Polarimeter to Unify the Corona and Heliosphere

WG 1A Overview

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PUNCH Science Meeting

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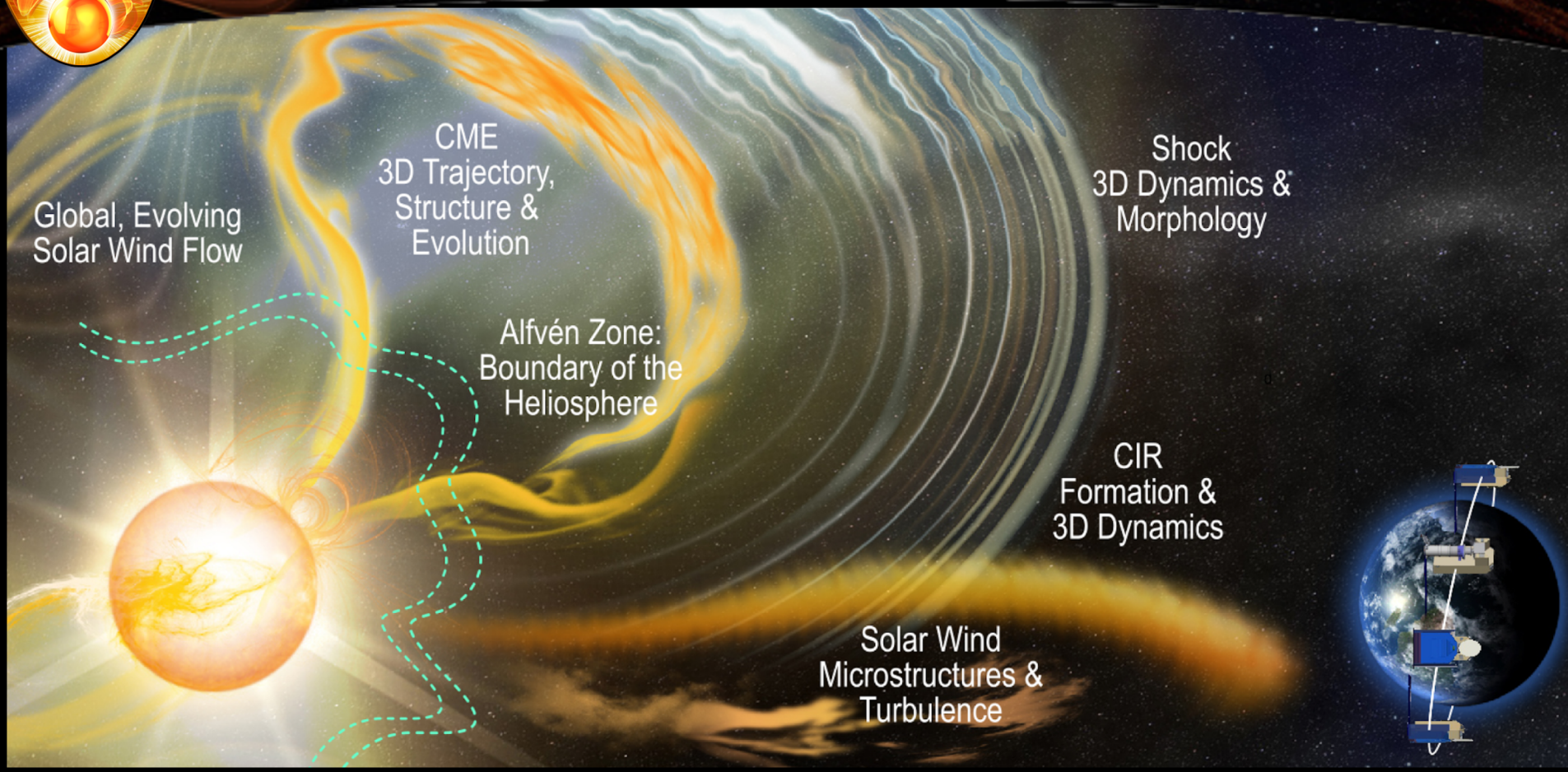
My House

PUNCH science objectives



PUNCH's science goal: comprehend the *cross-scale* physical processes – from microscale turbulence to the evolution of global-scale structures – that **unify the solar corona and heliosphere**.

PUNCH Science Goals

PUNCH Science Objective 1) *The Ambient Solar Wind: Understand how coronal structures become the ambient solar wind*

- 1A: How does the young solar wind flow and evolve on global scales?
- 1B: Where and how do microstructures and turbulence form in the solar wind?
- 1C: What are the evolving physical properties of the Alfvén surface?

PUNCH Science Objective 2) *The Dynamic Solar Wind: Understand the dynamic evolution of transient structures in the young solar wind*

- 2A: How do coronal mass ejections propagate and evolve in the solar wind in three dimensions?
- 2B: How do quasi-stationary corotating interaction regions form and evolve?
- 2C: How do shocks form and interact with the solar wind across spatial scales?

WG 1A: Global Solar Wind Flow

PUNCH quantifies day-to-day global evolution of the ambient solar wind flow.

- Wind speed can be traced using small features in the corona and heliosphere.
- The ambient solar wind is roughly bimodal, with fast and slow streams.
- Understanding how coronal structures and boundaries relate to solar wind characteristics is an outstanding problem and requires global measurements.

Movie: STEREO/COR2 72 hour
High cadence deep exposure campaign

PUNCH provides unique measurements of the global flow across the outer corona and inner heliosphere.

