

E-fields at a low activity comet derived from cometary ion velocity distributions

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Mission / Instruments

- Observations: by the Rosetta S/C, mainly the Ion Composition Analyzer (ICA)
- Target: Comet 67P
- Observation date: 2016-04-19
- Heliocentric distance: 2.8 AU
 - Low cometary activity
- Cometocentric distance: approx. 35 km



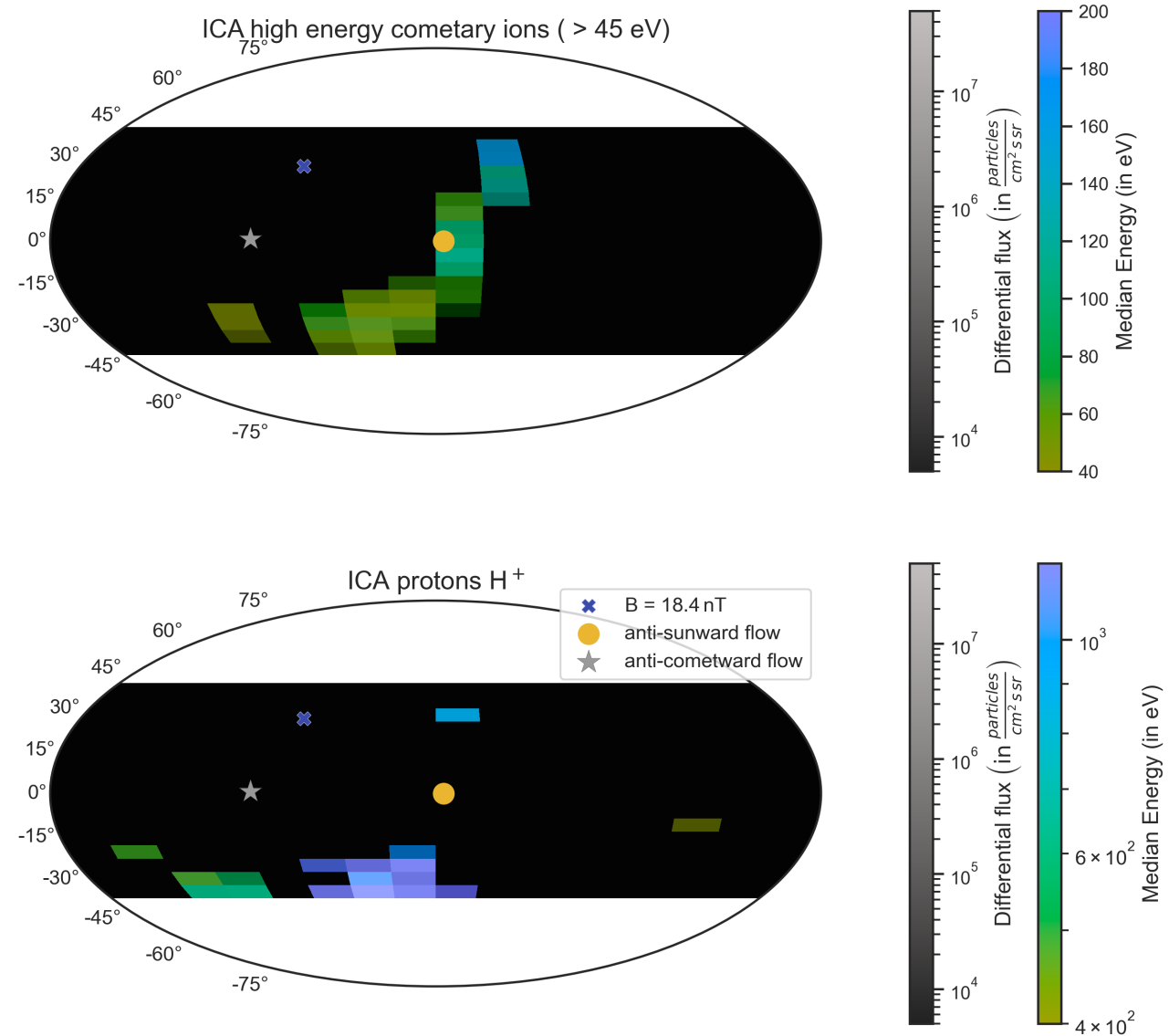
rosetta

→ LIVING

WITH A COMET

Ion observations: ICA's point of view

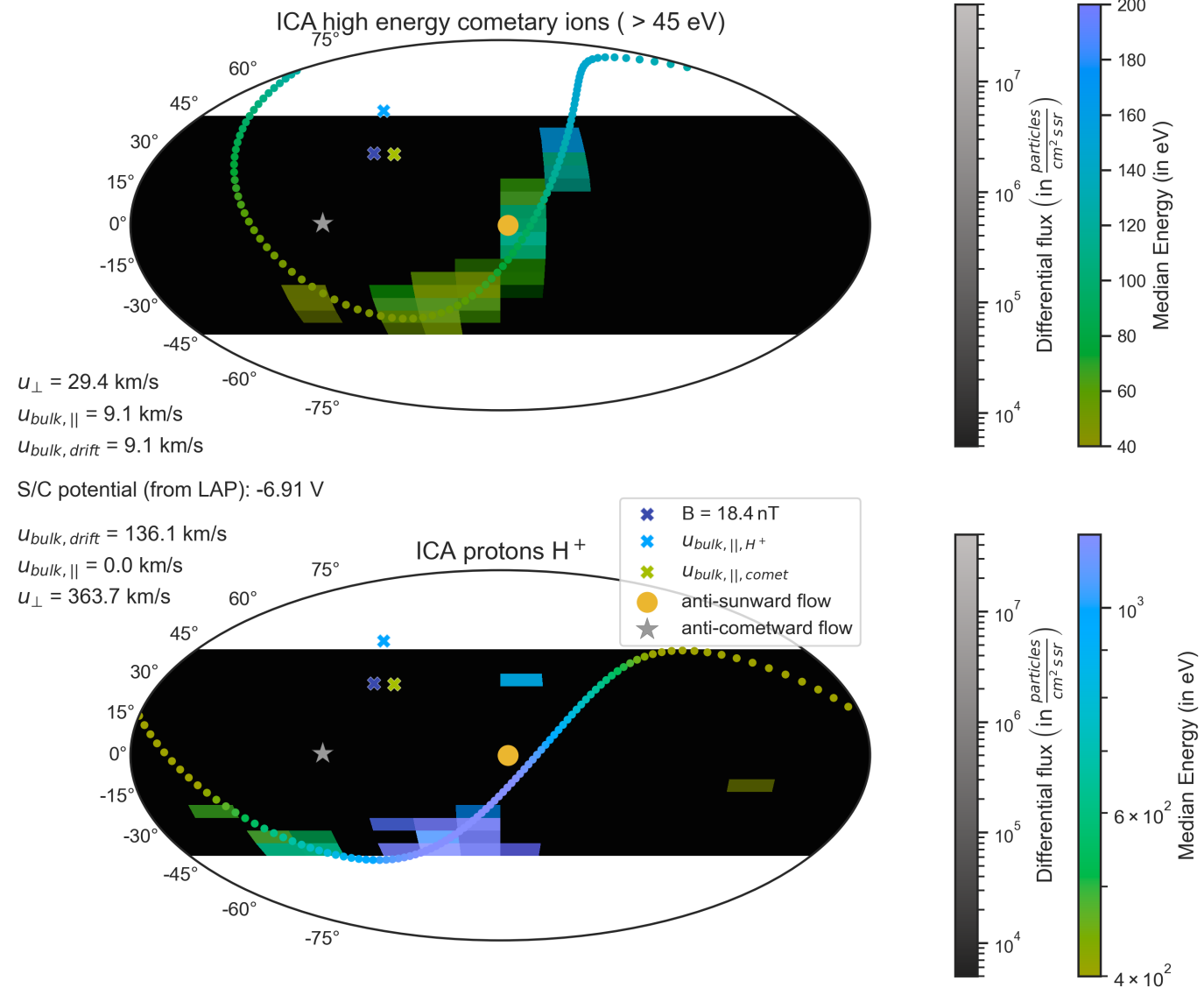
- Energy-angle dispersion of both cometary ions and SW protons.



