

# **The *Arcus* Astrophysics Probe Explorer**

Randall Smith  
For the Arcus Team



## *Why Arcus?*

### *X-ray & UV High-Resolution Spectroscopy With Order-of-Magnitude Improvements*

- *Astro2020: “In the next decade, spectroscopy will be the dominant discovery tool for astronomy.”*
- No planned mission has high-resolution ( $R > 2500$ ) soft X-ray or UV spectra.

### Baseline Science Objectives

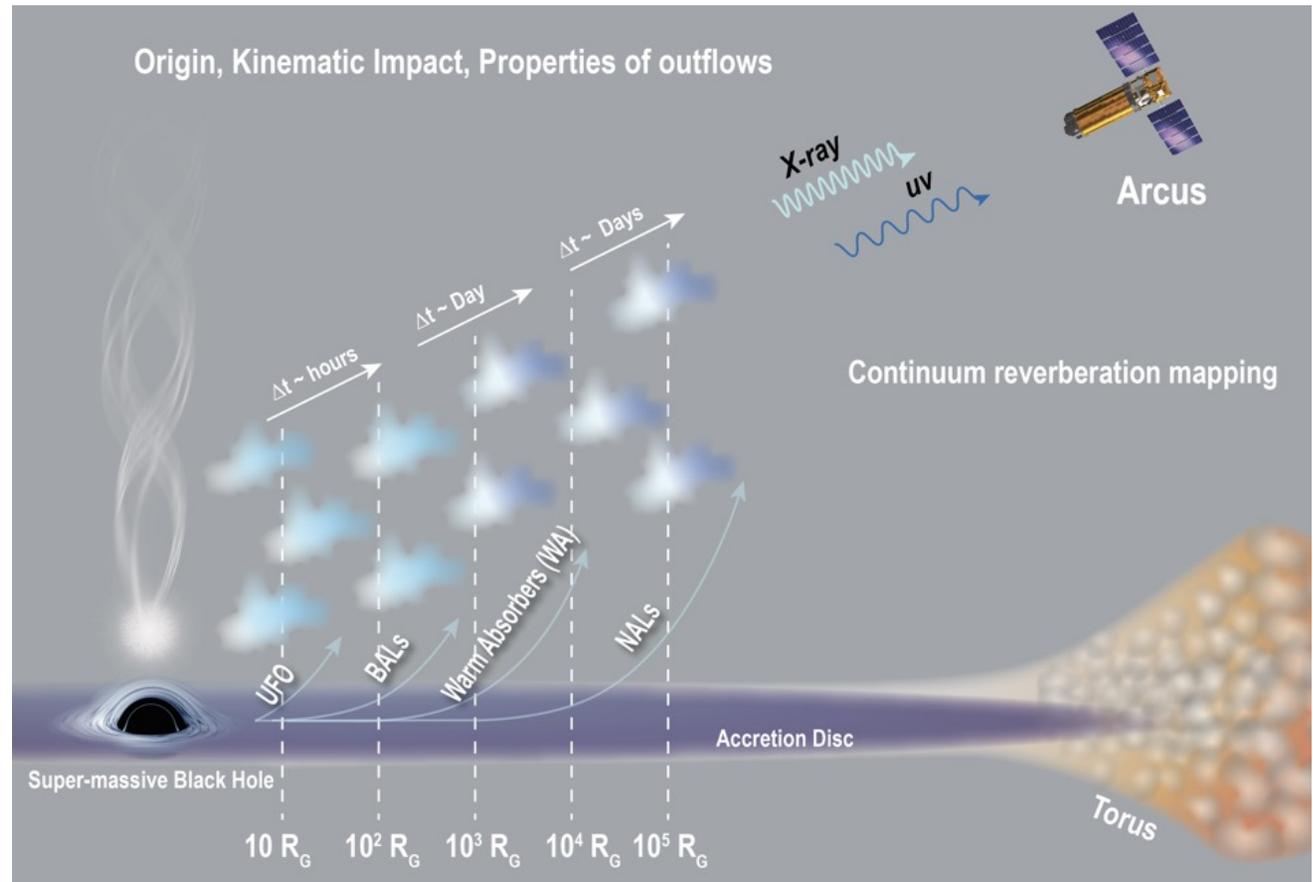
- **G1**: *Cosmic Ecosystems*: What powers the black hole winds that impact galaxies and clusters?
- **G2**: *Unveiling the Drivers of Galaxy Growth*: How does matter cycle in and out of galaxies?
- **G3**: *Worlds and Suns in Context*: How do stars & circumstellar disks form, evolve and die?

