SOLAR Instrumentation

2021

EUROPEAN SOLAR TELESCOPE

Jürgen Rendtel / Leibniz-Institut für Astrophysik Potsdam (AIP)

EINSTEIN TOWER COELOSTAT

THE VERY FIRST INSTRUMENT of a solar telescope is the device used to collect the sunlight and direct it to the optical laboratory inside the building. Coelostats provide a simple solution to that problem. They consist of two flat mirrors. One of them moves during the day following the Sun and reflects the light towards a second fixed mirror that sends the light beam to the interior of the building. The image shows the coelostat of the Einstein Tower in Potsdam (Germany), protected by a wooden dome.

EST

Jan 10-14
18th Conference on Space Weather, AMS101, online

Jan 25–29
SOLARNET School: A holistic view of the solar atmosphere - Combining space and ground-based observations

Jan 28–Feb 4
43rd COSPAR Scientific Assembly, Sydney, Australia

JANUARY

MON	TUE	WED	THU	FRI	SAT	SUN
28	29	30	31	01	02	03
04	05	06	07	08	09	**10**
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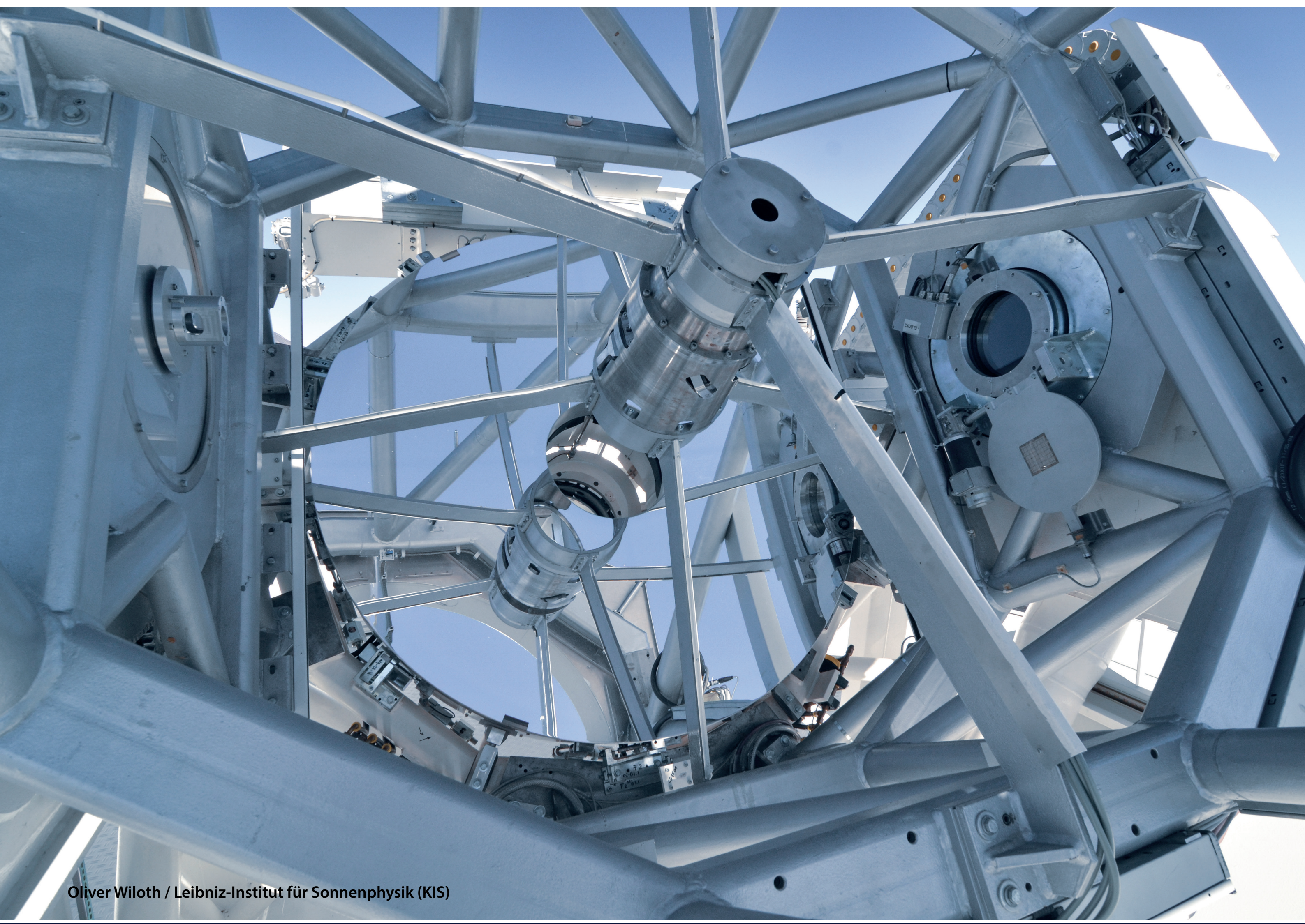
The European Solar Telescope (EST) is the next step in the European quest for a better understanding of the Sun



Oliver Wiloth / Leibniz-Institut für Sonnenphysik (KIS)

GREGOR PRIMARY MIRROR

SUNLIGHT CAN ALSO BE COLLECTED USING A REFLECTOR TELESCOPE DESIGN, with a primary and a secondary mirror plus other auxiliary mirrors to feed the instruments in the optical laboratory. The primary mirror of a solar telescope is concave and needs to be polished to a high degree of precision to deliver excellent image quality. Its size sets the spatial resolution and the sensitivity of the telescope. The image shows the primary mirror of the GREGOR telescope, with a diameter of 1.5 metres, in its supporting structure.

