

*Observing models for TAIPAN*  
*Lessons from 6dFGS and RAVE*

R. Jay Gabany, Blackbird Observatory

**Prospects for TAIPAN**  
**Sydney, 10 Dec 2012**  
*Fred Watson (AAO)*

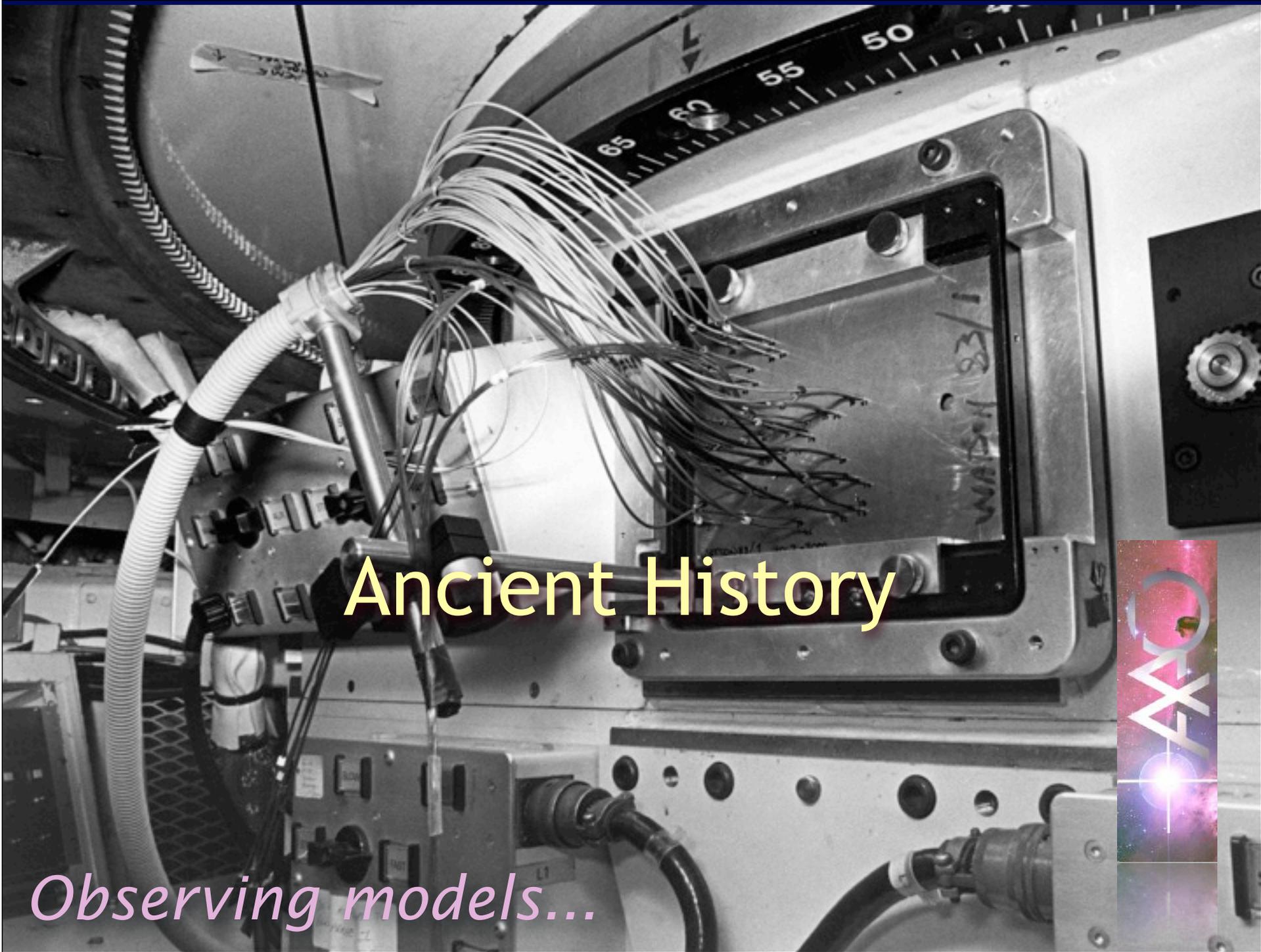


# *Observing models...*

## *A trilogy in five parts...*

- Ancient History
- 6dFGS and Beyond
- Lessons from the RAVE Survey
- Capitalising on the UKST
- An Observing Model for TAIPAN



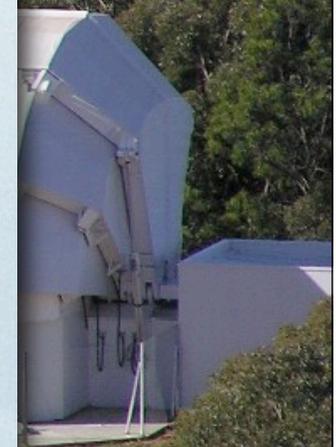
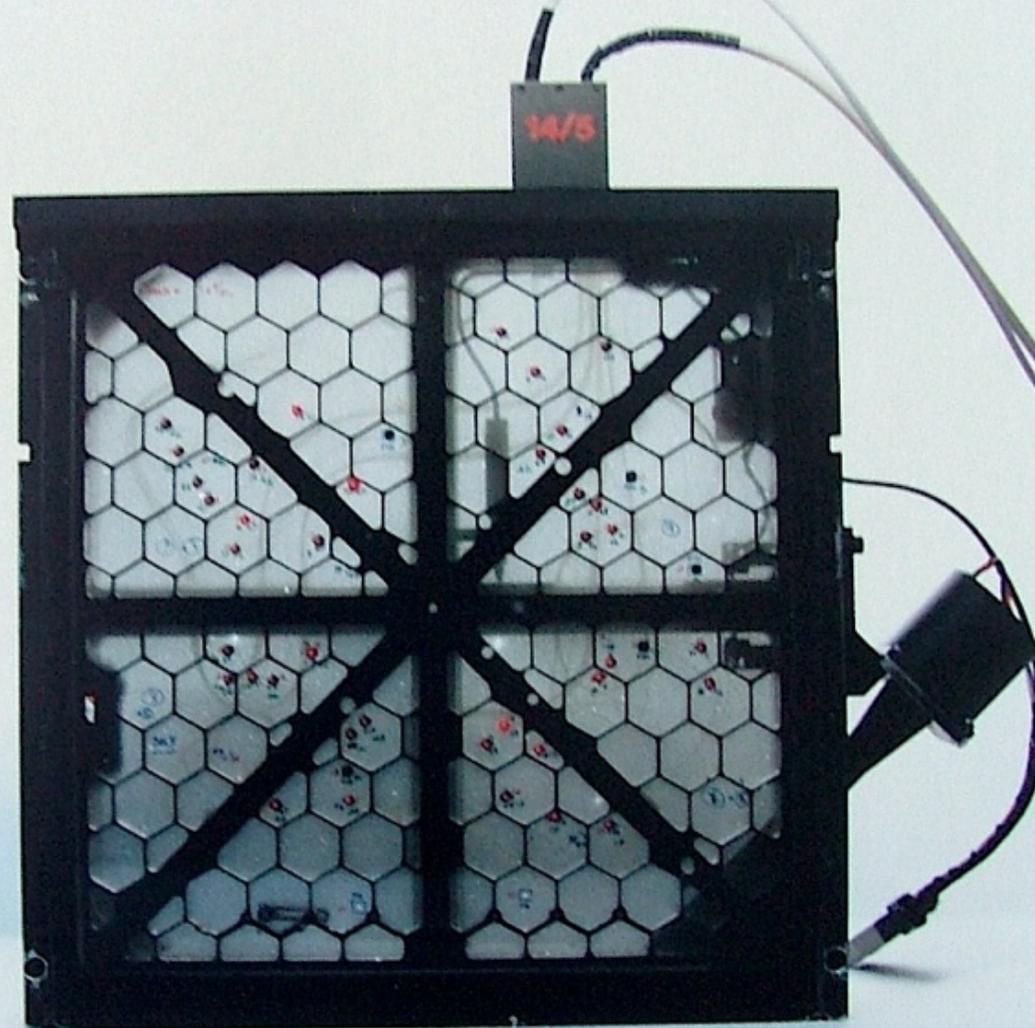


