Clumping in Hot Star Winds
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3D numerical model for an asymmetrical superbubble

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Massive stars usually form groups such as OB associations. Their fast stellar winds sweep up collectively the surrounding insterstellar medium (ISM) to generate superbubbles. Observations suggest that superbubble evolution on the surrounding ISM can be very irregular. Numerical simulations considering these conditions could help to understand the evolution of these superbubbles and to clarify the dynamics of these objects as well as the difference between observed X-ray luminosities and the predicted ones by the standard model (Weaver et al. 1977).

1 Numerical simulation

We only considered the interaction between OB stellar winds and the surrounding ISM. To do the 3D numerical simulation, we considered that the plane of the sky is in the xy plane of our simulation. From the same xy star configuration, three possible z coordinates distribution were generated by randomly choosing the z value. The different stellar configurations define different models in our simulations as we will see below. The cluster is limited by two molecular clouds at the North and South-West. These clouds are modelled as two bars which have high densities compared with the surrounding ISM.

Considering this scenario, we have carried out 3D numerical simulations with the Yguazú-a code (Raga et al. 2000, 2002). Its main characteristic is that it is an adaptive grid code. In our case five grid levels were employed with a maximum resolution of 7.26×10^{16}cm. A computational domain of $512 \times 512 \times 128$ pixels was considered in the x, y and z axis, respectively.

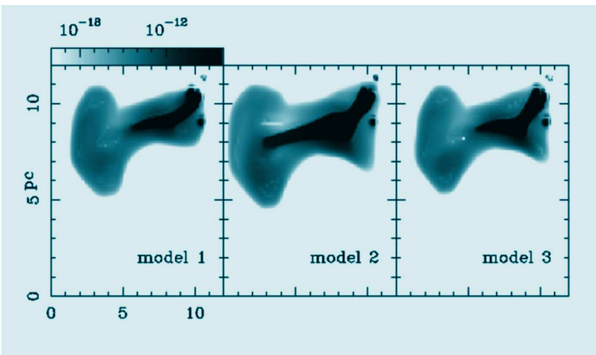

Figure 1: Simulated X-ray emission maps obtained from the models. The logarithmic scale is given in erg s^{-1} cm^{-2} sr^{-1}

2 Results

Figure 1 shows the X ray emission map for the three models, corresponding to an integration time of 2.1×10^5 years. The elongated shape observed in all models is produced by the presence of the two bars. Individual stellar winds begin to collide each other producing a stellar cluster wind. This stellar cluster wind interacts with both bars, which allow the cluster wind gas freely flow to the left, forming an asymmetric superbubble wind. The mechanism of stellar cluster wind formation is more efficient in the case of model 2 because its z-distribution of the stars reveals that they are located closer to each other. The total X-ray luminosities for the three models are quite similar to each other (see Table 1).

Table 1: Total X-ray luminosities

Model	L_X(erg s^{-1})
1	7.0×10^{33}
2	8.6×10^{33}
3	6.3×10^{33}

References

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