



FORECASTOR:

An Exposure Time Calculator and Web Tool for the CASTOR space mission



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The CASTOR Mission

The 2020s will see the launch of several next-generation space telescopes. Critically, there is a lack of UV capability in these missions, which will lead to a UV-optical gap.

The Cosmological Advanced Survey Telescope for Optical and ultraviolet Research (CASTOR) is a proposed Canadian-led 1m-class space telescope that will be able to perform wide-field imaging and spectroscopy in the UV and blue-optical regimes. CASTOR will be capable of producing images in the 150-550 nm spectral range with a FWHM of ~0.15" over a 0.25 deg² FOV.

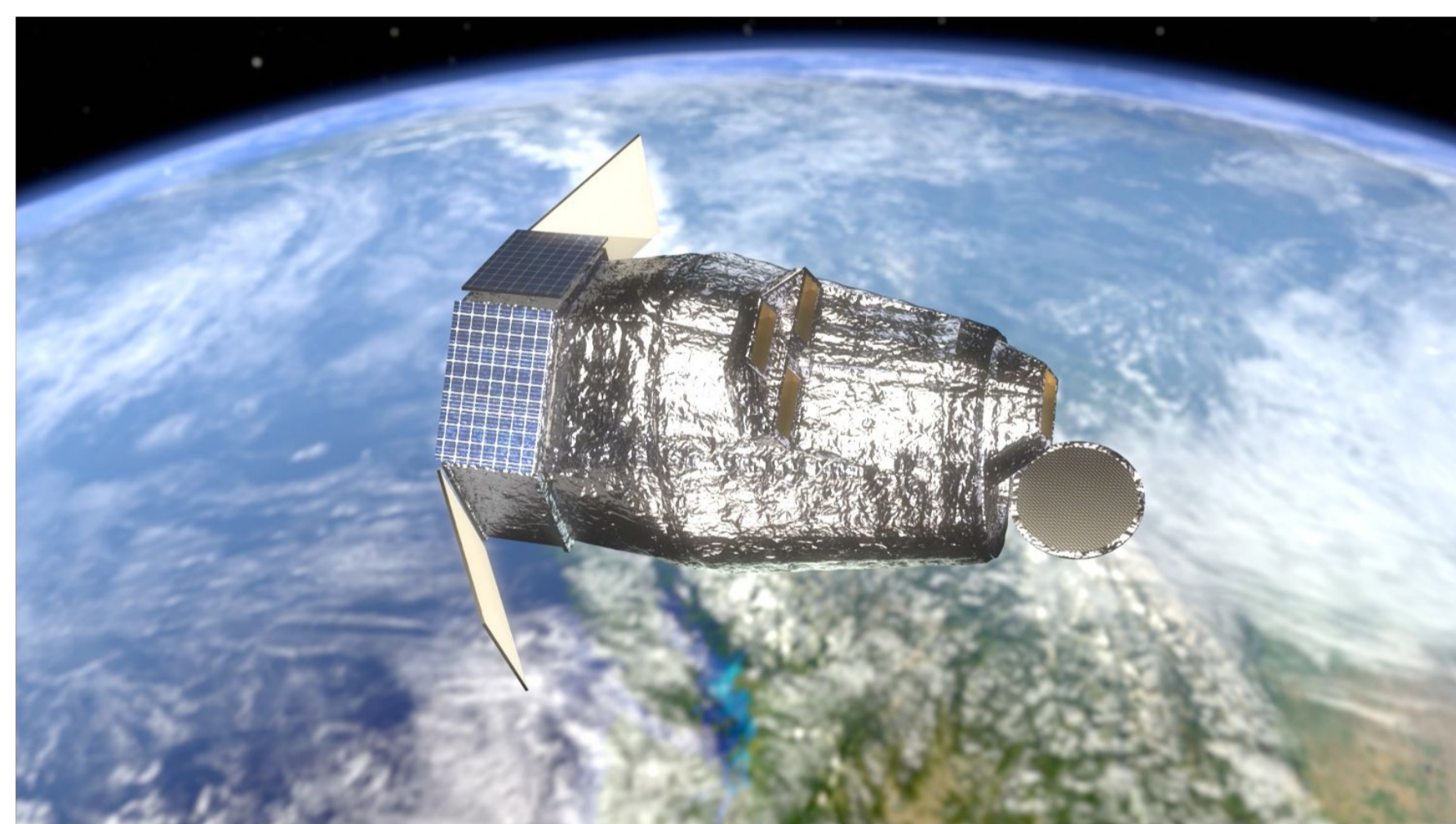


Fig 1. Visualization of CASTOR in orbit

CASTOR's UVMOS spectrograph will utilize a digital micromirror device to provide multi-object spectroscopy in the 150-300 nm range with a moderate resolution of R ~1500.

