

# Stellarium Gornergrat

**Timm-Emanuel Riesen<sup>1</sup>, Peter Schlatter<sup>1</sup>, Stéphane Gschwind<sup>2</sup>, Andreas Müller<sup>2</sup>,  
Simon Ruffieux<sup>3</sup>, Thomas Schildknecht<sup>4</sup>, Kevin Heng<sup>1</sup>**

<sup>1</sup> University of Bern, Center for Space & Habitability (CSH), Bern, Switzerland

<sup>2</sup> University of Geneva, Geneva, Switzerland

<sup>3</sup> Haute école d'ingénierie et d'architecture Fribourg, Fribourg, Switzerland

<sup>4</sup> University of Bern, Astronomical Institute (AIUB), Bern, Switzerland

timm.riesen@csh.unibe.ch

**Keywords:** outreach; robotic telescope; astronomy; space; school; education; pedagogical activity; Gornergrat; stellarium

## 1. Project description

The Stellarium Gornergrat is a long-term project carried out by an on-going collaboration between the Center for Space and Habitability (CSH), the Astronomical Institute (AIUB), the University of Geneva (UoG), and the International Foundation High Altitude Research Stations Jungfrauoch and Gornergrat (HFSJG). Its major focus lies with public outreach and education. The project's main goals are:

- To build bridges between science and society.
- To spark and foster the public's interest in space, space sciences, and astronomy.
- Attract young people to the field and illustrate potential careers in astronomy and space sciences.
- Help people recognize and understand different observable phenomena in the day and night sky and let them appreciate the beauty and delicacy of nature.

To achieve these goals, the partners installed and operate an observatory at the Kulmhotel Gornergrat with different instruments and hardware (see Figure 2). The instrumentation in the south dome has to survive challenging meteorological conditions and is under constant maintenance. Our instrument park currently consists of these 5 different instruments

1. The Allsky Camera (OMEA 8M) takes around the clock exposures of the day and night sky. This instrument replaces the previous Allsky Camera that was destroyed in the lightning incident. The camera is currently being commissioned in Bern.
2. The RiFast 600mm telescope with a huge Field of View (FOV) is ideal for deep sky objects.
3. The Planet Camera (Takahashi Mewlon-250) is ideal for planetary objects and small targets that require a smaller FOV.
4. The Constellation Camera is ideal to depict complete constellations, asterisms, and group of constellations. It has a customized housing that was developed and built in Bern.

5. The Look-through Telescope (Takahashi TAO-150) for local guests and guided tours at the observatory.

A major way to use the Stellarium Gornergrat is by scheduling observations remotely through a web portal that triggers robotic observing. Teachers, students, and the broad public can browse and pick among different astronomical activities and schedule observations. The Stellarium automatically works through the different scheduled observations and allows a registered user to access the obtained data or status information upon completion of an observation task.



*Figure 1. Comet 46P/Wirtanen observed with the 60cm DeepSky Camera at the Gornergrat. The exposure time was 120s and no filter was used. At least 4 galaxies are visible in the same frame.*

