Observations of low energy ions around the diamagnetic cavity of comet 67P

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1

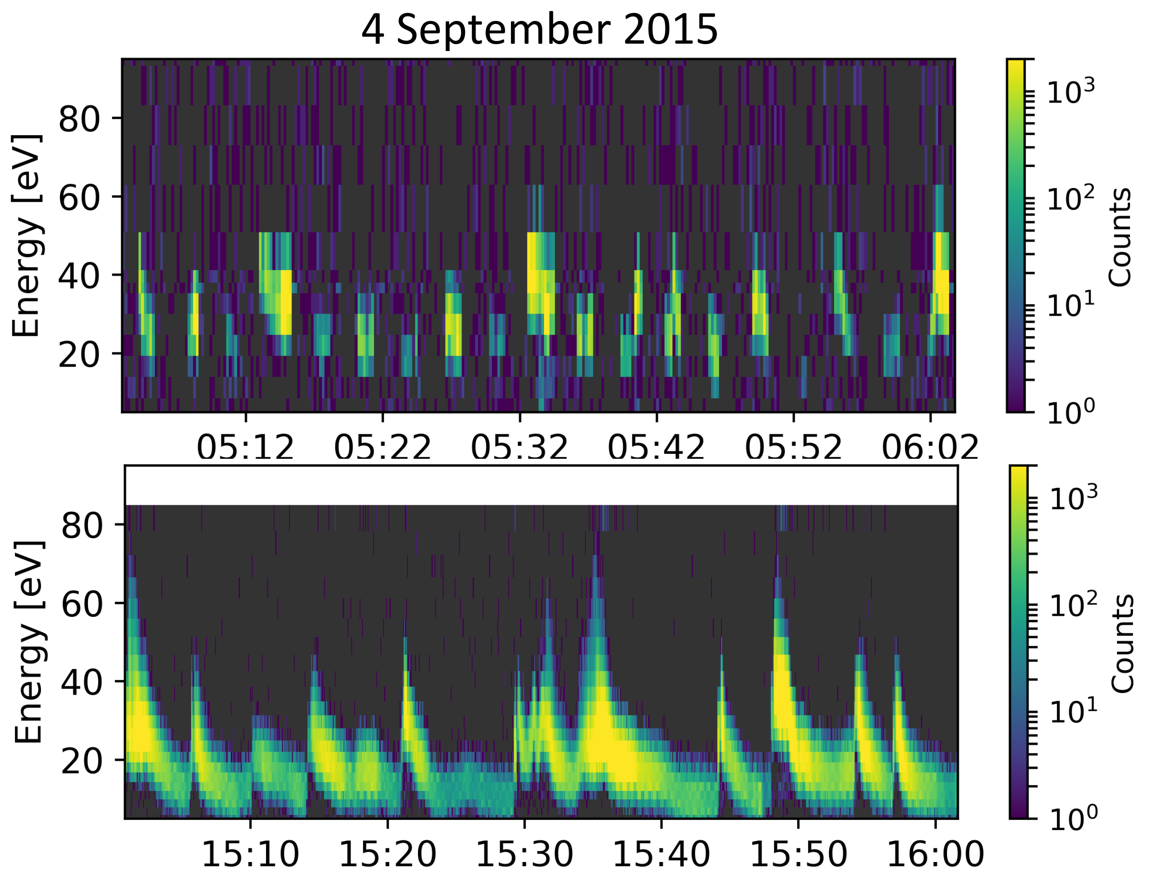
OBSERVING LOW ENERGY IONS WITH RPC-ICA

At comet 67P there **is lots of dynamics seen in the low energy ions**. For the ion mass spectrometer **RPC-ICA** (Ion Composition Analyzer) we implemented a new observational mode to observe this.

The top panel below shows measurements made with the normal mode and the bottom panel measurements with the **high time resolution mode**.

