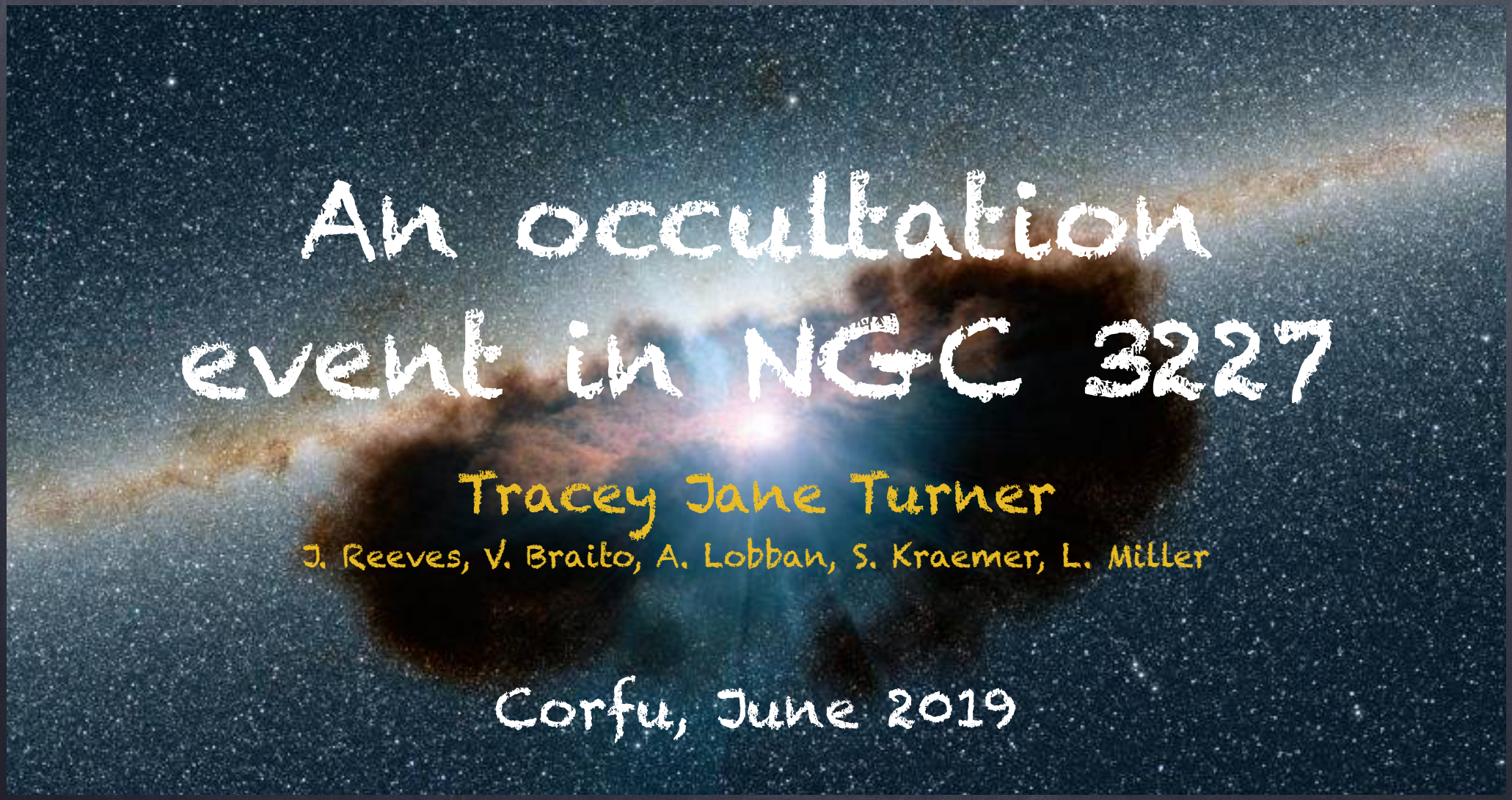
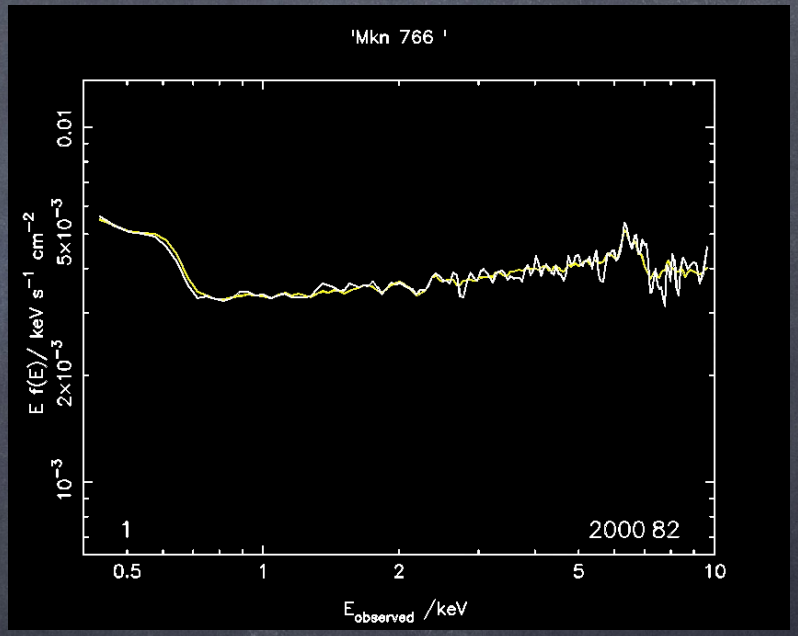