EST

Feb 1-5
International School of Space Science on Dynamical Systems and Machine Learning Approaches to Sun-Earth Relations, online

Feb 3
EAST General Assembly, online

Feb 20-24
Solar Orbiter remote-sensing check-out window 2 (0.51 AU)

FEBRUARY

MON	TUE	WED	THU	FRI	SAT	SUN
01	**02**	**03**	**04**	**05**	06	07
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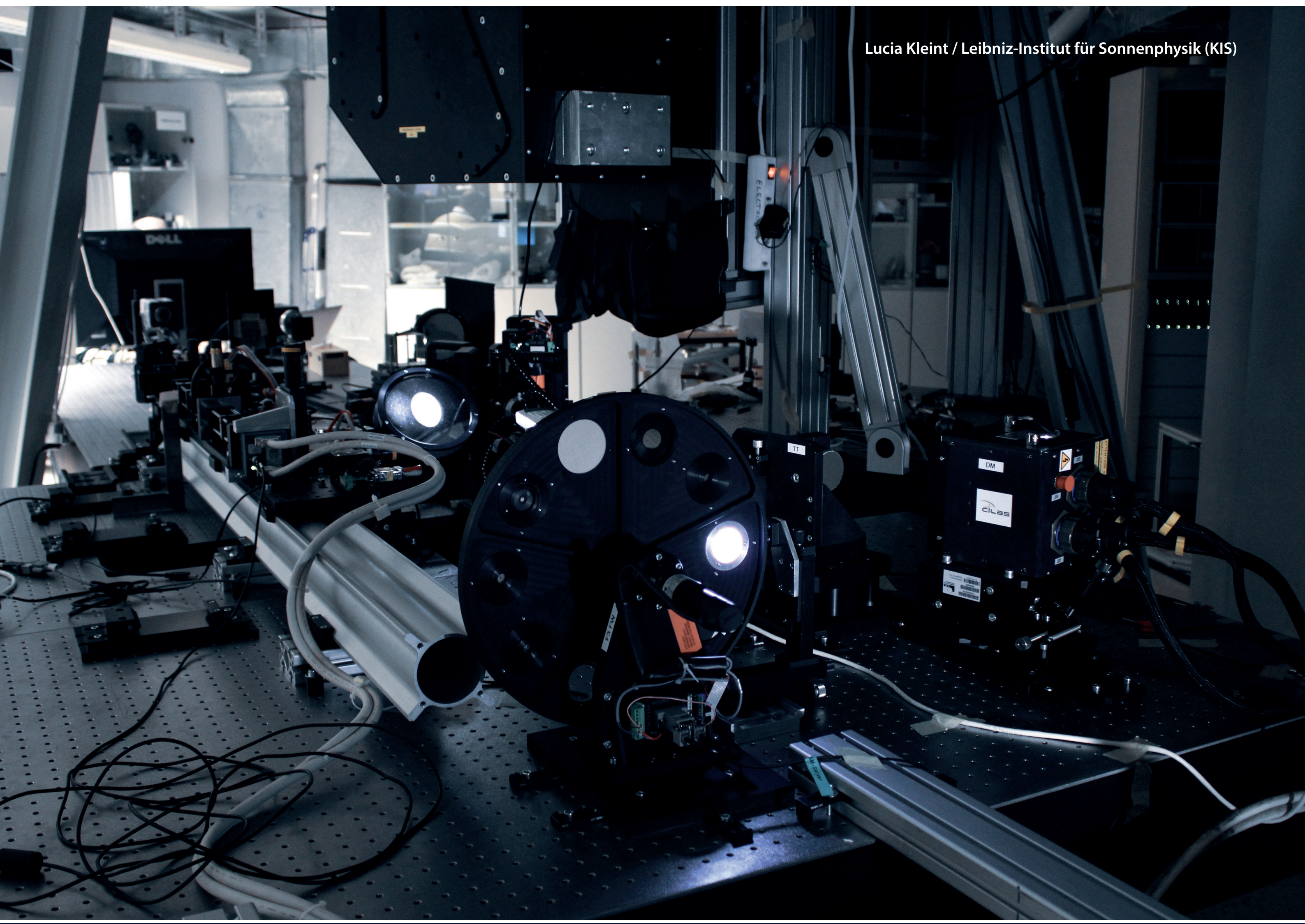

Lucia Kleint / Leibniz-Institut für Sonnenphysik (KIS)

GREGOR ADAPTIVE OPTICS

TURBULENCE IN THE EARTH'S ATMOSPHERE degrades the images taken by solar telescopes, making them blurry. This degradation is minimized with the help of adaptive optics systems. They consist of very fast wavefront sensors and deformable mirrors that correct the distortions of the incoming light in real time, restoring the quality of the images. EST will have a sophisticated Multi-Conjugated Adaptive Optics System with 5 deformable mirrors. The image shows the adaptive optics system of the GREGOR telescope in Tenerife (Spain).

EST

Mar 2-4
Cool Stars 20.5, virtual meeting

Mar 14
Peak of Normids meteor shower

Mar 20
Spring equinox (09:37 GMT)

Mar 21-23
Solar Orbiter remote sensing check-out window 3 (0.68 AU)

