Suppressing Hot Gas Accretion to Supermassive Black Holes by Stellar Winds

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ABSTRACT: We argue that one of the basic assumptions of the Bondi accretion process, that the accreting object has zero pressure, might not hold in many galaxies because of the pressure exerted by stellar winds of stars orbiting the central super massive black hole (SMBH). Hence, the Bondi accretion cannot be used in these cases, such as in the galaxy NGC 3115. The winds of these high-velocity stars are shocked to temperatures above the virial temperature of the galaxy, leading to the formation of a hot bubble of size ~0.1-10pc near the center. This hot bubble can substantially reduce the mass accretion rate by the SMBH. If the density of the hot bubble is lower than that of the ISM, a density inversion layer is formed. Adding to other problems of the Bondi process, our results render the Bondi accretion irrelevant for AGN feedback in cooling flow in galaxies and groups of galaxies and during galaxy formation.

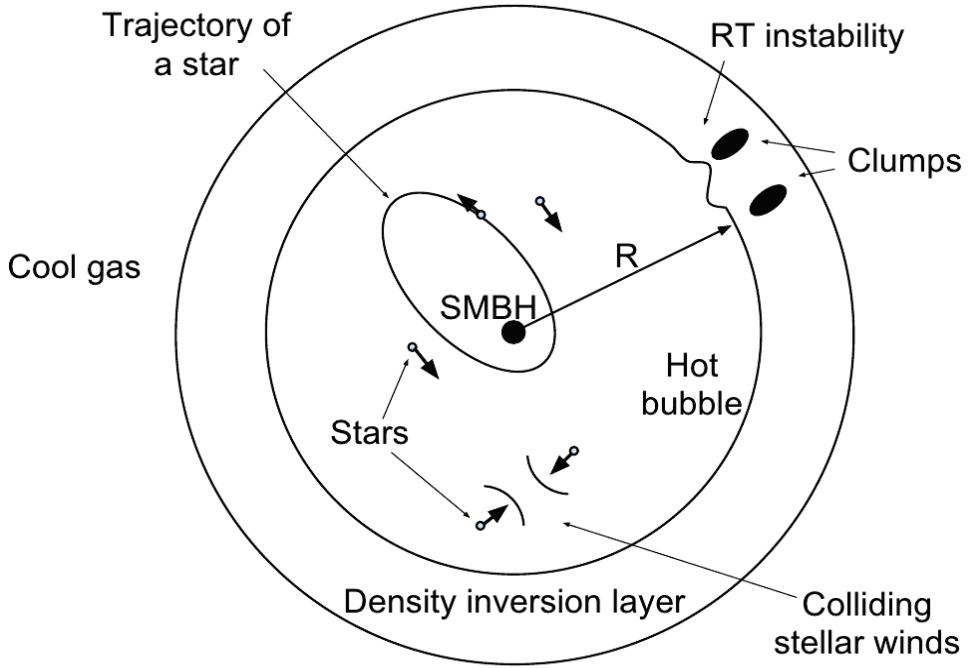

Fig. 1. A schematic drawing (not to scale) of the flow structure where a hot bubble, formed by stellar winds of high-velocity stars orbiting the central SMBH, exerts pressure on the ISM residing outside radius R. If the density in the hot bubble is lower than the ISM density, the flow at R is RT-unstable and a density inversion layer is formed.

Average properties of the hot bubble as a function of its radius

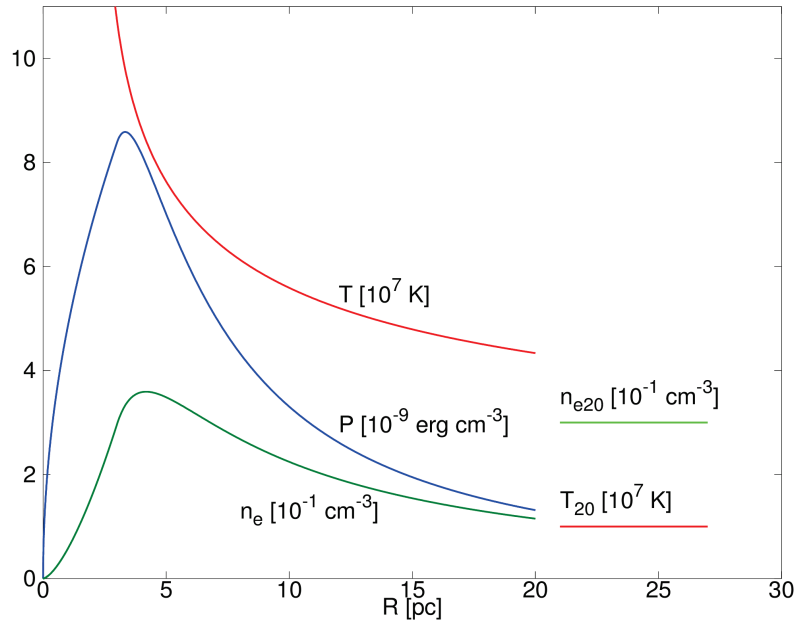

Fig. 2. The average density and pressure of the hot bubble, as well as the temperature that is calculated from the pressure for a stellar density based on NGC 3115. The two horizontal lines on the right side give the density (upper line) and temperature (lower line) at r=20pc in NGC 3115 according to (Wong et al. 2011). This shows that the winds of the circum-SMBH stars in NGC 3115 can completely suppress the Bondi accretion.