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ELFIN observations of the electron isotropy boundary

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ELFIN consists of two identical polar-orbiting 3U+ CubeSats designed to explore the mechanisms responsible for relativistic electron loss during magnetic storms. Pitch-angle resolved energy spectra of electrons between 50-5000keV are routinely measured, which have revealed many electron isotropy boundary crossings in both quiet and active intervals. The electron isotropy boundary (IB) for a particular energy is the nightside magnetic latitude at which levels of precipitating and trapped plasma sheet electron fluxes are first equal, interpreted as having resulted from equatorial field-line curvature scattering into the loss cone. The latitude of first appearance of isotropization (IB) provides a measure of the magnetotail field configuration in the near-earth plasma sheet where the particles were initially scattered, and is therefore an important near-instantaneous remote-sensing tool of the equatorial tail field. Fig. 1 (left) shows a typical IB energy versus L-shell signature during an ascending auroral oval crossing. The negative slope is representative of the usual situation when $B_z(x)$ monotonically decreases with distance from Earth, i.e., $dB_z(r)/dr < 0$. However, in the presence of a localized minimum in B_z at some distance r_m, representing the existence of a tailward B_z gradient ($dB_z(r)/dr > 0$ just tailward of rm, $r>r_m$), a reverse isotropy boundary can emerge (Fig 1, right), whose observations have been historically elusive. ELFIN crossings of several such events are presented and discussed.

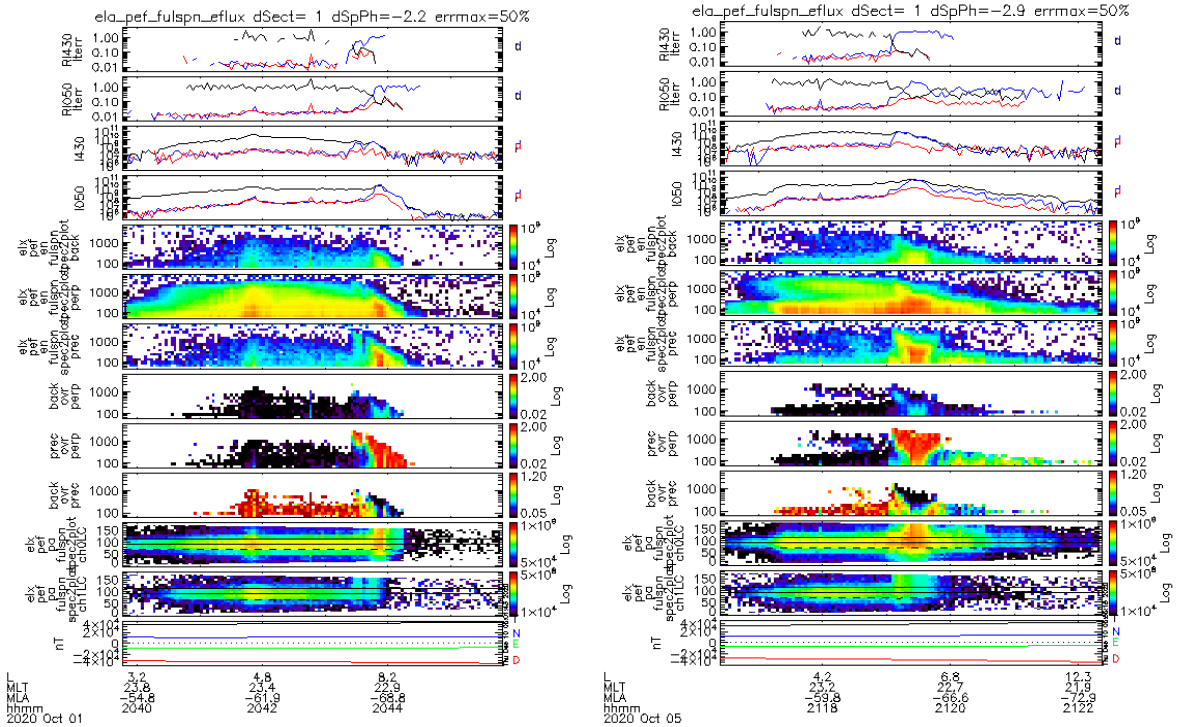

Figure 1. *Left*: ELFIN electron observations of the isotropy boundary (panel 9; ratio of precipitating to trapped fluxes) as it traversed the outer radiation belt into plasma sheet field lines, observing a rapid transition to isotropic fluxes around 2043.5UT (L~7.5). *Right*: Similar ELFIN electron observations following a minor storm (Dst~-30 nT) of an isotropy boundary near L~5.5, followed by a so-called reverse isotropy boundary at L~6.3. Such events are historically difficult to observe and may indicate the presence of temporary localized B_z extrema in the magnetotail.