CHANGING-LOOK AGN WITH COLIBRÍ

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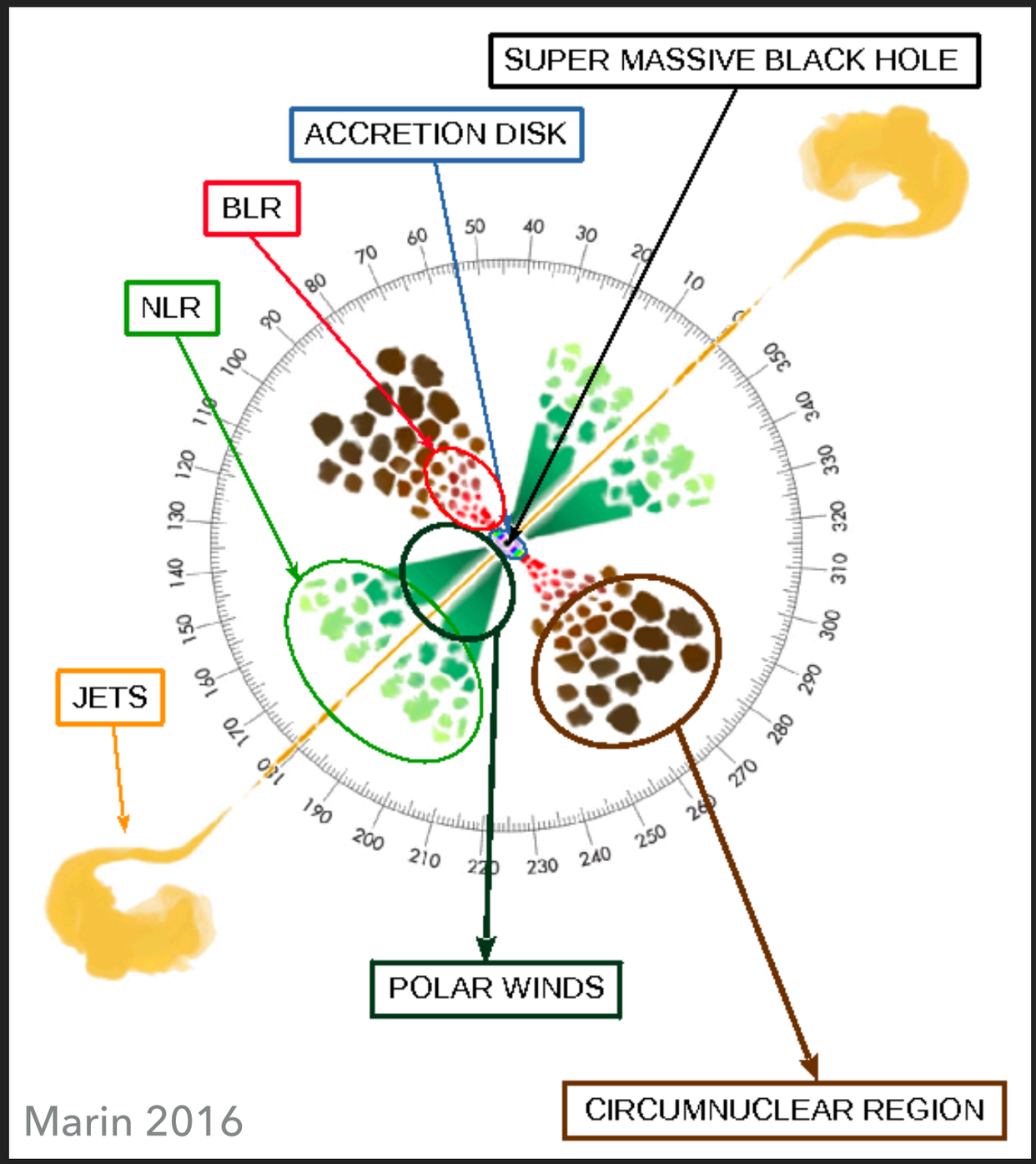
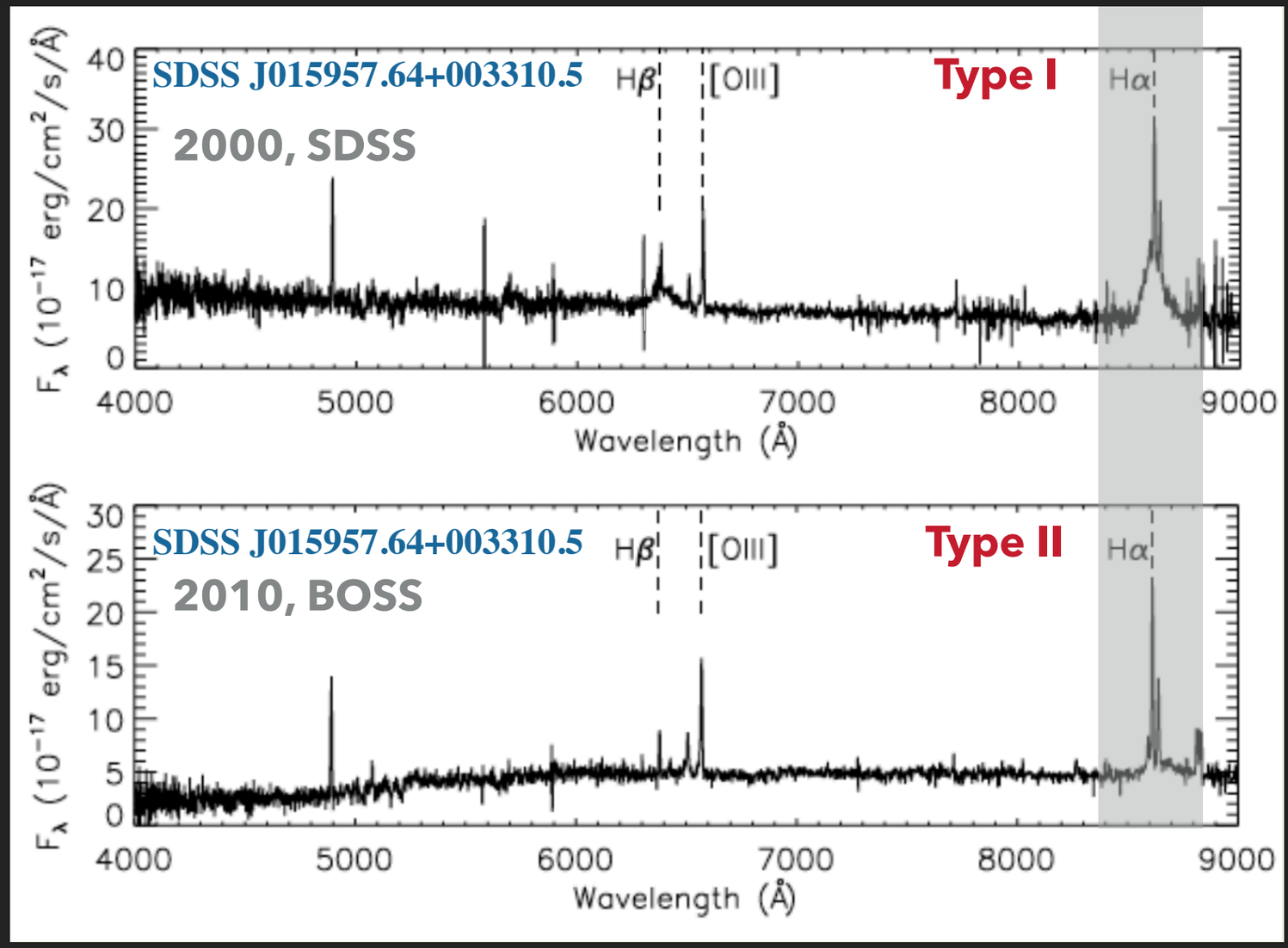
AGN SPECTRAL TYPES

- AGN with broad and narrow Balmer emission lines (type 1, angles 0-60°) and those with only narrow lines (type 2, angles 60-90°) are the same morphological objects but view from different angles.



