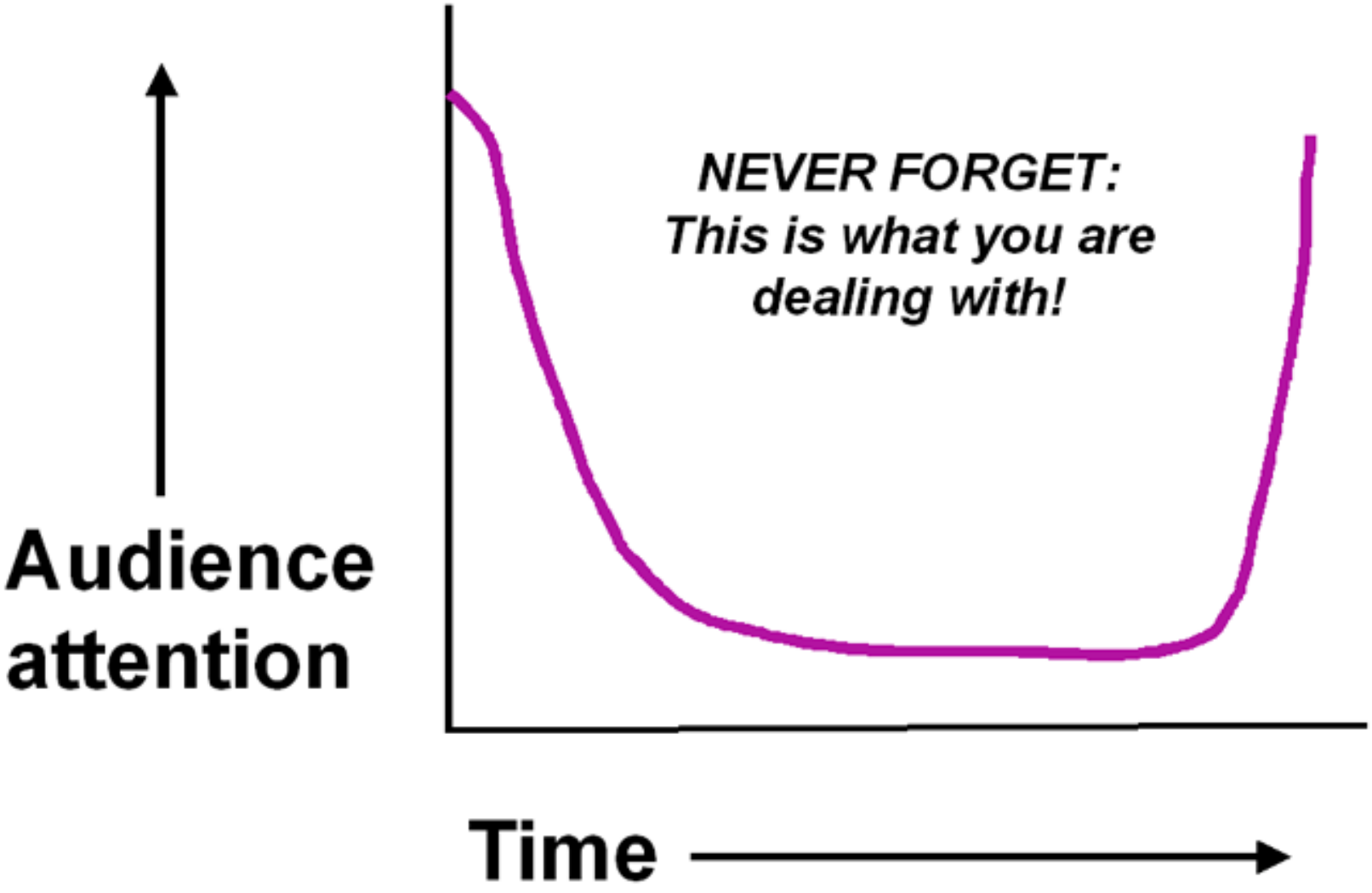
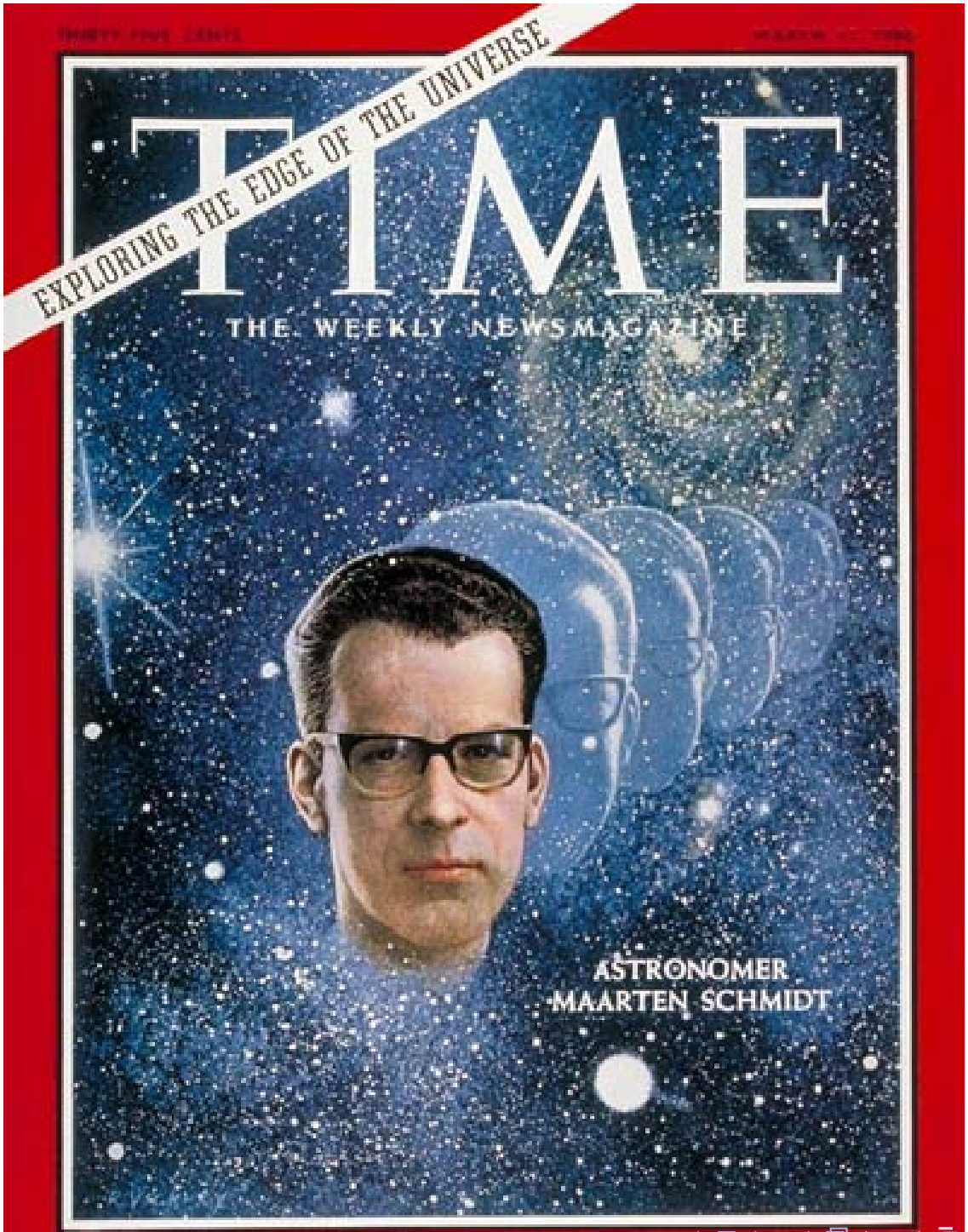
Mrk 1018: The black hole returns to the shadows

