Perspective on New Worlds, New Horizons

Roger Blandford
KIPAC
Stanford

On behalf of himself!

Features

- Science First
  - Discovery space->recommended projects
- C(R)ATE
  - Developed procedures, adapt to different projects
- Community Engagement
  - 324 SWP, 69 SOP, 70 TD+Th+C+LAp, 108 RA, 16 TH
- DOE
  - Cultural conflicts resolvable; mutually beneficial
- International connection
  - Many contacts before, during and after survey
- Funding uncertainty
  - JWST, long term commitment, decision rules

Changing world continues to mandate innovation

Science Frontiers

- Cosmology and Fundamental Physics
  - Gravitational wave astronomy
- Galactic Neighborhood
  - Time domain astronomy, astrometry
- Galaxies Across Cosmic Time
  - Epoch of reionization
- Planetary Systems and Star Formation
  - Identification and characterization of nearest habitable planet
- Stars and Stellar Evolution
  - Time-domain surveys

Major discoveries were "unscripted"

- CMB – antenna noise
- Quasars (massive BH) – radio source identifications
- Stellar BHs – X-ray source identifications
- Massive and mutable ν's – checking solar model
- Neutron stars – lunar X-rays
- Pulsars – interplanetary scintillation
- Gamma ray bursts – nuclear weapons monitoring
- Dark matter – galactic and stellar orbits
- Cosmic acceleration – supernova explosions
- Gravitational lenses – quasar follow up
- Gravitational radiation – pulsar timing
- …

Discoveries at interfaces; stovepiping is futile

Central Paradox of Strategic Planning

- **October 2014 - April 2015 (APS):**
  - **Planck results->standard model (wnf$_{nl}$$\Omega_km_\nu$□), dusty B-modes**
  - **8 "habitable??" exoplanets->life in the universe???**
  - **9 new dwarf galaxies -> dark matter limits**
  - **~10^{10} M_{sun} black hole at z=6->cosmic dawn**
  - **Gravitational lenses - SN, ALMA-> pre-SN, substructure**
  - **M82 neutron star with L~100 L_{edd}->accretion physics**
  - **PD456 outflows->environmental impact, galaxy formation**
  - **FRBs 40% circ pol->new transients 10-100mHz**
  - **IceCube neutrinos -> cosmological origin?**
  - **…**

By contrast we are making science plans for 2030s

Program Prioritization

- Electromagnetic Observations from Space
- Optical and Infrared Astronomy from the Ground
- Particle Astrophysics and Gravitation
- Radio, Millimeter and Submillimeter Astronomy from the Ground

- Space:
- WFIRST(AFTA), Exp, LISA (LPF), IXO (Athena)
- TD (NWP,IP)
- Small
- Ground:
- LSST, MSIP, GSMT, ACT(CTA)
- CCAT
- Small

More progress than seemed likely in summer 2010 !

International Context

- Most major projects are multinational
  - Private initiatives (GMT, TMT) intrinsically international
    - Cost and complexity vs stability
- Increasing foreign investment in fundamental research
  - Traditionally, Europe, Japan, Canada, Australia …
  - Now China, India, Korea, Taiwan, Africa, South America, Mexico…
    - FAST, AstroSAT, GMT, radio instrumentation, MeerKAT,optical, HAWC, LMT…
    - Is US becoming too risk averse, conservative, slow…?
- Major -> Equal -> Minor -> No role??
  - HST -> ALMA -> Planck -> SKA??
  - LSST, JWST (but Ariane launch!) vs Euclid, Astro-H
- Technology, visa limitations
  - Has US gained more than it has given?
- Open skies
  - Political considerations

US has to adjust to growing non-US program

Status of Profession

- Astronomy and Public Policy
- Computation and Data-Handling
- Demographics
- Education and Public Outreach
- Infrastructure
- International and Public-Private Partnerships

Large impact on report but output never published

Issues for Committee

- WFIRST/AFTA
  - Harrison: cost, schedule, risk, science trades, Euclid, Plan B…
- LSST science/data support
  - Scope of DOE science program, access, data
- GSMT
  - Schedule, risk, running costs relationship to JWST, LSST, ALMA
- Access to Space
  - Cost and capability, launch HDST?, learn from JWST, cubesats…
- OMB/OSTP
  - Budgets, agency programs, cancellation criteria, termination incentives
- International collaboration
  - Long-term commitment, open skies
- Facility perpetuation
  - Senior reviews -> facility/astronomer transitions, observatory closure

Report must reflect charge but discussion can be broader

Set up of Astro 2020

- Lessons Learned report (Space Science)
  - Consensus, CATE, budget, balance, stewardship…
- Clear charge from agencies
  - Add OMB/OSTP?; integrate SR?
- Smaller, younger committee
  - Individual breadth of experience, interests
- Engage community early
  - Acceptance of recommendations essential
- Formalize international coordination
  - Start early, keep IAU, AAS engaged
- Organize Profession/Infrastructure output
  - Plan dissemination of reports, data
- Long-term stewardship
  - AAS?, CAA/DSIAC

Candidate programs will be more mature this time