Transient iron fluorescence: new clues on the AGN disk/corona?

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in collaboration with:
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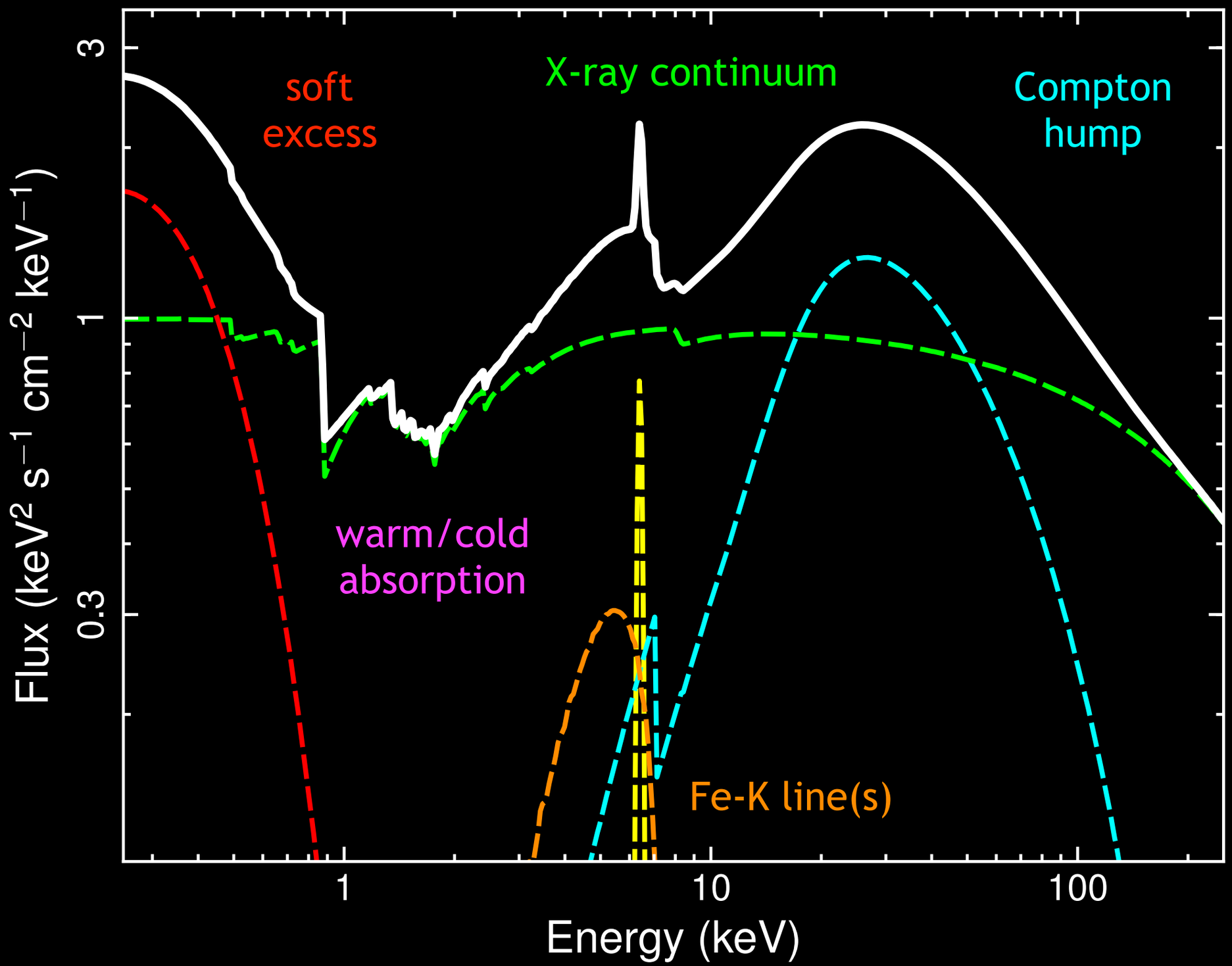
The X-ray Universe 2017 - Roma, 6-9 June 2017