An occultation
event in NGC 3227
Tracey Jane Turner
J. Reeves, V. Braito, A. Lobban, S. Kraemer, L. Miller
Corfu, June 2019

Motivation

- Outflows carry mass & energy from central engine
- Mass/energy feedback regulates growth of BH, host
- X-rays probe large radial range for reprocessor down to BH
- Bright local AGN inform models BH/host co-evolution

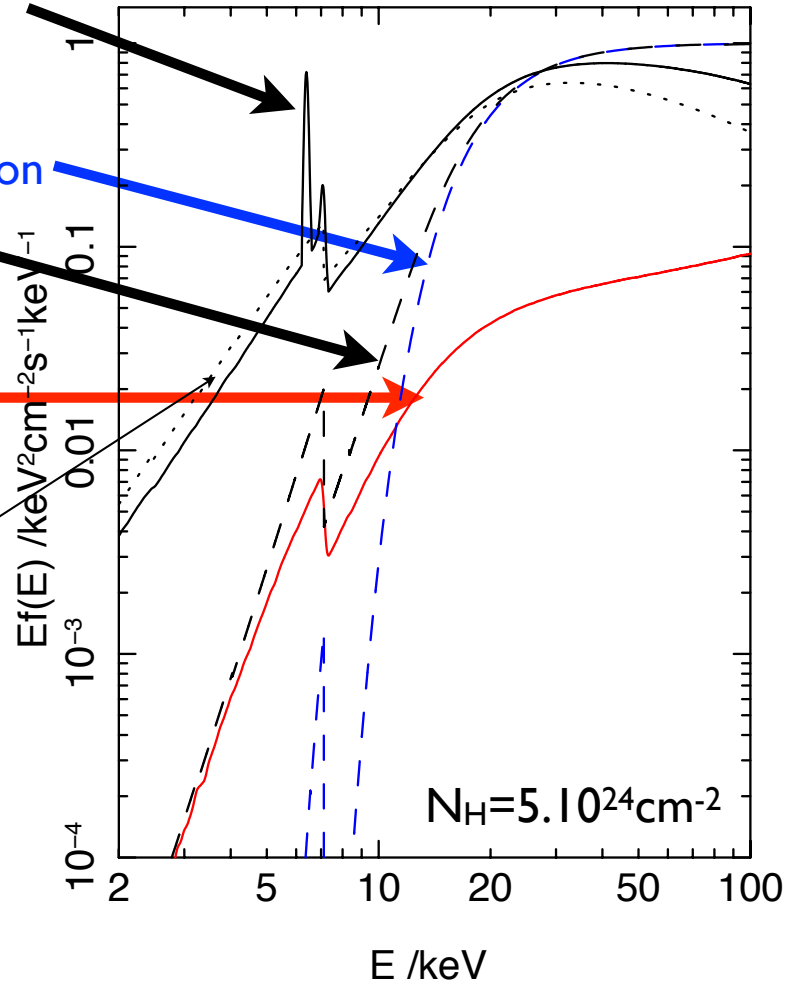
Isolate X-ray reprocessor signatures

- Absorption/outflow changes (days, BLR)



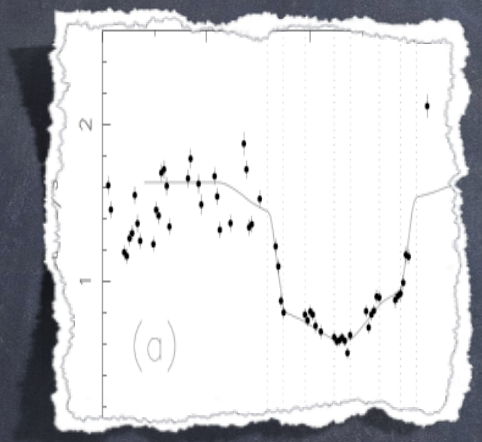
Transmitted and scattered signatures

- scattered light from sphere (scaled to full global covering)
- transmitted standard slab calculation
- transmitted, sphere same mean N_H as slab
- transmitted, sphere inc Compton scattering
- ….reflection from a plane slab

