Status of a Space-Based Gravitational-Wave Observatory in the U.S.

Robin Stebbins

Tenth International LISA Symposium

Gainesville, FL, 19 May 2014

Outline

- Where are we?
- Paths forward
- 2020 Decadal
- Beyond the 2020 Decadal
- What the GW community needs to do now

Where are we?

- The last 4 years have been turbulent and traumatic.
- I still believe that:

LISA, or something like it, is the best idea for a scientific measurement that I know of.

- The low frequency band of the GW spectrum promises revolutionary science.
- A LISA-like mission will have excellent scientific return for the investment.

Disclaimers

- This talk describes the programmatic situation in order to promote community action.
- It doesn't advocate a strategy.
- This is only a summary of the strategic situation.
- Agency plans are just that. Plans. Reality is usually different.
  - We tend to believe them, despite history.
- Agency plans are effectively the most optimistic possibility.
- We are unlikely to know our future with much certainty.

Recent events (US perspective)

- LISA got ranked third among ‘large’ space projects in the 2010 decadal survey.
- The LISA Project was terminated when NASA could not afford to participate in L1.
- NGO did not get selected for L1.
- NGO did not get selected for L2.
- The ‘Gravitational Universe’ science theme got selected for L3.
- LPF has been making significant progress towards launch in 2015.

