

# Interferometric Dreams of an Extragalactic Astronomer

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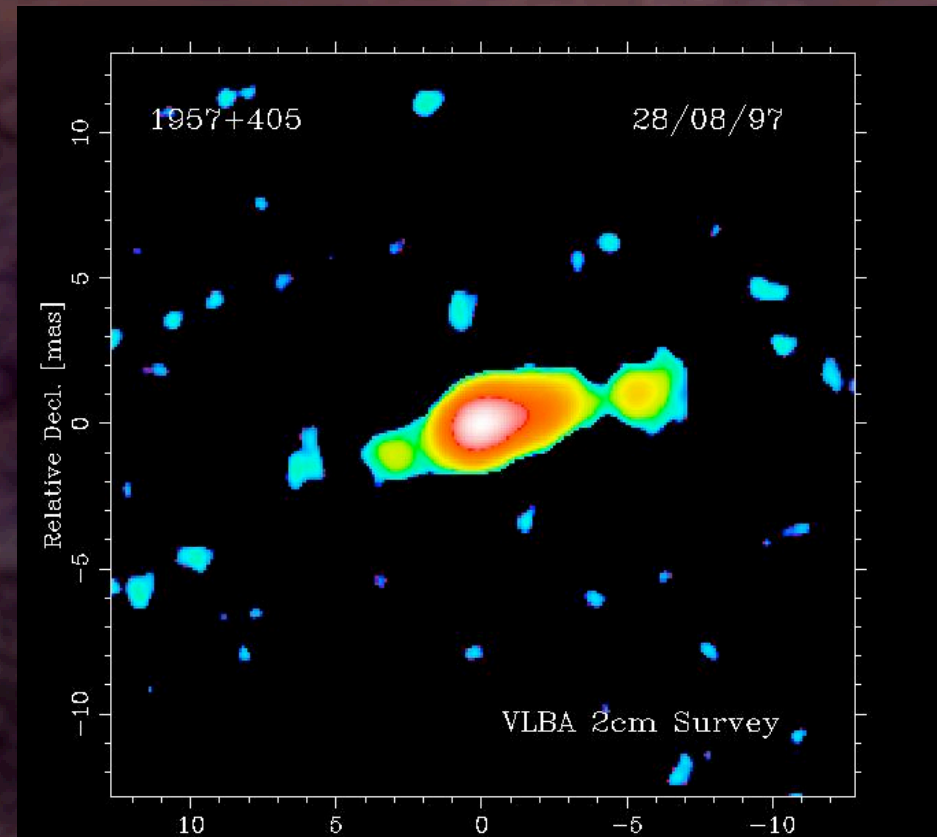
Max-Planck-Institut für Astronomie, Heidelberg

# Encouragement: How Dreams have Become True

Some lessons from the history of Radio Interferometry

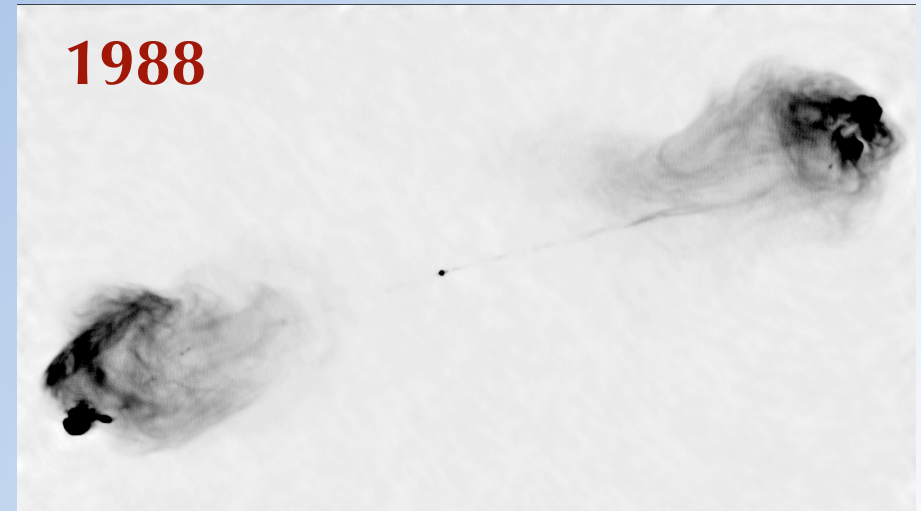
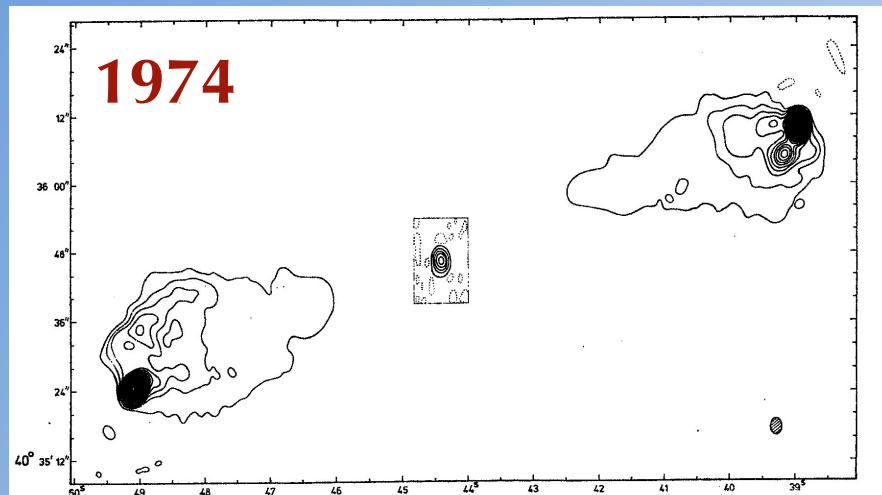
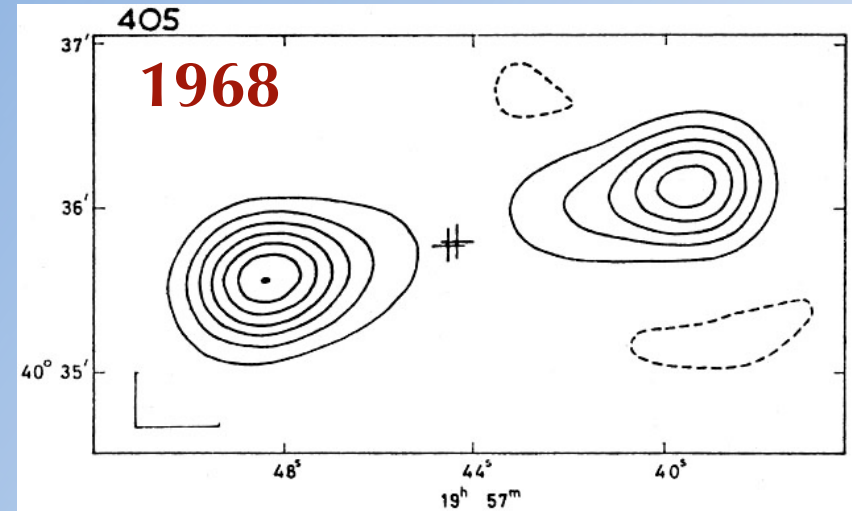
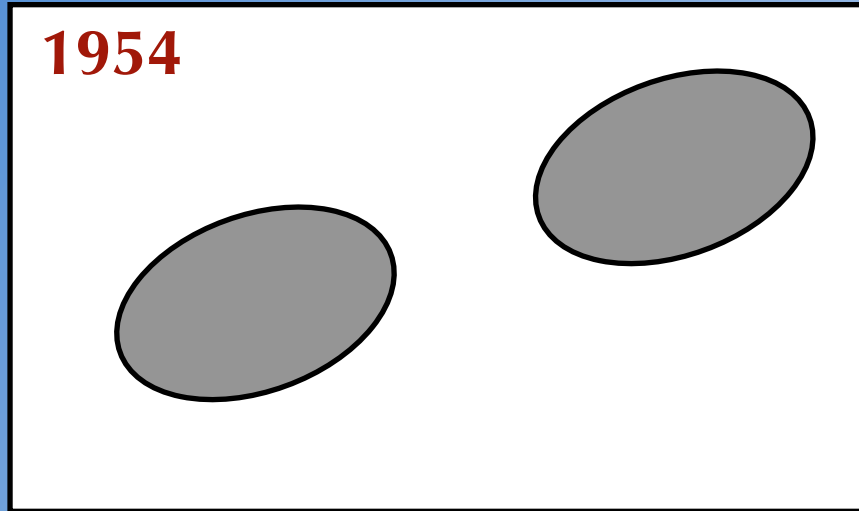
1948: Use the sea as reflector

