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MODIFICATION EQUATIONS OF DISK FOR MAGNETIC CORONA

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Abstract*. In this paper we investigate transform of the magneto-hydrodynamic equations of the hot advection accretion disk for physical conditions of the corona. We suggest correction in the magnetic viscosity in equations of thin optical thick disk as a result from form of coefficient* α_m*. Discuss the reasons and consequence from change. We consider how that cans influenced of process to solve of equations.*

Introduction

Objects, which we investigate showing greatly energy efficiency:

- Fast variability and jet existing;
- Strong X-ray emission;
- No blackbody specter;
- Light polarization;
- Annihilation Spectral lines; [1].

Such as the close binary systems, ecliptic binaries, active galaxies and quasars. When the system contain disk, falling on spiral material release part from angular moment together with potential energy for fixed orbit and radiate in X-ray.

Polarization of radiation and annihilation spectral lines shows presence of magnetic field (MF) in object. When we have accretion to the star with dipole MF there is development of three type fluxes: disk, corona and jets [3].

The disk often is approximate to Keplerian. The flow of mater is localizing in equatorial plane. The Plasma is optical thick and dominates the gas pressure or optical thin plasma and radial pressure close to compact object [5]. The equilibrium is secure of rotation.

Interaction of disk and MF engender instabilities and generating corona [4]. The flow in the corona backs from the centre and dominates magnetic pressure. The corona and disk are connected with magnetic loops.

The jets are direct along axis of dipole. They have a precession if the field axis and axis of rotation is not parallel and have outflow.

MF can be ownership of central star or outward of galaxy. If own MF is situated vertical on plane of disk, then angular moment will be increase inside to the centre. That effect can be compensating for hot advective disks on massive black holes, where powerful jets lead away excess moment [4].

Periodical replacement of hard and soft X-ray from such sources is indicated that around disk there is hot corona. Disk gives soft and the corona hard spectre [5,6]:

- Cold supersonic disk in the close binary systems giving blackbody spectre with $T \sim 10^4$K and no thermal corona with $T \sim 5.10^6$K;
- Hot no thermal disk in AGN with $T \sim 10^{7\sim9}$K and corona with $T \sim 5.10^{11\sim12}$K.

In this paper we transform the equations of the hot advection accretion disk for physical conditions of the corona.[2] Choose model with $\vartheta = 0$. There the resist of radial current create rotation. He is right to hot disks with low density and radioactive pressure. We can to use that for the corona.

Equations of the corona

We construct non-stationary, non-axisymmetric, one-temperature MHD model of Keplerian accretion disk with advection in the normal dipole magnetic field of the central object. We select the compact object to be a black hole. We consider geometrically thin, optical thick disk without **self**-gravitation. Fluid is incompressible. Disk is one-temperature, because the PRESENCE magnetic field assistance to effective transference of the energy from ions to the cooler component. We use pseudo-Newtonian gravitation poetical.

$$\frac{\partial\rho}{\partial t}+\nabla.(\rho v)=0 \qquad \nabla.v=0 \quad \nabla.B=0$$

$$\frac{\partial v}{\partial t}+v.\nabla v=-\frac{1}{\rho}\nabla p-\nabla\Phi+(\frac{B}{4\pi\rho}.\nabla)B+\vartheta\nabla^2 v$$

$$\frac{\partial B}{\partial t}=\nabla\times(v\times B)+\eta\nabla^2 B \qquad \eta=\frac{\eta_m}{\rho}=\frac{c^2}{4\pi\sigma} \quad \Phi=\frac{GM}{r-r_g}$$

$$\rho T\frac{\partial S}{\partial t}-\frac{\dot{M}}{2\pi r}T\frac{\partial S}{\partial r}=Q^+-Q^-+Q_{mag} \qquad r_g=\frac{2GM}{c^2}$$

$$p=p_r+p_g+p_m$$

For a normal dipole field term B_rB_φ in equation of motion have role of radial advection. OHM dissipation increase the effectiveness of radial accretion to 50%. The dynamical time scale is ~Ω^{-1} shorter from thermal time scale ~ $(\alpha + \alpha_m)^{-1}\ \Omega^{-1}$ and cooling is inefficient.

In disk rotation stability can to stop remove of MRI then they begin to growth. If disk have advection she moved instabilities inside and on this way hold magnetic viscous coefficient α_m closely to constant.

We choose α – constant lake as in standard theory, because α is hydrodynamic parameter. Then the basic system splits. Entropy is not a perimeter of the flow. She is a characteristic of the state. Its behavior is connected with global stability of disk.

This problem is treat in our previous publications where is present our results. Well be marked that in this case we consider disk and corona without mutual energetic. The aim of this paper is to adapt equations to conditions in the corona.

1. **v = 0 =** α
2. **σ(r) =>η(r) => α_m(r)**
   σ(r,z) =>η(r,z) => α_m(r,z)
3. **Q^V = 0**

$$\frac{\partial\rho}{\partial t}+\nabla.(\rho v)=0 \qquad \nabla.v=0 \quad \nabla.B=0$$

$$\frac{\partial v}{\partial t}+v.\nabla v=-\frac{1}{\rho}\nabla p-\nabla\Phi+(\frac{B}{4\pi\rho}.\nabla)B$$

$$\frac{\partial B}{\partial t}=\nabla\times(v\times B)-\nabla\times(\eta\nabla\times B) \qquad \eta=\frac{\eta_m}{\rho}=\frac{c^2}{4\pi\sigma} \quad \Phi=\frac{GM}{r-r_g}$$

$$\rho T\frac{dS}{dt}=Q_{mag}{}^+-Q^- \qquad r_g=\frac{2GM}{c^2}$$

$$p=p_r+p_g+p_m$$

Because of peculiar fell of density and quasi-spherical character of the flow the kinetic viscosity from the shift and corresponding dissipation vanish in corona.