Ion observations: ICA's point of view

- Energy-angle dispersion of both cometary ions and SW protons.
- Ring fitting is done in velocity space.
- If you are interested in the SW protons:

<https://doi.org/10.1029/2022JA031082>



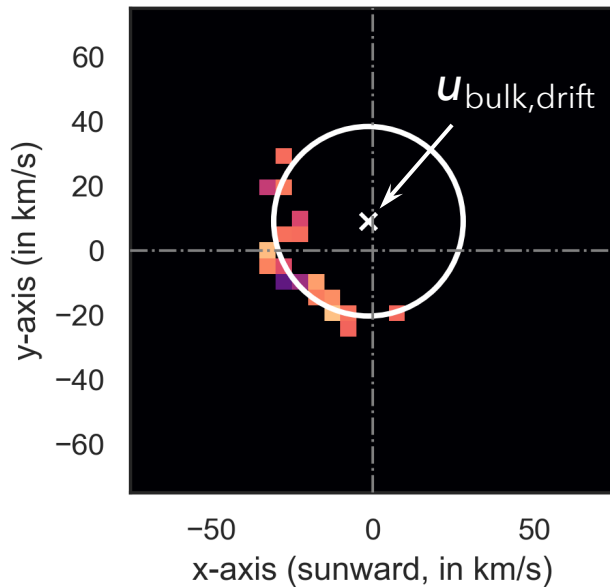
Projected velocity distributions

Coordinate system:

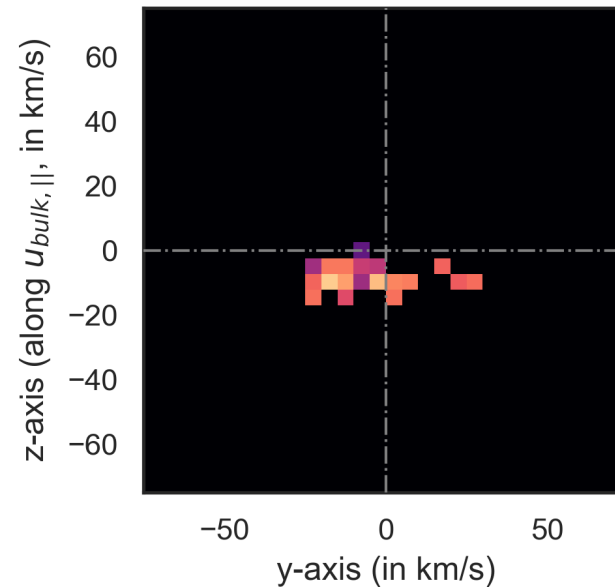
- z-axis: along $u_{bulk,||}$ and B
- x-axis: towards the Sun

Distribution shape:

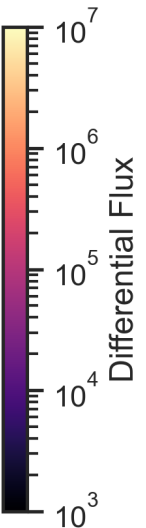
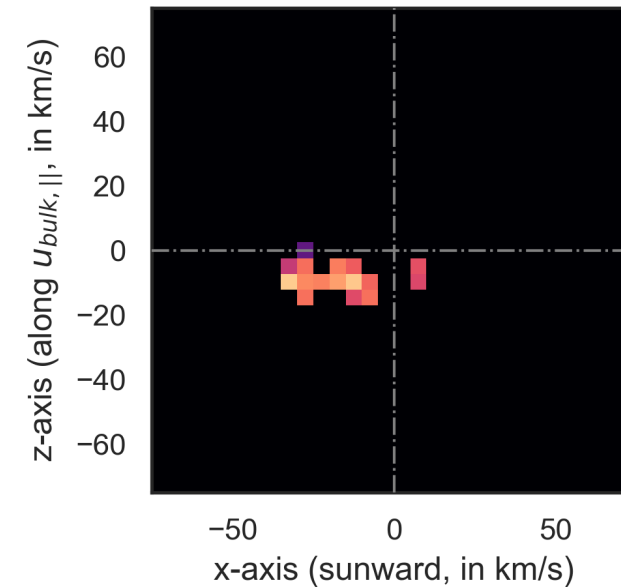
- Narrow distribution along z
- $u_{bulk,drift}$: centre of gyration



