

Unified CLUMPY X-ray model for the obscurer of AGN

Authors: Johannes Buchner, Murray Brightman, Kirpal Nandra, Franz E. Bauer, Robert Nikutta

Idea:

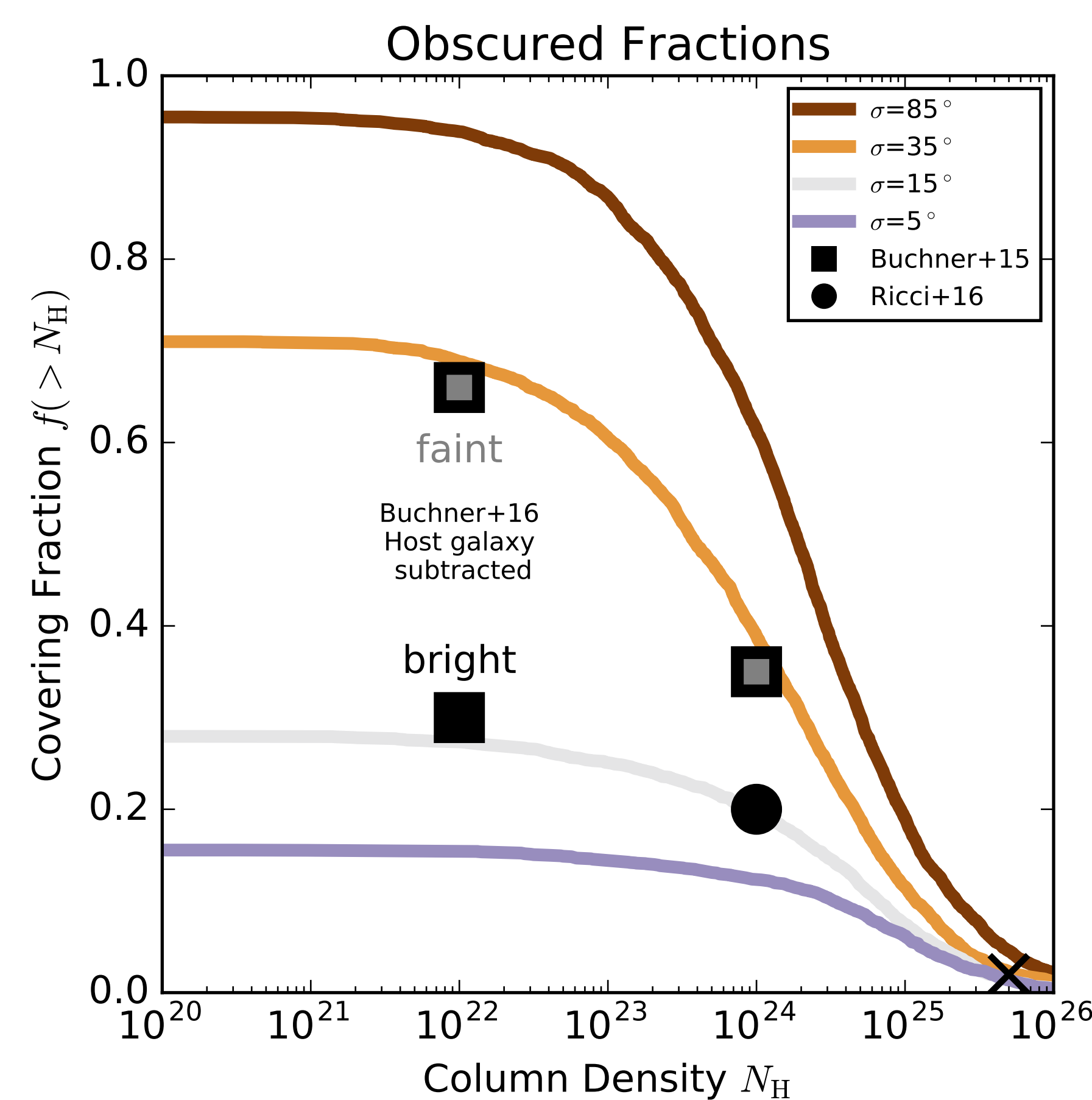
Develop X-ray spectral models of the obscurer (torus) of Active Galactic Nuclei (AGN), which fulfill the following known **constraints**:

- Unification:** Obscured / Compton-thick fractions of the AGN population should be predicted correctly. →
- Cloud eclipse events:** Clouds should be of the right size and distance so that the frequency of eclipses is reproduced. → →
- Augment existing infrared **CLUMPY** models (Nenkova+08): Vertical Gaussian distribution with std σ .