# Ancient History

*Observing models...*



# Observations with 1.2-m UKST





## 6dF multi-object spectroscopy system

*Typically* 110 science fibres over a  $5.9^\circ$  dia. field

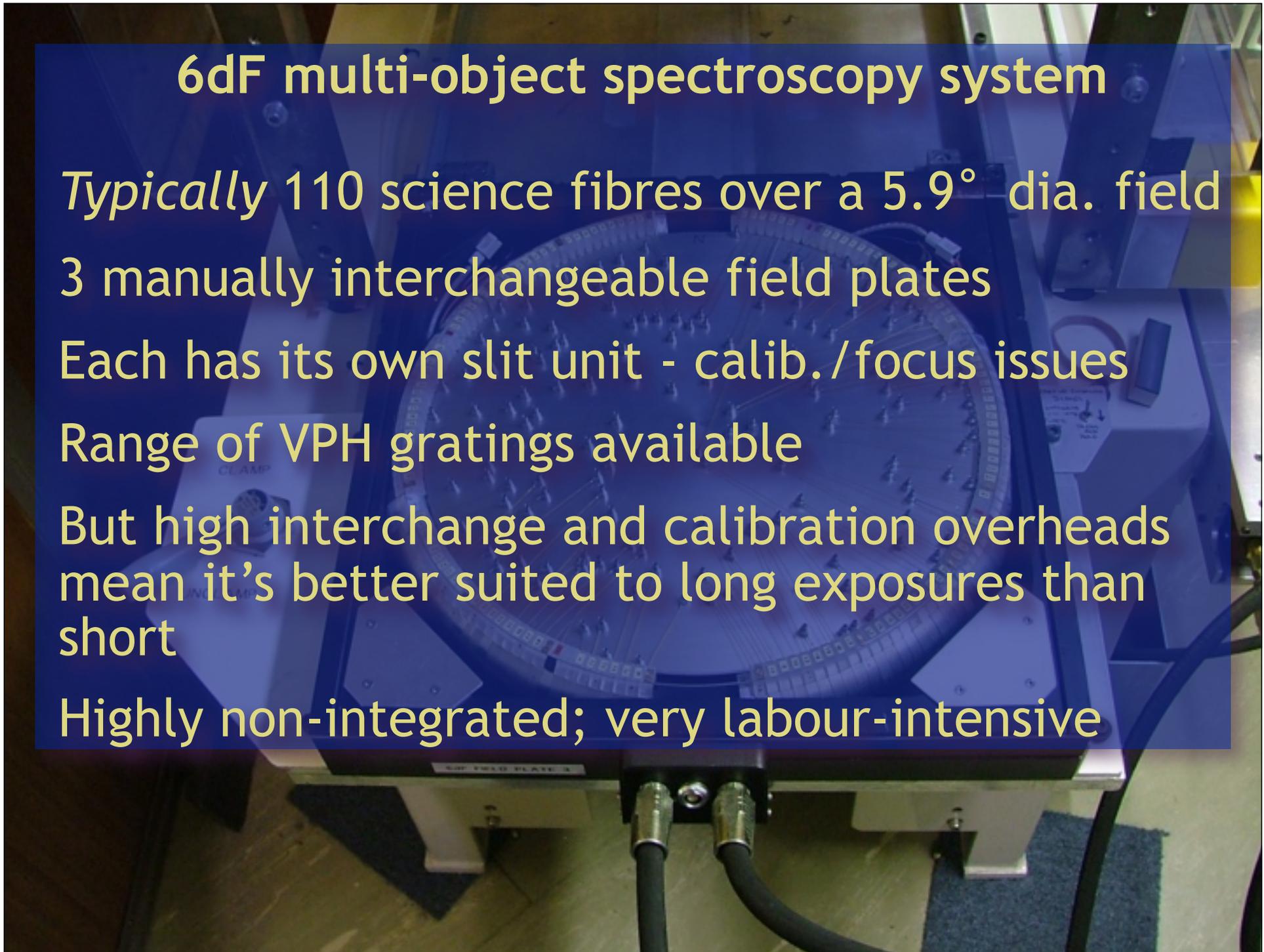
3 manually interchangeable field plates

Each has its own slit unit - calib./focus issues

Range of VPH gratings available

But high interchange and calibration overheads mean it's better suited to long exposures than short

Highly non-integrated; very labour-intensive









## 6dF Galaxy Redshift Survey

2001-2005 6dF Galaxy Survey (136,000 galaxies)

*Principal Investigator: Colless*

Funded by AAT Board - UKST funding ceased in 2005

2 waveband survey determining redshifts and peculiar velocities (for a subset)

Limited dynamic tiling

Effective survey plan - closed feedback loop



# Redshift Survey

Survey (136,000 galaxies)  
 Redshiftless

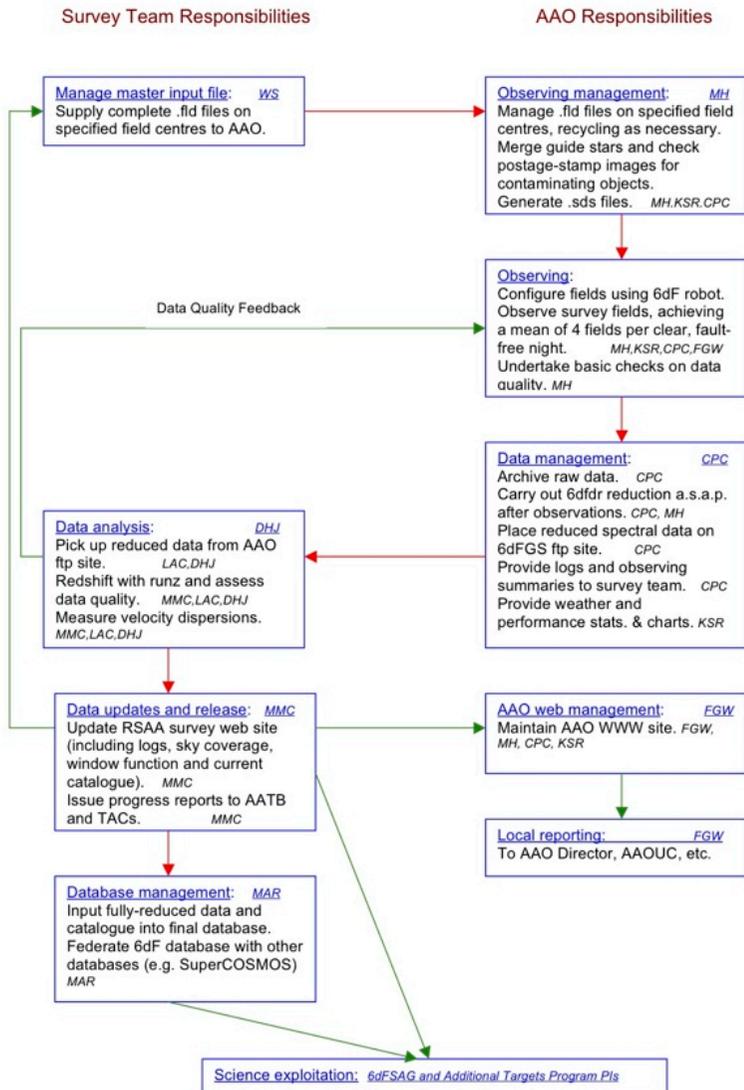
KST funding ceased in

mining redshifts and  
 subset)

closed feedback loop



Data and Information flow in the 6dF Galaxy Survey  
 (Sept 2002)



