Upgrade of the OCM Observatory New Control Software

CAMK Annual Meeting 2024



presented by: Marek Górski Mikołaj Kałuszyński Mirosław Kicia

OCA - set up, software environment & observers

I speaker:

Marek Górski

Member of the Araucaria Project

Nicolaus Copernicus Astronomical Centre of the Polish Academy of Sciences - Warsaw ASA training, installation, testing CCD, testing mount & components, network set-up, learning ASA, Andor (**SDK**), searching available technologies, constant troubleshooting





- cooperation with all observers
- **admins** (<u>Krzysiek</u>, Artur, Staszek, Przemek)
- Ernest Lasek, Piotr Wielgórski, Wojtek Pych

Complexity of OCM software



challenges - boundaries

- only 2 observers for 5 telescopes
- operator-focused control room
- remote control room (camk)
- 70 computers & VM's
- 30 systems
- ASA mount (alt-az, eq), Halfman
- optical CCD, NIR CCD, spectrometer
- different observing programs
- fully automated and fully remote software need
- existing software solutions do not meet our needs

| PERTPHERALS | Digniew 2101 Koss | SCZKONSKI 0.00 TEL | MOUNT | | | | Control | ing User: observer@nadi | | expire 40929 | s OIC 03:07:21 |
|----------------|-------------------|--------------------|-------------------|--------------------|------------|---------------|-----------------|-------------------------|--------------------------|------------------|----------------|
| - PERTFILENCES | | | | | | | | | | | |
| | | | | | | | | | Sensor | | |
| | Dome | | U <u>B</u> server | not set | | | Alrmass | | Image read | | |
| | | | | | | | | | Exposure param. | | |
| _ | Guider | | | | | | | | Exp. type Object | | |
| | | | | | | | | | Last mean Bin | | |
| | | | | | | | | | Colo | | |
| | | | | | | | | | Readoutmode | 1Mhz not | set |
| | | | | | | | | | Filter | [4] z not | set |
| - | | | | Park | | | At home | | | | |
| | Mirror Cover | | | | | | | | Rot. mech. Rotator mo | 21.246 .False | |
| | - Plan run | | | | | - - - | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Dome AZ | | not set | Control | Load Plan | Edit | r | Start | Stop | | | |
| - | Slaved mount | | | | E verb | | | | | | |
| | Slewing | | ID N | ме ті | ME ARGS KI | ARGS | | | | | |
| | | | 00_00 Z | ERO 7 DMEELAT 7 | 0s seq=1 | 9/V/0 | | | _ | | |
| | | | 00_02 D | DMEFLAT 7 | 41s seq=2. | V/1,2/V/2,2/V | /3,2/V/5,2/V/8, | 2/V/1,2/V/2,2/V/3,2/ | - | | |
| _ | | | 00_03 D | DMEFLAT 7 | 41s seq=2. | V/1,2/V/2,2/V | /3,2/\/5,2/\/8, | 2/V/1,2/V/2,2/V/3,2/ | | | |
| _ | Done Lights | | 00_05 S | KYFLAT 2 | 59s seq=7, | 1/a,7/z/a dom | e_follow=off di | ther=none | | | |
| | Cotv <u>I</u> R | | | | | | | | | | |
| | Screen light | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| CTRL+C Quit | CTRL+D Dark C | TRL+F Font | Nightplan 0 estim | ated time lengh | t: 54.9min | Nightplan 0 | written Up | loading Night Plan | Servers are conn | ected | |

| 🖲 😑 🛑 📄 oca-problems — observer@nadir: ~ — ssh mkalusz@araucaria.camk.edu.pl — 96×29 | |
|--|-----------------|
| observer@nadir:~\$ oca zb08 camera config Camera config Done 0:00:00 | |
| gain = 2 | |
| offset = 0 | |
| binning = 1x1 | |
| subframe = [0:2048,0:2048] | |
| subexposureduration = None | |
| readoutmode = 3 | |
| observer@nadir:~\$ oca zb08 dome statusdecimal | |
| Dome: ASA Dome (ASA Dome Alpaca) | |
| AZ: 179.66833 Connected: True Shutter: Closed Slaved: None Slewing: Fa. | lse |
| observer@nadir:~\$ oca zb08 dome slew 135 | |
| Currently telescope zb08 is controlled by observer@zenith. | |
| Do you want to take on control? [yes/no] [no]: yes | |
| Dome slewing to azimuth 135.00000 Azimuth: 134.69667, Slewing | : False 0:00:08 |
| observer@nadir:~\$ oca zb08 dome open | |
| | |

