MILLIMETRE METHANOL MASERS

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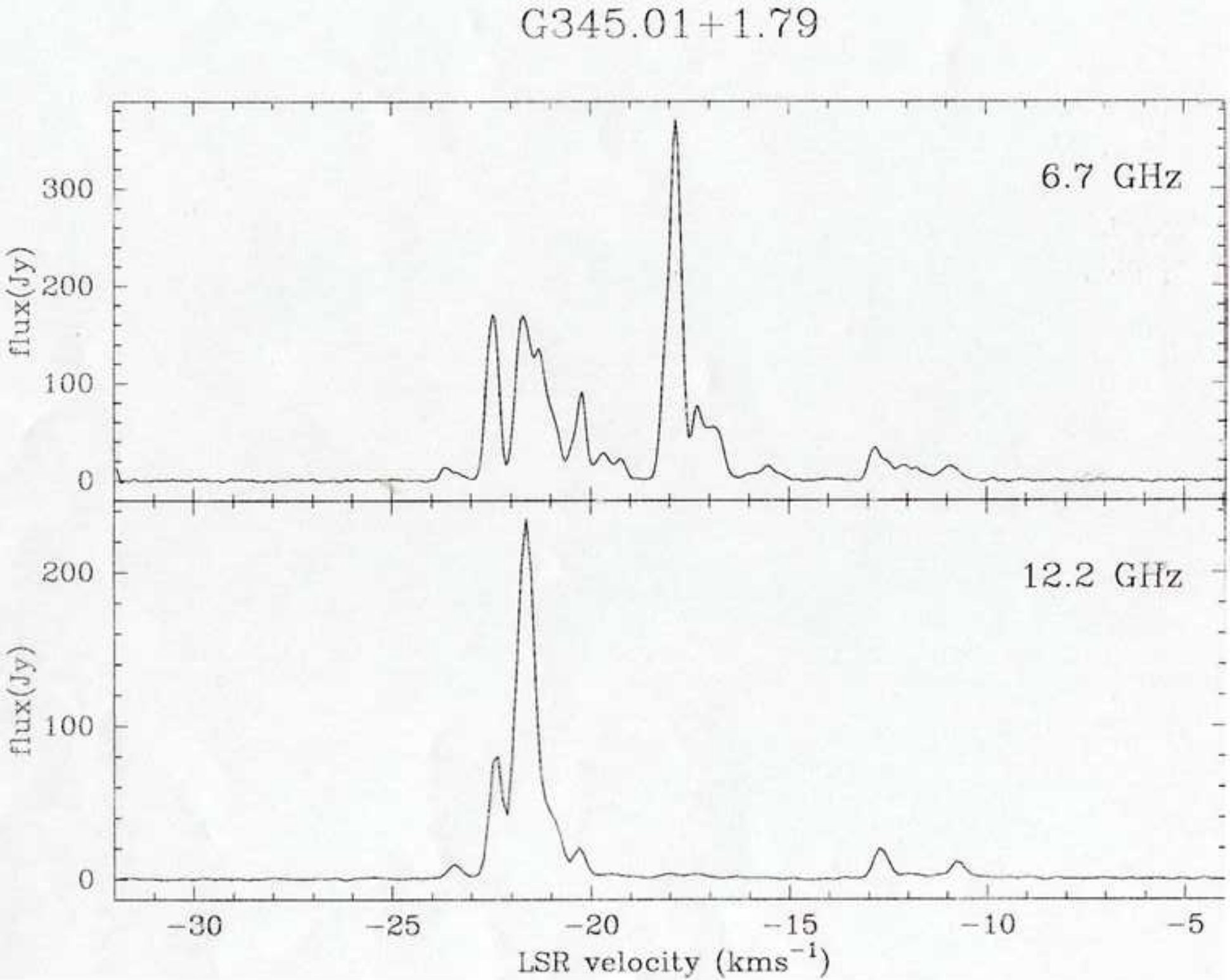
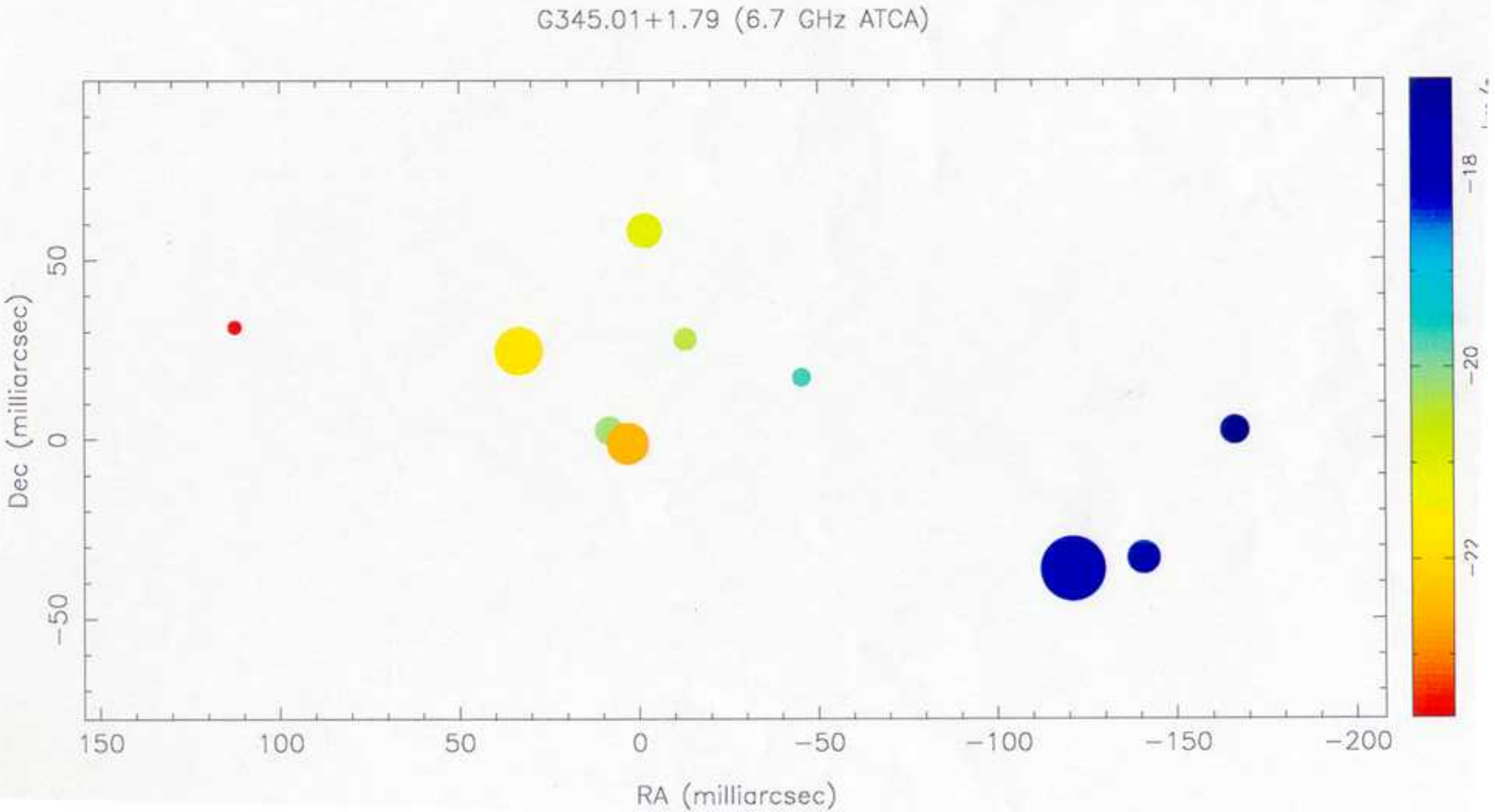
Class II Methanol masers