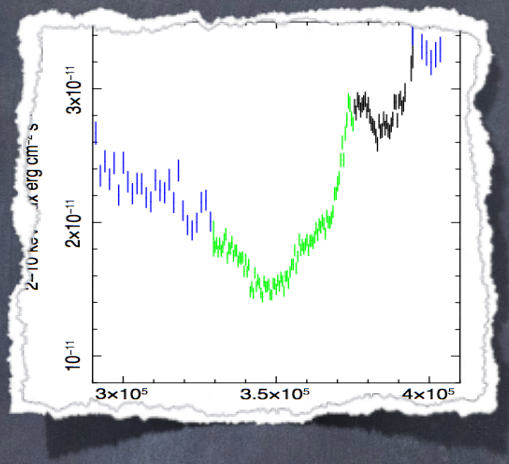


Miller & Turner 2013

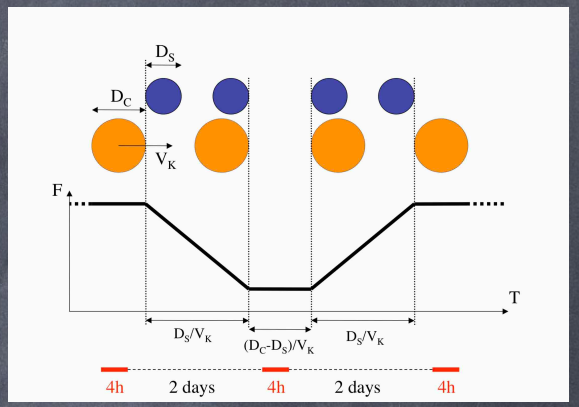
Isolate X-ray reprocessor signatures



MCG-6-30-15
McKernan & Yaqoob '98

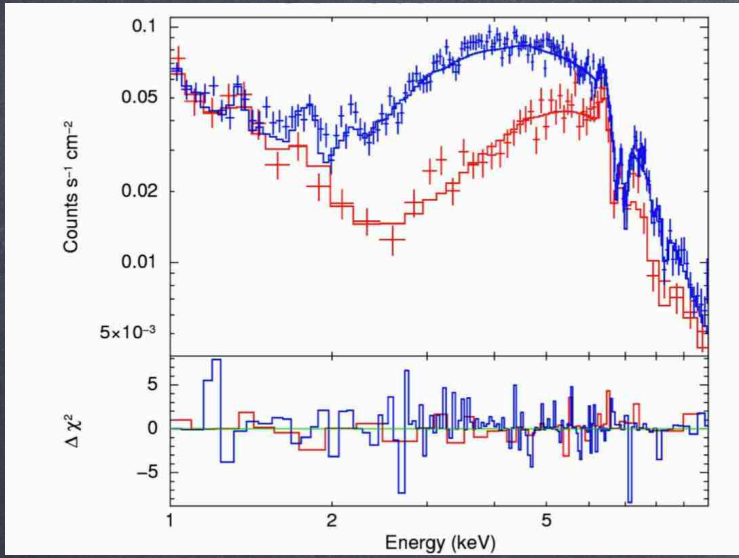


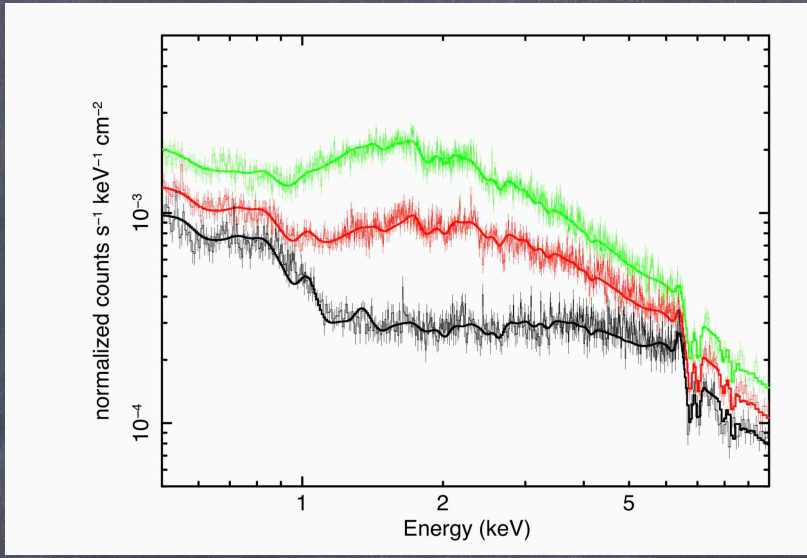
NGC 3516 Turner et al '08