toi, textUl, ocabox-cli

- fully manual
- subsystem automation (guider, focus, sequence)
- fully automatic
- intuitive & user-friendly

normal-operations, tests & troubleshooting

(remote-access, system-isolation)

| | | Telescope C | Operator Interface | | – 🗆 × | | ZB08 Au | x Monitor | - 0 | × | | zb08 Plan Manager | |
|-------------------|--------------|--------------|--------------------|--------------------------------|--------------|----------------|-------------------|---------------------|-----------|----------------------|--|---|--------------------------------------|
| C TIC | | observer@na | ıdir | | Take Control | Welcome Fo | ocus Fits | | | Obje | t Alt @ UT | | Commer |
| Date: 28/11/ | 2023 | UT: 02:52:22 | | Span to objects | Set Next | | | | | V1711_ | Sgr | RV Tau | |
| OJD: 24602 | 76.619699 | SID: 2:38:36 | | Sunset: 23:14 | | Mark satur | ated stars | | | V971_A | ql | - | |
| Telescope | Dome Mount | Instrument | Program | Sunrise: 09:43 Sun Alt: -37 | N | | | | e . | Z_Mic | | - | |
| WK-06 - | - | - | - | | | | | | | BT_Aqr | | - | |
| 28-08 - | | | - | 160 | • | | | | | ut=02:4 | 4:05 | - | |
| JK-15 - | - | - | - | | | | | | | DN_Aqr | | - | |
| | | | | w E | 97 1 | | | | | RV_Phe | | - | |
| | | | | | | | | | 1.1.1.1 | AU_Peg | | binary and dusty | envelope |
| Shutdown | Weather Stop | E E | mergeory Stop | | | | | | | ut=03:2 | 4:05 | - | |
| 02:52 Dome MOVIN | 4G | | | Moon: 0.99 Moonrise: 00:52 | | | | | | STOP | | - | |
| 02:52 Dome STOPP | ED | | | Moonset: 10:27 | s | | | | | BR_Aqr | 02:52 (44.8 |) | |
| 02:52 Dome STOPP | ED | | 3 | E | xit | | | | | RU_Scl | 02:55 (54.4 |) | |
| | | | | | | | | | | ut=03:3 | 7:05 03:37 | - | |
| | | ZB08 Moun | t Manual Controll | | - u x | a land data at | and the sector | mahada D | | UU_Cet | 03:37 (43.3 |) | |
| MOUNT | TRACKING | | | | MOTORS: | stars max AD | U: 31555 FWH | 1 X/Y: 2.7/3.: | 1 | ut=03:4 | 7:05 03:47 | - | |
| EPOCH: | | 2000 | AIRMASS: | 1.2 | 1.4 | mean/median: | 496/496 rms/ | /sigma_q: 133/2 | 20 | TPHE | 03:47 (47.8 |) 7 standards, cent | ered on TPHE B, mV b |
| TELESCOPE RA [h]: | 4:50:50.25 | 23:38:32.89 | TELESCOPE DEC [d] | -15:41:54.55 | 09:19:07.46 | | | | | AV_Peg | 03:52 (-6.1) | - | |
| TELESCOPE AZ [d] | 80.295 | 282 34 | TELESCOPE ALT [d]: | 57.811 | 15 39 | | 7000 lashauman | h Manual Cambra | | ut=03:5 | 8:05 03:58 | - | |
| TADOTT | DD Are | | CUIDING | | | | 2000 macromen | C Mandat Contro | | BH Peo | 03:58 (8.6) | - | |
| TARGET: | DK-Vdi | | GOIDING | | RACKING: | ccb | | | | | + Import to M | ANUAL | |
| PARK | | STOP | | SLEW | | OBJECT NAME | BR_Aqr | TYPE: | Science * | Del | | Up | Swap First |
| DOME | | | DOME STATUS: | STOPPED | | N: | | EXP TIME [s]: | | O Del A | | Down | Last |
| DOME AZ: | 79.91 | | STOP | MOVE | FOLLOW: | Sequence: | 1/lc/7,1/V/7,1/g/ | 17,1/t/7,1/i/7,1/z/ | 7 | • | | 10.00 | |
| VENTILATORS: | FANS OFF | | SHUTTER: | OPEN | | | | | DLE | Nex | Add | зкір | Edit |
| | | - | | | | Mode: | Normal * | | | current of | DB: | (44/30,10.00.00, | name . rocus, |
| DOME LIGHTS: | - | | | | | Binning: | 1x1 | 1x1 * | Set | 'started | ": True, 'done': Tr | ue, 'skipped': False, | 'timestamp_utc': |
| FLAT LIGHTS: | - | | MIRROR COVERS: | OPEN | | Subraster: | No T | | | 0 | 0:47 00 | | |
| M3: | (TODO) | Imager + | SET | | | GAIN: | 4x | 1x * | Set | {'id': '00 | ", 'name': 'Seque d': False, 'timesta | nce', 'started': True, mp_utc': '2023-11-2 | 'done': True, 8 00:47:58.803178'. |
| ROTATOR: | 19.97 | | SET | | | READ MODE: | 1MHz | 1MHz * | Set | 'c_type' | 'sequence'} | | |
| FILTER: | v | lc * | SET | | | CCD TEMP.: | -60.4/-60.0 | -60 | Set | 0 Pieto las | 0:47 auto | focus | adi Tara Manah |
| FOCUS: | 15266 | 15266 | SET | AUT | O OFFSET: | | | | Cooler 🌑 | True, 'si 00:47:5 | dpped': False, 'ti 8.803416', 'c_typ | mestamp_utc': '2023 e': 'night_plan') | 1-11-28 |
| | | | | | | ENIAD | DAUGE | STOP | STADT | | | | |