- Associated with recent massive star-formation
- ~ 500 Galactic sources at 6.6 and 12.1 GHz
- Spot size milliarcsec, clusters arcsec
- Brightness up to 10^{12} K
- 6.6 and 12.1 GHz masers coincide spatially
- ~ 30 sources also have weaker masers in mm range

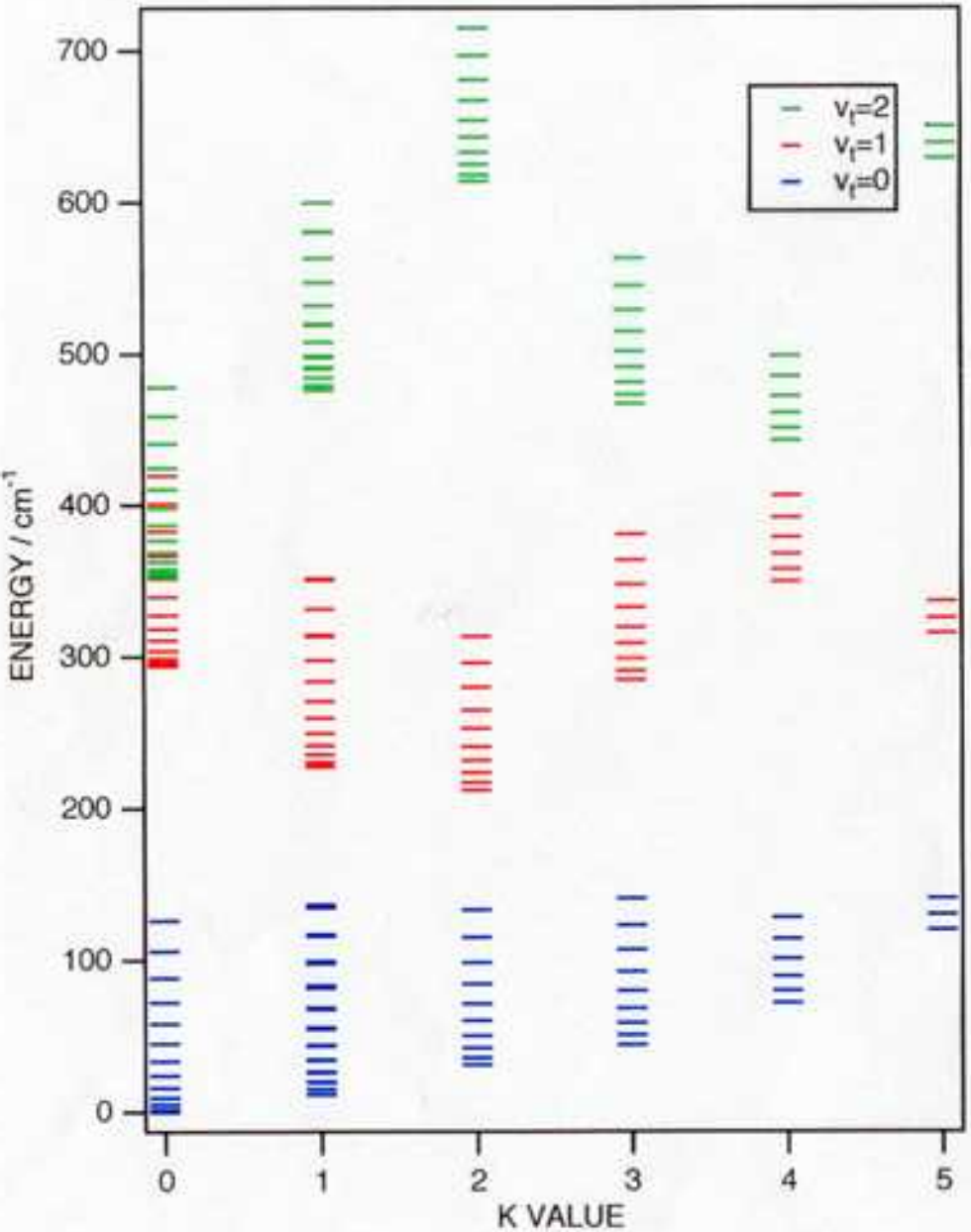
What is the spatial distribution of the mm masers?

