Multiphase Galactic Winds

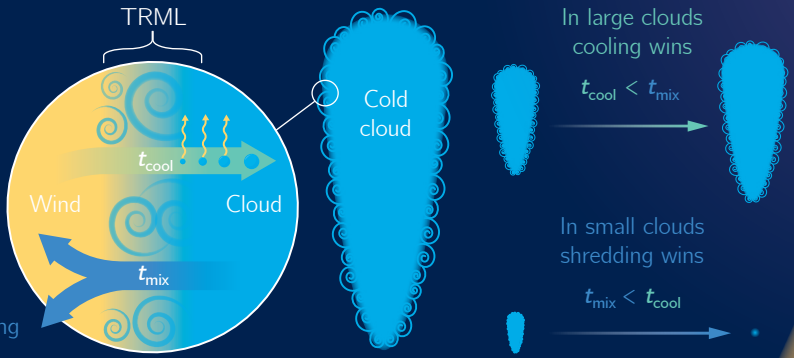
Supernovae drive hot (>10^6 K) winds that are peppered with pockets of cold (~10^4 K) gas out into the surrounding circumgalactic medium. The fate of these cold clouds — and their impact on the hot wind — depends on the competition between turbulent shredding and radiative cooling.

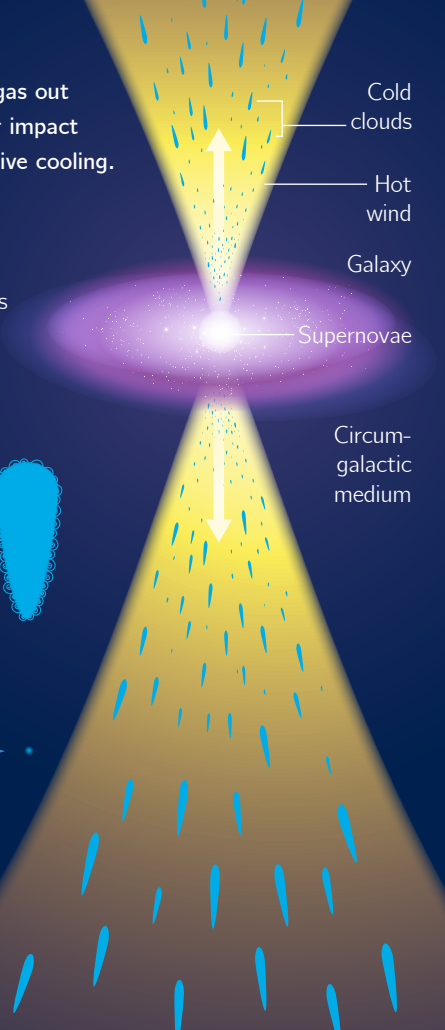
The Impact of the Hot Wind on the Cold Clouds

The relative motion of the hot wind and a cold cloud gives rise to a *turbulent radiative mixing layer* (TRML) at their interface. The cloud's fate is set by the relative timescales for cooling (t_{cool}; primarily set by the pressure and metallicity) and mixing ($t_{mix}=r_{cl}/v_{turb}$; where r_{cl} is the cloud's size and v_{turb} is the turbulent velocity).

t_{cool}
Clouds grow by drawing in the hot wind which then cools and condenses

t_{mix}
Clouds are depleted by turbulent shredding





The Impact of the Cold Clouds on the Hot Wind

The clouds back react causing the wind to:

Decelerate as momentum transfers to the clouds

Heat up from thermalization of relative kinetic energy

Cool down as it mixes with the cold material

Gain/lose mass from/to the clouds