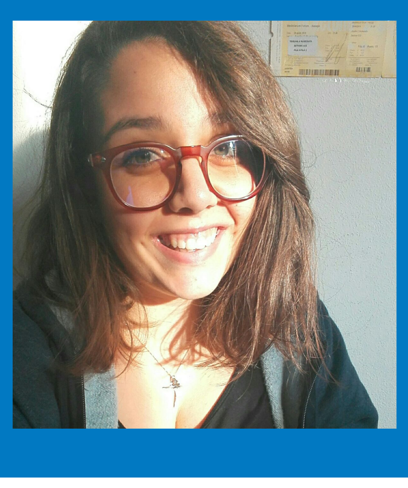

A NARROW-LINE SEYFERT 1 GALAXY WITH DISAPPEARING BROAD-LINE REGION: J0413-0050

A. Vietri[1], A. Tortosa[2], S. Ciroi[1], M. Berton[3], E. Järvelä[4], S.Chen[5]

1. The University of Padova, 2. INAF-OAR 3. ESO, 4. The University of Oklahoma , 5. Technion, Israel

The multi-epoch observations over 15 years have led to the identification of a new class of active galactic nuclei (AGN), showing incredible spectral and flux changes: the changing-look (CL) AGN. The reason behind this peculiar behaviour could be changes in the accretion rate of the supermassive black hole (*changing-state* CS-AGN), inducing variability in the continuum emission, or changes in the line-of-sight column density (*changing-obscuration* CO-AGN), possible due to a passing cloud or nuclear outflows, obstructing our view of the central engine.

2MASX J04130709-0050165

Here we present a peculiar object, J0413-0050, identified as a narrow-line Seyfert 1 (NLS1) galaxy based on the Six-degree Field Galaxy Survey (6dFGS) spectrum (2004). Further analysis indicated that based on its [OIII]/Hβ ratio this source could also be classified as Seyfert1.5, and thus the classification remains unclear. This source was recently observed again: with the New Technology Telescope in early 2021 and with the Nordic Optical Telescope at the end of 2021. These new spectra show the clear disappearance of the Hβ line while Hα line only changes in shape and the [OIII] line remains unchanged. This object has also been observed in the X-ray: with Chandra in 2014, and with Swift/XRT in 2022. We measure an increase of the X-ray flux between the two observations.

