PROCEEDINGS OF SCIENCE

MERLIN observations of OH/IR stars

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We present MERLIN OH 1612 MHz observations towards 3 OH/IR stars, OH15.7+0.8, OH38.3+1.9 and IRAS 19319+2214. The main objective of the project is to investigate if their complicated OH 1612 MHz spectral properties can be related to the phenomenon of highly time-variable mass loss found towards a handful of carbon stars, where detached shells with an overall spherical symmetry are present. Despite extensive searches, no oxygen-rich star with such a shell has been found in any molecular emission. Based on the MERLIN data however, we find that the circumstellar structure of the three OH/IR stars appears to be more complicated than that of detached shells. Signs of bipolarity in the outflows of OH38.3+1.9 and IRAS 19319+2214 could indicate that these are early post-AGB objects.

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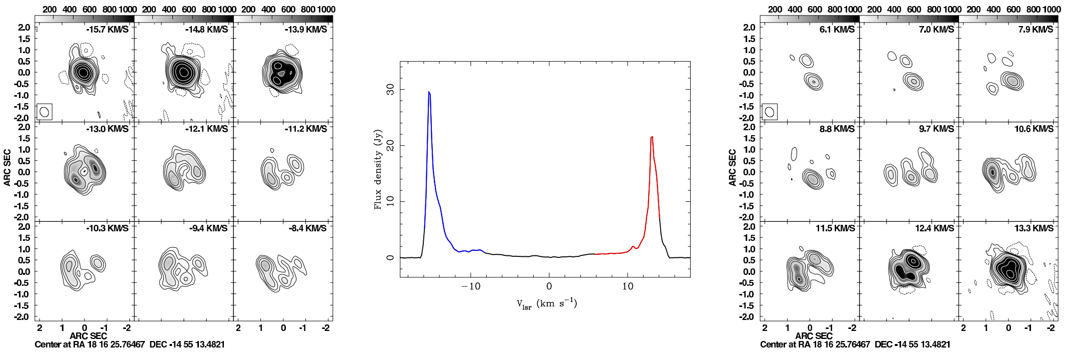

Figure 1: The integrated OH 1612 MHz spectrum (middle) and velocity channel maps (left; blueshifted and right; redshifted part of the line profile) towards OH15.7+0.8.

1. Introduction

When looking at a sample of OH 1612 MHz spectra towards OH/IR stars, one is struck immediately by their similarity. It was recognized early that the spectra have the twin-peaked shape characteristic of radial amplification in an expanding shell (e.g., Goldreich & Scoville 1976). However, in a few cases the line profiles are more complicated with additional pairs of emission lines. It is possible that this is related to the phenomenon of highly episodic mass loss, possibly connected to thermal pulses, seen towards a handful of carbon stars (Schöier et al. 2005). The relation between OH/IR stars and thermal pulses has been discussed by, e.g., Lewis (2004). On the other hand, Zijlstra et al. (2001) showed that bipolarity could explain a range of profile shapes in OH/IR stars with unusually large expansion velocities ($\Delta V > 50\,\mathrm{km\,s^{-1}}$).

Here we present preliminary results obtained with MERLIN towards 3 interesting candidates, OH15.7+0.8, OH38.3+1.9 and IRAS 19319+2214.

2. Observations

The OH 1612 MHz observations were carried out during 2005 using the MERLIN interferometer. Calibration and data reduction were done using MERLIN-specific software (dprograms) and AIPS. The resulting spatial resolution in the CLEANED data is $\sim 0.2'' - 0.4''$ and the rms in an emission free velocity channel ($\Delta V = 0.18\,\mathrm{km\,s^{-1}}$) $\sim 5\,\mathrm{mJy\,beam^{-1}}$

3. Result and discussion

OH15.7+0.8

The reason for observing OH15.7+0.8 was that unpublished MERLIN data (Steenman et al.) shows evidence for a multiple shell structure, although the line profile itself is that of a standard source. We find that the emission is well resolved and we see the expected shell structure close to the extreme velocities. No emission is detected at the systemic velocity. The multiple shell structure seen in earlier data is not corroborated by our data of significantly better quality. There is, however, some emission that complicates the interpretation in terms of a standard expanding shell,

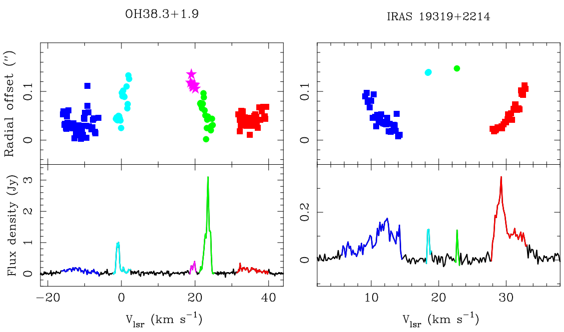

Figure 2: Left upper panel: Projected radial offsets (from centre of expansion) of fitted Gaussian components as a function of velocity of OH38.3+1.9. Left lower panel: The integrated OH 1612 MHz spectrum towards OH38.3+1.9. Right upper panel: Projected radial offsets (from centre of expansion) of fitted Gaussian components as a function of velocity of IRAS 19319+2214. Right lower panel: The integrated OH 1612 MHz spectrum towards IRAS 19319+2214.

e.g., the strong component seen in the velocity channel map at $9.7\,\mathrm{km\,s^{-1}}$ (see Fig 1, middle map of right panel).

OH38.3+1.9 and IRAS 19319+2214

The line profile of OH38.3+1.9 (Fig 2) shows, in addition to the standard line profile, a pair of weak broad peaks (blue and red symbols). Without high resolution OH data one might suspect that this line profile could be related to the phenomenon of varying mass loss. The OH brightness distribution suggests however, that the outer spectral features come from a more compact, non-spherical, region than the inner spectral features (see Fig 2).

The OH 1612 MHz spectrum towards IRAS 19319+2214 is complicated. Based on the MERLIN data and the model in Zijlstra et al. (2001) we find that the outer spectral features may perhaps be interpreted as a bipolar outflow, see Fig 2. In addition, the inner spectral features, at ~ 19 and $\sim 23\,\mathrm{km\,s^{-1}}$, do not coincide spatially as expected for a spherical spherical symmetric outflow, which complicates the interpretation.

Given their more complicated kinematical and morphological structure, when compared with the detached shells detected around carbon stars, it is possible that these objects are early post-AGB objects. However, much uncertainty exist as to the nature of the mass ejections from an AGB star in connection with a thermal pulse.

Dedication

This work was inspired by Jim Cohen who passed away on November 1, 2006.

References

[1] Goldreich P., Scoville N. 1976, ApJ 205, 144

[2] Lewis B.M., Kopon D.A., Terzian Y., 2004, AJ 127, 501

[3] Schöier F.L., Lindqvist M., Olofsson H., 2005, A&A 436, 633

[4] Zijlstra A.A., Chapman J.M., te Lintel Hekkert P., et al., 2001, MNRAS 322, 280