Imperial College London

Science & Technology Facilities Council
10 Years of Impact and Inspiration

In-situ properties of the slow solar wind at 0.3 AU

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Introduction

- Want to be able to use **in-situ measurements** to **predict source region** of measured slow solar wind (SSW)
- Well known that composition partially solves this…
- …but are there other in-situ diagnostics we can use?

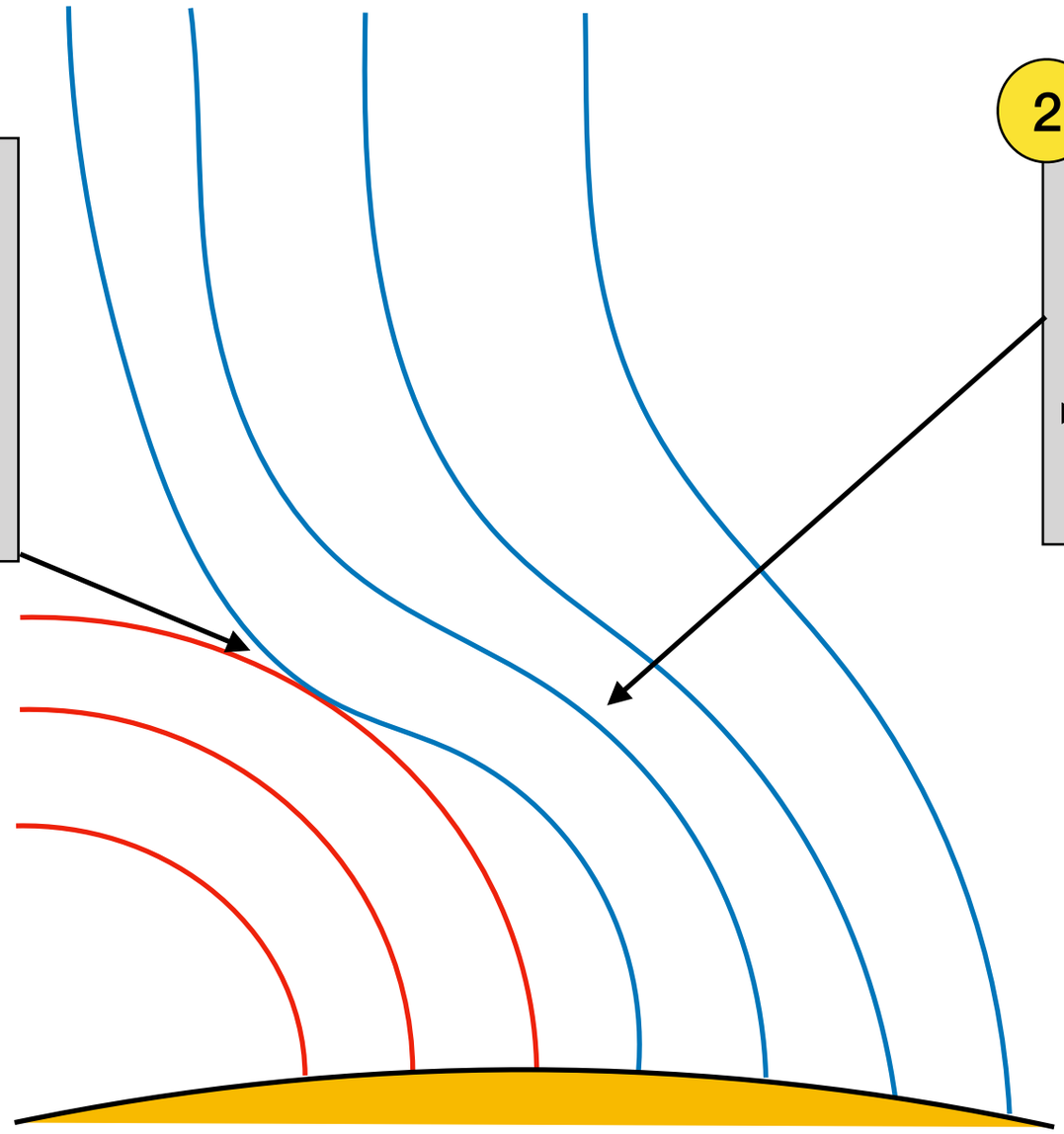
- Our re-analysis of Helios data reveals a SSW population that has same structure **and** thermodynamics as FSW
- A new method for identifying slow solar wind from open field regions

