First result from the Alpha Magnetic Spectrometer on the International Space Station:
Precision measurement of the positron fraction in primary cosmic rays of 0.5−350 GeV.
Supplemental online material.

(AMS Collaboration)

(Dated: March 15, 2013)

Abstract

Supplemental material concerning "First result from the Alpha Magnetic Spectrometer on the International Space Station: Precision measurement of the positron fraction in primary cosmic rays of 0.5−350 GeV."

Proton rejection power. Figure 1a shows the proton rejection power of the TRD estimator at 90 % e$^\pm$ efficiency measured on orbit. Figure 1b shows the proton rejection power of the ECAL estimator when combined with the energy-momentum matching requirement $E/p > 0.75$.

Event selection. The main selection cuts are shown in Table 1. They are independent of the charge–sign and nearly independent of the energy.

Example of E/p plot. Figure 2 shows the E/p distribution after event selection for a typical energy bin ($83.2 < E < 100\,\mathrm{GeV}$).

Positron Fraction. The measured positron fraction is presented in in Table 2 as a function of the reconstructed energy at the top of the AMS detector from 0.5 to 350 GeV.

TABLE I. Event selection cuts.

A shower axis within the ECAL fiducial volume.
A track in the Tracker containing at least one hit in planes 1 or 2 or 9 and hits in planes (3 or 4), (5 or 6) and (7 or 8). In addition, the projected track must pass within 3 cm in x and 10 cm in y of the center of gravity of the ECAL shower.
The relative error on the curvature (inverse of the rigidity) value from the track fit is less than 50 %, which ensures that tracks have rigidities well below their Maximum Detectable Rigidity.
The detector livetime exceeded 50 %, which excludes, for example, the South Atlantic Anomaly.
The particle velocity measured by TOF $\beta > 0.8$.
At least 15 TRD hits on the Tracker track traced through the TRD.
The value of ECAL estimator is required to be greater than -0.8.
The value of the absolute charge is required to be between 0.8 and 1.4.

TABLE II: Positron fraction as a function of energy. Errors due to: *stat.* statistical error, *acc.* acceptance asymmetry, *sel.* event selection, *mig.* bin-to-bin migration, *ref.* reference spectra, *c.c.* charge confusion and *syst.* total systematic error.

Energy[GeV]	N_{e+}	Fraction	$\sigma_{stat.}$	$\sigma_{acc.}$	$\sigma_{sel.}$	$\sigma_{mig.}$	$\sigma_{ref.}$	$\sigma_{c.c.}$	$\sigma_{syst.}$
0.50 - 0.65	822	0.0947	0.0034	0.0010	0.0016	0.0005	0.0002	0.0010	0.0022
0.65 - 0.81	3,045	0.0919	0.0016	0.0007	0.0014	0.0007	0.0002	0.0008	0.0019
0.81 - 1.00	6,504	0.0902	0.0011	0.0006	0.0012	0.0009	0.0002	0.0006	0.0017
1.00 - 1.21	9,335	0.0842	0.0008	0.0005	0.0009	0.0008	0.0001	0.0005	0.0014
1.21 - 1.45	12,621	0.0783	0.0007	0.0004	0.0007	0.0006	0.0001	0.0005	0.0011
1.45 - 1.70	15,189	0.0735	0.0006	0.0003	0.0005	0.0004	0.0001	0.0003	0.0008
1.70 - 1.97	18,400	0.0685	0.0005	0.0003	0.0005	0.0003	0.0001	0.0003	0.0007
1.97 - 2.28	23,893	0.0642	0.0004	0.0002	0.0005	0.0002	0.0001	0.0002	0.0006
2.28 - 2.60	22,455	0.0605	0.0004	0.0002	0.0005	0.0001	0.0001	0.0002	0.0006
2.60 - 2.94	21,587	0.0583	0.0004	0.0001	0.0005	0.0001	0.0001	0.0002	0.0006
2.94 - 3.30	21,158	0.0568	0.0004	0.0001	0.0004	0.0000	0.0001	0.0002	0.0005
3.30 - 3.70	20,707	0.0550	0.0004	0.0001	0.0003	0.0000	0.0001	0.0002	0.0004
3.70 - 4.11	19,429	0.0541	0.0004	0.0001	0.0002	0.0000	0.0001	0.0002	0.0003
4.11 - 4.54	18,370	0.0533	0.0004	0.0001	0.0001	0.0000	0.0001	0.0002	0.0003