1997: VLBA image



# The first revolution in interferometry

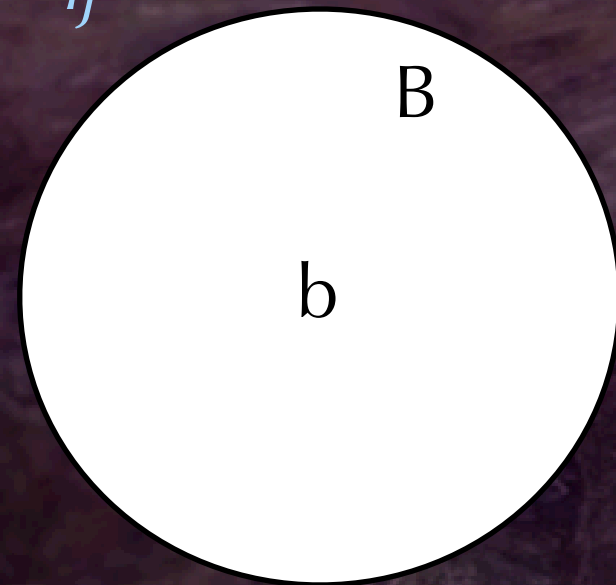
For example: Cygnus A



# Interferometry at Infrared Wavelengths (1.2 to 20 $\mu\text{m}$ )

## Example: VLTI

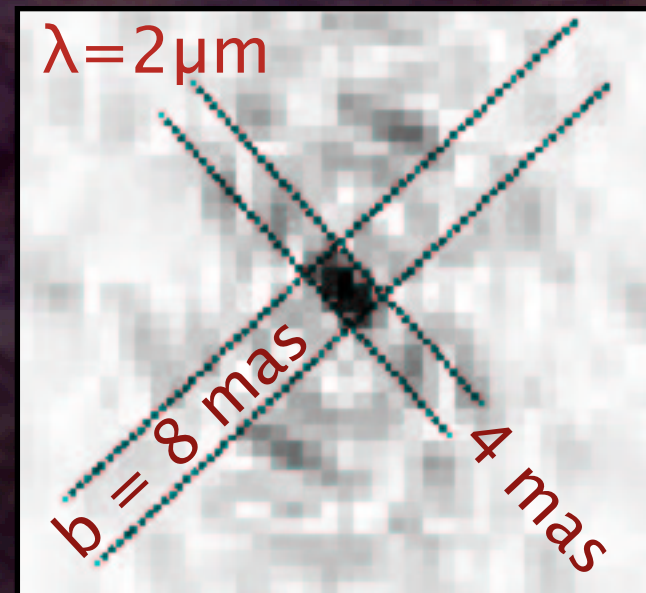
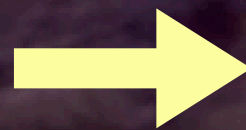
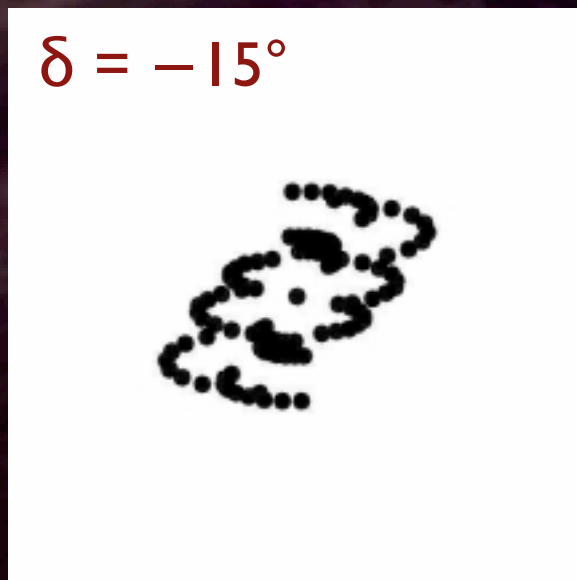
- Primary beam:  $B = 1.2 \lambda / D_{tel}$
- Interferometric beam:  $b = \lambda / d_{ij}$
- Ideal situation:



# Interferometry at Infrared Wavelengths (1.2 to 20 $\mu\text{m}$ )

## VLTI imaging:

- Phase closure ( $\geq 3$  telescopes - AMBER)
- External phase reference (Fringe tracker on PS)
- VLTI uv coverage:



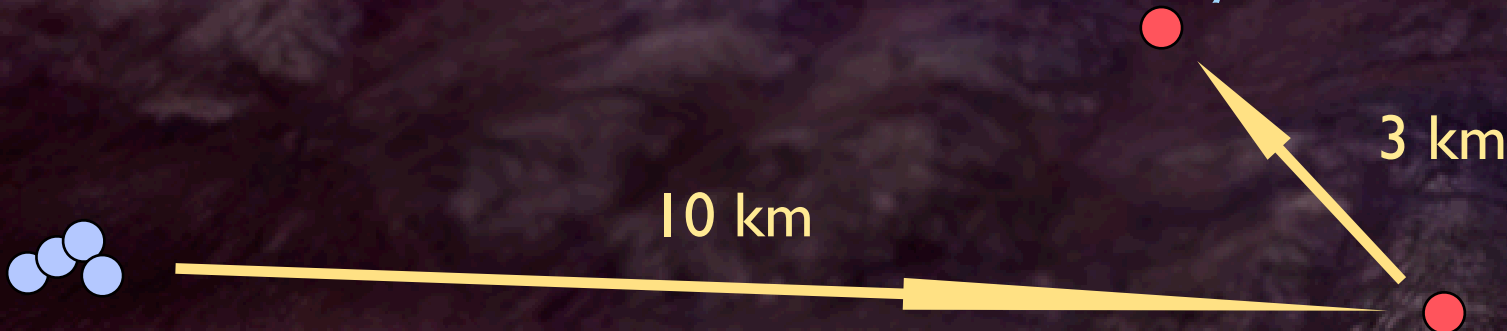
# Dreaming Realistically

(and some wilder dreams)

A. VLT1, full imaging, full AO at  $\lambda \geq 1.6 \mu\text{m}$

	B (mas)	b (mas)	auto	1h, $10\sigma$
AMBER $2\mu\text{m}$	60	4	10 mJy	0.1 mJy
MIDI $10\mu\text{m}$	300	20	400 mJy	10 mJy

