

# Radio emission in Ultracool Dwarfs

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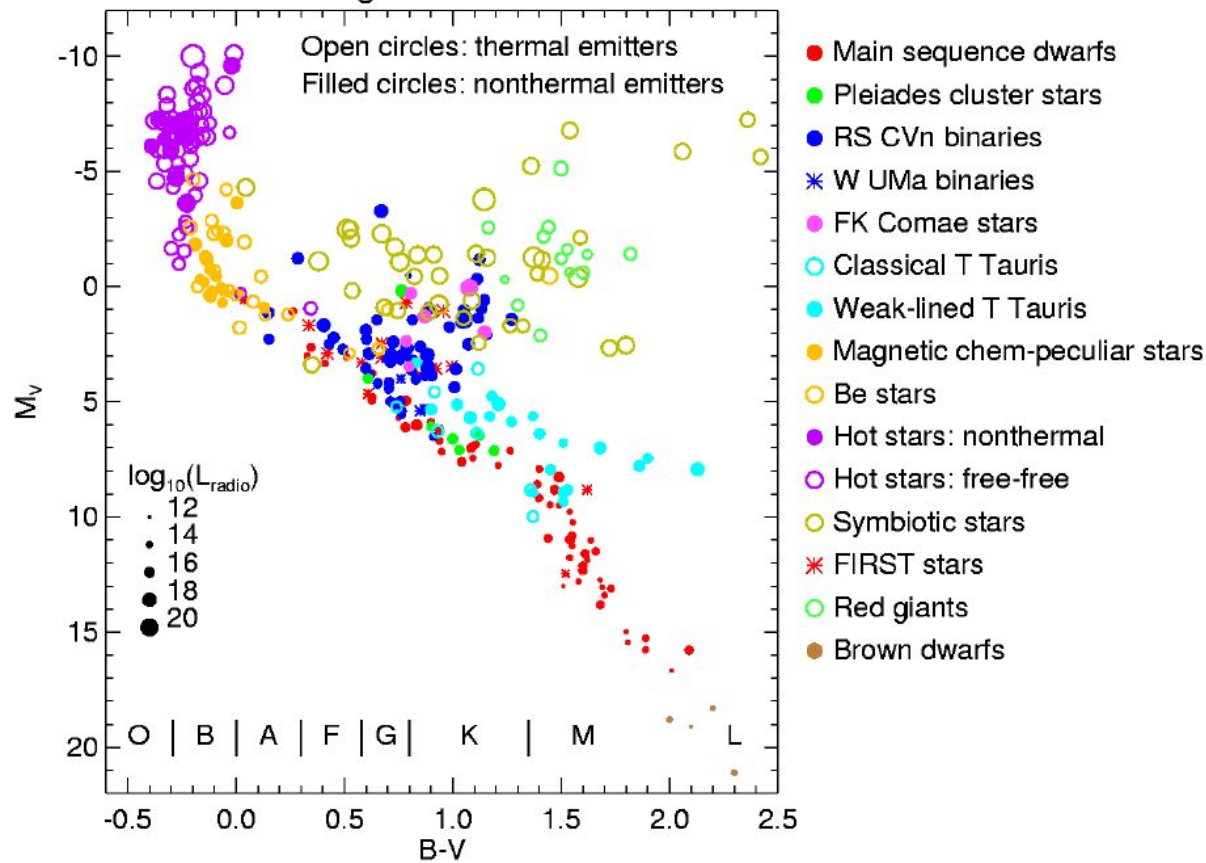
# Ultracool Dwarfs

WHAT ARE YOU  
TALKING  
ABOUT?



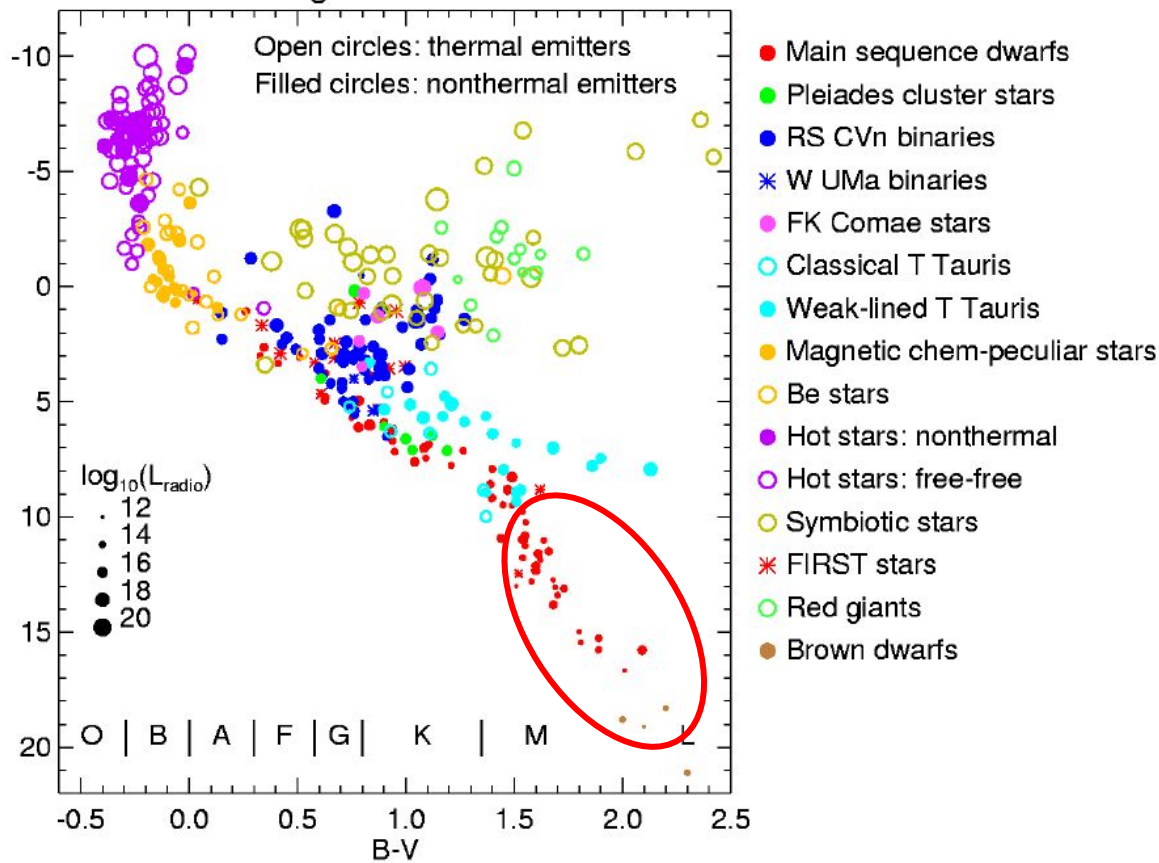
# Ultracool Dwarfs

Radio H-R Diagram: Radio Luminosities



# Ultracool Dwarfs

Radio H-R Diagram: Radio Luminosities



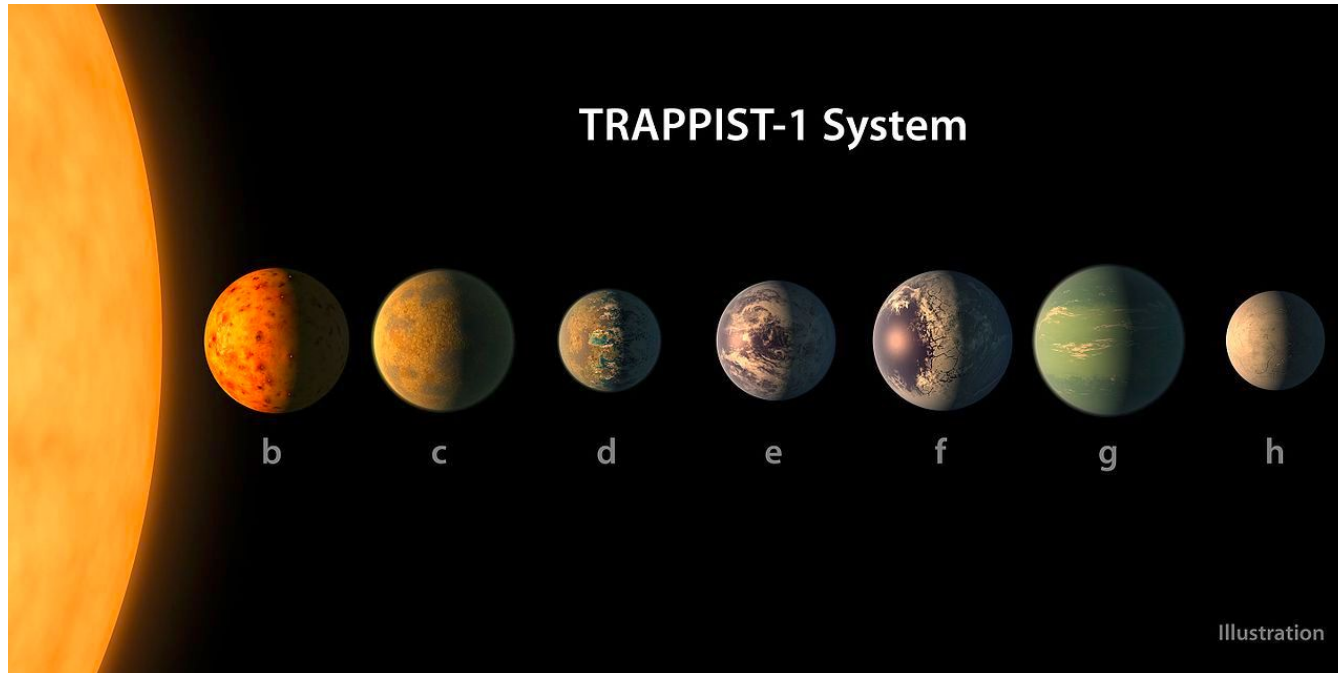
Ultracool Dwarfs are  
objects later than M5-7  
type(stellar or sub-stellar)