SSW release mechanisms

1

Transient release via. reconnection

- Variable and intermittent wind

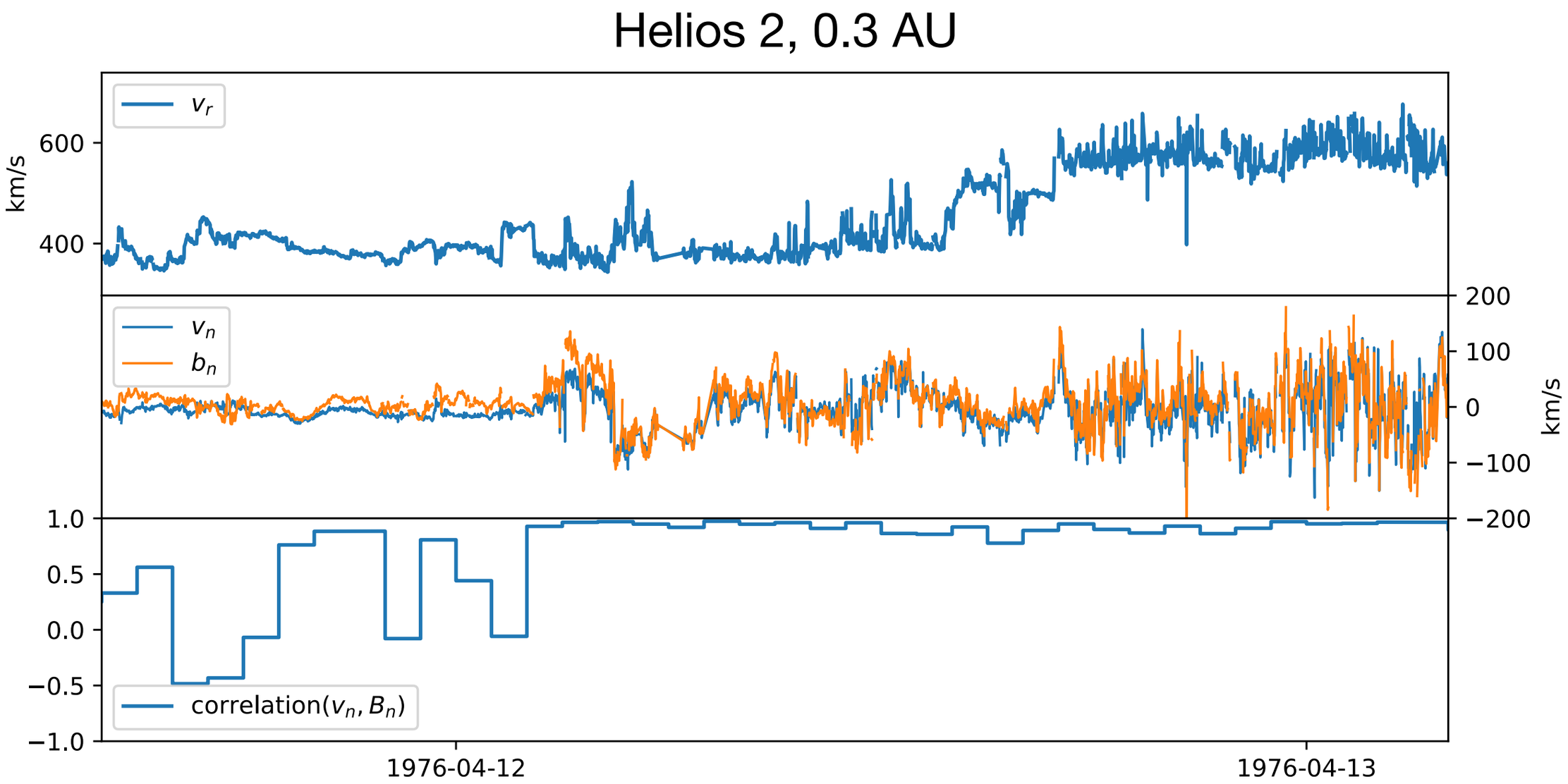


2

Continuous release on open field lines

