

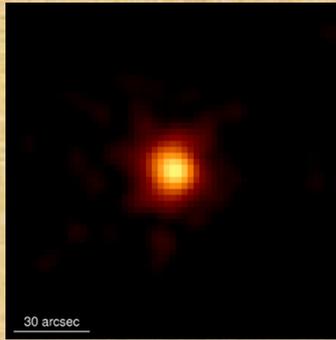
# **Astronomy Advisory Panel**

**Richard Bower, Michael Brown, Anthony Challinor, Chris Evans, Paul O'Brien (Chair), Don Pollacco, Will Sutherland, Serena Viti**

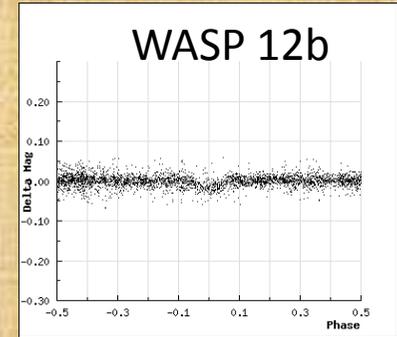
**Paul O'Brien**

**Report to UKON, 21 January 2013  
(based on report to PPAN, 20/11/12)**

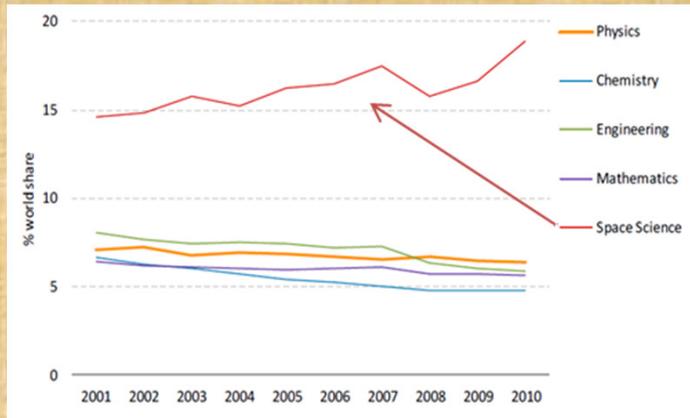
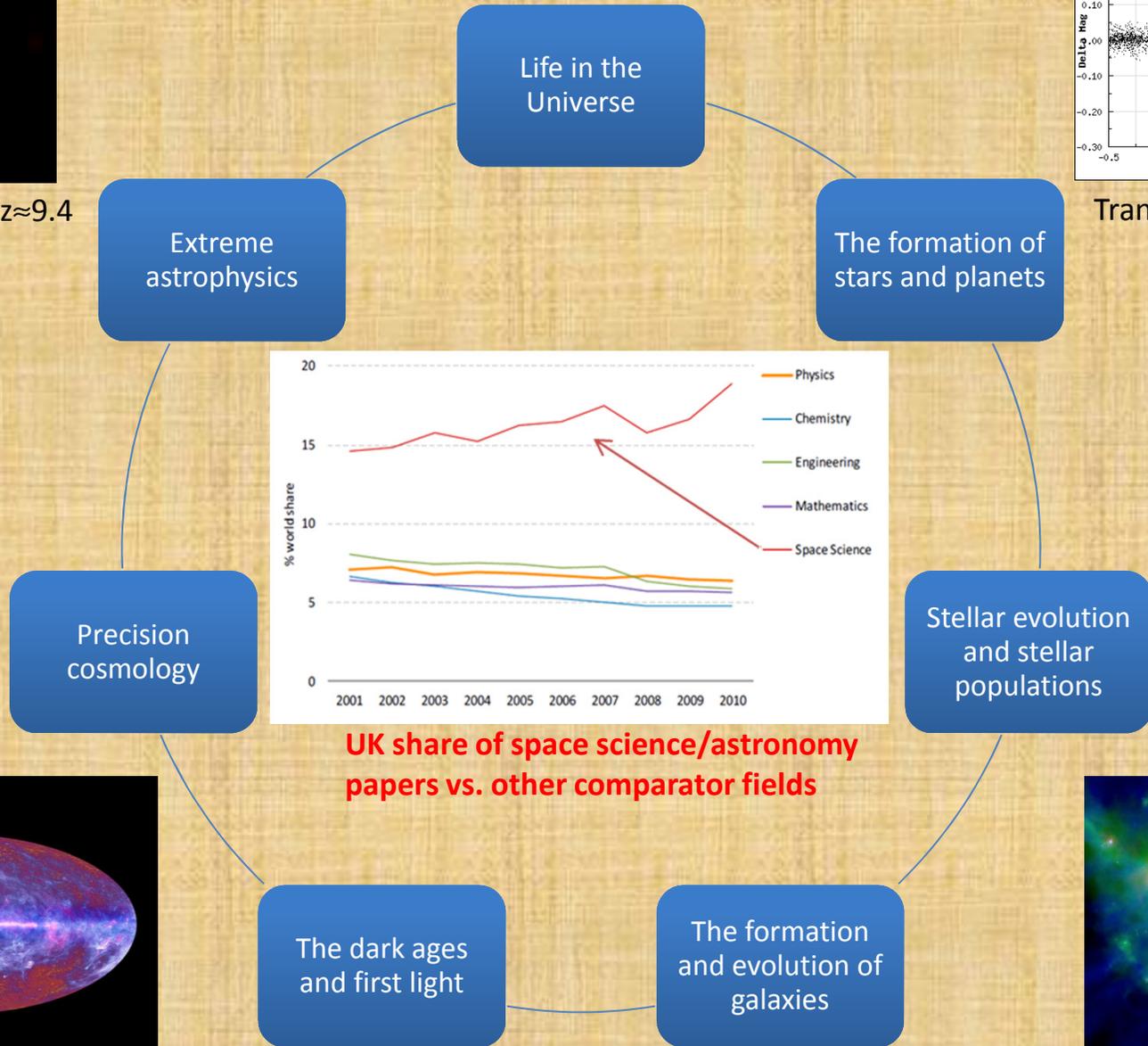
# World class science



