Wendelstein Observatory: Status, Use and Future Strategy

Faculty for Physics – University Observatory Munich
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for the Wendelstein team

Contents:

- mission and status
- telescopes, instruments, operation today
- future perspectives

Mission & Environment: Tasks Observatorium Wendelstein

- Education of students on all levels (Bachelor to PhD)

  - student lab exercises with night observations (imaging, spectroscopy)

  - thesis work (BC, MS, PhD: hardware, control & reduction software, science)

- Science projects: observational branches of USM+OPINAS+Cluster Origins

  from EXO-planets over stellar population to galaxy evolution and cluster lensing

- 3 full professor, 5 further professors, 3 goup leads & post-docs & students

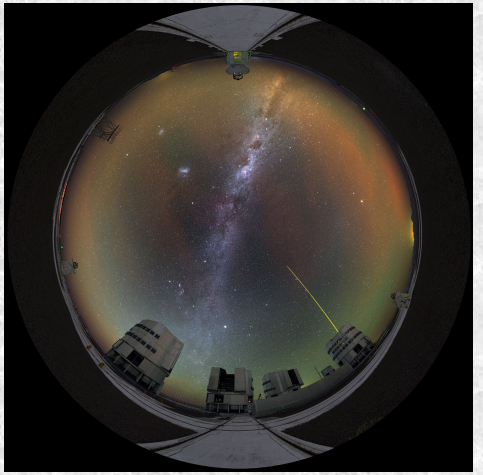
- - ~roughly 100 people (~1/3 to 1/2 observers)

  -> science requirements drive specification for instrument (& telescope) design

- *complementing*

  - USM share at 10m Hobby-Eberly telescope (Texas) →

  - GTO time at ESO facilities due to ESO instrument building (FORS1, FORS2, OmagaCam, KMOS, MICADO) →



Telescope: FTW 2m ray tracing

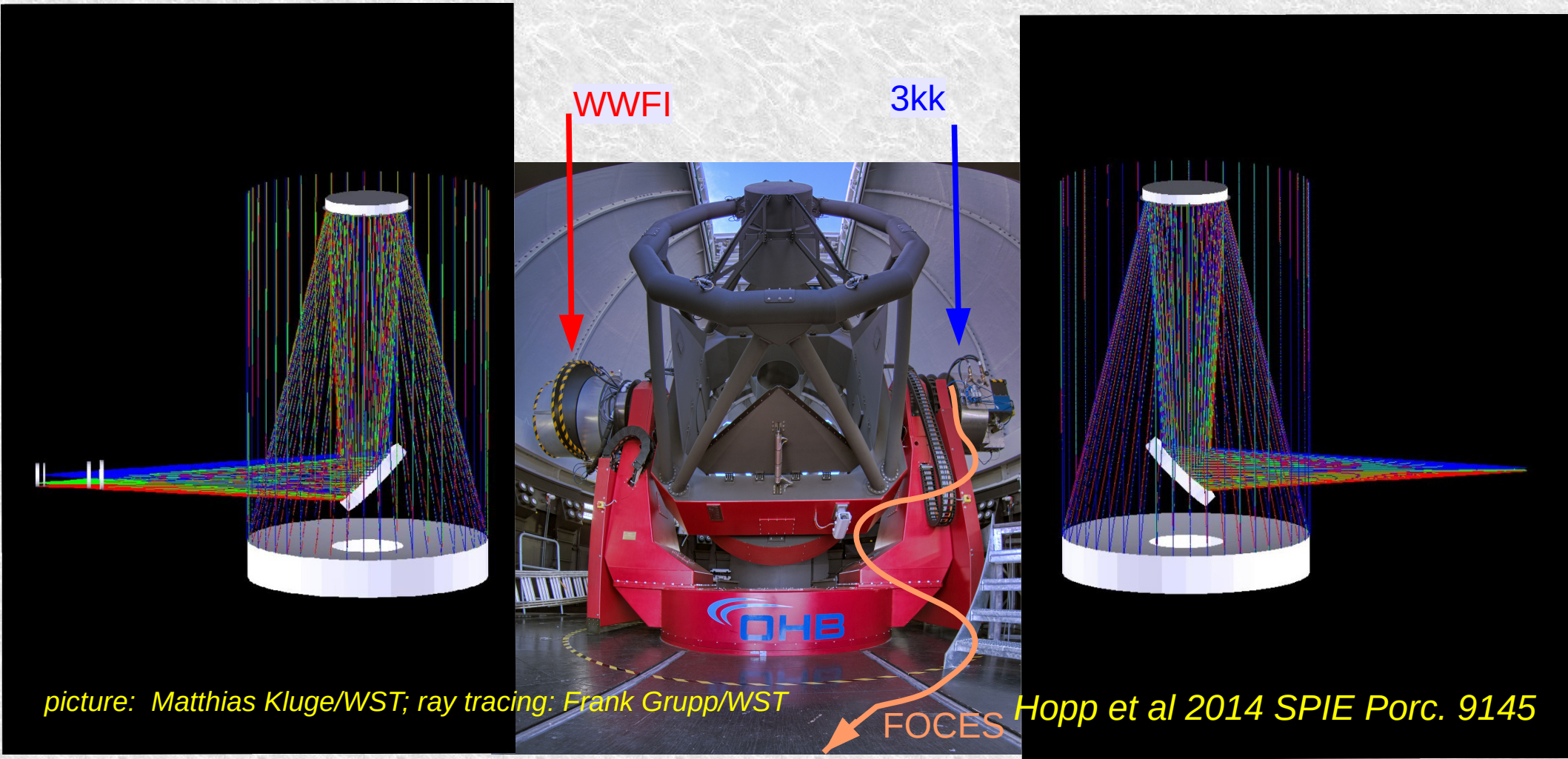
f/7.8 RC system with rotable third flat mirror