Normal mode
192 s time resolution
90x360° field of view
5 eV-40 keV

High time resolution mode
4 s time resolution
4x360° field of view
5-95 eV

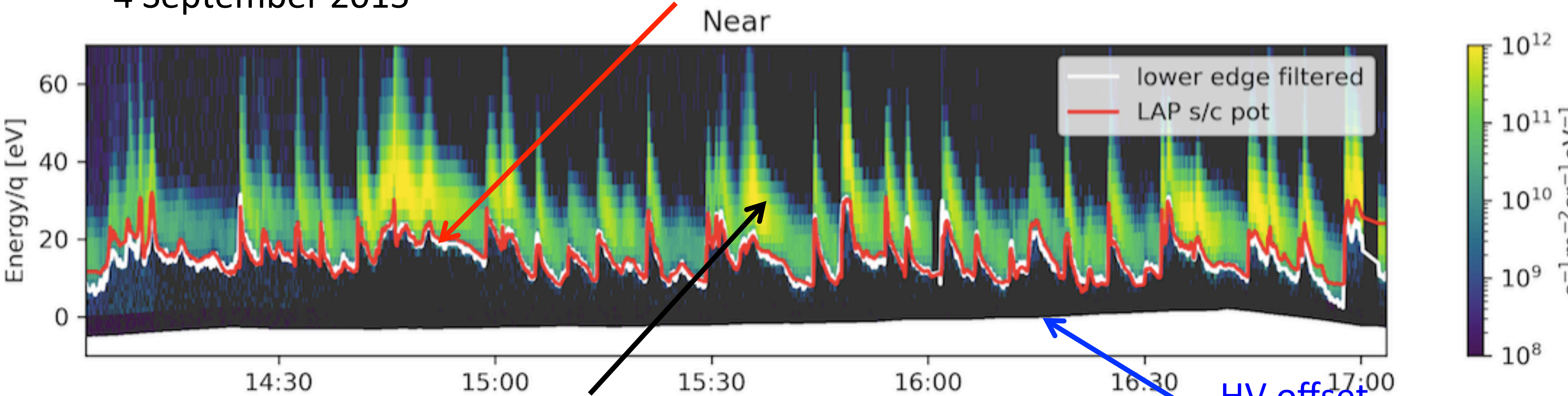


2

SPACECRAFT POTENTIAL AND HIGH VOLTAGE OFFSET

Negative of the spacecraft potential observed with LAP assuming LAP picks up 80% of the true potential