Model for event in NGC 1365 Risaliti et al '07, 09- dip shape from cloud complex

Isolate X-ray reprocessor signatures

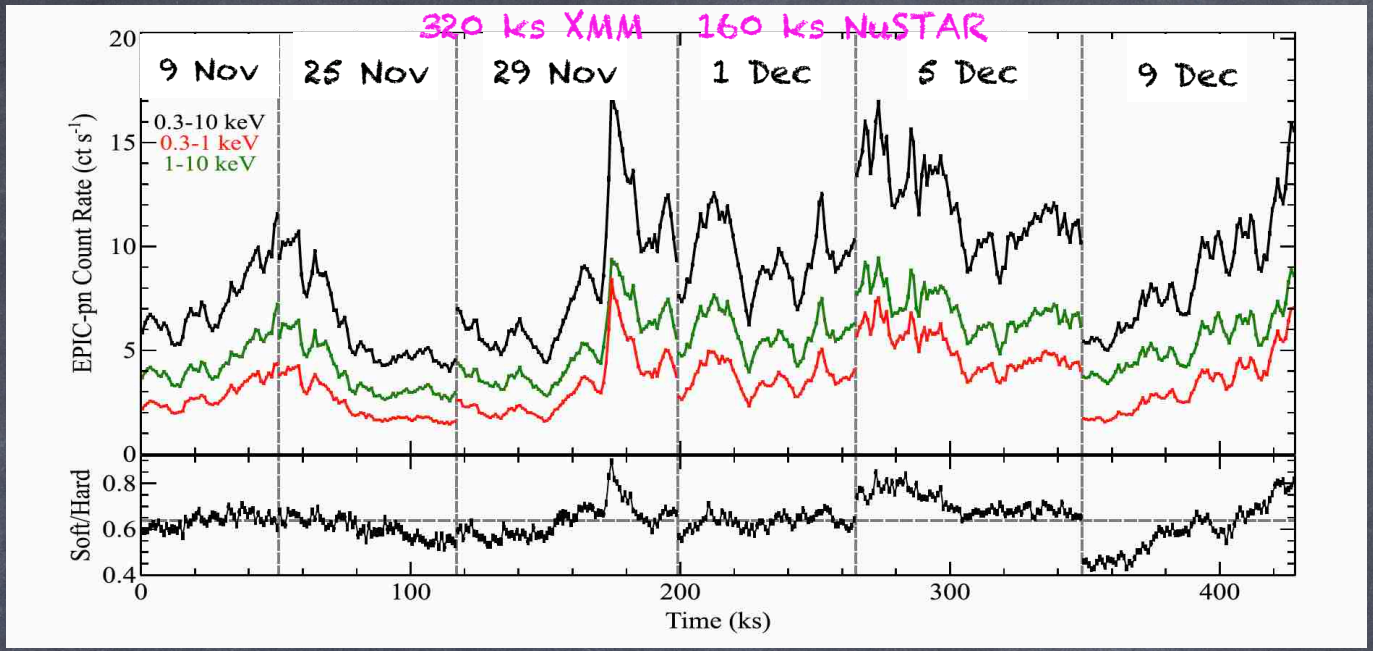




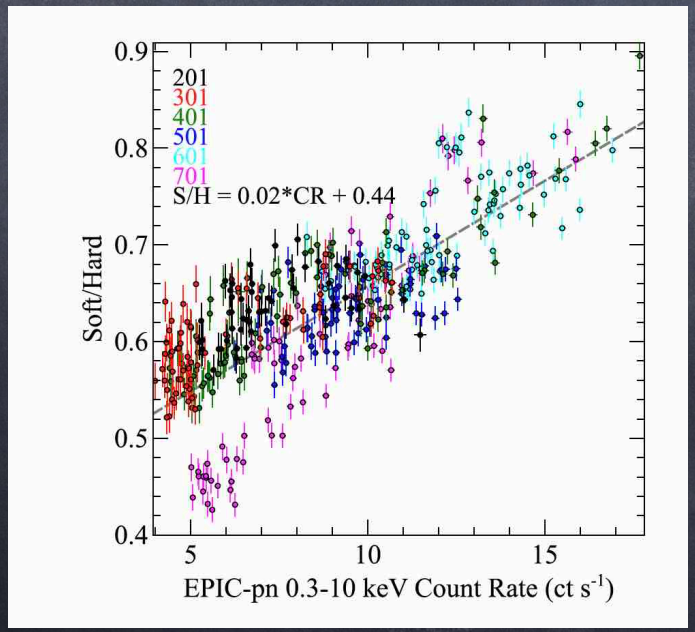
NGC 1365, Risaliti et al 2009, Maiolino et al 2010, Braito et al 2014