Typical temperature lower  
2700 K

# Ultracool Dwarfs

## Important things to know

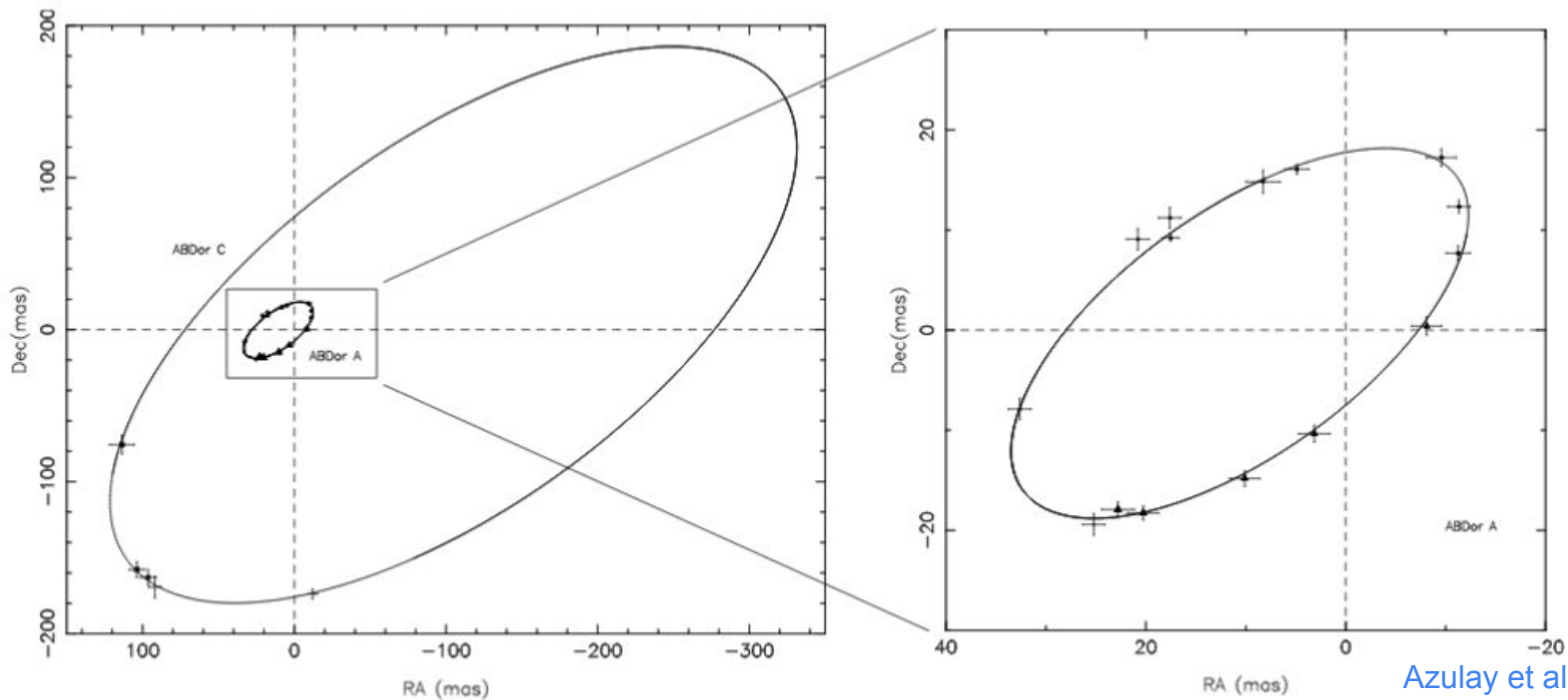
1. The accretion model suggests that may host Earth-like planets



# Ultracool Dwarfs

## Important things to know

2. In multiple systems: relevant as benchmarks for evolutionary models.



# Ultracool Dwarfs

## Important things to know

3. The radio emission is relevant to probe the magnetic field and stellar rotation in convective objects.

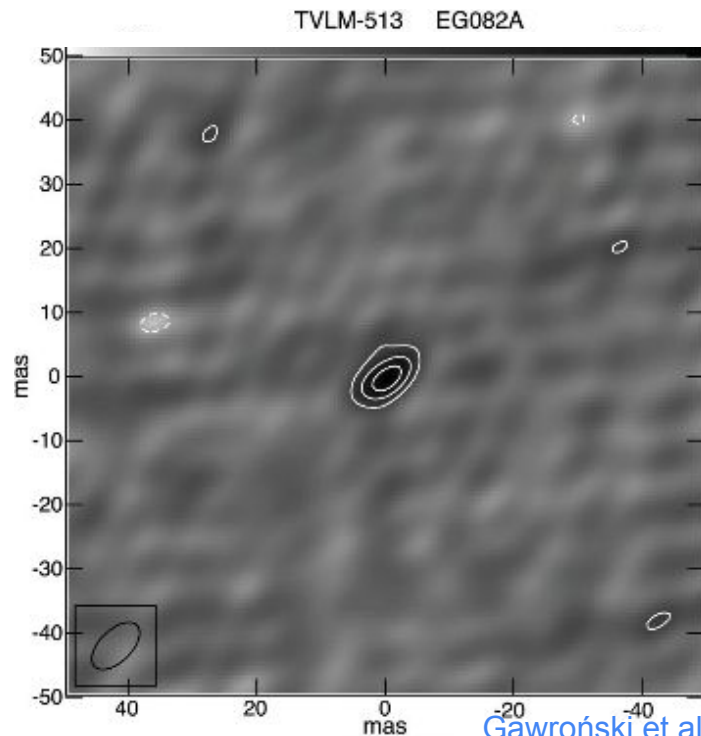
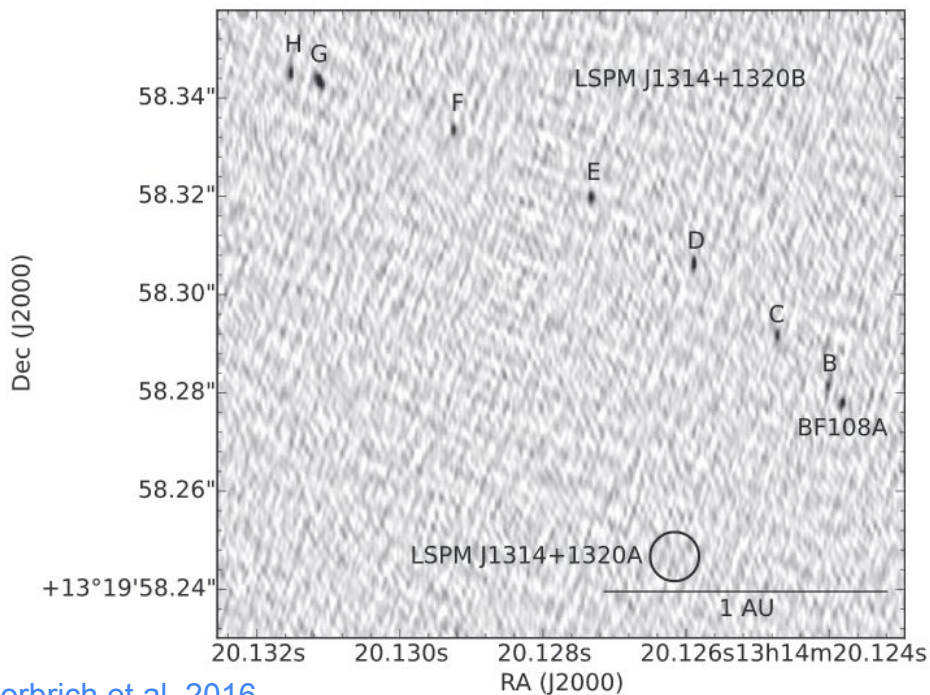


4. May open a route to detect radio emission on exoplanets (spoiler alert: no luck yet!) although we are getting closer... (Kao et al. 2018)