- Properties similar to fast wind

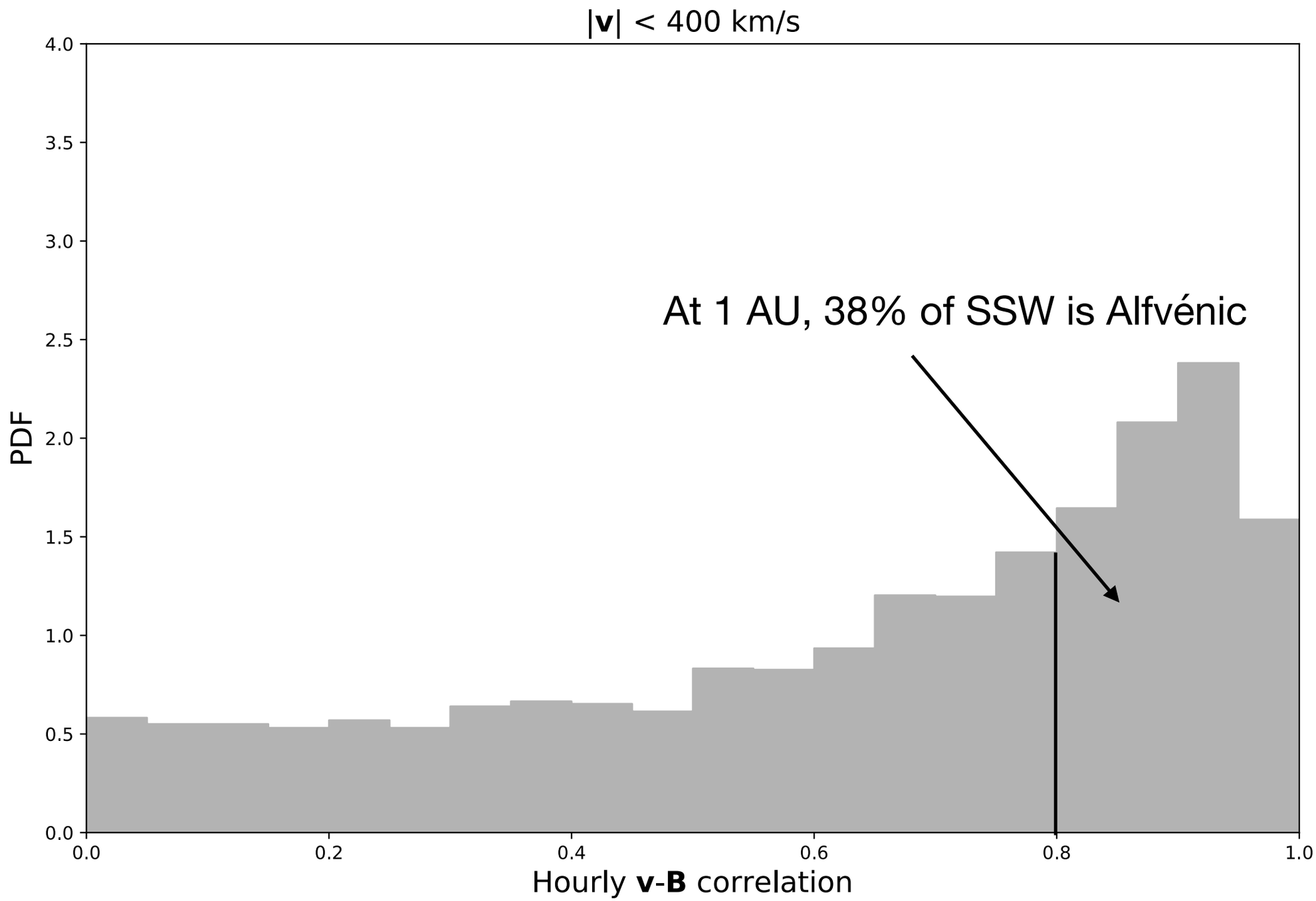
Three types of solar wind



- Backmapping from 1 AU suggests Alfvénic SSW comes from open field regions
  (*D'Amicis et. al. 2015, 2016)*

