

The optically elusive, changing-look active nucleus in NGC 4156

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E. Lusso, L. Casetti, M. Romoli & many others!



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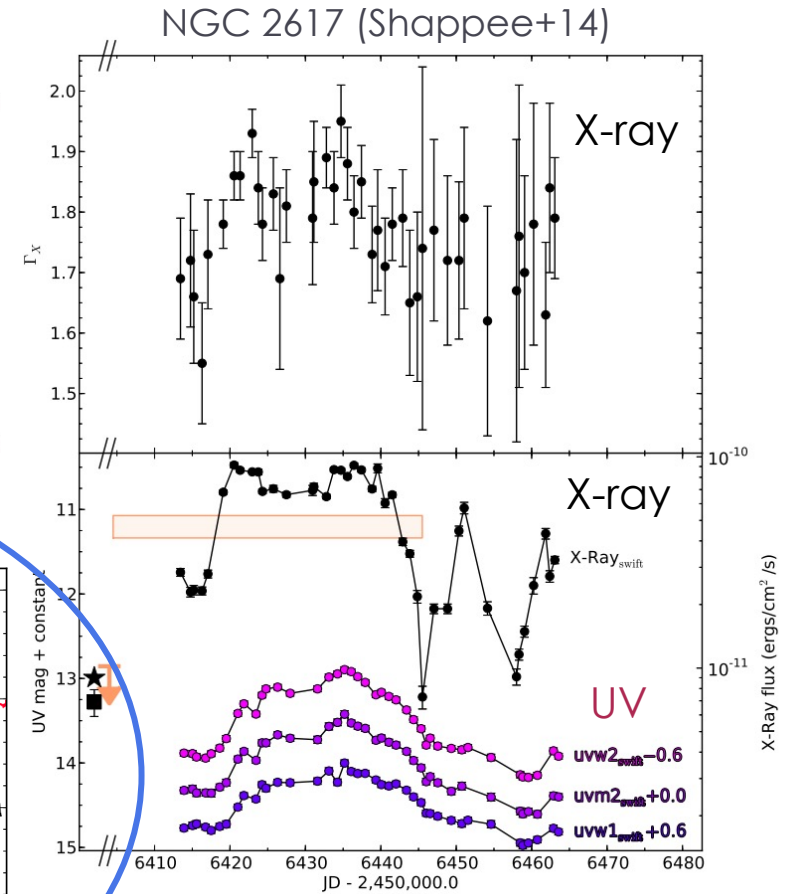
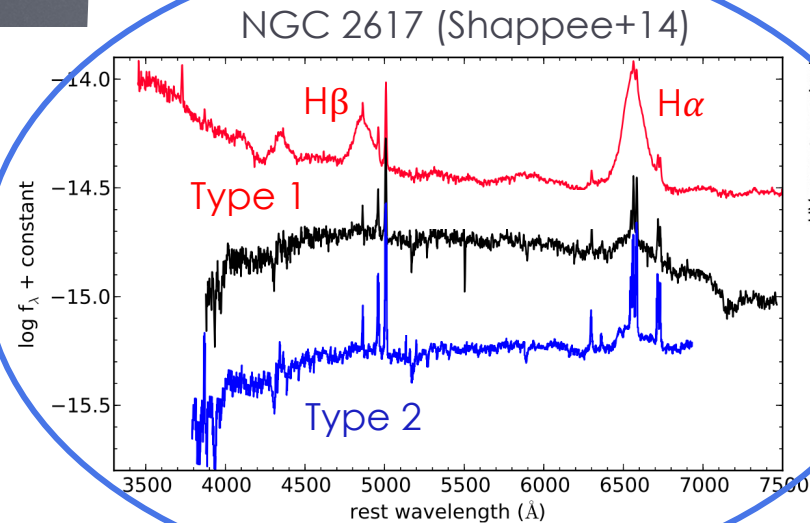
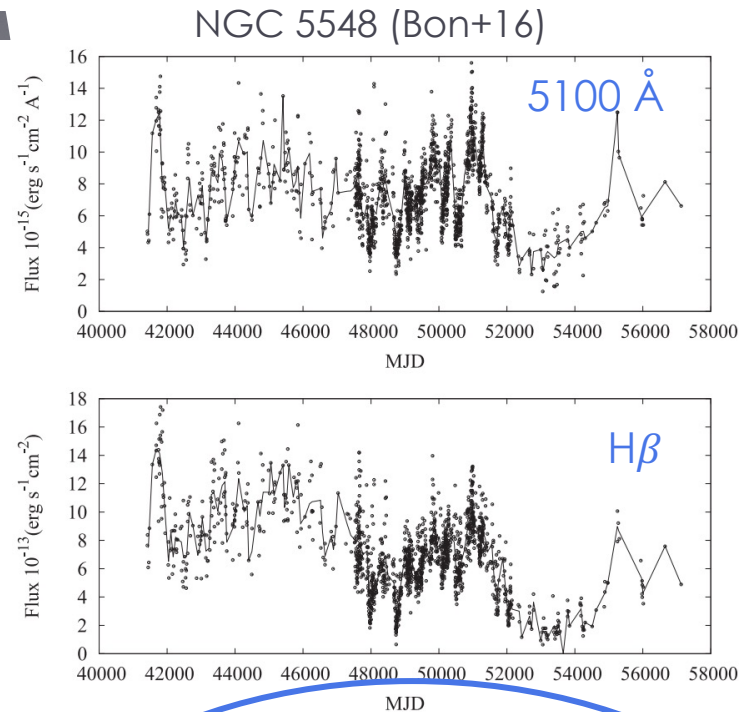
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AGN variability