Irradiation of clumpy model with new Monte Carlo code XARS.

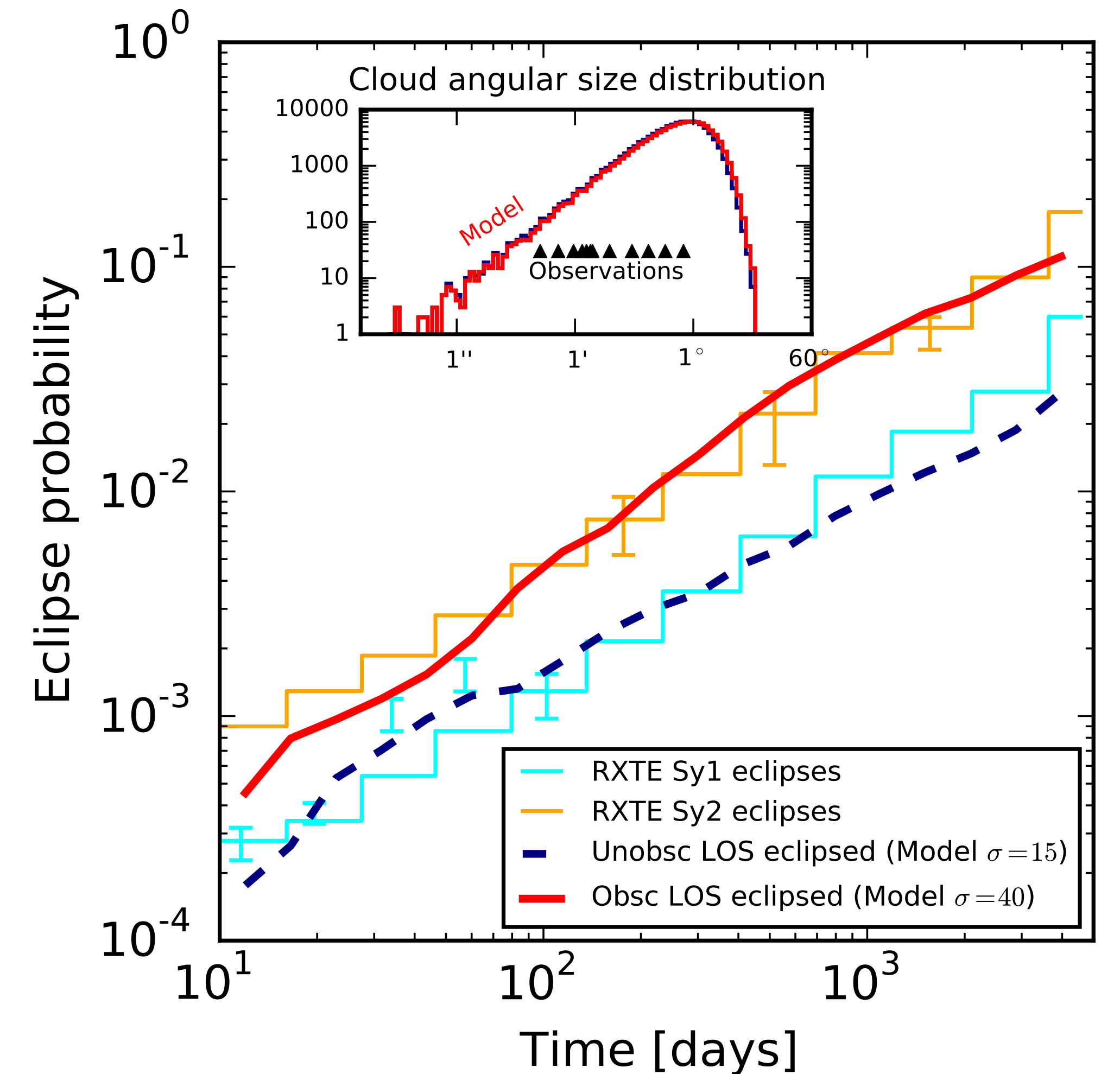
1. Reproduce obscured/CTK fractions

The model is required to reproduce the intrinsic N_H distribution of AGN population.