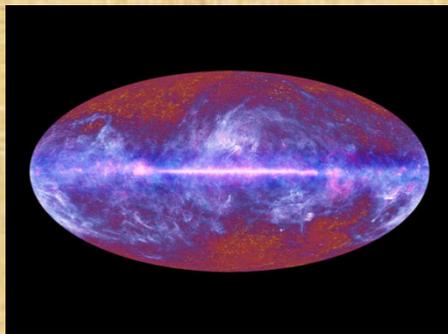
Most distant GRB,  $z \approx 9.4$



Transiting planet,  $1.4M_J$



UK share of space science/astronomy papers vs. other comparator fields



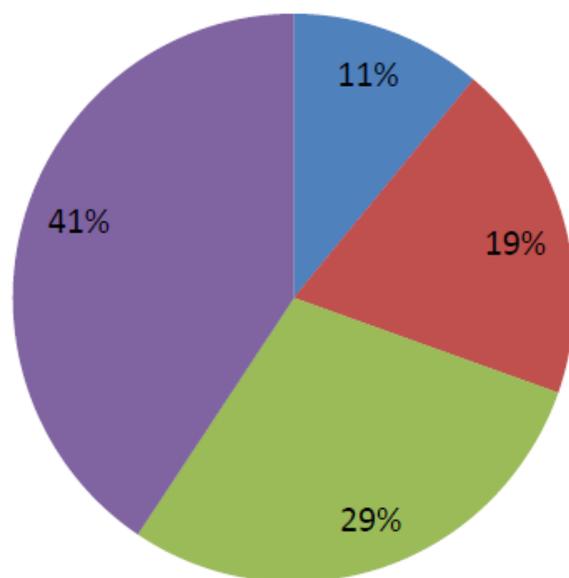
Microwave background, Planck



"Eagle" galaxy simulation

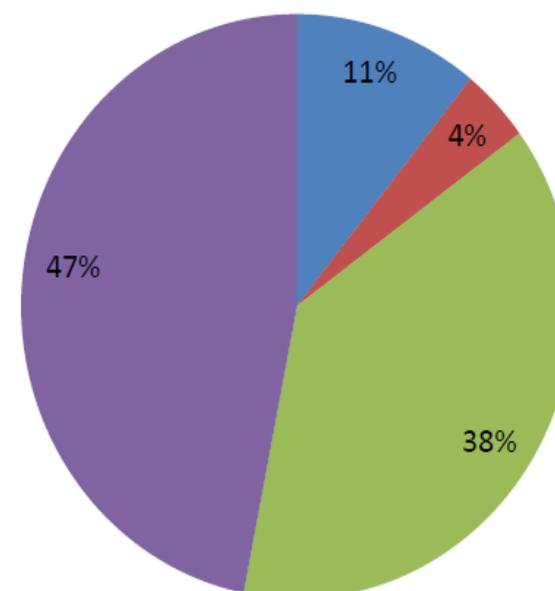
# The bad news – the astronomy budget

2012/13



- Total Astronomy Development (including all instrumentation development)
- Astronomy Operations
- Total ESO (including E-ELT contributions)
- Exploitation Grants

