# Exploring (extremely) obscured accretion

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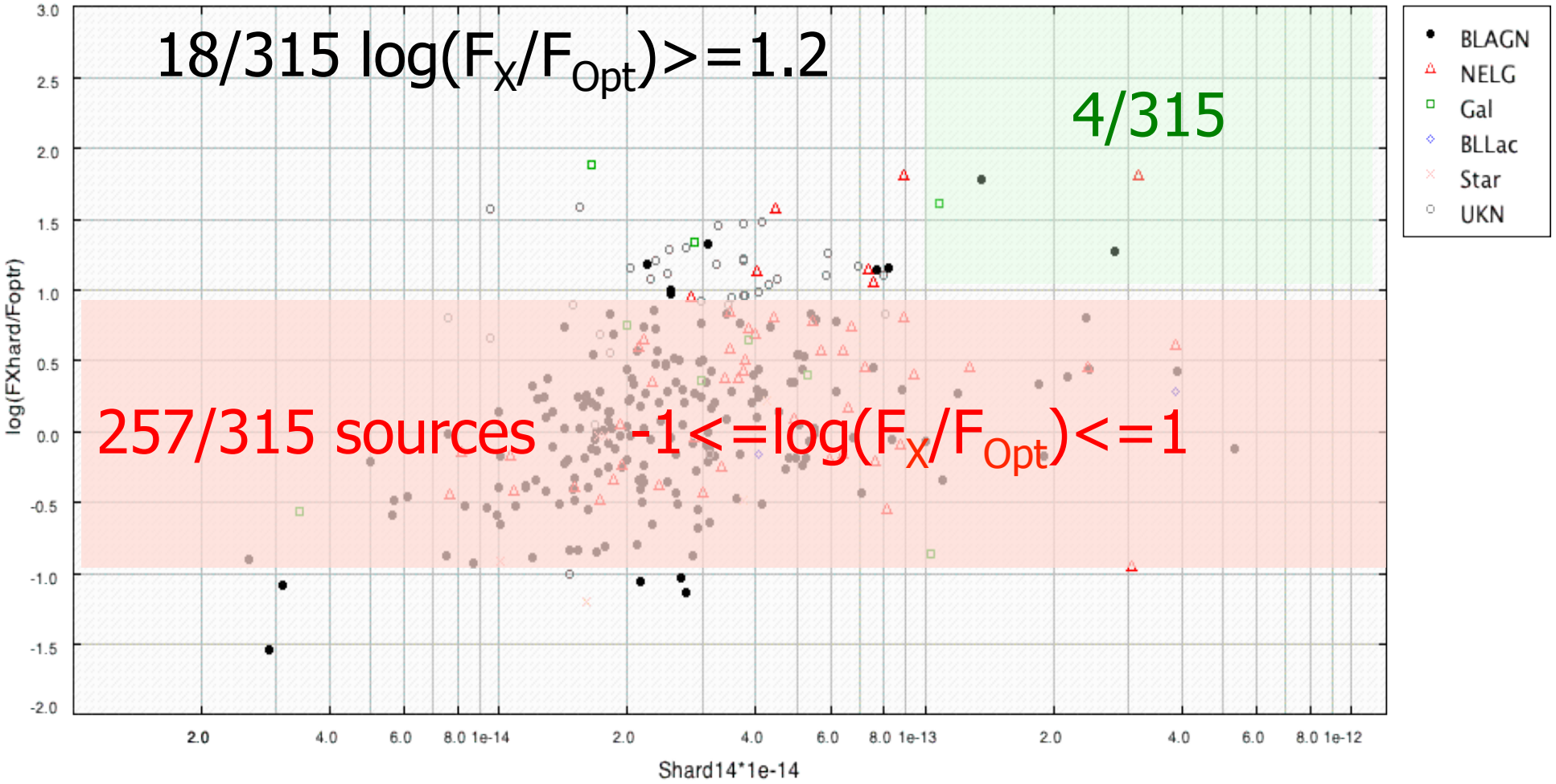
# Outline

- Obscured accretion and high $F_X/F_{Opt}$
- Our parent samples
- Our selection of high $F_X/F_{Opt}$ sources
- Our subsamples
- X-ray spectral properties
- Highlights:
  - High Eddington ratios (inc. Xabs BLAGN !?: NLSy1)
  - Transition object...
- Summary

# Obscured accretion and high $F_X/F_{Opt}$

- Most accretion in the Universe is thought to occur in obscured AGN
  - But perhaps not so much in CT (Gilli+07)
- Several methods to select obscured AGN:
  - [OIII],[NeV]...
  - MIR colours
  - ...
- Our method: high X-ray flux to optical flux ratio
  - based on much higher obscuration in rest-frame optical-UV with respecto to X-ray

