Discovery of the new changing look cases in NGC 1566

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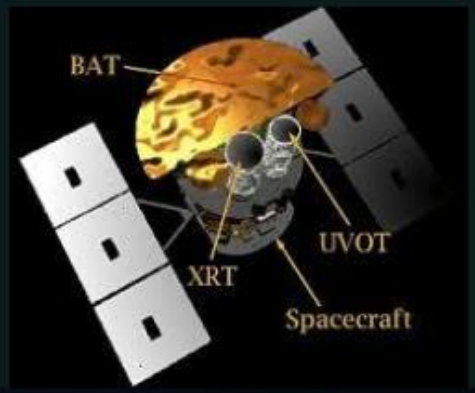
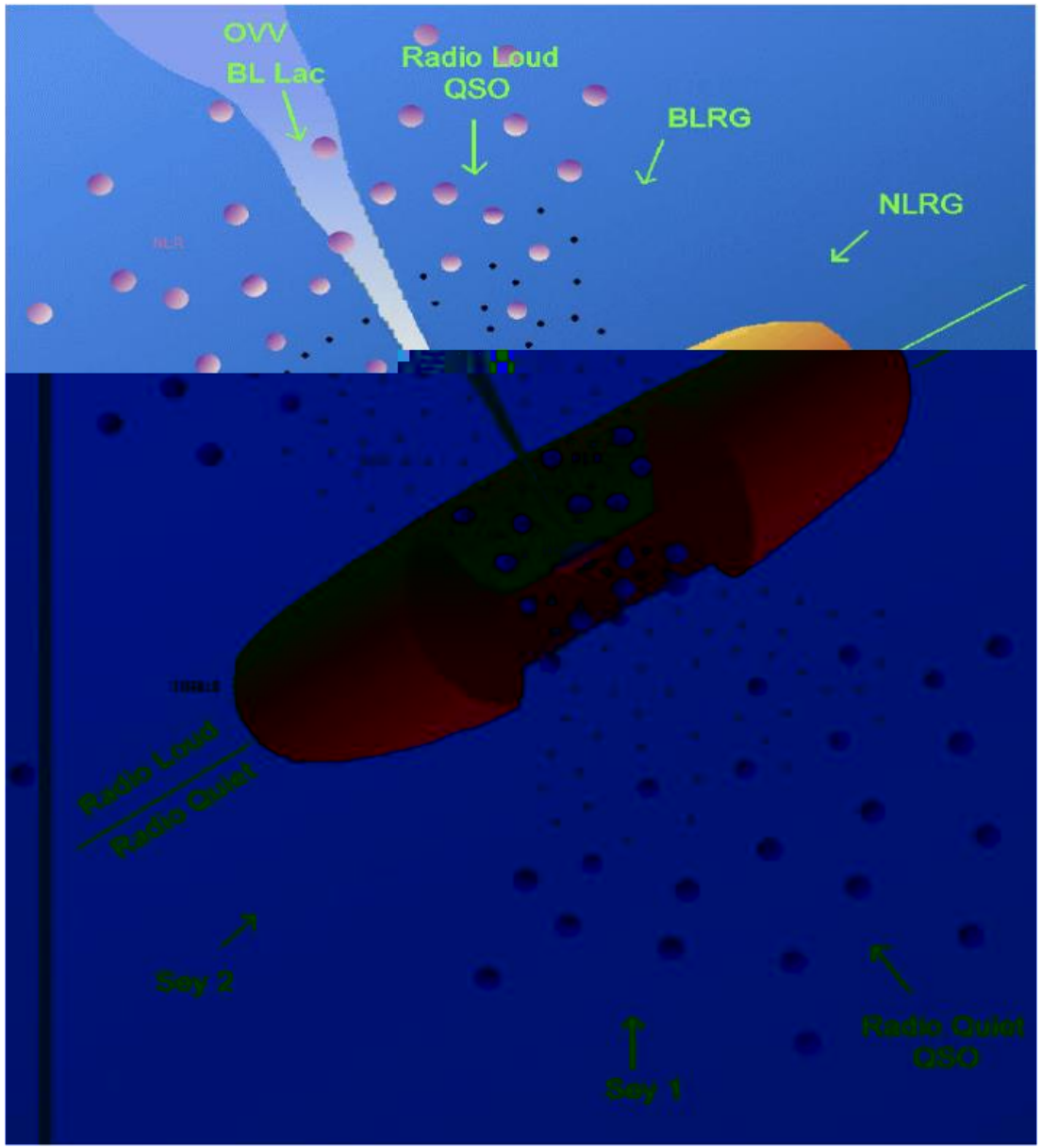
GL&AGN

Serbia 2019

MASTER and CL AGNs project


BAT
UVOT
XRT
Spacecraft



One of the biggest challenge to simple AGN unification schemes:
existence of "Changing-look" (CL) AGNs.

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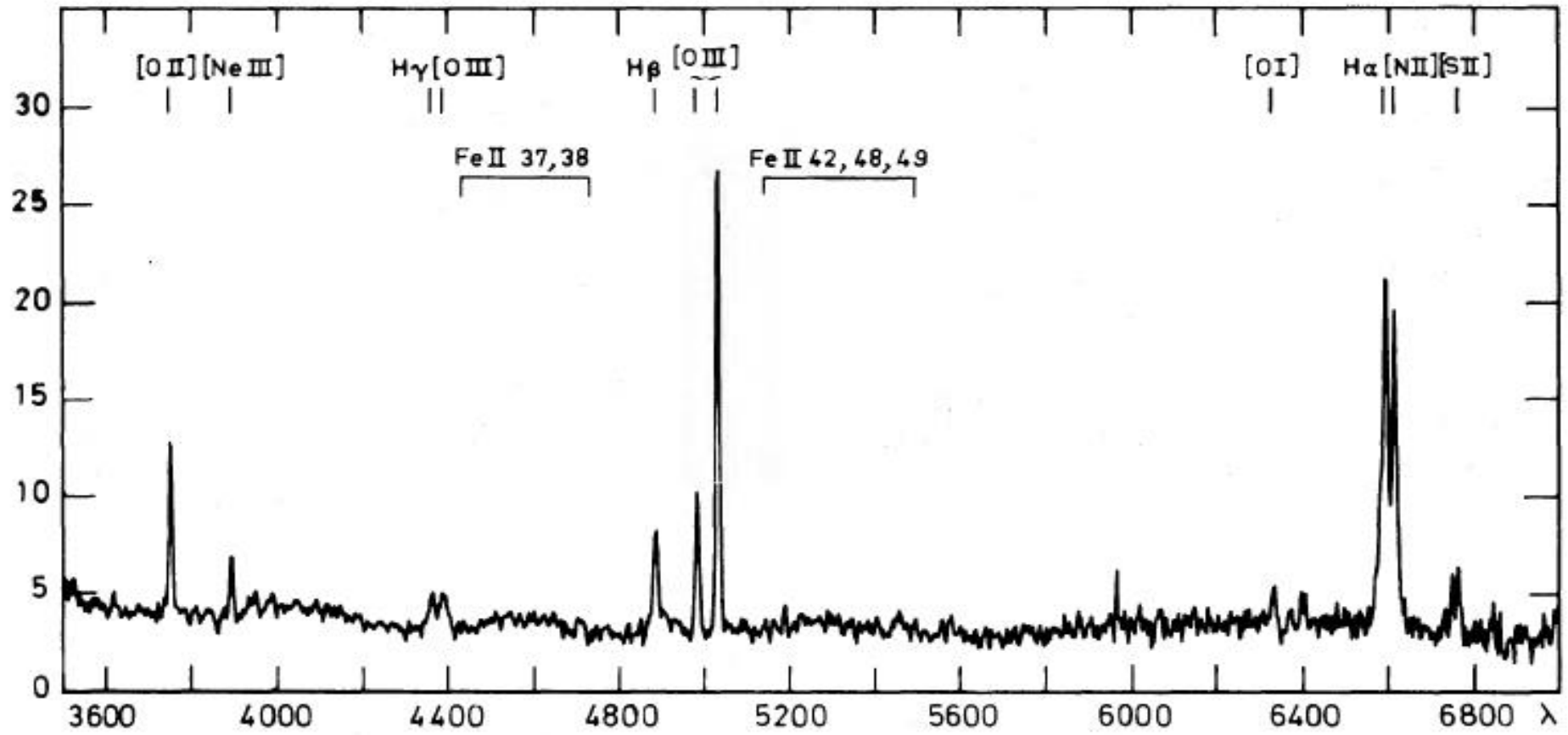
NGC4151 is one of the first discovered CL AGNs
Lyuty,Oknyansky,Chuvaev (1984)
Penston&Perez (1984)