- Strong variability at all wavelengths
- On different time scales: years, months, days
- Affecting the AGN broad-line and continuum emission
- Changing-look AGN (CLAGN)

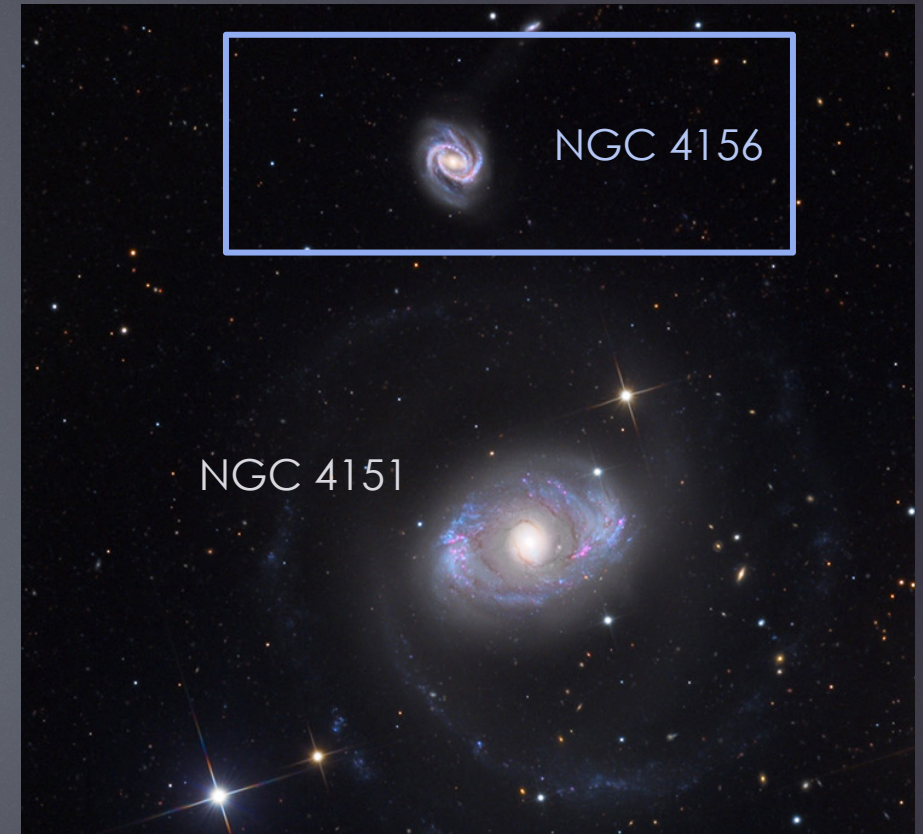
In this talk, optical type transitions:

- type 2 \rightarrow 1: broad $H\alpha$ & $H\beta$ appearing
- type 1 \rightarrow 2: broad $H\alpha$ & $H\beta$ disappearing



NGC 4156: an optically 'dull' galaxy

- $z \sim 0.0226$
- Face-on barred, spiral galaxy (Nieto+1984)
- Optical pair with the brighter NGC 4151
- Known AGN from X-rays (Elvis+1981, Guainazzi+05)
- No previous optical evidence: weak narrow emission lines (Elvis+1981), compatible with LINER-like ionisation (Nisbet+16)



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A student observing campaign at the TNG in 2019

Complementi di Astronomia – UNIFI
L. Casetti, E. Lusso, M. Romoli

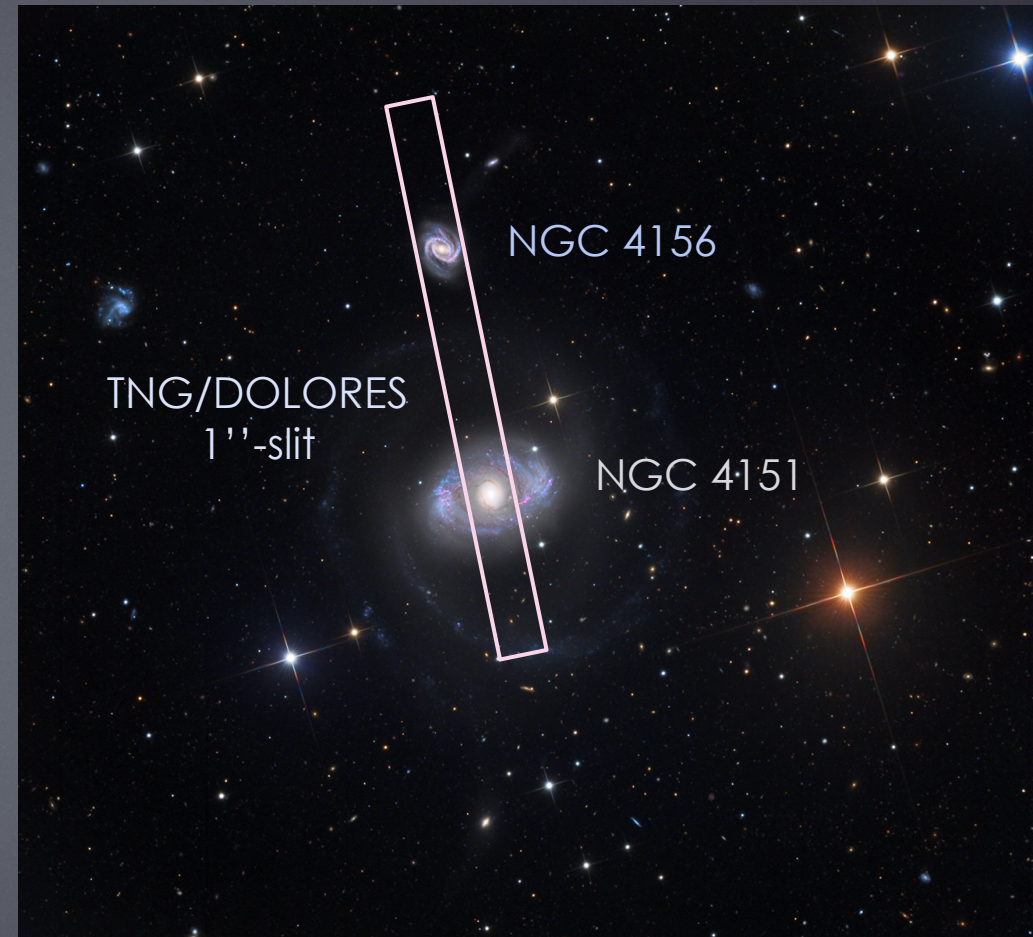
- Funded by University of Florence & INAF - Arcetri
- Imaging & spectroscopy of galaxies with TNG/DoLORES
- To measure the Hubble constant H_0 from galaxies' diameter & redshift