AGN X-ray spectral energy distribution



Ark 120: the 'bare Seyfert' prototype

★ Nearest and brightest

D = 144 Mpc

$F_X = 7 \times 10^{-11}$ erg/s/cm^2

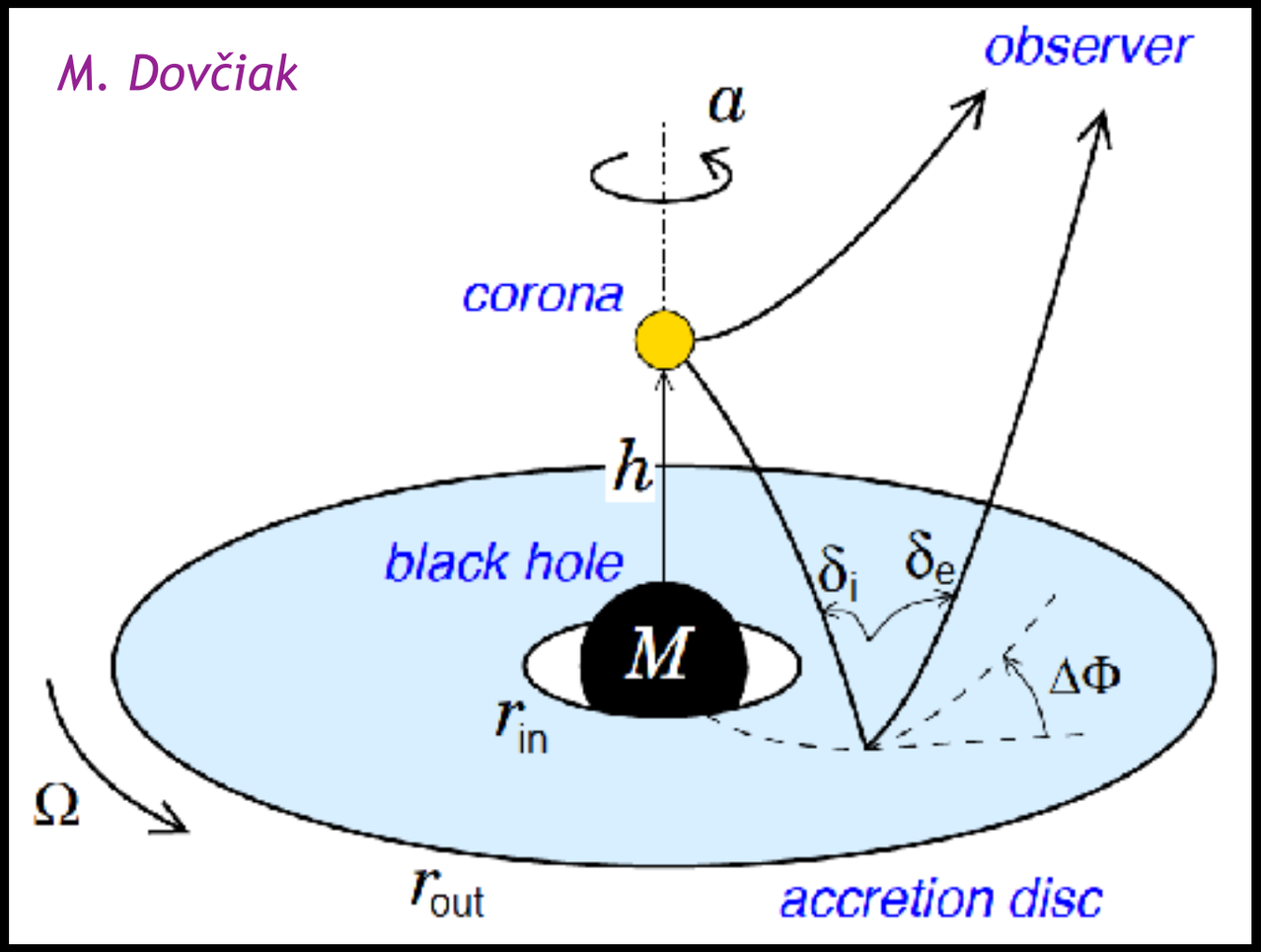
★ Bare line of sight *(Reeves+16b)*

$N_H <$ a few $\times 10^{19}$ cm^{-2}

★ BH mass known from reverberation mapping

$M_{BH} = 1.5 \times 10^8 M_{SUN}$

★ All X-ray spectral traits of a radiatively efficient SMBH



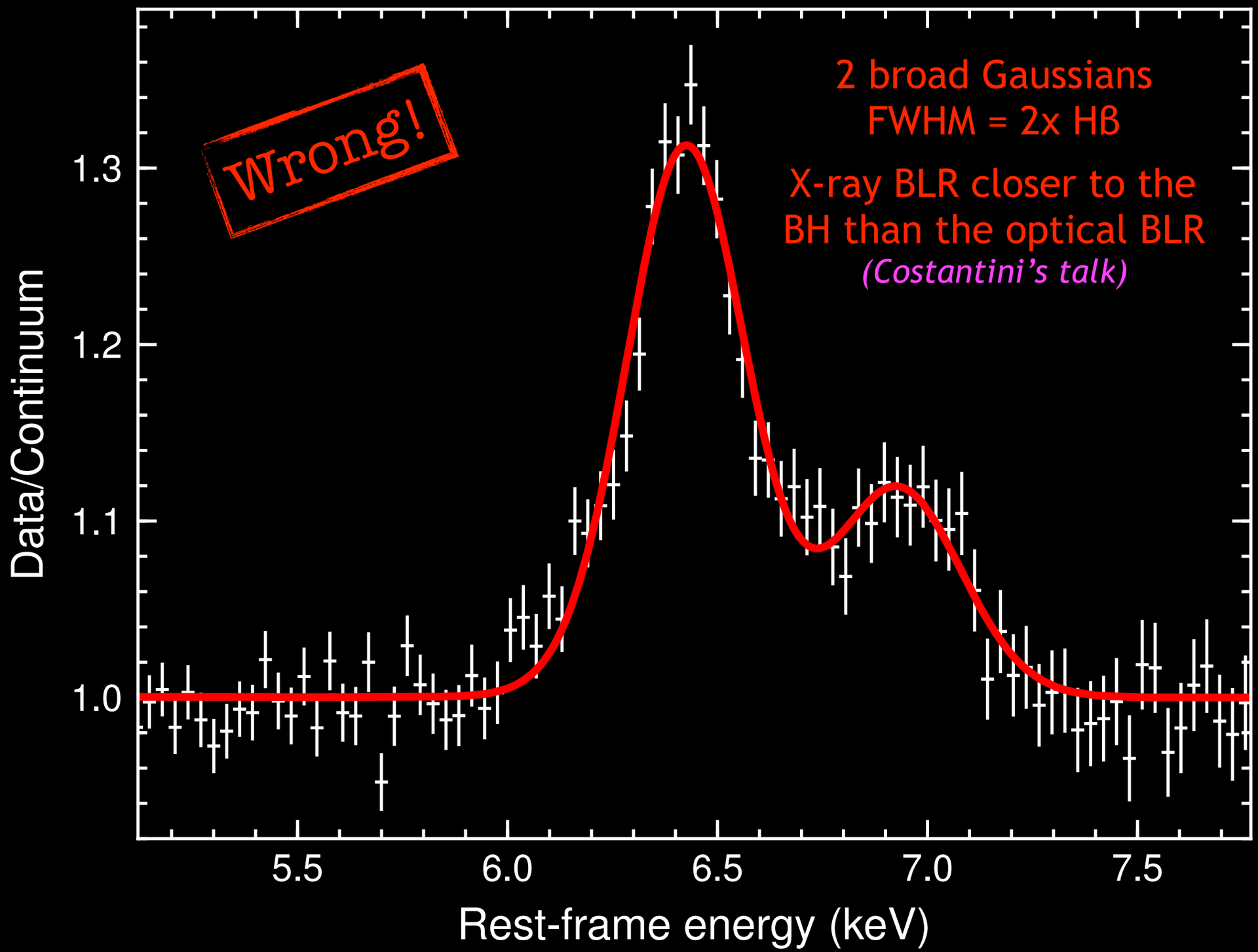
2014 X-ray campaign (PI: D. Porquet)

★ Four consecutive *XMM-Newton* orbits (7.5 days, net exposure 330 ks)

★ *Chandra* HETG spectrum overlapping with *XMM#2* + *XMM#3* (120 ks)

★ *NuSTAR* observation simultaneous with *XMM#3* (65 ks)

XMM time-averaged spectrum



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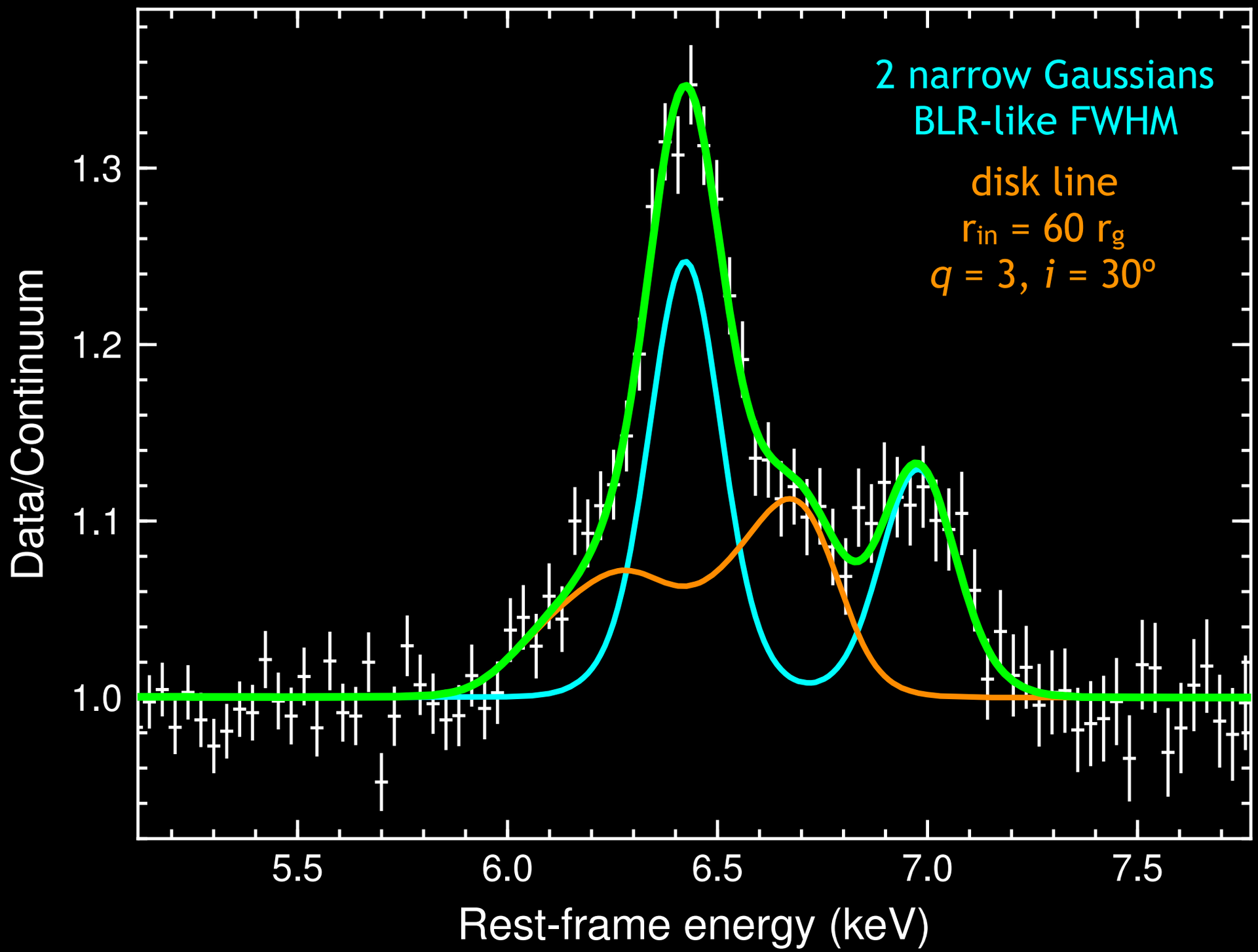