# $F_X/F_{Opt}$ ratio: XMS (Barcons+07)

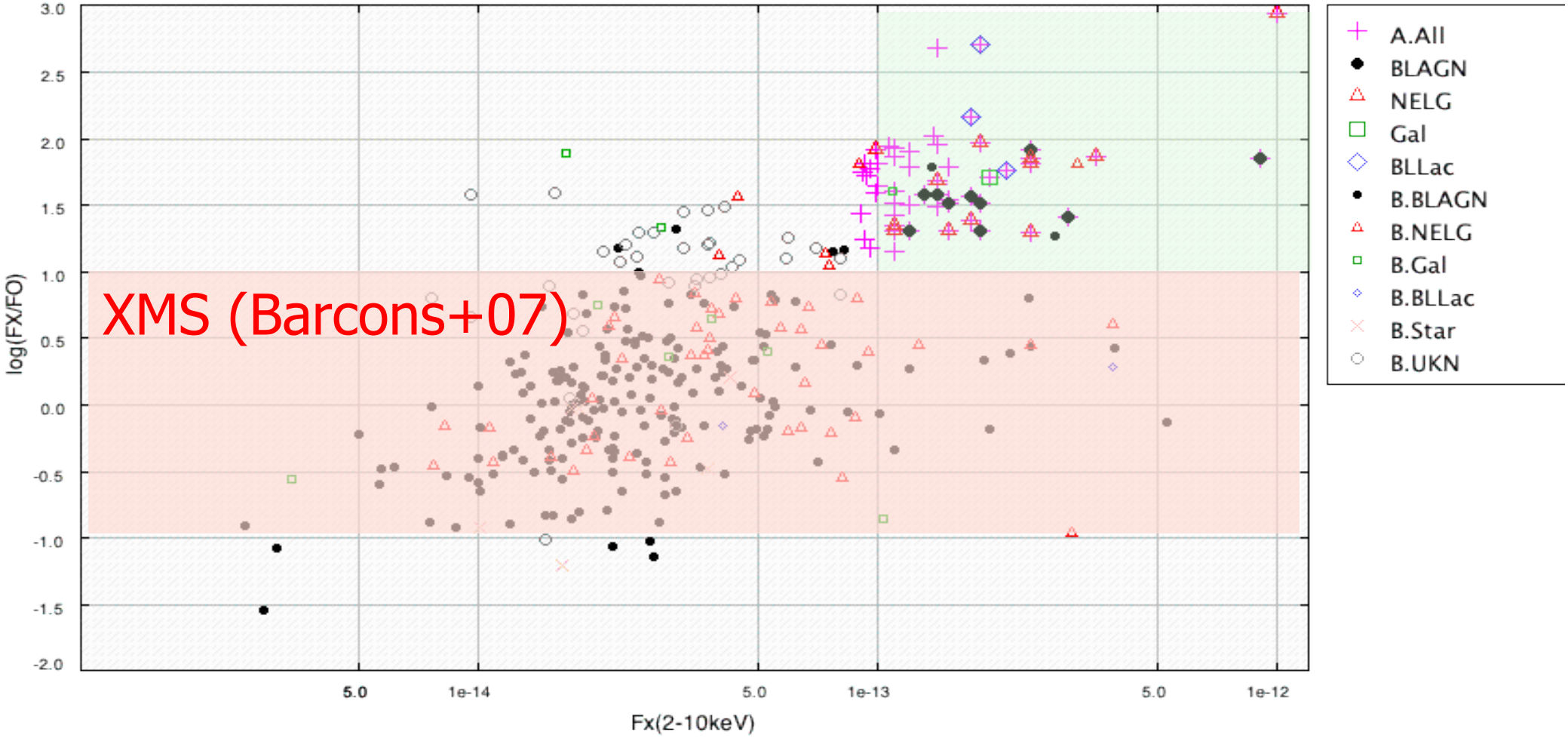


# Our parent samples

- Aim was to assemble a large number of identifications of sources with large $F_X/F_{Opt}$ ratio:
  - Objects rare ➔ need large sky areas
  - Looking for properties ➔ high fluxes
- Parent samples:
  - XBS (DellaCeca+04, Caccianiga+07): serendipitous XMM sources at bright fluxes
  - del Moro+09,(+11 in preparation): objects with extreme $F_X/F_{Opt}$ in 2XMMp vs. SDSS DR5
  - Della Ceca+11 (in preparation): objects with extreme $F_X/F_{Opt}$ in 2XMMiDR2 vs. SDSS
  - BUXS (Mateos+11 in preparation): 5-10keV survey from 2XMMi-DR3

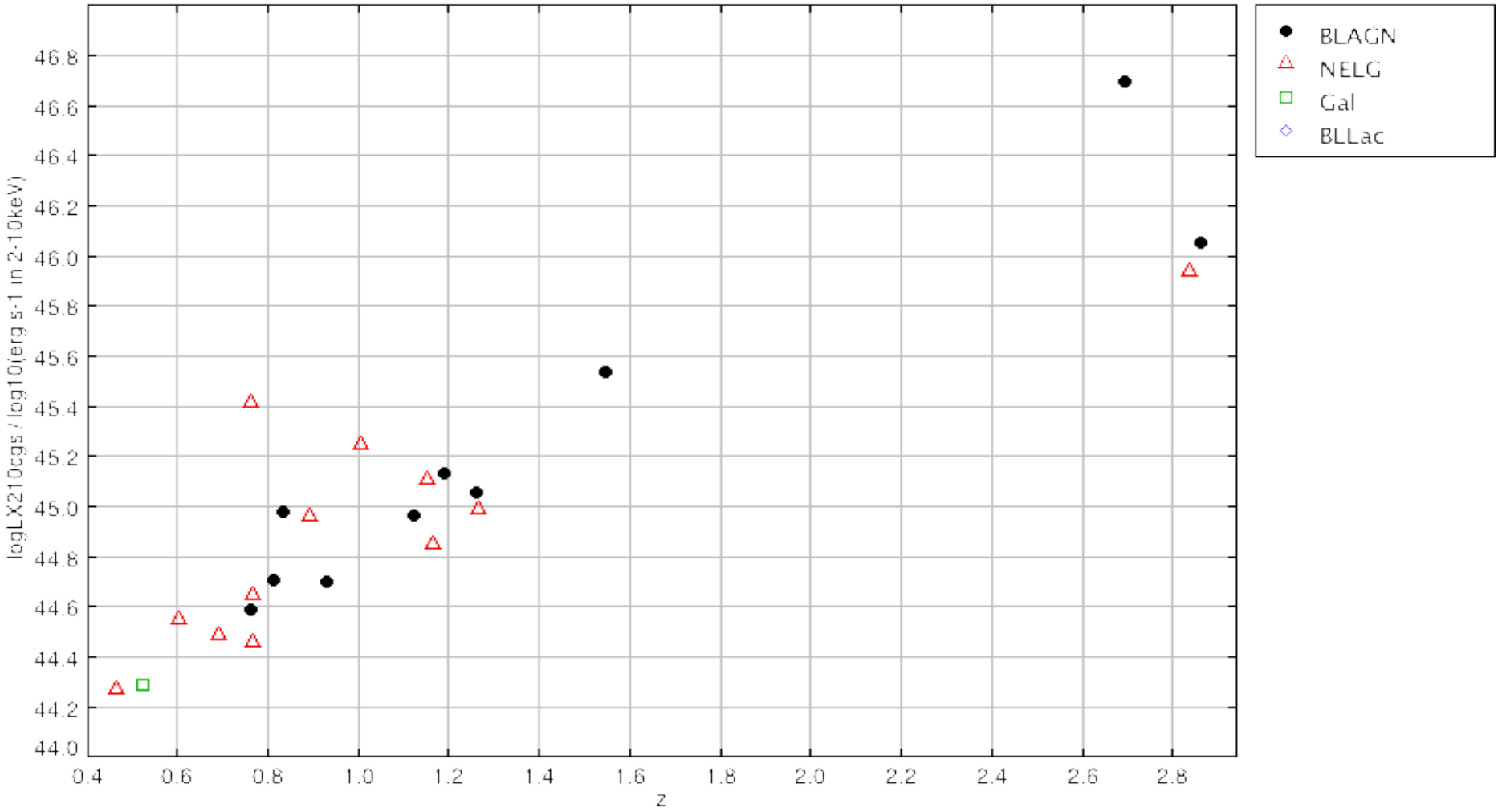
# Our selection of high $F_X/F_{Opt}$ sources

