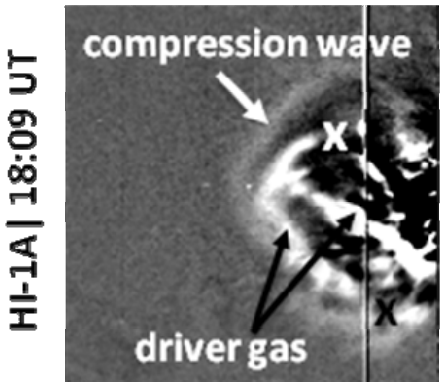
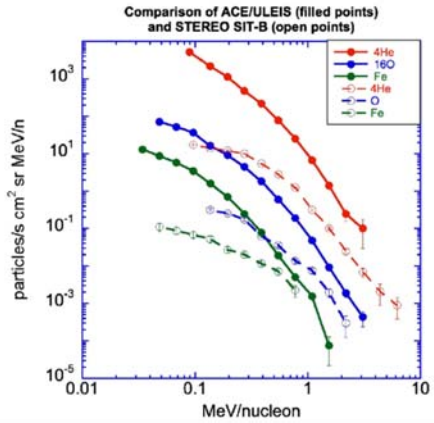
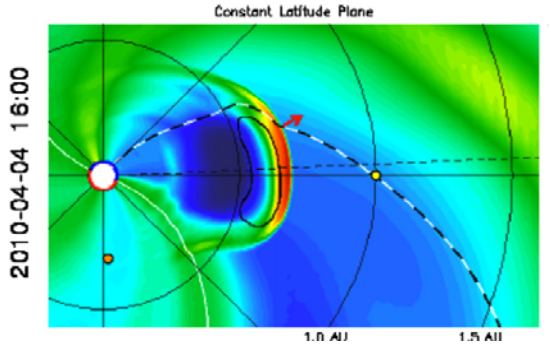
ACE News #140 – July 11, 2011
Modeling Solar Energetic Particles using ACE and STEREO Observations of the April 3, 2010 Event



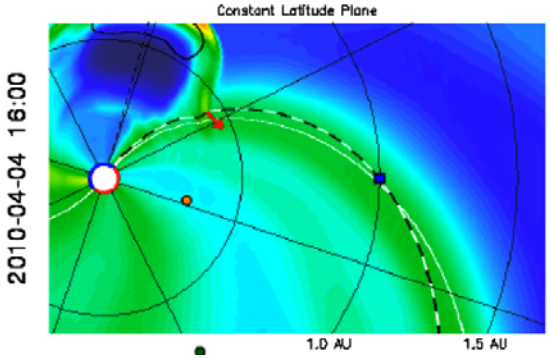
STEREO-A SECCHI HI-1A observation of CME liftoff near central meridian and propagating southward. Crosses mark limits of the out-flowing loops (driver gas) at 18:09 UT April 3.



ACE/ULEIS (filled points) and STEREO SIT-B (open circles) observed typical SEP spectra with intensities at ACE > 100 times that at STEREO-B at low energies, ~10 times higher above ~1 MeV/n.



ENLIL MHD calculation of the CME-driven shock at 16UT on April 4. Arrow shows connection of western edge of shock to field line going to ACE.



Same model calculation with arrow showing the connection of the eastern edge of the shock to the field line through STEREO-B

New insights into CME-associated Solar Energetic Particle (SEP) events are becoming available with combined observations from L1 and the two STEREO spacecraft, which allow more accurate reconstruction of the shock. The April 3, 2010 event produced a southward moving CME from near the central meridian (top left panel) whose shape and associated compression wave were constrained by STEREO-A, -B, and SOHO images. SEPs from the event were much more intense at ACE than at STEREO-B (top right panel). A detailed MHD model constrained by the observed CME images and observed solar wind speed was used to construct a picture of the outward moving shock (bottom panels). The calculated speeds and densities agree well with observations. The shock took 12 hours to connect to the field line leading to ACE, explaining a delay in the SEP onset. The much weaker particle event at STEREO-B is consistent with its field line intersecting only the eastern flank of the shock. The evolution of the shock compression ratio in the model peaked nearly at the same time as the multi-MeV SEPs indicating that in this event the compression ratio plays a more dominant role than the shock normal/magnetic field angle value. For a detailed discussion, see Rouillard et al., Ap.J. vol. 735, July 1, 2011, doi: 10.1088/0004-637X/735/1/7

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