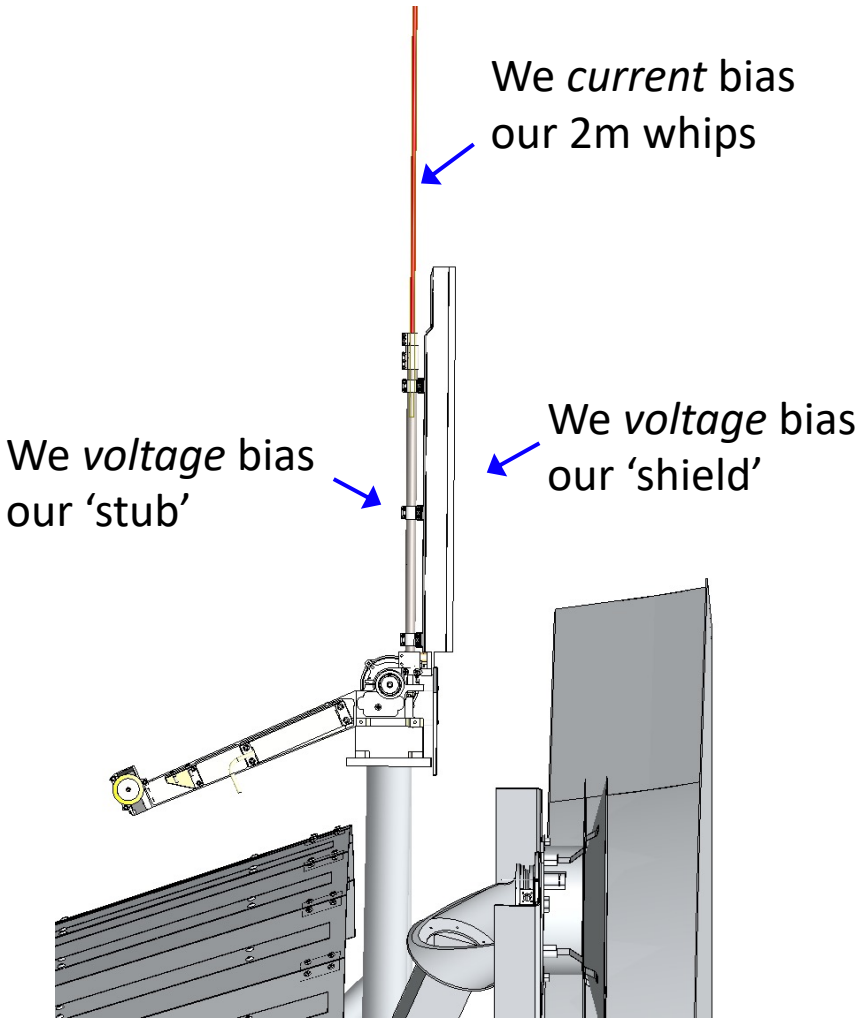
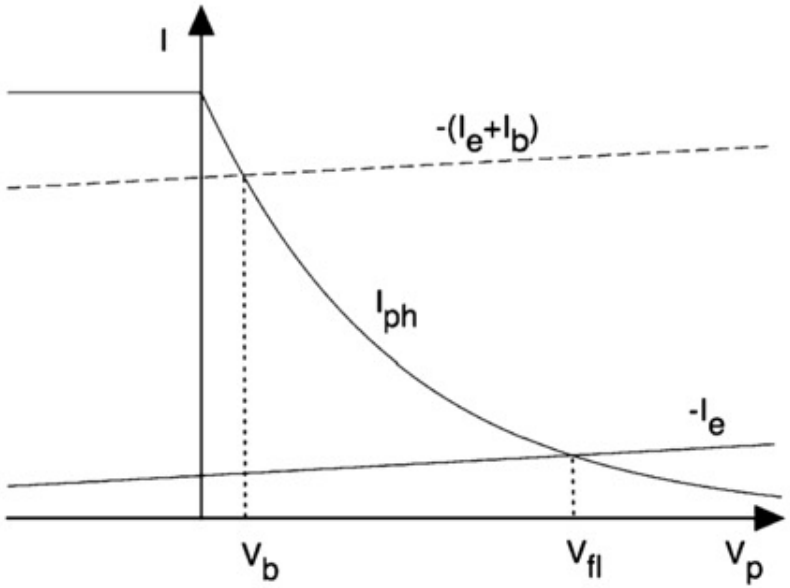
FIELDS Biasing Anomaly

Stuart D. Bale

Why does FIELDS apply bias currents and voltages?

