

# OH/IR STARS AS SIGNPOSTS FOR ANCIENT STARBURST ACTIVITY IN THE GALACTIC CENTER

L.O. SJOUWERMAN

*Onsala Space Observatory and Sterrewacht Leiden*

H.J. HABING

*Sterrewacht Leiden*

H.J. VAN LANGEVELDE

*Joint Institute for VLBI in Europe*

AND

M. LINDQVIST AND A. WINNBERG

*Onsala Space Observatory*

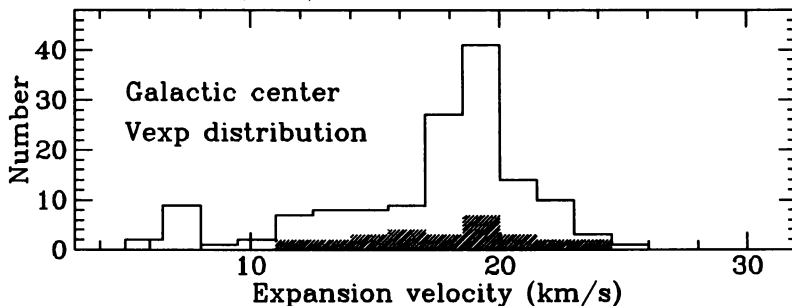
We have surveyed the Galactic center (GC) for OH/IR stars, evolved late-type stars of different masses - and thus ages - in a short-lived stage of heavy mass-loss. By observing the 1612 MHz OH masers generated in their circumstellar shells, it is found that a considerable fraction of these OH/IR stars has the same high-valued shell expansion velocity of  $19 \text{ km s}^{-1}$ .

The shell expansion velocity is related to the opacity (metallicity) of the circumstellar material and the stellar luminosity (Habing et al. 1994, A&A 286, 523). Combining several observable properties of these objects, we argue that the GC has undergone a distinct epoch of star formation more than a Giga-year ago, in which a large number of stars have formed.

From the observations it seems that in the GC three different groups of stars can be traced: 1) an overall old, dynamically relaxed low-mass, low expansion velocity bulge-like population; 2) a dynamically tight group of relatively young stars formed from continuously infalling clouds; and 3) a *shrinking population of (now) low-mass stars, formed from a rapidly rotating molecular cloud that suddenly - more than a Gyr ago - transformed into stars at a high rate.*

We hereby combine, and support the views of Lindqvist et al. (1992 A&A 259, 118), and *both* the view of Sevenster et al. (1995 A&A 299, 689)

and the view of Serabyn & Morris (1996 *Nature* 382, 602) that contradicts the view of Sevenster (1995).



We present a histogram of a new sample of OH/IR stars in the GC (Sjouwerman et al. 1997 *A&AS* in press), ordered by  $v_{\text{exp}}$ . The GC  $v_{\text{exp}}$  distribution is much more peaked than any other sample known, (eg. OH/IR stars in the Galactic bulge and disk; Sevenster et al. 1997a *A&AS* 122, 79, 1997b *A&AS* 124, 509), and has a relatively high mean value of  $19 \text{ km s}^{-1}$ . The very narrow  $v_{\text{exp}}$  distribution indicates that many of the “ $19 \text{ km s}^{-1}$ ” OH/IR stars have the same age.

The strongest argument that they were formed in a short period is based on dynamical grounds. The difference in velocity dispersion and sky distribution for low (large dispersion) and high (small dispersion)  $v_{\text{exp}}$  stars is evidence that the general group of high  $v_{\text{exp}}$  stars – which includes our “ $19 \text{ km s}^{-1}$ ” stars – have a shorter dynamical evolution; they were formed later (Lindqvist et al. 1992 *A&A* 259, 118; Sevenster et al. 1995 *A&A* 299, 689). The old age ( $> 1 \text{ Gyr}$ , see below), the strong rotation in the plane, and the fact that the “ $19 \text{ km s}^{-1}$ ” OH/IR stars have a velocity dispersion similar to the highest  $v_{\text{exp}}$  ( $> 20 \text{ km s}^{-1}$ ) stars, indicate that many of the “ $19 \text{ km s}^{-1}$ ” OH/IR stars originate from a single cloud circling the center.

Bolometric luminosities for GC OH/IR stars (Blommaert et al. 1997, *A&A* in press) are not representative for the whole sample (eg. in  $v_{\text{exp}}$ , shown as the shaded  $v_{\text{exp}}$  distribution). We therefore may hypothesize that many of the “ $19 \text{ km s}^{-1}$ ” stars have roughly the same luminosity ( $M_{\text{bol}} \approx -4.5$ ). Models then predict a mass of less than  $2 M_{\odot}$  and an age  $> 1 \text{ Gyr}$ . As the stars were formed in a relatively isolated period, the “ $19 \text{ km s}^{-1}$ ” stars are the most massive representatives from that period. Because the OH/IR phase is so short ( $10^5 \text{ yr}$ ), this means that many of the “ $19 \text{ km s}^{-1}$ ” stars have the same mass (and age), ie. in a very narrow range and independent of the length of the formation because they formed so long ago.

Given the lower limits on the number of stars formed (a few  $10^7$  over all masses), the mass of the original rotating cloud (a few times  $10^8 M_{\odot}$ ), and the luminosity produced in the nucleus during this event ( $\sim 10^{10} L_{\odot}$ ), the Galaxy would probably have been classified as a starburst galaxy.