Nasmyth focus 2:

WWFI
(large f.o.v. with 3 lens corrector)

Nasmyth focus 1:

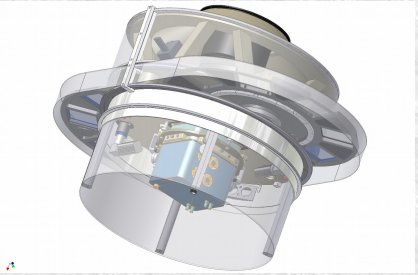
3KK, FOCES
(small f.o.v. no corrector)



picture: Matthias Kluge/WST; ray tracing: Frank Grupp/WST

Hopp et al 2014 SPIE Porc. 9145

Telescopes & Instruments



WWFI

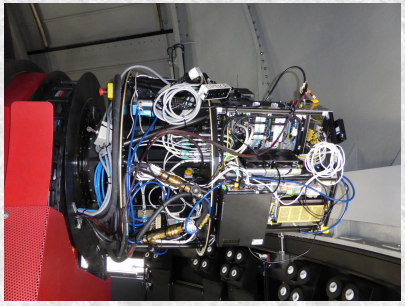
- 2 m telescope:

2013: 0.5° * 0.5° CCD mosaic imager *WWFI* (u'g'r'i'z' + free slots)
(Kosyra et al 2014 Experimtal Astron. 37)

2016: 8' * 8' three channel camera *3KK* (u'g'r'NB + i'z'+JHKs)
(Lang-Bardl et al. 2010 SPIE Proc. 7735)

2018: high resolution echelle spectrograph *FOCES* + frequency comb (R 70000) (Brucalassi et al. 2016 SPIE Proc.9908 & ref.)

2011: field spectrograph *VIRUS-W* (R 7500, on loan to McDonald 2.7m telescope, Texas) (Fabricius et al. 2012 SPIE Conf. 8446)



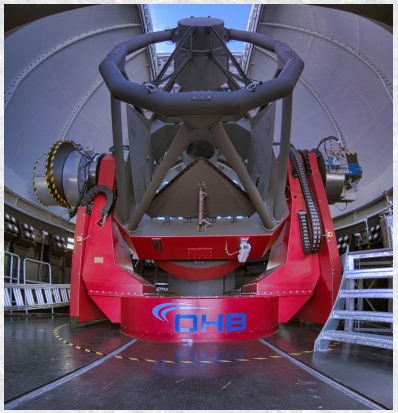
3KK

- 0.4 m telescope (student lab telescope):

0.75° * 0.75° CCD imager (g'r'i' L [OIII] Hα [SII])
low resolution spectrograph (student lab only)