2015/16 (projected)

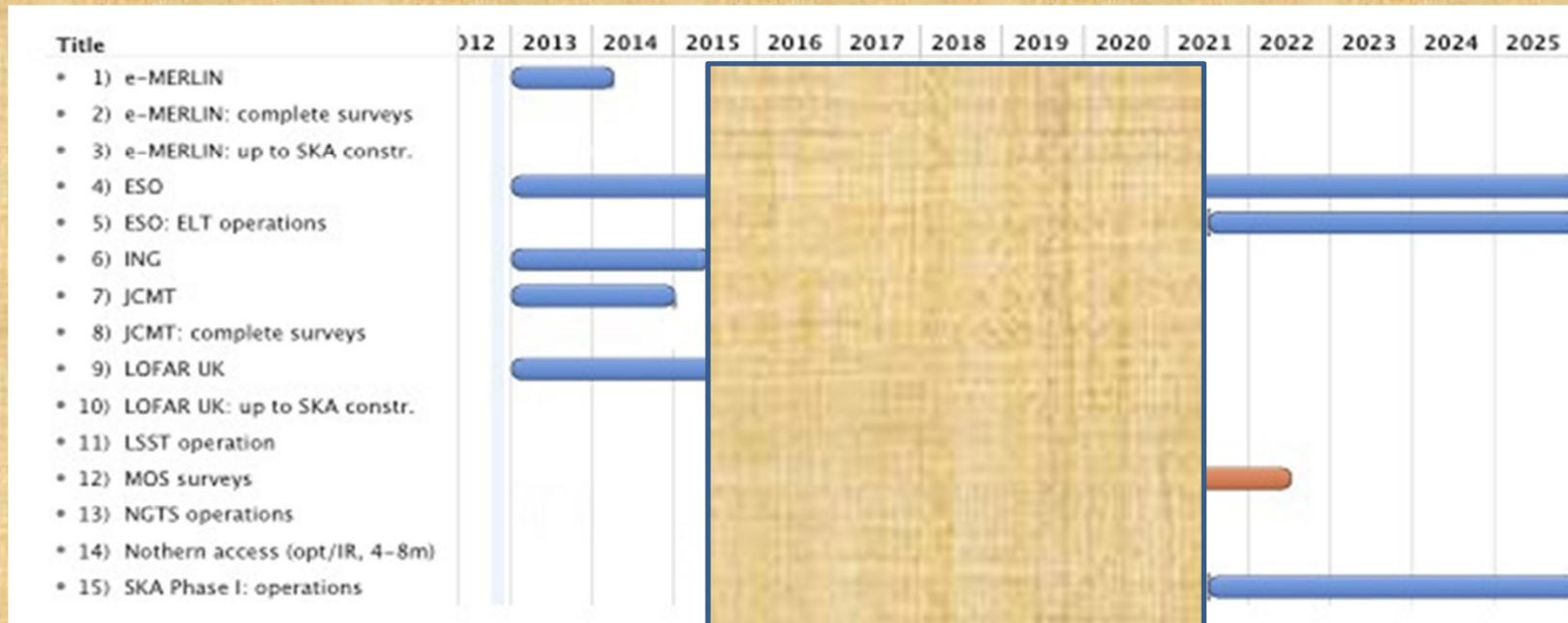


Total 2012/13 astronomy spend: £69.8M; total ESO subscription is £20.2M.

Astronomy spend planned to drop by 2015/16 by ~10% largely due to a withdrawal from non-ESO telescope facilities.

Over this period the ESO proportion will rise, due to the E-ELT, while exploitation and development keep roughly constant in accordance with previous PR rankings.

