Tracking the Iron Kα and the UFO in NGC 2992

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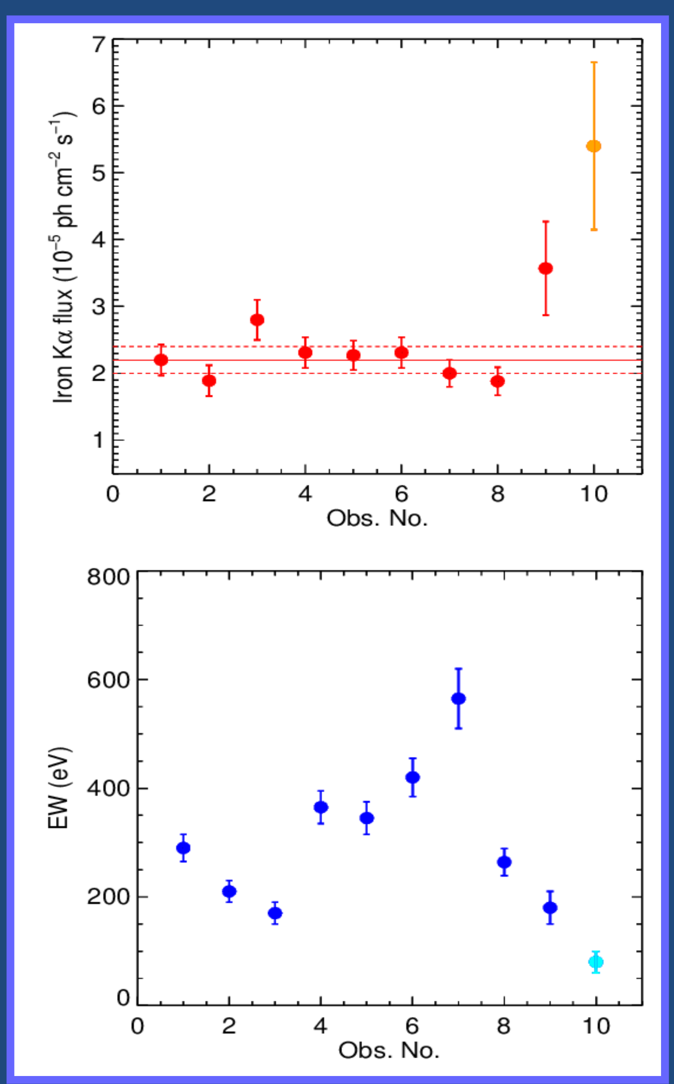
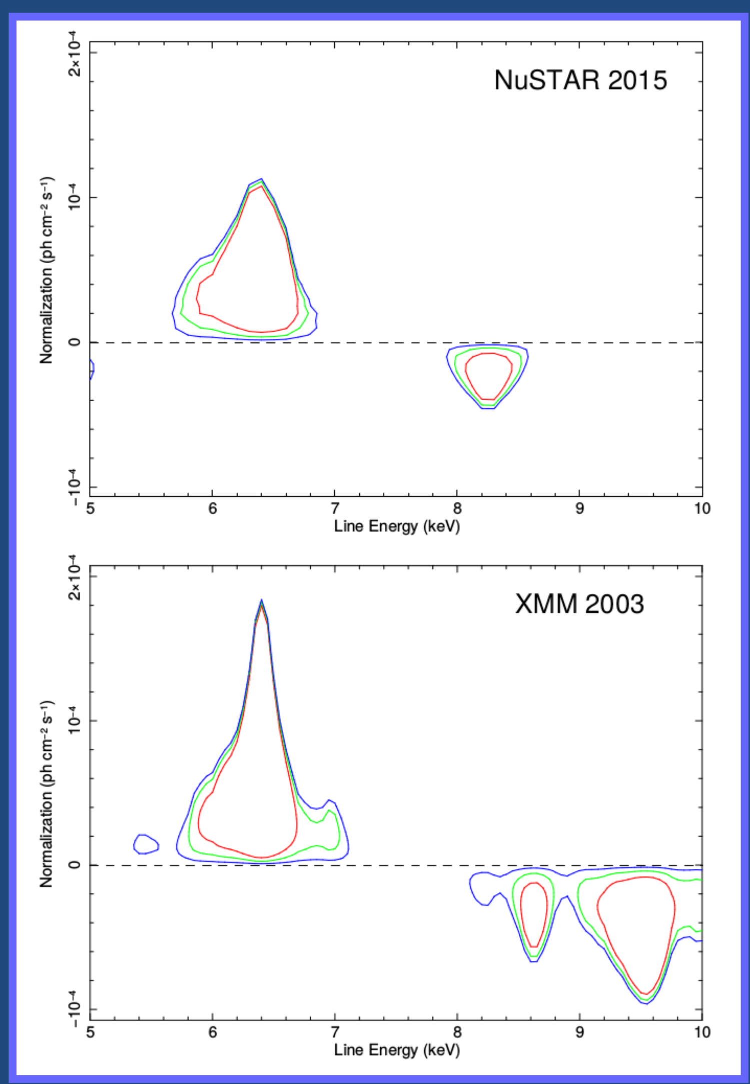
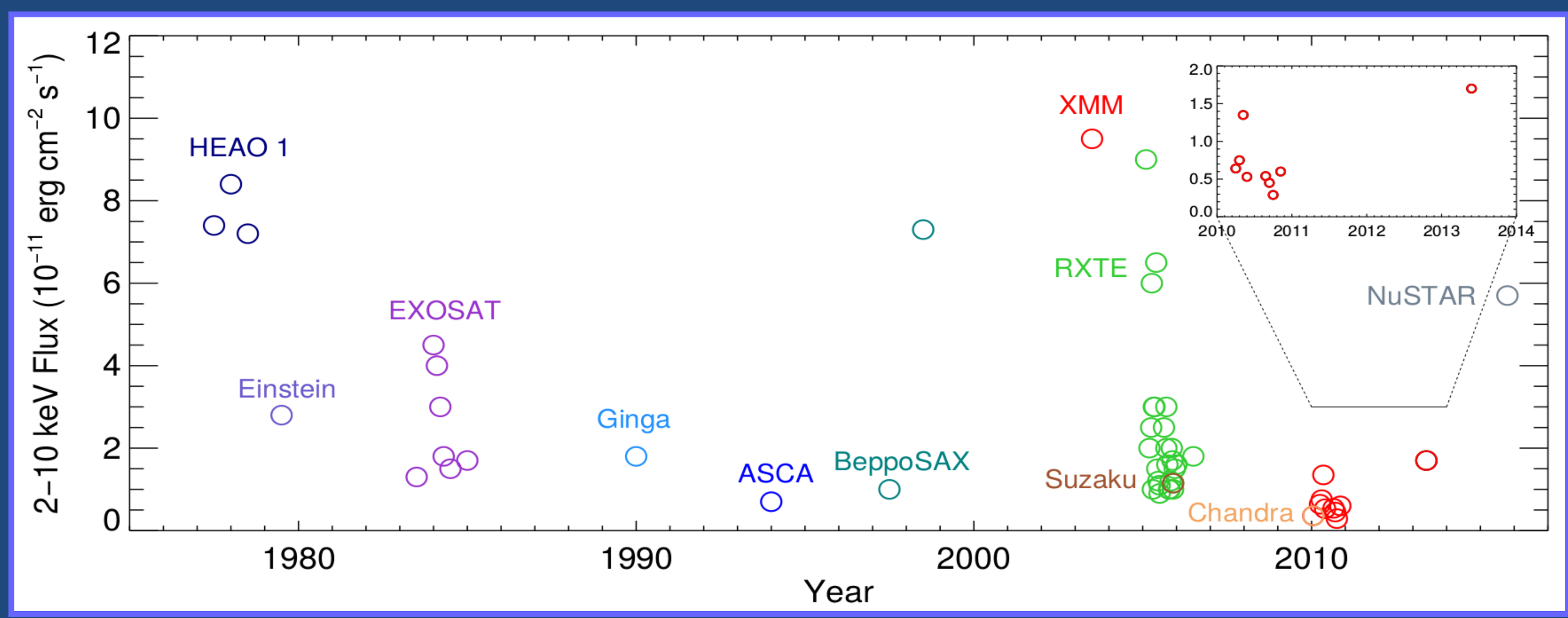
The Seyfert 2 galaxy NGC 2992 has been monitored eight times by XMM-Newton in 2010 and then observed again in 2013, while in 2015 it was simultaneously targeted by Swift and NuSTAR.
XMM-Newton always caught the source in a faint state (2-10 keV fluxes ranging from 0.3 to 1.6x10^{-11} erg cm^{-2} s^{-1}) but NuSTAR showed an increase in the 2-10 keV flux up to 6x10^{-11} erg cm^{-2} s^{-1}. The rise in brightness is accompanied by X-ray spectral features arising from an Ultra Fast Outflow (UFO) with velocity v_1=0.21±0.01*c*, one of the few ever detected with NuSTAR. A re-analysis of the 2003 XMM bright state confirmed such outflowing absorbing structure with an additional wind component detected at v_2=0.305±0.005*c*, one of the fastest ever detected in a Seyfert galaxy at modest accretion rate.
The analysis of the low flux 2010/2013 XMM data allowed us to determine that the Iron Kα emission line complex in this object is likely the sum of three distinct components: a constant, narrow one due to reflection from cold, distant material (likely the molecular torus); a narrow, but variable one which is more intense in brighter observations and a broad relativistic one emitted in the innermost regions of the accretion disk, which has been detected only in the 2003 XMM observation.