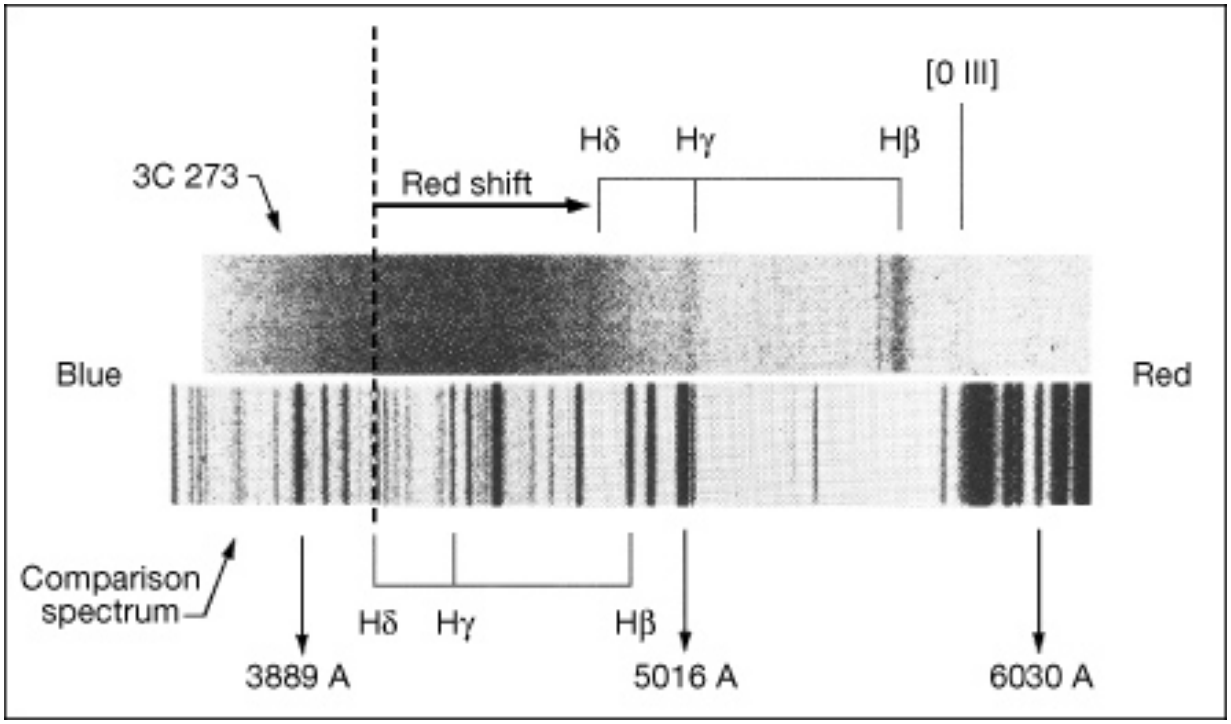
www.cars-survey.org

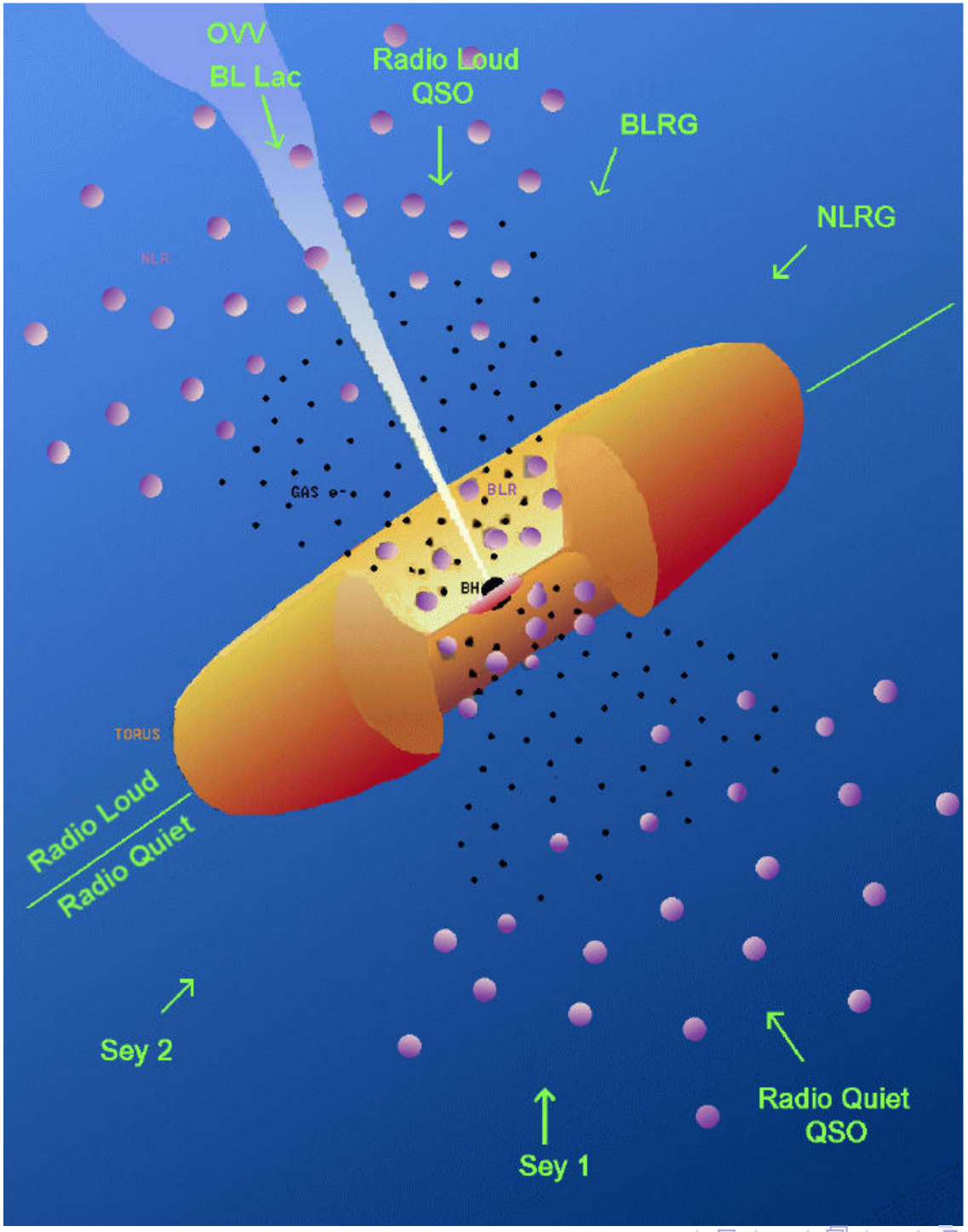
Miguel Pérez Torres
on behalf of the CARS team


NEVER FORGET:
This is what you are
dealing with!
Audience
attention
Time

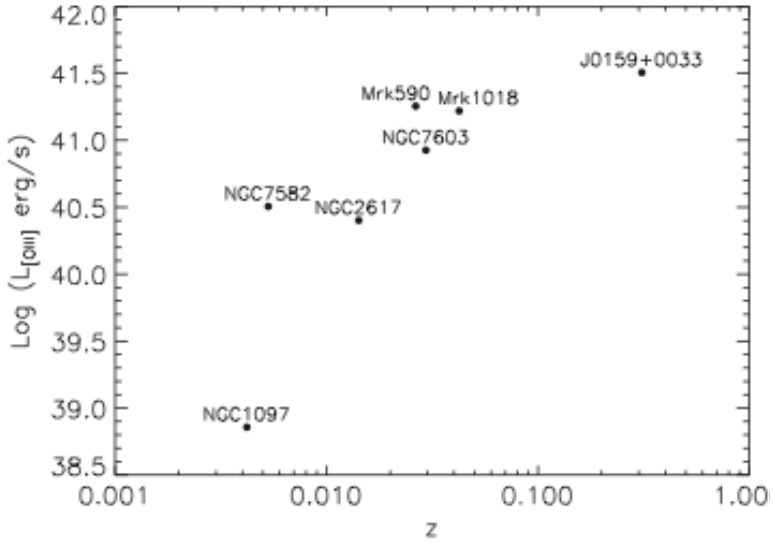

EXPLORING THE EDGE OF THE UNIVERSE
TIME
THE WEEKLY NEWSMAGAZINE
ASTRONOMER
MAARTEN SCHMIDT

3C273 - The discovery of the First Quasar

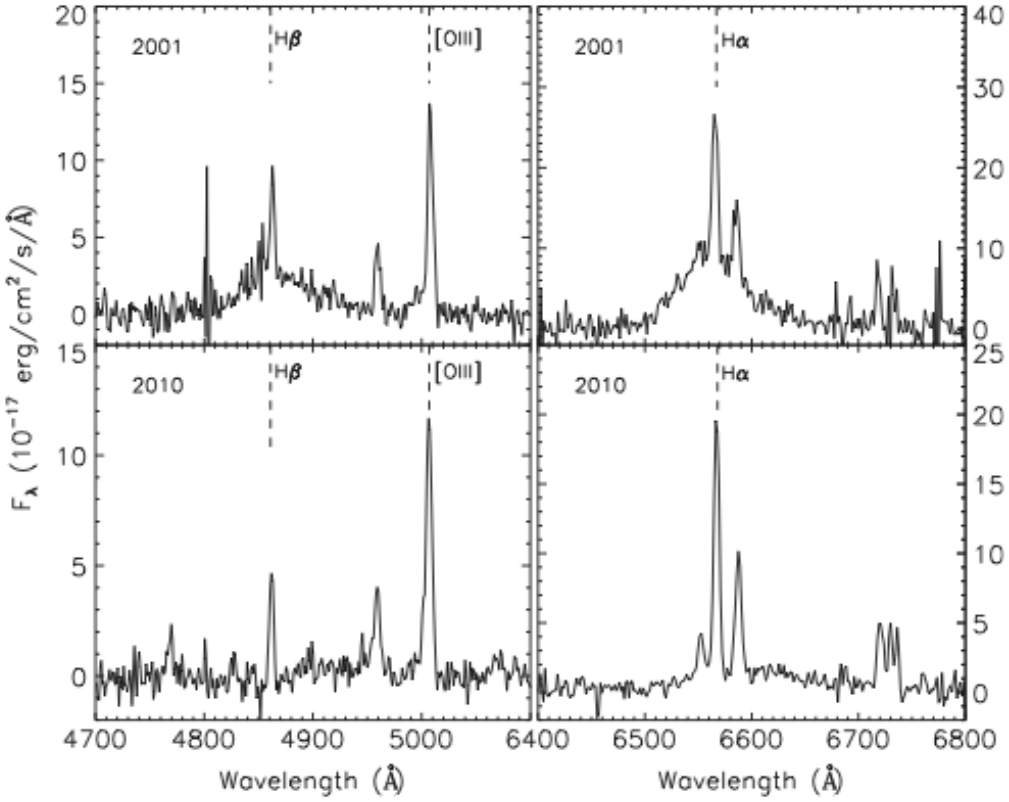



OVV
BL Lac
Radio Loud
QSO
BLRG
NLRG
NLR
GAS e-
BLR
BH
TORUS
Radio Loud
Radio Quiet
Sey 2
Sey 1
Radio Quiet
QSO

Changing look AGN



(LaMassa+2015)



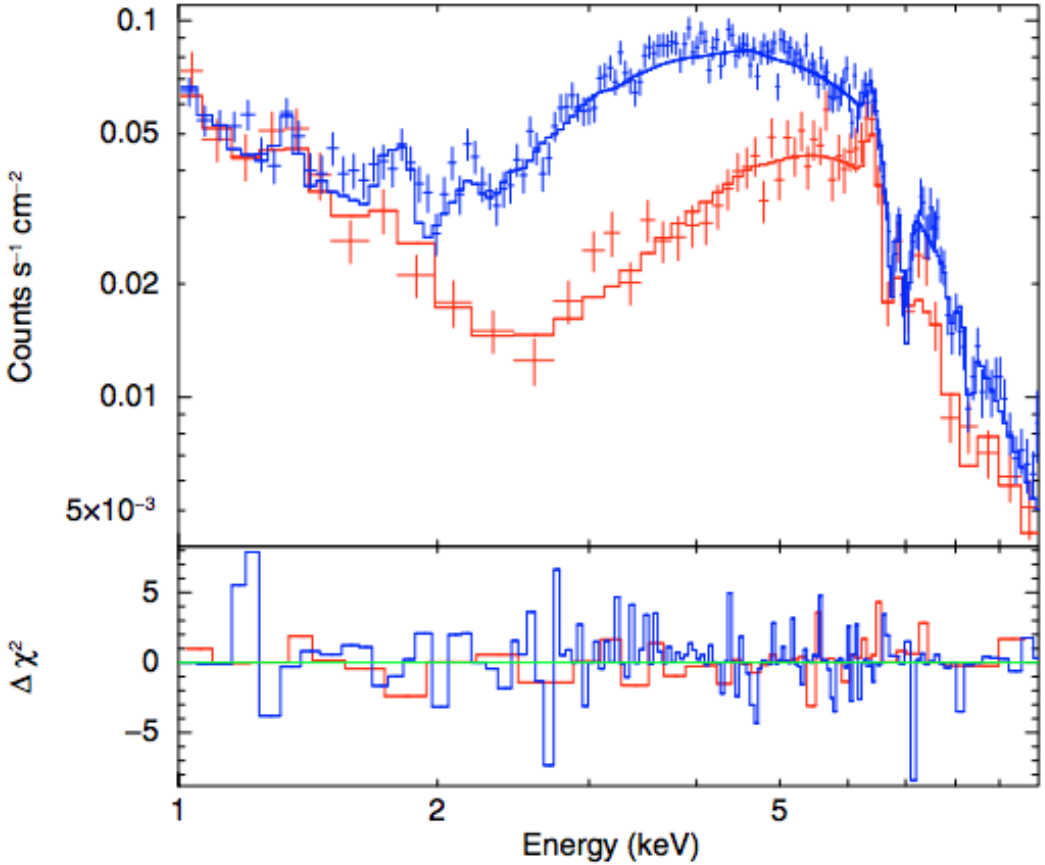
Optical type change (SDSS J0159+0033) from Type 1 to Type 2

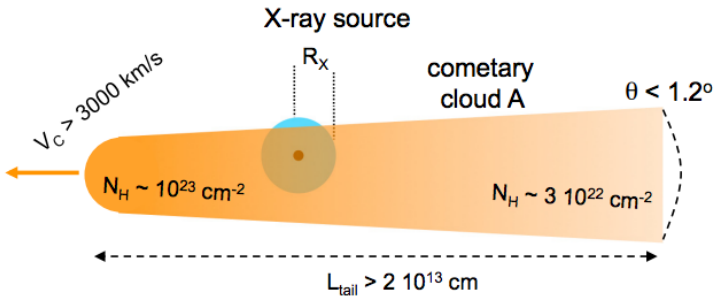
Why do AGN change their type

- Obscuration by a cloud from the torus
- Tidal Disruption Event (TDE)
- Change in accretion rate/flow