AGN SPECTRAL TYPES

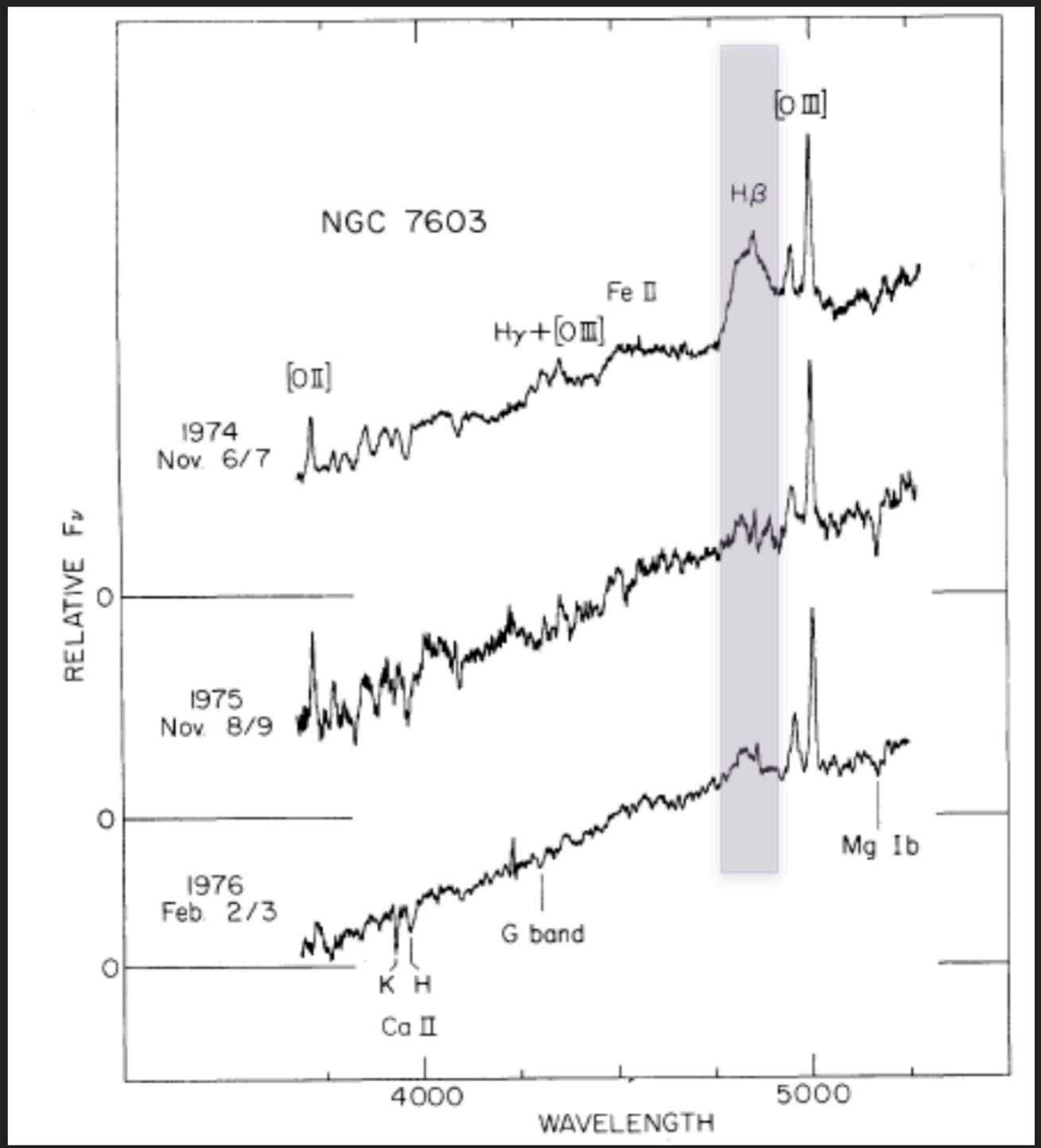
- Variability is a common property of AGN that can give us important information about nature of AGN
- But some AGN exhibit a peculiar type of variability **they change in type!**
- These peculiar type of AGN are called "Changing-look AGN"



OPTICAL SPECTRAL TYPE VARIABILITY

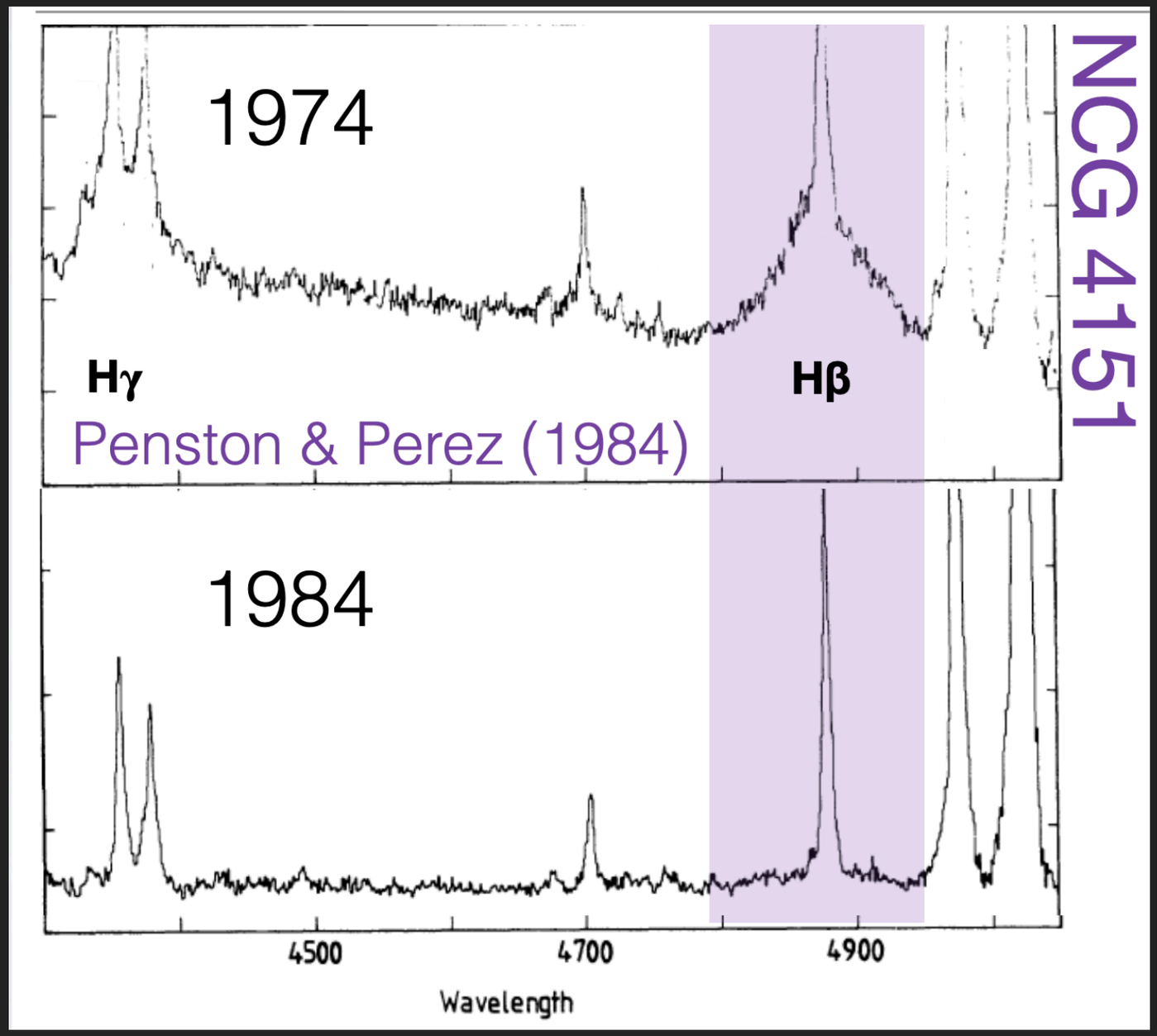
NGC 7603

- NGC 7603 first reported changing-look AGN (Tohline & Osterbrock **76**)



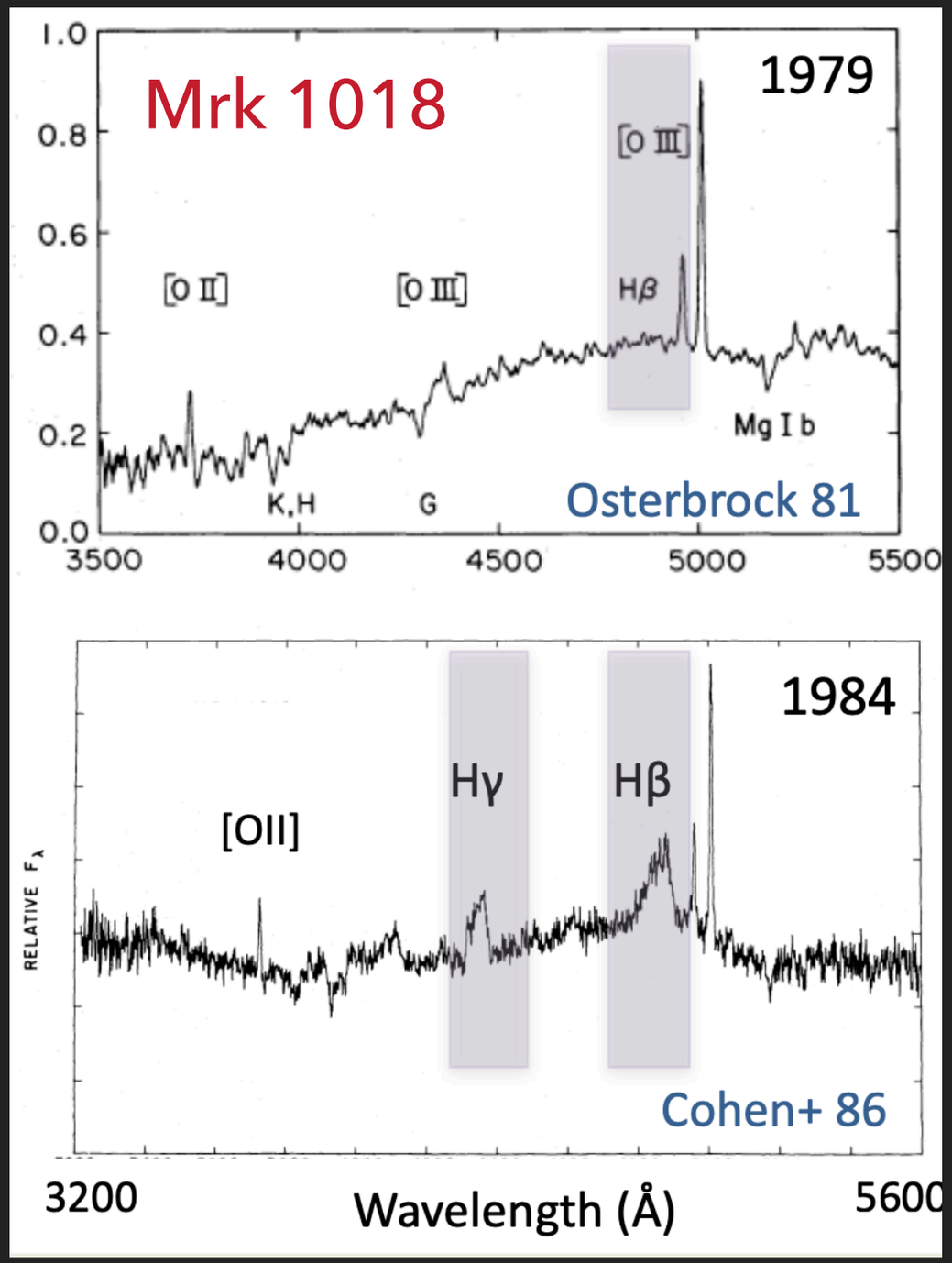
OPTICAL SPECTRAL TYPE VARIABILITY: CHANGING-LOOK AGN

- Although discovered more than 30 years ago, there are only few examples.
- In some of them, a broad line disappears from one observation to another



