The first look at the coincidence of methanol and excited OH masers around HMYSOs

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14/07/2022

Physical conditions

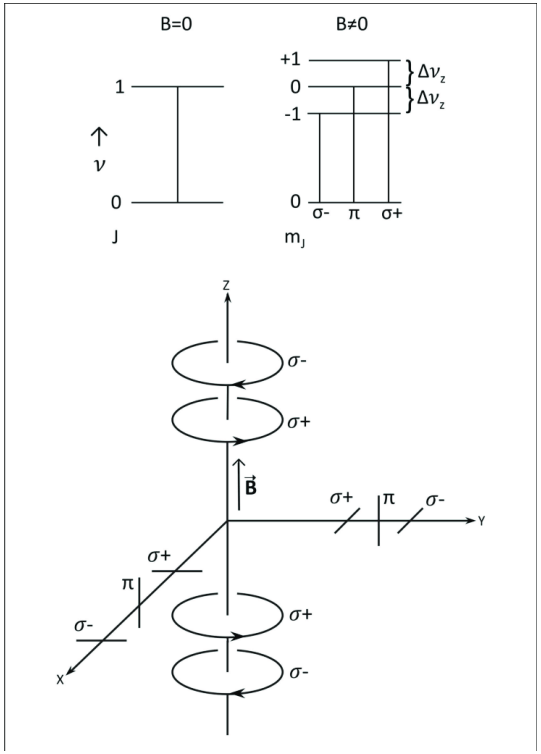
The project aims to search the coincidence of 6.7 GHz methanol (CH_3OH) and 6.035 GHz exited OH masers via simultaneous observations using e-MERLIN.

	Methanol 6.7 GHz	ex-OH 6.035 GHz
Kinetic temperature	$T_K < 200$ K	$T_K < 70$ K
Gas density	$10^{5.5} < \rho_{H_2} < 10^{7.5}$ cm^{-3}	$10^{6} < \rho_{H_2} < 10^{8.5}$ cm^{-3}
Dust temperature	$T_D > 100$ K	$T_D > 20$ K

Table: Physical conditions required for methanol and excited OH maser emission according to Cragg et al. (2002).

Magnetic field

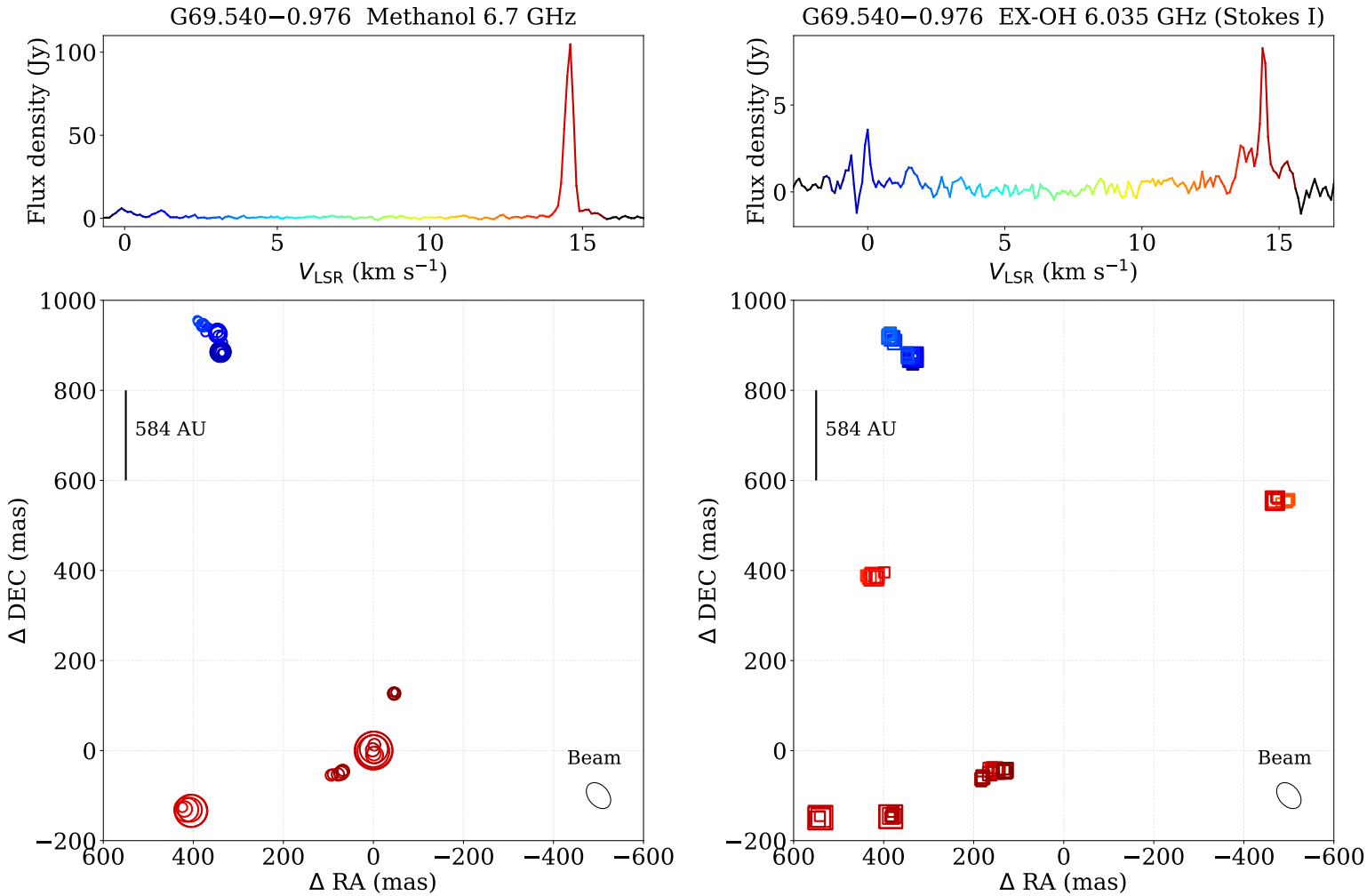
The next aim of the project is to measure magnetic field using the full polarization data (RR, LL, Q, U): 1) identification of the Zeeman pairs and 2) detection of linearly polarized emission.



