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EVOLUTION IN THE SYSTEM CORONA-DISK

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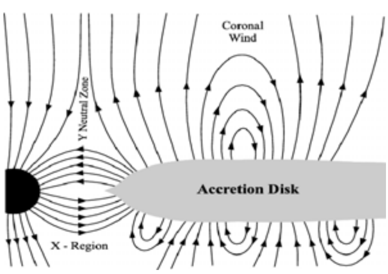
Abstract

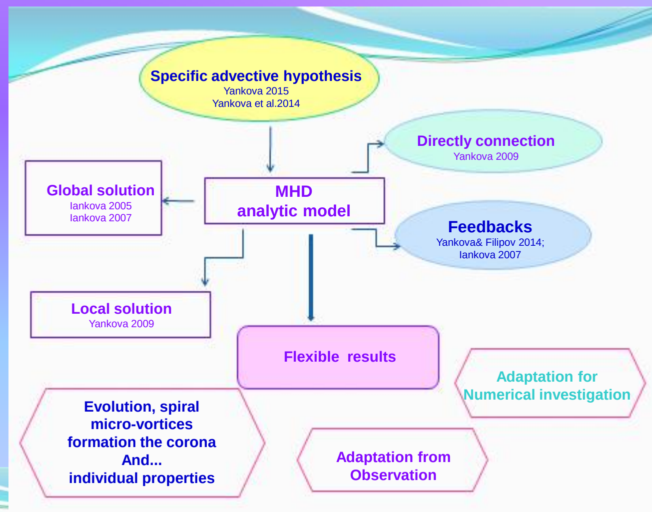
This paper considers magneto-hydrodynamics of the system disk-corona. We will researching the structuring of the flow on the secondary component. Analyze the influence of the destributions on boundery with the primary component. Discusses the significance of the type of the border for exchange of energy between components.

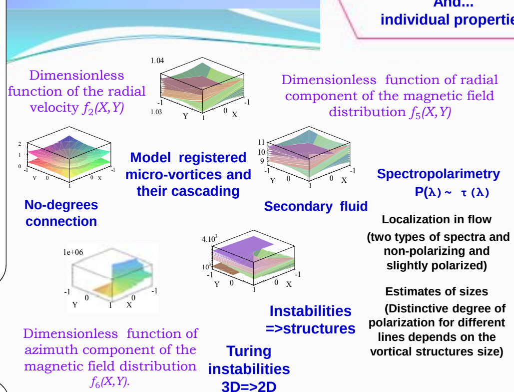
Unified model of the AGN
A. A. Abdo *et al.* 2009

http://www.uni-goettingen.de/en/216897.html

Group of 140 (one hundred and forty) authors started an observation program whose main conclusions are that no matter the host galaxy a quasar core shows similar structure and the same mechanism of development and differences in the observations are the result of different levels of accretion, mass and direction monitoring.







Boundary corona-disk is especially important because there manifest themselves the effects of the warming into the pad: Tightening of advective rings to the center in disk and negative entropy realized a new state. For radiative corona the warming is a major supports factor and does not allow corona to attenuation.

These results are another step in the direction of for creating full model of the system disk-corona. Also, tool for determining the degree to which the main component influenced the development of coronary component.

Basic model equations of the magneto-hydrodynamics of accretion - disk flow

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

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

$$\frac{\partial B}{\partial t}=\nabla\times(v\times B)+\eta\nabla^2 B \qquad \Phi=\frac{-GM}{r-r_g}$$

$$\rho T\frac{\partial S}{\partial t}-\frac{\dot{M}}{2\pi r}T\frac{\partial S}{\partial r}=Q^+-Q^-+Q_m \qquad \eta=\frac{\eta_m}{\rho}=\frac{c^2}{4\pi\sigma}$$

$$p=p_r+p_g+p_m \qquad r_g=\frac{2GM}{c^2}$$

Model equations of the fluid in the disk's corona, for sharp boundary between components

$$v_r\frac{\partial\rho}{\partial r}+v_z\frac{\partial\rho}{\partial z}+\rho\left(\omega+k_\varphi\Omega\right)=0$$

$$\frac{\partial B_r}{\partial r}=\mu z\frac{5r^2+z^2}{\left(r^2+z^2\right)^3\sqrt{4r^2+z^2}}-\frac{B_r+k_\varphi B_\varphi}{r}$$

$$v_r\frac{\partial v_r}{\partial r}+v_z\frac{\partial v_r}{\partial z}+v_r\left(\omega+k_\varphi\Omega\right)=-\frac{\partial v_s^2}{\partial r}-\frac{v_s^2}{\rho}\frac{\partial\rho}{\partial r}+\frac{k_\varphi B_\varphi B_r}{4\pi\rho r}+\frac{B_z}{4\pi\rho}\frac{\partial B_r}{\partial z}$$