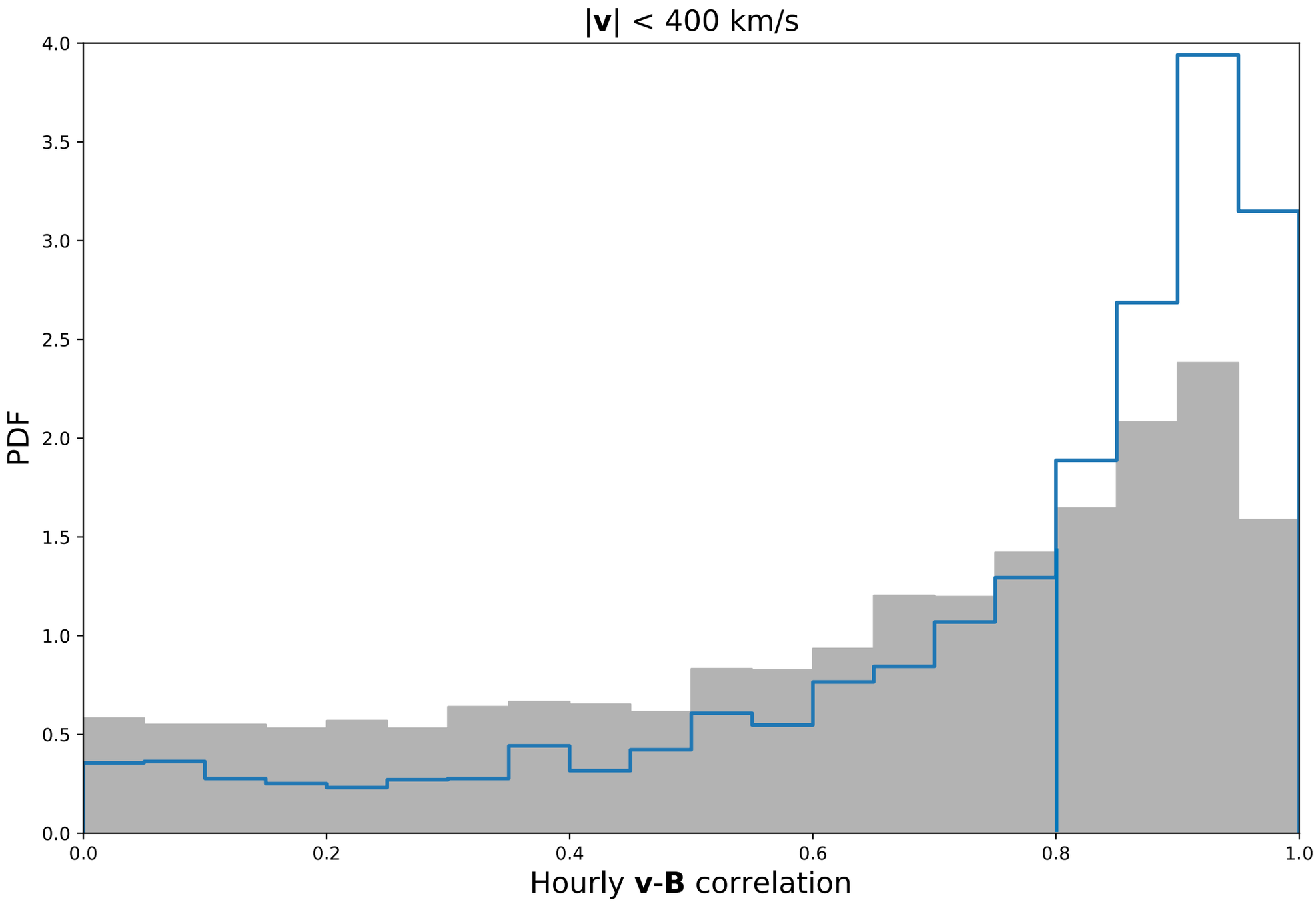
- ⇒ measure fraction of SSW that is Alfvénic to estimate fraction that comes from open field

Slow solar wind Alfvénicity (1 AU)



