
NOAO
AURA
NSF
Landscape 2025
David Silva (NOAO)
JWST
Euclid
Keck
Gemini
PLATO
ALMA
WFIRST
CCAT
TESS
GTC
VLT
Subaru
SKA
DESI
LSST
VLA
Astro-H
PFS
HSC
eROSITA
E-ELT
GMT
SPICA

One director's idiosyncratic view…
A USA perspective

- Where are scientific paradigm shifts possible (even likely) before 2025?
- How about that infrastructure?
- Towards Federal-TMT collaboration

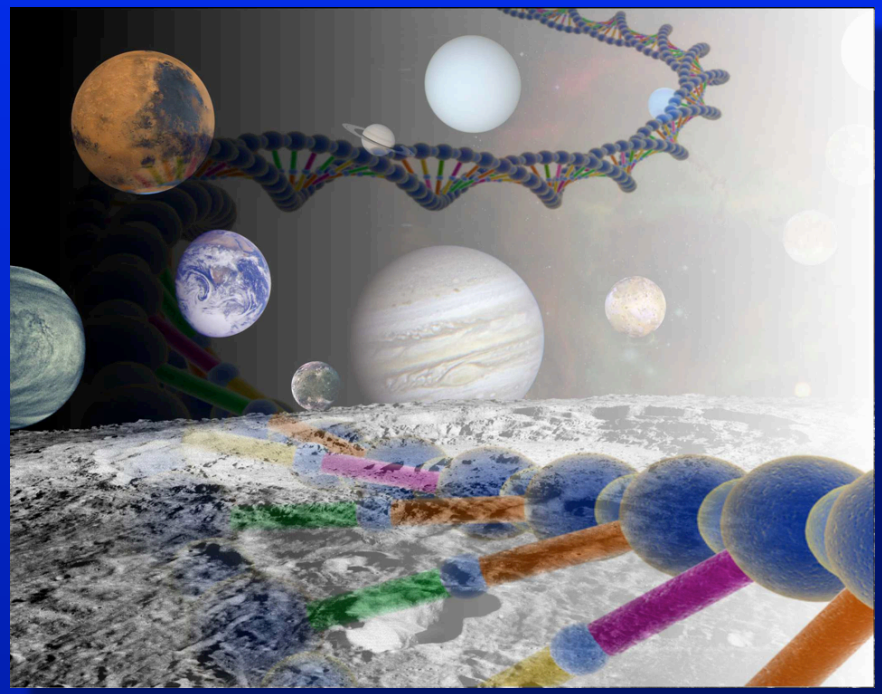
Possible (likely) paradigm shifts

Potential paradigm shifts by 2025

- Is there life on other worlds?
- How do planetary systems form and evolve?
- What is dark matter?
- What is dark energy?
- What lies beyond the Standard Model?
- What will opening the gravitational wave window reveal?

- Why should you care?
  - These are deep, exciting intellectual issues
  - Fundamental = excitement = $$$

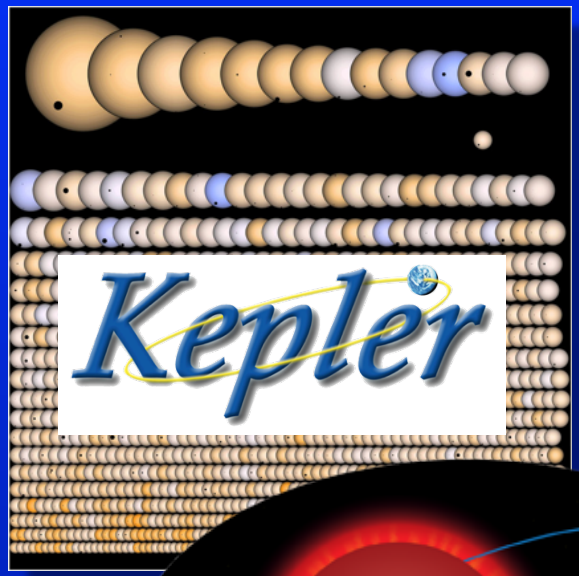
Validated biosignatures
Possible by 2025?

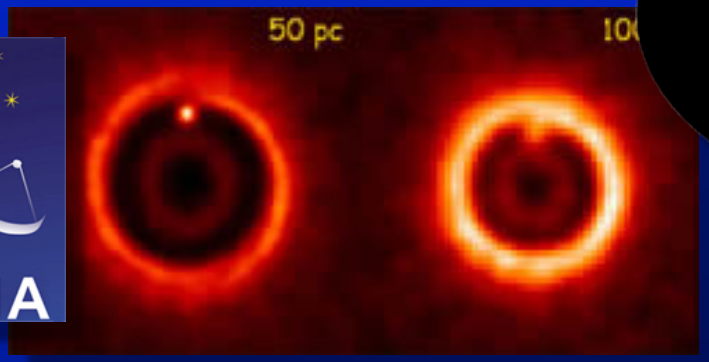


- Mars *in situ* → maybe (cf. various missions)
- Europa *in situ* → maybe (cf. NASA Europa Clipper)
- Exoplanet atmospheres → unlikely (cf. the discouraging history of remote spectroscopic analysis of Martian atmosphere)

How did exosystems form?

