

# **Spectral changes and BLR kinematics of eruptive changing look AGN**



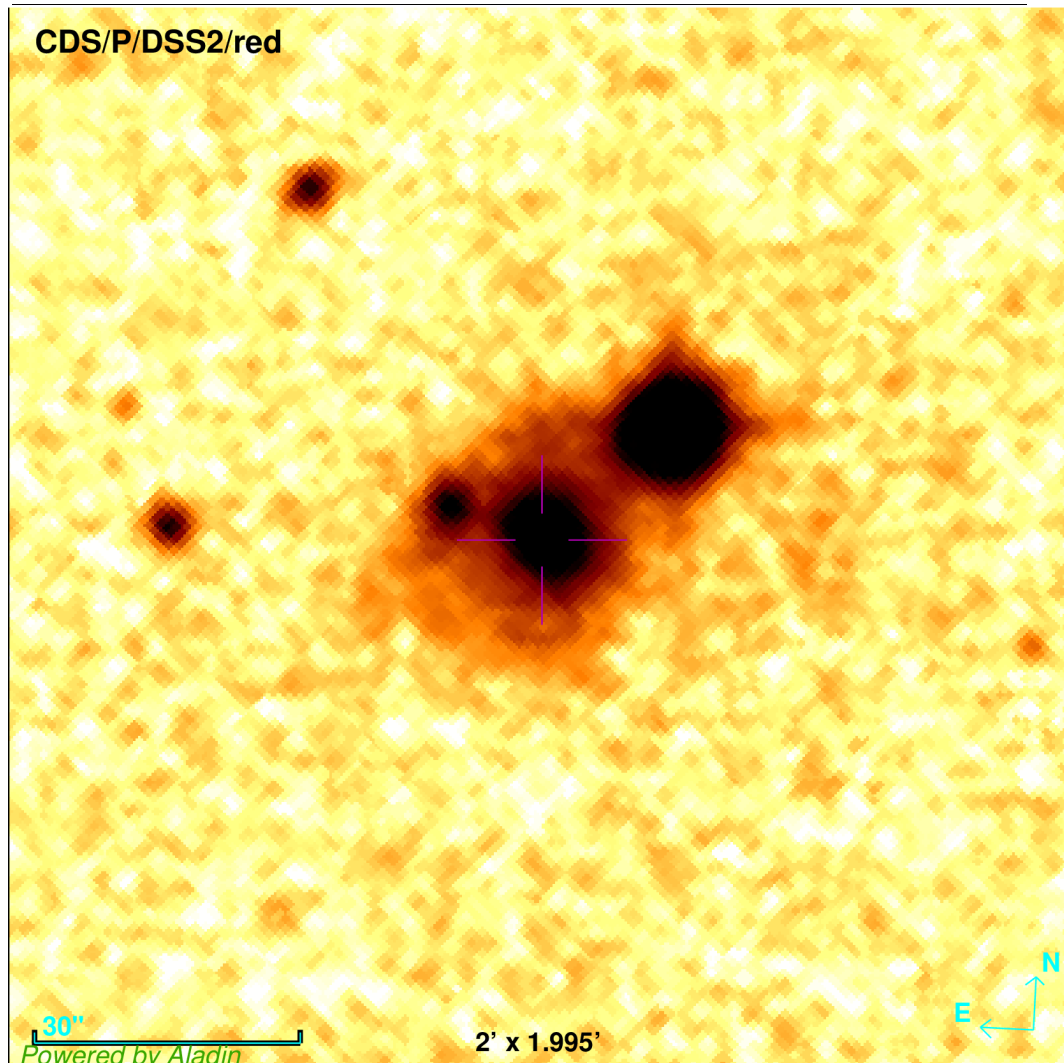
Martin W. Ochmann, Wolfram Kollatschny,  
Matthias Zetzl