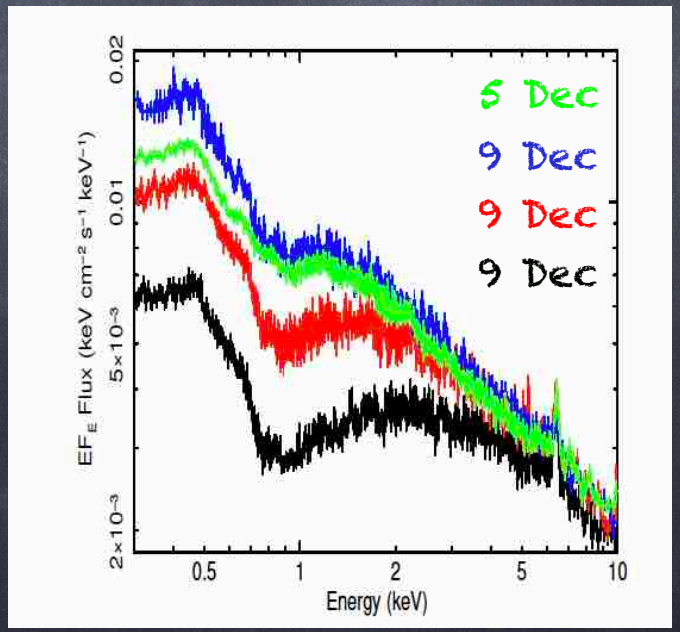
Changes in N_H and covering

2016 XMM/NuSTAR campaign - NGC 3227

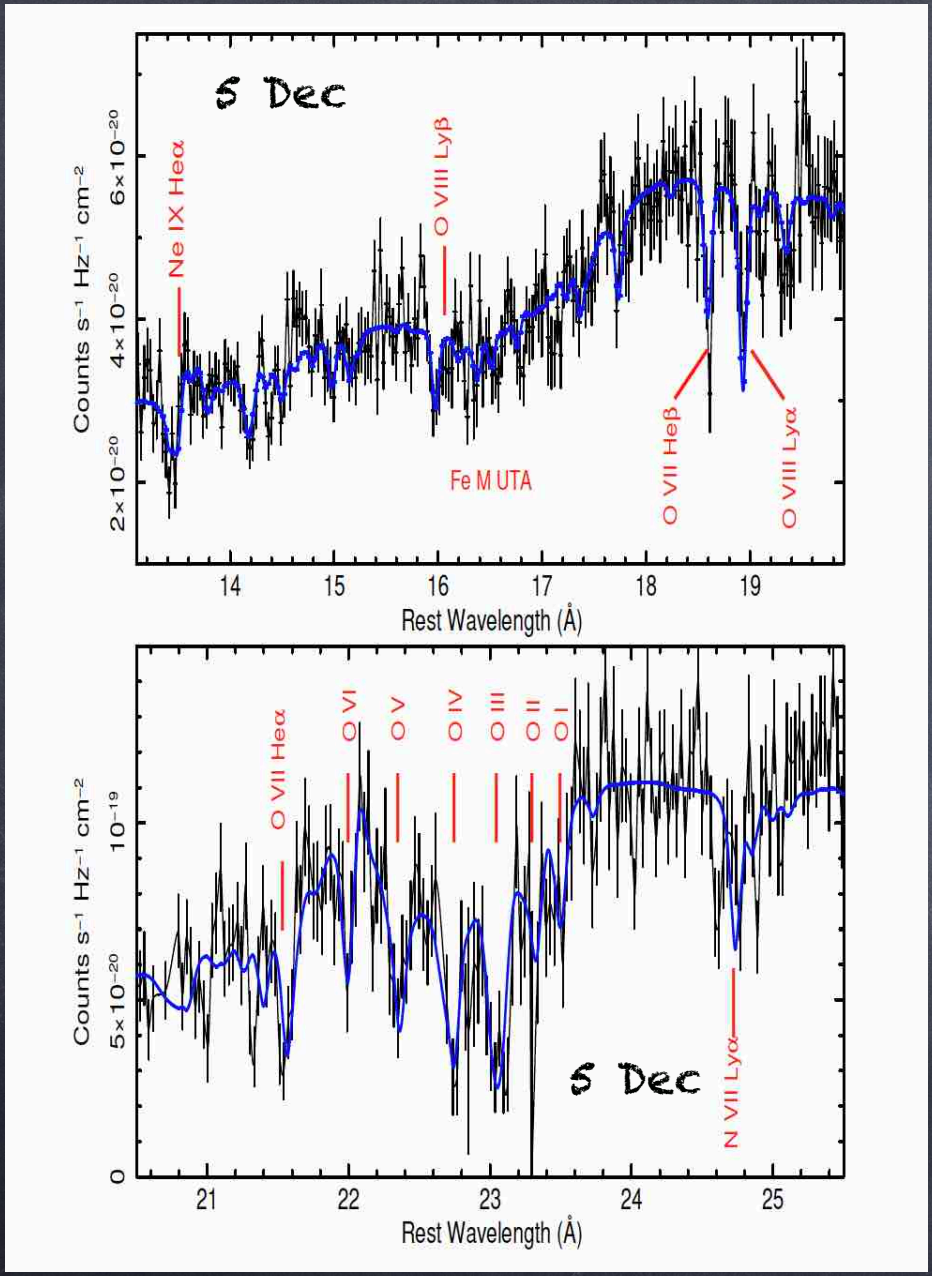


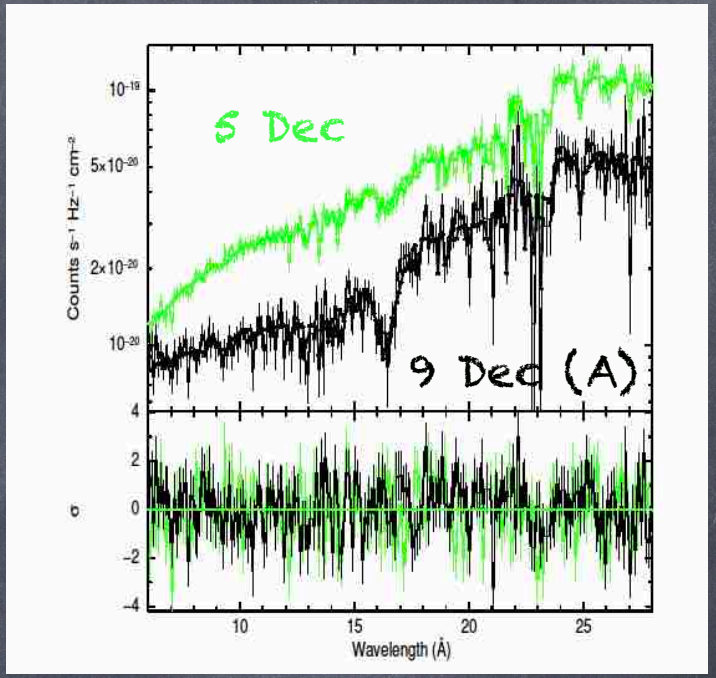
hardness plot isolated unusual behavior





3 full-covering WAs plus PC (UTA-producing) zone

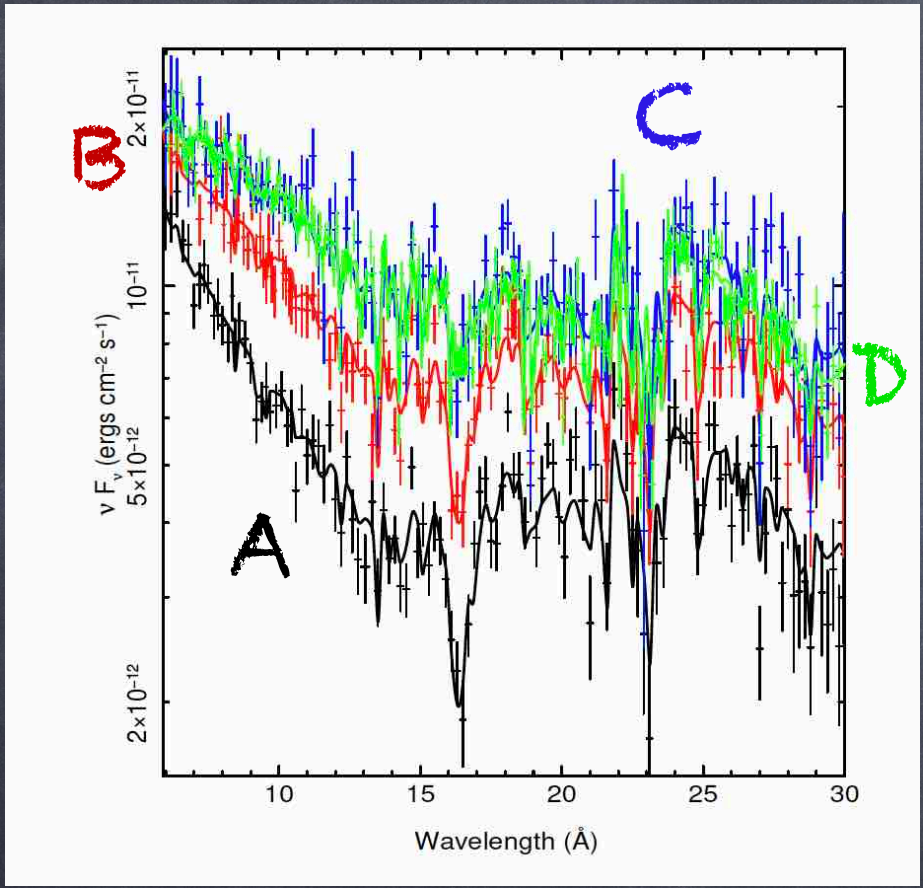