MARCH

MON	TUE	WED	THU	FRI	SAT	SUN
01	**02**	**03**	**04**	05	06	07
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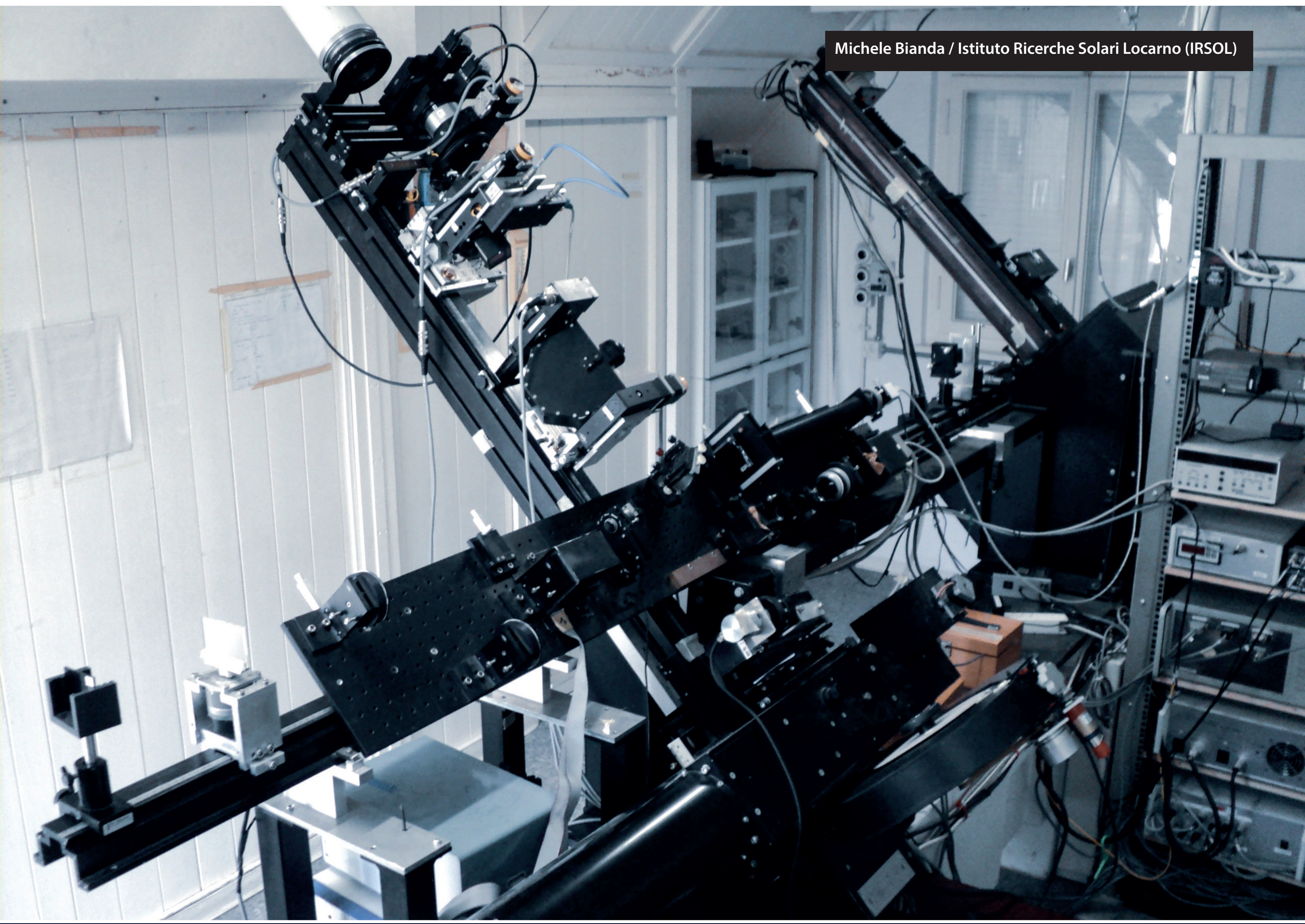

Michele Bianda / Istituto Ricerche Solari Locarno (IRSOL)

ZÜRICH IMAGING POLARIMETER

TO MEASURE THE POLARIZATION OF THE LIGHT with high sensitivity, solar telescopes are equipped with instruments called spectropolarimeters. They consist of a polarimeter, a spectrograph with a slit and a diffraction grating, and one or more cameras. The image shows the Zürich Imaging Polarimeter mounted near the focal plane of the Gregory Coudé Telescope in Locarno (Switzerland). This instrument is used to measure very weak polarization signals coming from the solar photosphere and chromosphere. It is the most sensitive of its class in operation.

Apr 6-9
Solar Orbiter School, Les Houches, France

Apr 17
Mars is 0.1 degrees North of the Moon

Apr 22
Peak of Lyrids meteor shower (13:00 GMT)

Apr 23
Peak of Pi Puppids meteor shower (12:00 GMT)

APRIL

MON	TUE	WED	THU	FRI	SAT	SUN
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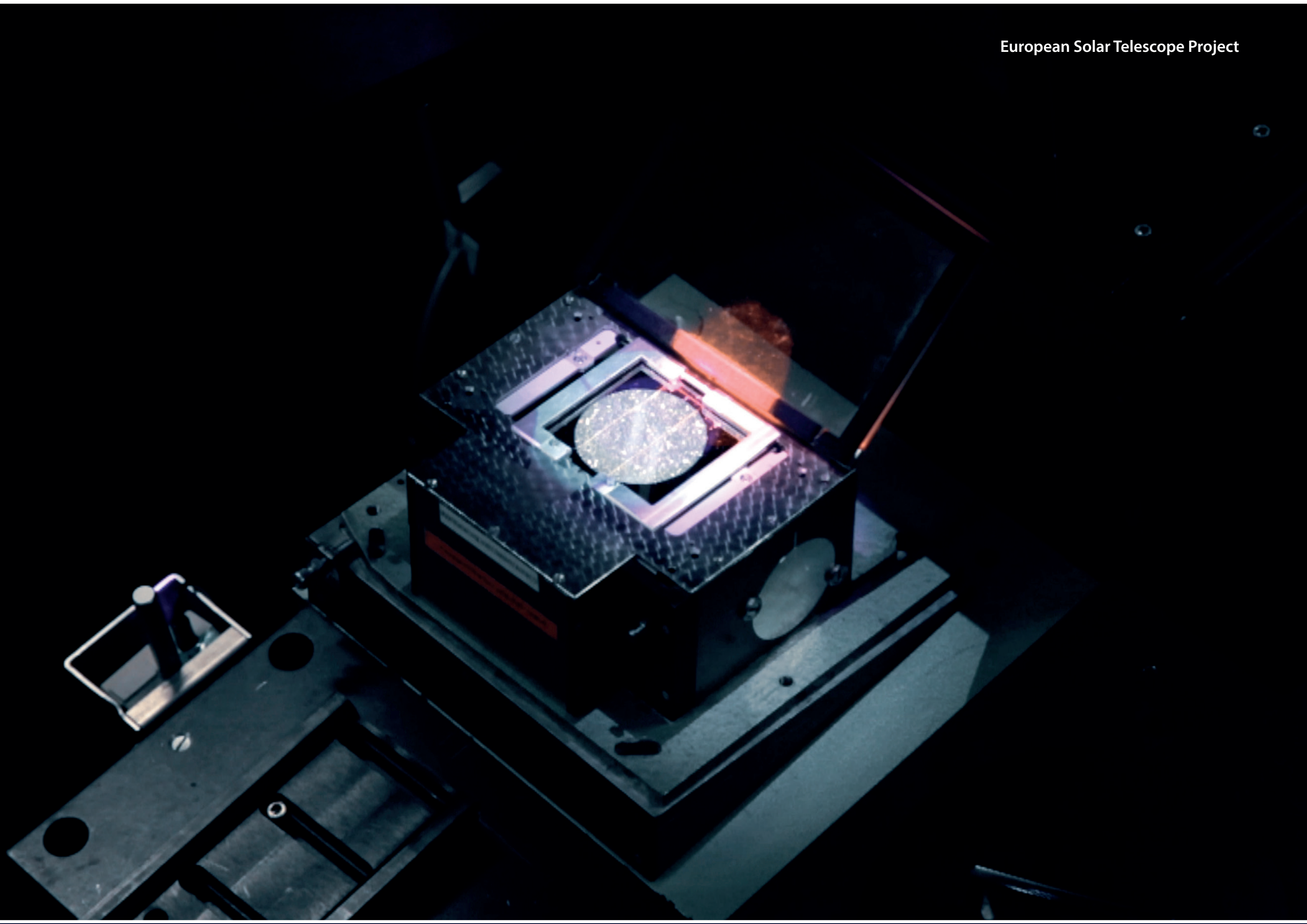