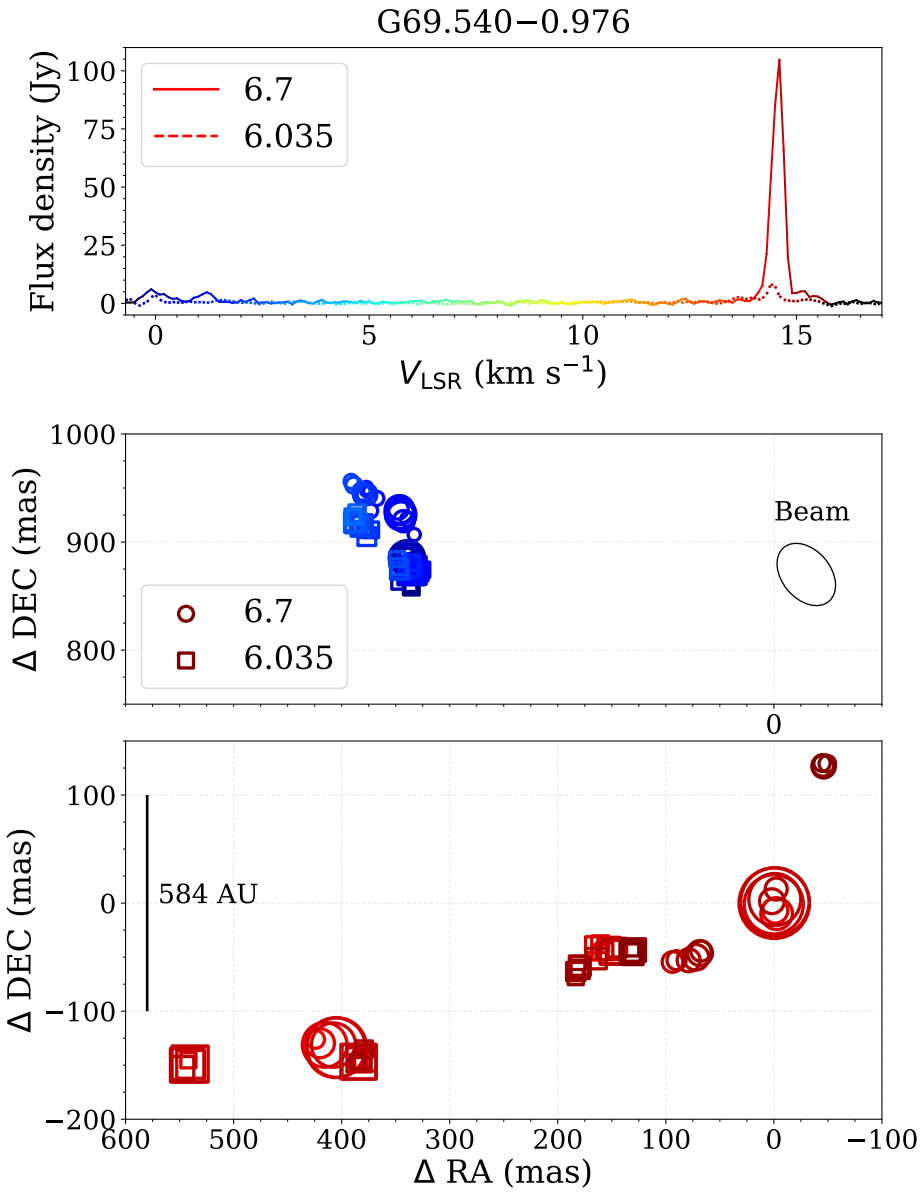
Zeeman triplet:
π - non -shifted component
σ - shifted compontens

If $\vec{B} \perp$ the line-of-sight $\Longrightarrow$ π is linearly polarized $\parallel B$ and σ are linearly polarized $\perp B$.
If $\vec{B} \parallel$ the line-of-sight $\Longrightarrow$ only σ - left and right-handed polarization arise (longitudinal Zeeman effect).
The magnetic field is calculated using the expression: $\frac{\Delta V(kms^{-1})}{H(mG)} = 0.056$ (Baudry et al. 1997), where ΔV is the difference between LHC and RHC polarized features.
If RHC component is more positive than LHC component $\Longrightarrow$ field is directed away from the observer.

