# Automatic Bubble Detection in Hi-GAL images

Morten Andersen, Julien Bardagi, Annie Zavagno, Delphine Russeil,

Antoine Llebaria and Yé Tian (LAM, France) Sergio Molonari, Davide Elia (INAF, Italy)

## HII regions in the Galaxy

HII regions are unique markers of the early phases of star massive star formation.
A census of the population of HII regions within the Galaxy is thus a direct tracer of the recent star formation. However, most Galactic HII regions are obscured and invisible in the optical. Instead the HII regions can be identified due to their heating of the surrounding dust making them stand out at mid- and far-infrared wavelengths.

## The Hi-GAL survey of the Galactic plane

The Hi-Gal survey is ideal to obtain a census of Galactic HII regions through detection of warm dust at 70 micron. We have implemented an automatic search for bubbles using the Line Adjacency Graph (LAG) method that identifies gradients within an image which makes it very well suited to identify bubbles and shells.
The large gradient regions are then fitted with an ellipsoid to obtain their size and their orientation on the sky.

## Results.

Figure 1 shows an example region at l=319 degrees and the identified bubbles. A comparison with the WISE identified bubbles (Anderson et al. 2012, A&A, 537, 1A).
The increased sensitivity and better spatial resolution has increased the sample substantially. Across the whole Galactic plane we detect 3500 sources. However, for the smallest regions there are contamination by point sources. Restricting the sample to objects with a semi-minor axis larger than 30 arc seconds reduce the sample to 2900.
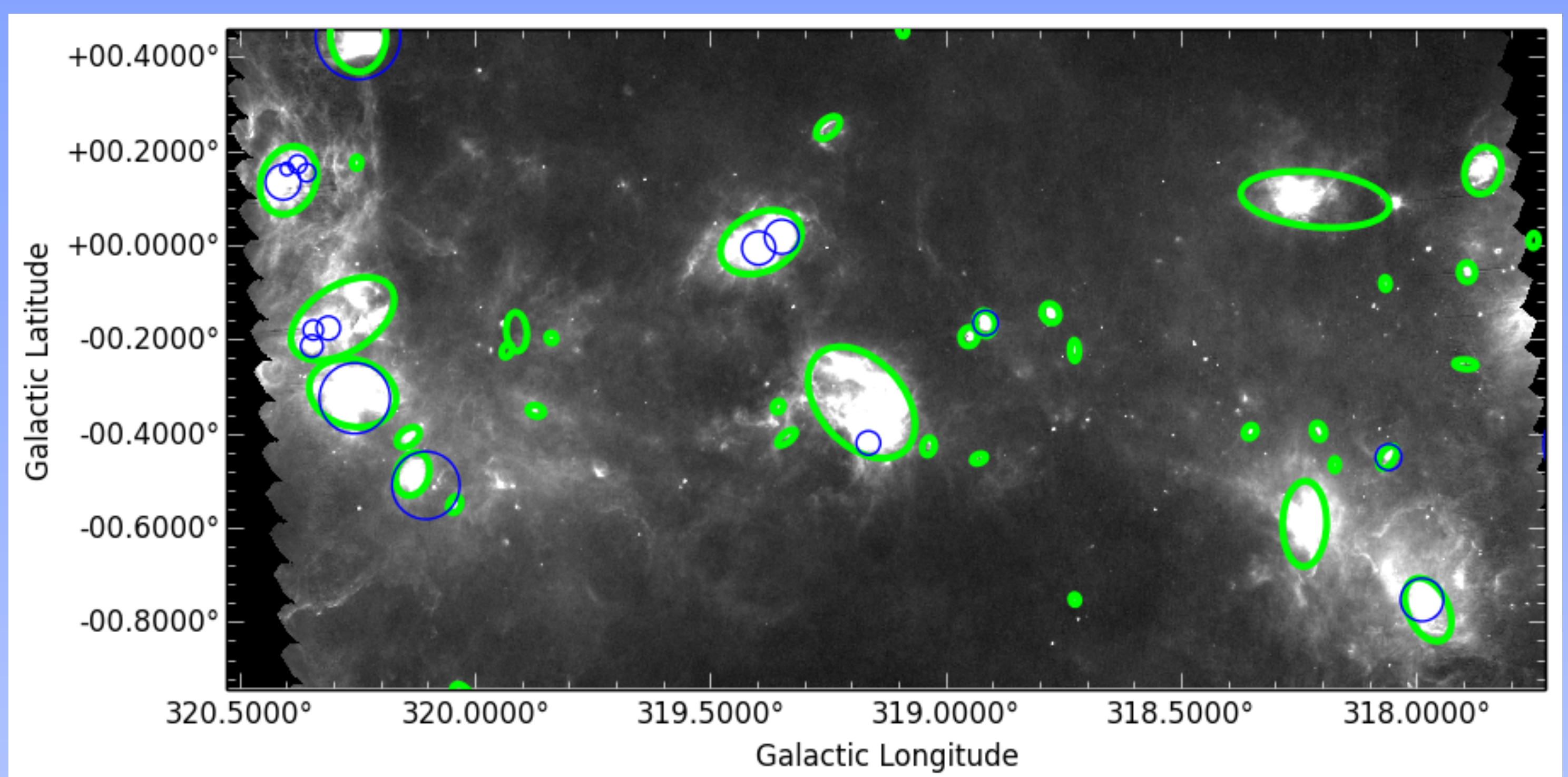