VTT SPECTROGRAPH SLIT

THE FIRST ELEMENT OF A GRATING SPECTROGRAPH IS THE SLIT. It is placed at the focal plane of the telescope and consists of a very thin, long hole that selects part of the solar image and lets the light go through. The spectrograph then disperses the light, producing the spectrum for each spatial position along the slit. The slit is etched on a coated metal plate. Usually, a camera takes images of that plate to provide context information. The picture shows the spectrograph slit assembly of the German Vacuum Tower Telescope in Tenerife (Spain).

May 6
Peak of Eta Aquariids meteor shower (03:00 GMT)

May 8
Peak of Eta Lyrids meteor shower

May 24-27
Hinode-14/IRIS-11 Joint Science Meeting, Washington, USA

MAY

MON	TUE	WED	THU	FRI	SAT	SUN
26	27	28	29	30	01	02
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Jürgen Rendtel / Leibniz-Institut für Astrophysik Potsdam (AIP)

EINSTEIN TOWER SPECTROGRAPH

AFTER CROSSING THE SLIT, the light is directed to the spectrograph grating. First, it has to be collimated and then focused on the camera. To ensure high wavelength dispersion, the light must travel a long distance, therefore spectrographs are large instruments. They can be mounted horizontally or vertically. The image shows the horizontal spectrograph of the Einstein Tower in Potsdam (Germany). The slit and the spectrograph cameras are on one end of the optical bench and the grating on the other end.

EST

Jun 10
Annular solar eclipse

Jun 15-22
NASA Heliophysics Summer School, Boulder, USA

Jun 21
Summer solstice (03:32 GMT)

Jun 28-Jul 2
2021 SDO Science Workshop: A Decade of Discovery, Vancouver, Canada

JUNE

MON	TUE	WED	THU	FRI	SAT	SUN
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Arkadiusz Berlicki / Astronomical Institute, University of Wrocław

MSDP IMAGING SPECTROGRAPH

SOME SOLAR SPECTROGRAPHS such as the Multichannel Subtractive Double-Pass (MSDP) instrument provide highly monochromatic images across a spectral line. The images sample a long but narrow region of the solar surface to avoid overlap of different wavelengths. This region is selected using a window instead of a slit. The picture shows the entrance window of the MSDP spectrograph near the Coudé focus of the 53-cm Large Coronograph of the Astronomical Observatory of the University of Wrocklaw (Białkow, Poland).

EST

Jun 28-Jul 2
2021 SDO Science Workshop: A Decade of Discovery, Vancouver, Canada

July 30
Peak of Delta Aquariids meteor shower

July 30
Peak of Capricornids Meteor Shower

JULY

MON	TUE	WED	THU	FRI	SAT	SUN
28	29	30	**01**	**02**	03	04
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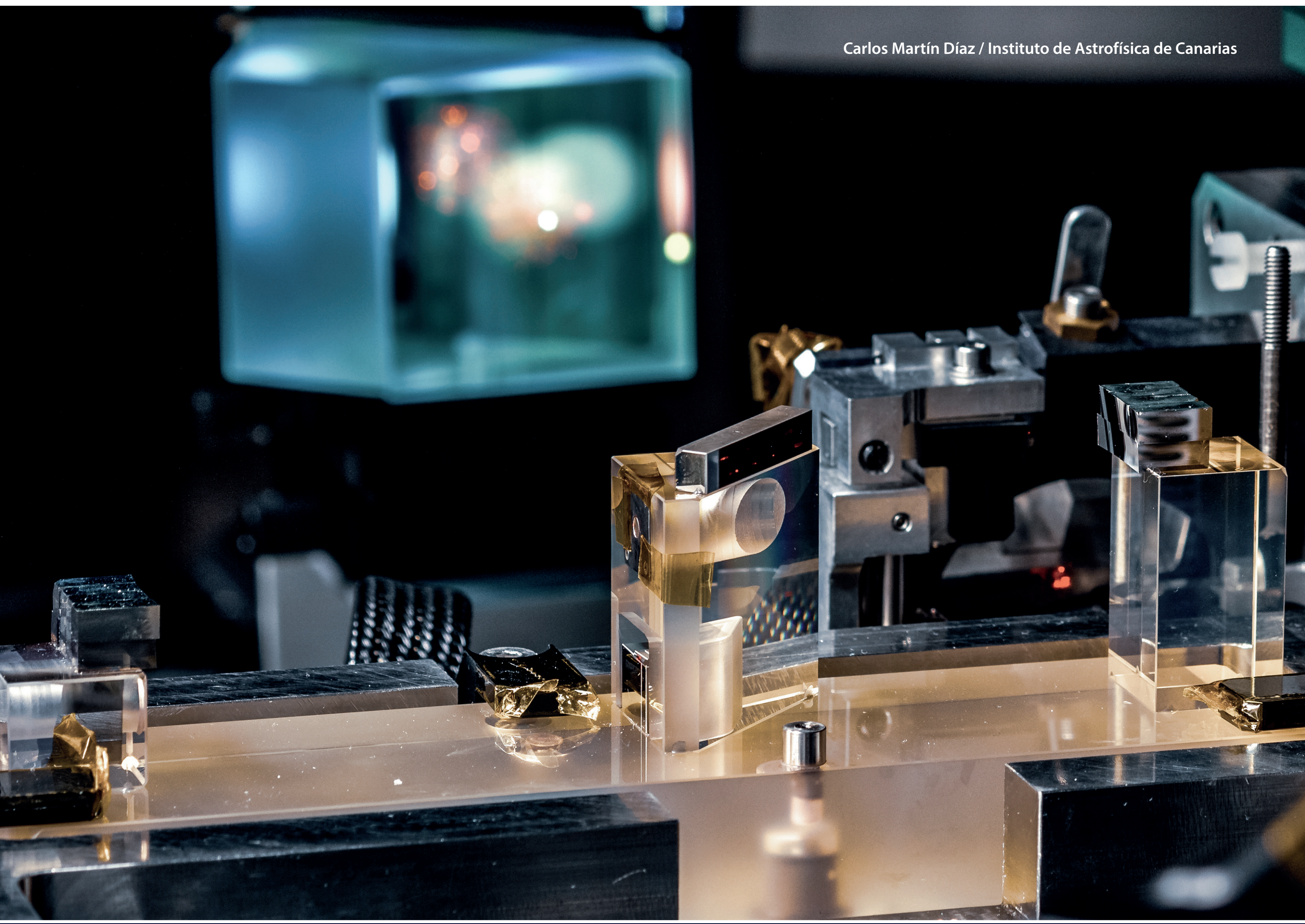
Carlos Martín Díaz / Instituto de Astrofísica de Canarias