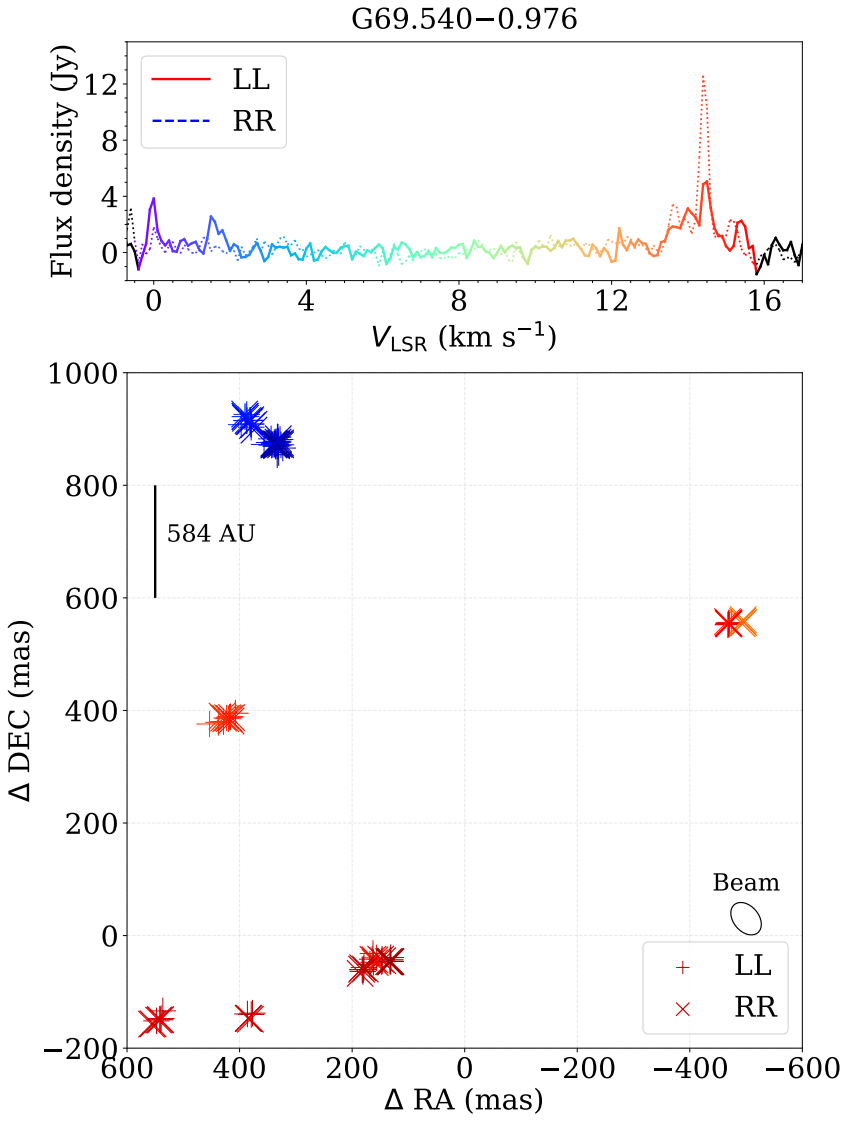
G69.540−0.976


G69.540−0.976 Methanol 6.7 GHz
Flux density (Jy)
V_{LSR} (km s^{-1})
584 AU
Beam
Δ DEC (mas)
Δ RA (mas)
G69.540−0.976 EX-OH 6.035 GHz (Stokes I)
Flux density (Jy)
V_{LSR} (km s^{-1})
584 AU
Beam
Δ DEC (mas)
Δ RA (mas)

