mation about the structure, stability, and dynamics of the disk. Using the basic thermal Keplerian disk paradigm, we consider in particular generalizations of the standard optically thin disk models needed to accommodate the extremely rich variety of dynamical phenomena exhibited by black hole candidates, ranging from flares of electron-positron annihilations and quasiperiodic oscillations in the X-ray intensity to X-ray novae activity. These in turn provide probes of the disk structure and global geometry. The goal is to construct a single unified framework to interpret a large variety of black hole phenomena. This paper will concentrate on the interface between basic theory and observational data modeling.

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NONLINEAR CALCULATIONS OF THE TIME EVOLUTION OF BLACK HOLE ACCRETION DISKS.
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Based on previous works on black hole accretion disks, I continue to explore the disk dynamics using the finite difference method to solve the highly nonlinear problem of time-dependent alpha disk equations.

Here a radially zoned model is used to develop a computational scheme in order to accommodate functional dependence of the viscosity parameter alpha on the disk scale height and/or surface density. This work is based on the author's previous work on the steady disk structure and the linear analysis of disk dynamics to try to apply to X-ray emissions from black candidates (i.e., multiple-state spectra, instabilities, QPOs, etc.).

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EVOLUTION OF VAPORIZING PULSARS.
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We construct evolutional scenarios for LMXBs using a simplified stellar model. We discuss the origin and evolution of short-period, low mass binary pulsars with evaporating companions. We suggest that these systems descend from low-mass X-ray binaries and that angular momentum loss mainly due to evaporative wind drives their evolution. We derive limits on the energy and angular momentum carried away by the wind based on the observed low eccentricity. In our model the companion remains near contact and its quasiadiabatic expansion causes the binary to expand. Short-term oscillations of the orbital period may occur if the Roche-lobe overflow forms an evaporating disk.

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CAN A VARIABLE ALPHA INDUCE LIMIT CYCLE BEHAVIOR AND EXPONENTIAL LUMINOSITY DECAY IN TRANSIENT SOFT X-RAY SOURCES?
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There has been, recently, a revival of the stability problem of accretion disks. Much of this renewed interest is due to recent observational data on transient soft X-ray novae, which are low-mass X-ray binaries. It is widely believed that nonsteady mass transfer from the secondary onto the compact primary, through an accretion disk, is the reason for the observed spectacular events in the form of often repetitive outbursts, with recurrence times ranging from 1 to 60 yr and duration time on the scale of months. Though not having reached yet a consensus about the nature of the mechanism that regulates the mass transfer, the disk thermal instability model [1–4] seems to be favored by the fact that the rise in the hard X-ray luminosity is prior to the rise in the soft X-ray luminosity, while the mass transfer instability model [5–7] seems to be hindered by the fact that the luminosity during quiescence is unable to trigger the thermal instability. However, it should be stressed that, remarkably, the X-ray light curves of these X-ray novae all show overall exponential decays ($L_d \approx \exp -t/t_1$), a feature quite difficult to reproduce in the framework of the viscous disk model, which yields powerlike luminosity decay. Taking into account this observational constraint, we have studied the temporal evolution of perturbations in the accretion rate, under the assumption that α is radial and parameter dependent. The chosen dependence is such that the model can reproduce limit cycle behavior (the system is locally unstable but globally stable). However, the kind of dependence we are looking for in α does not allow us to use the usual Shakura and Sunyaev procedure in the sense that we no longer can obtain a linearized continuity equation without explicit dependence on the accretion rate. This is so because now we cannot eliminate the accretion rate by using the angular momentum conservation equation. In other words, the stress now depends upon the surface density, the scale height of the disk, and the accretion rate. If we write the viscosity parameter as

$$\alpha = \alpha_0 f$$

where we have included the r-dependence in α_0 and the parameter-dependence in f, we obtain the linearized angular momentum conservation equation

$$\frac{\delta f}{f_0} = \frac{4}{3} R \frac{\partial}{\partial R}\left(-\frac{\delta \dot{M}}{\dot{M}_0} + u + 2h\right)$$

the linearized continuity equation

$$\Sigma_0 \frac{\partial}{\partial t} u = \frac{1}{2\pi R} \frac{\partial}{\partial R} \delta \dot{M}$$

and the linearized energy equation

$$(8 + 51\beta_0 - 3\beta_0^2) \frac{\partial}{\partial t} h + 3 (1 + 3\beta_0 + 4\beta_0^2) \frac{\partial}{\partial t} u =$$

$$\frac{2}{3}(5 + 18\beta_0 + 9\beta_0^2)\, \alpha_0 \Omega l_0^2 \frac{\partial^2}{\partial R^2} \left(u + 2h - \frac{\delta f}{f_0}\right) +$$

$$3\alpha_0\Omega \left[2(1+\beta_0)u + 2(5\beta_0 - 3)h - \frac{\delta f}{f_0}\right]$$

This equation only gives us the local response of the disk to these perturbations, and we see that the α r-dependence plays no role, the major role being locally played by the parameter dependence. When we look for the global response of the disk, this equation no longer applies, being substituted by the correct and more complicated set of coupled differential equations, which solution is highly dependent on the α radial dependence.

