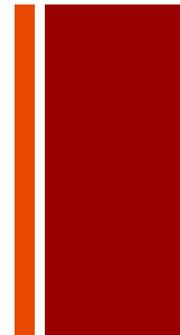


The **BlackGEM** Array for follow-up of GW sources

Radoud Universiteit Nijmegen



Steven Bloemen
BlackGEM Project Manager
Radoud University, Nijmegen, NL



BlackGEM and MeerLICHT



MeerLICHT

- 1 (prototype) telescope at Sutherland
- Optical data commensurate with MeerKAT
- Installed in July 2017

BlackGEM

- 3 telescopes at La Silla (Chile) in Phase 1
- GW follow-up
- Q4 2018
- Looking for funding to expand array to ~10

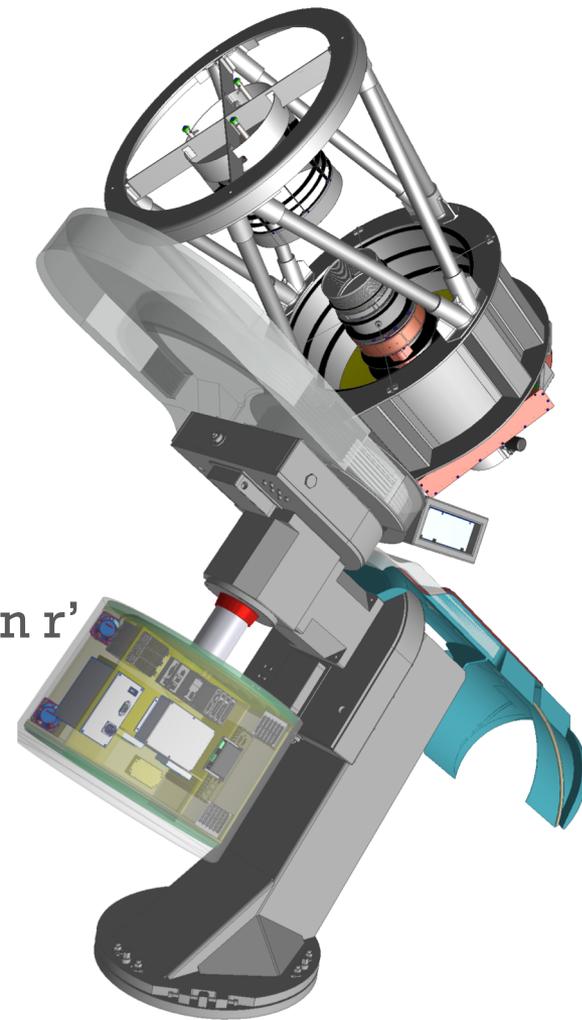
+ BlackGEM Array

- Phase-I: 3 telescopes
- Southern sky: ESO **La Silla** site (Chile)
- 2.7 sqd FOV using one 110 Mpix CCD
- Thanks to good site: $\sim 23^{\text{rd}}$ mag in 5 minutes in r'

PI: Paul Groot (Radboud University)

PS: Peter Jonker (Radboud University / SRON)

PM: Steven Bloemen (Radboud University / NOVA)