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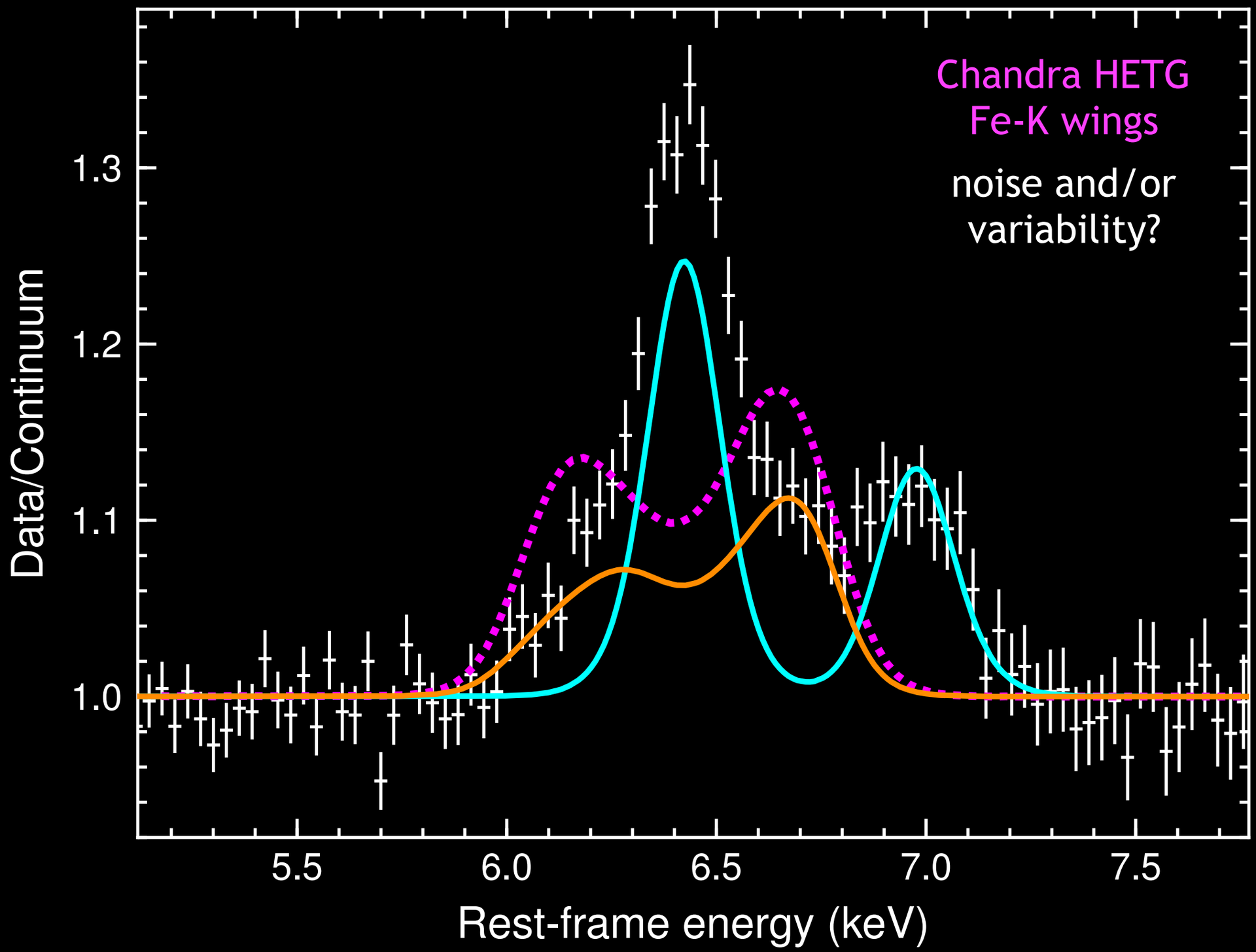
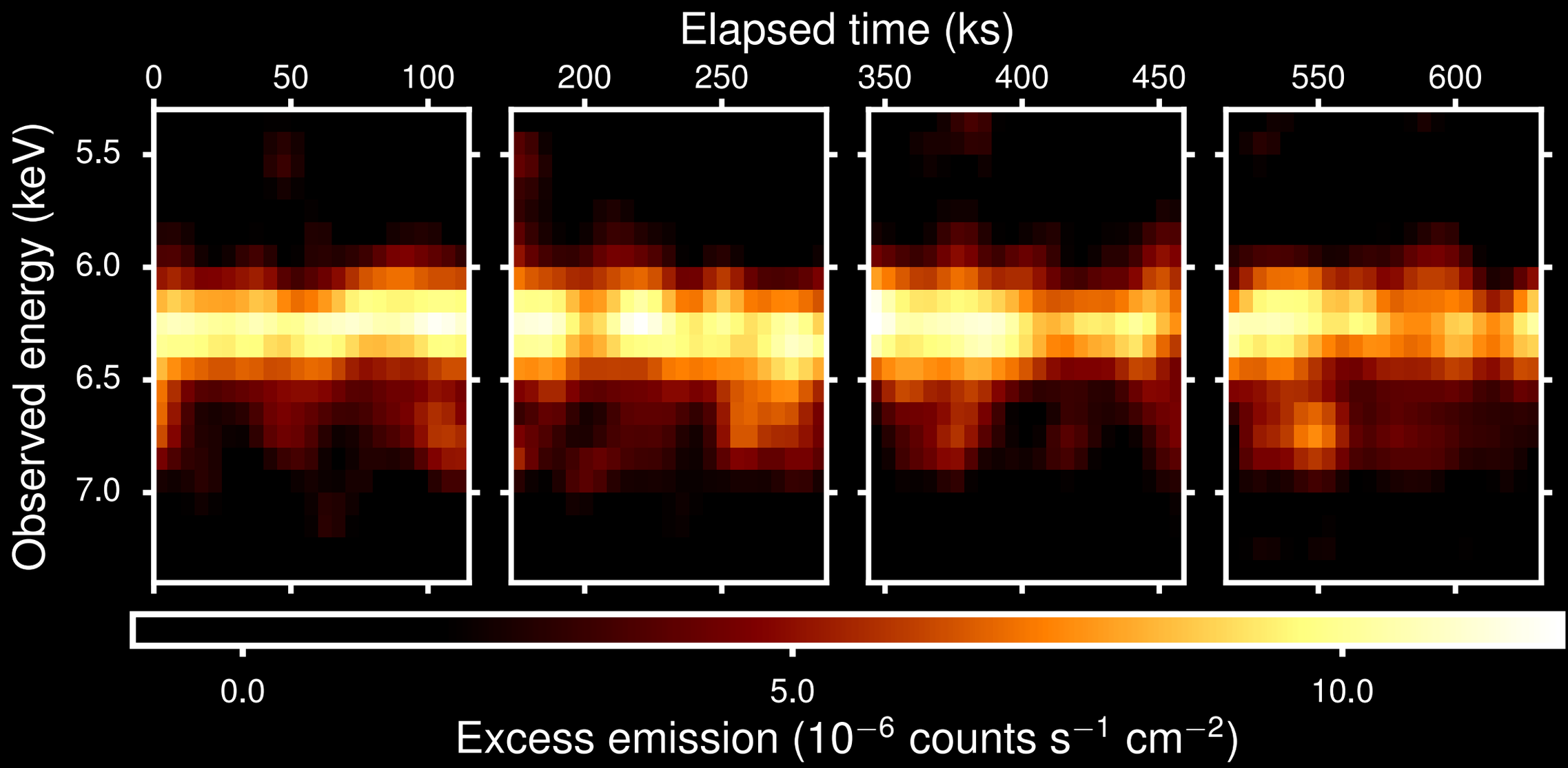