Vrdnik, 2019

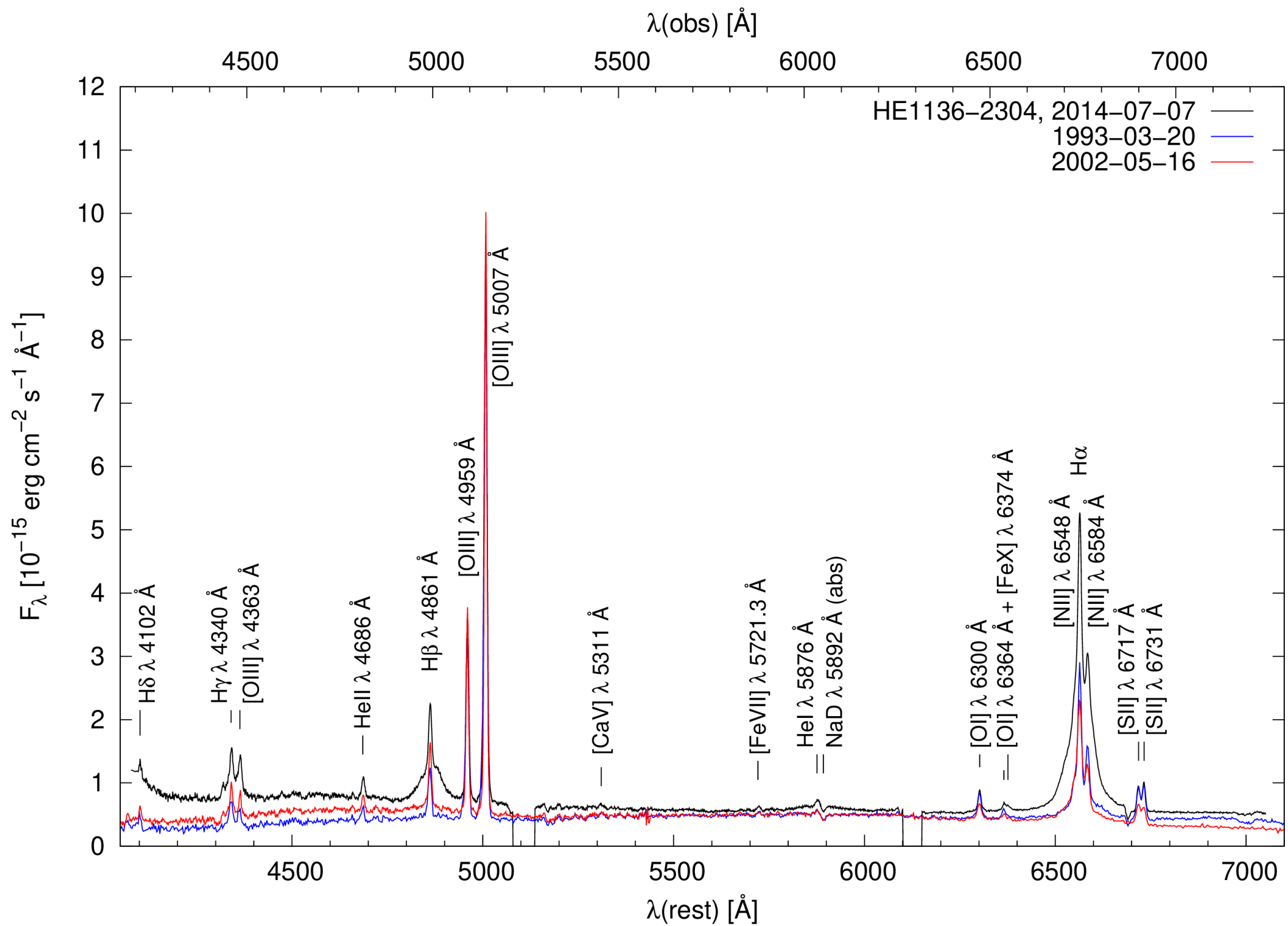
# Summary

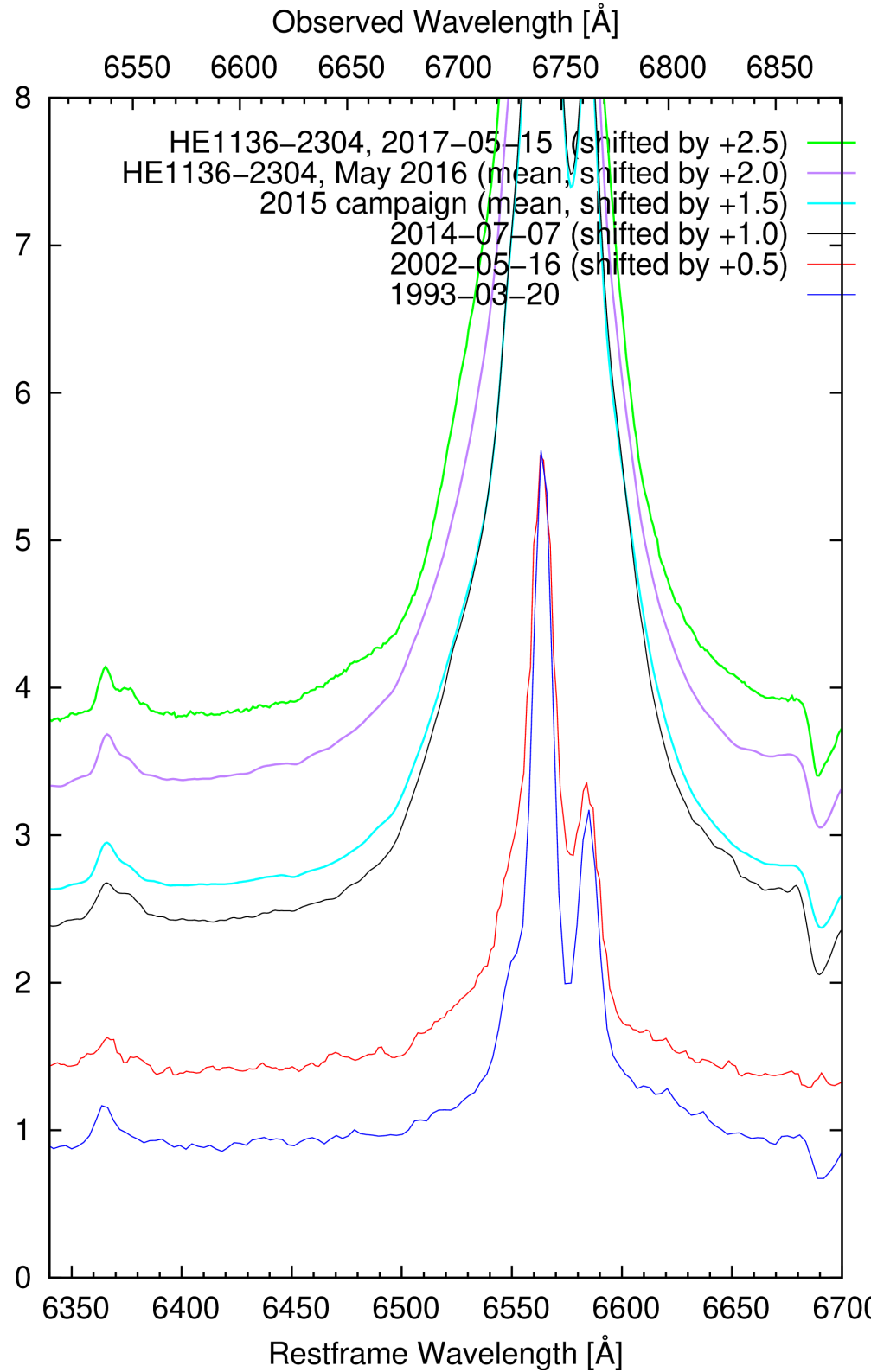
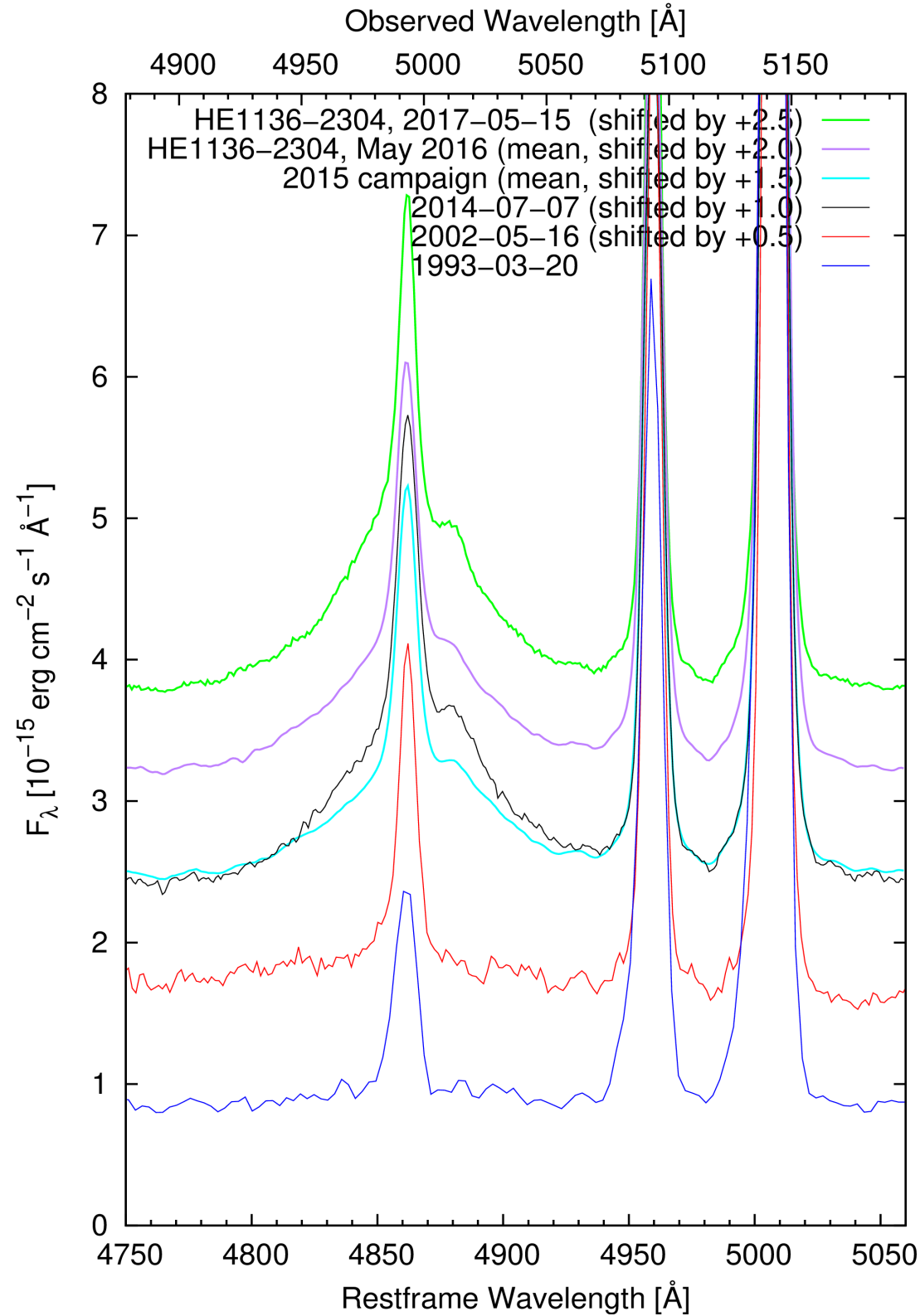
- optical changing look AGN: **Type I  $\leftarrow$   $\rightarrow$  Type II**
- multi-band behaviour (X-ray, UV, optical)
- cause for the flux/spectral changes are unknown
  - tidal disruption event (TDE) ?
  - changes in obscuration ?
  - accretion rate instabilities ?
- Results:
  - HE 1136-2304 (2014-2017 RM campaign)
    - lightcurve inconsistent with a TDE
    - BLR and continuum stratification
    - BLR structure consistent with that of non-CL AGN
  - NGC 1566
    - extreme changes in Balmer/high-ionization lines

