BOLETÍN DE LOS OBSERVATORIOS DE TONANTZINTLA Y TACUBAYA, VOL. 4, N°27, 1965.

G W ORIONIS, A 20 000 YEARS OLD T TAURI STAR?

Arcadio Poveda

SUMARIO

G W Orionis es una estrella del tipo T Tauri cuya magnitud y tipo espectral han sido observados por Joy y Wilson. De estos datos se obtiene la luminosidad el radio y la temperatura efectiva lo cual permite ubicarla en el diagrama H—R y comparar su posición con las trayectorias evolutivas de Hayashi, encontrándose que su masa es aproximadamente el doble de la masa solar.

Con estos datos y con la fórmula para la edad de una estrella en contracción gravitacional, se encuentra que la edad actual de G W Orionis es de alrededor de 20 000 años.

Our knowledge of the actual ages of very young stars is very meager; the first indication that we may be observing stars with ages of the order of 10 000 years came indirectly from the analysis of the density distribution in the Orion nebula (Kahn and Menon 1961) which showed that the latter could not have existed as an H II region for a period much longer than 10 000 years, thus setting a very small upper bound to the age of ϑ^1C Orionis as an ionizing source. On the other hand, since the total time of contraction to the main sequence, of a massive star, is of the order of 3×10^4 years, ϑ^1C Orionis should then be a star younger than 5×10^4 years.

A further evidence in favor of the existence of stars of a similar age bracket is afforded by a sample of stars that illuminate certain conical and cometary nebulae. A simple kinematical argument showed (Poveda 1965) that a sample of eleven such stars gave ages which ranged from 6 000 to 53 000 years, and although the individual values are somewhat uncertain, the mean age of 19 000 years found for the group is certainly more reliable.

The purpose of the present note is to point out that G W Orionis, a T Tauri star, is also a very young object with an age comparable to that of the Orion nebula and to the mean age of the stars at the vertices of cometary nebulae. The reasoning underlying the case of G W Orionis —which is very different from that used before— is based on the place which this star occupies in the H-R diagram and in the contraction times which a wholly convective star needs to arrive to its present values of R, L and Te.

G W Orionis is listed as a T Tauri star in the last catalogue compiled by Herbig (1962) who classifies its light curve, as one which remains most of the time at maximum. On the other hand Joy and Wilson (1949), who list it as MHα 265-2, assign to it a visual magnitude of 9.2 and spectral type K5e. These values combined with a modulus of 8.5*, lead to the following parameters for G W Orionis.

$$M_v = 0.7 \qquad M_{bol} = 0.14 \qquad L/L_\odot = 67.5$$

$$Te = 4\,400^\circ K \qquad R/R_\odot = 16 \qquad M/M_\odot = 2$$

The value of the effective temperature and the luminosity, permits to plot this star in the H-R diagram and to compare its position with the evolutionary tracks calculated by Hayashi, Hoshi and Sugimoto (1963); this is done in figure 1., where it is easily seen that the position of G W Orionis is very close to the track of 2 solar masses; thus we take this value as the actual mass of G W Orionis.

To calculate the present age of G W Orionis it rest only to use the formula derived by Hayashi et al (1963) for the age of a star in gravitational contraction, that is:

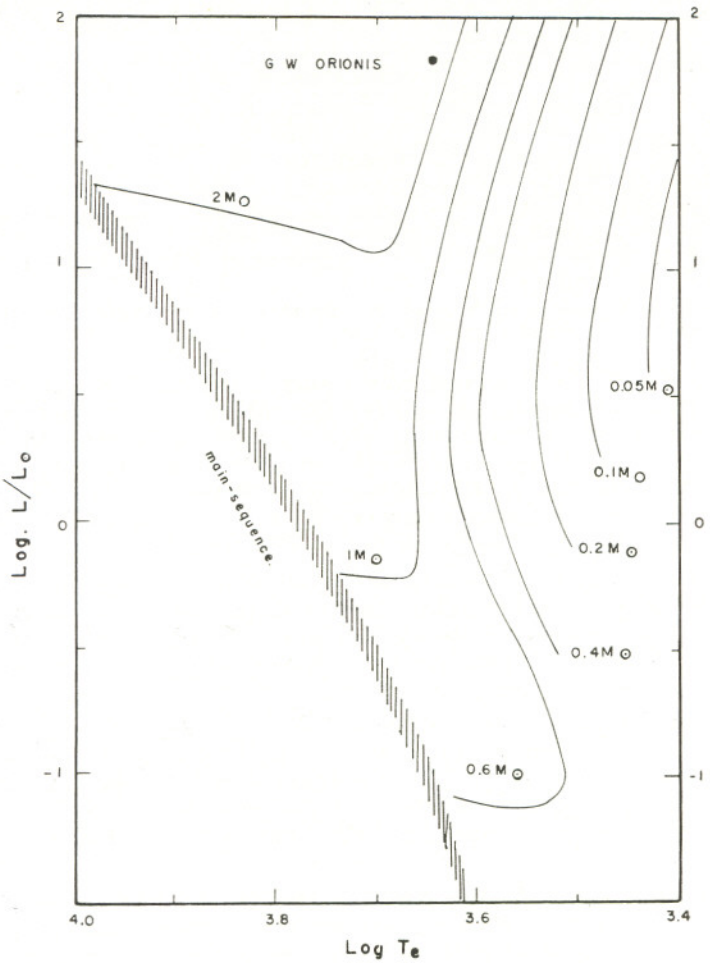
$$t = 10^{7.13} \frac{1}{1+\alpha} \left(\frac{M}{M_\odot}\right)^2 \left(\frac{R}{R_\odot}\right)^{-1} \left(\frac{L}{L_\odot}\right)^{-1} \quad \text{years}$$

where α is a number larger than 1.5 for wholly convective stars, as it is in the present case. Using the parameters listed above, we finally arrive at:

$$t \leqq 20\,000 \text{ years}$$

We want to emphasize that this value —which is surprisingly close to the age of the Orion nebula and the stars in cometary nebulae— has been found by an entirely different reasoning. It is also interesting to realize the increasing number of stars, within 500 parsecs from the sun, with ages around 2×10^4 years.

* Since it appears to be physically connected with the complex around λ Orionis.



REFERENCES

Hayashi, C. Hoshi, R. and Sugimoto, D. 1962 Supp. Progress of Theoretical Physics No. 22.

Herbig, G. 1962 in Z. Kopal Advances in Astronomy and Astrophysics Vol. I, p. 47; Academic Press.

Joy, A. H. and Wilson R. E. 1949 Ap. J. **109**, 231.

Kahn, F. D. and Menon T. K. 1961 Proc. Nat. Acad. Sci. Washington **47**, 1712.

Poveda, A. 1965 Boletin Obs. Tonantzintla y Tacubaya **4**, 22.