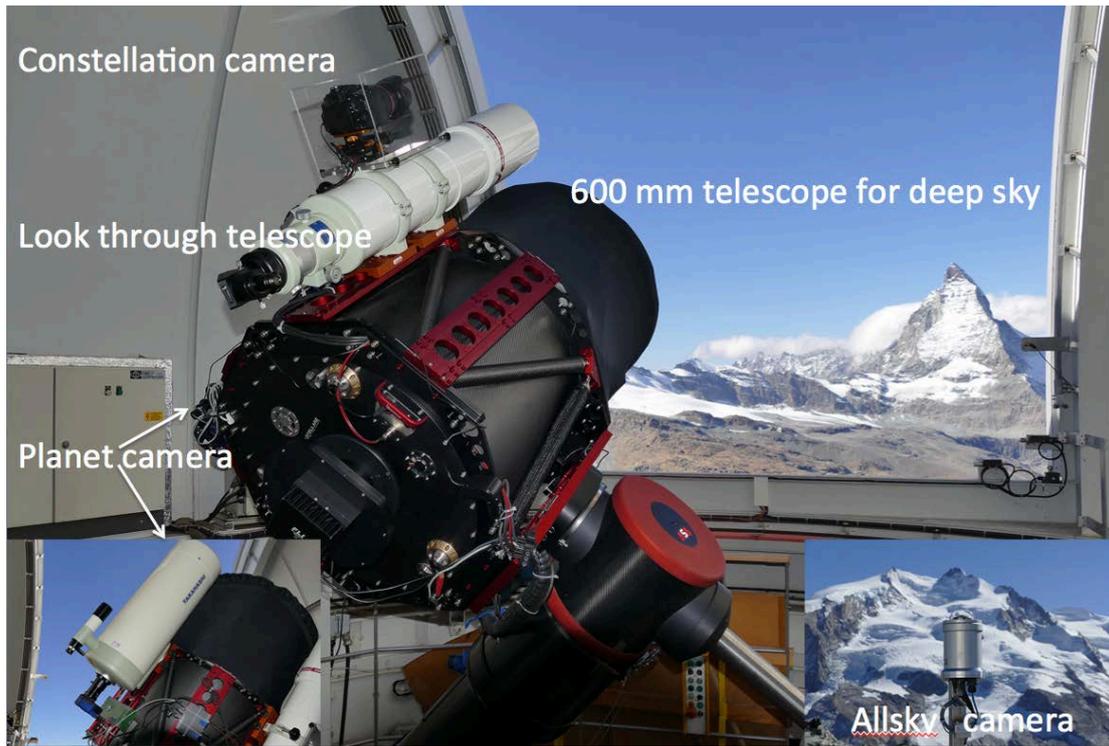


Figure 2. Available instruments at the Stellarium Gornergrat: On the ASA DDM 160 mount (with absolute encoders) inside the south dome are the Officina Stellare RiFast 600mm “Deep sky telescope”, the Canon 60Da “Constellation camera”, the Takahashi TAO-150 “Look-through telescope”, and the Takahashi Mewlon-250 “Planet Camera” (see image inset in the lower left). Mounted on a boom outside the north dome is the Alcor systems “Allsky camera” with a DMK51AG02.AS CCD sensor (see image inset in the lower right).

**2. Status of hardware and instruments**

Table 1. Instrument/hardware status and performance

Instrument	Status / Performance
Officina Stellare RiFast 60cm (DeepSky telescope)	The telescope performs very well and shows constant quality over the whole range of altitude in both equatorial orientations.
FLI Proline PL16803 (Main CCD detector)	Lightning <sup>1</sup> damage required the complete electronics to be exchanged by the manufacturer in the US resulting in a major downtime in summer 2018.
Takahashi Mewlon 250 (Planet camera)	The instrument worked as expected. The previously mounted black and white camera has been replaced with a colour camera with a wider field of view, to increase the fault tolerance in pointing.
Takahashi TOA 150 (Looking through telescope)	Telescope and eyepieces are in very good condition.

Canon 60Da (Constellation camera)	The camera is very good condition and working. Users reported having difficulties to work with the raw data. We are currently exploring options to produce images in an easier format, i.e. debayered and compressed.
ALCOR DMK51AG02.AS (Allsky camera)	This instrument was completely destroyed by lightning <sup>1</sup> . All attempts to repair it failed. A replacement (ALCOR OMEA 8M) was ordered but not yet received within the reporting period.
SAIA and weather sensors	The SAIA extension board responsible for communication with the dome’s angular encoder was destroyed in the lightning <sup>1</sup> and has been replaced. Cloud and rain sensors, and SAIA itself worked as expected. The Lambrecht weather sensor fails to report correct temperatures. Repairs will be done in 2019.

