AN AGN EMERGING FROM AN OBSCURED STATE

MULTI-EPOCH MONITORING OF THE X-RAY AND UV ABSORBERS IN NGC 985

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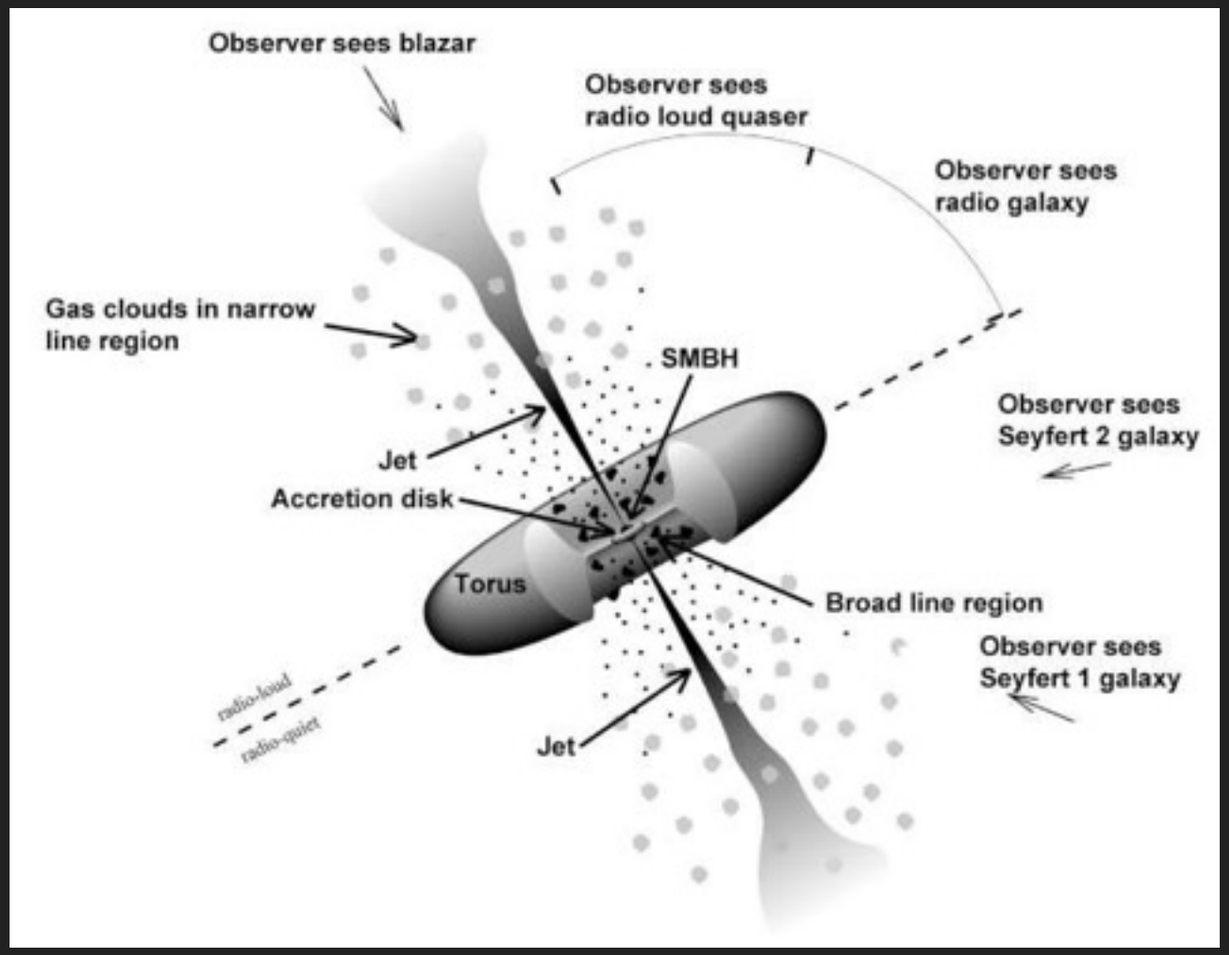
STRUCTURE OF AN AGN

- The surroundings of the central SMBH is a very dynamical environment.
- Gas and matter are moving at velocities ~100 - 10 000 km/s.
- Catching these intervening clouds crossing our line of sight may provide useful information on the physics and dynamics of the innermost regions of an AGN.



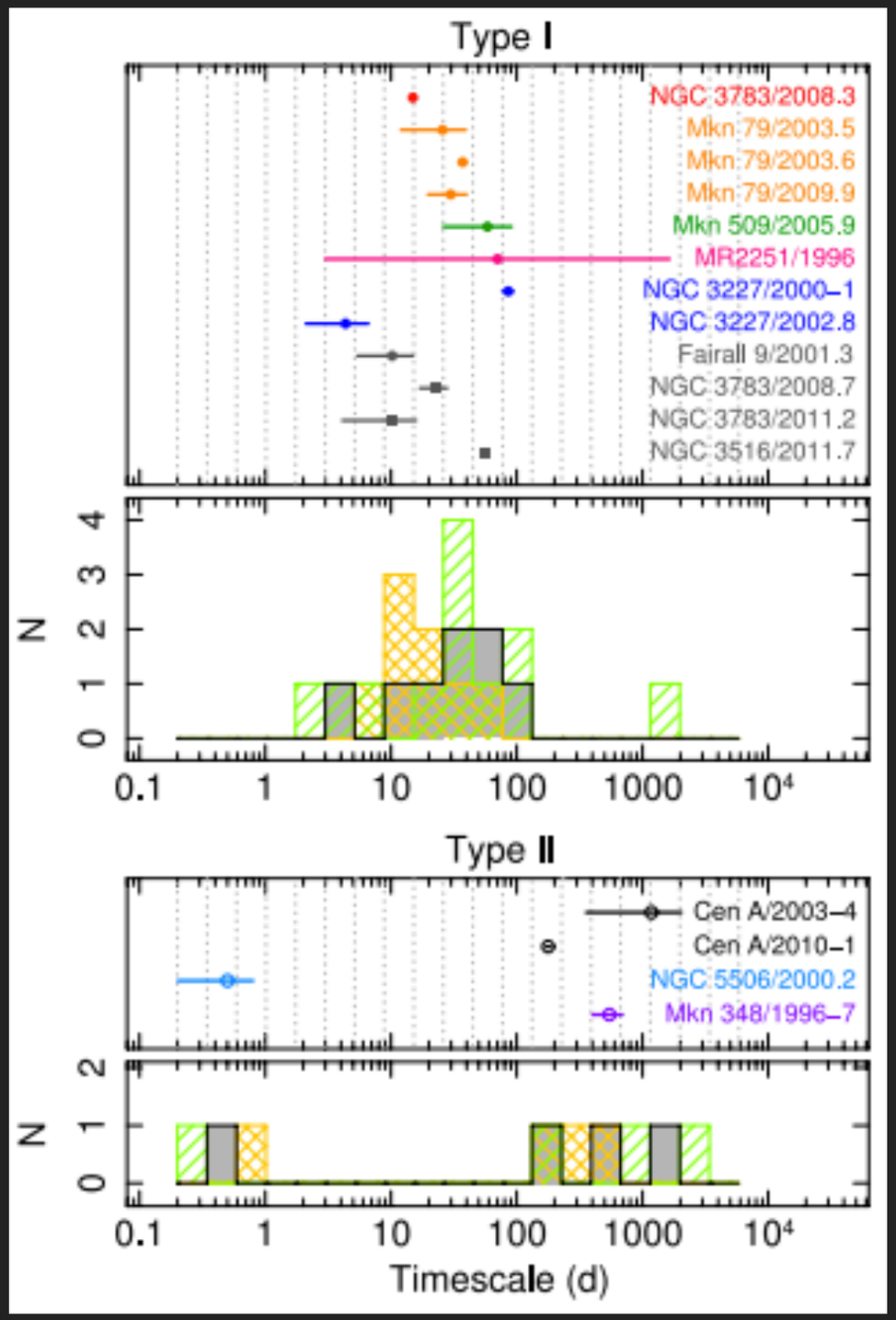
Urry & Padovani (1995)