Another speaker:

Mikołaj Kałuszyński

Member of the Araucaria Project

Nicolaus Copernicus Astronomical Centre of the Polish Academy of Sciences - Warsaw





Araucaria Database

• FITS Indexer:

Scans entire araucaria disk space for FITS files Calculates unique digest and discovers duplicates Determines instrument-independent metadata

- **FITS Database:** Stores and presents FITS files data
- **Object Database:** Stores and presents astronomica targets

• Coverage Charts:

Plots phase coverage charts and timelines for targets, based on FITS files *hjd*



| Filters | | | | • | ilters | | | | | | | | | | Det |
|--|--|---|--|---|---|-----------|--|--------------|---------------|--------------------------|--------------------------------|----------------|-----------------|--------------|---|
| arcmin limit se | n: 10.0 meta:obje earch: 100 | oralias equal: E_: | 246891964) | Do | wnload | ▼ 台 Add | 0 | | | | | | | | |
| Sear | ch Filtering | 9 | | | det | obstype (| object 0 | objoralias 🔅 | ia 0 | dec 0 | date 0 | filter | exptime 0 | instrument 0 | path |
| search b | ay words (Info | | | | q | SPECTR1D | E_246891964 | E_246891964 | 04:43:27.0480 | +16:40:24.2400 | 2021-01- 20T01:42:05.410000 | None | 899.996525 | HARPS | /work/corvu 19_safetore 20T01:42:01 |
| Start dat | te Enfo 01/2024, 12:30 | | × | | ٩ | SPECTR1D | E_246891964 | E_246891964 | 04:43:27.0480 | +16:40:24.2400 | 2021-01- 20T01:42:05.410000 | None | 899.996525 | HARPS | /work/corvut 19/HARPS.2 20T01:42:05 |
| End date | 8 Info | | _ | | | | | | | | | | | | Amerikan |
| 29/0 | 01/2024, 12:30 | | × | | Q | SPECTR1D | E_246891964 | E_246891964 | 04:43:27.0480 | +16:40:24.2400 | 2021-01- 20T01:42:05.410000 | None | 899.996525 | HARPS | 01-19/HARP 20T01:42:01 |
| Tele | scope | | | | ٩ | SPECTR | E_246891964 | E_246891964 | 04:43:26.7840 | +16:40:28.5600 | 2019-03- 17T23:54:23.345000 | None | 1099.998072 | HARPS | /work/corvu 17/HARPS.2 |
| Find s | site where value | Value | | | q | SPECTR | E_246891964 | E_246891964 | 04:43:26.7840 | +16:40:28.5600 | 2019-03- 17T23:54:23.345000 | None | 1099.998072 | HARPS | /work/corvu 17_safetore 17T23_54_3 |
| equal: | elescope where | Value | | | q | SPECTR | E_246891964 | E_246891964 | 04:43:26.7840 | +16:40:28.5600 | 2019-03- 17T23:54:23.345000 | None | 1099.998072 | HARPS | /work/corvu 03-17/raw/h 17T23_54_ |
| value | starts with: | Value | | | Q | SPECTR1D | E_246891964 | E_246891964 | 04:43:26.7840 | +16:40:28.5600 | 2019-03- 17T23:54:23.345000 | None | 1099.998072 | HARPS | /work/corv. 17_safetore 17T23_54_ |
| Find in value | nstrument whe starts with: | ere | | | | | | | | | 2019-03- | | | 114000 | /work/corvu |
| @ -@ | ina Home F | its Object (| Charts | | a | SPECTRID | E_246891964 | E_246891964 | 04:43:26.7840 | +16:40:28.5600 | 17T23:54:23.345000 | None | Fits 🚔 Your (| Object Decin | 17T23_54_ |
| @ · A | e na Home F | its Object (| Charts | | Q etails | Obj | E_246891964 ect details | E_246891964 | 04:43:26.7840 | +16:40:28.5600 | 17723:54:23.345000 | Your | Fits 🚔 Your (| Object Decin | 17T23_54_ |