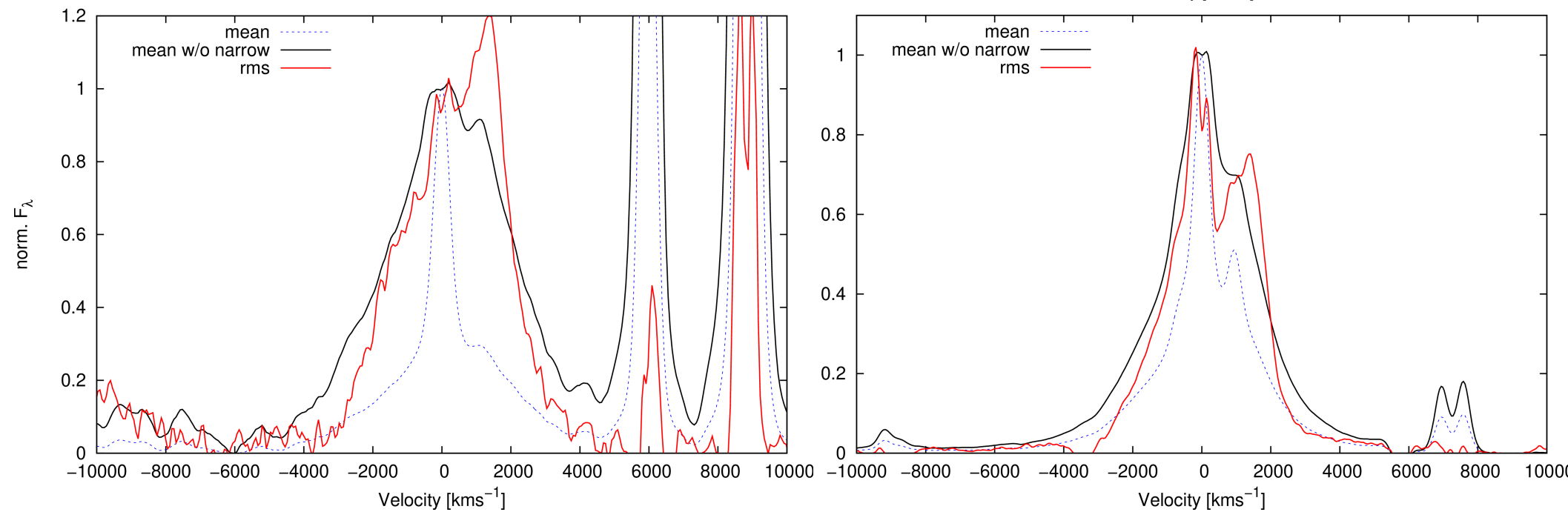
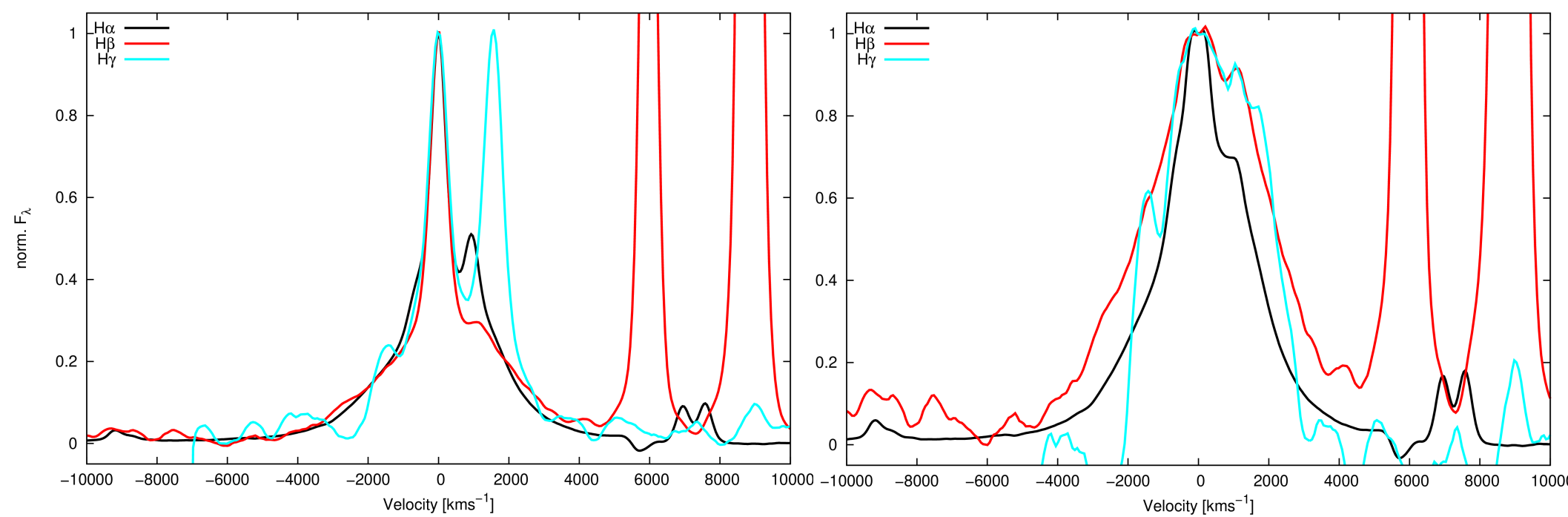
# HE 1136-2304



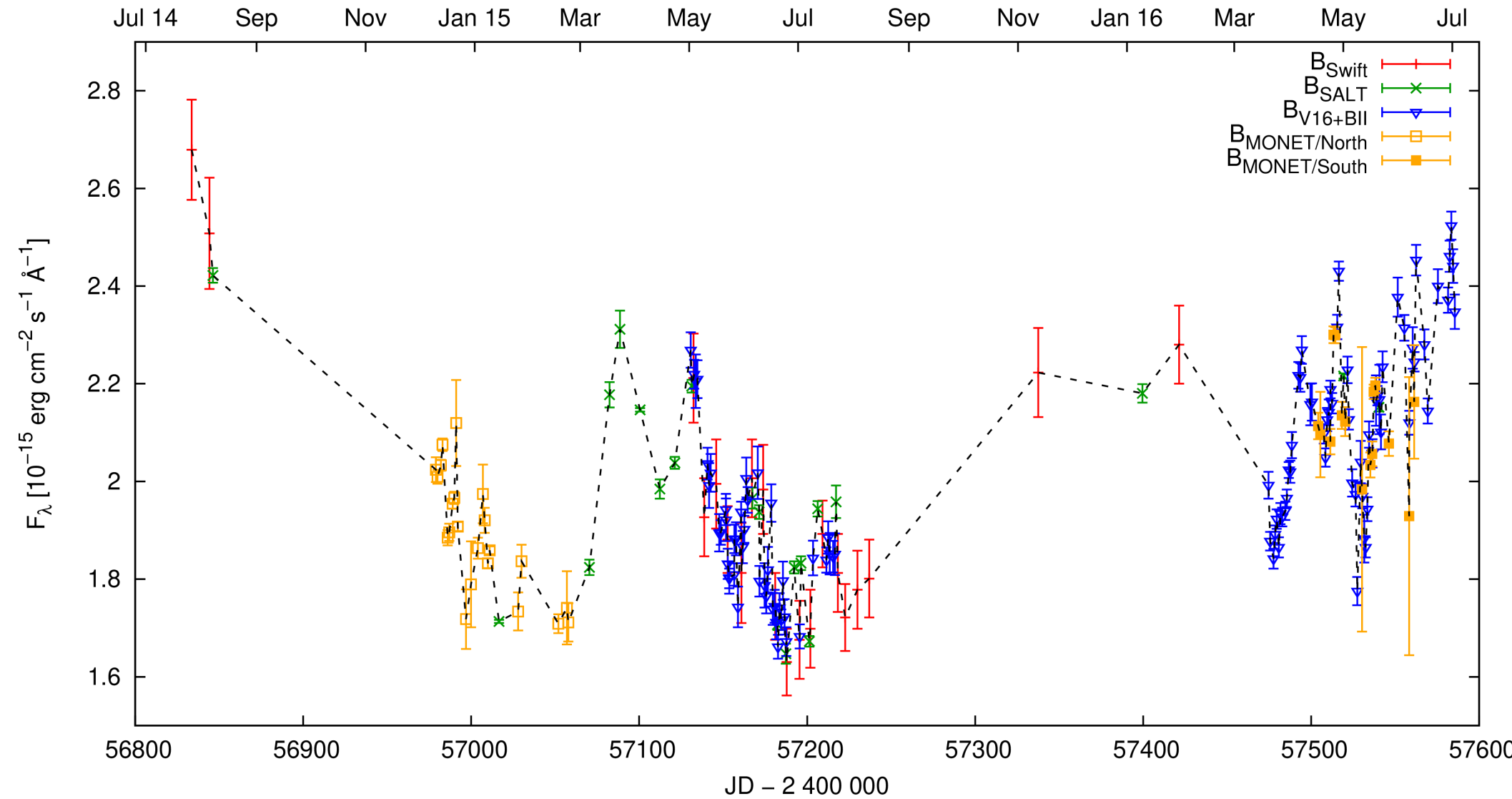
- variable X-ray source
  - ROSAT 1990
  - Swift 2012 (ratio  $\sim 13$ )
  - XMM 2014 (ratio  $\sim 10$ )
  - Swift 2014 (ratio  $\sim 30$ )
- follow-up observations with Swift (X-ray, UV), SALT (opt. spectroscopy), Vysos 16, Best II and MONET
- spectral type (1993  $\rightarrow$  2014):  
**Sy2  $\rightarrow$  Sy1**



