Monday Feb 4

Overview of observations, properties of vortex flows in solar plasmas and their detection

09:00-09:10: Welcome from ISSI
09:10-09:30: Overview of the meeting (Kostas Tziotziou)
09:30-10:00: An overview of observations of small-scale vortices and chromospheric swirls (Georgia Tsiropoula)
10:00-10:30: Magnetic tornadoes - What we know so far (Sven Wedemeyer)
10:30-11:00: Coffee break
11:00-11:30: High resolution observations from the GREGOR and VTT (John Kontogiannis)
11:30-12:00: Observational signatures of swirls and giant tornadoes from the visible to the EUV (Eamon Scullion)
12:00-12:30: Discussion
12:30-14:00: Lunch break
14:00-14:30: Vortex Automated Identification and Statistical Analysis (Viktor Fedun)
14:30-15:30: Future Work: A large-scale swirl with clear heating signatures in both IRIS and SDO (Eamon Scullion)
15:30-16:00: Coffee break
16:00-16:30: Prospects of observing chromospheric swirls with ALMA (Sven Wedemeyer)
16:30-17:30: Discussion & future tasks

Discussion points:

1) Available multi-wavelength observations for linking vortex motions across multiple spatial scales
2) Physical and statistical properties of vorticity-related structures in different heights
3) Do any scaling laws exist with regard to vortex motions that could be obtained from observations and/or simulations.
4) Structure of such vortex flows and the characteristic vortex velocity profile within them
5) Measurement of their rotational velocities and vorticity at different heights in the solar atmosphere
6) Detection methods of vortex motions/possible improvements
7) Derivation of limits on occurrence rates and numbers of such structures extending from the photosphere into the chromosphere and outer solar atmosphere
8) Properties of the magnetic field within vortex flows and its association to their dynamics
9) Inference of their mass density structure and estimation of mass transfer to higher atmospheric levels by such structures
10) Future proposals with DKIST and ground-based and space-based facilities (GREGOR, VTT, SST, ALMA, IRIS, SDO etc)

Tuesday Feb 5

Overview of MHD simulations of vortex flows in solar plasmas

09:00-09:30: Vortex tube formation and dynamics in quiet-Sun regions (Irina Kitiashvili)
09:30-10:00: Dynamics of small-scale vortices in solar plage region simulations (Yadav Nitin)
10:00-10:30: Discussion
10:30-11:00: Coffee break
11:00-11:30: Alfvén waves and vorticity in the solar photosphere (Sergiy Shelyag)
11:30-12:00: Future steps for simulating vortex flows (Sven Wedemeyer)
12:00-12:30: Discussion
12:30-14:00: Lunch break
14:00-14:15: Vortex tubes at the granular edges and their manifestation in the form of "granular lanes" (Oskar Steiner)
14:15-14:45: Non-magnetic bright points and their origin (Oskar Steiner)
14:45-15:15: Do photospheric non-magnetic bright points exist? (Sergiy Shelyag)
15:30-16:00: Coffee break
16:00-17:30: Discussion & future tasks

Discussion points:

1) Differences between available numerical codes of vortex motions
2) What is missing in simulations?
3) Possible updates to assess vortex signatures in the corona?
4) What is the role of the magnetic field in the development of vortex tubes in both swirls/spicules and how it can be investigated with simulations?
5) Why do we not see that many vortex flows in active regions?

Wednesday Feb 6

Fundamental physics of associated waves in vortex flows

09:00-09:30: Alfven waves and vortex motions in simulations including partial ionization effects (Elena Khomenko)
09:30-10:00: Slow magneto-acoustic waves and shocks in solar plage region simulations (Yadav Nitin)
10:00-10:30: Discussion
10:30-11:00: Coffee break
11:00-11:30: Searching for oscillations and waves related to the photospheric flows and bright point motions (John Kontogiannis)
11:30-12:00: Oscillations and waves in a persistent small-scale vortex flow seen in Ha and Ca II 8542 (Kostas Tziotziou)
12:00:12:30: Effect of flows on plasma instabilities and wave propagation (Samuel Skirvin)
12:30-14:00: Lunch break
14:00-14:30: Biermann battery, vorticity and generation of quiet Sun magnetic fields (Elena Khomenko)

14:30-15:00: Relative contributions to the generation of vorticity from the equation of vorticity (Oskar Steiner, short report)
15:30-16:00: Coffee break
16:00-17:30: Discussion & future tasks

Discussion points:

1) Identification of MHD/Alfvén waves in observations and numerical simulations
2) Observational signatures distinguishing between the different models for propagation of torsional motions and waves
3) Energetics of waves, proposed dissipation mechanisms and spatial and temporal scales for the dissipation of energy confined in vortex motions
4) What implication does partial ionisation have for vortex motions as sources of MHD/Alfvén waves
5) What can we learn about the differences in energy transport due to flows and/or waves in the lower solar atmosphere in partially ionised plasmas?
6) Is there any Kolmogorov-type scaling law for vorticity and what implications does it have for energy dissipation/transport (turbulent heating?) etc
7) Scaling/power-law relationship with regard to Alfvén wave energy and magnetic vorticity?

Thursday Feb 7

Coupling of vortex flows between different solar atmospheric layers

09:00-09:30: Local helioseismic diagnostics of subsurface vorticity and helicity (Alexander Kosovichev)
09:30-10:00: Helical energy channels from the subsurface to the chromosphere (Irina Kitiashvili)
10:00-10:30: Discussion
10:30-11:00: Coffee break
11:00-11:30: Swirls, swirling strengths, and magnetic coupling (Oskar Steiner & Aleksei Bossart)
11:30-12:00: Numerical simulation of the vortex motion in the solar magnetic structures: multi-flux tube approach (Viktor Fedun, 30 min)
12:00-12:30: Discussion
12:30-14:00: Lunch break
14:00-14:30: Dynamics and structure of twisted magnetized structure in the solar corona (Irina Kitiashvili)
14:30-15:00: High-resolution observations of vortex dynamics of sunspots (Alexander Kosovichev)
15:00-15:30: Helicity in quiet/active sun regions (Kostas Tziotziou)
15:30-16:00: Coffee break
16:00-17:30: Discussion & future tasks

Discussion points:

1) Generating mechanisms of small-scale and giant tornadoes
2) Alfvén/MHD wave origins in the twisting motions and flows of plasma along helical magnetic structures
3) When does vorticity become more important than helicity?
4) Role of magnetic helicity in such structures and how can it be derived from velocity-based and magnetic field-based techniques
5) Coupling of hydrodynamic (plasma- dominated) vorticity with magnetically-dominated vorticity
6) Helioseismology diagnostics of subsurface vortex flows

Friday Feb 8

Summary of meeting and assignments for next period

09:00-10:30: Compilation of discussions/results during previous days and discussion of appropriate future steps/actions and collaborative work
10:30-11:00: Coffee break
11:00-12:30: Continuation of morning session and discussion about a review paper and other collaborative publications
12:30-14:00: Lunch break
14:00-16:00: Wrap-up of meeting and decision about future meeting dates (Regular telecons?). AoB
16:00 End of Meeting