NGC1566

- NGC 1566 is a galaxy with a very well-studied variable active !!) ! !21!-!) ! 24-!!! ! !8/3!Mpc)
- The most significant recorded past out-bursts were observed in 1962 and 1988 (da Silva et al. 2017)
- First RM Baribaud et al. (1992), Oknyansky&Horn (2001).
- On 12-19 June 2018 data from the INTEGRAL showed that NGC 1566 was in outburst in hard X-rays (Ducci et al. 2018)
- Follow-up observations with the Swift observatory (Kuin et al. 2018; Ferrigno et al. 2018; Grupe et al. 2018, 2019).
- Brighten 1.0 mag at 3.4 microns and 1.4 magnitudes at 4.6 micron January 2017 - July 2018 (Cutri et al. 2018)
- Discovery of CL case Oknyansky et al. (2018, 2019)

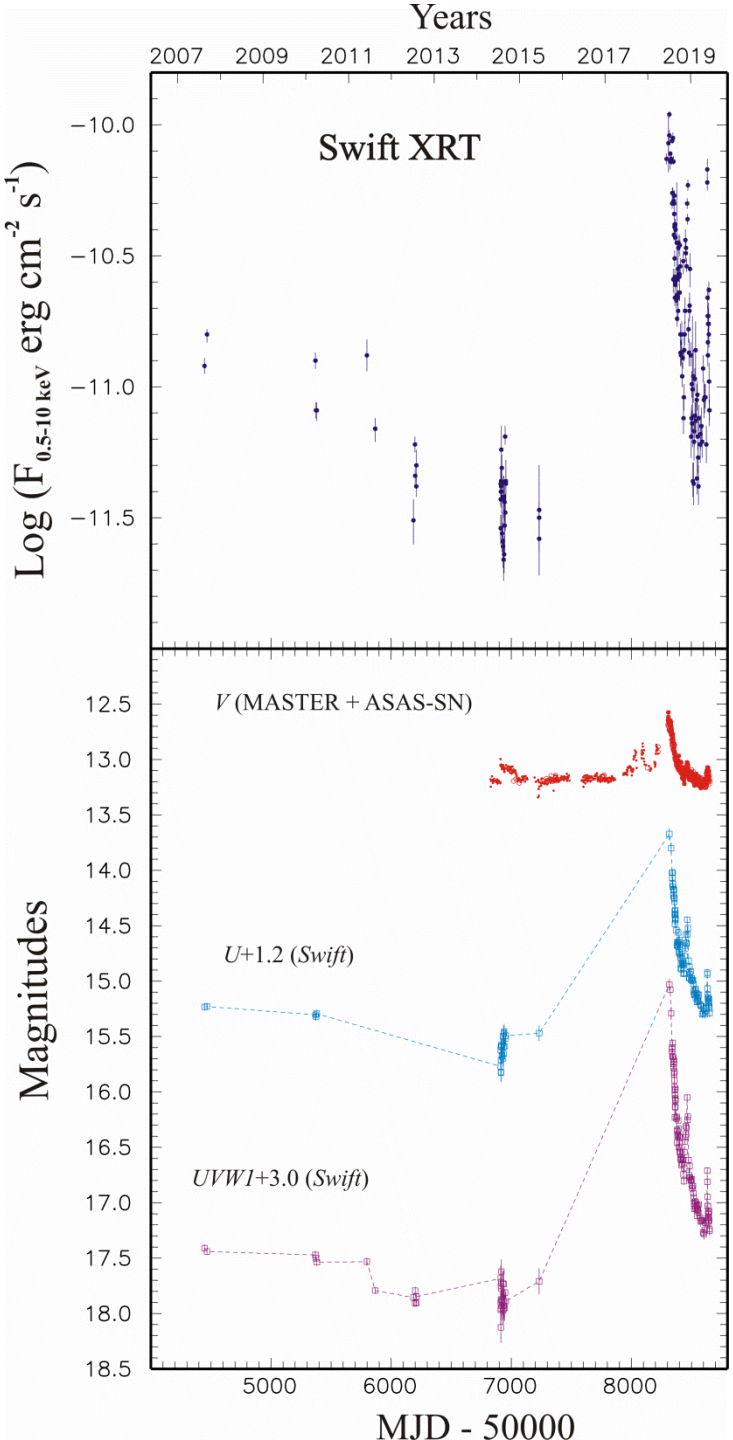