Is this source a

CS-AGN *... or both?* *CO-AGN*

OPTICAL SPECTRA

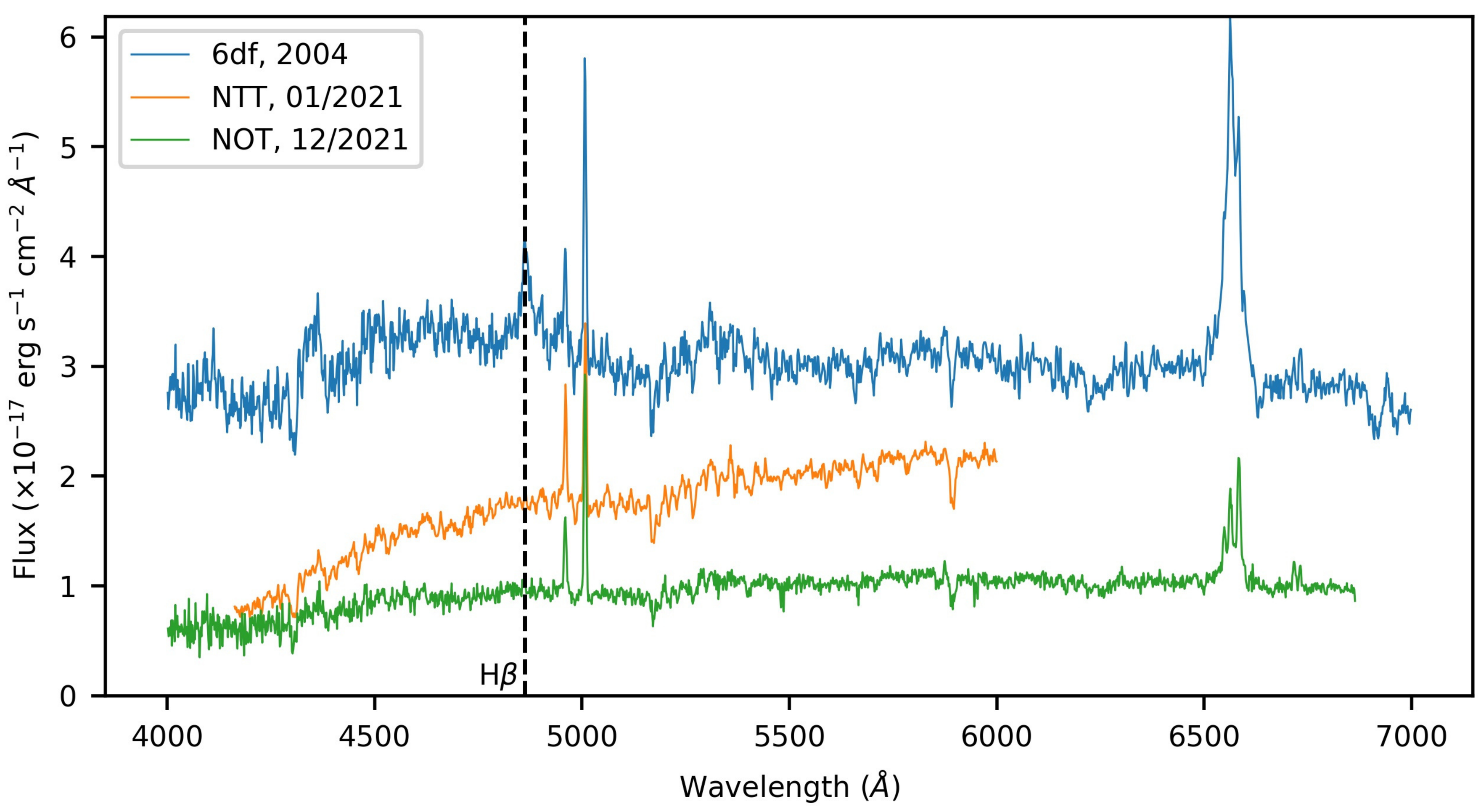

Fig. 1: Comparison of the normalised spectra shifted in flux. The continuum shape has changed during the years, suggesting a possible change in the accretion-driven radiation field.

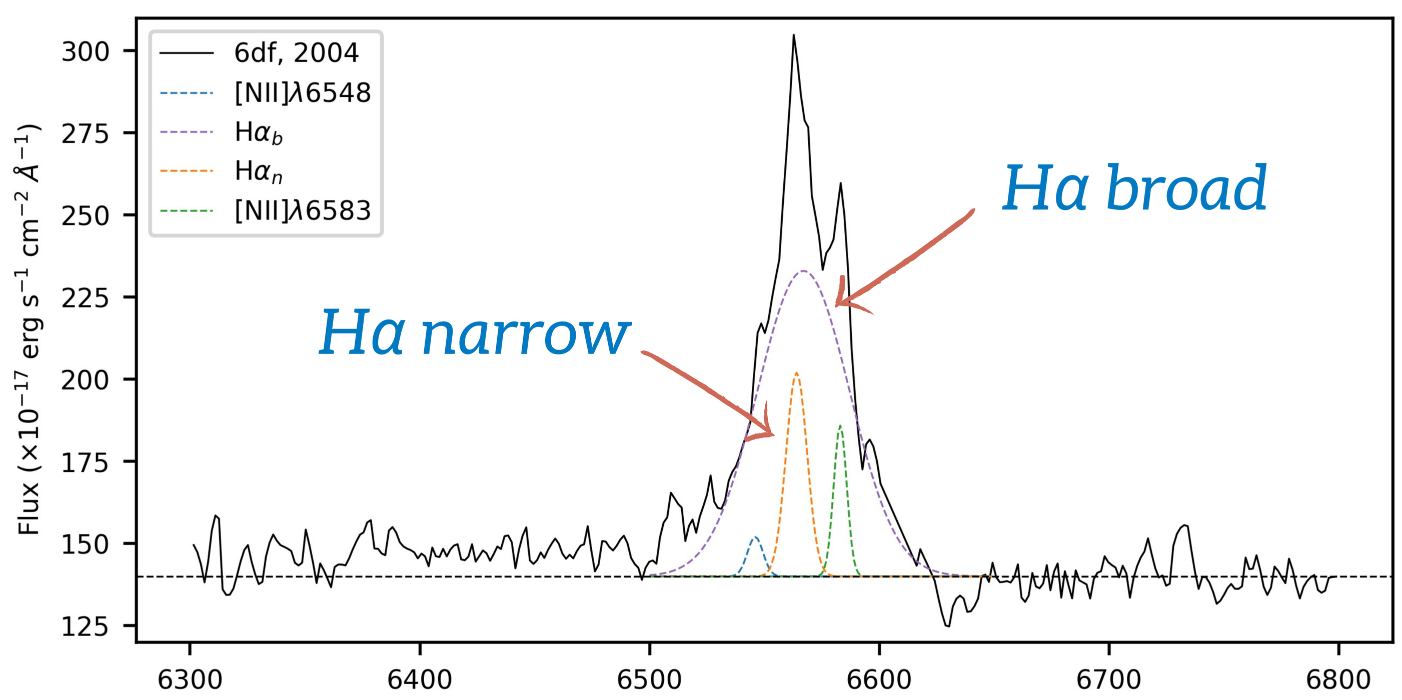

Fig. 2: Both broad and narrow component of Hα are present in this spectrum with an Hβ counterpart (2004). Unclear classification: NLS1 or Sy1.5?

