Heavy Absorption in AGNs and Simbol-X

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Outline:

i) Type-II AGNs
ii) Semi-relativistic outflows in (RQ)AGNs

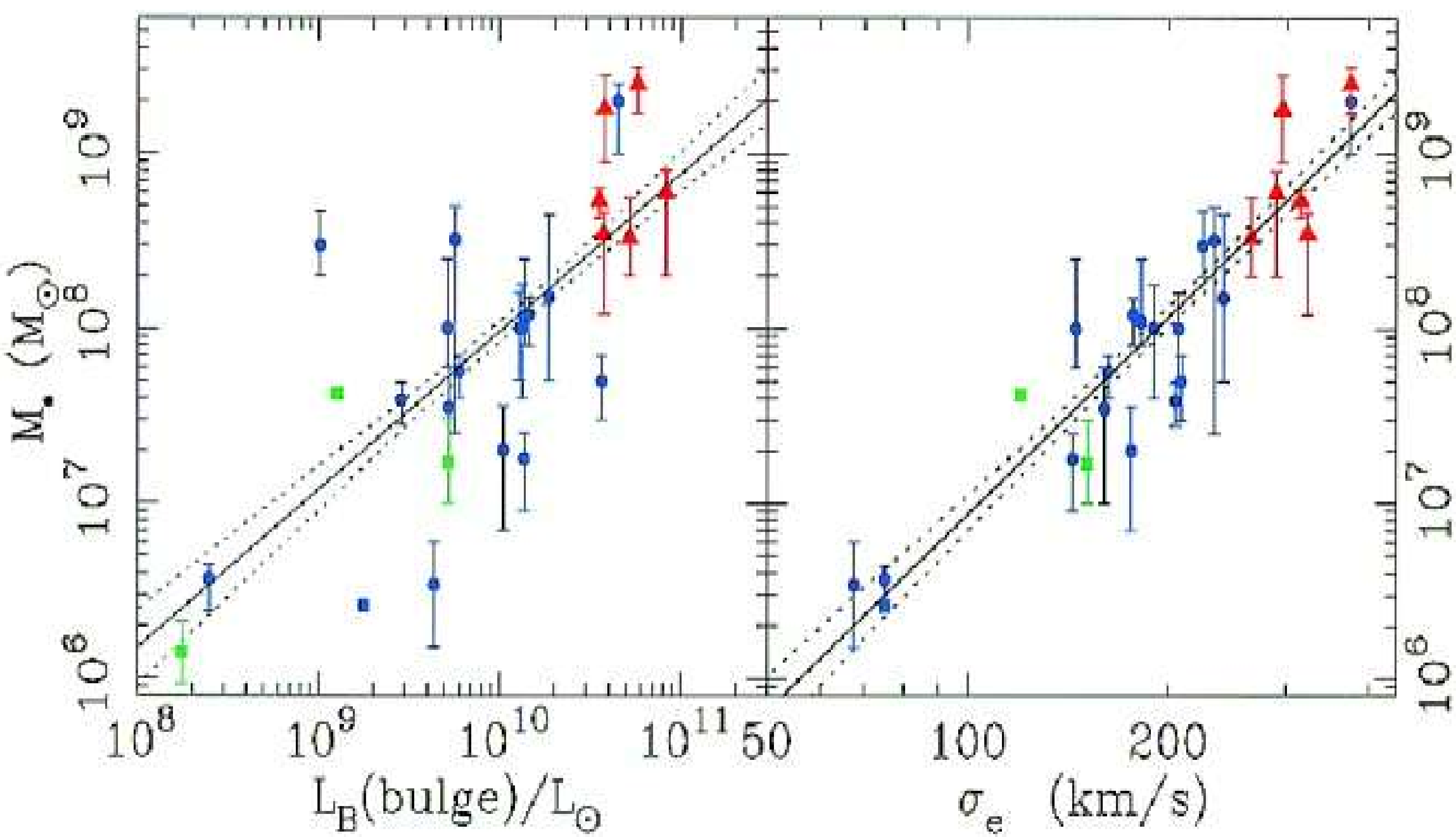
General framework

Among the most important results, in recent years, in the field of extragalactic astronomy, has been the realization that most (if not all) galaxies host a SMBH in their center; (e.g. review by Kormendy & Richstone, '95, ARAA)

The two topics of this talk address two important open issues:

i) why (only) some galaxies are active?

ii) we know there must be a fundamental link between (nuclear) SMBH and (stellar) host galaxy, but what is this link?



$\mathcal{M}_{bh} \sim 6^4$

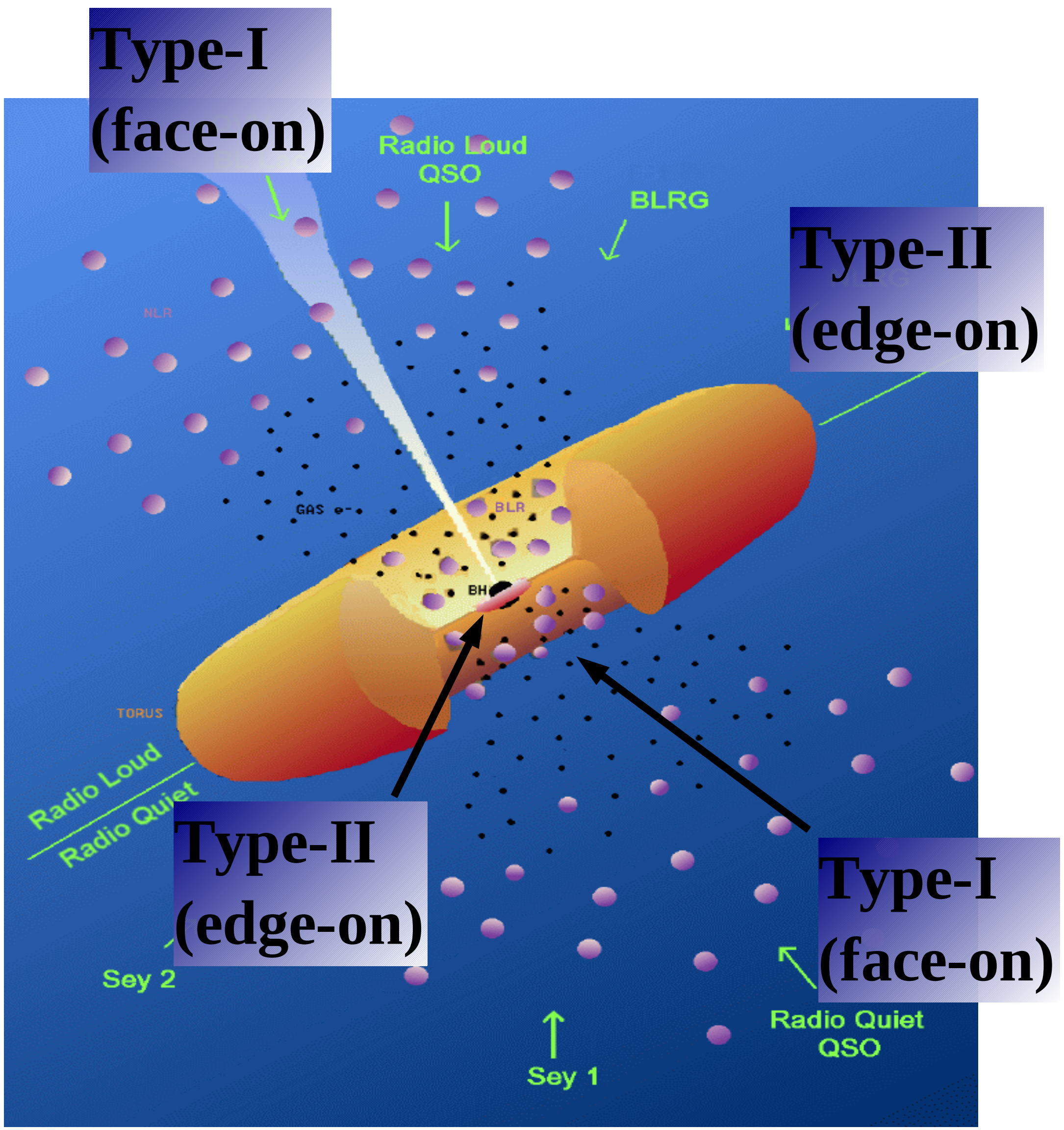
Magorrian et al. '98
Tremaine '02
Gebhardt '02
...etc