Survey results have had their host-galaxy obscuration subtracted (Buchner+17b).

2. Reproduce Cloud eclipse events

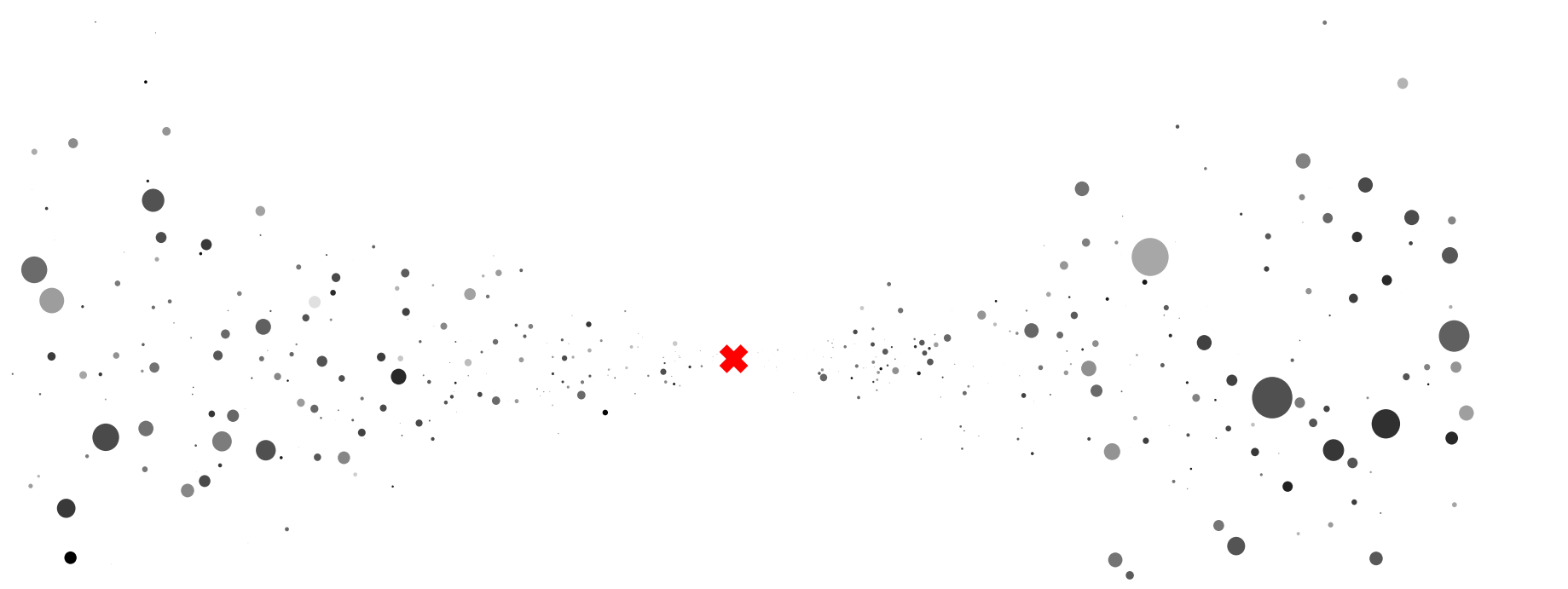


Model reproduces eclipse events (Markowitz+14), with clouds placed on circular Keplerian orbits.