B. ~~X~~VLT1, fiber-linked, heterodyne ?

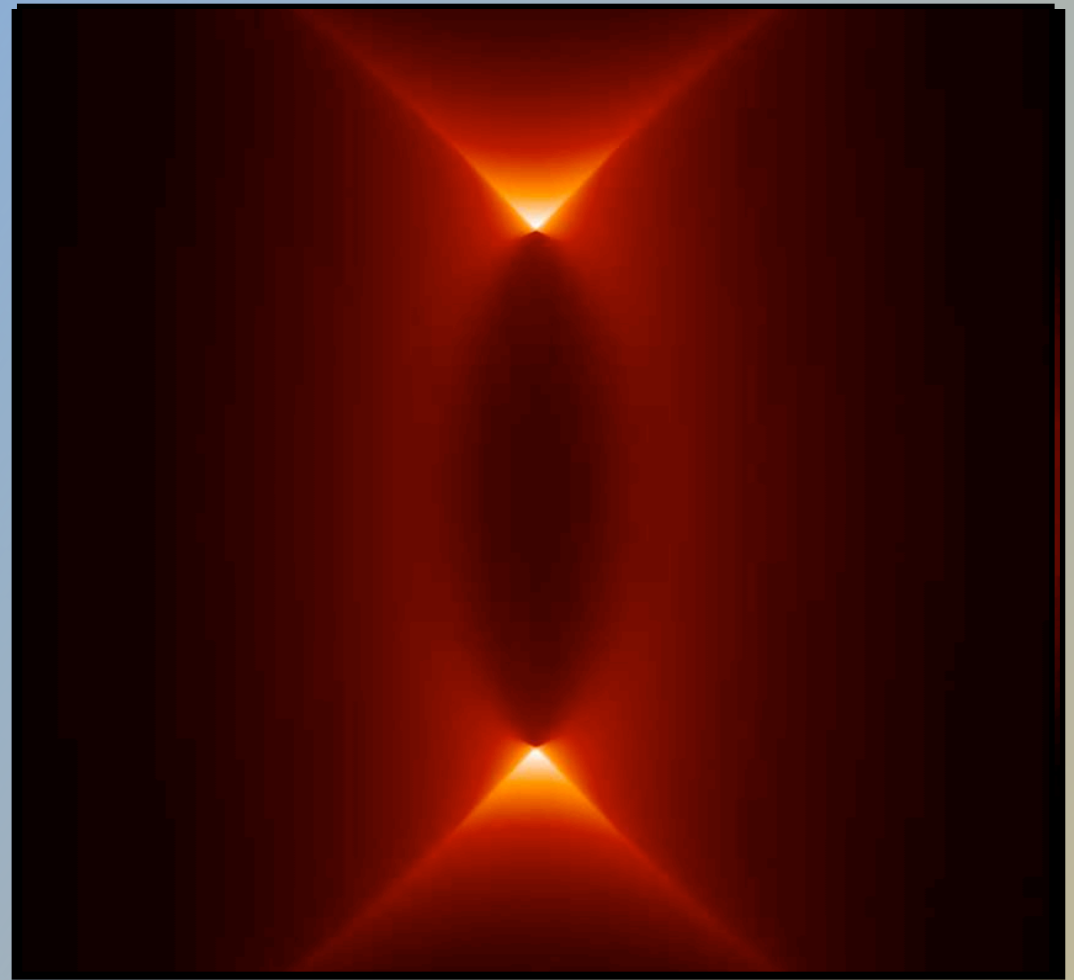


# My Current Dreams:

- **Dream I:** Detect and investigate the dusty tori in AGNs
- **Dream II:** Witness the formation of radio jets
- **Dream III:** Resolve the BLR in nearby AGNs
- **Dream IV:** Measure proper motion of nearby galaxies

# Dream 1: Dusty Tori in AGNs

What do we expect ?



10pc

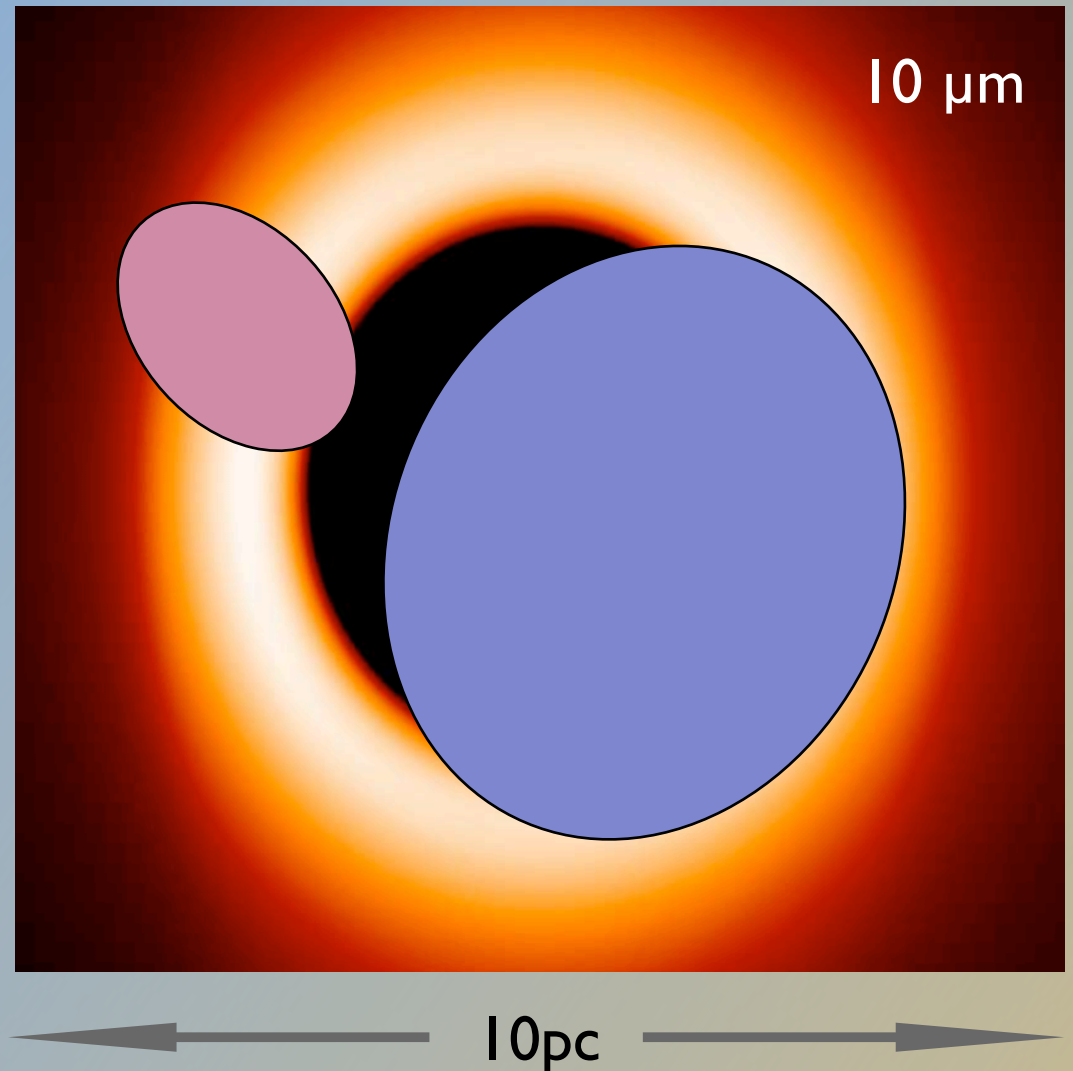


# Dream I: Dusty Tori in AGNs

What do we want to know ?

## Seyfert I galaxies:

- Size of the torus
- Inner diameter
- Temperature distribution
- Fine structure - clumps ?