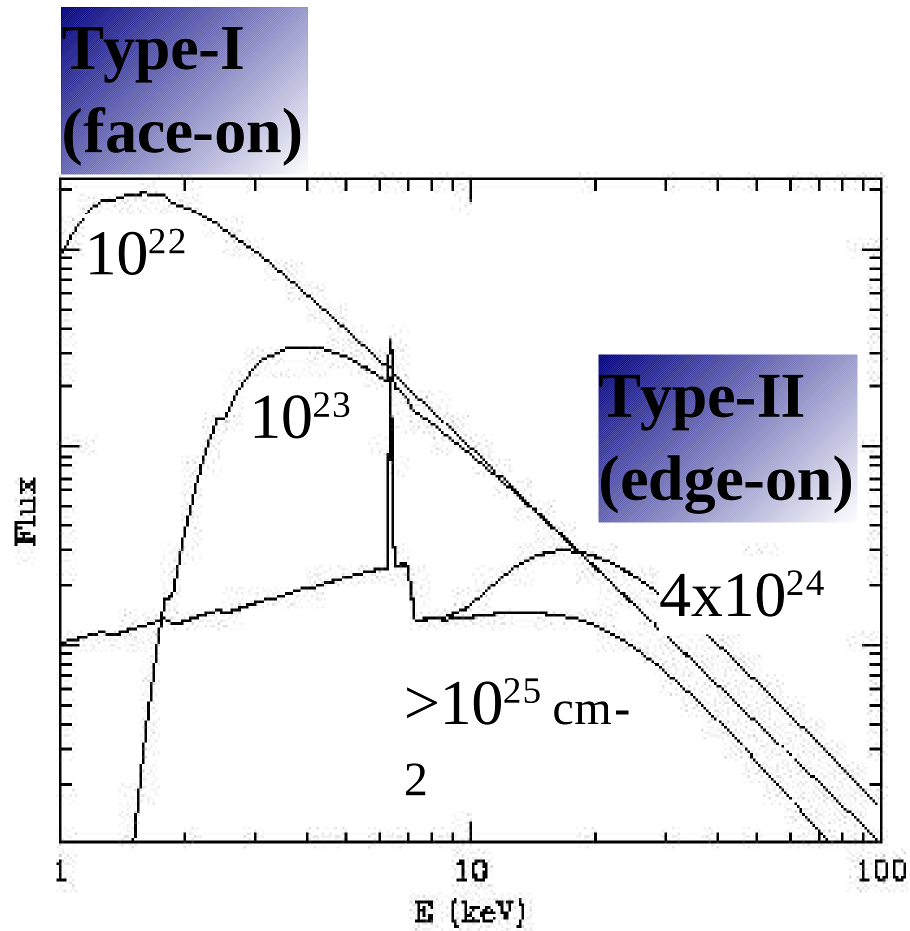
Type-II AGNs: (1/2)

Take a sample of nearby galaxies in the sky...not only they have SMBHs, but:

⟹ *>40% will show nuclear (non-stellar) activity: LINERs and Seyferts*

⟹ *$>(4/5)^{th}$ are classified as type-II (typeI/typeII=1/4) ! (Ho et al. '99,'00)*