Variety is astounding! / Exolife hosts?

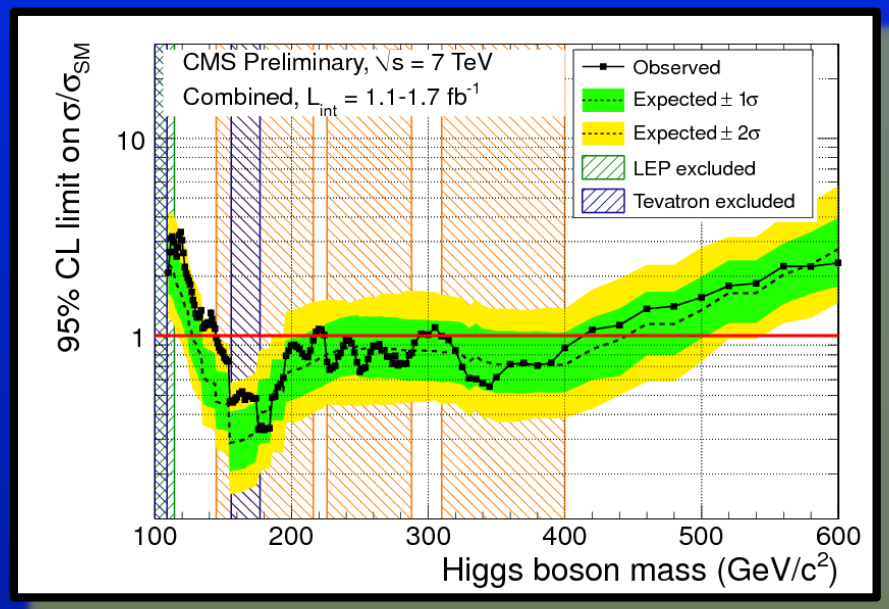


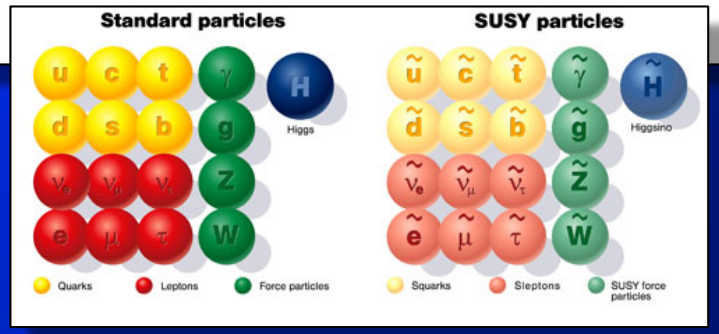


SUSY in trouble

If not MACHOS or WIMPS, what is dark matter?

*[The] discovery of the 125 GeV Higgs boson, and nothing else at LHC, caught [SUSY theorists] by surprise dramatically changing the overall picture and the state of minds in the community…**one could feel the mood of perplexity in the audience.** – Shifman, Oct 2012*





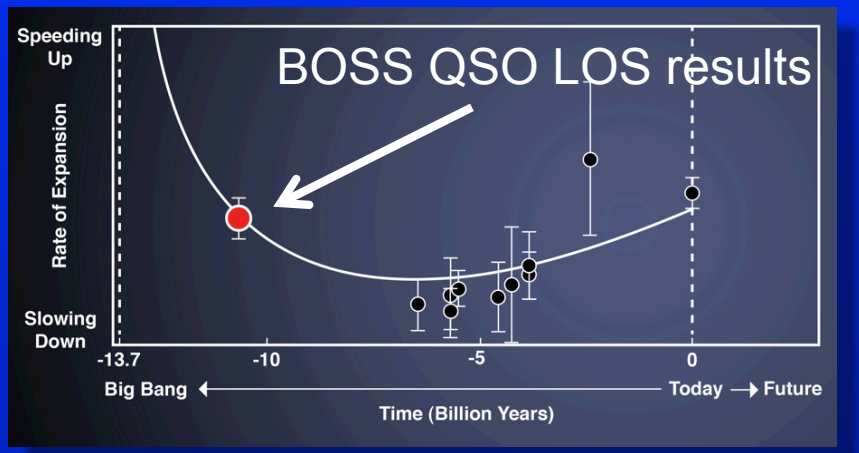
LHC Run-2 could kill SUSY!