# The current plan = facility gap



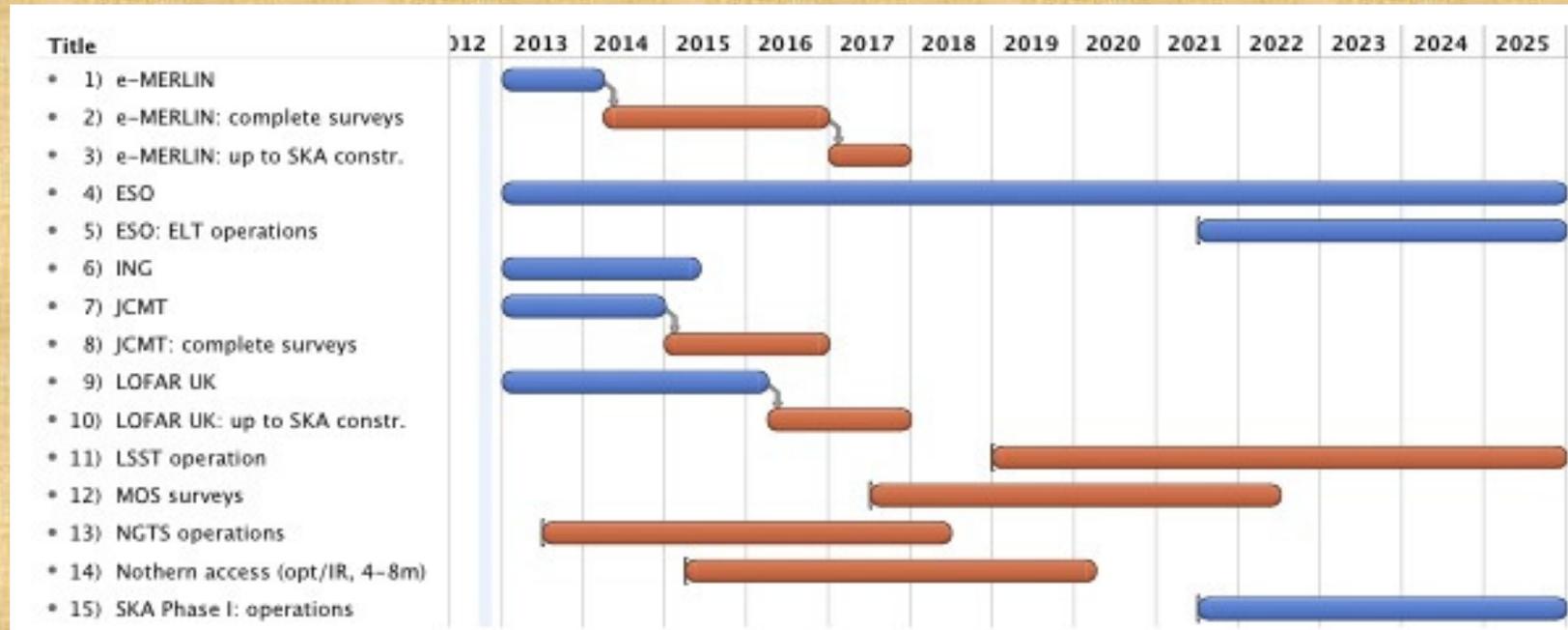
## The highest-priority and high-priority ground-based (photonic) observing facilities

The blue and orange bars indicate the facilities which are planned under the “current astronomy programme” (section 5.2 of the AAP report). This will result in a factor of several reduction in UK observing time and will harm UK technology development.

This is not what our ESO partners are doing

**Need to fix the lack of diversity and boost science leadership and technology expertise**

# The “sustainable astronomy” plan



## **The highest-priority and high-priority ground-based (photonic) observing facilities**

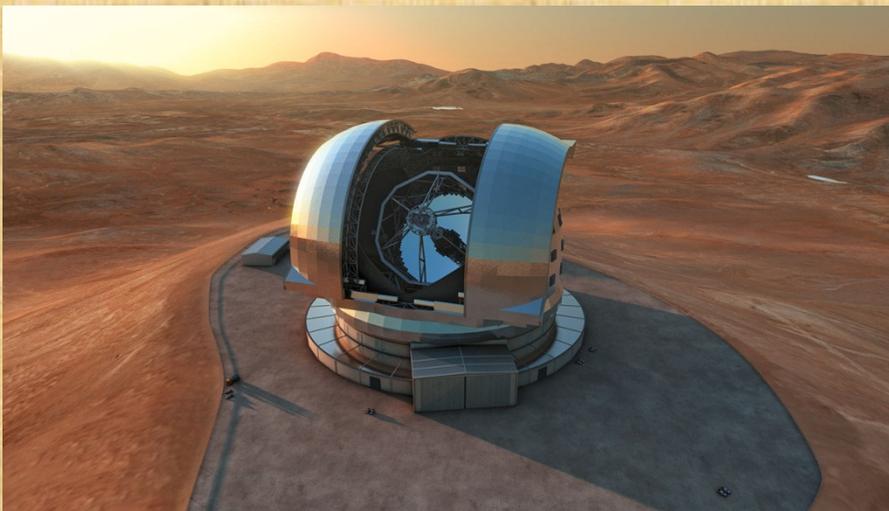
The blue and orange bars indicate facilities which are affordable under the “sustainable astronomy programme” as described in section 5.1 of the AAP report.