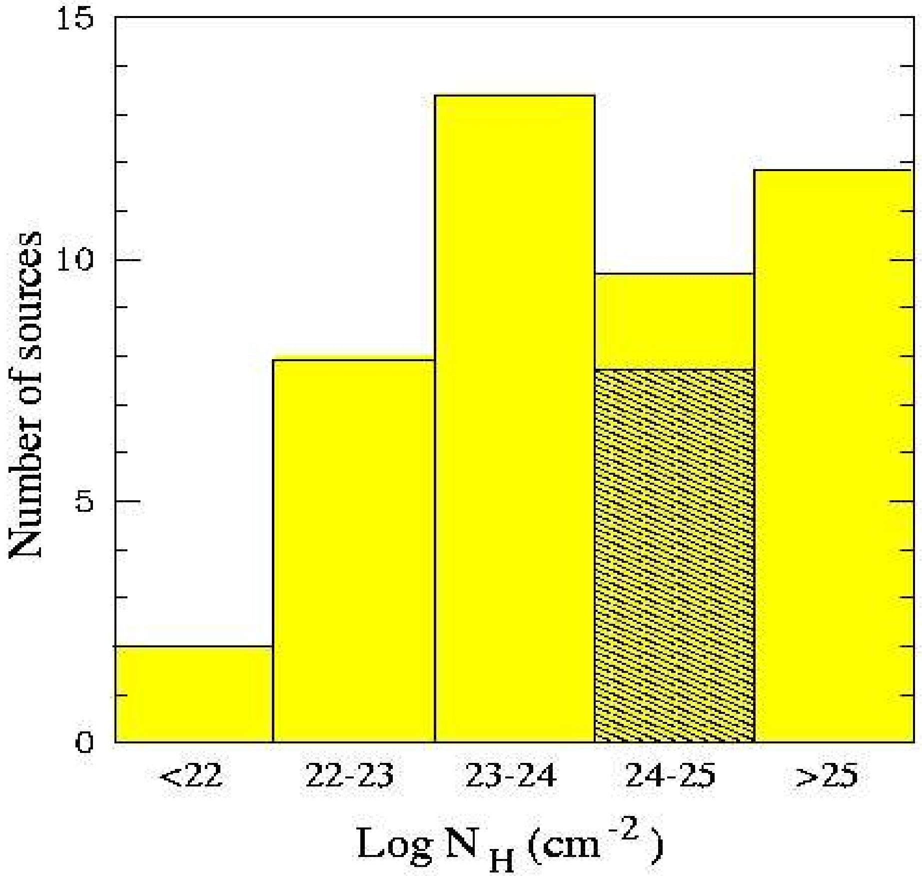


Type-II AGNs: (2/2)

X-ray surveys of nearby Seyfert Galaxies ⟹

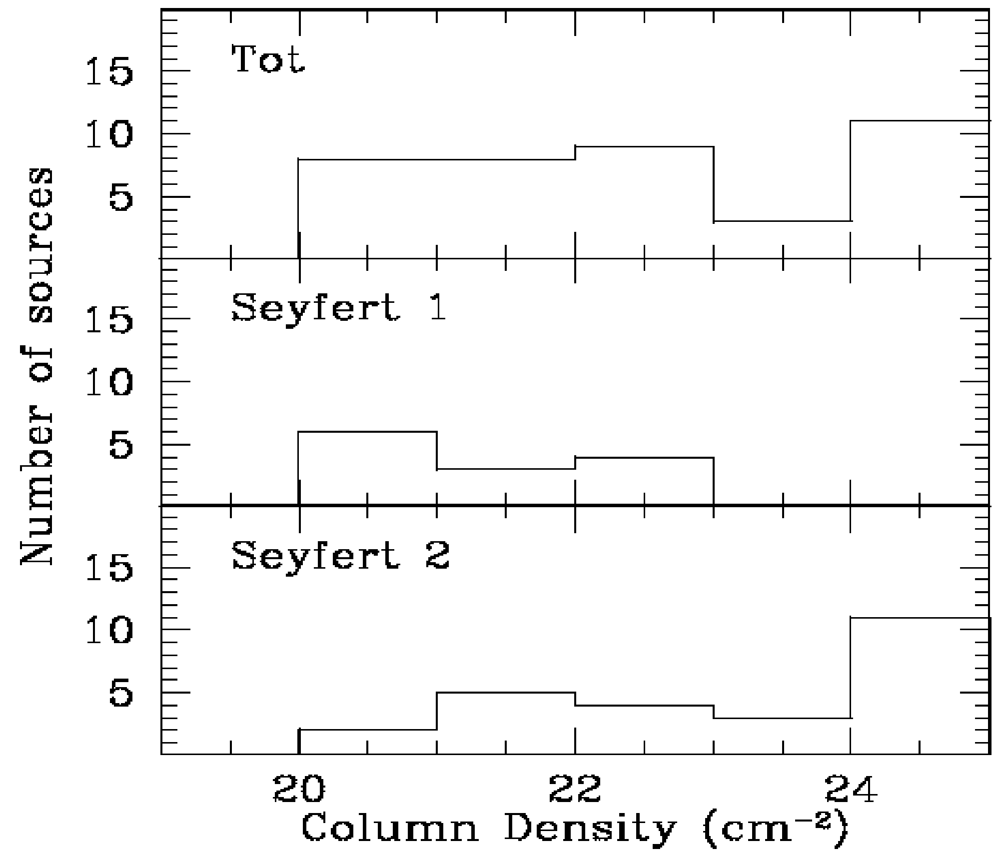
BeppoSAX

Risaliti et al., '98



XMM-Newton

Panessa et al., in prep.