Institutional partners



Radboud University

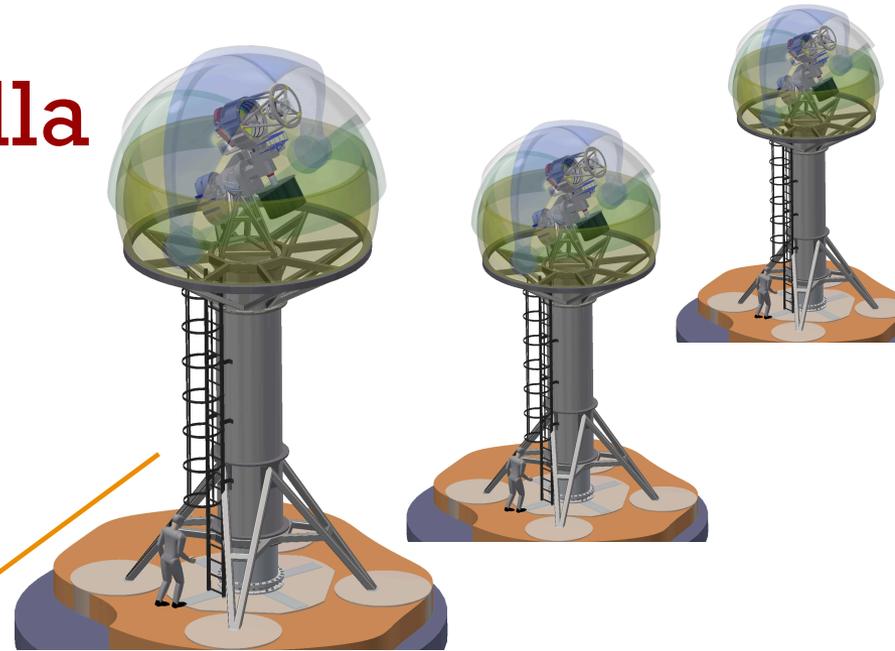


KU LEUVEN

PI-level partners



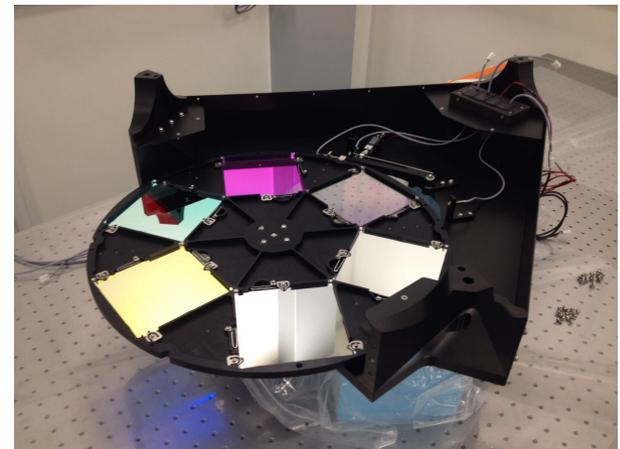
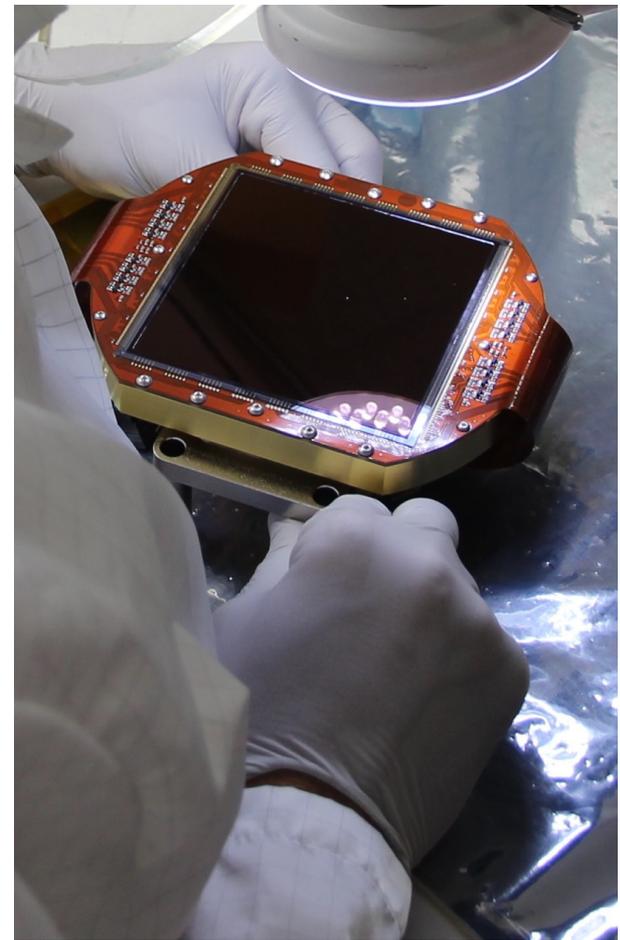
+ BlackGEM site: La Silla