4 September 2015



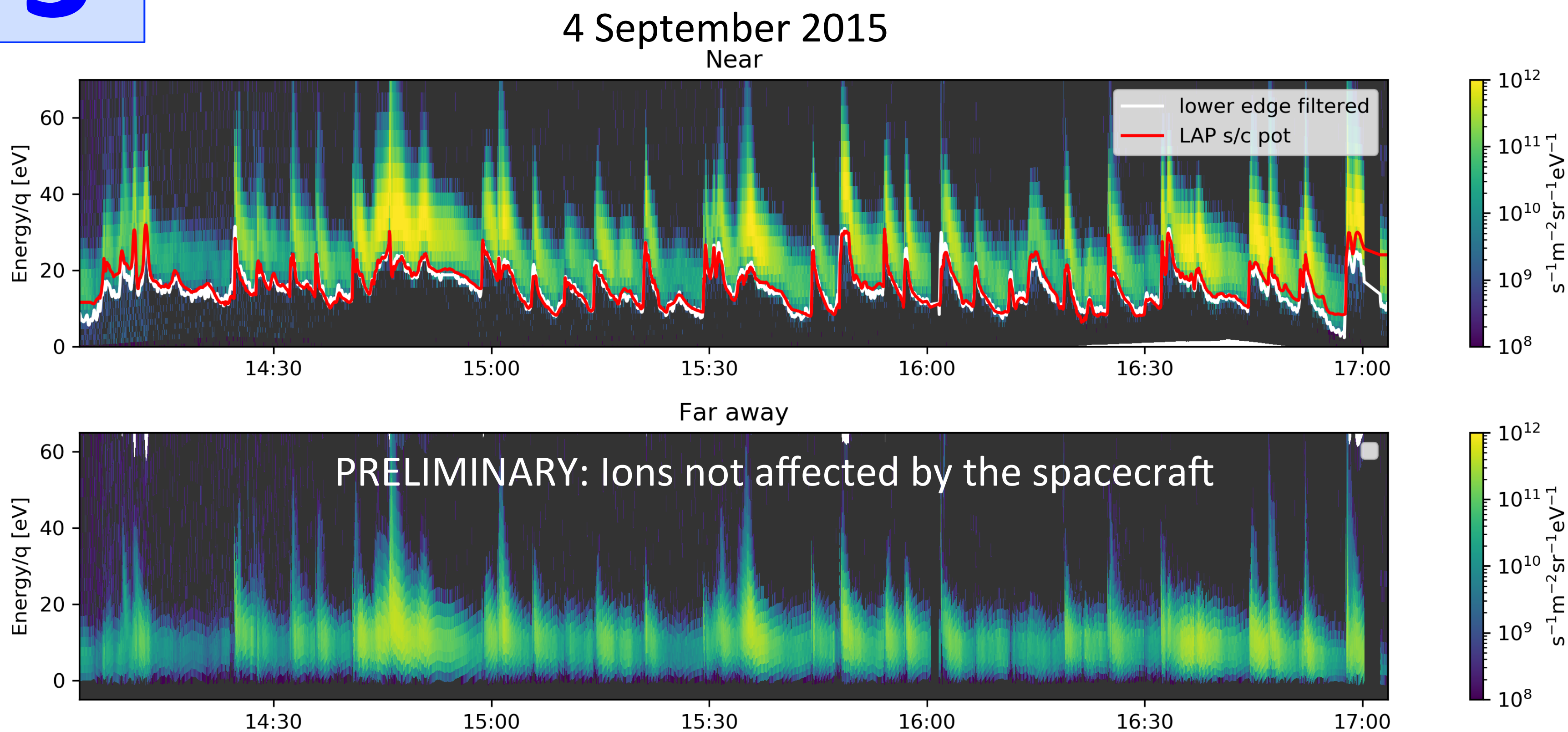
ICA data shifted to match LAP spacecraft potential

HV offset drift

The spacecraft potential is often negative **accelerating ions into the instrument**. The low energy cutoff in the observations therefore often corresponds to the negative of the spacecraft potential. The Langmuir probes (**RPC-LAP**) measures (a fraction of) the spacecraft potential and **we match LAP and ICA observations to find the true potential**. The high voltages used in ICA drift with time and depends on temperature. This **high voltage offset can also be estimated** by comparing ICA and LAP observations.

3

IONS ‘FAR AWAY’ FROM THE SPACECRAFT



We are interested in the **plasma properties ‘far away’ where the ions are not affected by the presence of the spacecraft**. Therefore we remove the acceleration caused by the spacecraft potential. The geometric factor used to convert from observed counts to physical differential flux is also adjusted.

