1.1.3.2.1 How does the Sun's magnetic field change over time?

Description of the objective:

The process by which the Sun's field reverses at solar maximum is highly complex: lack of observations of the polar solar field greatly hampers our understanding of this process. Ulysses in situ observations contributed to measurements of the previous cycle's reversal (e.g Jones et al., 2003). Solar Orbiter will image the polar field with PHI while simultaneously measuring the field in space at a range of locations, making more precise measurements of the solar reversal and its effects on the heliosphere. While the nature of the solar field reversal is part of Objective 4: How does the solar dynamo work and drive connections between the Sun and the heliosphere?, here we are interested in how this affects the coronal and heliospheric magnetic fields.

We will measure how the polarity and large scale structure of the Sun's magnetic field in interplanetary space varies close to the Sun as it moves from solar minimum towards maximum and the global field reverses.

Even though part of this objective can be addressed with in situ only measurements, it would make more sense to have access to full disk remote sensing observations in order to properly understand how the in situ changes are linked to the overall changes in the solar field. For this, we need long-term observations at synoptic modes (for telemetry reasons), by targeting the full disk for both photospheric and coronal fields. Since such (low resolution) observations already exist from Earth, it would mostly be interesting to observe when Solar Orbiter is at the far side of the Sun or for intermediate regions between an alignment with the Earth and the far side (regular spacing in longitude). This should also be repeated for different latitudes. Since in situ MAG measurements are key for this objective, good statistics during EMC Quiet periods are required.

This objective can be addressed by SOOP L_FULL_HRES_LCAD_MagnFieldConfig, which has been mainly created for this goal.

- SPICE:
  - Target: As appropriate for the connectivity with *in situ* instruments and other spacecraft, coronal holes.
  - Observing mode: Composition mapping
  - Slit: 30"
  - Exposure time/cadence and number of X positions: 180 s, X=32
  - Field of View: 16'x11'
  - Number of repetitions of the study: 5
  - Observation time: 8 hours (1.6 hours per study) – faster raster to allow observations of possible temporal changes of the source composition.
  - Key SPICE lines to be included: Ne VIII 770 Å, Ne VIII 780 Å, Mg IX 706 Å, O II 718 Å, O IV 787 Å, O V 760 Å, O V 761 Å, O VI 1032 Å, Ne VI 999 Å, Ne VI 1010 Å, Mg VIII 772 Å, Mg VIII 782 Å, C III 977 Å, Fe III 1017 Å, Si II 992 Å – 15 lines (2 profiles+ 13 intensities)
  - Observing window preference: Long term observations, multiple orbits, high latitude preferred.
  - Other instruments: All instruments.
  - Comments: *The choice of lines, and also the number of intensities and profiles, is flexible, although the sum of the intensities and profiles is constrained to a maximum (e.g 15 for composition mapping). While varying the number of intensities and profiles, within the maximum, has no effect on the duration of the study, it will have an effect on the telemetry*.