TABLE II – *Continued from previous page*

Energy[GeV]	N_{e+}	Fraction	$\sigma_{stat.}$	$\sigma_{acc.}$	$\sigma_{sel.}$	$\sigma_{mig.}$	$\sigma_{ref.}$	$\sigma_{c.c.}$	$\sigma_{syst.}$
4.54 - 5.00	17,064	0.0519	0.0004	0.0001	0.0001	0.0000	0.0001	0.0002	0.0003
5.00 - 5.50	16,385	0.0512	0.0004	0.0001	0.0001	0.0000	0.0001	0.0002	0.0003
5.50 - 6.00	14,244	0.0508	0.0004	0.0001	0.0000	0.0000	0.0001	0.0002	0.0002
6.00 - 6.56	13,880	0.0501	0.0004	0.0001	0.0000	0.0000	0.0001	0.0002	0.0002
6.56 - 7.16	13,153	0.0510	0.0004	0.0001	0.0000	0.0000	0.0001	0.0002	0.0002
7.16 - 7.80	11,747	0.0504	0.0005	0.0001	0.0000	0.0000	0.0001	0.0002	0.0002
7.80 - 8.50	10,910	0.0513	0.0005	0.0001	0.0000	0.0000	0.0001	0.0002	0.0002
8.50 - 9.21	9,110	0.0510	0.0005	0.0001	0.0000	0.0000	0.0001	0.0002	0.0002
9.21 - 9.95	7,501	0.0515	0.0006	0.0001	0.0000	0.0000	0.0001	0.0002	0.0002
9.95 - 10.73	7,161	0.0519	0.0006	0.0001	0.0000	0.0000	0.0001	0.0002	0.0002
10.73 - 11.54	6,047	0.0528	0.0007	0.0001	0.0000	0.0000	0.0001	0.0001	0.0002
11.54 - 12.39	5,246	0.0535	0.0007	0.0001	0.0000	0.0000	0.0001	0.0001	0.0002
12.39 - 13.27	4,787	0.0549	0.0008	0.0001	0.0000	0.0000	0.0001	0.0001	0.0002
13.27 - 14.19	4,166	0.0551	0.0008	0.0001	0.0000	0.0000	0.0001	0.0001	0.0002
14.19 - 15.15	3,698	0.0543	0.0009	0.0001	0.0001	0.0000	0.0001	0.0001	0.0002
15.15 - 16.15	3,326	0.0556	0.0010	0.0001	0.0001	0.0000	0.0001	0.0001	0.0002
16.15 - 17.18	3,007	0.0583	0.0011	0.0001	0.0001	0.0000	0.0001	0.0002	0.0003
17.18 - 18.25	2,663	0.0586	0.0011	0.0001	0.0001	0.0000	0.0001	0.0002	0.0003
18.25 - 19.37	2,410	0.0592	0.0012	0.0001	0.0001	0.0000	0.0001	0.0002	0.0003
19.37 - 20.54	2,322	0.0634	0.0013	0.0001	0.0001	0.0000	0.0001	0.0002	0.0003