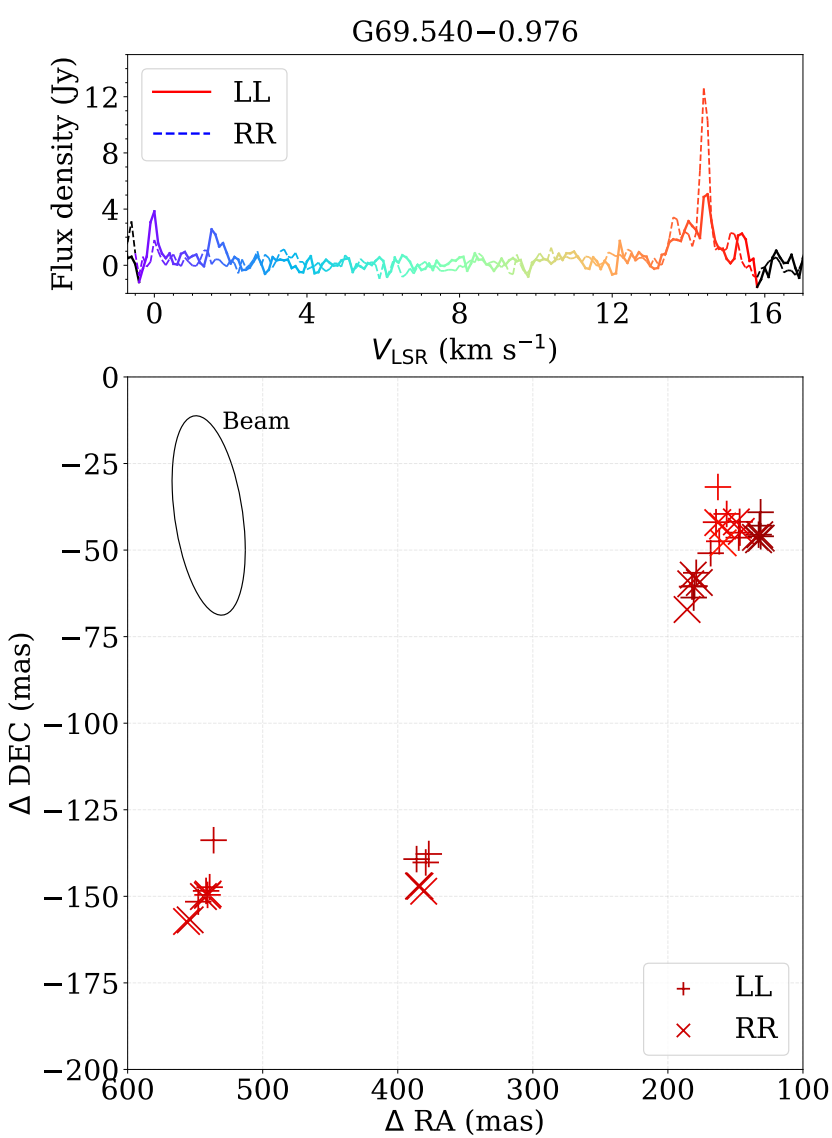
G69.540−0.976

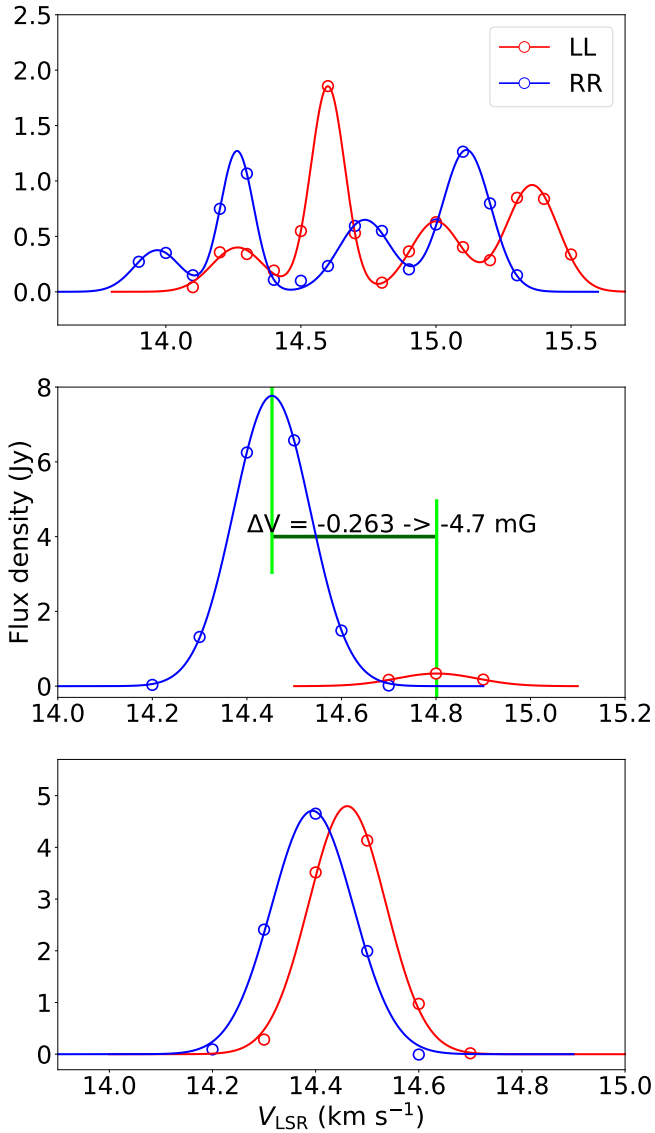

G69.540−0.976
Flux density (Jy)
100
75
50
25
0
6.7
6.035
0
5
10
15
V_{LSR} (km s^{-1})
Δ DEC (mas)
1000
900
800
Beam
6.7
6.035
0
Δ DEC (mas)
100
0
−100
−200
584 AU
600
500
400
300
200
100
0
−100
Δ RA (mas)