# Ultracool Dwarfs

## Important things to know

### 5. Some remarkable VLBI observations

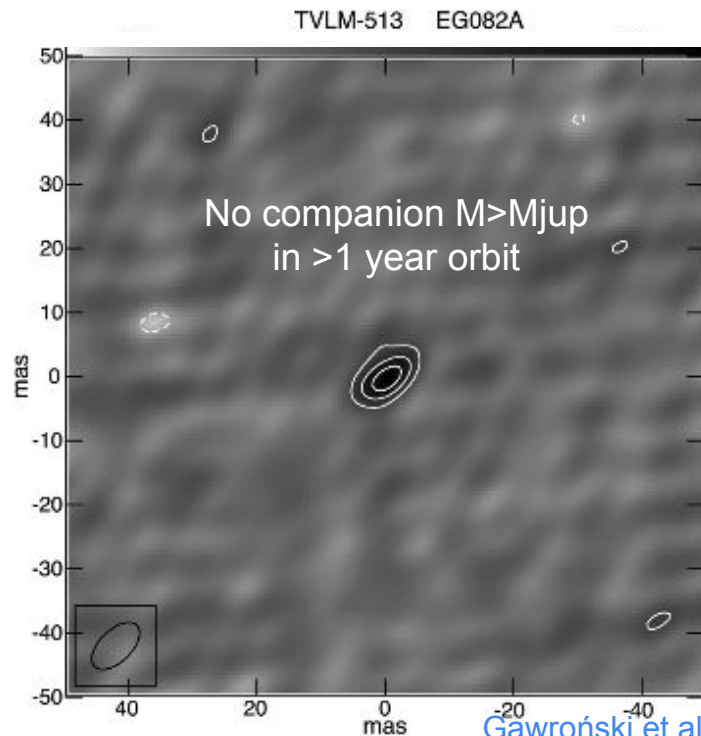
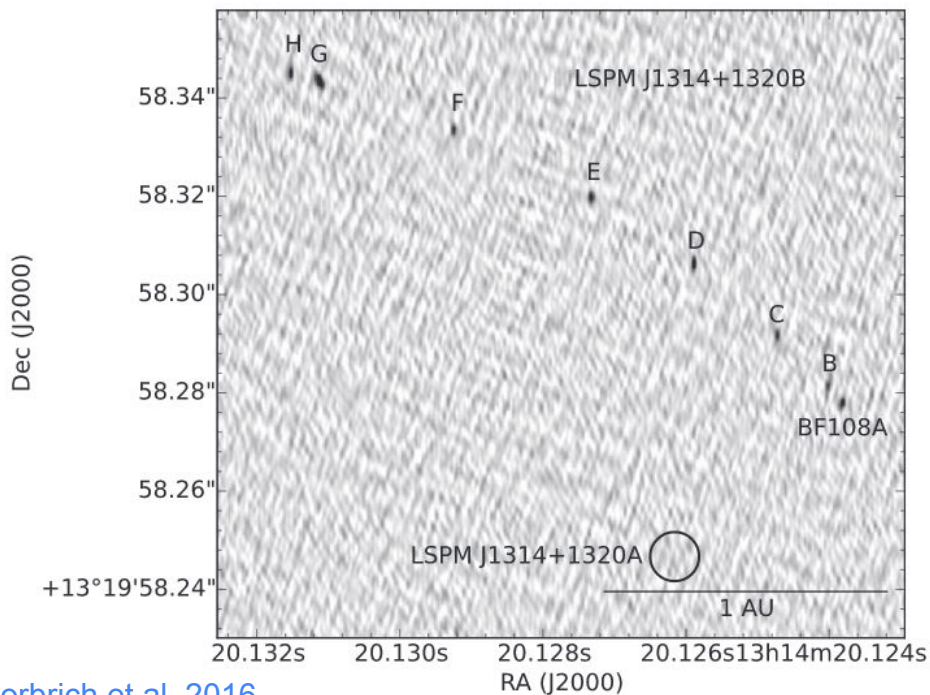




# Ultracool Dwarfs

## Important things to know

### 5. Some remarkable VLBI observations



# Ultracool Dwarfs

## How many do we know (in radio)?

Source name	Other name	SpT	Var?	First radio detection
2MASS J09522188-1924319 AB		M7*		McLean et al. (2012)
2MASS J13142039+1320011 B	NLT T 33370 B	M7	Y	McLean et al. (2011)
2MASS J14563831-2809473		M7		Burgasser & Putman (2005)
2MASS J00275592+2219328 AB	LP 349-25 AB	M8*	N	Phan-Bao et al. (2007)
2MASS J15010818+2250020	TVLM 513-46546	M8.5	Y	Berger (2002)
2MASS J18353790+3259545	LSR J1835+3259	M8.5	Y	Berger (2006)
2MASS J10481463-3956062	DENIS J...	M9	Y	Burgasser & Putman (2005)
2MASS J00242463-0158201	BRI B0021-0214	M9.5	Y	Berger (2002)
2MASS J03393521-3525440	LP 944-20	M9.5	Y	Berger et al. (2001)
2MASS J07200325-0846499 AB		M9.5+T5	Y	Burgasser et al. (2015)
2MASS J07464256+2000321 B		L1.5	Y	Berger et al. (2009)
2MASS J19064801+4011089	WISE J...	L1		Gizis et al. (2013)
2MASS J05233822-1403022		L2.5		Berger (2006)
2MASS J00361617+1821104		L3.5	Y	Berger (2002)
2MASS J13153094-2649513 AB		L3.5+T7		Burgasser et al. (2013)
2MASS J00043484-4044058 AB		L5+L5		Lynch et al. (2016)
2MASS J04234858-0414035	SDSS J...	L7.5	Y	Kao et al. (2016)
2MASS J10430758+2225236		L8	Y	Kao et al. (2016)
2MASS J06073908+2429574	WISE J...	L9		Gizis et al. (2016)
2MASS J01365662+0933473	SIMP J...	T2.5	Y	Kao et al. (2016)
WISEP J112254.73+255021.5		T6	Y	Route & Wolszczan (2016)
2MASS J10475385+2124234		T6.5	Y	Route & Wolszczan (2012)
2MASS J12373919+6526148		T6.5	Y	Kao et al. (2016)

23 as of mid 2017

+

a few of them since  
then

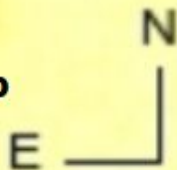
# VHS 1256-1257

VISTA Ks

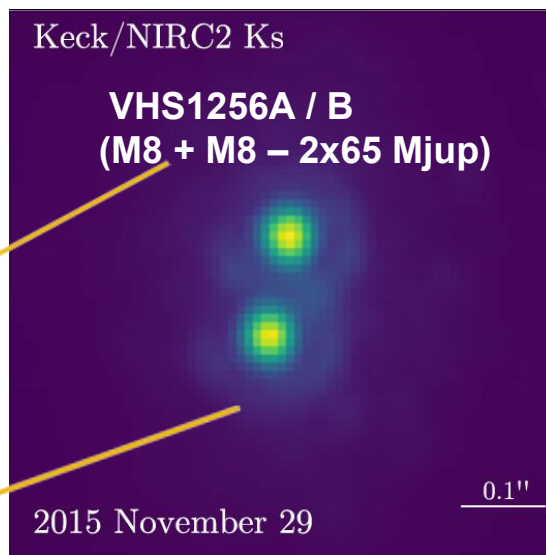
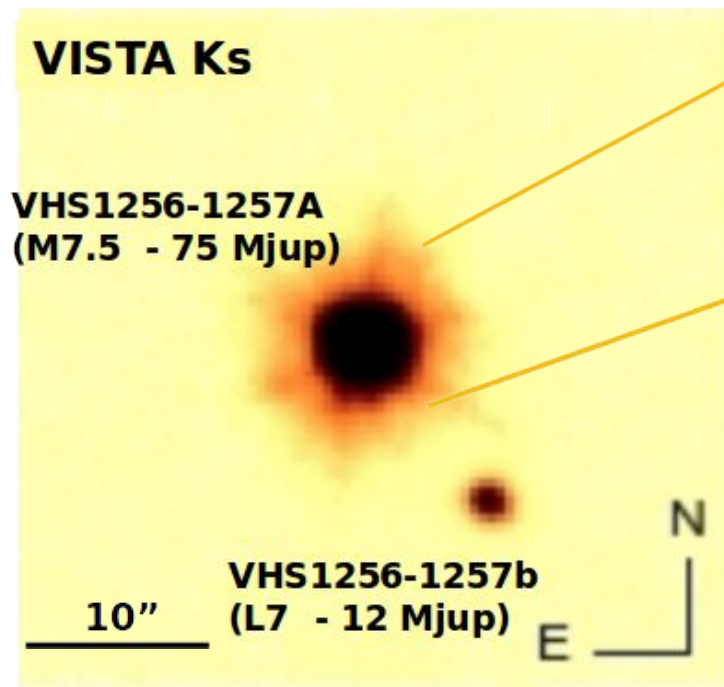
VHS1256-1257A  
(M7.5 - 75 Mjup)