GREGOR INFRARED SPECTROGRAPH

SPECTROGRAPHS PRODUCE NARROW IMAGES, but when combined with Integral Field Units (IFUs) they can deliver 2D polarization measurements over large fields of view. EST will be equipped with IFUs based on image slicers and microlens arrays. Image slicers "cut" the solar image into long and narrow stripes that are reordered and directed to the slit of a classical spectrograph. The picture shows the image slicer of the GRIS spectropolarimeter installed on the GREGOR telescope (Tenerife, Spain).

EST

Aug 9-13
IAUS 365: Dynamics of Solar and Stellar Convection Zones and Atmospheres, Moscow, Russia

Aug 12
Peak of Perseids meteor shower (19-22 GMT)

Aug 16-27
XXXI General Assembly of the International Astronomical Union, Busan, Republic of Korea

AUGUST

MON	TUE	WED	THU	FRI	SAT	SUN
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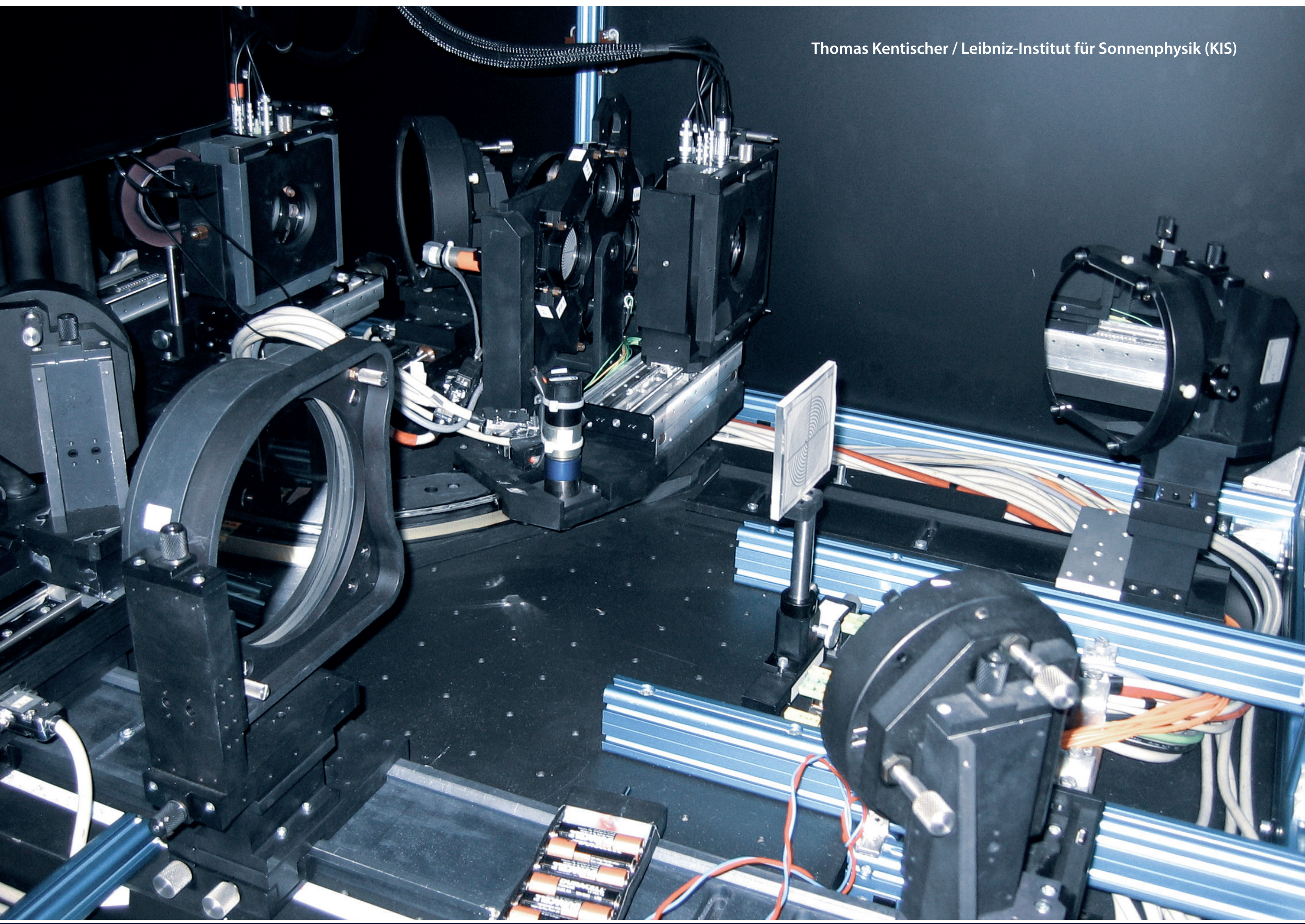

Thomas Kentischer / Leibniz-Institut für Sonnenphysik (KIS)

TRIPLE-ETALON SOLAR SPECTROMETER

NARROW-BAND TUNABLE FILTERS provide highly monochromatic images of the solar surface. Spectral lines can be scanned by tuning the wavelength transmitted by the filter sequentially. These instruments are usually based on Fabry-Pérot interferometers and can have polarimetric capabilities. They allow us to study large-scale physical processes occurring on the Sun. The image shows the Triple-Etalon Solar Spectrometer (TESOS), a narrow-band tunable filter operating at the German Vacuum Tower Telescope on Tenerife (Spain).

