The refill of superbubble cavities

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Short overview

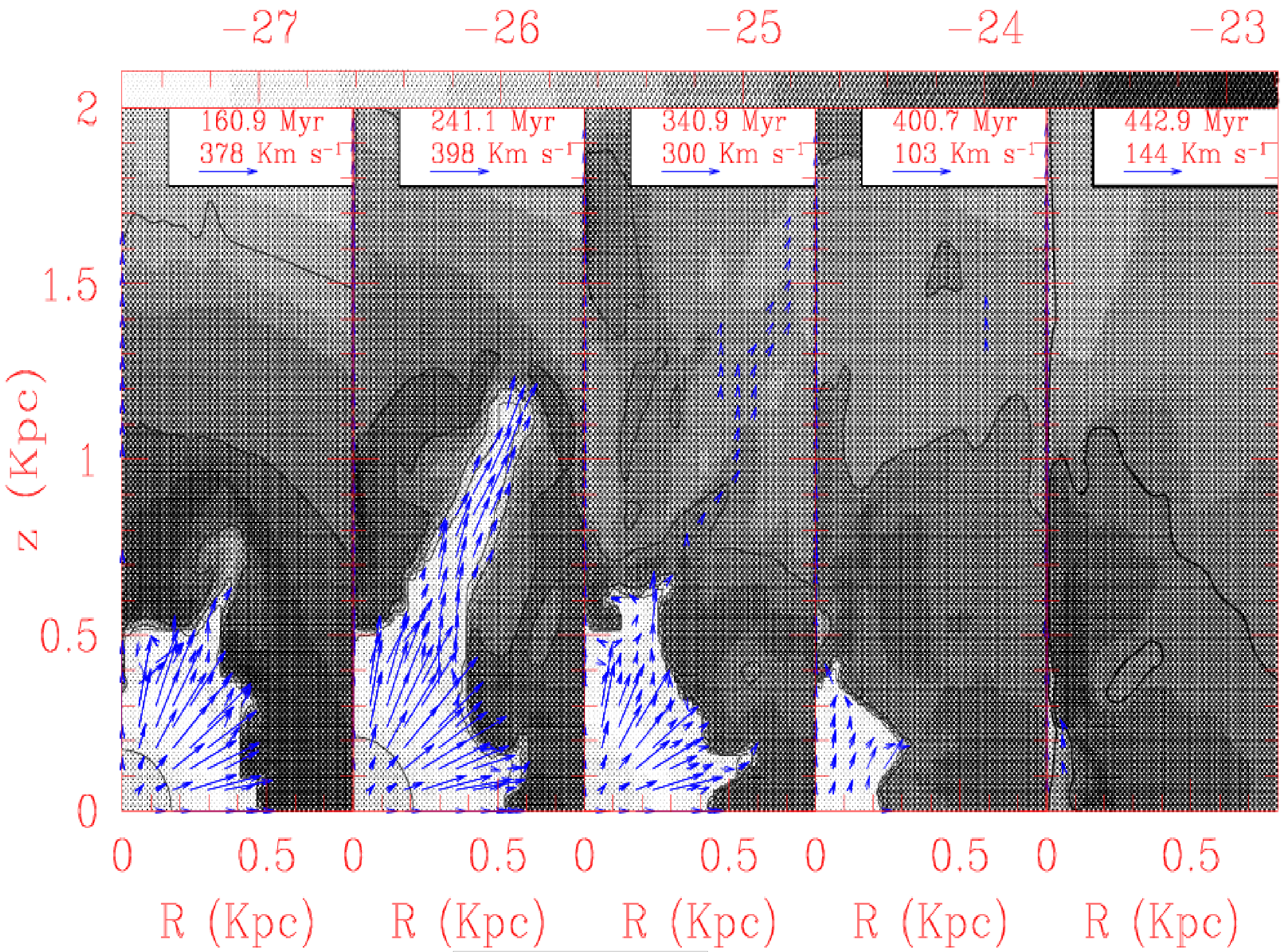
This paper studies the time it takes to refill a superbubble by modeling an elliptical galaxy of different gas masses and different star formation rates. They find, with their conditions, a refilling time scale in the range of 125-600 Myrs.

Summary

Superbubbles are caused from type Ia supernova (when white dwarfs exceed the Chandrasakar limit), TypeII supernovas, and stellar winds from star forming regions. After a bubble is created, it will begin to refill as the energy from type Ia supernova and star forming regions decline. The authors of this paper model the refill timescale for a dwarf galaxy of two different gas masses and star formation rates.

They assume an HI mass of 10^8 (model 'L') and 1.8x10^8 solar masses (model 'H'). They consider a single star formation episode with different durations and intensities. Model 'S' has star formation lasting 25 Myrs at a rate of 0.5 solar masses per year, and mode 'L' has a star formation lasting 200 Myrs at a rate of 0.05 solar masses per year. The authors estimate that all the energy and mass input from the star forming regions and Type Ia supernova occur in the central 200x200 pc^2 as estimated from observations of NGC1569, a post-starburst galaxy. Therefore, their refill time scale is defined to be the time it between the end of the star formation phase to the moment when the cavity becomes smaller than 200x200 pc^2.

They find that at 160 Myrs, a weak galactic wind is formed due to TypeIa and TypeII supernova. Energy from TypeII supernovas ends at t ~ 230 Myrs and at t ~ 400 Myrs the bubble has decreased to the original size of the star forming region. Figure 1 illustrates the outflow at five different times. Table 1 lists the HI mass, star formation duration and rate, and refill timescale for four different models, LS, LL, HS, and HL. The first letter refers to the HI mass (low or high) and the send letter to the star formation rate (short or long).



Model*a*	H I mass (108	SF duration (Myr)	SF rate (	Refill timescale (Myr)
LS	1.	25	0.5	415
LL	1.	200	0.05	600
HS	1.8	25	0.5	125
HL	1.8	200	0.05	200

Question to authors

Braunsfurth & Feizinger (1983) and Oey & Smedley (1998) report refilling time scales of ~10^6 years. Can you comment on the difference between your results and theirs?

Links to class material

We discussed bubbles and their link to the galactic fountain model.

Follow up project

Model for larger galaxies with various

Cume question

The paper talks mentions that the cooling time of a very hot medium is very large. How much, roughly does the cooling time very between gas of 10^6 and 10^8 K?

tcool = (3/2)kT/(n*Alpha)
take ratio and left with T/Alpha
cooling curve image
$t_8/t_6 = (10^8/10^6)*(10^{-23.25}/10^{-22.75})$
t_8/t_6~300x longer to cool