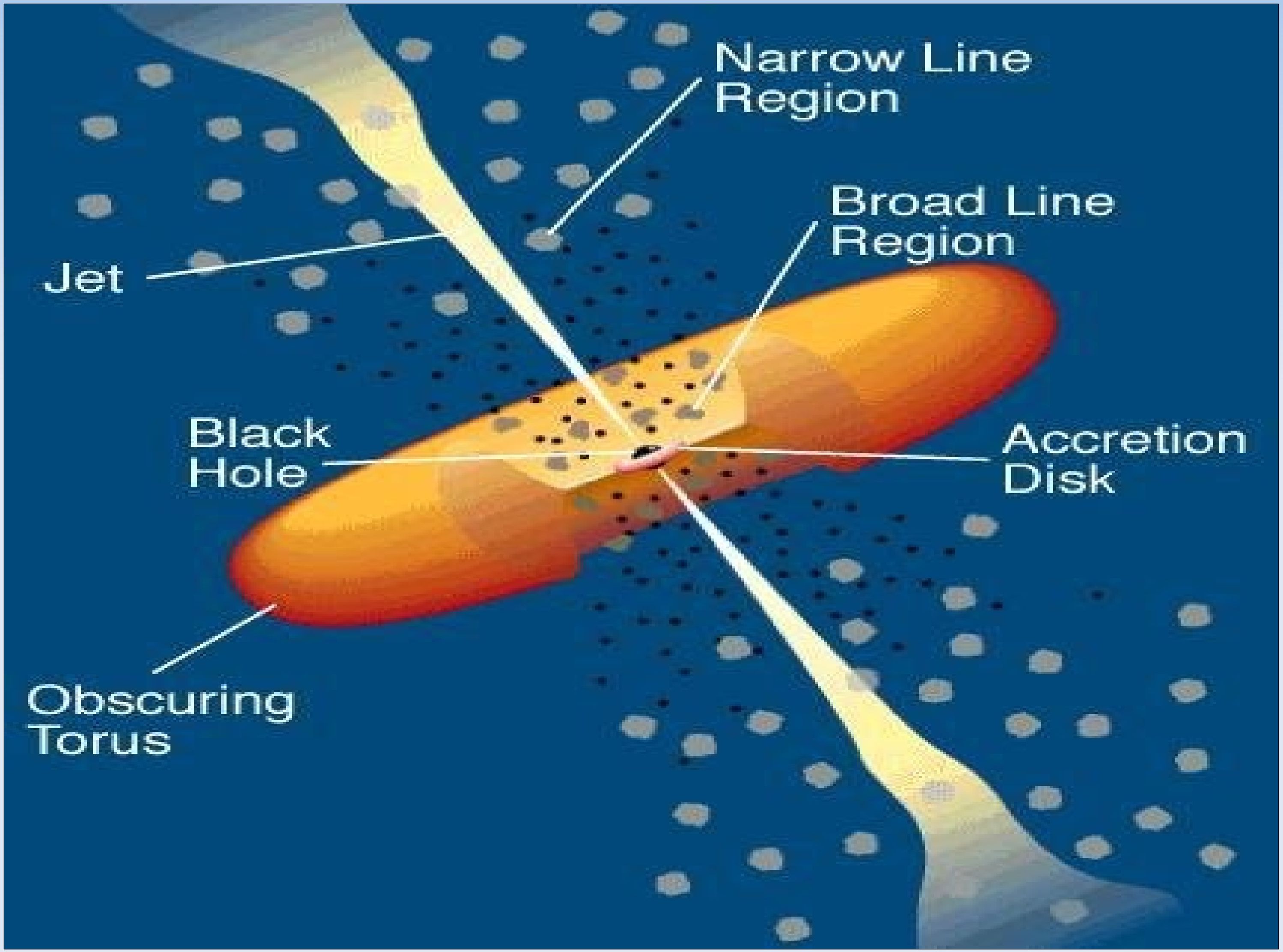
X-ray signatures of the polar dusty gas in AGN

Jiren Liu

National astronomical observatory of China

Sebastian Honig, Claudio Ricci, Stephane Paltani

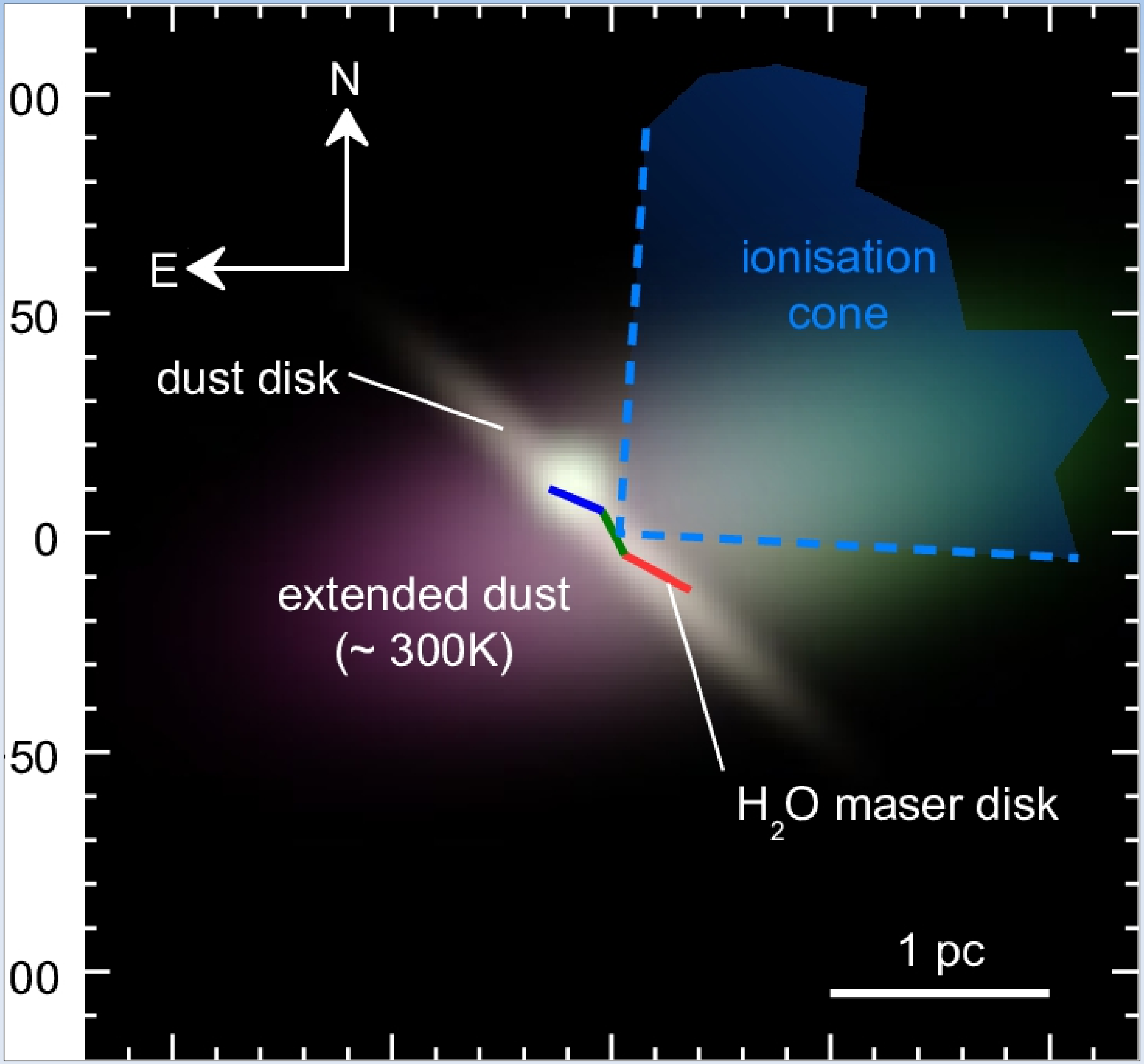
Standard unification scheme of AGN



Torus is hard to resolve spatially by current single telescope.