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CONVECTIVE SOLAR NEBULA. C. Meirelles Filho and M. Reyes-Ruiz, Space Physics and Astronomy Department, Rice University, Houston TX 77251, USA.

Analyzing turbulent flows with rotation, Dubrulle and Valdettaro [1] have concluded that some new effects come into play and may modify the standard picture we have about turbulence. In that respect the value of the Rossby number is of crucial importance since it will determine the transition between regimes where rotation is or is not important. With rotation there will be a tendency to constrain the motion to the plane perpendicular to the rotation axis and as a consequence the horizontal scale will increase as compared to the longitudinal one, which means that the turnover time in this direction will increase. The net effect is that the energy cascade down process is hindered by rotation. As a matter of fact, when rotation is present one observes two cascades: An enstrophy (vorticity) cascade from large scales to small scales and an inverse energy cascade from small scales to large scales. Since the first process is not efficient on transporting energy to the dissipation range, what we see is energy storage in the large structures at the expense of the small structures. This kind of behavior has been confirmed experimentally by Jacquin et al. [2], who observed that, with rotation, $L_{hor} \approx R_o^{-\gamma} L_z$, where γ is a parameter that depends on the Reynolds number and measures the influence of rotation on turbulence and R_o is the Rossby number. For a very large γ we obtain, in the inertial range, a spectrum of k^{-3} instead of the usual Kolmogorov's $k^{-5/3}$ spectrum. In reality, when rotation is dominant, energy gets stored in inertial waves that propagate it essentially in the longitudinal direction. In that case, we can no longer assign just one viscosity to the fluid and, what is most important, the concept of viscosity loses its meaning since we no longer have local transport of energy. According to Dubrulle [1], $R_o = 1$ is the borderline between these two scenarios: For $R_o > 1$ turbulence is not affected by rotation, for $R_o < 1$ it will be greatly affected. It is worth mentioning that compressibility effects will also affect turbulence through the generation of waves, shocks, etc. These aspects have been underestimated by Cabot et al. [3] in their application of the theory of large-structure turbulence developed by Canuto and Goldman [4] for the turbulence generated by convective instability, in the sense that no discussion about the behavior of the characteristic scale lengths in the problem under the influence of rotation is made nor the conditions under which there will be local energy dissipation and an effective viscosity can be assigned to the flow. Also, not apparent in their results are effects such as inverse energy cascade with consequent diminishing of the angular momentum transport efficiency or even how the spectrum in the inertial zone, i.e., Kolmogorov's spectrum, is affected by rotation. In a previous paper [5], employing results from [1], we have shown that even for Rossby number >1 turbulence is affected by rotation, but it succeeds in forming smaller structures, as compared to the case without rotation, in such a way as to overcome rotational effects. As far as the efficiency of angular momentum transport is concerned, the value of the viscosity parameter is highly affected, even if the Rossby number is much greater than 1.

Such results, however, were derived considering a hot disk, in which opacity is mainly given by electron scattering. In the present work we have applied the formulation developed in the previous work for the description of the viscous-stage solar nebula. Following Wood and Morfill [6] we have used two piecewise continuous powerlaws that depend only on the temperature, corresponding to regions in which opacity is provided either by water ice grains or silicate and Fe grains. It should be remarked, however, that by taking into account the z-structure of the disk, there will be, no matter the radius, a region close to the surface of the disk, where the lower-temperature opacity law applies. As we go further out, this region approaches the midplane of the disk. In the outer regions, where the temperature is below the ice condensation point, only the lower-temperature law is applicable. The height of the point separating these regions will be crucial in the determination of anisotropy factor and the viscosity parameter as well as in the possible existence of critical parameters for the flow. Although our results are preliminary compared to other results in the literature, the efficiency for angular momentum transport we have obtained is higher. These high values of α may imply that within this formulation the viscous evolutionary stage of the nebula is shorter. Our formulation also implies a minimum accretion rate to ignite convective instabilities. Since the mass of the disk is related to the accretion rate the main implication of this is related to the age of the nebula.

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ROTATIONAL EFFECTS IN TURBULENCE DRIVEN BY CONVECTION. C. Meirelles Filho, M. Reyes-Ruiz, and C. Luo, Space Physics and Astronomy Department, Rice University, Houston TX 77251, USA.

We have treated turbulence with rotation in a thin Keplerian disk. Highlighting implicit assumptions already existent in the α model together with a geometrical but physically reasonable deduction of the degrees of freedom of the largest eddies, which is of paramount importance in our formulation, we were able to obtain relations satisfied by parameters of the turbulence, such as turnover