Fe-K variability, short timescales



Excess map technique, used to reveal energy/intensity modulation of Fe-K lines within long exposure observations, but at smaller BH mass *(Iwasawa+04, Turner+06)*

Energy vs. time resolution: 100 eV x 5 ks (orbital time at Kerr ISCO)
Image smoothing: elliptical Gaussian kernel with 250 eV x 15 ks FWHM

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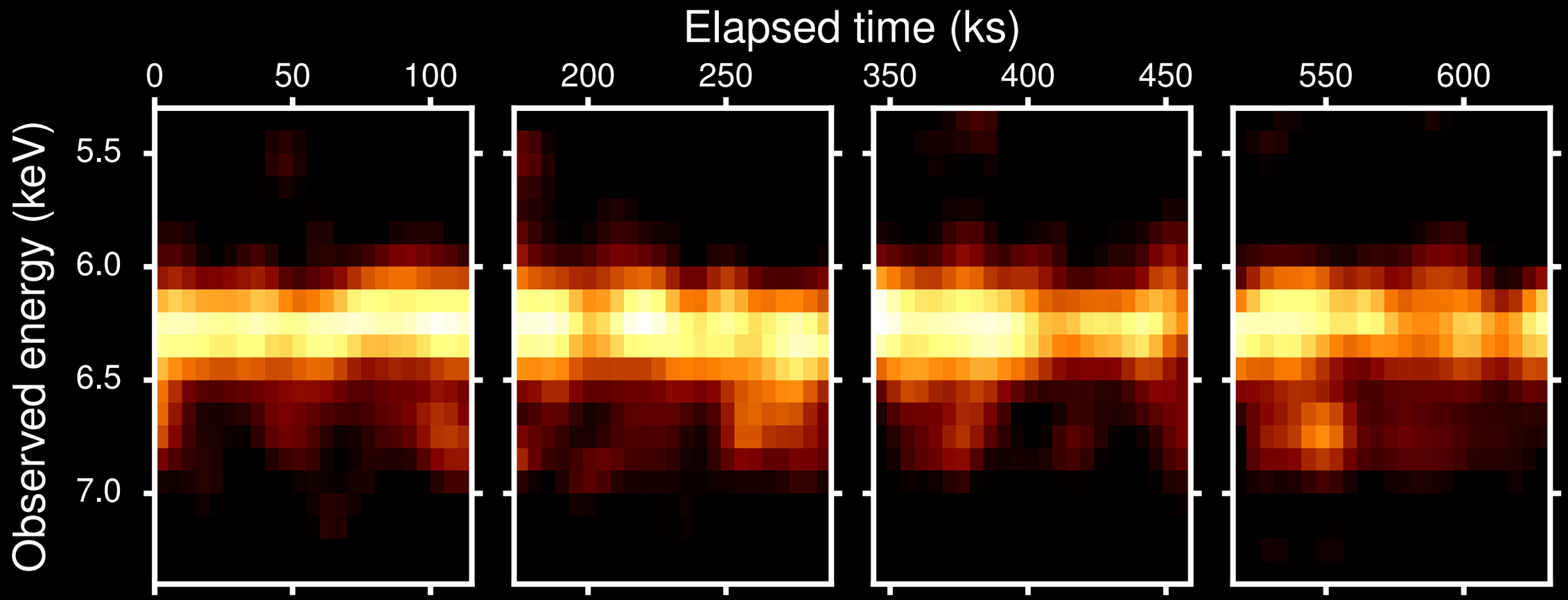

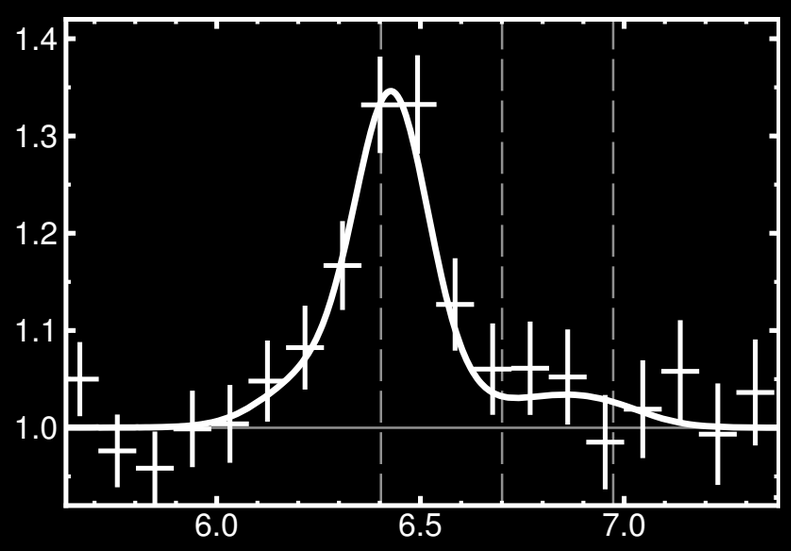

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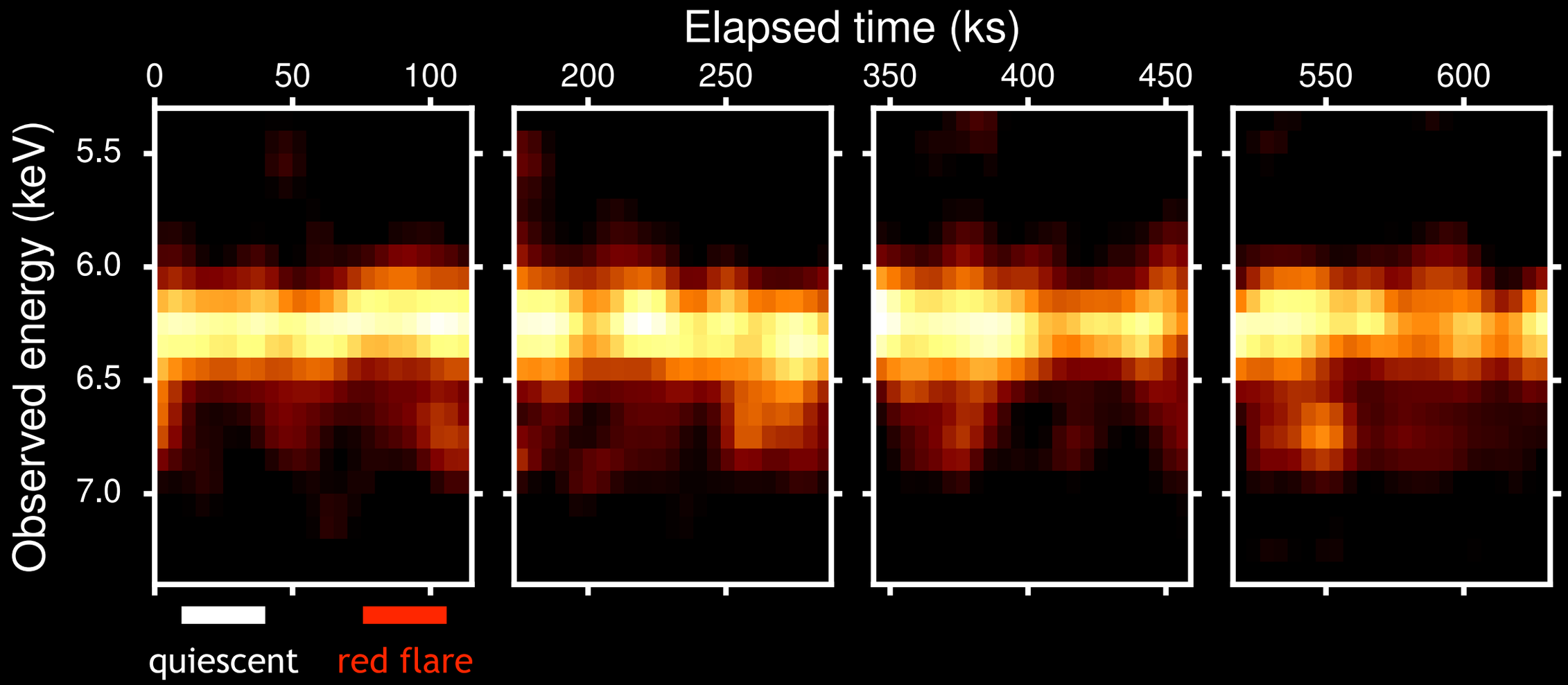