OBSCURATION EVENTS IN AGN

- Transient obscuration events have been recorded for a number of sources so far: Mrk 766 (Risaliti et al. 2011), NGC 1365 (Walton et al. 2014), Mrk 335 (Longinotti et al. 2013), NGC 3783 (Mehdipour et al. 2017), ...

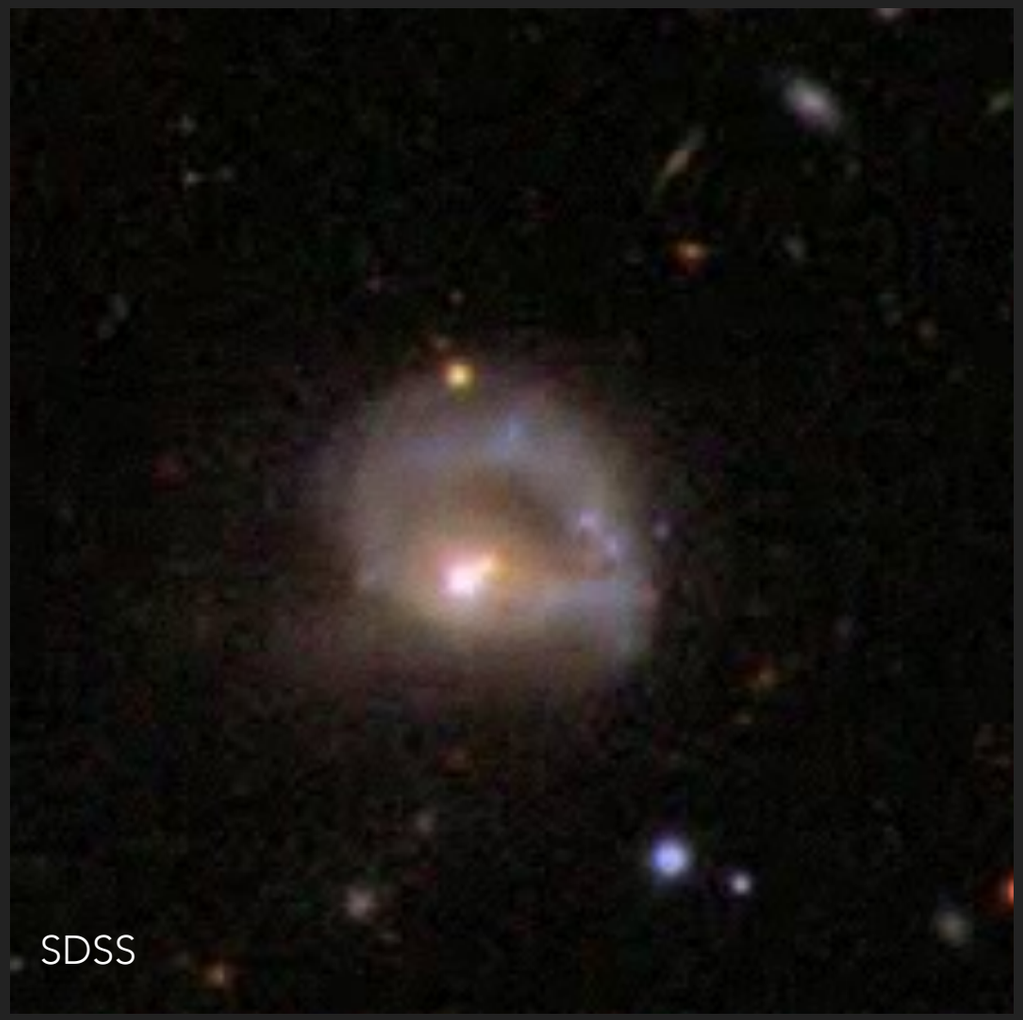
- Systematic analysis of RXTE fluxes and HR of AGN revealed 12 obscuration events in 8 sources out of a sample of 55 (Markowitz et al. 2014).

- Limited to obscuring columns $>10^{22}$ cm^{-2} so, if occultations by lower column absorbers are considered, the occurrence of this phenomenon could be even higher.