EST

Sep 5-10
16th European Solar Physics Meeting, Turin

Sep 19
Radial alignment of Solar Orbiter, Parker Solar Probe and Stereo-A

Sep 22
Autumn equinox (19:21 GMT)

Sep 28–Oct 1
Big Science Business Forum, Granada, Spain

SEPTEMBER

MON	TUE	WED	THU	FRI	SAT	SUN
30	31	01	02	03	04	**05**
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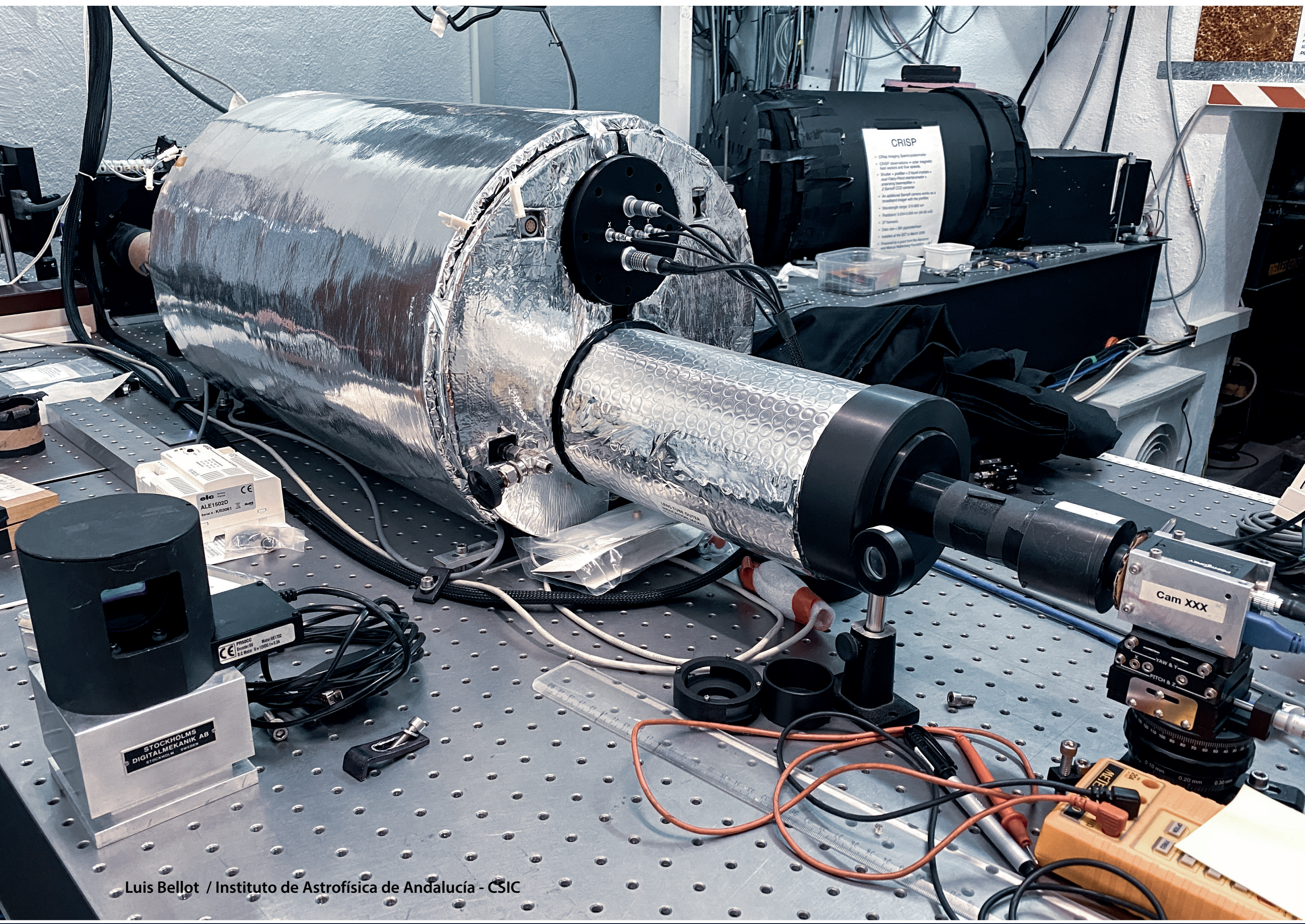

Luis Bellot / Instituto de Astrofísica de Andalucía - CSIC

CHROMOSPHERIC IMAGING SPECTROMETER

NARROW-BAND TUNABLE FILTERS are used to scan spectral lines formed in the solar photosphere and the solar chromosphere. To achieve excellent spatial resolution, they need to beat the degradation produced by turbulence in the Earth's atmosphere by taking images at very high rates (up to 80 frames per second). The picture shows the CHROMIS instrument at the optical laboratory of the Swedish 1-m Solar Telescope on La Palma (Spain). The Crisp Imaging Spectro-Polarimeter (CRISP) can be seen in the background, to the right.