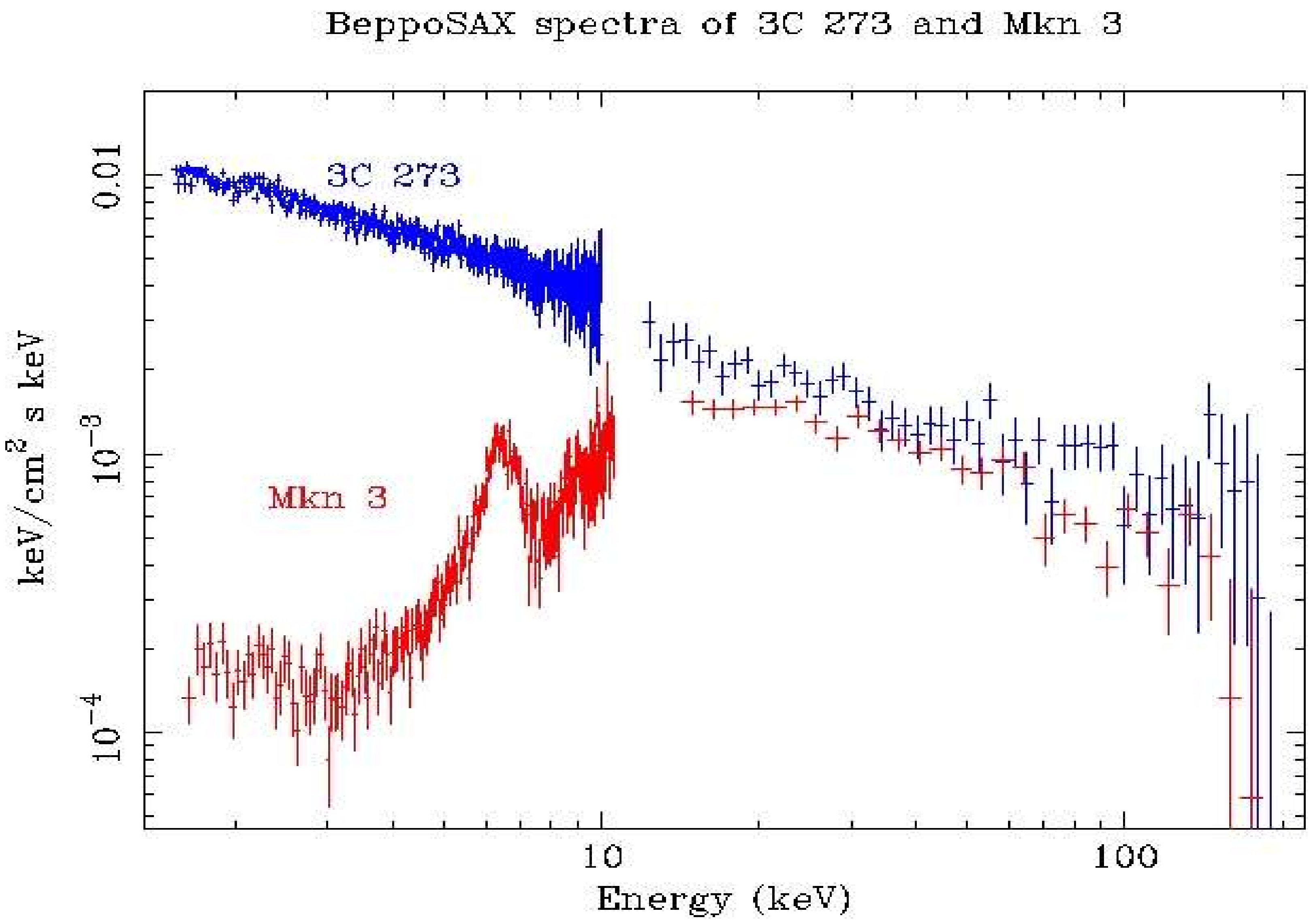


⟹ *X-ray surveys of nearby Seyferts demonstrate that most (>50%) nearby AGNs are heavily (>10^{24} cm^{-2}) absorbed*

⟹ *Type-II AGNs are the dominant population of AGNs (at z=0, see G. Hasinger's talk, tomorrow, for the case of more distant AGNs and contribution to the XRB)*

Simbol-X and Type-II AGNs: (1/3)

Simbol-X will take advantage of its unprecedented sensitivity between 5-50 keV

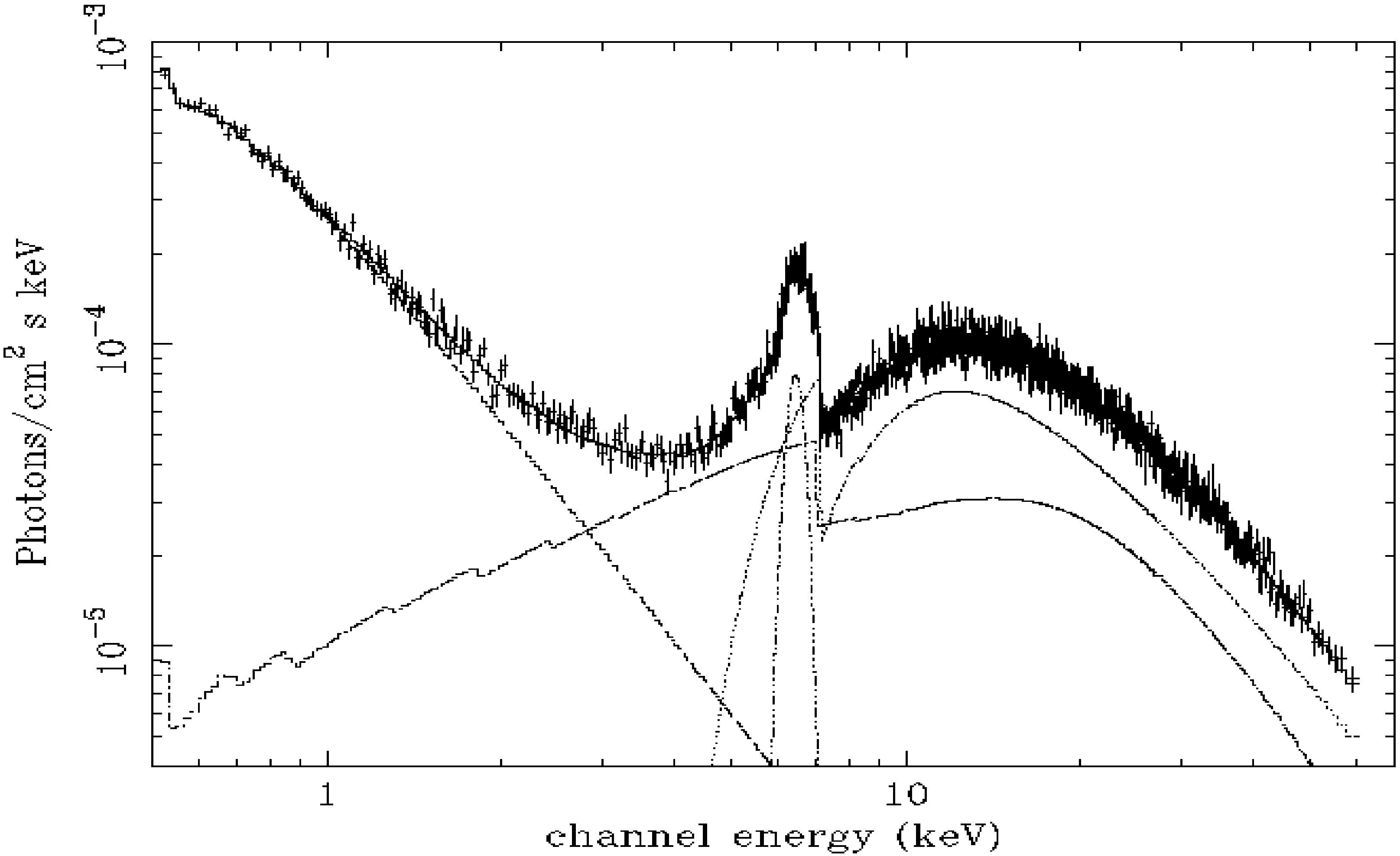


Simbol-X should be ~10-100 times more sensitive than BeppoSAX

Simbol-X and Type-II AGNs: (2/3) Simulations

I use the "archetypical" Sey2 galaxy Mkn3 ⟹ It is bright (not brightest!) but standard spectrum