Urry & Padovani 1995

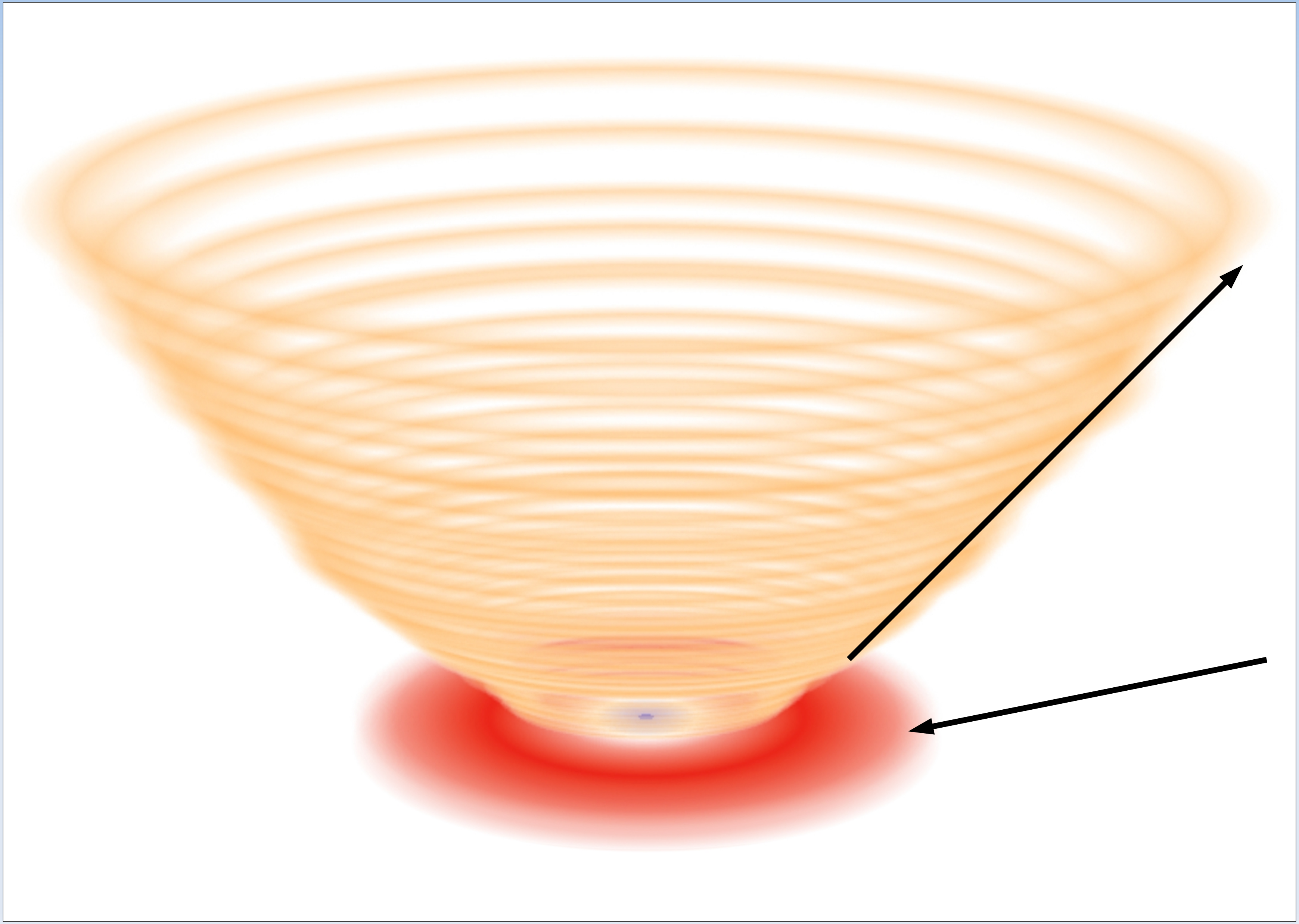
MIDI interferometry revealed a pc-scale polar component for nearby AGN



The extended polar component accounts for ~80% mid-IR emission!

Circinus galaxy, Tristram et al. 2014

Radiation-driven polar dusty wind?



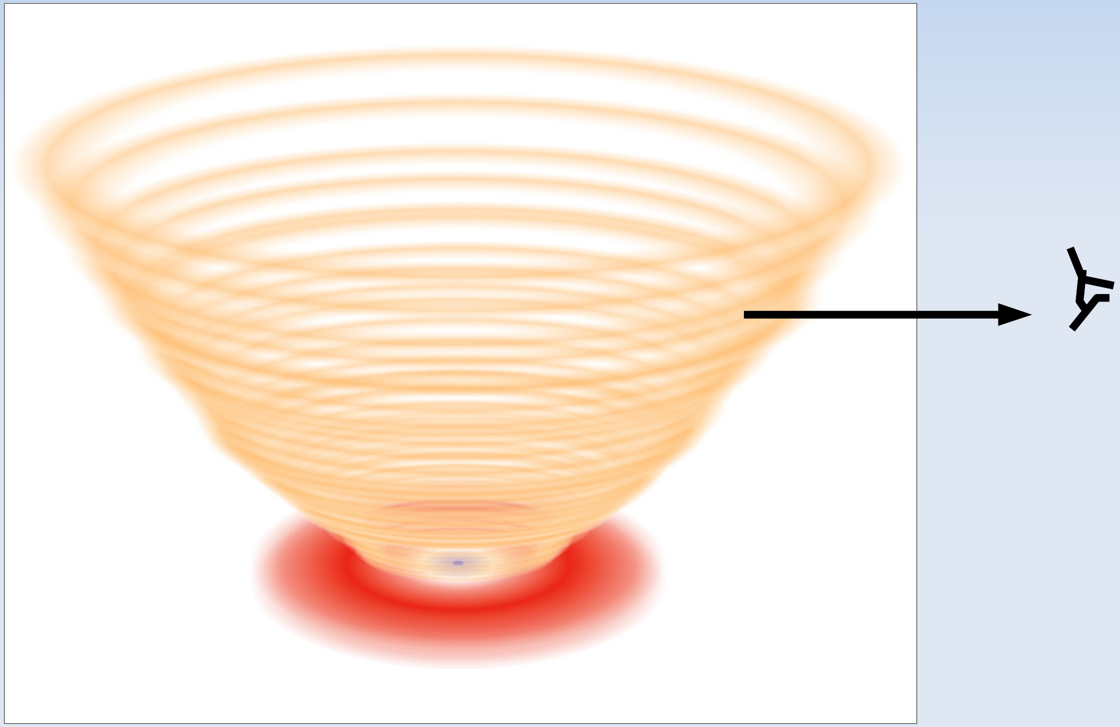
Dust opacity is high.

Honig et al. 2012

What is the X-ray signature of a polar dusty wind?

Emission of polar gas sufferes no absorption by the torus!

X-ray photons are reprocessed by dust, producing scatterred continuum and fluorescence lines, most prominent in type II AGN, the intrinsic radiation of which is heavily obscured.



