

# Interest of the Italian community on the scientific exploitation of SWA data

**R. Bruno**  
IAPS-INAf

## Various steps towards a scientific aggregation of a common interest

September 2019:

- national heliophysics community invited to suggest possible scientific cases based on *in-situ* data, with particular emphasis on SWA measurements.

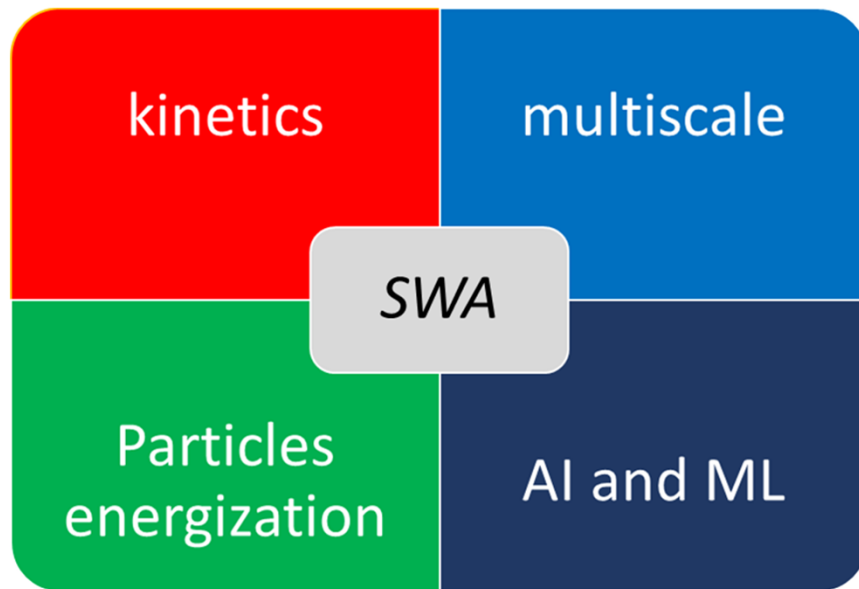
December 2, 2019:

- National Solar Orbiter Info-Day held at ASI HQ, in Rome, with participation of ESA representatives.
- Round-table on scientific interest collected from the community, key to start a collaborative process.

January 2020:

- Creation of a national website dedicated to SWA (<https://sites.google.com/view/italian-solar-orbiter-swa>)
- 4 WGs were created to foster collaborations and avoid to duplicate efforts also with respect to the guidelines described in the Solar Orbiter Science Activity Plan (SAP)
- We all thank Denise Perrone (ASI) for her work and continuous support during this aggregation process.

## The 4 WGs



Each WG has a coordinator who will:

- organize telecons
- invite people to present their activity
- stimulate discussions
- keep news, documents, presentations, etc on the webpage dedicated to the corresponding WG

Kinetics: Franco Valentini (UNICAL);

Mesoscale: Raffaella D'Amicis (IAPS);

Particles energization: Silvia Perri (UNICAL);

ML and AI: Rossana DeMarco(IAPS)

- We already had the first 4 introductory telecons and already scheduled the next 4 on science topics of interest.
- Each WG will schedule 1 TC every 3 weeks

## Short summary of proposed science topics\* (1/3)

### Kinetics

*Focus on Plasma heating based on observations and kinetic simulations*

- Identification of physical processes responsible for dissipation and heating via comparison between fields and particles observations and multidimensional kinetic simulations + automatic indicator of departure from Maxwellian
- Electron heating via Landau damping observations and model prediction comparison
- Signatures of wave particle interaction and heating partition among different ion species
- Search in proton VDF fine scale velocity structures, as observed in Vlasov simulations and MMS VDF, suggesting a velocity-space turbulent cascade. New technique based on 3D Hermite transform of the VDF.
- velocity-space structures locally responsible for increase of collisions, simulation-observations comparison.
- Simulations-observations comparison of coherent structures in the kinetic-scale turbulent cascade
- Simulations-observations comparison to identify fundamental processes at the basis of turbulence across ion cyclotron frequency.
- kinetic effects generated at the shock front via comparison between kinetic modelling and observations

(\*) topics of some proposals merged together to shorten this list

## Short summary of proposed science topics\* (2/3)

### Multiscale:

*Focus on turbulence, reconnection, advected density structures mainly focused on observations*

- simulations and data analysis comparison to study the link between turbulent reconnection, particle acceleration and heating in regions in the vicinity of the Sun
- Systematic search for reconnection exhausts to assess the role of reconnection events in the expanding solar wind.
- Reconnection events with low plasma  $\beta$  regions and in the current sheet at front region of the ICME
- Quasi-periodic density structure in the solar wind and possible origin in coronal reconnection processes
- Radial evolution of turbulence studied via different indicators contained in a proxy of the local energy transfer rate based on the third order SF
- Linking fluid and kinetic scales turbulence within different turbulent regimes
- Alfvénic slow wind origin and radial evolution
- Assessing the physical properties of cometary tails crossed by Solar Orbiter on its journey around the Sun.
- Synergic studies using Swarm and Solar Orbiter to better understand the ionosphere response to interplanetary conditions

(\*) topics of some proposals merged together to shorten this list

## Short summary of proposed science topics (3/3)

### Particles energization:

*Focus on shocks*

- formation and the evolution of CMEs driven shocks and their role in SEP acceleration
- Combining EPD and SWA observations to identify the seed particle population
- Observations of suprathermal particles pitch-angle scattering related to both for shock acceleration models and for SEPs propagation

### Artificial Intelligence and Machine Learning:

*Focus AI and ML applied to Solar Orbiter RS and IS observations*

- ML and AI techniques adopted as a new approach for the exploitation of data from past and planned European space missions such as Solar Orbiter. AIDA project funded within Horizon 2020 framework.
- ML as a possible tool to separate different populations forming the particle velocity distribution function

## Some considerations

- There is a need for a shared effort by proposers and coordinators of the WGs to understand what the necessary observations are and whether SWA is able to provide them or not.
- The national panorama is only a subset of all the scientific themes collected in SAP.
- It is desirable that this aggregating process could be exported, if not present yet, towards the SWA community and towards the In-situ community at large
- Active participation in the expanded ISWG can provide the right environment in which ideas can converge and be compared.