$u_{bulk,drift} = 9.1$ km/s
 $u_{\perp} = 29.3$ km/s



$u_{bulk,||} = 9.1$ km/s
 Angle between $u_{bulk,||}$ and the Sun: 63.70°



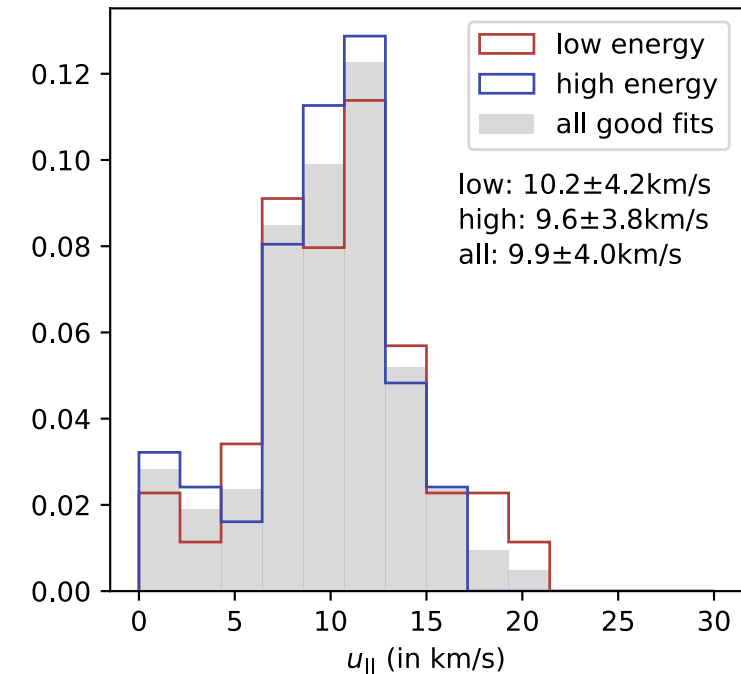
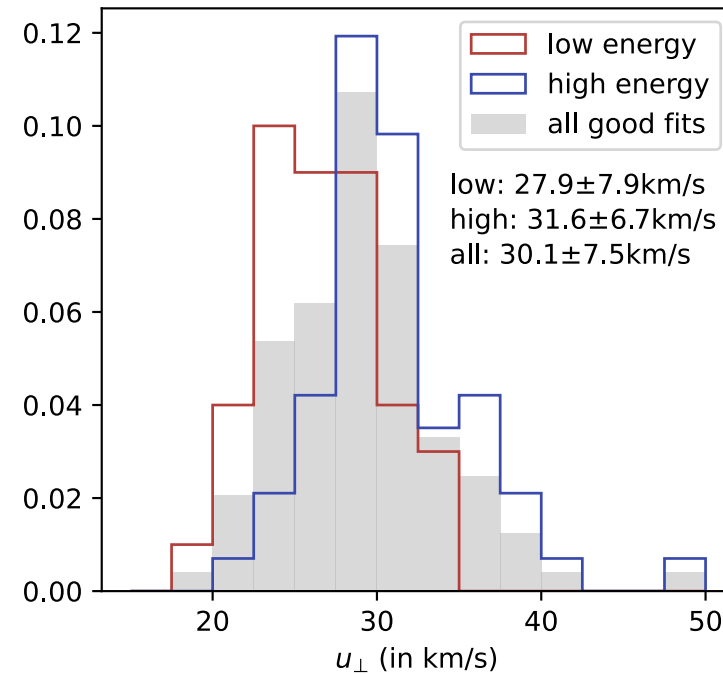
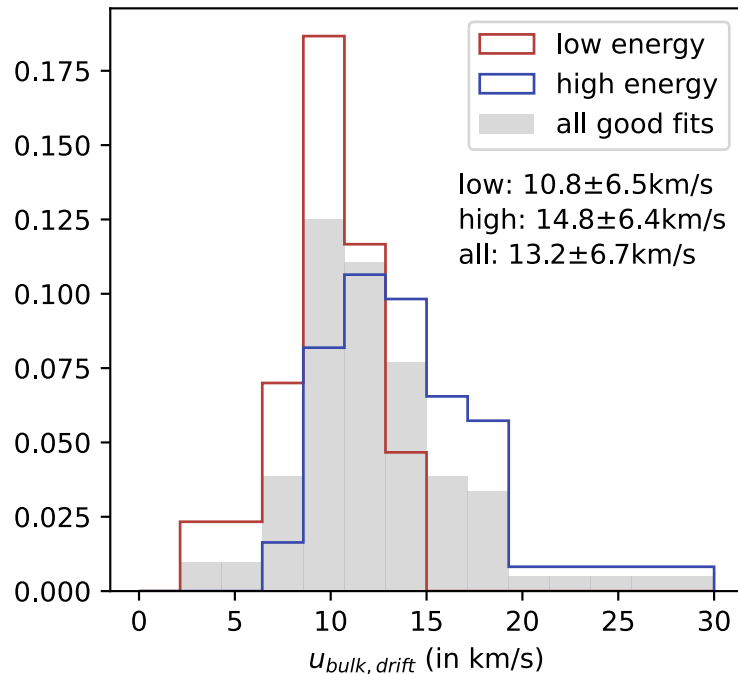
Fitted velocities - statistics

