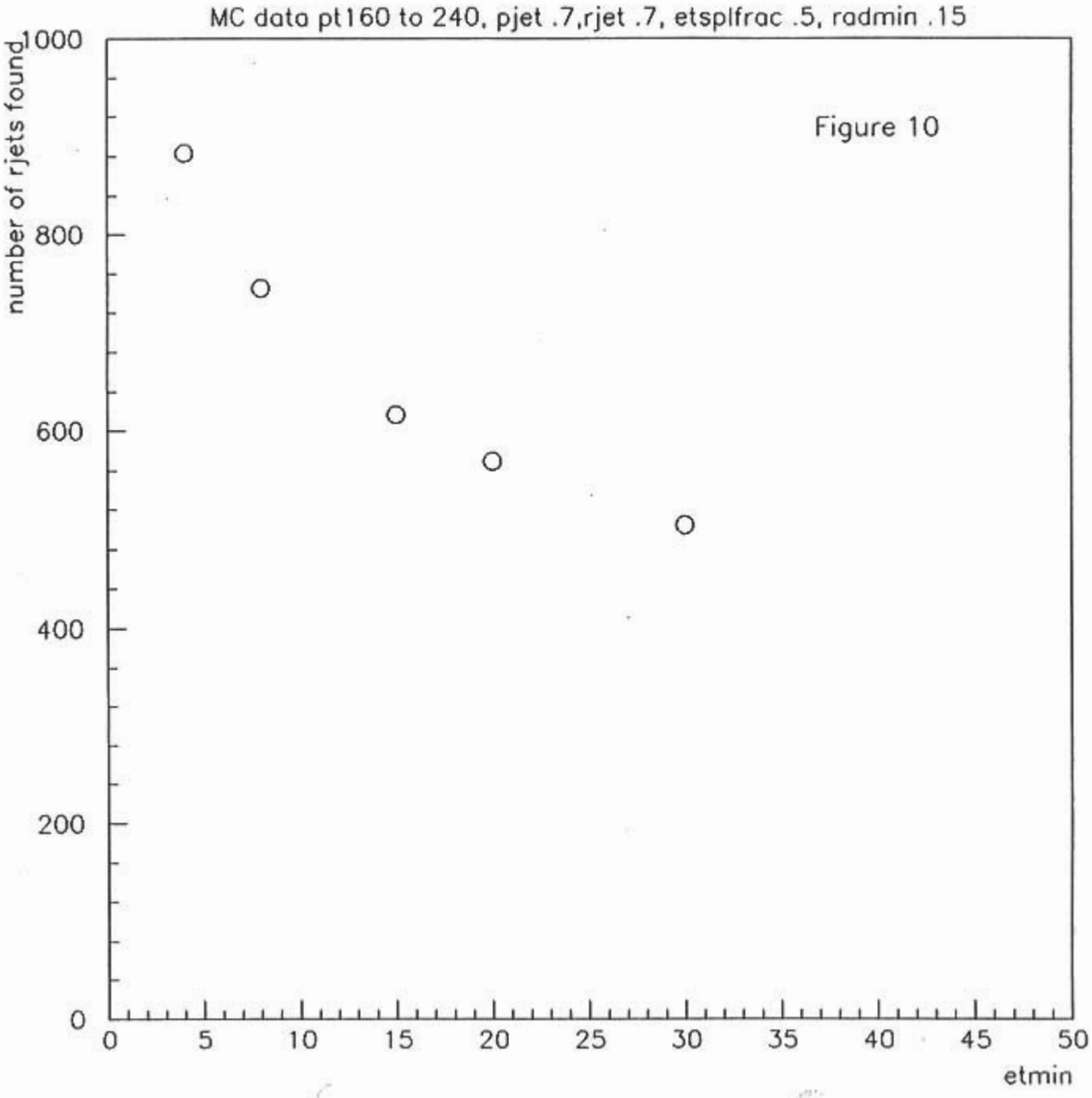
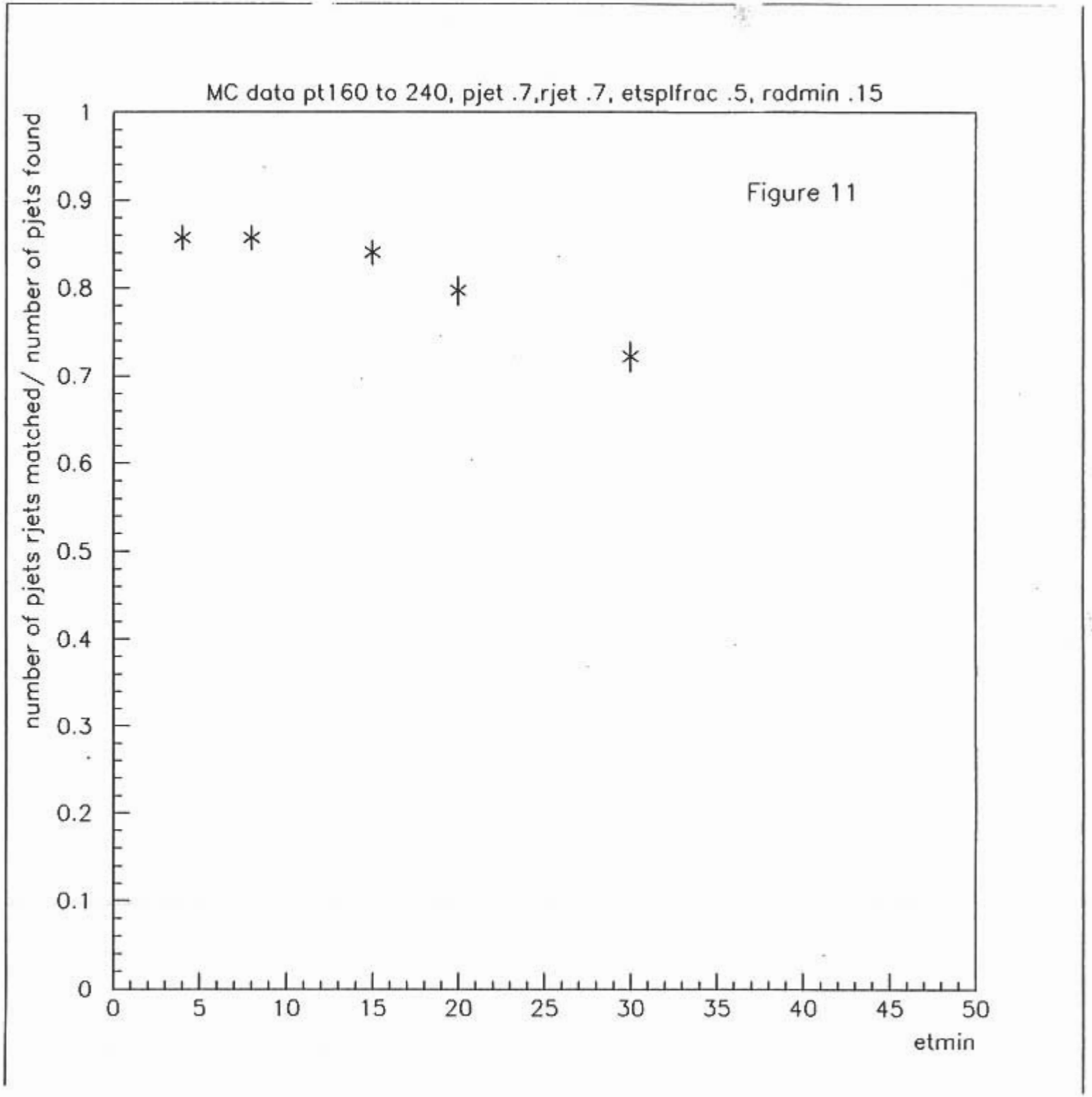
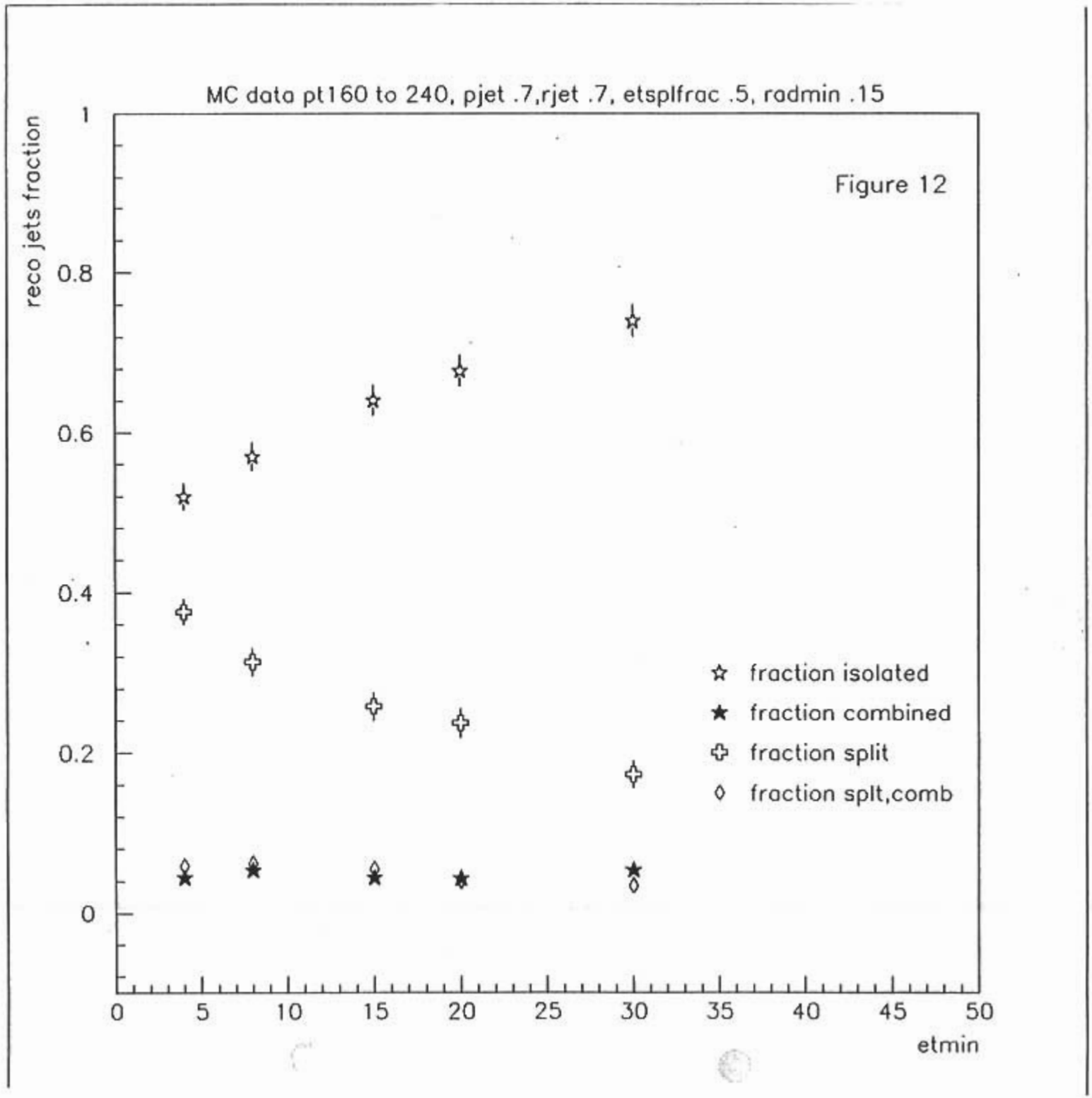

MC data pt160 to 240, pjet .7,rjet .7, etsplfrac .5, radmin .15
number of rjets found
1000
800
600
400
200
0
0
5
10
15
20
25
30
35
40
45
50
etmin

Figure 10


MC data pt160 to 240, pjet .7,rjet .7, etsplfrac .5, radmin .15
Figure 11
number of pjets rjets matched/ number of pjets found
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
25
30
35
40
45
50
etmin


MC data pt160 to 240, pjet .7,rjet .7, etsplfrac .5, radmin .15
Figure 12
reco jets fraction
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
30
35
40
45
50
etmin
fraction isolated
fraction combined
fraction split
fraction splt,comb