Recent MERLIN results: Missing masers in W3(OH)

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Introduction

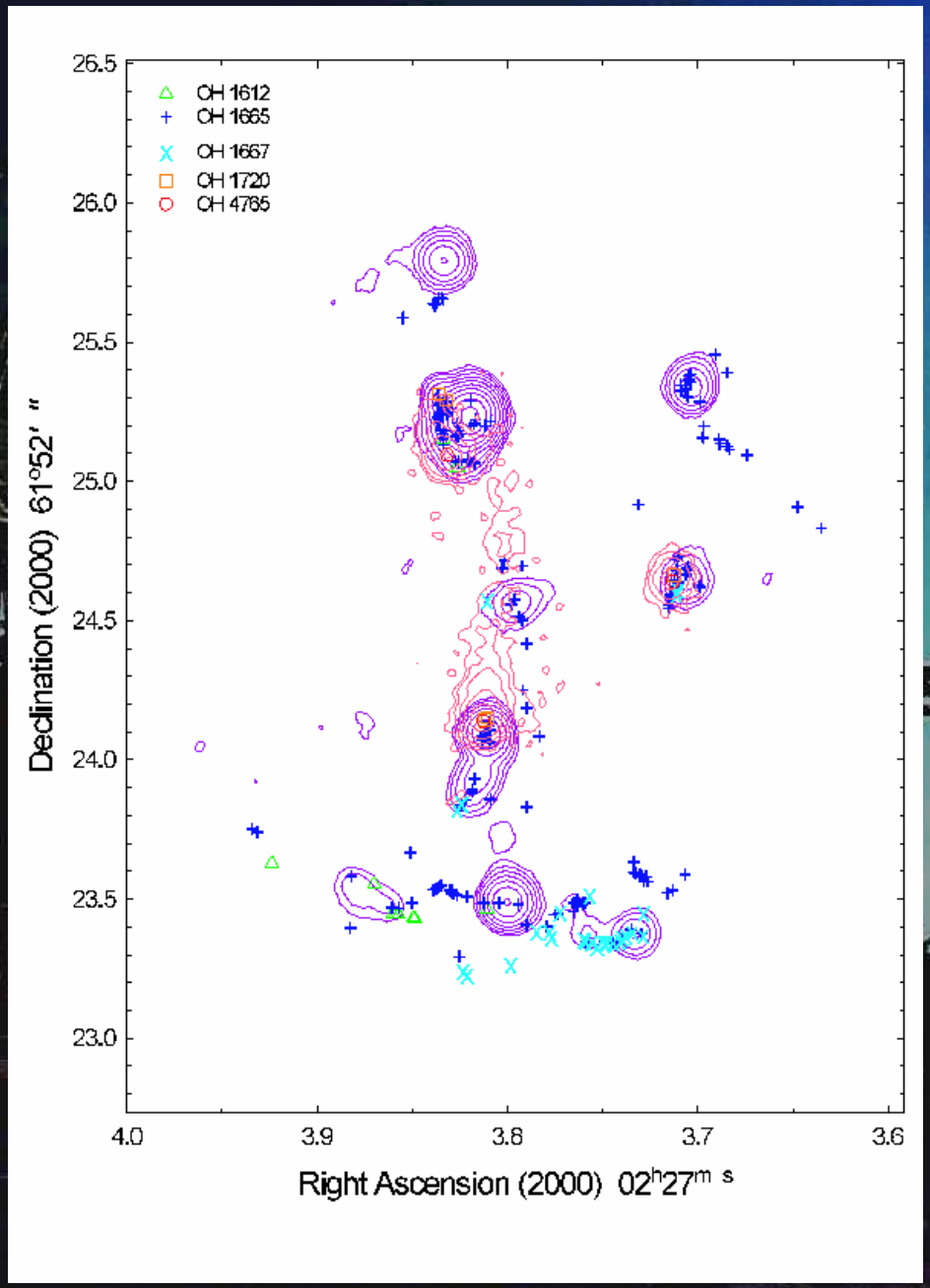
- MERLIN has new broadband (4-8 GHz) C-band receivers (installed November 2004).
- MERLIN is now capable of methanol observations at 6.7 GHz.
- The methanol transition at 6.7 GHz is a bright and important tracer of massive star formation.
- Massive stars contribute a great deal to the ISM, but their formation is not readily understood.