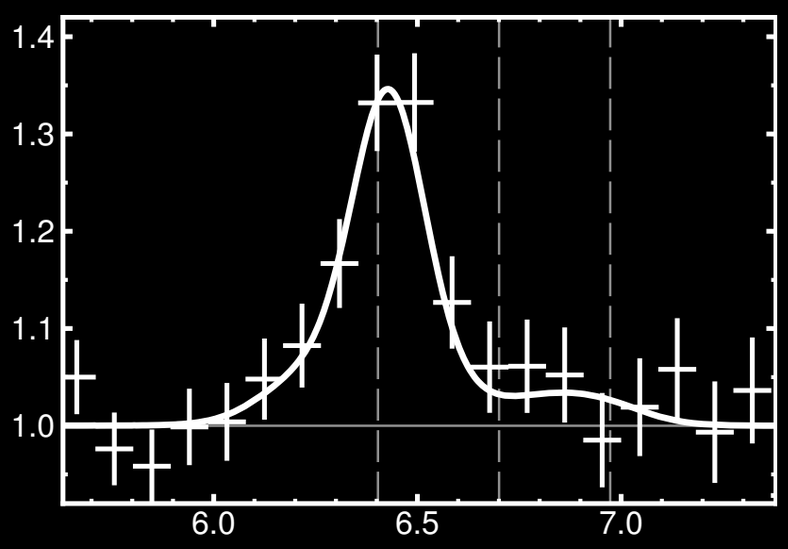

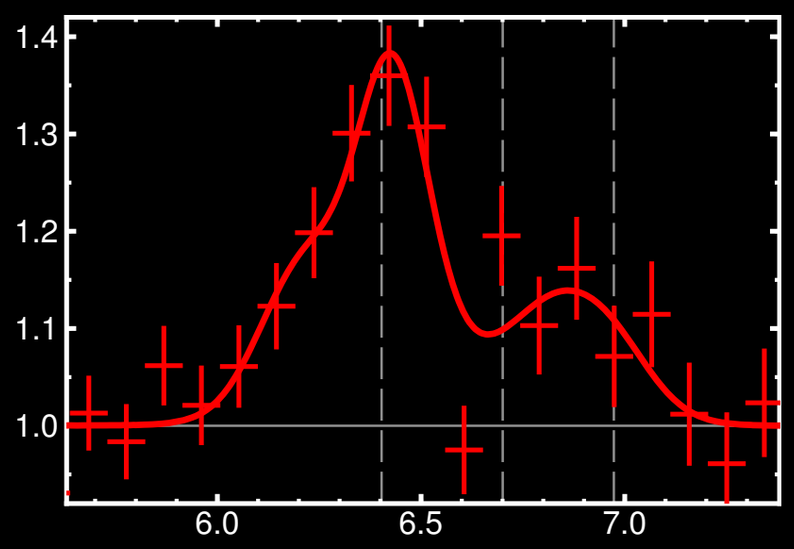

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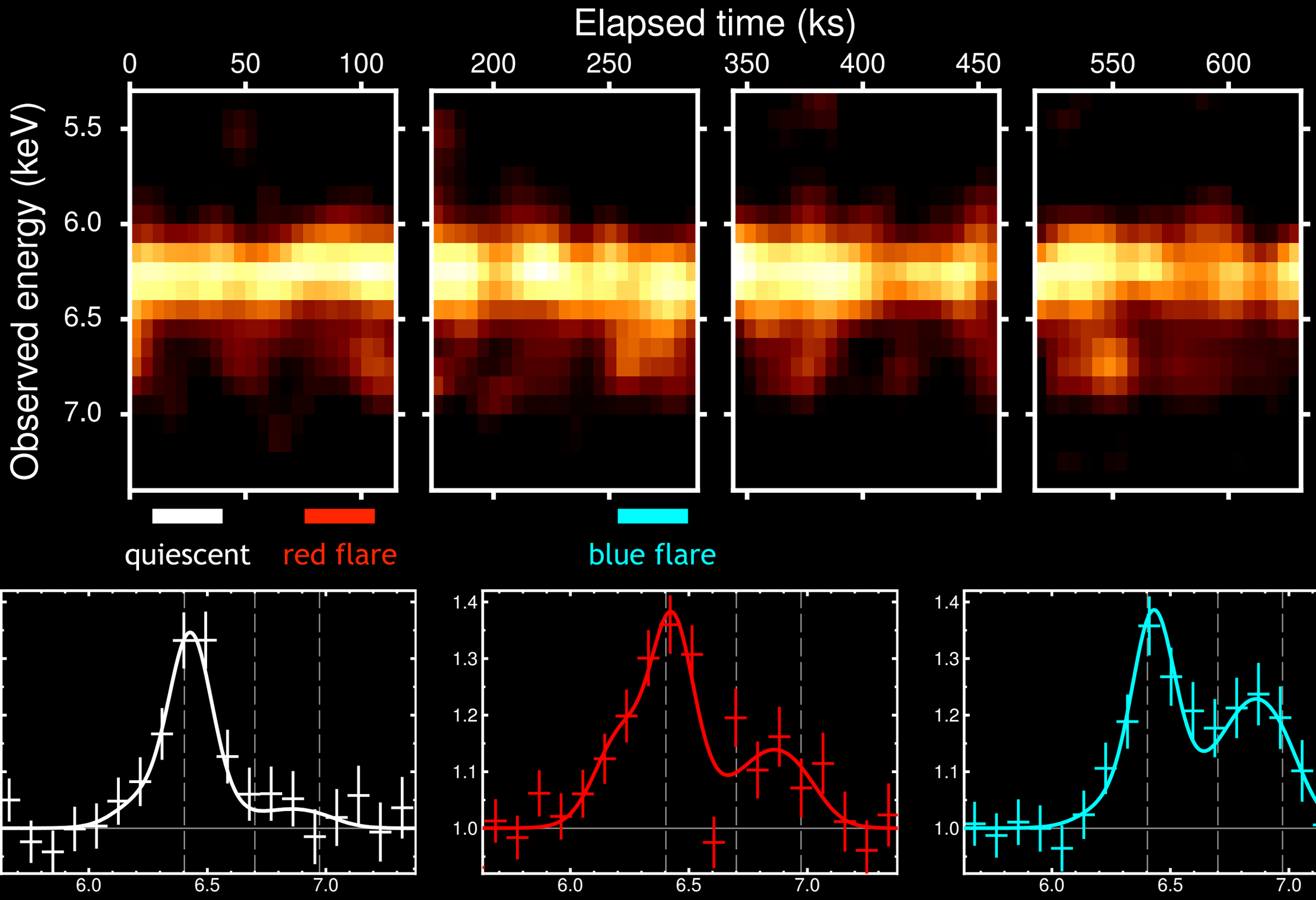
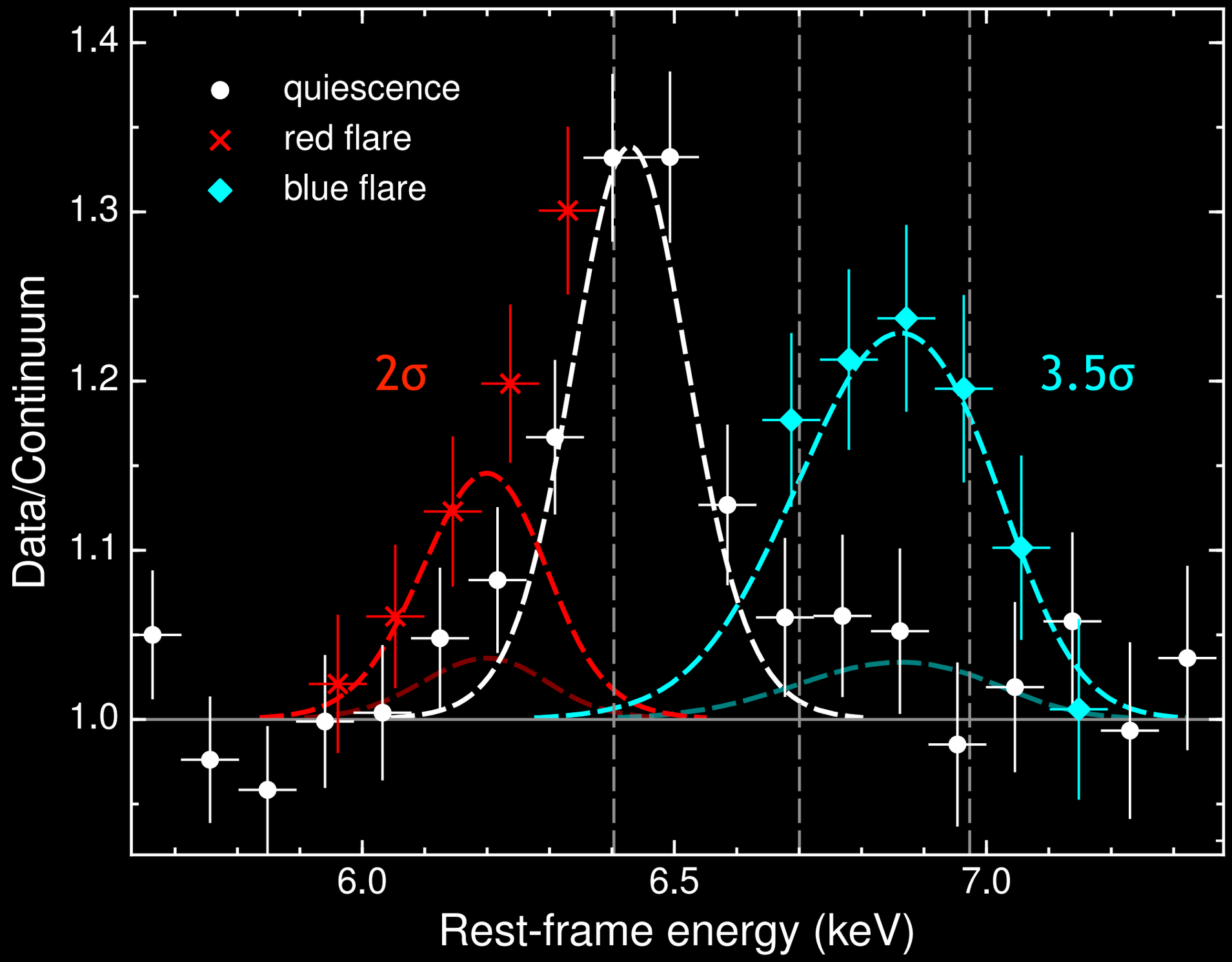
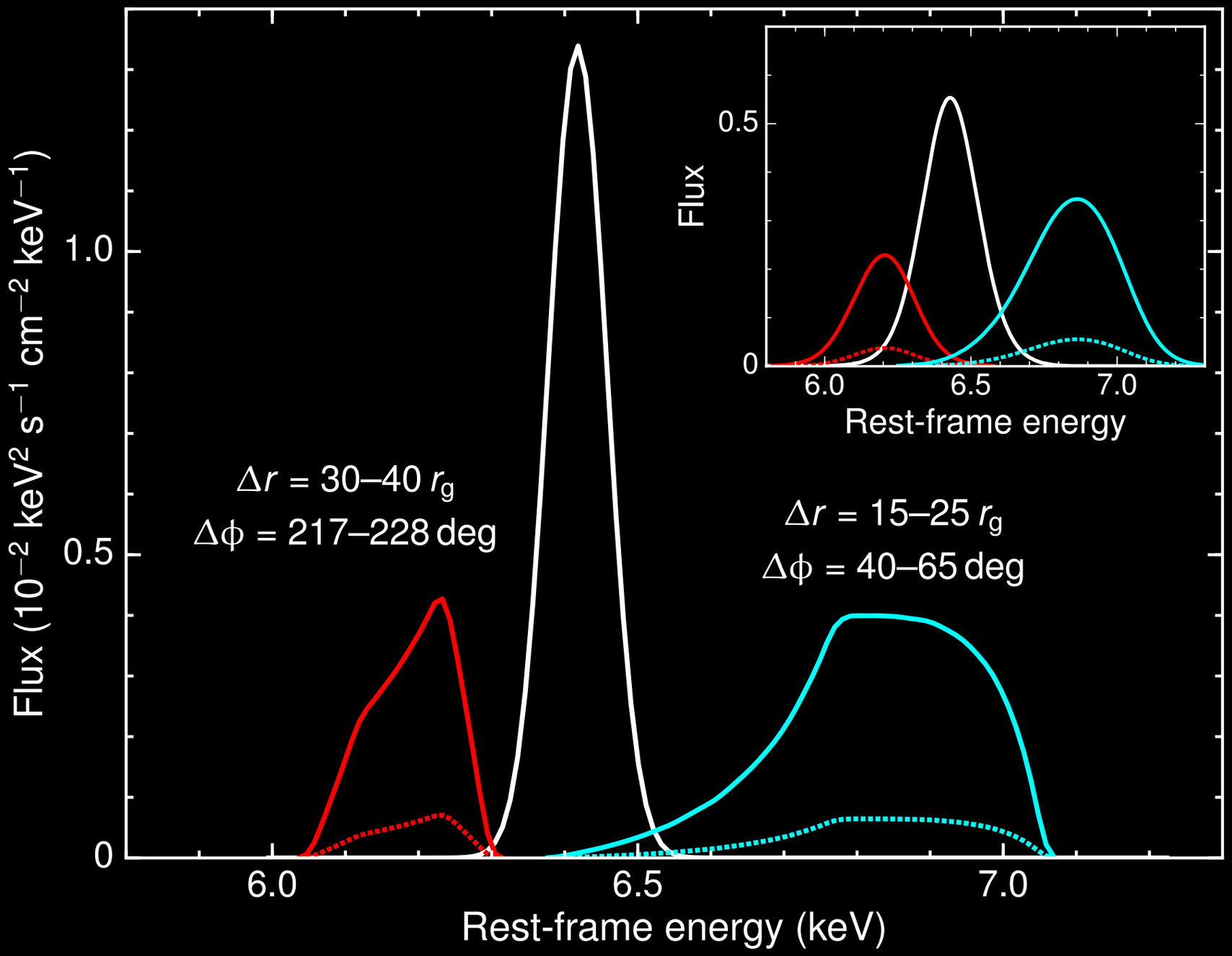


XMM time-resolved spectra



The ‘orbiting hotspots’ scenario

Transient red/blue structures with no obvious periodicity nor correlation with each other: short-lived, individual *hotspots* at several tens of gravitational radii?



