Remote Observing with HdA/MPIA's 50cm Telescope

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AstroTechTalk
May 5th 2017

Remote observing with HdA/MPIa's 50cm telescope

- The telescope and its instrumentation
- Remote observing – how does it work?
  - Remote vs. robotic telescopes
  - Things to consider: Operations and protective measures
  - Showcase: the ROTAT observatory at OHP
- Current status of turning the 50cm telescope into a remote observatory and ToDos
- Future opportunities for users
- Tour to the telescope

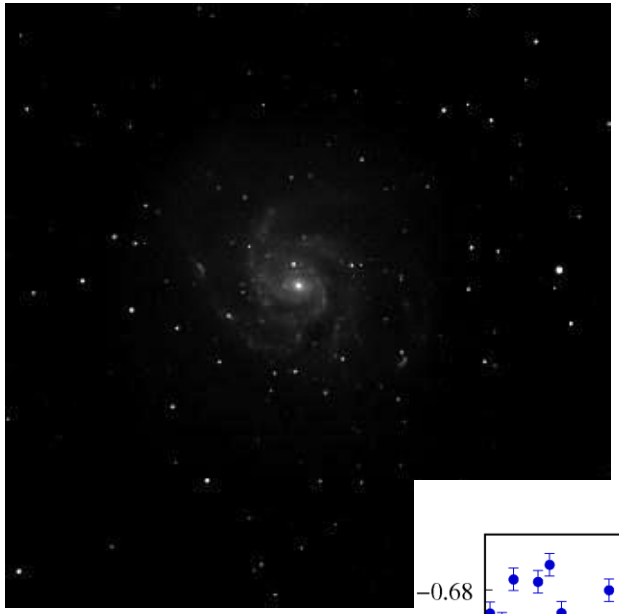
The Telescope

- Off-the-shelf 20“ (51cm) Planewave astrograph, f = 3450mm, f/6.8
- Modified Dall-Kirkham optics (elliptical primary, spherical secondary, field correction lens)
- Integrated motor focus
- Heavy-duty German equatorial mount 10micron GM4000 QCI
- Pointing model based GoTo function with (programmable) object database
- Both stand-alone or computer-controlled operation possible