What are the physical conditions in the maser regions?

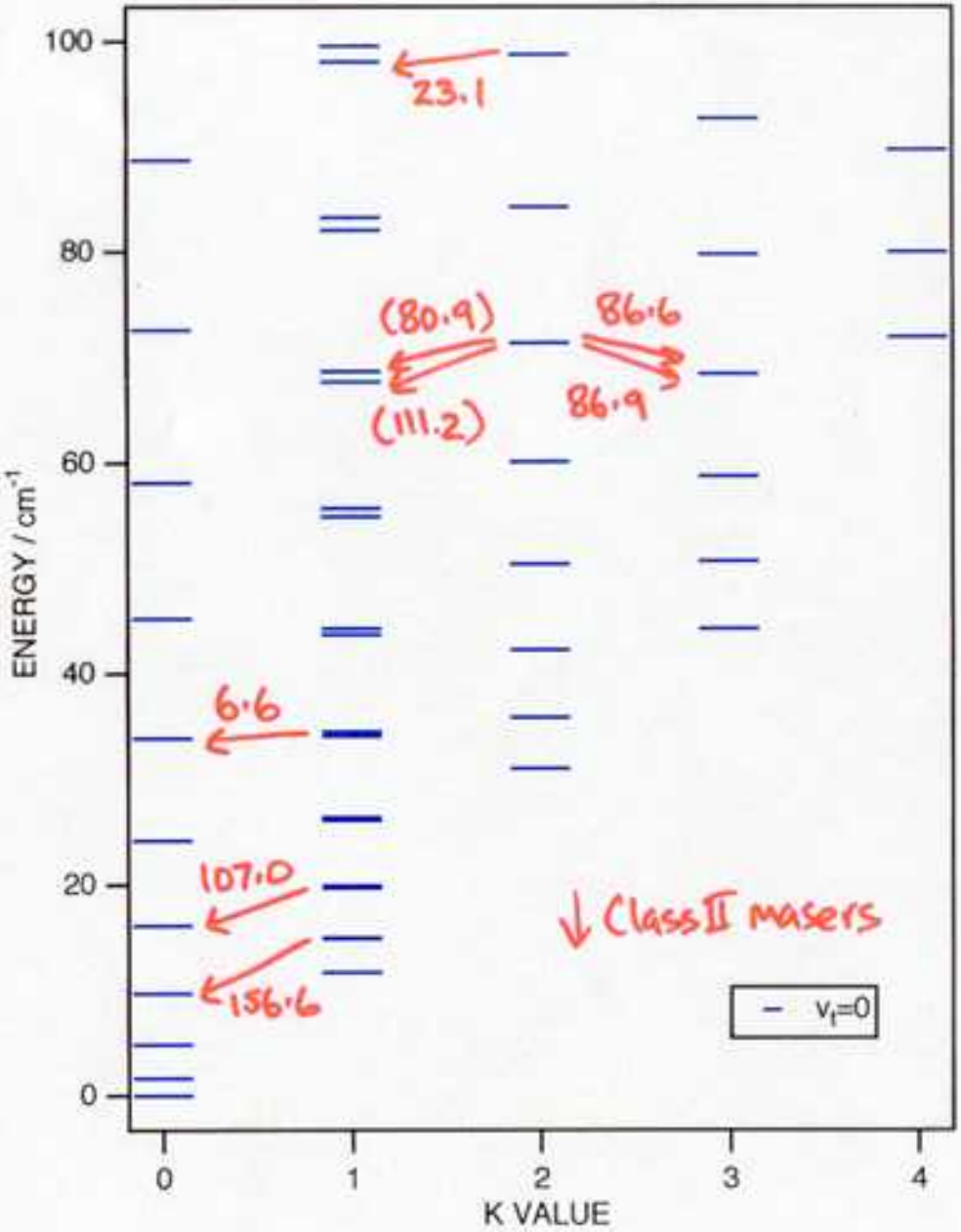

G345.01+1.79
6.7 GHz
12.2 GHz
flux(Jy)
flux(Jy)
300
200
100
0
200
100
0
−30
−25
−20
−15
−10
−5
LSR velocity (kms^{-1})


G345.01+1.79 (6.7 GHz ATCA)
Dec (milliarcsec)
RA (milliarcsec)
50
0
−50
150
100
50
0
−50
−100
−150
−200
−18
−20
−22