Obscuration by a cloud from the torus

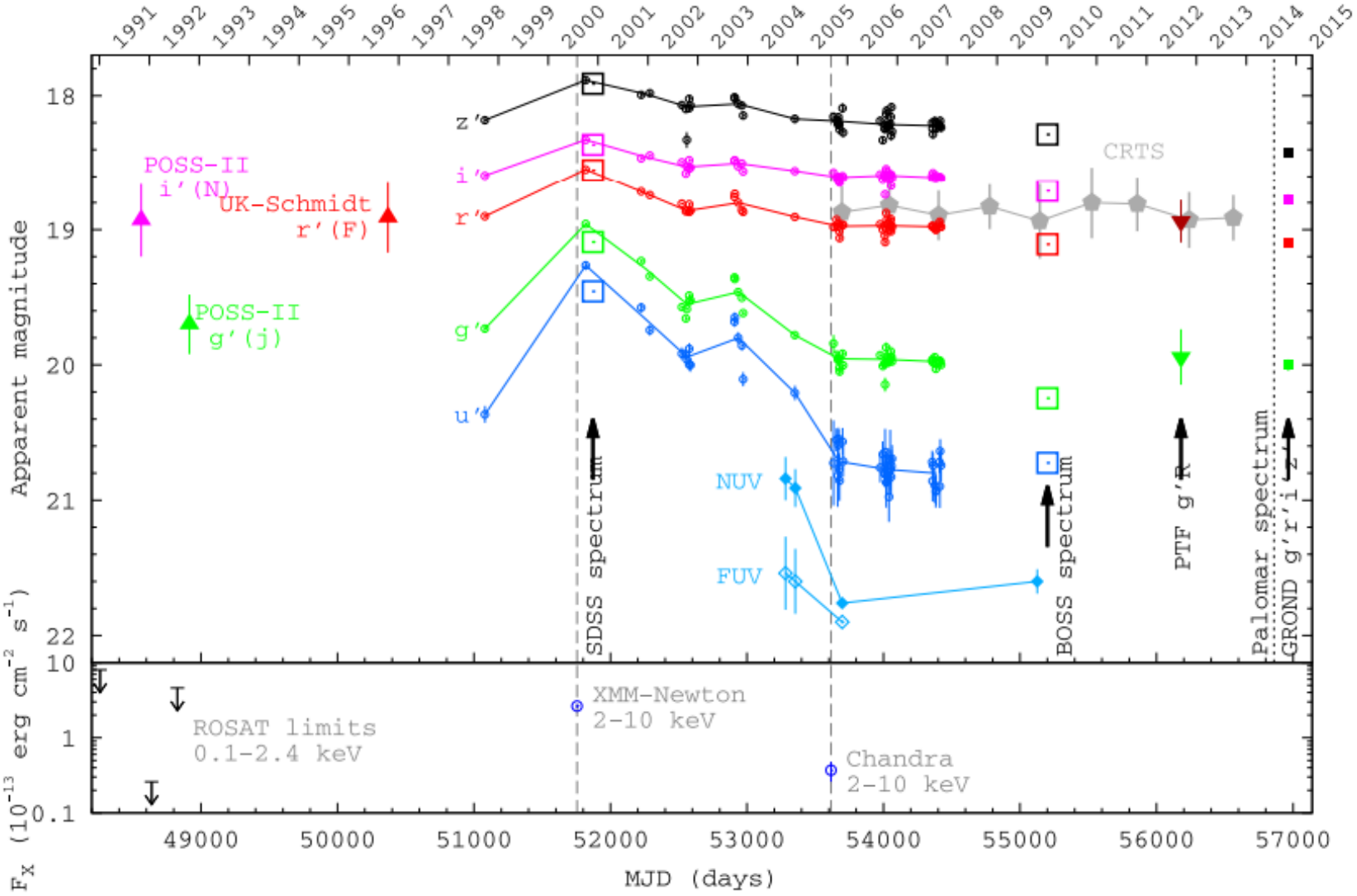
⇒ Cloud event lasts hours to ∼month (e.g., NGC1356 - Maiolino+2010)





Tidal Disruption Event (TDE)

$\Rightarrow$ Bright flare with power-law decline ($L \propto t^{-5/3}$) decline



Change in the accretion rate

$\Rightarrow$ Long timescale (extrapolated from jetted X-ray binaries)

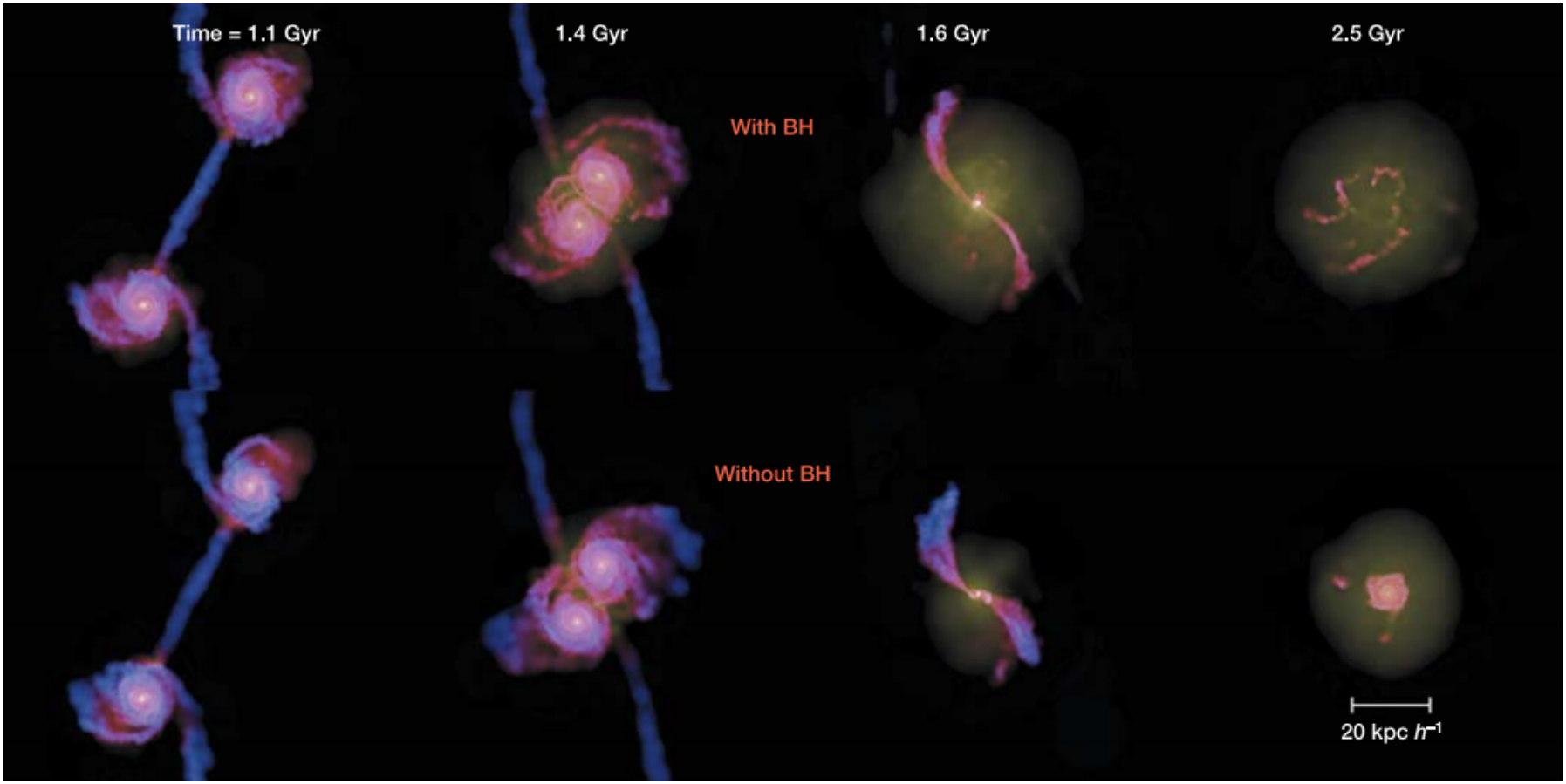
CLOSE AGN

CARS

REFERENCE SURVEY

Motivation

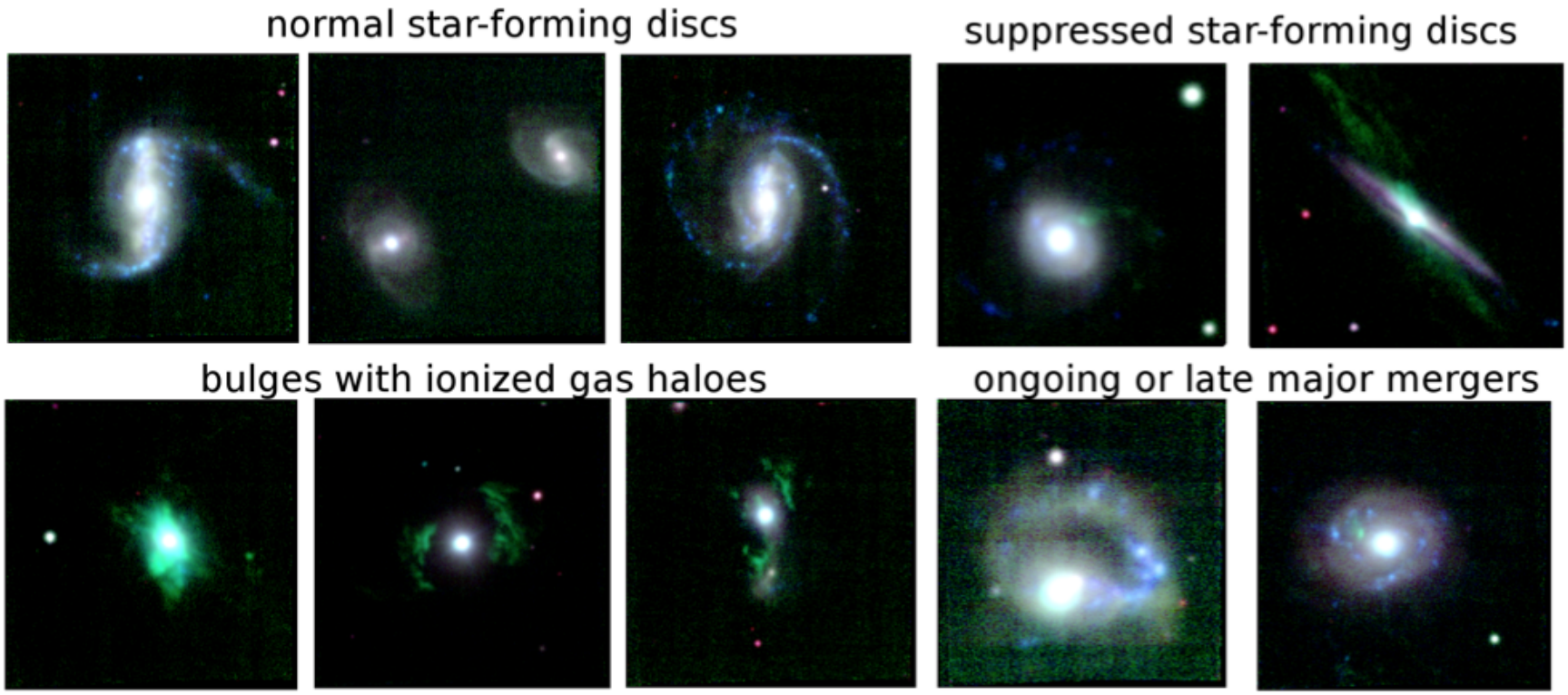
(Di Matteo+2005, Nature)



Quasars regulate the growth and activity of BHs and their hosts

Galaxy-galaxy collision → SF burst (+strong gas inflow to SMBH) → Quasar expels energy → (SF *and* BH growth) quenching

The CARS AGN sample in a nutshell



- 40 unobscured (Type 1) AGN from Hamburg/ESO survey with $z < 0.06$
- Follow-up multi-wavelength data (X-ray to radio)
- All targeted with VLT-MUSE IFU in 2015

Primary aim of CARS: Study the AGN-host relation (www.cars-survey.org)