| Object | Home F | its Object (| Charts | | Q etails | Obj | E_246891964 ect details | E_246891964 | 04:43:26.7840 | +16:40:28.5600 | 17723:54:23.345000 | None | TU99,998072 | Object Decin | Accour |
| Object Group na | tlist | its Object (| Charts | | Q etails | Obj | ect details | E_246891964 | 04:43:26.7840 | +16:40:28.5600 | 17723-54:23.346000 | None | Fits | Object Decin | nal Accour |
| Object Group na Obje | t list ame ALL • | its Object (Find | Charts | | Q | Obj | E_246891964 ect details tails chart ⊽ Chart Filters | E_246891964 | 04:43:26.7840 | +16:40:28.5600 | 17723:54:23.345000 | None | Tugg gg 2 | Object Decim | hal Accour |
| Object Group n: Object | tiist ame ALL • nload ~ \Leftrightarrow A | its Object (Find | Charts | | Q etails | Obj | E_34699964 ect details tals chart → Chart Filters | E_24699994 | 04.4326.7840 | +164028.5600 Radial \ | r7723:54:23.345000 | Your | Fits 🔬 Your (| Object Decim | nitiz3_54_3 |
| Object Group nu Obje | tiist arre ALL • nload • \Leftrightarrow A | Find | Charts | | q etails | Obj | ect details tails chart Chart Filters | E_346991964 | 0413267840 | +16-4028-5600 | r/rt23:54:23.345000 | None | Fits d Your (| Object Decin | Accour |
| Object Group nu Objec Down | tilst ame ALL + ntoad > 42 A name 0 Tyces74- | Find Find hame I Tyc6874- | Charts Search ra 0 | dec | Q etails ≣ ▼ type | Obj | ect details tais chart ♥ Chart Filters | E_34091964 | 0443267840 | Radial | r77235423346000 | Kone A Your | Fits 🚔 Your C | Object Decin | • HARPS |
| Object Group nu Objec Down | tiist ame ALL € name ALL € name ALL € name ALL € name ALL € name ALL € | Find Find Mdd C TYCe872- 632-1 E 24681944 | Charts Search 288.0421 70.8832 | dec 0 -23.0064 | Q etails ∷≣ ▼ type ECL ECL | Obj | ect details ect details ehart Chart Filters | E_34699964 | 0443267840 | Radial | relocity Diagram | Hone | Fita de Your C | Object Decin | • HARPS |
| Object Group nu Object Object Object | tiist ame ALL • name ALL • name ALL • rame ALL • rame ALL • rame ALL • rame ALL • rame ALL • | Its Object I Find I I kdd 0 I I YC6872- 632-1 I I I L,246891964 V440, Per I I | Search 288.0421 70.8637 35.9656 | dec 4 18.6758 55.3649 | Q etails type ECL ECL PULS | Obj | ect details tais chart ♥ Chart Filters | E_34091964 | 0413267840 | Radial | relocity Diagram | None Your | Fits the Your C | Object Decin | • HARPS |
| Object Group not Object | Mome F tist ALL € ect list: name nload ~ | Its Object I Find I I Mdd I I Nname I I TYC6874- 332-1 I I E_246891964 V440_Per BQ_Ind | Read 286 70.4637 35.9656 313.8953 313.8953 | dec 0 -23.0064 55.3649 -56.742 | etails type ECL ECL PULS | obj | ect details tais chart Chart Filters | E_34691964 | 041326780 | Radial | relocity Diagram | Kone Your | Fita de Your C | Object Decin | • HARPS |
| Object Group ni Objec Ob | Item Home F tilst ame ALL * * ecct list: name * * name * * * YYC6874- 033-1 * * * yYC6874- 00_md * * * | Its Object (Find Add C) hname (032-1 c,24691964 V440_Per BQ_Ind 2513_06m | Results | dec 0 -230064 55.3049 55.3049 20.5703 | etails type ECL PULS PULS | de | ect details ect details chart Eilters | E_34691964 | 0413267840 | Radial | /elocity Diagram | Kone | Fits de Your C | Object Decin | • HARPS |