Alloin et.al. (1985),
Jan. 1981

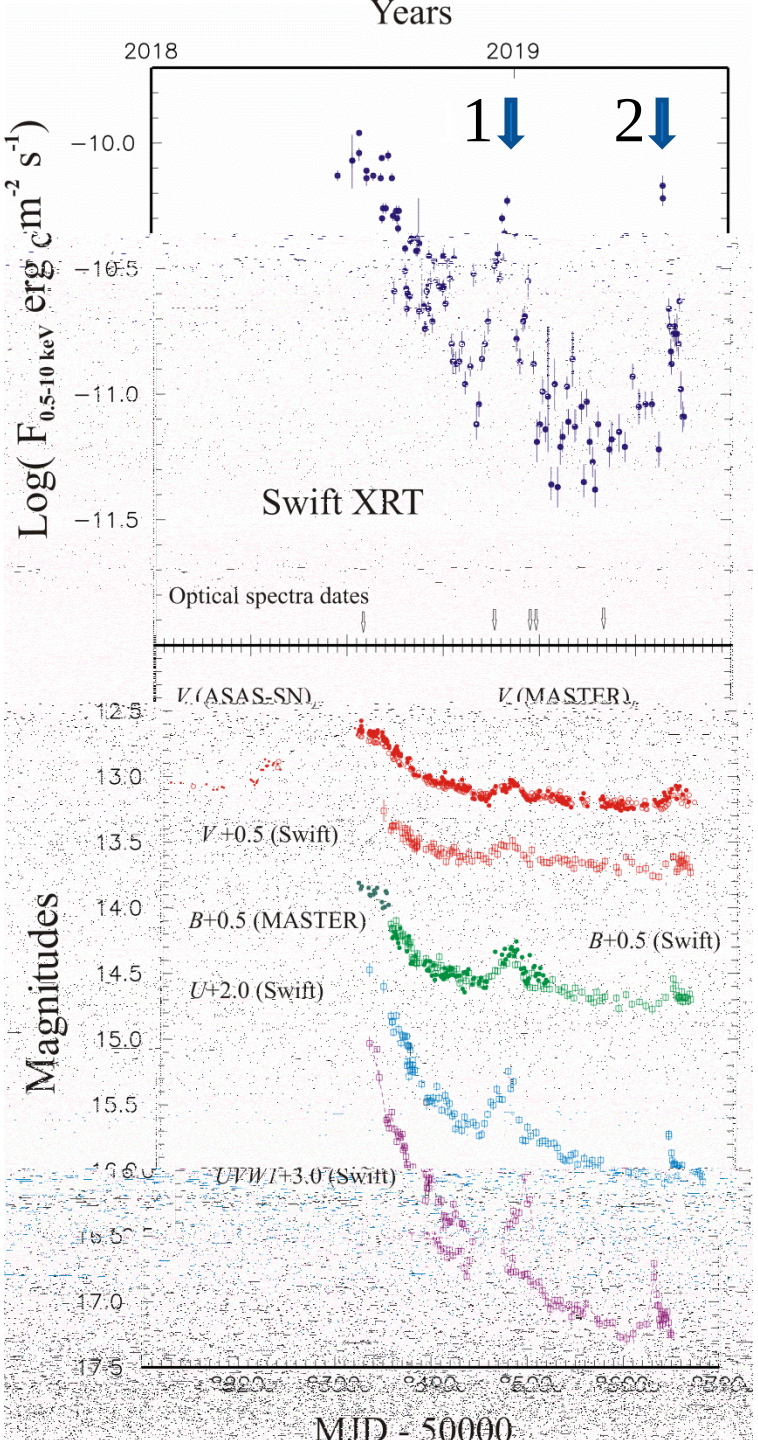
NGC1566



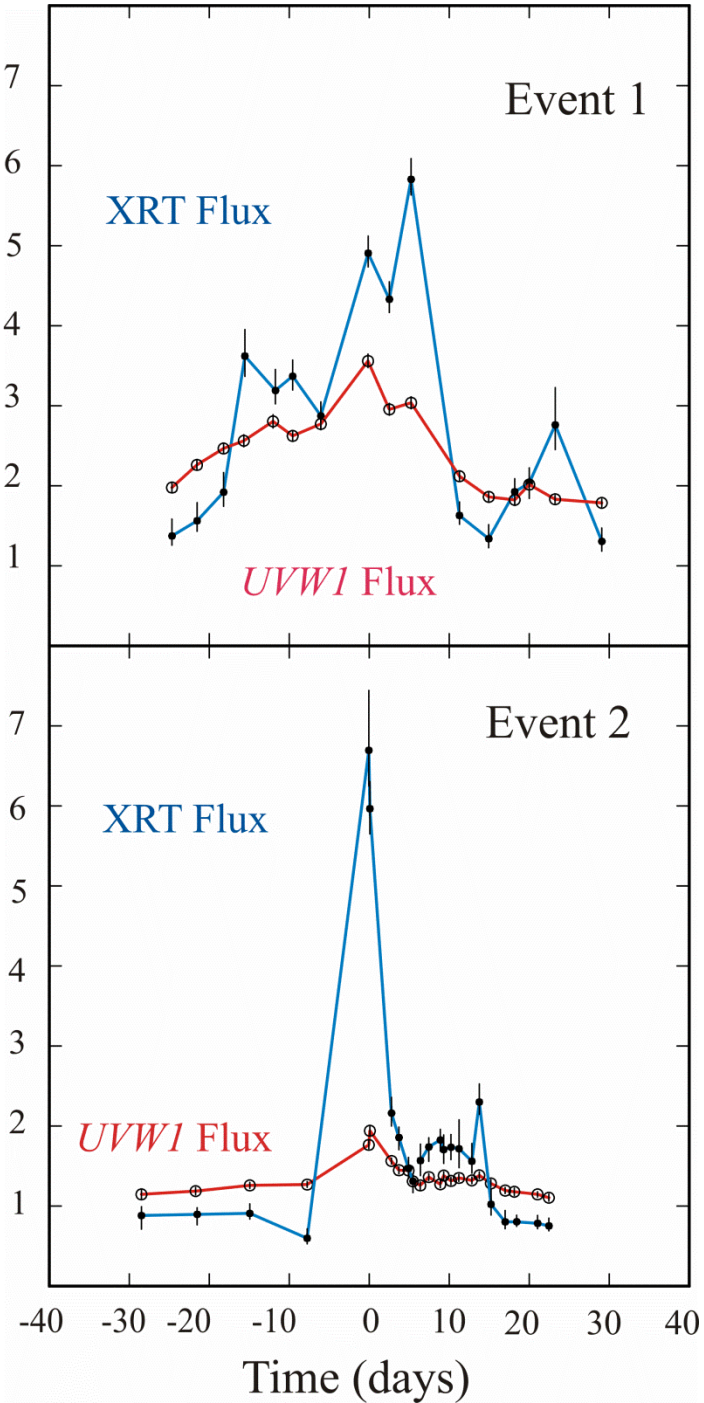
2018-2019
New results

NGC1566

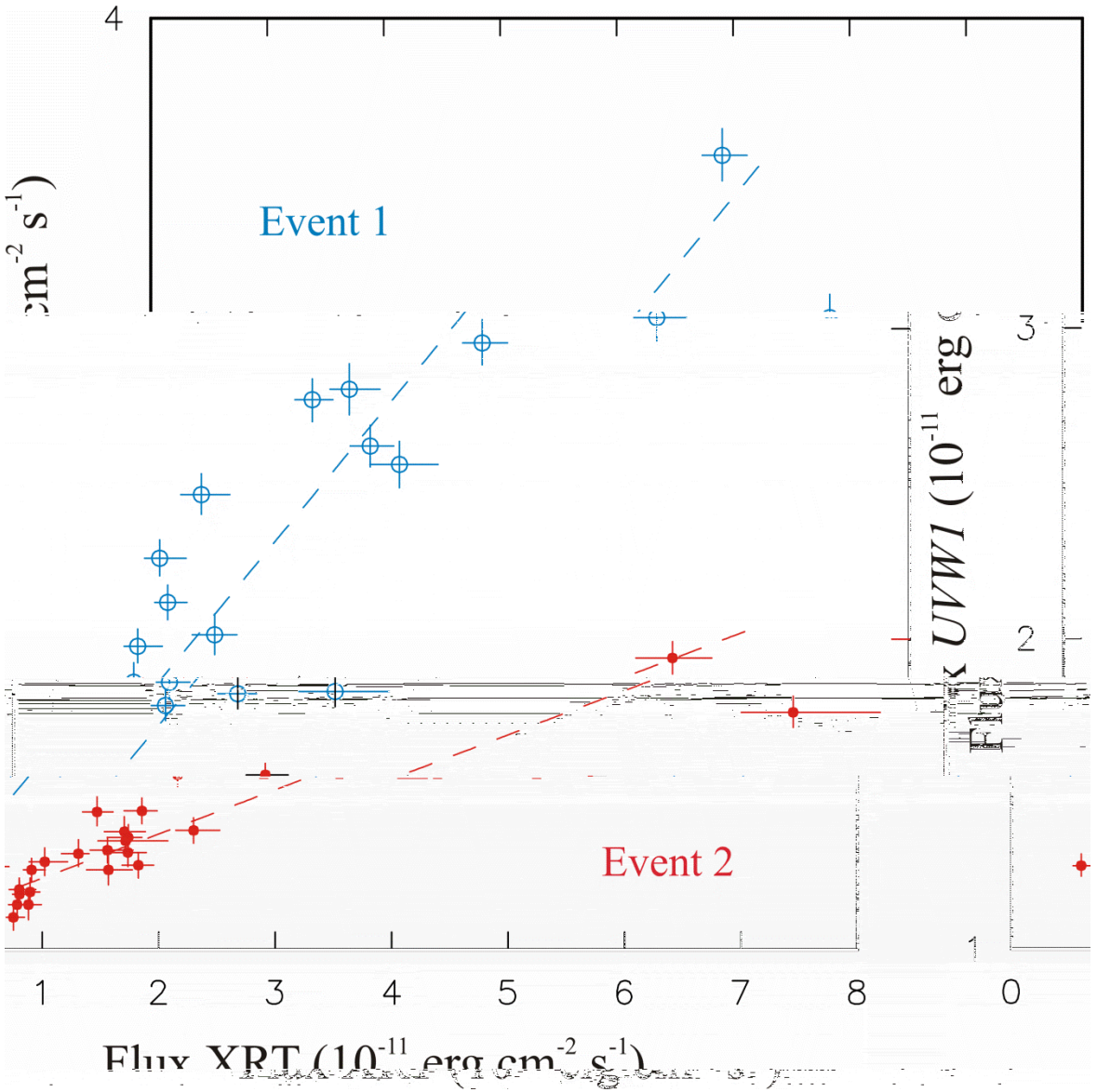


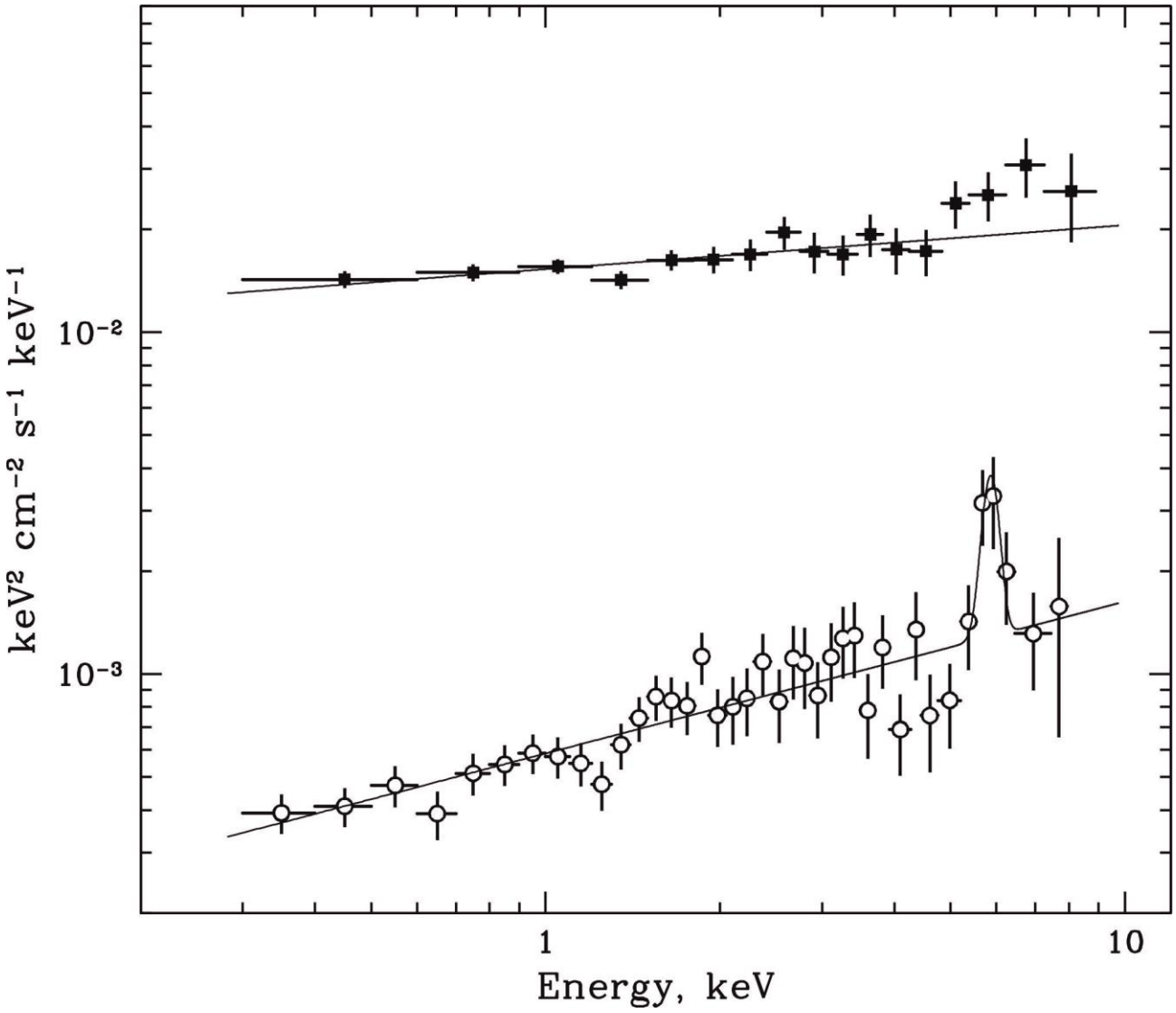


SWIFT
NGC1566



SWIFT
NGC1566



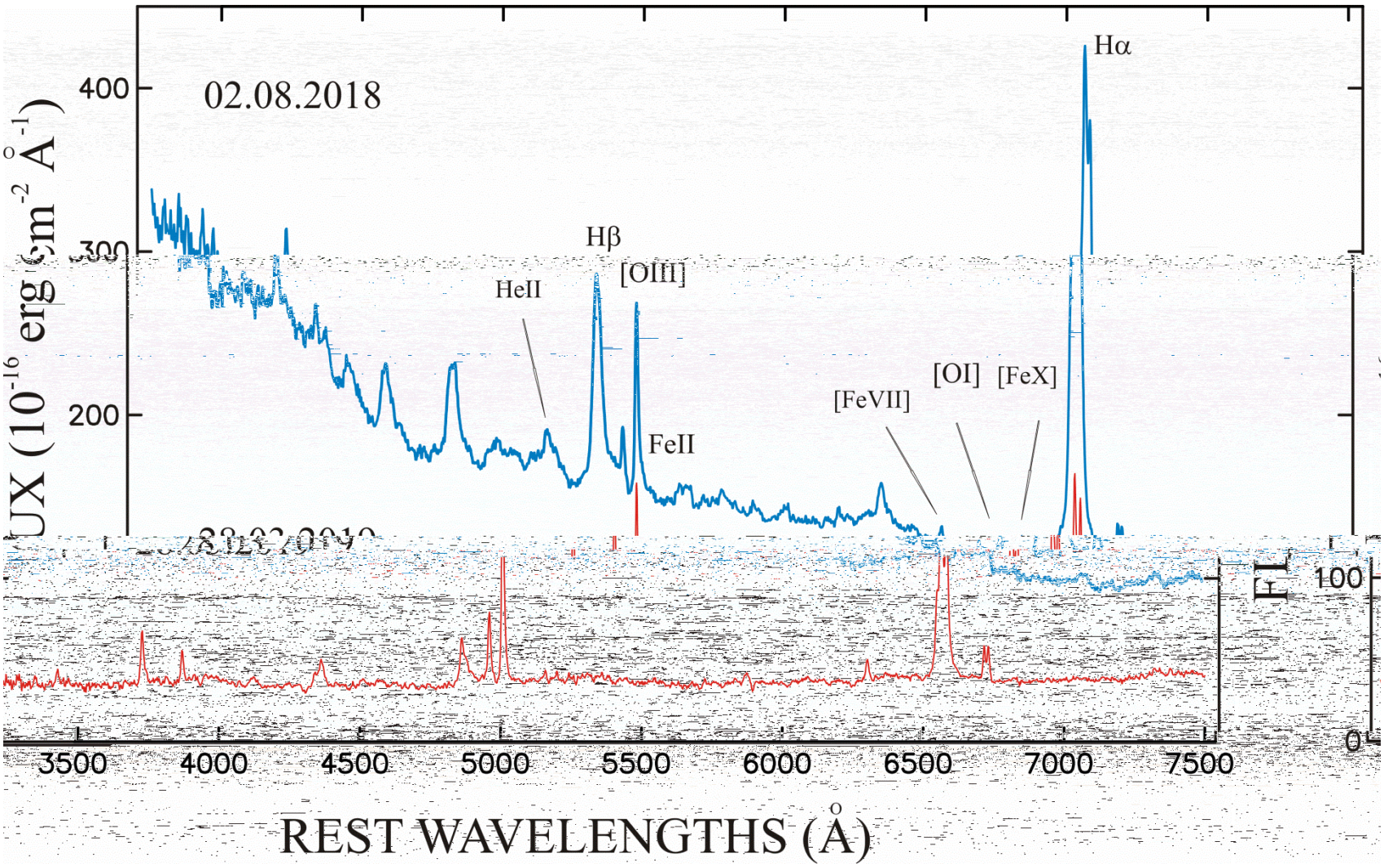