A SPECIES CH_3OH, v_t=0,1,2



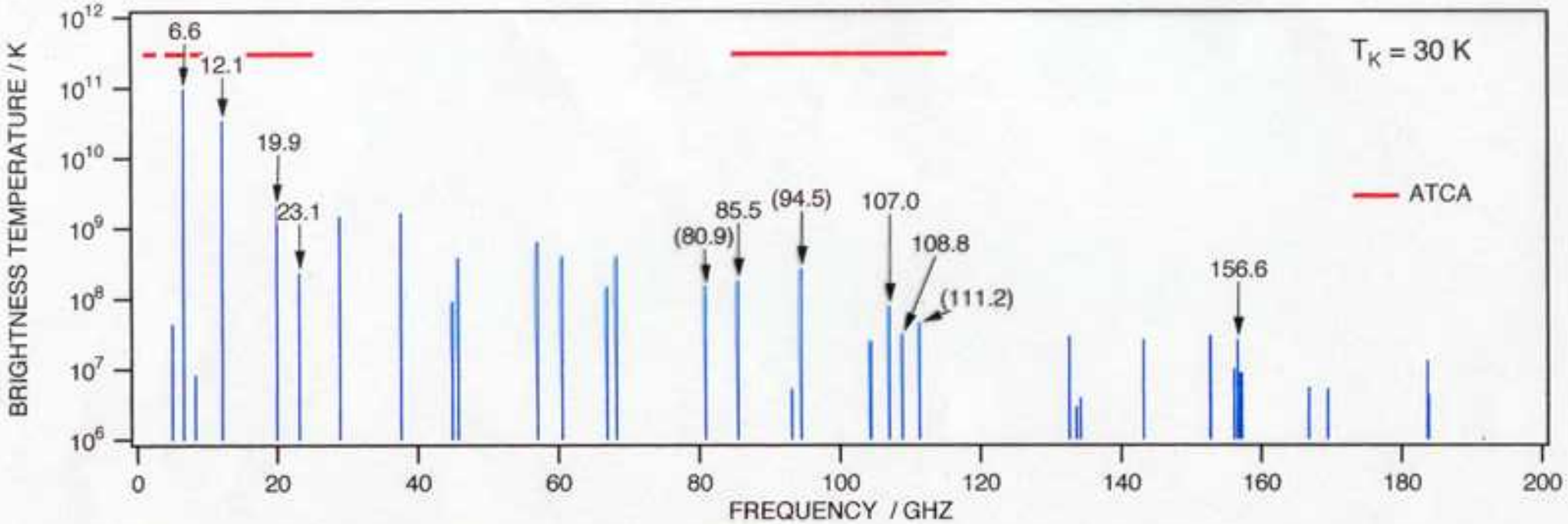
A SPECIES CH_3OH, TORSIONAL GROUND STATE