CARS: Building-up a unique dataset

Radio

mm

sub-mm

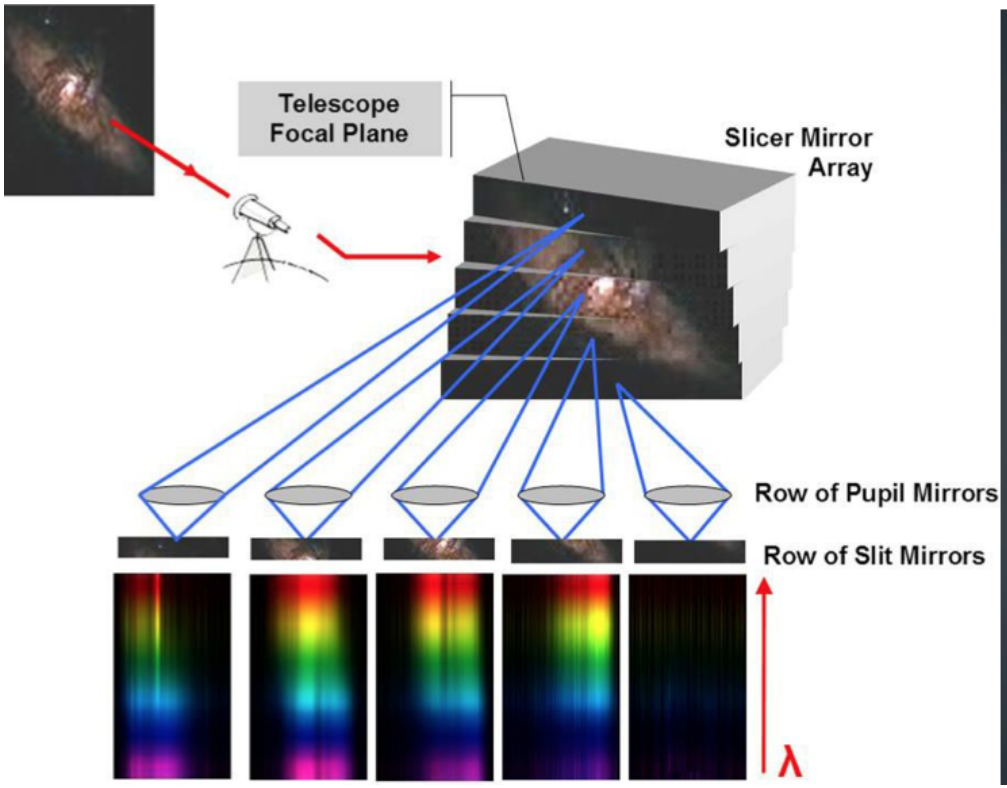
FIR

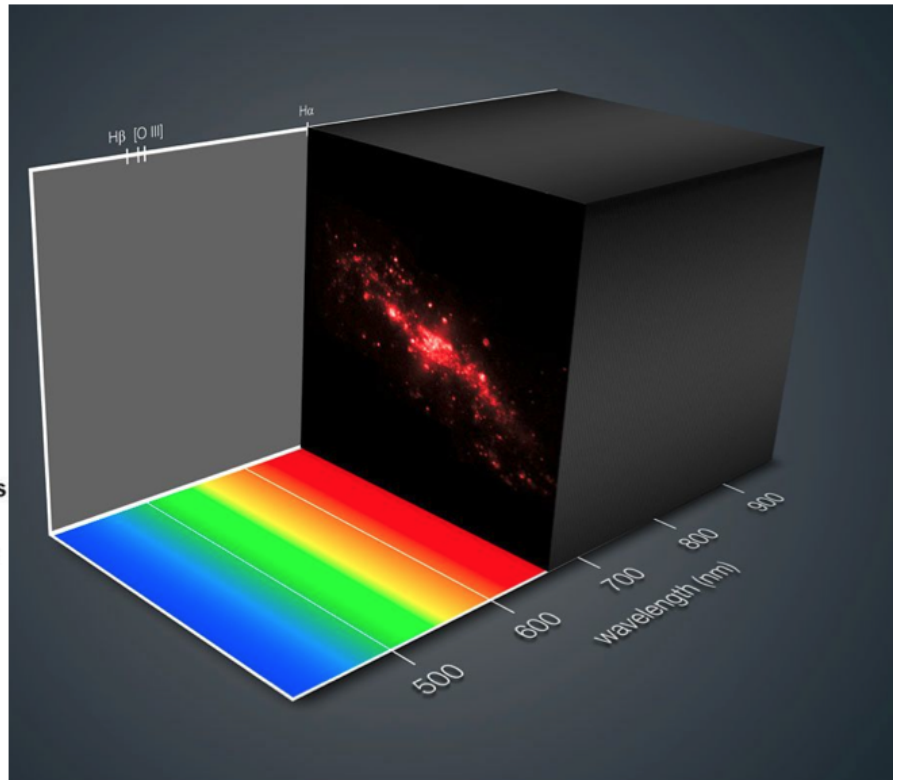
Opt

NIR/Opt/UV

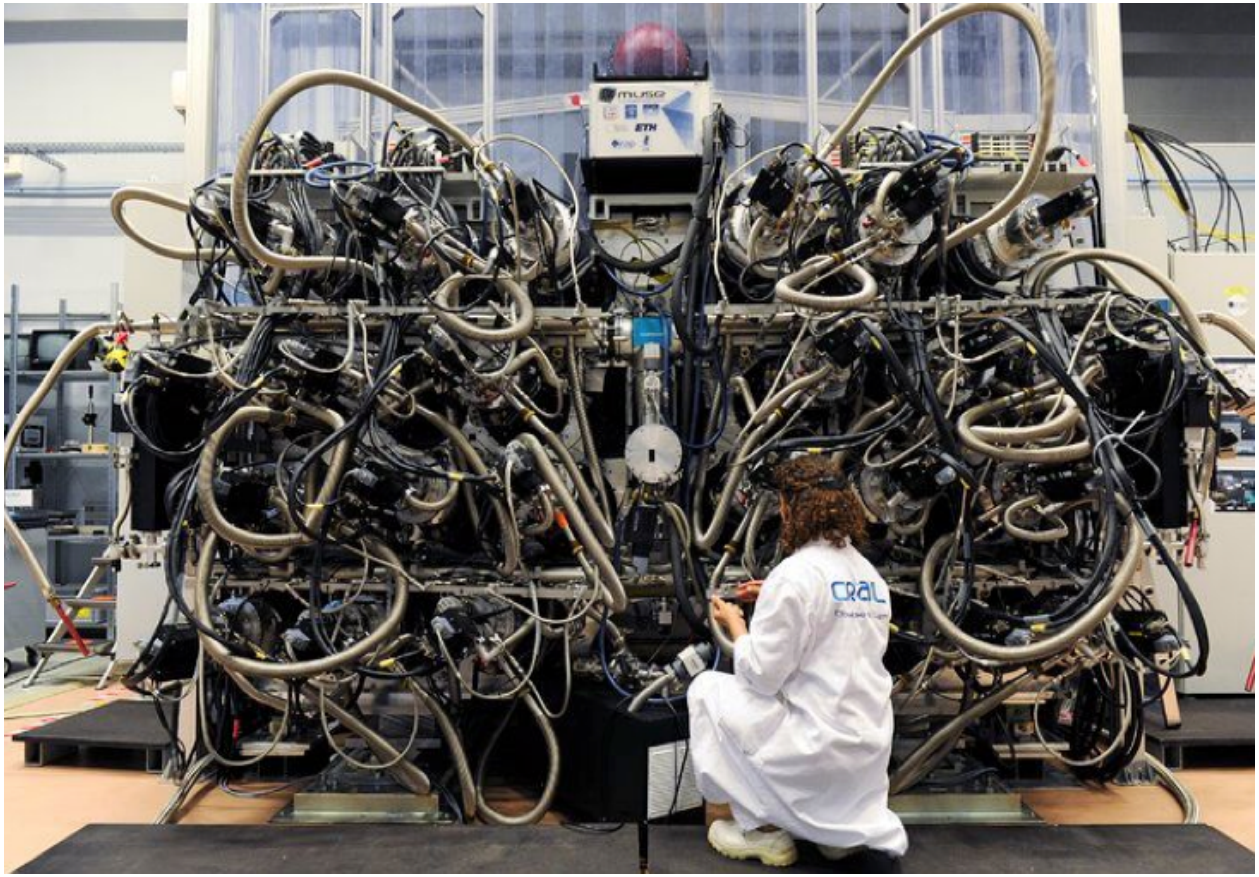
X-rays

3D optical spectroscopy





MUSE - the game changer



CARS Backbone

- 1 arcmin^2 FoV
- $0.2'' \rightarrow$ 90 000 spectra(!!)
- 4700-9300 A
- Snapshot survey

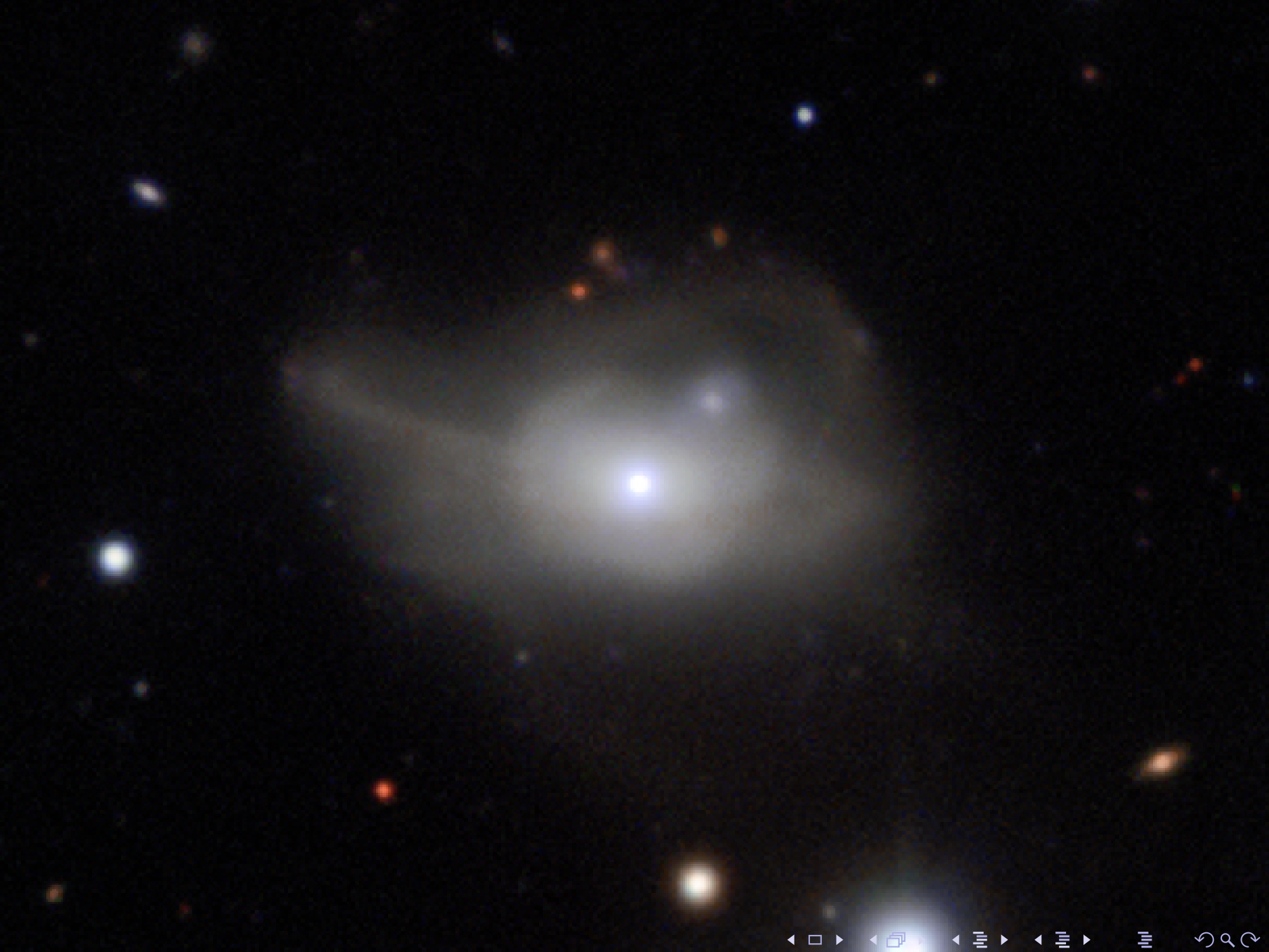
High-spatial radio observations of CARS galaxies