This plan is achievable with an additional ~£5M/yr by 2015 – above the planning figure – while still withdrawing from Hawaii by 2016 and giving suitable priority to E-ELT and SKA.

**This does not require a funding level above that in the 2012 astronomy programme.**

# Highest priority

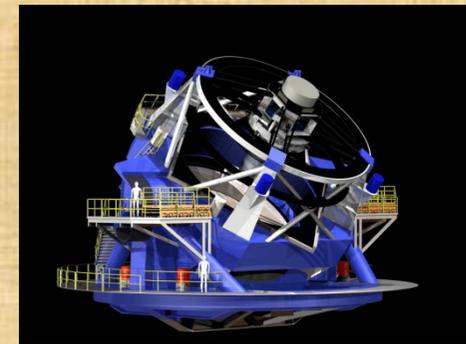
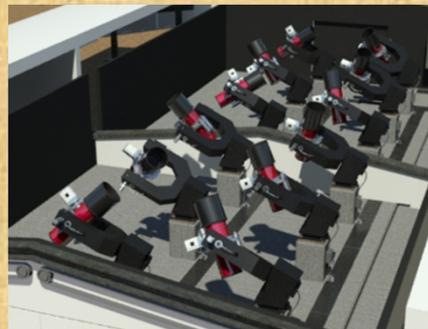
- Grants, studentships & fellowships – maintain exploitation and training funding – increase pro-rata with any uplift.
- ESO – maintain access to VLT and ALMA, provides a pathway to E-ELT.
- E-ELT & SKA R&D – support project/instrument development - these projects have the capability to provide large contracts for UK industry.
- High Performance Computing access – fund hardware upgrades via direct BIS grant. PPAN area including astronomy provides excellent HPC development opportunities.



# High priority - maintain innovation

Provide science for VLT, ALMA, E-ELT, SKA, GAIA, JWST, Euclid...

- Complete SCUBA-2 survey by 2016 – targets for ALMA, JWST, E-ELT, SKA...
- Complete eMERLIN surveys and maintain LOFAR until SKA phase 1 – SKA pathfinders
- Build new MOS instrument – key to UK science leadership in GAIA and Euclid
- Fund UK role in Next Generation Transit Survey – then follow-up on JWST, E-ELT...
- Fund UK access to Large Synoptic Survey Telescope – SNe, GRBs, dark energy...
- Maintain access to large (4-8m) northern telescope – GW sources, GAIA, exoplanets...



# Example future project: Large Synoptic Survey Telescope (LSST)



6-band imaging survey, 20,000 square degrees, observe objects  $\approx 1000$  times over 10 years

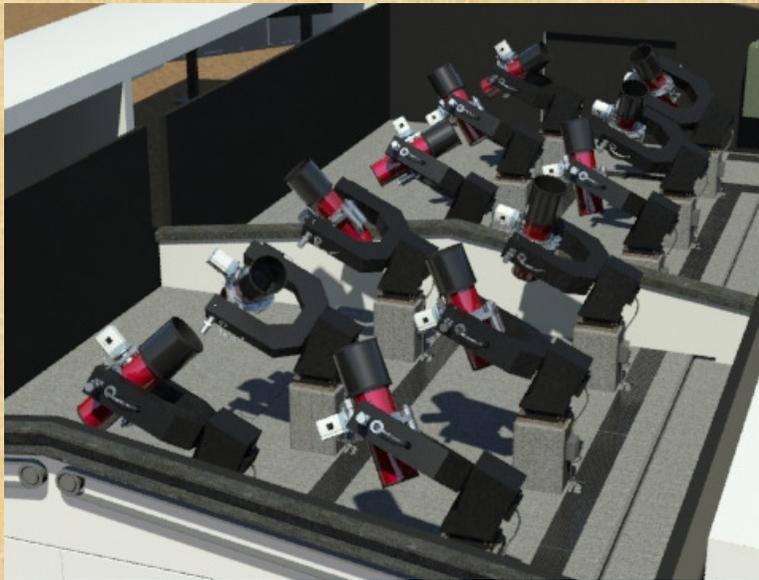
Many UK science areas: dark energy/matter, galactic structure, transients, solar system...