Fig. 1: Example field around the region l=319 degrees. Green ellipses indicate LAG identified bubbles, blue circles indicate WISE detected HII regions.
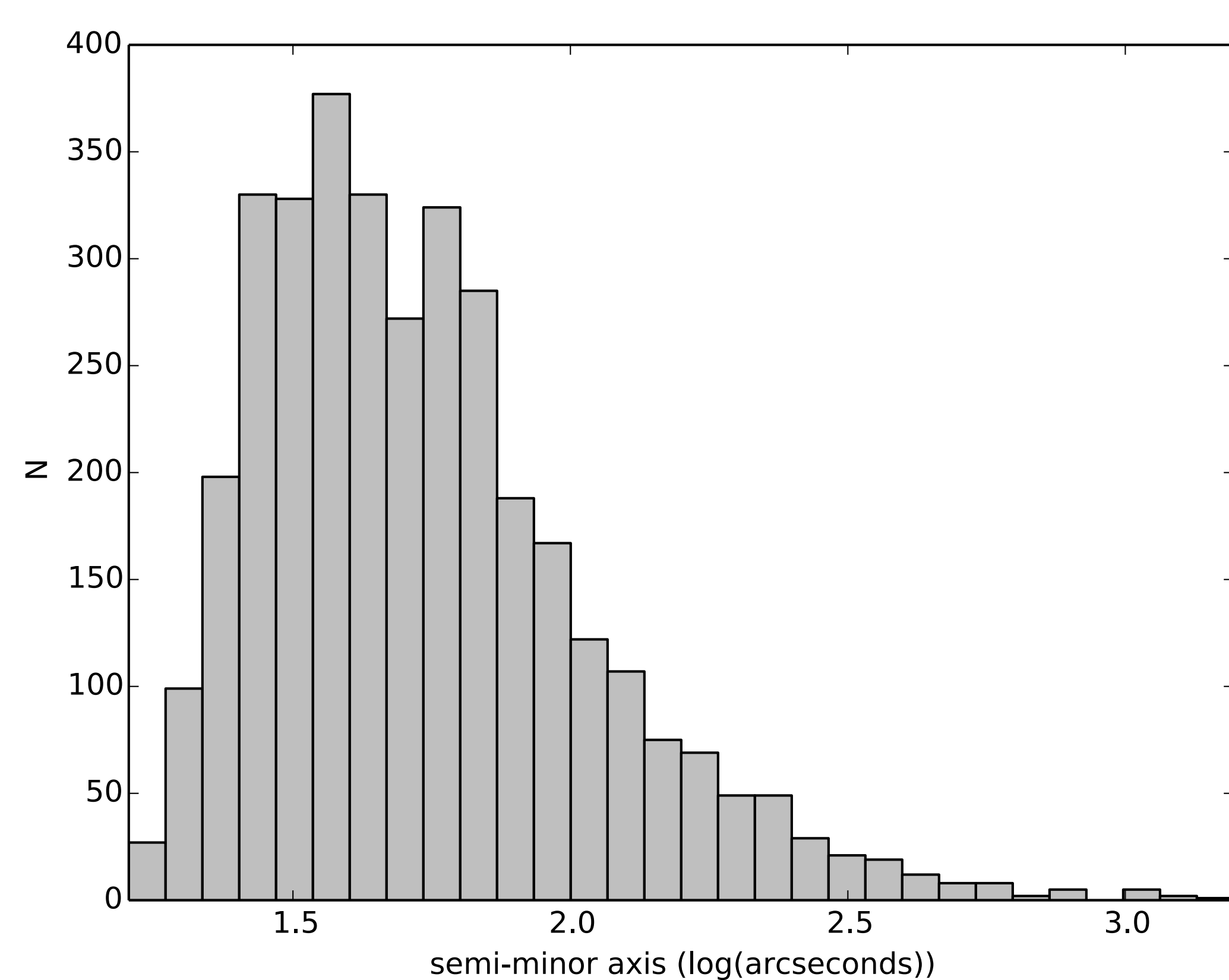
## Future work

The multi wavelength HI-GAL observations provide the means to deduce the dust characteristics for the sample of HII regions. However, there is substantial unrelated dust along the line of sight in the Galaxy and HII regions will overlap in the more crowded regions. Utilising large scale millimetre line surveys in conjunction with the Hi-GAL survey will enable to disentangle the different components and further be fundamental to determine the velocity structure for the individual HII regions.



Fig. 2: The distribution of semi-minor axis for the whole sample. For the final catalog objects smaller than 30 arseconds have been removed.