Translational Tomography with PSP-WISPR

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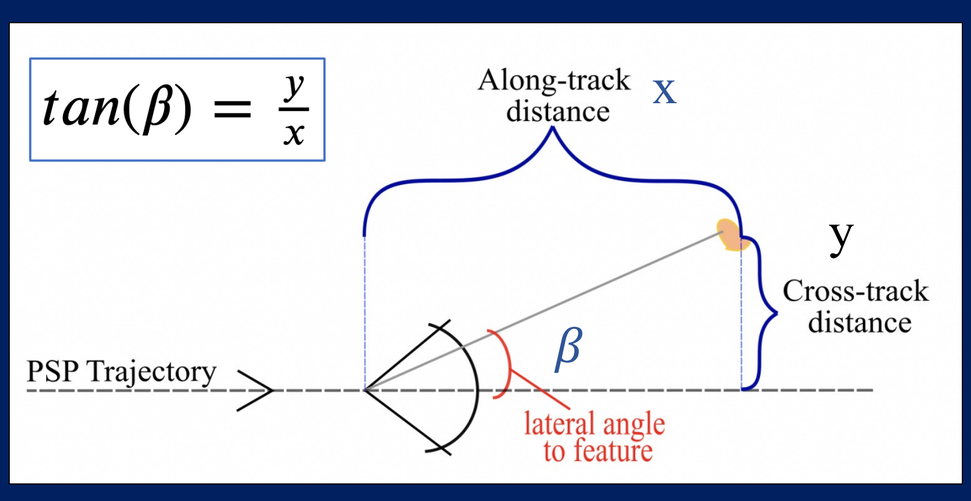
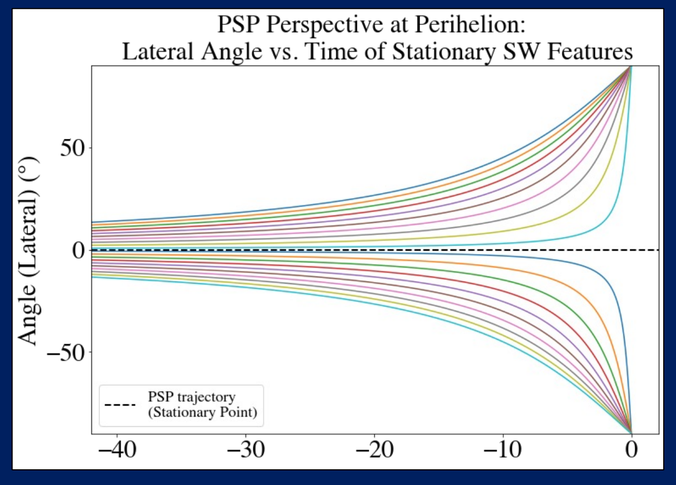