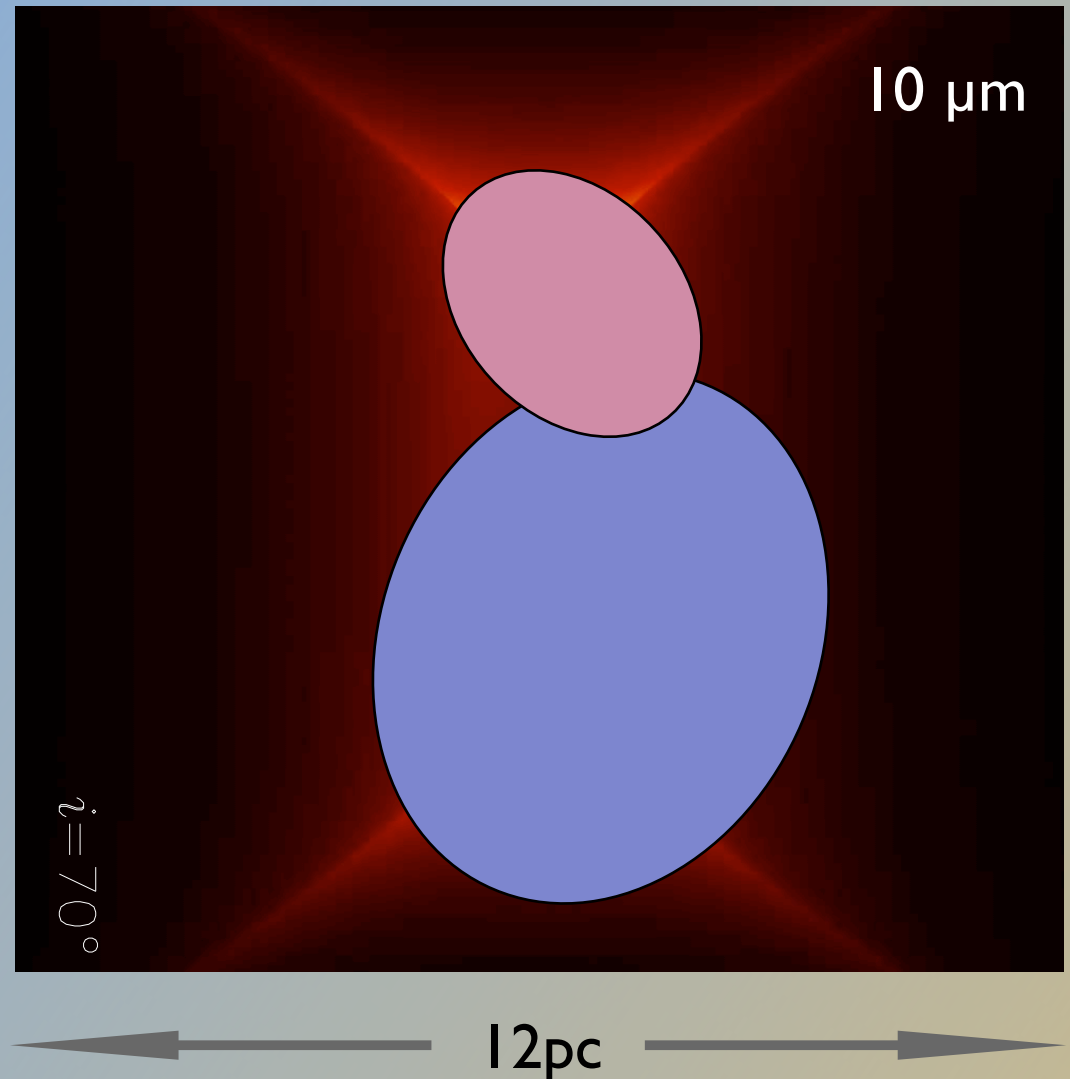


# Dream I: Dusty Tori in AGNs

What do we want to know ?

## Seyfert II galaxies:

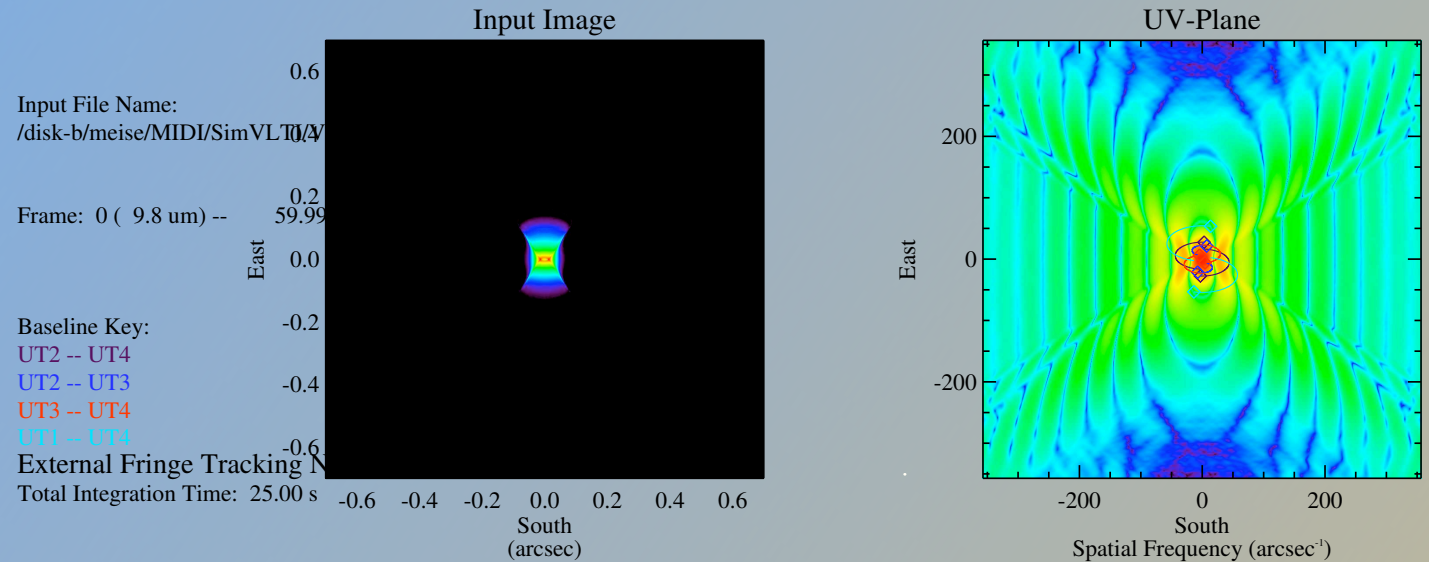
- Orientation of torus - Unification ?
- Inner diameter
- Temperature distribution
- $\tau(\lambda, r)$ : SiO/continuum