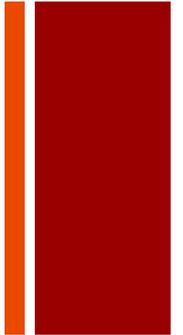
- Site of European Southern Observatory
- 3 telescopes on 7m high towers
- Former location of GPO

+ Custom optical + mechanical design

- 100% designed for GW follow-up
- 65 cm optical telescope
- Built around 110 Mpix CCD
- 6 colour filters
→ *Crucial to recognize GW counterpart*
- 2.7 square degree instantaneous field-of-view per telescope

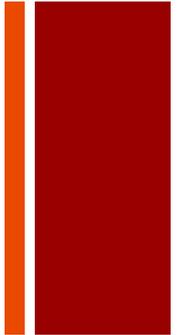


+ BlackGEM filter set and depth

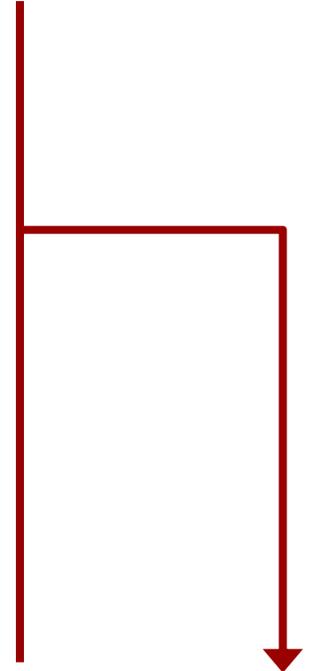


Filter	Wavelength range (nm)	Depth in 1 min ; 5 min (AB mag)
u	350 – 410	19.8 ; 20.9
g	410 – 550	21.9 ; 22.9
r	563 – 690	21.3 ; 22.3
i	690 – 840	20.7 ; 21.7
z	840 – 990	20.4 ; 21.4
vr	440 – 720	22.2 ; 23.2