EST

Oct 8
Peak of Draconids meteor shower (18:30 GMT)

Oct 10
Peak of Southern Taurids meteor shower

Oct 25-29
17th European Space Weather Week, Glasgow, UK

OCTOBER

MON	TUE	WED	THU	FRI	SAT	SUN
27	28	29	30	01	02	03
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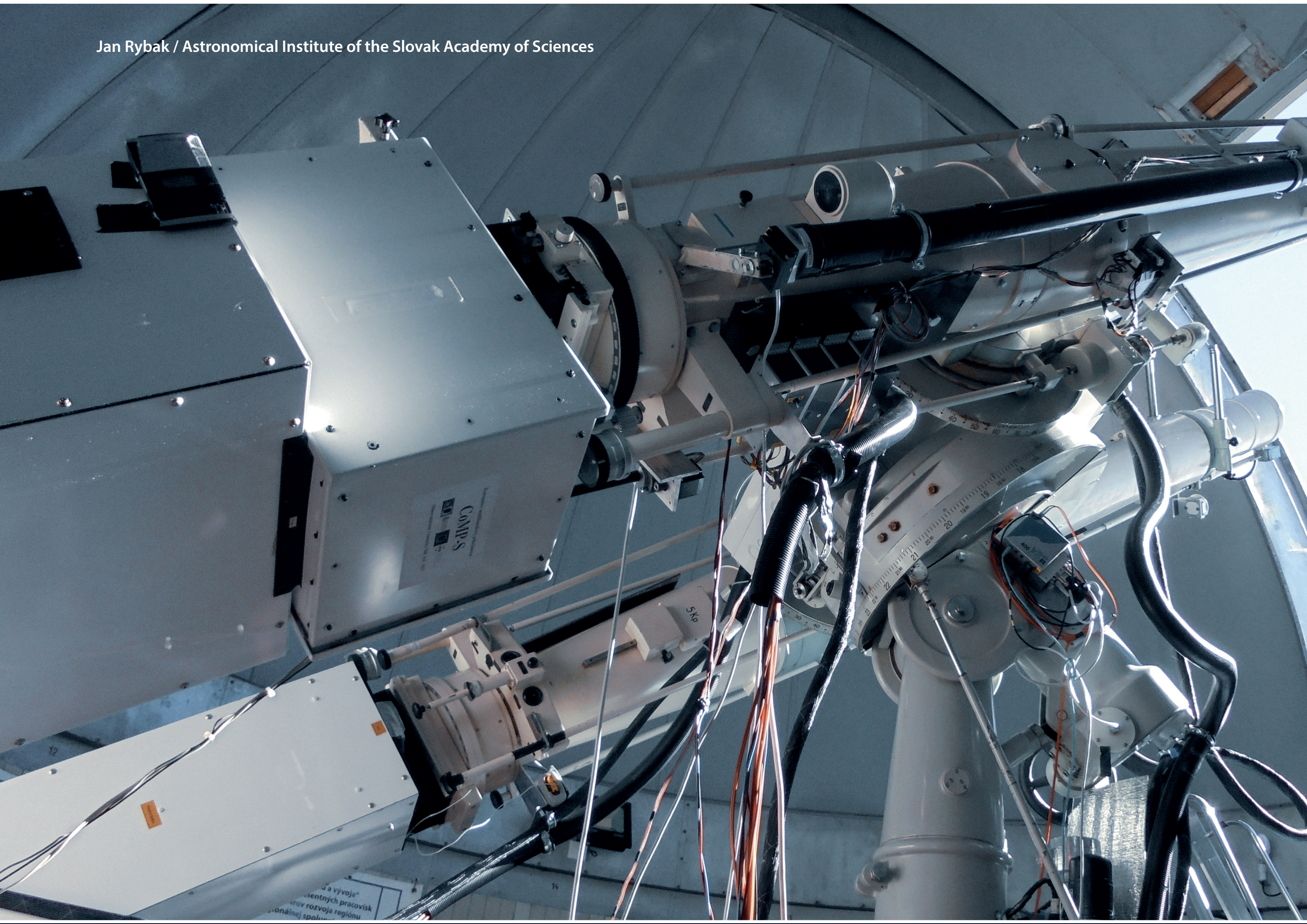

Jan Rybak / Astronomical Institute of the Slovak Academy of Sciences

CORONAL MULTICHANNEL POLARIMETER

MEASURING POLARIZATION SIGNALS IN THE SOLAR CORONA is extremely challenging, due to the weakness of coronal spectral lines. They are millions of times fainter than the solar photosphere, and thus very difficult to observe. To overcome this problem, the solar disk must be blocked to see them. This is achieved by means of special devices called coronographs. The image shows the Coronal Multichannel Polarimeter (CoMP) attached to the coronograph of the Lomnický Štít Observatory (Slovakia).

Nov 12
Peak of Northern Taurids meteor shower

Nov 26
Solar Orbiter Nominal Mission Phase starts

Nov 27
Solar Orbiter Earth Gravity Assist Manoeuvre (EGAM1)

NOVEMBER

MON	TUE	WED	THU	FRI	SAT	SUN
01	02	03	04	05	06	07
08	09	10	11	**12**	13	14
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22	23	24	25	**26**	**27**	28
29	30	01	02	03	04	05
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Max-Planck-Institut für Sonnensystemforschung (MPS)

POLARIMETRIC AND HELIOSEISMIC IMAGER

GROUND-BASED SOLAR TELESCOPES can reach extremely high spatial resolution and sensitivity. However, they are unable to observe the Sun poles properly, because of the unfavorable perspective from the Earth. This can be overcome by space missions that go out of the ecliptic. The image shows the Polarimetric and Helioseismic Imager on ESA and NASA Solar Orbiter spacecraft. It consists of two telescopes and an imaging spectropolarimeter that will measure magnetic fields in the solar polar regions with unprecedented accuracy.

Dec 4
Total solar eclipse

Dec 14
Peak of Geminids meteor shower (07:00 GMT)

Dec 21
Winter solstice (15:59 GMT)

Dec 22
Peak of Ursids meteor shower (07:00 GMT)

DECEMBER

MON	TUE	WED	THU	FRI	SAT	SUN
29	30	01	02	03	**04**	05
06	07	08	09	10	11	12
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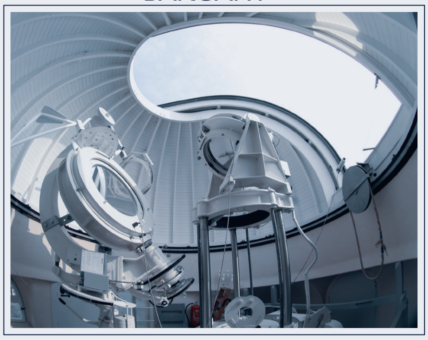
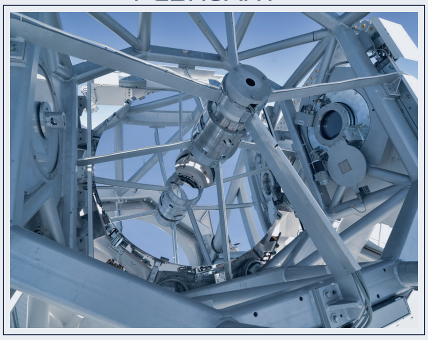
JANUARY