*Observing models for  
TAIPAN...*

# The RAVE Survey





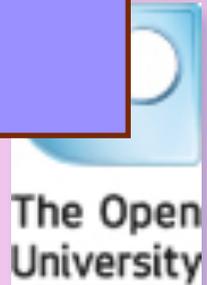
The University of Sydney



All of which have contributed financially



Leibniz-Institut für Astrophysik Potsdam



RAVE PI: MATTHIAS STEINMETZ, AIP



The University of Sydney

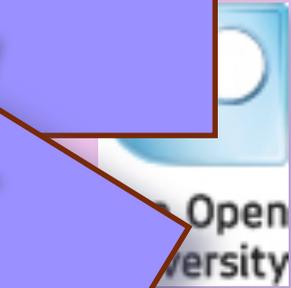


But in an ad hoc manner, leaving most of the load to a few institutions...

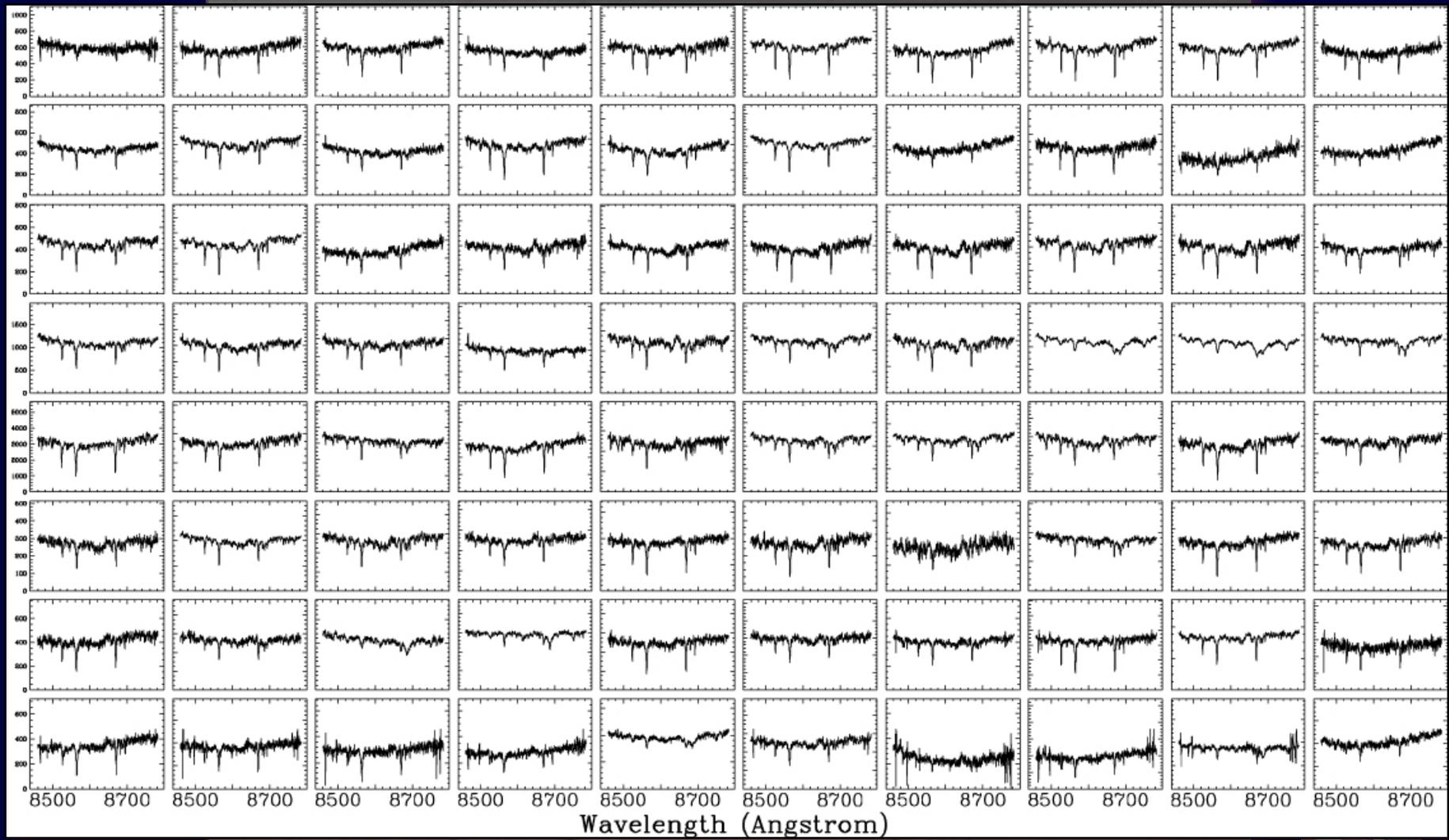
control... have... ally



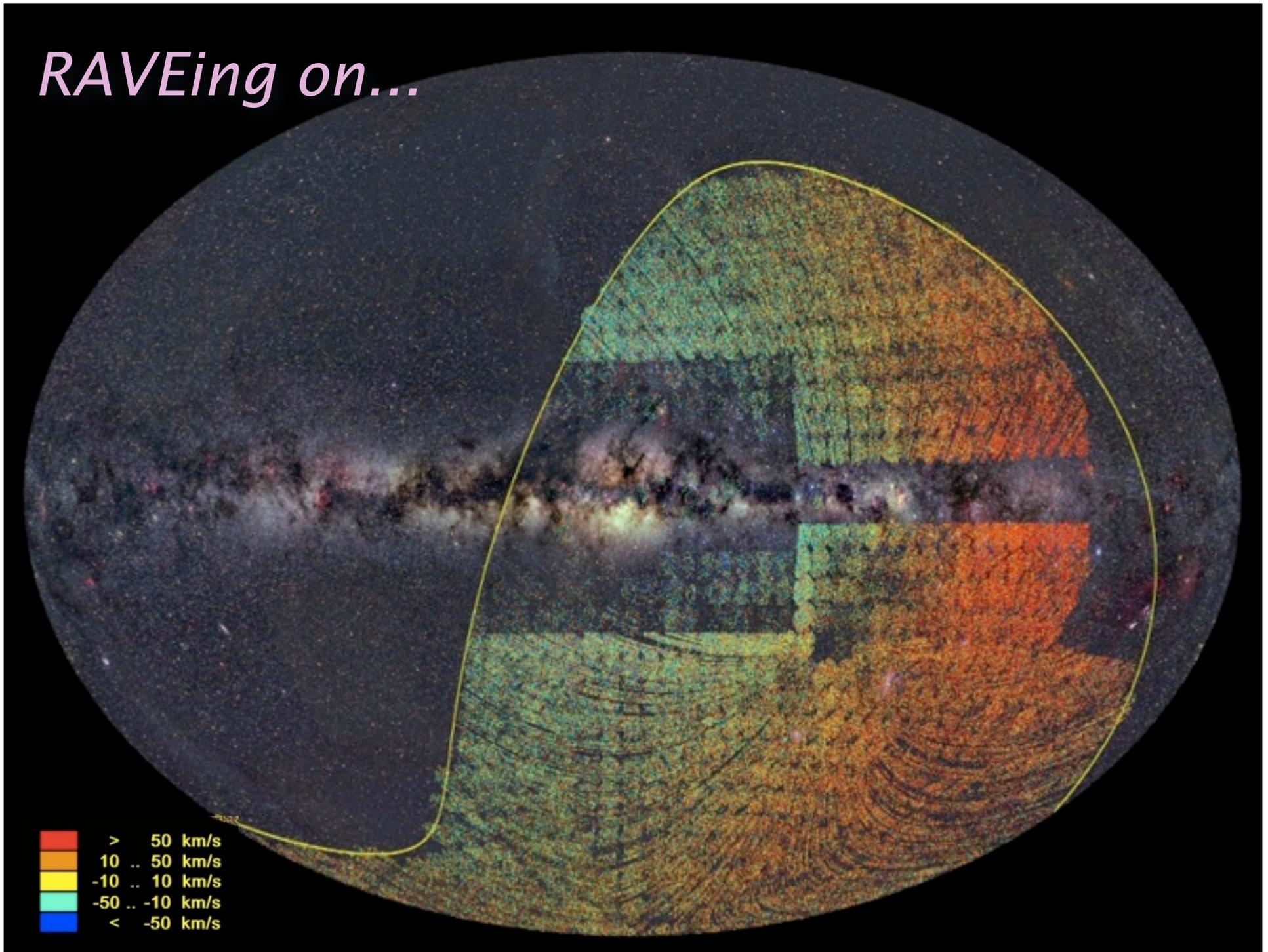
Leibniz-Institut für Astrophysik Potsdam



RAVE PI: MATTHIAS STEINMETZ, AIP



*RAVEing on...*

