TAIPAN Instrument Parameters for FunnelWeb Science

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Australian Government
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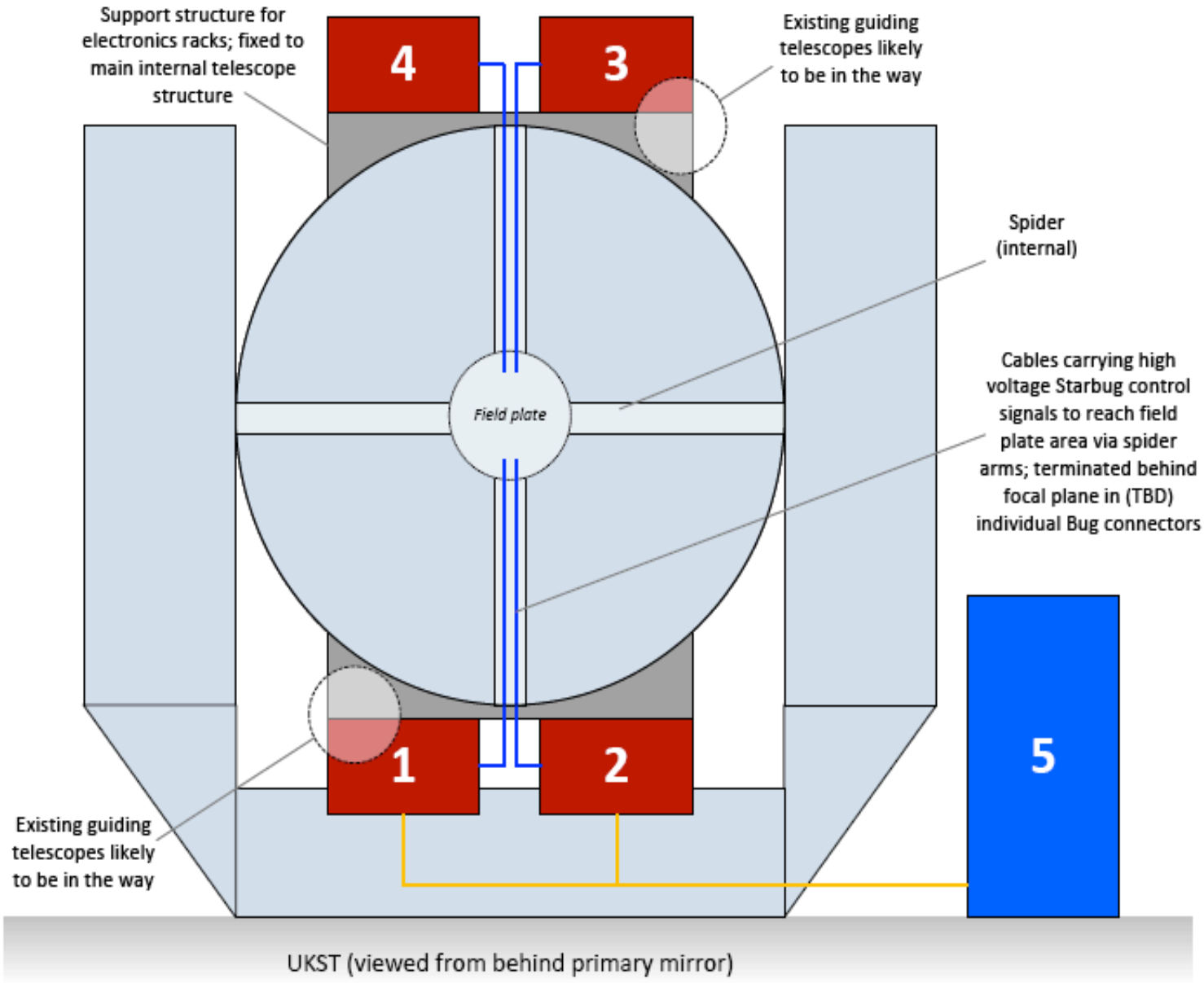
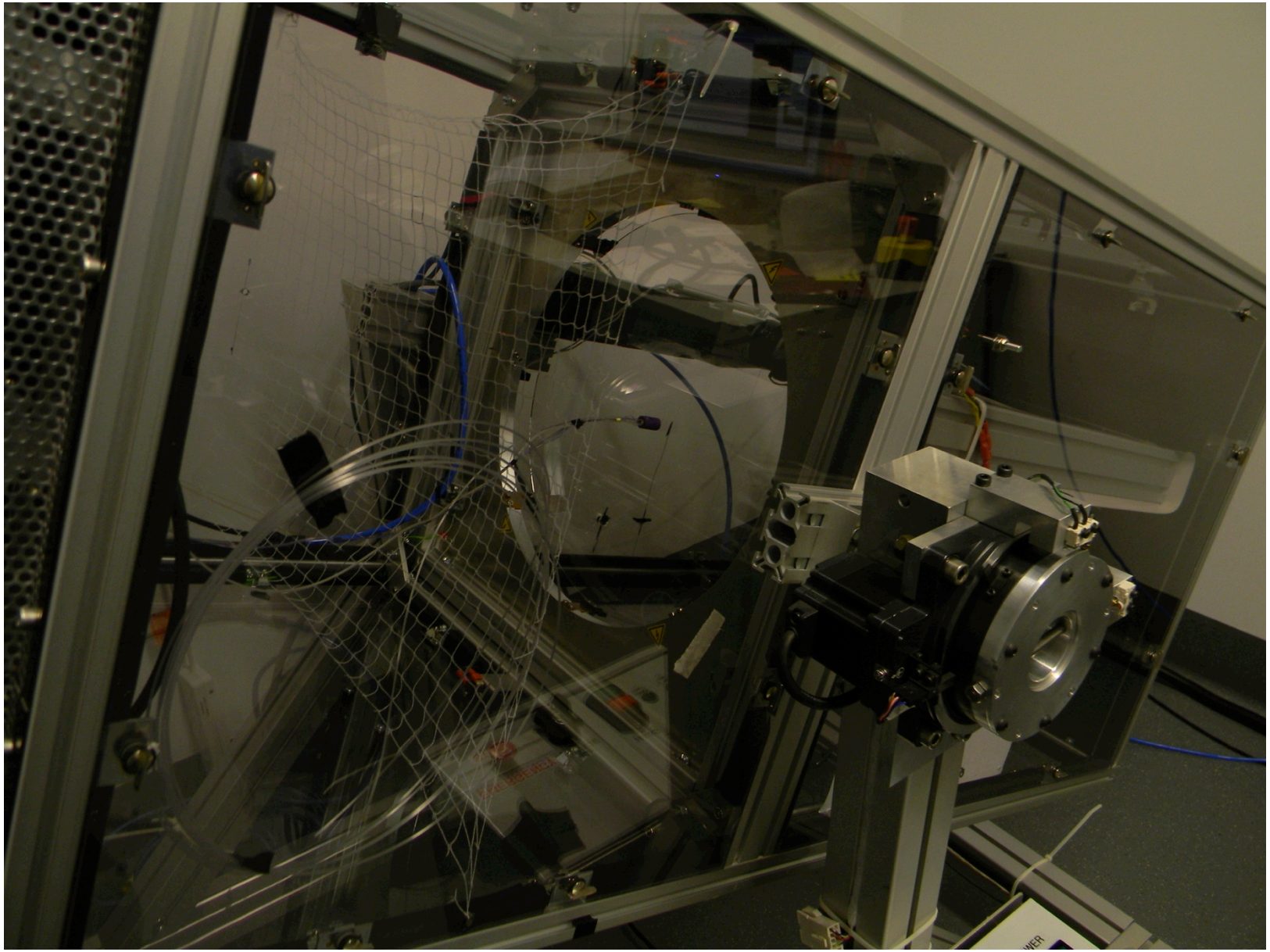
AAO

