

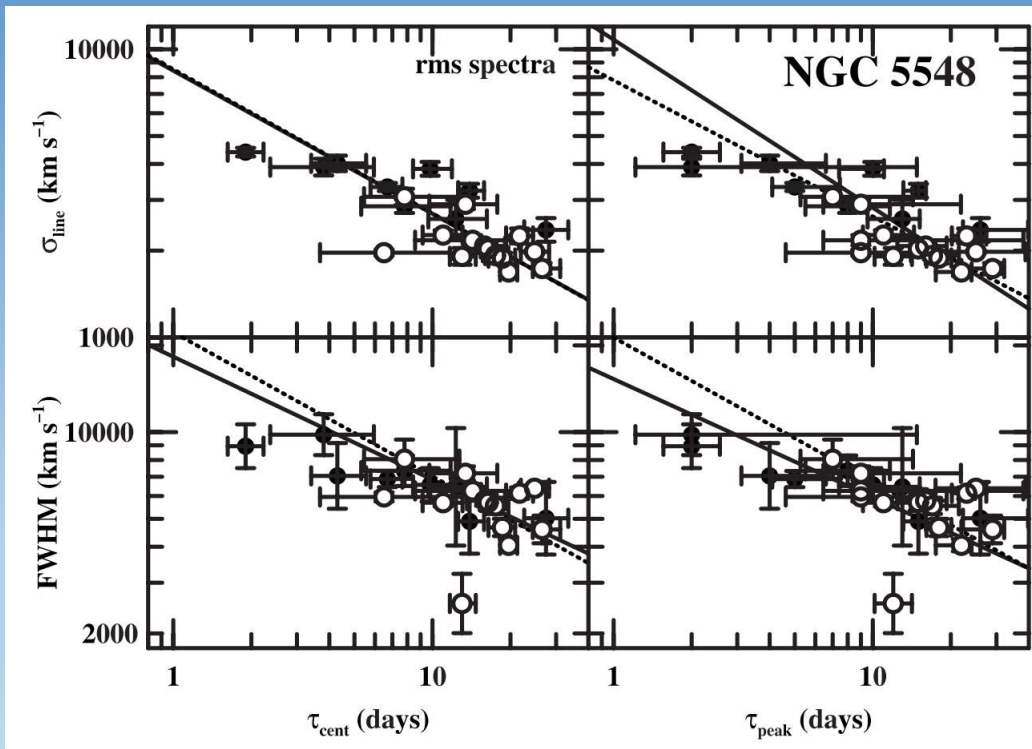
# **A High-quality Velocity-delay Map of the BLR in NGC 5548**

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# NGC 5548: ideal laboratory to investigate the geometry and kinematics of the BLR

Plentiful data: 19 reverberation mapping campaigns

e.g. AGN Watch project; Bentz et al. (2007); Denney et al. (2009); LAMP2008 Project; Lu et al. (2016) Lijiang.

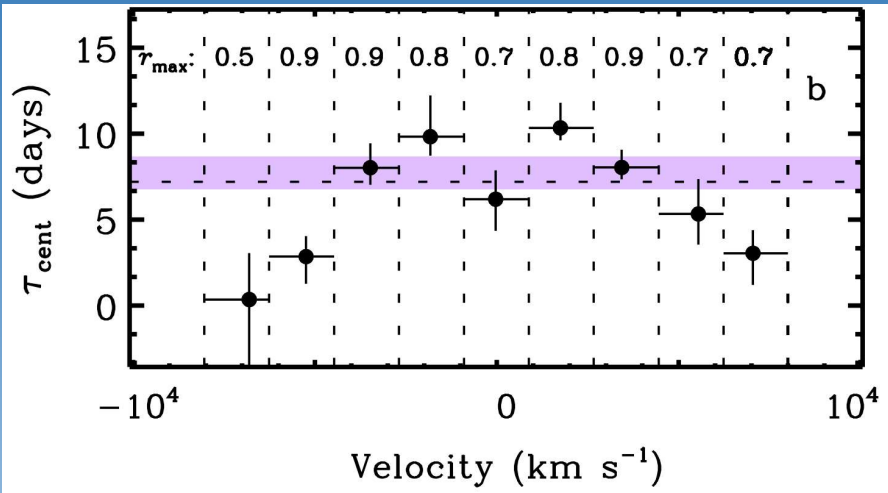


Virialized motion of the BLR clouds

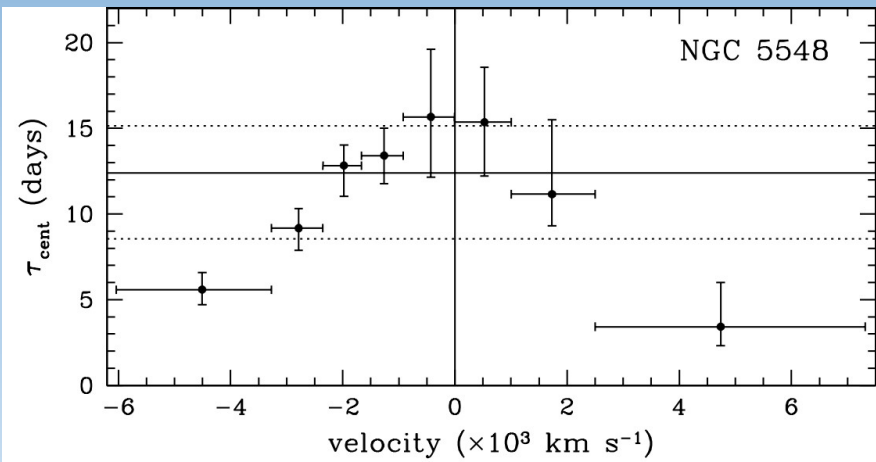
$V \propto \tau^{-1/2}$  (dotted line)