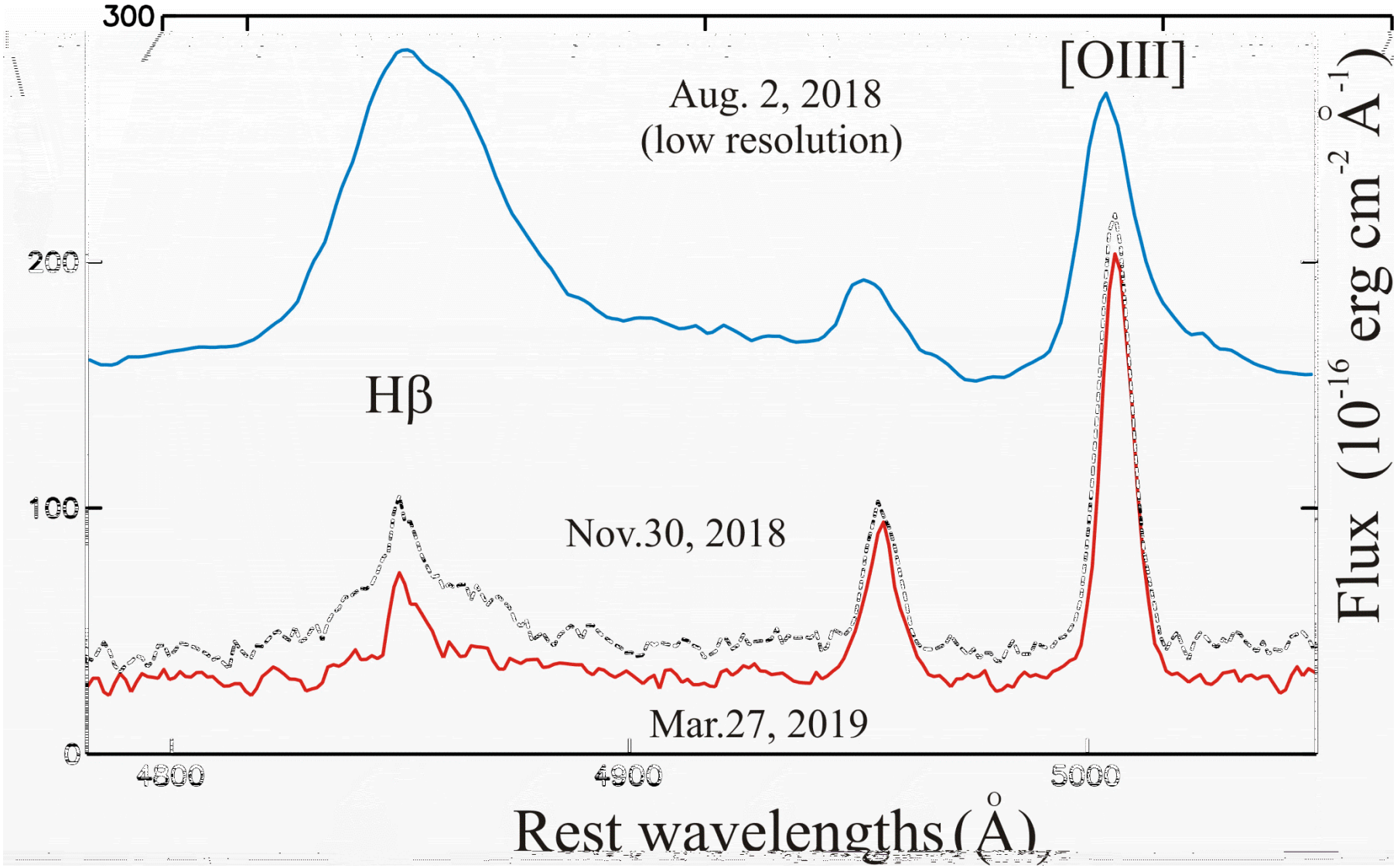
Energy spectra of NGC 1566 obtained with the Swift/XRT telescope in low state (MJD 56185 56210; open circles) and high state (MJD 58339.7; squares). Solid lines correspond to the best-fit models consisting of the power-law in the high state and power-law plus Gaussian emission components in the low state.