VHS1256-1257b  
(L7 - 12 Mjup)

10"

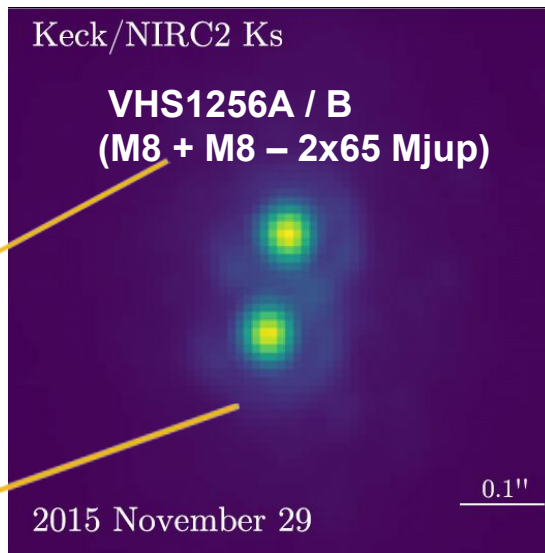
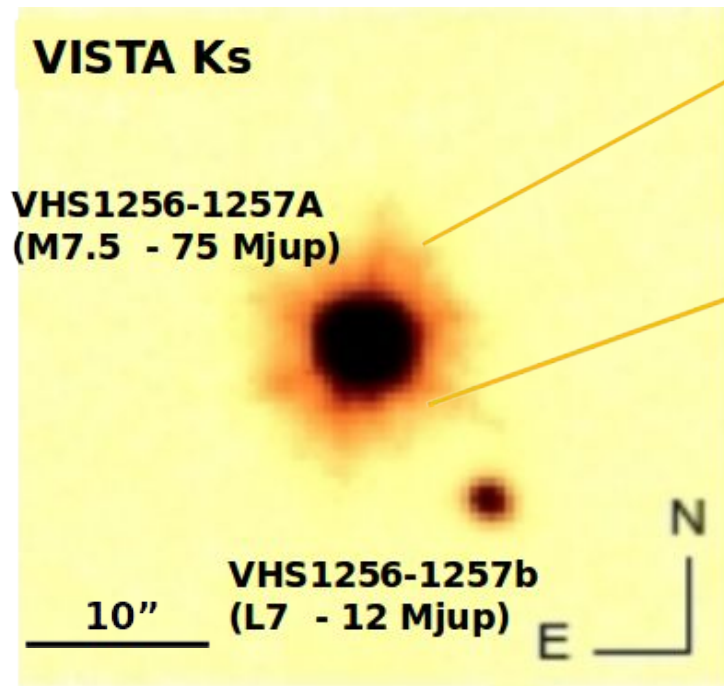


# VHS 1256-1257



Stone et al. 2016

# VHS 1256-1257

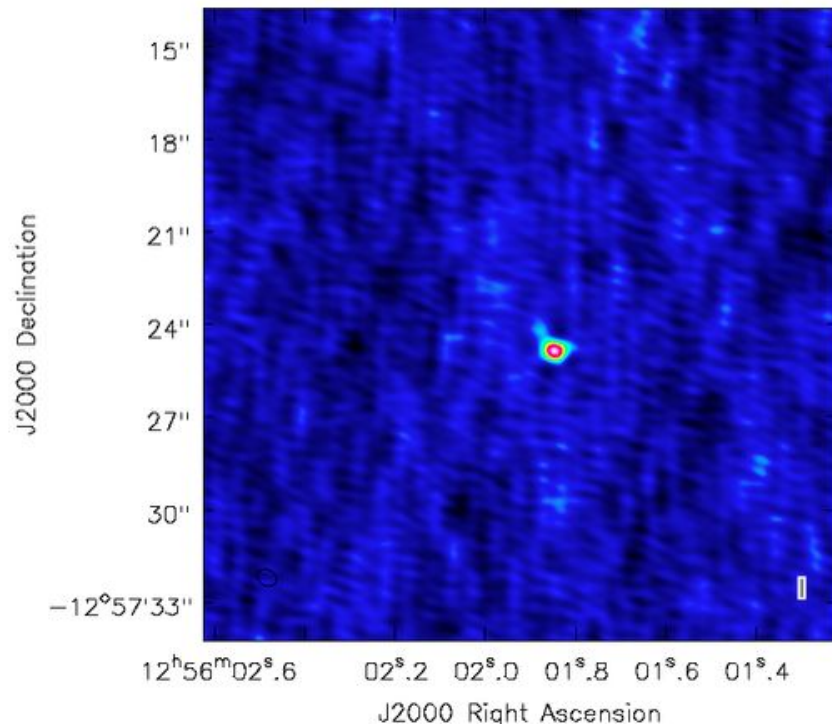


Stone et al. 2016

- Relatively young: 300 Myr
- Relatively nearby: 15.8 pc
- 3 components are sub-stellar
- Radio emission?

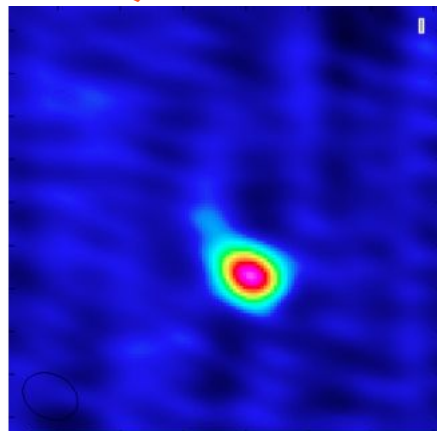
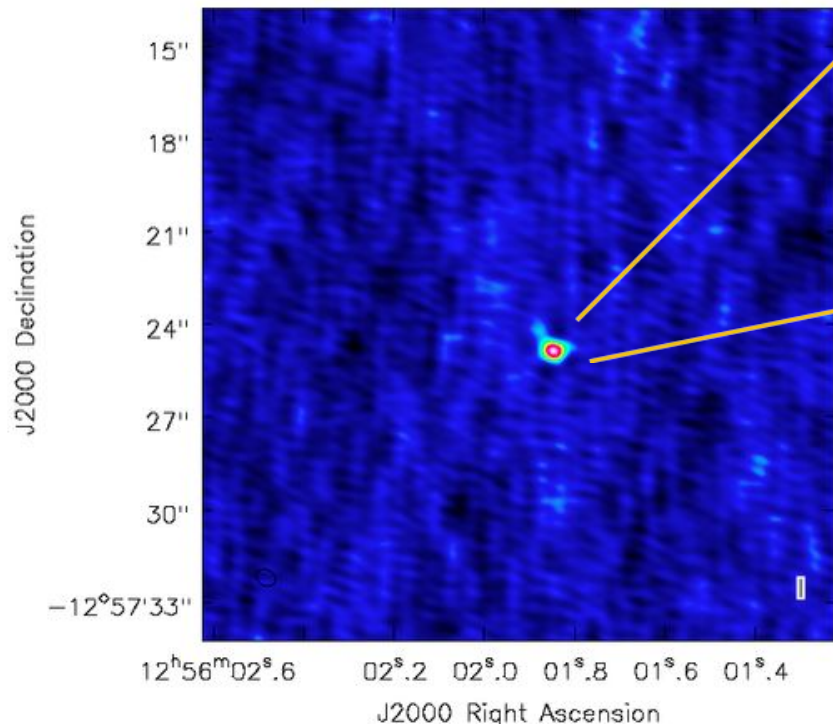
# VHS 1256-1257 (Guirado et al. 2018)

## VLA X-band



# VHS 1256-1257 (Guirado et al. 2018)

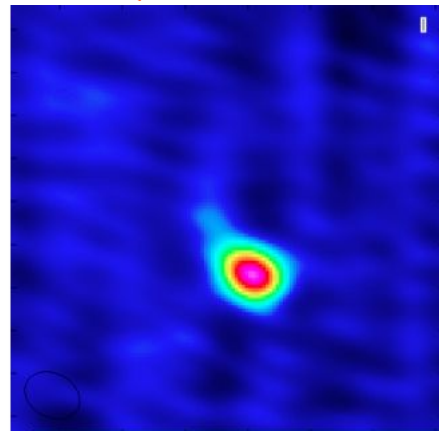
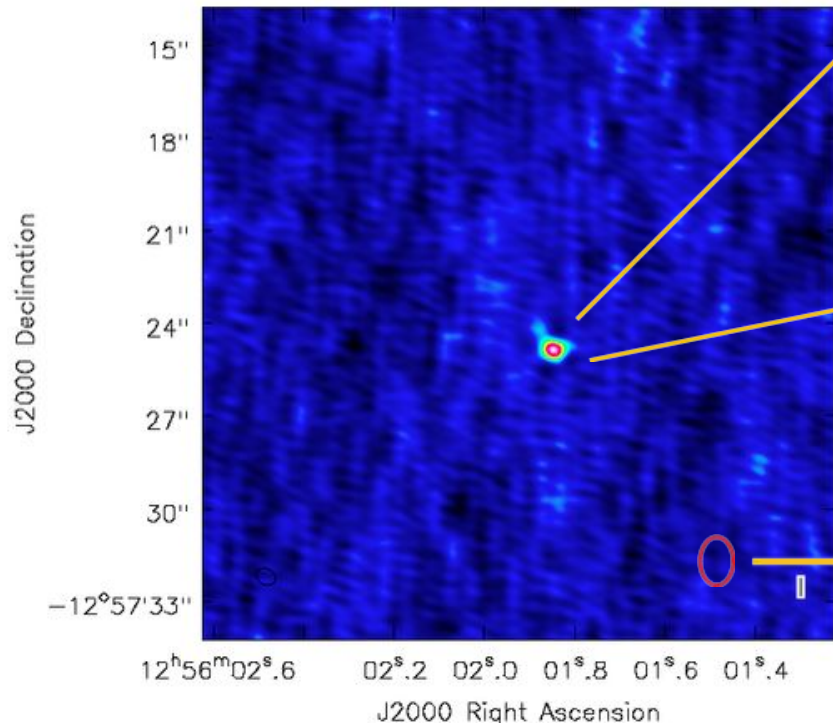
## VLA X-band