Peterson et al. 2004

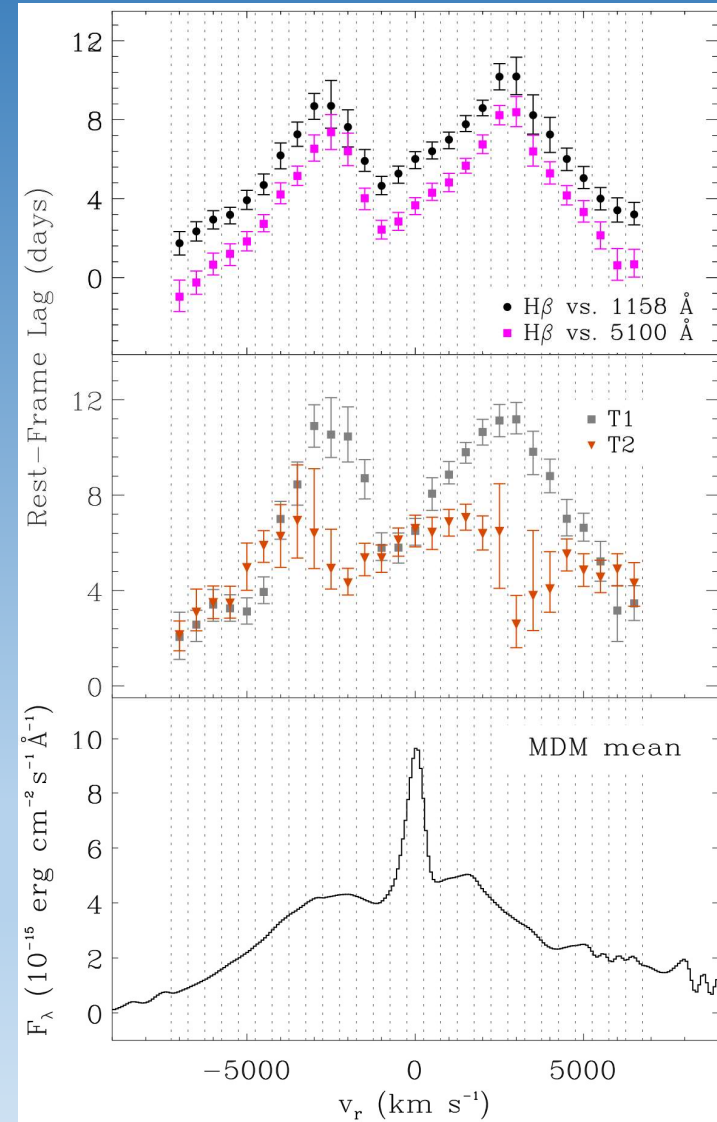
# Velocity-resolved results of NGC 5548



Lu et al. 2016



Denney et al. 2009

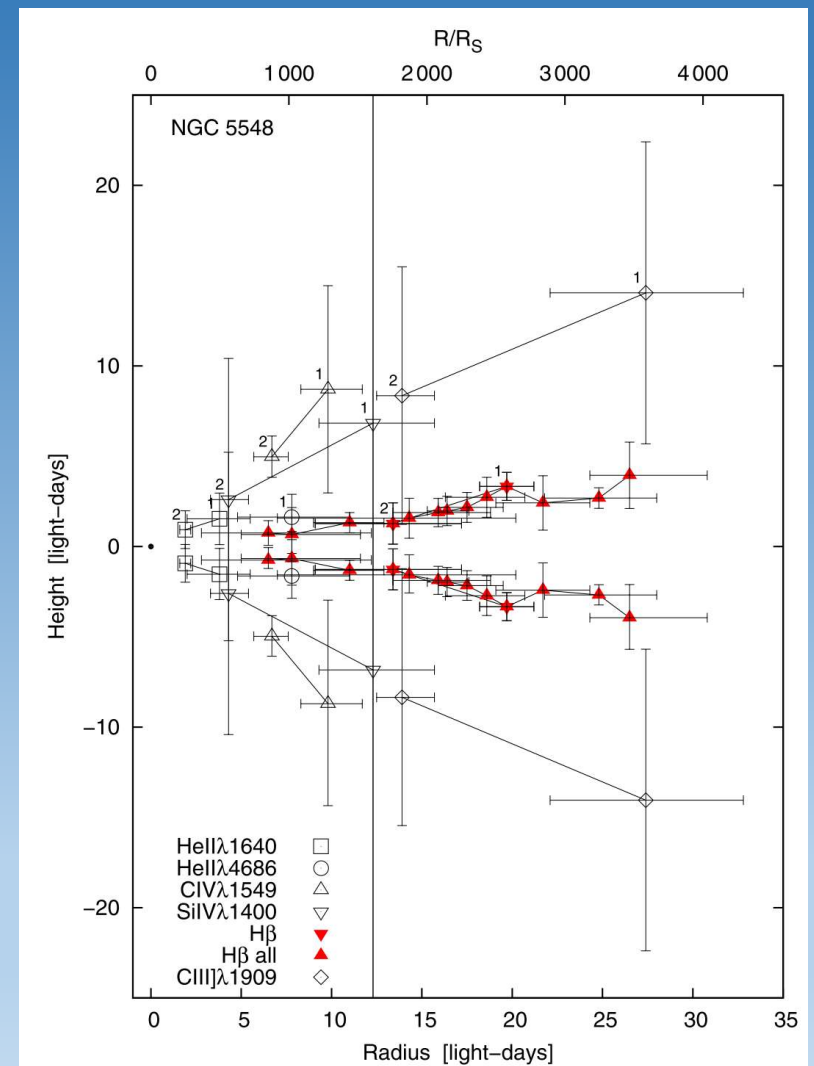