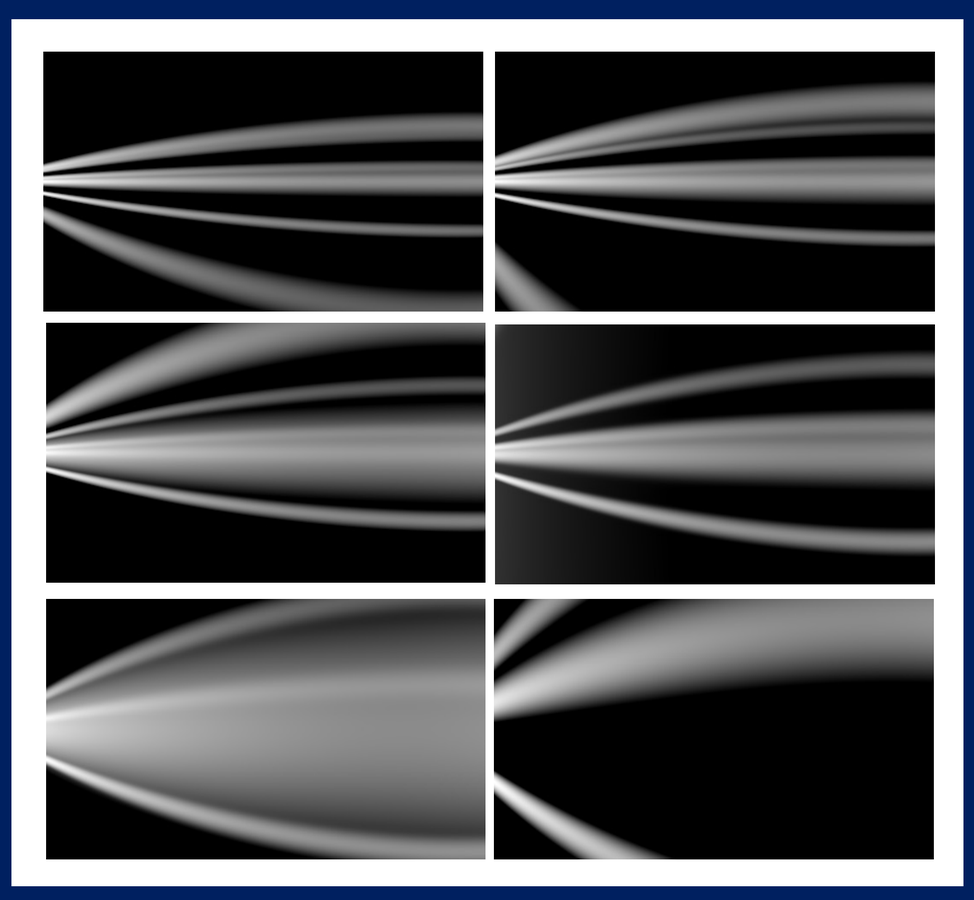
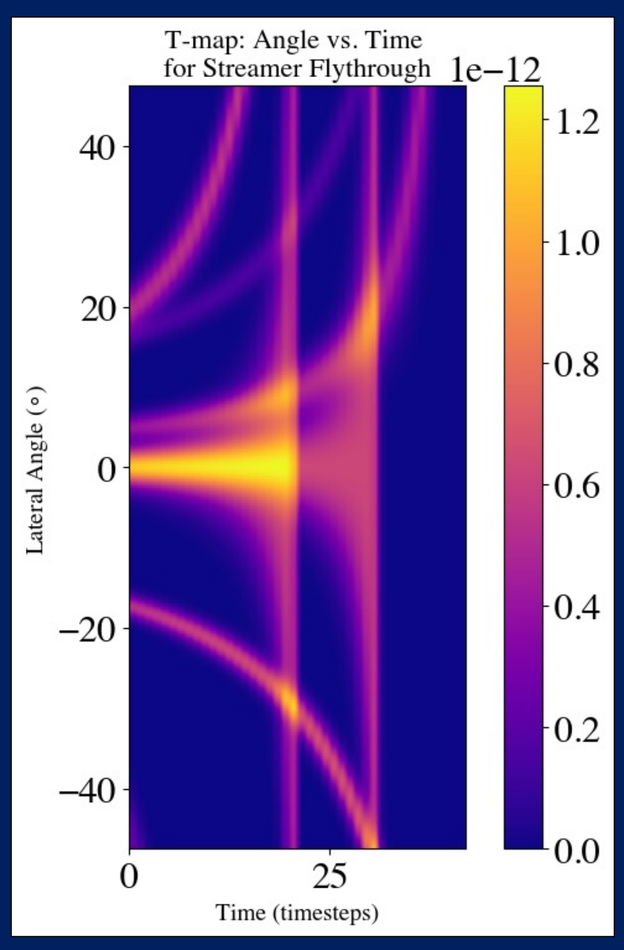
Question: Can we reconstruct linear density features in the corona and solar wind using PSP-WISPR images captured near perihelion?