FOCES tank and frequency comb in basement

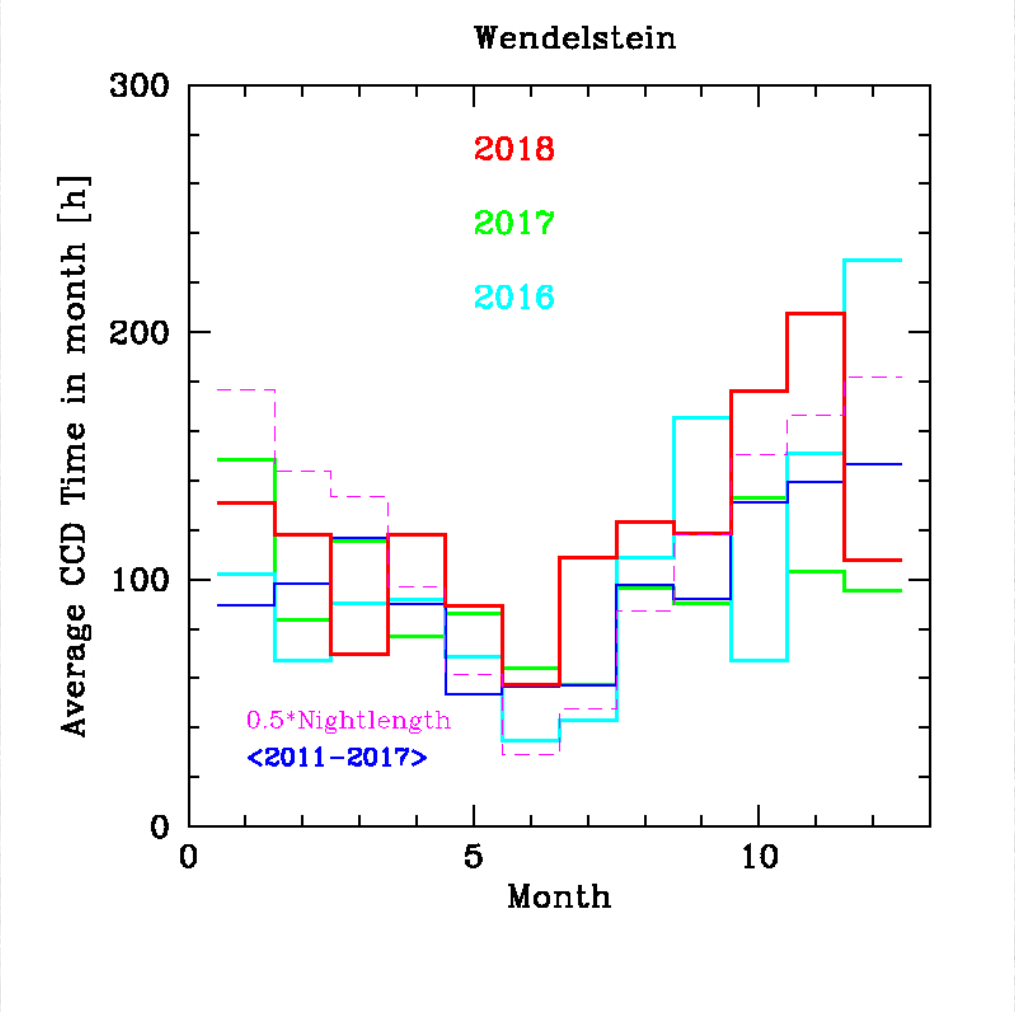
40 cm Planewave + SBIG STX-10



FTW 2m

Observing time (mid-Europe!):
~1200 h/yr on average, varies from ~890 to 1506 h/yr

clear hour statistics, e.g. 2016 - 2018

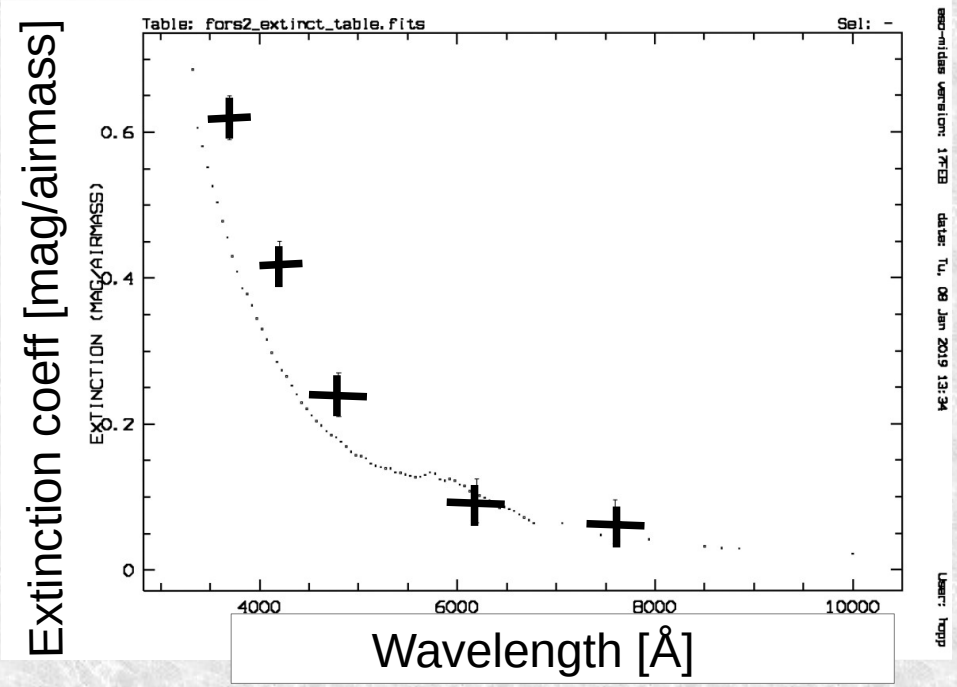


Extinction

as measured with the 40cm telecope and its CCD camera (errobars);

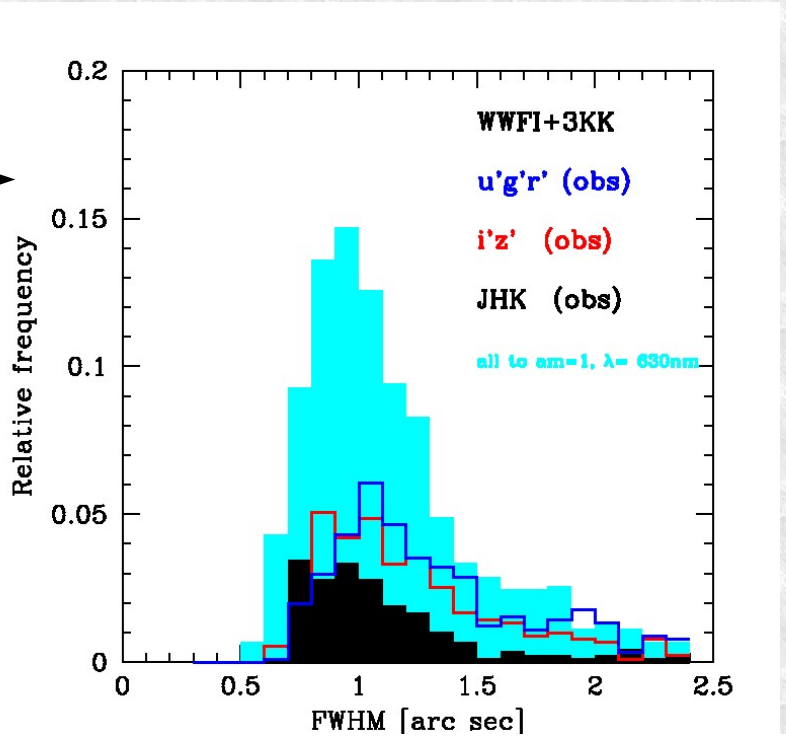
Bindel, 2011, Master Thesis, LMU;