Observations

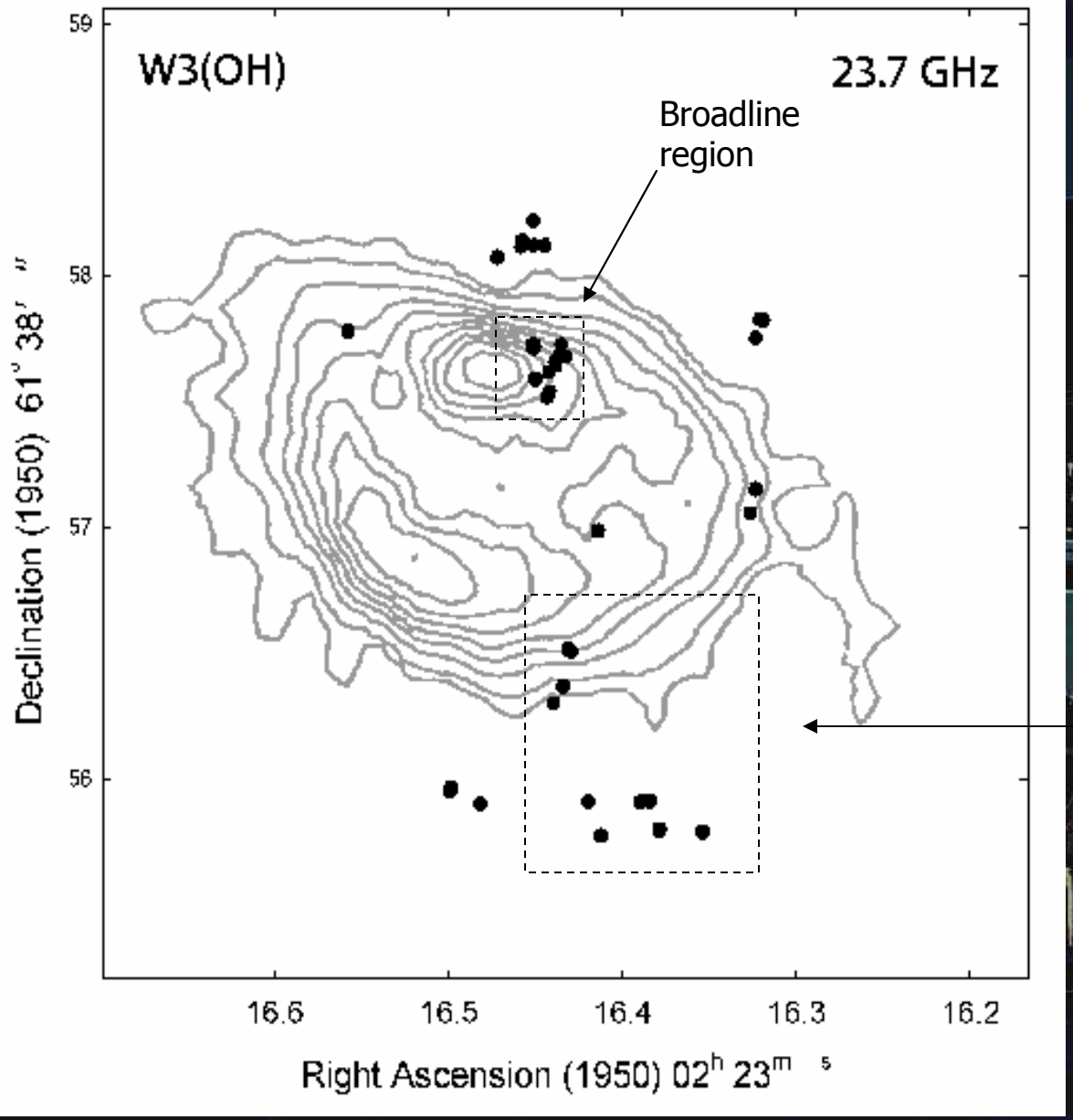
- We studied W3(OH) using the Mk2, Pickmere, Darnhall Knockin & Cambridge telescopes in December 2004.
- This was a follow-up of MERLIN observations of excited OH masers which discovered the 'missing maser flux' in W3(OH).

