16.89J / ESD.352J Space Systems Engineering
Spring 2007

Assignment #1: Existing Designs for Major Astronomical Telescopes

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This assignment asks you to assemble key information about an existing design of a major astronomical telescope. From your research, and the results collected by the class, we hope you will become familiar with the key drivers and trade-offs in telescope design, and with some real-world examples that may help guide your thinking during the 16.89 project.

You will be assigned to study one of the following major Earth-based or space-based telescope designs. These designs have been studied, developed, and/or built during the past few decades for (primarily) deep space observations in the visible, infrared, and radio wavelengths. We have excluded shorter wavelengths (X-ray, gamma ray) since these present substantially different challenges for telescope design.

- Hubble Space Telescope (HST) [1990-present]
- Keck I & II [1993-present] / Keck Interferometer [1995-present]
- Spitzer Space Telescope (SST, formerly SIRTF) [2003-present]
- Very Large Telescope (VLT) [2005-present]
- Arecibo Observatory [1963-present]
- Highly Advanced Laboratory for Communications and Astronomy (HALCA, formerly MUSES-B) [1997-2005]
- James Webb Space Telescope (JWST, formerly NGST) [~2013-?]
- Stratospheric Observatory for Infrared Astronomy (SOFIA) [2007-?]
- Herschel Space Observatory (HSO, formerly FIRST) [2008-2011]
- Very Large Array (VLA) [1980-present]
- Infrared Space Observatory (ISO) [1995-1998]
- European Extremely Large Telescope (E-ELT) [~2017-?] / Overwhelmingly Large Telescope (OWL) [concept]
- Microvariability and Oscillations of STars (MOST) telescope [2003-present]
- Galaxy Evolution Explorer (GALEX) [2003-present]
- Southern African Large Telescope (SALT) [2005-present]
- AKARI (formerly ASTRO-F, ISIS) [2006-present]
- Cambridge Optical Aperture Synthesis Telescope (COAST) [1995-present]
- Extreme Ultraviolet Explorer (EUVE) [1992-2001]
- International Ultraviolet Explorer (IUE) [1978-1996]

For the design assigned to you, we ask you to compile a 2-page report providing information **(with numbers)** on the following elements of the design. Make a reasonable effort given the availability of information for your design—rough data is better than no data, but you should indicate the reliability of the data you present. Please be sure to **cite your sources** so that we can compile them for future reference.

1. Scientific rationale
   - major questions or inquiries addressed
   - classes of astronomical targets observed
   - major users and beneficiaries of research
2. Observation characteristics
   - location (site/orbit) and viewable region (of sky)
   - spectrum range observed (wavelengths)
   - range of targets observable within target classes (apparent magnitude)
   - effective resolving power achieved (feature resolution)
3. Primary collector structure
   - type of geometry for primary collector(s)
   - real/effective aperture diameter(s)
   - real/effective focal length(s)
   - masses of primary collector(s) and supporting structure
4. Observational sensitivity
   - thermal environment of primary instruments (noise temperatures)
   - instantaneous overall signal-to-noise ratio (SNR)
   - cumulative SNR for typical individual observations
5. Program support
   - sources of funding
   - operators (telescope, instruments, data analysis, etc.)
   - development cost
   - operations cost (annual budget)