Telescopio Nazionale Galileo (TNG), La Palma, Canary Islands, Apr 2019

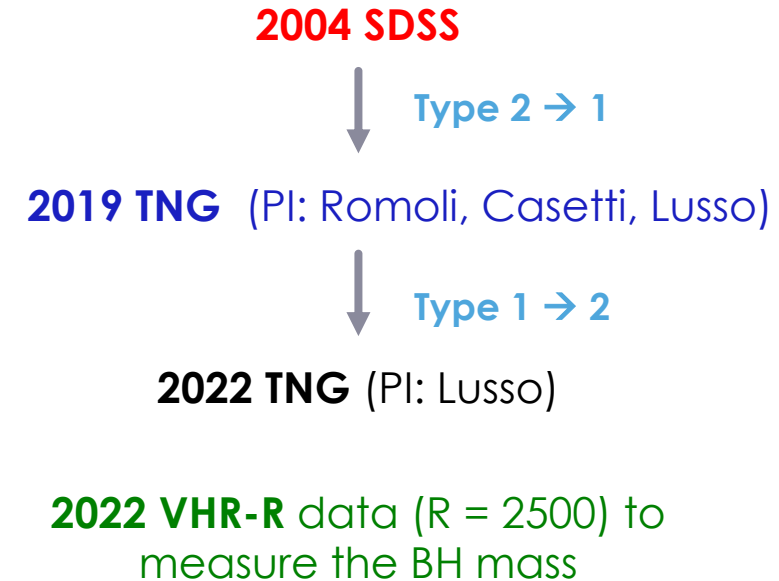
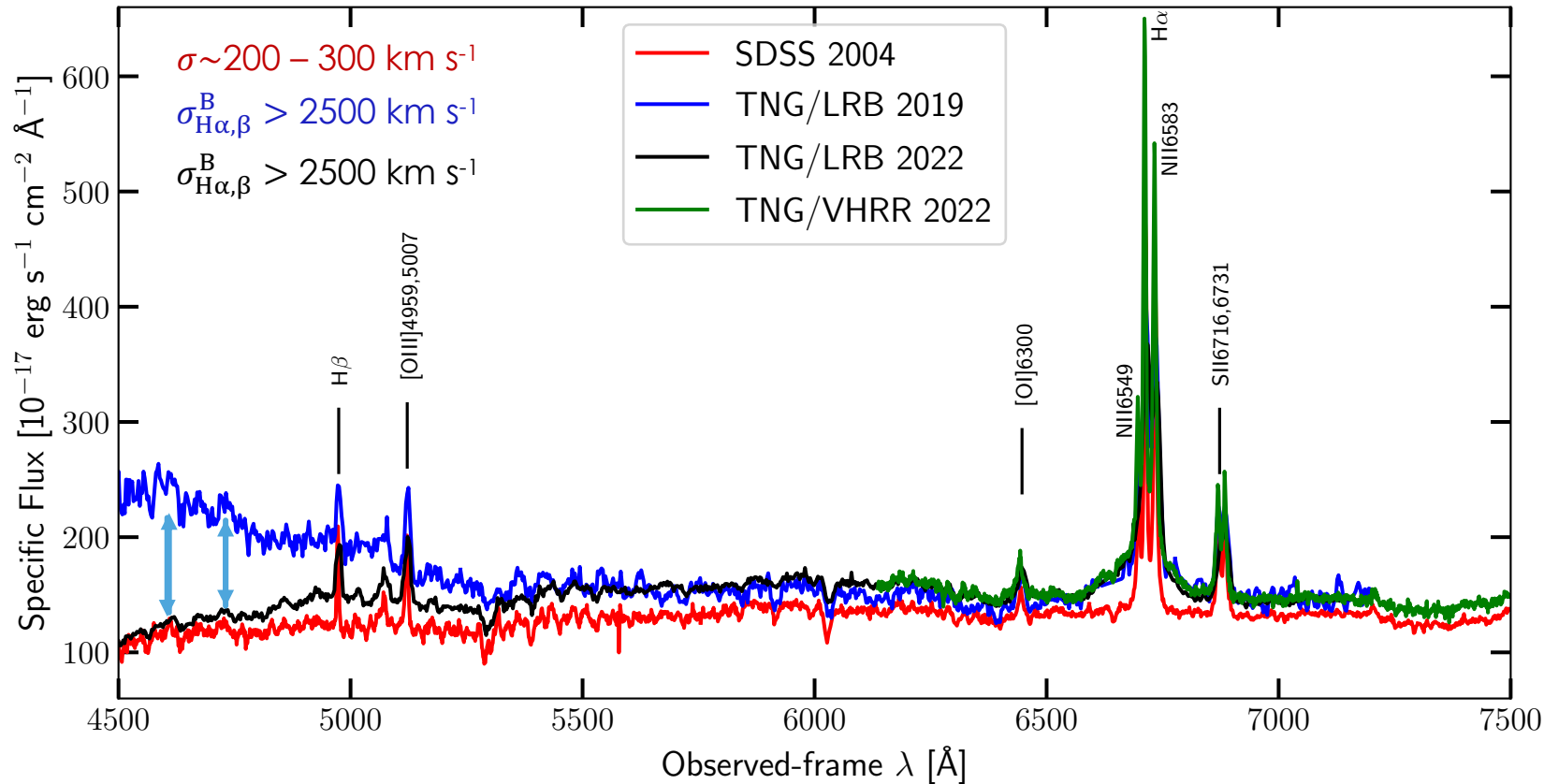
Our TNG observations of NGC 4156 & NGC 4151

