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Estimates of the energetic proton environment at L1 point

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The interplanetary space is permeated by 'thermal' solar wind plasma and by a higher energy particle component, which increases of several orders of magnitude during Solar Energetic Particle (SEP) events. The estimation of this high energy particle background is essential for any mission profile. For instance, protons with energies in the range 50 - 500 keV (the so called soft protons) are of particular interest for the ATHENA mission, as they enter the mirrors, being concentrated towards the focal plane instruments.

Here, proton flux data obtained from both ACE and IMP-8 spacecraft, covering the 1997-2015 interval (solar cycles No. 23 and 24) and the 1973-2001 interval (solar cycles No. 21, 22, and 23), respectively, have been used to estimate the energetic proton environment at L1 point. In particular, cumulative distribution functions (CDFs) have been obtained for the 8 differential energy channels (in the energy range 0.70 - 4.75 MeV) of the EPAM/LEMS120 experiment onboard ACE as well as for two energy channels of CPME experiment on board IMP-8. Since the EPAM/LEMS120 first energy channel (P1') is affected by an unphysical quasi-periodic modulation, it has been filtered by using the Hilbert-Huang Transform (HHT) approach, based on both Empirical Mode Decomposition (EMD) and Hilbert Spectral Analysis (HSA). In this way, a corrected (filtered) P1' signal has been derived from which CDFs can be properly evaluated, showing that the unphysical modulation tends to increase values of a factor ranging between 1.2 and 2. Moreover, both ACE and IMP-8 proton fluxes are compared on similar energy channels showing a similar CDFs behavior, although solar cycles behavior was different in the different time intervals.