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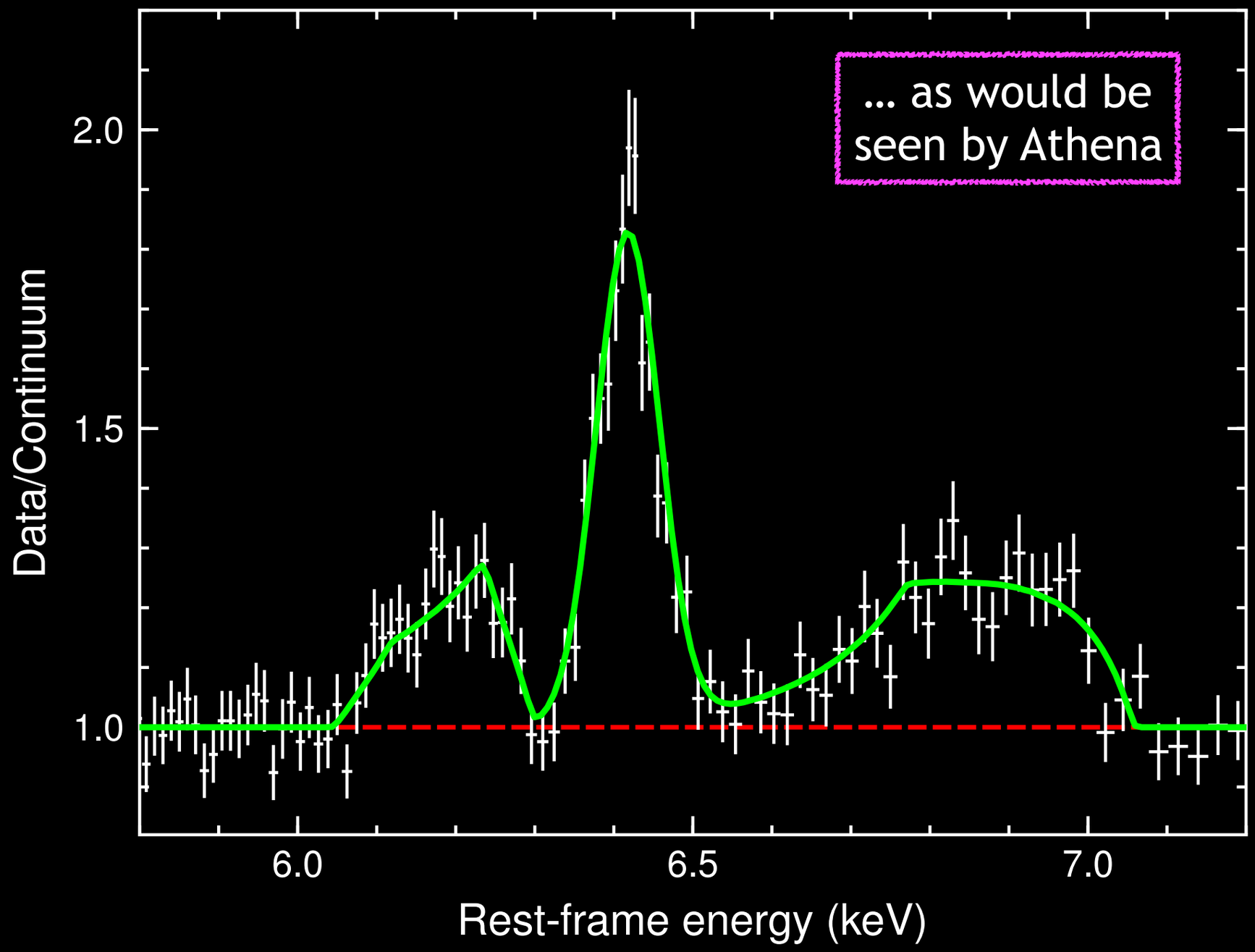

Implications on the AGN corona

Alternative explanations are still viable, e.g. *disk instability* (photon bubbles on suborbital timescales) or *hybrid corona* (no Fe-K feature from around the ISCO)

The broadband picture: *(Porquet's talk)*

Broad FeK feature and mild Compton hump (consistent with each other) suggest reflection in the disk at several tens of gravitational radii, while the soft excess might have a different origin (Comptonization in a warm, optically thick medium)

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MNRAS 448, 703–712 (2015) doi:10.1093/mnras/stu2524

The Comptonization of accretion disc X-ray emission: consequences for X-ray reflection and the geometry of AGN coronae

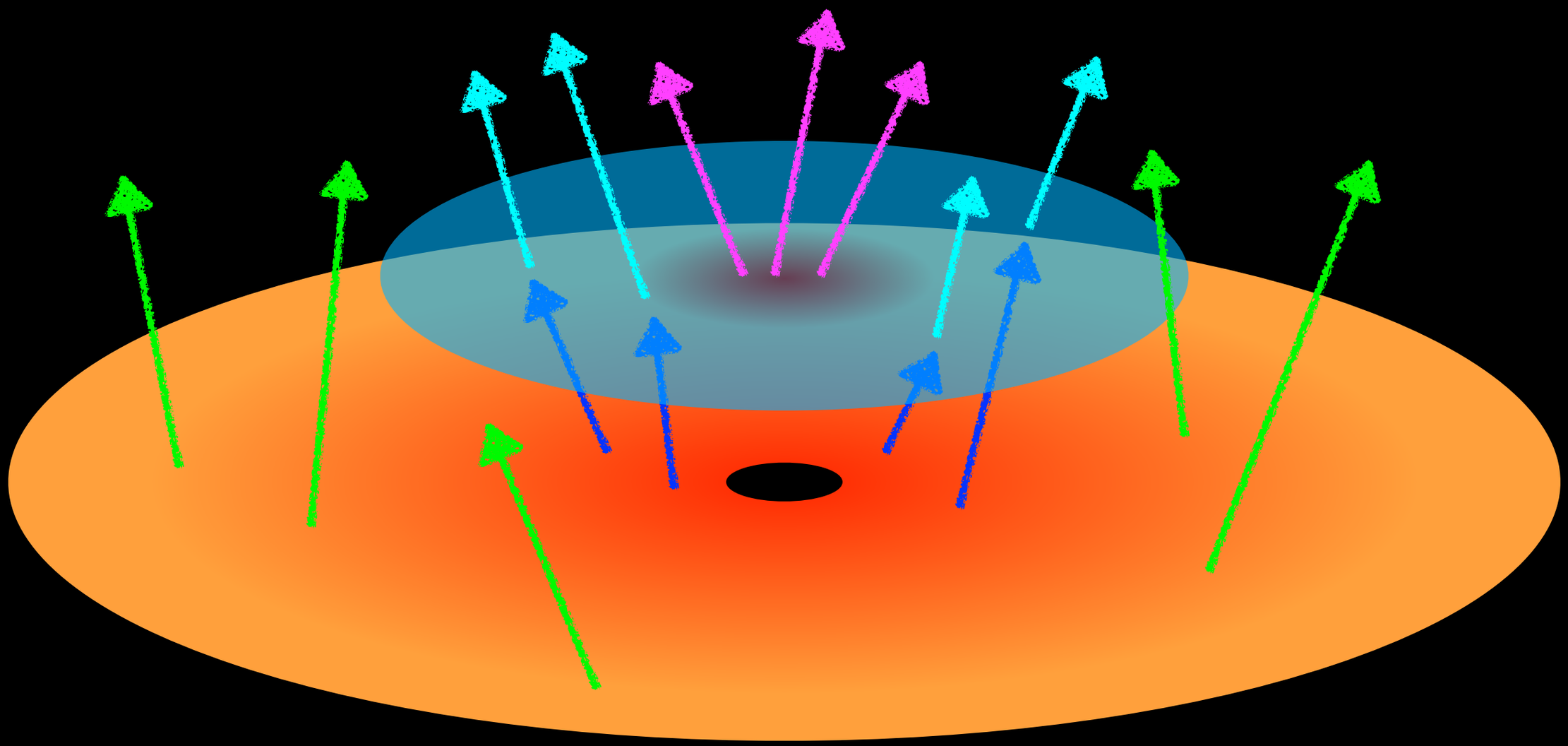
D. R. Wilkins*† and L. C. Gallo

The Astrophysical Journal, 836:119 (12pp), 2017 February 10 https://doi.org/10.3847/1538-4357/836/1/119