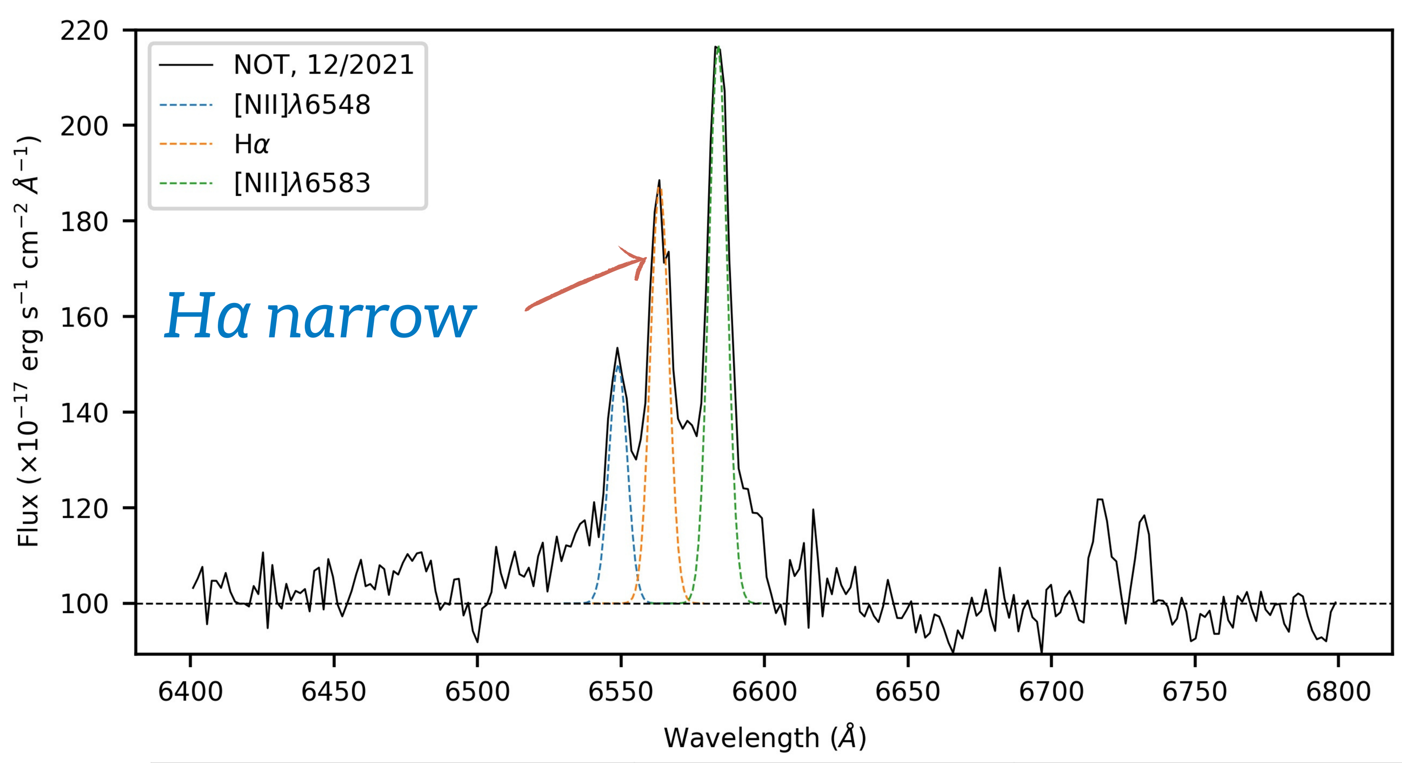

Fig. 3: The detection of a narrow component of Hα with no Hβ counterpart implied a Seyfert 2 classification (2021), that could suggest the existence of an obscured BLR.

