# CASTOR: A Proposed Wide-Field, UV-Blue, Imaging Space Telescope

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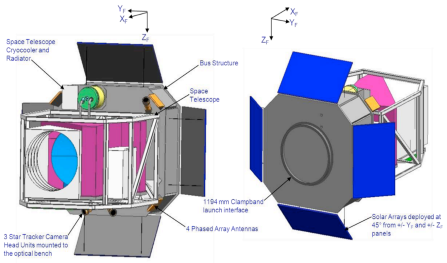
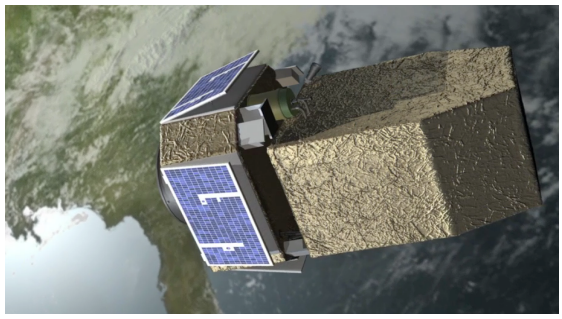
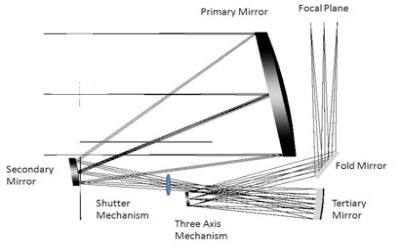





**(Above)** *The optical design features an off-axis primary mirror and a wide field of view with excellent quality. A shutter is located at an intermediate image plane, and a three-axis fine-steering mechanism sits at a pupil. This can take the form of either a plane mirror for imaging or a grating for slitless spectroscopy.*


## SUMMARY

The *Cosmological Advanced Survey Telescope for Optical and UV Research* (**CASTOR**) is a proposed CSA mission — a unique capability for panoramic, high-resolution imaging at UV/optical (150–550 nm) wavelengths. In addition to the UV access, **CASTOR** would far surpass any ground-based optical telescope in angular resolution, and provide ultra-deep imaging in three broad filters that supplement longer-wavelength data from future dark energy missions (Euclid, WFIRST). Combining the largest focal plane ever flown in space with an innovative optical design that delivers HST-quality images over a field two orders of magnitude larger than HST, **CASTOR** would image about 1/8th of the sky to a (u-band) depth ~1 magnitude fainter than will be possible with LSST even after a decade of operations.


## Key Features and Capabilities:

- A 1m-diameter unobscured Three Mirror Anastigmat (TMA) telescope provides Hubble-like image quality of ≈0.15″ over an unprecedented 1.16° x 0.58° field of view.
- A huge 725 Megapixel camera with wavelength coverage from 150-550 nm, allowing access to wavelengths not visible from the ground.
- High observing efficiency allows a minimum survey area of 5,000 deg$^2$ in less than two years.
- A u-band sensitivity of ~27.1 AB magnitude in the Wide Survey (see Table 1). High angular resolution leads to improved depth for unresolved sources; CASTOR would have comparable point source sensitivity to a 40m ground-based telescope in good (0.6″) seeing.
- **CASTOR** is designed to fulfill Canada's top space astronomy decadal priority, and be of wide scientific and public interest. International partners are welcome.

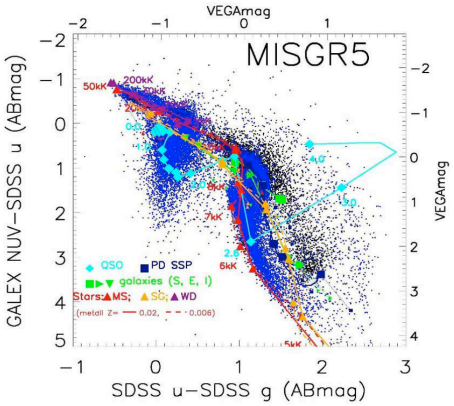
**Table 1. CASTOR Legacy Surveys**

| Survey | Area (deg$^2$) | Mode | $UV_{lim}$ (mag) | $u_{lim}$ (mag) | $g_{lim}$ (mag) | T (years) |
|---|---|---|---|---|---|---|
| Wide | 5000 | contiguous | 25.79 | 27.10 | 27.78 | 1.8 |
| Deep | 40 | contiguous | 29.35 | 29.84 | 29.90 | 0.4 |
| Nearby Galaxies | N ≈ 125 | pointed | 26.82 | 28.00 | 28.44 | 0.15 |
| Nearby Clusters | 150 | contiguous | 26.82 | 28.00 | 28.44 | 0.15 |

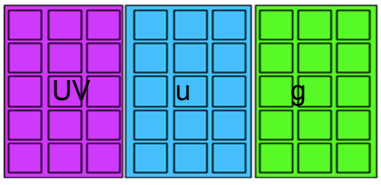
Mission operations would combine major surveys with GO programs.

