Using shock-accelerated electrons to study CME-driven IP shock structure

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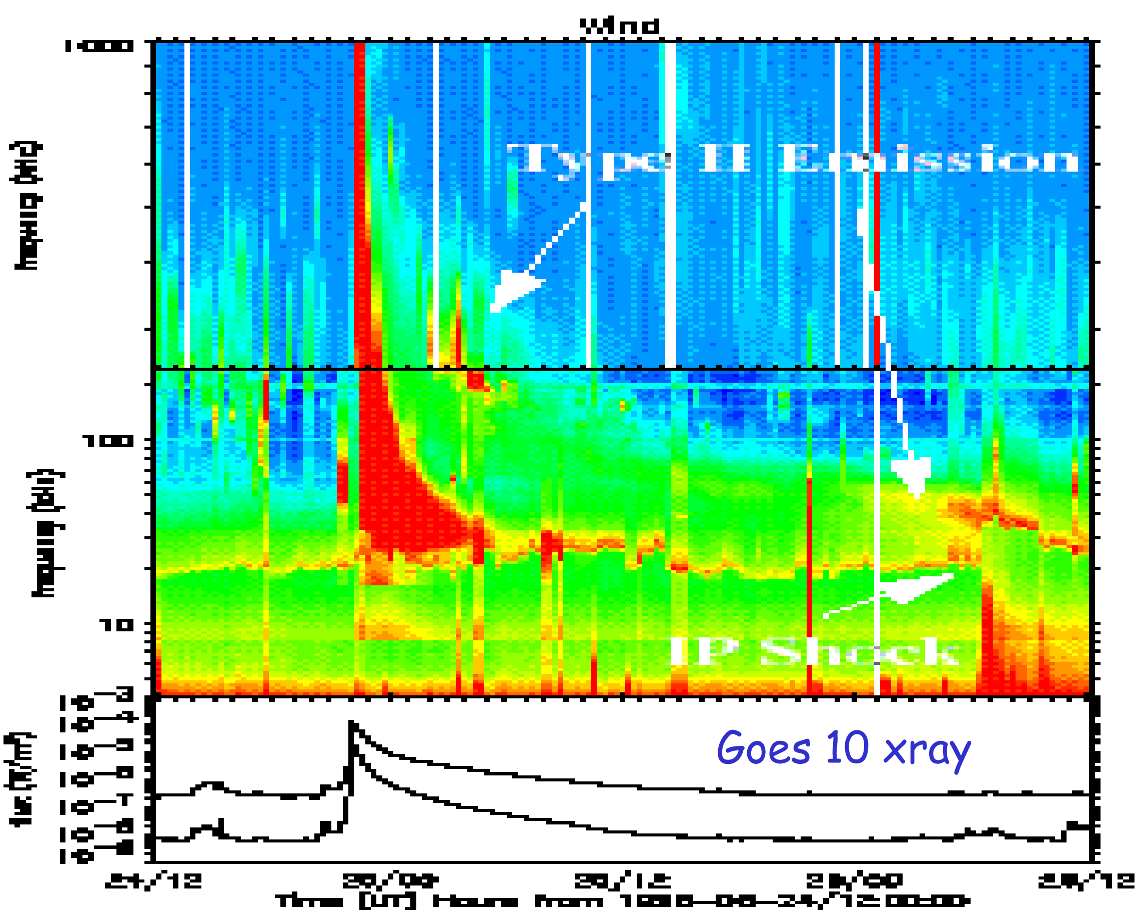
Strong CME-driven IP shocks often accelerate electrons into a foreshock region upstream of the shock. This foreshock is also the source of the type II radio emission associated to fast CMEs. Like the terrestrial foreshock, the electrons become time-of-flight dispersed along the bundle of magnetic field lines just tangent to the shock surface. The velocity dispersion observed on these field lines can be used to estimate the distance back to the shock front. Combined with the propagation of the shock in the solar wind,this technique can be used to remotely sample the shock front and,often, discern macroscopic structure. We present several examples of velocity dispersed electrons originating at CME-driven shock observed by the 3DP instrument on Wind and discuss the potential for this technique using STEREO/IMPACT observations.