Fitting is done for a 13h time period:

- 99 successful fits (out of 169 scans)

Measured energies > 200eV?:

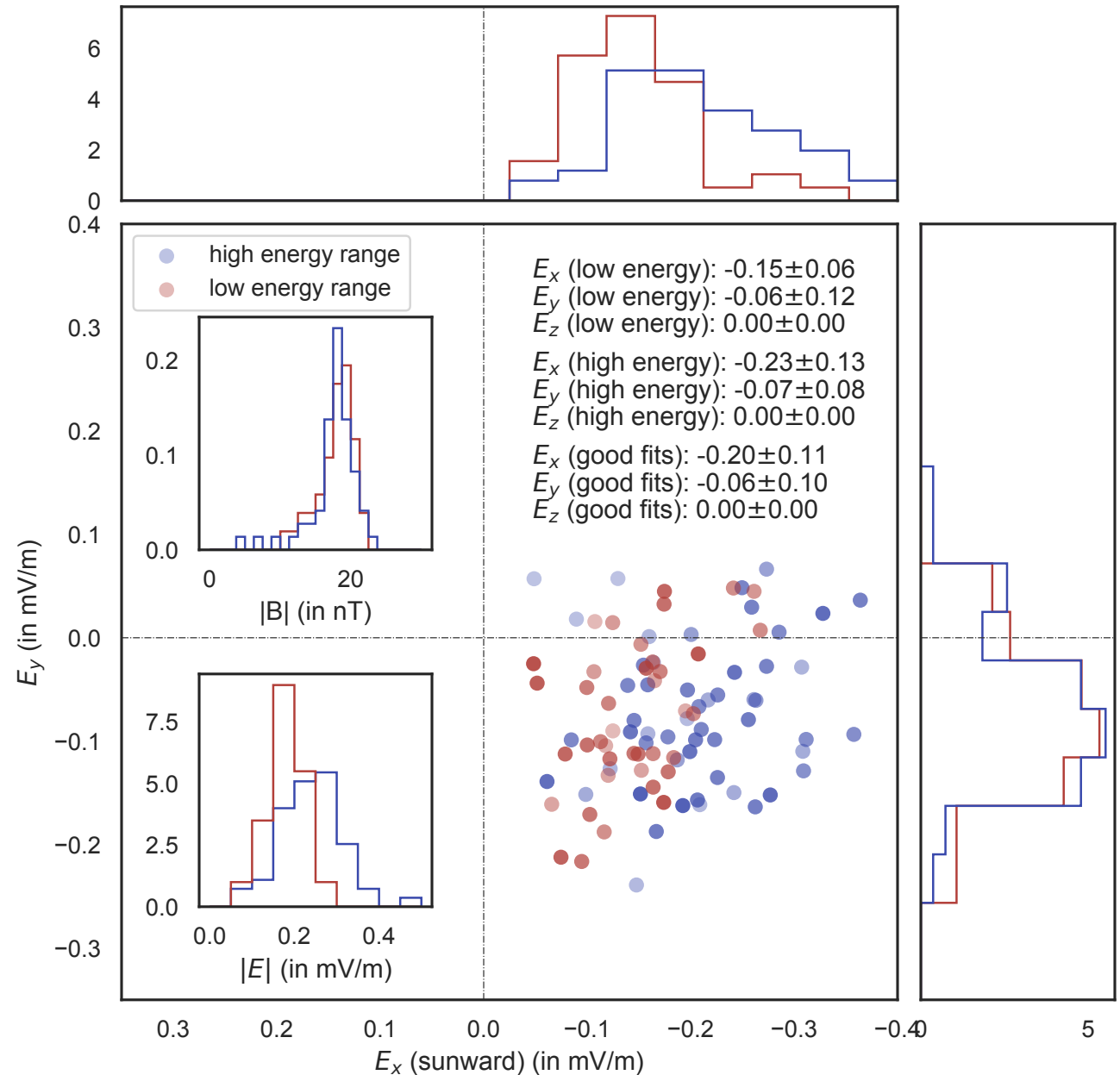
- 'low energy': 41 scans
- 'high energy': 58 scans