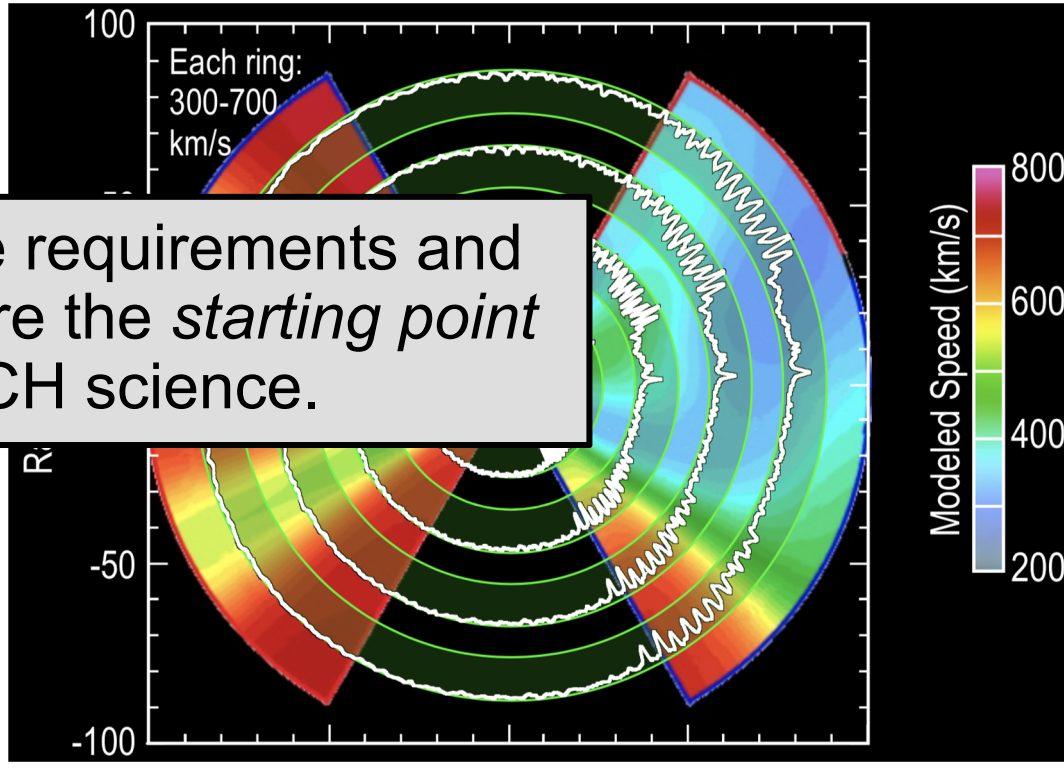
WG 1A: Global Solar Wind Flow

Science Activities for PUNCH WG 1A

Measure time-dependent solar wind flow from the outer corona to the inner heliosphere

- Identify the
  between fas
- Determine
  context for
  and to provide ground-truth verification for global simulations
- Characterize the global solar wind conditions through which transient structures propagate

PUNCH science requirements and data products are the *starting point* for PUNCH science.



Data products:

- Velocity maps at four radial positions (14RΘ, 28RΘ, 44RΘ, and 60RΘ) twice daily
- Quicklook @ 14RΘ once per orbit.

Extended Science Measurement Targets

Measurements that can provide vital information on how coronal structures become the ambient solar wind

M1. Measure velocity vs latitude (source) and radius (acceleration/advection) on global scales
- Nonradial
- Out of plane/ 3D-ish
- Multi-LOS features

M2. Measure velocity vs latitude and radius on small scales e.g. shears and compression regions, and relate to density structures
- M1 measurements
- Small-scale structures: evolution and development

M3. Relationship between small flows, global flows, and singular large structures
- Same as above but with a CME in measurement realm

M4. Characterize inward flows and waves

Extended Science Measurement Targets

How the Extended Science measurement targets connect to the Science Objectives:

1A. How does the young solar wind flow and evolve on global scales?

M1. measure velocity vs latitude (source) and radius (acceleration/advection) on global scales
M2. measure velocity vs latitude and radius on small scales e.g. shears and compression regions

1B. Where and how do microstructures and turbulence form in the solar wind?

M2. flow shears and compression regions, and relate to density structures
M3. with WG2, relationship between small flows, global flows, and singular large structures

1C. What are the evolving physical properties of the Alfvén surface?

M4. Must capture inward flows and waves component
M2. Also probably useful to do flow shears and compression regions, and relate to density structures

PUNCH Flow Tracking WG Objectives

To make progress towards the Extended Science Measurement Targets, the PUNCH Flow Tracking Working Group was formed.

The group held workshops in November 2020 and July 2021 to advance our ability to identify and track flows in coronal imagery.

1) Understand the various methods and characterize their performance on different fronts (small/large scale, close/far from Sun, directionality)
2) Work on adapting these methods in preparation for use on PUNCH data.
3) Optimize measurement method for model interpretation

You will hear a summary of the Flow Tracking group's activities as well as several talks highlighting progress in flow tracking methods.

PUNCH welcomes talented scientists!

Thank you for attending this workshop!

As you learn about the other PUNCH working groups and science goals, we invite you to consider what this wealth of new and unique data can do.

Our scene-setting talk describes several exciting scientific advances that can be made by taking full advantage of PUNCH's capabilities.

"Solar Wind Statistical Relationships Useful for Providing Analysis Constraints and Additional Space Weather Data Products" by Heather Elliott