OPTICAL SPECTRAL TYPE VARIABILITY: CHANGING-LOOK AGN

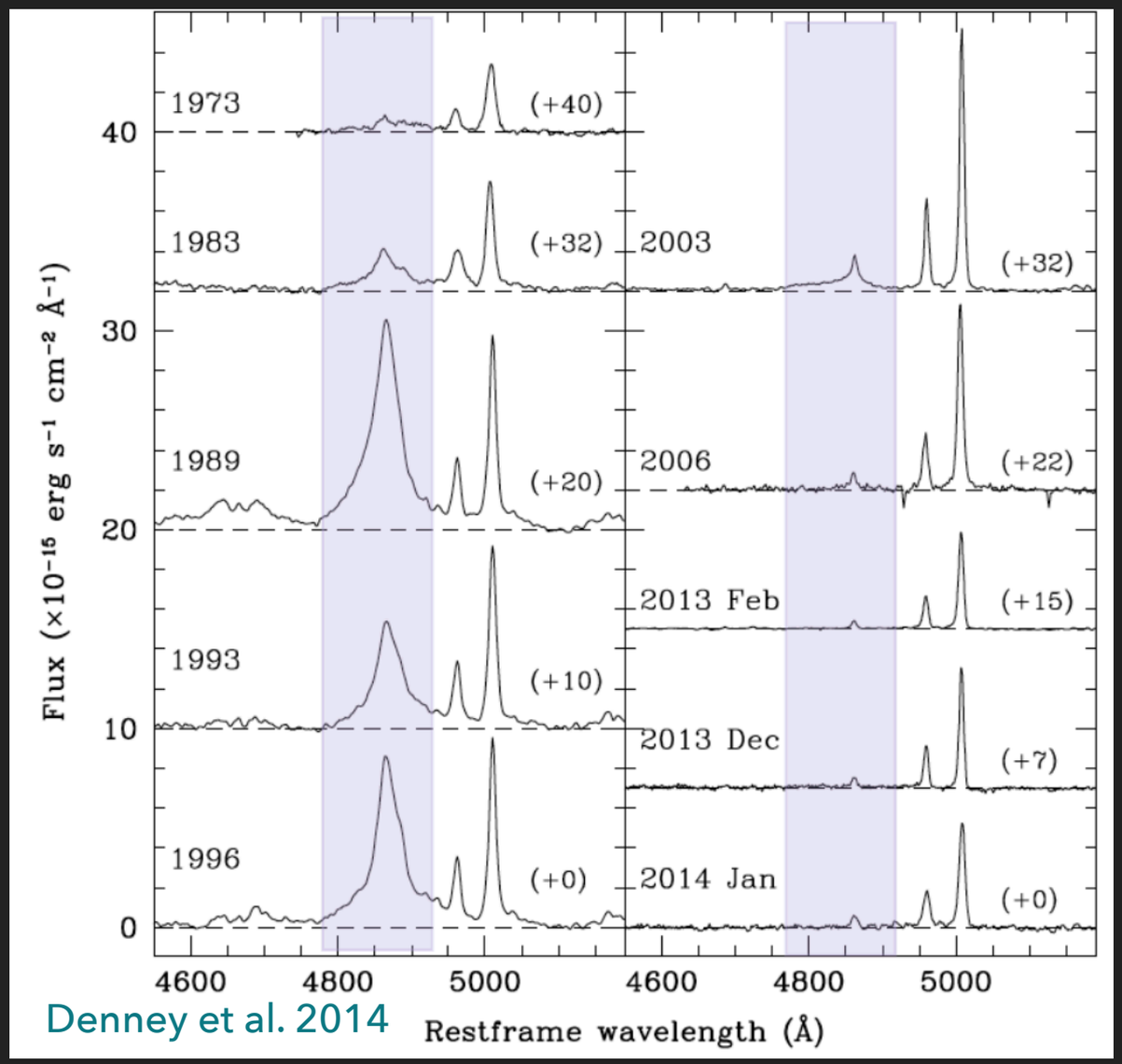
- In some of the changing look AGN, a broad line disappears
- In others a broad line appears



OPTICAL SPECTRAL TYPE VARIABILITY: CHANGING-LOOK AGN

- In some of changing look AGN, a broad line disappears…
- or appears…
- and sometimes disappears again.