Imaging the neutral atomic gas of CARS

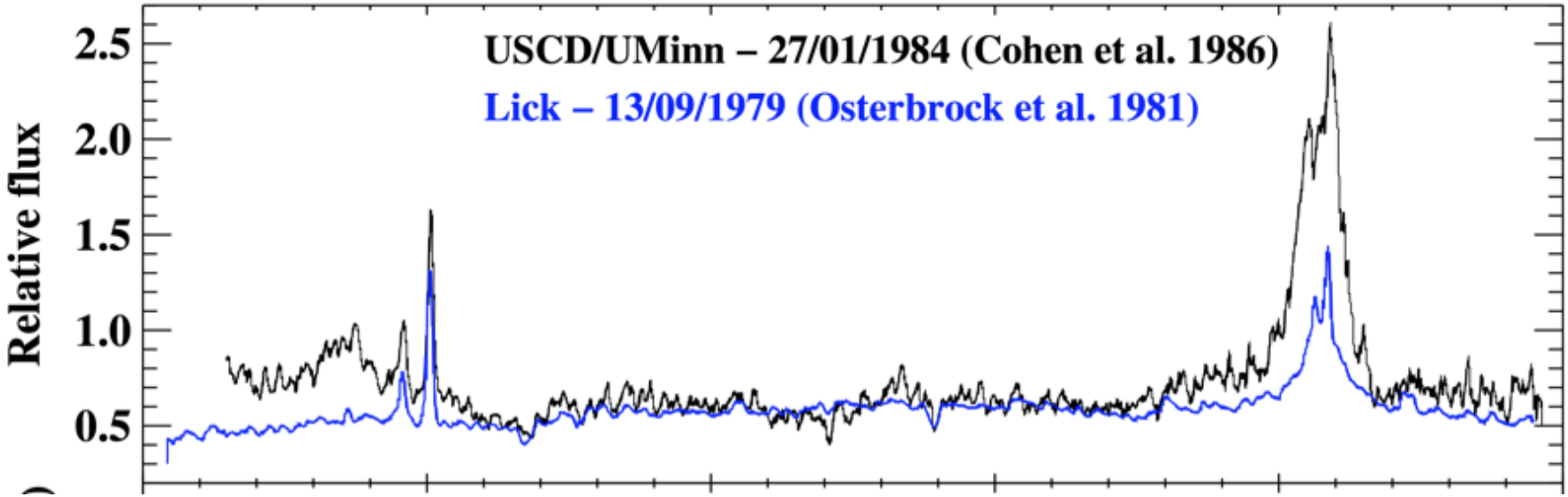
VLA-H I maps PI: Pérez-Torres
Very deep H I images ($M_{HI} \lesssim 1.2 \times 10^9 M_\odot$)
Obtain H I maps at same angular resolution as CO maps $\Rightarrow$ Total gas content, H2/HI ratio, large scale inflow vs. outflow

Imaging the radio synchrotron emission of CARS

Multi-frequency VLA continuum PI: Pérez-Torres
$\Rightarrow$ Trace compact SF and jet activity in the central $\sim$500 pc.

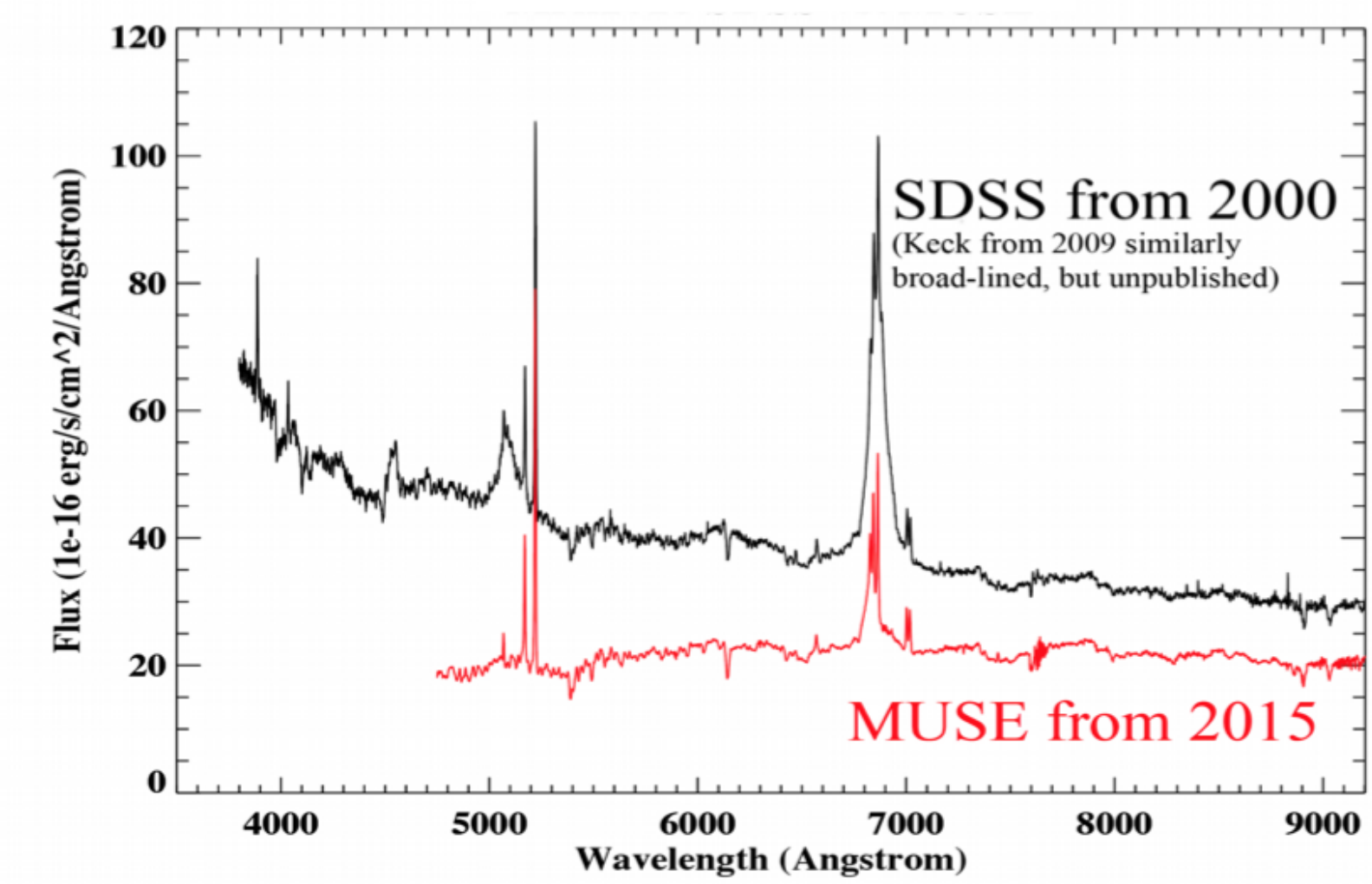


Mrk1018: “Changing-look” AGN in the 1980’s



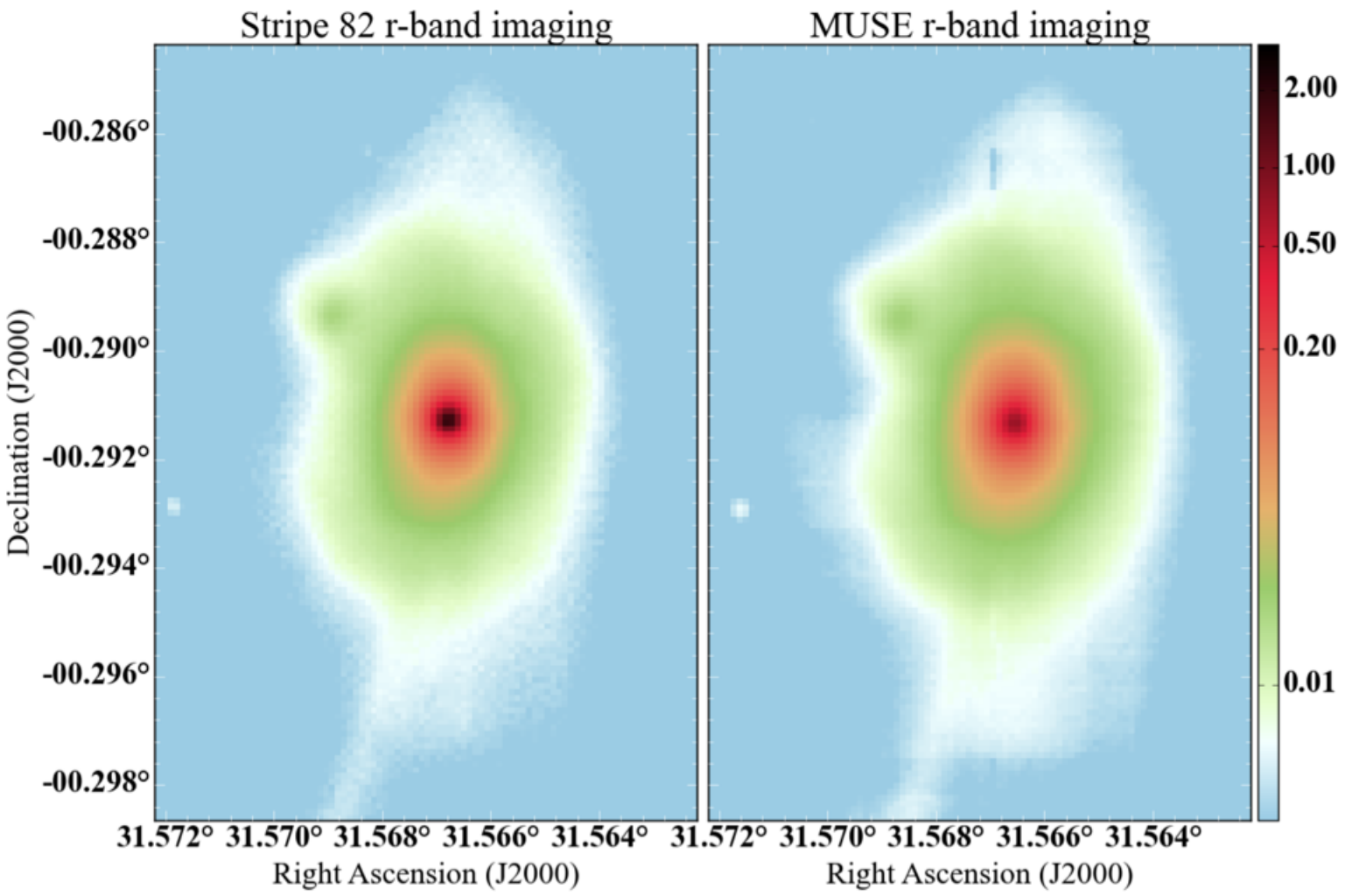
From Type 2 (obscured, faint) to Type 1 (unobscured, bright)