# G1: Cosmic Ecosystems



- *Arcus* will calculate wind momentum from response time of the wind to changes in the ionizing flux on timescales from 10 ks to 10 Ms.
- Breaks degeneracy between the density of the outflowing wind and its radius:

$$\text{Gas ionization } \xi \propto \frac{L}{nr^2}$$



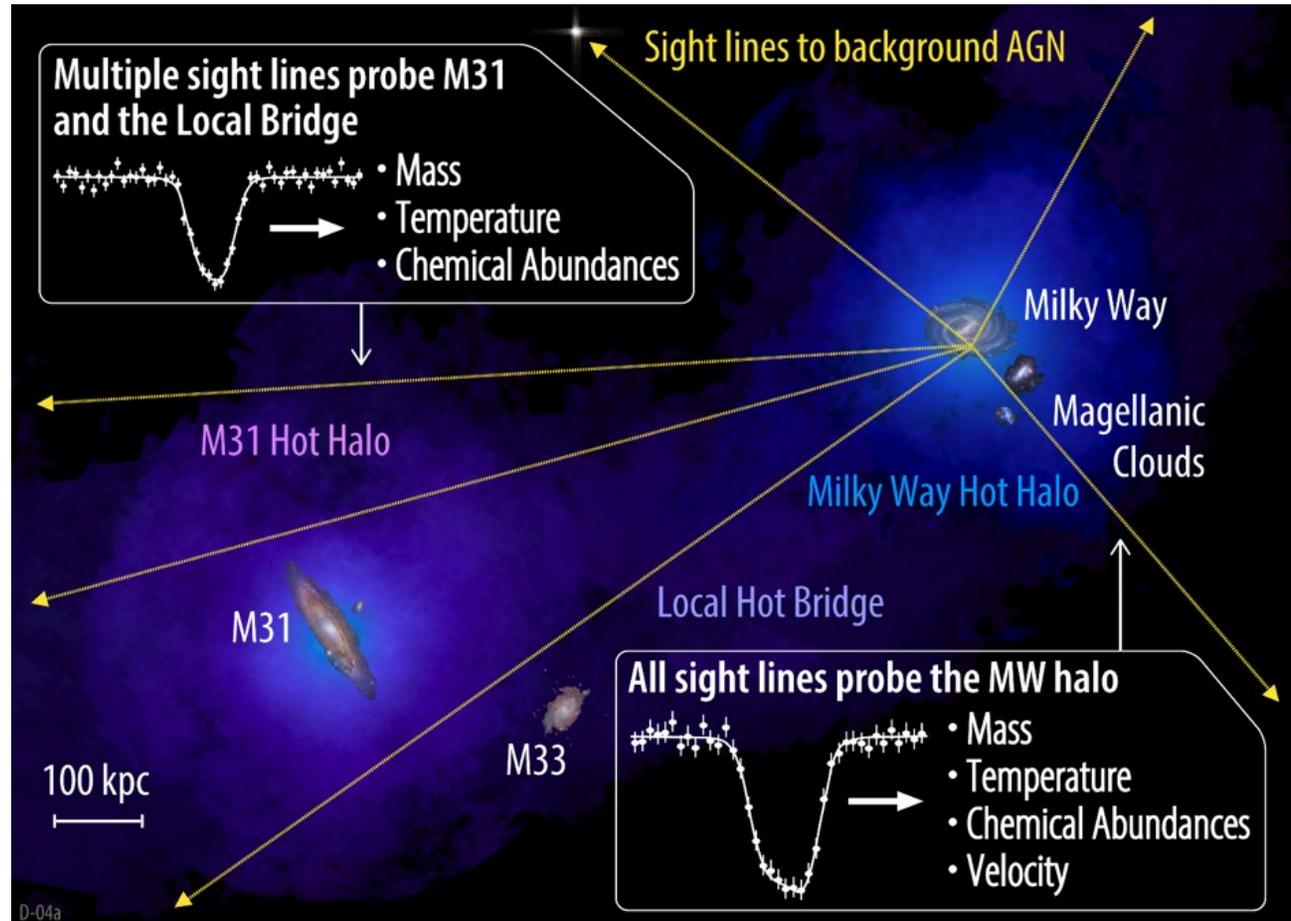
- Reveals AGN wind feedback role in shaping host galaxies: kinetic power  $\propto v^3 N_H r$ .