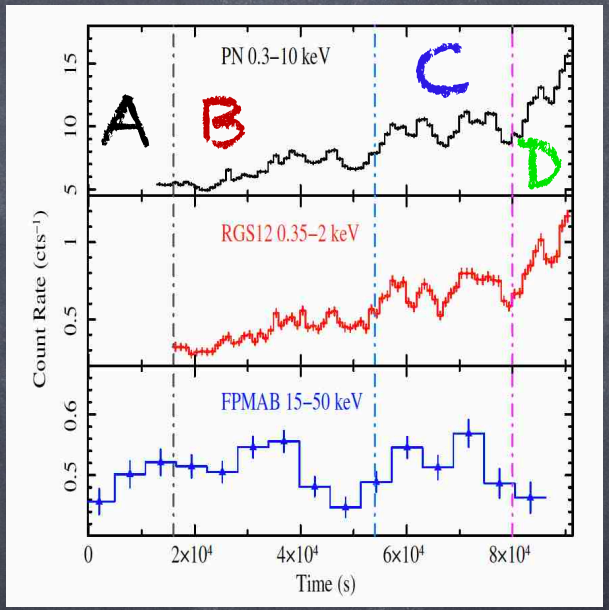


Zone	N_H $\times 10^{21}$ cm^{-2}	Log ξ	Velocity km/s
1 (full)	$1.79^{+0.16}_{-0.19}$	$-0.65^{+0.06}_{-0.07}$	-157(f)
2 (full - UTA)	1.47±0.23	$1.28^{+0.08}_{-0.13}$	-798 (f)
3 (full)	6.56±0.27	$2.80^{+0.11}_{-0.10}$	- 792 (f)
4 (PC)	50.0±2.30	$2.23^{+0.08}_{-0.13}$	-798 (f)

