HI and the triggering of AGN: the intriguing case of PKS B1718-649

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HI in Radio AGN

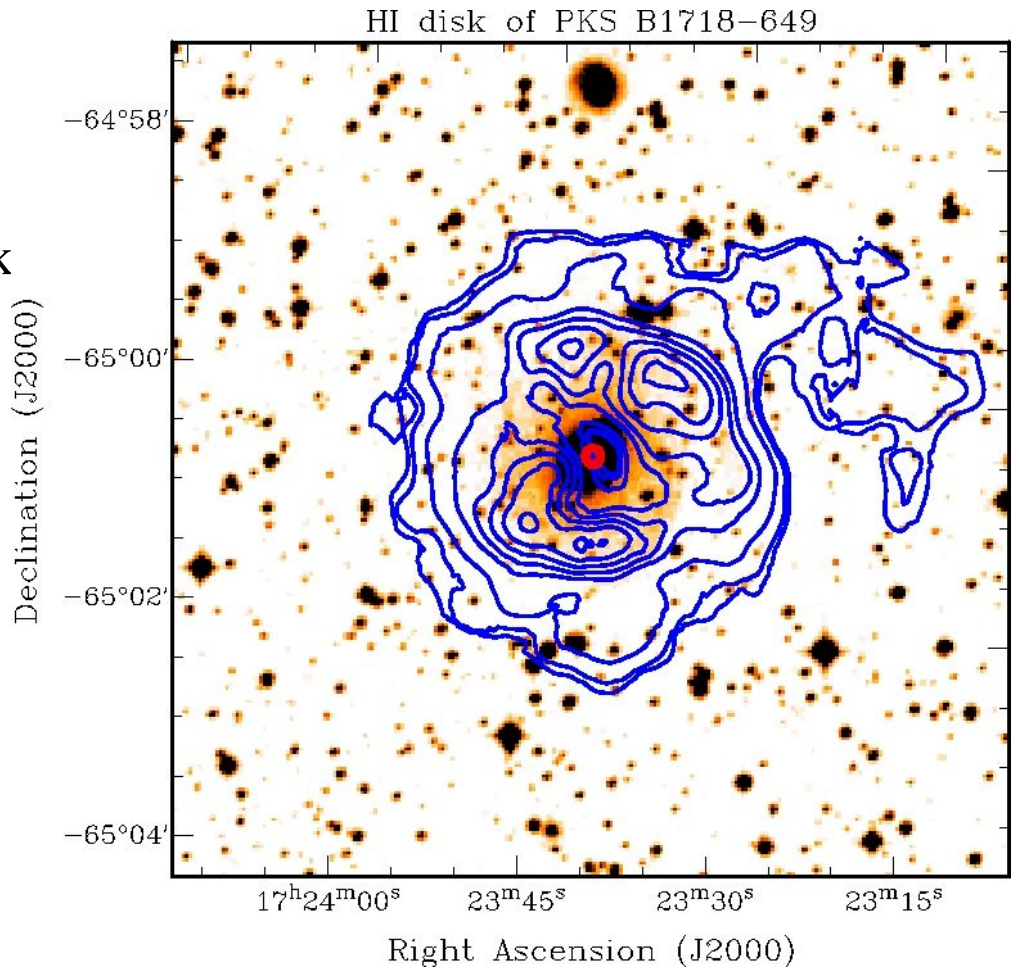
- ETGs are the typical host of radio loud AGN.
- ATLAS^{3D}: in ETGs, when detected, the HI is mostly distributed in a settled configuration.
- Many HI disks may have formed from past merger or interaction events, which are also often invoked to trigger the nuclear activity.
- Problem:
  - There are young radio sources hosted by an ETG with a settled HI disk. (for example B2 0258+35, B2 0648+27)
  - The time for the HI to settle in a disk (time since the last interaction) is much larger than the lifetime of the radio activity.
  - HOW ARE THESE AGN TRIGGERED?
- Young radio sources are often more gas rich.
  - Is the neutral hydrogen important in the first phases of the radio activity?
- The detailed study of the HI kinematics of young radio galaxies, hosted by ETGs, may give insights into their triggering.