Pei et al. 2017

## Vertical structure of BLR Disk liked

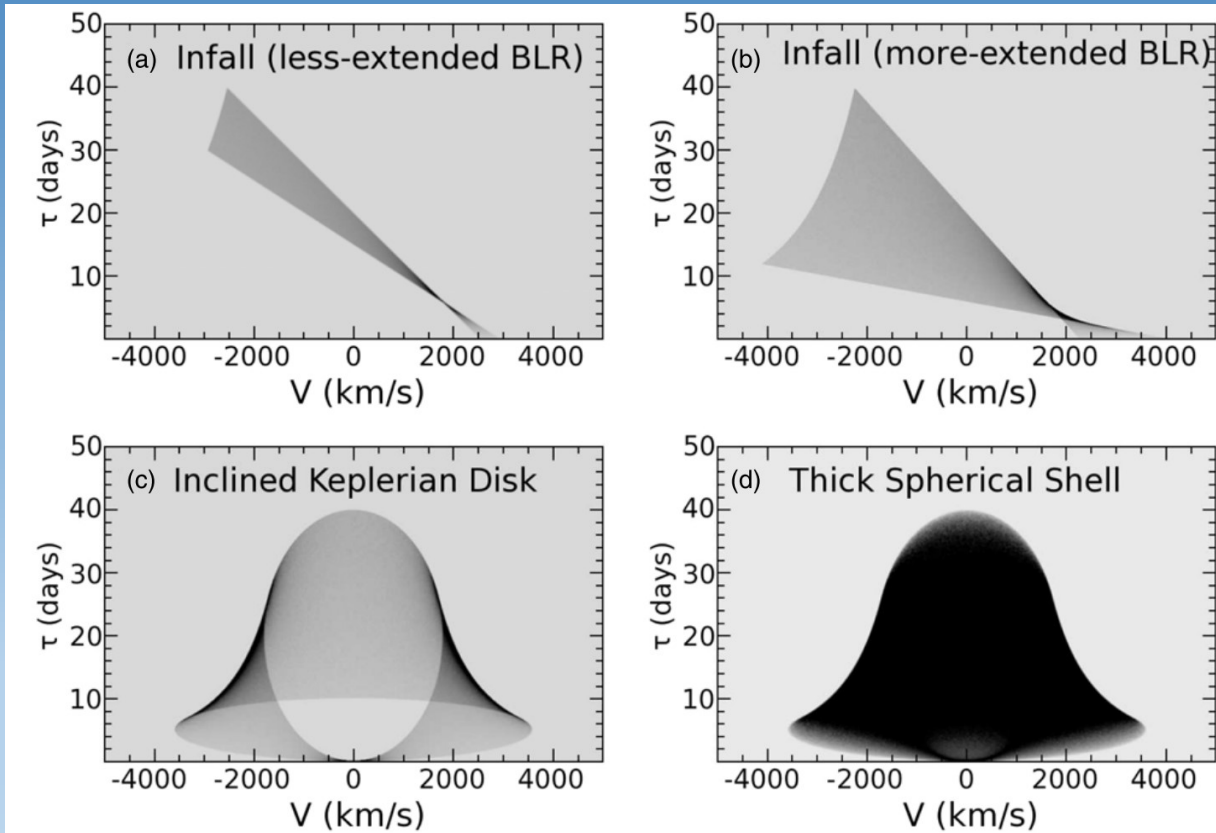
$$H/R = (1/\alpha)(V_{\text{turb}}/V_{\text{rot}})$$

