Unified CLUMPY X-ray model for the obscurer of AGN

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

1. **Unification**: Obscured / Compton-thick fractions of the AGN population should be predicted correctly.
2. **Cloud eclipse events**: Clouds should be of the right size and distance so that the frequency of eclipses is reproduced.
3. **Augment existing infrared CLUMPY models** (Nenkova+08); Vertical Gaussian distribution with std $\sigma$. Irradiation of clumpy model with new Monte Carlo code XARS.

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. ⇒ Need high-column reflector close to corona!

The problem resolved
Inserted a Compton-thick, inner torus wall.

Modified model, with inner torus wall

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:
1. New, fast, open-source X-ray Monte Carlo Code: XARS.
2. New unified clumpy model, XSPEC tables released publicly. Benefits:
   - Reproduces obscured & CTK fractions of the AGN population.
   - Reproduces eclipse events.
   - Separate parameters for covering $(\sigma)$, 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.
3. New CTK inner torus wall reflector detected in multiple obscured AGN.

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