FWHM(OIII]λ5007)	EW([OIII]λ5007)	FWHM(Hα)
284 km/s (6dFGS)	6.7 (6dFGS)	2125 km/s (6dFGS, broad)
317 km/s (NTT)	8.5 (NTT)	344 km/s (6dFGS, narrow)
208 km/s (NOT)	15.3 (NOT)	171 km/s (NOT, narrow)

Tab. 1: The [OIII]λ4957,5007 lines remain unchanged during time. Its equivalent width $EW = f_{[OIII]}/(f_*+f_{AGN})$ progressively increases, meaning that the disappearance of the broad Balmer lines is coincident with the suppression of the AGN contribution. Hα narrow components are comparable in both spectra.

X-RAY SPECTRA

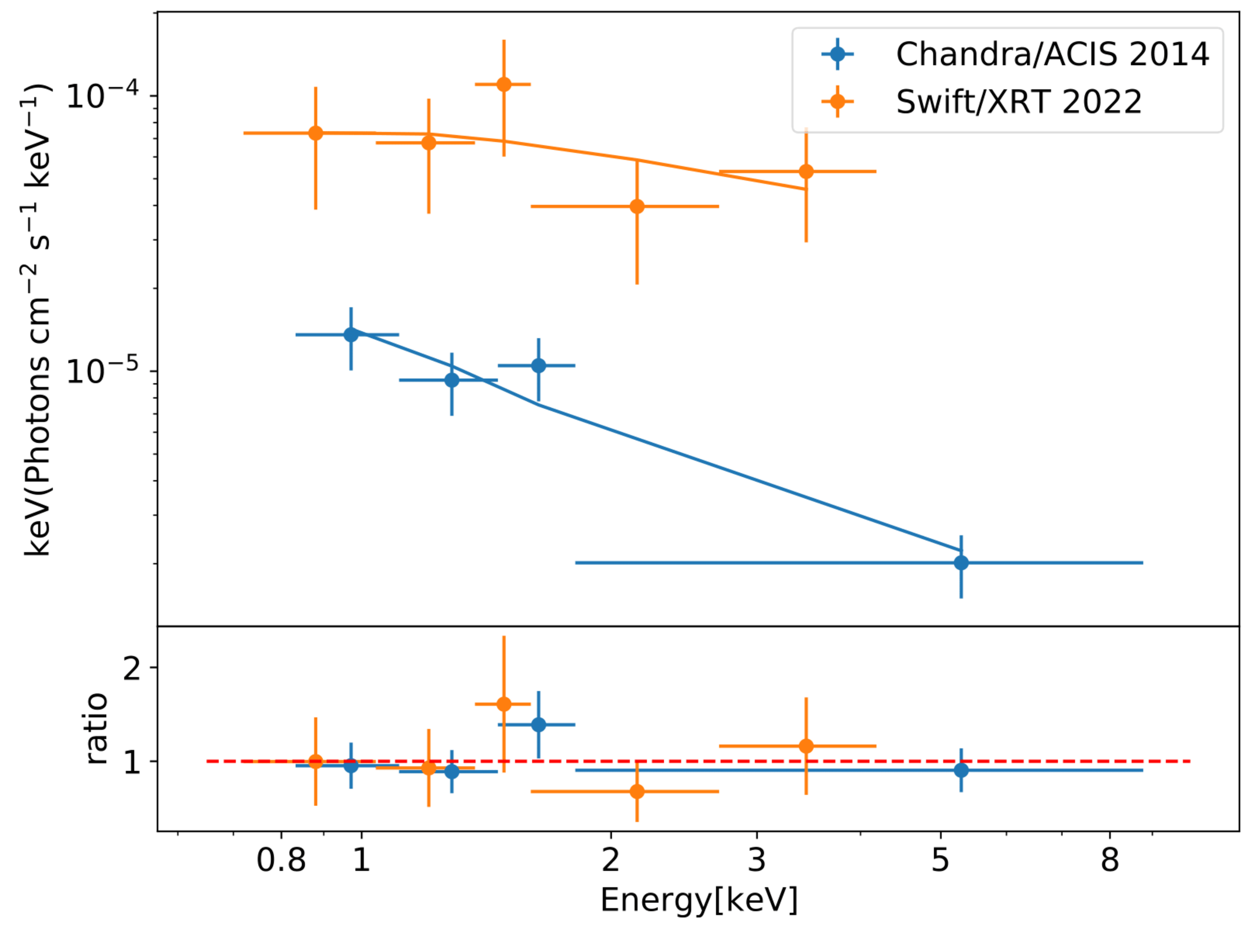

Fig. 4 shows the 0.5-7 keV spectra of the source from Chandra and SWIFT/XRT observations. We performed a fit with a power-law absorbed by galactic absorption:

$$N_H = 9 \cdot 10^{20}\ \mathrm{cm}^{-2}$$

Despite the low net count rate, we were able to constrain the photon index of the primary power-law (Γ) and the 2-10 keV Flux (**Tab. 2**).