Also: No validated evidence for WIMPS in current generation direct detection experiments.

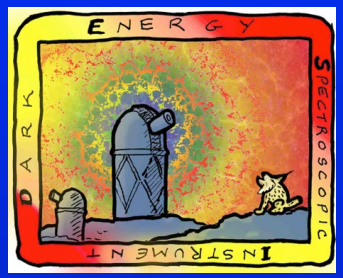
Leaving us with axions (cf. ADMX, matter/antimatter ratio, etc.) ?

Dark energy 2025

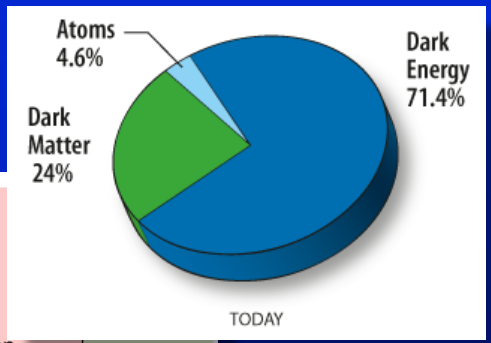
Is dark energy density constant or not?
Are inflation & dark energy fields related or not?

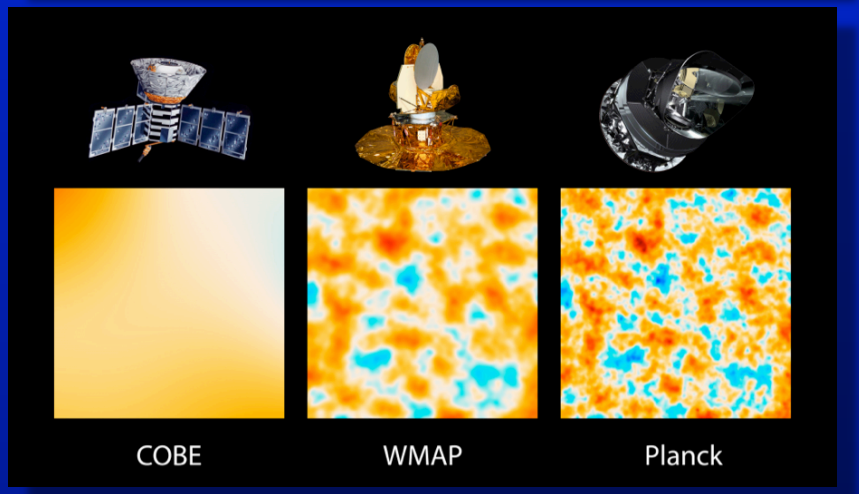


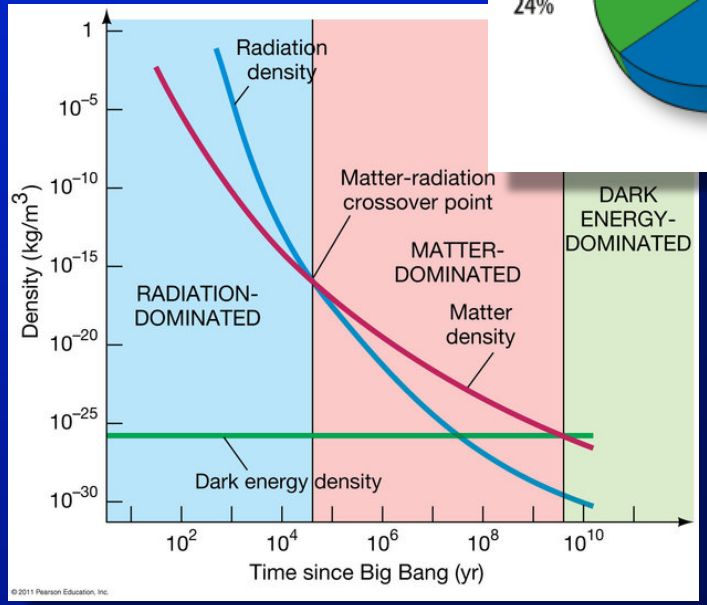