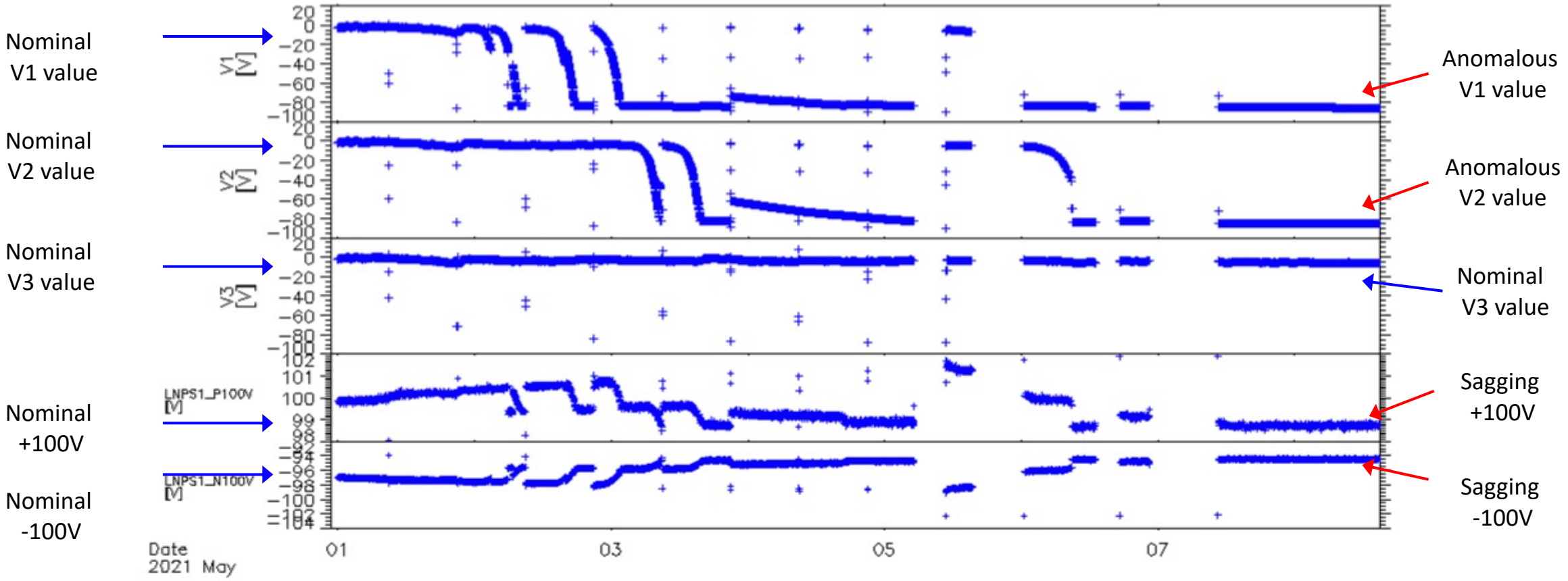


- The floating potential of a surface in space is determined by current balance between (1) thermal solar wind electrons I_e, (2) photoelectrons I_{ph}, (3) secondary electrons I_s, and (4) ions I_i
- Dominated (in sunlight) by thermal I_e and photoelectrons I_{ph}
- To make a true DC electric field measurement, we need our antenna potential to be stable and close to the local plasma potential
- To achieve this, we apply a current bias I_b to the whip
- We voltage bias the antenna base surfaces to isolate from spacecraft
- Current bias is adjusted over the PSP orbit to compensate for plasma conditions and photoelectron flux



