STUDY OF DECAY PHASES IN GRADUAL AND IMPULSIVE SOLAR ENERGETIC PARTICLE EVENTS

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We studied the decay phases of gradual and impulsive solar energetic particle (SEP) events associated and non-associated to coronal mass ejections (CMEs) and interplanetary shocks using the multispacecraft (ms/c) observations accomplished in the end of 1970s and 1980s. This was done based on a database of 1-100 Mev protons, 1-100 MeV/nucl alphas and 0.3-3.0 MeV electrons, as well as solar wind and interplanetary magnetic field, from the Prognoz, Venera, Vega, Phobos 2, Helios, ISSE 3 and IMP s/c.
We could analyse about 70 SEP-events related to CME-flare associations and nearly the same number of events related to flares only and observed at different points of the inner heliosphere simultaneously. The correlated observations were applied to consider a relationship between spatial structures in solar wind and magnetic field topology and energetic particle intensity-time profiles at late phase of event when influence of the sources at and near the Sun becomes neglegible. Here we present empirical dependencies of SEP-event decay phase characteristics (flux decay rate, energy spectrum, anisotropy of particle fluxes etc.) upon a distance from the Sun and heliolongitude under various conditions in interplanetary space. We obtained that in the case of large CME-associated events the feature of spatial and temporal invariance in particle energy spectra discovered earlier for protons in wide energy interval is inherent to energetic electrons and alpha particles too. The results obtained are considered from the point of view of energetic particle acceleration at travelling CME-driven shocks. In addition, we applied the results of our analisis to the recent SEP-event observations onboard the SOHO s/c.