*Arcus* Probe will provide the first true measurements of AGN wind feedback.

# G2: Unveiling the Drivers of Galaxy Growth



- *Arcus* will observe 100+ lines of sight towards bright AGN, using them as backlights to detect hot and warm gas in absorption from the foreground IGM and galactic halos.
- Observations of halos in lines of H Ly $\beta$  w/ OVI, O VII, and O VIII (& C, N ions) will reveal the temperature, density, metallicity and dynamics of the tenuous cosmic web.

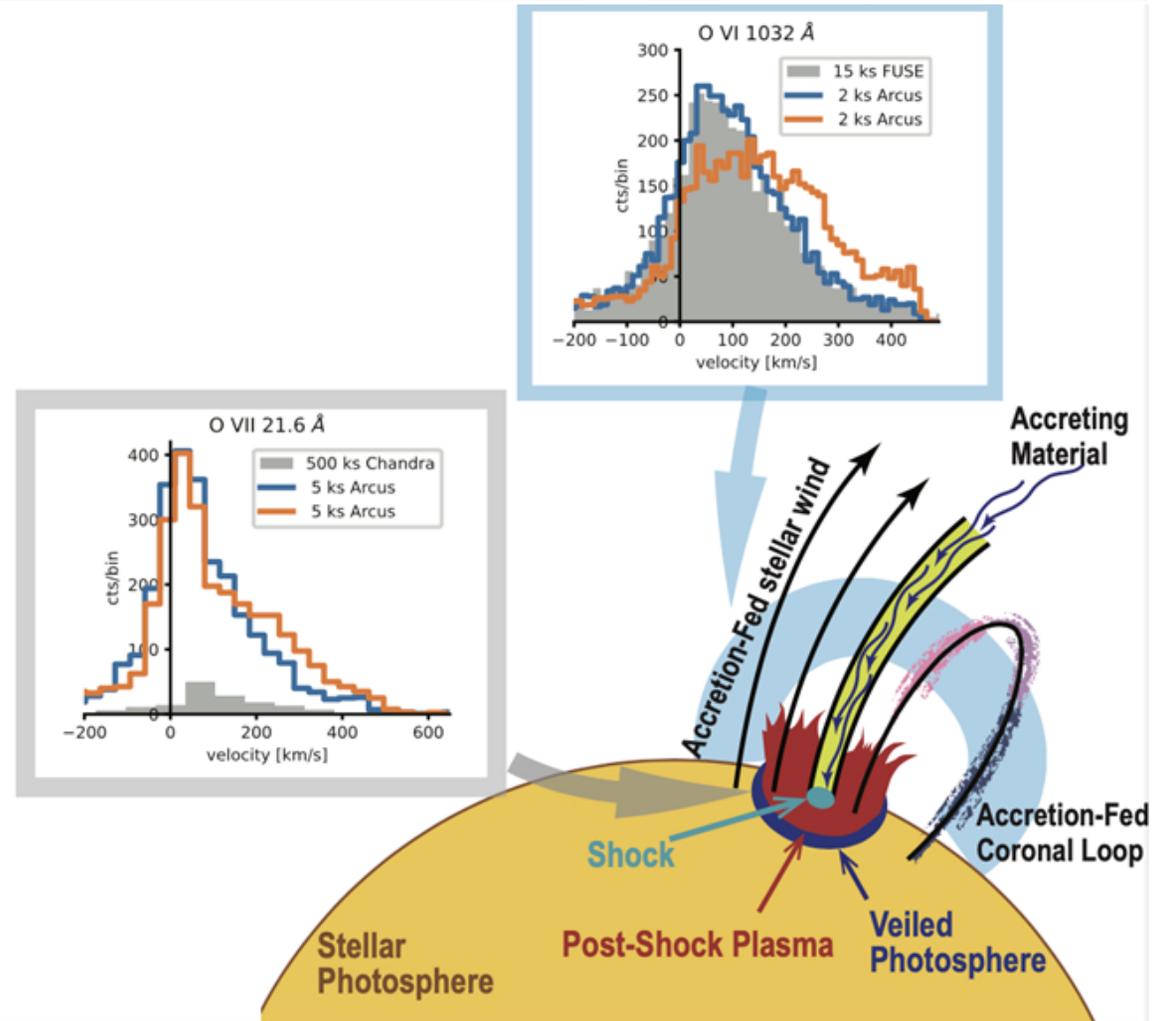


*Arcus* Probe will provide the first true census of baryons and metals in the Universe.