DARK ENERGY SURVEY



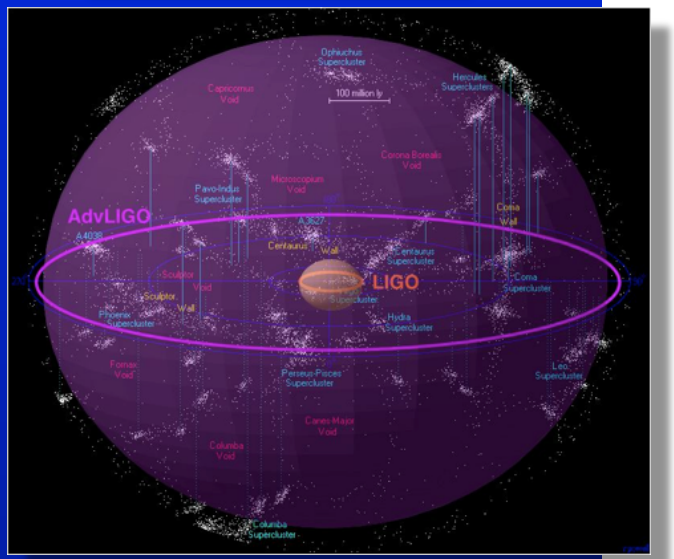
esa
European Space Agency
Euclid

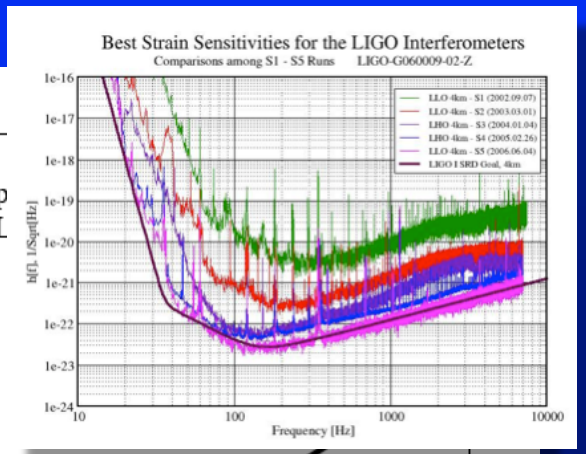






Gravitational wave astronomy
Advanced LIGO





OK, let's talk about infrastructure…

US Optical-Infrared System 2014
What do we want this to look like in 2025?

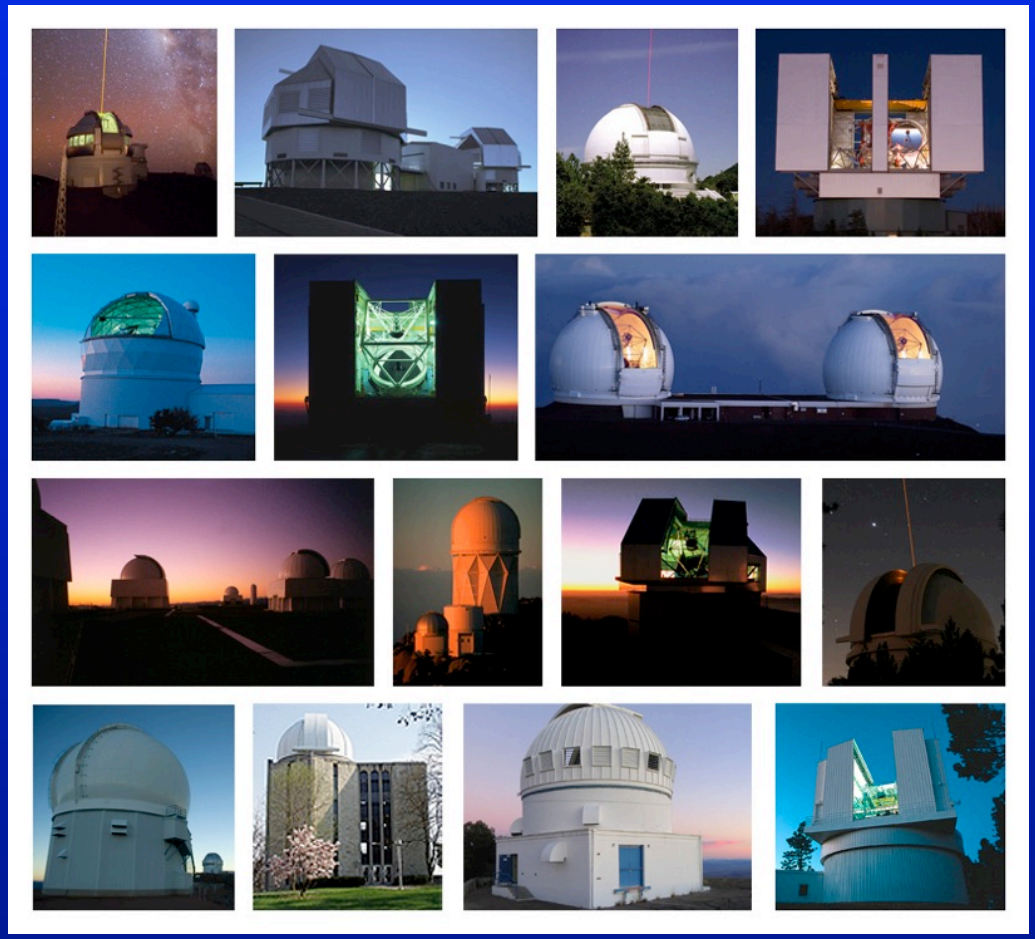
The ensemble of all Federal and non-Federal observatories

