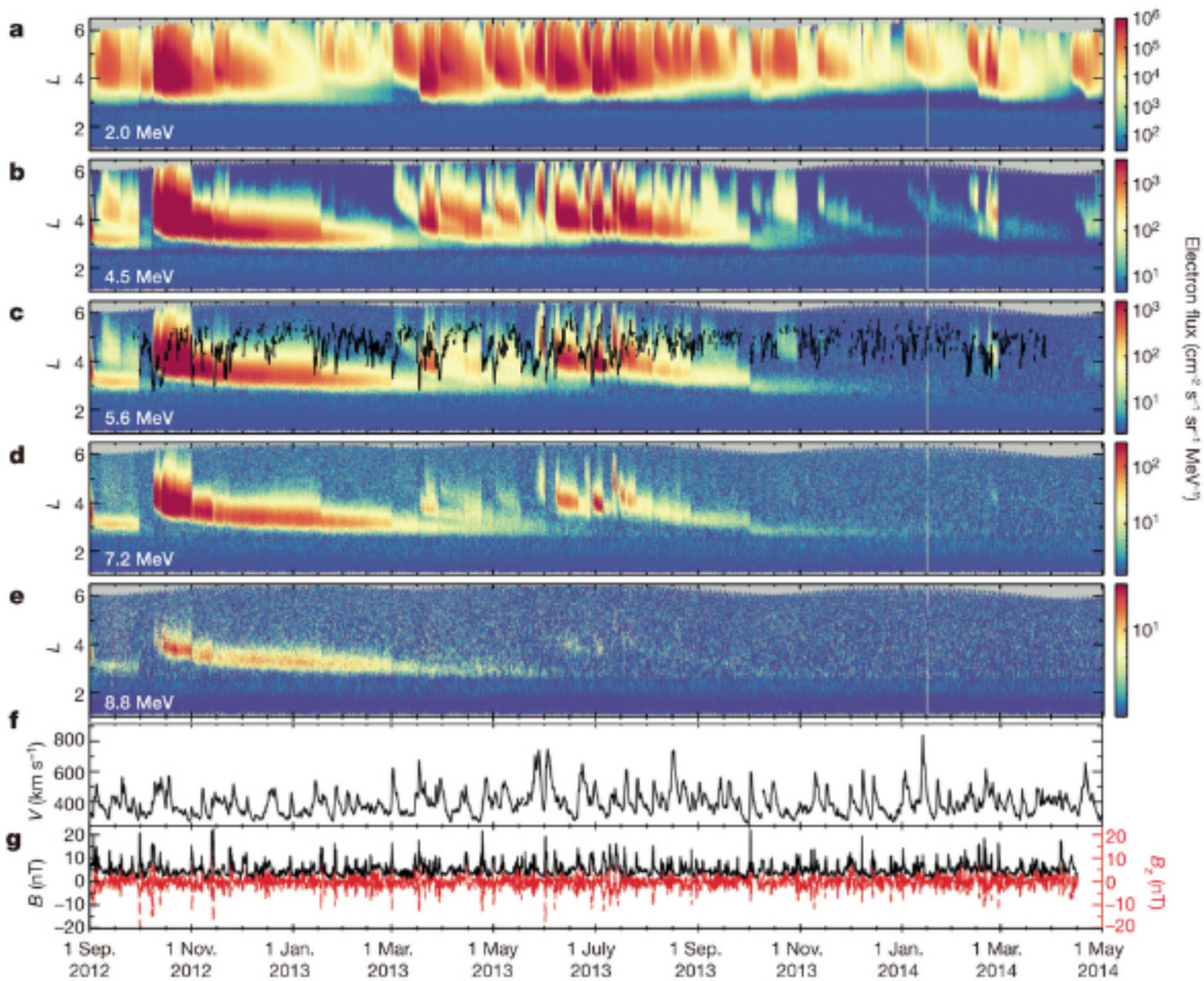
Electron radiation belt



"Electron radiation belts can change dramatically in a few seconds or slowly over years. Important issues in understanding such changes are:

1. What is the source of electrons in the radiation belts?
2. How important is radial diffusion compared to other radial transport mechanisms?
3. What are the detailed changes in the magnetosphere that produce radial diffusion?
4. Why is the response of the electron radiation belt to changes in the solar wind different from that of substorms and of the ring current?
5. Are processes other than radial transport, such as wave-particle interactions, important in energizing electrons in the radiation belts?"