# G3: Worlds and Suns in Context



- The *Arcus* Stellar Sample includes 100+ of all types, including main sequence, young stars, and those hosting exoplanet transits.
- Combining X-ray and FUV spectra will show stellar impact on exoplanet atmospheres, providing important precursor data for *HWO*.



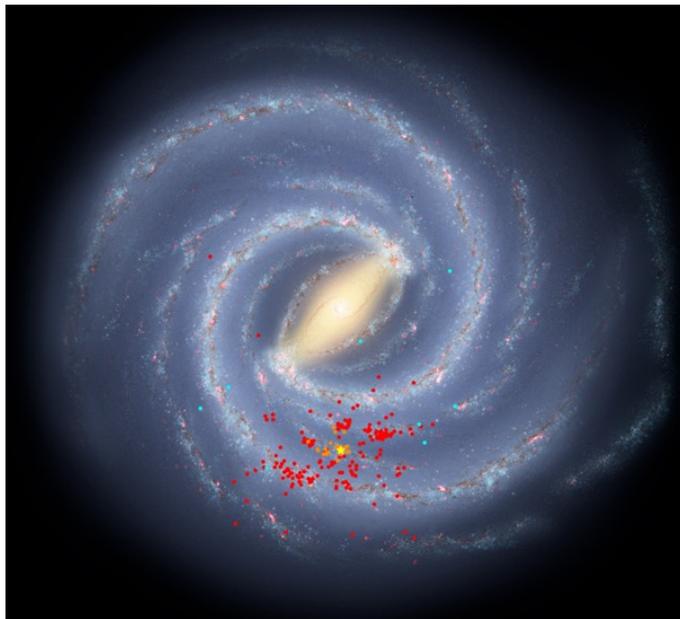
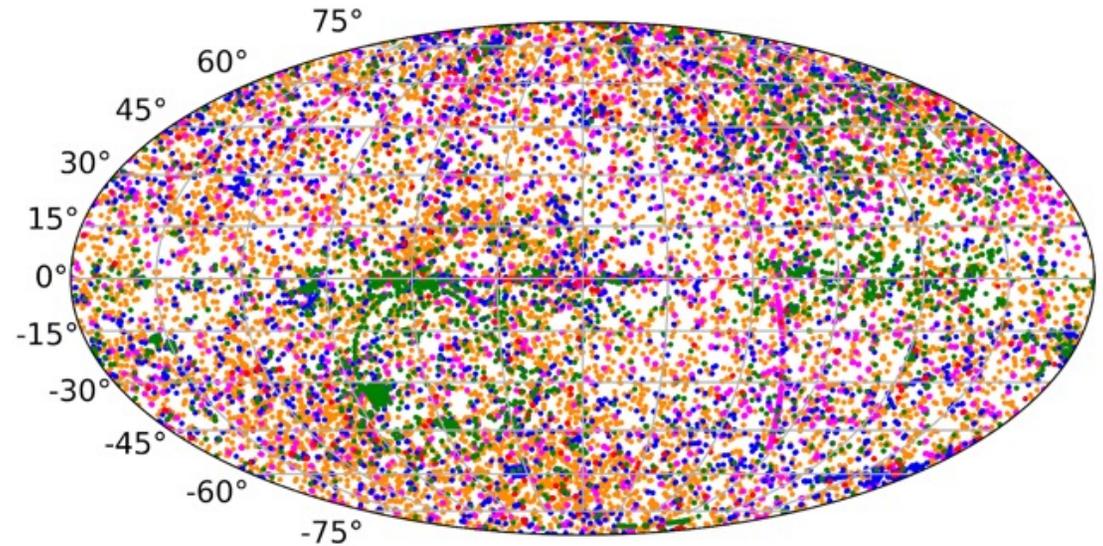
*Arcus* provides unique in-depth data on star formation, evolution, and death and the environments of potentially habitable worlds.