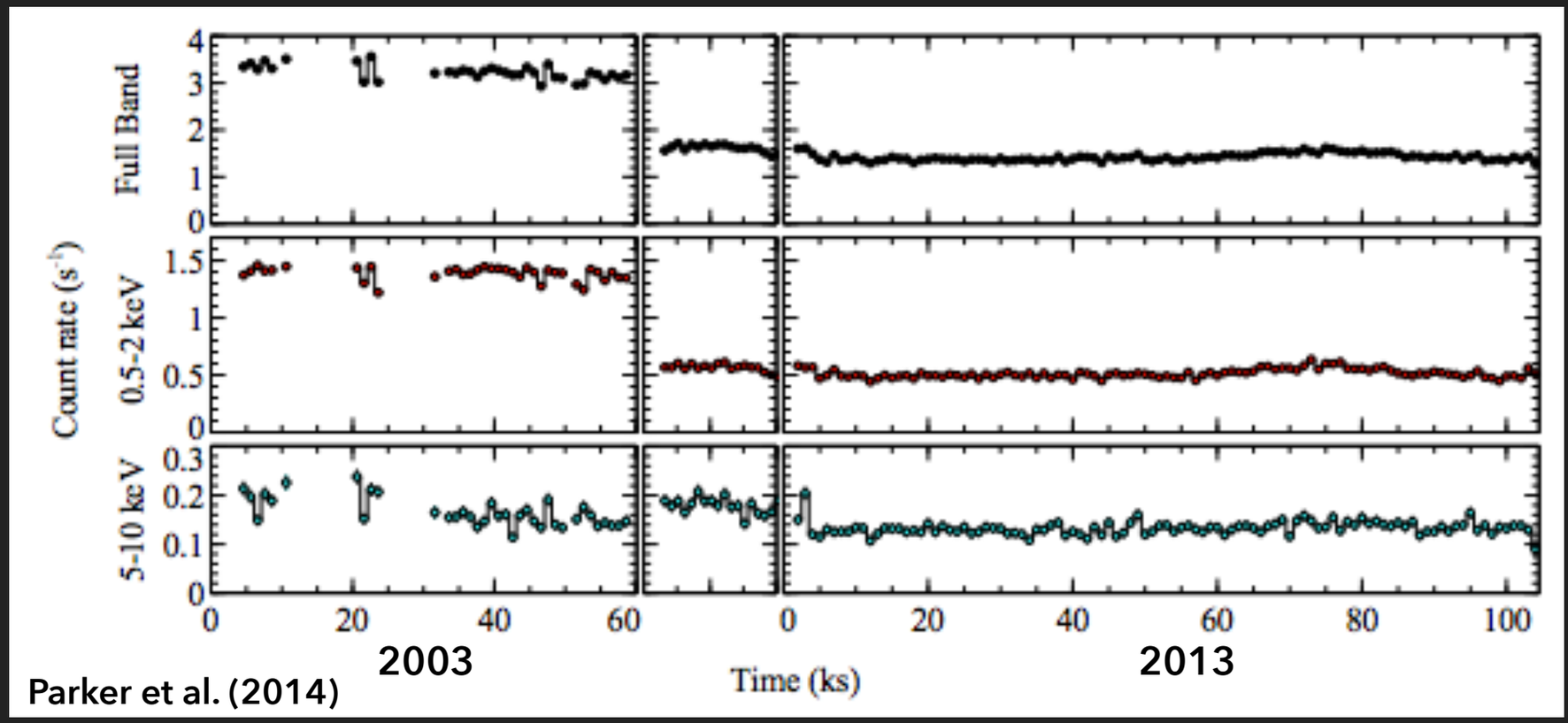
Markowitz et al. (2014)

NGC 985



- Seyfert 1 galaxy at z = 0.043.
- Ring-shaped structure, signature of a past merger event. Secondary nucleus at ~3.5 kpc; only the primary is active.
- Strong star formation along the ring.
- Known to host a multi-component warm absorber (WA) in both X-rays and the UV.
- Ionised gas with different levels of ionisation outflowing at velocities of ~100 - 1 000 km/s, detected as absorption troughs superimposed to the continuum.

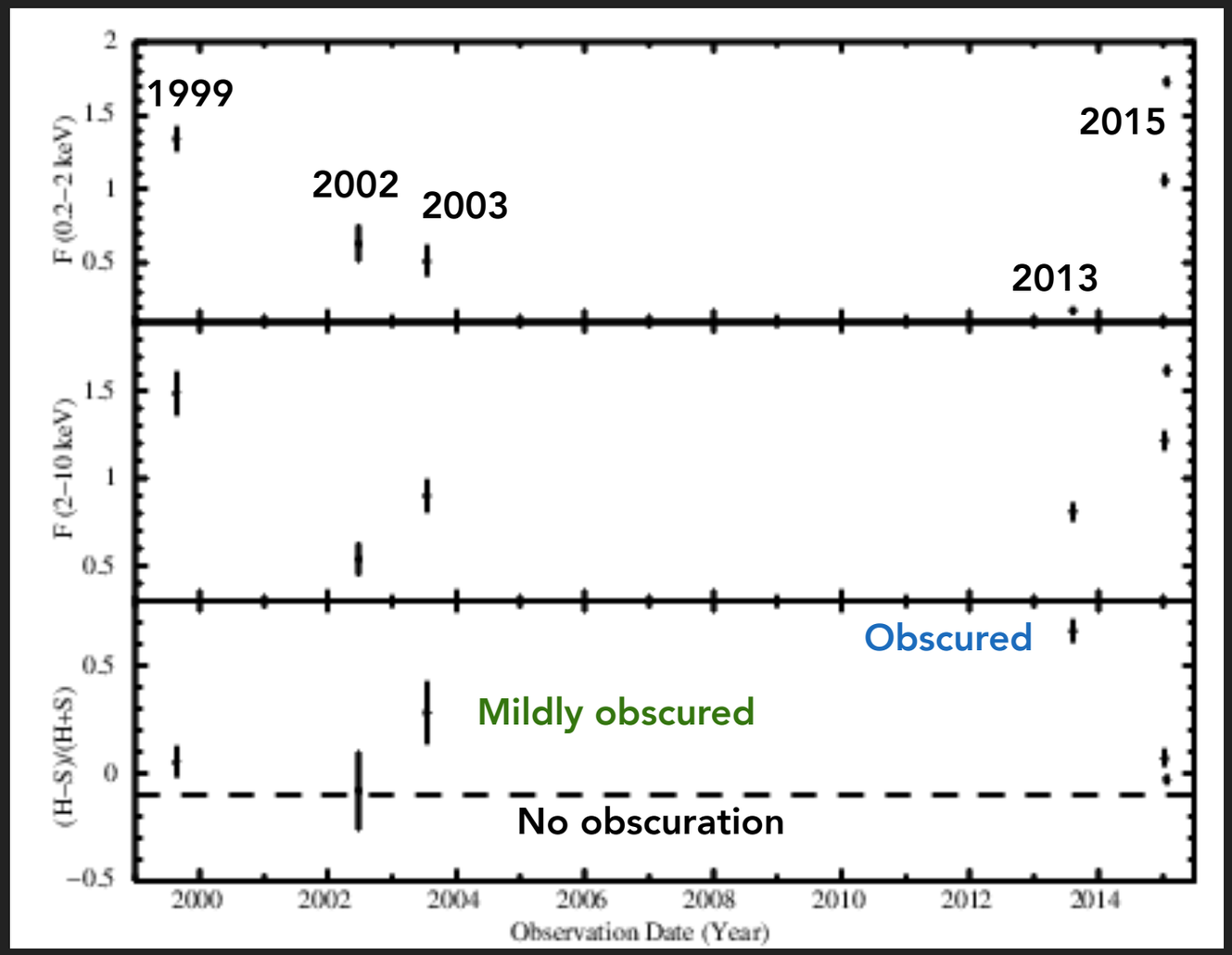
X-RAY LIGHTCURVES



Parker et al. (2014)

- NGC 985 was found in a low soft X-ray flux state (3 times lower than historical fluxes) in 2013 while the hard X-ray flux kept similar values.
- An XMM-Newton + HST observations were triggered founding an additional obscuration due to neutral gas (Parker et al. 2014).