Gradient in properties, complex cloud

Dec 9 RGS, time sliced



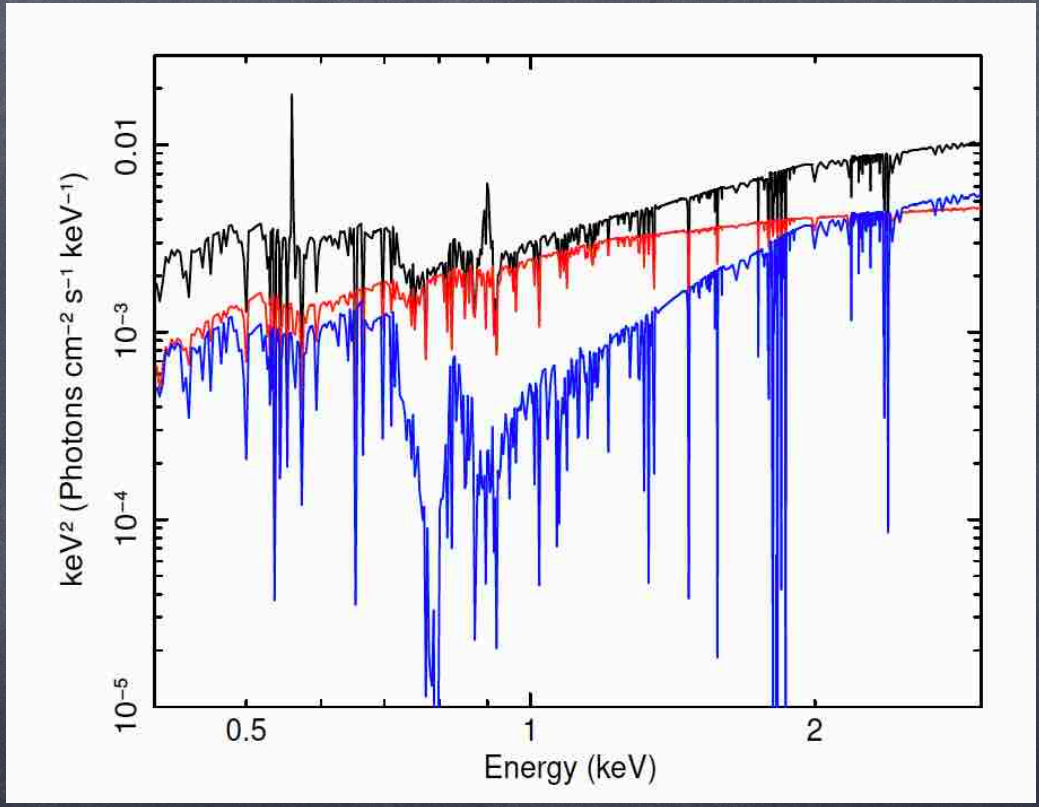


Slice A Dec 9 model zones

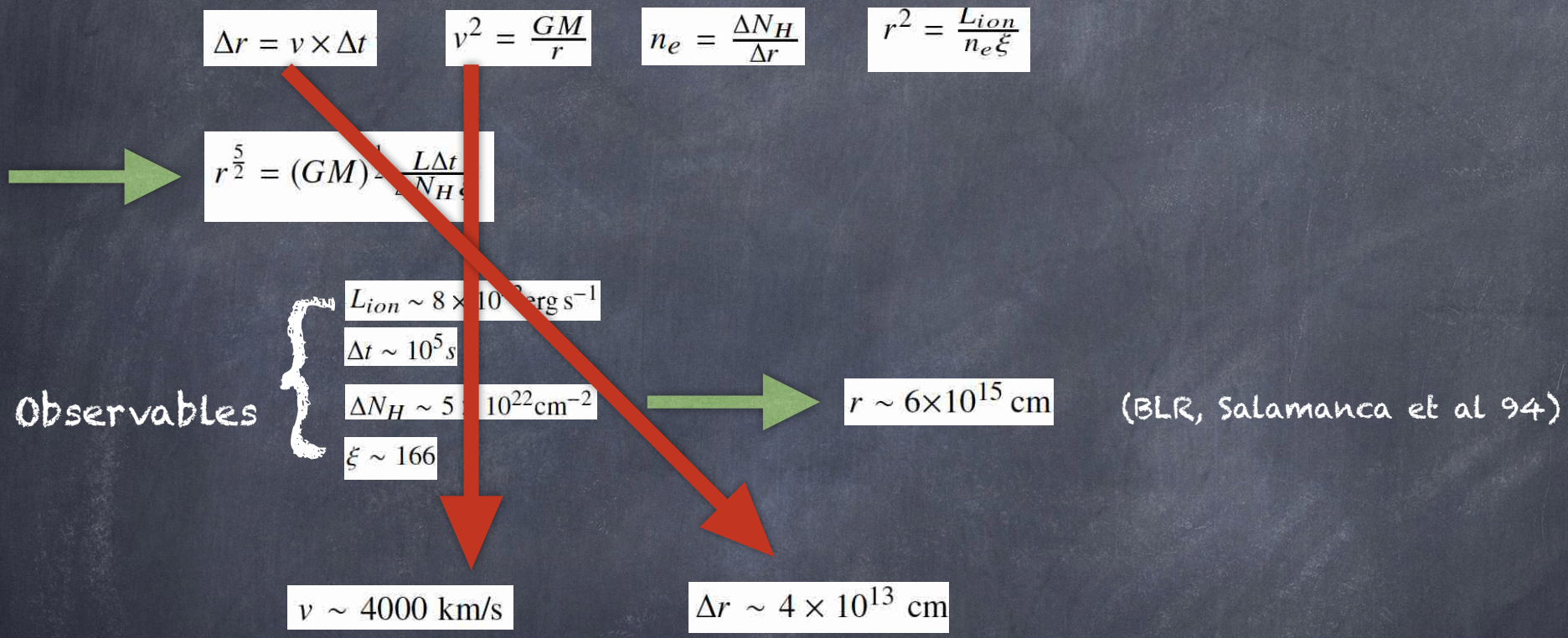
Total model w/ emission

Constant WA complex

Var covering from 0 – 60% PC zone 5×10^{22} log ξ ~2.2, -800 km/s accounts for change in UTA & spectral curvature

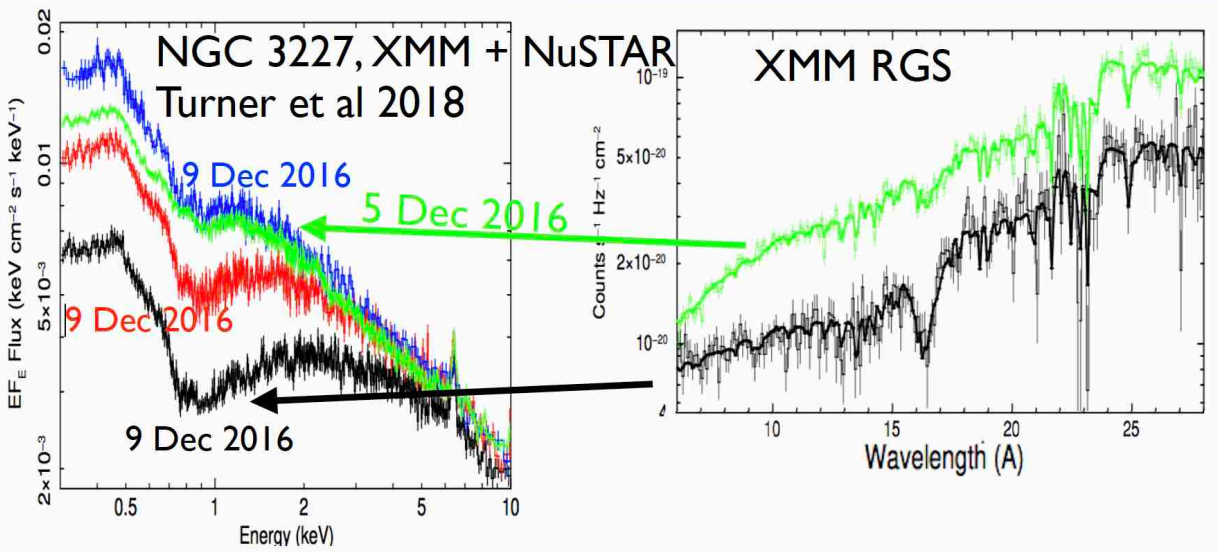


Variable X-ray absorption - days



Tidal shearing constraint OK (Elitzur & Shlosman 2006; Beuchert et al 2015)