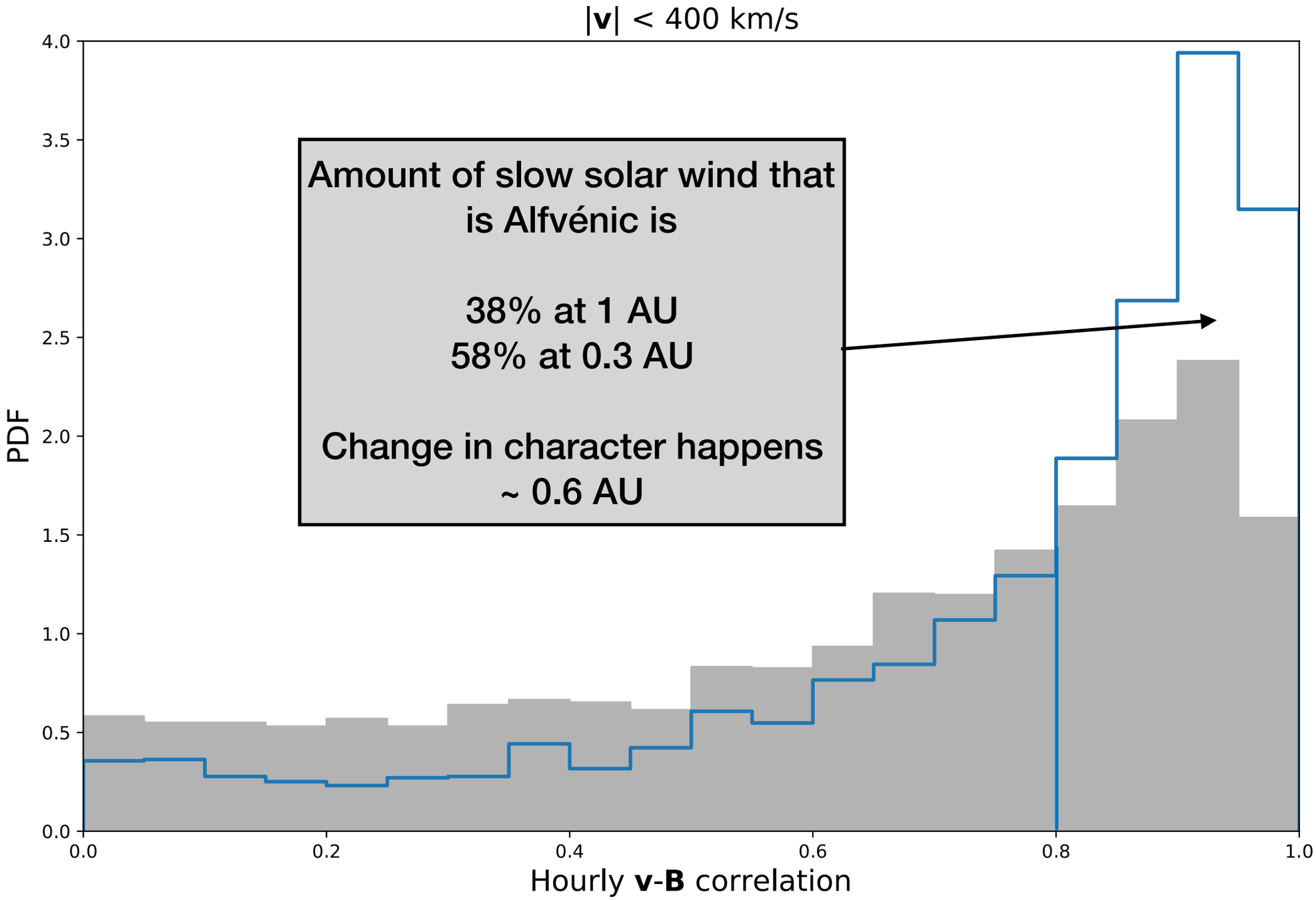
- Previous studies show more Alfvénic SSW at 0.3 AU
  (*Luttrell et. al. 1987, Roberts et. al. 1987)*

Slow solar wind Alfvénicity (0.3 AU)



- Is Alfvénicity a good proxy for whether SSW has the same source as FSW?

