Space Weather activities in Slovakia

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• The research related to **space weather (SWE)** has one of the longest history among other space research topics in Slovakia.
Collection of Capabilities and Assets in Slovakia related to SWE frameworks

Table 4.1: List of Slovak assets in space weather framework (according domains presented in Section 3).

<table>
<thead>
<tr>
<th>NAME</th>
<th>TECHNOLOGY</th>
<th>OPERATOR</th>
<th>COUNTRY</th>
<th>LOCATION</th>
<th>LON [deg]</th>
<th>LAT [deg]</th>
<th>ALT [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronagraphs</td>
<td>Telescopes for solar corona observations</td>
<td>AI SAS</td>
<td>SK</td>
<td>Lomnický</td>
<td>20.2131</td>
<td>49.1951</td>
<td>2634</td>
</tr>
<tr>
<td>SWE-S</td>
<td>Spectroscopic telescope for solar corona and prominences</td>
<td>AI SAS</td>
<td>SK</td>
<td>Lomnický</td>
<td>20.2131</td>
<td>49.1951</td>
<td>2634</td>
</tr>
<tr>
<td>Solar telescopes</td>
<td>Telescopes for solar atmosphere observations</td>
<td>SUH</td>
<td>SK</td>
<td>Hrušovany</td>
<td>18.1911</td>
<td>47.8754</td>
<td>114</td>
</tr>
<tr>
<td>Solar telescopes</td>
<td>Telescopes for solar atmosphere observations</td>
<td>AOP</td>
<td>SK</td>
<td>Prešov</td>
<td>21.2563</td>
<td>48.9997</td>
<td>282</td>
</tr>
<tr>
<td>Solar telescopes</td>
<td>Telescopes for solar atmosphere observations</td>
<td>AOP</td>
<td>SK</td>
<td>Rimavská Sobota</td>
<td>20.0051</td>
<td>48.3742</td>
<td>218</td>
</tr>
<tr>
<td>Space R&amp;D</td>
<td>Laboratory infrastructure for Space R&amp;D</td>
<td>IEP SAS</td>
<td>SK</td>
<td>Košice</td>
<td>21.2609</td>
<td>48.7060</td>
<td>203</td>
</tr>
<tr>
<td>Neutron Monitor</td>
<td>Detectors of secondary cosmic rays</td>
<td>IEP SAS</td>
<td>SK</td>
<td>Lomnický</td>
<td>20.2131</td>
<td>49.1951</td>
<td>2634</td>
</tr>
<tr>
<td>SEVAN</td>
<td>Detectors of secondary cosmic rays</td>
<td>IEP SAS</td>
<td>SK</td>
<td>Lomnický</td>
<td>20.2131</td>
<td>49.1951</td>
<td>2634</td>
</tr>
<tr>
<td>AMOS-E, AMONET</td>
<td>Detectors of thermosphere-ionosphere</td>
<td>IEP SAS</td>
<td>SK</td>
<td>Koloniecke sedlo</td>
<td>22.2737</td>
<td>48.3347</td>
<td>448</td>
</tr>
<tr>
<td>INTERMAGNET</td>
<td>Detectors of the Earth's magnetic field</td>
<td>ESI SAS</td>
<td>SK</td>
<td>Hrušovany</td>
<td>18.1911</td>
<td>47.8754</td>
<td>114</td>
</tr>
</tbody>
</table>

Table 5.1: List of Slovak entities in space weather framework.