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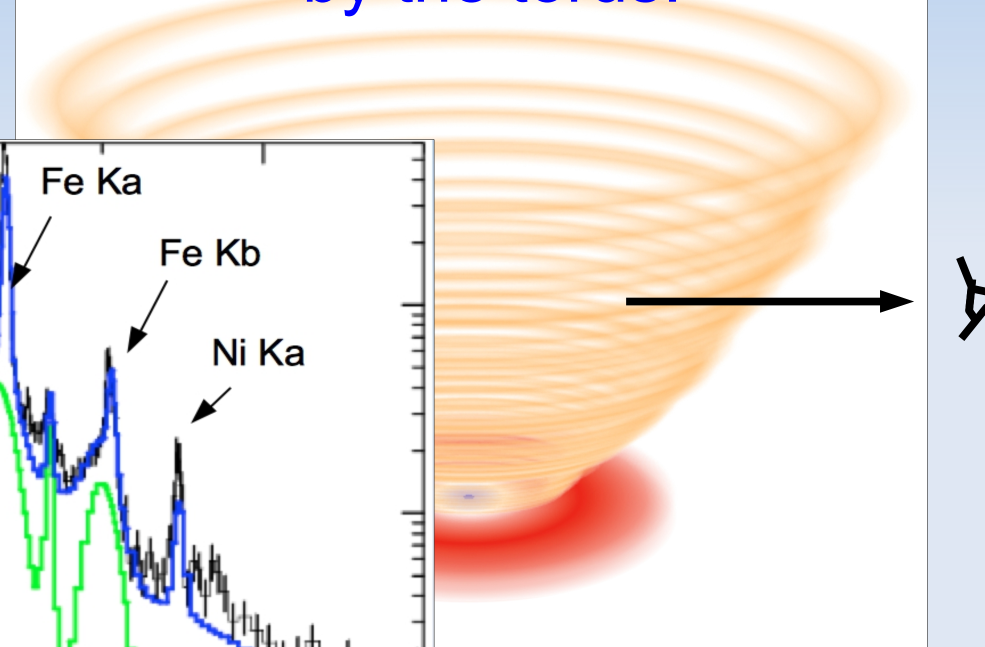
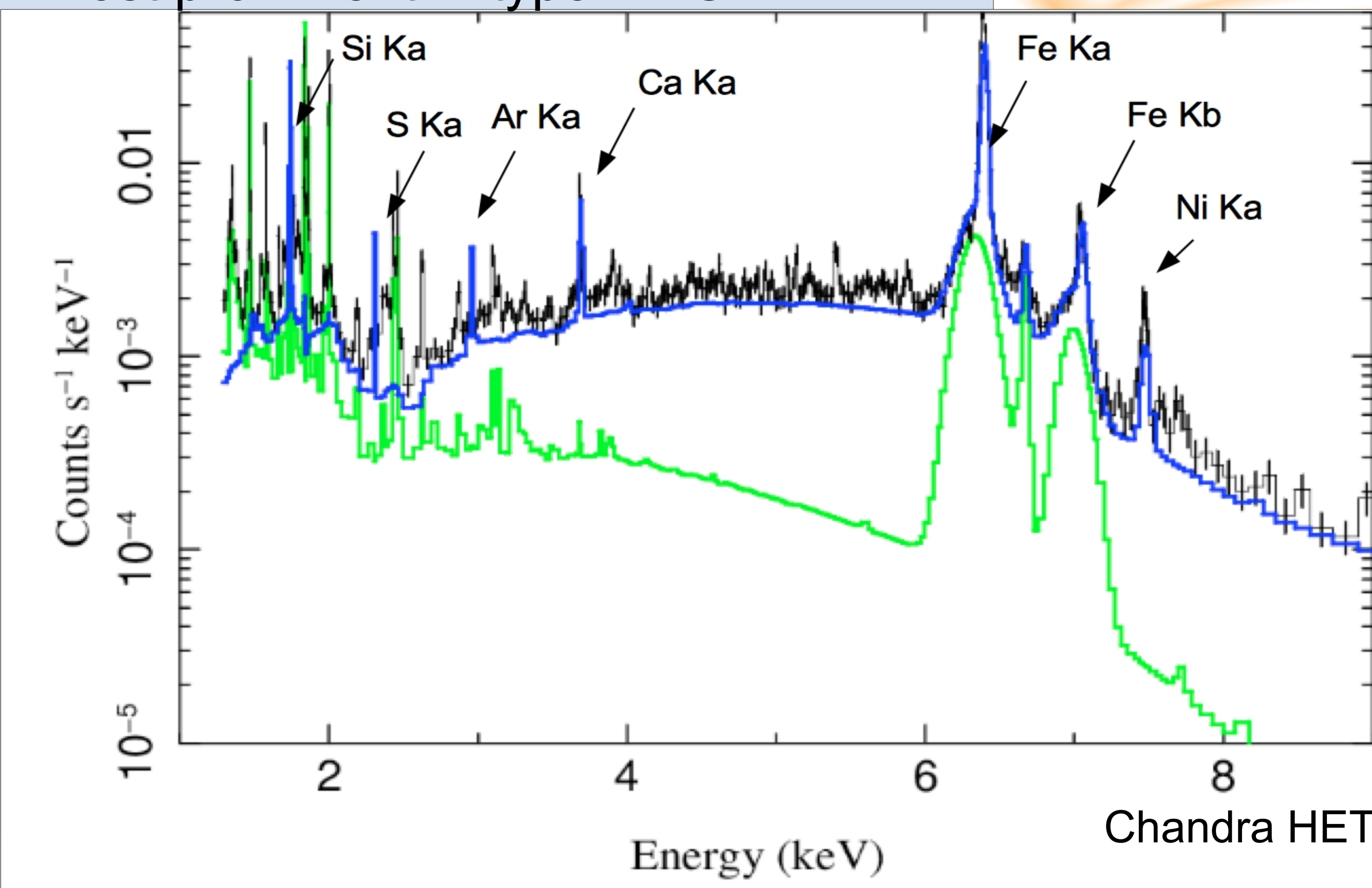
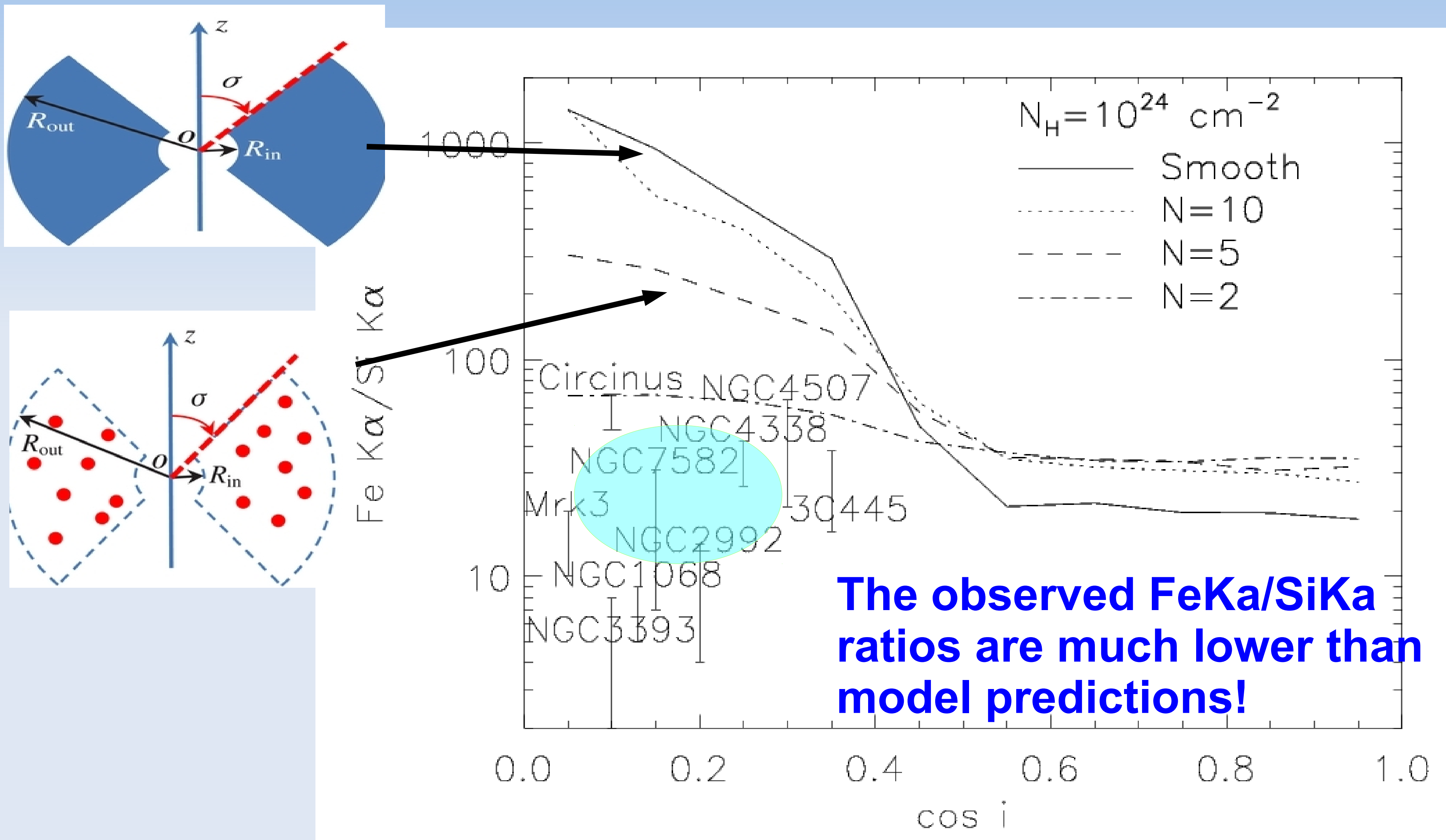