X-RAY LIGHTCURVES

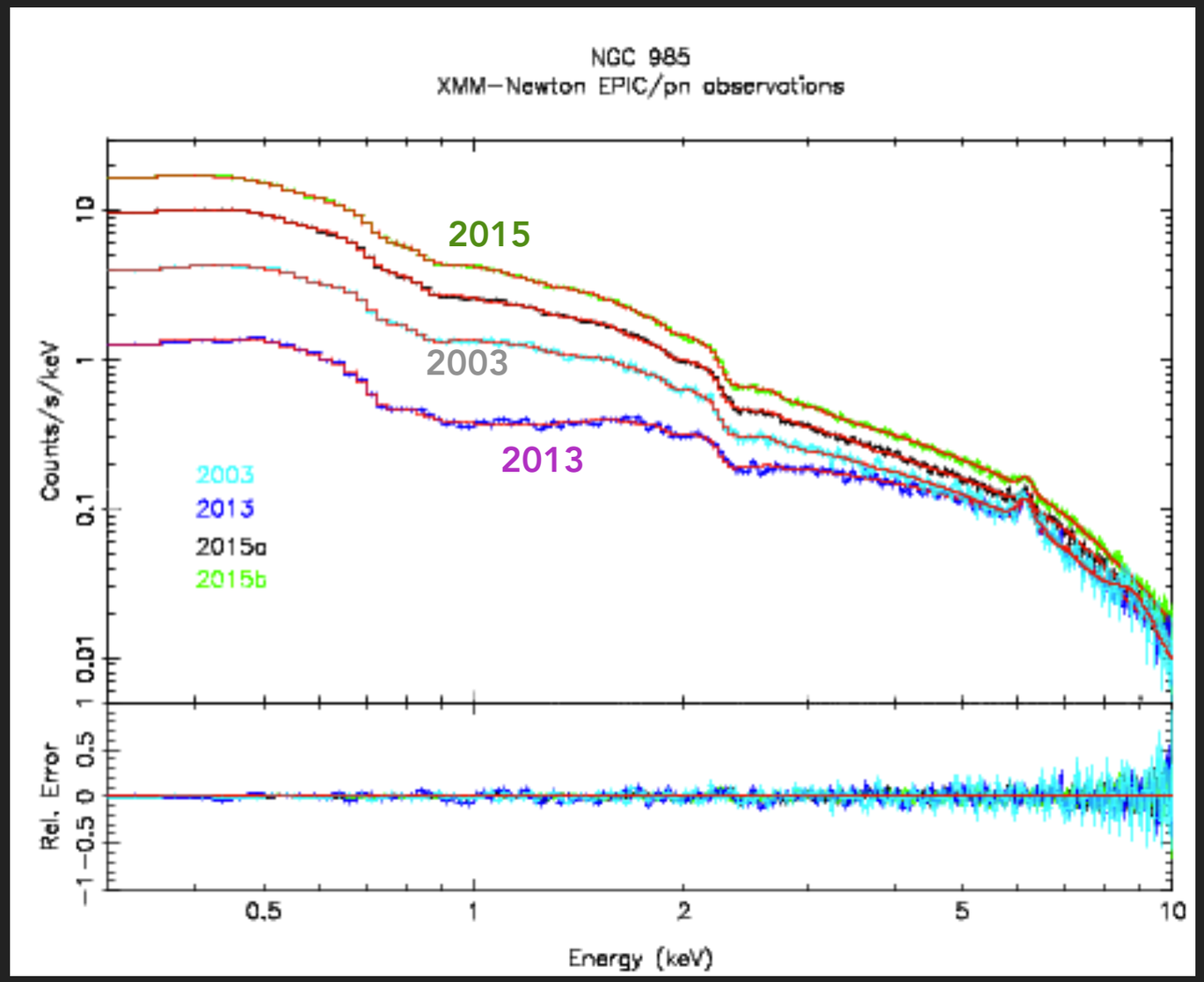


Ebrero et al. (2016)

- In 2015 the source emerged from the obscured state of 2013.
- In 2003 the source was somewhat obscured while in 2002 it was unobscured.
- This points out to a recurrent phenomenon.

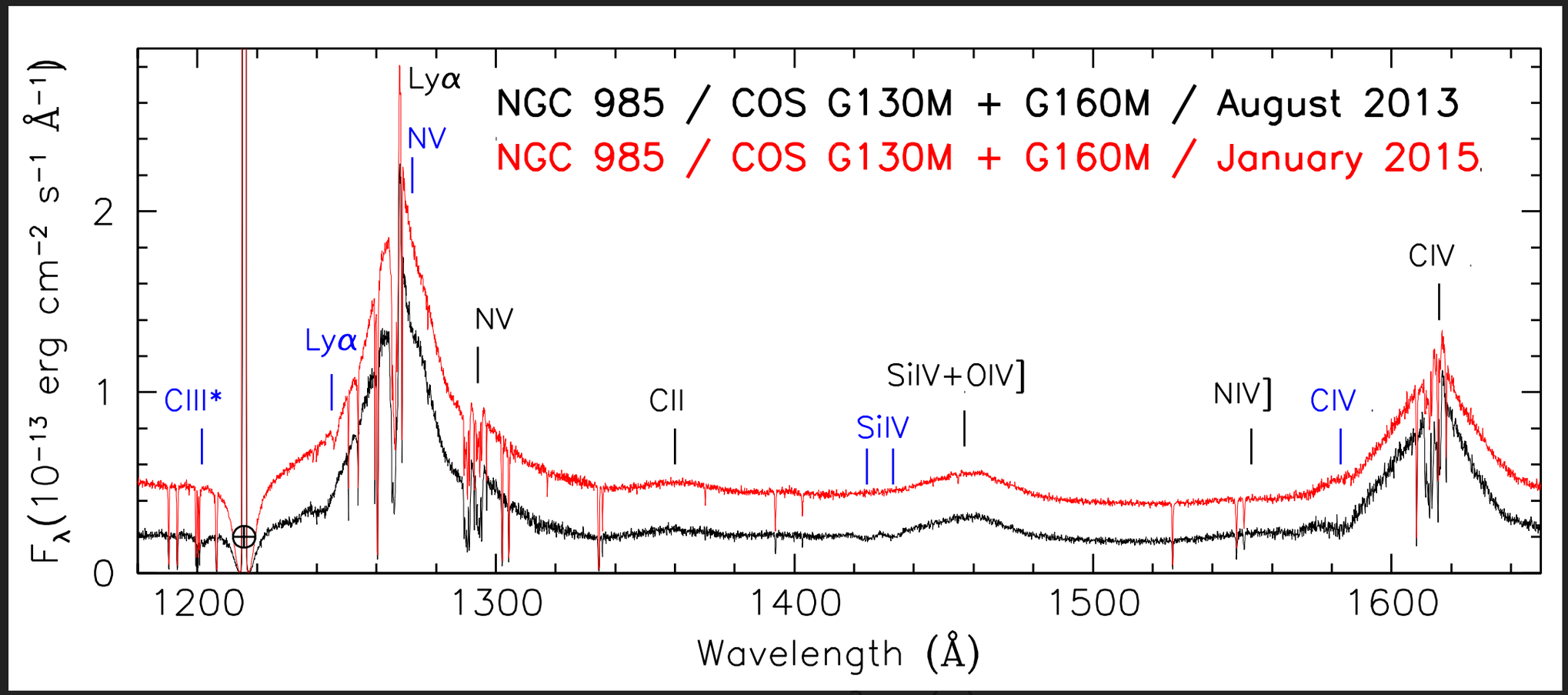
THE BROADBAND X-RAY SPECTRA

- Fits to the EPIC-pn spectra require absorption from a multi-component WA plus and intervening mildly ionised gas with column densities of ~10^{22} cm^{-2}.
- Spectral changes can be explained just by variations in the covering fraction of this gas: 90% in 2013, 25-30% in 2015, and 65% in 2003.