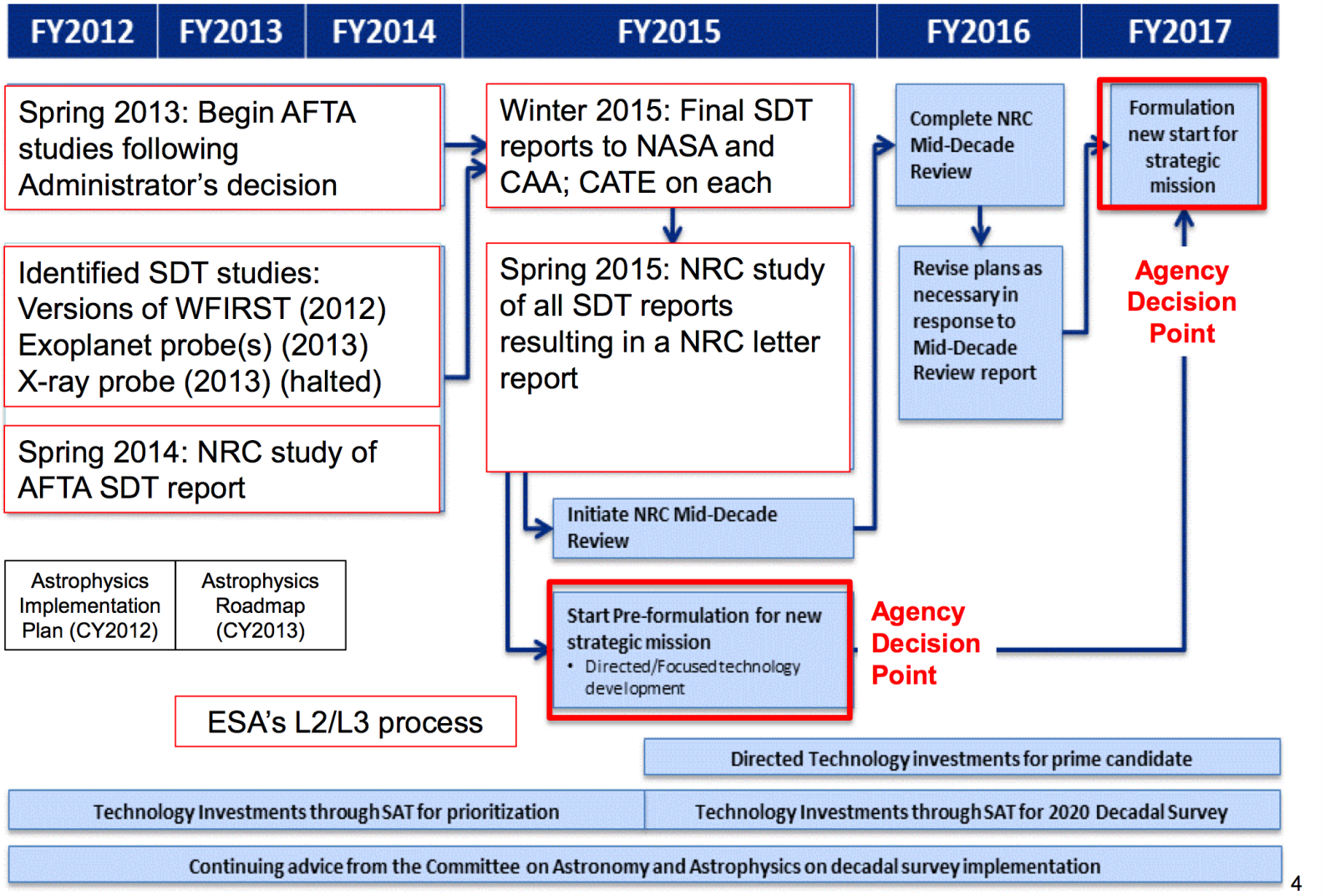
Recommendations from NRC Reviews

- 2000 Decadal (aka AANM, 2001)
  - Second priority behind GLAST (now Fermi) in the moderate category.
- Connecting Quarks with Cosmos (aka Q2C, 2003)
  - Proceed with an advanced technology program to develop instruments capable of detecting gravitational waves from the early universe
- Beyond Einstein Program Assessment (aka BEPAC, 2007)
  - The flagship mission of the program, after LPF launch
- 2010 Decadal (aka NWNH, 2010)
  - Third priority in the large category, conditioned on LPF success

The Astrophysics Division

- The budget anticipated in 2010 decadal didn't materialize.
- The Astrophysics Division and JWST
- Astrophysics Implementation Plan
  - Prepare for facility-class mission (WFIRST) or a probe
- WFIRST, the highest recommendation from 2010 decadal
  - Design concept evolved from decadal to probe to upscope
  - Gifted telescopes
  - Expanded exoplanet scope with addition of coronagraph
  - Congressional support for pre-project

Astrophysics Implementation Plan



Recent GW mission activities in the U.S.

- Concept study (2012)
  - No viable probe class mission exists
  - SGO Mid is the most reasonable compromise between science, cost and risk.
- Technology development roadmap (2013)
  - The eLISA and SGO Mid concepts require the same technology

STRATEGIC OPTIONS

Minor Partnership in L3

- NASA has expressed an interest.
- Advantages
  - Definite plan
  - Builds on strong European commitment in the past
  - Builds on long history of collaboration on LISA and LPF
  - May be compatible with NASA's willingness to invest
- Disadvantages
  - Very long range plan
  - Uncertain mission concept (as seen from NASA HQ)
  - Subject to slipping of L1, L2, L3, M3 and M4
  - Erosion of technical readiness
  - Uncertain U.S. role, weak hand in 2020 decadal

NASA-led, SGO Mid

- NASA lead has been the NRC recommendation.
- Advantages
  - Strong(er) hand in 2020 decadal
  - NASA has a history of successfully carrying out large and complex missions.
  - NASA has strong systems engineering.
- Disadvantages
  - There is no plan.
  - Requires strong performance in highly competitive 2020 decadal
  - Astrophysics may have few new missions in 2020's, after HST de-orbit, WFIRST launch in 2025, slipping and unpredictable budgets
  - Technology development would be non-standard
  - Unclear role for ESA and other potential partners

2020 DECADAL

2020 Decadal Process

- The 2020 process is undefined, but planning has started.
- What happened last time over a 2+ year period
  - Pre-decadal costing
  - Science white papers: 9 responses, 70 pages total
  - RFI 1: 20 page response to questionnaire, >300 received
  - RFI 2: 92 page response to questionnaire, 22 requested
  - Written questions: 18 page response
  - Public meetings: 2 public meetings, 5 town halls, 3 workshops
  - Community outreach blitz
  - Web sites at JPL, GSFC and Europe: 6 primary documents, 9 secondary documents, 693 pages total
  - Panel interview: 2 days, 122 slides
- Science white papers in 2018, recommendations in 2020

State of the chessboard

- Science events: B-mode reports, LIGO detections, PTA detections, time-domain astronomy
- Missions/projects: Kepler, TESS, JWST, LSST, WFIRST
- Competition
  - HST de-orbit
  - Exoplanet missions
  - Large UVOIR telescope (e.g., ATLAST)
  - CMB mission(s)
  - Renegade x-ray proposal
- The curse of Jon Morse: You will always end up in second place to a telescope.

Beyond the 2020 decadal

- "Golden moments" (Kennel and Dressler, Jan. 10 issue of *Science*)
  - A mission concept needs to do well in the decadal
  - The Agency needs adequate budget to carry out the recommendations.
  - The "stakeholders"
    - SMD and the Administrator
    - Office of Management and Budget (OMB)
    - Presidential Science Advisor and the Office of Science and Technology Policy (OSTP)
    - Congress: congressional staffers, powerful members of Congress
  - Unexpected external events (e.g. AFTA telescopes)

What will NASA do?

- [The really speculative part!]
- Carry out a study to determine the community consensus for a strategy
- Prepare for the decadal
- The Program Office is concerned about sustaining the external community.
- Sustain the internal core team
- Maintain technical readiness, retire technical risks
- NASA's motivation? NRC recommendations, science

What does the GW community need to do?

- The US community needs to settle on a strategic plan.
- Whatever plan we choose
  - Prepare for the 2020 decadal with
    - A science case, preferably with exciting, new science
    - A well-understood mission concept, with a robust costing
    - A programmatic concept for technology development and international partnering
  - Ready before 2018! ~3 years.
- The international community needs to understand that there are complicated, internal US dynamics.