Chandra HETG spectrum of Circinus

Observational motivation: FeKa/SiKa ratio of type II AGN

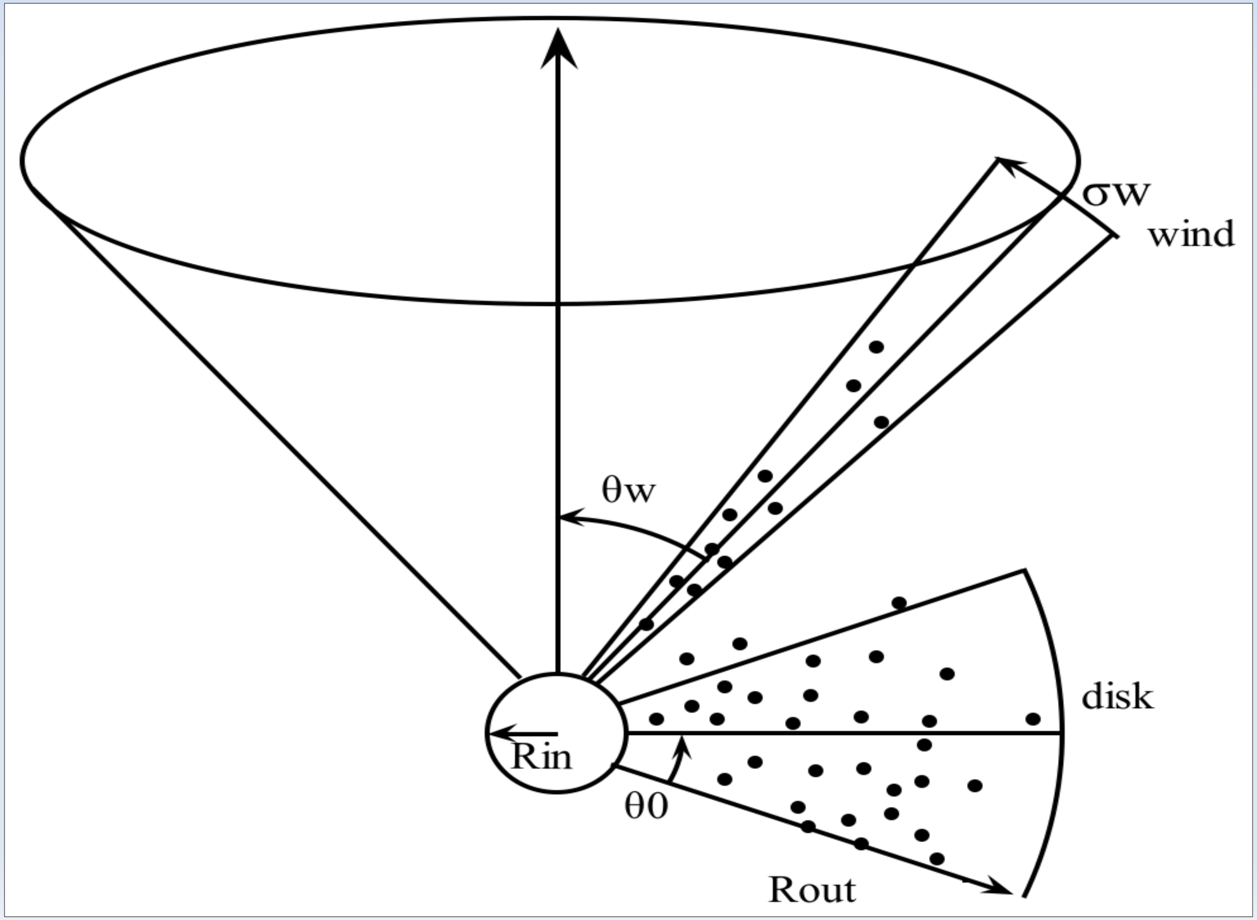


The observed FeKa/SiKa ratios are much lower than model predictions!