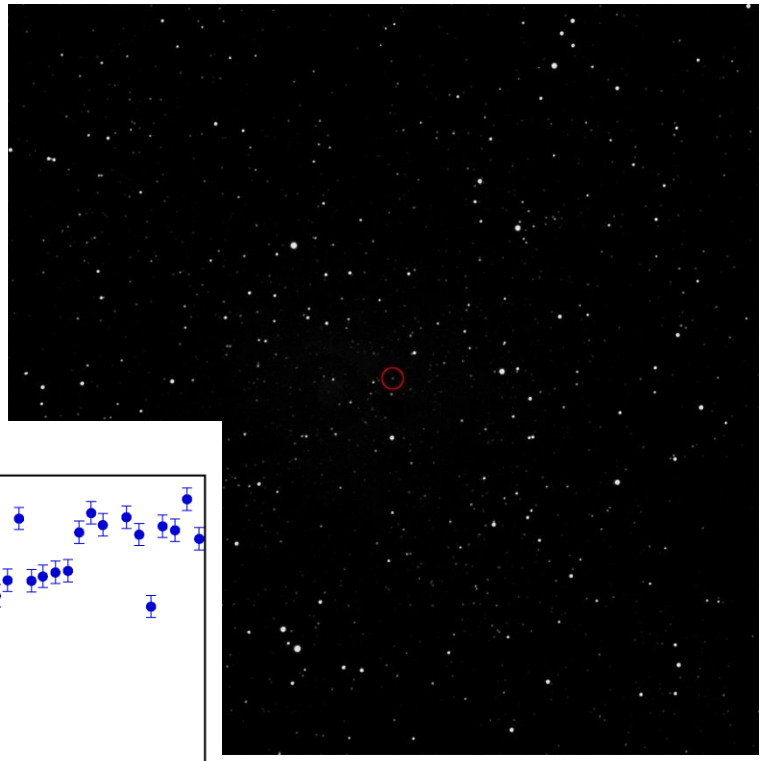
The main camera

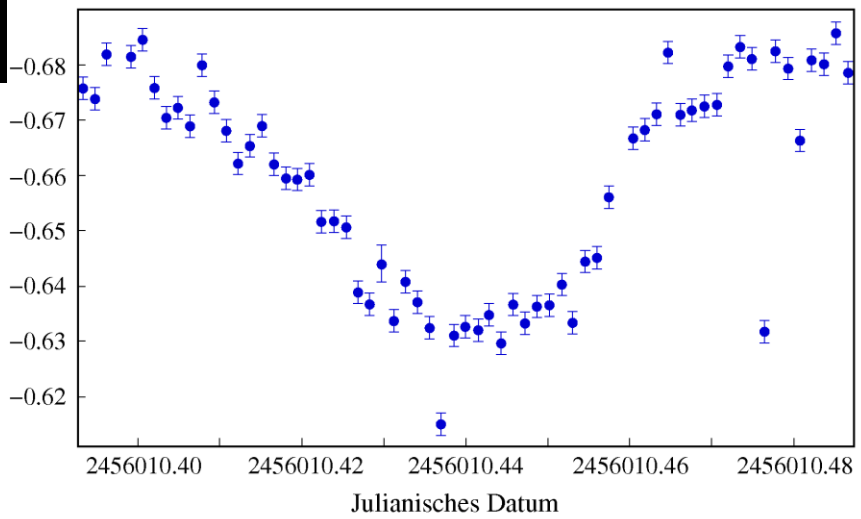
- Peltier-cooled wide field CCD camera Moravian Instruments G4 16000
- Chip size 36x36mm, pixel size 9µ
- Moderate anti-blooming gate: linearity is ensured until saturation is reached
- Off-Axis guider with separate imager
- Photometric filters BVR_c (Johnson-Cousins), Hα (8nm band width), O III (9.5nm band width), UV/IR cut

Examples



First Light image of camera: M101





Exoplanet transit lightcurve

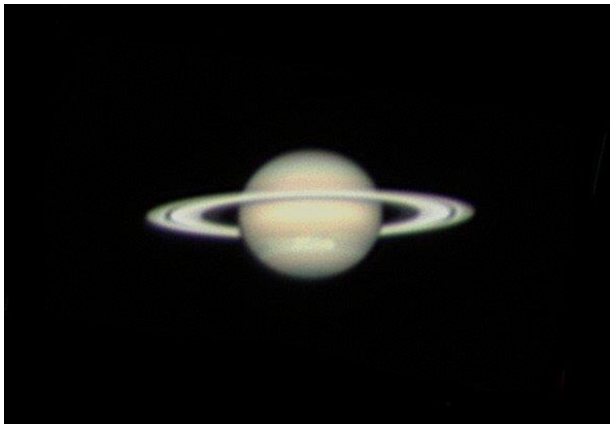
Pluto astrometry at New Horizons arrival

Low- and mid-res spectrograph DADOS

- Gratings 200 or 900 lines/mm
- Three integrated slits: 25, 35 and 50 μm
- Spectral resolution: $\Delta\lambda/\lambda$ up to 700 (200 lines/mm) and $\Delta\lambda/\lambda$ up to 5000 (900 lines/mm)
- Can be used with eyepiece, DSLR or CCD (ST8-XME available)
- Guiding unit
- Magnitude limit: SNR ≈ 50 in 20 minute exposures with 25μm slit for $m_v \approx 8$ (200 lines/mm) and $m_v \approx 6$ (900 lines/mm)

Video astronomy (lucky imaging)

- Monochrome cameras DMK31, DMK41, ASI 120 and ASI 178 available for video imaging of planets, moon surface etc.
- Focal length multiplication with barlow lenses
- Single frames to be analyzed, quality-sorted and stacked by amateur software (e.g. Autostakkert, Registax)



- Additional image processing (sharpening)
- RGB color image creation with filters

Also available

- Taking pretty pictures with HdA-owned DSLRs (Canon EOS 450D and 750D)
- Adaptors to attach DSLRs from several manufacturers
- Light pollution reduction filters
- Several eyepieces and filters for visual observations

…but

Typical time interval between observations: 1-2 months, mostly casual

Let‘s turn the 50cm telescope into a remote observatory!

Remote observing

- User operates the telescope via network, doing the same or similar steps as if on site. Physical presence at the telescope ideally not required at any time
- Everything has to be done remotely
  - Telescope and camera control
  - Opening/closing/moving the dome
  - Switching power on and off
  - Opening/closing covers/dust caps
  - (Changing instruments)
- Requires additional hardware: Computer for controlling mount, focus and camera, dome control system, IP power controllers, motorized covers

Safety measures

- Protect the telescope against all kinds of damage resulting from technical or human failures
  - Weather monitoring
  - UPS unit for emergency shutdown for all necessary devices
  - Automatic procedures?
  - Cameras to monitor the telescope during operations
  - Software blocker to avoid pointing the telescope towards the Sun
- Protect people at the telescope from injuries resulting from remote operation

Robotic telescopes

- Telescope operates automatically, no user interaction required
- Users specify observation settings (exposure times, filters, etc.) in advance
- Taking into account contraints (time interval, limits for air mass or moon distance, etc.), the control software optimizes scheduling

$\Rightarrow$ Very efficient, making the most out of observing time.