FORECASTOR

The Finding Optics Requirements and Exposure times for CASTOR (FORECASTOR) program will provide a comprehensive suite of mission planning tools for this project.

The FORECASTOR exposure time calculator (ETC) is an invaluable asset in understanding the telescope's capabilities and performance as well as a critical part of the proposal preparation process.

A Pixel-Based Exposure Time Calculator, Responsive GUI, and Open-Source Tools on GitHub

castor_etc python package – highlights

- Completely customizable telescope parameters with automatic calculation of photometric zero-points and pivot wavelengths
- Arbitrary surface brightness profiles
 - e.g., Sérsic model, ellipse with exponential scale lengths, uniform disk, point source with Gaussian PSF, custom image
- Pixel-by-pixel synthetic photometry supporting non-zero aperture centres and fractional pixel weighting
- Browser-based GUI
 - uses React and Typescript with a Flask API
 - Resizable panels, interactive figures, and calculations update as parameters are saved

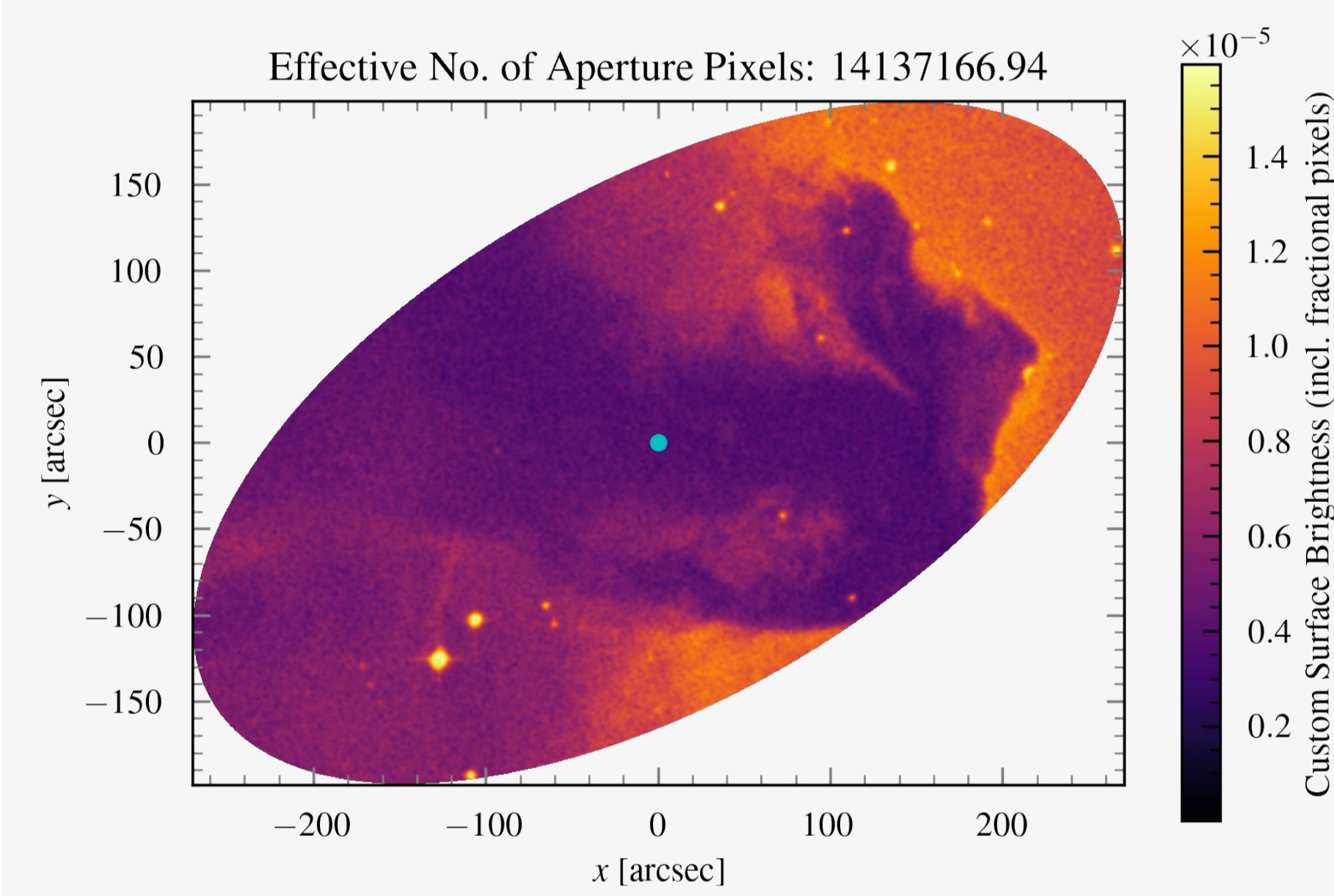
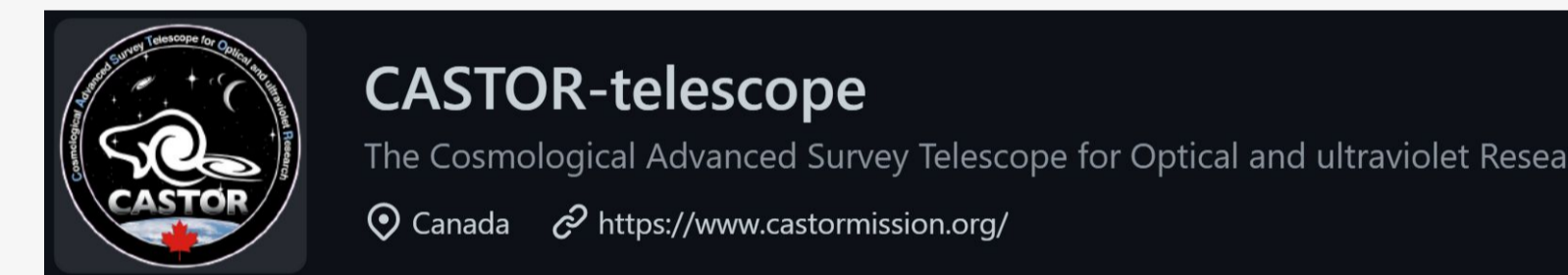