- 41 initial sources: $F_X >= 10^{-13}$cgs $\log(F_X/F_{Opt}) >= 1.2$ (r'/R~21-25)



# Identifications

- Used GTC/OSIRIS (18), VLT/FORS2 (1), Subaru/MOIRCS (3)
- Identified 22+3: 10BLAGN, 11NELG, 1Gal, 3BLLacs



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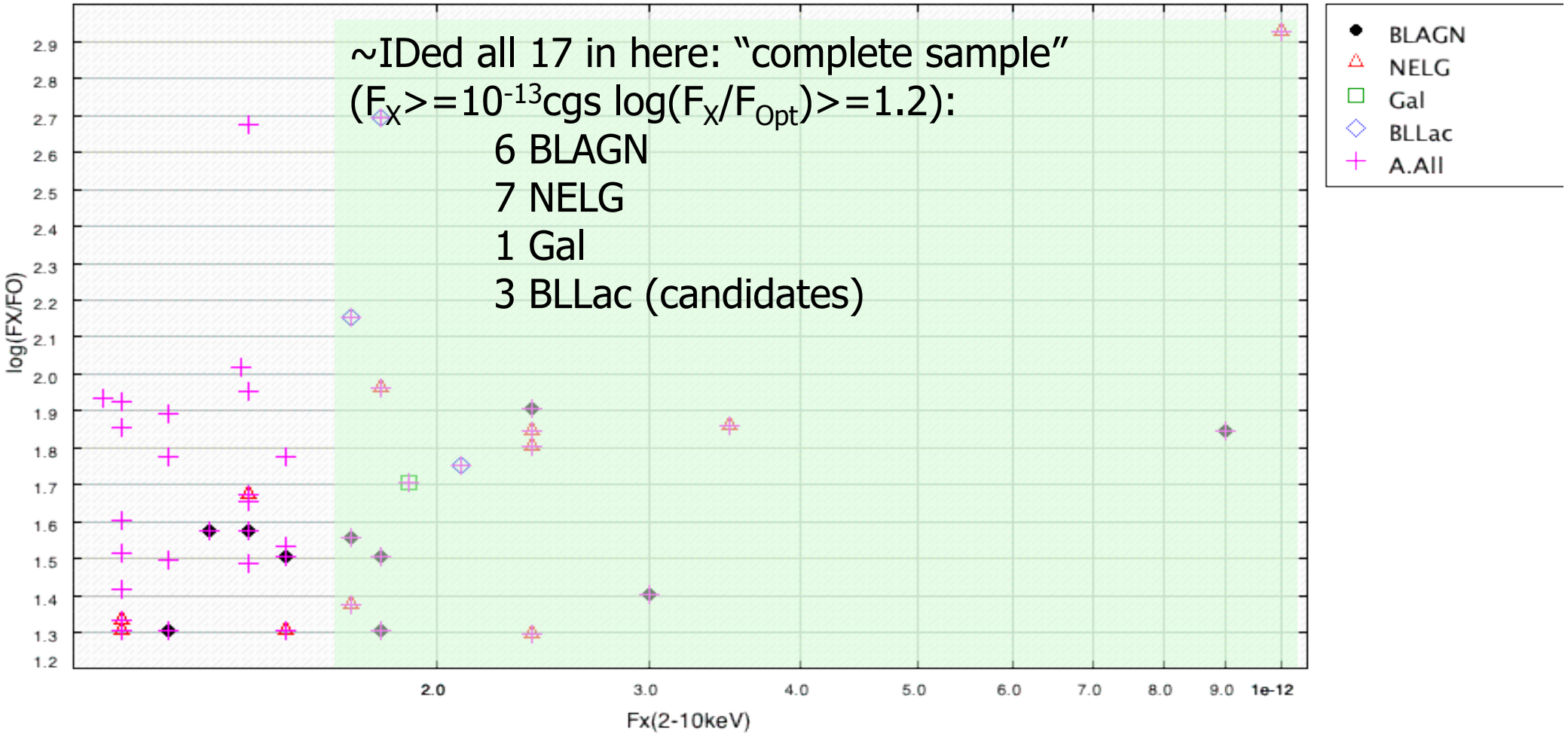

