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Analysis techniques in the measurements of e^+, e^- fluxes variation in time

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Summary. — The Alpha Magnetic Spectrometer (AMS-02) is a Cosmic Rays (CRs) detector. Thanks to the its large acceptance is possible to study electrons and positrons fluxes variation, due to the solar modulation. This will help in the understanding of solar physics and in the propagation of CRs in the Heliosphere environment. In this contribution, the employed analysis techniques in the measurements of electrons and positrons fluxes variation in time will be discussed.

1. – Introduction

AMS-02 is a magnetic spectrometer designed and built to the detect charged CRs, which are mainly composed by protons (89%), helium (9%), heavier nuclei (1%), electrons (1%), positrons, antiprotons and other rare components ($<$ 0.1%); the detector has also neutral particles (photons) detection capabilities. AMS-02 is taking data since its installation on the International Space Station (ISS), on May 19th 2011. The detector has a volume of $5\times4\times3\,\mathrm{m}^3$, weights 7.5 tons and was built to be operated in space for at least 20 years. The AMS-02 detector is described in details in [1]. The long exposure time, combined with a large detector acceptance ($0.45\,\mathrm{m}^2\mathrm{sr}$), gives the possibility to study the primary CRs fluxes in the energy range O(GeV) - O(TeV) with high precision. At low energies ($E \leq 30\,\mathrm{GeV}$), the spectrum of charged CRs is modulated by the solar activity. Thanks to the AMS-02 large acceptance is possible to study the e^+, e^- fluxes variation, due to the solar modulation [2], with a very high time granularity. The long exposure time will allow to observe the fluxes trend during an entire solar cycle (11 years). The knowledge of the solar modulation is important in order to extrapolate the spectrum in the local interstellar medium (LIS).

2. – Analysis techniques and results

In order to determine the e^+, e^- fluxes, a high e/p rejection power is needed. This power has been reached in the analysis by means of two sub detectors: the Transition Radiation Detector (TRD) and the electromagnetic calorimeter (ECAL). In TRD, the

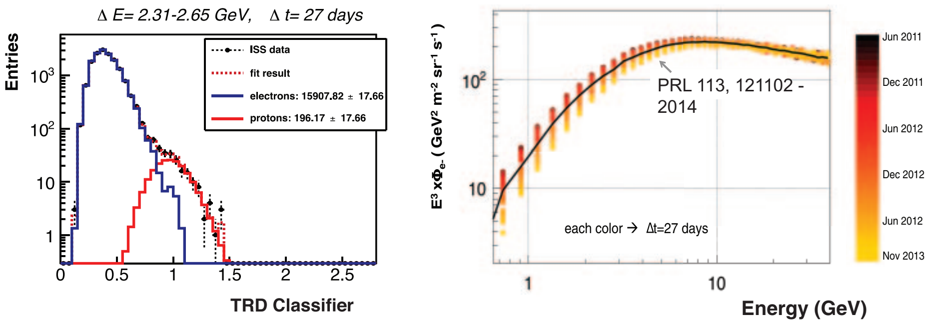

Fig. 1. – On the left: Example of the template fit to the TRD classifier distribution in the energy bin 2.31–2.65 GeV for a time period of 27 days. The area of the reference spectra, fitted to the data (black points), give the number of electrons (blue) and protons (red). On the right: Flux of electrons as a function the energy, scaled by E^3, in 33 different periods of 27 days each.

signals are combined in a *TRD classifier* based on a likelihood approach. An *ECAL classifier*, based on a boosted decision tree algorithm [3], is constructed using the 3D shower shape development in the ECAL. The analysis techniques are the same used for the $(e^+ + e^-)$ and e^+, e^- fluxes measurement at high energies [4,5], but the measurement of e^+, e^- fluxes at low energies, has been performed for each energy interval ΔE and in different time periods ΔT:

$$\Phi^{e^\pm}(\Delta E, \Delta T) = \frac{N_{obs}^{e^\pm}(\Delta E, \Delta T)}{\Delta E \; T_{exp}(\Delta E, \Delta T) A_{geom}(\Delta E) \epsilon_{sel}(1+\delta)\epsilon_{trig}(\Delta E, \Delta T)} \quad (1)$$

Figure 1, on the left, shows an example of the template fit to the TRD classifier distribution, from the fit result is possible to extract the number of events ($N_{obs}^{e^\pm}$) in each ΔE and ΔT. The exposure time (T_{exp}), the trigger efficiency (ϵ_{trig}), the event selection efficiency (ϵ_{sel}) and the data-derived correction (δ) also have been measured in each ΔE and in each ΔT. The geometric acceptance (A_{geom}) [6] has been estimated from MC [7] in each ΔE.

3. – Conclusions

The analysis was performed over the first ~ 30 months of ISS Data (7 Jun 2011 - 14 Nov 2013) and a time granularity of $\Delta T = 27$ days (~ 1 Bartel's rotation) has been chosen. Figure 1, on the right, shows the flux of electrons as a function the energy. The result is still preliminary but the variation with time at low energy is clear.

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