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

$$v_r\frac{\partial v_z}{\partial r}+v_z\frac{\partial v_z}{\partial z}+v_z\left(\omega+k_\varphi\Omega\right)=-\frac{\partial v_s^2}{\partial z}-\frac{v_s^2}{\rho}\frac{\partial\rho}{\partial z}-\frac{\partial\Phi}{\partial z}+\frac{\mu B_r}{2\pi\rho r}\frac{z^4+5z^2r^2-2r^4}{\left(r^2+z^2\right)^3\sqrt{4r^2+z^2}}$$

$$\frac{\partial v_r}{\partial r}+\frac{v_r}{r}+\frac{\partial v_z}{\partial z}=0 \qquad \frac{aT^4}{3\rho}=v_s^2-v_a^2/2-RT$$

$$B_r(\omega+\frac{\eta}{r^2}+\frac{\eta k_\varphi}{r^2}-\frac{2\eta k_\varphi^2}{r^2}+k_\varphi\Omega)=(\frac{k_\varphi v_r}{r}-\frac{\eta k_\varphi^2}{r^2}-\frac{2k_\varphi\eta}{r^2})B_\varphi-$$
$$-\left(\frac{\eta}{r}+\frac{\eta k_\varphi}{r}-v_r\right)\frac{\mu z(5r^2+z^2)}{(r^2+z^2)^3\sqrt{4r^2+z^2}}+B_z\frac{\partial v_r}{\partial z}-v_z\frac{\partial B_r}{\partial z}-B_r\frac{\partial v_z}{\partial z}+\frac{B_r+B_z}{r}\eta\frac{\partial k_\varphi}{\partial r}+$$
$$+\eta\frac{\partial^2 B_r}{\partial r^2}+\eta\frac{\partial^2 B_r}{\partial z^2}+\frac{\partial\eta}{\partial z}\left[\frac{\partial B_r}{\partial z}-\frac{2\mu}{r}\frac{z^4+5z^2r^2-2r^4}{\left(r^2+z^2\right)^3\sqrt{4r^2+z^2}}\right]$$

$$B_\varphi(\omega-\frac{\eta}{r^2}-\frac{v_r}{r}+k_\varphi\Omega)=(\frac{3\Omega r}{2\left(r-r_g\right)}-\frac{2k_\varphi\eta}{r^2})B_r+\frac{\eta k_\varphi\mu z(5r^2+z^2)}{r(r^2+z^2)^3\sqrt{4r^2+z^2}}+$$
$$+\Omega B_z+rB_z\frac{\partial\Omega}{\partial z}+(\frac{2\eta}{r}+\frac{\eta k_\varphi}{r}-v_r)\frac{\partial B_\varphi}{\partial r}-v_z\frac{\partial B_\varphi}{\partial z}+\frac{\partial\eta}{\partial z}\frac{\partial B_\varphi}{\partial z}+$$
$$+\eta\frac{\partial^2 B_\varphi}{\partial r^2}+\eta\frac{\partial^2 B_\varphi}{\partial z^2}+\frac{\partial\eta}{\partial r}\left[\frac{B_\varphi-k_\varphi B_r}{r}+\frac{\partial B_\varphi}{\partial r}\right]$$

$$v_r B_z+rB_z\frac{\partial v_r}{\partial r}+\left[2\mu v_r+\frac{2\mu\eta}{r^2}+\frac{2\mu}{r}\frac{\partial\eta}{\partial r}\right]\frac{z^4+5z^2r^2-2r^4}{\left(r^2+z^2\right)^3\sqrt{4r^2+z^2}}-v_z B_r-rB_r\frac{\partial v_z}{\partial r}-rv_z\frac{\partial B_r}{\partial r}-$$
$$-k_\varphi v_z B_\varphi-\frac{9\eta B_z}{r}-\frac{\eta}{r}\frac{\partial B_r}{\partial z}-\frac{\partial\eta}{\partial r}\frac{\partial B_r}{\partial z}+\frac{\eta k_\varphi}{r}\frac{\partial B_\varphi}{\partial z}=0$$

$$\frac{\partial S}{\partial t}+\frac{3}{2}\frac{v_r v_s v_a^2}{\Omega r^2 T}=\frac{\eta v_s}{\Omega rT}\frac{1}{4\pi\rho}(\frac{\partial B_r}{\partial z}-\frac{2\mu}{r}\frac{z^4+5z^2r^2-2r^4}{\left(r^2+z^2\right)^3\sqrt{4r^2+z^2}})^2-\frac{c\rho}{\pi T}(v_s^2-\frac{v_a^2}{2}-RT)$$