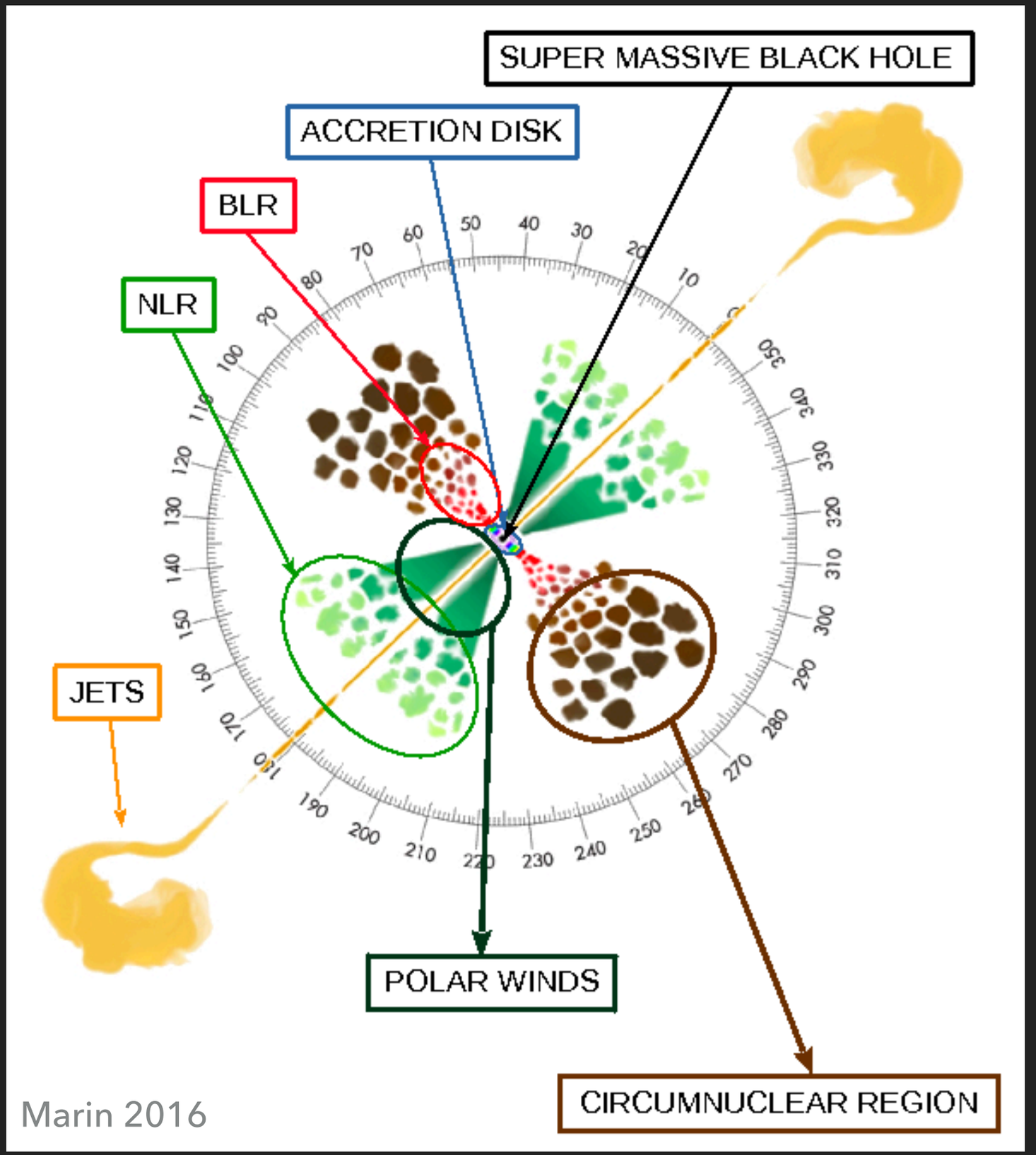
Mrk 590



Denney et al. 2014

WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

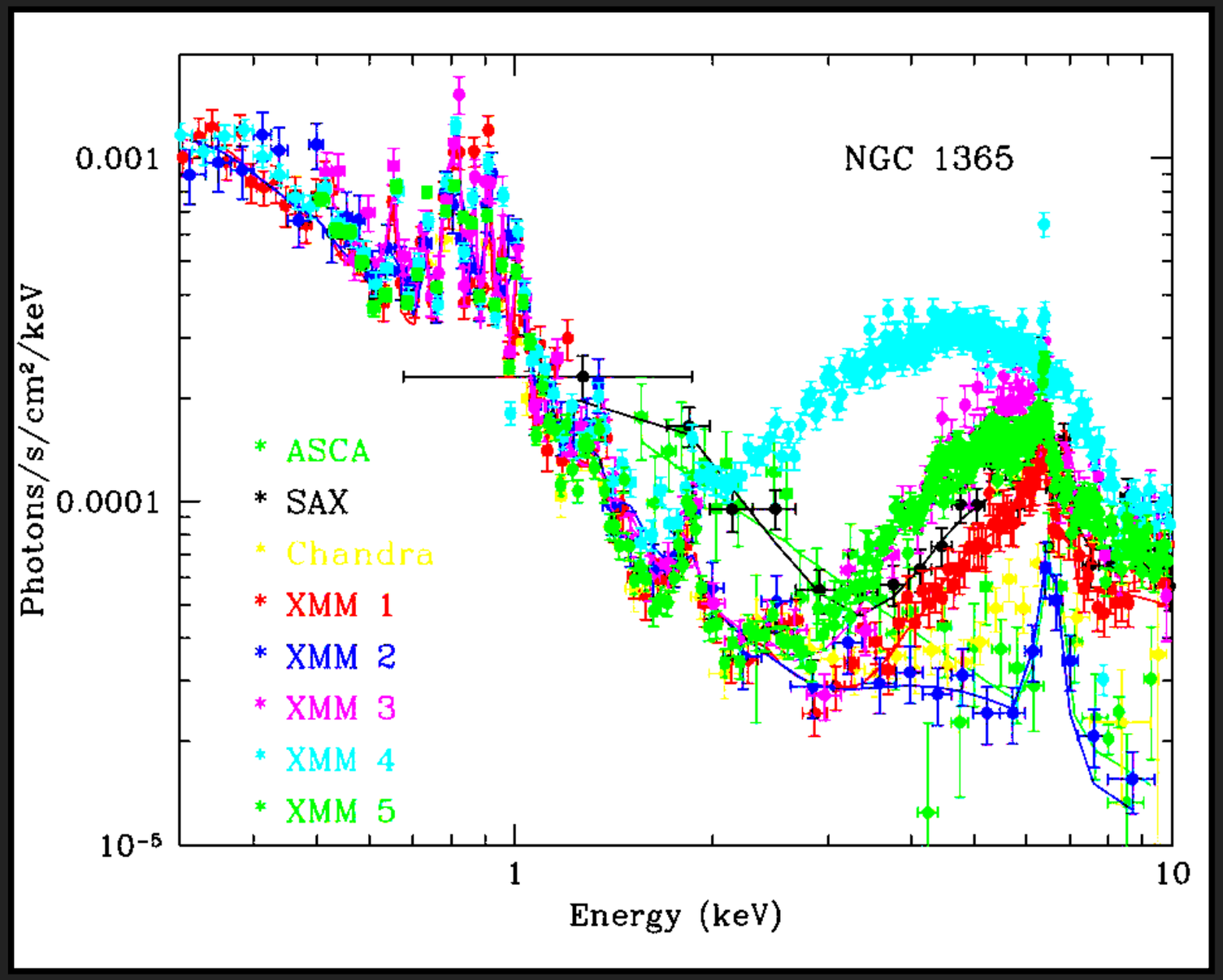
CHANGING-LOOK AGN WITH COLIBRÍ

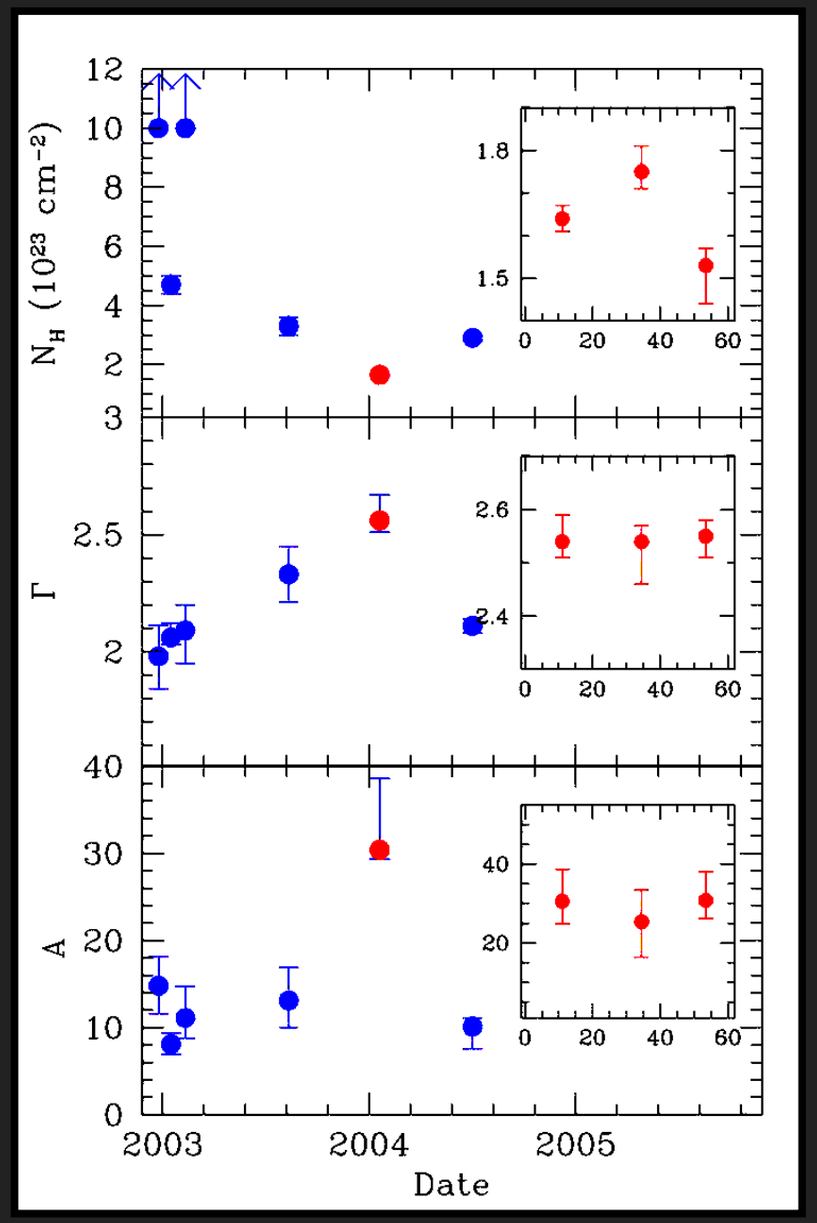


WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

DUST/COLD EXTINCTION

NGC 1365 Risaliti + 2007



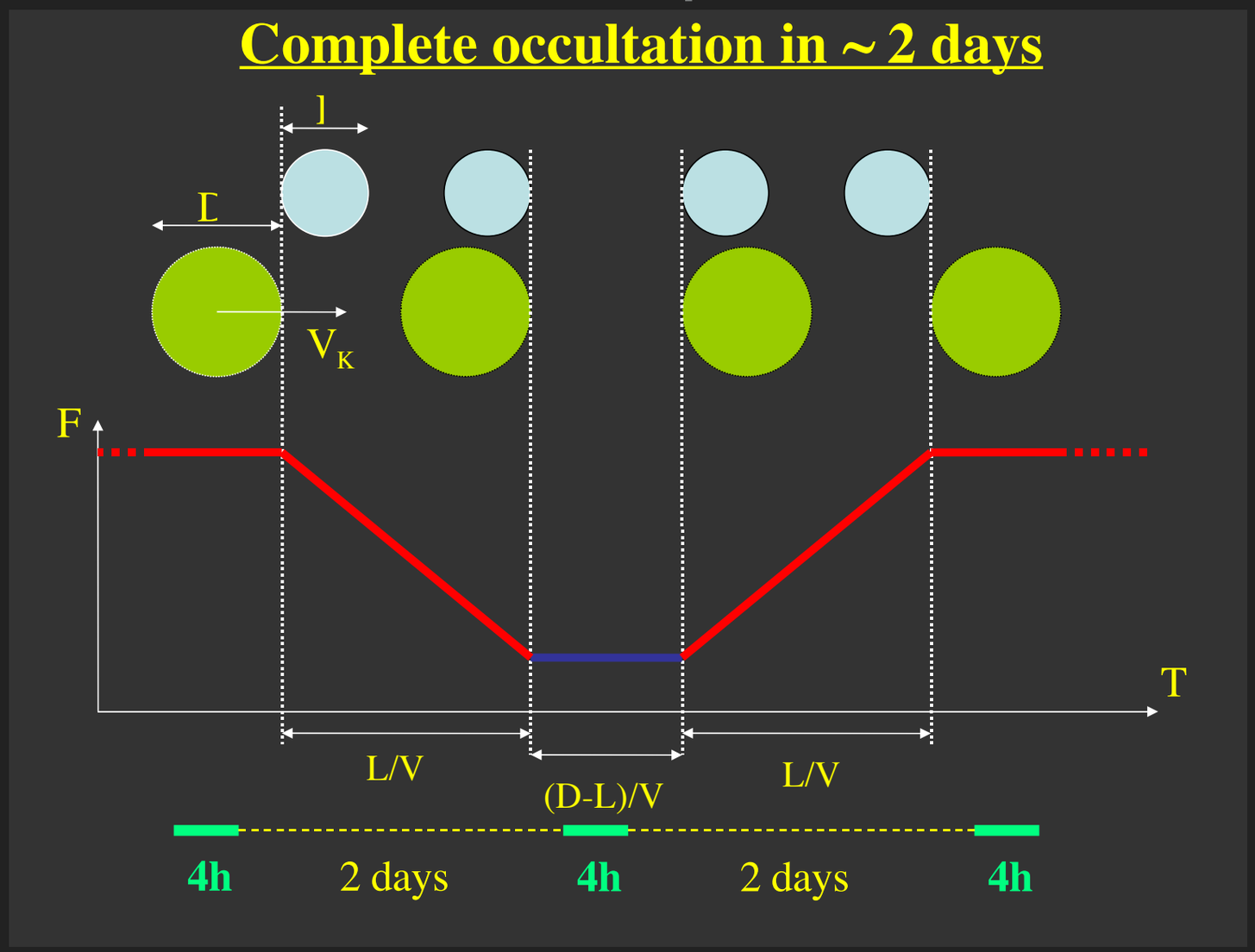


WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

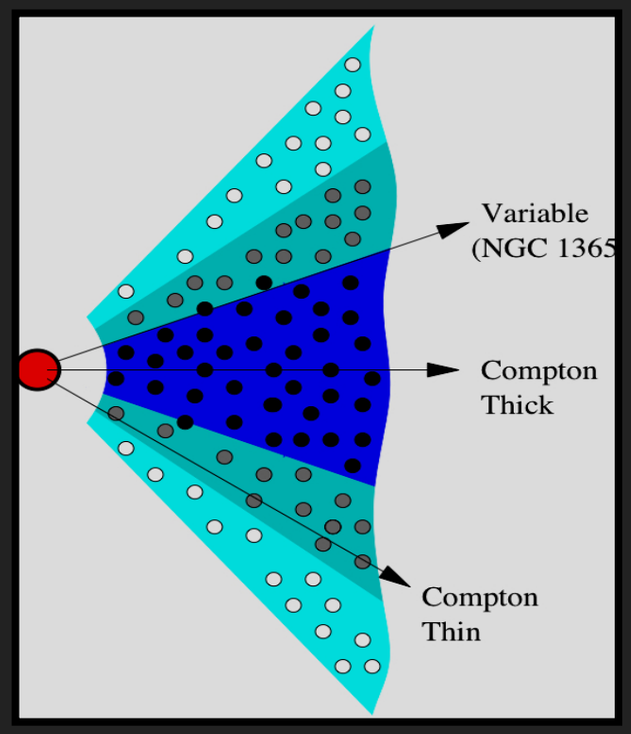
DUST/COLD EXTINCTION

NGC 1365 Risaliti + 2005

Variable cold absorption



- V=10,000 km/s
- Size 4×10^{13} cm
  --> Earth-sun distance
- At 10 rg



WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

DUST/COLD EXTINCTION

NGC 1365, Mrk 1018, Mrk 993, NGC 7603, NGC 1097, NGC 7582 (?)

WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

