QUASI-SPHERICAL ACCRETION ONTO THE BLACK HOLE : THE VIRIAL REGIME

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1. The Model

We are studying the slow ($\dot{m} < 1$) spherical accretion of a gas onto a supermassive ($M \approx 10^8 M_\odot$) black hole in the presence of a strong tangled magnetic field. In the core with radius $2.5\, r_g < r < 10\, r_g$ protons are isotropized due to scattering in magnetic field, but are not thermalized since the characteristic time of pp - Coulomb scattering is less than the infall time. A proton moves in the electron gas with a friction due to pe - scattering, gradually transferring energy to electrons. The standard equations for the proton gas allow the virial regime of accretion when the kinetic energy of the proton is a function of a distance only $E_k(r) = (2/5)\, m_p c^2\, (r_g/r)$. The model is relevant to the slow subsonic settling of matter onto the black hole, as, for example, in the upstream region after the shock standing at a distance $r \sim 20\, r_g$ (Mészáros and Ostriker 1983). Electrons are thermalized and are cooling predominantly by bremsstrahlung radiation. For $\dot{m} \lesssim 0.1$ the core is transparent for bremsstrahlung photons. In agreement with Park (1990) the e^+e^- - pair production is found to be insignificant. The equilibrium between the energy release in pe - scattering and the bremsstrahlung radiation results in the almost isothermal core with the temperature $T_e \approx 4\, m_e$, which slightly increases towards the inner edge of the core. The only role of magnetic field is the isotropization of the proton gas, as the synchrotron radiation is strongly self-absorbed. Therefore the model is insensitive to the precise value of H.

The spectrum is characterized by a strong emission with $E_\gamma \sim 2\, MeV$, and by a broad line at $E_\gamma \lesssim 70\, MeV$ which is a sign of pion production in pp - collisions. The predicted fluxes are detectable by COMPTEL and EGRET detectors of the Compton GRO.

2. References

Mészáros, P., and Ostriker, J. P. 1983, ApJ, 273, L59
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