Fig 2. The Horsehead Nebula as seen by CASTOR through an elliptical aperture.



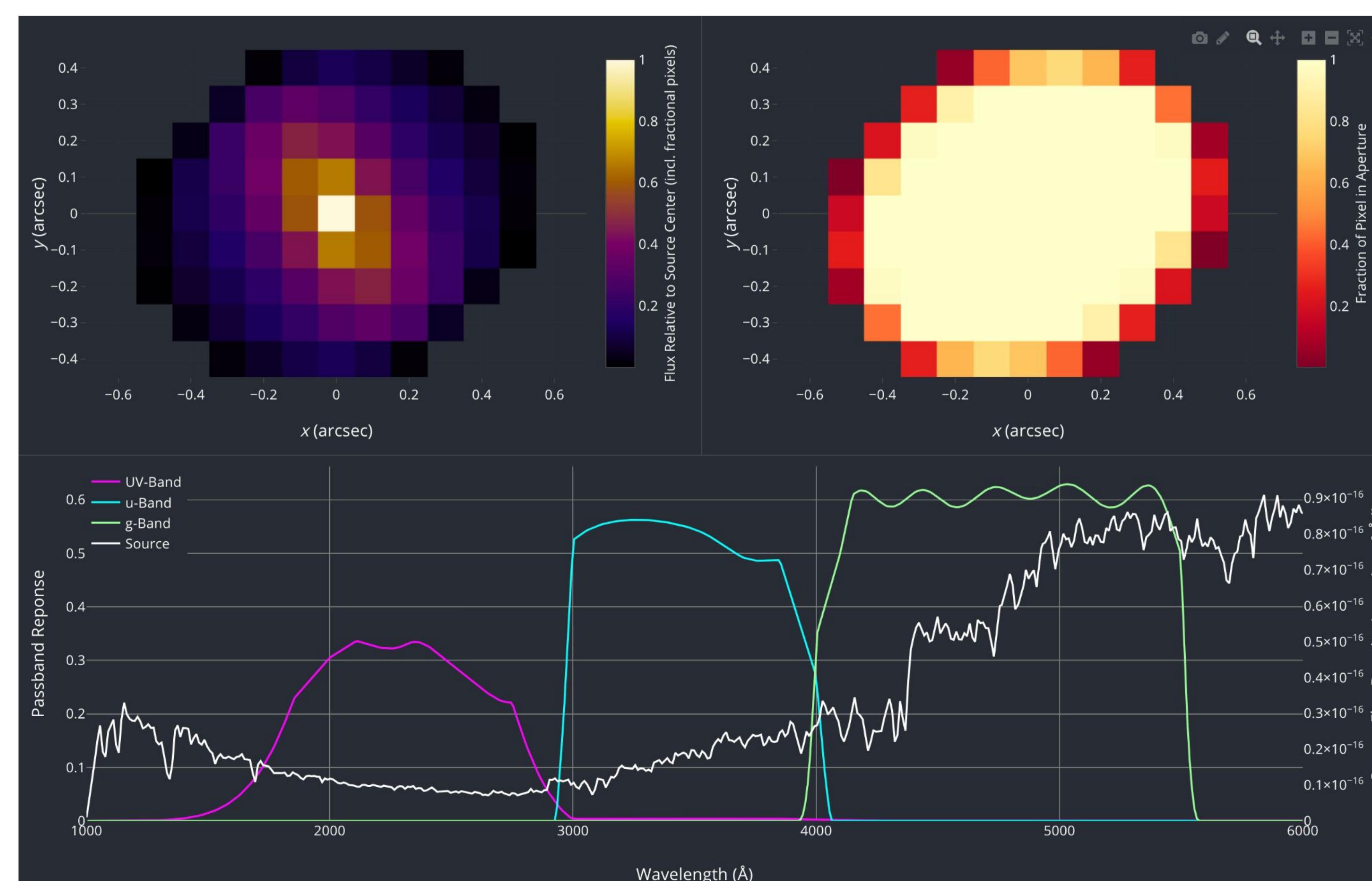
FORECASTOR GitHub repositories located in the [CASTOR-telescope](https://github.com/CASTOR-telescope) organization

[FORECASTOR ETC Python package](#)

[FORECASTOR ETC GUI](#)

[FORECASTOR ETC example Jupyter notebooks](#)

Fig 3. Preconfigured Jupyter Lab environment + web GUI hosted on CANFAR



Preliminary ETC for UVMOS

An exposure time calculator (ETC) for the CASTOR UVMOS mode is in progress. Here, we report early results in reproducing a UV spectrum on the CASTOR detector, including a preliminary noise model, as an initial step to finding exposure times.

The spectrum is constructed by projecting a 3x10 pixel slit onto the detector with a dispersion of 0.1nm/pixel.