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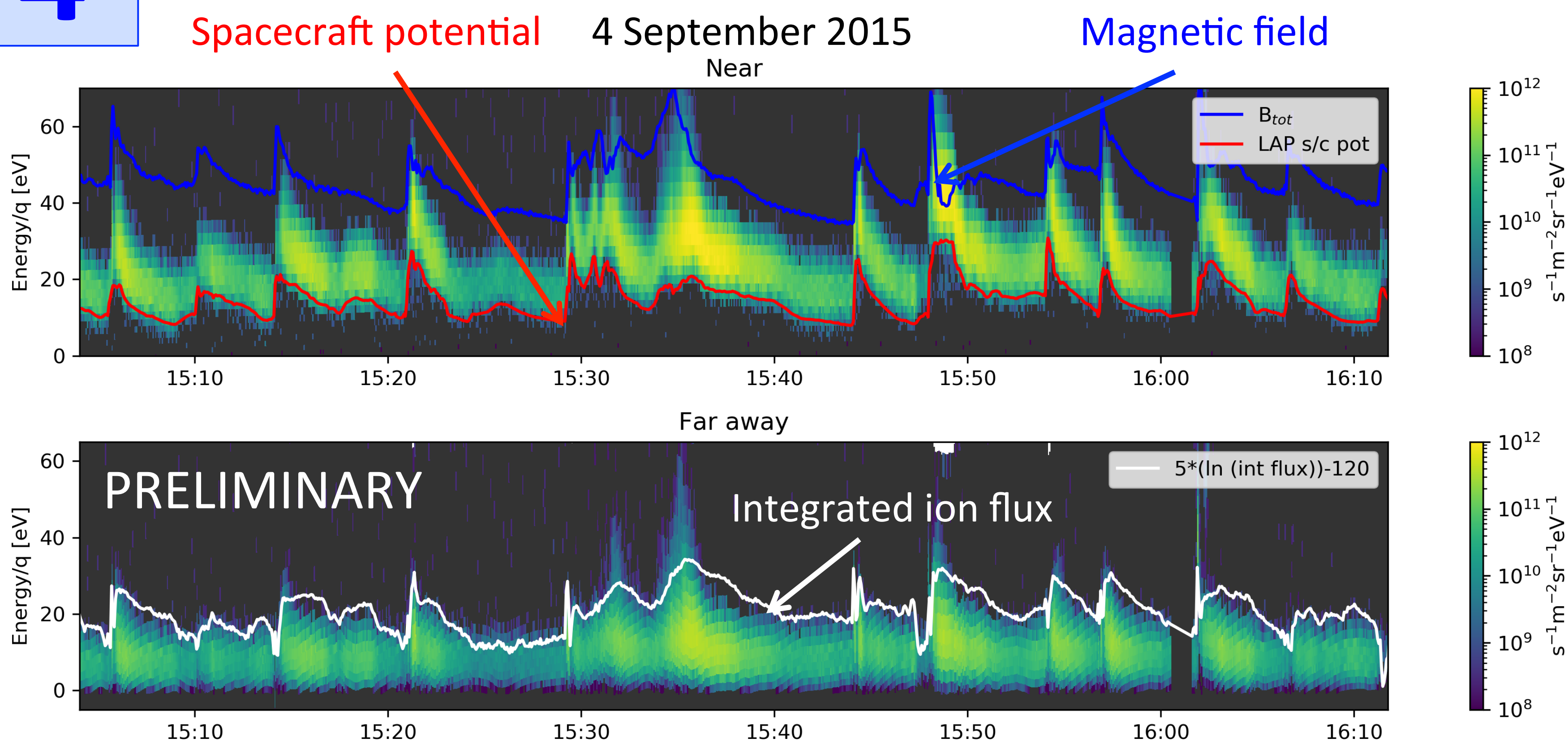
IONS JUST OUTSIDE OF THE DIAMAGNETIC CAVITY



Typical observations of ions just outside the diamagnetic cavity. The top panel shows the original measurements together with the **spacecraft potential** and the observed **magnetic field**. The bottom panel shows the corrected ion data. The white line indicates how **the energy-integrated ion flux** varies (scaled to fit in the panel).