Mrk1018: Changing back again after 30 yr



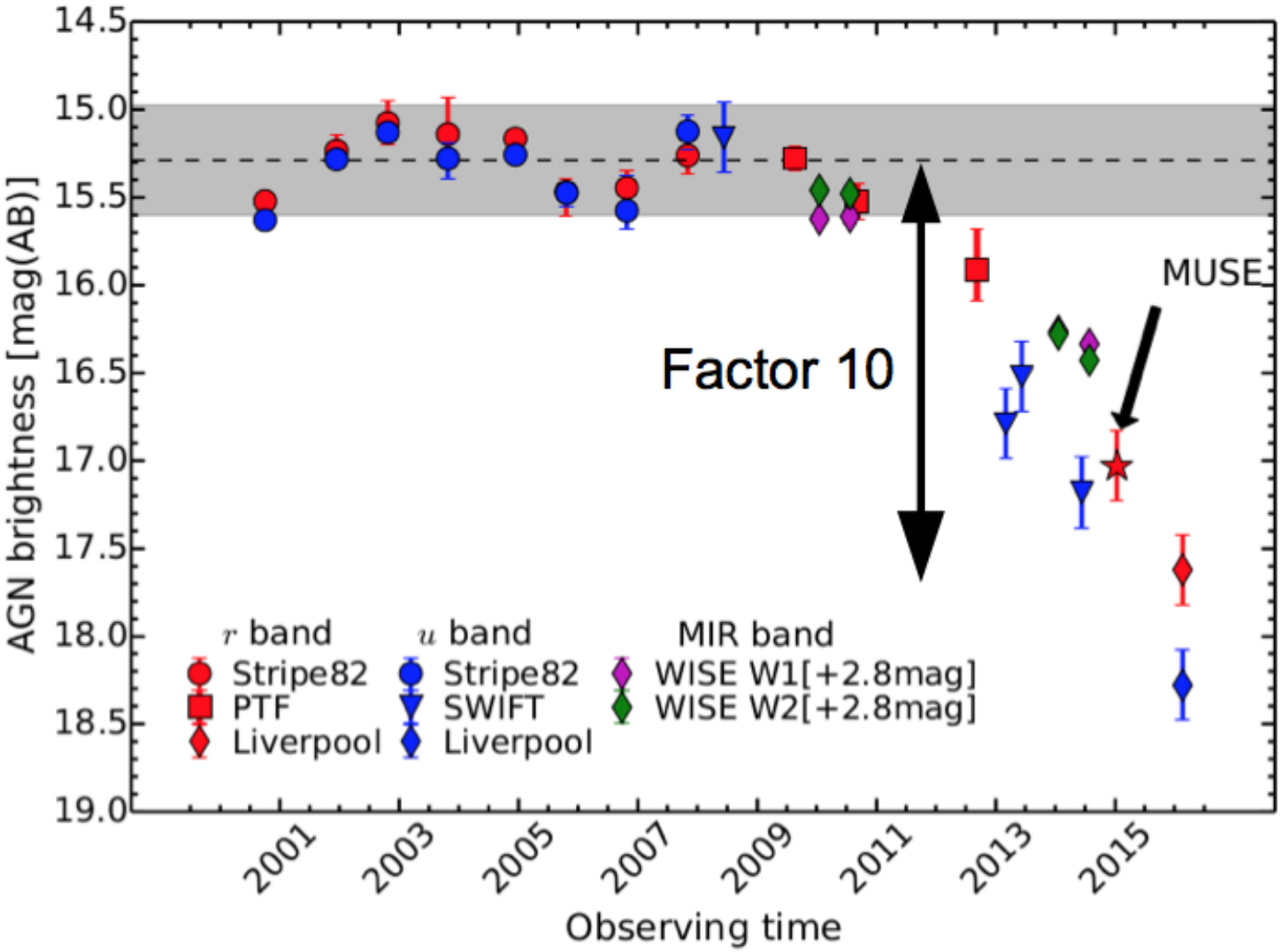
From Type 1 (unobscured) back to Type 2 (obscured)

Mrk1018: Changing back again after 30 yr



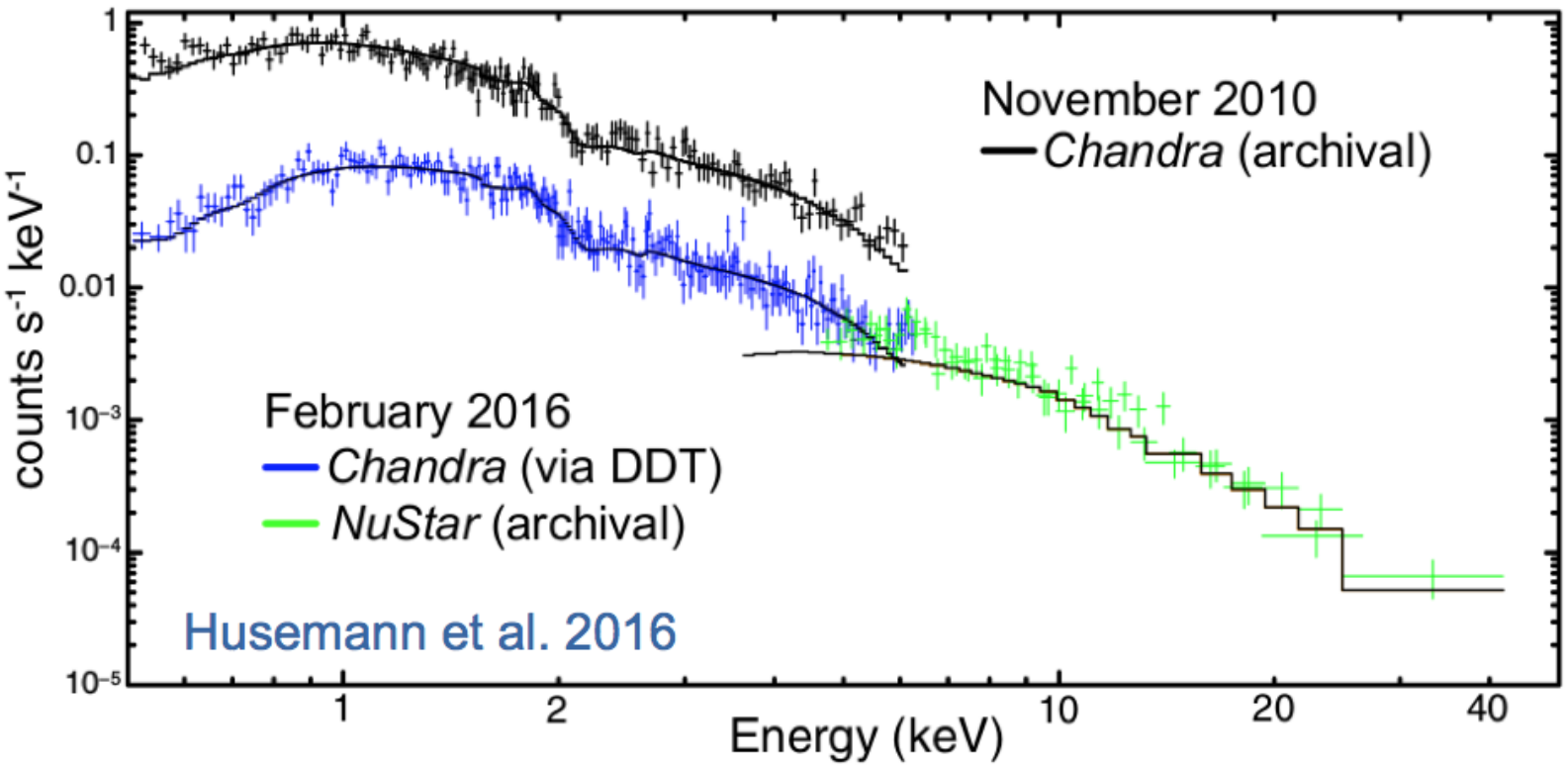
From Type 1 (bright) back to Type 2 (faint)

Mrk1018: The light curve in the past 15 yr



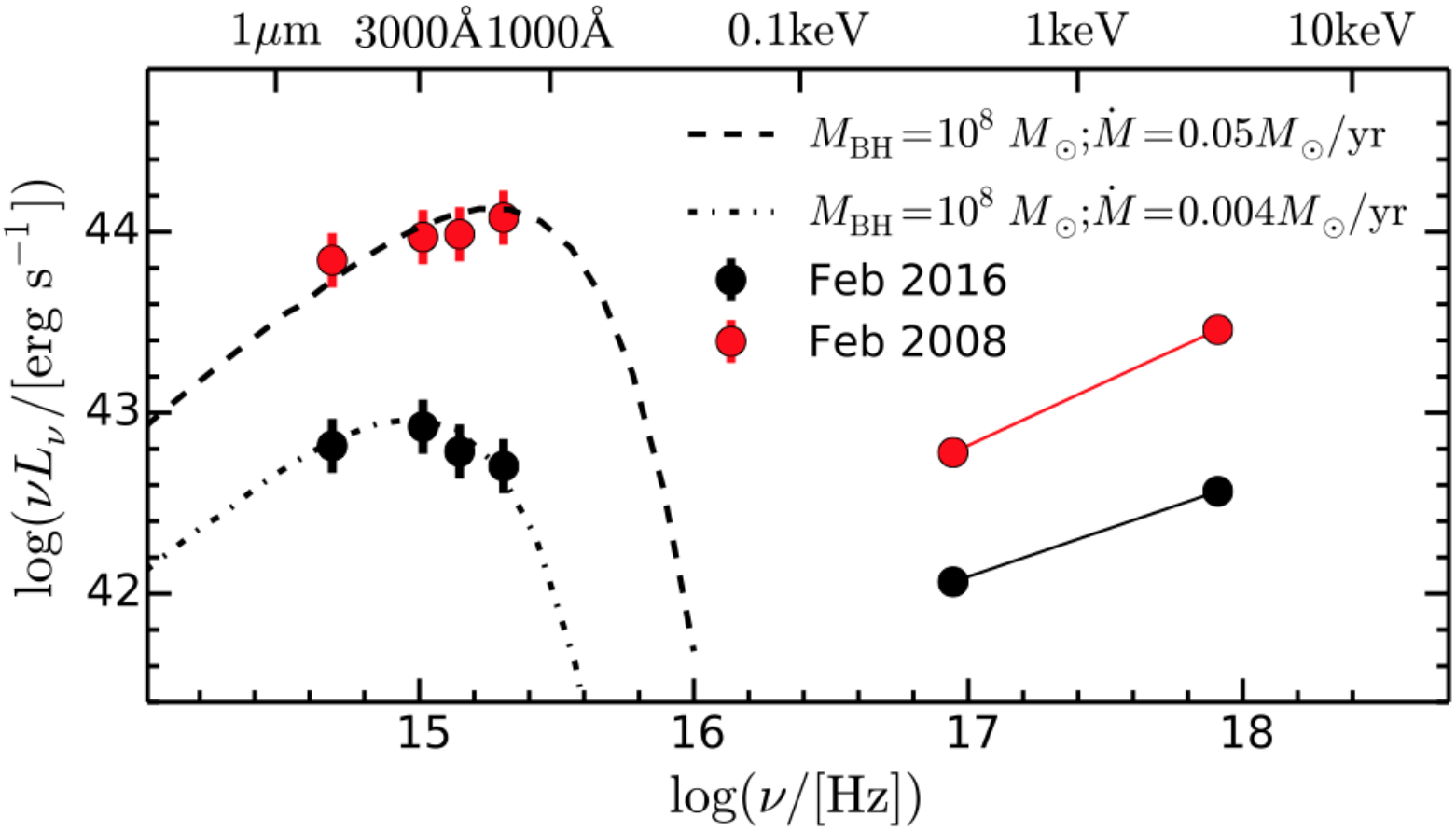
- TDE very unlikely due to persistent activity over ∼30 yr (McElroy+PT+2016)

Mrk1018: X-ray spectra (Chanda + NuStar)