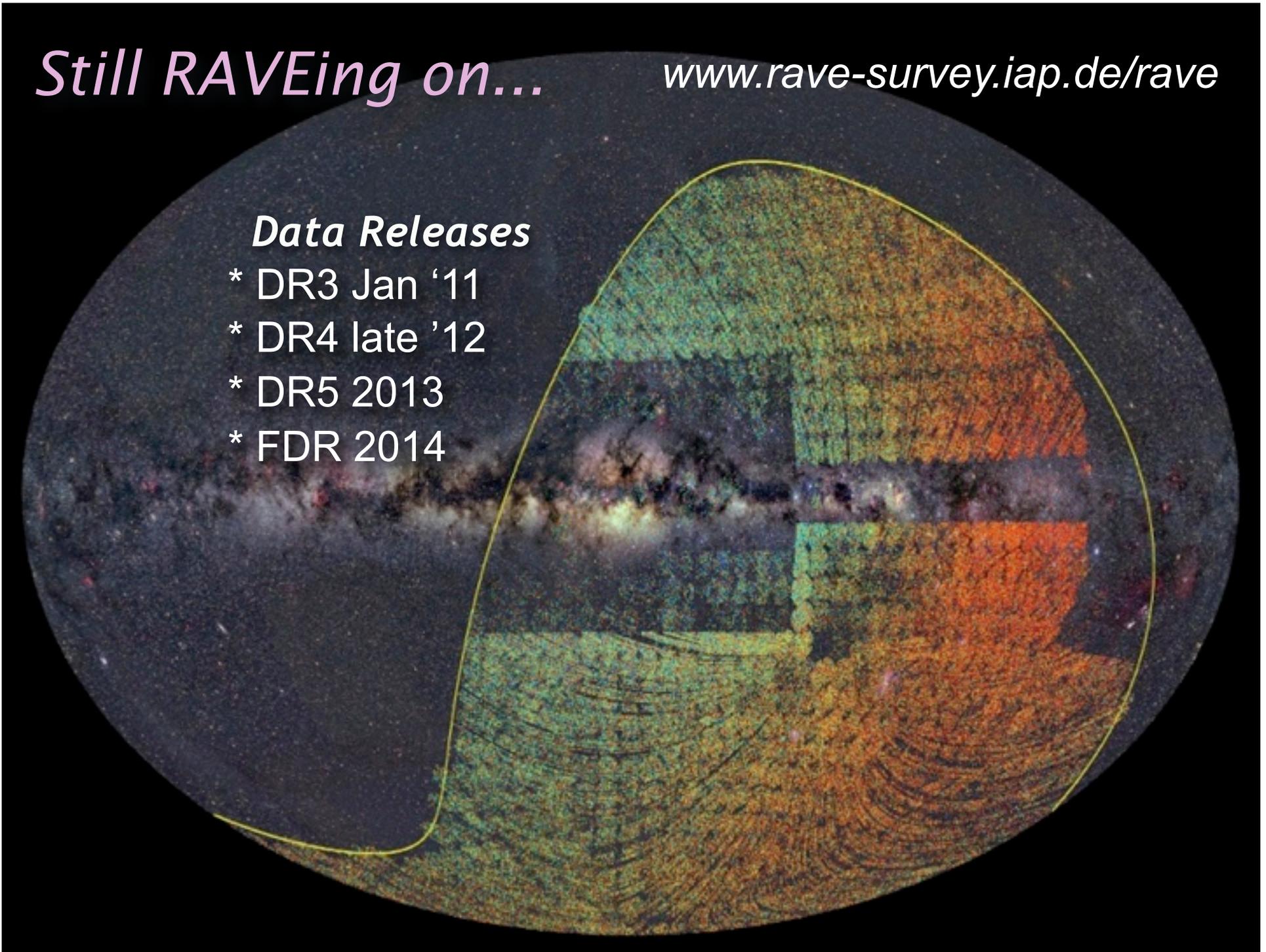


*Still RAVEing on...*

[www.rave-survey.iap.de/rave](http://www.rave-survey.iap.de/rave)

***Data Releases***

- \* DR3 Jan '11
- \* DR4 late '12
- \* DR5 2013
- \* FDR 2014



*Still RAVEing on...*

[www.rave-survey.iap.de/rave](http://www.rave-survey.iap.de/rave)

### *Data Releases*

- \* DR3 Jan '11
- \* DR4 late '12
- \* DR5 2013
- \* FDR 2014

### *Spectra*

- \* Calcium triplet region for stars with  $8 < I < 12$
- \*  $R \sim 7500$
- \* Velocity precision everywhere better than 2 km/s
- \* Errors in  $T_{\text{eff}}$ ,  $\log g$  and  $Fe/H$  depend on mag.