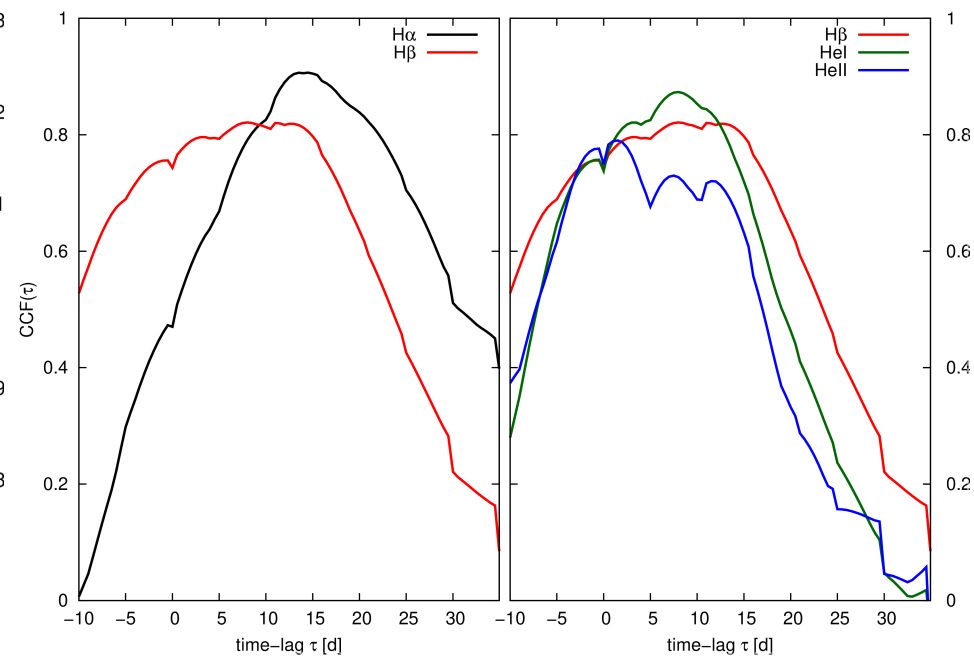
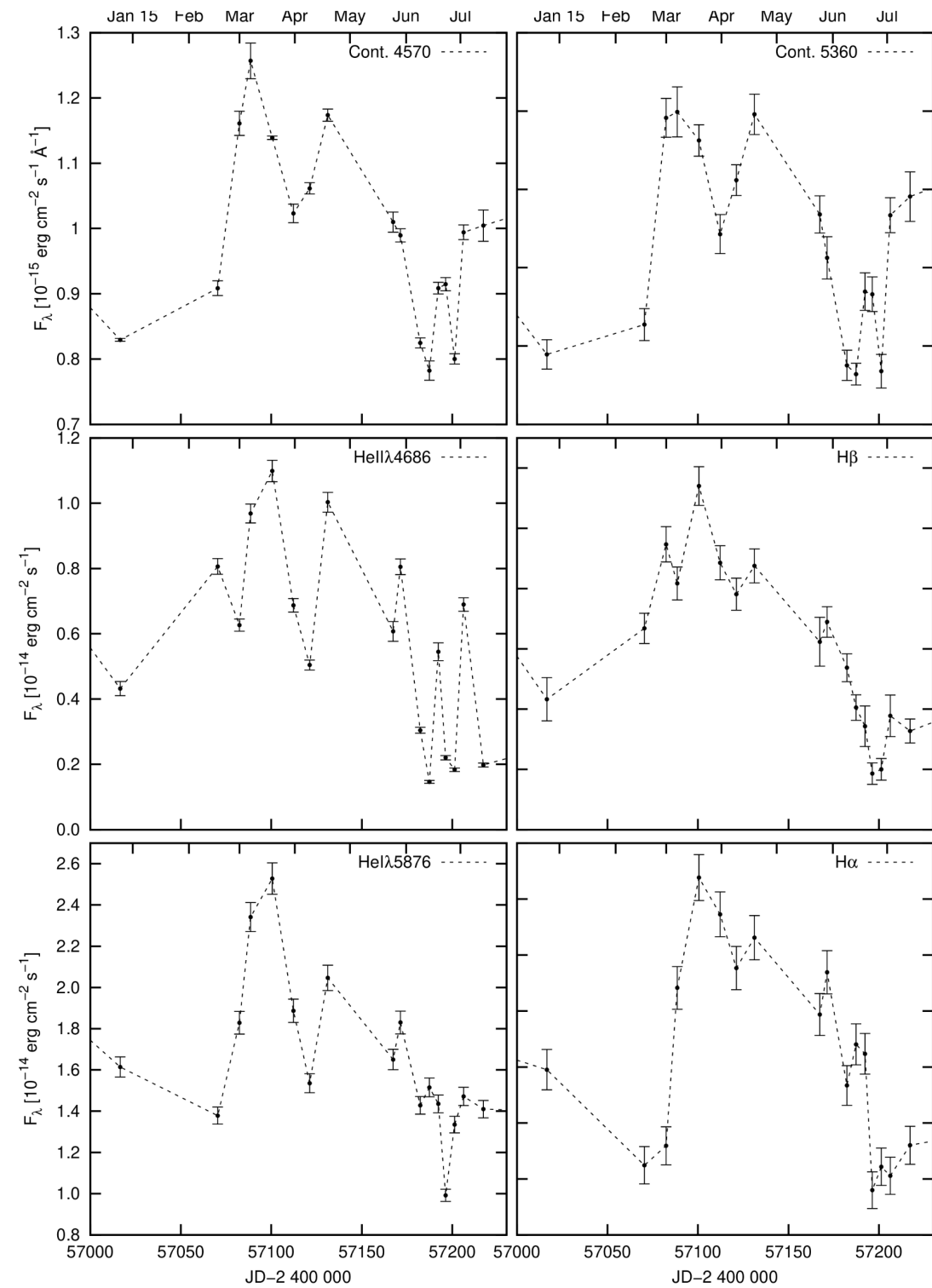