Results:

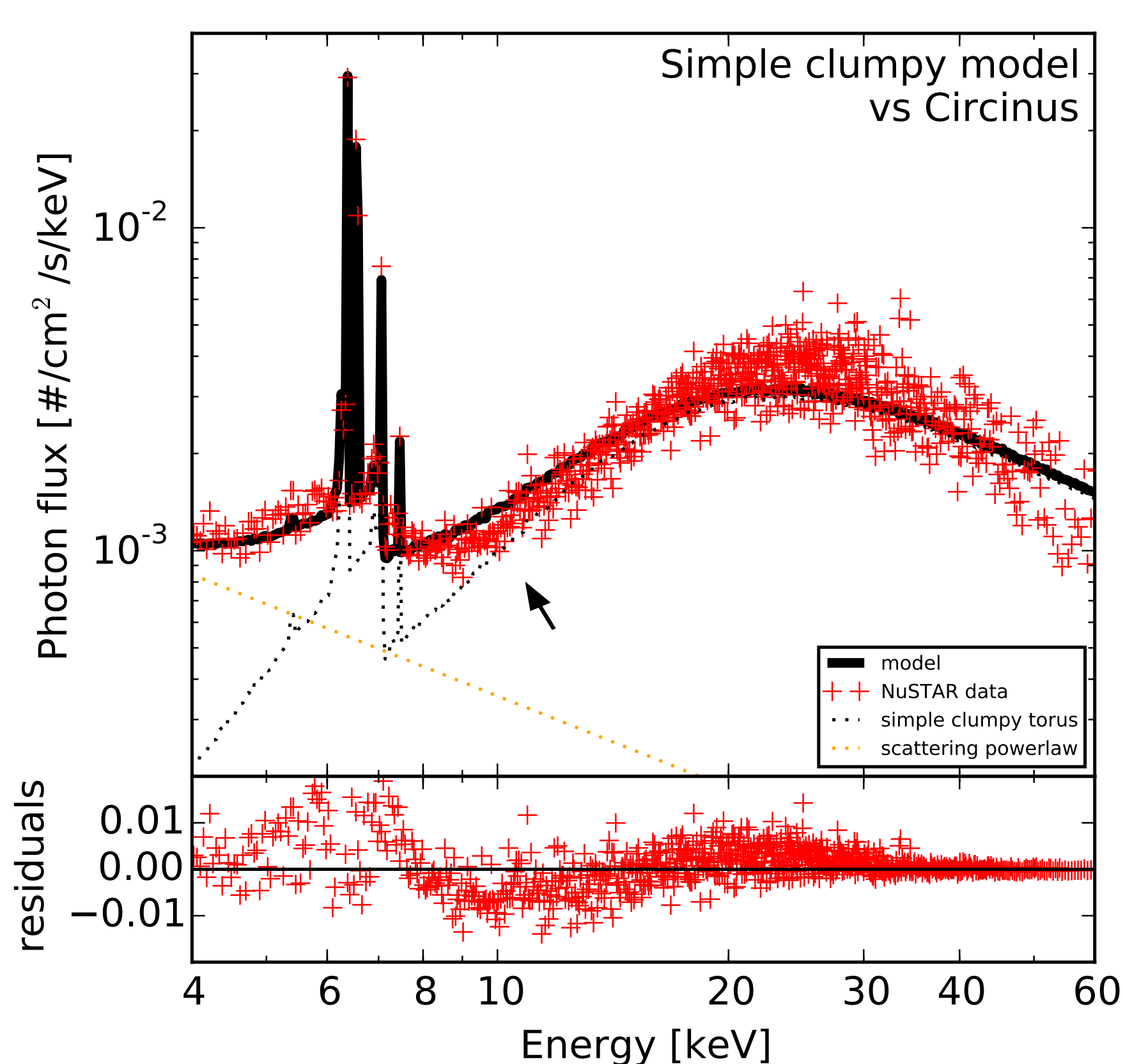
Model Geometry

Cross-section through the $\sigma = 15^\circ$ model with $N_{\text{clouds}} = 100000$, $Y = 100$. Watch the fly-through video at <https://vimeo.com/218031864>



