Self-Sealing Shells: Blowouts and Blisters on the Surfaces of Leaky Wind-Blown-Bubbles and Supernova Remnants

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Blowouts can occur when a dense shell confining hot, high pressure, gas ruptures. The venting gas inflates a blister on the surface of the shell. Here we examine the growth of such blisters on the surfaces of wind-blown-bubbles (WBBs) and supernova remnants (SNRs) due to shell rupture caused by the Vishniac instability. On WBBs the maximum relative size of the blister ($R_{rm bstall}/R$) is found to grow linearly with time, but in many cases the blister radius will not exceed 20 per cent of the bubble radius. Thus blowouts initiated by the Vishniac instability are unlikely to have a major effect on the global dynamics and properties of the bubble. The relative size of blisters on SNRs is even smaller than on WBBs, with blisters only growing to a radius comparable to the thickness of the cold shell of SNRs. The small size of the SNR blowouts is, however, in good agreement with observations of blisters in the Vela SNR. The difference in relative size between WBB and SNR blisters is due to the much higher speed at which gas vents out of WBBs, which translates into a greater energy flux through a rupture of a given size from interior gas of a given pressure. Larger blisters are possible if shell ruptures are bigger than expected.
We expect the observed velocity structure of SNR shells to be affected by the presence of blisters until the shell is no longer susceptible to ruptures, since the initial expansion of blisters is faster than the ongoing expansion of the shell.

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