Fantastic value for money – USA pays full construction costs (\$700M) + 2/3 of operations

UK gets full data rights for \$20k per academic (inc. 2 PDRAs+2 students) – estimate £1.5M/yr

Need to sign MOU by early 2014 (start paying mid-decade; first light in 2019)

# Example future project: Next Generation Transit Survey (NGTS)



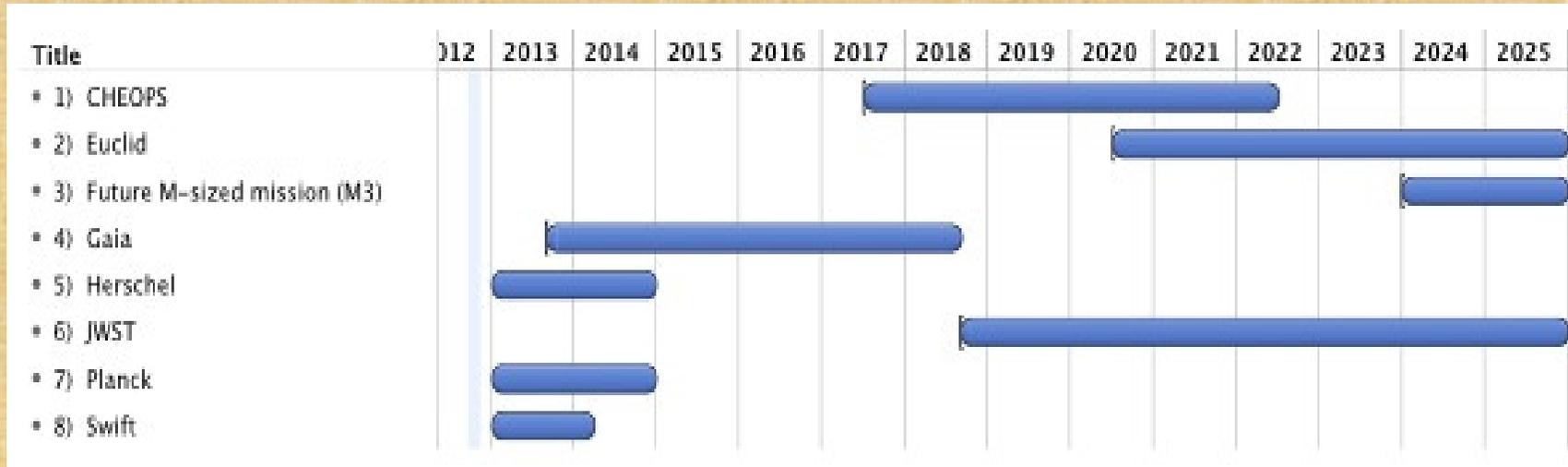
Find Neptune-sized planets around bright stars, and superearth's and rocky planets around nearby M stars – ideal for follow-up with VLT, E-ELT, JWST,...

Located on world's best observing site, Paranal, close to VLT and E-ELT

UK-led project (Warwick, Leicester, QUB) – hardware funded by the consortium

STFC funding of operations boosts UK science leadership role

# Space astrophysics plan (UKSA)



Timeline of approved space astrophysics missions with UKSA funding and the future ESA S1 (CHEOPS) and M3 missions. For missions currently in flight (Swift, Herschel and Planck) funding extensions are possible and should happen. The other ESA astrophysics missions, XMM-Newton and Integral, are also vital to UK astronomy.

**We will not be able to fully exploit the UK investment in existing and future space missions, such as GAIA, JWST and Euclid, without a balanced portfolio of ground-based observing facilities.**

# Conclusions

- The astronomy community and the AAP believe the current STFC spending plan will result in an unsustainable astronomy programme by 2015-16.
- Too much focus on too few facilities will cause considerable damage to UK leadership in both science and technology, will reduce training, technology development and harm our ability to properly exploit UK investment in E-ELT, SKA and ESA missions.
- STFC should rebalance the programme by better phasing of facility closures matched to new starts to maintain UK leadership leading up to E-ELT and SKA. This will benefit the astronomy, solar system and astroparticle research areas.
- Including a pro-rata uplift of exploitation grants, the AAP sustainable astronomy programme requires modest, additional, targeted funding of  $\approx$ £5m/yr by 2015.
- This does not require an increase relative to the 2012 astronomy budget.