- Longslit (1'') data with LR-B grism
- 2019: analysis of NGC 4151 data
- 2022: NGC 4156 data reduced for the first time – by chance!



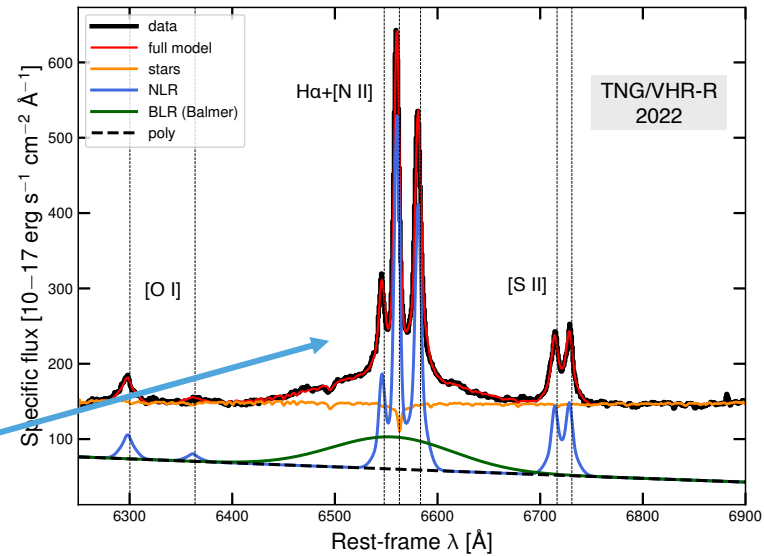
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Serendipitous discovery of the changing-look AGN in NGC 4156