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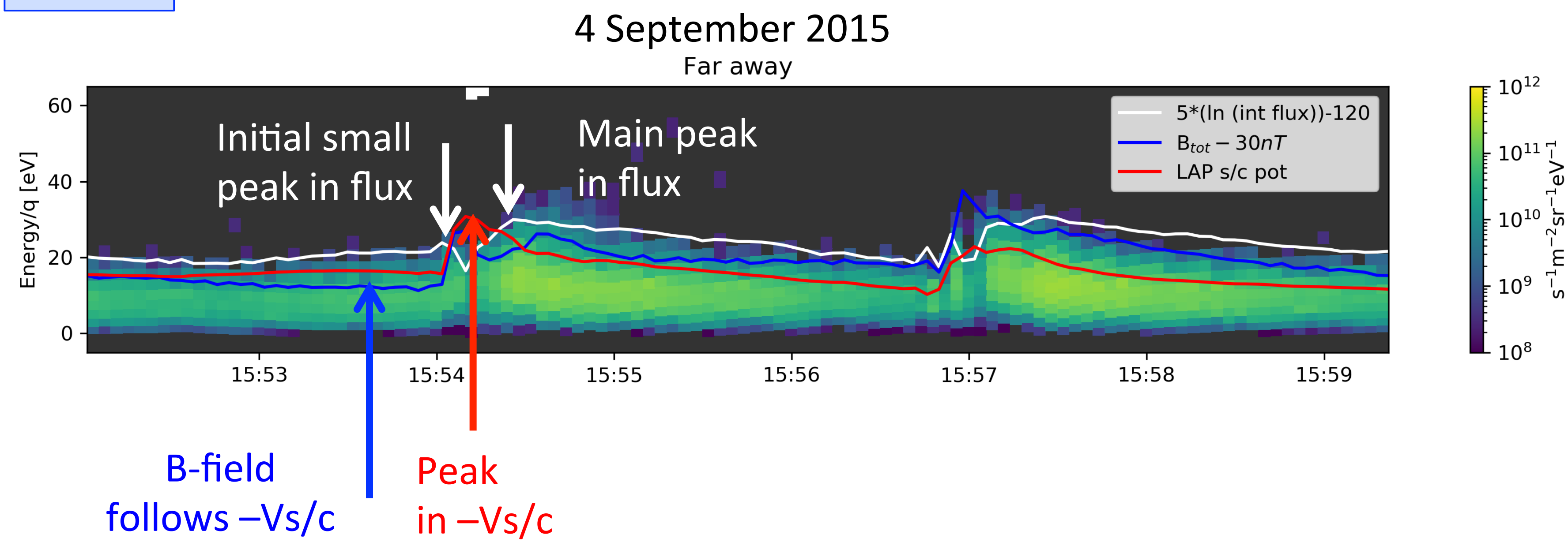
SPACECRAFT POTENTIAL, B-FIELD AND ION FLUX