Temporal behavior of the flux and EW of the Fe Kα emission line in 2010-2015 (when only a single, narrow component of the line is included in the model).



Contour plots at 68%, 90% and 99% c.l. between the normalization and line energy when a Gaussian is left free to vary in the 5-10 keV energy range. The adopted model for the continuum is composed of an absorbed power law.

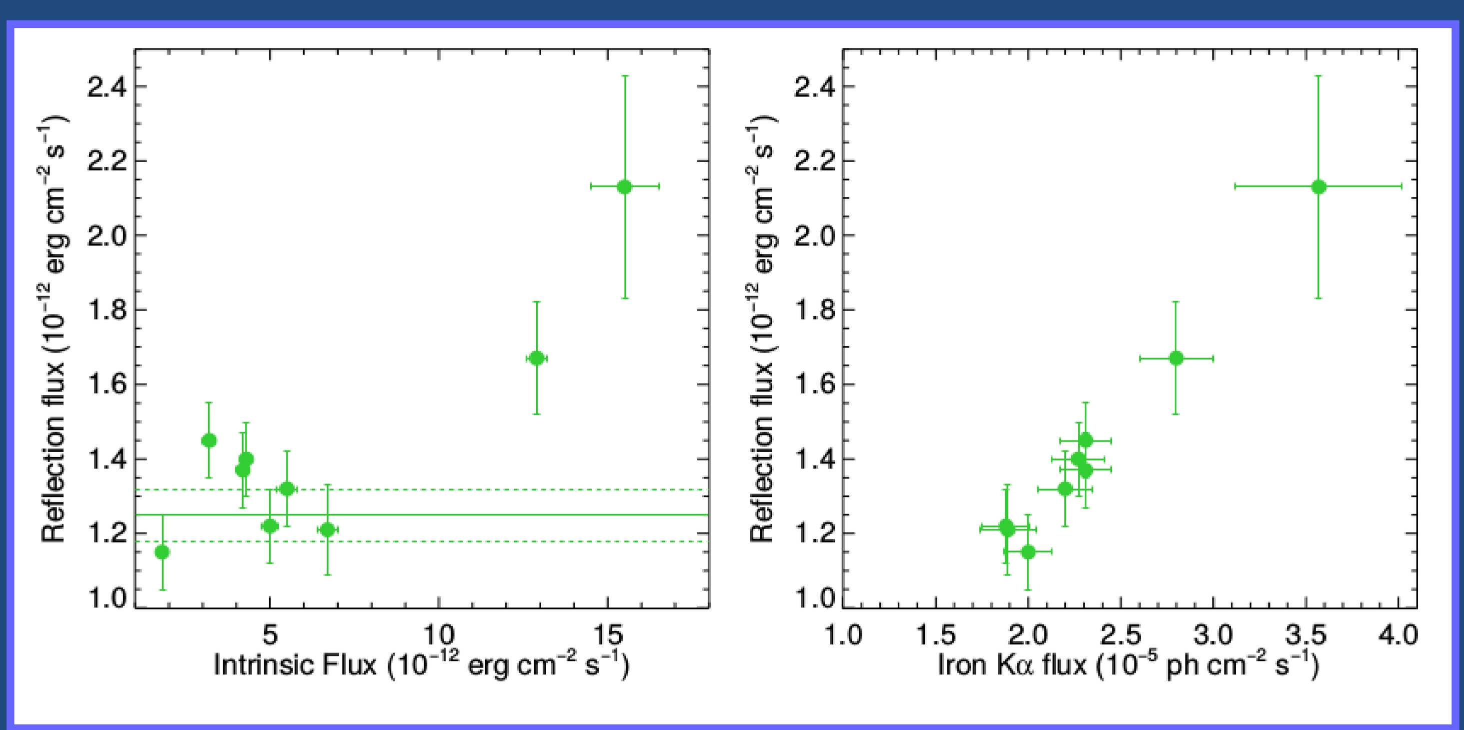


Historical 2-10 keV light curve of the source. This plot is an extension of the one previously presented in Murphy, Yaqoob & Terashima (2007)

	Energy (keV)	Flux (10^{-5} ph cm^{-2} s^{-1})	EW (eV)	Significance σ	v_{out}/c	$\Delta\chi^2$/dof
2015	$8.26^{+0.09}_{-0.12}$	-1.8 ± 0.8	-45 ± 20	2.6	0.21 ± 0.01	-9/2
2003	8.61 ± 0.05	-2.2 ± 1.2	-40 ± 25	2.7	0.209 ± 0.006	-9/2
	9.27 ± 0.10	-2.0 ± 1.3	-45 ± 30	1.9	0.31 ± 0.01	-8/2
	9.57 ± 0.06	-3.3 ± 1.3	-70 ± 25	3.6	0.307 ± 0.006	-26/2

	$\log N_H$ (cm^{-2})	$\log U$	v_{out}/c	$\dot{M}_{out}$ (g·s^{-1})	$\dot{E}_k$ (erg·s^{-1})	$\dot{p}_{out}$ (g·cm·s^{-2})
2015	22.25 ± 0.25	2.45 ± 0.25	0.21 ± 0.01	3.5×10^{23}	6.9×10^{42}	2.2×10^{33}
2003	$23.35^{+1.10}_{-0.55}$	>3.1	0.215 ± 0.005	3.8×10^{24}	7.9×10^{43}	2.5×10^{34}
	$23.35^{+0.15}_{-0.40}$	$3.40^{+0.40}_{-0.15}$	0.305 ± 0.005	2.7×10^{24}	1.1×10^{44}	2.4×10^{34}

Best fit parameters for the two absorbing layers, energies are reported in the rest-frame of the source. The statistical significance of the four absorption lines is calculated via Monte Carlo simulations. Column densities and ionization parameters are inferred via CLOUDY generated tables.