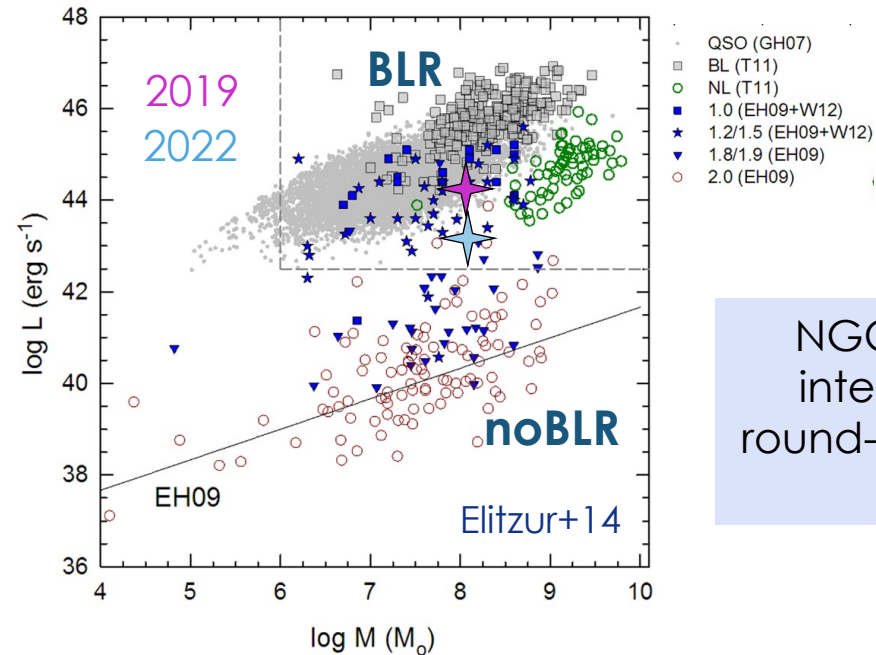
Physical properties of the AGN in NGC 4156

- Broad H α (Greene & Ho, 2005):
 - first single-epoch (2022)
 $\log(M_{\text{BH}}/M_{\odot}) \sim 8.1$
 - $\log(M_{\text{BH}}/M_{\odot}) \sim 7.7$ from $M_{\text{BH}} - \sigma_*$ relation
- AGN continuum luminosity at 4400 Å (Duras+20):
 - $L_{\text{bol}}^{2019} = (2.4 \pm 0.5) \times 10^{44} \text{ erg s}^{-1}$
 - $L_{\text{bol}}^{2022} = (2.1 \pm 0.4) \times 10^{43} \text{ erg s}^{-1}$