VHS1256-1257(A+B) 60  $\mu$ Jy  
component A?, B?, A+B?

# VHS 1256-1257 (Guirado et al. 2018)

## VLA X-band



VHS1256-1257(A+B) 60  $\mu$ Jy  
component A?, B?, A+B?

VHS1256-1257b not detected.  
Noise floor 3  $\mu$ Jy

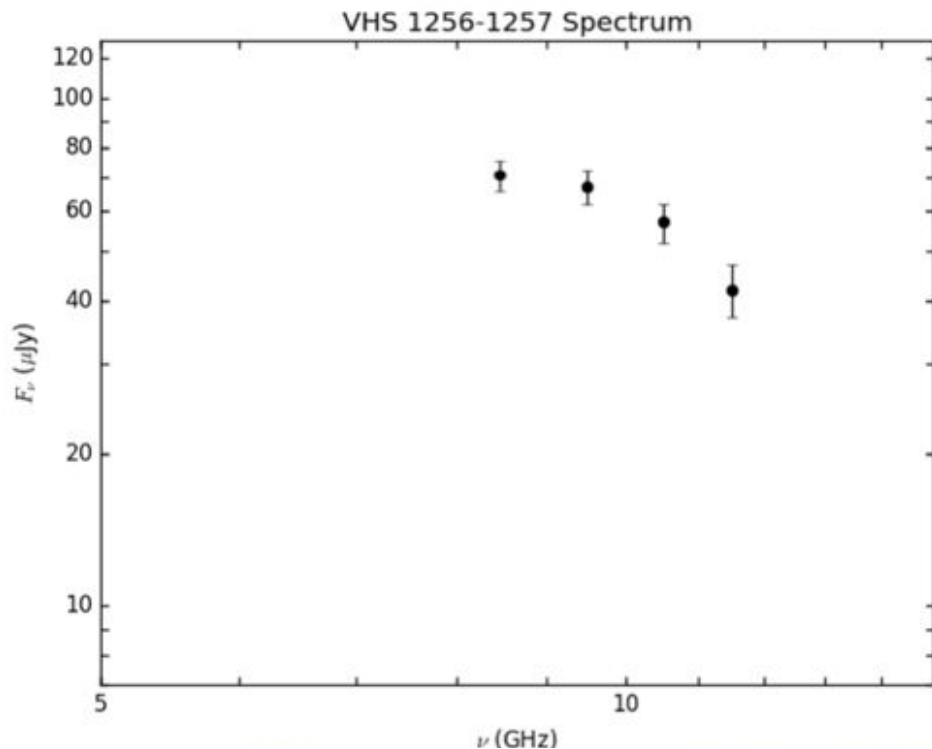


# VHS 1256-1257

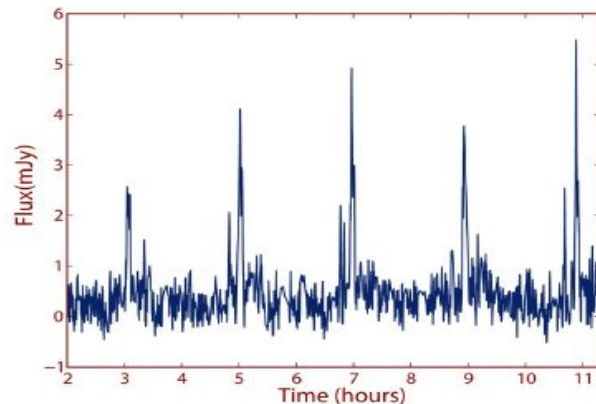
## VLA X-band (8-12 GHz)

$$S \propto \nu^\alpha$$

$$\alpha = -1.1 \pm 0.3$$



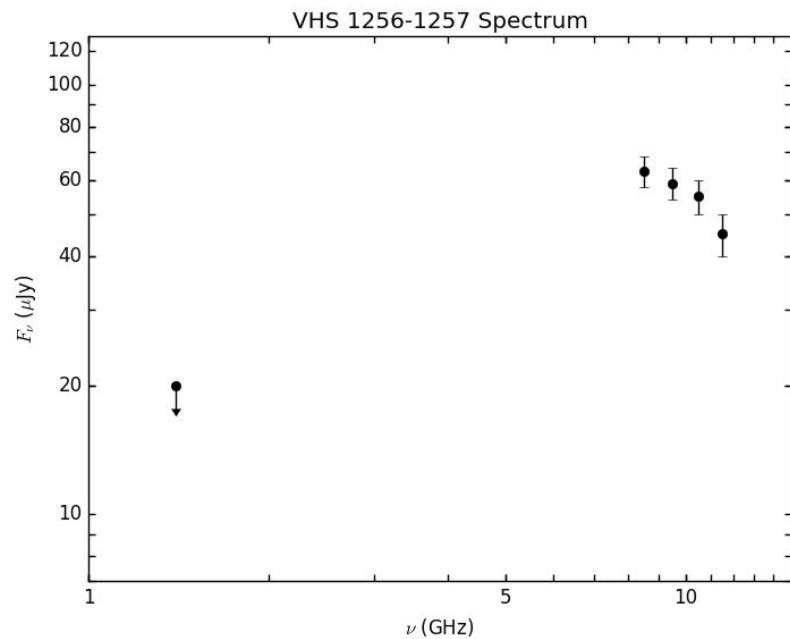
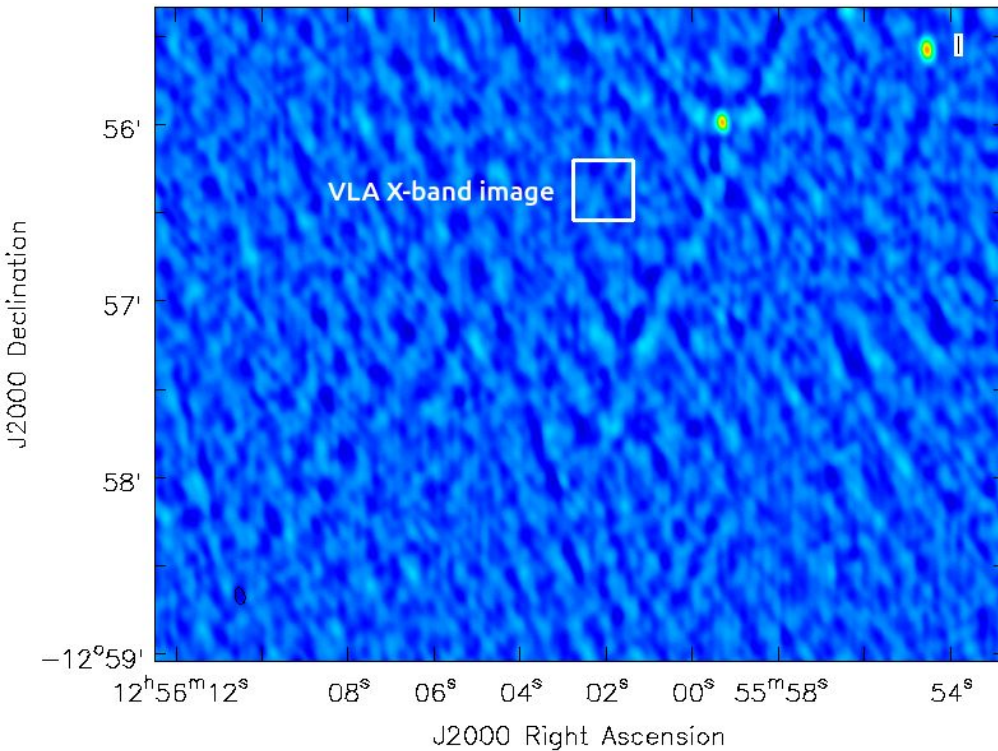
- Optically thin, non-thermal synchrotron or gyrosynchrotron
- No circular polarization