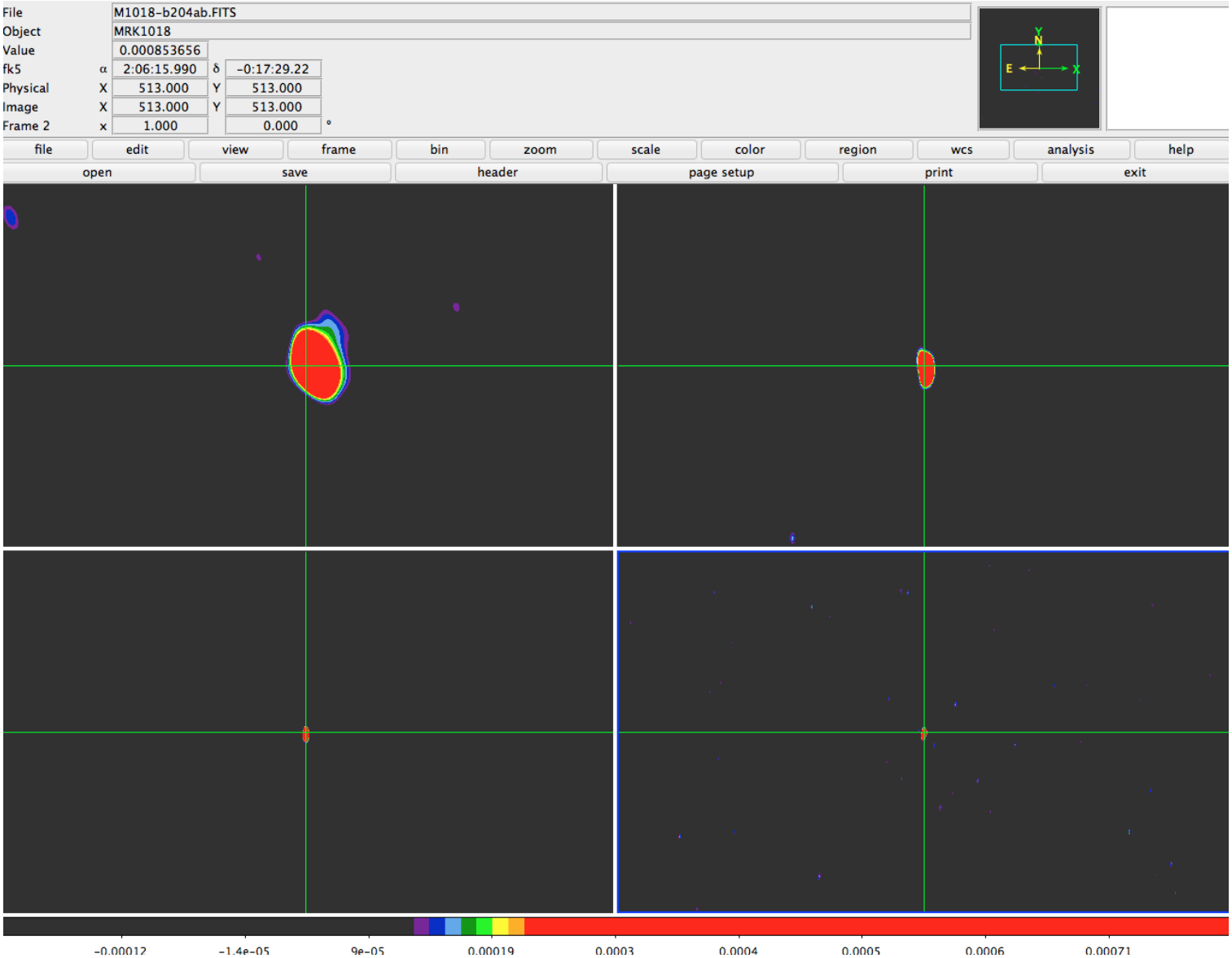
- X-ray spectra consistent with no absorption
- ⇒ Accretion disc luminosity is declining (Husemann+PT+2016)

Mrk1018: Optical to X-ray SED



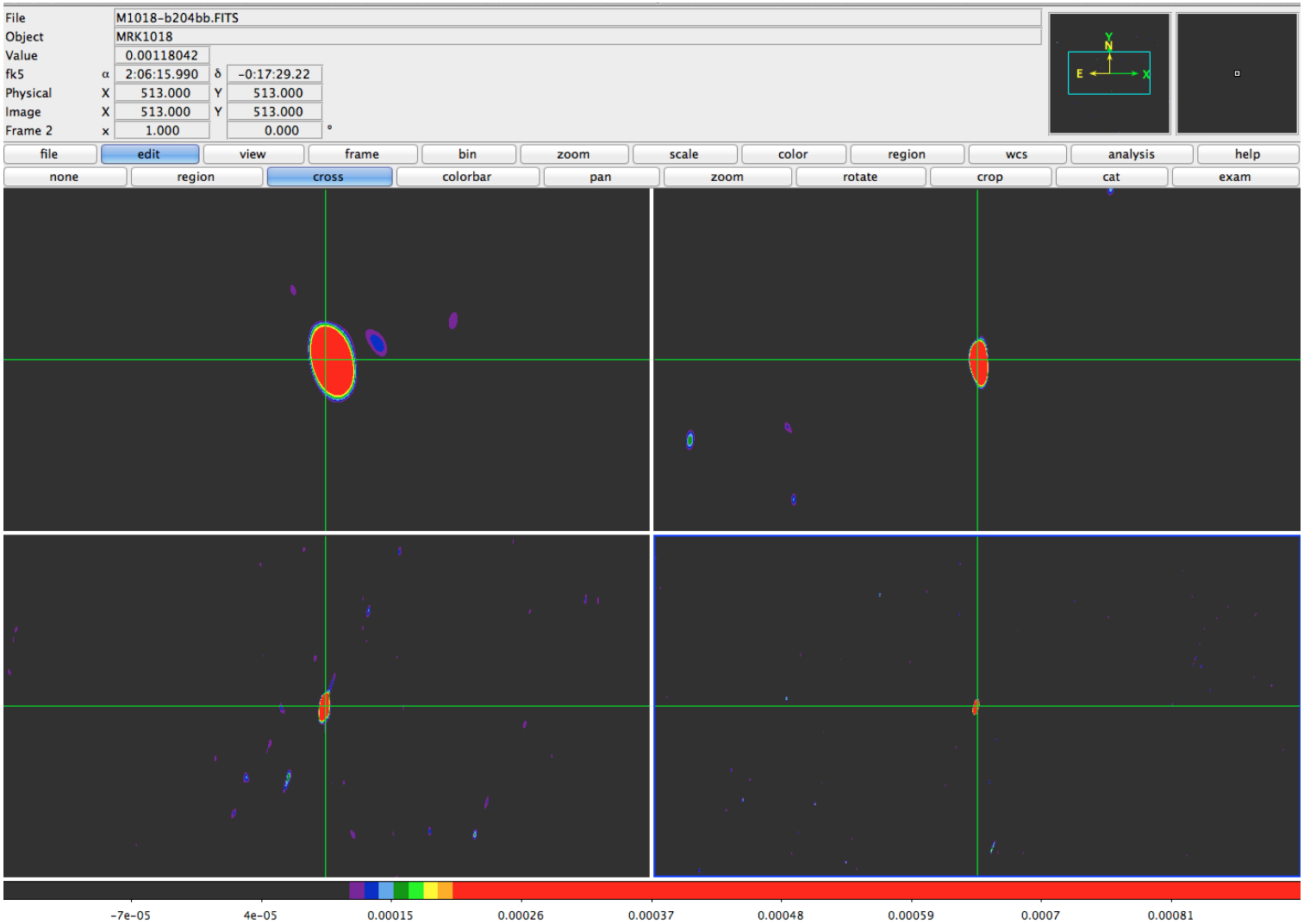
- Peak luminosity shifts by a factor of ~ 2 in wavelength
- Roughly consistent with $L \propto T^4$ relation
- $\Rightarrow$ Support for intrinsic changes in accretion

Mrk 1018: Radio interferometry (VLBA) observations



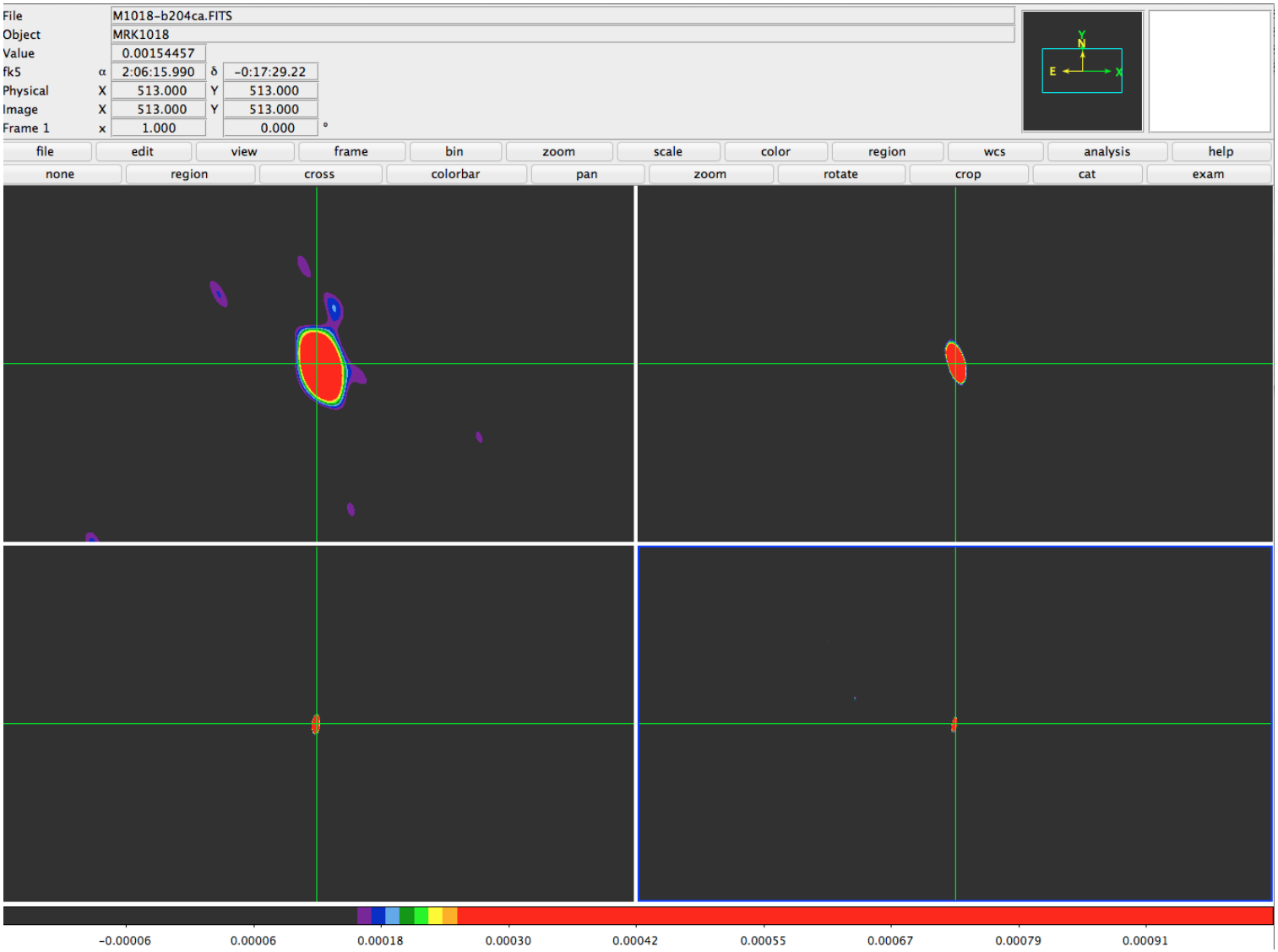
(VLBA observations on 30 June 2016 - PT+, in preparation)