$$\sigma_{\text{H}\alpha}^{\text{B}} \approx 2690 \text{ km s}^{-1}$$

$$L_{\text{H}\alpha}^{\text{B}} \approx 1.9 \times 10^{41} \text{ erg s}^{-1}$$



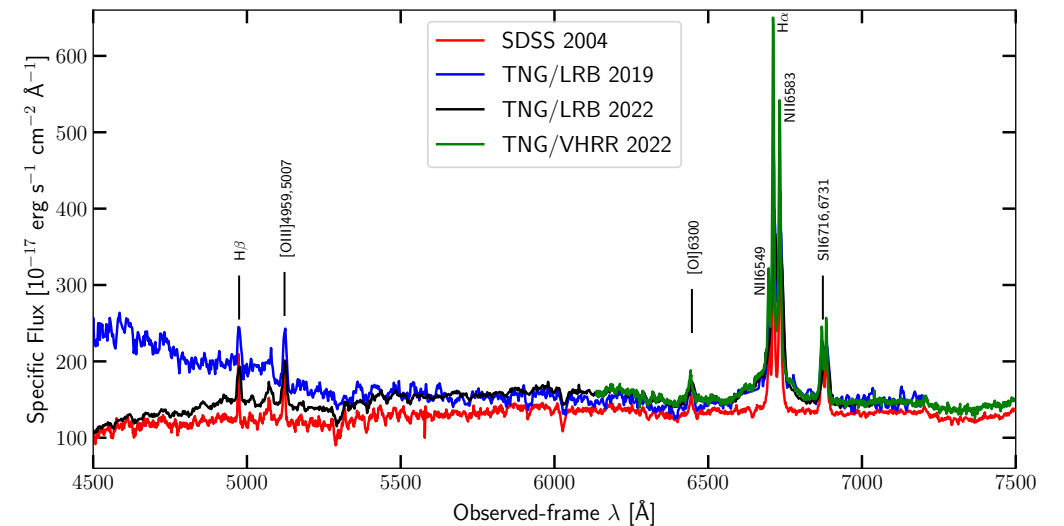
NGC 4156 caught in two intermediate states of its round-trip along the evolution sequence

What determines the AGN type transitions in NGC 4156?

Possible combination of variable accretion & dust absorption

Optical data from 2004 to 2022 point to a double type transition:

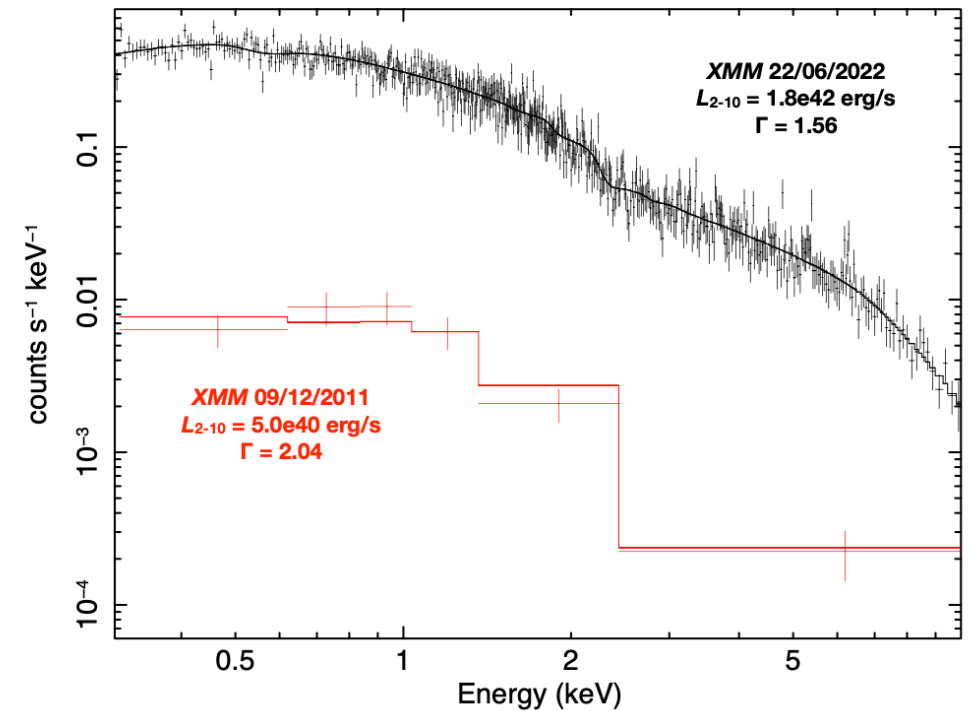
- 2004 – 2019: type 2 \rightarrow 1 (1.2/1.5 in 2019)
- 2019 – 2022: backwards \rightarrow 2 (1.8 in 2022)
- Variable (decreased) AGN accretion activity suggested by the observed spectral change
- Variable dust absorption cannot be tested with the available data, however likely contributing as well