ASA DDM160 (Equatorial mount)	The mount did not perform well in cold temperatures below -15°C. The manufacturer remained unable to explain the issues to our satisfaction. We replaced the mount with its successor, an ASA DDM160 mount with absolute encoders. The process was taking significantly more time than expected due to a serious bug in the delivered software that prevented safe and autonomous operations between April and July 2018.
EATON USV (Large UPS in the cellar)	The lightning <sup>1</sup> damaged the UPS' COM board and the RF45 port that was in use failed. For a few months, it continued to work on port 2 but this port failed near the end of the reporting period. A replacement COM board will be ordered in 2019. The UPS itself works on spec and has been serviced.
USB hubs, and active repeaters	Most of the active USB components did not survive the lightning <sup>1</sup> and have been replaced.

<sup>1</sup>) On July 20<sup>th</sup> 2018, a complex system of lightning hit the Kulmhotel Gornergrat. Several arms hit both of the domes, the Allsky camera, and other parts of the hotel. Exterior protective measures prevented a fire, but the existing inside protection was unable to prevent all components of the hotel and the Stellarium from further damage.

Table 1 summarizes the instrument status throughout the reporting period. It has been a challenging year: In Q1, the ASA mount started to fail in correlation with very cold temperatures between -15°C and -25°C. It seemed that the mount lost orientation as it started to behave erratic on attempted slews. This forced us to take the Stellarium offline for remote (and unattended) operations. In Q2, the mount was replaced with a successor that was promised to be more temperature resistant and has been upgraded with absolute encoders that require no nightly home find procedure. Problems with the delivered software however forced us to keep the Stellarium offline to our remote users until a working patch was delivered near the end of Q2. A short summer of excellent and stable operations was quite brutally ended when a storm system created heavy lightning that hit both the domes and other parts of the Kulmhotel. Both the hotel, and the Stellarium infrastructure suffered substantial damage and in the aftermath, tedious checking and trouble shooting was necessary to isolate all faulty parts in electronics and repair all damaged systems. More details are listed in Table 1. At the end of the reporting period, this process was nearly completed; some late failures might still happen because of the additional strain to some parts due to low temperatures in the cold winter seasons.

All damaged parts and the extra hours have been collected and itemized for submission to the involved insurance company and we aim to conclude the financial aftermath of the lightning incident in Q1 2019. The Stellarium itself was once again online for a slightly narrowed down set of remote users, as e.g. students collecting data for writing matura theses, in fall 2018 and will reopen to all users in January 2019.

On site, the Burgergemeinde Zermatt devoted another batch of money to our project and ordered the implementation of the most urgent pending renovation works, such as new windows for the control room, better sealing of an improvised window a floor higher up, new hoe position of elevators outside to prevent light pollution, and a few other smaller items. We are very grateful for these improvements as they really make a difference.

In 2018, a total of more than 720 people visited the Stellarium and got a tour through the facility and/or night time observing on site.

### 3. Remote Observations

The software responsible for autonomous observing runs on the control computer on the Gornergrat. It is constantly augmented and under further development. Especially the mount related problems in the first half of the year required many workarounds in the code. Polling weather sensors, maintaining emergency procedures, and dealing with hardware issues in an autonomous way requires regular monitoring of errors and logs which is an ongoing process that has always room for improvement.

### 4. Pedagogical Activities

The Stellarium Gornergrat supported 6 matura theses and improved the organization and available web content and resources to better support teachers with suitable project ideas and their students with data from the Stellarium, ordered by the students through our web portal. We also implemented some rules like e.g. receiving a copy of a supported thesis after completion, and the need of acknowledging our project in turn for receiving support and data, so we can better report and measure our success.

Our co-workers in Geneva report that a German physics education foundation (Kuhn-Stiftung) will support the development of new educational content (in German) for the Stellarium Gornergrat by a grant of 200'000 EUR (≈ 2 yrs post-doc position).

---

#### Internet data bases

<https://www.stellarium-gornergrat.ch>  
<https://lists.stellarium-gornergrat.ch>

#### Address

Stellarium Gornergrat  
 University of Bern  
 Center for Space and Habitability (CSH)  
 CH-3012 Bern  
 Switzerland

#### Contacts

Dr. Timm-Emanuel Riesen  
 Tel.: +41 31 631 3318  
 e-mail: [tim.riesen@csh.unibe.ch](mailto:tim.riesen@csh.unibe.ch)