Methanol Results

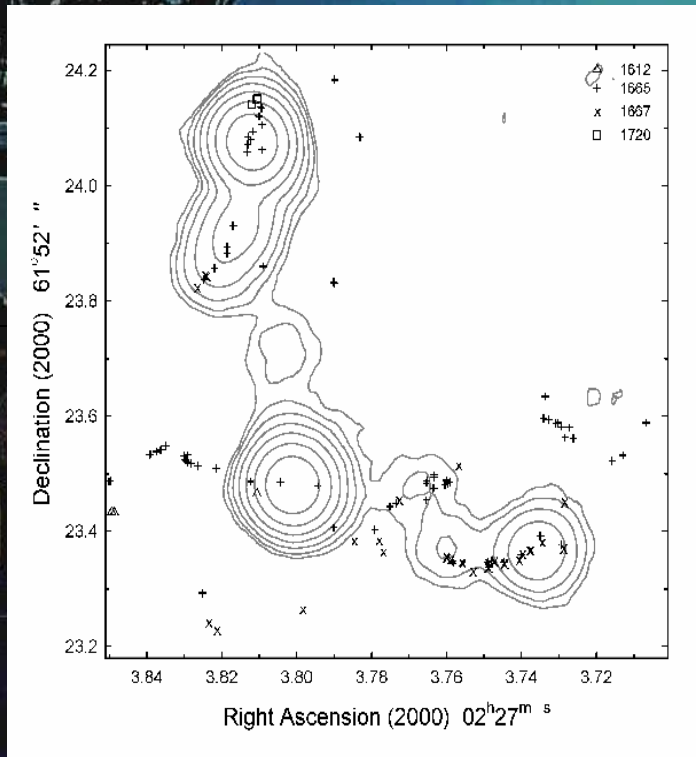
- MERLIN found all the methanol flux.
- The methanol maps show similar maser filaments which follow the same arcs.
- The methanol & OH avoid each other on small scales, together form a giant maser filament (3100 au).