H $\beta$  originates at 0.7 to 4 light days above the midplane

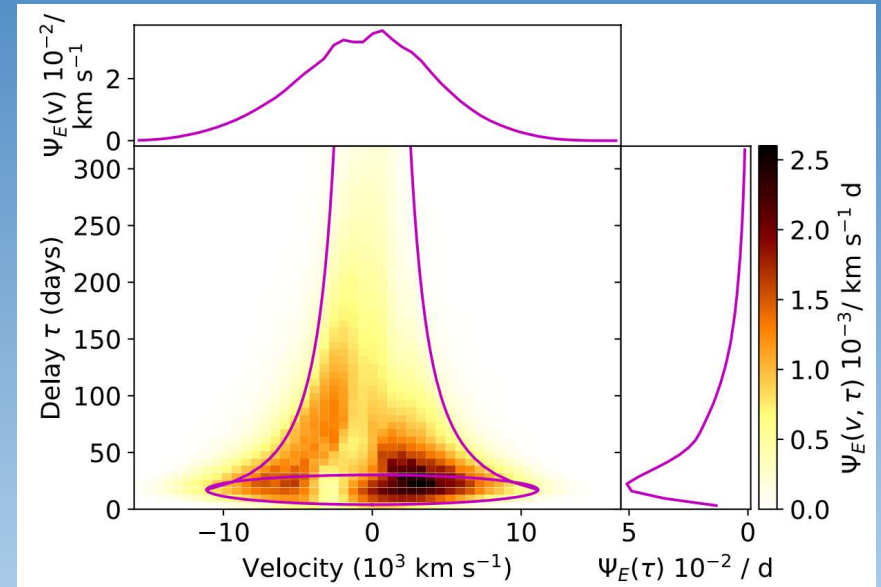


Kollatschny et al. 2004

# Velocity delay map



Grier et al. 2013



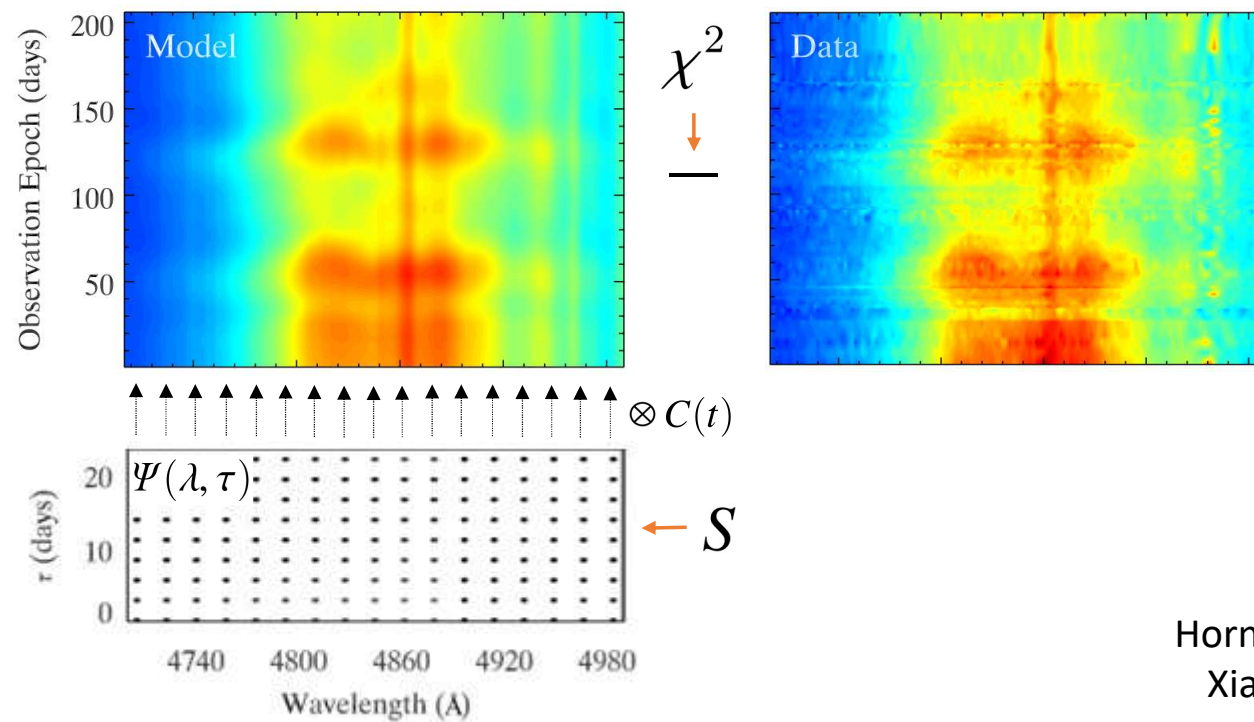
S. W. Mangham et al. 2017

***Caution of diagnose***

## Maximum Entropy Method (MEM)

$$\Delta L(\nu, t) = \int_{-\infty}^{\infty} \underbrace{\Psi(\nu, t)}_{\text{velocity-delay map}} \Delta C(t - \tau) d\tau$$