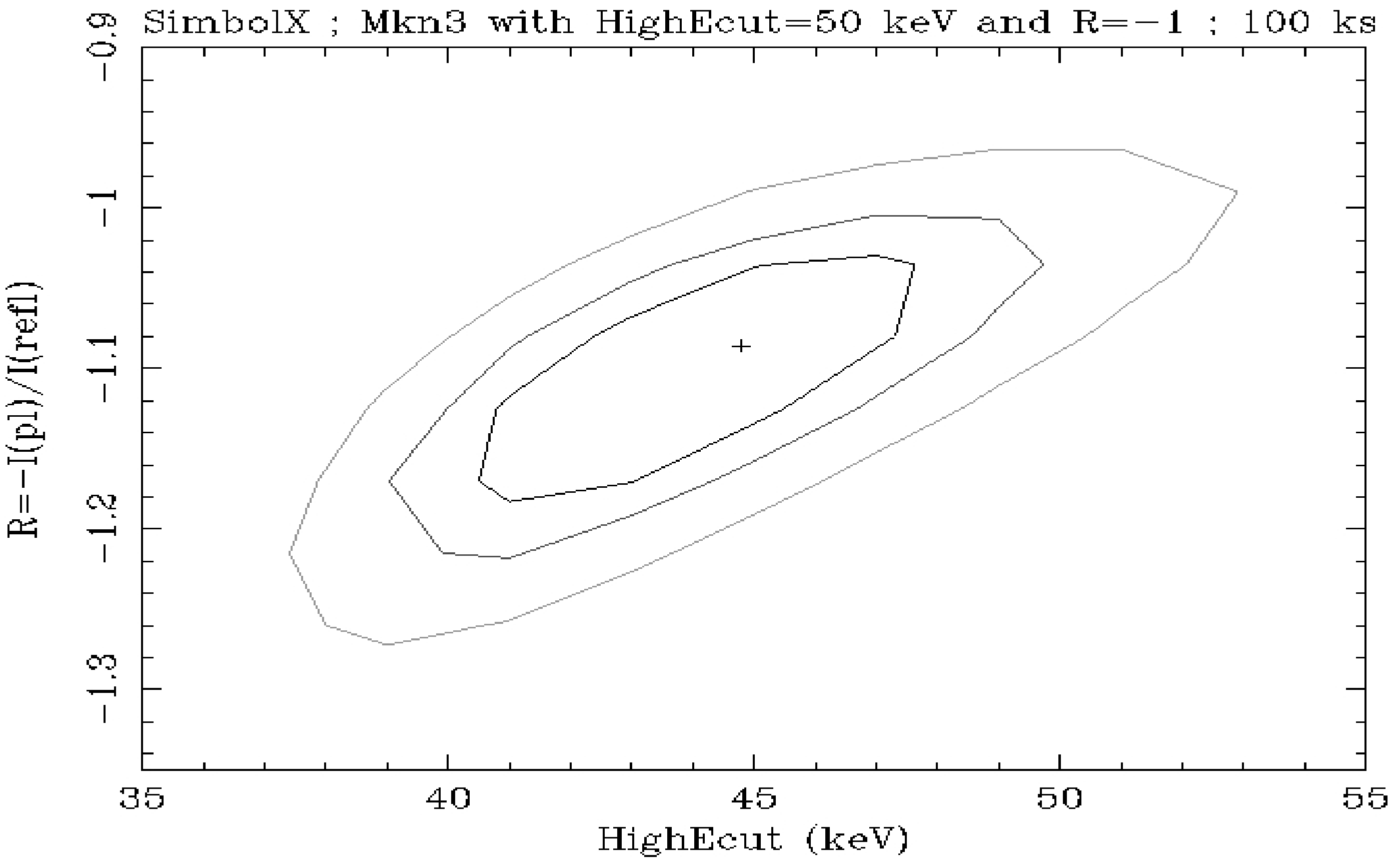
model=soft-scattered + heavily absorbed direct component + reflection component + FeK line (from transmission+reflection)



$\mathcal{F}(2\text{-}10)=5\times10^{-12}$ cgs; $\mathcal{F}(10\text{-}100)=10^{-10}$ cgs; Exp.= 100 ks

⟹ 10^5 cts in sdd and 5×10^4 cts in CZT

Simbol-X and Type-II AGNs: (3/3) Simulations



⟹ *R and HighEcut constrained within 10% (even with HighEcut=100 keV)*

If scale down Exp. by factor of 10, still 10000+5000 counts ⟹ timing possible on R and HighEcut ⟹ (see Laura's and Petrucci's talks for it's astrophysical importance)

If scale down 2-10 keV flux by factor of 100, still 1000+500 counts ⟹ larger sample and/or extension to lower-luminosities is possible (better than Risaliti et al., and Panessa et al.) ⟹ compare accretion physics at high and low luminosities

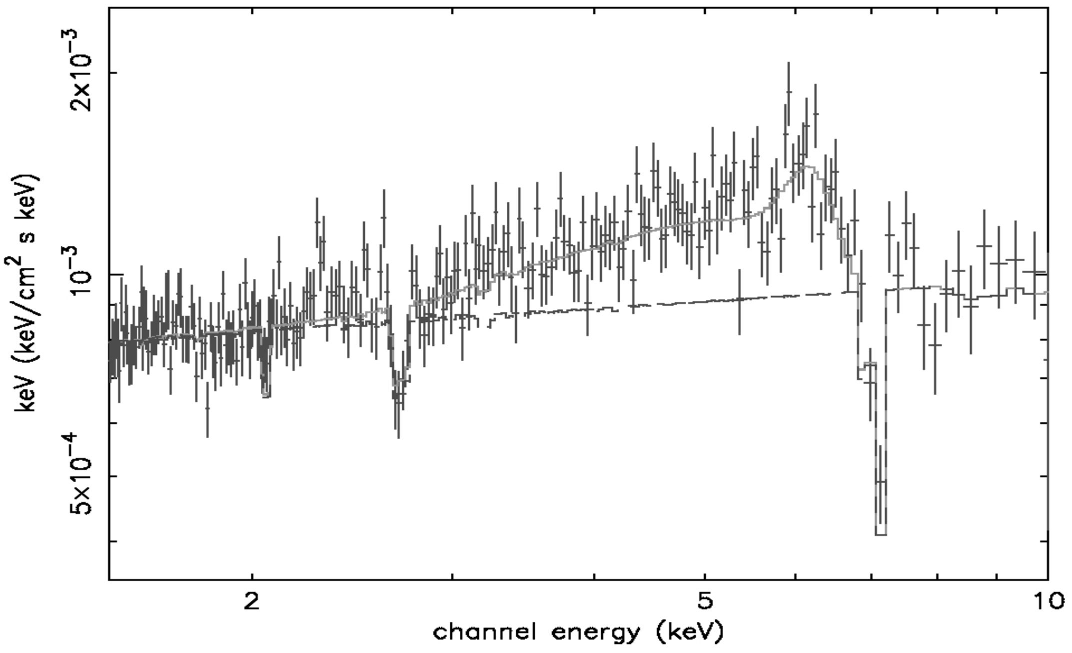
ii) Semi-relativistic outflows in (RQ)AGNs: (1/2)

Recent XMM-Newton and Chandra observations

$\Rightarrow$ *massive, high velocity and highly ionized outflows in several RQ AGNs/QSOs*