Harvey-Smith & Cohen (2006) *MNRAS, in prep.*

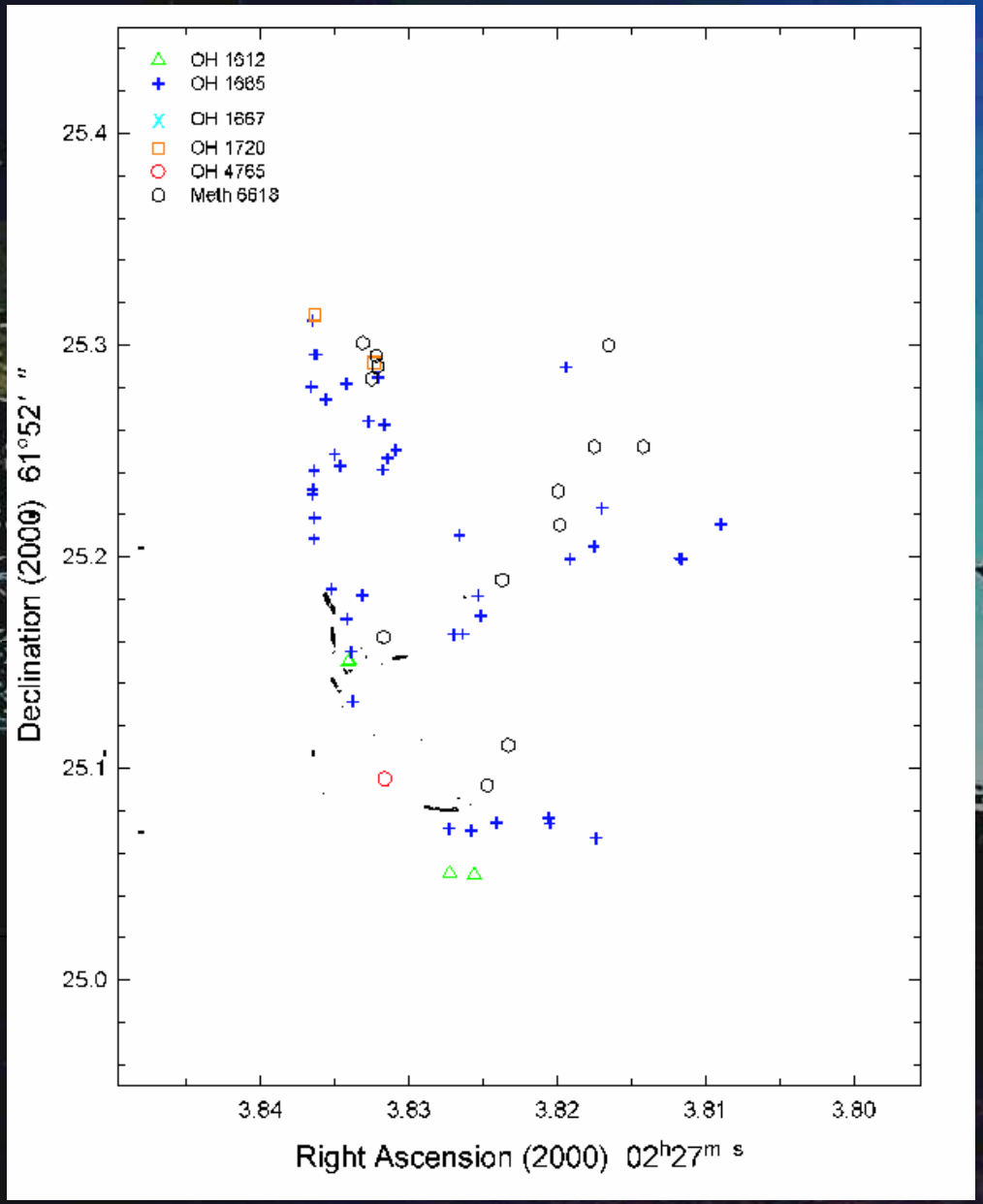


Several smaller maser filaments probably trace shocks.