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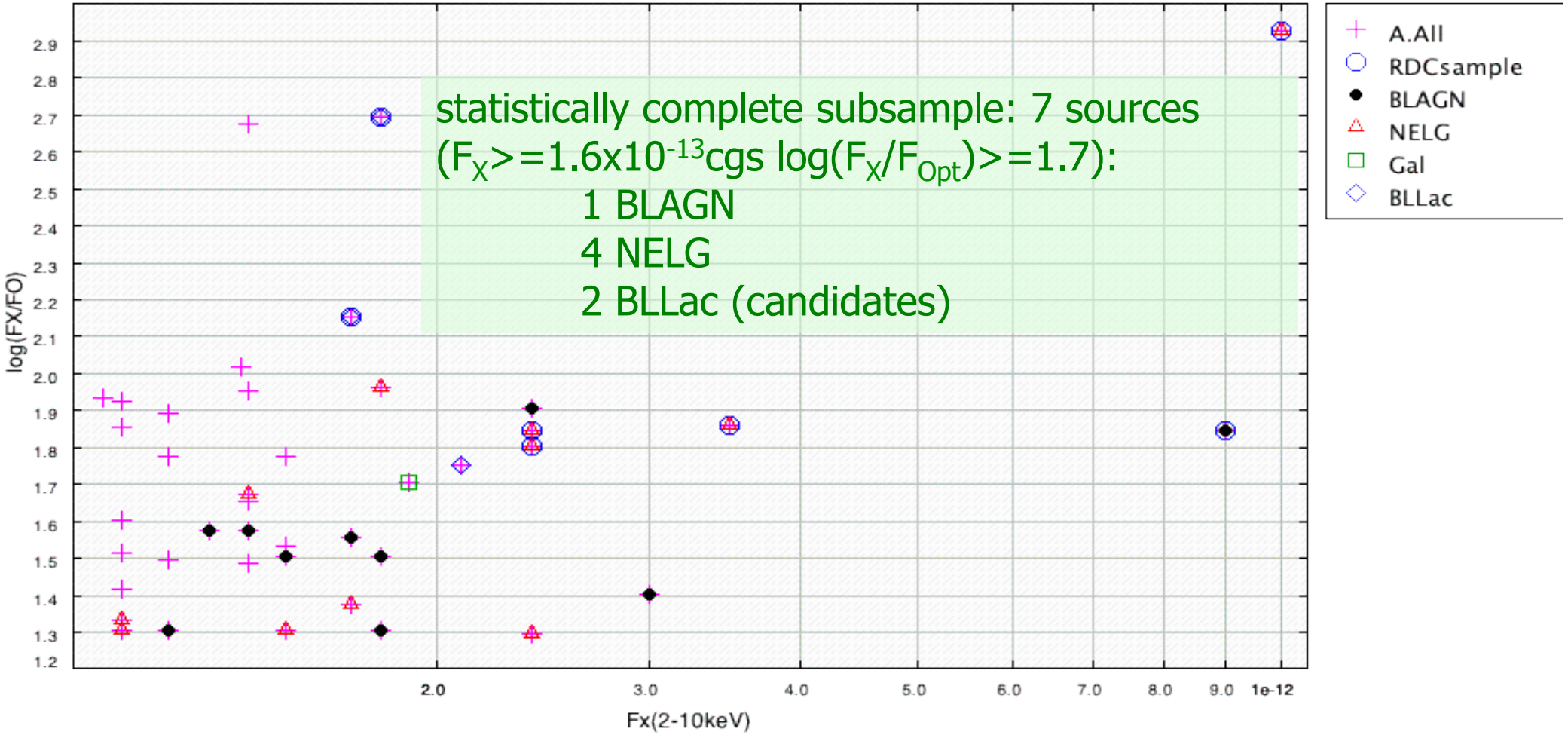