Investigating X-ray variability of NGC 4156

Multi-epoch X-ray data of NGC 4156:

- 9 different *XMM-Newton* observations tailored to NGC 4151, revealing **some X-ray variability of NGC 4156**
- **2022**: new *XMM-Newton* obs of NGC 4156 (PI: Lusso) showing **no sign of absorption**

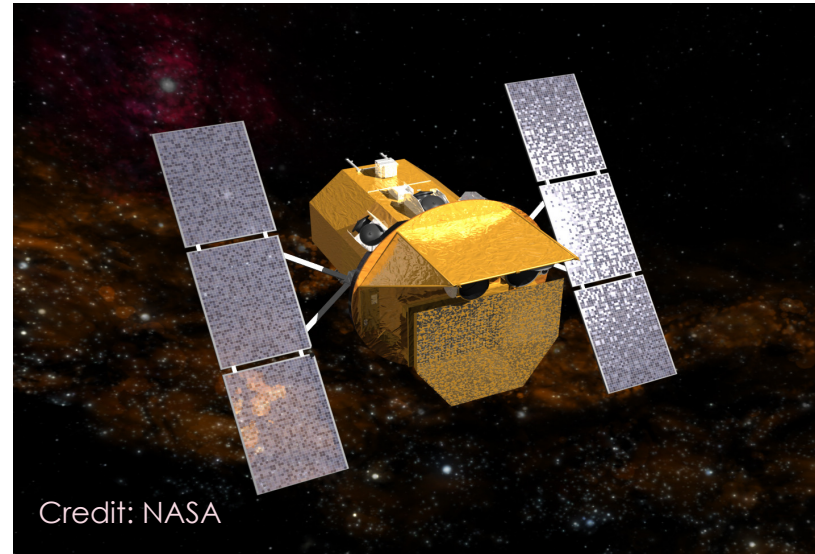


Lusso et al., in prep.

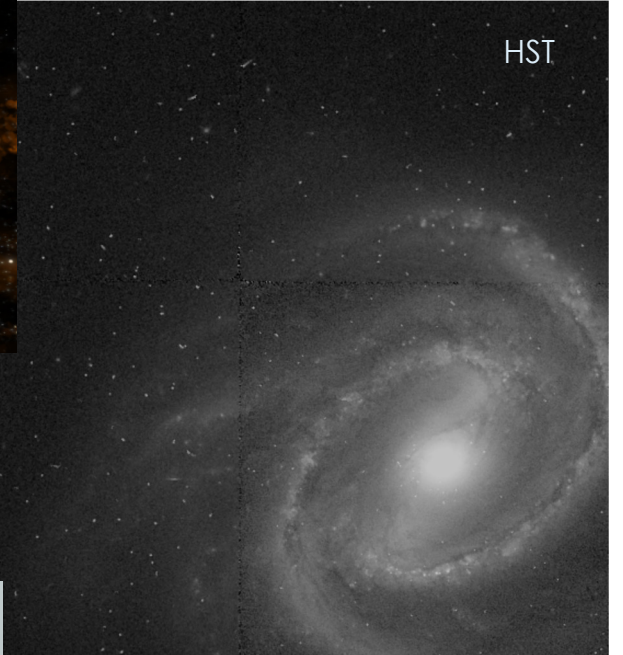
The changing-look nature of NGC 4156: next steps

- Completing X-ray analysis of multi-epoch *XMM-Newton* data of NGC 4156 (Lusso+, in prep.)
- Ongoing X-ray monitoring with *XRT-Swift* (PI: Middei): every 2 weeks Apr - Jul 2023, and Oct 2023 - Mar 2024
- Ongoing optical monitoring with Asiago telescope (PI: Casetti)

X-ray monitoring with *Swift*



Optical monitoring with Asiago



*Complementi di Astronomia class,
La Palma, Canary Islands, Apr 2019*



Thanks for your
attention!



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