# *RAVE science...*

**25 science papers in the last five years.**

**>6 PhD theses**

***Wide range of galactic topics:***

- **High-velocity stars**
- **Stellar distance determinations**
- **Thin and thick disc formation mechanisms**
- **Metal-poor stars**
- **Eccentricity distribution in thick disc stars**
- **New stellar streams**



# RAVE spectrum..?

\$A vs. €



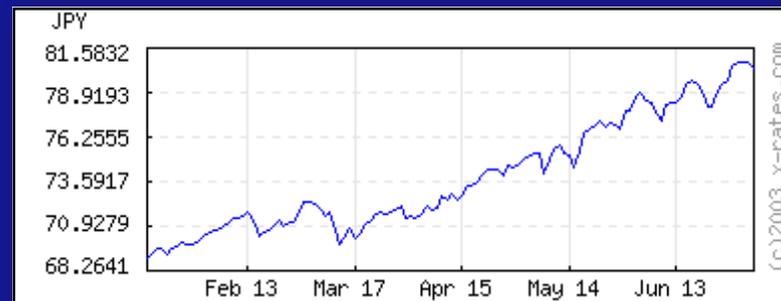
\$A vs. £



\$A vs. \$US



\$A vs. ¥



# *RAVE's Final Year*

*RAVE's observational phase will come to an end on 15 February 2013.*

*This has been determined primarily by the financial constraints...*

*...in which biggest single contributor is the extremely strong Australian dollar  
(e.g.  $\text{£}/\text{\$}_{2012} \approx 0.5 \text{ £}/\text{\$}_{2003}$ )*



*Observing models for  
TAIPAN...*

## Lessons from RAVE





Stuff we did wrong...

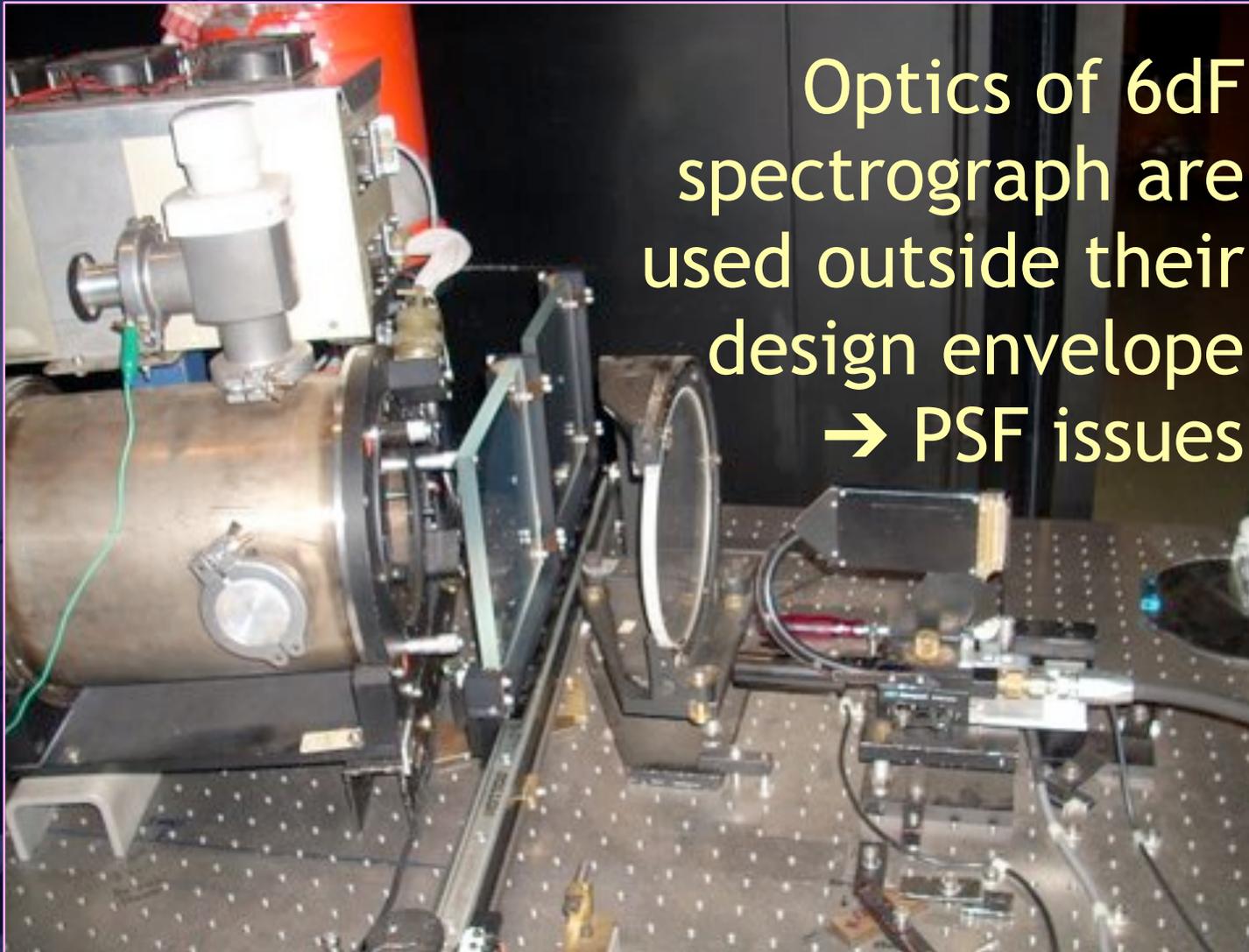
## *Lessons from RAVE*

### Instrumental issues

- We used the wrong instrument - but...
- 6dF fibres are inherently lossy
- 6dF fibre throughput has degraded with time (but now all replaced by AIP)
- We have always struggled to maintain fibre availability...