PKSB1718-649: a compact-young radio source

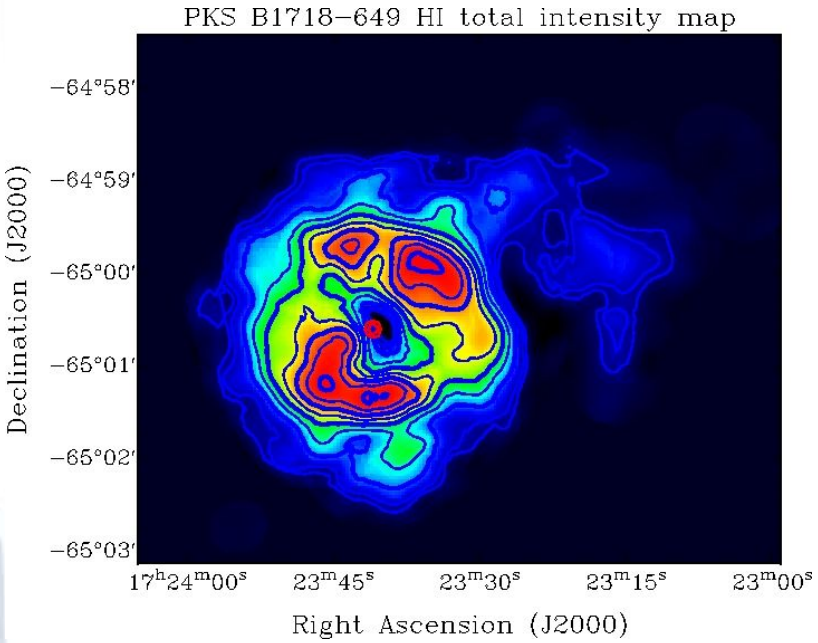
- VLBI observations (Tingay et al. 1997);
  - Young source: ~ $10^{2\text{-}5}$ years
  - Closest compact source: z=0.0144

- 1995, Veron-Cetty: identified an HI disk
  - HI detected in absorption
- 2013: new ATCA observation 36 h
  + 24h (1995 VC observations)

- **study the overall kinematics of the HI disk**
  - **date the last interaction event and compare it to the age of the radio source.**
- **understand the nature of the absorption features**
  - **can the HI be linked to the nuclear activity?**

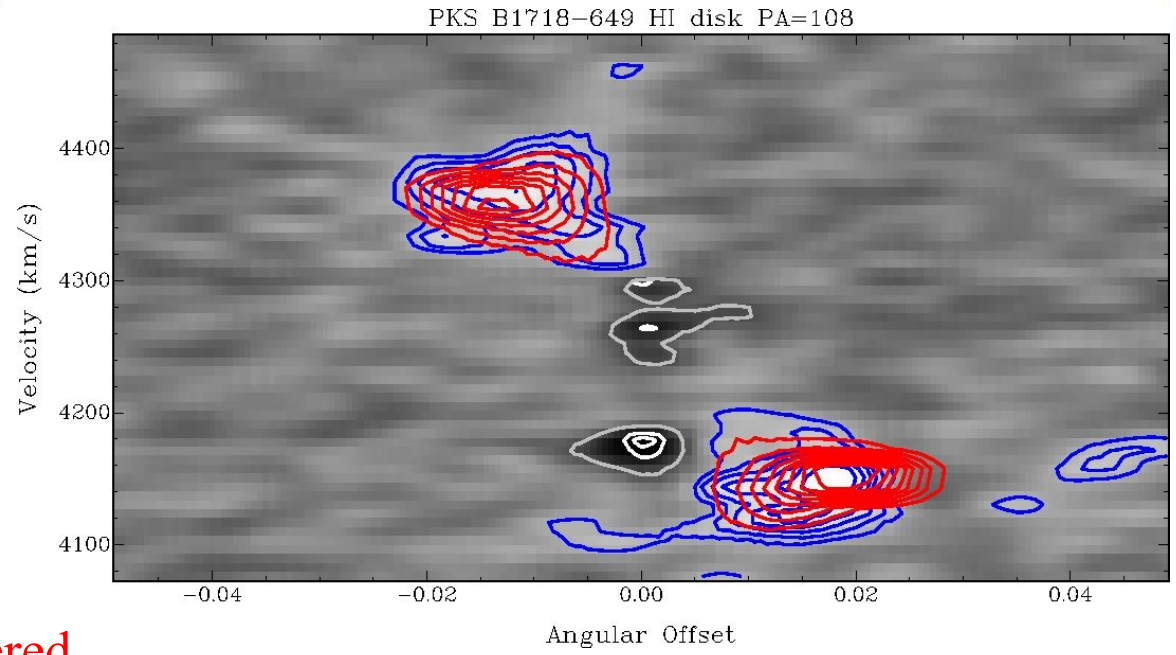


HI disk model



- HI in a circular disk with a central depression.
- HI mass = 1.1 x 10^{10} M_{sun}
- The external regions have asymmetries.