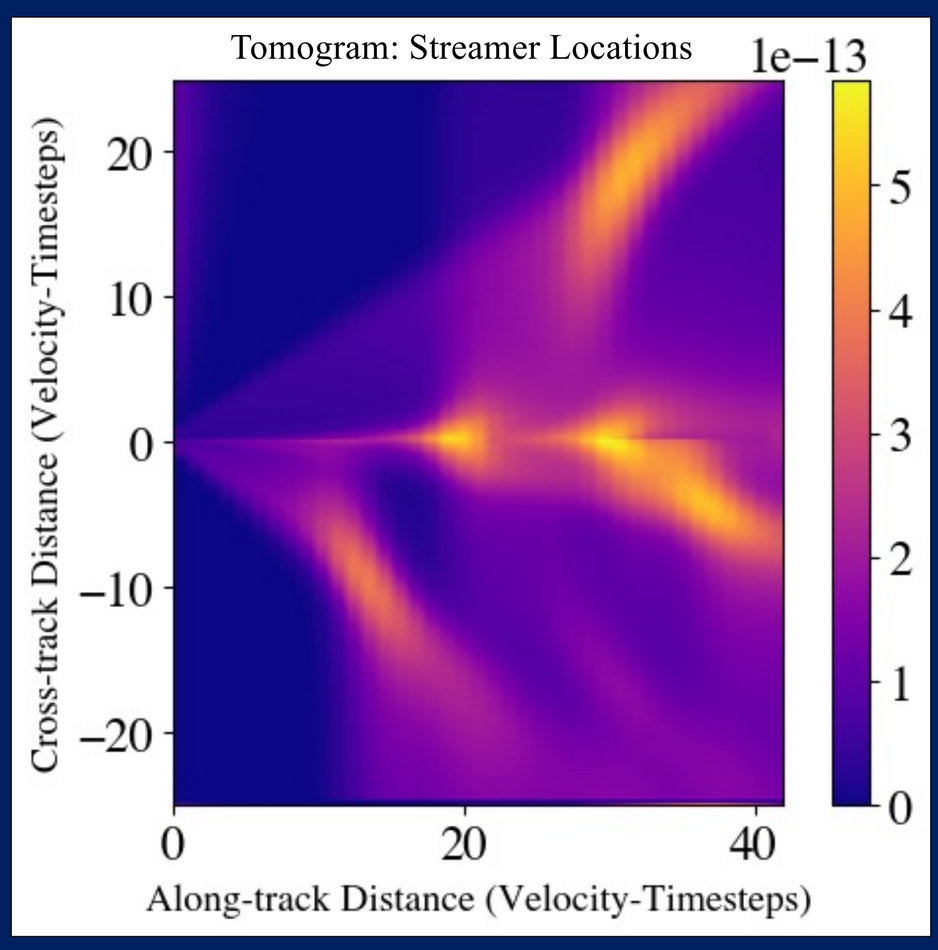


Method: Let's treat each feature like it's stationary as PSP flies past. In a straight-line trajectory approximation, the (lateral) angle (β) that WISPR sees to each feature is the arctangent of y (perpendicular distance of the feature to the trajectory) over x (parallel distance along the trajectory to the feature).

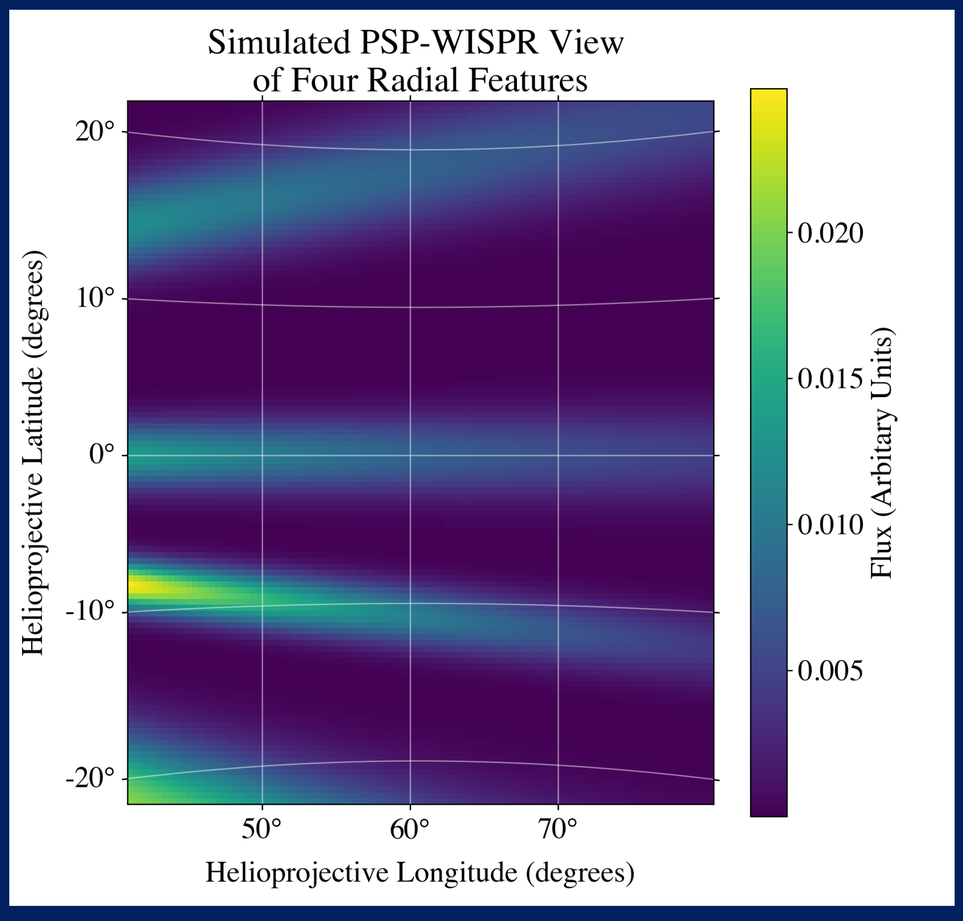








Above (left) you see a sample set of images from a synthetic WISPR flythrough (Liewer et al. 2019) and a 'T-map' (center) showing how lateral angle to these modeled features changes with time. We use images of our arctangent curves as basis functions that partially span the WISPR image vector space. We then back out which (x,y) basis element resulted in a curve that fit each feature the best by taking the dot product of our basis elements with the T-map. This tomographic reconstruction of feature locations is our 'tomogram' (right).



Current Progress: We didn't get the answer perfectly right using the synthetic flythrough from Liewer et al. (2019), so my current work is focused on building my own synthetic flythrough – where we know all the bits and pieces.

The left figure shows my first-cut, model WISPR view of 4 radial features (constant angular size – 2°) at one instant in time (i.e. at one PSP location).

What's next:

- Add time dependence (i.e. put PSP on an orbit) – make an image sequence – and other bells and whistles to the model
- Make a T-map and tomogram using my model flythrough to test/validate our tomographic method
- Reconstruct features from real WISPR perihelion datasets

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