However it was not possible to constrain the intrinsic column density, necessary to determine the level of obscuration of the source, which conversely do not follow the 'softer-when-brighter' behaviour typical of type-1 AGN.

Tab. 2

Telescope	Γ	log(F_{2-10}) [erg cm^{-2} s^{-1}]	Total net counts
Chandra/ACIS	2.56 ± 0.50	-13.70 ± 0.57	60
SWIFT/XRT	1.57 ± 0.78	-12.44 ± 0.62	24

Also: RADIO MAP

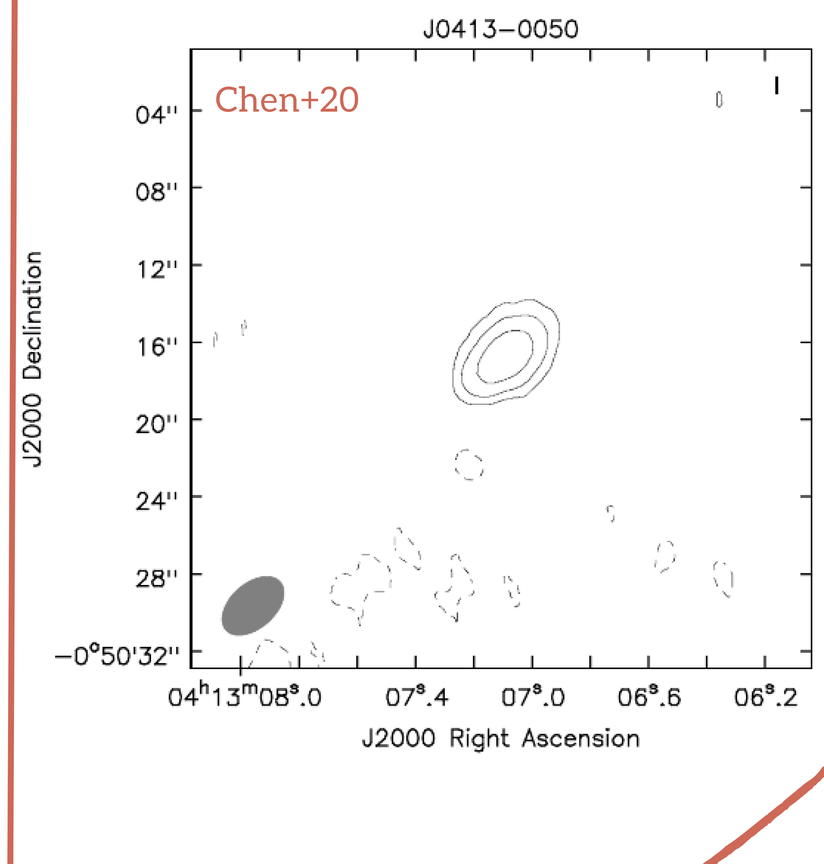

Fig. 5: Radio data from Karl G. Jansky Very Large Array C-configuration at 5.5 GHz do not show any presence of radio jets for this source (2020).

CONCLUSIONS

From these preliminary analyses it is not possible to determine which kind of CL this object is. From the optical spectra, it seems that the disappearance of the BLR could possibly indicate that the AGN has switched off between 2004 and 2021 (CS AGN). At the same time, the X-ray spectra reveals an increase in the flux between 2014 and 2021, pointing towards the opposite direction. Without the NH measurements, it cannot be pointed out if this CL AGN underwent a CO phase.

NEXT STEPS

- X-rays and optical new simultaneous and multi-epoch observations ⟶ to monitor changes in the accretion rate
- X-ray spectra with higher counts are needed ⟶ to measure the intrinsic column density
- Near-infrared observations ⟶ to trace the hot dust emission

References:

Ricci, C., & Trakhtenbrot, B. 2022, arxiV:211.05132; Gilli, R., Maiolino, R., & Risaliti, G., et al. 2000, A&A, v.355, p.485-498; Chen, S., Berton, M., & La Mura, G., et al. 2018, A&A, Vol. 615, id.A167, 9pp; Sobolewska, M.A., & Papadakis, I. E. 2009, MNRAS, Vol. 399, pp. 1597-1610; Chen, S., Järvelä, E., & Crepaldi, L., et al. 2020, MNRAS, 498, 1278.