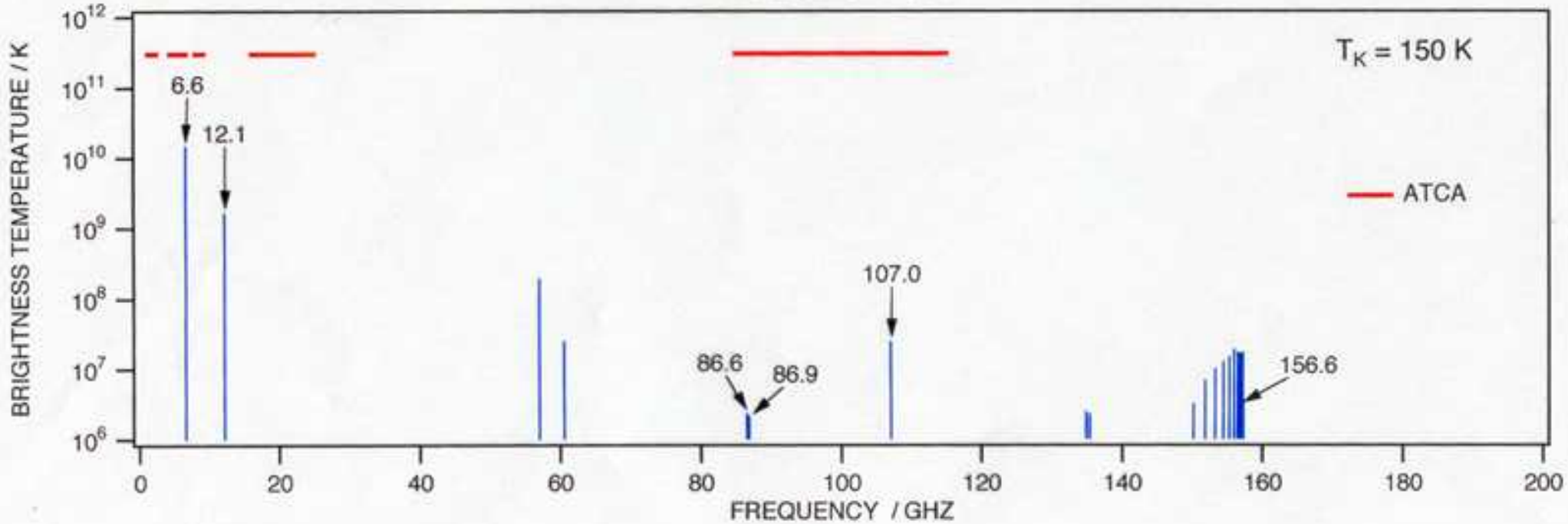


Sobolev-Deguchi maser pumping model

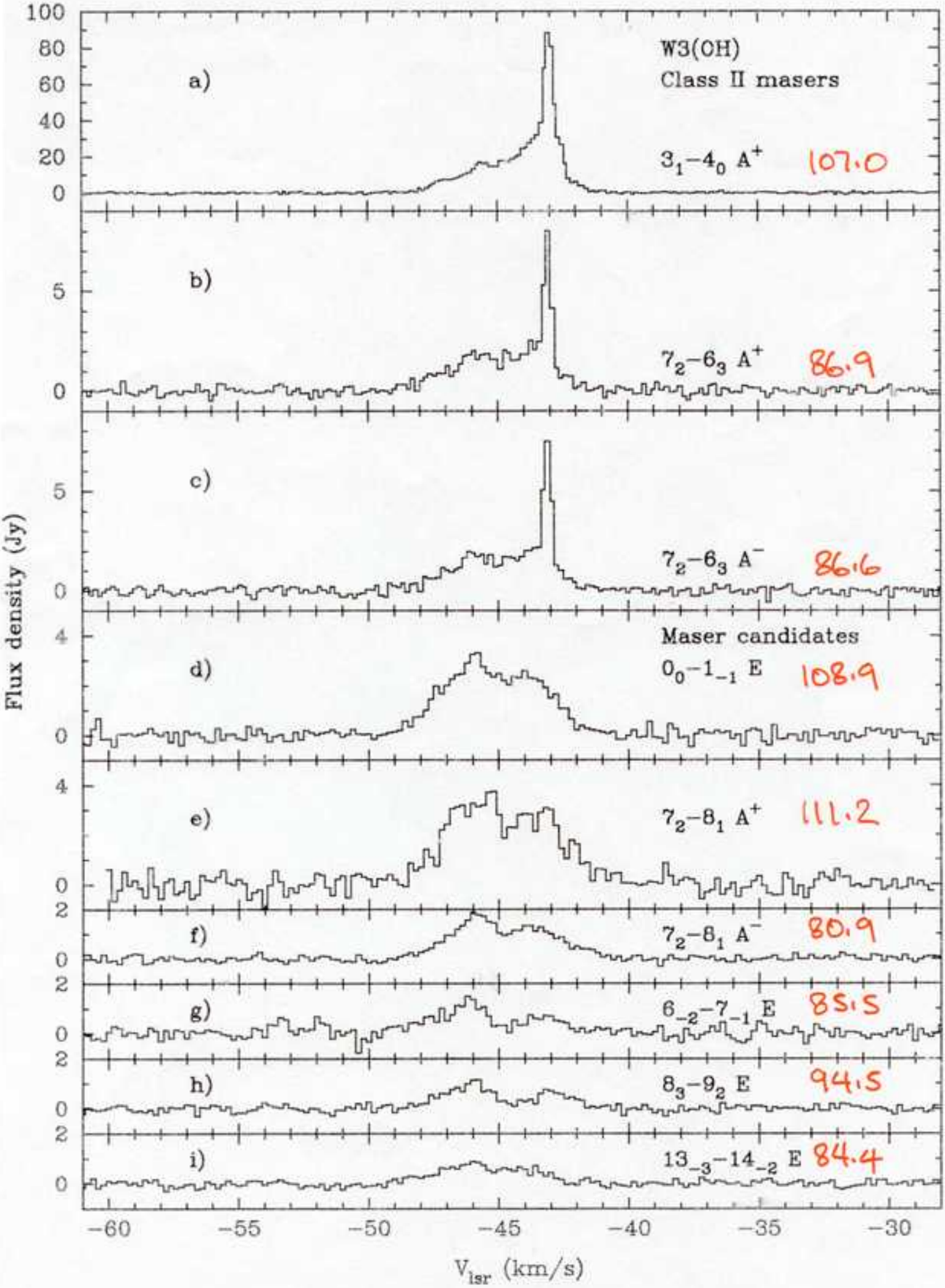
- IR radiation from warm dust (T_d) pumps methanol molecules to torsionally excited states
- Collisions with cool gas (T_k, n_H) determine radiative/collisional balance
- Large column density of methanol (N_m) for strong masers
- Beamed geometry (ε^{-1})
- Masers amplify ucHII background continuum (W_{HII})