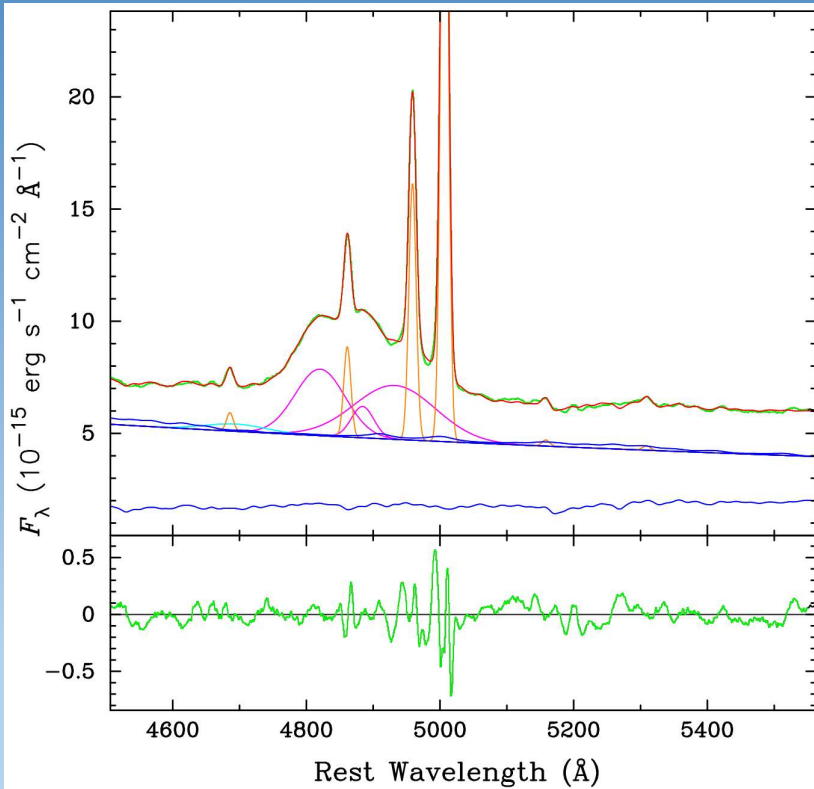
$$Q = \chi^2 - \alpha S$$



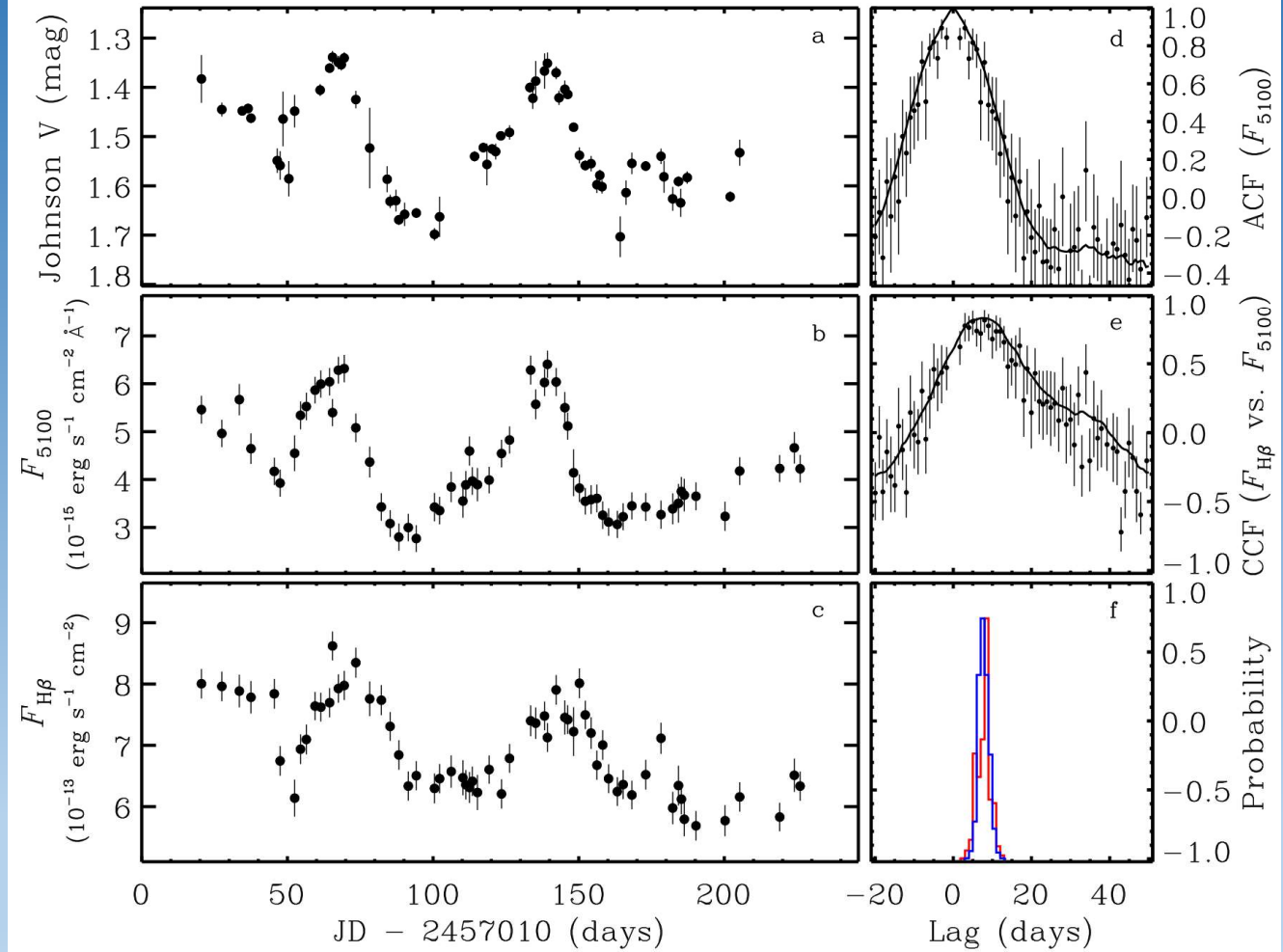
Horne et al. 1994  
Xiao et al. 2018

# Lijiang RM campaign 2014-2015

Lu et al. 2016



$V_{\text{FWHM}} = 9912 \pm 362 \text{ km/s}$   
 Spectral resolution  $\approx 500 \text{ km/s}$