+ BlackGEM surveys



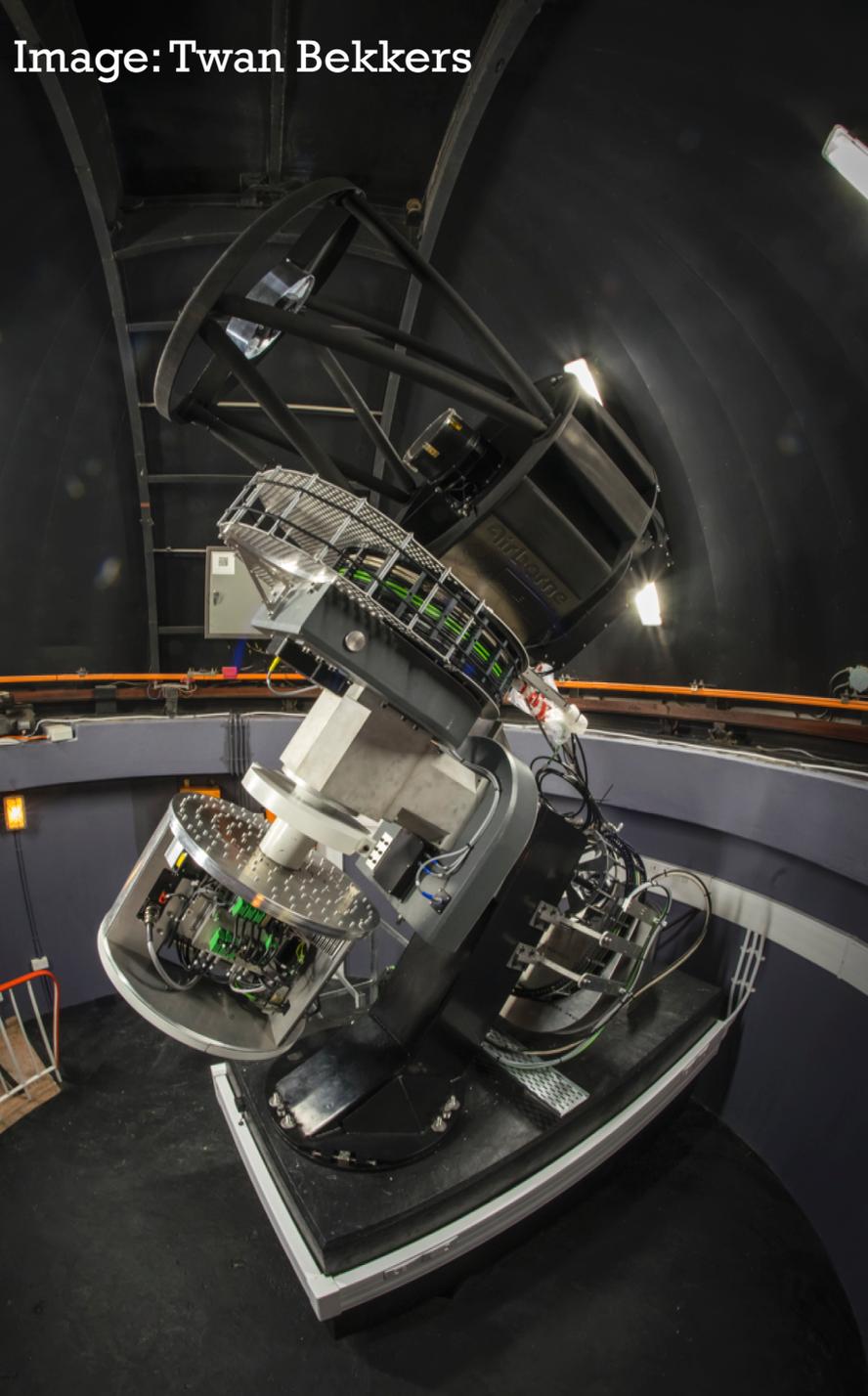
- **BlackGEM Southern All Sky Survey: 'Southern Sloan'**
→ 30 000 sqd down to 22nd mag in u,g,q,r,i,z at 1" median seeing
- **BlackGEM q-band Scan: 'What was there yesterday?'**
→ Visible 10 000 square degrees in q-band every 14 days
- **BlackGEM Fast Synoptic Survey: 'What else goes bang?'**
→ 1 min cadence, multi-colour (simultaneous), wide-field, 1-2 weeks
- **BlackGEM Twilight Program: 'Local Universe transients'**
→ Every twilight (30 minutes) scan Local Universe galaxies in 2 bands for new transients
- **BlackGEM Trigger Mode: 'Transients Galore'**
→ GW error box coverage in multiple colours