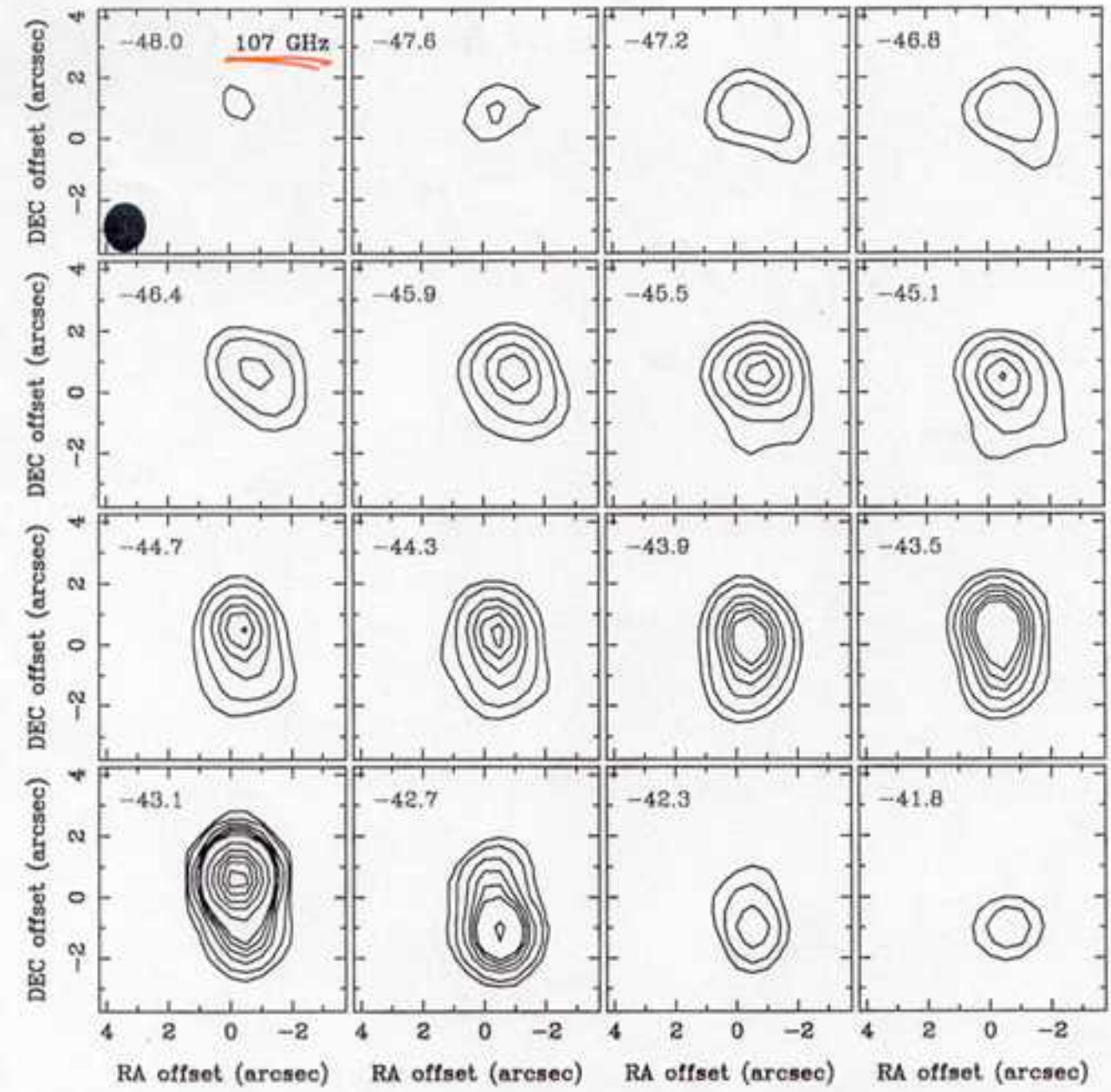
PREDICTED CLASS II METHANOL MASER SPECTRA

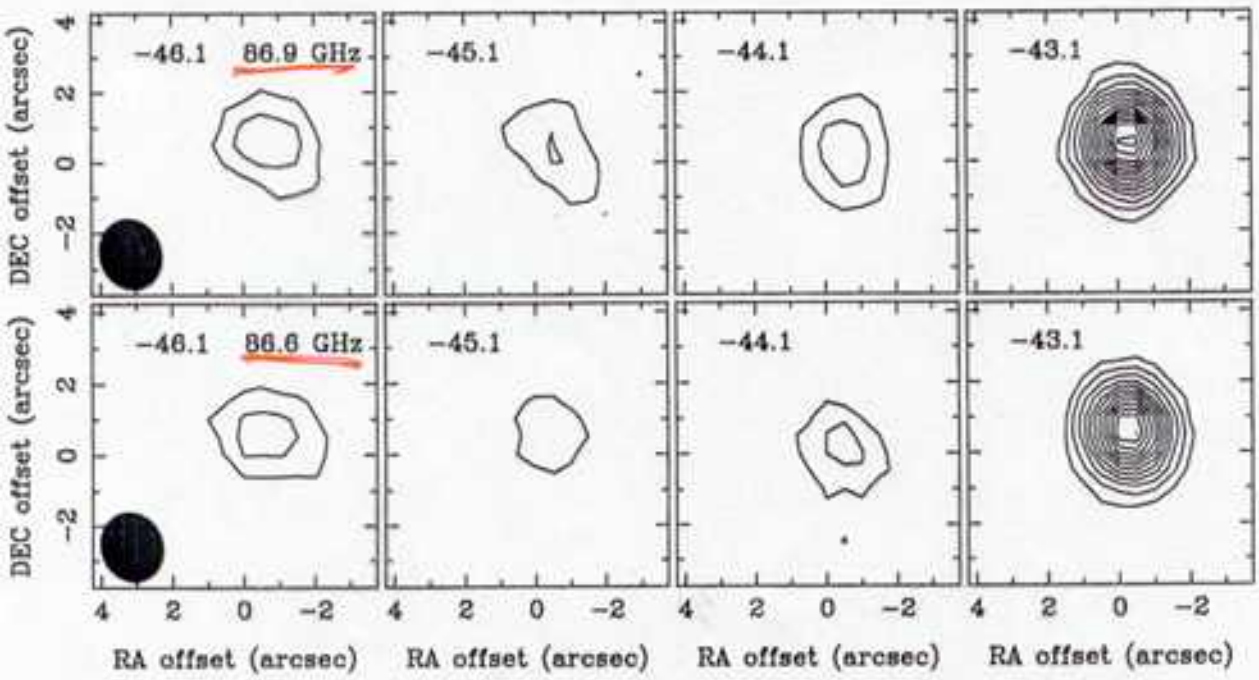




BIMA Observations of W3(OH)

