ULTRAVIOLET ASTRONOMY IN THE XXI CENTURY

JcUVa

Bridging the gap: High-resolution UV spectroscopy in the 2020s and 2030s

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What are the issues?

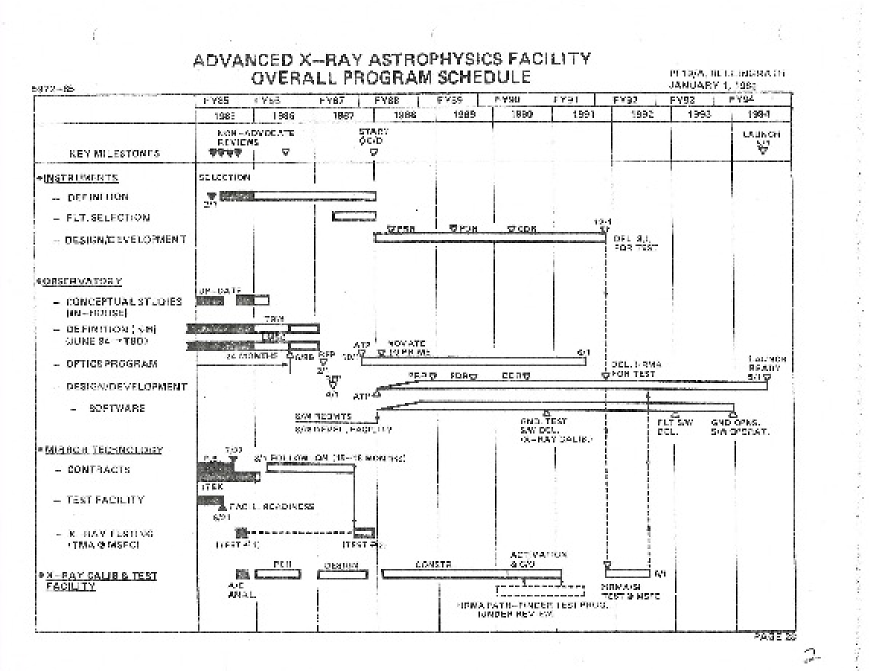
- HST has provided excellent high- and moderate-resolution spectroscopy since 1990 with 3 spectrographs (GHRS, STIS, COS), but the end of mission is coming in about 5 years.
- There is no satellite with similar capabilities that is ready for launch. We will hear about possible launch date for WSO-UV at this meeting
- Flagship missions can take many years from proposal to endorsement to approval and then to launch (HST, Chandra, SIRTF, JWST, etc.).
- LUVOIR with its UV spectroscopic instruments (LUMOS and POLLUX) will be excellent but not until 2040 or so if past experience is relevant. LUVOIR is not yet an approved mission and there are 3 other competitors for the same slot.
- There may be other flagship missions from China, ESA, India, etc. that could come somewhat before LUVOIR.

What is the typical time from an Astronomy Survey Committee endorsement to launch?

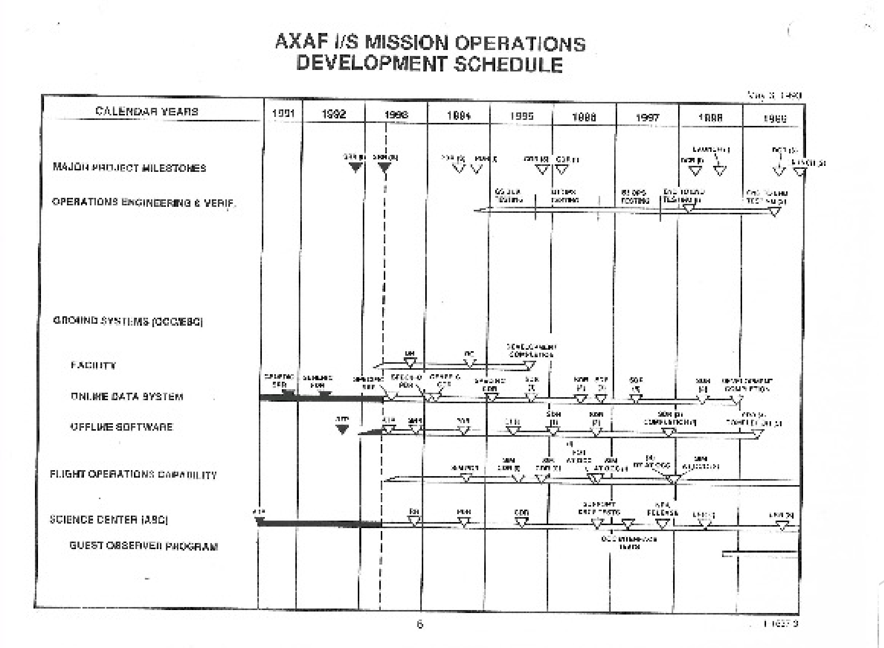
- Hubble Space Telescope: Proposed in 1946 by Lyman Spitzer. Endorsed in 1971. Descoped from 3m to 2.4m telescope. Launched in April 1990 – 19 years
- Chandra X-ray Observatory: Endorsed in 1981. Descoped from 6 to 4 nested mirror pairs and one less focal plane instrument. Launched in July 1999 – 18 years
- Far Ultraviolet Spectroscopic Explorer: Endorsed in 1991. Descoped with a smaller telescope and no EUV instrument. Launched in June 1999 – 8 years

There can be large time delays during construction : For Chandra during 8 years an accumulated time delay of 6 years

In 1/1986 > launch 5/1994



5/1993> launch 12/1999



Examples of how optimization led to successful missions and instruments

- Kepler: optimized by only one observing mode (multi-target extremely high precision continuous photometry for long durations), but only in the visible.
- TESS and CHEOPS: like Kepler but all-sky or many pointed observing times.
- Cosmic Origin Spectrograph (COS): optimized for highest sensitivity moderate-resolution spectroscopy by using only one optical element for aberration correction, wavelength dispersion, and focusing the dispersed light on the detector.
- Cubesats will be optimized in many different ways as illustrated at this meeting, but limited volume, power, telemetry, and cost will limit what moderate-resolution spectroscopy can be obtained.

My message: Go simple, go focused, go modest in science goals – some ideas

- A COS-like instrument with a 1m telescope and low noise detector - more efficient than HST for spectroscopy because loss of throughput (2.4m > 1m telescope) is made up by better primary mirror, no time sharing with other instruments, and longer exposures. Even better in a high orbit or L2.
- Exoplanet transit observatory with an optimized Lyman-α spectrograph and a 1m telescope that is diffraction limited at Lyman-α.
- Stellar activity observatory – moderate-resolution spectra only at MgII and CIV.
- Stellar flare and exoplanet observatory with high time resolution – narrow band photometry at several wavelengths with several small telescopes each with its own narrow-band filter.
- Use your imagination!
- Bottom line: Stellar and exoplanet studies need focused modest sized missions in addition to cubesat and flagship missions.