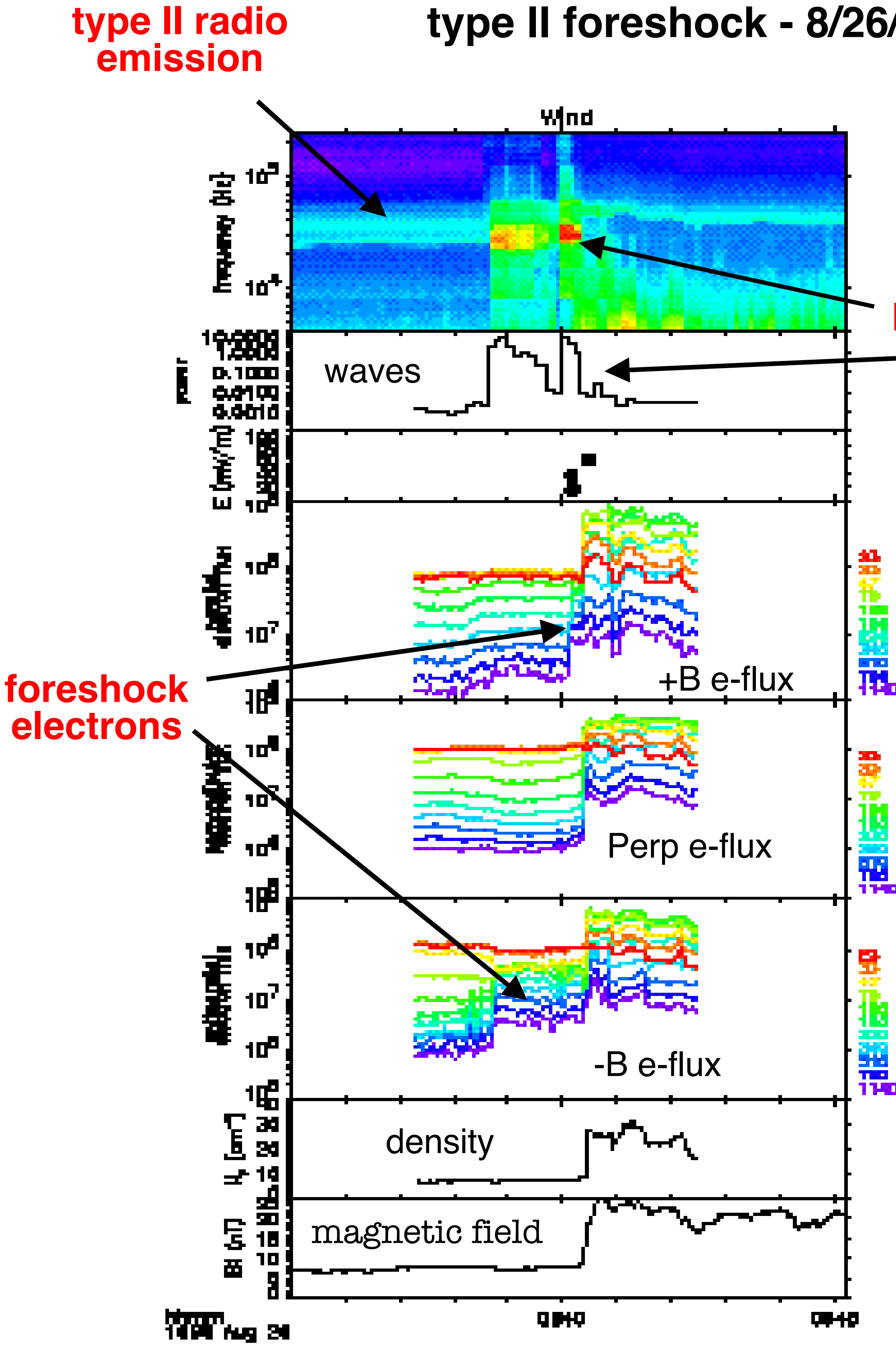
Reiner, Bougeret, Kaiser, Krucher, Larson

August 24-26, 1998
type II

- **X1.0 class and Ha flare 22:09 UT 1998/8/24**
- **Immediate type III and type II**
- **Shock arrives at 1AU at 06:40 UT 8/26/98**
  - **Travel time 32 hours -> 1300 km/s, consistent with speed from type II drift rate**