Liu et al. 2016

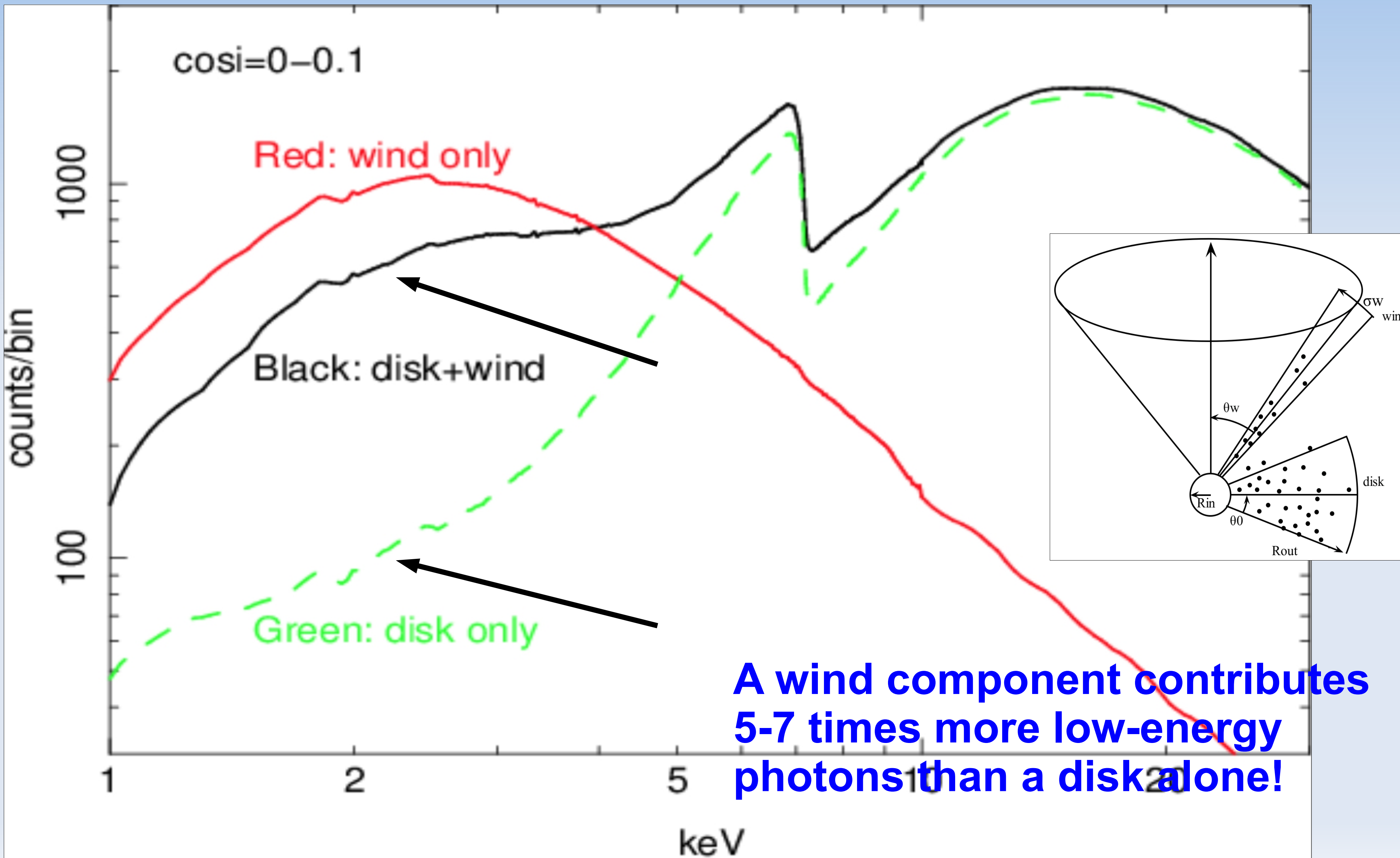
Simulation of a polar dusty wind

RefleX code: ray-tracing of X-ray photons for arbitrary geometries (Paltani & Ricci 2017)



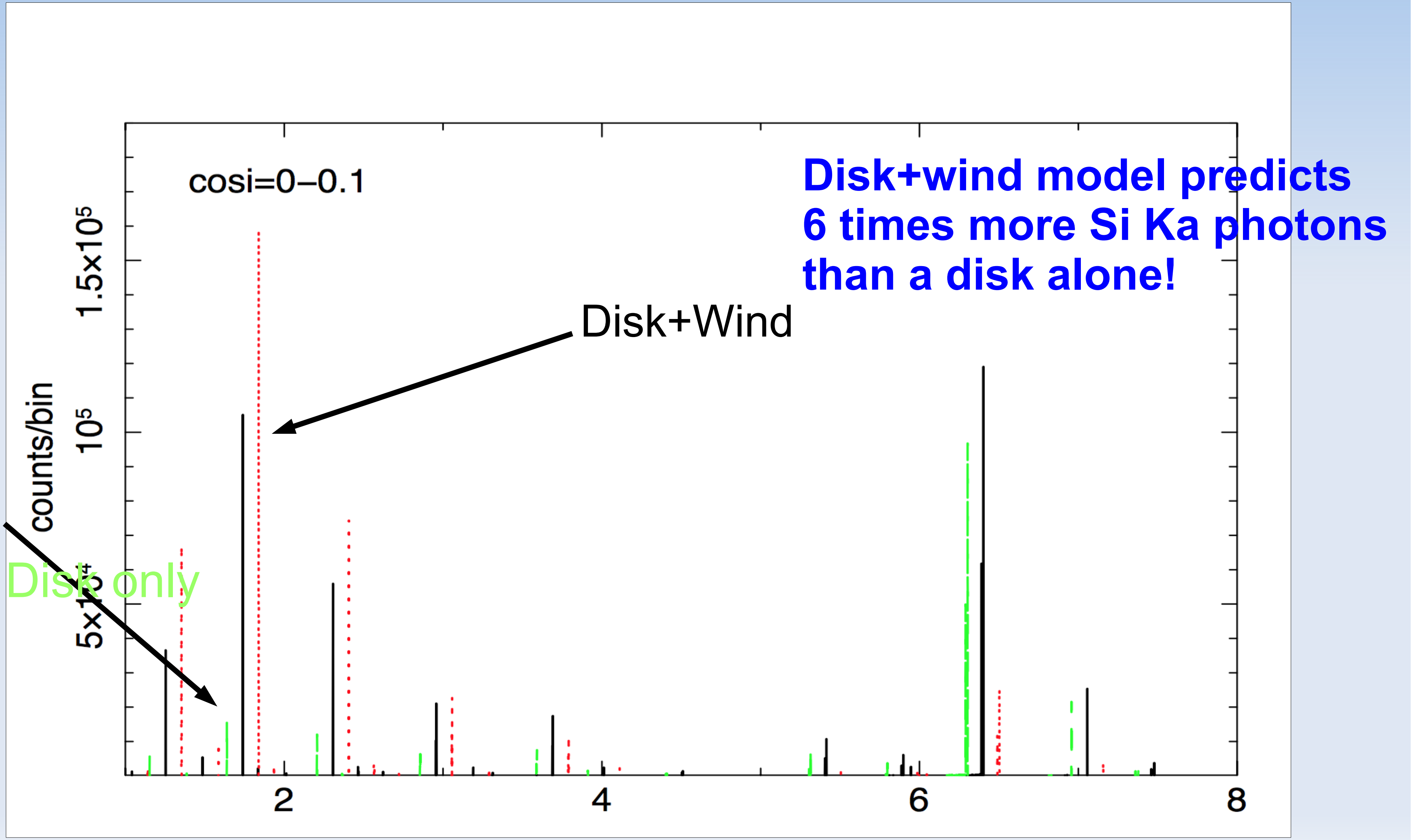
A hollow cone
$N_H=4x10^{22}cm^{-2}$
$\sigma_w=15°$
+
a disk/torus
$N_H=3x10^{24}cm^{-2}$
$\theta_0=22.5°$