# Dusty Tori in AGNs

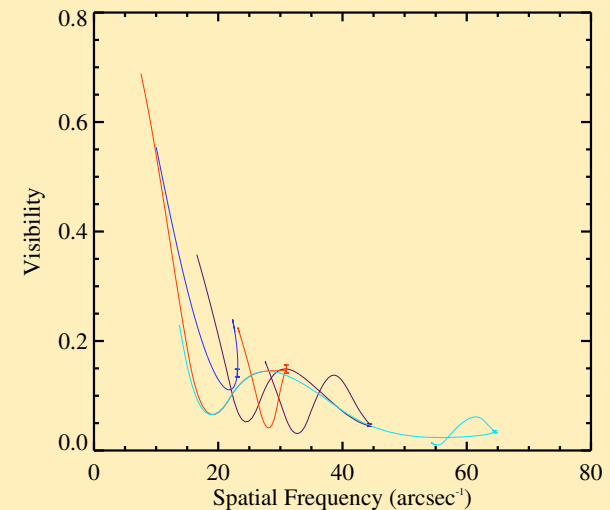
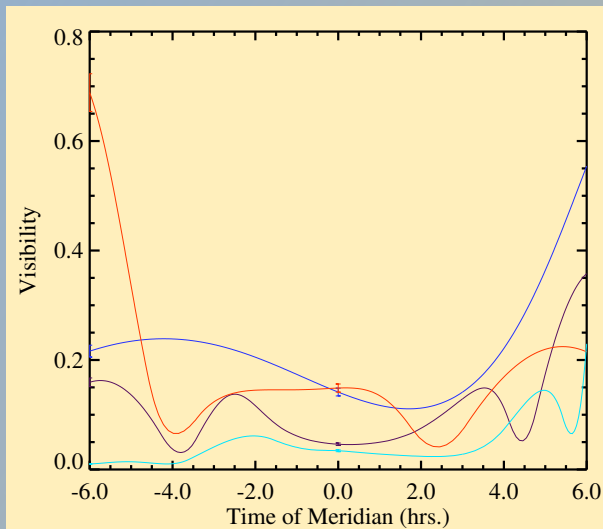
The next steps with MIDI:

2003 ... 2006



e.g. Seyfert II galaxy

- Size as function of  $\lambda$
- Orientation of torus
- Fine - structure ?



# Dream II: Witnessing the Formation of Radio Jets

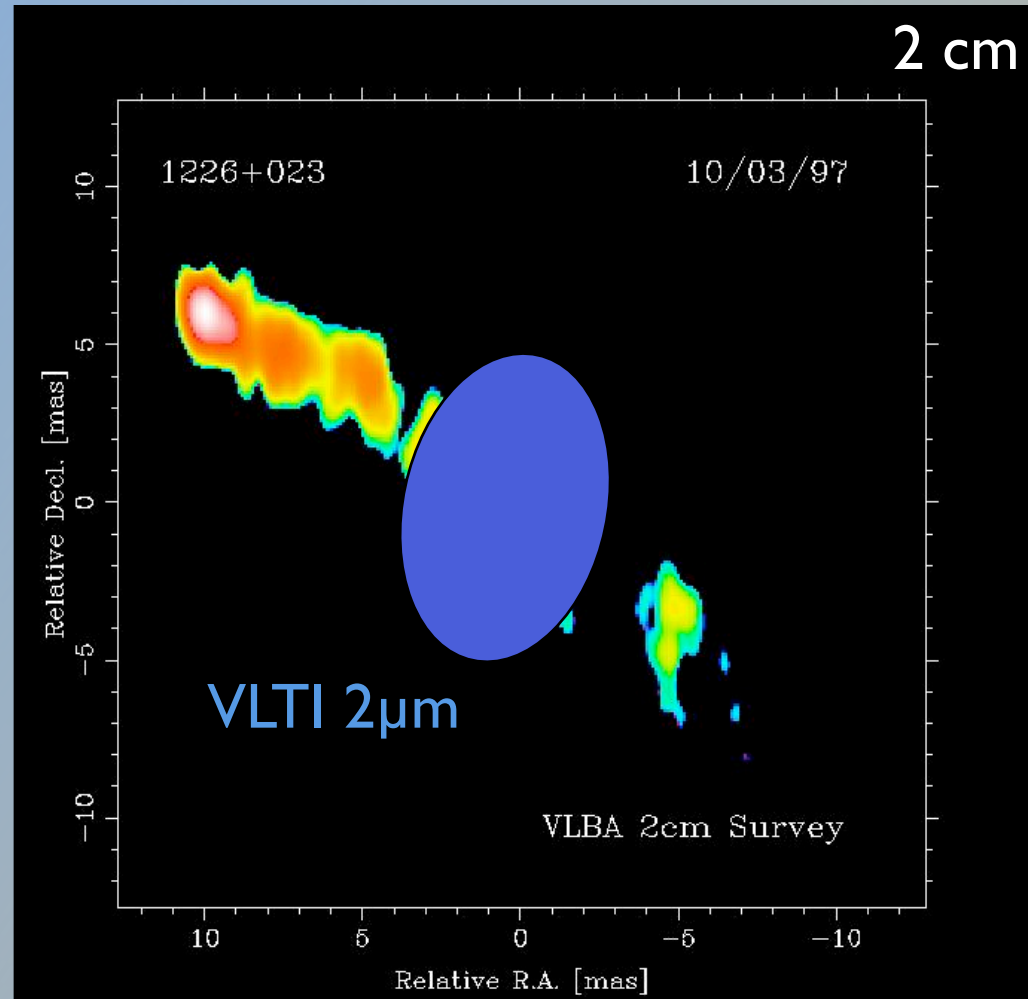
What do we expect ?