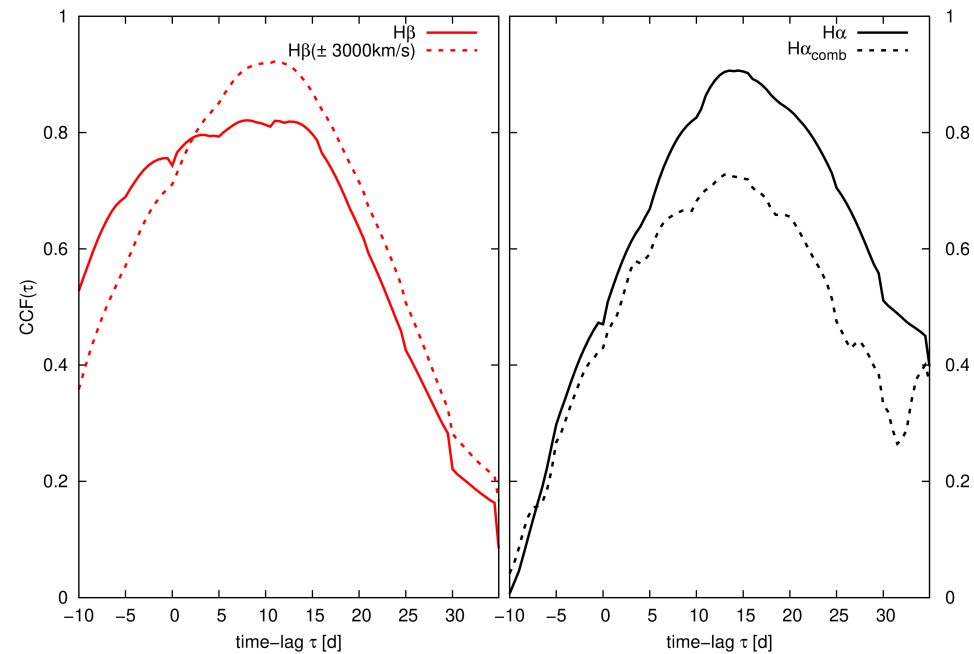
- $\text{FWHM}(\text{H}\alpha) < \text{FWHM}(\text{H}\beta)$
- RMS: strong red components, weaker blue components



- combined light curves of several instruments
- no systematic trends in both B- and V-band light curves
- TDE excluded as cause of the spectral changes
- time-lags  $\tau$  between continuum and lines constrain BLR



## SALT lightcurves and 1D-CCFs





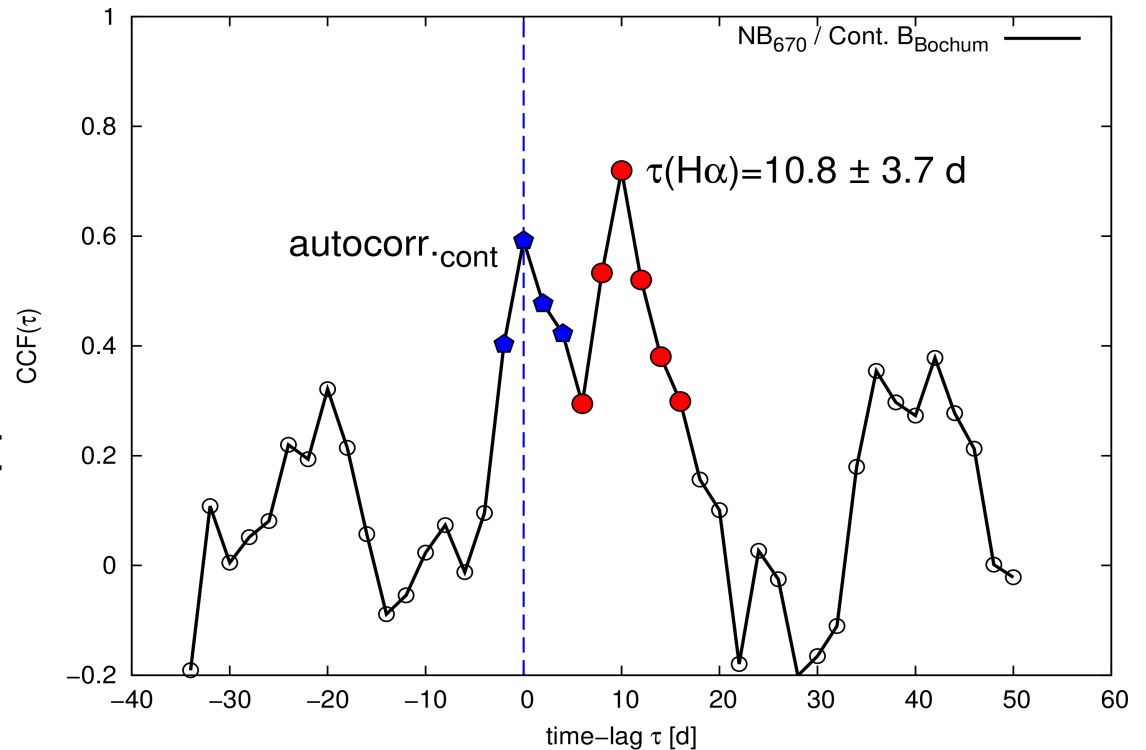
Line	$\tau$ (days)
H $\alpha$	$15.0^{+4.2}_{-3.8}$
H $\beta$	$7.5^{+4.6}_{-5.7}$
He I $\lambda$ 5876	$7.3^{+2.8}_{-4.4}$
He II $\lambda$ 4686	$3.0^{+5.3}_{-3.7}$

Line	$\tau$ (days)
H $\alpha$ <sub>SALT</sub> /Cont. $B_{\text{comb}}$	$16.7^{+2.3}_{-5.5}$
H $\alpha$ <sub>comb</sub> /Cont. 4570 Å	$13.7^{+2.9}_{-5.0}$
NB <sub>670</sub> /Cont. $B_{\text{Bochum}}$	$10.8^{+3.7}_{-3.7}$

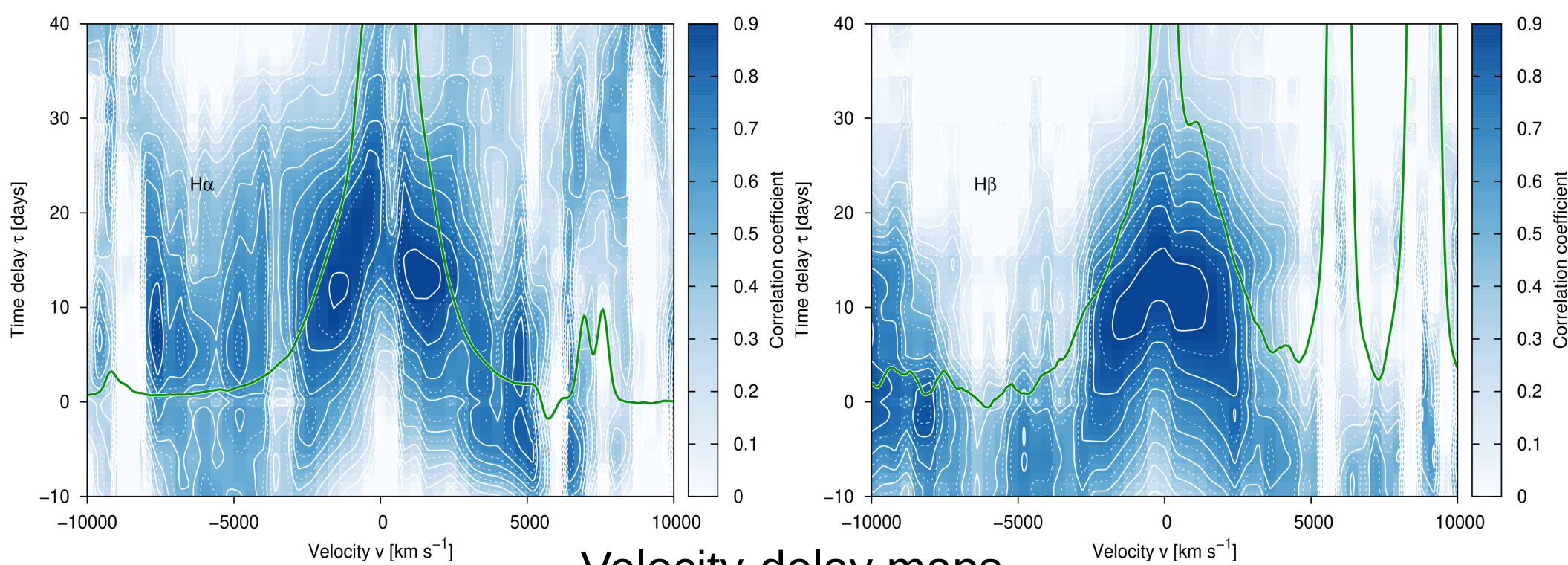
Time-lags (SALT) of the lines w.r.t to the optical continuum