DUST/COLD EXTINCTION

- **Not in all cases we detect change in the absorption signatures in X-ray spectrum**

J0159+0033

- Similar drop in optical & X-ray fluxes

$(\lambda L_{5100,bright}/\lambda L_{5100,dim}) = 5.5$

$(F_{2\text{-}10keV,bright}/F_{2\text{-}10keV,dim}) = 7.2$

- tcross for cloud to eclipse also the BLR

$$t_{\rm cross} = 0.07 \left[\frac{r_{\rm orb}}{1{\rm lt}-{\rm day}}\right]^{3/2} M_8^{-1/2} \arcsin\left[\frac{r_{\rm src}}{r_{\rm orb}}\right] \ {\rm yr},$$

- t cross > 10-20 yr
- t change ~3 yr

This scenario explains only the classical X-ray changing-look

WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

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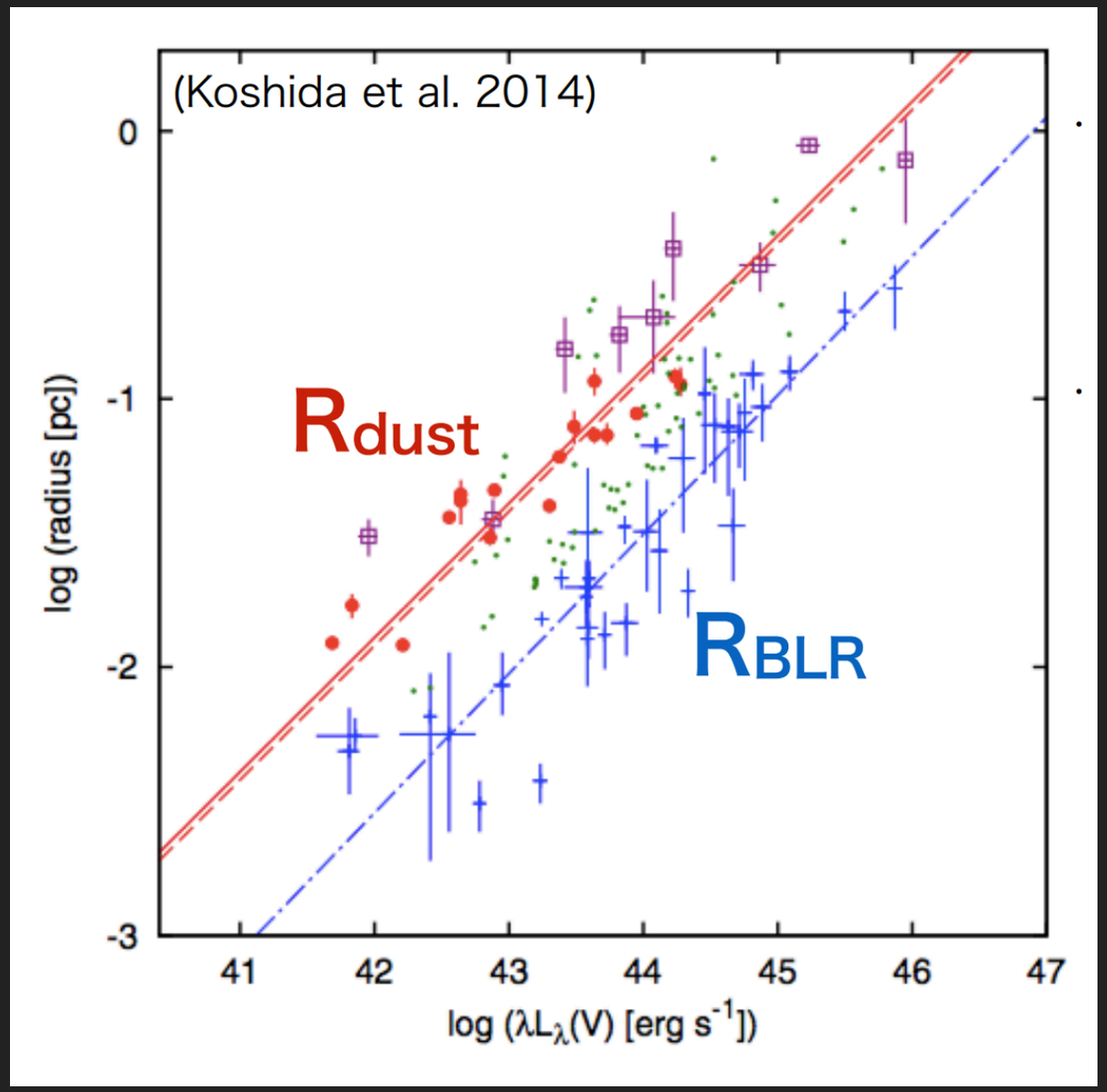
IONIZING CONTINUUM

Mrk 590, NGC 2617, Mrk 883, NGC 3065, J0159+0033 (?)