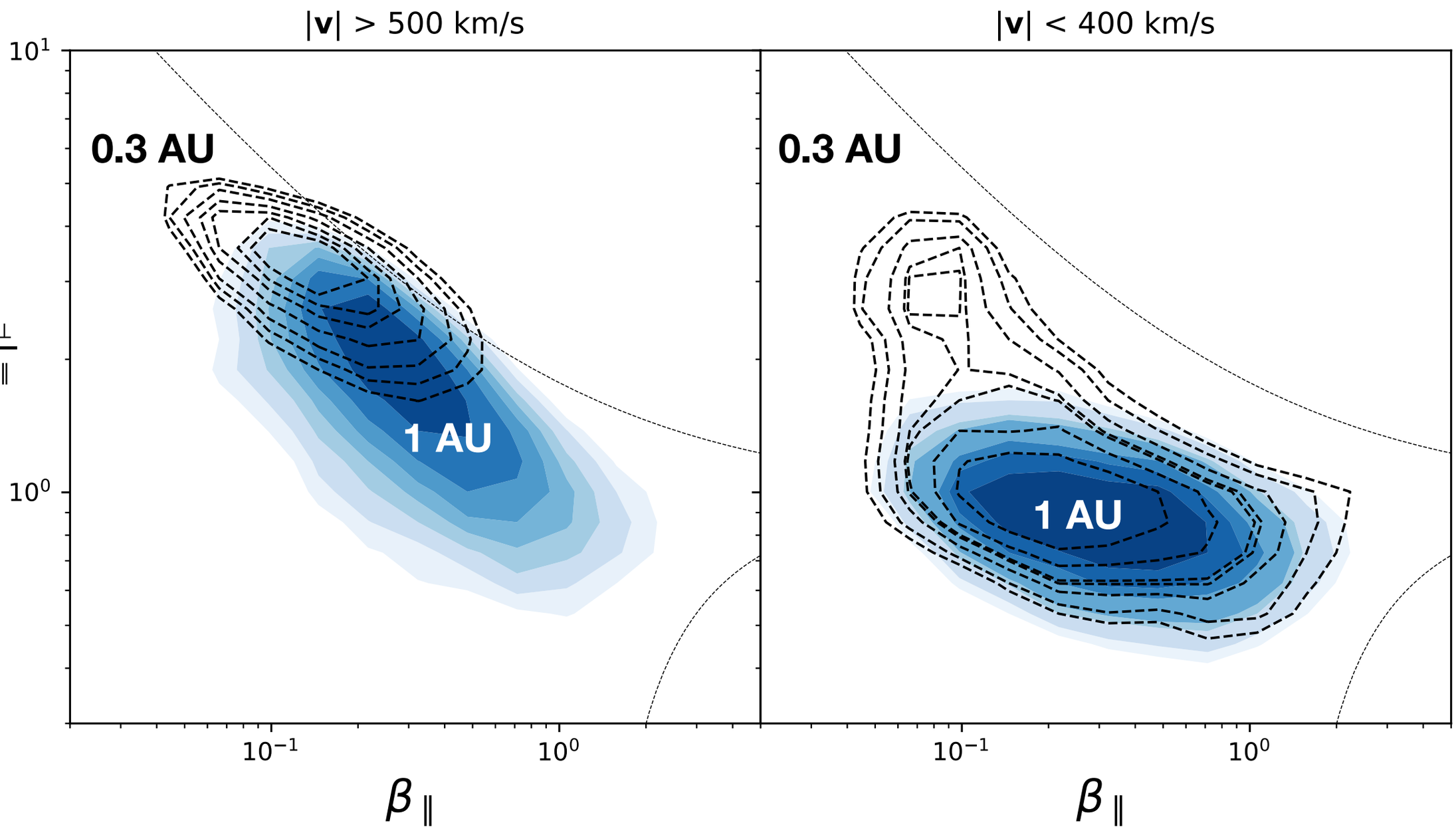
Slow solar wind Alfvénicity (0.3 AU)



- Is Alfvénicity a good proxy for whether SSW has the same source as FSW?

