Photographic and Digital Surveys at Sonneberg Observatory

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Large Surveys with small telescopes (ASTROPLATE III)
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Photographic Surveys

Introduction

Sonneberg

Surveys at Sonneberg Observatory
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Introduction

Brief history

- 1925: founded by Cuno Hoffmeister as municipal observatory
- 1931: Branch station of Berlin-Babelsberg Observatory
- 1946: Institute of German Academy of Science
- 1992-1994: Branch station of Tautenburg Observatory
- 1995-2003: Municipal observatory
- since 2004: Operated by private company (Ltd.) 4π Systeme - Gesellschaft für Astronomie und Informationstechnologie mbH
- near future?: associated institute of Coburg University of Applied Sciences and Arts?
Plate collection

- Total: approx. 275,000 plates
- Epochs: 1923 – 2010
- Exposure times: 15' ... 4h
- Taken with:
  - Schmidt 500/700/1720 (8,500)
  - Astrographs 400/1950, 400/1600, ... (25,000)
  - Tessars 55/250 (150,000)
  - others
- Plates sizes:
  - 6 × 6 cm², ..., 13 × 13 cm², ..., 30 × 30 cm²
- FoV: 3° ... 30°
- Sky coverage: δ > −30°; + some southern fields
- 99% direct images, 1% spectral plates
Schmidt telescope: 500/700/1720
Sky Patrol: \((8 \text{ pg} + 6 \text{ pv}) \times \frac{55}{250}\)
Plate archive: Astrograph plates
Plate archive: Astrograph plates
Plate archive: Sky patrol plates
1980ies: key punching log books (dBase), \( \approx \) 90%

1991: Simple line scanner with projection objective (3 years / 5000 plates)

2004: Bulk scanning started

Today:

- Small plates (sky patrol): 211,751 scans
- Big plates (astrograph): 25,679 scans
- Total: \( 237,430 \) \( \approx \) 85%

Resolution: 20 \( \mu \text{m} \) (1200 dpi), 16 bit

File format: TIFF + gzip compression (to 80\% . . . 90\%)
\( \rightarrow \) \(<\text{SCANID}>\).tif.gz

Sizes: 72 . . . 450 MB (raw data)
Digitization hardware

HP Scanjet 7400C with illumination unit + VueScan 6.2
Digitization hardware

Microtek ScanMaker 9800 XL + VueScan 6.2
Today: total of approx. 25 TB (uncompressed)
initially 2700 DVDs (double storage!)
plus 4 HDs (2 TB)
NEW (since 2019): NAS with 30 TB
Current and future activities

- Continuing key-punching log books and scan meta data
- Database conversion
- Historic long-time light-curves of prominent objects (e.g. Boyajian’s star)
- Search for (rare) outbursts of WZ-Sge-stars
- WCS solution for Sky Patrol plates (see poster SOPHIA)
- New scanner to be procured
- Scanning of remaining plates (≈ 40,000)
- Scanning of “foreign” plates (≈ 5,000)
- Integration in APPLAUSE?
Digital Surveys: ASPA (not realised)

- Goal: Continuation of sky monitoring by direct digital imaging
- mid 1990ies: initiated by Nikolaus Vogt et al.
- Digital Sky Patrol planned at 6 astro-sites world-wide
- **ASPA** – All-Sky Patrol Astrophysics
- All proposals rejected . . .

- How to continue? → Set up a (low budget) sky monitoring!
- See also our poster about Sonneberg Observatory Digital All-Sky Survey (SODASS)
Digital Surveys

All-sky monitoring with fish-eye cameras

Fish-eye cameras

Starlight XPress Oculus

In-house dev. (f=1.37 mm / 2.5)
Fish-eye cameras

- Operated since 2015 / 2017 (parallel)
- Image size $1k \times 1k / 1.5k \times 1.5k$ pixels
- Exposure time: 20 sec, readout: 2.5 sec
- Limiting magnitude (integral): $6^m / 7^m$ (zenith)
- Continuous monitoring from dawn to dawn (600 ... 2500 images/night)
- Every day: morning video → What happened last night?
- Monitoring of stars: 25,000 ... 100,000 data points/year
Comparison of the two cameras

[Images of two all-sky monitoring fish-eye camera views from Sonneberg Observatory, labeled AllSkyCam 1 and AllSkyCam 2, showing the sky at different times with meteors visible.]

2019-02-26T20:00:00 UTC Sonneberg Observatory

2019-02-26T19:59:54 UTC Sonneberg Observatory
Bright meteors and fireballs

Fireball of 2018-06-30 → meteorite fall predicted near Bamberg!
Test case \(\delta\) Cephei

(Classical estimation with Argelander method in other context. Automatic photometric reduction still to be made!)
Goal: going deeper!
Approach: make use of existing optics with consumer cameras
Tessar 80/360 mm + Canon EOS 5D Mark 1
Limiting magnitude (V): \( \approx 12^m \) (3 min)
Field of view: \( 3.8^\circ \times 5.7^\circ \)
Fields selected to observe prominent or important objects
Running since 2014
All clear nights used, even gaps of one hour (Walter Fürtig)
Field monitoring

Digital Surveys

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Examples (2014 – present, G channel): R CrB, SX Her, VV Cep
Next step: Many automatic telescopes

- Goal: Cover all sky at high cadence down to $12^m$ or deeper
- Approach: Several small telescope (low-cost mount) placed on a parallactic platform (daily motion)
- Study by Simon Gast (2017):  

![Telescope and platform images]