<table>
<thead>
<tr>
<th>Entity</th>
<th>HQ</th>
<th>Industry</th>
<th>Domains</th>
<th>Type of business</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institute of Experimental Physics, Slovak Academy of Sciences (IEP SAS)</td>
<td>Košice, Slovakia</td>
<td>Academia, R&amp;D institute, Observatory</td>
<td>SWE - Ionosphere, Weather</td>
<td>HW, SW, services, exports</td>
<td><a href="http://iei.sk/">http://iei.sk/</a></td>
</tr>
<tr>
<td>Observatory Astronomical Institute, Slovak Academy of Sciences (AI SAS)</td>
<td>Turčianske Teplice, Slovakia</td>
<td>Academia, R&amp;D institute, Observatory</td>
<td>SWE - Solar, Weather</td>
<td>HW, SW, services, exports</td>
<td><a href="https://astro.sk">https://astro.sk</a></td>
</tr>
<tr>
<td>Slovak Central Observatory Hrušovany (SCH)</td>
<td>Hrušovany, Slovakia</td>
<td>Academia, Observatory</td>
<td>SWE - Solar, Weather</td>
<td>HW, SW, services, exports</td>
<td><a href="http://www.sch.sk">http://www.sch.sk</a></td>
</tr>
<tr>
<td>Earth Science Institute, Slovak Academy of Sciences (SASI)</td>
<td>Bratislava, Slovakia</td>
<td>Academia, Observatory</td>
<td>SWE - Geomagnetic Conditions</td>
<td>Services, expertise</td>
<td><a href="http://www.egu.sk">http://www.egu.sk</a></td>
</tr>
<tr>
<td>Faculty of Mathematics, Physics and Informatics (FMPI)</td>
<td>Bratislava, Slovakia</td>
<td>Academia, University, Observatory</td>
<td>SWE - Geomagnetic Conditions</td>
<td>Services, expertise</td>
<td><a href="http://www.fmpi.sk">http://www.fmpi.sk</a></td>
</tr>
<tr>
<td>Faculty of Electrical Engineering and Informatics, Technical University of Košice (FEIUK)</td>
<td>Košice, Slovakia</td>
<td>Academia, University, R&amp;D institute, Observatory</td>
<td>SWE - Ionosphere, Weather</td>
<td>SW, services, exports</td>
<td><a href="http://www.feiuk.sk/">http://www.feiuk.sk/</a></td>
</tr>
<tr>
<td>Globalogic Slovakia s. a.</td>
<td>Košice, Slovakia</td>
<td>IT company</td>
<td>SWE - Ionosphere, Weather</td>
<td>SW, services</td>
<td><a href="http://www.globalogic.com/sk/">http://www.globalogic.com/sk/</a></td>
</tr>
<tr>
<td>SPACE@LAB startup</td>
<td>Košice, Slovakia</td>
<td>Startup</td>
<td>SWE - Ionosphere, Weather</td>
<td>SW, services</td>
<td><a href="https://space@lab.sk/space/index.php">https://space@lab.sk/space/index.php</a></td>
</tr>
<tr>
<td>Q-Products s.r.o.</td>
<td>Bratislava, Slovakia</td>
<td>Company</td>
<td>SWE - Heliospheric, Weather</td>
<td>HW, services</td>
<td><a href="https://www.q-products.sk/">https://www.q-products.sk/</a></td>
</tr>
<tr>
<td>CTRL s.r.o.</td>
<td>Košice, Slovakia</td>
<td>Company</td>
<td>SWE - Heliospheric, Weather</td>
<td>HW, services</td>
<td><a href="http://www.ctrl.sk/">http://www.ctrl.sk/</a></td>
</tr>
</tbody>
</table>
SLOVAK NATIONAL SPACE SAFETY PROGRAMME (SK-S2P) WORKSHOP

- Space Weather (SWE)
- Planetary Defence, Near-Earth objects (NEO)
- Space debris and Clean space

15th FEBRUARY 2022
3.1) Solar Weather [https://swe.ssa.esa.int/solar-weather]
- Development of instruments for ground-based observations of solar disk and corona in VIS and IR spectral lines by the coronagraph
- Observations of solar prominences and solar corona in emission spectral lines with the coronagraph
• New instrument for spectropolarimetry of the solar corona and prominences at the Observatory Lomnický Štít:

COMP- S: Coronal Multi-channel Polarimeter for Slovakia

- Lyot filter with polarimeter (VIS and IR, 500 – 1100nm)

• Solar telescopes for solar atmosphere observations at public observatories:
  - Slovak Central Observatory in Hurbanovo, Astronomical Observatory in Prešov,
    Astronomical Observatory in Rimavská Sobota, Astronomical Observatory in Hlohovec

3.1) Solar Weather [https://swe.ssa.esa.int/solar-weather]
• Study of solar activity during solar cycles:
  - Telescopes with a lense and with a mirror for optical observation of the sunpots in the solar photosphere
  - LUNT telescope with H-alpha filter for photographic observation of the solar chromosphere and prominences