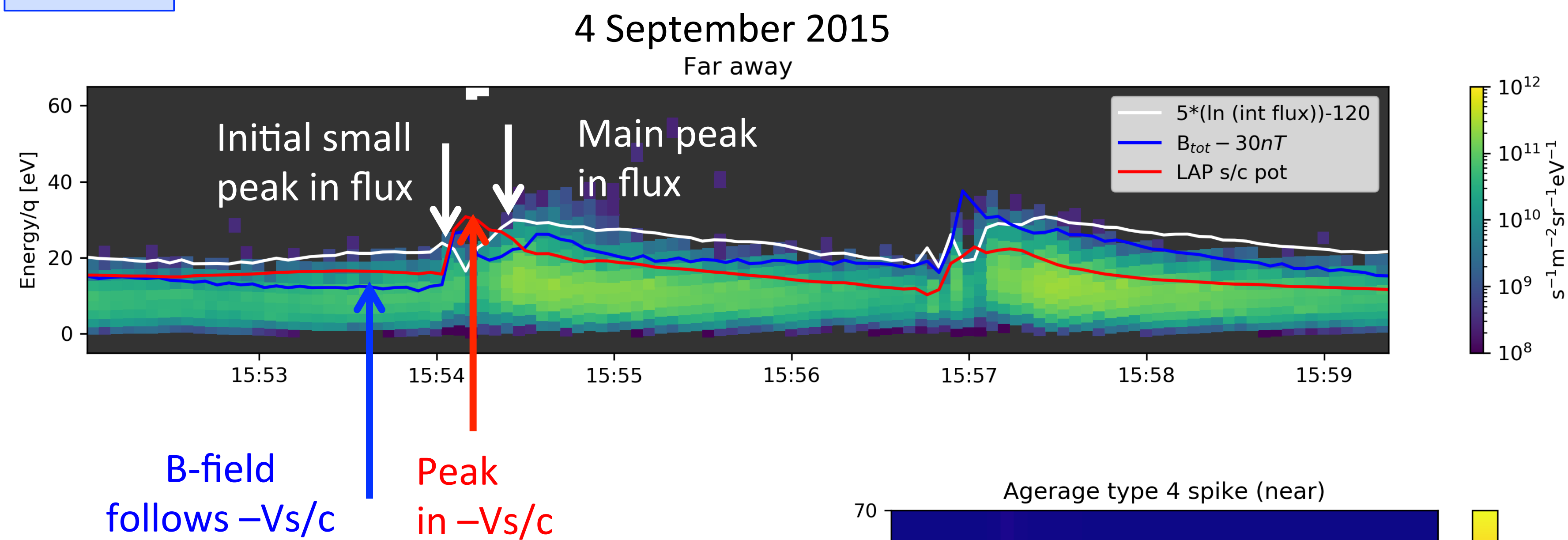


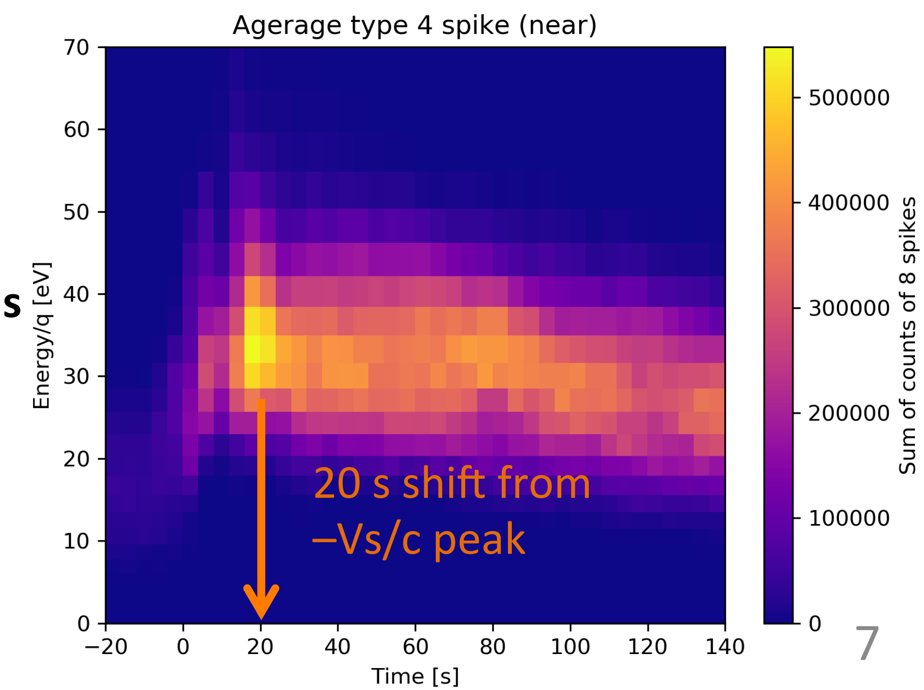
Zooming in on a few ion flux increases, we can look at **the timing of the potential, the magnetic field** and **the ion flux**.
We see that the magnetic field follows the spacecraft potential. **The main ion flux peaks** are, however, **lagging** the magnetic field and spacecraft potential peaks.

It is possible to see a **smaller peak** in the ion flux coinciding with the steepest gradient in the spacecraft potential (and the magnetic field).

