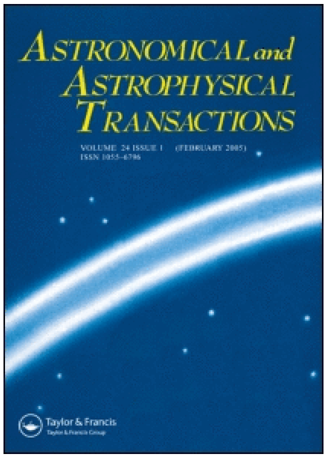

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ON THE POSSIBLE NATURE OF THE SOURCE OF X-RAY RADIATION IN QUASARS

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The possible nature of the source responsible for X-rays in quasars is discussed. High luminosity accretion disks around supermassive black holes are considered according to the approach which is somewhat different from the standard accretion disk theory.

KEY WORDS Quasars, X-rays, accretion disk theory

X-ray spectra of quasars are known to be like the X-ray spectrum of the galactic X-ray source Cyg X-1 (Pozdnyakov L. A. *et al.*, 1983, Inoue, H., 1989). It points to the similarity of the physical conditions in the radiating plasma of these objects. We shall show that in the framework of the α-disks theory (Shakura N. & Sunyaev R., 1973) there exist high ($\sim 10^7$ K) temperature solutions, being independent of the central object's mass.

We shall consider high luminosity ($\sim L_{\rm Edd}$) accretion disks around supermassive ($\sim 10^9\, M_\odot$) black holes in the zone where radiation pressure is dominant. Our approach differs from the standard accretion disks theory in the following points:

1. Radiation pressure is considered exactly, and it is not considered the LTE approximation: $P_{\rm rad} \neq bT^4$.
2. Radiation transfer is considered in the Eddington approximation with the Compton effect included, and it is not considered in the diffusion approximation.

These differences lead to modification of the temperature structure of accretion disks only, and two high temperature solutions may appear under certain conditions, in addition to the known solution. They exist because a cooling function $\Lambda(T)$ has a local minimum at $T \sim 10^6$ K, and when the energy generation rate becomes greater than the cooling rate at $T \sim 10^6$ K on the given disk radius, two additional solutions appear.

We may write the balance of thermal energy equation for these high temperature states:

$$\frac{\pi}{\sigma}\frac{u_0}{2z_0}\Lambda(T) + \sigma_{\rm e}\frac{kT_{\rm e}}{m_{\rm e}c^2}DT_{\rm eff}^4\left(\frac{3}{16}\sigma_{\rm e}u_0 + \frac{\sqrt{3}}{4}\right) - \frac{T_{\rm eff}^4}{2u_0} = 0 \tag{1}$$

Using Tuker's (1975) analytical approximation for $\Lambda(T)$, we find two solutions:

$$T_{\rm e} = 1.47 \cdot 10^9 \alpha^2 D^{-1} \dot{m}^2 r^{-3} s^2 \tag{2}$$

$$T_{\rm e} = 5.5\alpha^{-2} Z \dot{m}^{-4} r^6 s^{-4} \tag{3}$$

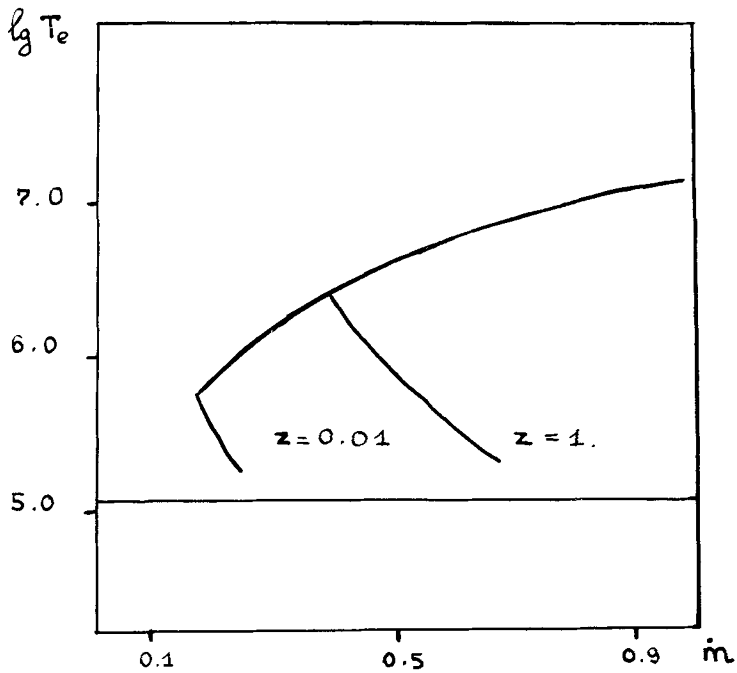

Figure 1 Dependence of the central temperature of accretion disk for radius $r = 2$ on accretion rate. The accretion disk around Schwarzchild's black hole has parameters $m = 10^9$, $\alpha = 1$, $D = 0.875$. A high temperature solution for two ($Z = 0.01$ and $Z = 1$) heavy element abundances is shown.

We use here designations and nondimensional parameters from Shakura & Sunyaev (1973). Moreover, D is a parameter characterizing the Compton cooling rate of plasma ($0 \leqslant D \leqslant 4$), and Z is the heavy element abundance relative to the solar value.

The results obtained are illustrated in Figure 1, where dependence of the central temperature of the accretion disk for radius $r = 2$ on accretion rate is shown. The accretion disk around Schwarzchild's black hole has parameters $m = 10^9$, $\alpha = 1$, $D = 0.875$. A high temperature solution for two ($Z = 0.01$ and $Z = 1$) heavy element abundances is shown.

Because the radiation pressure dominant zone is unsteady (Shakura N. & Sunyaev R., 1976), the conditions for high temperature state appearance may be carried out under a smaller mass accretion rate. Since $\partial u_0 / \partial m < 0$ in the obtained solutions they are unsteady too.

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