NUCLEAR FUELING BY RADIATIVE AVALANCHE INDUCED BY STARBURSTS

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1. Radiative Avalanche

Recently, as a solid physical mechanism which links circumnuclear starbursts to AGN fueling, Umemura, Fukue, & Mineshige (1997a) have proposed *a radiative avalanche* which is the black hole accretion driven by intensive radiation from circumnuclear starbursts of $\lesssim$ 100 pc.

If a surface layer of a rotating gas disk is irradiated by intensive starlight, then it could lose angular momentum via radiation drag, resulting in an avalanche of the layer as an inevitable consequence. The resultant mass-accretion rate at radius r is given by $\dot{M}(r) = \eta(L_*/c^2)(r/R)^2(\Delta R/R)(1 - e^{-\tau})$, where η ranges from 0.2 up to 1, L_* and R are respectively the bolometric luminosity and the radius of a starburst ring, ΔR is the extension of the emission regions, and τ is the face-on optical depth of a disk (Umemura, Fukue, & Mineshige 1997b). In an optically thick regime, the rate depends upon neither the optical depth nor the surface mass density distribution of the disk. If a nuclear disk includes dust of similar abundance to the solar neighborhood, the accretion timescale is given by $t_\gamma \equiv 8\pi c^2 R^2/3\chi L_* = 2.4 \times 10^6 \mathrm{yr}\,(L_*/3 \times 10^{12} L_\odot)^{-1}\,(R/100\mathrm{pc})^2$.

Y. Sofue (ed.), The Central Regions of the Galaxy and Galaxies, 137-138.

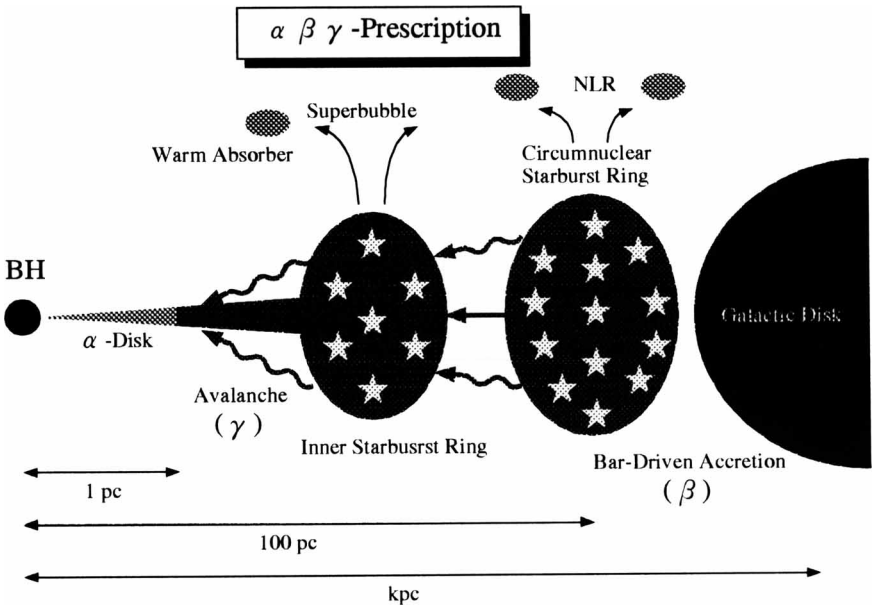

Figure 1. A schematic illustration of $\alpha\beta\gamma$- Prescription.

2. $\alpha\beta\gamma$- Prescription

In galactic scales, a weak bar-like potential (if such exists) could accumulate a large amount of gas around 100 pc (referred to as β-accretion). If the accumulated gas is ignited by starbursts, the radiative avalanche could drive the further accretion down to $\sim$ 1 pc (referred to as γ-accretion). An intensive starburst might induce an inner starburst via radiative force, stellar winds, superbubbles, UV ionization, and so on. In innermost regions of subparsecs, the viscous accretion could be efficient (referred to as α-accretion). The vertically integrated mass accretion rate for viscous accretion is $\dot{M}_\alpha = (9L_*/2c^2)(r/R)^{3/2}(t_\gamma/t_\alpha)\tau$, where $t_\alpha \equiv RV/\alpha c_s^2$ with the viscous parameter, α, the sound speed, c_s, the rotation velocity around the edge, V. Hence, for a case of $\tau = 10^2$, the regions of $r/R \lesssim 0.01$ (say $r \lesssim 1$ pc for $R = 100$ pc) undergoes accretion predominantly by α-viscosity (referred to as α-accretion). In this $\alpha\beta\gamma$-prescription, a continuous accretion from galactic disk regions to very central nuclear regions could be possible.

References

Umemura M., Fukue J., Mineshige S. (1997a) Radiative Avalanche: Starburst Induced Fuelling to AGNs, *Astrophysical Journal Letters*, **Vol.479 no.2**, pp. 97–100

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