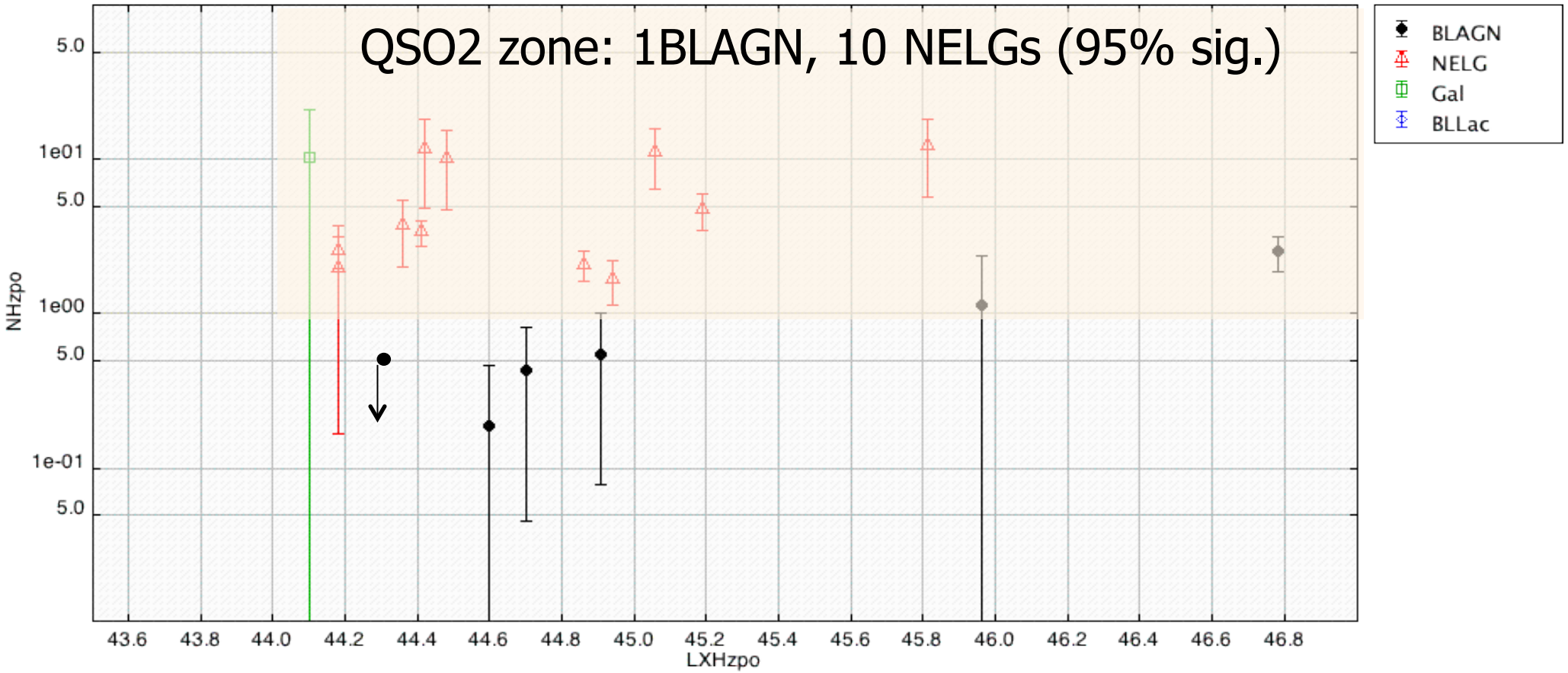
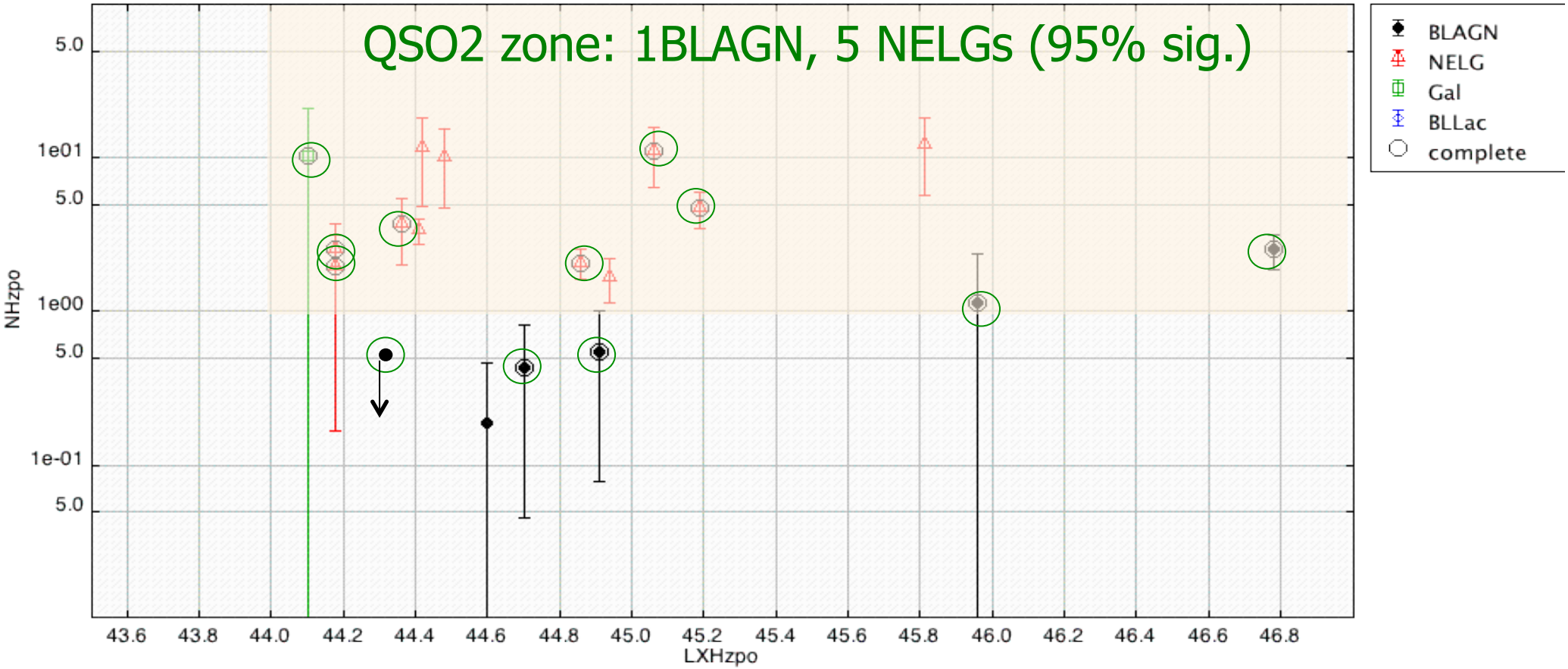