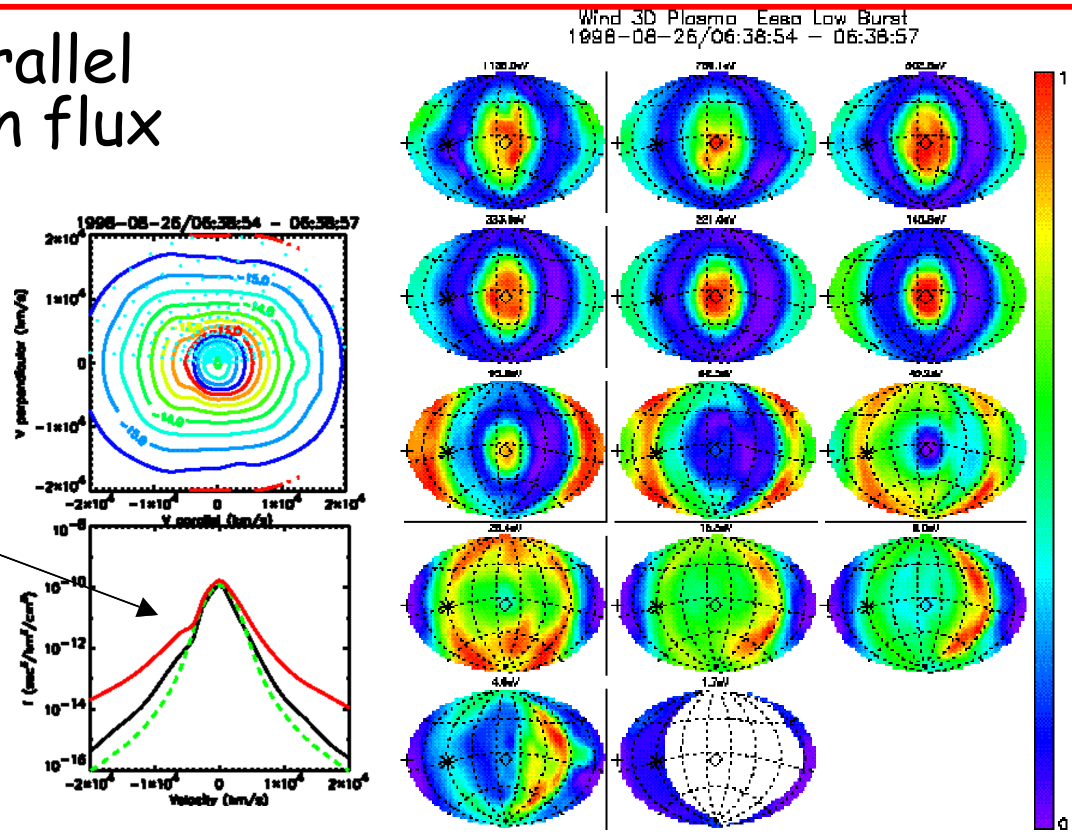


type II foreshock - 8/26/98



wave generation region

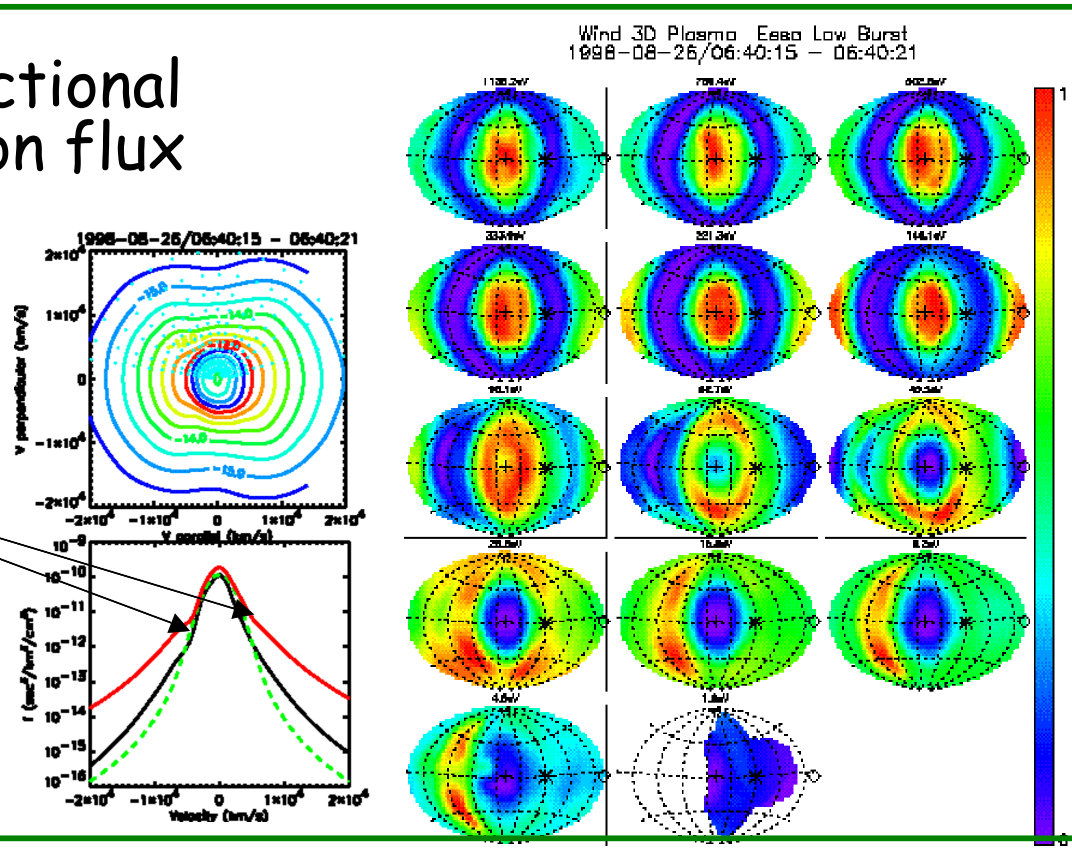
antiparallel electron flux



beam

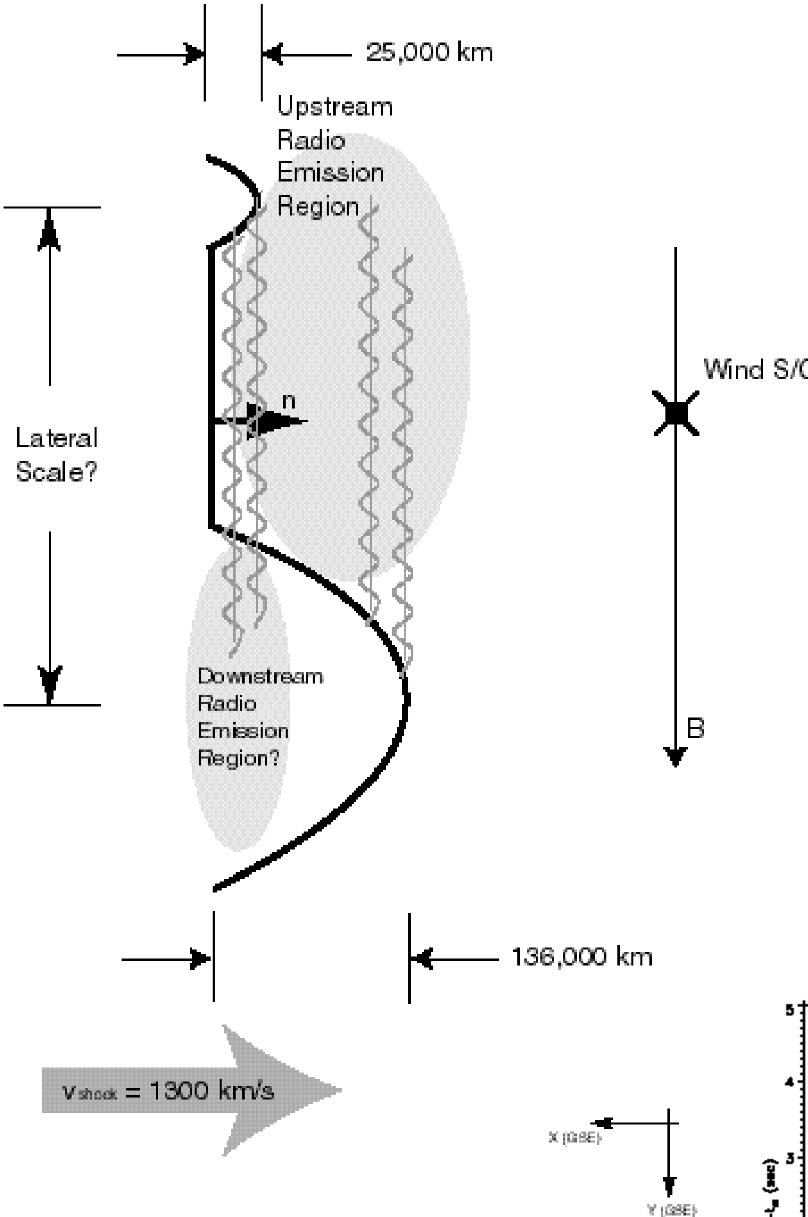
