3.2.4 How do large and small-scale structures modulate particle fluxes?

The sharp decreases of high energy cosmic ray fluxes at the Earth, known as Forbush decreases (e.g. Ifedili, 2004), are caused by the passage of “magnetic barriers” in the solar wind. As well as magnetic clouds, these barriers are often the sheaths of compressed solar wind ahead of ICMEs, or compressed CIRs (Clack et al., 2000). Such compressions lead to “planar magnetic structures” (e.g. Jones et al., 2002: see Figure below) and it appears to be these sheets of magnetic field that efficiently block the particles (Intriligator et al., 2001). However, the efficiency of these barriers, as they develop close to the Sun, is not known.

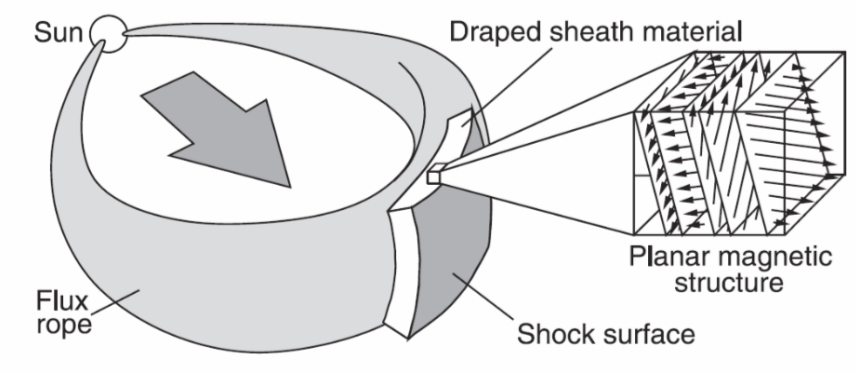

Figure 2-8: Illustration of the generation of a planar magnetic structure ahead of an ICME. Such structures can block the propagation of energetic particles such as cosmic rays. Figure from Jones et al., 2002.

- Study of the planarity and large-scale structures of the magnetic field within and around CIRs and ICMEs and investigate their effect on the fluxes of solar energetic particles and cosmic rays as these structures evolve with heliocentric distance.

At a much smaller scale, “particle channels” of dramatically enhanced or reduced particle flux during solar particle events, lasting only around an hour, as well as comparable duration burst of Jovian electrons observed several AU from the planet, demonstrate the existence of very small scale magnetic connections and disconnections from particle sources. Solar Orbiter will travel much closer to the solar sources of particles and, by nearly co-rotating with the Sun, distinguish temporal variability from spatial structures.

- Determine the small-scale diffusion of particles around and within particle channels, as well as the spatial and temporal scales of these structures and their connectivity to the Sun.