- Associated with quiescent emission or binarity

# VHS 1256-1257

## VLA L-band + 3xEVN L-band

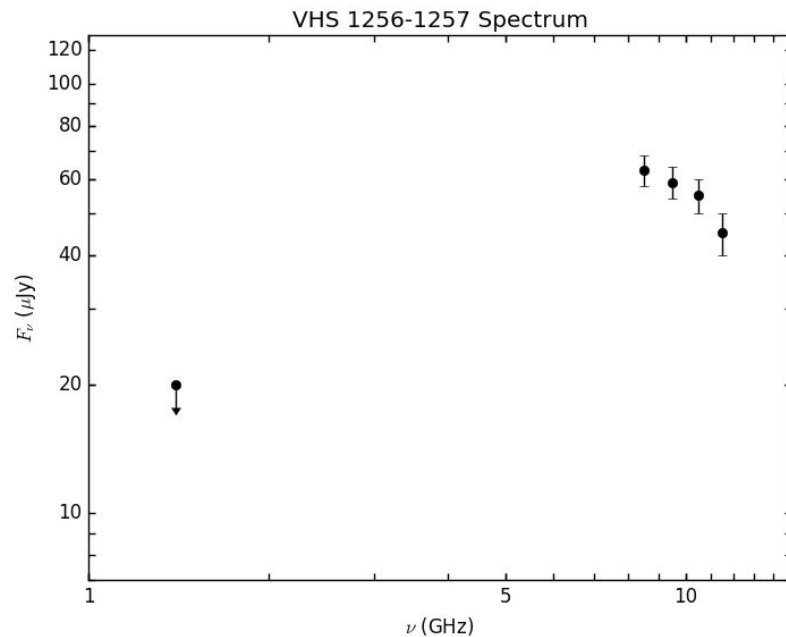


# VHS 1256-1257

## VLA L-band + 3xEVN L-band

### Why no detection at L-band?

- Strong variability of the binary as other UCD
- Self absorption



# VHS 1256-1257

## VLA L-band + 3xEVN L-band

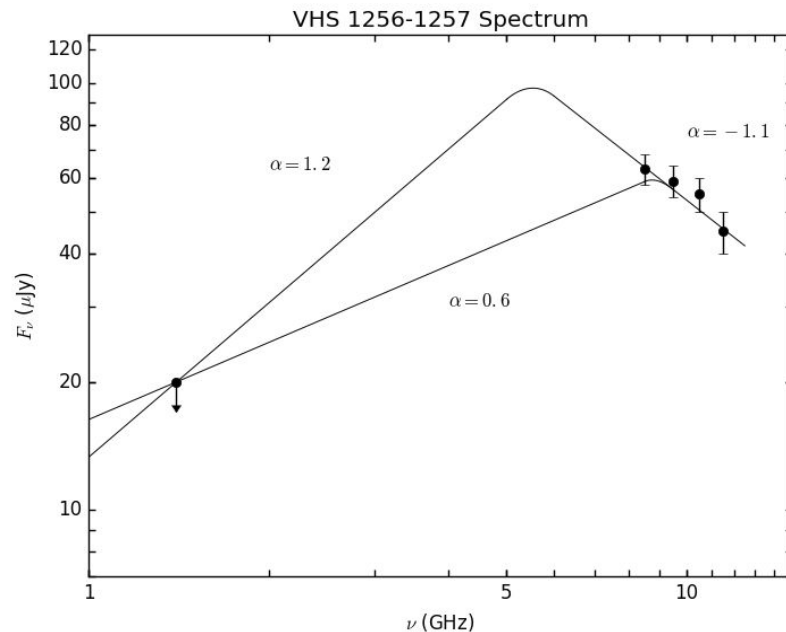
### Why no detection at L-band?

- Strong variability of the binary as other UCD
- Self absorption: model White et al. 1989

$$\nu_{\text{peak}} = 5.5 - 8.8 \text{ GHz}$$

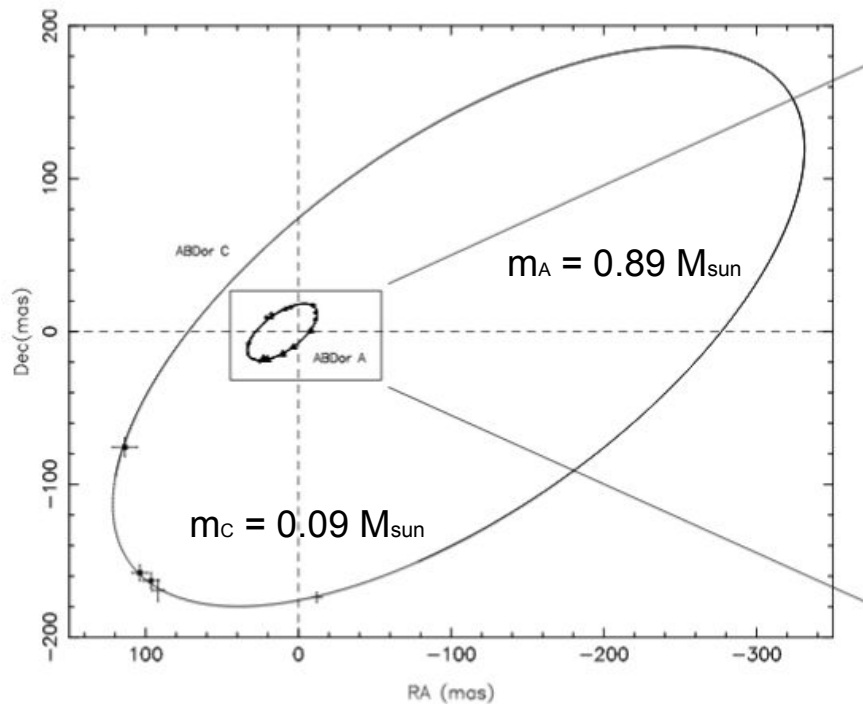
$$B = 1 - 2 \text{ kG}$$

In accordance with Reiners 2010



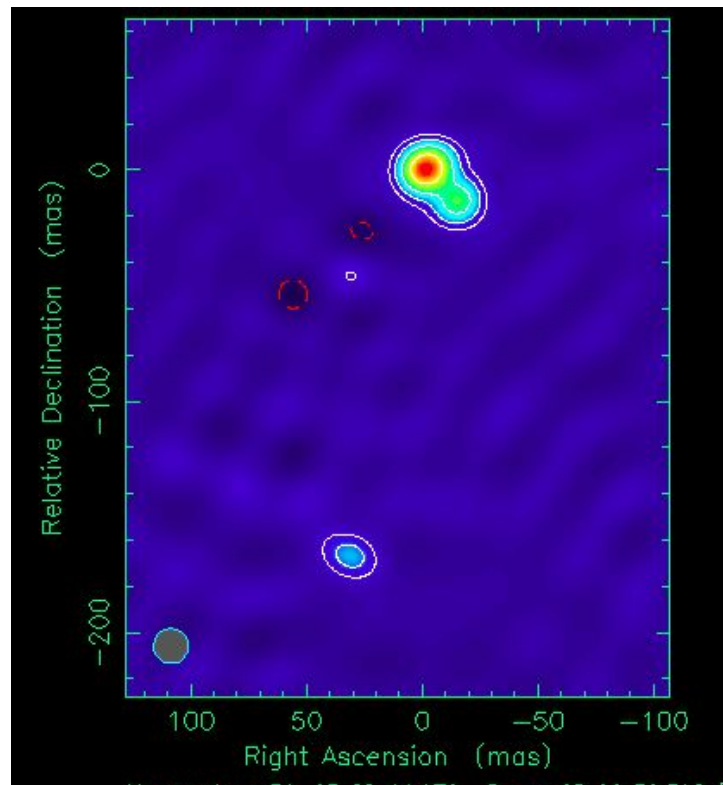
# AB Dor A/C (Climent in prep.)

