The High Energy X-Ray Probe (HEX-P)

Predictions of Coronal Configurations with the *kerrC* Model

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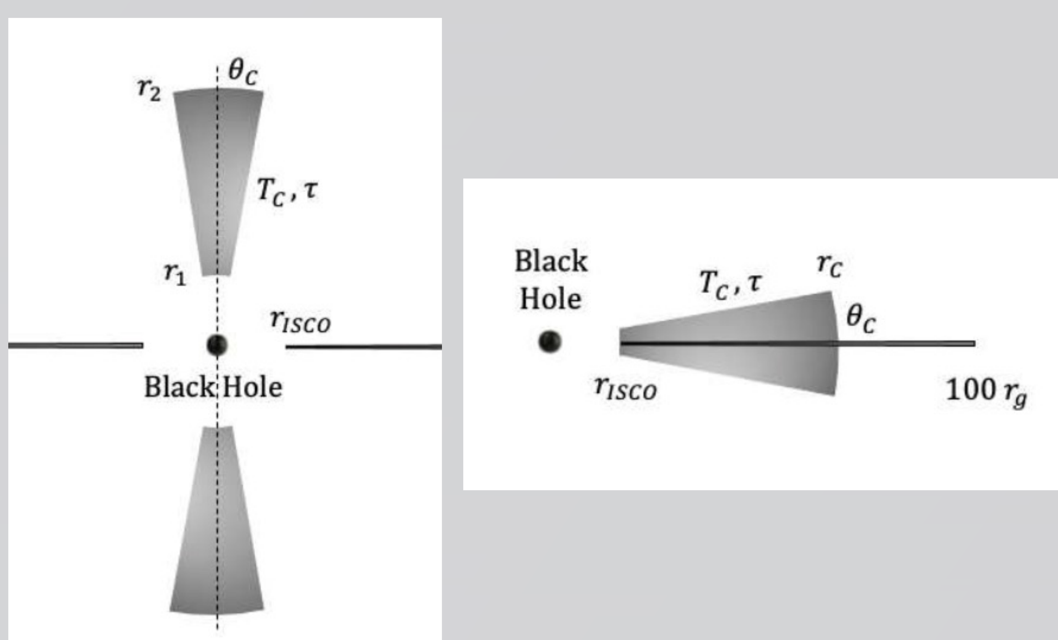
Overview:

HEX-P is a probe-class mission concept that will combine high spatial resolution X-ray imaging (<10 arcsec FWHM) and broad spectral coverage (0.1-150 keV) with an effective area far superior to current facilities (including XMM-Newton and NuSTAR) to enable revolutionary new insights into a variety of important astrophysical problems. Distinguishing coronal geometries in stellar mass black hole observations is essential to understanding the physics that occur in the inner accretion flow as well as recognizing the degeneracies of black hole spin, mass, and inclination. Evidence for preferential coronal orientations have been recently reported using polarimetry, but so far no instrument has been able to discern them from energy spectra alone. We present simulations of the next-generation HEX-P mission covering the 0.1—150 keV energy range with the general relativistic ray tracing code kerrC. This code allows us to simulate spectra for 68,040 black hole, accretion disk, and corona configurations for the HEX-P instrument. We identify spectral differences in the >100 keV energy band corresponding to cone, wedge, and truncated disk geometries that can only be obtained with this new all-purpose X-ray observatory. More information on HEX-P, including the full team list, is available at hexp.org.

kerrC

- Fitting model based on over 68,040 black hole, accretion flow, and corona configurations
- Replaces the lamppost corona hypothesis with customizable spatially extended coronae



(Krawczynski & Beheshtipour 2022)

Do you have ideas for how HEX-P would revolutionize your science? Get in touch!