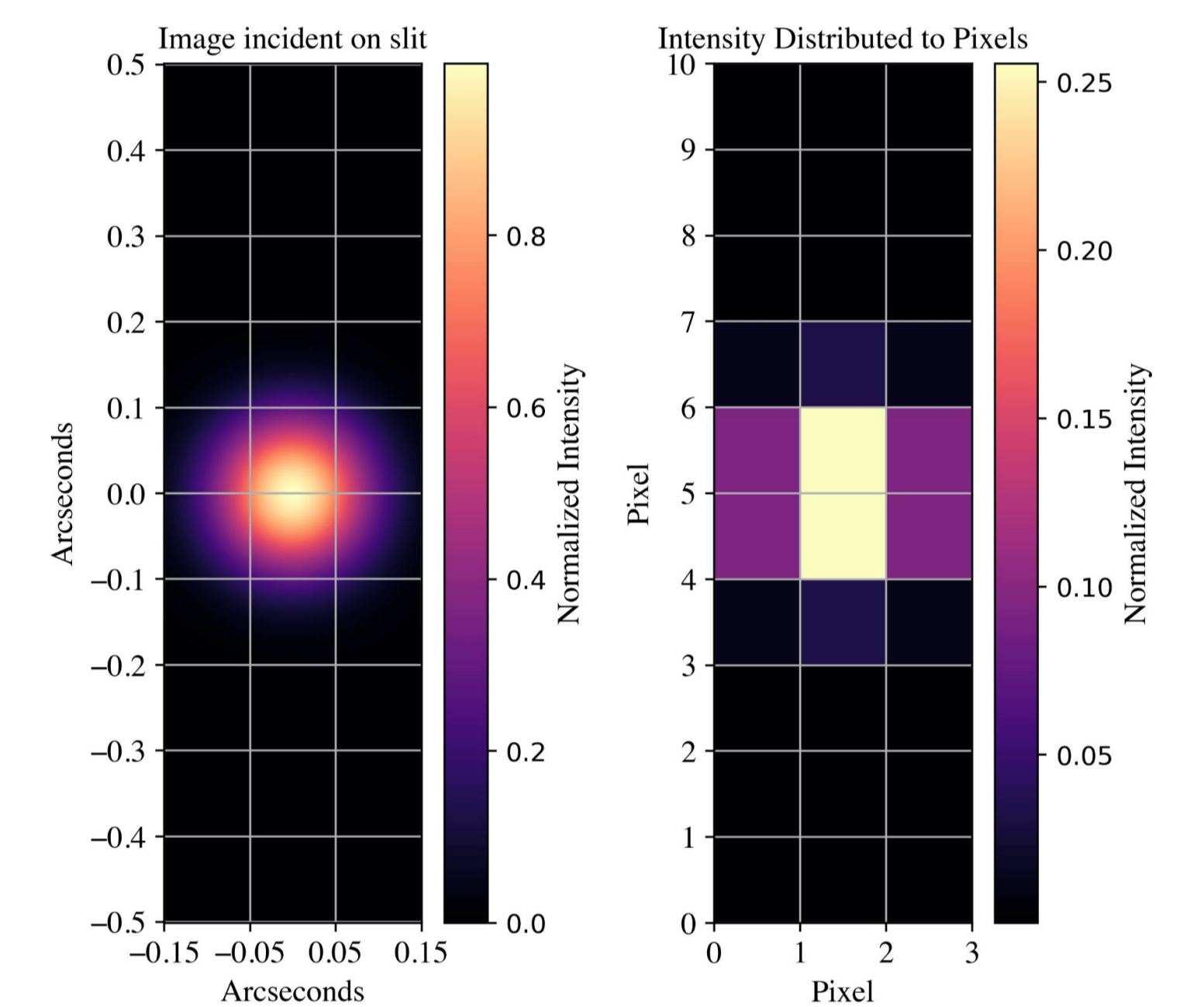


Fig 4. The projection of a slit image on the CASTOR detector.

Our prediction for the CASTOR detector spectrum of the hot star HR 1886 (B1V, V=5.5) based on its Hubble Space Telescope UV spectrum is shown below.

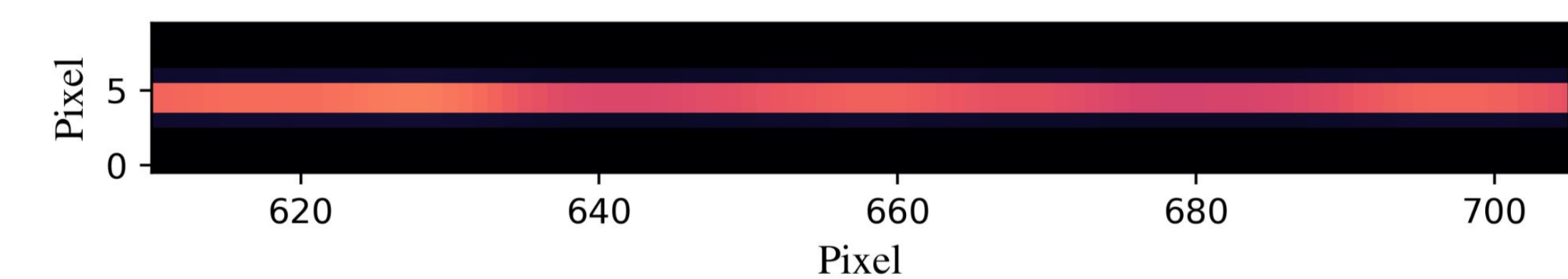


Fig 5. A segment of the simulated spectrum for HR 1886 on the CASTOR detector (~ 2100 to 2200 Å).