- LBA (4 antennas) @ 1.4 GHz
- 4.5 hours

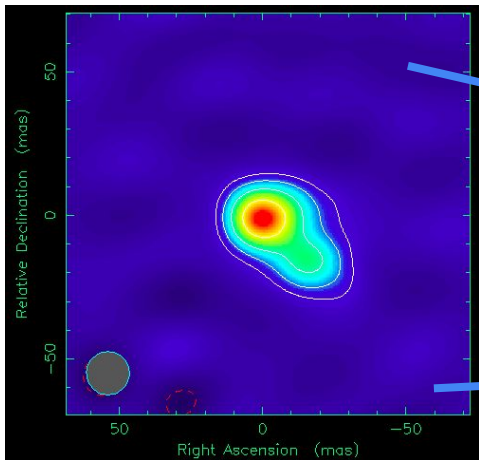


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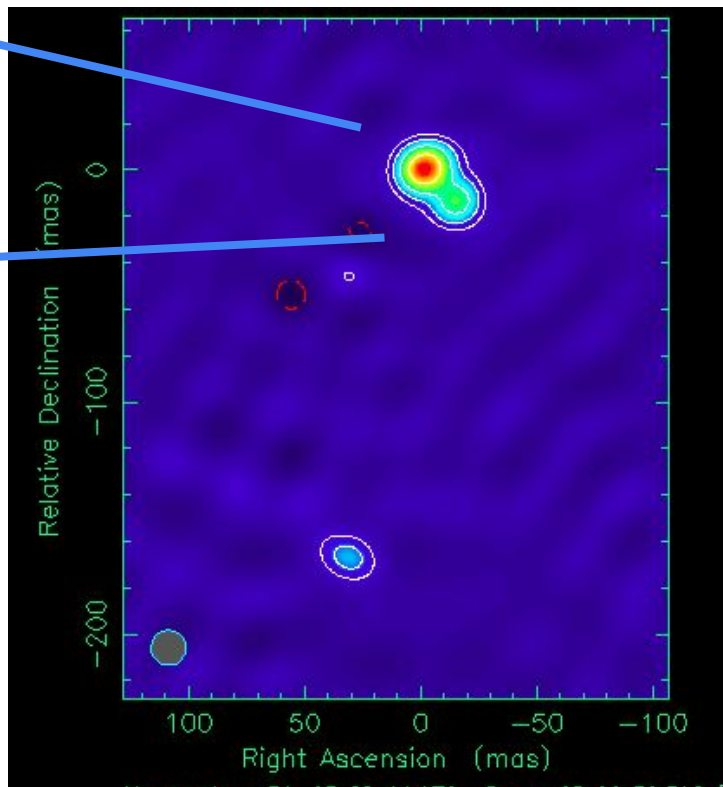
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# AB Dor A/C



- LBA (4 antennas) @ 1.4 GHz
- 4.5 hours



Substructure may correspond to a dense coronal structure produced by the intense magnetic activity of this ultrafast rotating star

# AB Dor A/C

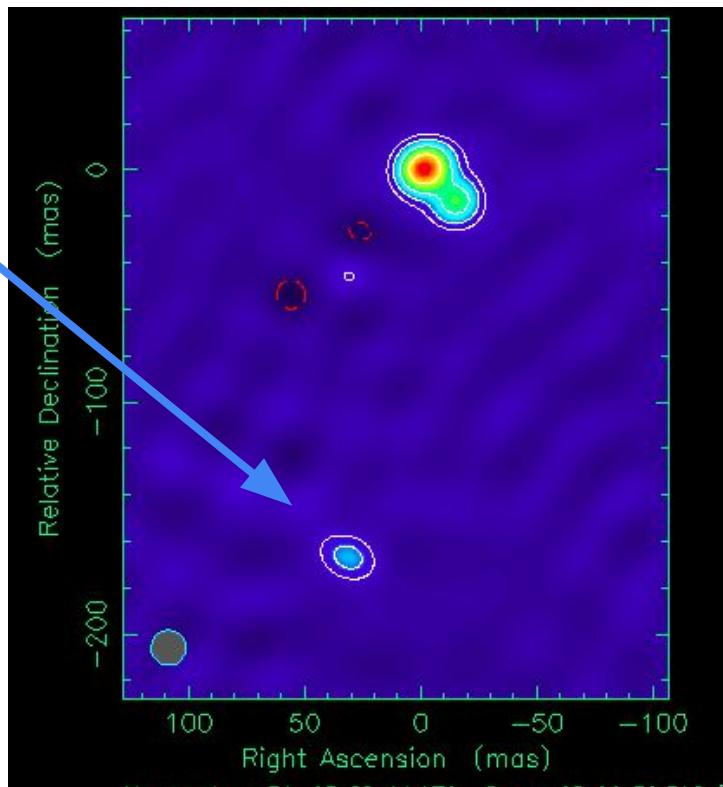
At the expected position...  
AB Dor C

- Flux density  $\sim 260 \mu\text{Jy}$
- Circular polarization  $< 15\%$
- Not observed at X-band

Emission might come from:

1. Quiescent state
2. Binary

- LBA (4 antennas) @ 1.4 GHz
- 4.5 hours





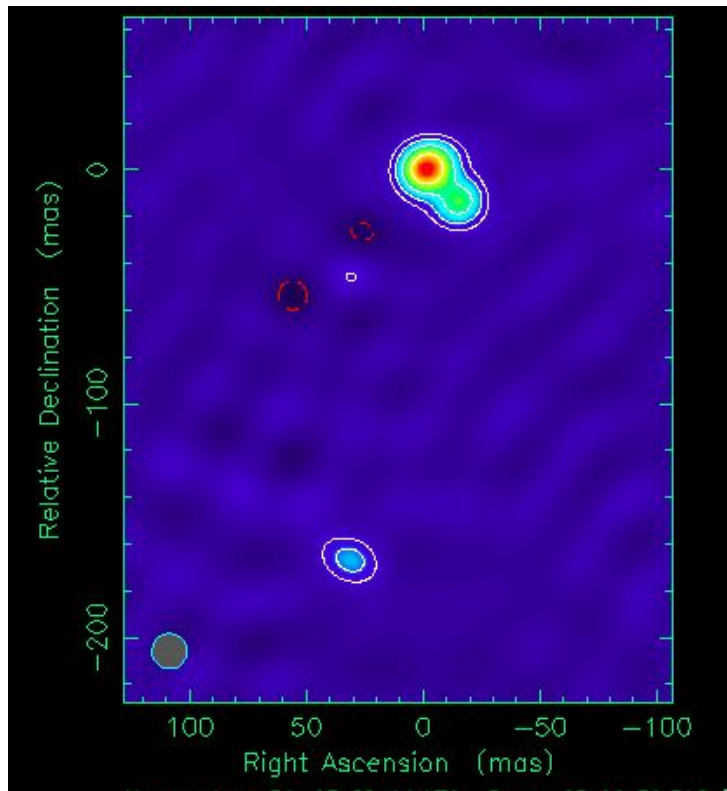
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## May AB Dor C be a binary?

It had been considered a likely binary system itself by Marois et al. (2005) and Nielsen et al. (2005)