6dF FIELD PLATE 3

## *Lessons from RAVE...*

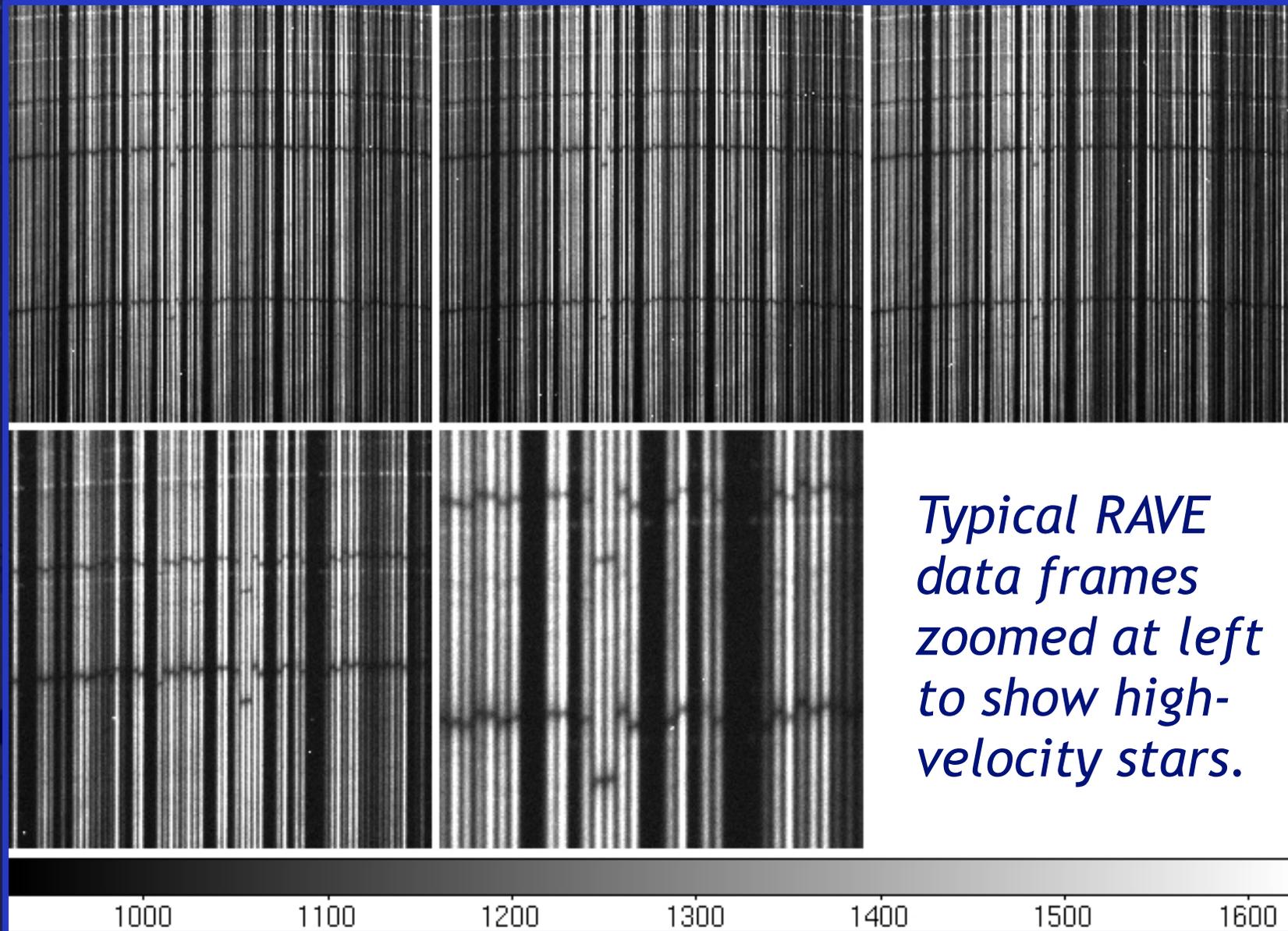


Optics of 6dF spectrograph are used outside their design envelope  
→ PSF issues

✓ But it is extremely stable...

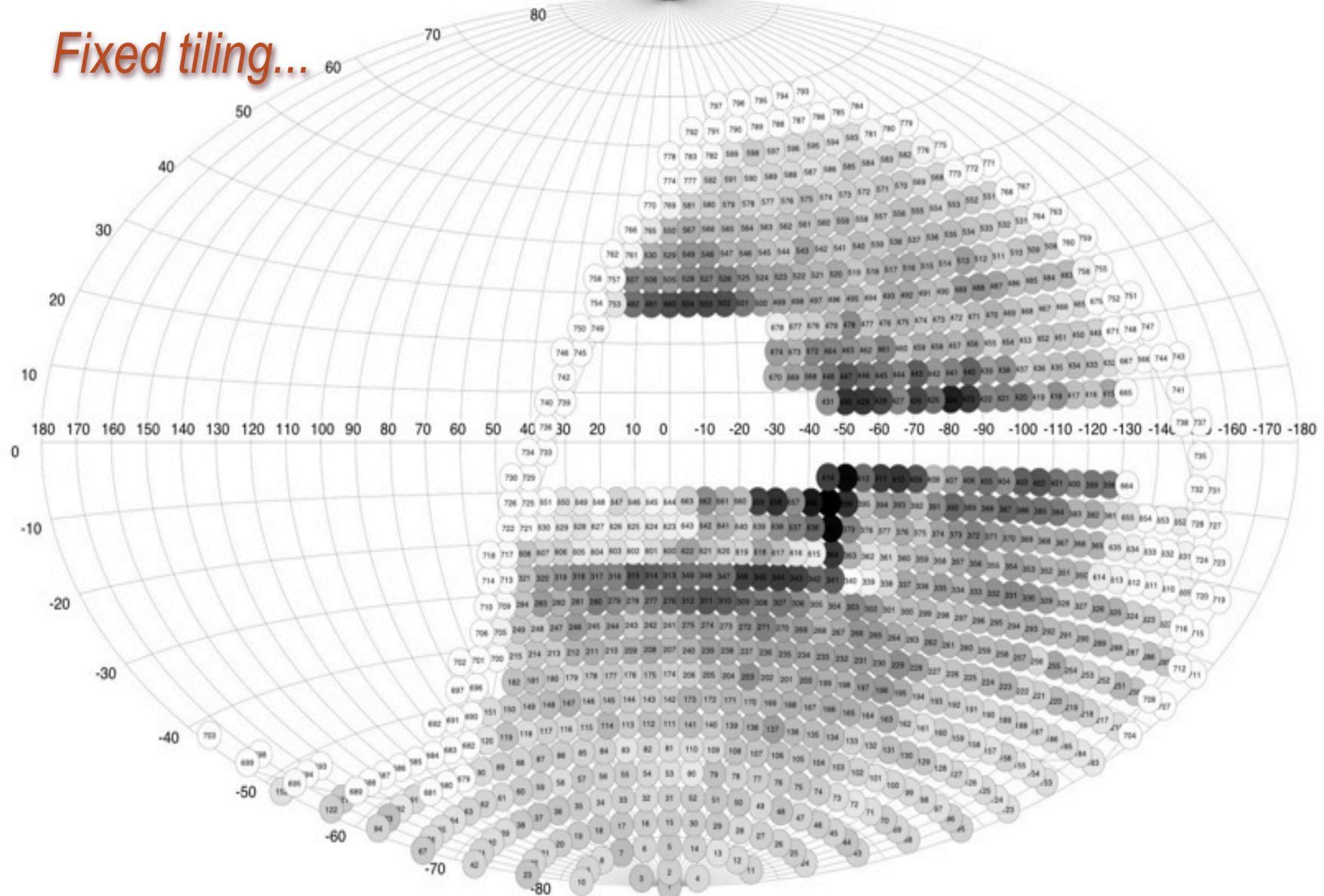


# *Scope creep...*



*Typical RAVE  
data frames  
zoomed at left  
to show high-  
velocity stars.*

*Fixed tiling...*



*Completeness not well-controlled*

*Lessons from RAVE...*

What we did right



# *Governance*

- RAVE has a PI (Steinmetz) and an Executive Board, with one representative from each country (more or less).
- One MOU between AIP and AAO has made for lightweight bureaucracy.
- Additional personnel include Science Coordinator (Freeman), Project Scientist (Zwitter) and Project Manager (Watson)



# *Data Management*

- Data stream: UKST (observing) - Macquarie (quality control) - Asiago ( $\lambda$ -calibration) - Potsdam (analysis and data-serving)
  - ➔ BUT reverse data flow never properly addressed
- Process monitored by Data Management Group
- Calibration has probably demanded at least as much person-power as observing
- Multiple observations for binarity etc.