Araucaria Database

- **FITS** Database (existing): RAW, Calibrated, Spectroscopic
- **Objects** (existing): Targets, Fields, Variability
- **Organization**: Projects, Proposals, People
- Scheduling
- **Results**: Curves, Field photometry





IT Architecture Foundations

- Autonomy state of the internet connection does not affect operations
- **Modern** solutions and technologies no technical debt
- **Python** language as the programming language our group is familiar with
- Container-ready Microservice architecture
- **Redundancy** no single point of failure thanks to distributed architecture
- Local/Remote control rooms in Observatory and CAMK
- **Open Source** Software (MIT license). Universal software for different kinds of observatories
- Drivers for various telescope interfaces: **ASCOM**, ACS (Alma Common



Another speaker:

Mirosław Kicia

Member of the Araucaria Project

Nicolaus Copernicus Astronomical Centre of the Polish Academy of Sciences - Warsaw



OCM software development

We are finishing the first iteration of software development, necessary to perform observations:

- Telescope and peripheral communications
- Night plan runner (new syntax)
- Graphical user interfaces (GUI)
- Remote operating
- Observations scheduler





Visualization and preliminary data analysis



source: pixabay

The multitude of tools allows observers to simply and easily track simultaneous observations and verify the collected data. If they are occupied at observation time reporting and communication system allow to make "quick look" on parameters and if needed they have more detailed and specialized summary reports.



Real-time data processing

Gives observers and data users greater opportunities to easily control massive amounts of data, without unnecessary workload:

- Parameters display
- Telescope pointing verification
- Target saturation verification
- Instrumental calibrated images
- Photometry and light curves (ongoing)





Machine learning and other modern analytics methods





- Scheduling observations
- Automatic rating calibration and science data
- Faster and more reliable calibration and reduction methods
- Use of computer vision and object analysis
- other