Ebrero et al. (2016)

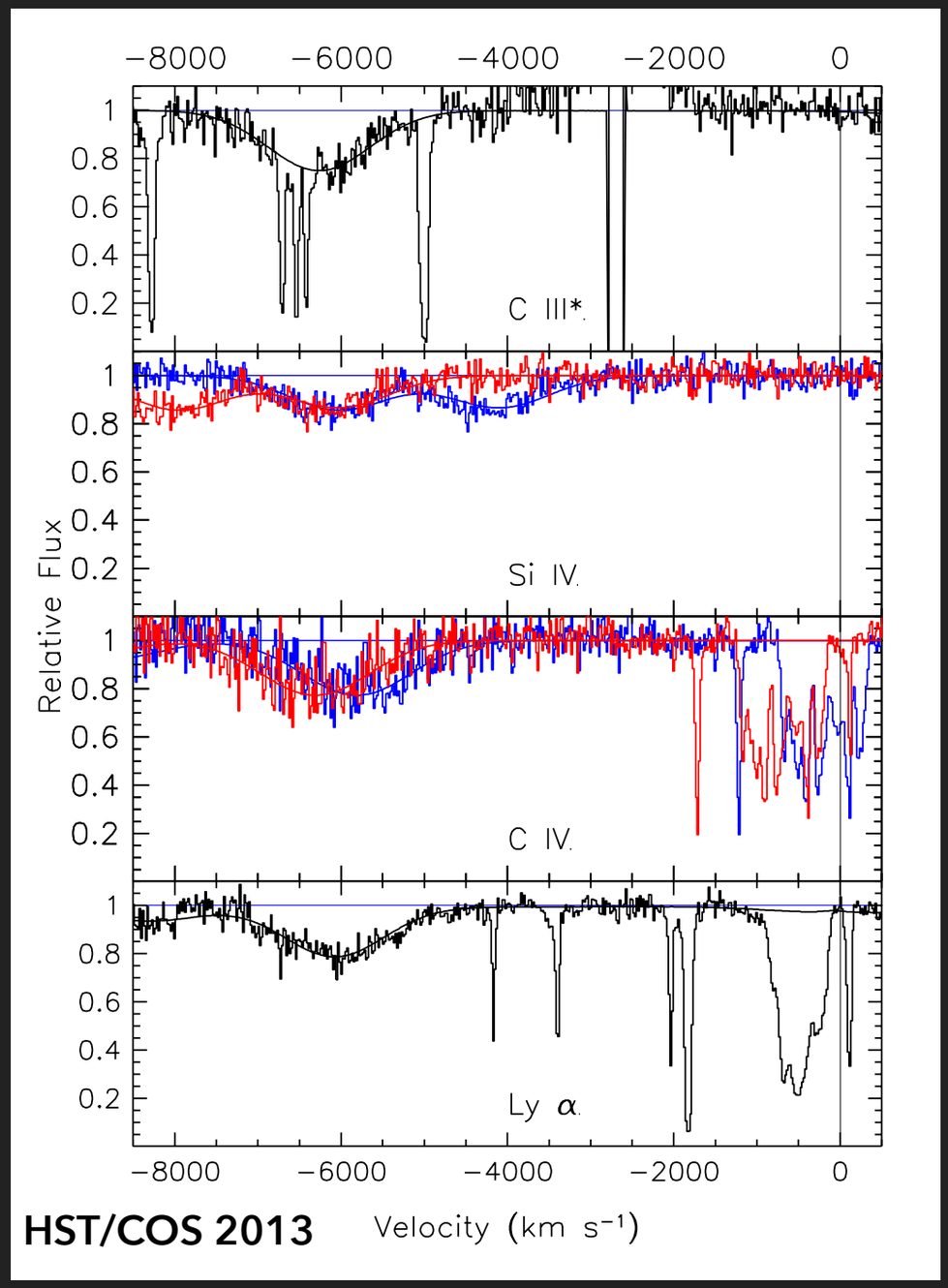
THE UV SPECTRA OF NGC 985



Ebrero et al. (2016)

- Emission lines are labeled in blue; broad absorption lines are labeled in black, more prominent in 2013.
- Only traces of C IV and Lyα in absorption are present in 2015.