World leader in research, education and public outreach

Facilities in the OIR System

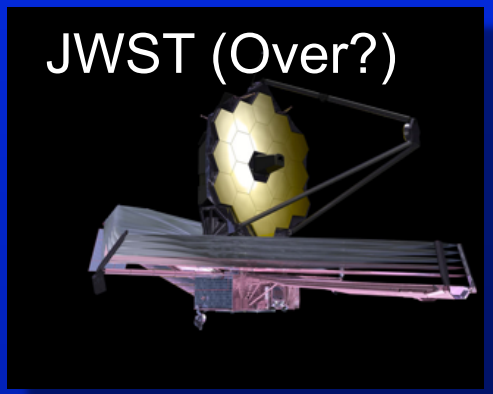
GTC (via Florida)
Keck (1, 2)
Large Binocular Telescope
SALT (through US partners)
Hobby-Eberly
Gemini (North, South)
Magellan (Baade, Clay)
MMT

Palomar (Hale)
SOAR
NOAO (Mayall, Blanco)
Discovery Channel (2012)
AEOS
WIYN
ARC
Shane
IRTF

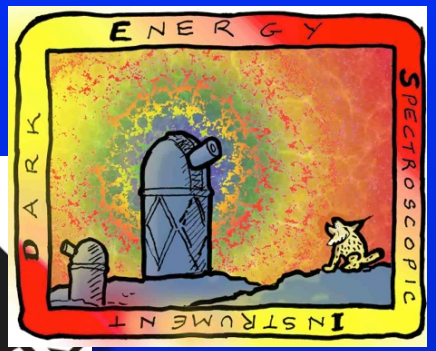



A typical OIR System strategic planning session…
…can we do better over the next decade?
Nicolas Poussin (1594 – 1664) *The Battle*

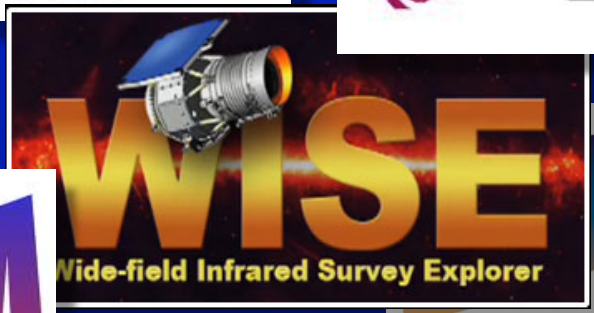
By 2025, what was once new…



What's guaranteed for 2025?
The age of mega-surveys



Coming soon: **ZTF**



An embarrassment of riches
The sample selection problem

- "Static" universe
  - Billions of objects in range r = 18 – 28
  - Cannot observe everything
  - How are samples selected?

- "Variable" universe
  - Background vs. rare
  - How are samples selected?

What data tools are needed?

- Lots of survey “providers”
- Too few “data discovery” tools
- Few (no?) survey “amalgamation” tools, systems, providers
- VAO is dying, the right vision too soon?