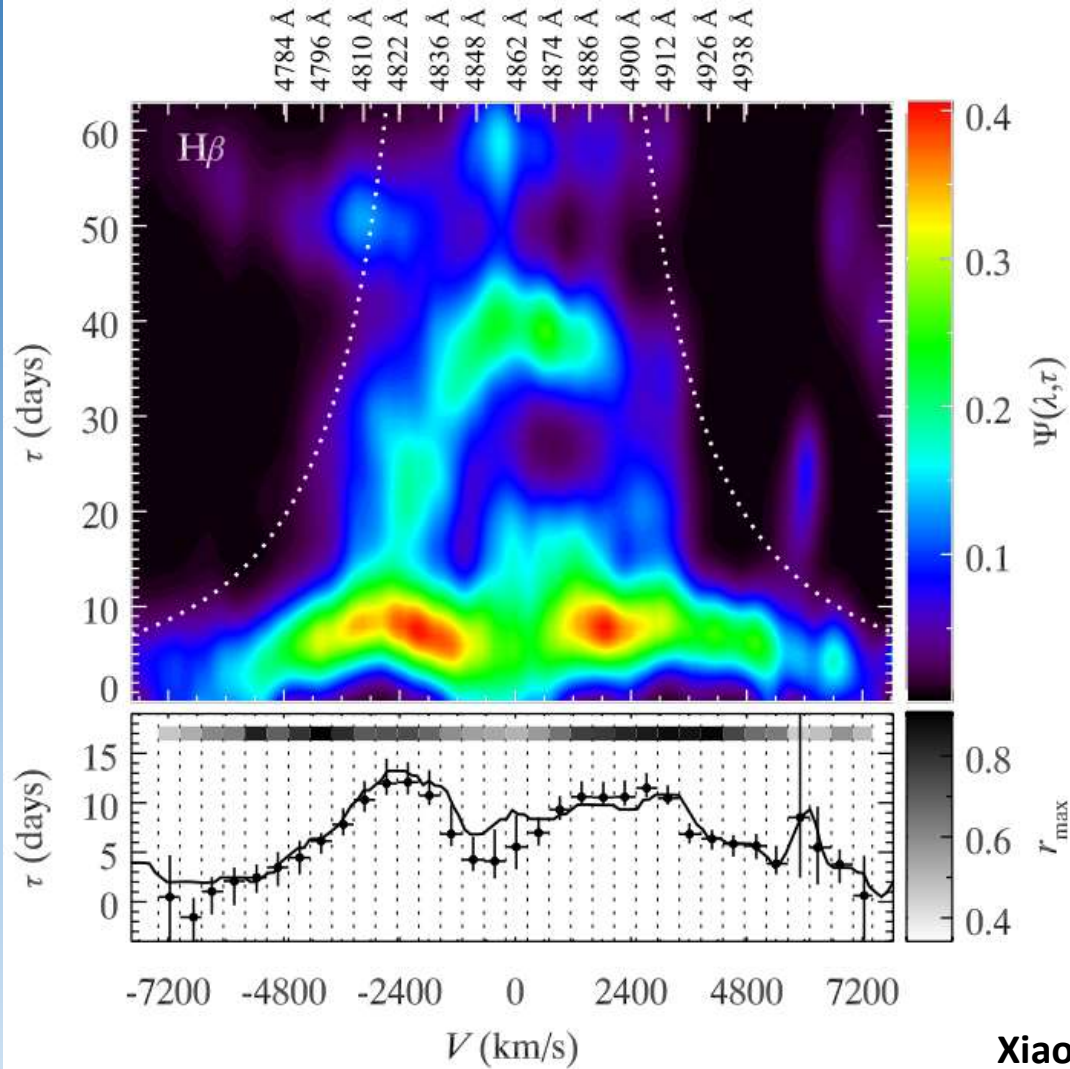


Time period = 180 days; Cadence  $\sim 3.4$  days

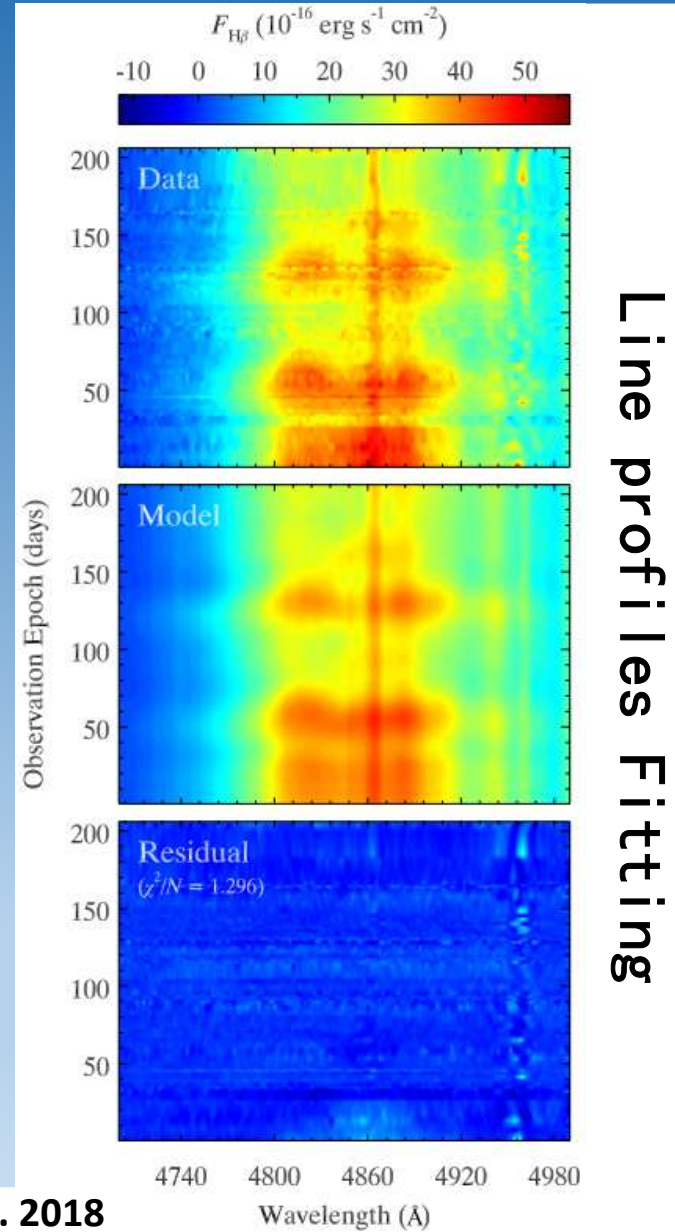


# The velocity-delay map of our Lijiang campaign

NGC 5548

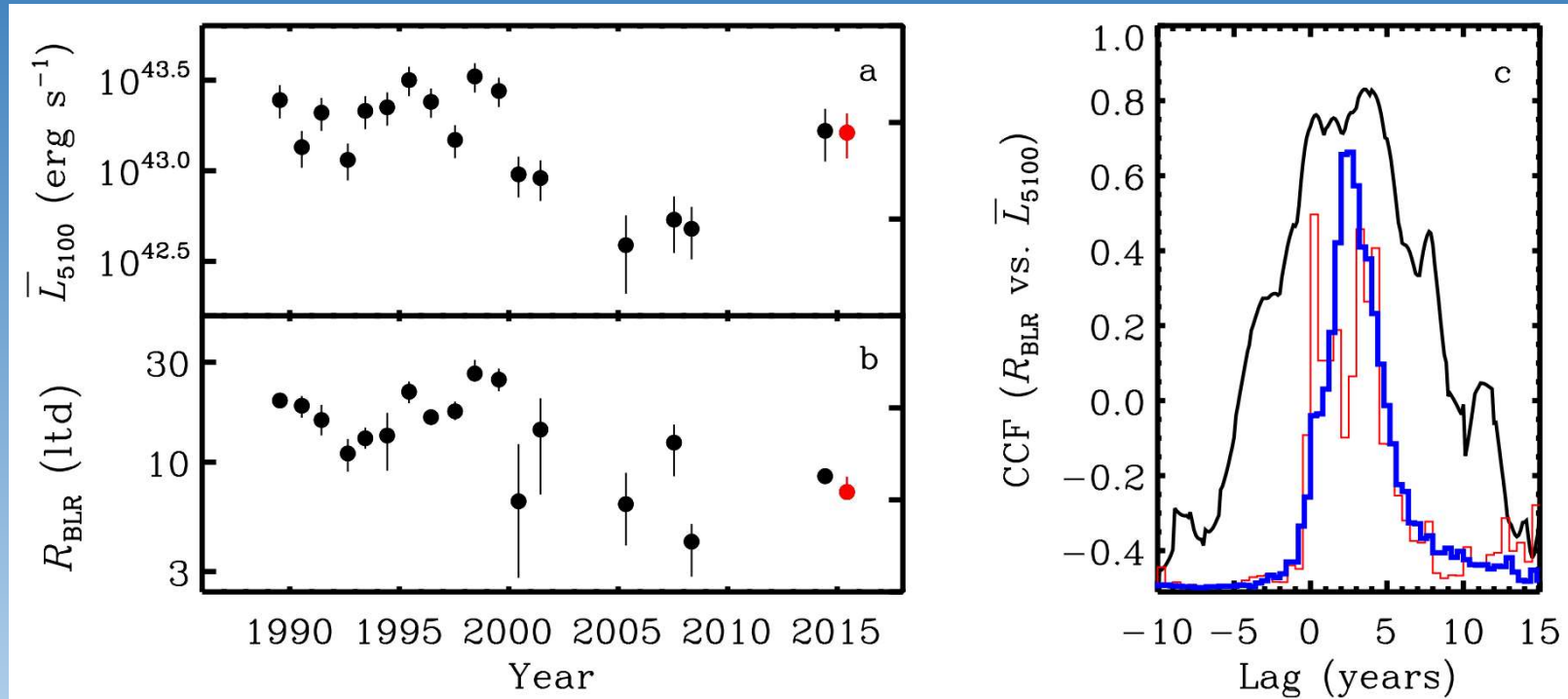


Xiao et al. 2018