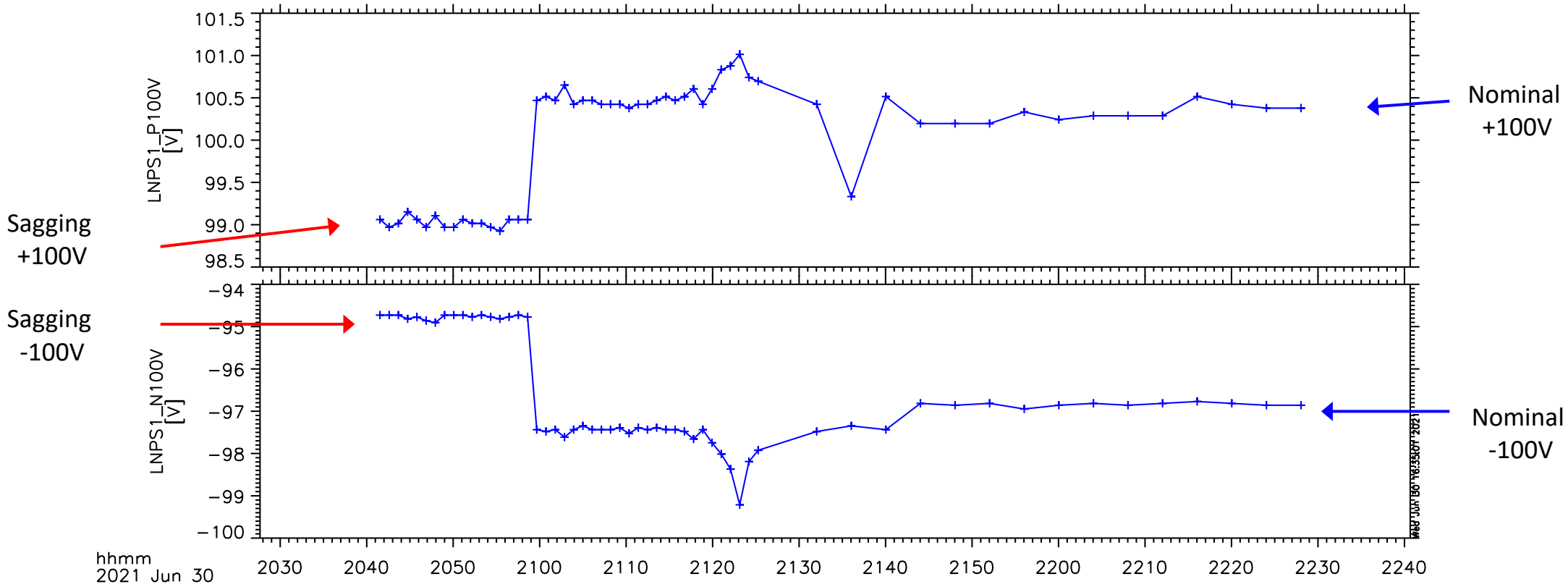
Biasing anomaly

- On the outbound leg of Encounter 08, the measured floating voltage of the FIELDS V1 and V2 antennas became anomalously *large and negative* (~ -100 V)
- The increased load caused the FIELDS1 +/- 100V power supplies to ‘sag’
- No anomaly on V3 nor V4



Biasing commanded back to nominal on June 30, 2021

- Commanded whip voltages to ~0V
- Observed low whip voltages in real time data
- HK data shows FIELDS1 +/-100V power supplies have returned to nominal values



Possible root causes

- Collision of ATS and RTS commands at FIELDS turn-on (following Ka turn-off)
- Overly aggressive biasing strategy
- Changing photoemission properties of whips
- A high impedance *short* in the antenna system

What's next?

- New RTS is now in EEPROM (as of June 30, 2021)
- Run 'bias sweeps' to assess the photoemission properties of the whips – any degradation?
- Move guard and stub voltage bias to look for coupling to the whip – a short?
- Less aggressive, more 'tapered' biasing scheme for Encounter 09