## Requirements

Resolution:  $< 10$  mas

Sensitivity:  $\sim 0.5$  mJy

Dynamic range:  
 $> 125:1$

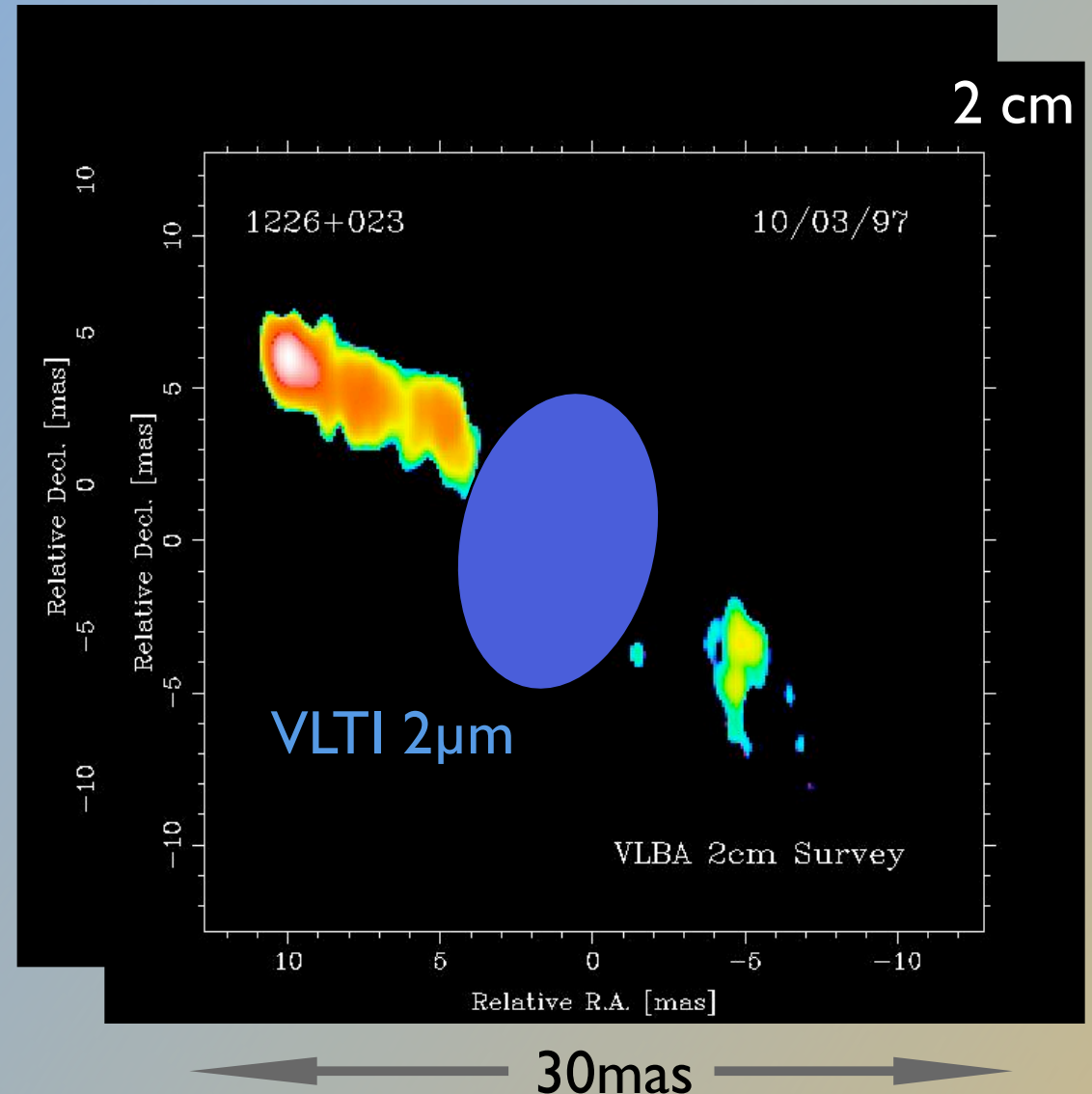


30mas

# The Formation of Radio Jets

What do we want to see?