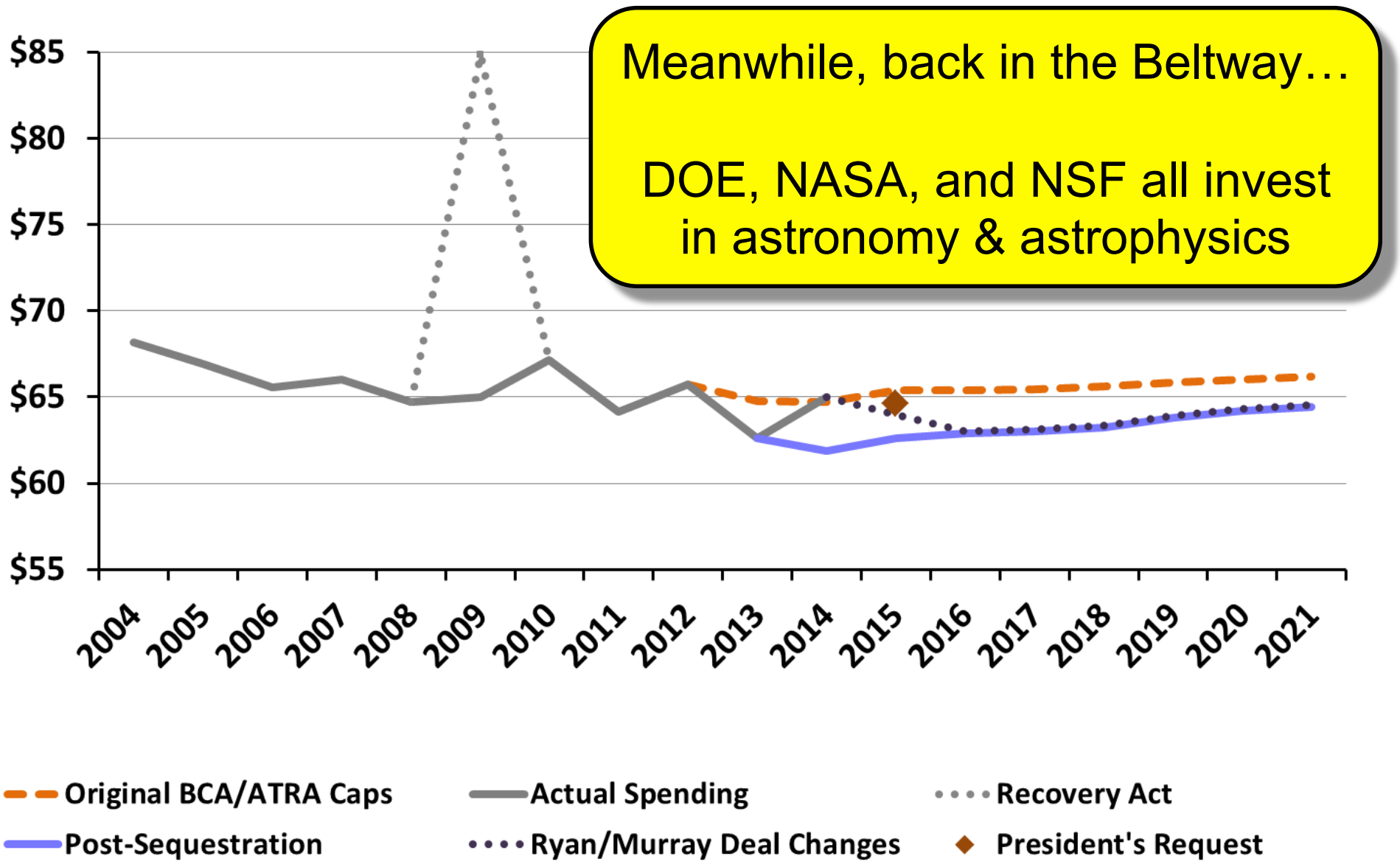
- What tools do we really want before 2025?
- What tools do we really need before 2025?
- How do science cases drive the design?

Toward a Federal investment in TMT

Let's tie this all together…

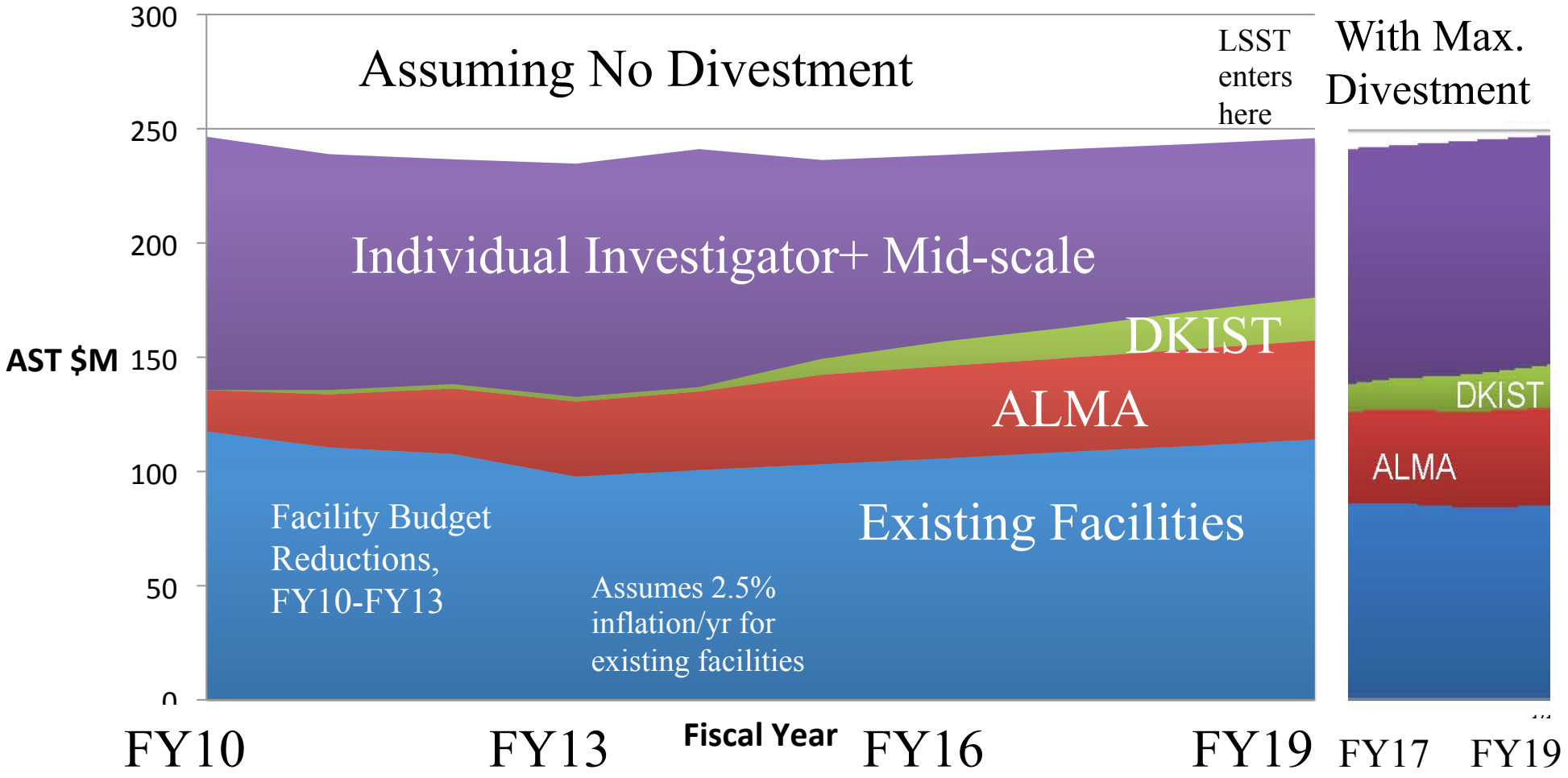
Federal Nondefense R&D Under Various Scenarios