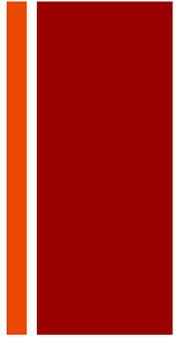
GW trigger

Outgoing transient triggers

Image: Twan Bekkers



MeerLICHT



BlackGEM prototype

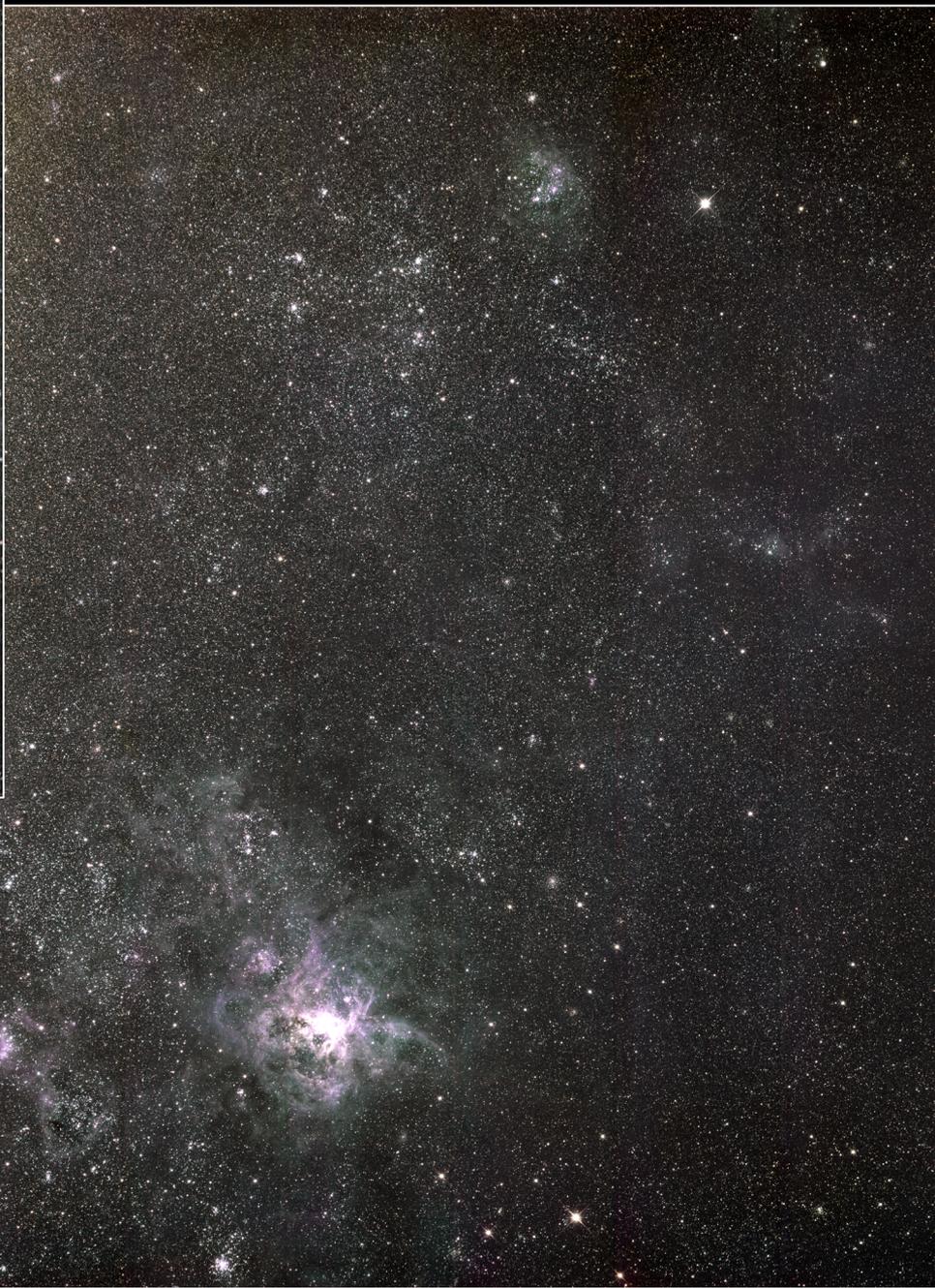
At Sutherland, **South Africa**

Changing transient science to truly multi-wavelength

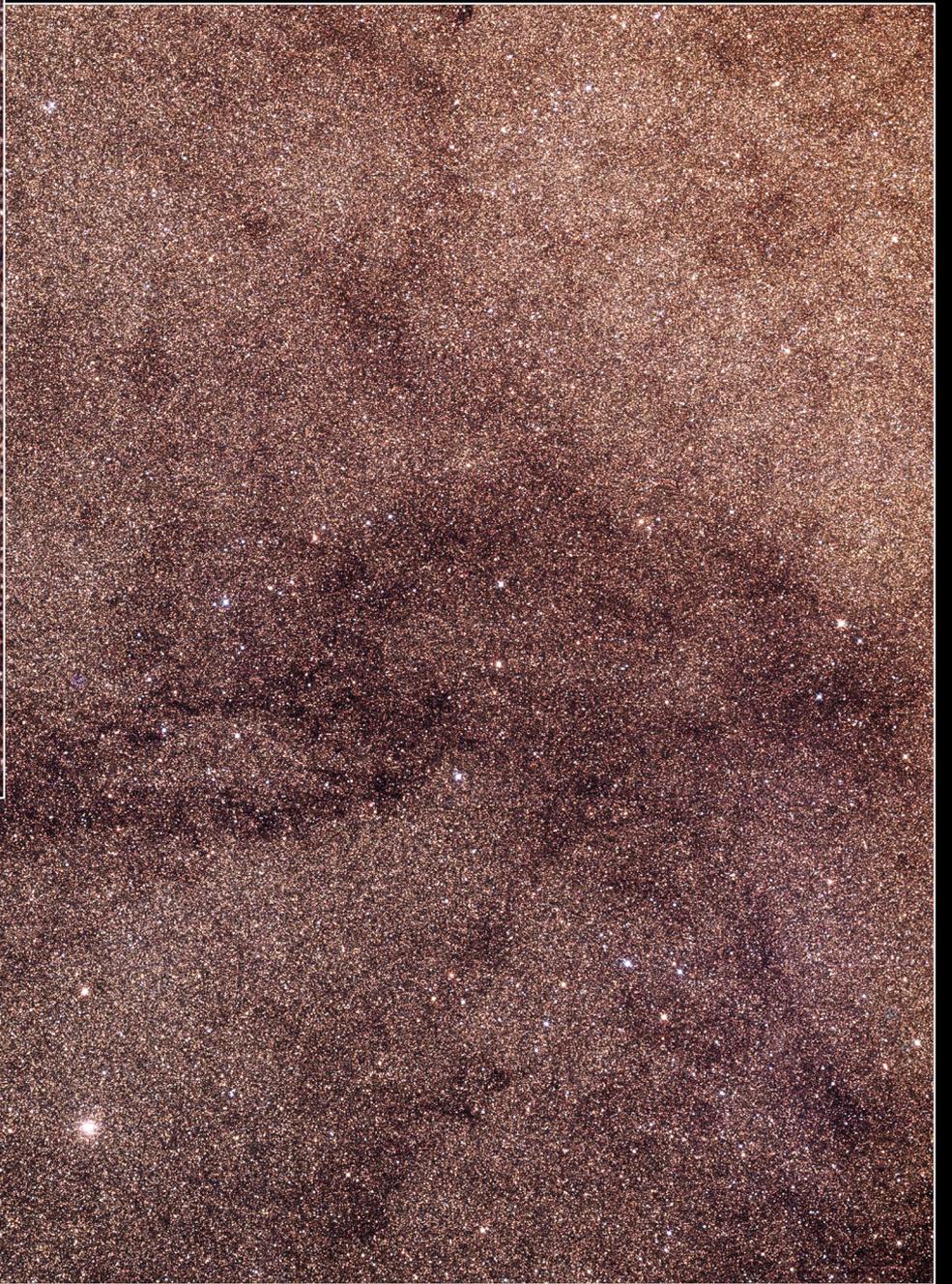
Pointing determined by **MeerKAT** radio telescope

In South Africa: bridge between SALT and SKA/MeerKAT

Partners: Radboud, UvA, NWO (NL); UCT, SAAO (SA); Oxford, Manchester (UK)



Tarantula Nebula
MeerLICHT
@ Sutherland
1-min exp. in 6 bands



Baade's Window
MeerLICHT
@ Sutherland
1-min exp. in 6 bands

+ Now building BlackGEM

Now assembling telescopes at NOVA group in Groningen
Installation at La Silla Q4 2018





Small Magellanic Cloud
MeerLICHT @ Sutherland
1 min exposures in 6 bands

MeerLICHT – Radio/optical transients – South Africa – operational now
www.meerlicht.org @MeerLICHT_ZA

BlackGEM – Gravitational wave counterparts – Chile – installation Q4 2018
www.blackgem.org @BlackGEM_Array