Boundary distributions from results of 3D-model of the disk, for sharp boundary

$$f_1(x,H)=\frac{c_1+c_3}{(1-c_{12}-c_{14})^4x^{21/2}}\left[1-(x-x_g)\right]+1$$

$$f_2(x,H)=(9c_{z10}+2)(1-c_{12}-c_{14})(x-1)+1$$

$$f_3(x,H)=\frac{c_6}{2}(1-c_{12}-c_{14})^4(x^2-1)x^4+\frac{c_{z7}}{3}(1-c_{12}-c_{14})^2(x^3-1)x^2+$$
$$+\frac{c_5}{4}(1-c_{12}-c_{14})^2(x^2-1)+(c_1+c_3)\left(\frac{1-c_5(1-c_{12}-c_{14})^2}{2(1-c_{12}-c_{14})^2x^{1/2}}\right)(x-x_g-1)+1$$

$$f_5(x,H)=\frac{1+c_4}{3}(1-c_{12}-c_{14})\left(\frac{1}{x^2}-x\right)+1$$

$$f_6(x,H)=(1-c_{12}-c_{14})^{-2}\left[3\frac{2+\alpha c_{z10}}{4c_8x^{17/2}}(x-x_g-1)-\frac{2\alpha c_{z10}-1}{c_8x^{15/2}}\frac{1}{(x-x_g)}+\frac{\alpha c_{10}}{c_8x^{13/2}}\frac{1}{(x-x_g)^2}+\frac{\alpha c_{z10}-1}{c_8x^2}\right]-$$
$$\frac{c_1(1-c_{12}-c_{14})^{-4}}{c_8}\left(\frac{1}{x^8(x-x_g)}-\frac{1}{x^4}\right)+\frac{c_{z9}}{3c_8}\left(\frac{1}{x^3}-1\right)+(1-c_{12}-c_{14})^2\frac{1}{2}\left(\frac{1}{x^2}-x^2\right)$$

$$f_7(x,H)=-(1-c_{12}-c_{14})^{-1}\left[\frac{c_3}{c_1}+\frac{c_3}{2c_1c_4}\right]\left(\frac{1}{x^{1/2}(x-x_g)}-\frac{1}{x}\right)-$$
$$-\frac{c_3(1-c_{12}-c_{14})^{-1}}{c_4c_1}\left(\frac{x^{1/2}}{(x-x_g)^2}-\frac{1}{x}\right)-\frac{c_{17}(1-c_{12}-c_{14})^{-3}}{c_1}\left(\frac{1}{x^3}-\frac{1}{x^{3/2}(x-x_g)}\right)+$$
$$+\frac{5+20c_{z10}}{c_1}(1-c_{12}-c_{14})\left(\frac{1}{x}-x\right)-\frac{4c_{z6}}{c_1}\left(\frac{1}{x}-1\right)$$

$$f_8(x,H)=\left(-\frac{c_4+1}{k_{\varphi0}}-\frac{2c_4}{c_{z6}}\right)(x-1)+\frac{(c_1+c_3)}{c_{z6}(1-c_{12}-c_{14})^2x^{1/2}}(x-x_g-1)-$$
$$-\frac{k_{\varphi0}^2+2}{2k_{\varphi0}(1-c_{12}-c_{14})^2}\left(1-\frac{1}{x^2}\right)+\frac{c_{z5}}{c_{z6}(1-c_{12}-c_{14})^2}\left(\frac{1}{x}-\frac{1}{x^2}\right)+$$
$$+\frac{1+c_4}{(1-c_{12}-c_{14})}\left(1-\frac{1}{x}\right)$$

$$f_9(x,H)=\frac{c_{z3}}{(x-x_g)}-\frac{c_{z2}(1-x^{-2})}{2(1-c_{12}-c_{14})^2}-\frac{c_{z4}(1-c_{12}-c_{14})^2}{3}(x^3-1)x^2-c_{Z3}+1$$

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