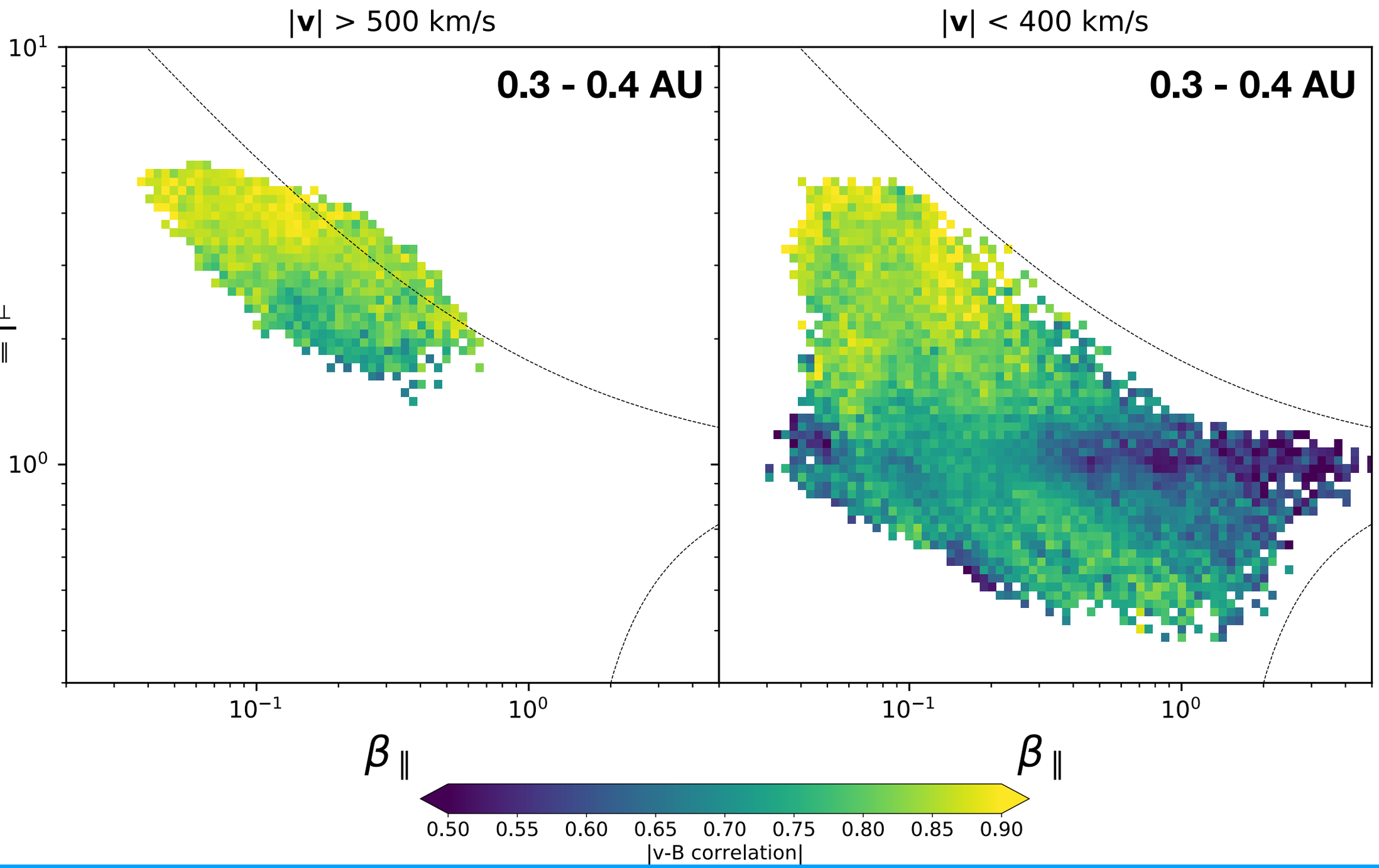
Slow wind thermodynamics

- As well as looking a structure, we can now look at thermodynamic properties

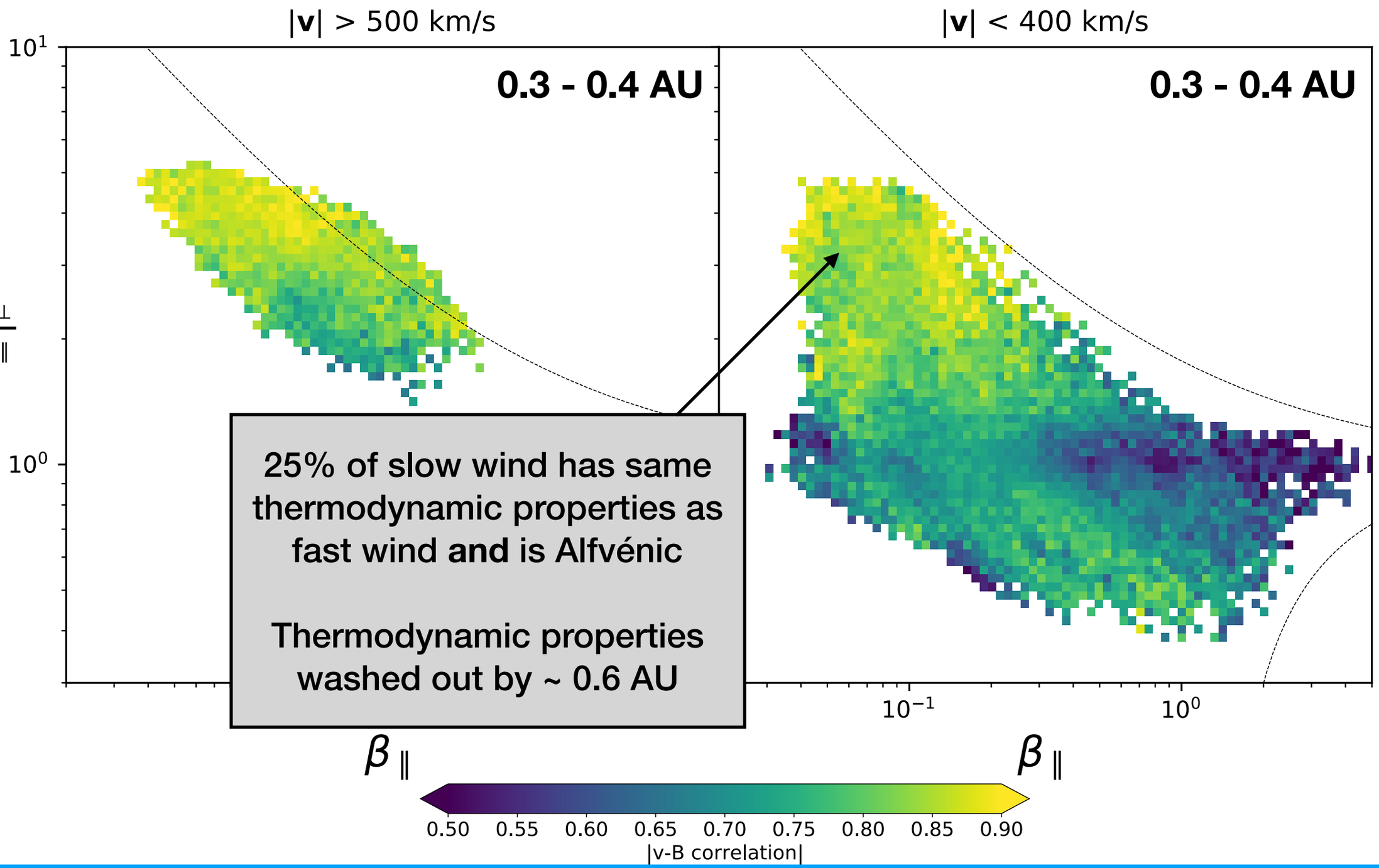


Fast wind after *Marsch et. al. 2004* and *Matteini et. al. 2007*

Slow wind thermodynamics



Slow wind thermodynamics

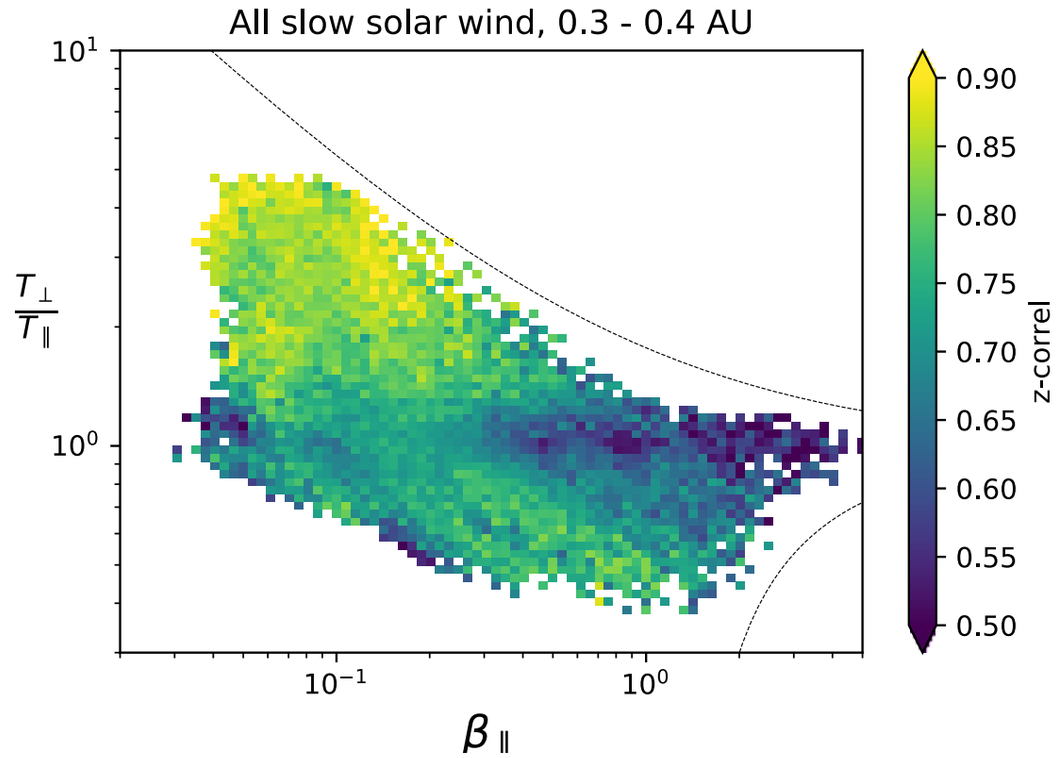


Conclusions

- At 0.3 AU some slow solar wind is Alfvénic **and** has high temperature anisotropies

- This population has the same structure **and** thermodynamics as fast solar wind

⇒at least 25% of slow solar wind Helios measured was released on permanently open field lines



Implications for Solar Orbiter

- Distinguishing 2 SSW populations possible inside ~0.6 AU

- **New in-situ diagnostic for SSW origin**

Re-processed Helios plasma dataset available at
https://dstansby.github.io/helios