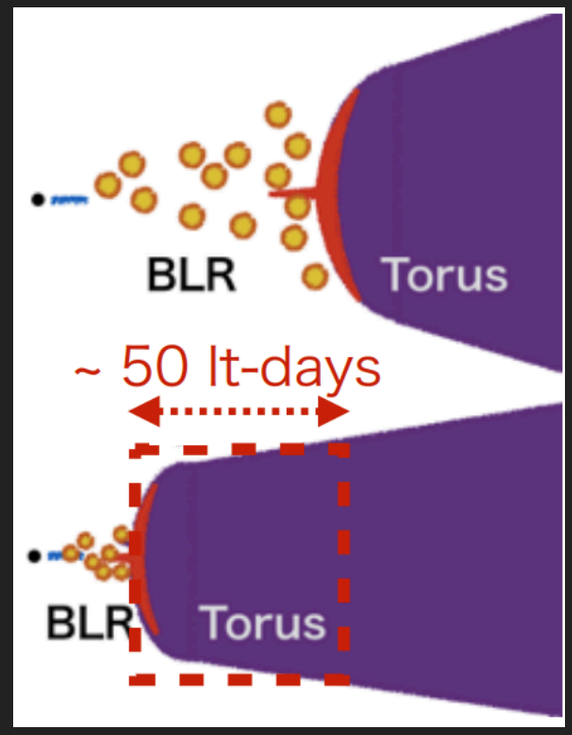
WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

IONIZING CONTINUUM

- Dramatic changes in the ionizing continuum can generate changes in the structure of the BLR/torus



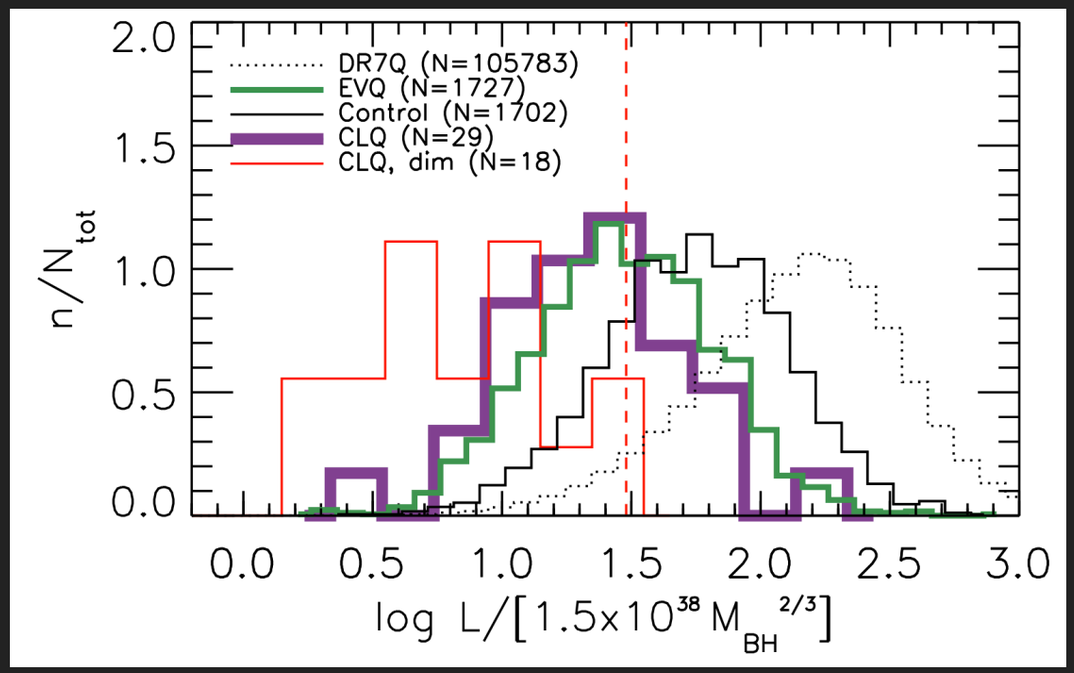
- The sublimation limit for dust is R_{dust}
- $R_{dust} \propto L_{opt}^{0.5}$
- $R_{BLR} \propto L_{opt}^{0.5}$
- $R_{dust} \sim 4\ R_{BLR}$



WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

IONIZING CONTINUUM

- The CLQs are found near the critical luminosity below which the BLR disappears
- Connection between duration of the changing phase and the theoretical events in the accretion disc are fundamental.



This scenario is the most promising but the physics are not well understood.

WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

DUST/COLD EXTINCTION

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IONIZING CONTINUUM

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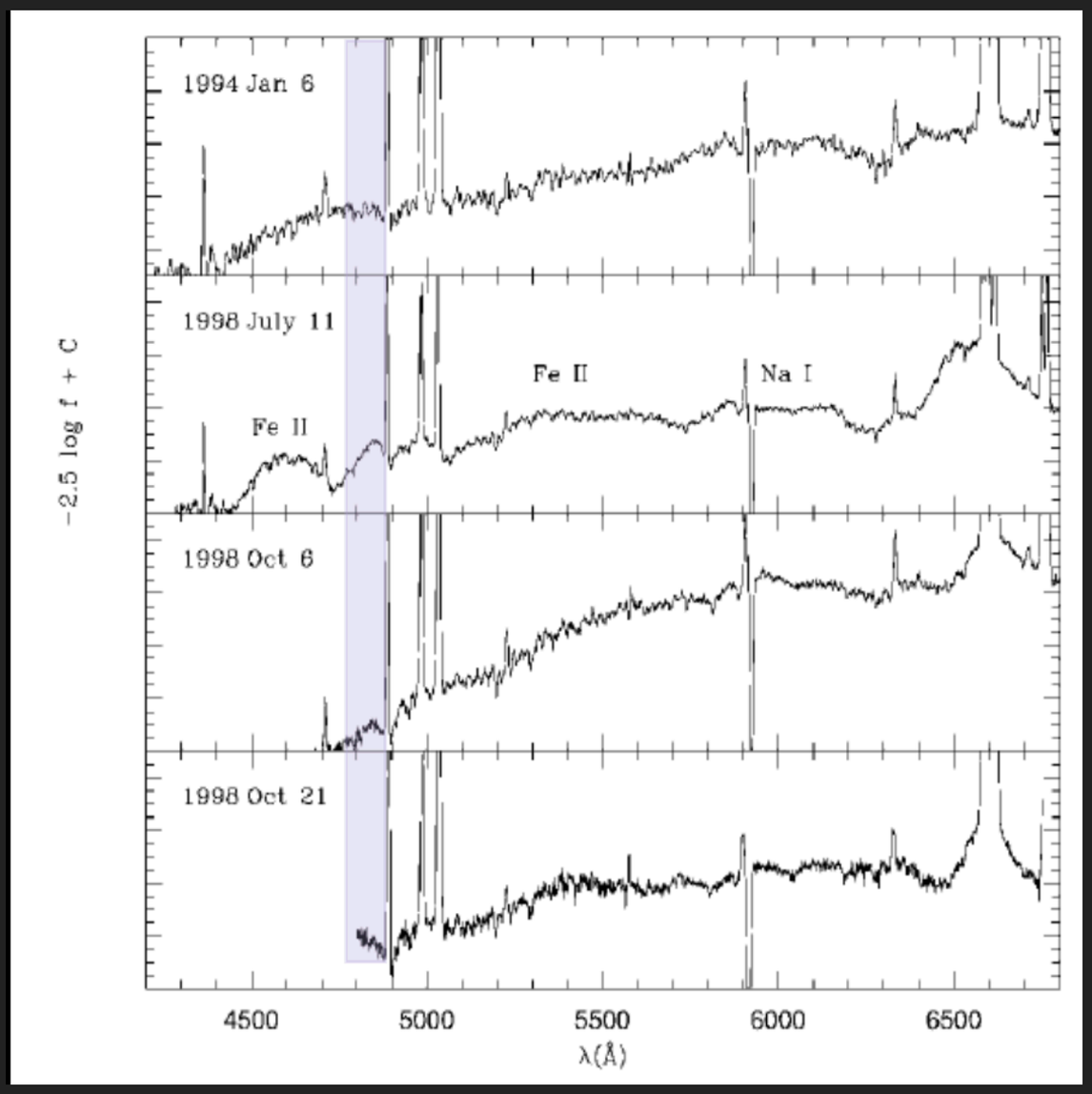
SUPERNOVAE

NGC 7582 (?)

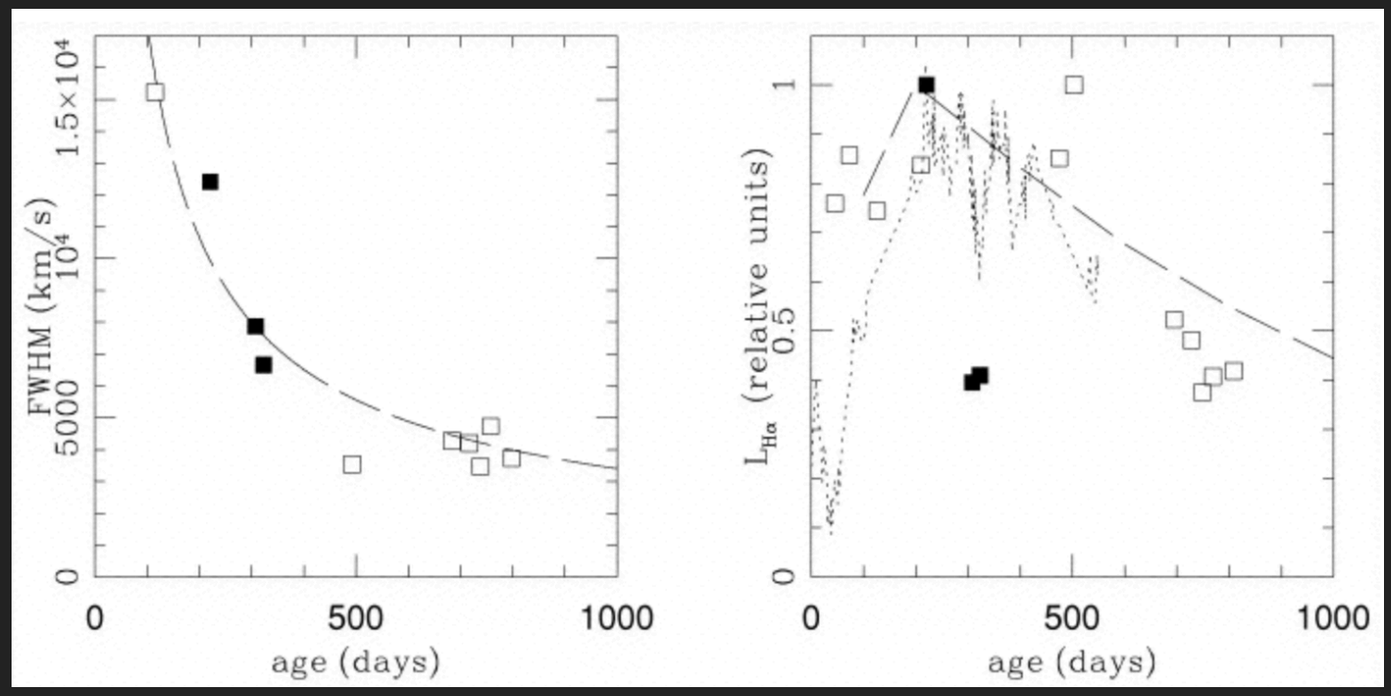
WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

SUPERNOVAE

NGC 7582



"There is little doubt that if a SN II explodes in the center of a normal galaxy, the nucleus would be classified as a Seyfert 1, while the prominent broad lines remain visible."