- Detect a VLBI knot !
- Determine spectrum
- Proper motion
- Spectral evolution

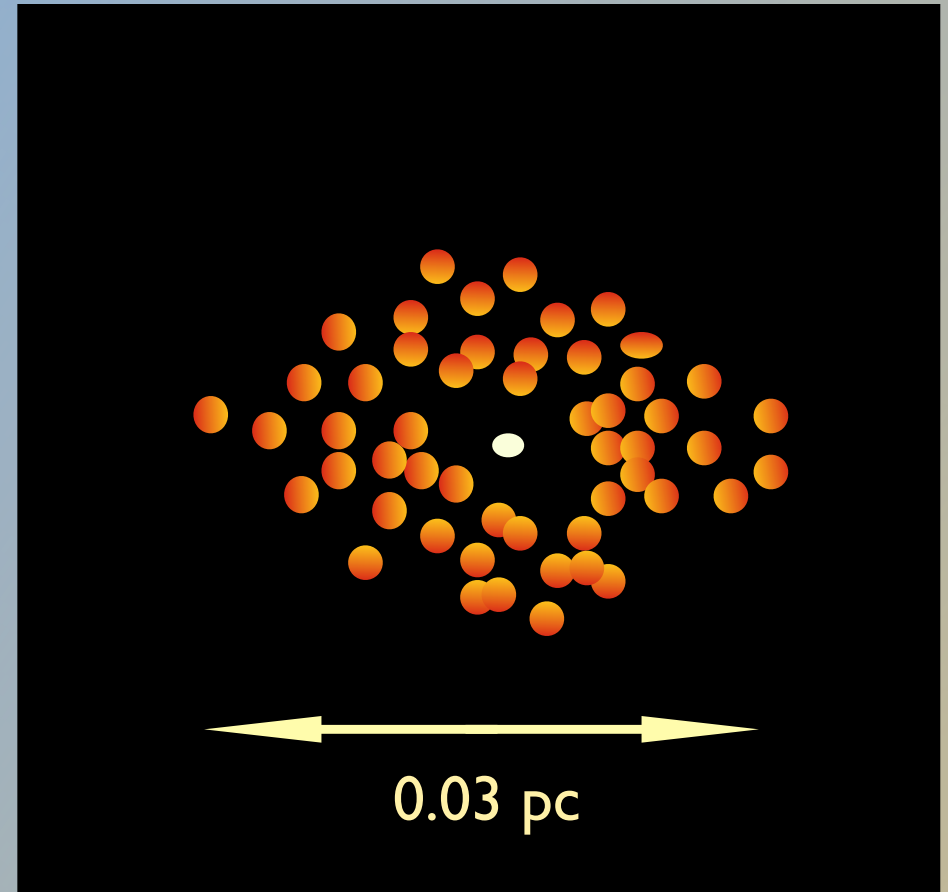


# Dream III: Resolve the BLR in nearby AGNs

What do we expect ?

## Requirements:

- Resolution: 100  $\mu\text{as}$  at 2  $\mu\text{m}$
- Spectral lines:  $P_{\beta}$  &  $Br_{\alpha}$



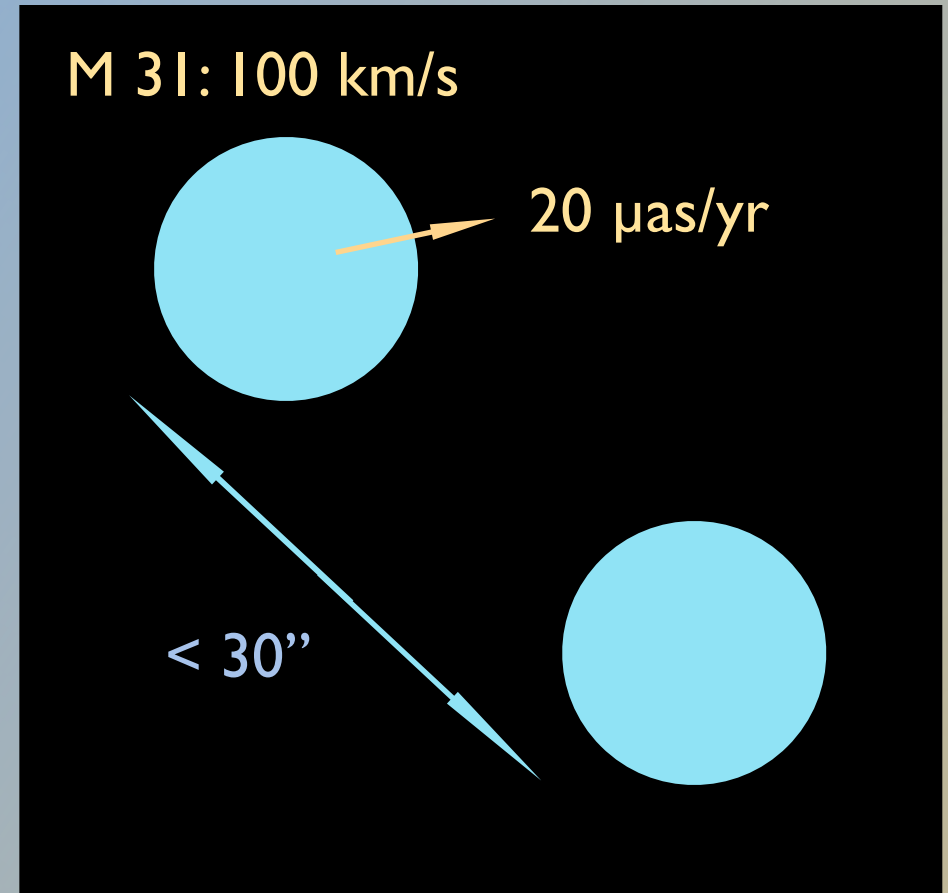
140  $\mu\text{as}$  at  $z = 0.01$

# Dream IV: Proper motions in nearby galaxies

What do we expect ?

## Requirements:

- Dual Beam (PRIMA)
- Astrometry to  $< 50 \mu\text{as}$
- Reference star  $m < 15$
- Known PM of reference:  
SIM - GAIA - quasars



# Summary

On the morning after ...

- **VLT with current instruments (MIDI, AMBER, PRIMA) :**  
**Dusty tori (5...10), radio jets (1...3), proper motions (?)**
- **VLT with next generation (better sensitivity, imaging) :**  
**Dusty tori (50), radio jets (10), proper motions (many)**
- **beyond VLT → XVLT (3 – 10 km, heterodyne, ...) :**  
**Dusty tori ( $z = 0.3$ ), radio jets ( $z = 1$ ), BLRs in AGNs,  
proper motions (Virgo)**