20.54 - 21.76	2,052	0.0618	0.0014	0.0001	0.0001	0.0000	0.0001	0.0002	0.0003
21.76 - 23.07	1,992	0.0653	0.0015	0.0001	0.0001	0.0000	0.0001	0.0002	0.0003
23.07 - 24.45	1,788	0.0651	0.0016	0.0001	0.0001	0.0000	0.0001	0.0002	0.0003
24.45 - 25.87	1,642	0.0657	0.0016	0.0001	0.0001	0.0000	0.0001	0.0002	0.0003
25.87 - 27.34	1,447	0.0668	0.0018	0.0001	0.0001	0.0000	0.0001	0.0003	0.0003
27.34 - 28.87	1,260	0.0694	0.0020	0.0001	0.0001	0.0000	0.0001	0.0003	0.0003
28.87 - 30.45	1,137	0.0710	0.0021	0.0001	0.0002	0.0000	0.0001	0.0003	0.0004
30.45 - 32.10	1,094	0.0701	0.0022	0.0001	0.0002	0.0000	0.0001	0.0003	0.0004
32.10 - 33.80	888	0.0707	0.0024	0.0001	0.0002	0.0000	0.0001	0.0004	0.0005
33.80 - 35.57	807	0.0718	0.0026	0.0001	0.0003	0.0000	0.0001	0.0004	0.0005
35.57 - 37.40	787	0.0747	0.0027	0.0001	0.0003	0.0000	0.0001	0.0004	0.0005
37.40 - 40.00	982	0.0794	0.0026	0.0002	0.0004	0.0000	0.0001	0.0004	0.0006
40.00 - 43.39	976	0.0802	0.0026	0.0002	0.0005	0.0000	0.0001	0.0004	0.0007
43.39 - 47.01	856	0.0817	0.0029	0.0002	0.0005	0.0000	0.0001	0.0004	0.0007
47.01 - 50.87	739	0.0856	0.0032	0.0002	0.0006	0.0000	0.0001	0.0004	0.0008
50.87 - 54.98	605	0.0891	0.0038	0.0002	0.0006	0.0000	0.0001	0.0004	0.0008
54.98 - 59.36	558	0.0957	0.0041	0.0002	0.0008	0.0000	0.0001	0.0005	0.0010
59.36 - 64.03	448	0.0962	0.0047	0.0002	0.0009	0.0000	0.0002	0.0006	0.0011
64.03 - 69.00	392	0.0978	0.0050	0.0002	0.0010	0.0000	0.0002	0.0007	0.0013
69.00 - 74.30	324	0.1032	0.0057	0.0002	0.0010	0.0000	0.0002	0.0009	0.0014
74.30 - 80.00	276	0.0985	0.0062	0.0002	0.0010	0.0000	0.0002	0.0010	0.0014
80.00 - 86.00	232	0.1023	0.0067	0.0002	0.0010	0.0000	0.0002	0.0010	0.0014
86.00 - 92.50	240	0.1120	0.0075	0.0002	0.0010	0.0000	0.0003	0.0011	0.0015