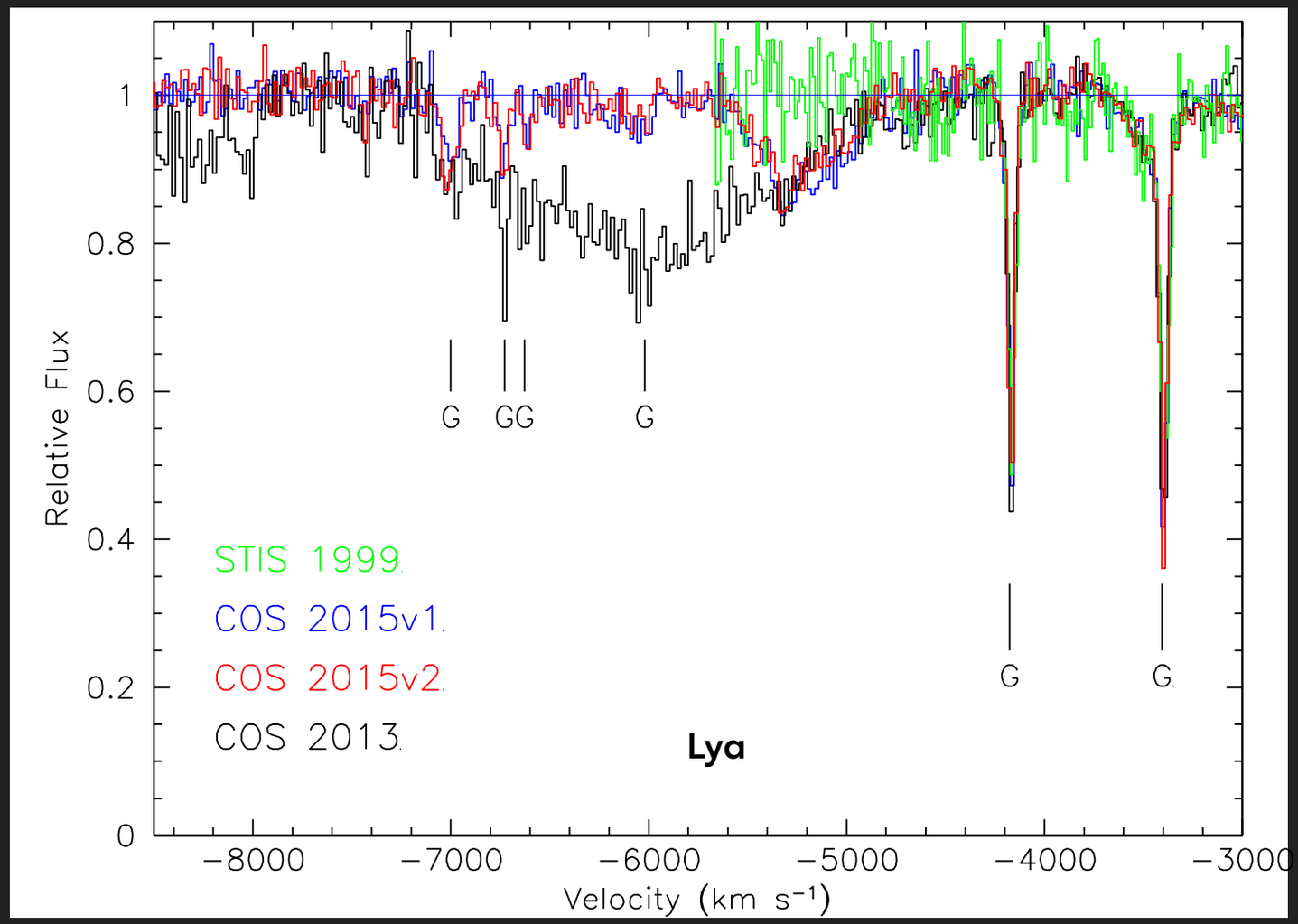
THE OBSCURER IN THE UV



Ebrero et al. (2016)

- The obscurer is outflowing at ~-6000 km/s; FWHM is 1430 km/s.
- Red and blue components of the Si IV and C IV doublets are close to saturation.
- The obscurer only partially covers the UV source (10-30%).
- Low ionisation states compatible with gas with log ξ ~ 0.5.

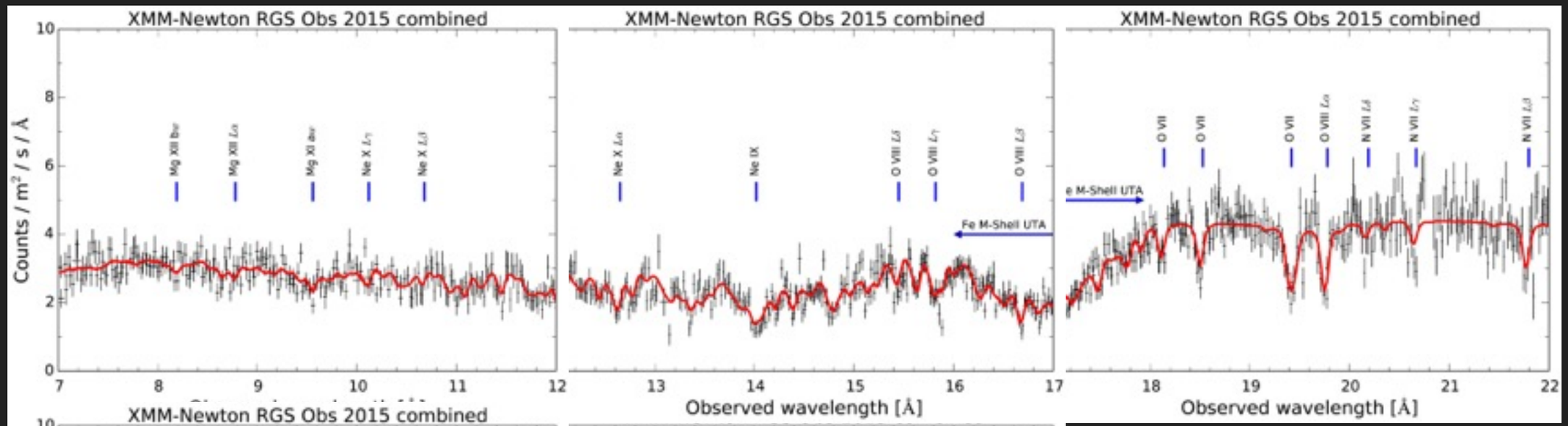
THE OBSCURER IN THE UV

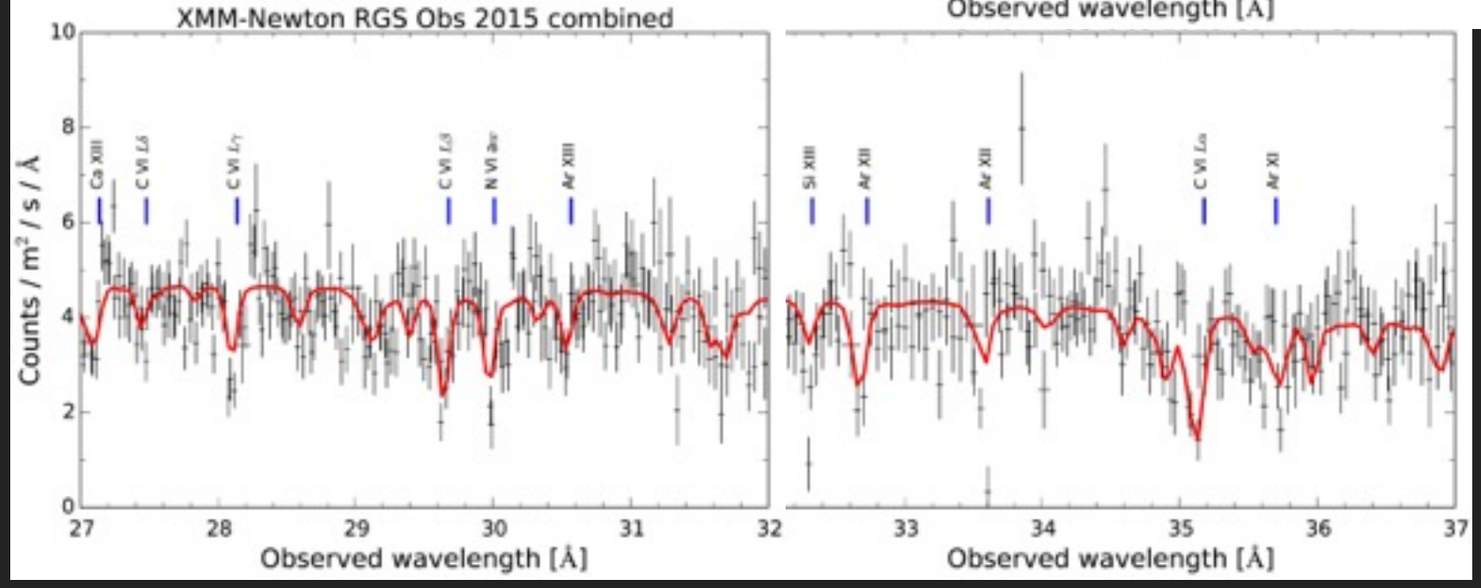


Ebrero et al. (2016)

- No signatures of obscuration in 1999. Strong obscuration in 2013, almost gone (but not quite entirely!) in 2015.
- This possibly indicates a recursive event.