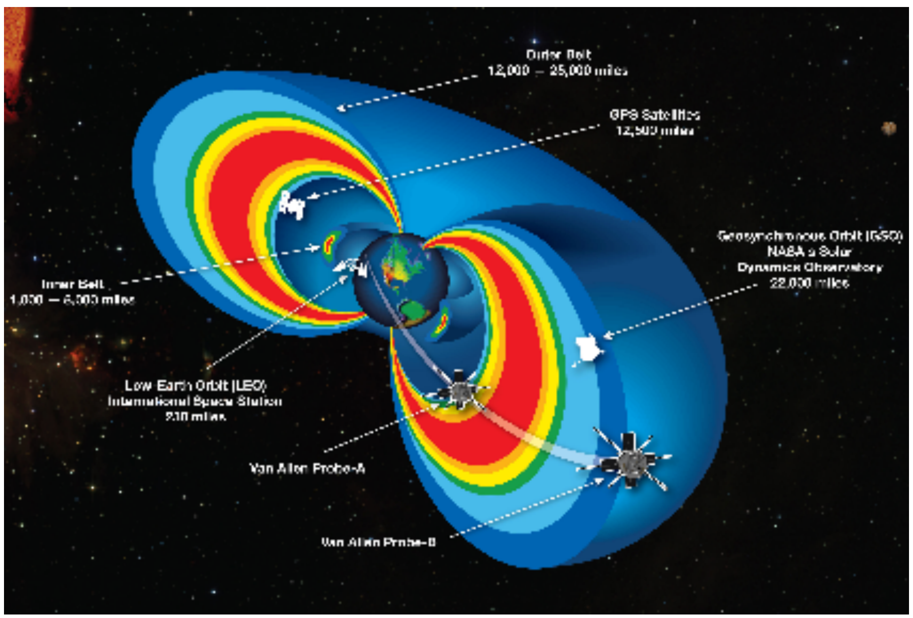
- Li and Temerin, The Electron Radiation Belt, SSR, 2001

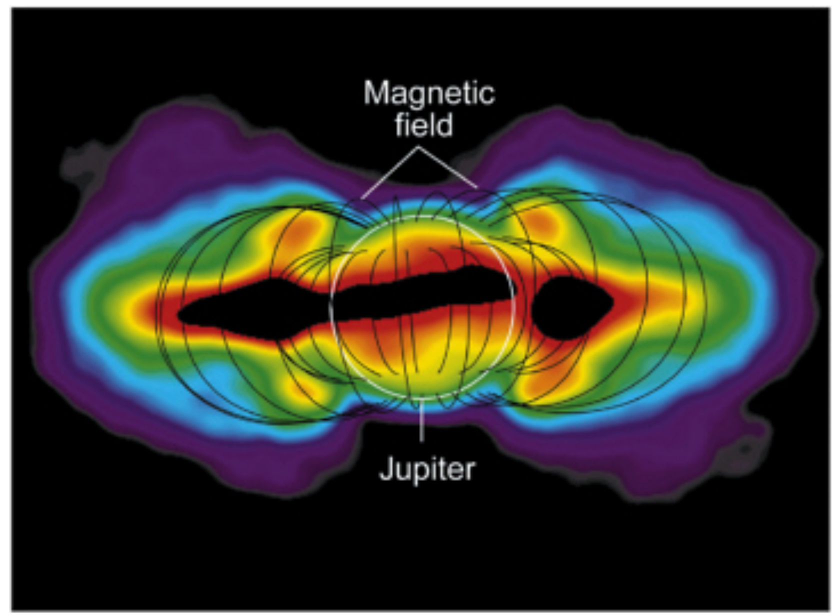
Baker et al., Nature, 2014

How to observe?