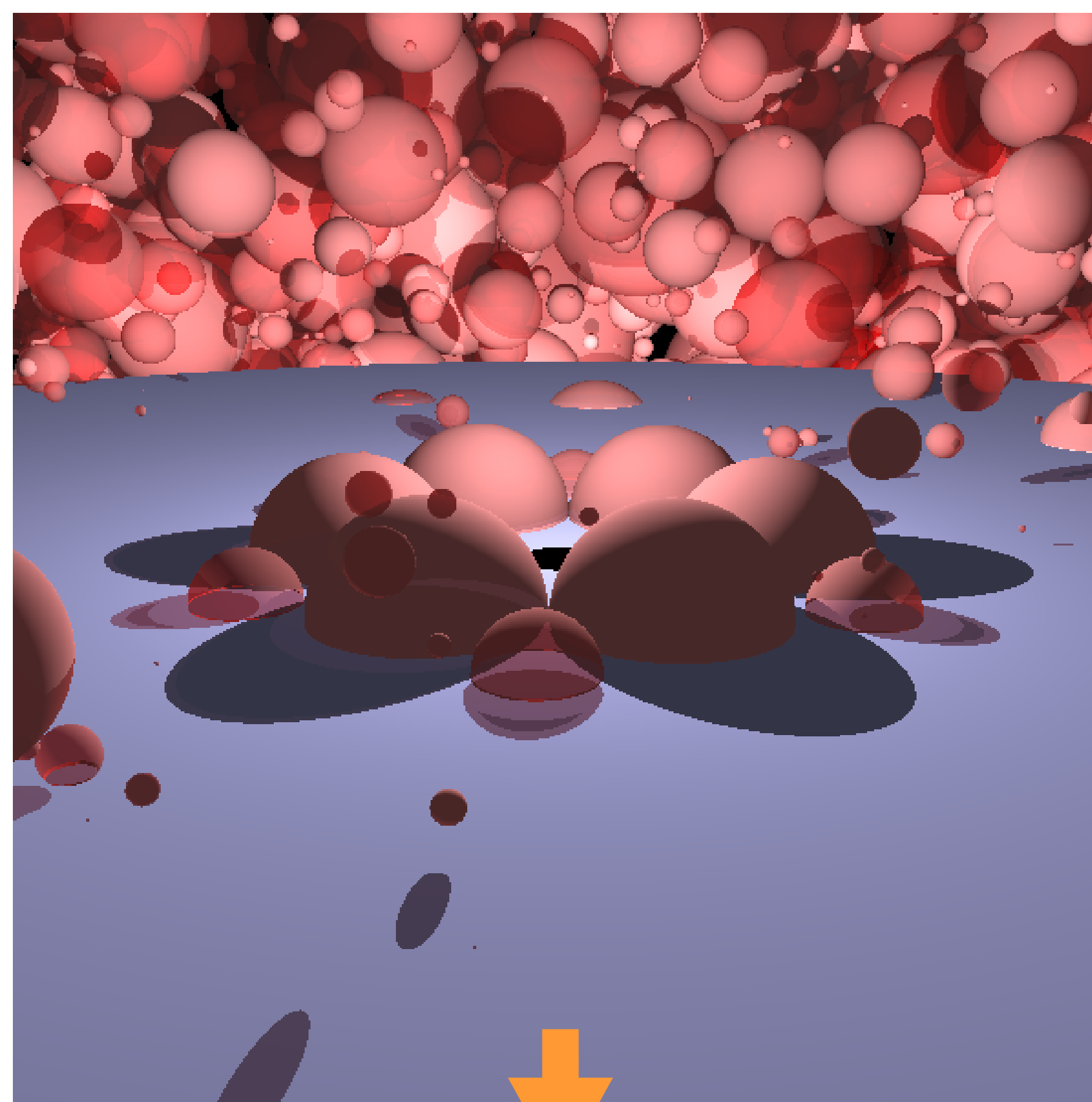
The problem

Mismatch to Circinus NuSTAR data at 8-15keV. The low- N_H clouds make a low-energy Compton hump. \Rightarrow Need high-column reflector close to corona!