in comparison to FORS measurements at Paranal (dots) *Patat et al 2011, A&A 527*



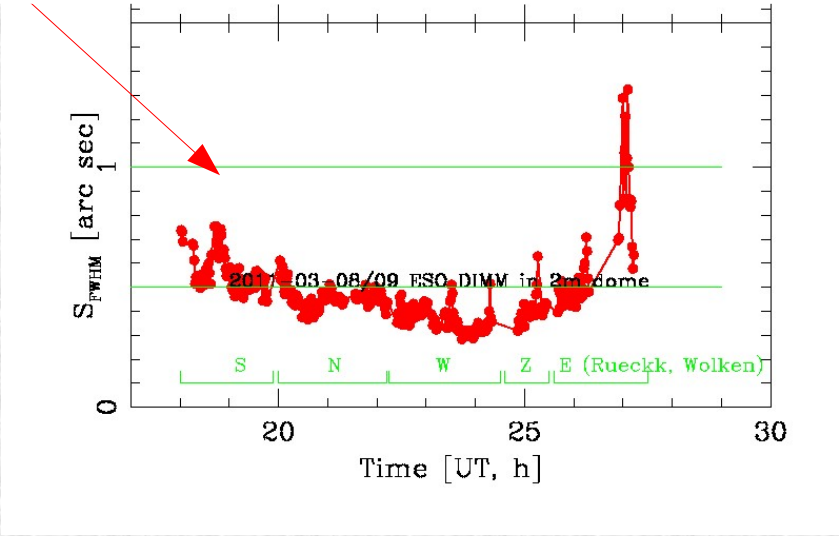
Hopp et al 2008 SPIE 7016, 58

Seeing 2018 statictics FTW 2m:
1.06” median - 6% < 0.7” (zenith, r-band)



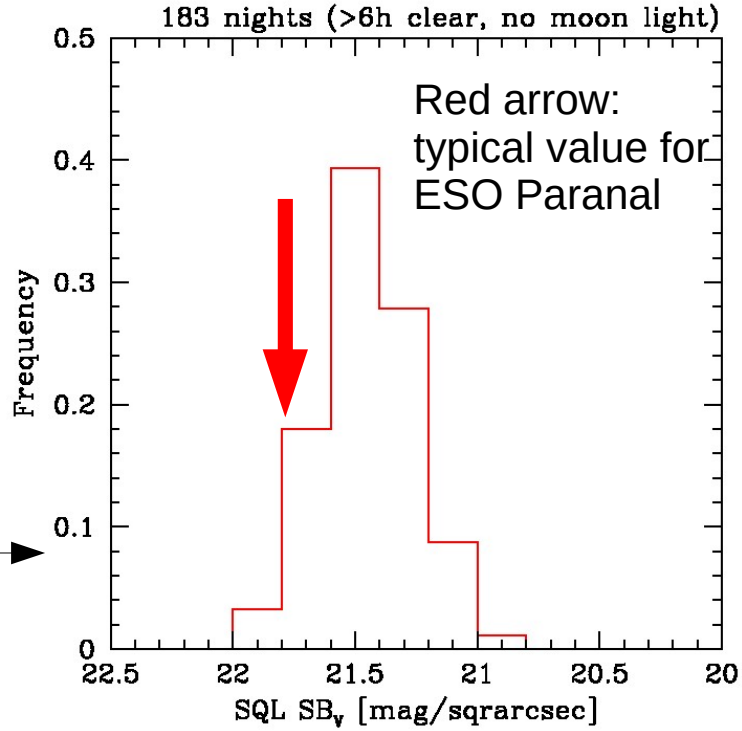
Seeing

as measured with an ESO DIMM within the Wendelstein 8.5 m dome (no 2m telescope, data reduced to zenith, r-band)