Time-lags between combined/NB H $\alpha$  and different B-band continua

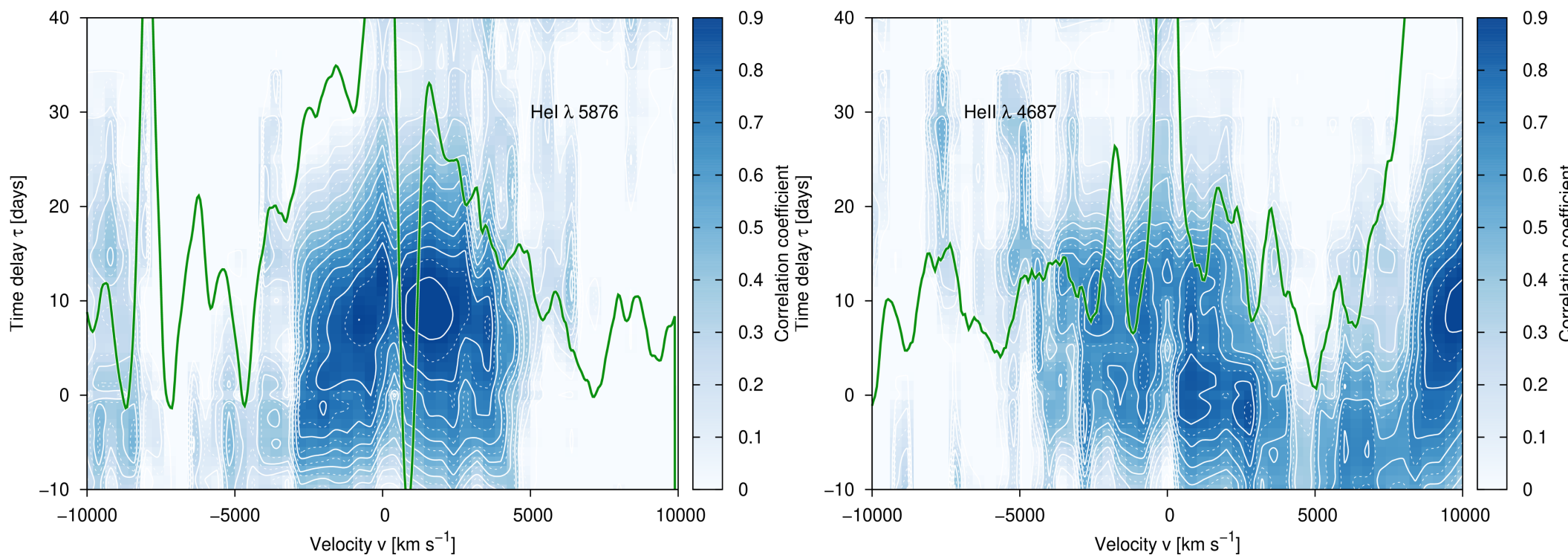
- stratification of the BLR
- line-wing origin at smaller radii than central region
- photometric RM consistent
  - autocorrelation present

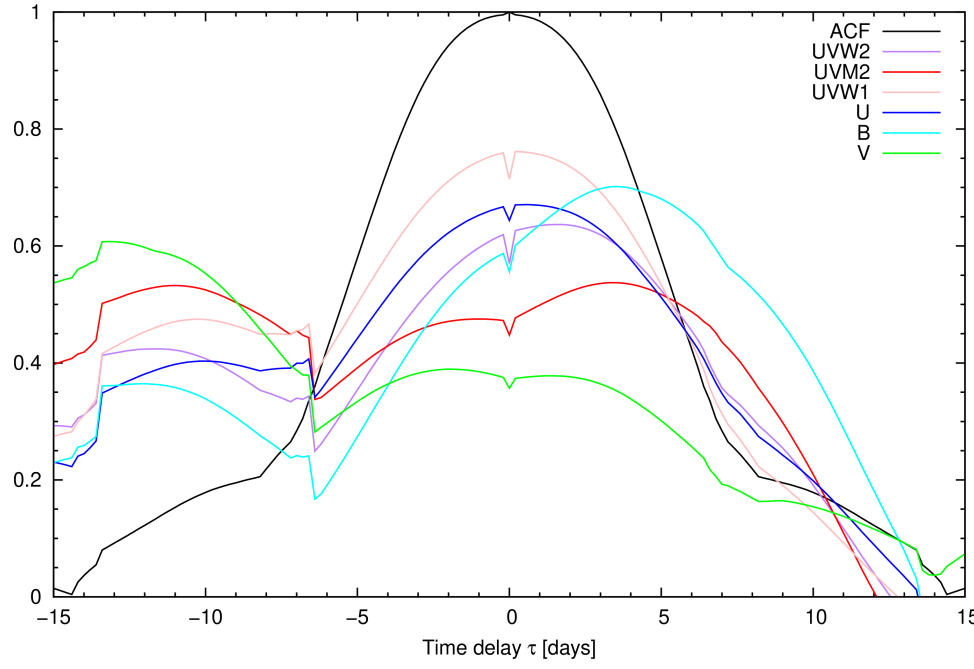
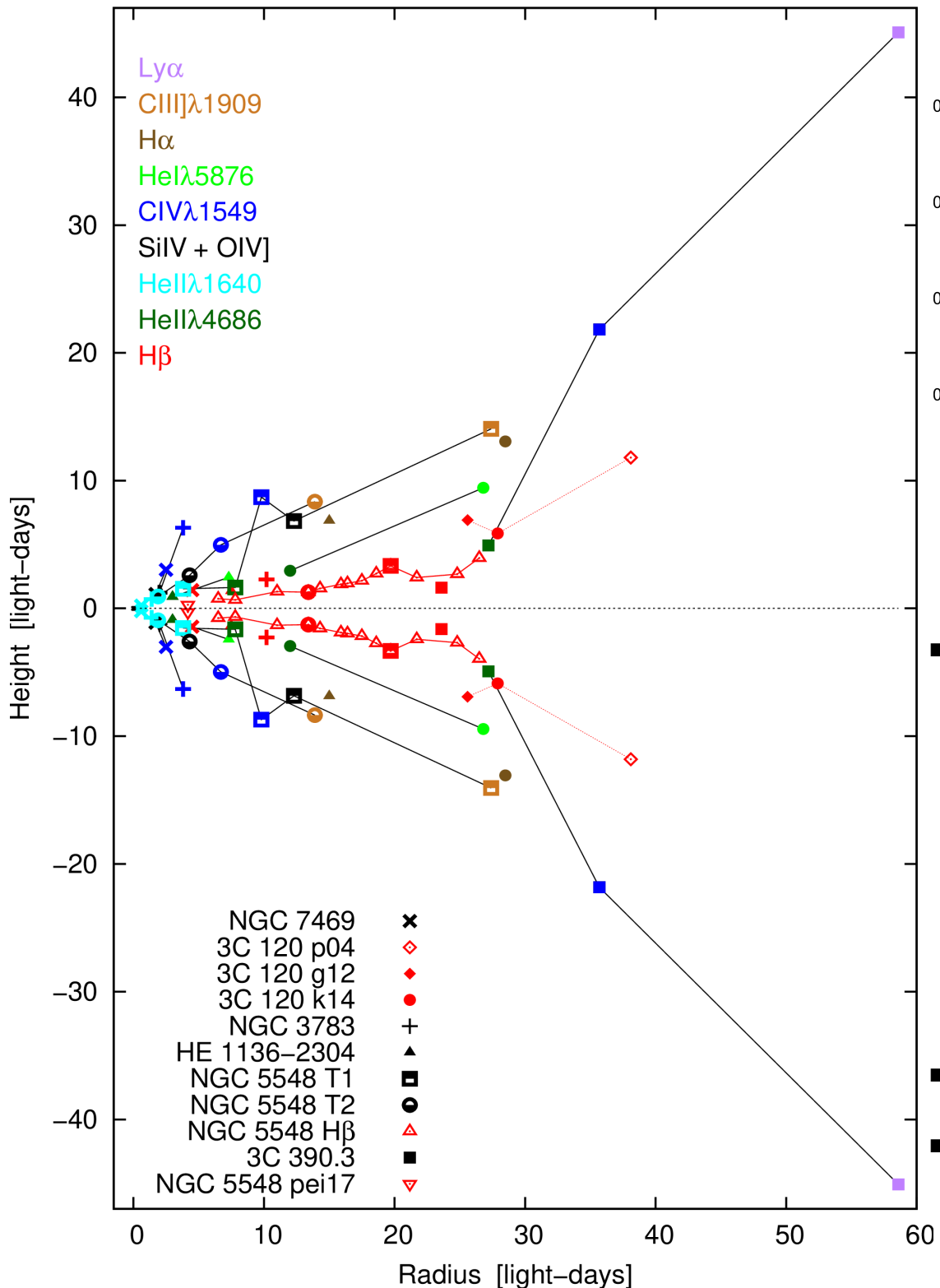