# X-ray spectral properties



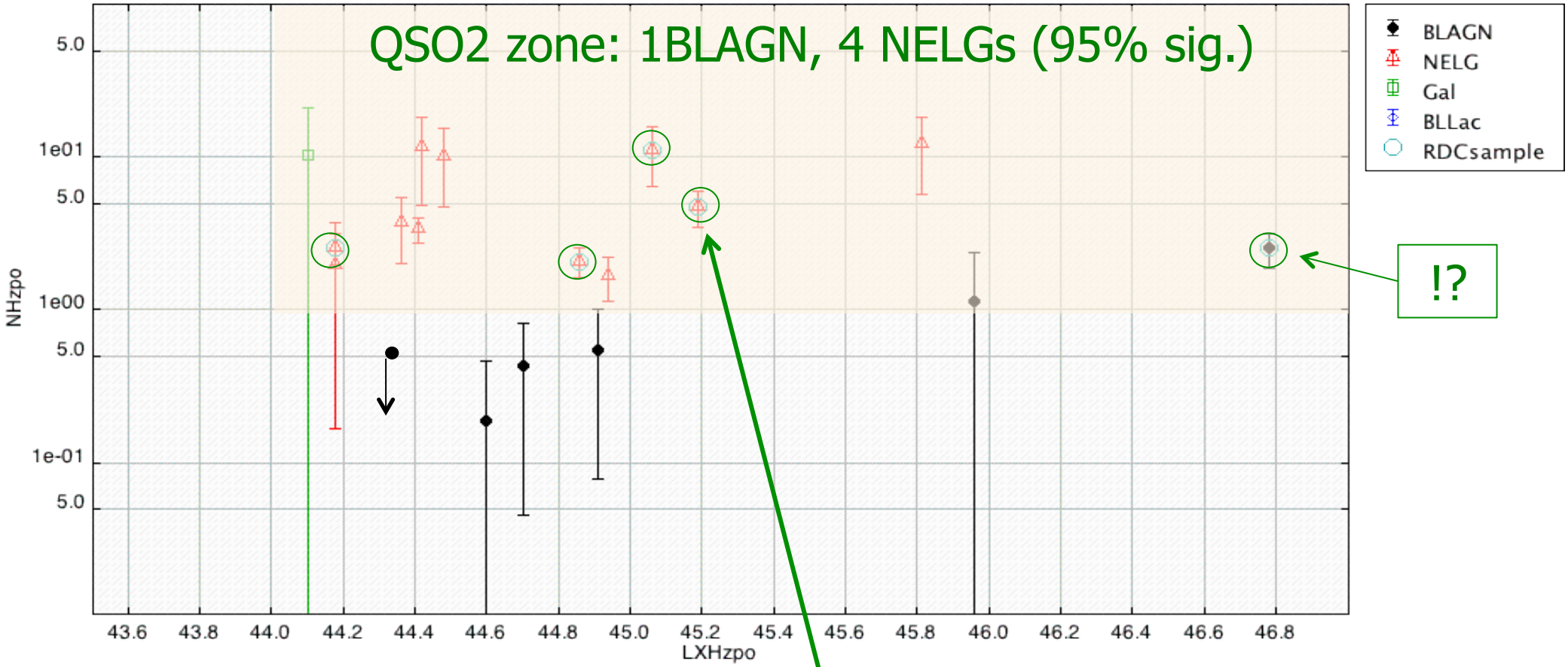

- Fitted powerlaw and intrinsically absorbed powerlaw to 22 sources, signif. from F-test (all $\log(L_{X,2\text{-}10keV})>\sim44$):
  - No signif. abs. 8 sources: 4BLAGN ($2N_H<<$), 1NELG, 1Gal, 2BLLac
  - Signif. abs.: 14 sources: 3BLAGN, 10NELGs, 1BLLac
    - 3 sources $\log(N_H)<=22$ 95% signif.: 2BLAGN, 1BLLac

# X-ray spectral properties



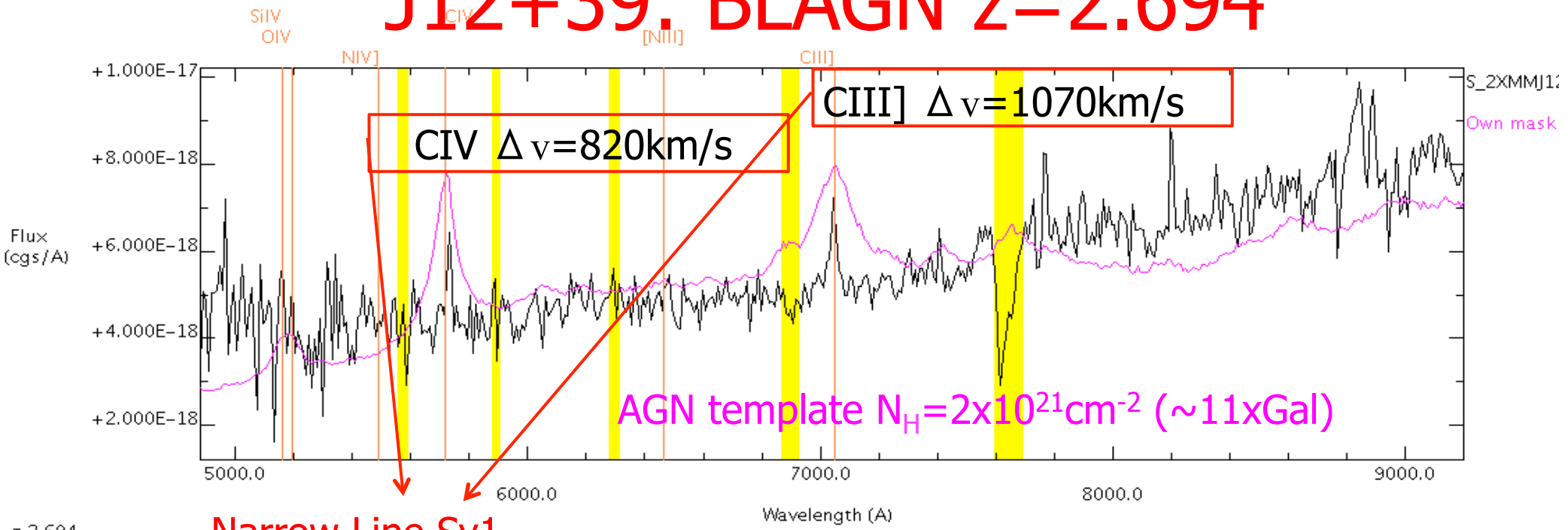

- "Complete" sample: 15 sources (2 more no X-ray spec.):
  - No signif. abs. 8 sources
  - Signif. abs.: 7 sources: 1BLAGN, 5NELGs, 1BLLac
    - 1 sources $\log(N_H)<=22$ 95% signif.: 1BLLac

# X-ray spectral properties

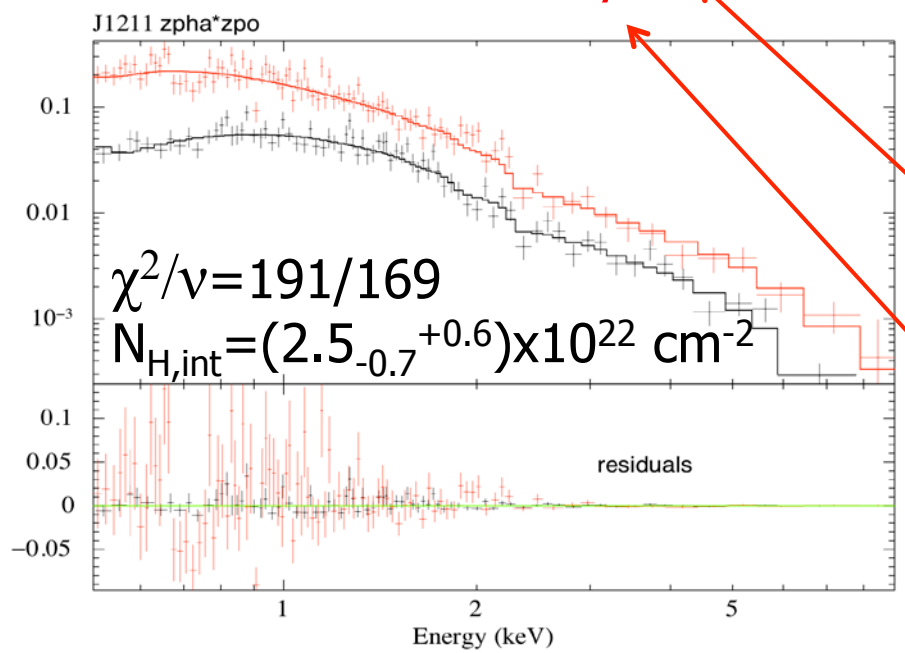



- Statistically complete sample: 7 sources:
  - No signif. abs. 1 source: 1BLLac
  - Signif. abs.: 6 sources: 1BLAGN, 4NELGs, 1BLLac
    - 1 sources log($N_H$)<=22 95% signif.: 1BLLac
    - Only 1 source $\Gamma$<1.4 (95% signif.): XMM J1232+2152 (delMoro+09, z=1.87 -0.76?-)