# General Observer Science



*Arcus's* unique combination of soft X-ray and UV sensitivity will open an underused wavelength window

>150,000 easily observed known sources from *ROSAT*; *Swift/UVOT*; *XMM-Newton*; *XMM/OM*; *FUSE*

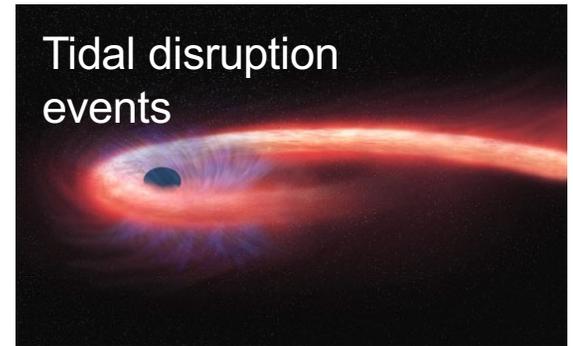


**UVS will permit UV studies of lightly-to-moderately reddened sightlines.** Targets observable by both UVS and COS in 50 ks are in cyan; in red: UVS only. Orange: FUSE sightlines from Rachford+ (2002).

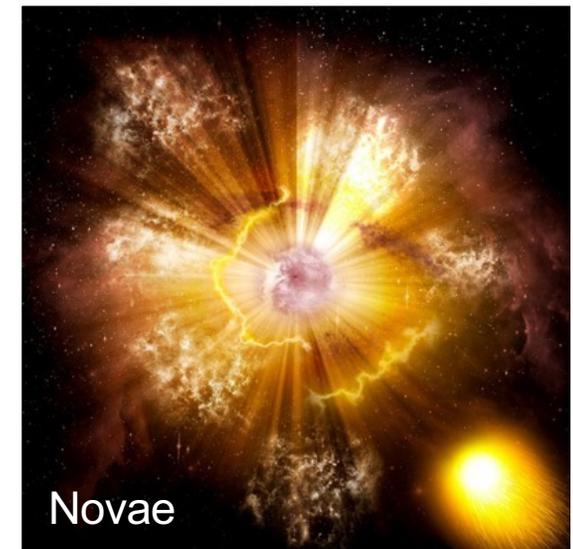
**Arcus has a 24 hour response for DDT targets and for pre-approved automated sources, as fast as 4 hours. GO Targets could include:**

Source	Timescale (Start – End)
Gravitational wave sources (LIGO <i>and</i> LISA)	Hours – Days
Tidal Disruption Events	Hours – Months
Supernovae	Hours – Days
Gamma-Ray Bursts	Seconds – Days
Changing-look quasars	Hours – Months/Years
Black hole outbursts	Seconds – Months/Years
Stellar flares	Seconds – Hours