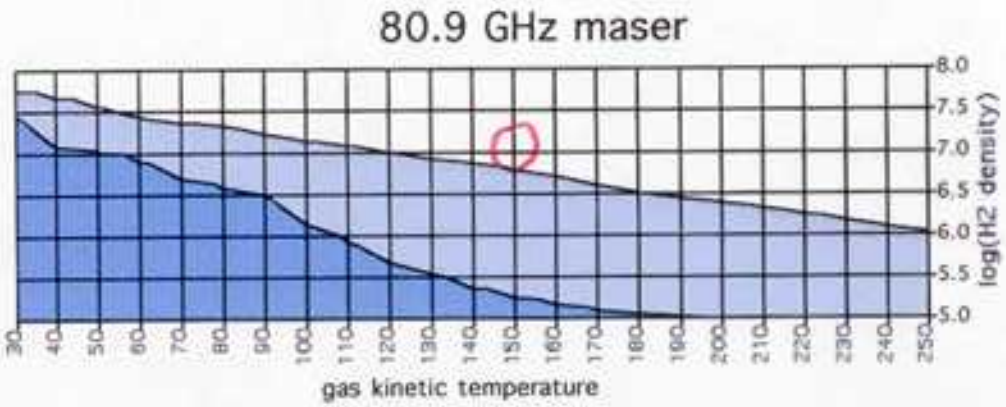


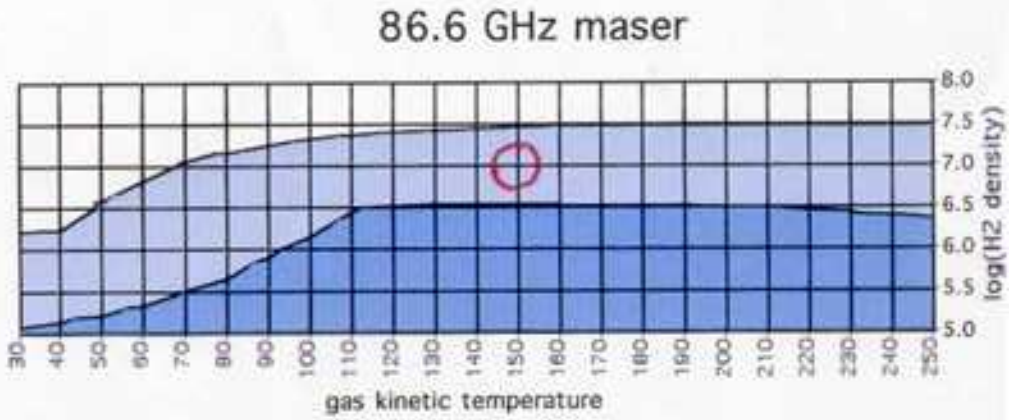

107 GHz
−48.0
−47.6
−47.2
−46.8
−46.4
−45.9
−45.5
−45.1
−44.7
−44.3
−43.9
−43.5
−43.1
−42.7
−42.3
−41.8
DEC offset (arcsec)
RA offset (arcsec)