# J12+39: BLAGN z=2.694

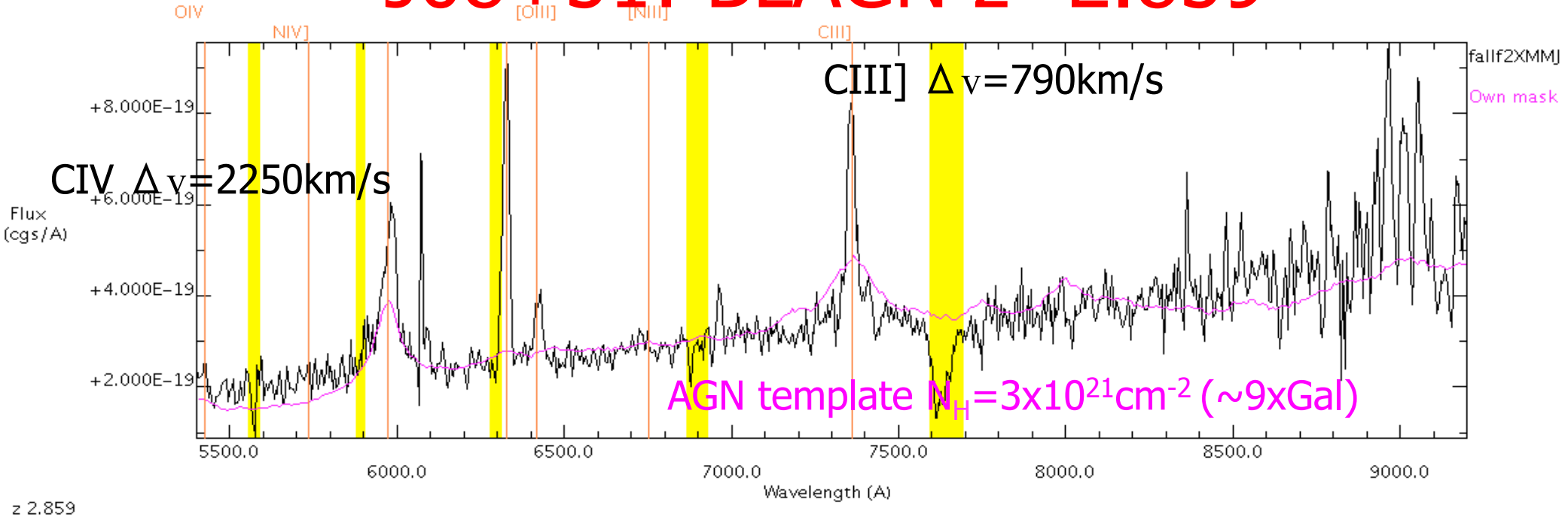


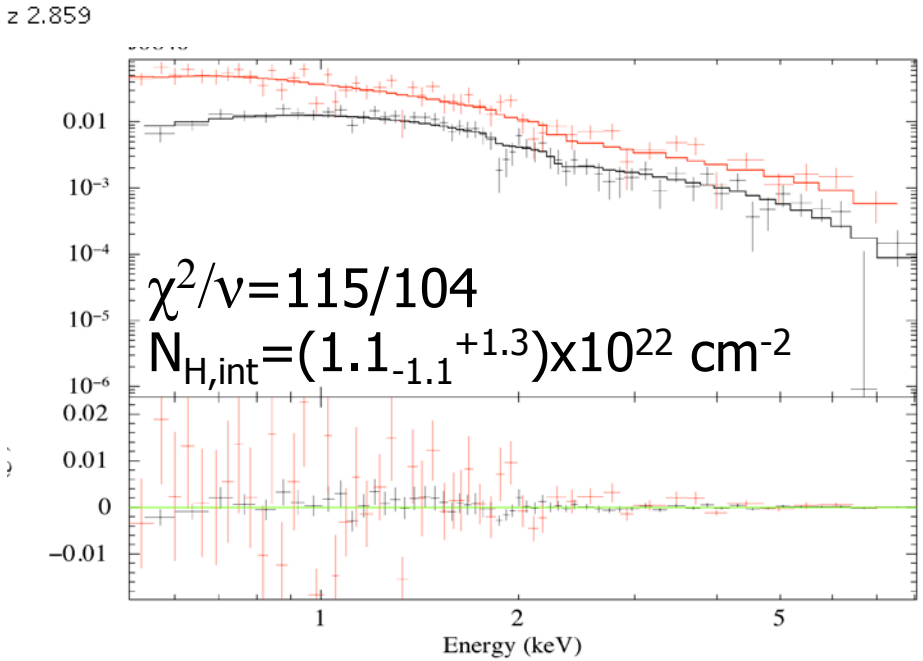

Narrow Line Sy1




- From Opt. spec.:
  - log($M_{BH}/M_{sun}$)=7.6
  - log($L_{Edd}$/cgs)=45.7
- From X-ray spec.:
  - log($L_{X,2\text{-}10keV}$/cgs)=46.8
  - $\Gamma$ ~2.3 (but no ion. abs.)
- Edd. ratio>100 ($\kappa$ =35)