Light curves. New and published results (Oknyansky et al. 2019, MNRAS)

- We summarize a study of optical, UV and X-ray light curves of the nearby changing look active galactic nucleus in the galaxy NGC 1566 obtained with the ***Swift*** Observatory and the MASTER Global Robotic Network over the period 2007-2019.
- A substantial increase in X-ray flux by 1.5 orders of magnitude was observed following the brightening in the UV and optical bands during the first half of 2018 year. After a maximum was reached at the beginning of July 2018, the fluxes in all bands decreased with some fluctuations.
- The most remarkable re-brightenings in the light curve following the decline from the bright phase were observed at MJD range 58440-58494 and 58603-58654.
- The amplitude of the flux variability is strongest in the X-ray band and decreases with increasing wavelength.
- If take into account the host galaxy contamination in the used aperture then partial decreases from the maximum in July 2018 to minimum in June 2019 in the different UV/Opt bands became about the same (~ 9 times).
- The obscuration scenario along can be rejected since we didn't find any signature of variable absorption from the X-ray and UV/Opt data.

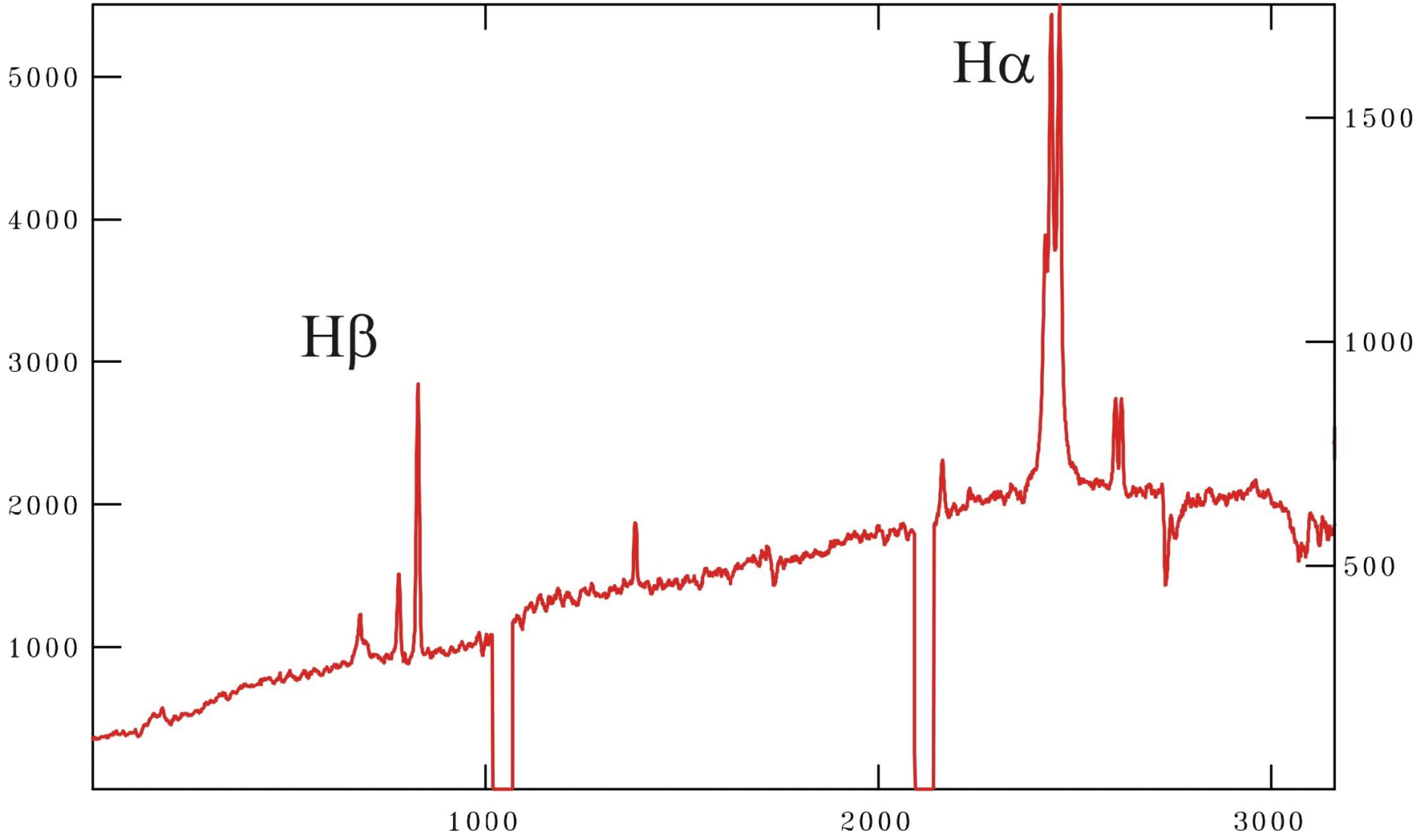
NGC1566


02.08.2018
Hα
Hβ
[OIII]
HeII
FeII
[FeVII]
[OI]
[FeX]
400
200
3500
4000
4500
5000
5500
6000
6500
7000
7500
REST WAVELENGTHS (Å)
100
0


300
200
100
0
Aug. 2, 2018
(low resolution)
[OIII]
Hβ
Nov.30, 2018
Mar.27, 2019
4800
4900
5000
Rest wavelengths (Å)
Flux (10^-16 erg cm^-2 Å^-1)

NGC1566 SALT 9 Sep 2019

(Wolfram Kollatschny)