*Lessons from RAVE...*

RAVE has been to  
some cool places



# *RAVE-ups - a vital part of the process*

- **2002 Potsdam, Cambridge**
- **2003 Potsdam, Sydney**
- **2004 Edinburgh, Basel**
- **2005 Coonabarabran**
- **2006 Ljubljana**
- **2007 Strasbourg**
- **2008 Baltimore**
- **2009 Padua**
- **2010 Groningen**
- **2011 Coonabarabran**
- **2012 Potsdam**
- **2013 Oxford**



# *RAVE's Final Year*

***End-product is a uniformly-calibrated data set of over 500,000 spectra with very high science and legacy potential***



*Observing models for  
TAIPAN...*

Capitalising on the UKST



**Dawe & Watson, 1982**

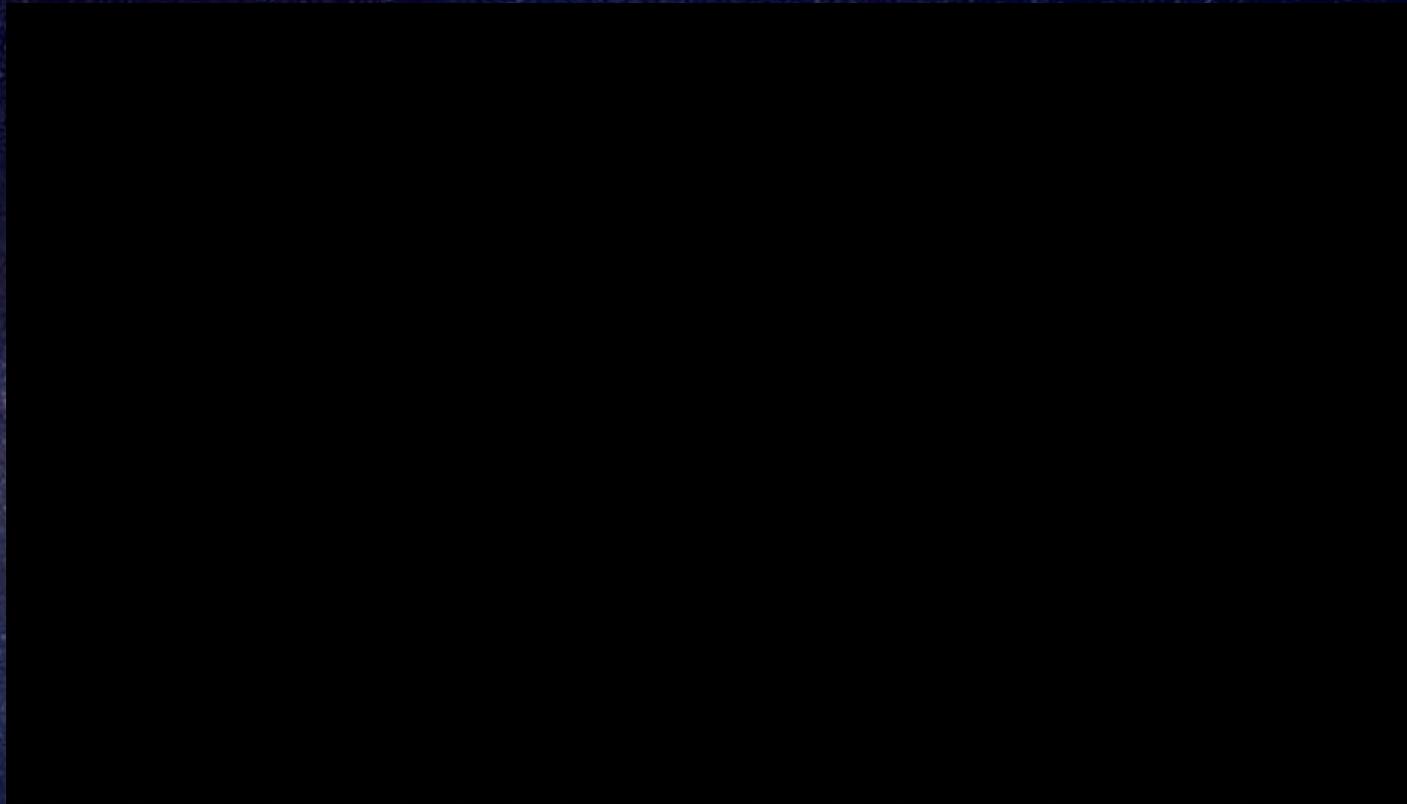
*A $\Omega$ -product of AAT (2-deg field): 60.8 m<sup>2</sup>deg<sup>2</sup>*

*A $\Omega$ -product of UKST (6.5-deg field): 60.8 m<sup>2</sup>deg<sup>2</sup>*



*Observing models for  
TAIPAN...*

'Starbugs' position the fibres autonomously...



Prototype for MANIFEST on GMT

## *Gain, gain, gain...*

- Field interchange overheads dramatically reduced - no need to bring the telescope to access park every time
- Calibration overhead dramatically reduced - spectrograph mechanically undisturbed
- Lossy fibre bending over tight radii eliminated
- Smaller fibres permitted by fibre nudging to compensate for field distortion by atmospheric refraction
- Even with only 100 fibres, estimated survey speed improvement over 6dF would be up to a factor of 10
- AND would permit remote/semi-autonomous operation