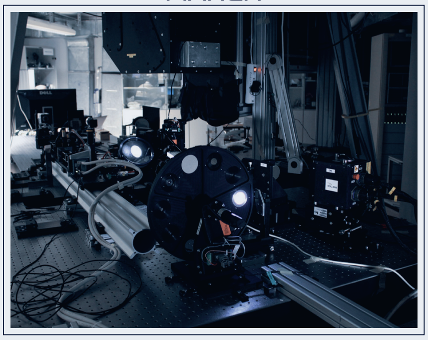
Einstein Tower coelostat
Jürgen Rendtel / AIP

FEBRUARY



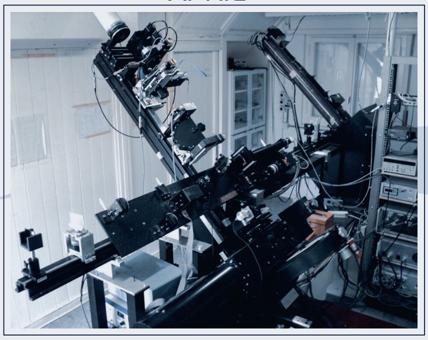
GREGOR primary mirror
Oliver Wiloth / KIS

MARCH



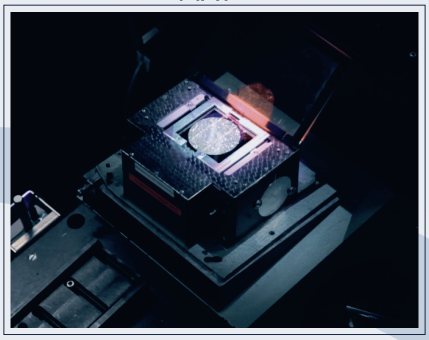
GREGOR adaptive optics
Lucia Kleint / KIS

APRIL



Zürich Imaging Polarimeter
Michele Bianda / IRSOL

MAY



VTT spectrograph slit
European Solar Telescope Project

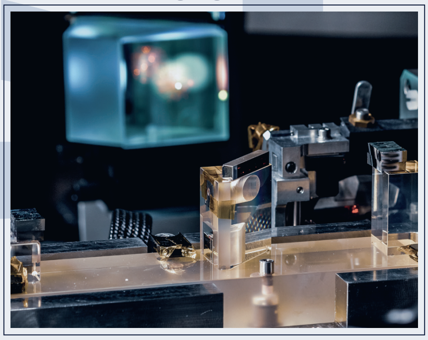
JUNE

Einstein Tower spectrograph
Jürgen Rendtel / AIP

JULY

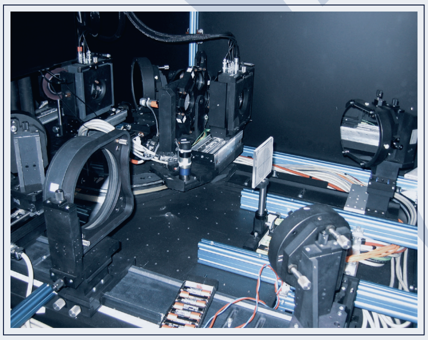
MSDP imaging spectrograph
Arkadiusz Berlicki / University of Wrocław

AUGUST



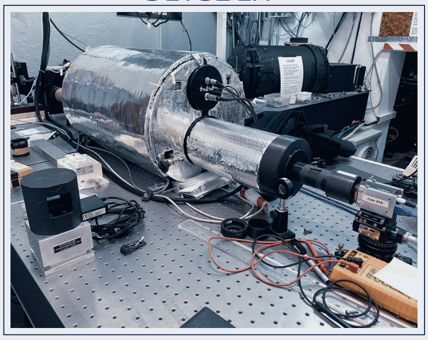
GREGOR Infrared Spectrograph
Carlos Martín Díaz / IAC

SEPTEMBER



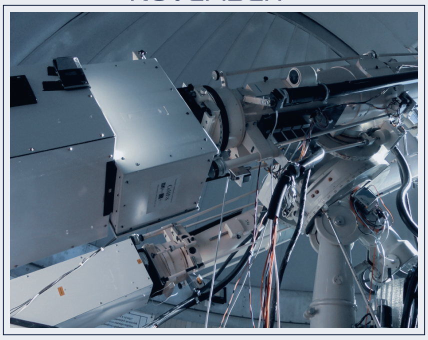
Triple-Etalon Solar Spectrometer
Thomas Kentischer / KIS

OCTOBER



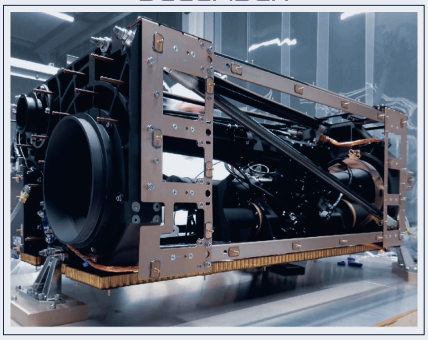
Chromospheric Imaging Spectrometer
Luis Bellot / IAA - CSIC

NOVEMBER



Coronal Multichannel Polarimeter
Jan Rybak / AISAS

DECEMBER



Polarimetric and Helioseismic Imager
Max-Planck Institut für Solarsystemforschung

european solar telescope

www.est-east.eu

COVER: BACK SIDE OF GREGOR'S PRIMARY MIRROR

The image shows the 1.5 metre primary mirror (M1) of the GREGOR solar telescope from the back. The petals house the fans used for M1 cooling. The circular structure at the center of M1 holds GREGOR's tertiary mirror (M3). The horizontal cylinder on the left side of the elevation axis contains M5, that directs the light to the optics laboratory through a vacuum tube. GREGOR is the largest solar telescope in operation in Europe. It is located at the Observatorio del Teide (Tenerife, Spain).

Credit: Oliver Wiloth / Leibniz-Institut für Sonnenphysik (KIS)

This activity has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 739500