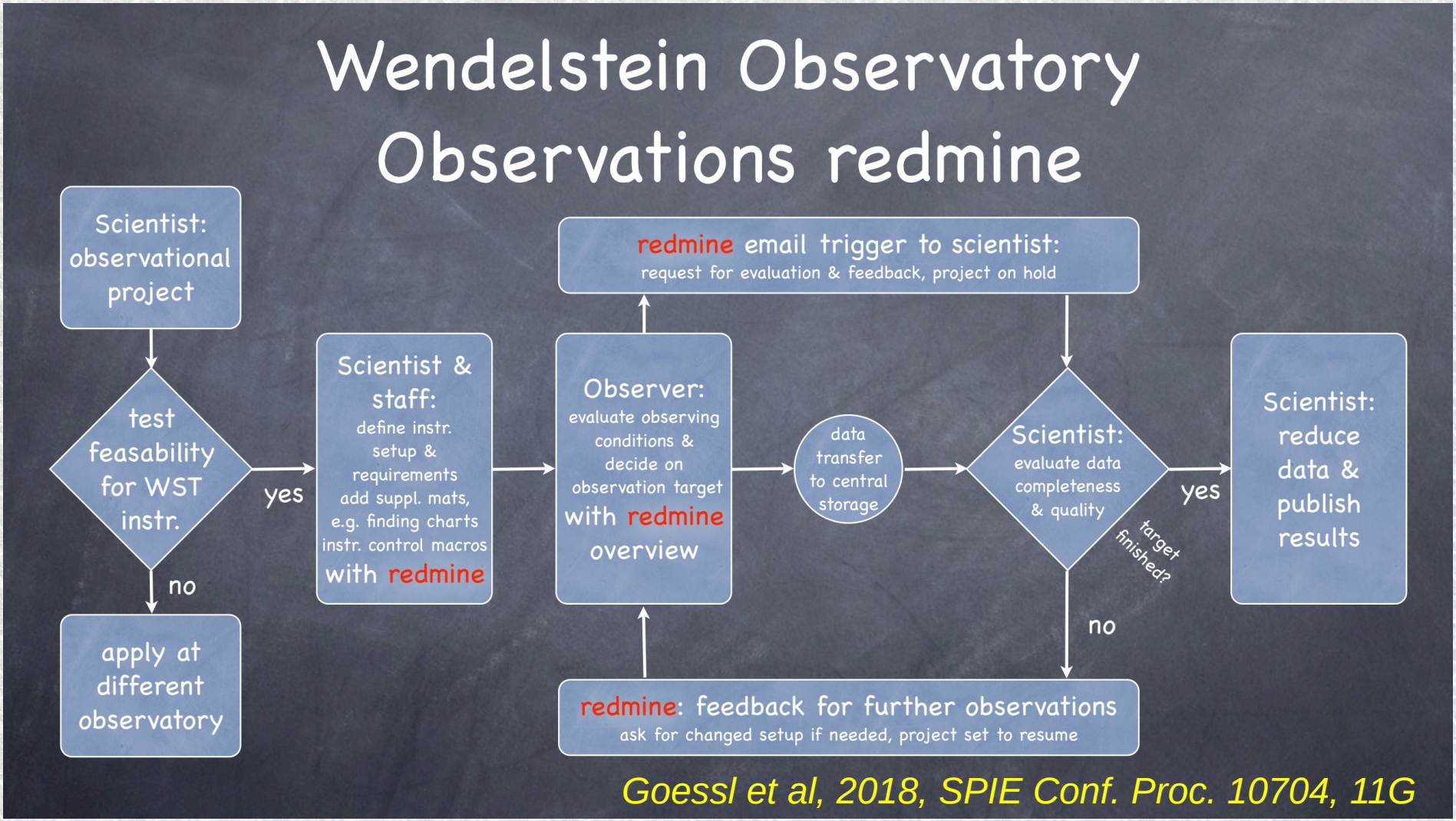


Night sky brightness: zenith, V.band

Hopp et al 2008 SPIE 7016, 58



See Poster by Claus Goessl for details !!



Wendelstein Observatory data rates:

clear winter nights up to ~120 GB of science+calibration data (meta data on top!)
~6.3 TB/yr science raw data (2013 – 2017) + meta data

Small time domain projects:

e.g.: Occultation of star (V~17)
by the dwarf planet Haumea
(one of four trans-Neptunian dwarf plants)
Ortiz et al. 2017 Nature 550,219

- 21. January 2017
- Vhaumea ~ 17
- distance 43 AU
- ➔ diameter ~2000 km
- ➔ shape !
- ➔ ring !!!