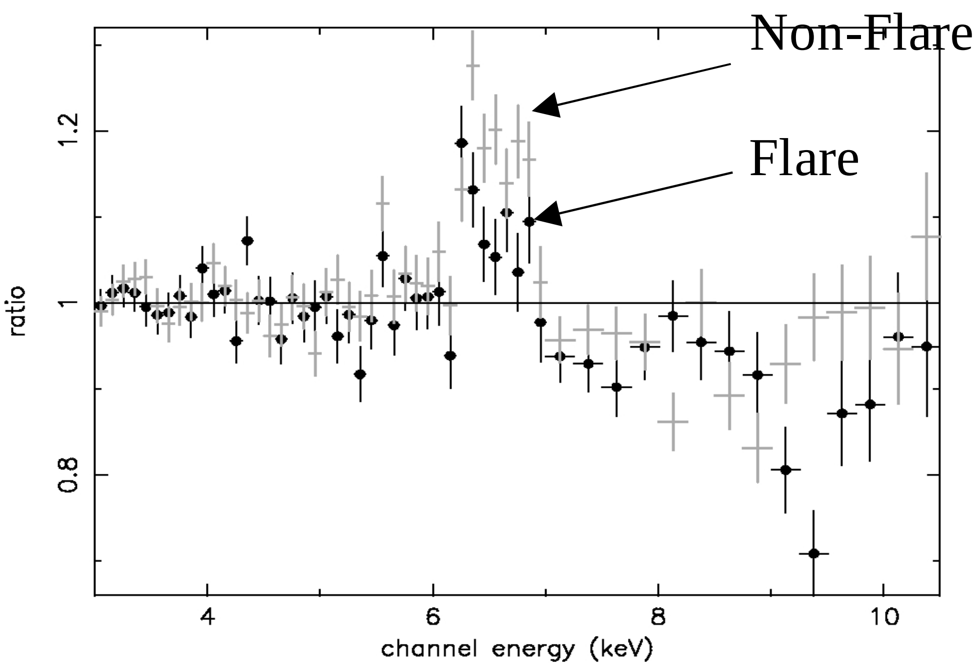
mass: comparable to Eddington accretion rate

velocity: at least ~0.1-0.2 c



PG1211+143

Pounds et al. 2003



Mkn 766

Pounds et al. 2003

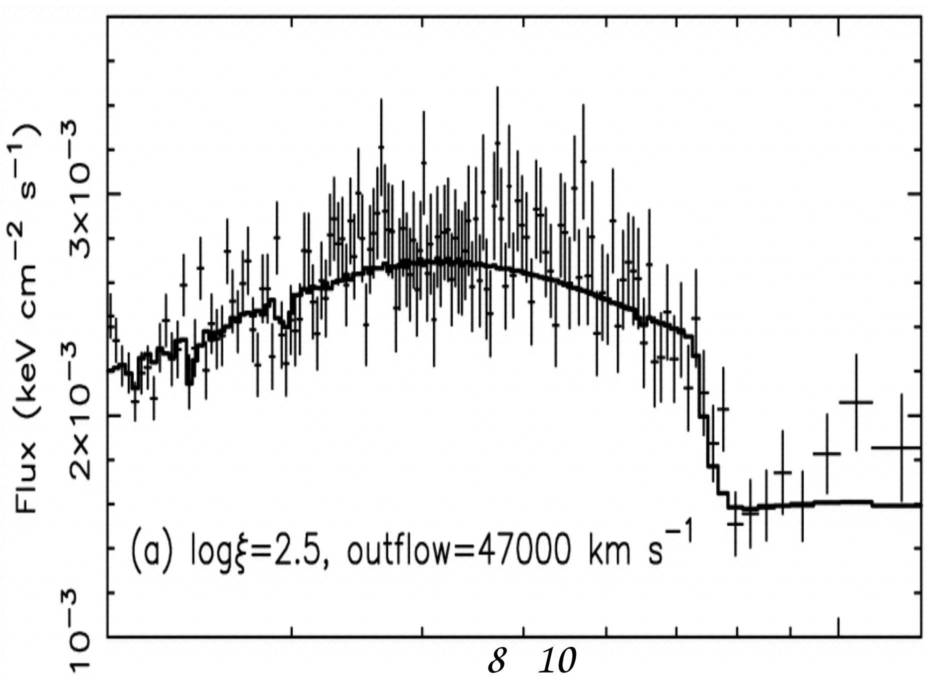
Semi-relativistic outflows in (RQ)AGNs: (2/2)

XMM-Newton observation of quasar PDS456 (Reeves et al. 2003)