X-RAY WARM ABSORBERS IN NGC 985



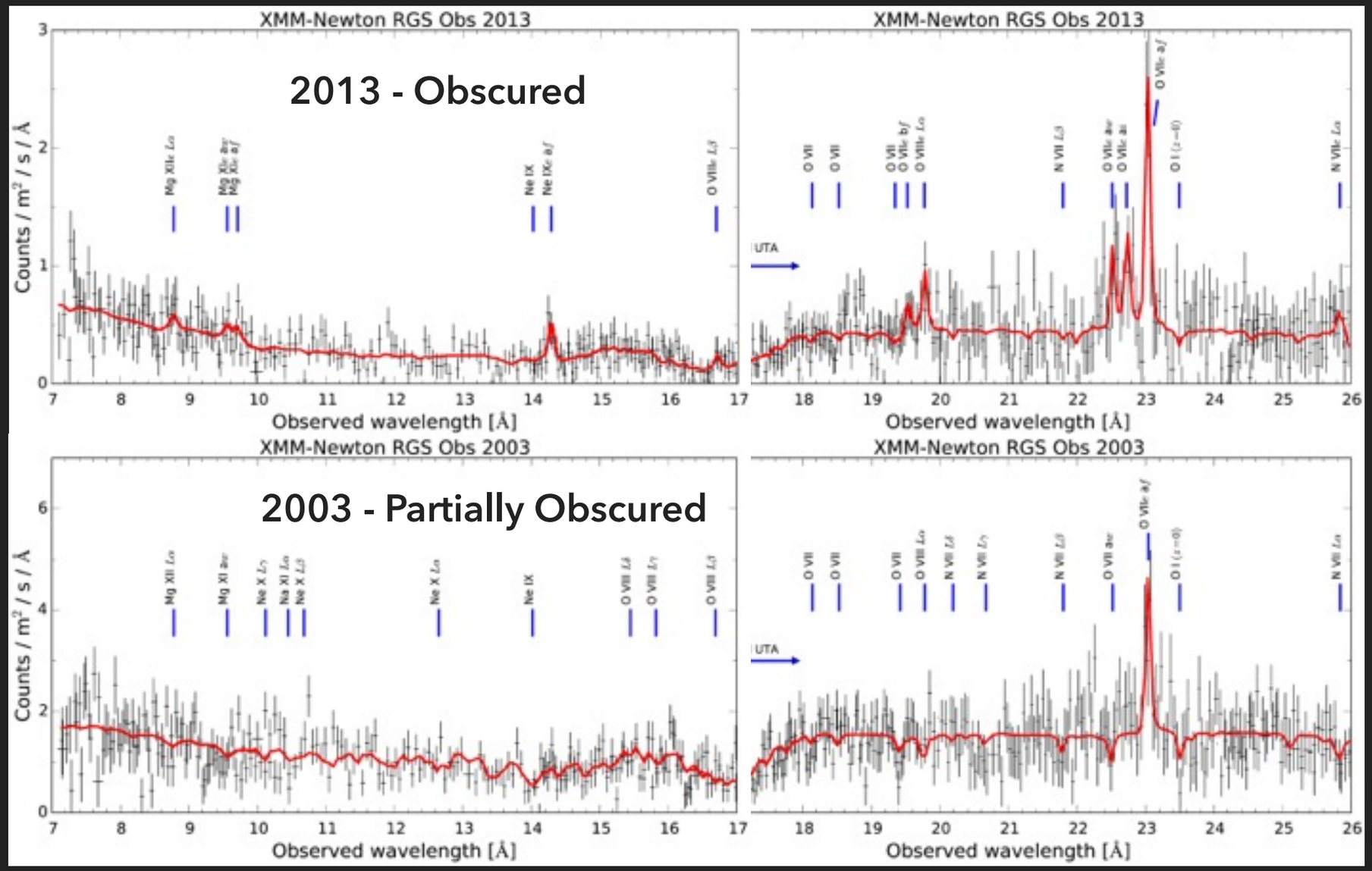


Ebrero et al. (2017), in prep.

- Multi-component WA, with log ξ in the range 1.5 - 2.8.
- Outflow velocities in the range -350 to -5000 km/s.
- Deep absorption troughs, with $N_H \sim 10^{21}$ to 2×10^{22} cm^{-2}.

The fastest WA component share a lot of properties with the obscurer, except for the ionisation state. Clouds being ionised again or trailing cometary structure?

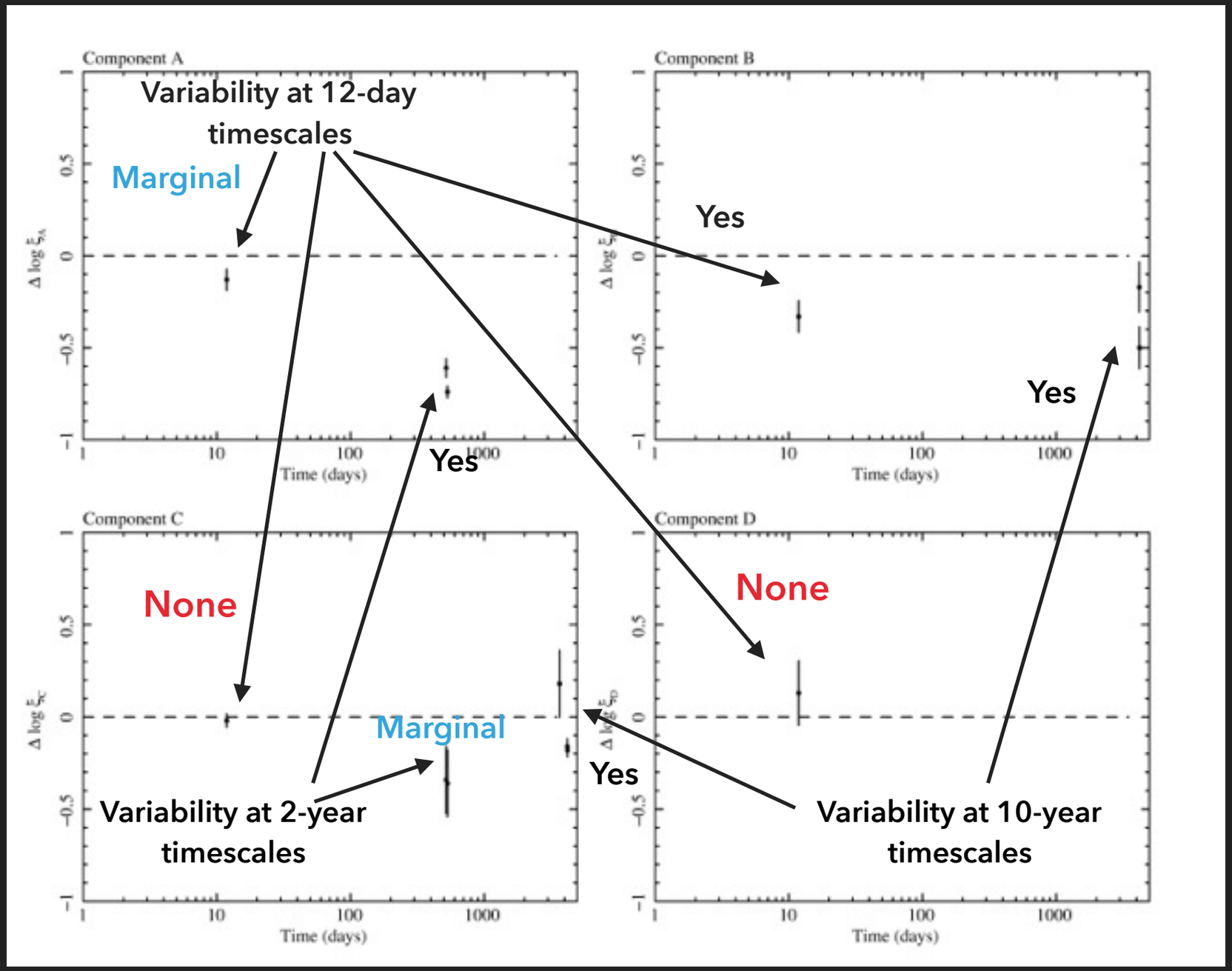
(OBSCURED) X-RAY WARM ABSORBERS IN NGC 985