SWE observes positive slopes

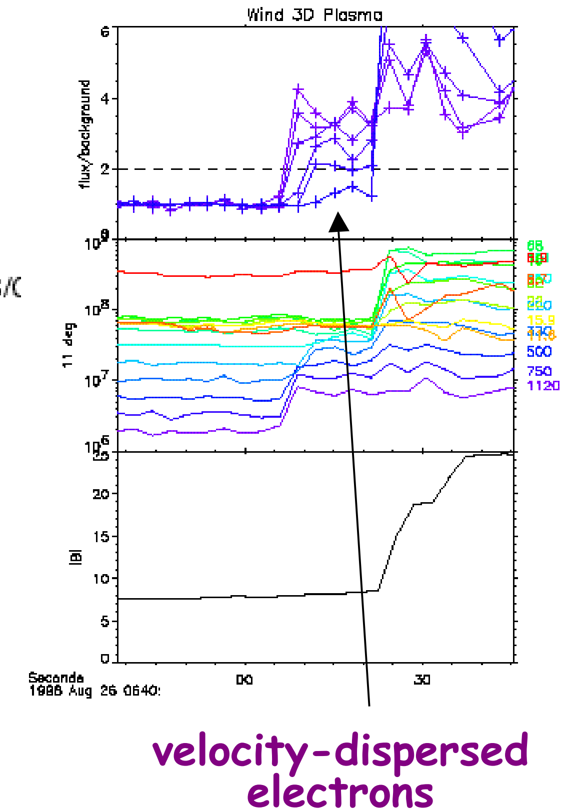
bi-directional electron flux

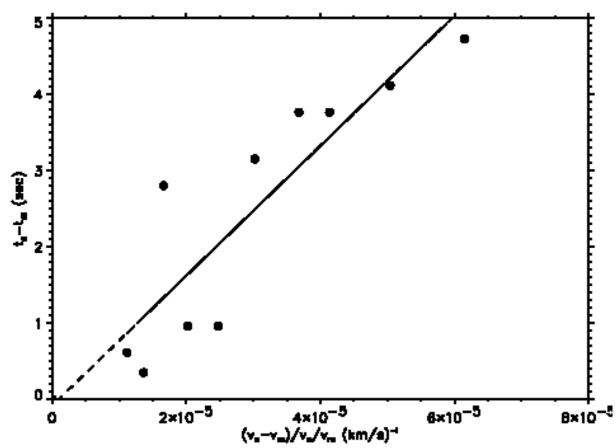


beams

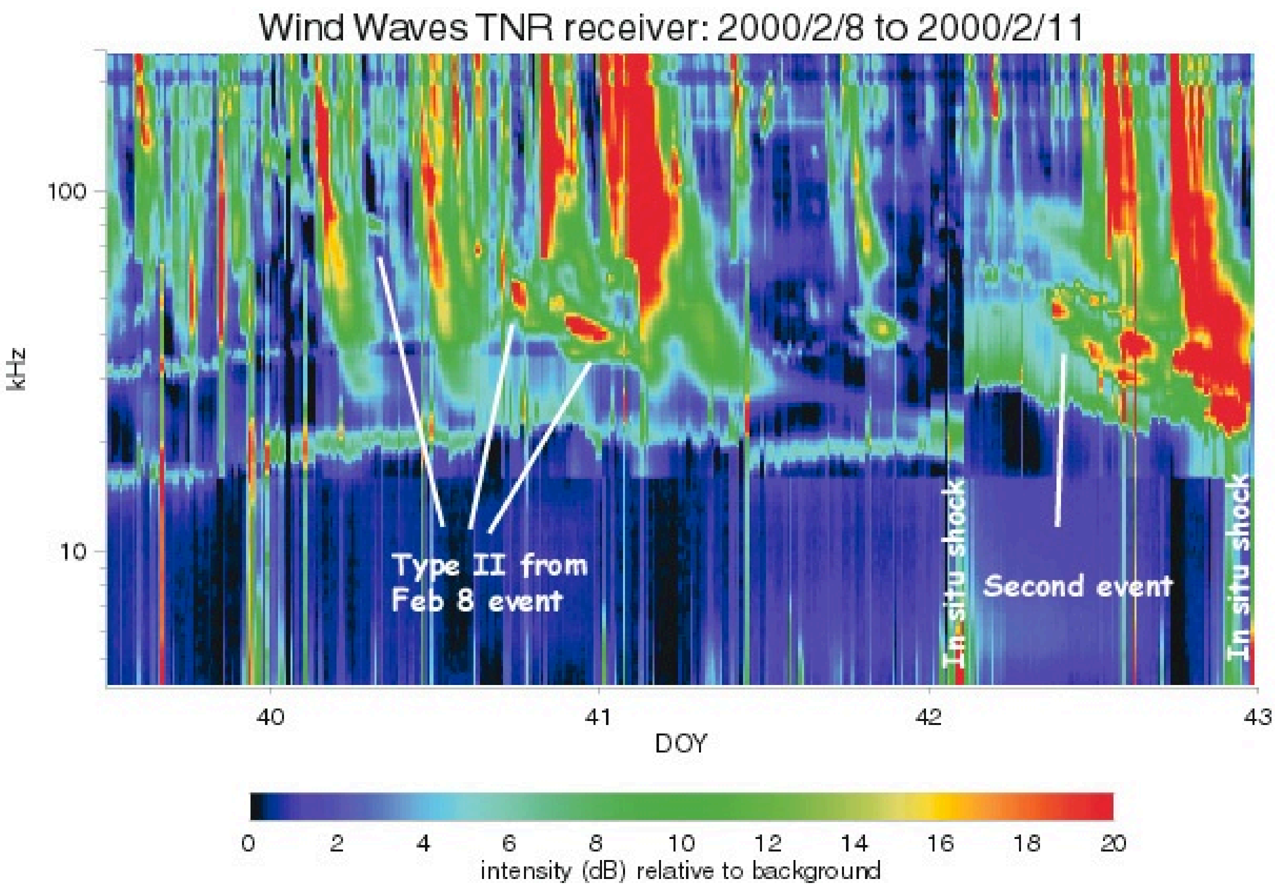