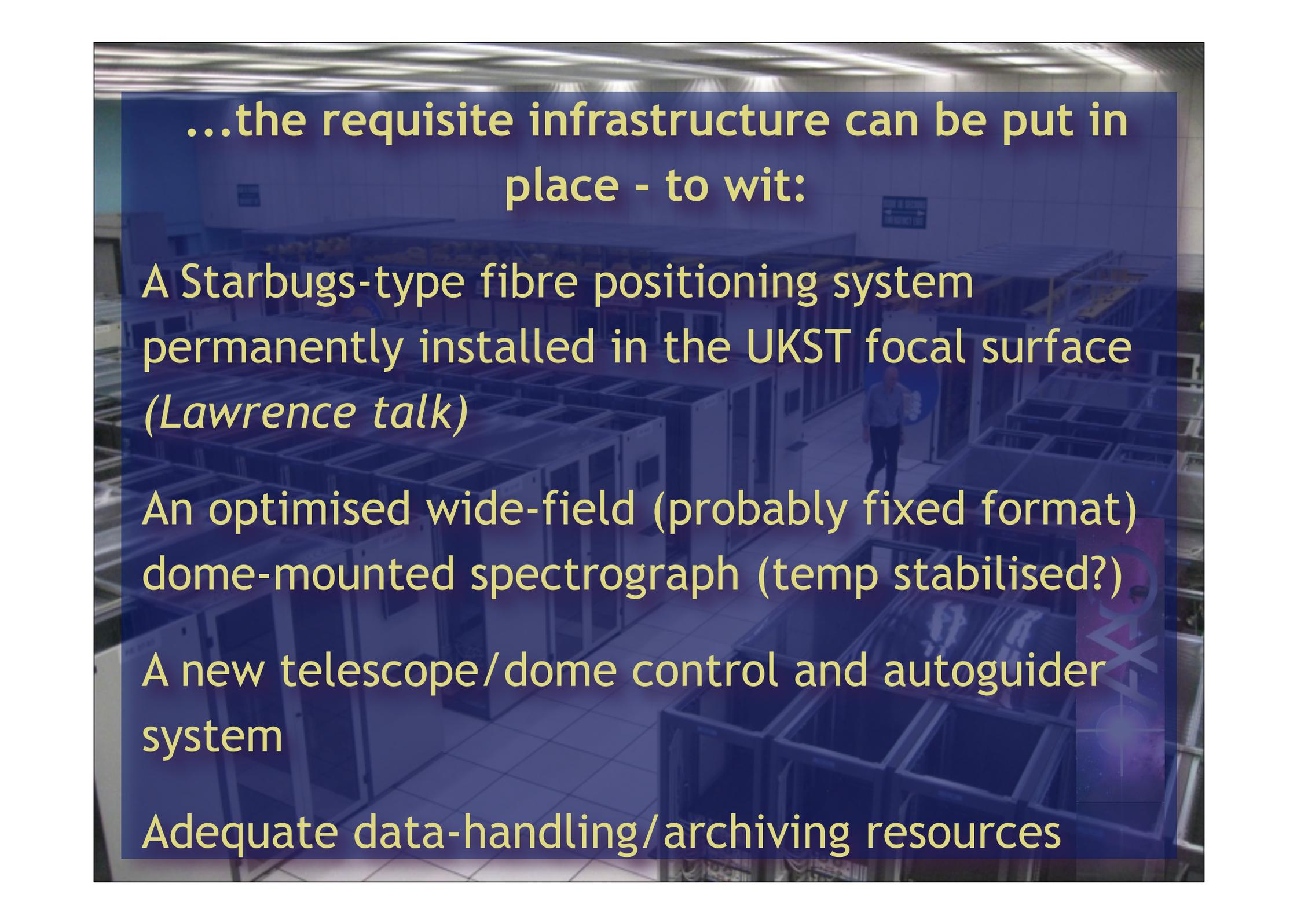


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If...





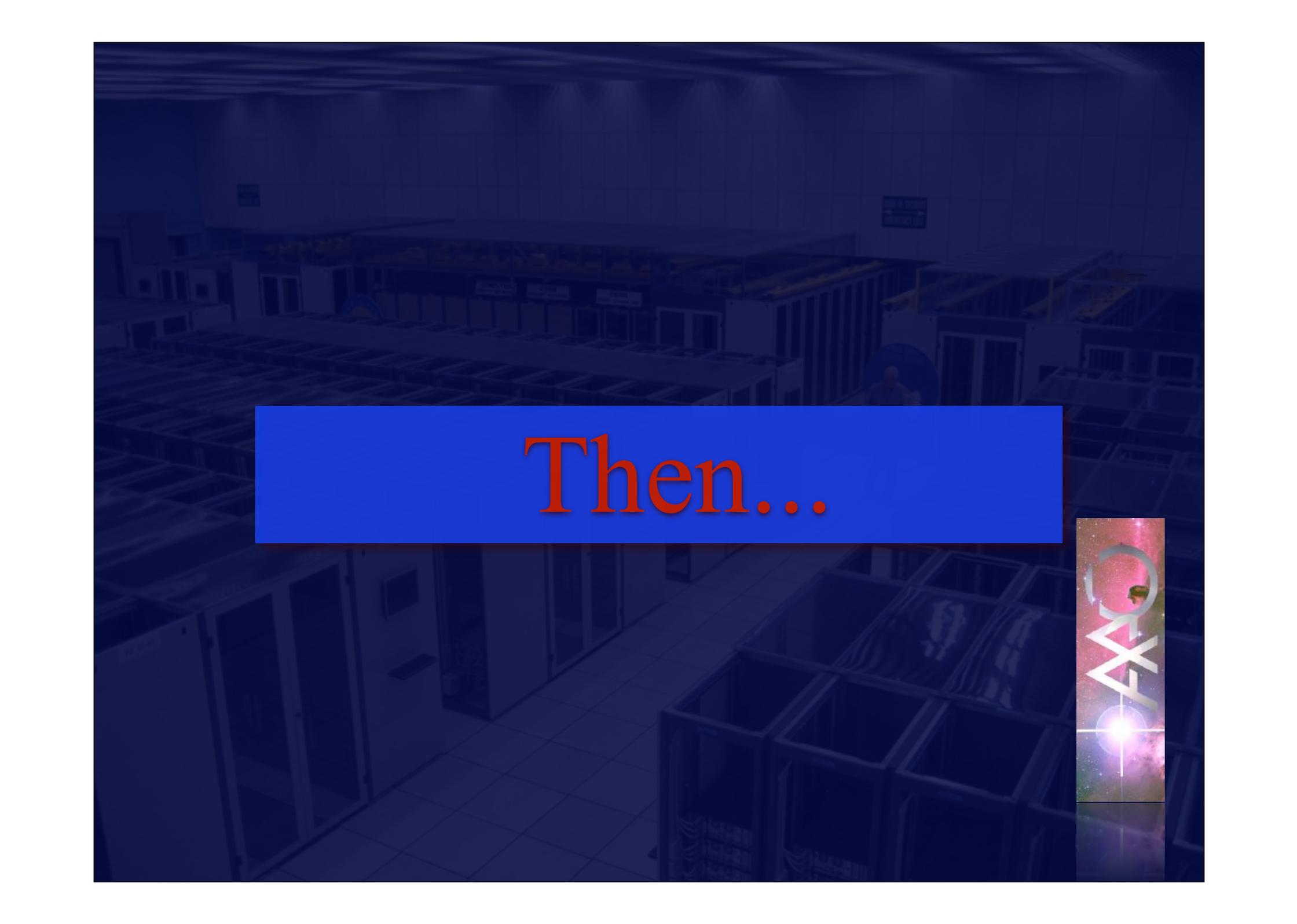
...the requisite infrastructure can be put in place - to wit:

A Starbugs-type fibre positioning system permanently installed in the UKST focal surface (*Lawrence talk*)

An optimised wide-field (probably fixed format) dome-mounted spectrograph (temp stabilised?)

A new telescope/dome control and autoguider system

Adequate data-handling/archiving resources



Then...



# *The observing model is...*

## 1. Project initialisation

- Financial contributions of participating institutions are fixed *ab initio* (*Colless talk*)
- Survey scope is defined at the outset and FIXED
- TAIPAN work-groups are set up (input catalogue, observing, data-reduction, data-management, data-serving, science)
- Input catalogue is defined at the outset  
- *but who does the eyeballing?*
- Probably set up dynamic tiling - but requires excellent liaison between input-catalogue and observing groups
- High level of automation in data-handling



# *The observing model is...*

## 2. Observational phase

- Telescope controlled remotely by assigned Survey Observer from home or Siding Spring (without penalty rates!) following predetermined schedule
- OR - telescope controlled by AAT Night Assistant
- Calibration exposures (arcs and flats) at start and end of night; calibration objects built into observing schedule
- First pass QC undertaken asap by data reduction group: fibre throughput, spectrograph focus etc.
- Night-time technical call-out for simple faults only (e.g system re-set)
- Instrument design must allow fibre maintenance



# *The observing model is...*

## 3. Survey progress

- Potential to average 5 pointings per clear night
- With 25-night lunations (optimistic?), obtain:
  - 100k spectra per year (for 100-Starbug system)
  - 300k spectra per year (for 300-Starbug system)(Scales linearly because no difference in overheads, unlike 6dF)
- Schedule Bright-of-Moon down-time (cryostat pumping, Starbugs maintenance, etc.)
- Phased data releases
- Skim off cream science
- Regular meetings in cool places...



*Observing models for  
TAIPAN...*

*Thanks, everyone*

NGC 6791. HST



*Observing models for  
TAIPAN...*

*Thanks, everyone*