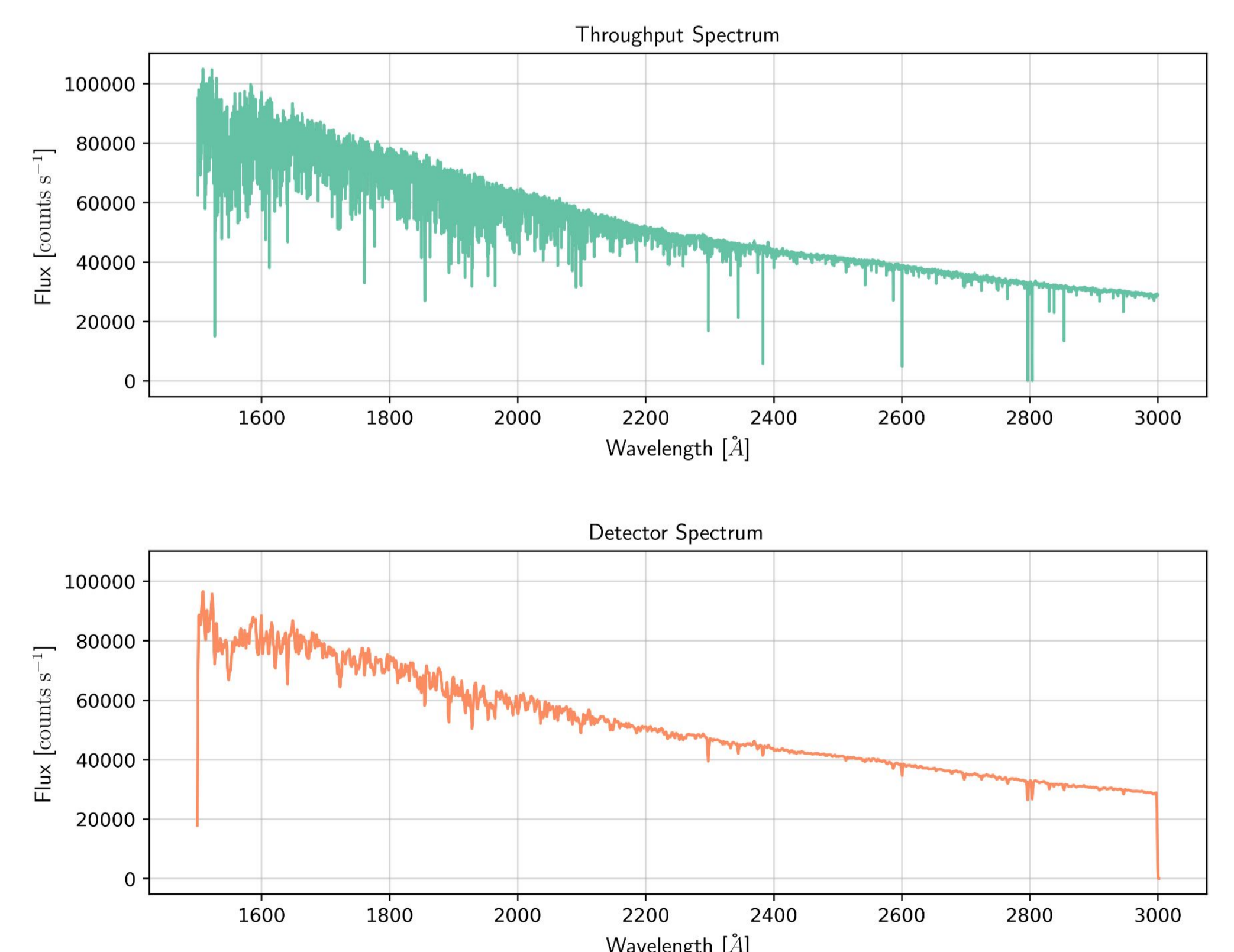


Fig 6. The projected CASTOR spectrum for HR 1886.

With industry partners, Magellan and Honeywell, we are refining the noise and throughput models before the ETC is released.