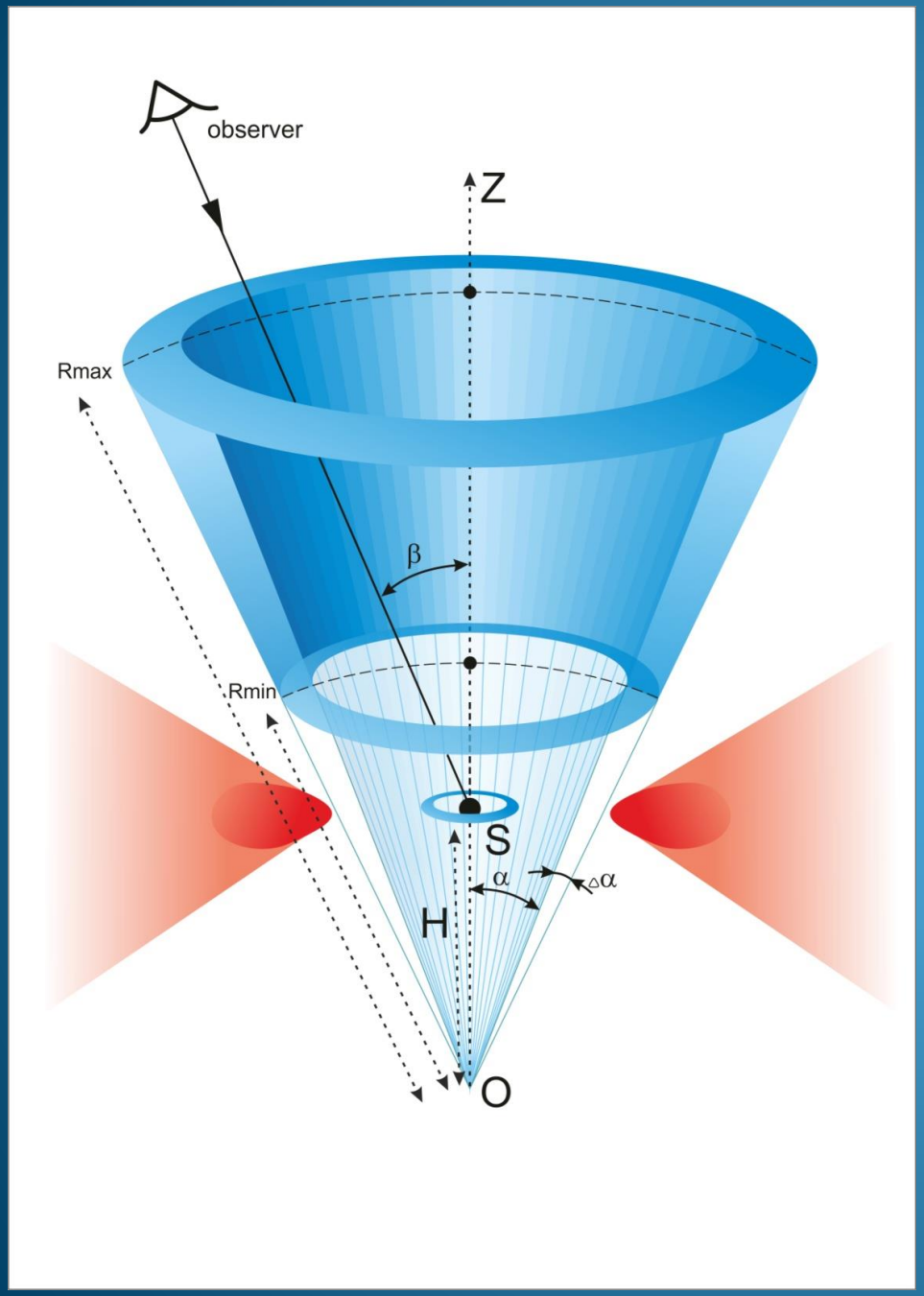
Our published results on spectral variability (Oknyansky et al. 2019, MNRAS)

- is quite a lot brighter than [OIII]5007A. The total to [OIII]5007A line ratio is about 4.2 0.4, corresponding to a Sy1.2 classification according to the criteria proposed by Winkler (1992).
- The to ratio for the Gaussian broad components is 2.7 0.3 . The obscuration of the broad line region is negligible.
- The HeII4686A emission feature is bright and broad.
- The [FeX]6374A coronal emission line is stronger than [OI]6300A, something that has not been seen before in NGC 1566. (The variability of coronal lines has also been detected in a number of CL AGNs: NGC 4151, NGC 5548, NGC 7469, 3C 390.3 and others (Oknyanskij & Chuvaev 1982; Oknyanskii et al. 1991; Veilleux 1988; Landt et al. 2015a,b; Parker et al. 2016)
- A strong UV continuum is clearly seen in our spectrum, and was far more prominent than what is visible in spectra collected during earlier low states.
- FeII emission is evidently much stronger now than in recent years.

We suspect that such strong outbursts in NGC1566 may be recurrent events with the timescale about several tens of years.

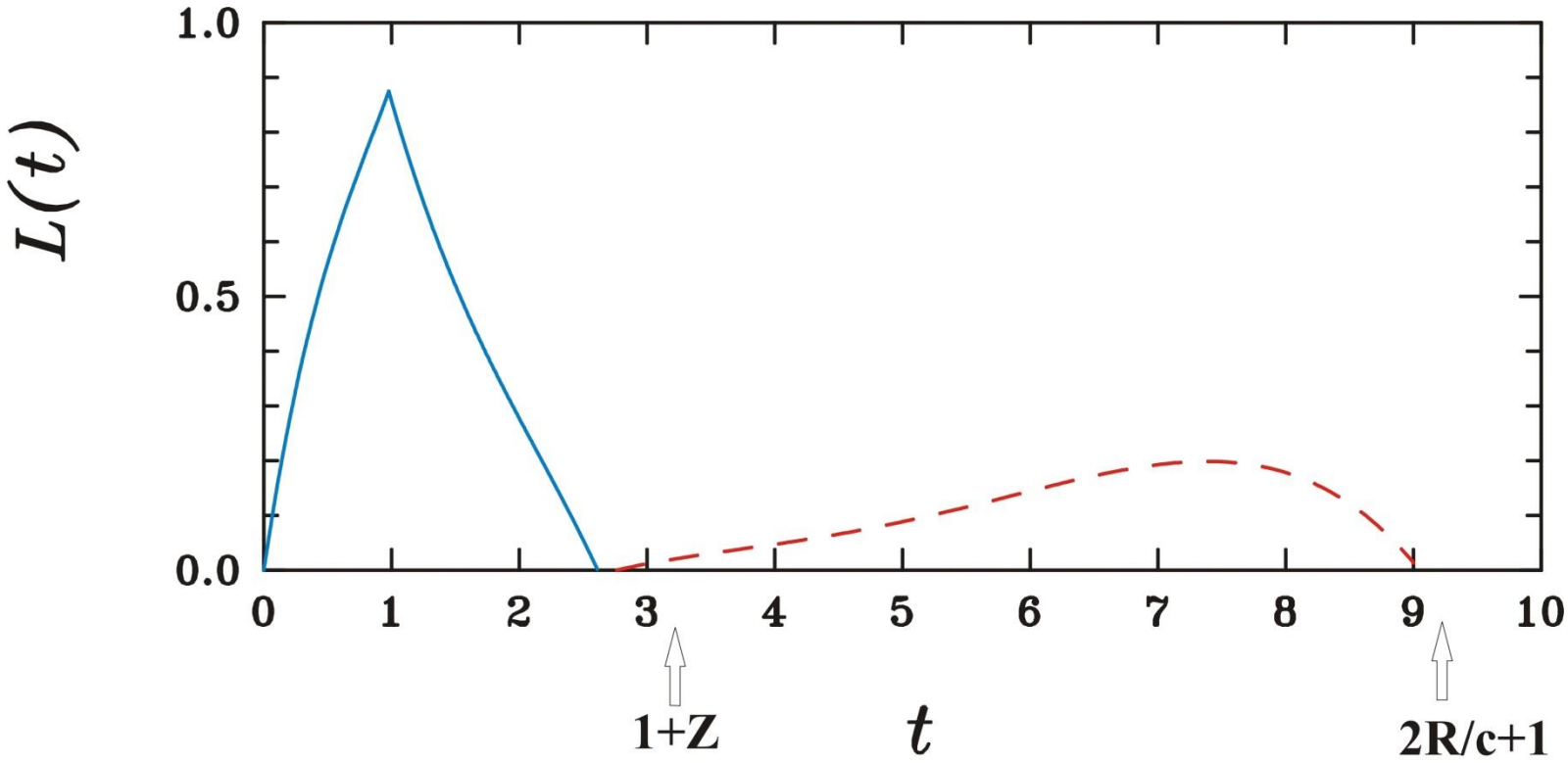
New spectral results (Mar. 27-28, 2019)