Tidal disruption events



Novae



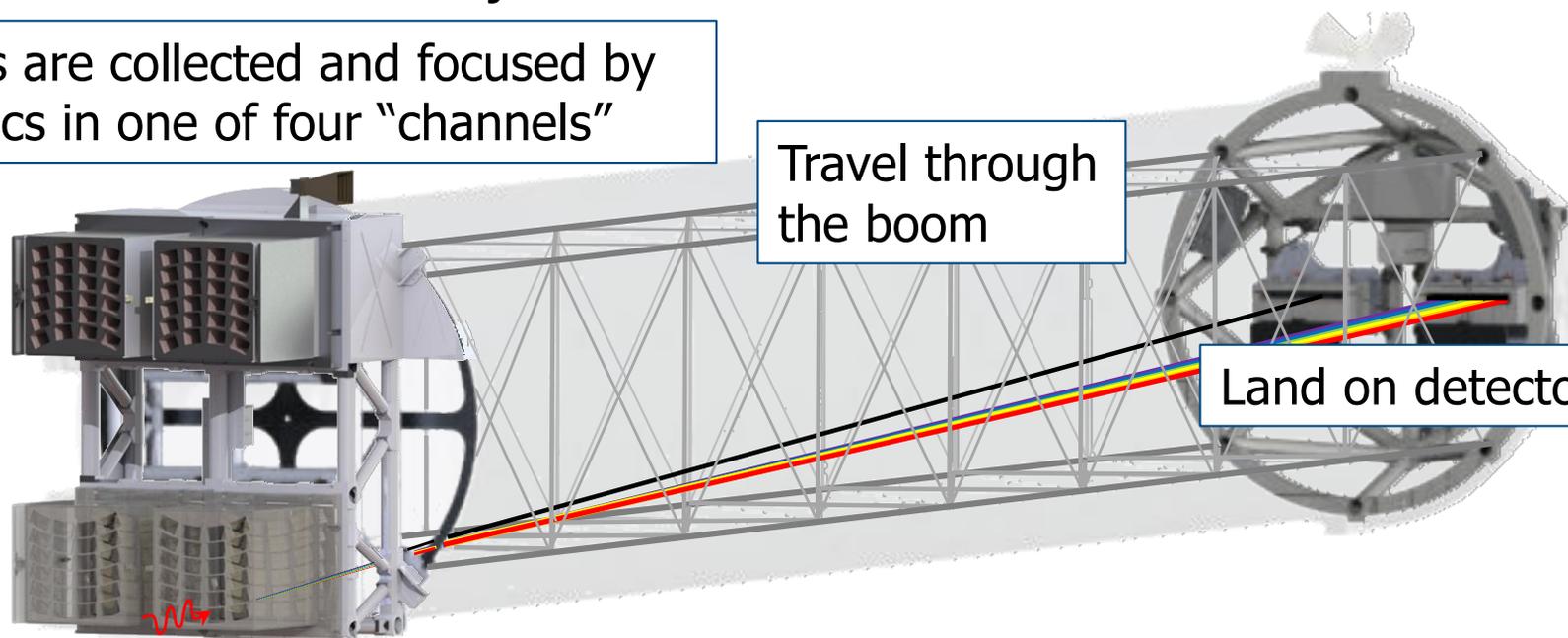
# The *Arcus* X-ray Spectrometer

- Silicon Pore Optics in Wolter-Schwarzschild design with Critical-Angle Transmission (CAT) gratings & CCD detectors
- 12-50Å bandpass with Effective Area  $> 270 \text{ cm}^2$  and  $R > 2500$
- $>100x$  the sensitivity of Chandra HETG at launch

Photons are collected and focused by the optics in one of four "channels"

Travel through the boom

Land on detectors



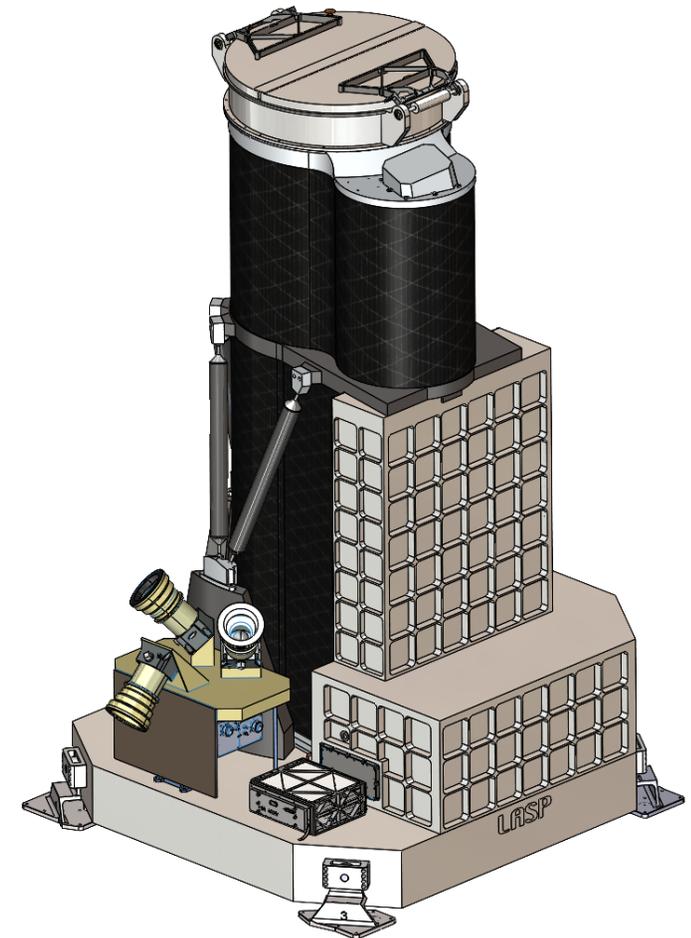
Diffacted by the associated CAT gratings

The Arcus instruments provide a robust platform to achieve mission goals

# The *Arcus* UV Spectrometer



- Off-axis Cassegrain telescope feeding a two-channel imaging spectrograph with a microchannel plate detector.
- UVS's optics are coated with enhanced LiF (eLiF).
- Bandpass of 1020-1540Å with Effective Area (at O VI) > 250 cm<sup>2</sup> and R>17,000
- At O VI, 10x the sensitivity of FUSE



The Arcus instruments provide a robust platform to achieve mission goals



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