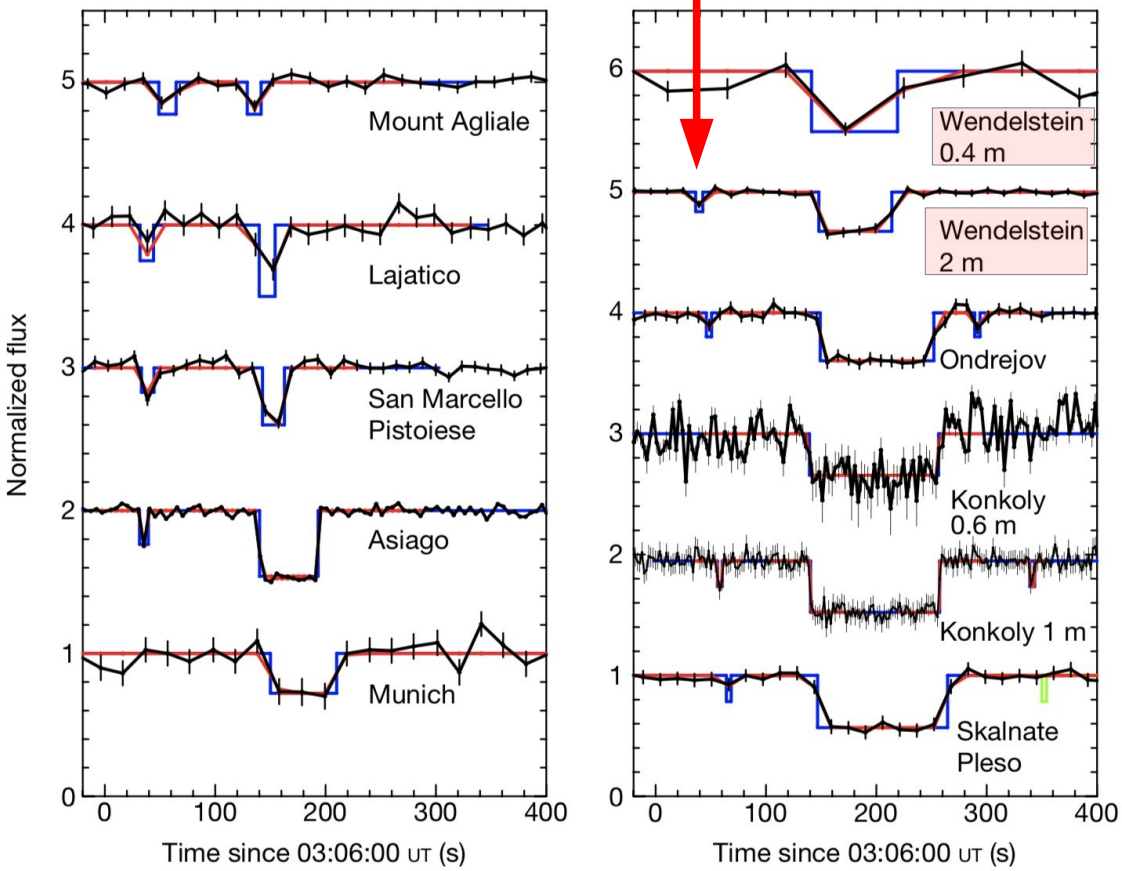
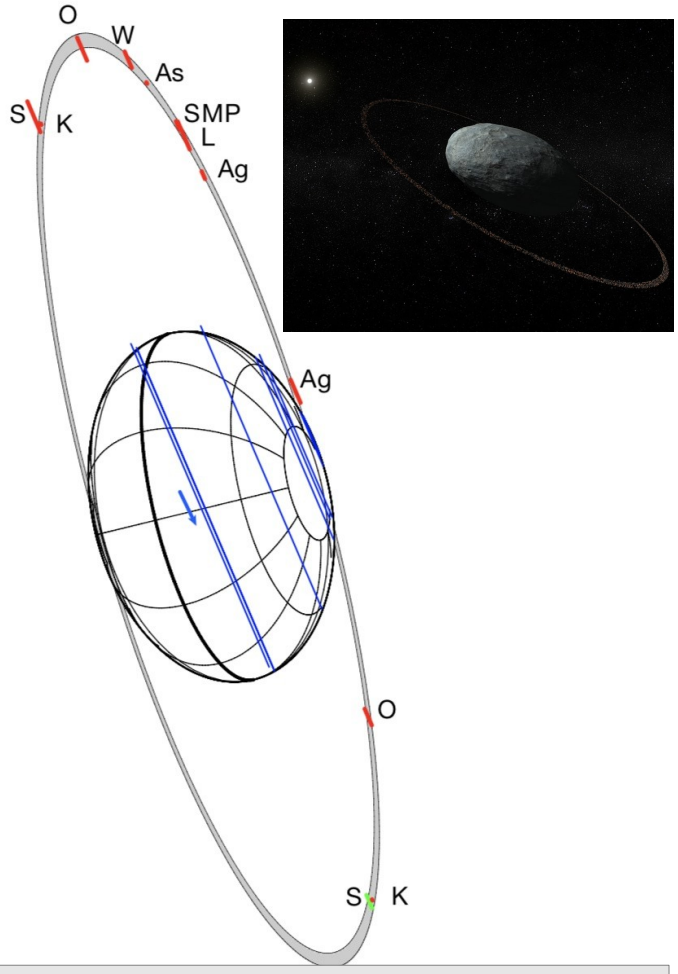


Figure 1 | Light curves of the occultation. Light curves in the form of



Other examples: evolution of coma of comets (67P, 41P, 46P, Gault, with MPS Göttingen)
exo-planet transits (talk Obermeier)
pixel lensing M31 (talk Riffeser)

Survey for dedicated objects: e.g.: Evolution of brightest cluster galaxies

- ~150 clusters: z<0.08, |l|>+5°, δ>-5°
- FTW2m WWFI: all in g' with some additional in u' and 3KK – Ks so far 373 h of shutter-open time
- HET LRS2 and 2.7m-VIRUS-P kinematic survey
- surface photometry in g' ready to publish (Kluge et al 2019 in prep)
- *Matthias Kluge 2018 Master Thesis, 2019 PhD Thesis LMU*