G69.540−0.976

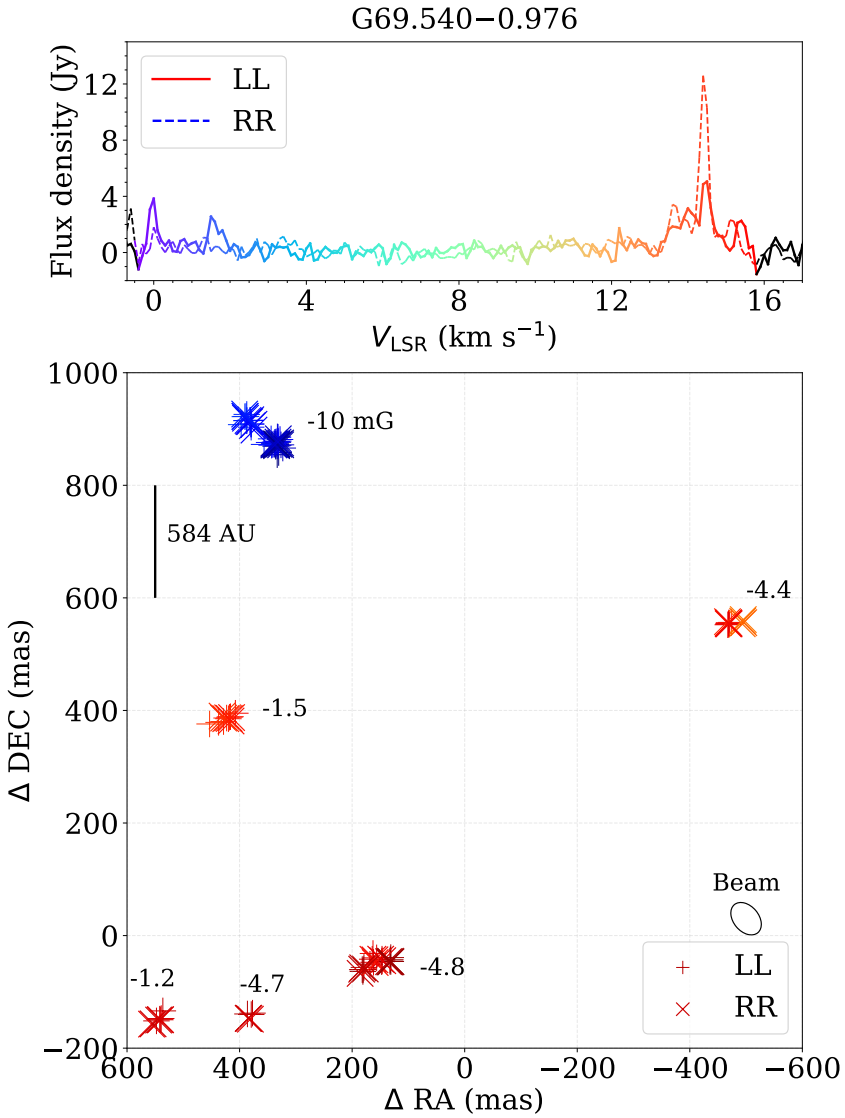

G69.540−0.976
Flux density (Jy)
LL
RR
V_{LSR} (km s^{-1})
584 AU
Beam
LL
RR
Δ DEC (mas)
Δ RA (mas)

G69.540−0.976

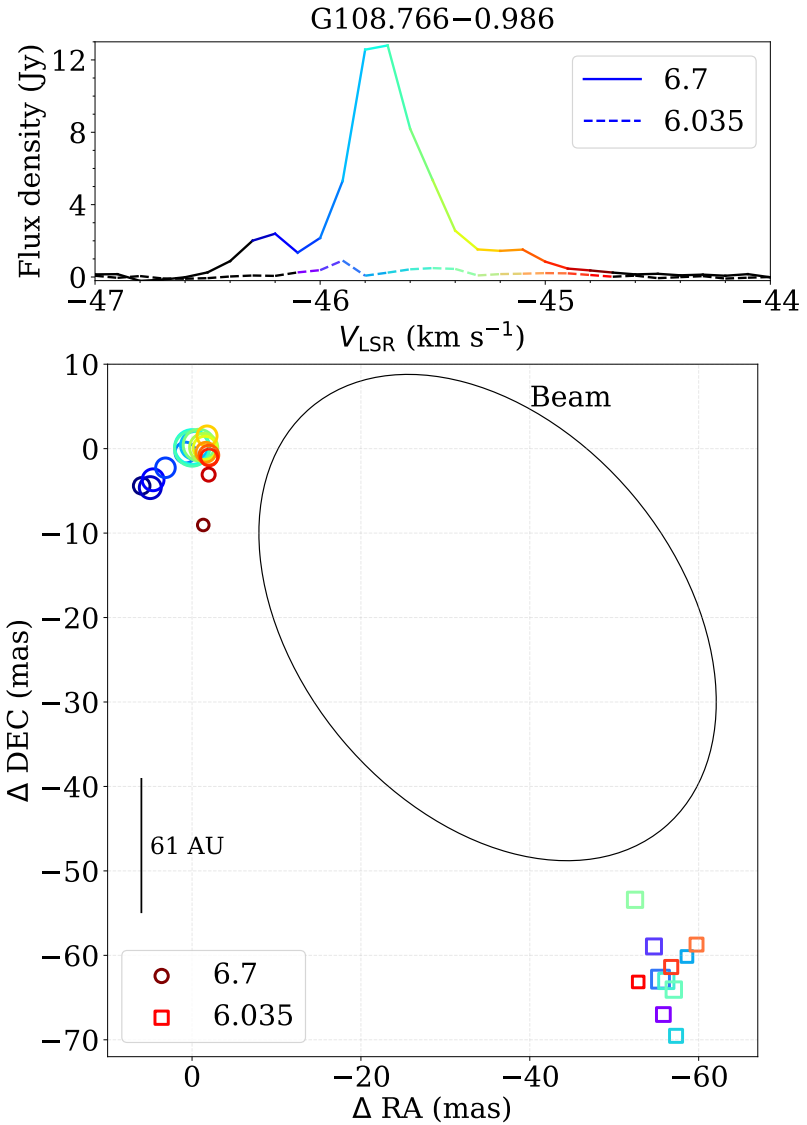

G69.540−0.976
Flux density (Jy)
LL
RR
V_{LSR} (km s^{-1})
Beam
Δ DEC (mas)
Δ RA (mas)
LL
RR


LL
RR
Flux density (Jy)
ΔV = -0.263 -> -4.7 mG
V_{LSR} (km s^{-1})