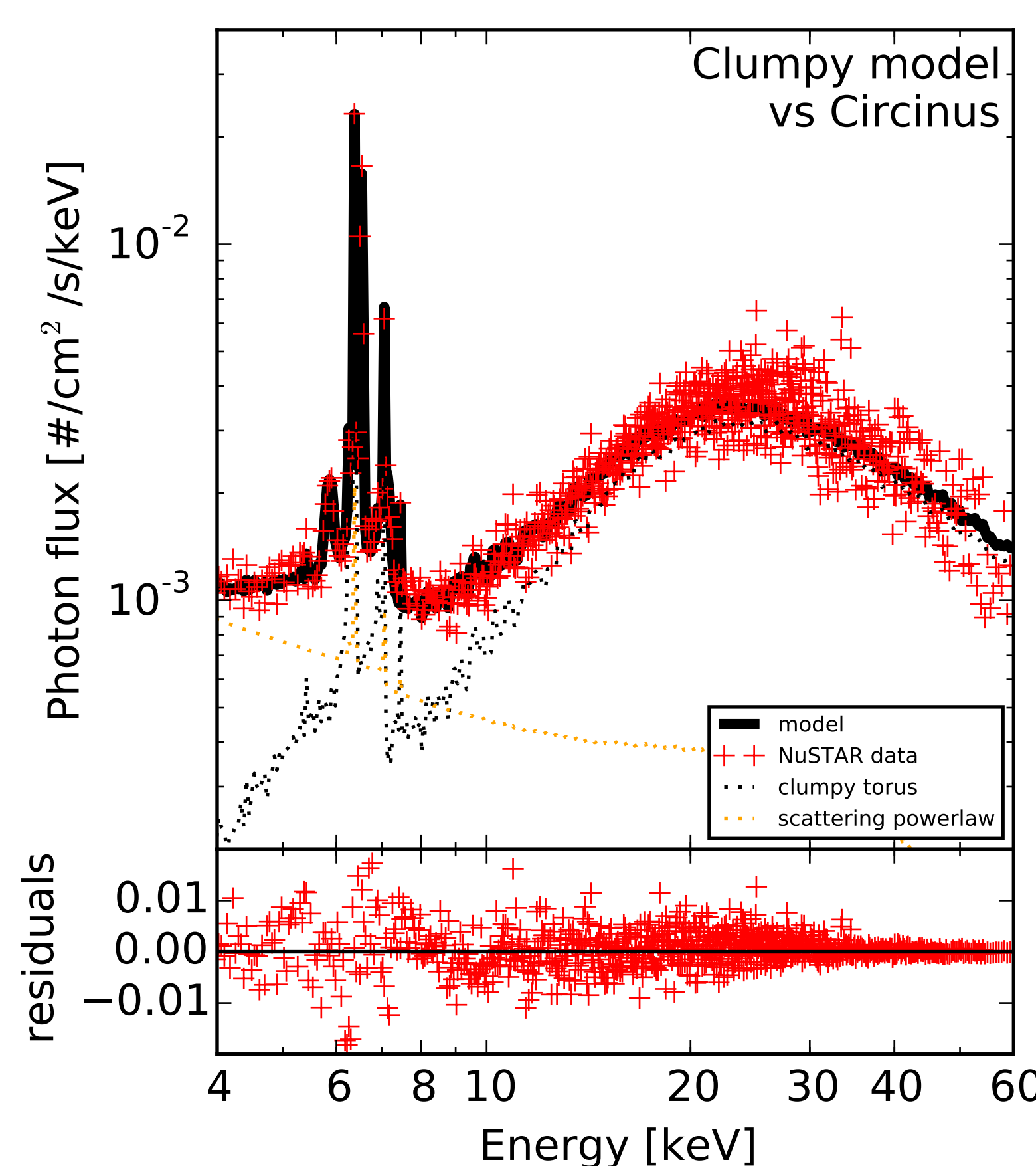


Modified model, with inner torus wall

Inserted a Compton-thick, inner torus wall.