A 671


A 1142


A 1213


A 1257


A 1367


A 1656


A 2151


A 2199

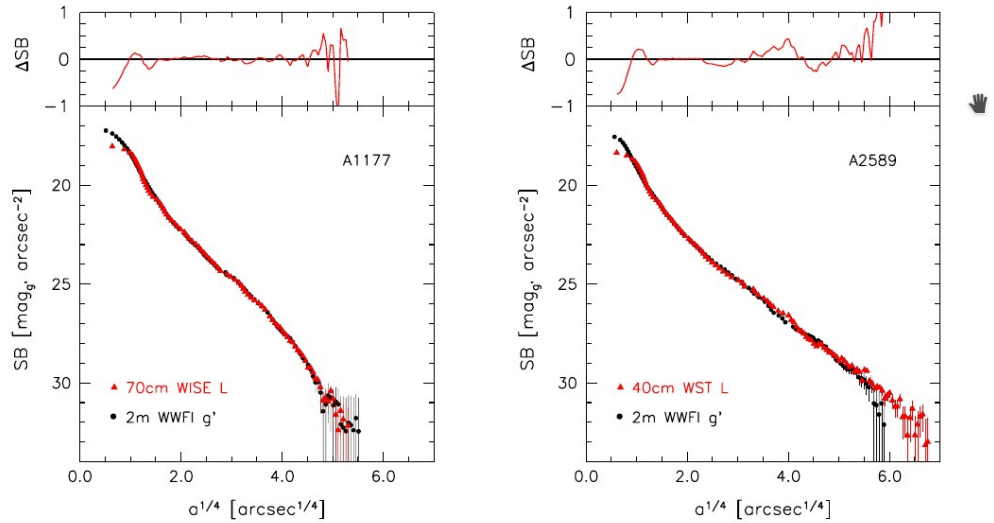


Figure 11. Control sample of two BCGs that were observed independently with different telescopes (red triangles). *Left panel:* 70cm telescope at the WISE observatory, owned and operated by Tel Aviv University. The raw data was kindly provided by Noah Brosch. *Right panel:* 40cm telescope at the Wendelstein observatory. The data points were kindly provided by Bianca Neureiter. The photometric zeropoints of the L-band profiles are adjusted so that the L-band profiles match the WWFI g'-band profiles for comparison. Color gradients in the two filters are assumed to be negligible. The deviations of the spline-interpolated profiles are shown in the top panels.

Abell 262 WWFI g

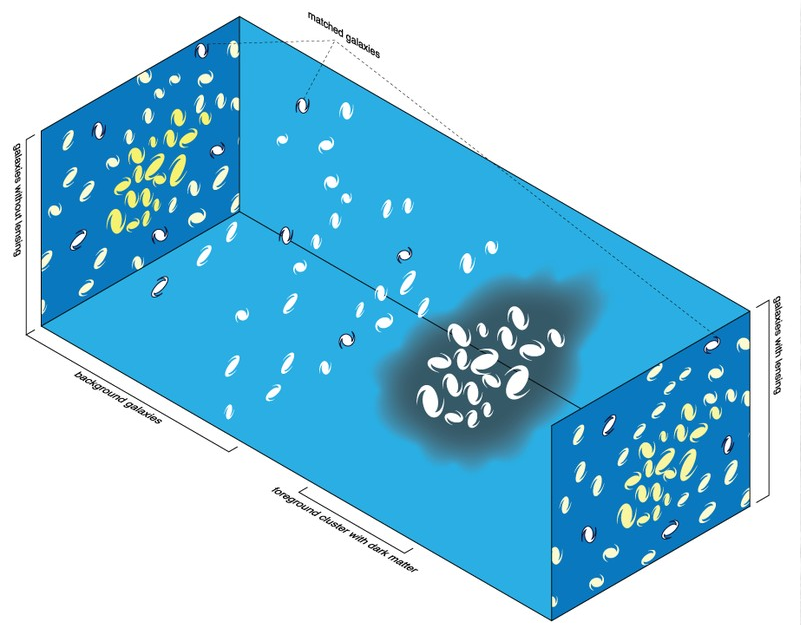
Surface photo-metry to extreme depth!
30 mag_g/sqrarcsec

<->

understand the systematics of your data to extreme levels

thesis M. Kluge & Kluge et al. in prep

Another example for survey for dedicated objects: Planck-Cluster follow-up: total mass



Weak lensing aperture mass reconstruction for psz 139 (colored map) -> get mass

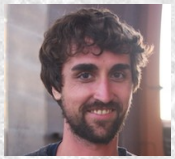
e.g. psz 139 z~0.27 (1321 Mpc)