Simulation results I. edge-on spectrum

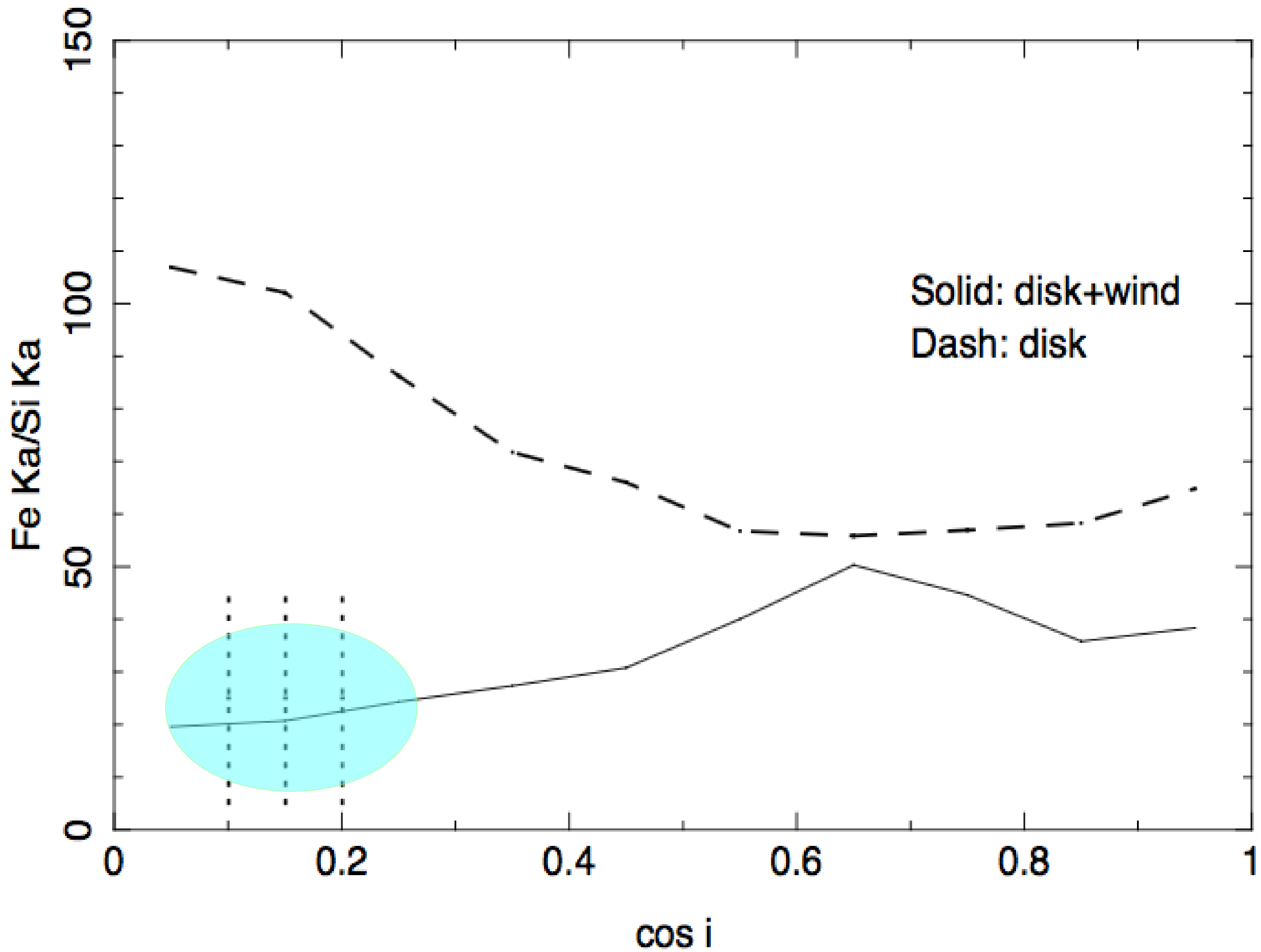


A wind component contributes 5-7 times more low-energy photons than a disk alone!

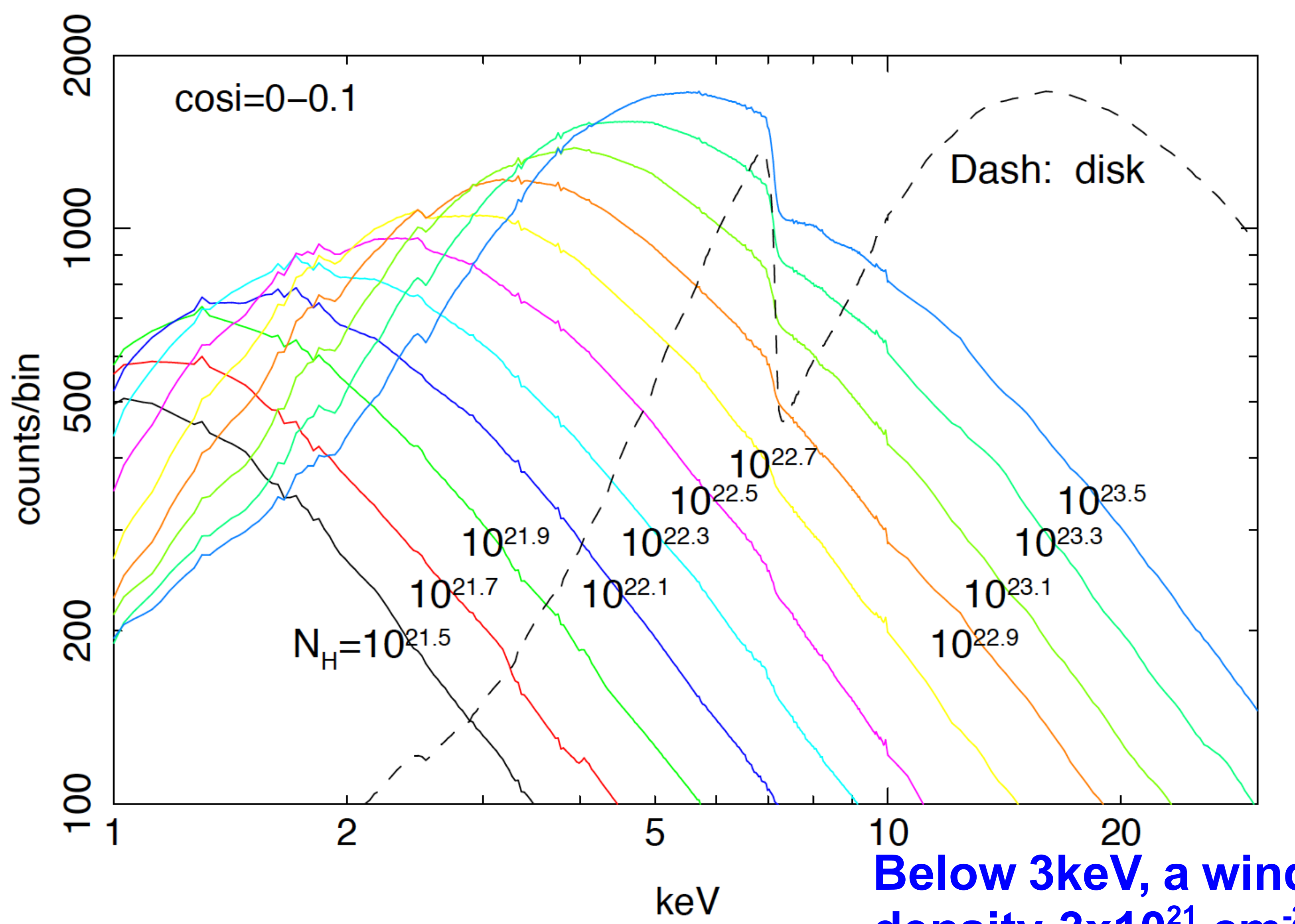
Simulation results I. Fluorescence lines