- The radius where the disk is not regularly rotating dates the last merger/accretion event:



=> 'tilted ring model':

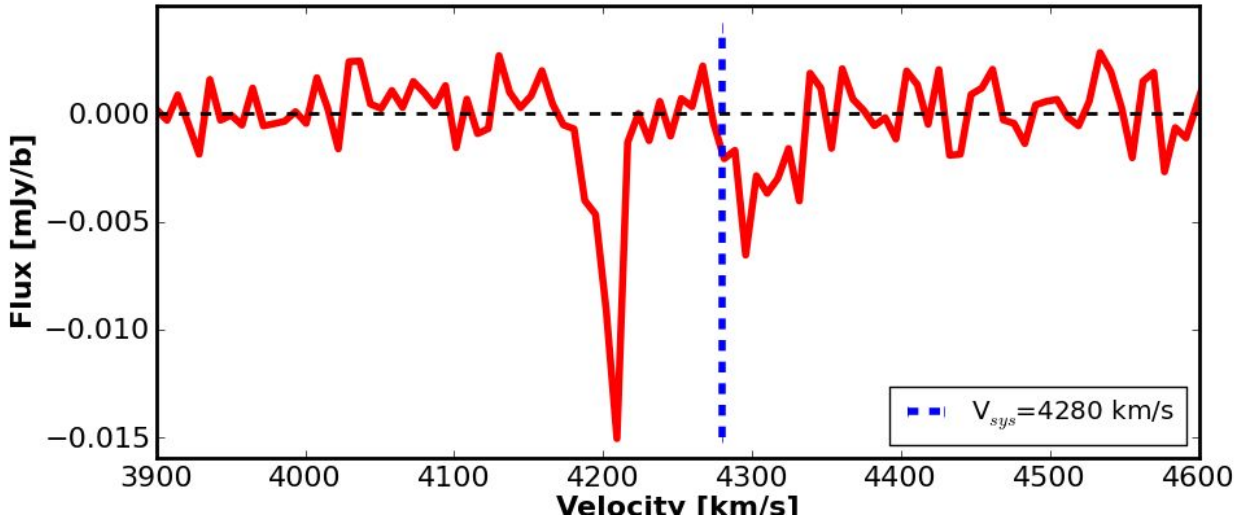
- we model a regularly rotating disk
- we identify where the observed disk diverges from the model.

$$R \sim 17\mathrm{kpc}(1') \rightarrow t_{\mathrm{dyn}} \sim 8 \cdot 10^{8}\mathrm{yr}$$

$$t_{\mathrm{dyn}} >> t_{\mathrm{radio}}(10^{2-5}\mathrm{yr})$$

The radio source has not been triggered by a merger or an accretion event

HI absorption spectrum



HI regularly rotating: seen in absorption at the systemic velocity.

BUT

Narrow absorption line: blueshifted

Broad absorption line: redshifted

• The absorption traces gas not regularly rotating.

- Clouds with radial motions within the disk may fall towards the inner regions of a galaxy
- Accretion from small clouds may trigger a low-Eddington efficiency AGN.
  - Radio, X-ray and Optical properties suggest PKS B1718-649 is such AGN

Line	Narrow	Broad
$F_{\rm peak}$(mJy beam^{-1})	-14.9	-7.1
$F_{\rm abs}$ (mJy beam^{-1})	-35.4	-26.0
τ	0.009	0.007
$N_{\rm H\,I}$ (cm^{-2})	$7.03 \cdot 10^{19}$	$7.74 \cdot 10^{19}$
FWZI (km/s)	43	65

Mass estimate from absorption is limited to the size of a radio source. Assuming the maximum radius of HI clouds (1 kpc):

$> 1.4 \times 10^6 M_{sun}$

Summary and Conclusions

- ATCA observations of PKS B1718-649 + Model of the HI kinematics:
  - The triggering of the AGN is not related with the events that formed the HI disk.
- This is observed also in other objects: e.g. Centaurus A, B2 0258+35
  - Galaxies like PKS B1718-649 are a particular class of AGN
    - Small clouds of HI in the inner regions may interact with the nucleus, triggering a low-efficiency AGN.
  - What is the link between the HI and the properties of these AGN?
- FUTURE PROSPECTS:
  - Apertif, ASKAP, Meerkat (and SKA) will reveal large samples of galaxies where the HI can be observed in detail:
    - Is it common for ETGs with HI disks to trigger in some time of their life a low-efficiency radio activity?
    - What physical parameter defines the role of the HI in the nuclear activity?