billions of constant 2014 dollars



Source: AAAS R&D reports and analyses of agency and legislative documents. Adjusted for inflation using deflators from the FY 2015 request. R&D includes conduct of R&D and R&D facilities.

AST Portfolio Scenarios



AST budget assumption: FY15=Request, 1%/yr growth thereafter

BOARD ON PHYSICS AND ASTRONOMY

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

A Strategy to Optimize the U.S. Optical and Infrared System in the Era of the Large Synoptic Survey Telescope (LSST)

Project Information

- Statement of Task
- Upcoming Meetings & Events
- Community Input
- Committee Member & NRC Staff
- Sponsor

New BPA project, just starting
Chair: Debbie Elmegreen

Statement of Task

In order to position the observational, instrumentation, data management, and support capabilities of the U.S. optical and infrared astronomy (O/IR) system to best address the science objectives identified in the 2010 NRC report entitled *New Worlds, New Horizons in Astronomy and Astrophysics* and the 2011 NRC report entitled *Vision and Voyages for Planetary Sciences in the Decade 2013-2022*, and to help achieve the best science return from the National Science Foundation investment in O/IR astronomy over the next 10-15 years, the National Research Council will convene a committee to write a short report that will:

1. Identify the principal capabilities that exist in the U.S. ground-based optical and infrared (O/IR) system--both federal and non-federal--and are critical to addressing the New Worlds, New Horizons science objectives over the next 10-15 years.
2. Identify the most important additions and adjustments to the U.S. ground-based O/IR system that would best position the system to address the New Worlds, New Horizons science objectives over the next 10-15 years.

The committee will develop its own working definition of the U.S. O/IR system that will include both federal and non-federal components. The committee will consider instrumentation, data management, and support capabilities alongside observational capabilities in its consideration of (1) and (2) above. The committee may make recommendations or offer comments on organizational structure, program balance, and funding, with discussion of the evidentiary bases as appropriate.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SCIENCE, TECHNOLOGY and INNOVATION
Whether it's improving our health or harnessing clean energy, protecting our security or succeeding in the global economy, our future depends on reaffirming America's role as the world's engine of scientific discovery and technological innovation.
– President Barack Obama

Towards a US Federal strategy
A few personal thoughts – I

- 10% share of TMT (cartoon)
  - $150M up front + $5M per year for 20 years
  - 600 nights over 20 years @ 400K per night (more or less)

- If we cannot change “agency culture”, we must adapt
  - NSF = PI-based research (“small is beautiful”)
  - DOE and NASA = team-based research with specific missions

- In the ensemble, TMT is an “easy sell”
  - At the 10% level? Not so much.
  - Need to think differently…

Towards a US Federal strategy
A few personal thoughts – II

- Community science case must be compelling
  - Cannot be merely derivative of existing ELT science cases
  - Must be clear about what will (or might) be known in 2025
  - Must be comprehensive about other funded facilities
  - Leadership must be achievable within 5 – 10% of time
  - Including specific international collaboration with pooled resources and expertise would be A Very Good Thing
  - Time allocation model must included and..
    - Be motivated by maximizing scientific impact (leadership)
    - Not be motivated by maximizing access