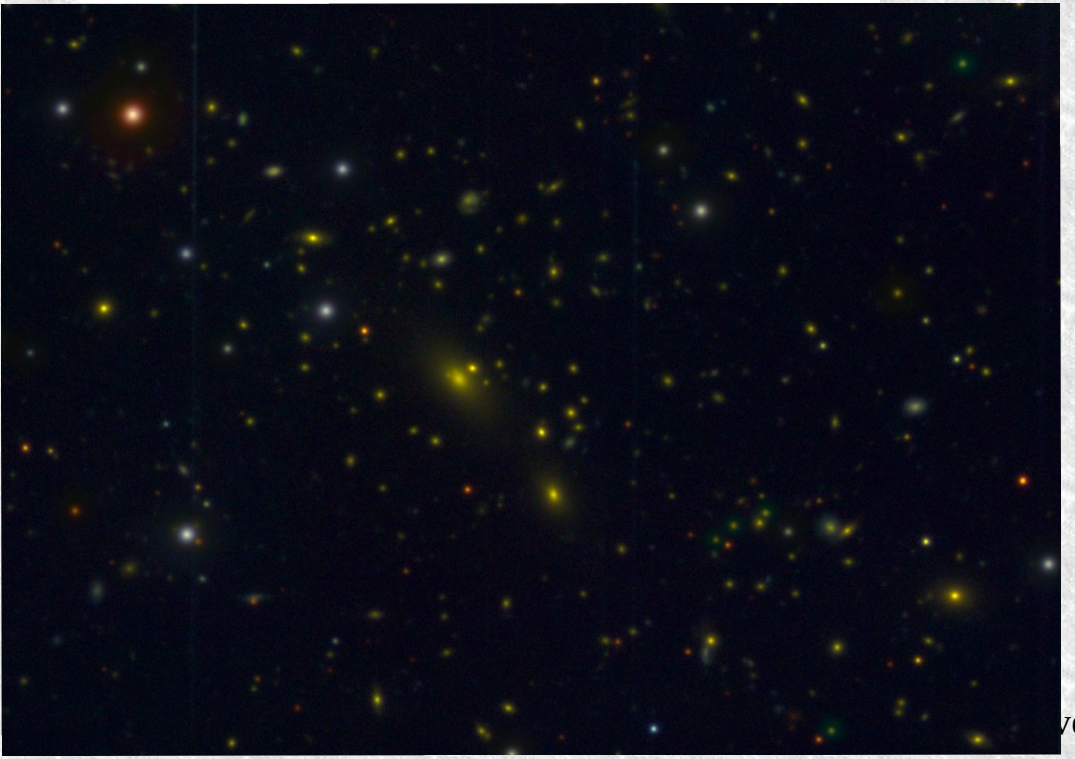
WST 2m WWFI 13.3 h
(shutter open time: g' 2.9 h; r' 4.8 h; i' 3.0 h; z' 2.6 h)

R. Rehmann 2016 (Master thesis), and Rehmann et al. acc. MNRAS, astro-ph/1806.10614)

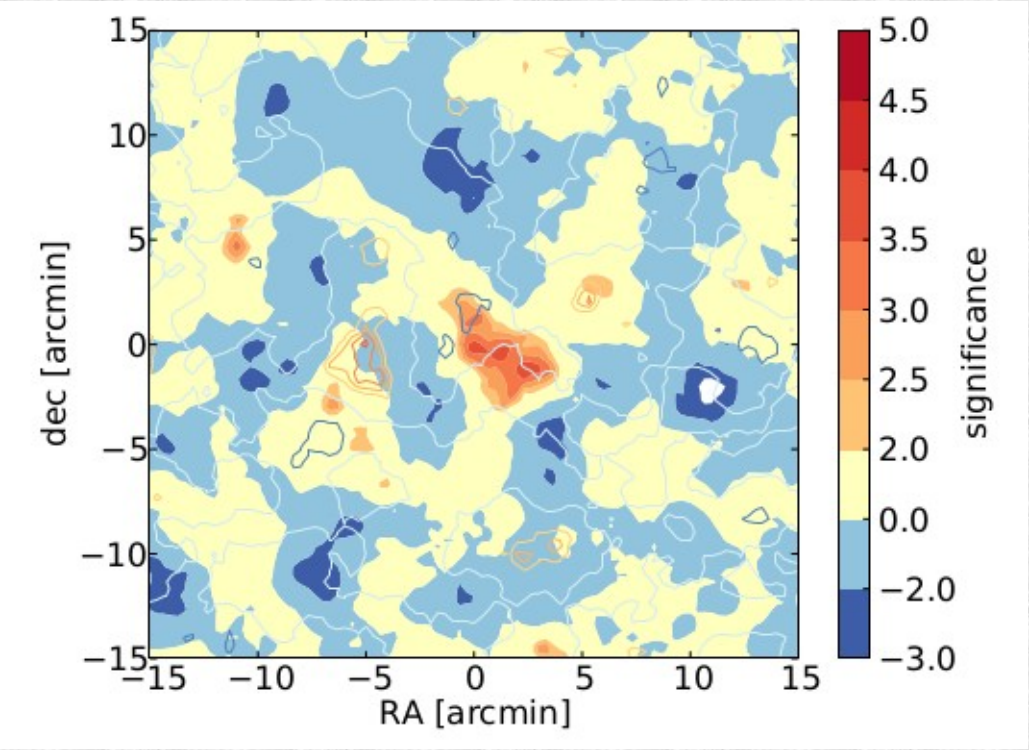

Rehmann


Seitz


Grün



~ 1/6 of field of view of CCD imager



R. Rehmann 2016

Summary and future

- Wendelstein has 2m telescope with 2 imaging instruments operational 365 days / yr
- echelle spectrograph still ramping up to regular observing scheme
- ~120 clear nights while observations in ~200 n/yr
- we are very flexible in scheduling (quasi queue scheduling)
- we are not at all flexible in adding other instruments

- focus on LMU science projects (but some small scale external collaborations)

- capabilities mostly in follow-up projects for large surveys, esp. where LMU participats
  examples: PanSTARRS, PLANCK, TESS, HETDEX, eROSITA(?), EUCLID
- can devote relatively large amount of observing time to individual projects:
  either survey follow-up and/or participation in major large time domain work
  (e.g. exo-planets – see next talks)

- rather large number of 1-2m class survey telescopes esp. for time domain

- LSST and similar large surveys (esp. non-optical!) will require huge follow-up capabilities

→ we see our rôle mostly in follow-up of 'external' survey