- is significantly lower than [OIII]5007A. The total to [OIII]5007A line ratio is about 0.50 0.05, corresponding to a Sy1.8-Sy1.9 classification according to the criteria proposed by Winkler (1992).
- The to ratio is 6.08 0.3. If take into account [NII] lines then the ratio is big still ~4.9. The obscuration of the broad line region? Different location of H and H region? See Ilicn et al. (2012) for another explanations.
- The HeII4686A emission feature is about not seen.
- The [FeX]6374A coronal emission line is about not seen. So we see strong drop down of the line during half-year after the maximum
- The UV continuum is not seen in our spectrum, and it is strongly different with the past spectra at Aug 2. 2018 and it is the same is it visible in spectra collected during earlier low states.
- FeII emission is evidently much lower now than in the summer 2018 spectrum.
- **Effectively, two changing look (CL) cases were observed for this object: changing to Sy1.2 type and then returning to the low state as Sy 1.8 - Sy 1.9.**



The proposed model

Oknyansky&Gaskell (2015)

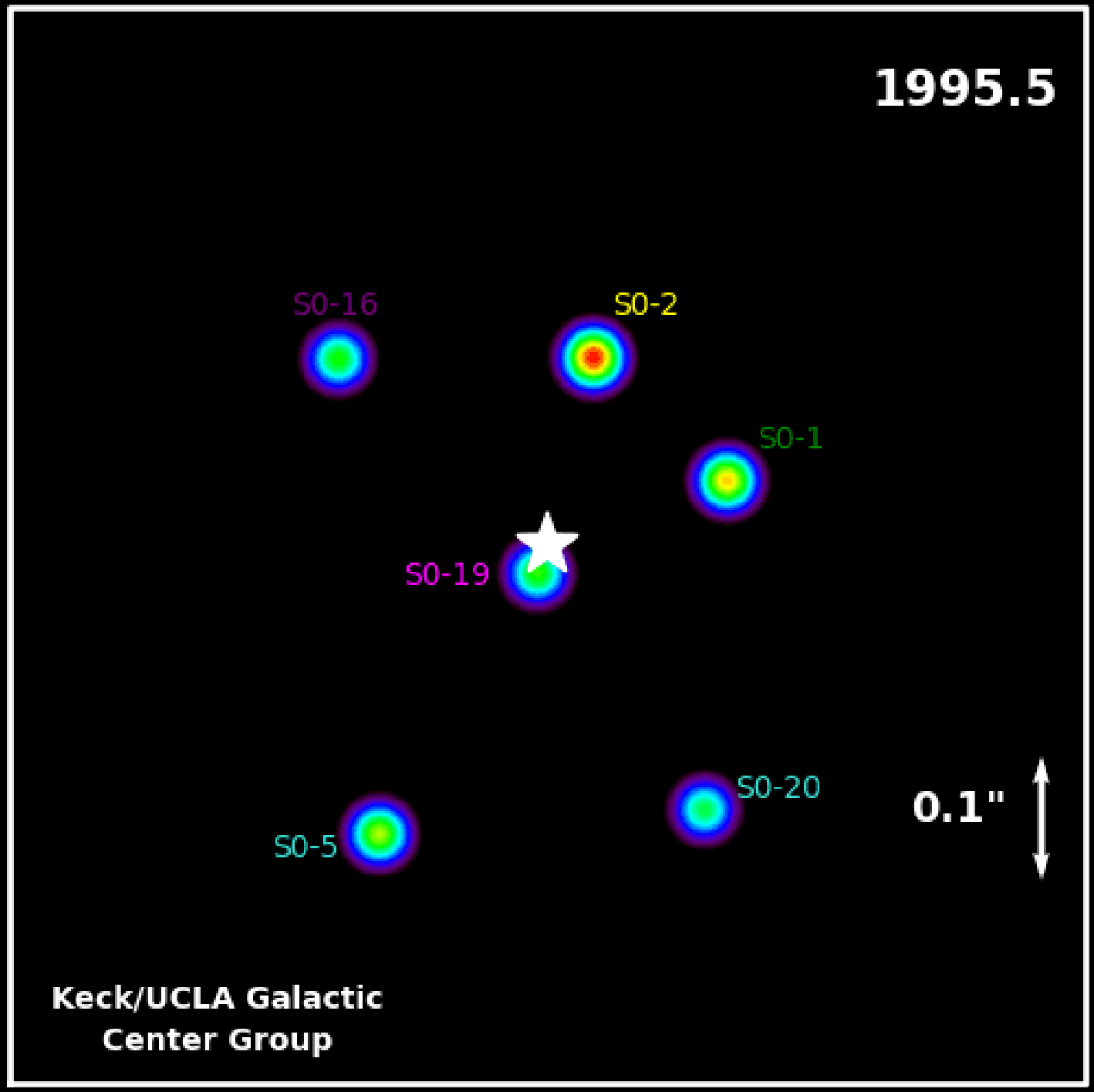

1.0
0.5
0.0
L(t)
0
1
2
3
4
5
6
7
8
9
10
t
1+Z
2R/c+1

Post Script

- black hole and it is totally ripped apart by tidal forces. It may also happen that the star is not close enough to the black hole to be totally disrupted and a less dramatic event might happen. If the stellar orbit is bound and highly eccentric, just like some stars in the centre of our own Galaxy, repeated flares should occur. (Campana et al., 2015, Ivanov and Chernyakova, 2006).

*Thanks to **Pavel Ivanov** and **Konstantin Malanchev** for useful discussions, thanks to the **Swift, SAAO** and **MASTER** teams for organizing the observations. Thanks to the **IAU** for the travel grant.*

Thanks to you for attention


1995.5
S0-16
S0-2
S0-1
S0-19
S0-20
S0-5
0.1"
Keck/UCLA Galactic
Center Group