Self-consistent Black Hole Accretion Spectral Models and the Forgotten Role of Coronal Comptonization of Reflection Emission

James F. Steiner[1,6], Javier A. García[2,3,4,7], Wiebke Eikmann[4], Jeffrey E. McClintock[3], Laura W. Brenneman[3], Thomas Dauser[4], and Andrew C. Fabian[5]

A radially extended corona?



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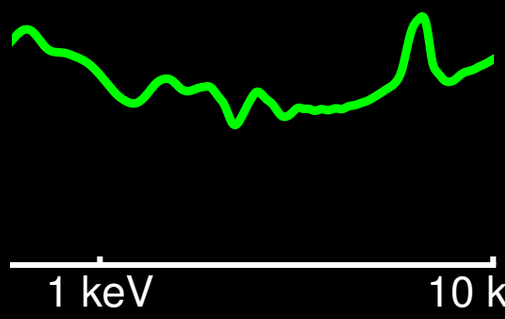

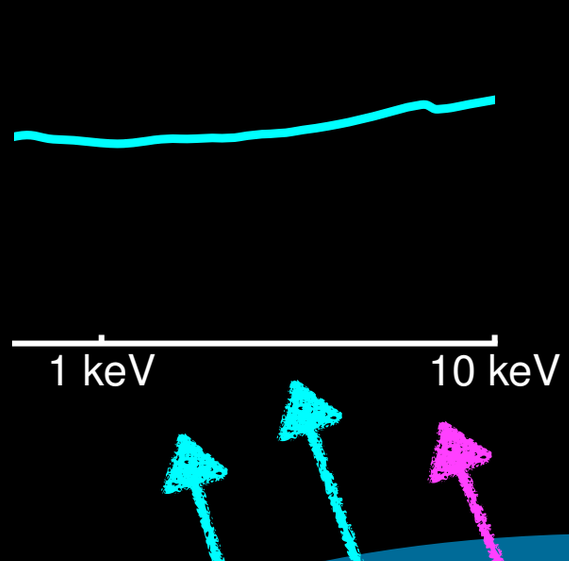

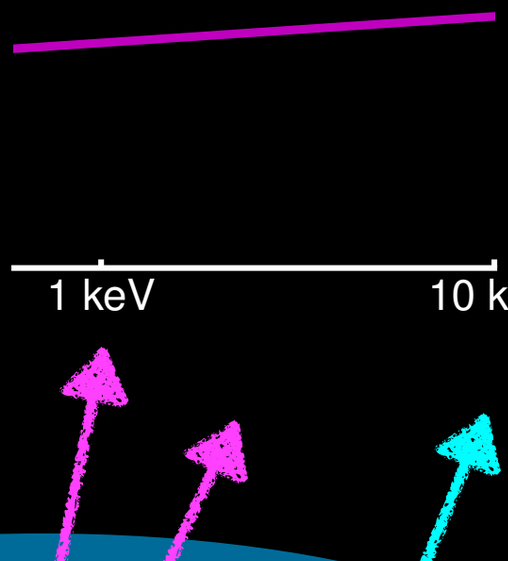

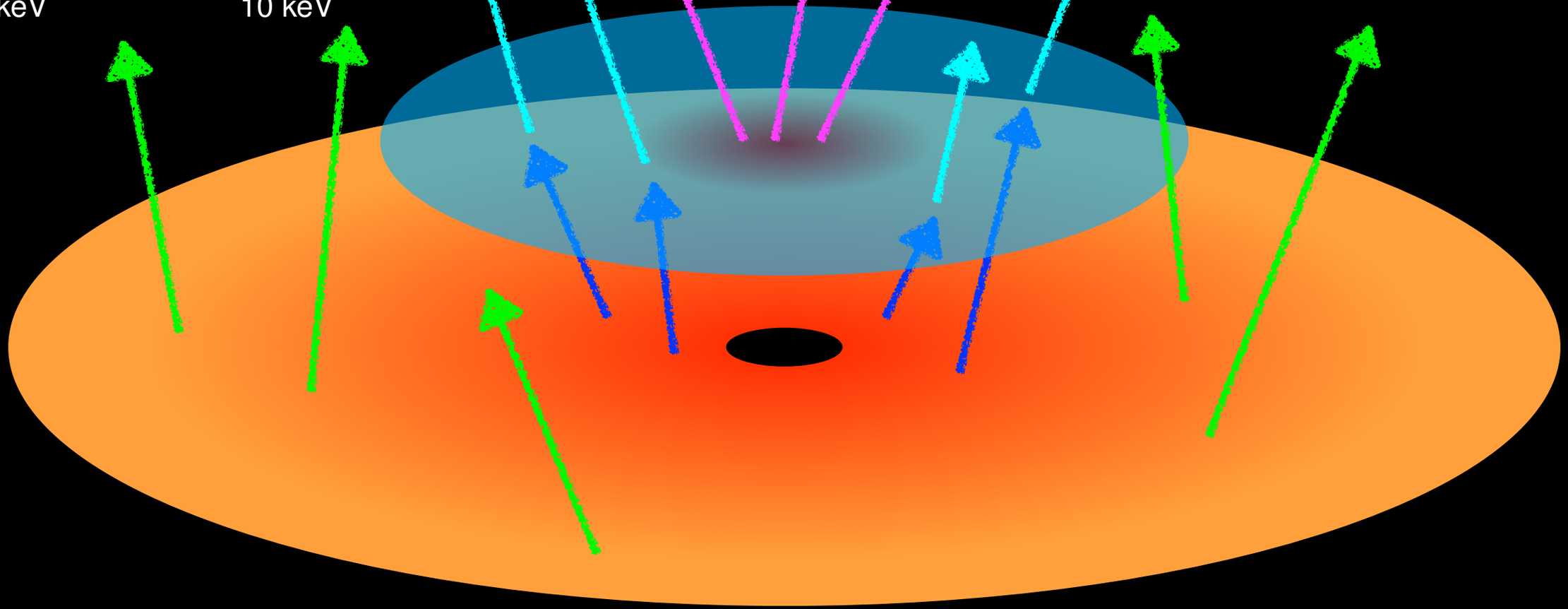

Porquet+ in prep.
and next papers in the Ark 120 series

Summary

★ Evidence for rapid (several tens of ks) variability of Fe-K fluorescence in the bare Seyfert Ark 120, compatible with flares/hotspots, inhomogeneity and/or instability

★ Are these physical conditions and the underlying processes common among AGN? Should we expect any implications on broad Fe-K features and SMBH spin measurements?

★ To reveal any fine structure in the Fe-K profile and perform a proper time-resolved spectral analysis, large effective area AND high energy resolution *(read: Athena)* are needed.

★ Ark 120 is possibly the most promising source to study the properties of the accretion disk/X-ray corona system in a nearby AGN, and of its flaring, transient component(s).

Nardini et al. 2016, ApJ 832, 45