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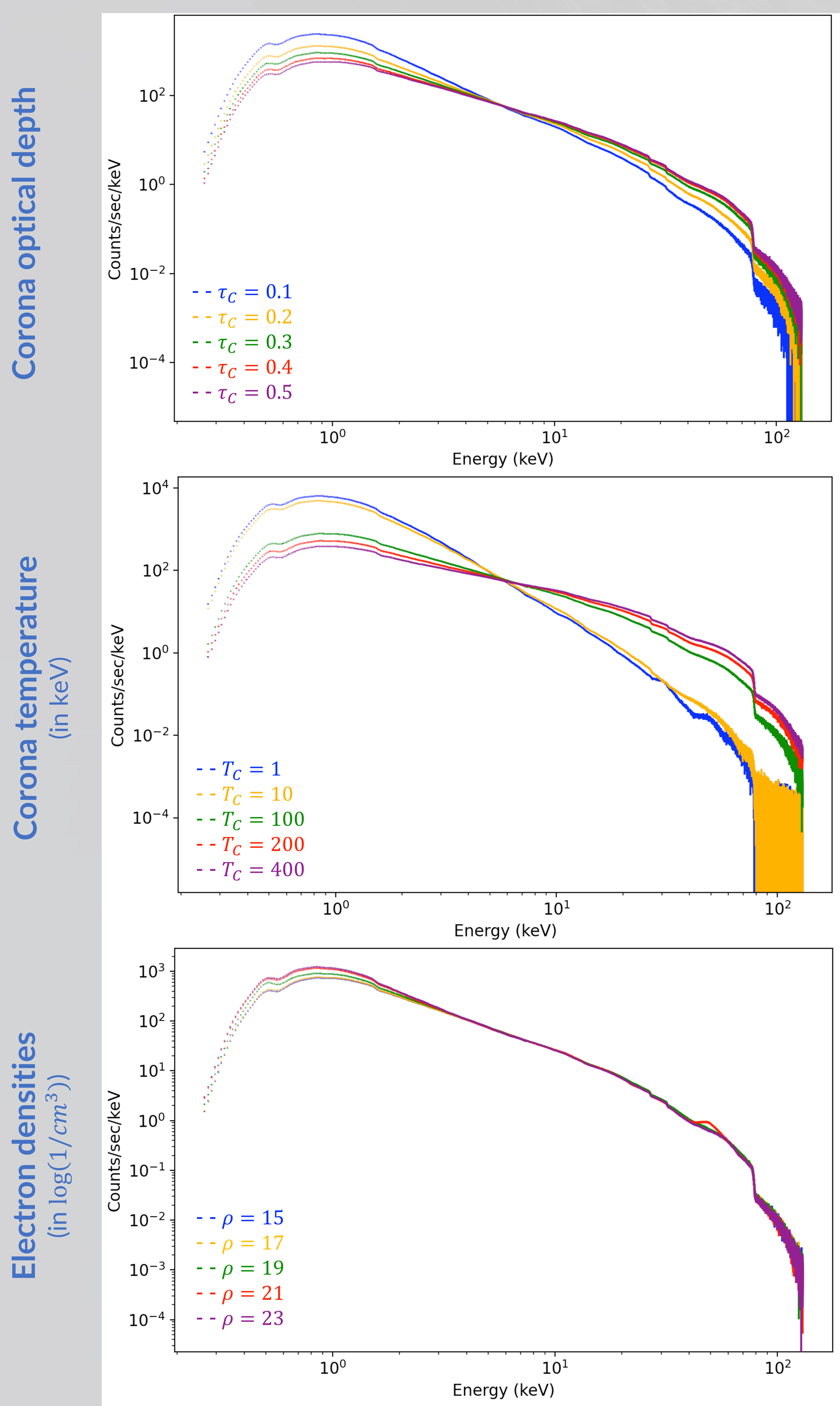
Broad energy coverage and high resolution

- The high energy resolution of HEX-P over a wide energy range will allows us to better constrain properties of black hole coronal plasma
- Enables us to constrain properties of the inner accretion flow seen in thermal, coronal, and reflected emission



Corona geometries

- HEX-P could measure significant differences in spectral parameters to help identify the geometry of the corona

Predicted Parameter	Wedge-shaped	Cone-shaped	T-score
Mass accretion rate	0.019387 +/- 0.000031	0.0216 +/- 0.0001	20.8213
Spin	0.99647 +/- 0.00015	0.98186 +/- 0.00083	17.3580
Photon Index	1.65367 +/- 0.00011	1.62368 +/- 0.00021	128.8961
Power-law norm	2.13634 +/- 0.00045	2.04731 +/- 0.00099	80.7203

- 1,000 simulated* 300 ksec HEX-P observations for low and high energy instruments

*Models based on NuSTAR 4070201700#(2,4,6) and NICER 510032010#(1-10) observations of Cygnus X-1 in the low hard state

HEX-P

- Enable detailed studies of coronal emission in the high X-ray bands
- Probe absorption and reflection properties in the soft X-rays bands
- Discern corona geometries from spectral measurements of black hole X-ray binaries

Future Work

- Additional spectra simulations for sources in the high soft and intermediate states
- Incorporate the truncated disk hot inner-flow corona model

HEX-P
HIGH ENERGY X-RAY PROBE

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