

IHOP_Submission

Title of Proposed Observation:

[SOOP: R_SMALL_HRES_MCAD_Polar-Rotation] Solar Orbiter Extended Polar Rotation coordinated with Hinode

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Main Objective:

The aim of the HOP is to obtain coordinated observations of the north pole between SO/PHI-HRT and Hinode/SP while Solar Orbiter maps the pole from out of the ecliptic during a large part of a solar rotation, for twenty-one days.

Scientific Justification:

The goal of this HOP is to acquire coordinated observations between the High Resolution Telescope (HRT) of the Polarimetric and Helioseismic Imager of Solar Orbiter (SO/PHI) and the Hinode spectropolarimeter (Hinode/SP), of the solar north pole. The observation plan corresponds to the Polar Rotation SOOP (RSG_111) which will take place between October 9 and 30, 2025, during the last week of Remote Sensing Window (RSW) 24 of the Solar Orbiter mission and extending for two more weeks after it. SO/EUI and SO/SPICE will also support the SOOP from the Solar Orbiter side.

Solar Orbiter will be observing the north pole from an out-of-ecliptic orbit, reaching solar latitudes as large as almost 17 deg, on October 14, and declining just to 15.5 deg by the end of the SOOP. The spacecraft will be situated at a distance between 0.53 and 0.74 au, which will allow HRT to achieve a resolution of 190 km on the Sun at the closest point. The longitudinal separation angle between Solar Orbiter and Earth will range from 1.92 deg to 16.52 deg, from start to end of the SOOP.

SO/PHI will be observing for the whole 21 days of SOOP duration, taking data at a regular cadence of 1 hour. This will provide unprecedented information of the polar cap evolution during a large fraction of a full solar rotation while being out of the ecliptic, at a heliographic latitude larger than 15.5 deg for the whole period. The changes in small magnetic features already seen during recent campaigns will be followed in more detail in this long plan from high latitudes all along. Along with this, the SOOP starts with Solar Orbiter almost in alignment with Earth, and the angle between Solar Orbiter and Earth viewpoint will be increasing up to 16.5 deg separation while the latitudes change only slightly in the same period. This configuration will allow to see the same polar features from Hinode and SO/PHI, with the more direct Solar Orbiter view, at a collection of increasing angles, adding layers of information both for observations, modelling and constraints for stereoscopic studies that will open the possibility of three-dimensional view of polar features.

SO/EUI will support the SO/PHI-HRT observations along the SOOP, performing 2-hour HRI-EUV bursts twice a day, matching with Proba-3/ASPIICS observations, with cadences of 10 seconds. This strategy will be followed between October 9 and 16. From October 14T00:00:00 to October 15T00:00:00, 24-hour HRI-EUV bursts will be performed, with a cadence of 1 minute, coinciding with the maximum latitude achieved by the spacecraft in this window. Then, for the rest of the extension period (17-30 October), one 2-hour HRI-EUV burst per day, with cadences of 10 seconds, will be carried out. FSI synoptic observations are conducted during all the SOOP with a cadence of 6 minutes.

SO/SPICE will support the SOOP as well during its whole duration. SO/SPICE will perform a combination of large polar limb rasters with 13' FOV and small faster ones of 4' with 1 hour cadence, to obtain both larger context maps and shorter evolution dynamics.

Dates: 9-30 October 2025, co-observations of north pole with Solar Orbiter during a 21 days period polar mapping.

See Additional remarks about breaks and particular events during the SOOP time period.

Time window:

9 October 00:00 UT to 30 October 00:00 UT, 21 days, as co-observation with SO/PHI-HRT, SO/EUI and SO/SPICE.

Interruptions during the co-observations are not an issue.

Target(s) of interest: Polar region: Solar north pole.

The exact pointing will be made public via the dedicated SO web page:

<https://s2e2.cosmos.esa.int/confluence/display/SOSP/Solar+Orbiter+Planning+-+for+coordination+with+external+parties>

SOT requests:

Time interval: From 9 October 2025, 00:00 UT to 30 October 00:00 UT

Pointing: North Pole. See the remarks section below for the URL to the Solar Orbiter pointing webpage.

Please ensure that the limb is contained in the field of view.

During the Polar Rotation SOOP observation interval, as telemetry allows, please schedule 1 or 2 full-FOV fast maps of the north polar region ****per day****. The program listed for FSM for HOP81, including the appropriate margin factor, can be used

(https://www.isas.jaxa.jp/home/solar/hinode_op/hop.php?hop=0081).

EIS requests:

Please run EIS as in Study ID 618 (HOP81_new_study_v2)

XRT requests:

Please run the standard polar observation mode:

<Al/poly>

FoV 384 pix x 384 pix, Binning: 1 x 1, Time resolution: < 1 min.

Exposure time: 16.34 sec, JPEG Quality: Q75

Data rate: 7.6 Mbits/h (one image/1 min)

<G-band>

FoV 384 pix x 384 pix, Binning: 1 x 1, Time resolution: 30 min

IRIS requests:

Additional instrument coordination:

Co-observations with Solar Orbiter

SOOP: R_SMALL_HRES_MCAD_Polar-Rotation: RSG_111

<https://s2e2.cosmos.esa.int/confluence/display/SOSP/Solar+Orbiter+Planning+-+for+coordination+with+external+parties>

Previous HOPs:

Prior HOPs were submitted for co-ordinated polar observations with Solar Orbiter during the October 2023, October 2024 and March 2025 Remote Sensing Windows. This HOP is similar to those previous cases, corresponding to HOPs 0470, 0494 and 0499. Particularly, the present one is an extended version of HOP 0499, with the SOOP being itself a longer version of the March 2025 one.

Work performed with the co-ordinated SO/PHI-HRT and SP observations from October 2023, dealing with the reprojection and analysis of magnetic field configuration from the two vantage points, has been presented by Alejandro Moreno in several meetings (COFFIES workshop, XVI Reunión científica SEA, IX REFSH...) and is being prepared for publication.

Additional remarks:

There will be two breaks in the 21-days observation period:

i) October 9th, between 03:15 and 07:00,

ii) and from October 16th at 16:15 until October 17th at 01:35.

During those times the spacecraft will stop its polar pointing for trajectory manoeuvres.

On October 14th, during the maximum heliographic latitude of Solar Orbiter, EUI will observe for the whole 24 hour period at 1 min cadence.

From October 9th to 16th, during Proba-3/ASPIICS observations, EUI will arrange their bursts to coincide with ASPIICS, to get co-observation information.