Simulation results I. FeKa/SiKa ratio



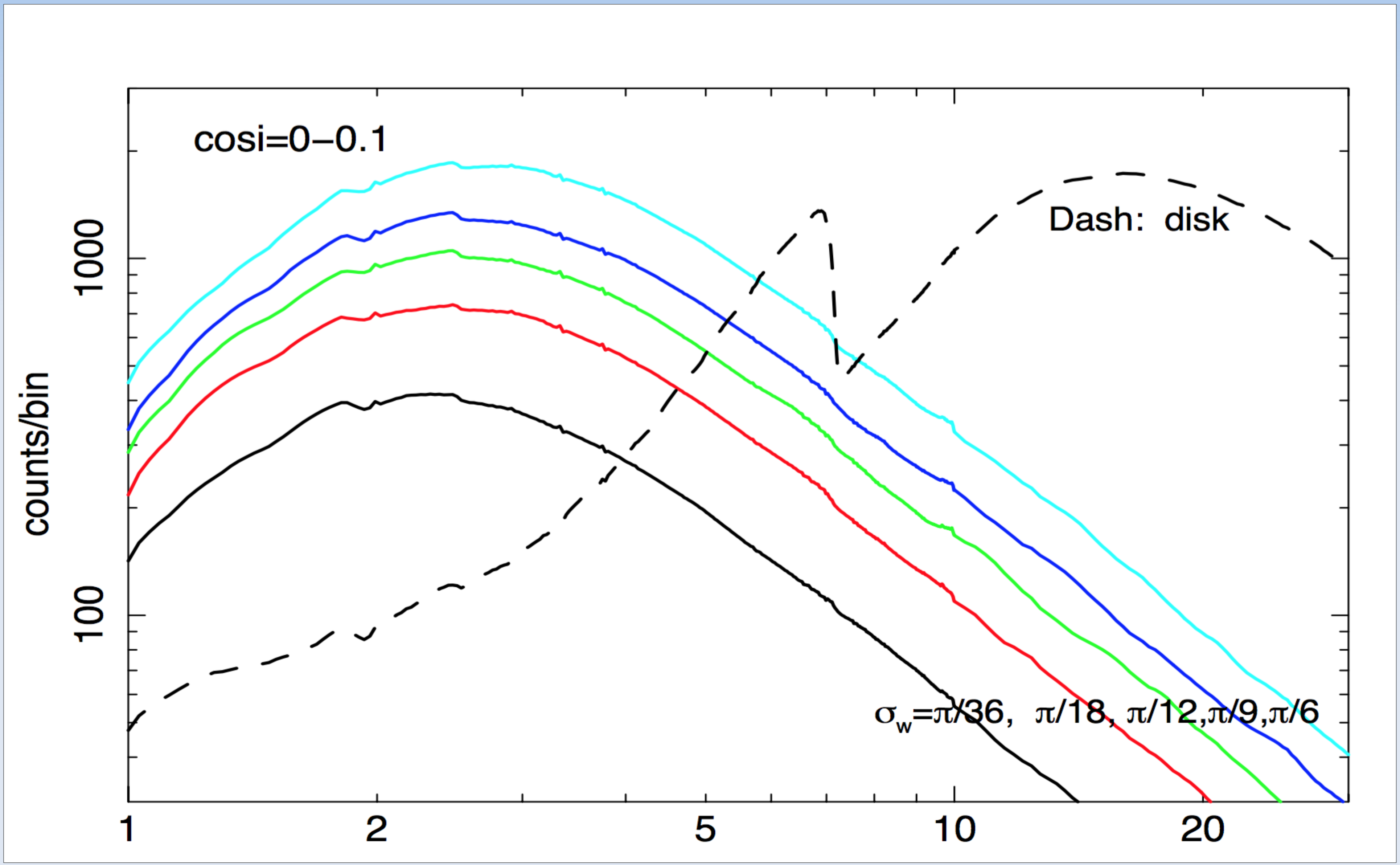
Simulation results II. para study of N_H(wind)



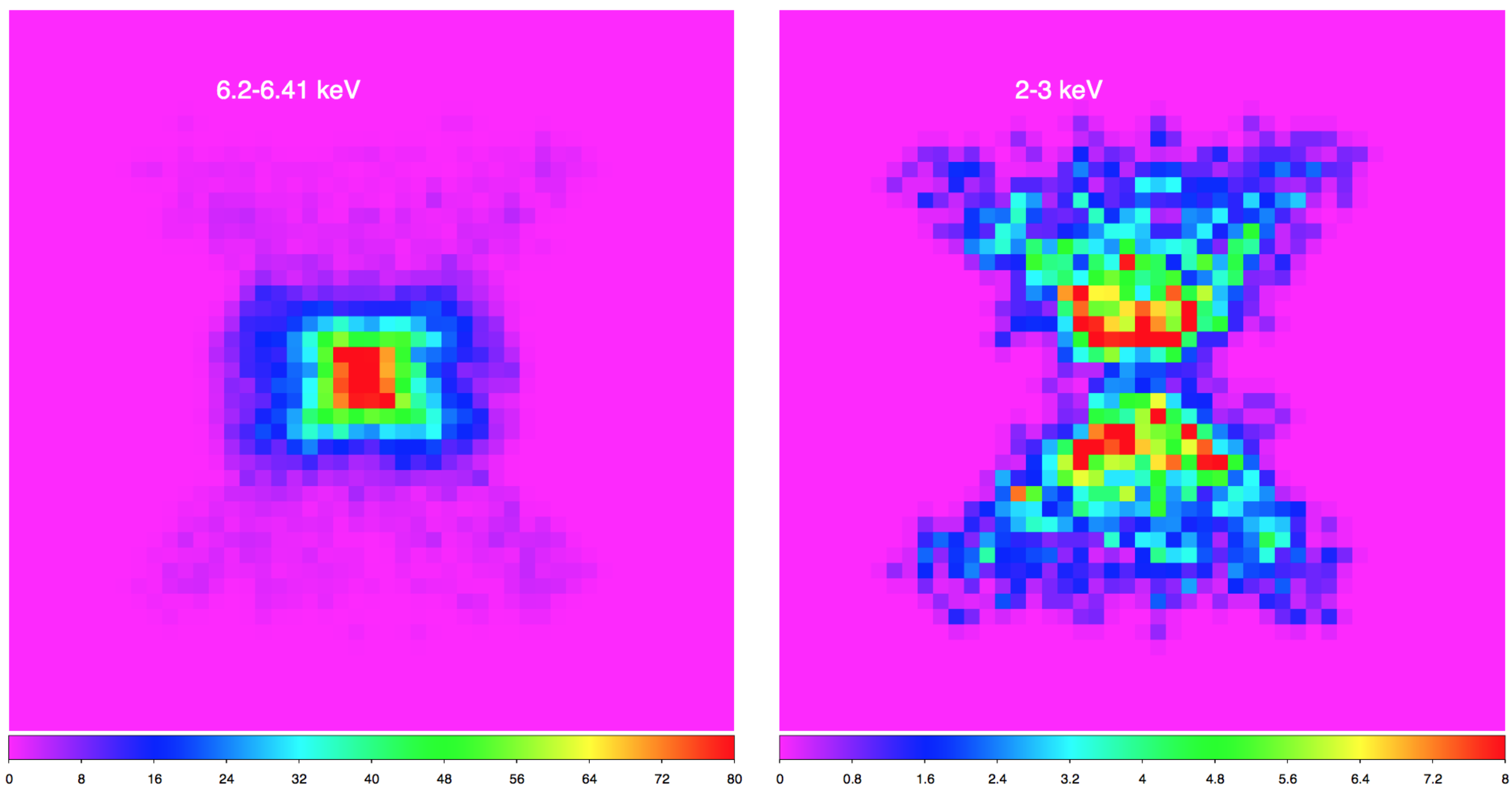
Wind only.

Below 3keV, a wind of column density 3×10^{21} cm^{-2} can dominate over the disk contribution!