Mrk 1018: VLBA observations



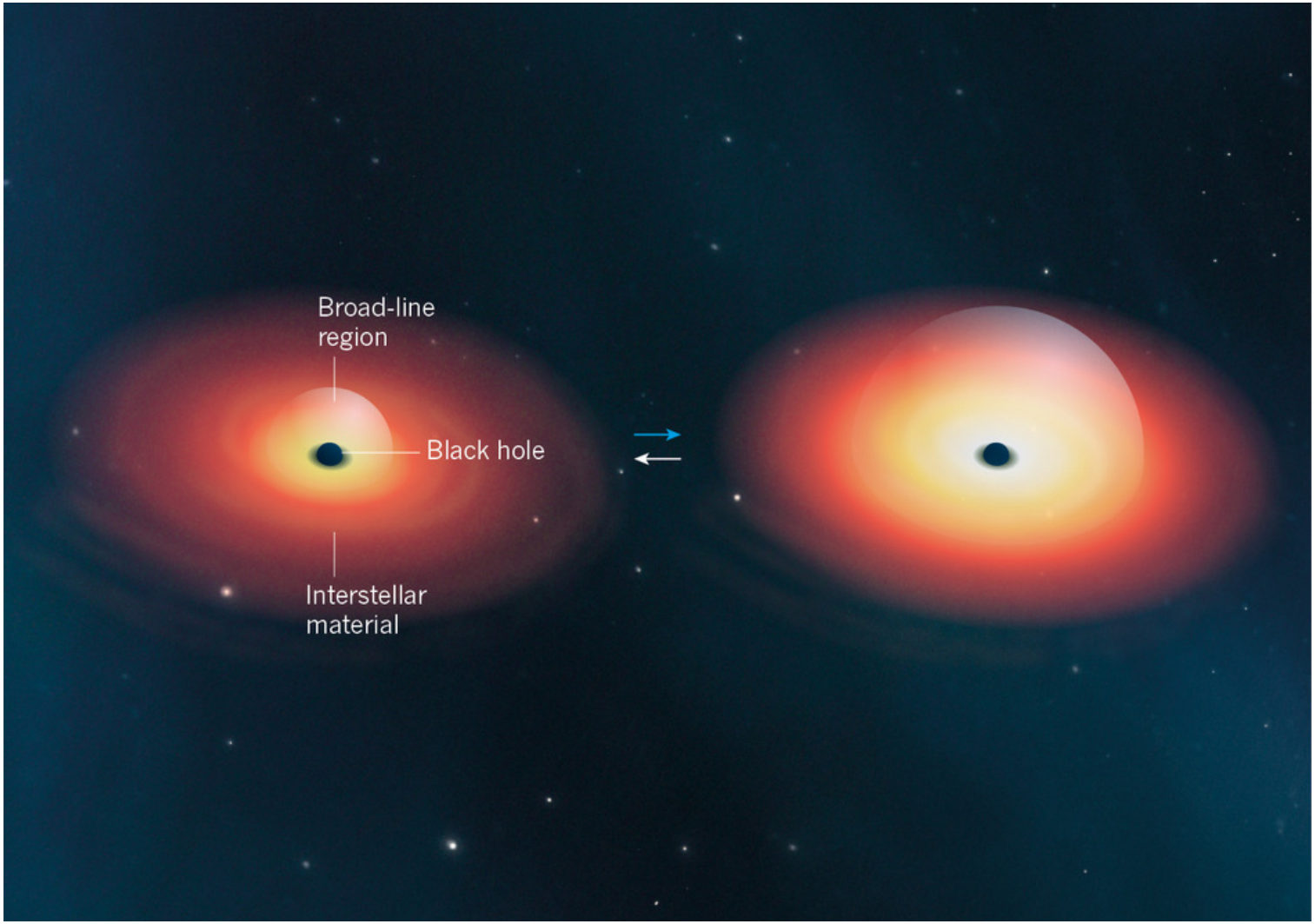
(VLBA observations on 30 July 2016 - PT+, in preparation)

Mrk 1018: VLBA observations

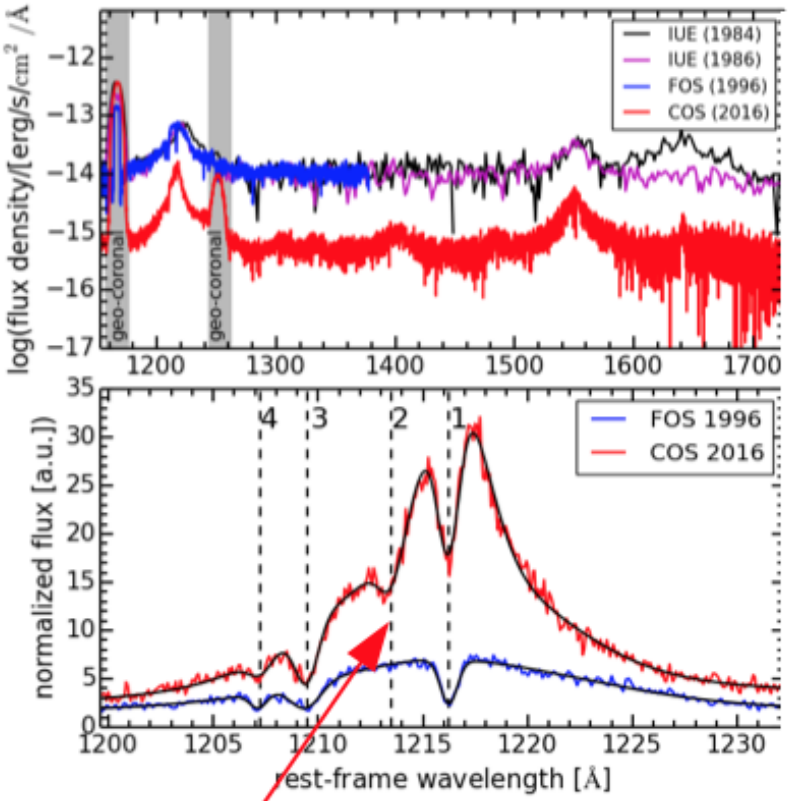


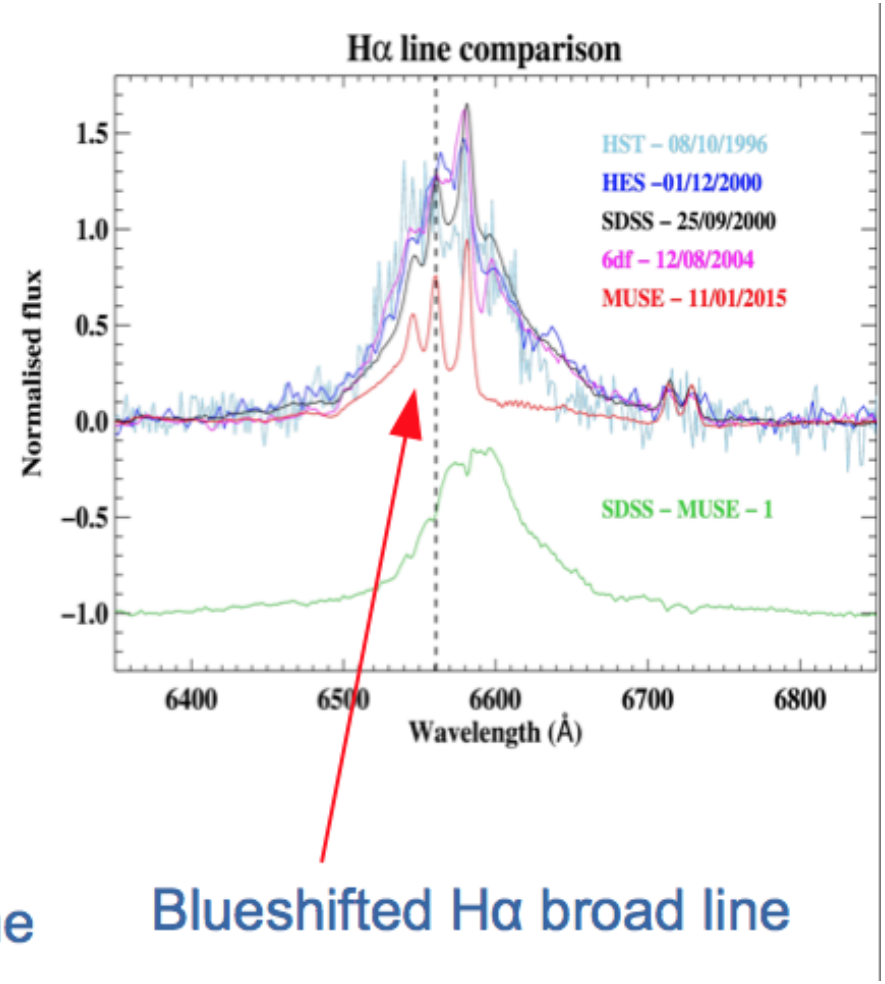
(VLBA observations on 20 Sept 2016 - PT+, in preparation)

Mrk 1018: A changing look AGN



What is causing the change in accretion rate?



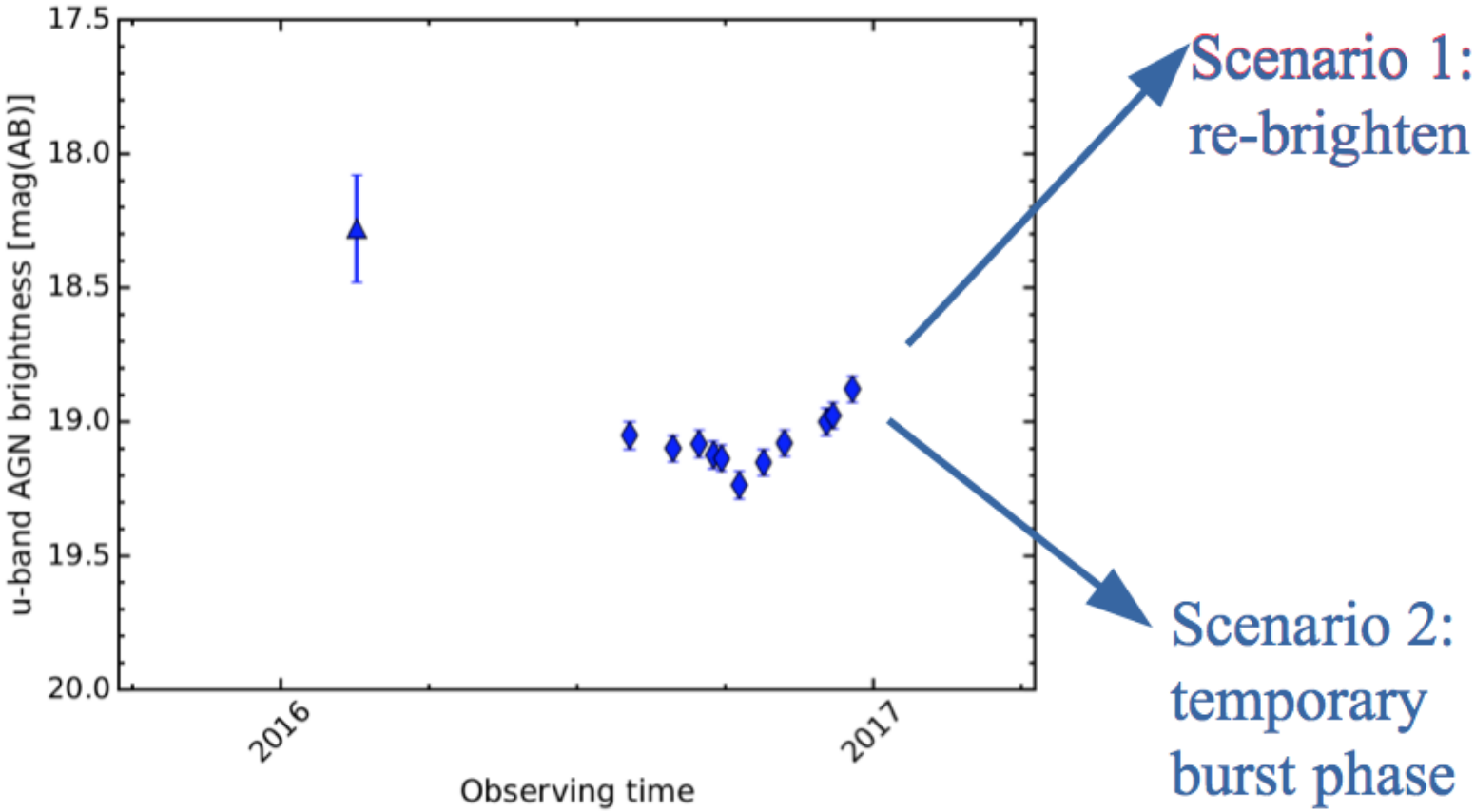


New narrow Lyα absorption line

Blueshifted Hα broad line

Ignition of an outflow? Binary SMBH?

What is the future of Mrk 1018?



Continue monitoring to verify the trend in middle 2017!

Take-away messages

- Mrk1018 is a unique changing-look AGN
- Bright phase constrained to $\sim$30 yr (periodic?)
- Eclipsing cloud event and TDE ruled out
- All data support declining accretion rate
- Potential scenarios
  1. Ignition of an outflow that suppresses accretion
  2. Interactions in a close binary SMBH system
  3. ???