Conclusion: NGC 3227 occultation event

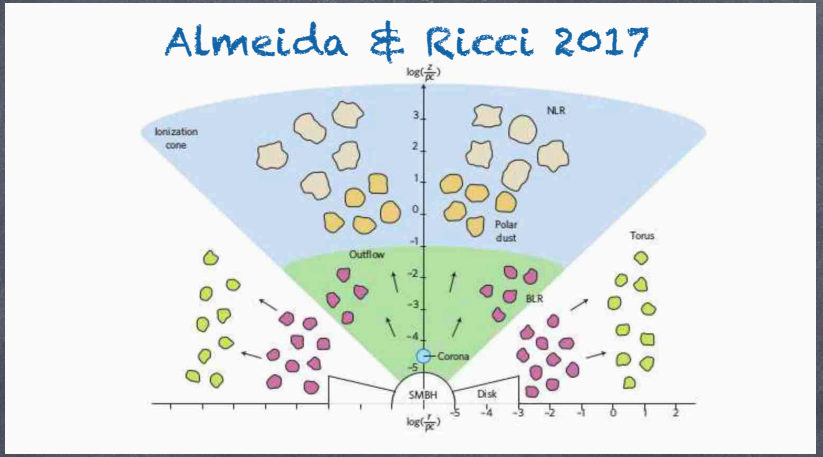


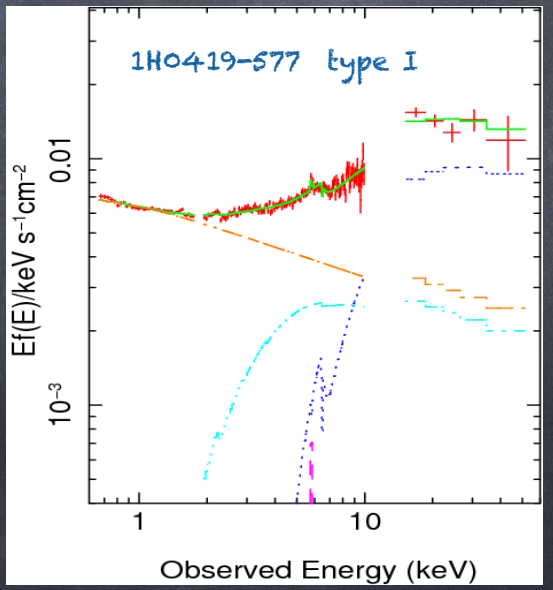
- broadband spectral variations accompanied by clear absorption features (here RGS spectra of UTA)
- resolved timescale ~ 1 day, distance ~ 2 light-days from BH

- Cloud 5×10^{22} log ξ ~2.2, -800 km/s into los to cover 60% of continuum, inner BLR
- Previous (Beuchert et al 2015) absorption events outer BLR
- 2-7 day event (Markowitz et al 2014) - clouds outer BLR
- 80 day eclipse event suggested by Lamar et al (2003) - clouds at inner dusty torus

Bigger picture

- New Unified Model - cloud ensemble (inc clumpy torus) obscuring/reflecting
- Cloud distribution has polar angle dependance (Nenkova et al 02, 08; Elitzur & Shlosman 06)
- IR supports cloud ensemble (Alonso-Herrero et al 2011)
- Evidence for clumpy CT gas (Turner et al '09, Tatum et al '13, '18) in local type 1 AGN

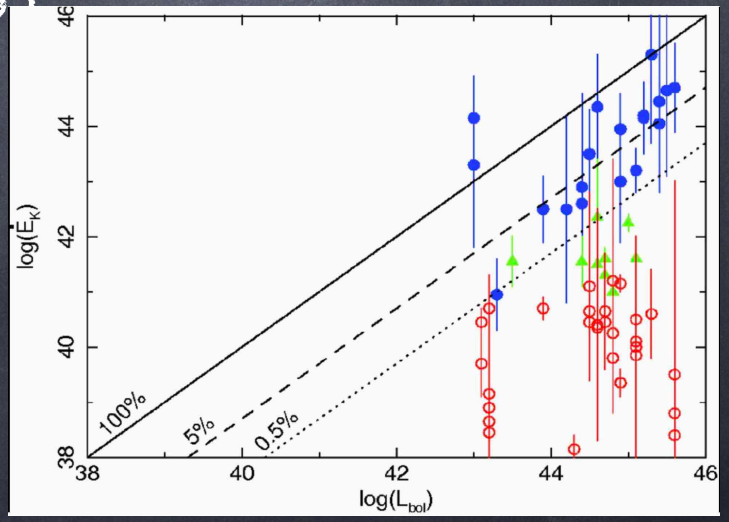




- Complete census of obscured AGN still missing - does partially obscured type 1 light make sig contribution?

Bigger picture

- Lag/reverberation results show additional gas lying closer in tens-hundreds r_g
- Range of gas from tens of r_g to outside of BLR
- WA kinetic power $\dot{E}_k \sim 10^{40}$ - UFOs $\dot{E}_k \sim 10^{46}$ (e.g PDS 456, Reeves et al 2003)
- $E_{wind} \sim 10^{53} - 10^{61}$ erg over life of AGN
- $\dot{E}_k / L_{bol} \sim 0.1-0.5\%$ for sig feedback - estimates limited by solid angle uncertainty



Tombesi et al 2013