DCF of photometric RM-campaign

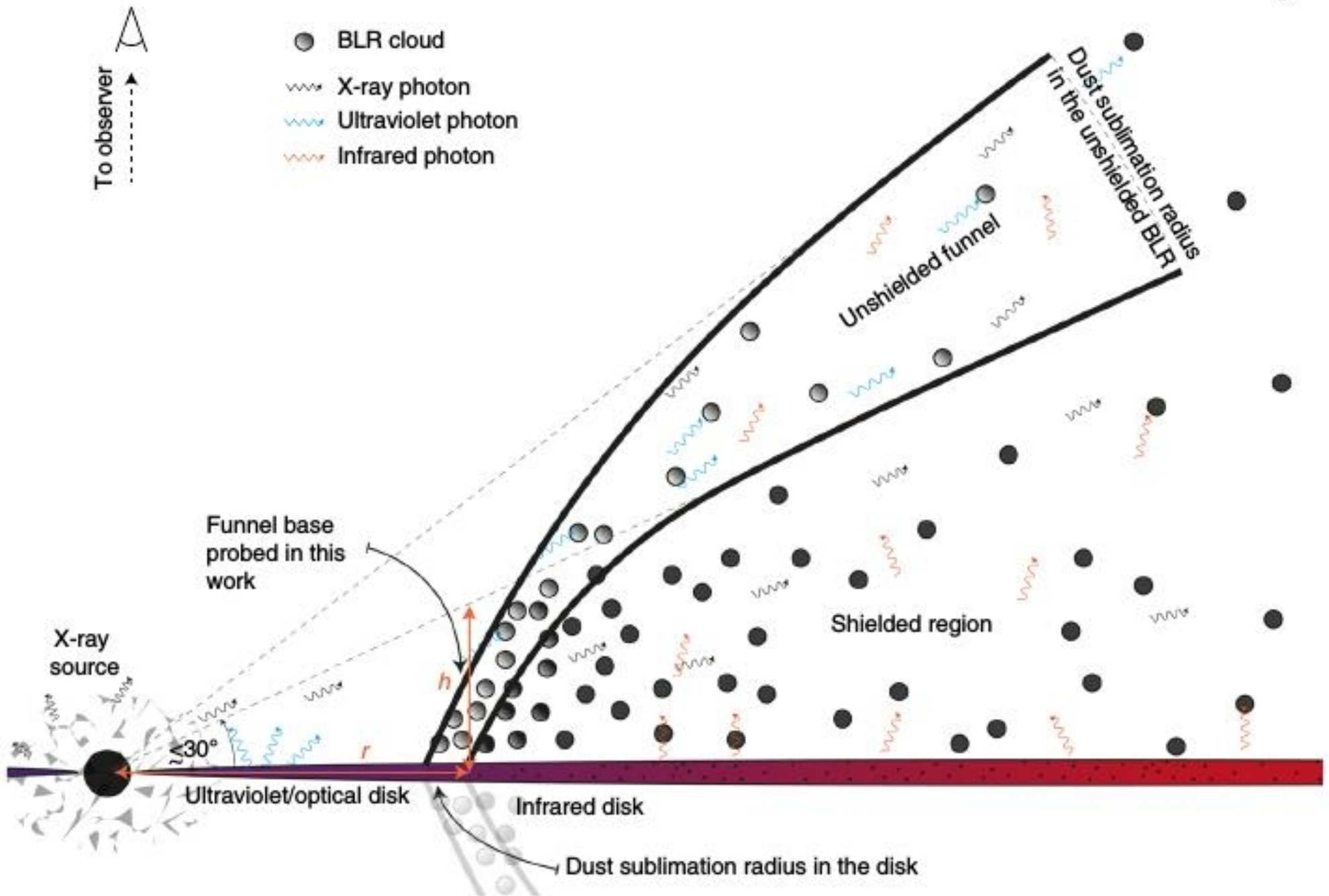


## Velocity-delay maps



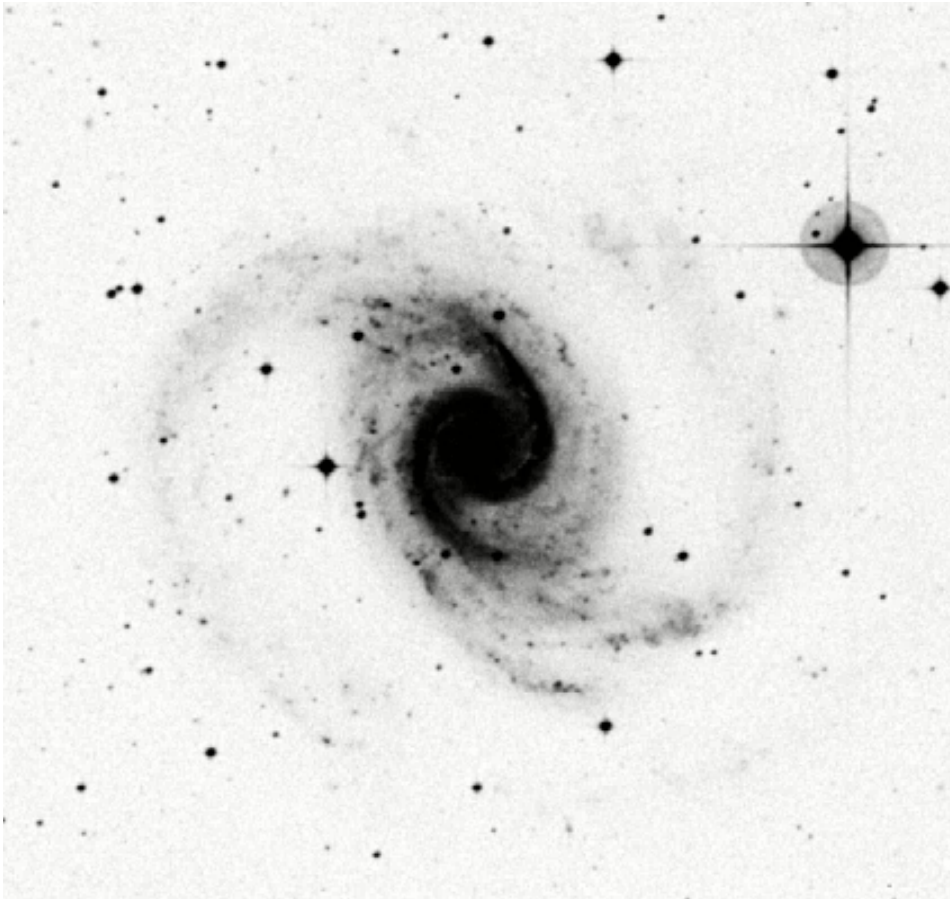


- modelling of BLR gas
  - turbulence + rotation
  - result: bowl-shaped BLR
  - BLR of HE 1136-2304 fits the bowl-shape structure
  
- inter-continua time-delays
- several continuum regions?