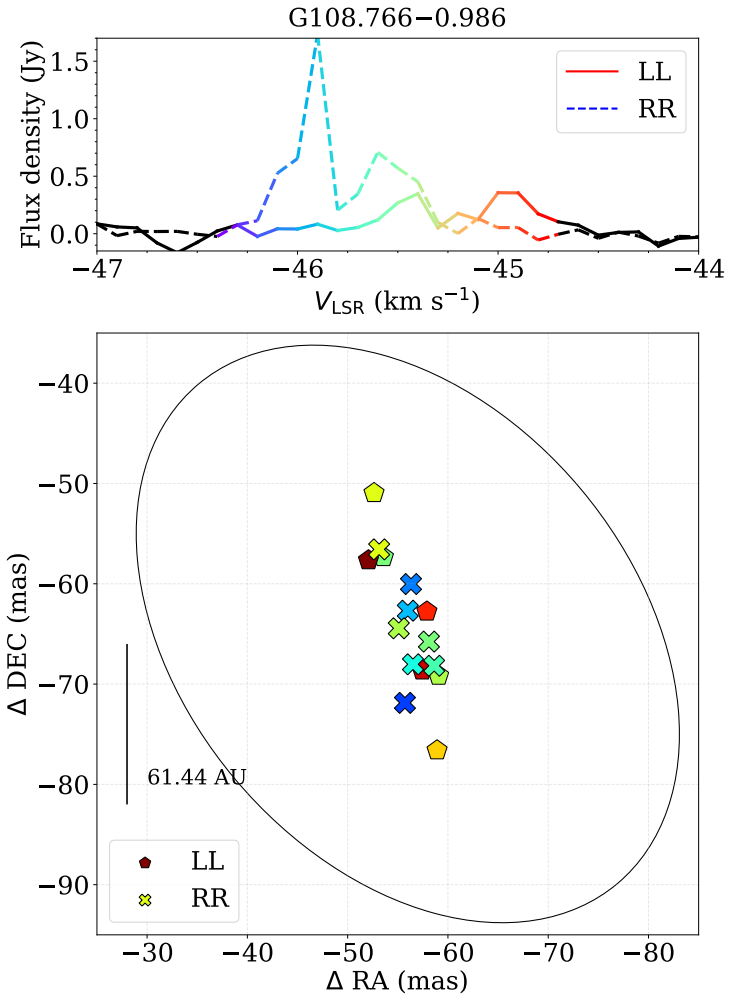
G69.540−0.976

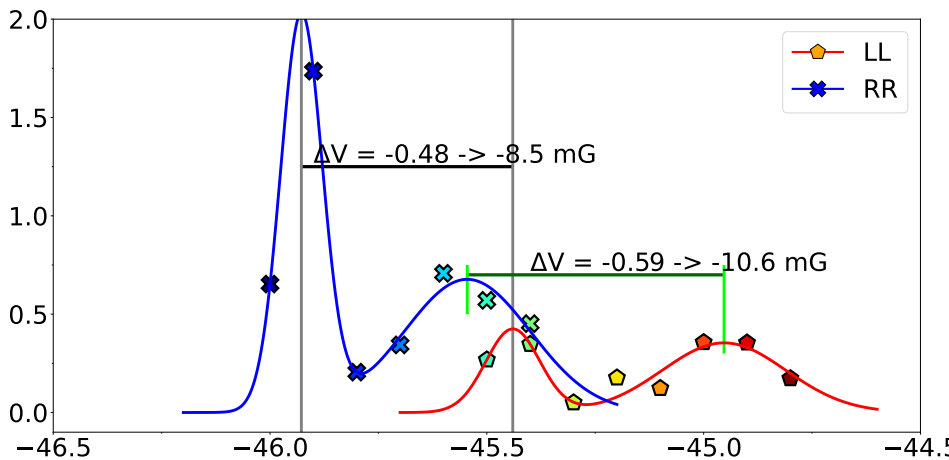

G69.540−0.976
Flux density (Jy)
LL
RR
V_{LSR} (km s^{-1})
-10 mG
584 AU
-4.4
-1.5
-1.2
-4.7
-4.8
Beam
LL
RR
Δ DEC (mas)
Δ RA (mas)