Aretxaga +99

This scenario explains the changing look with a broad lines disappearing fast

WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

DUST/COLD EXTINCTION

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IONIZING CONTINUUM

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SUPERNOVAE

This scenario explains the changing look with a breadlines disappearing fast

TDE

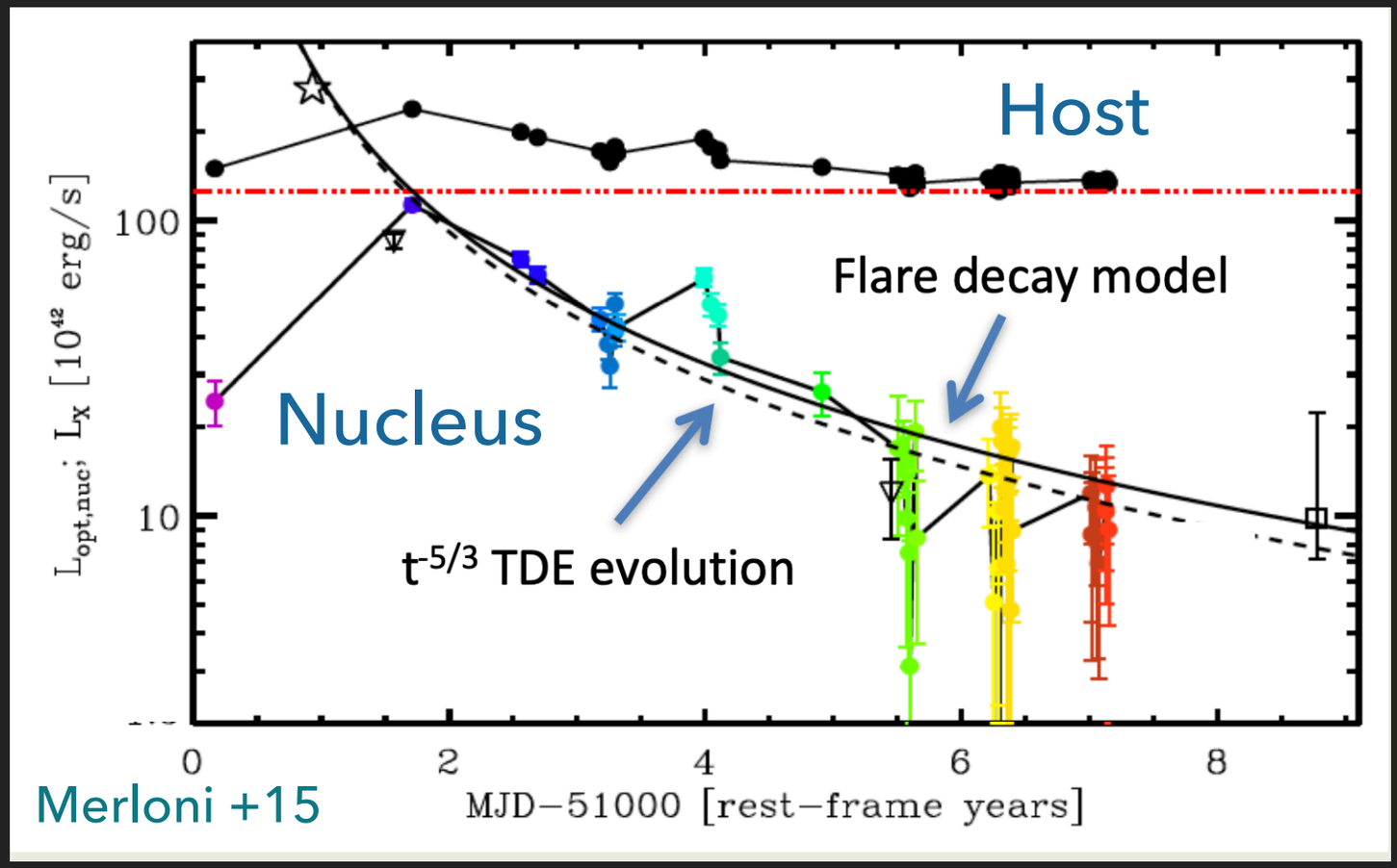
NGC 3065 (?), NGC 7582 (?), J0159+0033 (?)

WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

TDE

SDSS J0159+0033

The ‘changing look’ AGN could also be a luminous flare produced by the tidal disruption of a supersolar mass star passing just a few gravitational radii outside the event horizon of a ~10^8 M nuclear black hole.



However, in general, flares in CL AGN live longer than TDEs

WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

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EVOLUTION

(?)

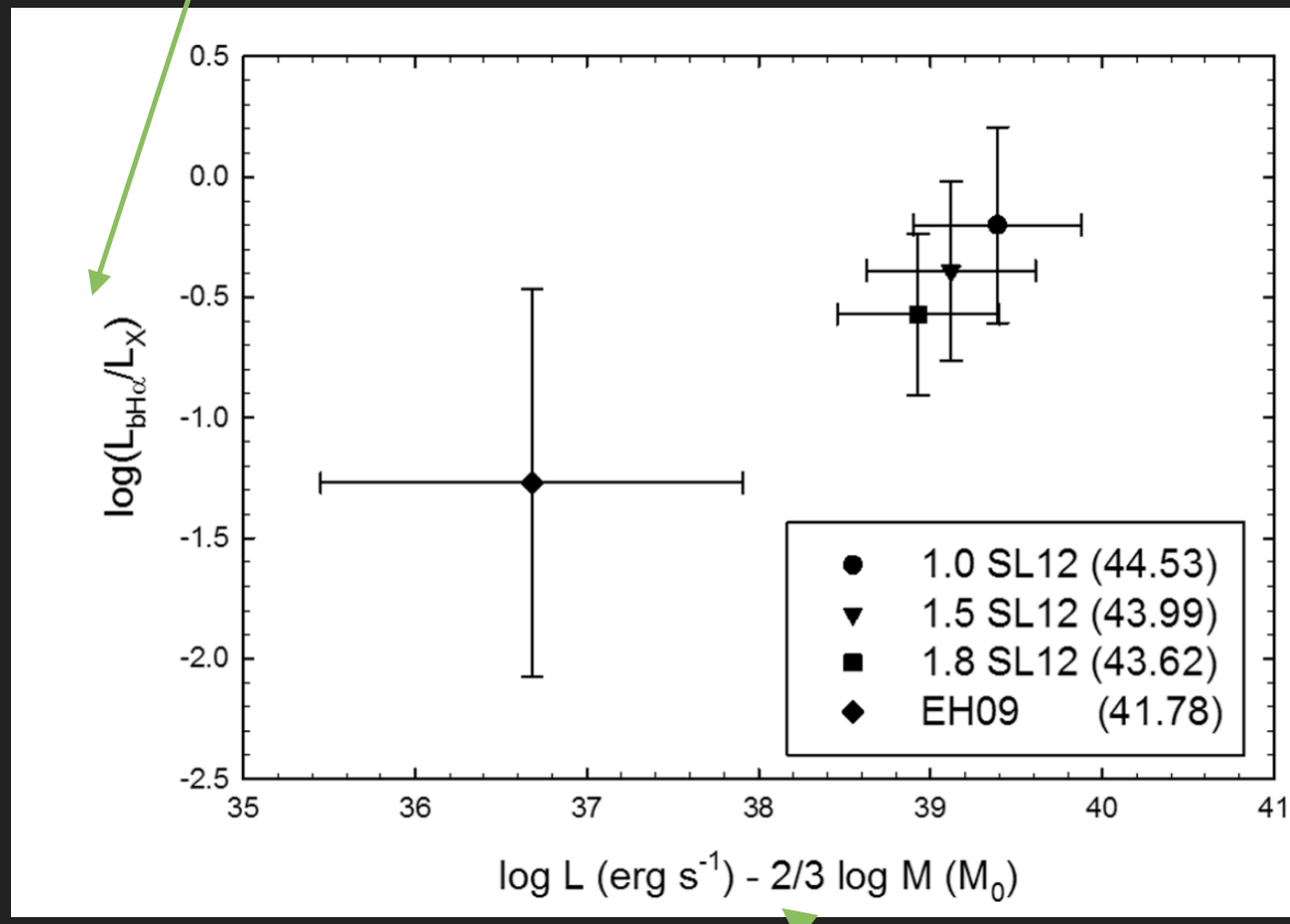
WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

EVOLUTION

SDSS J0159+0033

- Evolutionary sequence:
  Type 1 –> Type 1.2/1.5 –> Type 1.8/1.9 –> Type 2 (**true type**)
- Accretion correlates with $L_{bol}/M^{2/3}$
- AGN type follows the decrement on accretion rate of the AGN
- Disk wind model: low L_{bol}, so low accretion rate, as mass accretion decreases, the mass outflow can not be sustained and destroys the BLR and the torus

Type



Elitzur +14

accretion

This scenario explains only the true type Seyfert 2 and the changing look in one direction

WHAT CAUSES THE CHANGE IN LOOK OF AN AGN?