Hurbanovo:
- Radio spectrometer CALLISTO: registration of solar radio bursts at 45 – 800 MHz (ISWI instrument)
- Spectrometer Ocean Optics HR4000 and horizontal solar telescope (50/3500 cm): measurements of solar continuum in VIS spectral band with the aim to detect solar flares (Astronomical institute, CAS, Ondřejov, Czech Republic)
• Institute of Experimental Physics (IEP), SAS, Košice (Department of Space Physics)

• 3.2) Heliospheric Weather [https://swe.ssa.esa.int/heliospheric-weather]
  - Measurements of energetic particles by own instruments on space missions: as Radioastron, Double Star, BepiColombo, JUICE, and etc.
  - Infrastructure for Space R&D projects

• 3.3) Space Radiation [https://swe.ssa.esa.int/space-radiation]
  - Cosmic Rays measurements (ground based observations using Neutron monitor and SEVAN) [http://neutronmonitor.ta3.sk]

• 3.4) Ionospheric Weather [https://swe.ssa.esa.int/ionospheric-weather]
  - AMON (Airglow MONitor) - processes in the thermosphere-ionosphere system
  - ASPIS - predictions of ionospheric scintillations

More at http://uef.saske.sk
3.5) Geomagnetic Conditions [https://swe.ssa.esa.int/geomagnetic-conditions]

- Registration of the Earth’s magnetic field:
  Technical details of instruments in Hurbanovo within the INTERMAGNET:
  ▪ DI-fluxgate magnetometer (type ELSEC 810, Zeiss Theo 015B)
  ▪ DI-fluxgate magnetometer (type LEMI 203)
  ▪ proton magnetometer (type PMG 1)
  ▪ Torsion photoelectric magnetometer (TPM) employing Bobrov-type quartz variometers
  ▪ Magson fluxgate magnetometer

- Investigation of the geomagnetic bursts.
• Potential new players:

  - **Q-Products a.s.** (ruggedized computers and displays, https://www.qproducts.sk/about-us/)
  - **CTRL s.r.o.** (cyber-physical systems, http://www.ctrl1.eu)
  - **Faculty of Electrical Engineering and Informatics, Technical University of Košice** (space/geo data processing and support of their decision processing using machine/deep learning approaches, https://kkui.fei.tuke.sk/en/)
  - **GlobalLogic Slovakia s.r.o.** (leader in digital engineering, https://www.globallogic.com)
  - **SPACE::LAB startup** (Slovak Space Incubator team connected directly to the IEP SAS in Košice: digital solutions by advanced machine learning techniques)
• EU Space Programme and European Union Agency for the Space Programme (EUSPA)

- Two Slovak scientists are nominated as National representatives to the EU Space Programme Committee - the Space Situational Awareness (SSA)/Space Weather (SWE).

- The National Commission for Space Activities in the Slovak Republic is coordinated by the Slovak Space Office at the Ministry of Education, Science, Research and Sport of the Slovak Republic.
• **International Space Weather Initiative (ISWI) in Slovakia**

  **National Coordinator:** I. Dorotovič

  **Instruments:**

  1. **CALLISTO** in the Slovak Central Observatory in Hurbanovo
     - operational since **December 2011**
     - Data available at: [http://soleil.4ds.ch/solarradio/callistoQuicklooks/](http://soleil.4ds.ch/solarradio/callistoQuicklooks/)

  2. **SEVAN** in the Department of Space Physics of the IEP SAS, Lomnicky Peak Observatory
     - operational since **March 2014**
     - Data available at: [http://crd.yerphi.am/Lomnicky_stit_SEVAN_Data](http://crd.yerphi.am/Lomnicky_stit_SEVAN_Data)

  **Events:**

  **National Solar Physics Meetings (NSPMs)**
  - 26th NSPM in June 2022
  - contributions on space weather events and studies as well

• **COSPAR and SCOSTEP:**

Slovak scientists are actively participating also in both the

• **COSPAR**, [http://nccospar.saske.sk/](http://nccospar.saske.sk/)

and the

• **SCOSTEP/PRESTO**, [https://scostep.org/presto-science-program/](https://scostep.org/presto-science-program/)

activities.