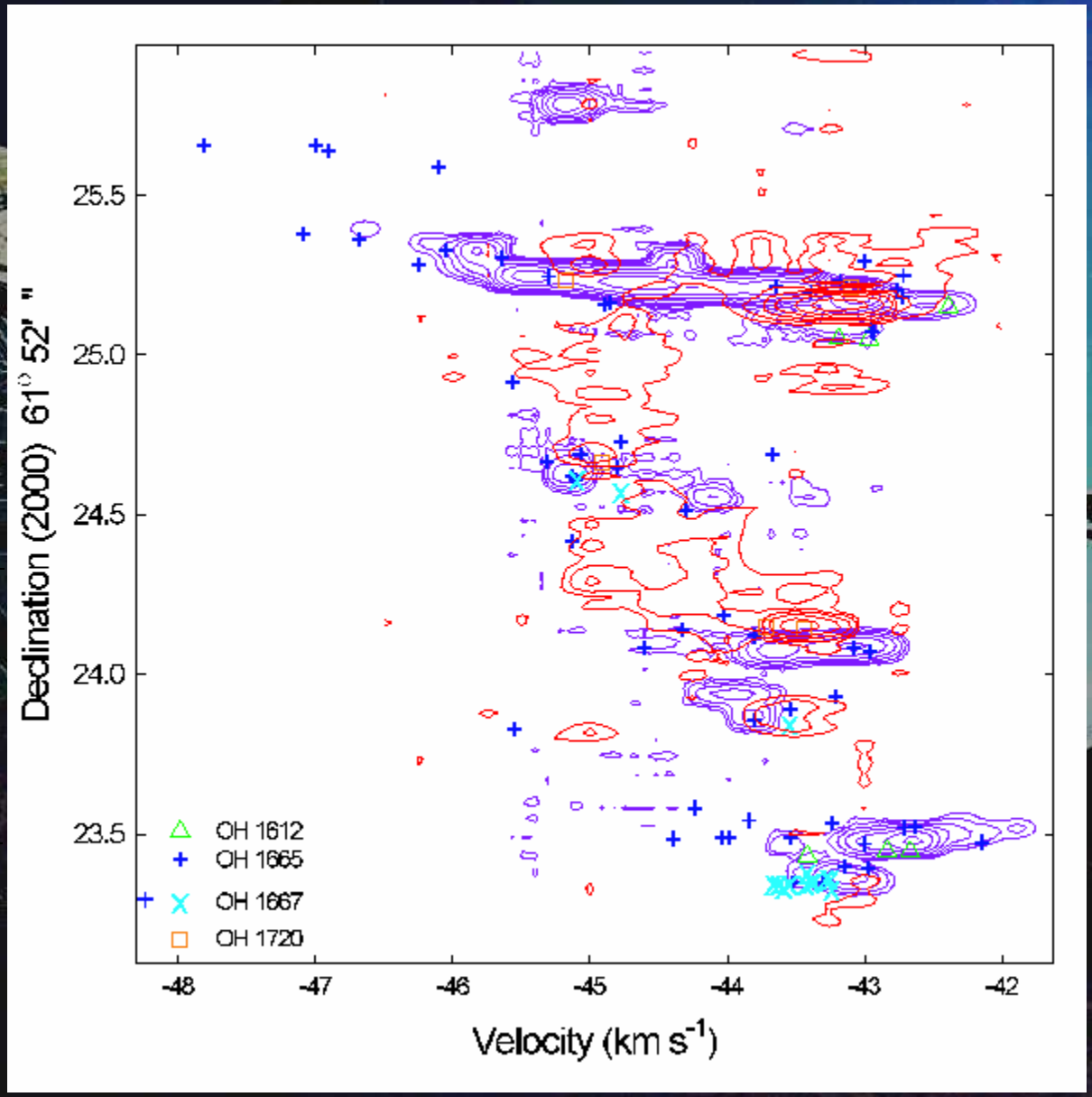
The broadline region

- The central region contains 13 methanol masers with relatively broad line profiles.
- Dominant emission (80%) comes from a filament 400 au long.
- This coincides with brightest continuum emission, strongest B field and is surrounded by an ellipse of OH masers.



The broadline region

- Velocity gradients are complex but enable us to understand small-scale motions.
- The broadline filament has a velocity gradient of 47 km s^{-1}arcsec^{-1}.
- Methanol 12.2 & OH 1.7 GHz masers have same velocity gradient.