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EVOLUTION

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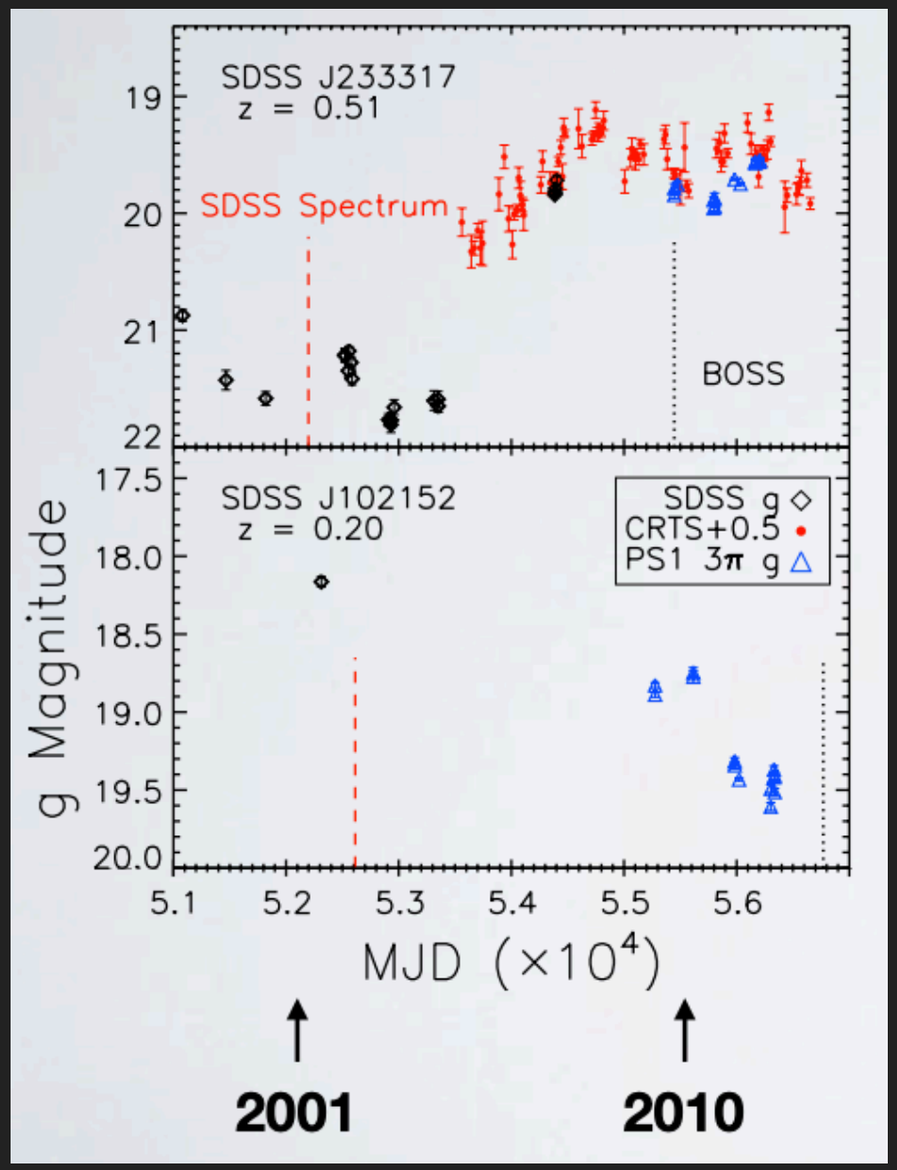
CHANGING-LOOK AGN WITH COLIBRÍ?

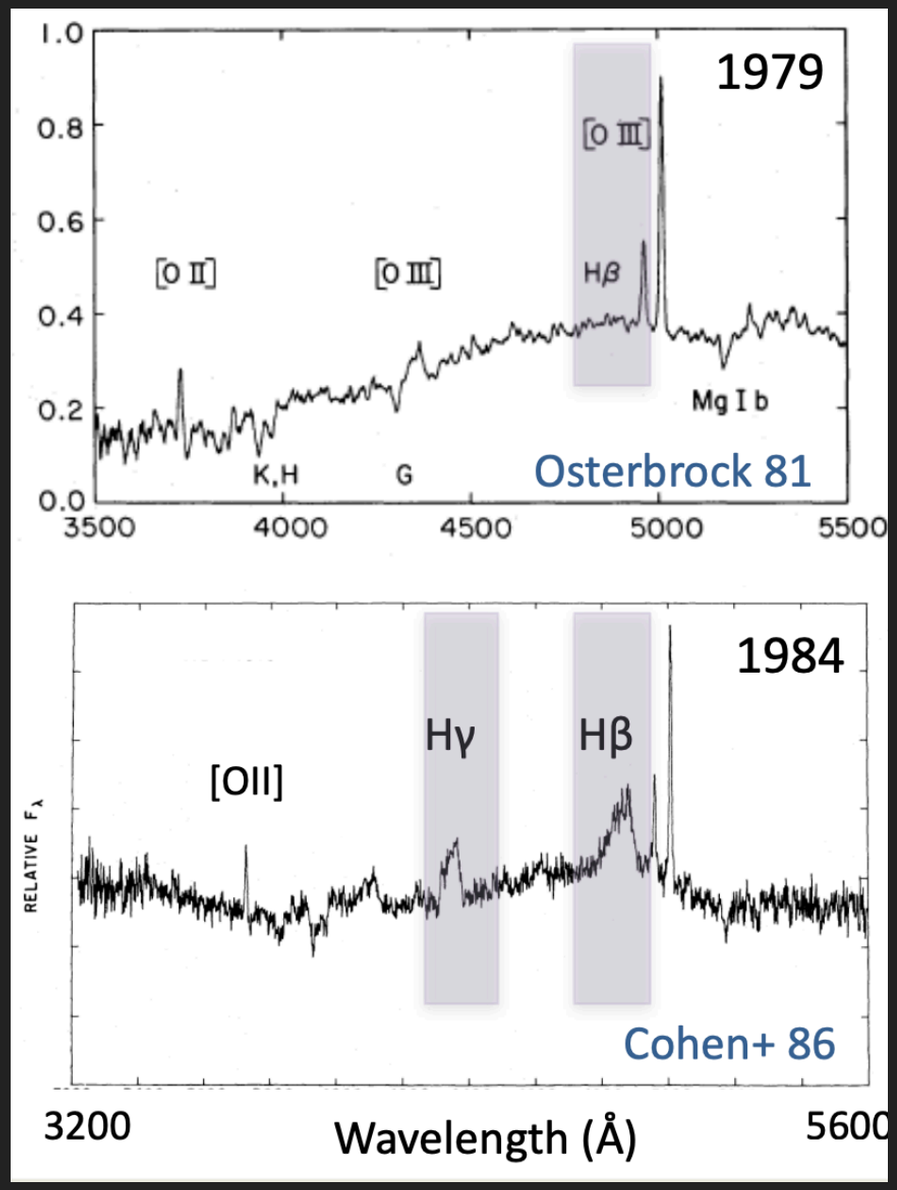
- Changing-look AGN are rare: only a few tens including Changing-look bonfide, changing Seyfert types and changing-look QSO.
- Mainly serendipitously discovered.
- In timescales evolved years up to few decades but trended by historical monitoring data.
- Several systematic studies are starting: 102 AGN only 3 changing-look and 39 changing-type. (Ruan+2012)

CHANGING-LOOK AGN WITH COLIBRÍ?



- Photometric studies to discover CLAGN: The CLQ fraction increases from 10% to ~50% as the 3420Å continuum flux ratio increases from 1.5 to 6.
- The majority are caught in a low state
- Photometry is useful to follow up and detect CL AGN
- X-ray coverage allows to determine the real nature of the source
- Second generation spectrograph is fundamental to study the CLAGN.

CHANGING-LOOK AGN WITH COLIBRÍ?



Mrk 1018: A pilot programme

- Mrk1018 is a well known CLAGN
- A variability campaign to monitor Mrk 1018 with Swift was launch from September to November 2018.

- We performed simultaneous observation with RATIR in optical and nIR
- We are analyzing the data but the preliminary results do not see dramatic variability in X-rays.
- Design the observational method using Colibrí and SVOM

SUMMARY OF THE TALK

- Changing-look AGN are rare and mainly serendipitously discovered.
- Timescales for variability: years up to few decades but trended by historical monitoring data.
- Several scenarios are proposed. The most probable explanation would be related to a change in mass accretion.
- Photometric studies monitoring dramatic changes in flux have been probed to be useful to detect CLAGN. Colibrí will do a good job.
- X-ray coverage allows to determine the real nature of the source. SVOM is a great ally.
- Second generation spectrograph is fundamental to systematically study the CLAGN.