Simulation results II. para study of σ_w



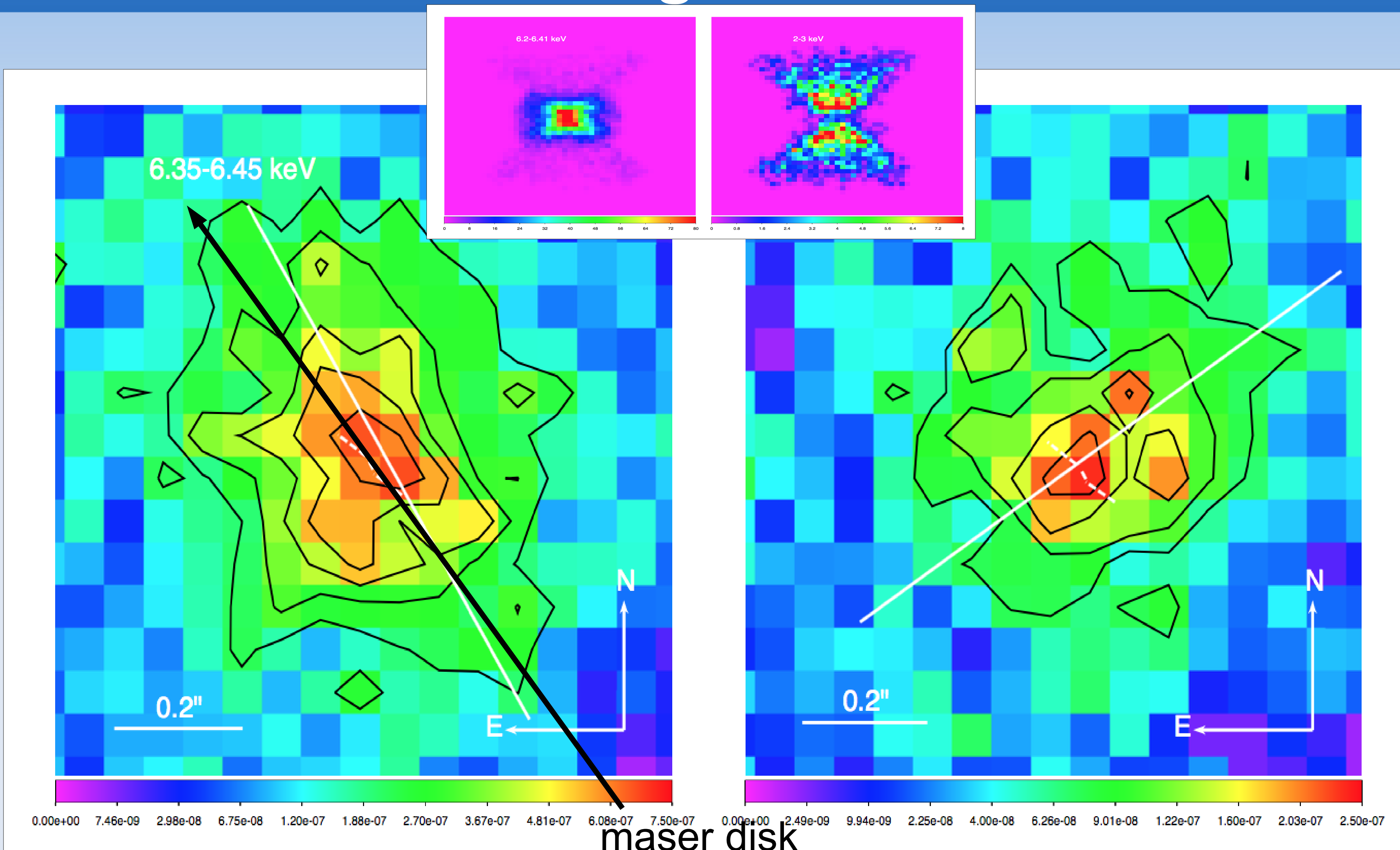
Simulation results III. morphology



6.2-6.41 keV 2-3 keV

The disk dominates the high-energy end, while the wind dominates the low-energy part.

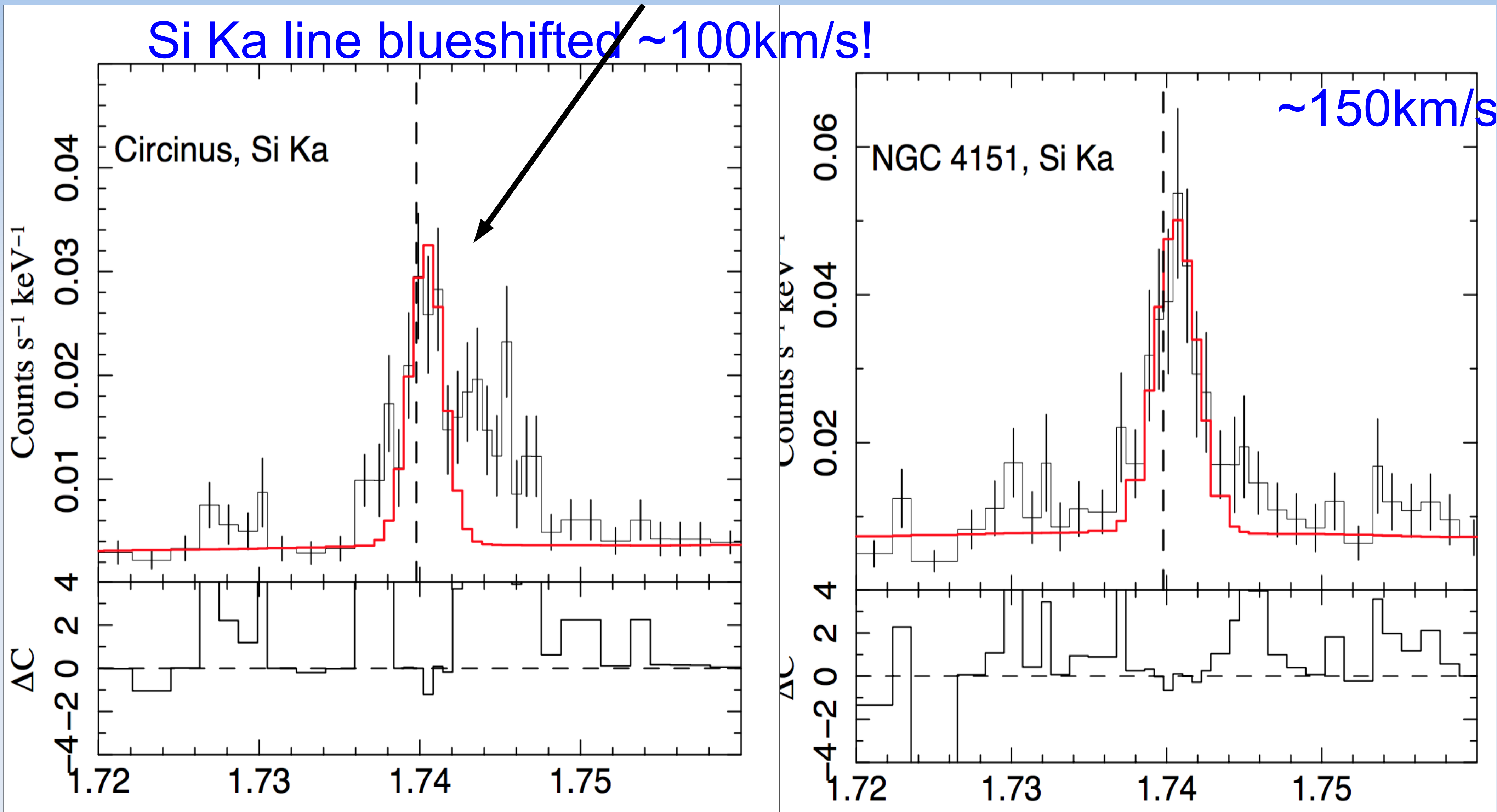
Tentative evidence of polar gas: I. Chandra image of Circinus



6.35-6.45 keV

2.5-3 keV

Tentative evidence of polar gas: II. Blueshifts of Si Ka line



Blueshifts on the level of Chandra HETG accuracy.

Summary

1. The polar dusty gas can contribute significantly to low-energy X-ray emission of type II AGN.

2. The polar gas naturally explains the observed anomalous FeKa/SiKa ratios.

3. The low-energy scattered X-ray emission is potentially a powerful probe of the polar dust.