Towards a US Federal strategy
A few personal thoughts – III

- Not science case but <u>science reference mission</u>?
  - Define specific, achievable, team-based “missions”
  - Include all desired resources (not just TMT nights)
  - Define coherent, reusable datasets
  - Combine with data from other facilities (ground and space)
  - Look to frontier (TMT is not just a big 8-m)

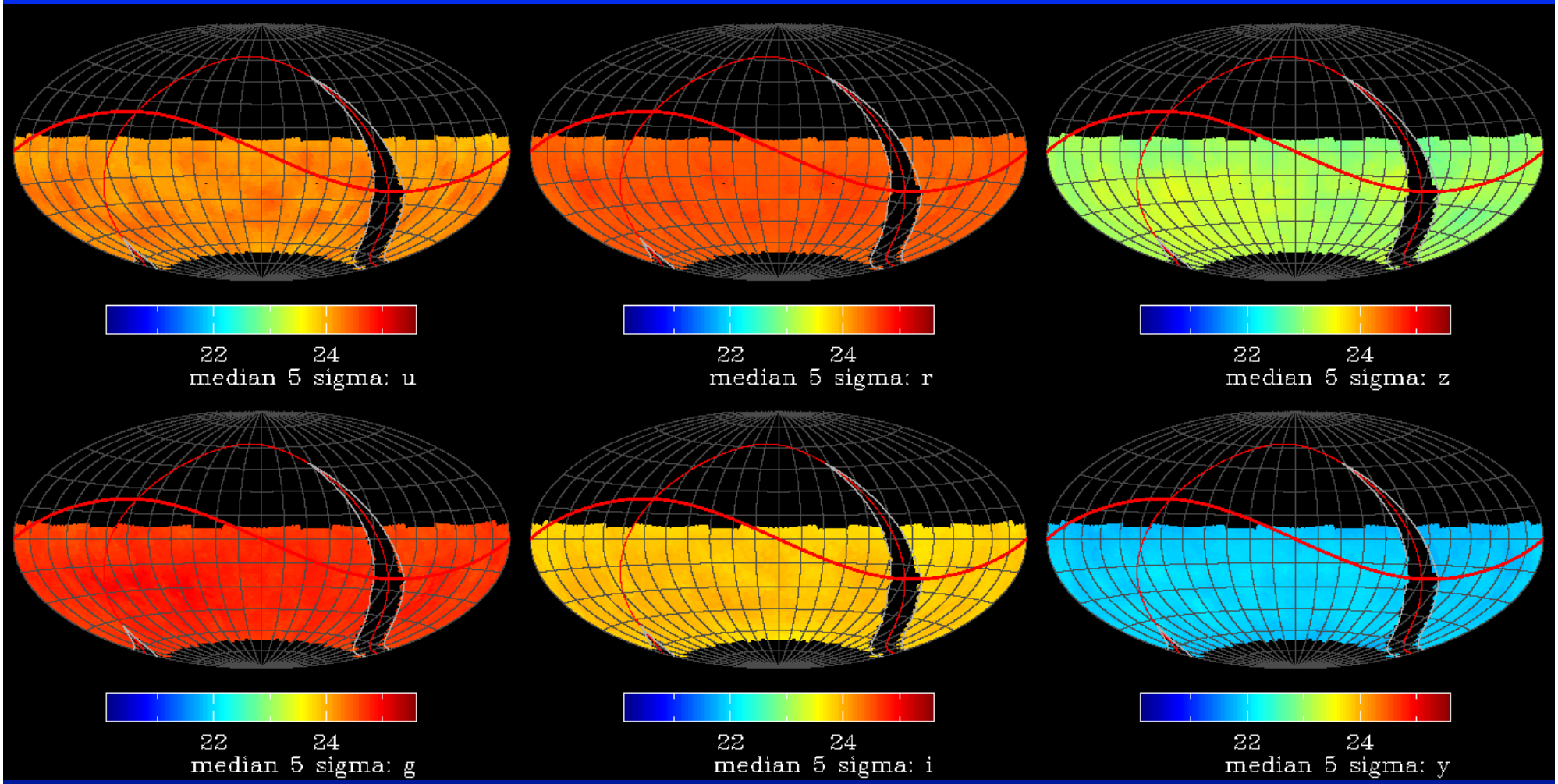
YOU'RE DOOMED

GIVE UP


We Can Do It!
POST FEB. 15 TO FEB. 28
WAR PRODUCTION CO-ORDINATING COMMITTEE


End of presentation

LSST survey
Single visit depth, 5σ limits



LSST survey
Full depth, 5σ limits