Ebrero et al. (2017), in prep.

- The suppressed continuum makes the detection of WA features challenging.
- Some components can be significantly detected, albeit in a lower ionisation state with respect to 2015.

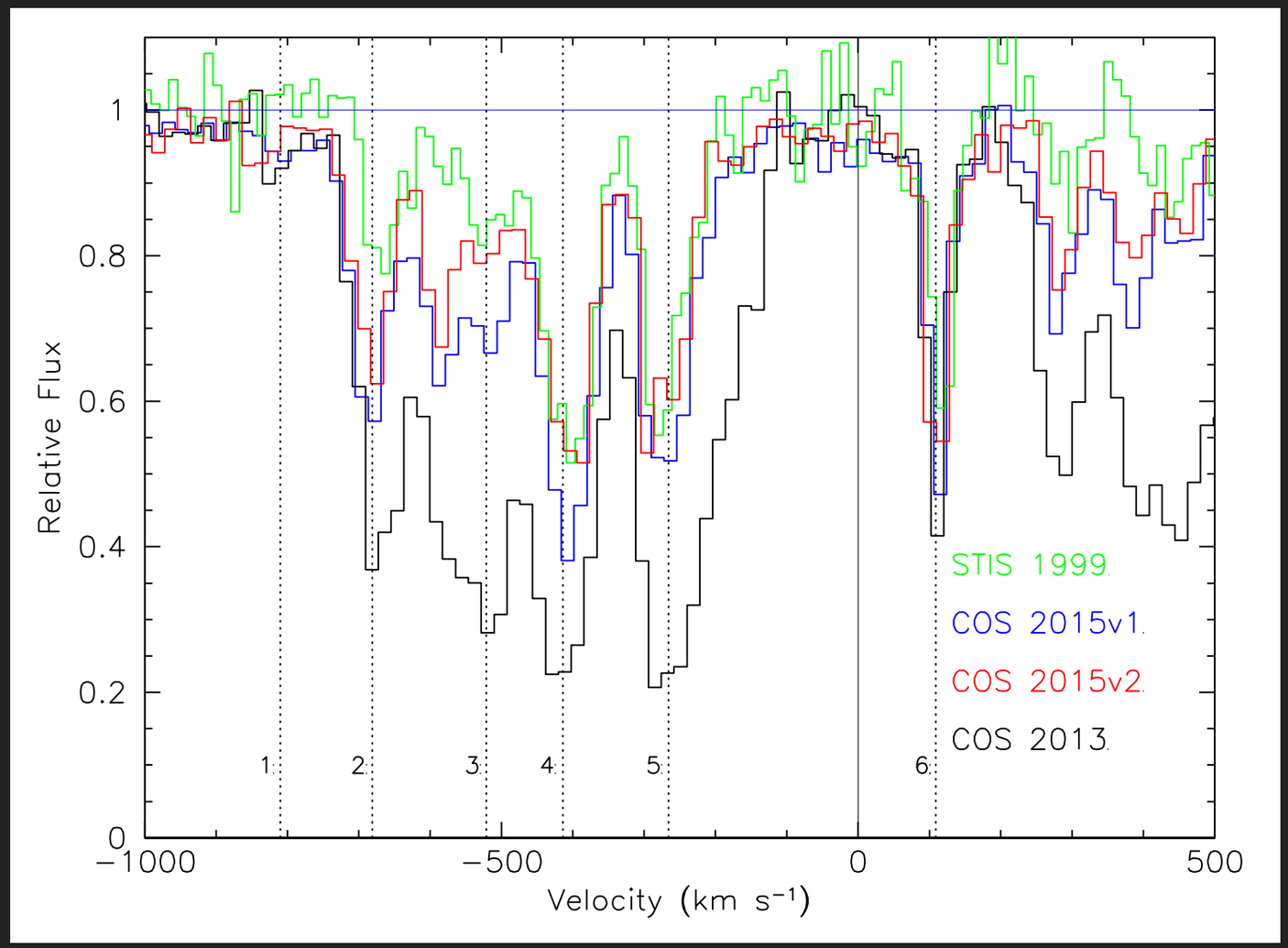
LOOKING FOR VARIABILITY IN THE WA



Ebrero et al. (2017), in prep.

- WA components are located at pc to tens of pc distances.
- Keep in mind we are just looking at snapshots in the life of the AGN.

LOOKING FOR VARIABILITY IN THE UV



Kriss et al., in prep.

- Persistent narrow absorption lines in Lyα, N V, and C IV, possibly associated with the lowest ionisation X-ray WA.
- Troughs vary in concert with changes in the continuum flux.
- Changes can be measured on timescales as short as 12 days.

SUMMARY

- Transient obscuration events in AGN may be a common phenomenon.
- If monitored, they can provide unique information on the physical properties of the (ionised) gas in the surroundings of the AGN.
- Joint X-ray and UV observations are crucial to get the whole picture.
- Obscuring clouds launched close to the BLR effectively block the ionising continuum allowing to measure changes in the WA.