G108.766−0.986

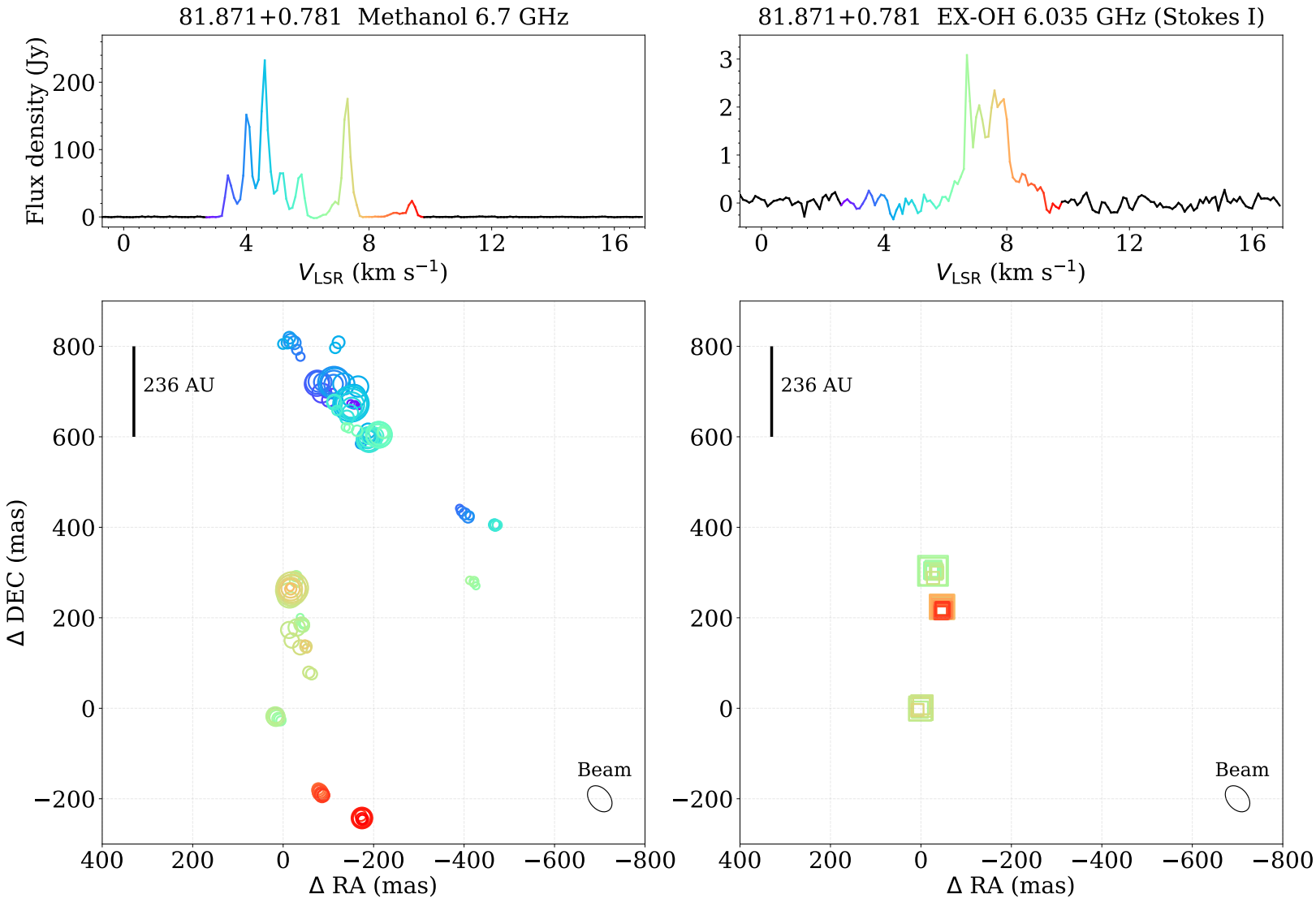


G108.766−0.986

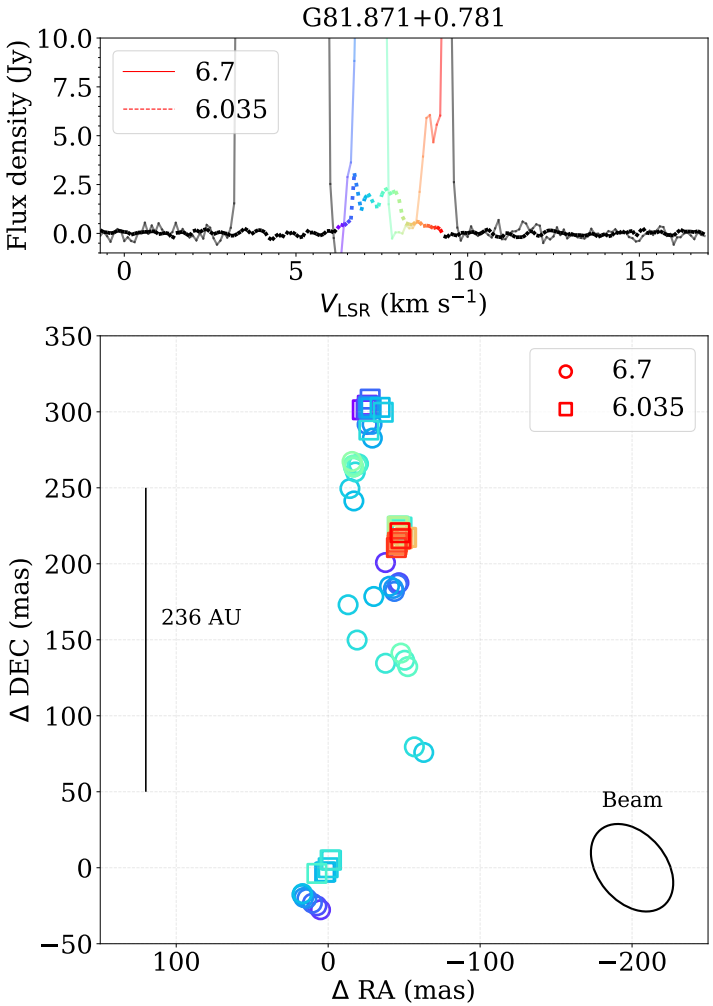




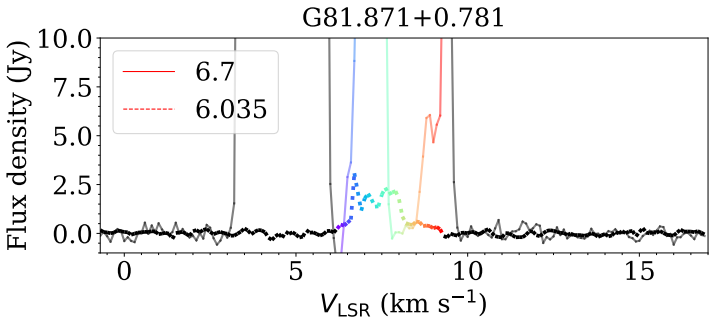
W75N

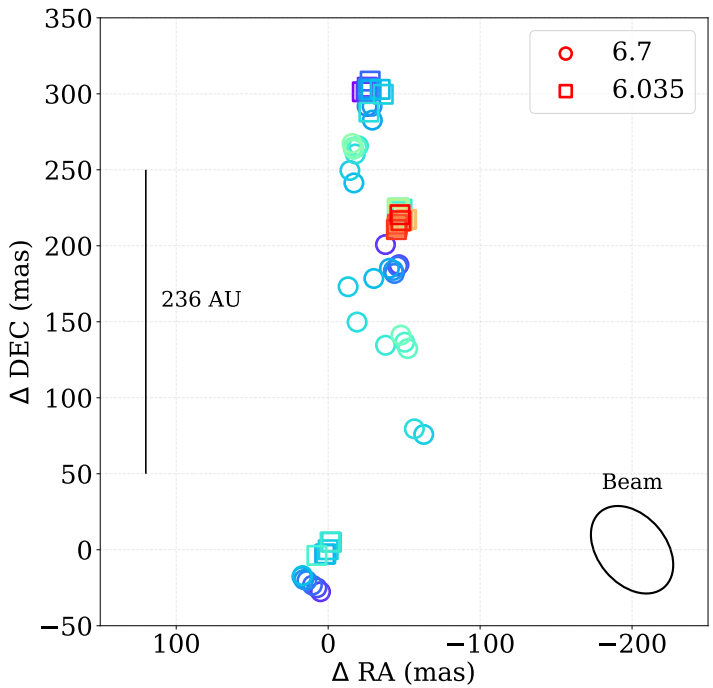

81.871+0.781 Methanol 6.7 GHz
Flux density (Jy)
V_{LSR} (km s^{-1})
81.871+0.781 EX-OH 6.035 GHz (Stokes I)
V_{LSR} (km s^{-1})
236 AU
Beam
Δ DEC (mas)
Δ RA (mas)
236 AU
Beam
Δ RA (mas)

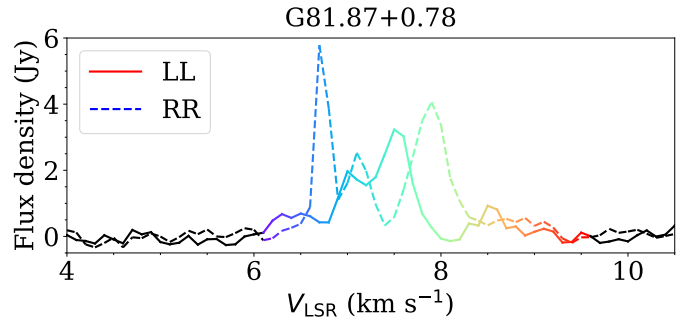
W75N

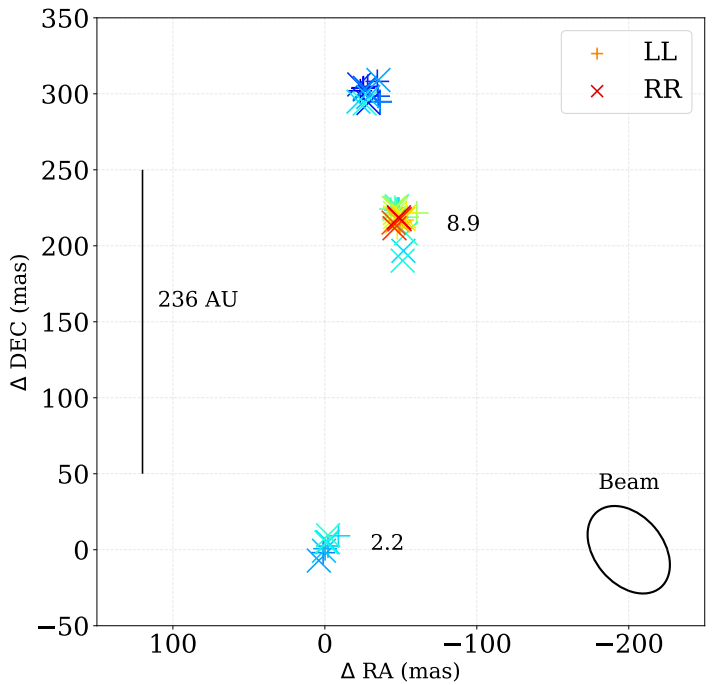

G81.871+0.781
Flux density (Jy)
10.0
7.5
5.0
2.5
0.0
6.7
6.035
0
5
10
15
V_{LSR} (km s^{-1})
350
300
250
200
150
100
50
0
−50
Δ DEC (mas)
236 AU
Beam
100
0
−100
−200
Δ RA (mas)

W75N


G81.871+0.781
Flux density (Jy)
6.7
6.035
V_{LSR} (km s^{-1})


6.7
6.035
236 AU
Beam
Δ DEC (mas)
Δ RA (mas)


G81.87+0.78
Flux density (Jy)
LL
RR
V_{LSR} (km s^{-1})


LL
RR
8.9
2.2
236 AU
Beam
Δ DEC (mas)
Δ RA (mas)

Summary

- G69.540−0.976
  - Partially overlapping both masers transition is observed,
  - six Zeeman pairs were identified indicating strength of the magnetic field from 1.5 to 10 mG in the direction towards the observer.
- G108.766−0.986
  - Distance between the emission two transitions is ∼150 AU,
  - rough estimate of the magnetic field gives values 8.5 and 10.6 mG in the direction towards the observer,
  - more spatial resolution is needed to resolve the ex-OH maser structure.
- W75N
  - Tentative coincidence between methanol and ex-OH masers (<20 mas) in the north. VLBI observations are needed,
  - the magnetic field direct away from the observer with values 2.2 mG and 8.9 mG.

This work was supported by the Centre of Excellence in Astrophysics and Astrochemistry that is a part of Excellence Initiative - Research University at the NCU in Toruń.