E-field estimates

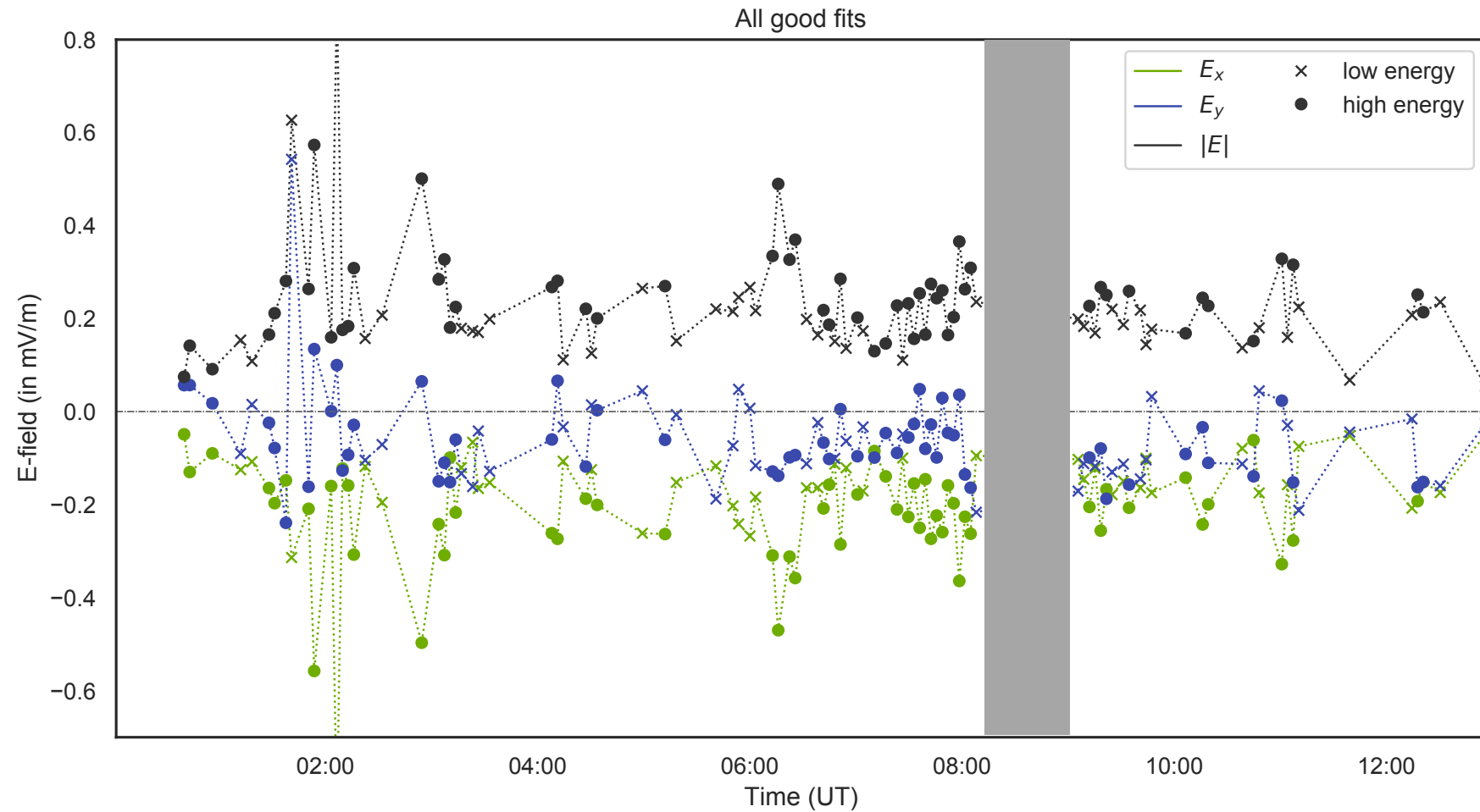
- $E = -u_{\text{bulk,drift}} \times B$
- Average electric field:
(-0.20, -0.06, 0) mV/m
- Anti-sunward component (E_x) is larger for the high energy range scans.

E-field distribution, projected (B only along z)



E-field - timeseries

Electric field estimates (projected)



Summary & Conclusions

- Cometary ions are distributed as a *partial ring* in one plane in our case study at low activity.
- The fitted rings provide estimates of the bulk velocity and gyration speed.
- We obtain an estimate of the *strength and direction* of the average *electric field* close to the nucleus.
- The estimated electric field has a strong *anti-sunward* component.

Outlook

- Where do the particles originate?
- Distance of particle origin to the nucleus vs. observed fluxes (*Nilsson et al., 2018*).
- Another estimate of the *electric field at a larger scale* can be obtained by the SW protons.

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