shock geometry



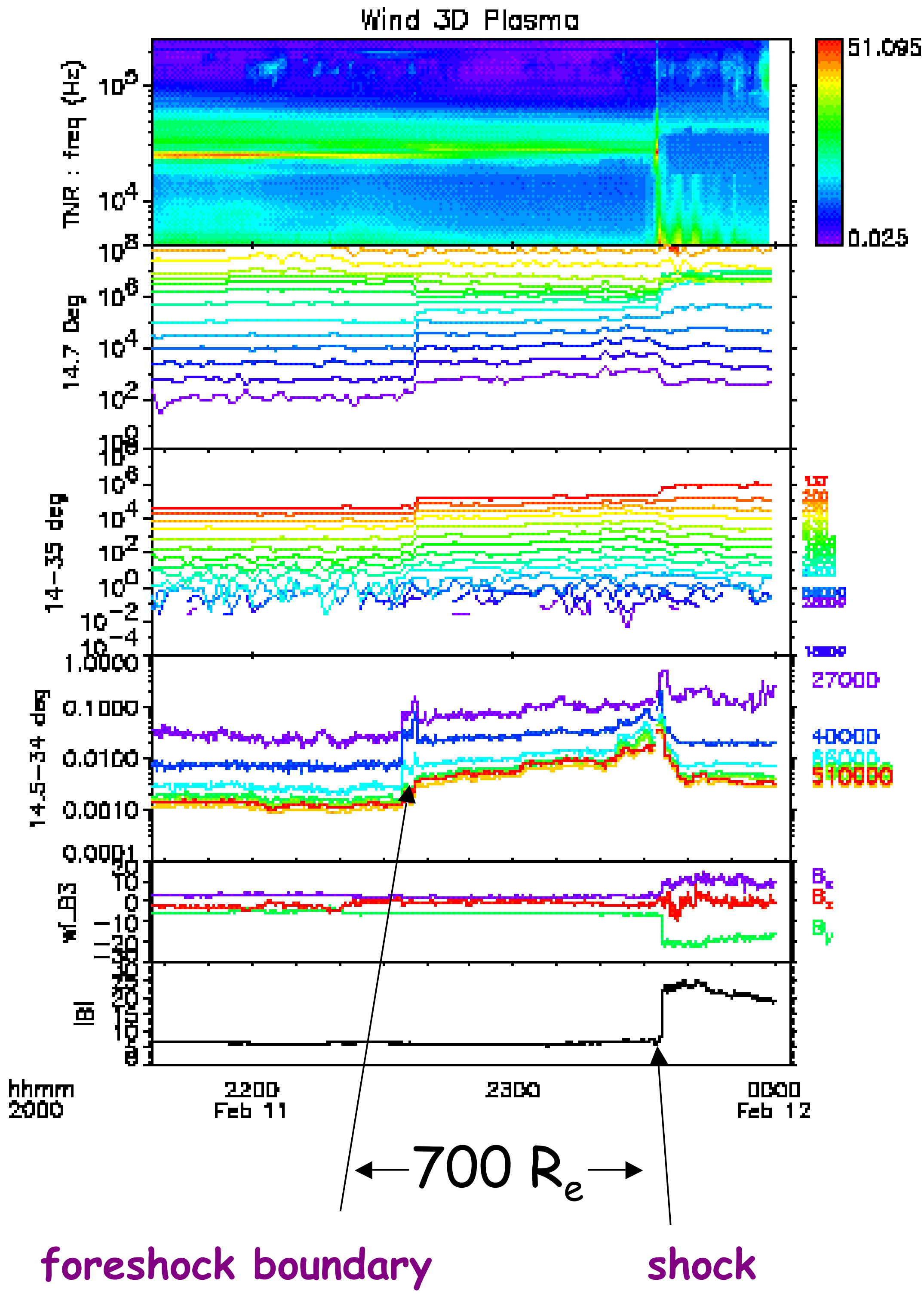




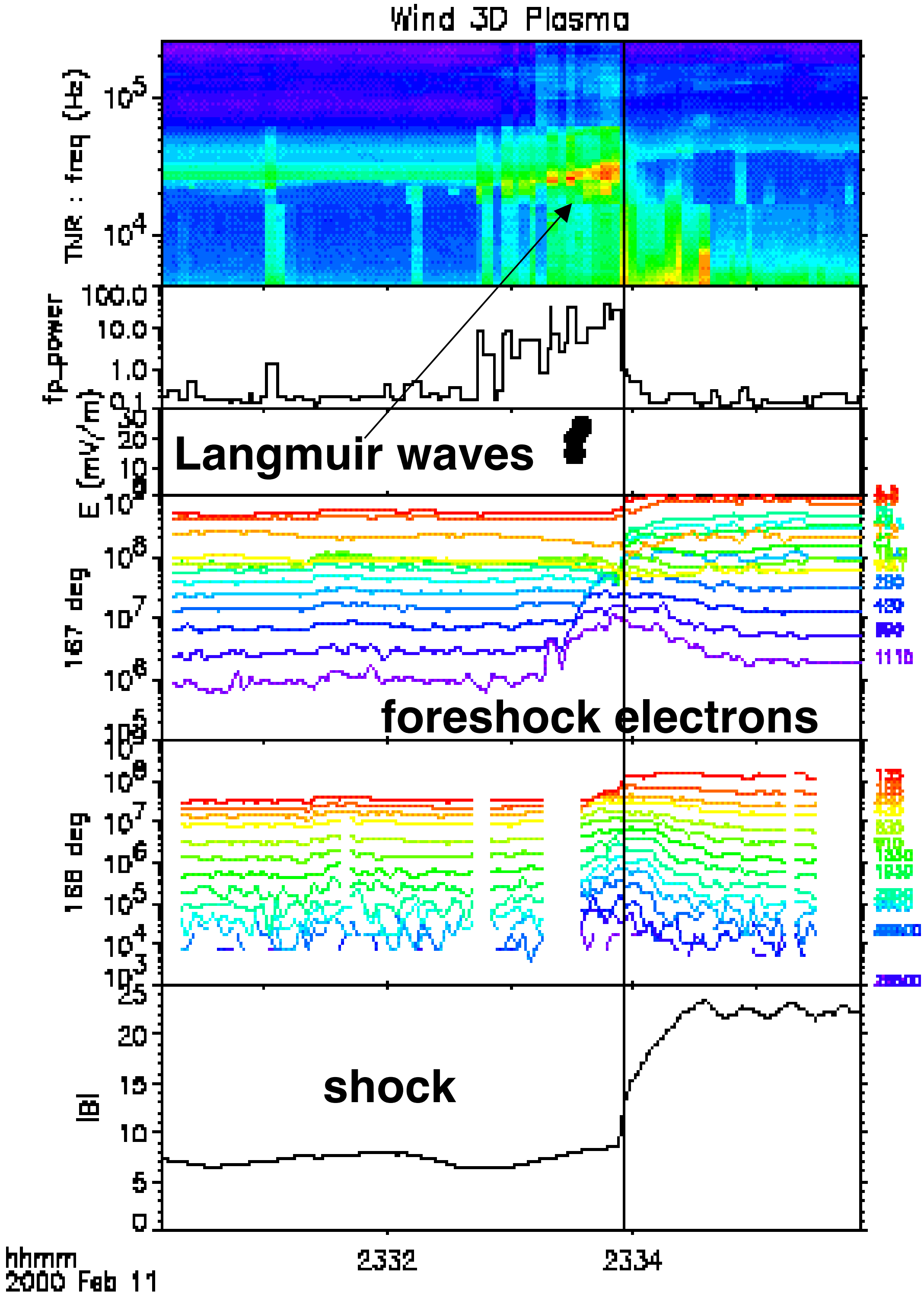
february 11, 2000
type II



extended foreshock

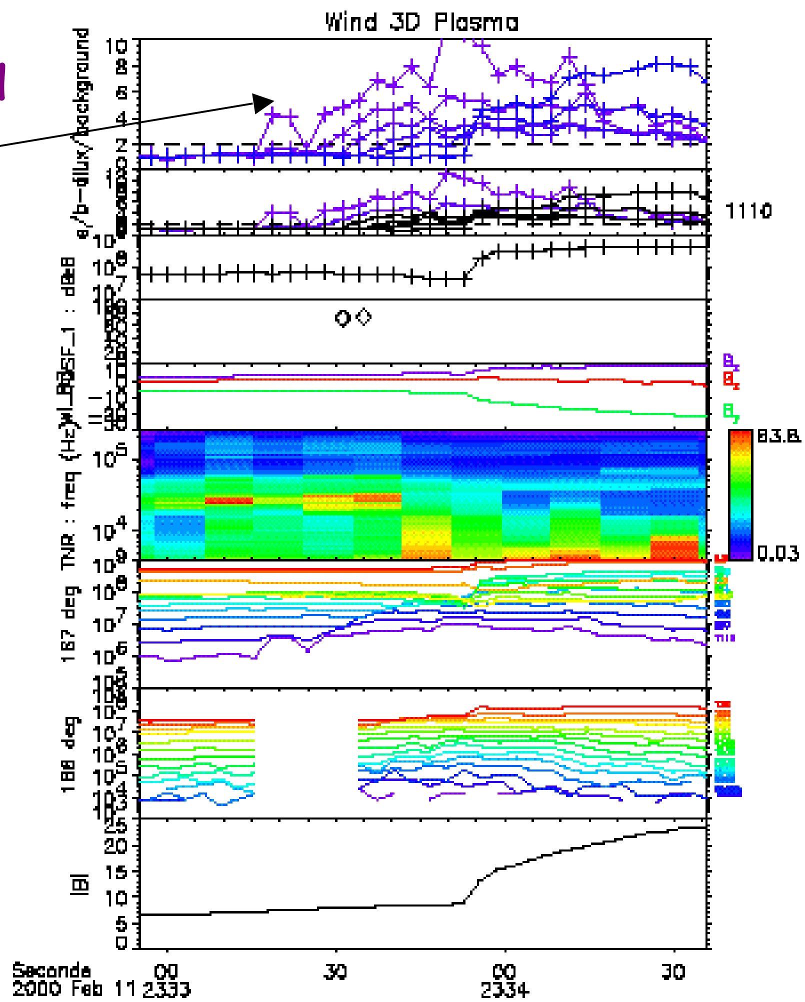