Left panel: 2-10 keV fluxes for the reflection and primary components are shown. Solid and dashed lines indicate best fit value and error bars when data are fitted simultaneously. *Right panel:* 2-10 keV fluxes for the reflection component is plotted against the flux of the Iron Kα emission line.

We concluded that the Iron Kα emission line complex in this object is likely the sum of three distinct components: *(a)* a narrow one due to reflection from cold, distant material (likely the molecular torus) which is constant,with a 2-10 keV flux F=1.25±0.08x10^{-12} erg cm^{-2} s^{-1} and not responding to variations of the primary continuum; *(b)* an unresolved, variable one which is more intense in brighter observations (Obs. 3, 9 and NuSTAR 2015). The emitting gas could be located in the outer parts of the accretion disk or in the BLR; *(c)* a relativistic line emitted in the innermost regions of the accretion disk, which has been detected only in the 2003 XMM observation.

In NGC 2992 the fast wind features are sporadic, only appearing in the two brightest observations, at accretion rates larger than ~2% L_{Edd}. The total kinetic energy rate of the NuSTAR outflow is ≈ 5% L_{bol}, sufficient to switch on feedback mechanisms on the host galaxy. The winds are launched in the innermost regions of the accretion disk, at a few tens of gravitational radii. We speculate that the wind can be more effectively accelerated when the luminosity and thus the accretion rate is higher, somehow revealing the innermost regions of the disk. Indeed, such accretion disk winds are accompanied by a broad component of the Iron Kα emission line.

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More details can be found in Marinucci et al. (2018), MNRAS, 478, 5638