Enabling Technologies for the Next Generation of UV-Optical Missions

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Technology and Missions: Chicken or Egg ?

- What drives the selection of the next mission: science drivers or technical capability?
- Science question → mission concept → technical requirements → technology funding (NGST/TPF)
- New technological development → new astronomical capability → new mission to utilize capability (FUSE)

Only Large Missions Can Afford the First Approach

- Explorers, discovery, etc. missions wait for available technology and then propose the best possible science with them. Typically, they address questions that have been around for a while.
- Giga-missions (+ $1B) should start with the question (TPF)
- NASA needs both kinds

Examples:

- *Copernicus* → FUSE
  - (coatings, detectors)
  - local astronomy → galactic astronomy
  - next generation → extragalactic FUV
- IUE → GHRS → STIS → COS
- COBE → MAP

Generic UV - 0ptical Technology Drivers

- Optics:
  - size with high figure quality
  - size w/o high figure quality
  - ultra-low scatter
  - efficient wide field designs
  - better dispersive optics (aberration control/scatter/efficiency)
  - new transmitting materials

UV - 0ptical Technology Drivers

- Detectors
  - larger format
  - long-life / slow space degradation
  - lower background
  - higher efficiency
  - energy resolving
  - higher dynamic range

Example Science Goals for the Next Generation of non-G$ UV/optical missions

- The baryon census in the modern universe
- D/H as a function of z
- The dynamics and recycling of the interstellar medium
- The proto-extra-solar system environment
- NONE OF THESE WILL SELL AN HST CLASS MISSION

Where we have been:

- As a community we have proposed to build the best possible successor to HST: the largest possible mirror, best possible detectors, greatest field of view and most sensitive spectroscopy - we have then enumerated the many science objectives that can be achieved with such an instrument: all true -
- *This has not produced a viable NHST, and will not in the current environment.*

Where we need to go:

- 1: Develop of community consensus on the over-arching scientific objective of a single, great observatory
- 2: This need not, in fact, *should not* be a technically viable mission with today's technology
- 3: Get this *scientific* vision into the strategic plan, and a mission concept identified with it

Where we need to go: (II)

- 4: Identify the technology drivers needed, including spacecraft, electronics, propulsion, etc.
- 5: As these technologies develop, spin-off concepts for SMEX, MIDEX or smaller class missions will spontaneously arise from the community
- 6: When built, the NHST will of course, do much more than the over-arching goal

An example

- The Ultimate Sky Survey
  - Deeper than ever, with greater spatial resolution than ever - catalog the universe
- Technology Drivers:
  - Huge format detectors
  - Ultra low noise, radiation tolerant detectors
  - “UVB” class energy resolution
  - operate out of the ecliptic to control zodiacal light (nuclear)
  - process and telemeter vast amounts of data

Potential Spin-offs

- Ultra-large detector formats:
  - Type Ia SN searches
  - Microlensing searches
- Nuclear power and propulsion
  - planetary missions
  - in situ ISM measurement
- Energy resolution
  - simultaneous color photometry of time variable events - reverberation mapping

Conclusions: What can NASA do?

- Fund enabling technology from both directions. Do not require that technology directly support an identified mission in the strategic plan.
- For non-mission specific research - keep all areas moving forward: detectors, optics, structures, mission implementation

Conclusions: What can the UV-optical community do?

- 1: Develop a vision for NHST that has a "killer-ap" and push it single-mindedly.
- 2: Choose a truly ambitious goal.
- 3: Stop worrying how an approved NHST might weaken support for your pet program.
- 4: Do this soon.