In Situ – Two spacecraft Van Allan Probe mission

Remote sensing! Electron radiation belt produces synchroton radiation, but for Earth the emission is blocked by the ionosphere and can only be seen in space





Jupiter at 127-172 MHz with VLA

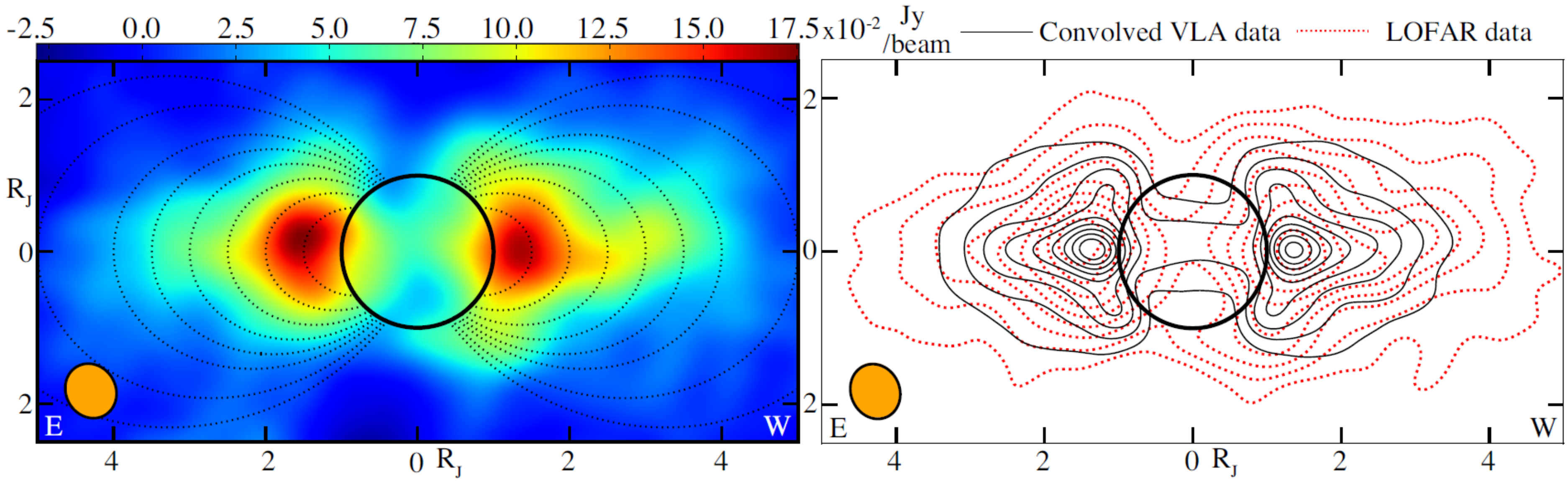


Fig. 6. Best LOFAR high resolution image to date of Jupiter's radiation belts, integrated over the entire 23 MHz band of observation distributed from 127 and 172 MHz, and a 7-h interval from ~19:00 to ~02:00 UT. The same image is displayed in both panels with color scale (*left*) and contours (*right*). The frequency-averaged clean beam size and shape (~18″ × 16″) are displayed in the bottom left of each panel. Pixel size is 1″ × 1″. Rms noise is 4.7 mJy/beam and the S/N (maximum peak flux divided by standard deviation) is 37. The S/N is approximately 14 at the 30% flux level (corresponding to the extremity of the emission). Dipolar field lines with apex at 1.5, 2, 2.5, 3, 3.5, 4 and 5 R_J are superimposed in the *left panel*. Contours superimposed in the *right panel* are derived from a rotation-averaged VLA image (obtained from Santos-Costa et al. 2009, in *C* band), which was convolved down to match the LOFAR observation angular resolution. Each set of contours represents relative intensity levels by steps of 10% of the maximum radiation peak: in the convolved VLA image (black line) and in the LOFAR image (red dotted line).

Our work

- A lunar array seems perfect for this
  - A near side array would always face Earth
- Figure out time and spatial resolution for imaging Earth’s radiation belt needed to understand global dynamics of belts
- Develop model of emission power as a function of frequency and location by combining magnetic field model with typical electron fluxes and energies from Van Allan Probes
- Generate requirements for array sensitivity and size and see how compares with needs for other science goals