$\Rightarrow$ *Gamma~2;* $N_{warm} \sim 10^{24}\ cm^{-2}$; *log ~ 2.5*

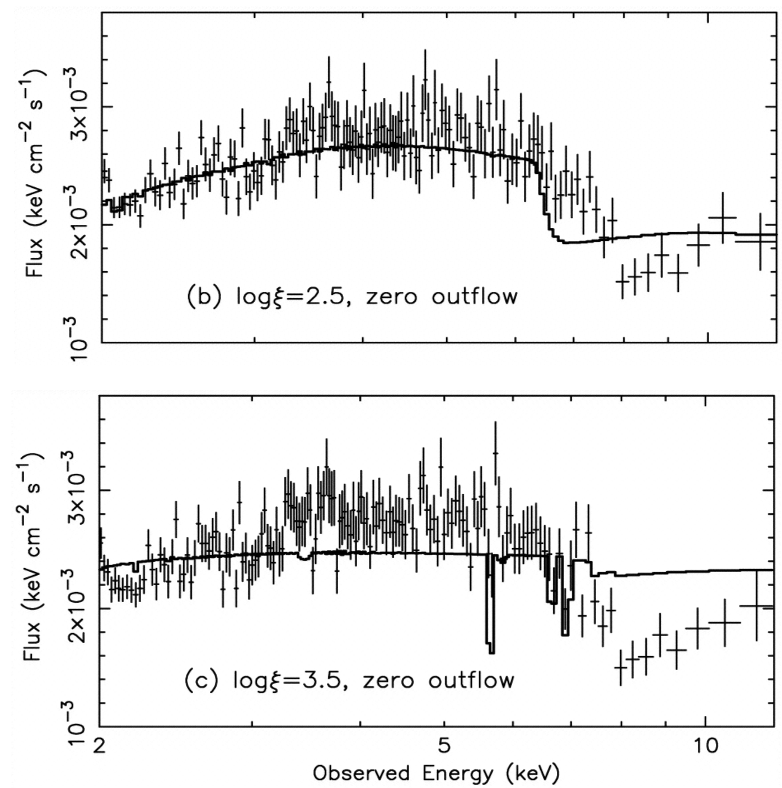
Without outflow

With outflow v=0.15c



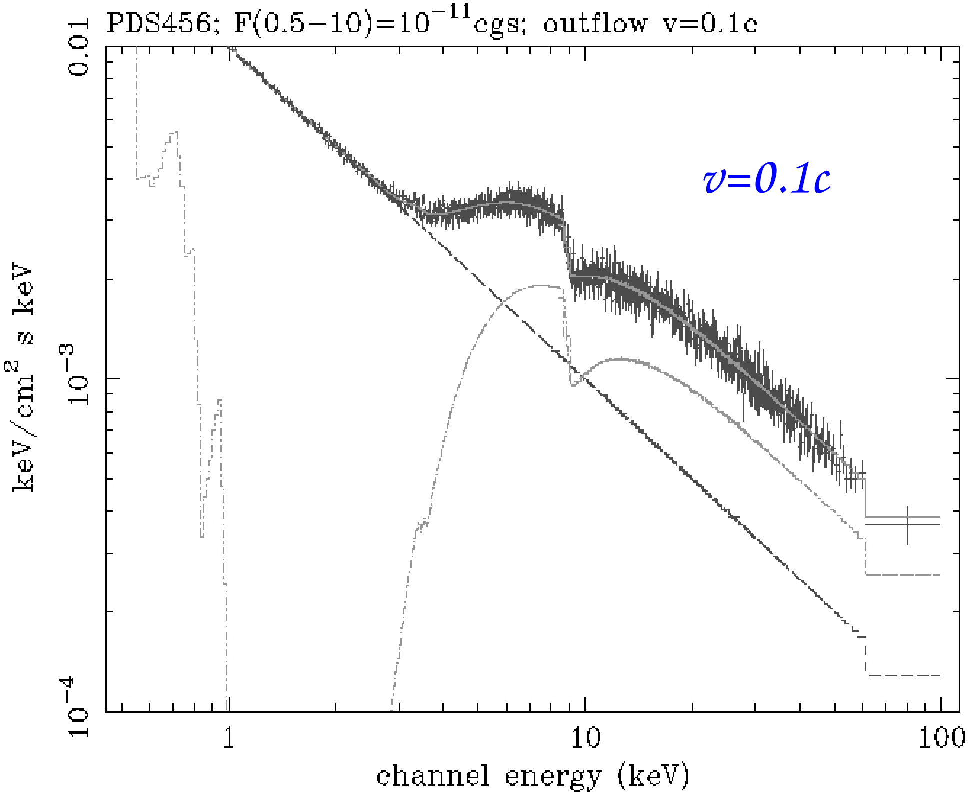
8 10

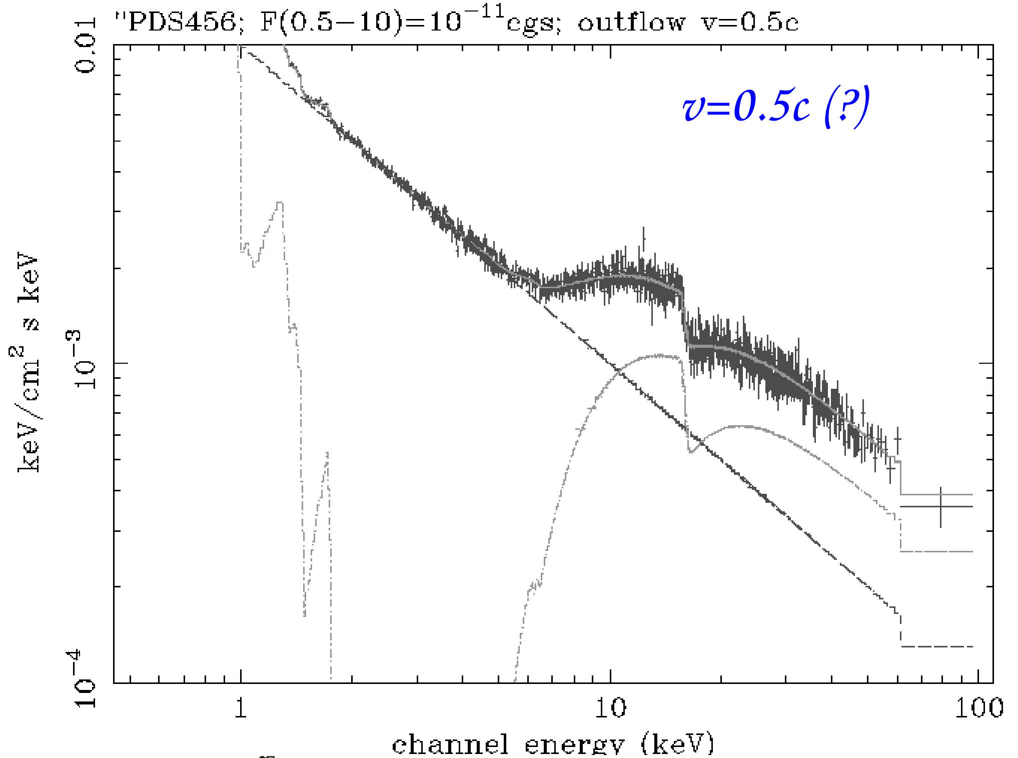
keV



Simbol-X and semi-relativistic outflows in AGNs:

Simulations of PDS456:



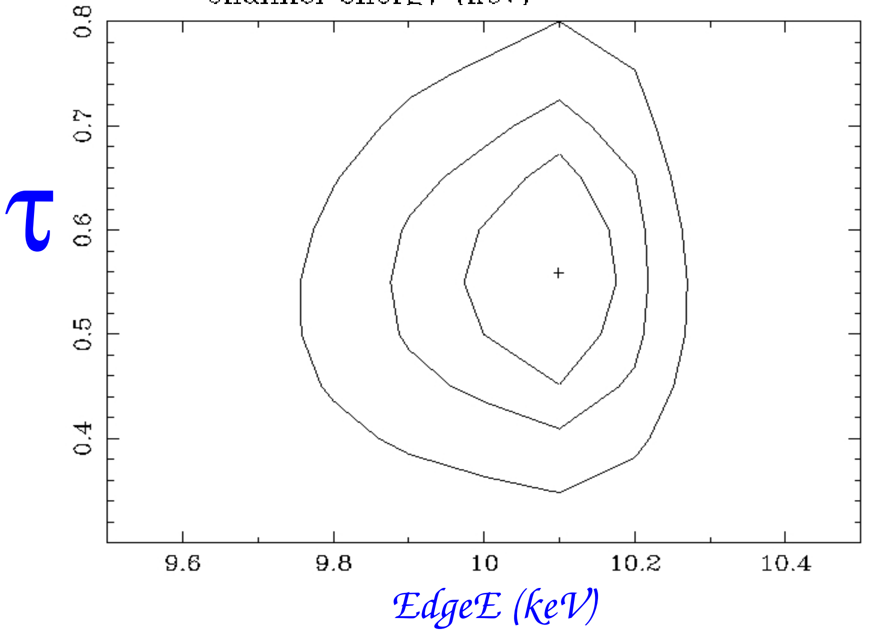


Edges at E~7.1-9.0 keV and v_{out} ~ 0.1-0.5c

⇒ *E_{obs} ~ 8-14 keV*

F(2-10)=10^{-11} cgs ⇒ τ *within 5-10%, DeltaE<Eres.*

F(2-10)=10^{-12} cgs ⇒ τ *within 20-30%, DeltaE~Eres.*



⇒ *Possible to constrain Nh, , v of outflow*

Studying massive outflows is of fundamental importance to understand feedback SMBH-host galaxy (see e.g. King and Pounds 2003) and physics of launching/acceleration mechanism (that may also lead to relativistic jets in RLAGNS)

v/c=0 0.1 0.2 0.3 0.4

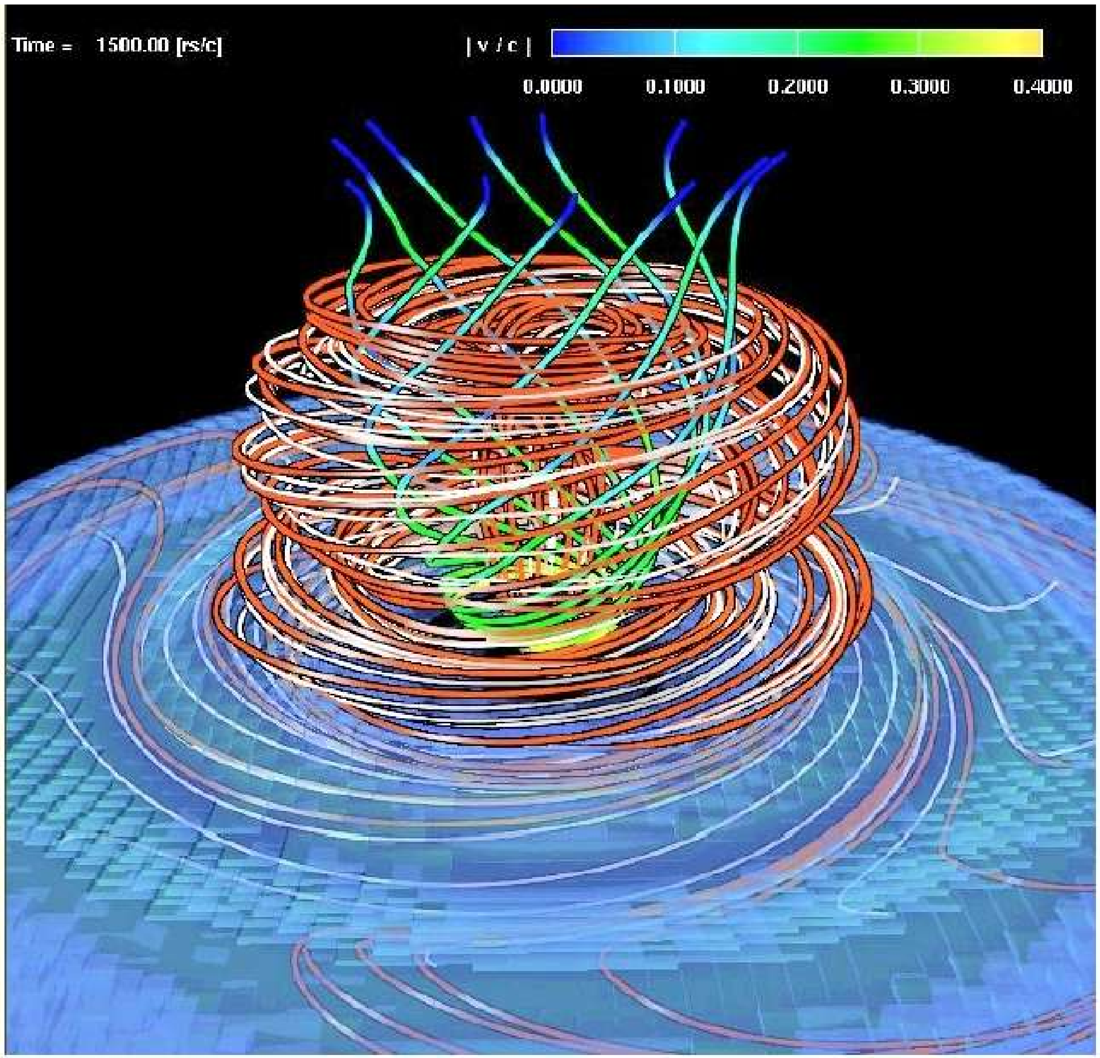


FIG. 3.— Perspective view of magnetic fields lines in Phase I of Model A. Thick red (or thin white) lines indicate magnetic field lines which are anchored to the innermost (somewhat outer) zones at $(r, z) = (1, 1.5)$ $[(r, z) = (56, 10)]$, respectively. Thick green lines denote the streamlines of velocity vectors integrated from $(r, z) = (8.5, 7)$, whereas the color bar indicate the velocity. Light-blue shaded region indicate the isovolume of the density ($\rho = 0.025\rho_0$). Accumulated toroidal fields emerging from the disk produce a magnetic tower, thereby driving an MHD jet. Jet material is surrounded by toroidal magnetic fields, whereas poloidal (vertical) fields dominate inside the jet.

Magnetic Tower

by Kato et al. 2003

Summary

I illustrated two scientific topics of major interest nowadays, that Simbol-X could address/tackle with great potential

Type-II AGNs ⟹ detailed modelling of R and HighEcut for brightest type-II AGNS with first-ever timing possible
⟹ Nh measurements on larger, and/or farther, and/or to lower- luminosity sample than before
⟹ compare AGNs to LLAGNs to understand why not all galaxies are active

Massive outflows ⟹ detailed modelling of intensity, energy and frequency of these features
⟹ fundamental for understanding launching mechanism and possibly missing link between SMBH and host galaxy.

The key potential offered by Simbol-X, in addressing both these topics, is the unprecedented throughput between 4-40 keV...