UKST Modifications



Starbugs + GFP in AAO Test Rig



TAIPAN Design Parameters

- UKST Aperture = **1.13m**
- Baseline starbug has 45 micron fibre = **3" diameter**, **150x multiplicity** (+A&G)
- Testing underway of improved bug design, including science fibres
- Bugs have 50mm patrol radius on GFP with **6^{o} field of view**
- Spectrograph has **R=2300** (2 pixels/SRE)
- Wavelength range: **370nm to 870nm**
- Overhead between exposures is **5 min** (field reconfiguration, slewing, etc.)

Calculated exposure times for a variety of parameters:

- **Stellar Magnitude** 6, 10, 11, 12, 14
- **Point Sources** with 1.5" seeing (alternate designs do not improve signal)
- **SNR** = 100
- **Bright** (V=18.0, B=17.5) sky
- Hardware **throughput** efficiency 15% and 25% (x 0.9 for sky transmission)

→ Calculated Number of Pointings, Number of Objects Observed, Survey Area:

How do these values fit in with science requirements and goals?

Baseline Magnitude Limits

For SNR = 100 in Bright time, we will reach

- **6^{th} mag in 0.4 s**
- **10^{th} mag in 28 s**
- **11^{th} mag in 70 s**
- **12^{th} mag in 180 s**
- **14^{th} mag in 1300 s**

Would this benefit from Dynamic Allocation of fibres based on multiples of 300 or 600 s exposures?
e.g. 50 fibres at 1200 s, 50 fibres at 600 s x 2, 50 fibres at 300 s x 4
→ 350 stars with 150 fibres yields a 2.33x increase in efficiency
(modulo 2-4x increase in readout time)

Survey Parameters

5 years
x **365** nights
x **½** (good weather fraction)
x **0.40** (Bright time)
x **8** hr/night on average
x **3600** s/(**exptime + 300** s overhead)

Yields the Number of Pointings = **6570** for 1300 s, OR **21900** for 180 s

x [$\mathbf{3^2\pi}$ sq. deg. OR **150** starbugs per exposure]
x [$\mathbf{1/N_{Repeat\ Field}}$ OR $\mathbf{1/N_{Repeat\ Object}}$]

= Survey Area OR Number of Galaxies Observed (at what completeness?)

185762 sq. deg. / $N_{Repeat\ Field}$ → 6.2 field repeats for 30K sq. deg.
(x 3.33 for shorter exptime, x 2.33 from Dynamic Allocation = 48 repeats)
985500 objects / $N_{Repeat\ Object}$
(x 3.33 for shorter exptime, x 2.33 from Dynamic Allocation = 7.7M objects)

Conclusions/Discussion

Design parameters have been modeled to determine the **exposure times** for the required S/N of 100, e.g.

We can observe stars to **12th (14th) magnitude** in bright time in **180 (1300) s**, even with conservative estimates on the throughput.

Given that the baseline fibre area is equal to the expected point source PSF, **larger fibres** would not be helpful, but would **only increase noise**.

Assuming the longest exposure time, **6 field repeats** are trivial, while **20-50 field repeats** are possible for more reasonable exposure times.

With the basic exposure time unit of **300 seconds**, dynamic allocation of fibres may improve number of observed objects by about a **factor of 2**.

Goal of **3 minute reconfigurations** improves performance even further…

Are you happy with these survey parameters as derived from the instrument design?