## The evolving BLR

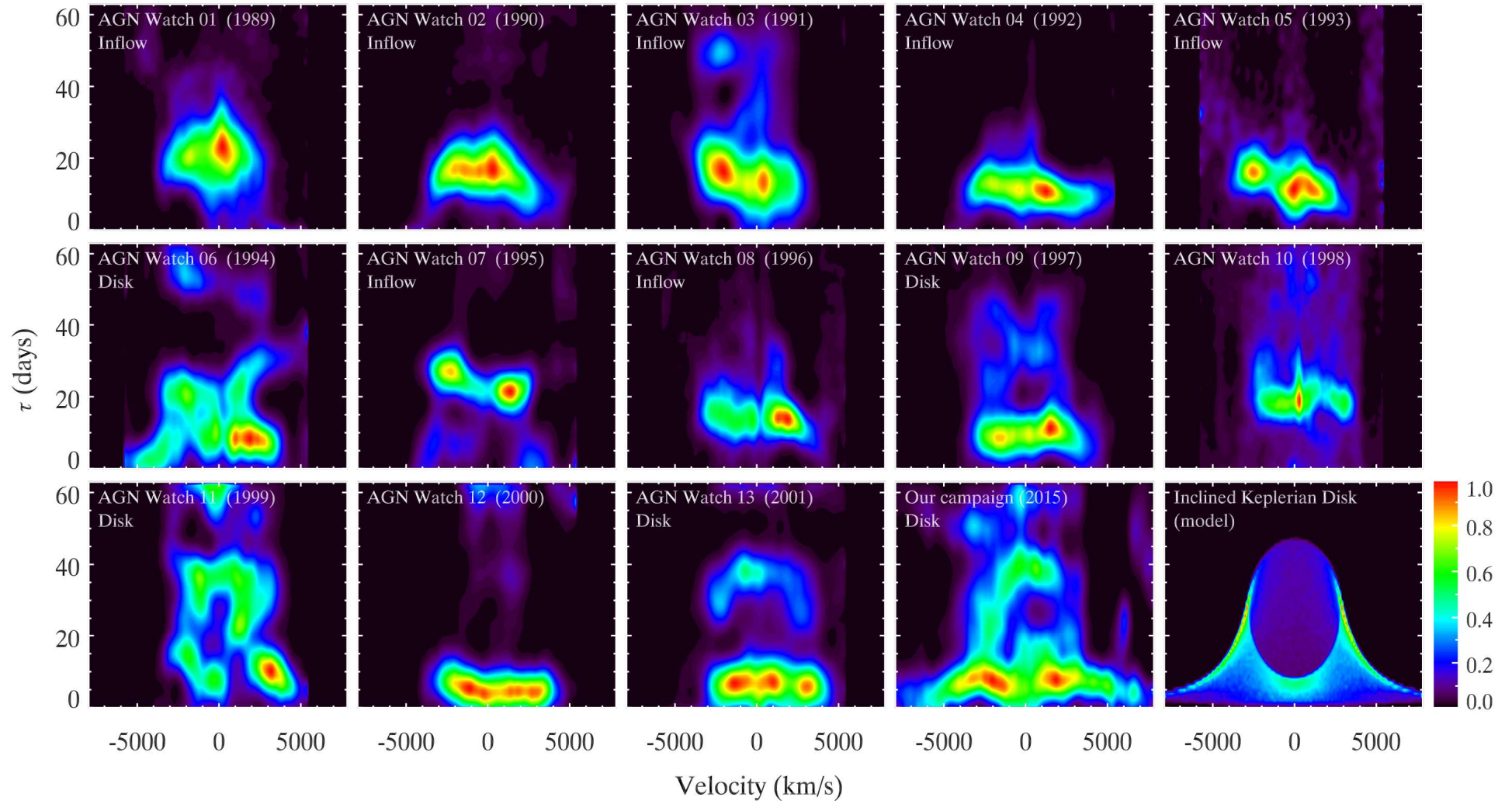


Time delay between  $R_{\text{BLR}}$  and  $\bar{L}_{5100} \sim 2.35^{+3.47}_{-1.25}$  yrs

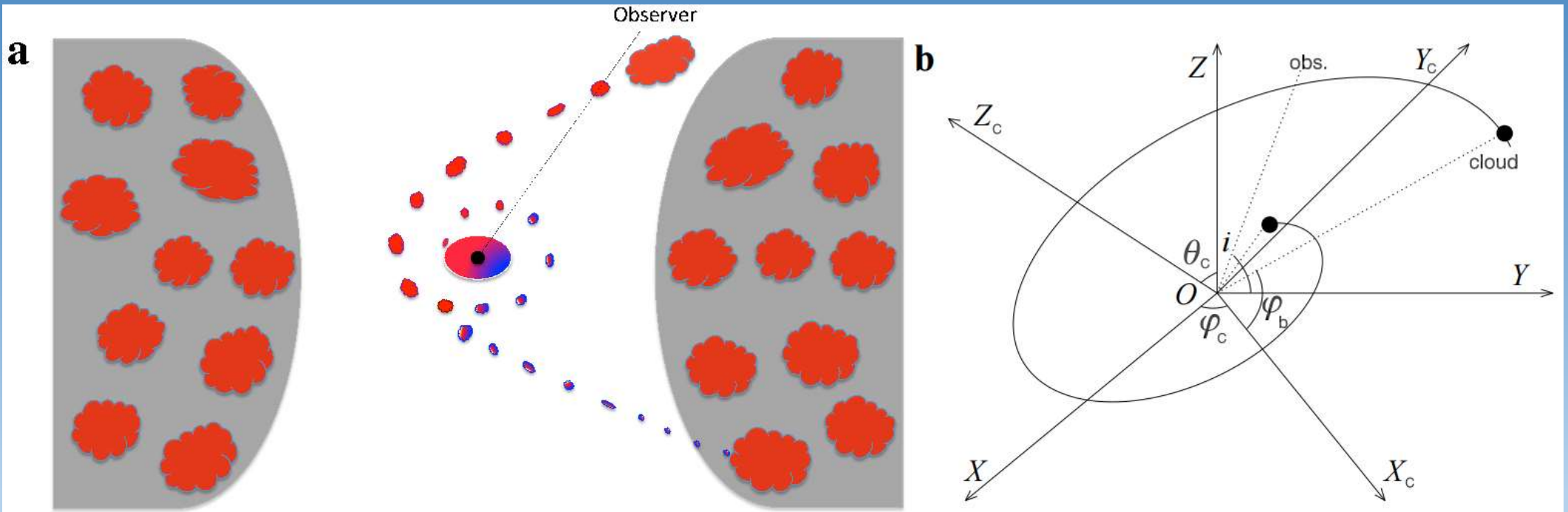
BLR dynamical timescale  $\sim 2.10$  yrs

## Long-term Variability

Velocity delay maps recovered from AGN Watch data (fig. 01-13, yr 1989-2001), from our campaign (fig. 14, yr 2015), and a simulated map of an inclined keplerian disk (15)



## The inflow-disk evolution is consistent with the Tidal-disruption BLR forming model



# Thank You

Wang et al. 2017 NatAs