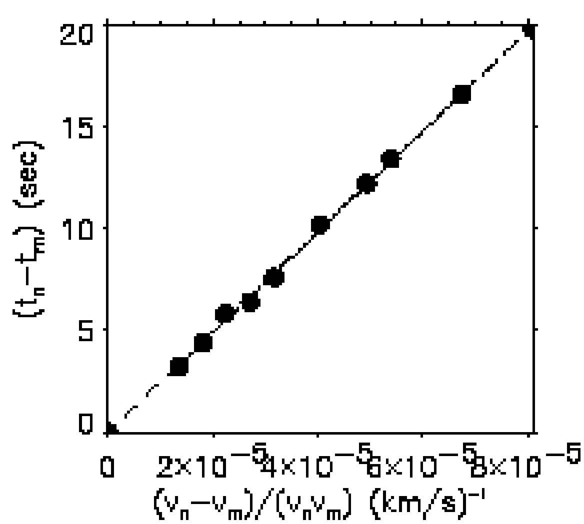
source region



shock geometry

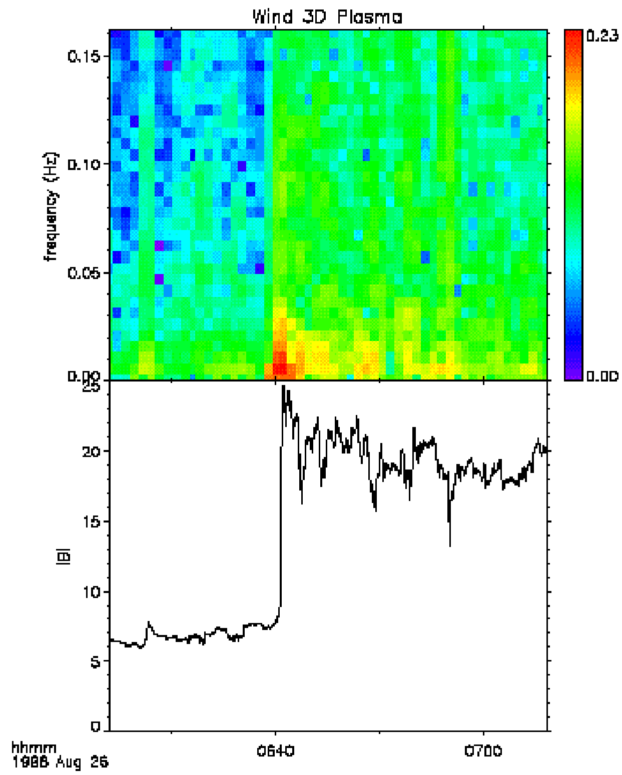
velocity-dispersed electrons





Downstream emission?

- Electron beams from one contact point may penetrate the shock elsewhere
  - deHoffman-Teller potential ~100 V
- One problem: magnetosheaths are very noisy - emission may be trapped



for STEREO - IMPACT; WAVES

→ "burst data"

Conclusions

- Shock structure is important for radio emission
- Plasma emission is very similar to terrestrial foreshock
- Downstream emission is possible, but not evident