TABLE II – *Continued from previous page*

| Energy[GeV]	N_{e^+}	Fraction	$\sigma_{stat.}$	$\sigma_{acc.}$	$\sigma_{sel.}$	$\sigma_{mig.}$	$\sigma_{ref.}$	$\sigma_{c.c.}$	$\sigma_{syst.}$
92.50 - 100.0	226	0.1189	0.0081	0.0002	0.0011	0.0000	0.0003	0.0012	0.0017
100.0 - 115.1	304	0.1118	0.0066	0.0002	0.0015	0.0000	0.0003	0.0015	0.0022
115.1 - 132.1	223	0.1142	0.0080	0.0002	0.0019	0.0000	0.0004	0.0019	0.0027
132.1 - 151.5	156	0.1215	0.0100	0.0002	0.0021	0.0000	0.0005	0.0024	0.0032
151.5 - 173.5	144	0.1364	0.0121	0.0002	0.0026	0.0000	0.0006	0.0045	0.0052
173.5 - 206.0	134	0.1485	0.0133	0.0002	0.0031	0.0000	0.0009	0.0050	0.0060
206.0 - 260.0	101	0.1530	0.0160	0.0003	0.0031	0.0000	0.0013	0.0095	0.0101
260.0 - 350.0	72	0.1550	0.0200	0.0003	0.0056	0.0000	0.0018	0.0140	0.0152