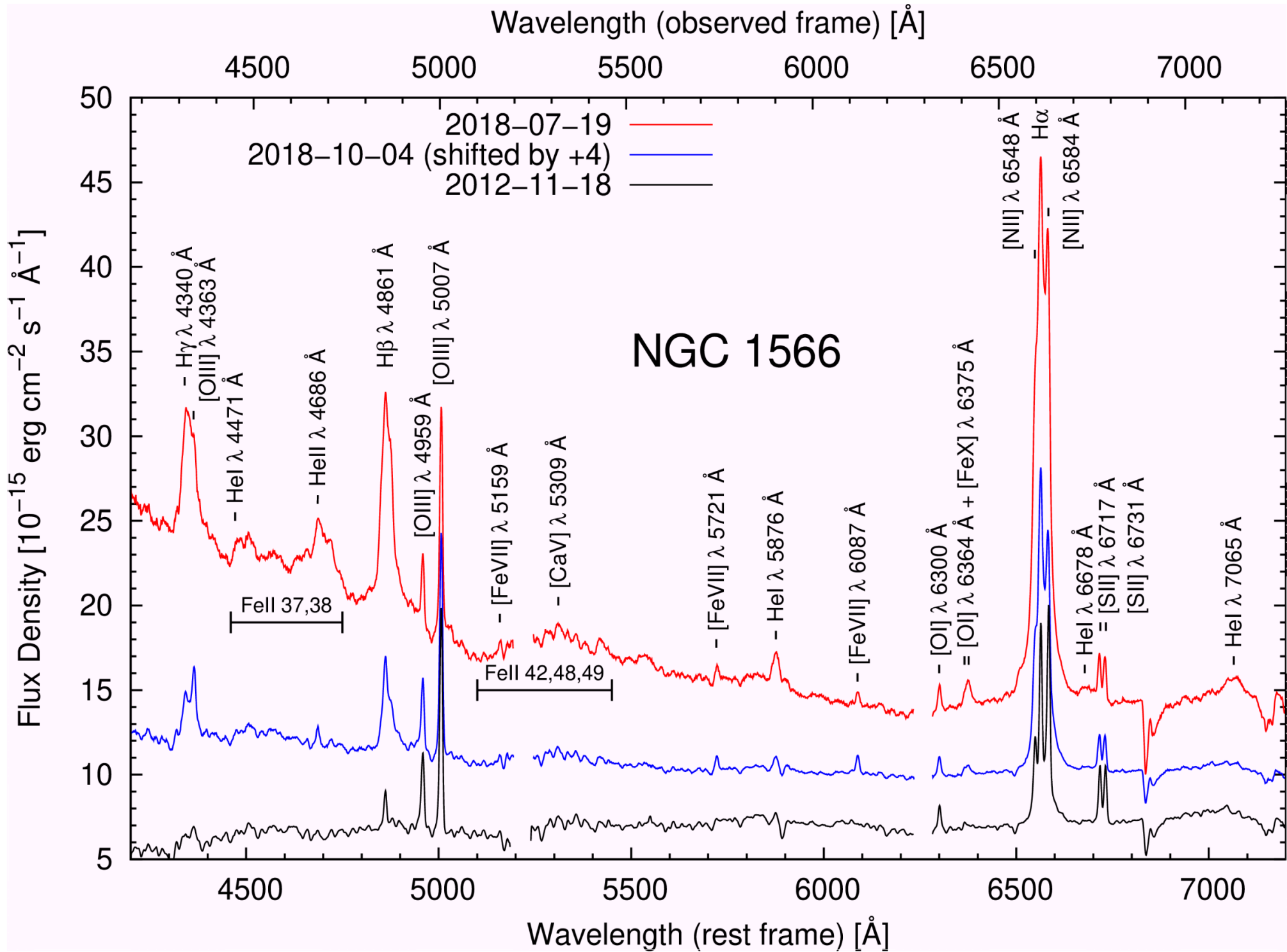


Chelouche, D., Pozo Nuñez, F., Kaspi, S. Direct evidence of non-disk optical continuum emission around an active black hole. *Nature Astronomy* 3, 251 (2019)

# NGC 1566 - a periodic changing look galaxy?

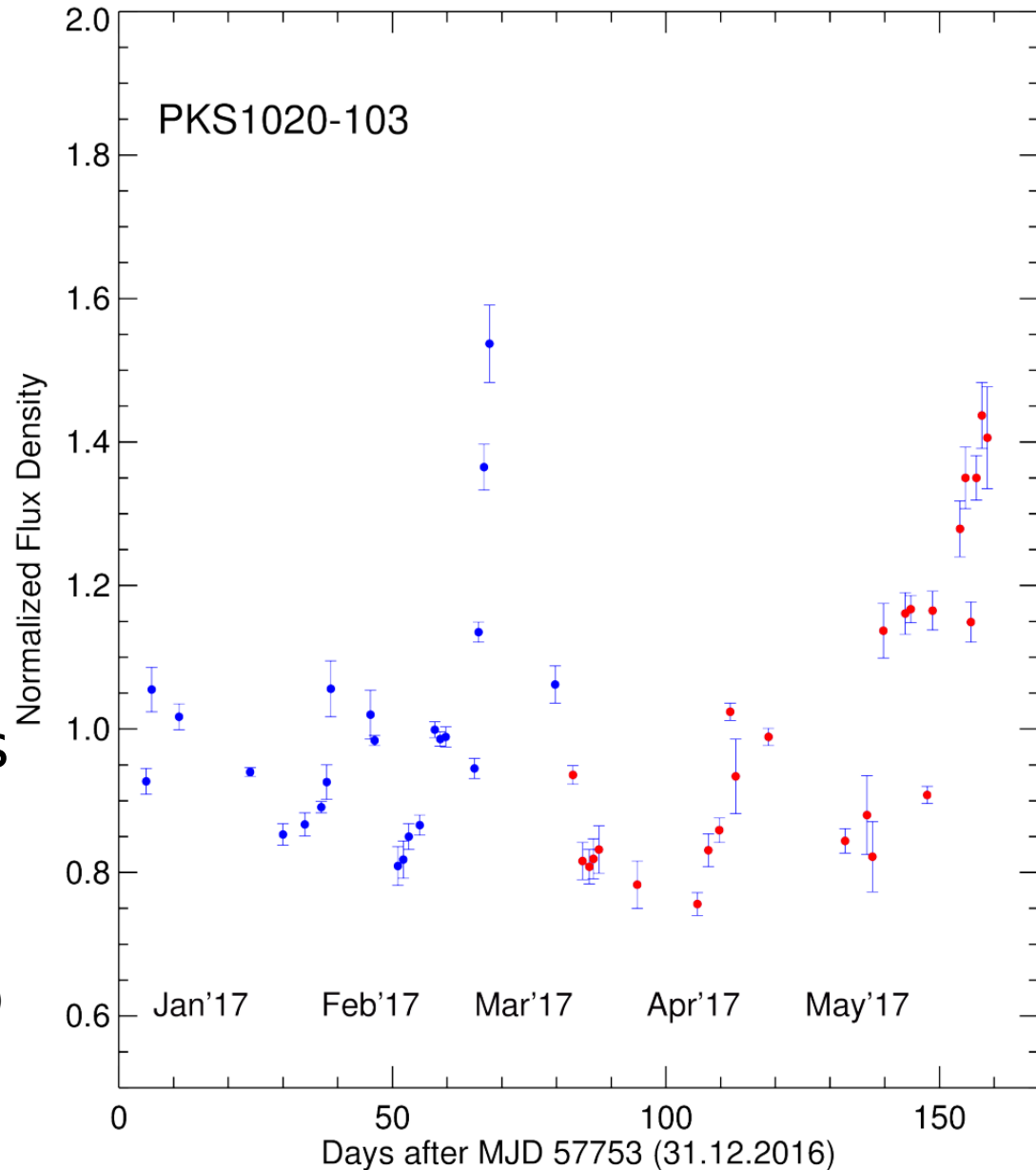


- close face-on spiral ( $z=0.005$ )
- repeated CL AGN
- periodic outbursts?
- ~~recent outburst June 2018~~
- recent outburst May 2019
  
- RM campaign with SALT in 2012 - 2013 (low state)
- ToO (SALT) on 2018 July 17th



# Summary & Outlook

- HE 1136-2304
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  - stratification of BLR
  - stratification of continuum (X-rays, UV, optical)
  - outburst no TDE-event
- NGC 1566
  - strong continuum changes
  - strong line changes
- PKS 1020-103 (to be continued...)



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хвала на слушању