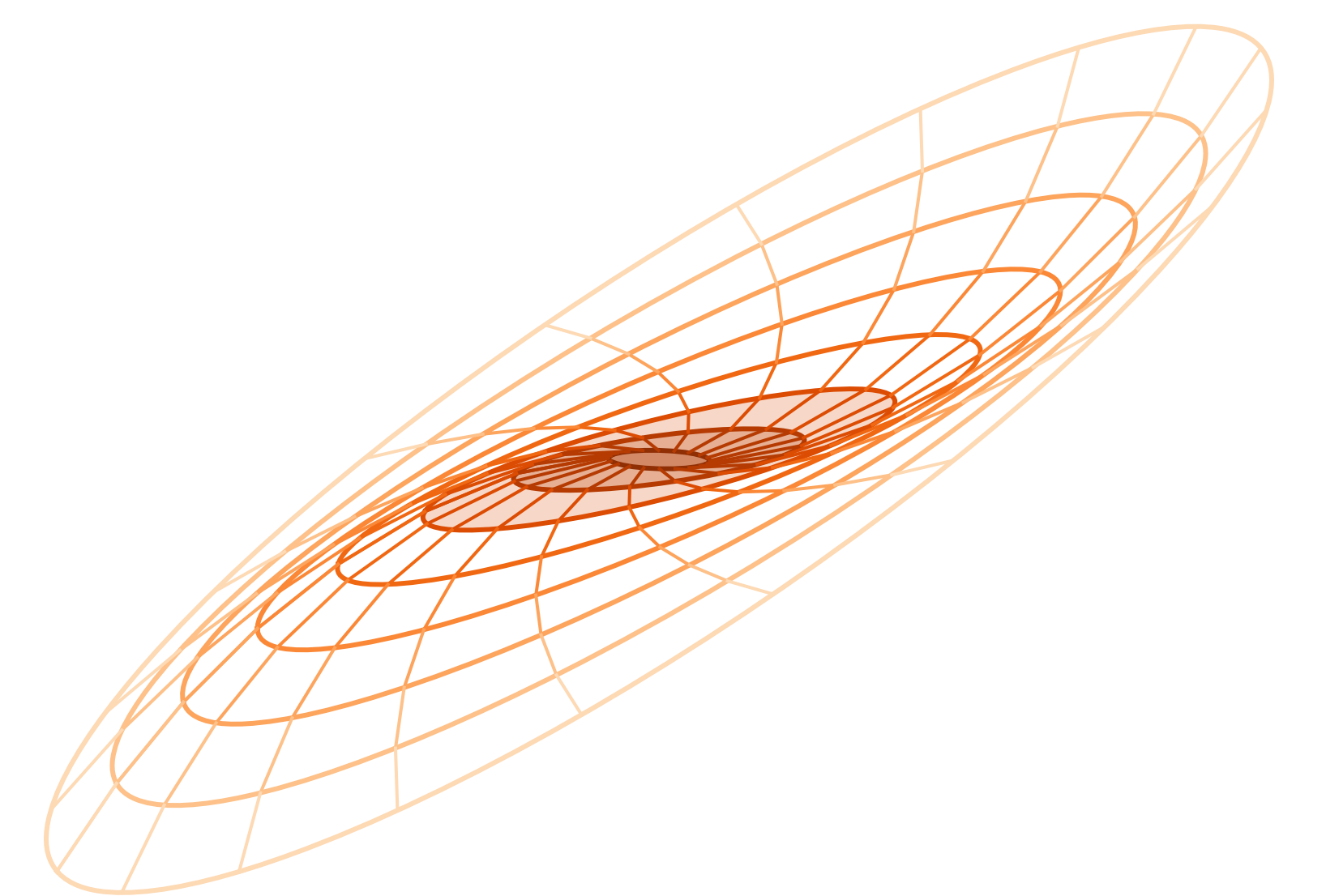


The problem resolved



Alternative CTK reflector

Warped CTK (maser) disks are known to exist in AGN, including Circinus. When simulating this geometry, the discrepancy is also resolved.



Summary:

- New, fast, open-source X-ray Monte Carlo Code: XARS.
- New unified clumpy model, XSPEC tables released publicly. Benefits:
 - Reproduces obscured & CTK fractions of the AGN population.
 - Reproduces eclipse events.
 - Separate parameters for covering (σ), viewing angle and LOS N_H . Meaningful fits on variable N_H !
 - Self-consistent computation of Compton scattering, line fluorescence and absorption. Can learn about geometry of sources.
- New CTK inner torus wall reflector detected in multiple obscured AGN.