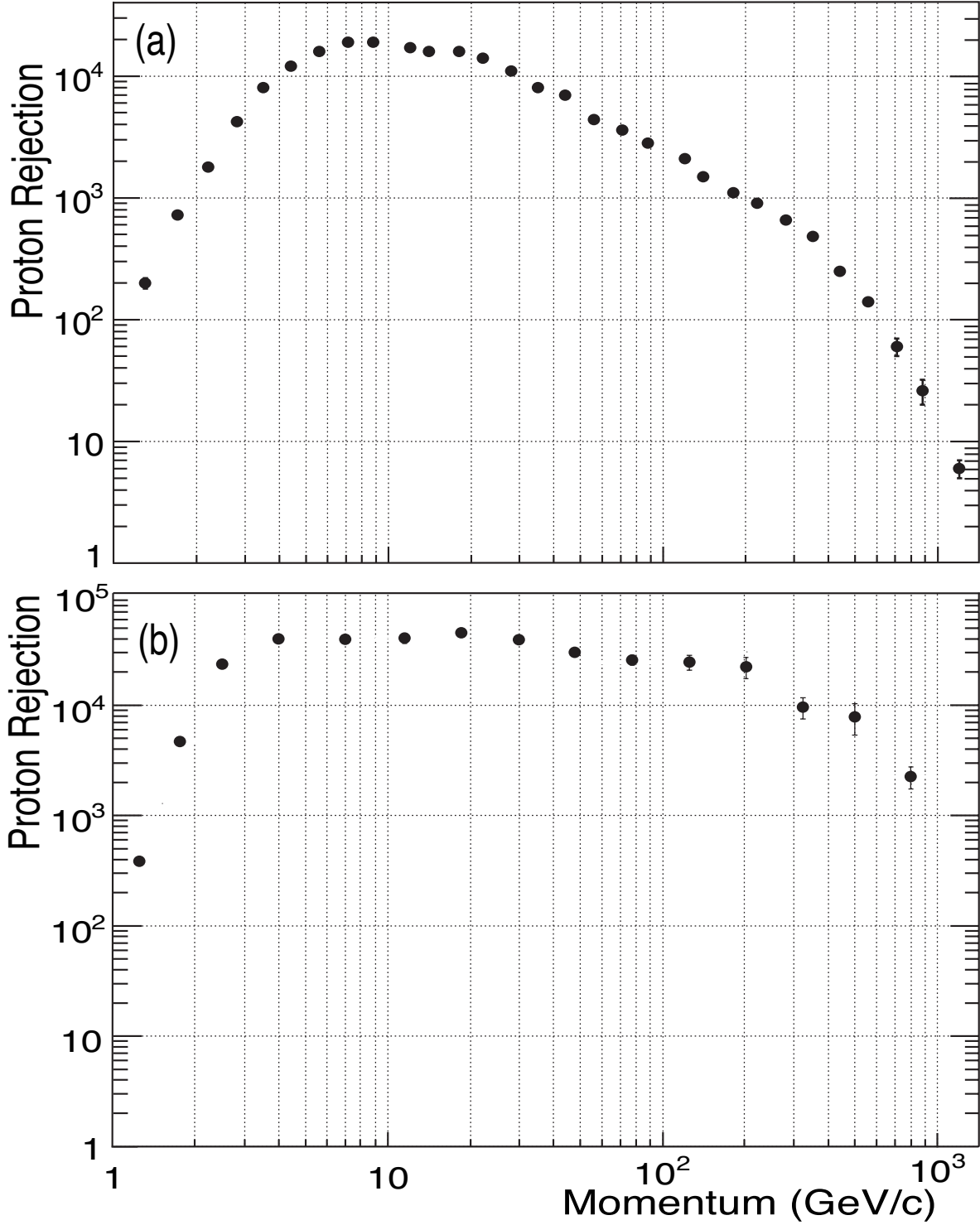
FIG. 1. (a) The proton rejection measured by the TRD as a function of track momentum at 90 % selection efficiency for e$^\pm$. (b) The measured proton rejection using the ECAL and the Tracker. For 90 % e$^\pm$ ECAL selection efficiency, the measured proton rejection is $\sim$10,000 for the combination of the ECAL and the Tracker in the momentum range 3–500 GeV/c, independent of the TRD.
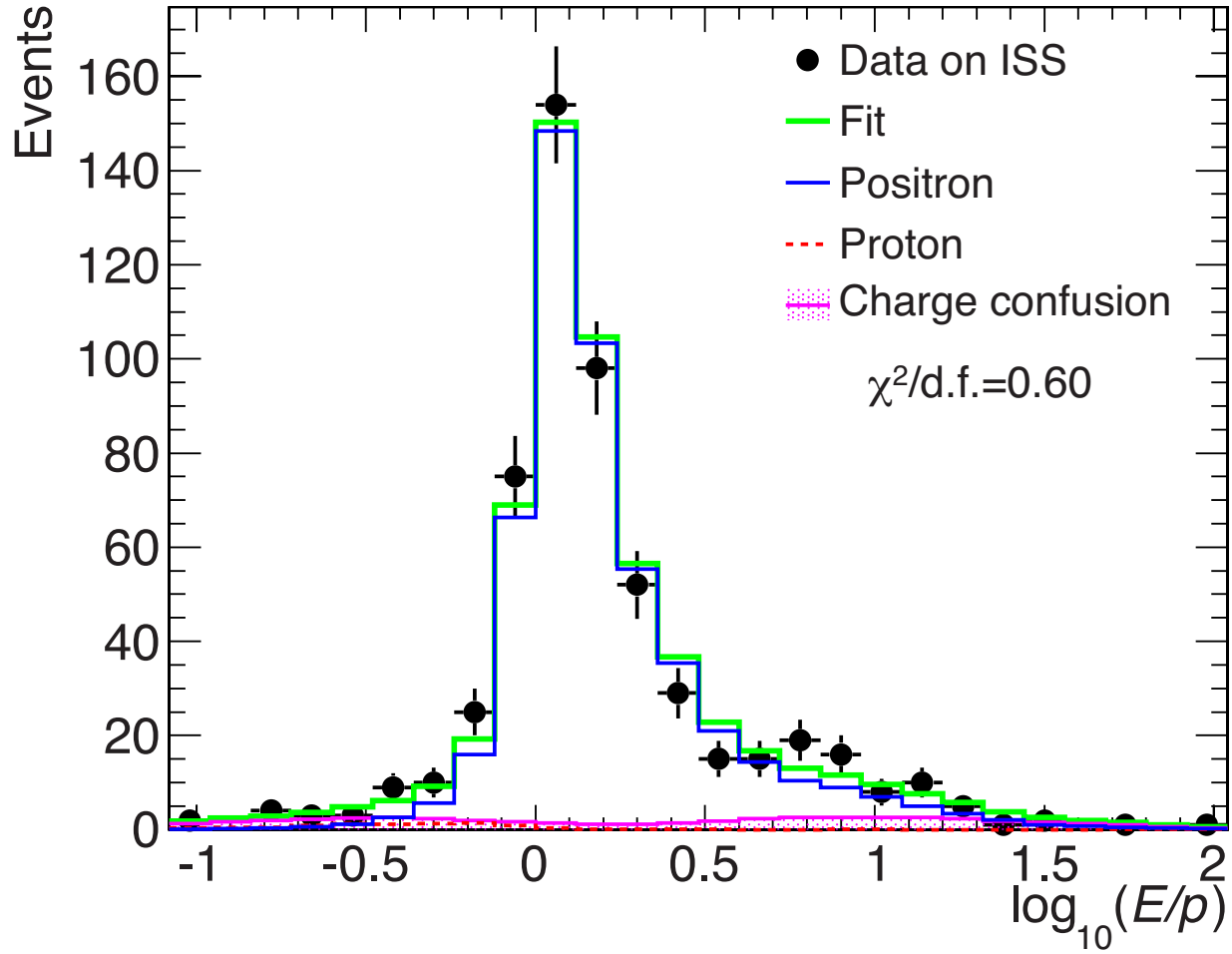
FIG. 2. A representative energy–momentum ratio, E/p, distribution in the energy range 83.2–100 GeV for the positively charged selected data sample with a TRD estimator < 0.75. The proton background is estimated to be 1 % in this region.