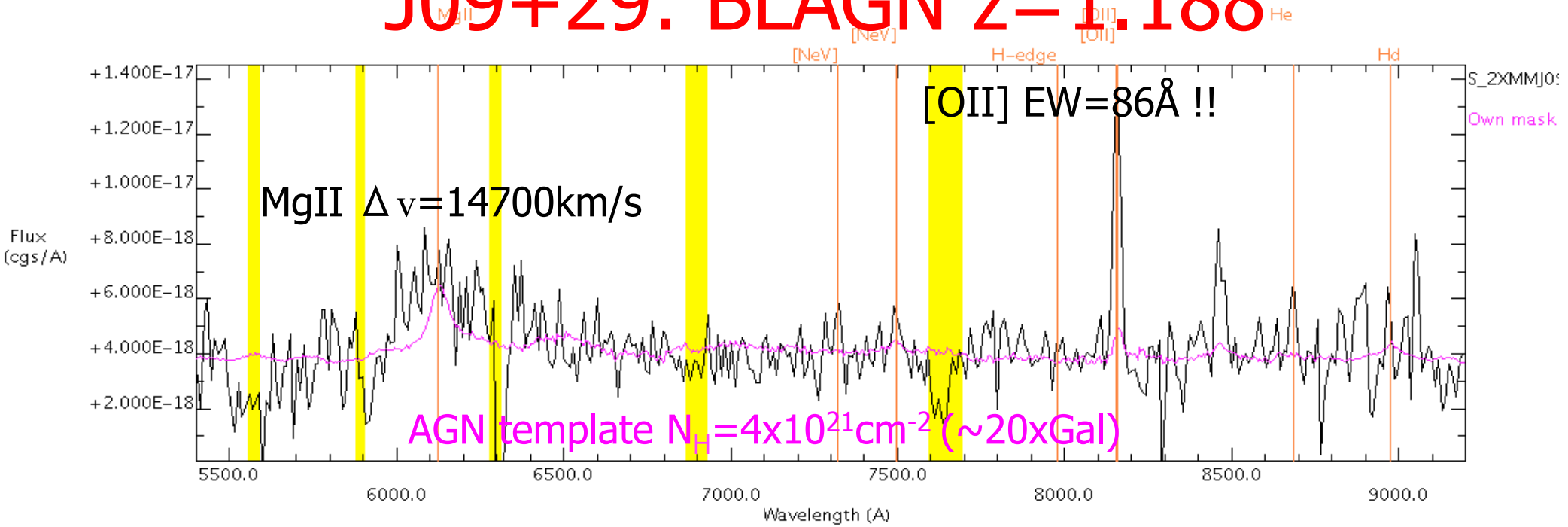
# J08+51: BLAGN z=2.859

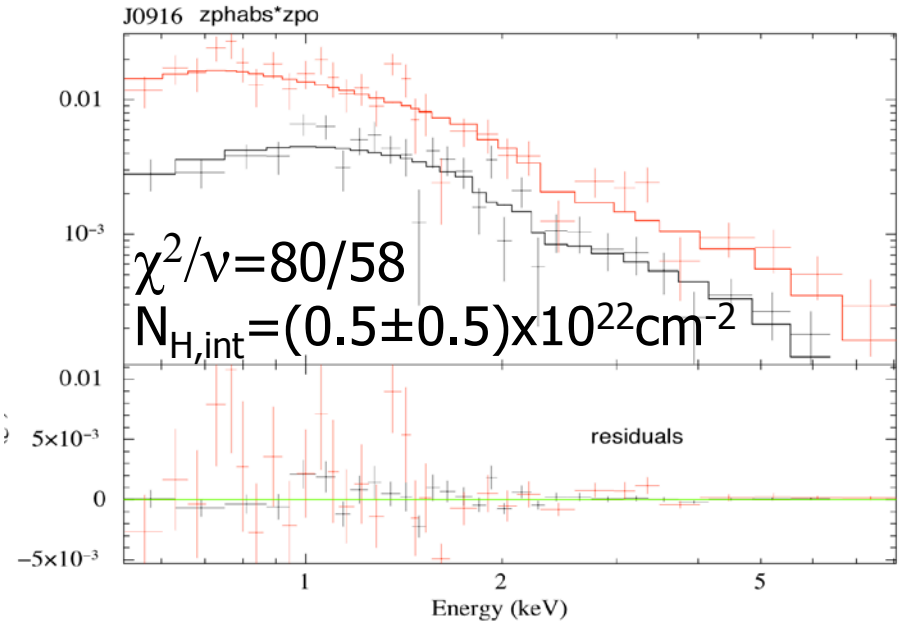



- From Opt. spec.:
  - log($M_{BH}/M_{sun}$)=7.5
  - log($L_{Edd}$/cgs)=45.6
- From X-ray spec.:
  - log($L_{X,2\text{-}10keV}$/cgs)=46.0
  - No signif. neutral of ion. abs.
- Edd. ratio~100 ($\kappa$ =35)

# J09+29: BLAGN z=1.188




- From Opt. and X-ray spec.:
  - Edd. ratio~0.05 ( $\kappa$ =35)
- Out of 200BLAGN in XBS:
  - only 2 EW~50-60Å, most <10-20Å
  - int. abs. opt. @[OII]~1/3
- In Sy2 EW~200Å:

  ⇒ transition object?

# Summary

- Looking for obscured AGN at high FX/FOpt values
  - Good quality X-ray spectra ➔ high FX values ➔ rare objects
  - Merging of objects from several large samples (XBS, BUXS...)
- Using OSIRIS on GTC (and others)

- Identified 22+3 sources (10 BLAGN, 11 NELG, 1 Gal, 3 BLLacs?):
  - All $F_X$>1.5x$10^{-13}$cgs log($F_X/F_{Opt}$)>=1.2: 17 (6 BLAGN, 7 NELG, 1 Gal, 3 BLLacs)
  - Statistically complete sample: 7 (1 BLAGN, 4 NELGs, 2 BLLac)
- XMM-Newton X-ray spectra of 22 sources:
  - 14 significant absorption, 11 log(NH)>22 (95% signif.):
    - 1 BLAGN: J12+39 z=2.694 NLSy1
    - 10 NELGs: all QSO2s
      - including J1232+2152 (delMoro+09)
    - no evidence for Compton Thick absorption
  - Statistically complete sample:
    - 2 BLLacs no signif. abs. or log($N_H$)<22 (95% signif.)
    - signif. abs.: 1 BLAGN (J12+39), 4 NELGs (all QSO2s)
  - Many BLAGN:
    - Two highest $L_X$ BLAGN super-Eddington, next one down transition?...

⇒ Good method to select QSO2s but not CT