6

SPACECRAFT POTENTIAL, B-FIELD AND ION FLUX

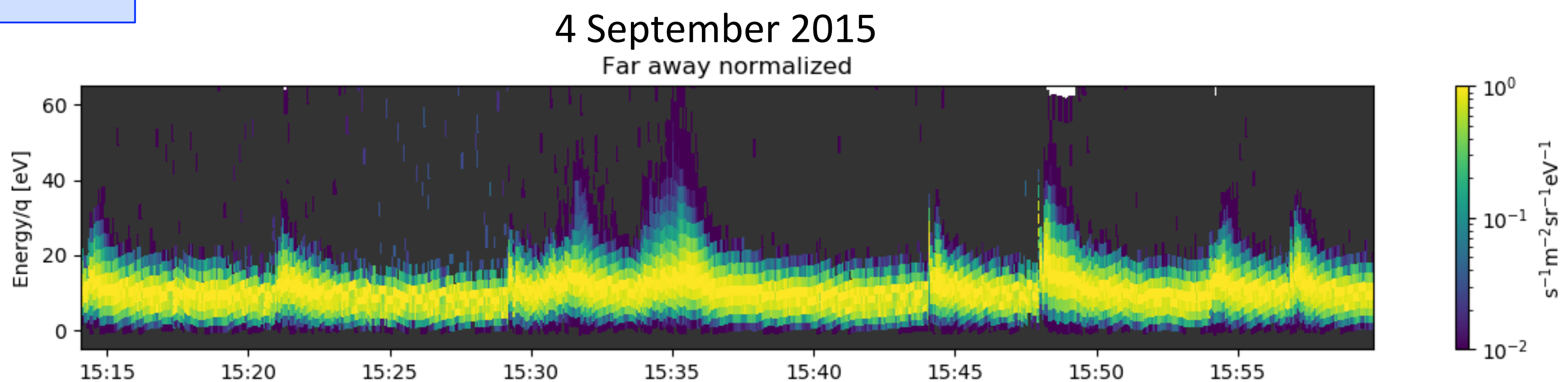




Averaging over several ion flux peaks we note that **the time shift is about 20 seconds** from the peak in the spacecraft potential.

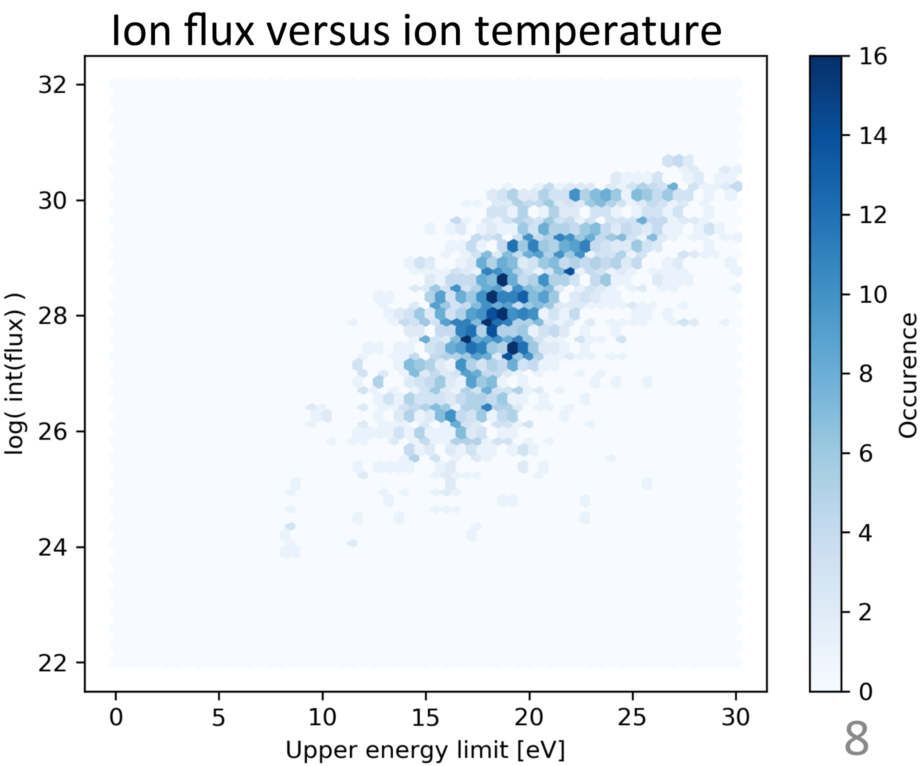
7

ION TEMPERATURE AND ION FLUX



The **upper energy limit** of the ion observations is an indication of the ion **temperature**. We normalize the flux to get rid of the widening of the spectrum due to an increase in flux. Some possible temperature increases still remain (panel above).

There is **weak correlation between ion temperature and ion flux** as shown to the right.



8

CONCLUSIONS

- Variations in observed ions outside the diamagnetic cavity coincide with variations in spacecraft potential and magnetic field

- The ion flux peaks lag the spacecraft potential and the magnetic field by 20 s: what is the reason for this?
  - Can there be a change in the electron temperature?
  - Are we missing some ions, considering the limited field of view?

- There is weak correlation between apparent ion temperature and ion flux.