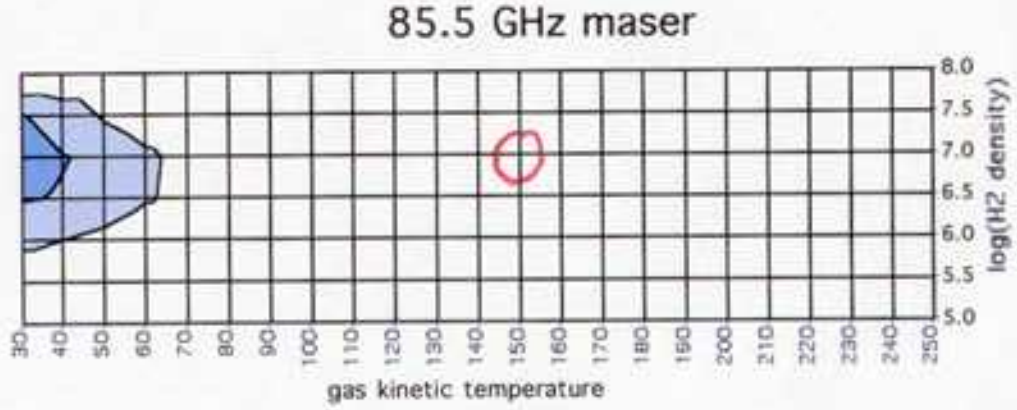

86.9 GHz
86.6 GHz
−46.1
−45.1
−44.1
−43.1
DEC offset (arcsec)
RA offset (arcsec)

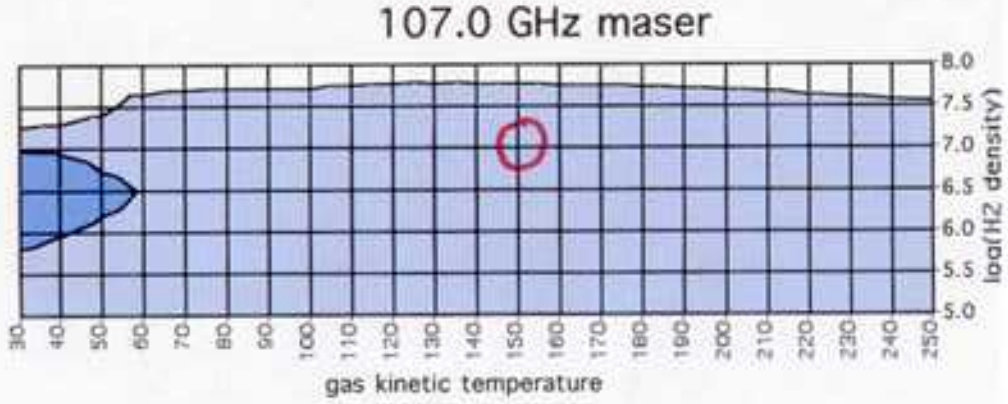
W3 (OH) BIMA

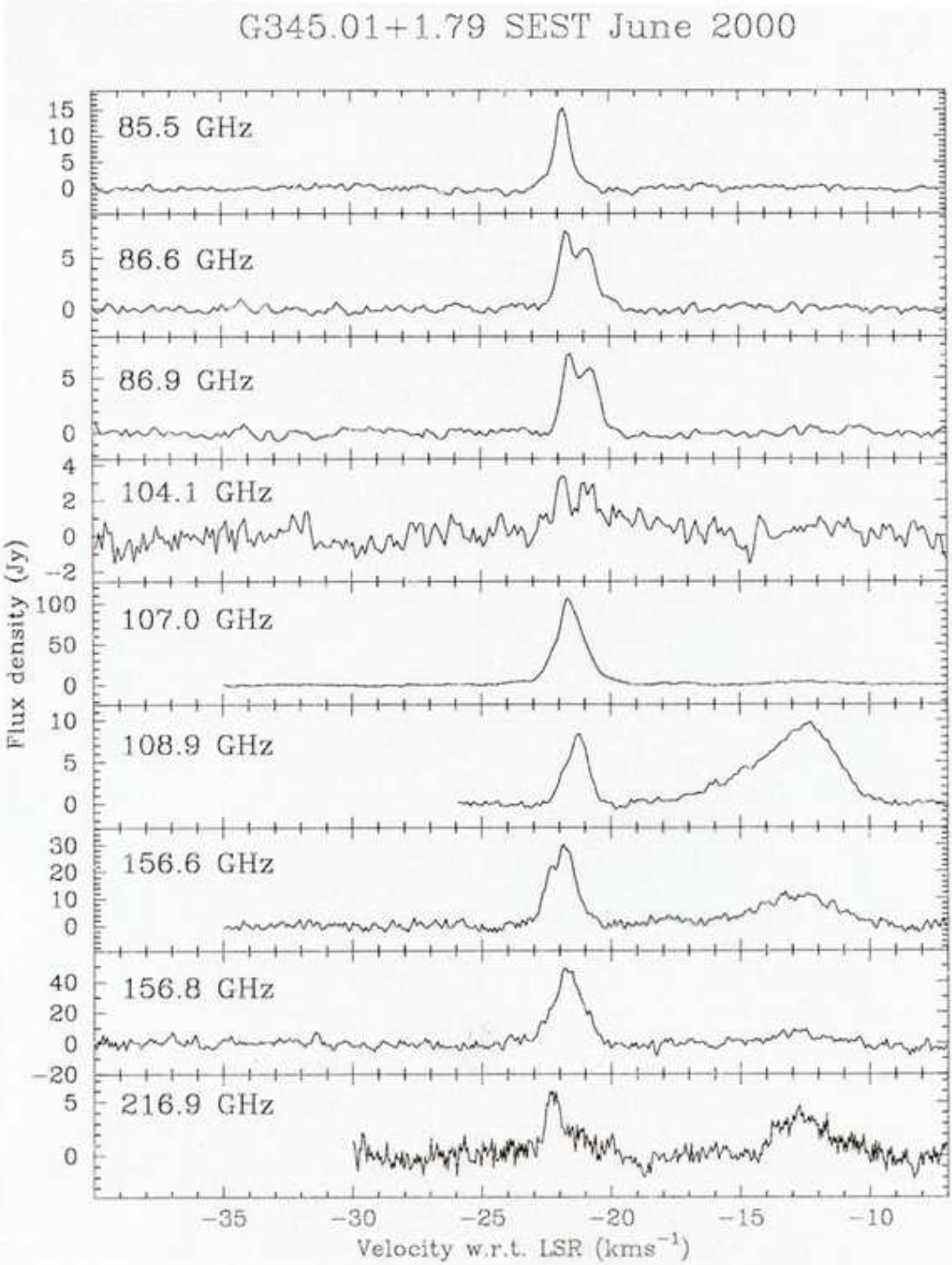
CONTOURS OF MASER BRIGHTNESS FROM MODEL CALCULATIONS

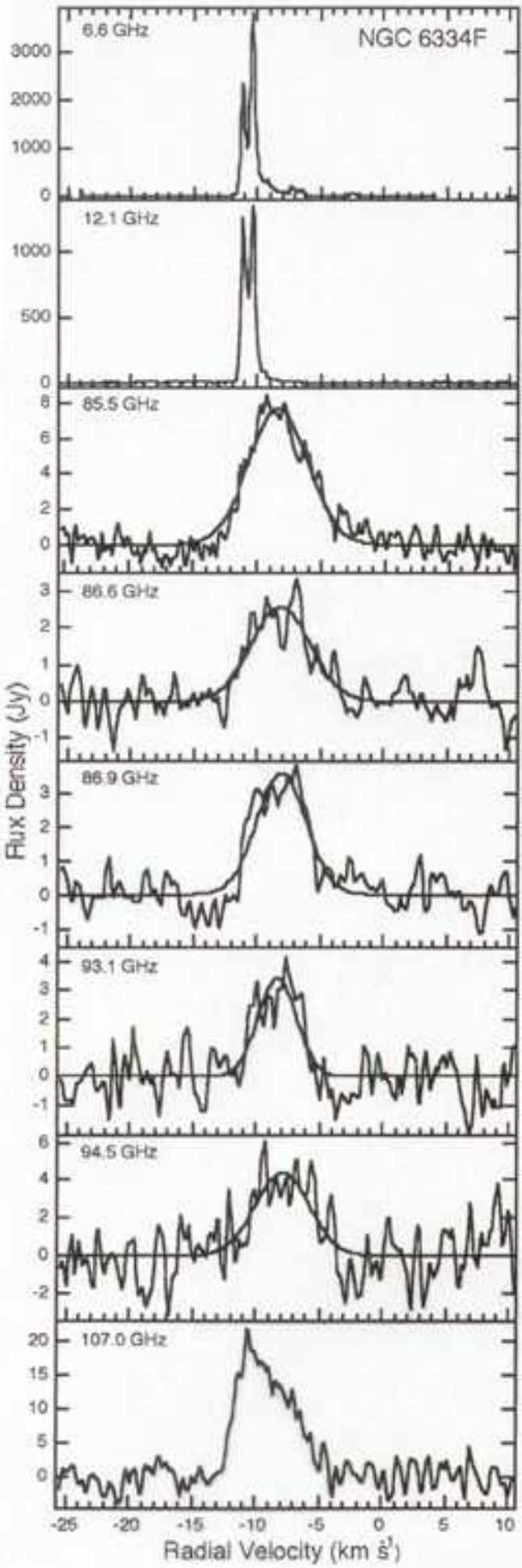









G345.01+1.79 SEST June 2000
85.5 GHz
86.6 GHz
86.9 GHz
104.1 GHz
107.0 GHz
108.9 GHz
156.6 GHz
156.8 GHz
216.9 GHz
Flux density (Jy)
Velocity w.r.t. LSR (kms^{-1})
−35
−30
−25
−20
−15
−10


NGC 6334F
6.6 GHz
12.1 GHz
85.5 GHz
86.6 GHz
86.9 GHz
93.1 GHz
94.5 GHz
107.0 GHz
Flux Density (Jy)
Radial Velocity (km s⁻¹)