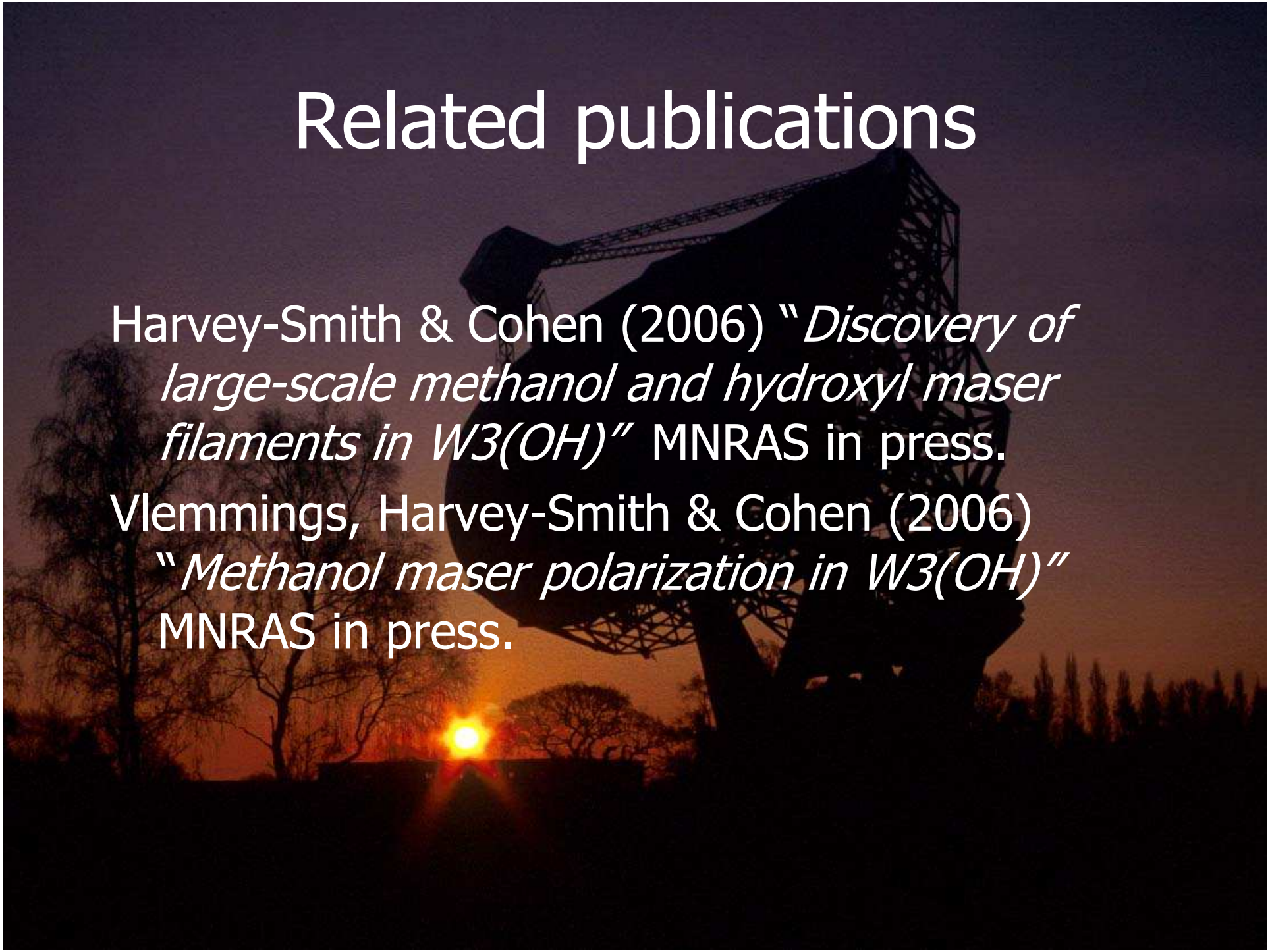
Conclusions

- The gradient in the broadline region is consistent with a rotating disc around a central 13 M_s object.
- We believe the broadline region hosts the centre of star-formation in W3(OH), as proposed by Baudry & Diamond (1998).
- There are many similarities with elongated methanol structure in NGC 7538 (Minier et al. 1998) has a velocity gradient of 55 km s^{-1} $arcsec^{-1}$ and was interpreted as an edge-on Keplerian disc.
- There appears to be a maser `bubble' surrounding the broadline region, similar to that in Cep A (H_2O masers).

Future observations

- MERLIN observations of OH 6.0-GHz masers will soon add to the montage of extended maser emission in W3(OH).
- EVN+MERLIN observations --ideal for probing the broadline region at higher angular resolution whilst retaining the ability to image the extended maser emission.
- The extended masers show that the conditions for OH-methanol overlap are limited to the boundaries between emission of each species.
- This approach to maser research has great potential for improving astrophysical and astrochemical models in UC HII regions and for understanding the origins of interstellar masers.

Related publications



Harvey-Smith & Cohen (2006) "*Discovery of large-scale methanol and hydroxyl maser filaments in W3(OH)"* MNRAS in press.

Vlemmings, Harvey-Smith & Cohen (2006) "*Methanol maser polarization in W3(OH)"* MNRAS in press.