- Examples: Las Cumbres Observatory, ESO Service Mode

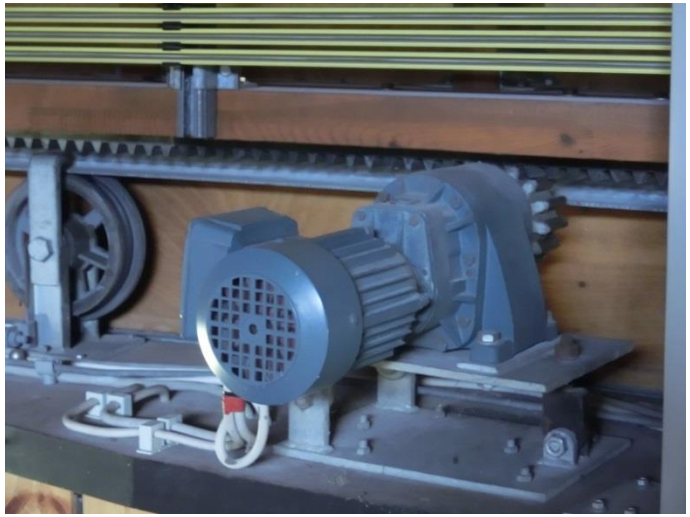
$\Rightarrow$ Overkill for observing conditions like in Heidelberg

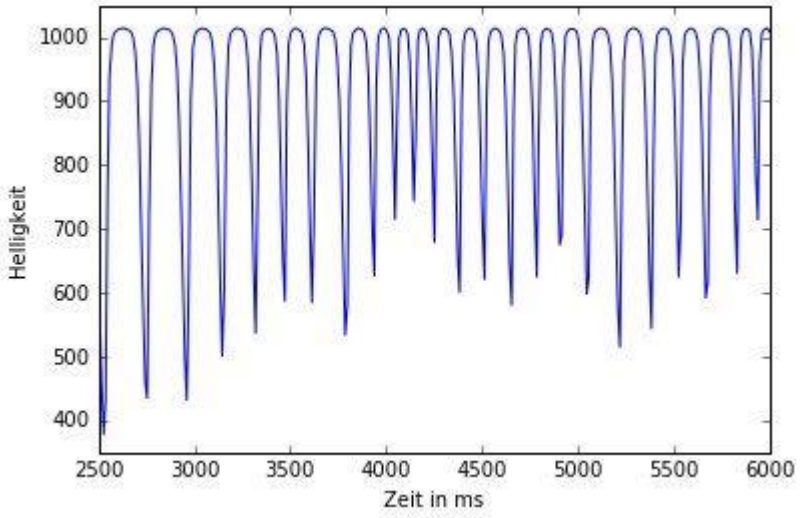
Computer hardware

- Dome PC: Use amateur observatory control software for Windows, based on ASCOM driver platform integrating mount, camera, focus, dome control, guiding
- To be operated via remote desktop software, ideally Teamviewer
- ToDo: Replace the current PC with newer hardware; set up network environment
- Wishlist for the future: easy-to-use web interface

The dome control system

- In-house development of an angular transmitter based on a microcontroller with photo sensor and a pinhole gear wheel made by the precision mechanics workshop
- ToDo: Installation; RS232-controlled relay box for opening/closing/rotation; ASCOM software driver that enables dome tracking

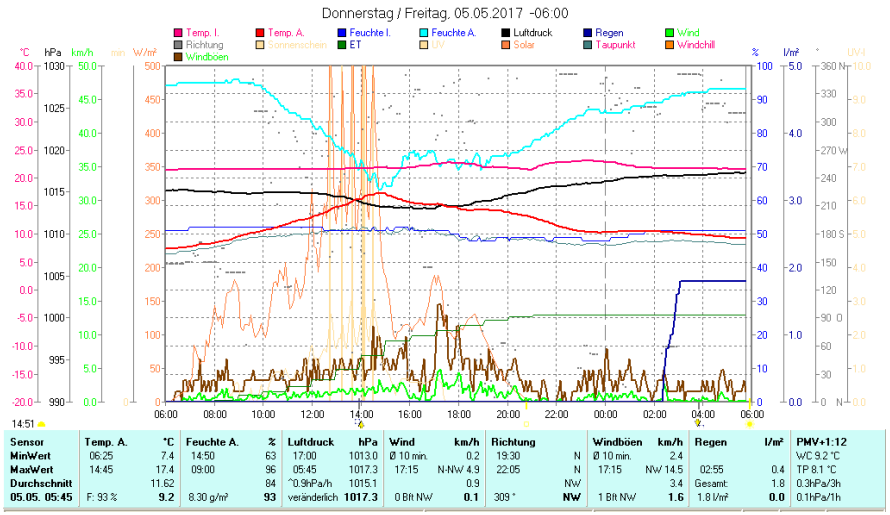




Weather station and All-Sky camera

- Thesis projects at HdA in 2017

Robin Jäger: Setting up and testing an All-Sky camera with 24/7 operation



Lars Meier: Setting up an online weather station and evaluate its data

Future use

- Telescope should be available to all MPIA staff after having an introduction
- HdA high school student projects (e.g. Heidelberger Life-Science Lab)

- In commissioning: Echelle spectrograph with $\Delta\lambda/\lambda$ = 10.000/19.000
- Remote imaging will be default, but visual observations and usage of other cameras or instruments still possible
- Booking system required

We want your project

- Suitable for all kinds of projects where a telescope of that size with Heidelberg‘s observing conditions is sufficient
- Lightcurves for variables, exoplanet transits
- Low- or mid-res spectra
- Monitoring programs
- Thesis or Miniforschung projects