Weakly rotation can not to stabilize instabilities and shackles over magnetic viscose coefficient fall away. Now resistance is no more parameter of system and she have not to split even in case $\eta=\alpha_m v_s H$.

Then we have

$$\nabla\times(\eta\nabla\times B)=\nabla[\eta\times(\nabla\times B)]=(\nabla.\eta)\times(\nabla\times B)+\eta\times(\nabla.\nabla\times B)=$$
$$=(\nabla.\eta)\times(\nabla\times B)?\pm\eta\nabla^2 B \quad .$$

Let to see unrolled system by coordinates.

$$\frac{\partial\rho}{\partial t}+\frac{1}{r}\frac{\partial}{\partial r}(r\rho v_r)+\Omega\frac{\partial\rho}{\partial\varphi}+\frac{\partial}{\partial z}(\rho v_z)=0$$

$$\frac{\partial}{\partial r}(rB_r)+\frac{\partial B_\varphi}{\partial\varphi}+r\frac{\partial B_z}{\partial z}=0$$

$$\frac{\partial v_r}{\partial t}+v_r\frac{\partial v_r}{\partial r}+\Omega\frac{\partial v_r}{\partial\varphi}+v_z\frac{\partial v_r}{\partial z}=-\frac{1}{\rho}\frac{\partial p}{\partial r}+\frac{1}{4\pi\rho r}(B_\varphi\frac{\partial B_r}{\partial\varphi}+rB_z\frac{\partial B_r}{\partial z})$$

$$\frac{\partial}{\partial t}(\Omega r^2)+v_r\frac{\partial}{\partial r}(\Omega r^2)+v_z\frac{\partial}{\partial z}(\Omega r^2)=\frac{1}{4\pi\rho r}[B_r\frac{\partial}{\partial r}(r^2B_\varphi)+r^2B_z\frac{\partial B_\varphi}{\partial z}]$$

$$\frac{\partial v_z}{\partial t}+v_r\frac{\partial v_z}{\partial r}+\Omega\frac{\partial v_z}{\partial\varphi}+v_z\frac{\partial v_z}{\partial z}=-\frac{1}{\rho}\frac{\partial p}{\partial z}-\frac{\partial\Phi}{\partial z}+\frac{B_r}{4\pi\rho}\frac{\partial B_z}{\partial r}$$

$$\frac{\partial v_r}{\partial r}+\frac{v_r}{r}+\frac{\partial v_z}{\partial z}=0$$

$$\frac{\partial B_r}{\partial t}=\frac{1}{r}\frac{\partial}{\partial\varphi}(v_rB_\varphi)-\frac{\partial}{\partial\varphi}(\Omega B_r)+\frac{\partial}{\partial z}(v_rB_z)-\frac{\partial}{\partial z}(v_zB_r)-\frac{1}{r}\frac{\partial\eta}{\partial\varphi}\left[\frac{B_\varphi}{r}+\frac{\partial B_\varphi}{\partial r}\right]+$$
$$+\frac{1}{r^2}\frac{\partial\eta}{\partial\varphi}\frac{\partial B_r}{\partial\varphi}+\frac{\partial\eta}{\partial z}\frac{\partial B_r}{\partial z}-\frac{\partial\eta}{\partial z}\frac{\partial B_z}{\partial r}$$

$$\frac{\partial B_\varphi}{\partial t}=\frac{\partial}{\partial r}(\Omega rB_r)-\frac{\partial}{\partial r}(v_rB_\varphi)+\frac{\partial}{\partial z}(\Omega rB_z)-\frac{\partial}{\partial z}(v_zB_\varphi)+\frac{\partial\eta}{\partial z}\frac{\partial B_\varphi}{\partial z}+$$
$$+\left(\frac{\eta}{r}+\frac{\partial\eta}{\partial r}\right)\left[\frac{B_\varphi}{r}+\frac{\partial B_\varphi}{\partial r}-\frac{1}{r}\frac{\partial B_r}{\partial\varphi}\right]$$

$$\frac{\partial}{\partial r}(rv_rB_z)-\frac{\partial}{\partial r}(rv_zB_r)-\frac{\partial}{\partial\varphi}(v_zB_\varphi)-\left(\eta+r\frac{\partial\eta}{\partial r}\right)\left[\frac{\partial B_r}{\partial z}-\frac{\partial B_z}{\partial r}\right]-\frac{\partial\eta}{\partial\varphi}\frac{\partial B_\varphi}{\partial z}=0$$

$$\rho T\frac{dS}{dt}=Q_{mag}{}^{+}-Q^{-}\qquad p=p_r+p_g+p_m$$

Change-over z-component of magnetic field $B_d=\frac{\mu}{r^3}\frac{\left(4+z^2/r^2\right)^{0.5}}{\left(1+z^2/r^2\right)^2}$ will be introduce expletive terms in equations. Opacity will not comfortably form of constant, too.

The big difficulty is not new terms but is in very much variables. We need from other expletive relations to closed system. Then we can treat corona with rectification model of disk. This is necessity for easily transition to case disk and corona with total energetic.

Expecting results

Magnetic reconnection [7] is one of basic mechanism connected with structuring of cosmic plasma. We here focus on physical problem on dynamical self-organization of accretion disc and generation of his corona. For us is especially importance the model to be comfortable for parallel with other theoretical or observation results.

We expect the select model to work in corona. Then we can sew in the solution by initial condition from surface of disc.

Question arise: how much boundary between disc and corona is asperity ?

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