**Table 2. Data Volume Budget**

| | |
|---|---|
| Gigapixels/exposure | 0.725 |
| Exposures/image | 4 |
| Time per exposure | 10 min |
| Bits per pixel | 16 |
| Bits per Image | 46.4 |
| Exposure time per image | 40 min |
| Data generation rate | 2.4 MB/sec |
| Operation duty cycle (target) | 80% |
| Orbit period | 100 min |
| Data per orbit | 12 GB |
| Data per day | 172.8 GB |

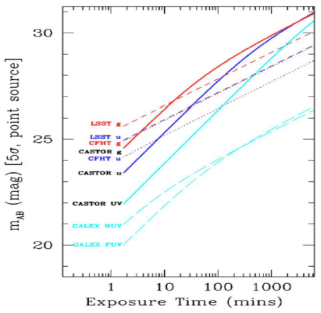



**(Above)** *Diagnostic power of the NUV, u, and g bands, from GALEX and SDSS data; these correspond closely to CASTOR's bands. Blue points show sources that are unresolved in SDSS while black points show extended objects.The cyan track shows typical QSO colors over the range 0 < z < 4. Other curves show stellar tracks for a range in effective temperature.*

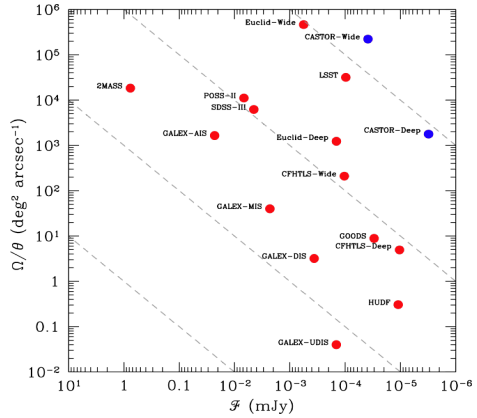



**(Above).** *Proposed focal plane array (FPA) layout for CASTOR, which has a total of 45, 4k x 4k detectors. Each band is covered by 3 x 5 FPAs.*

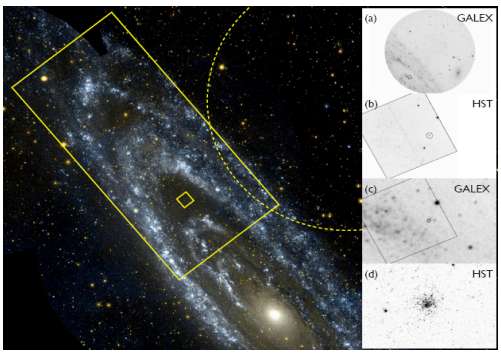
Tracking for the fine pointing mirror image stabilizer would be done using small window fast reads in the science array on selected guide stars without interrupting scientific integrations.



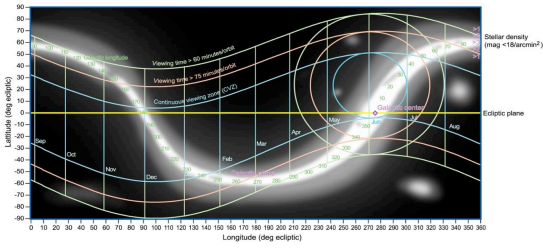

**(Left)** *Comparison of photometric depth as a function of exposure time for four UV/optical telescopes: CASTOR, CFHT, LSST, and GALEX.*




**(Above)**. *Information content of wide-field imaging surveys in the UV, optical and IR spectral regions. The abscissa gives the depth in mJy while the ordinate shows Ω/θ, where Ω is the survey area in sq. deg and θ is the resolution in arcsec. Information content increases diagonally toward the upper right corner.*




**(Above)** *CASTOR, relative to HST and GALEX. The underlying image is a GALEX UV mosaic of M31 (inset a). A single GALEX image is the dashed circle. The large rectangle shows the CASTOR field of view, which measures 1.16° × 0.58°. The smaller polygon shows the HST field, which is ~1/200th that of CASTOR (inset b). Inset c shows the HST field at GALEX resolution. Inset (d) shows a magnified view from HST indicated by the small circle from inset (b). CASTOR would have angular resolution comparable to HST.*




With the preferred polar terminator orbit, observations will be concentrated in the anti-sun direction, as with ground-based astronomy. Solar panels are mounted on the sun side, angled to permit use at off-anti-sun angles to 40 degrees. The continuous viewing zone is close to the anti-Sun direction for much of the year.