NIR AMBER Interferometry Observations



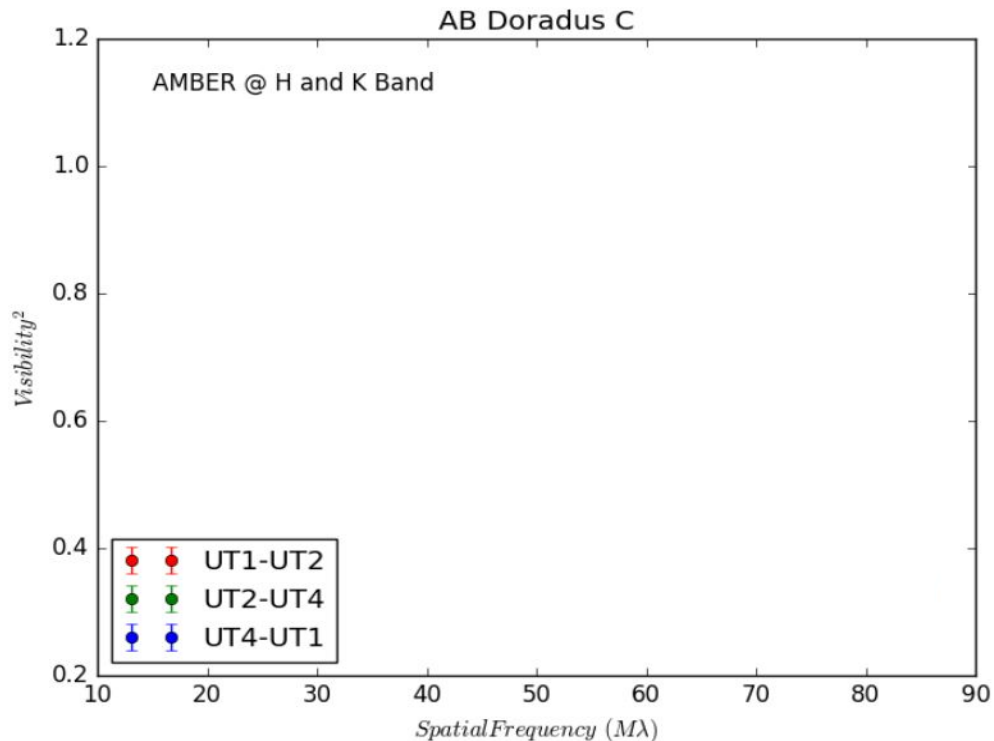
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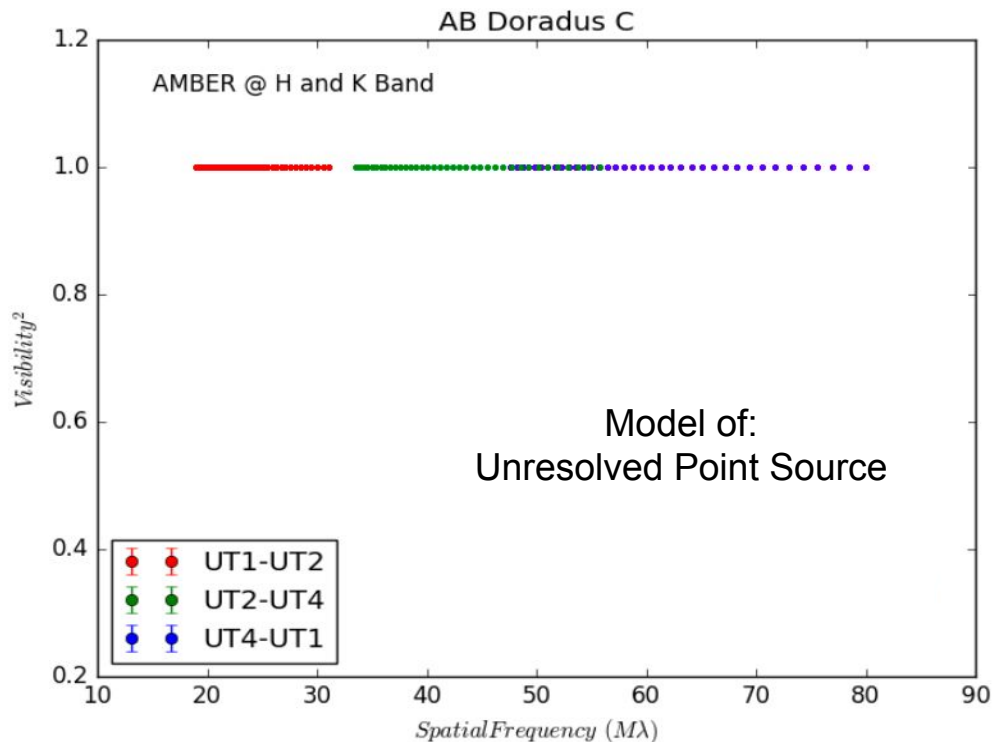
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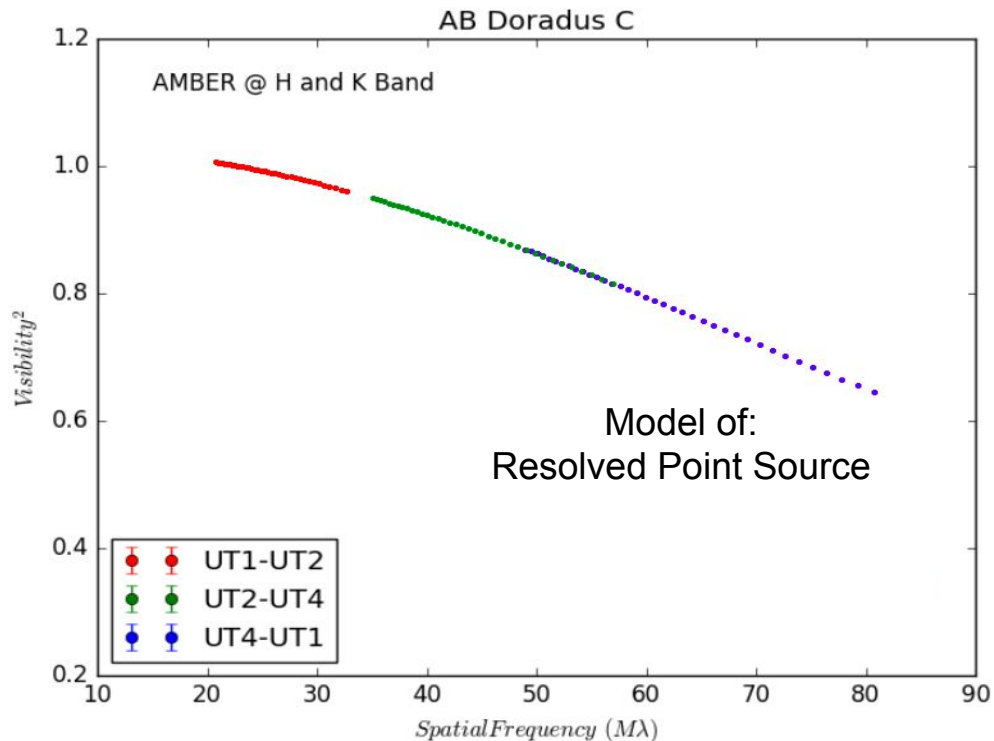
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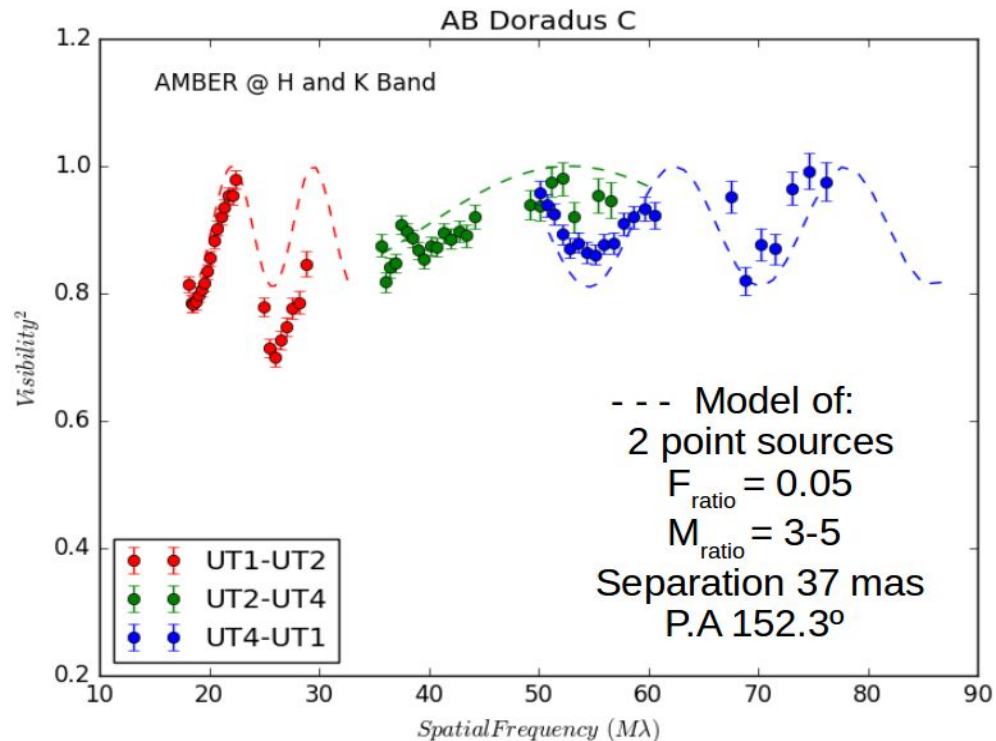
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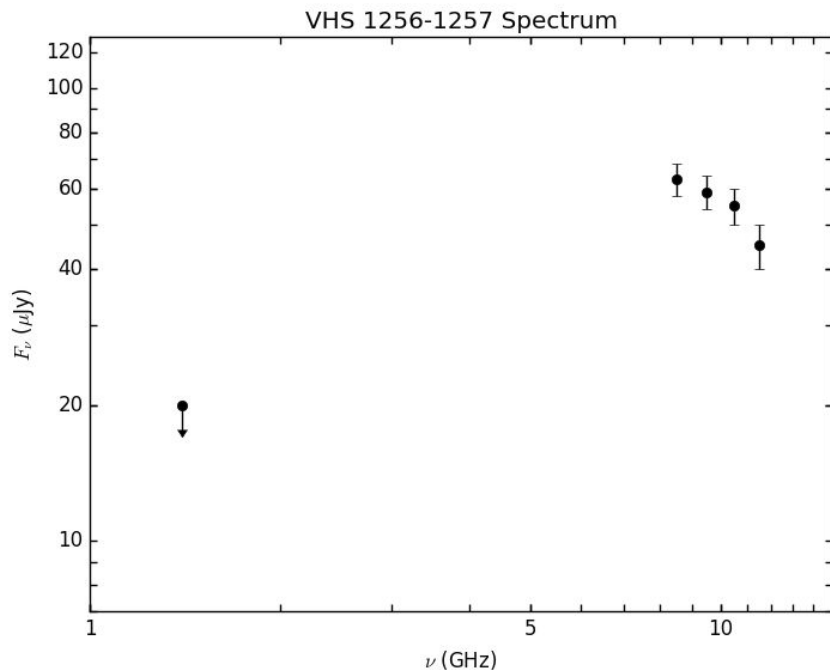


NIR AMBER Interferometry Observations



# Future work

- C band EVN observations this month for VHS
- EVN proposal of previously detected UCD
- VLA Proposal in order to detect radio detection of new binary systems



**Thank you for your attention and...**  
**Let's eat!**