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time and α. The effects of rotation in the turbulence we have taken implicitly through an anisotropy factor (x), which is simply related to the Rossby number. Convection is the process assumed to generate turbulence, and we have used Canuto and Goldman's [1] treatment of convective instability, whose characteristic growth time we have assumed equal to the turnover time. We have also used their procedure to obtain the turbulent viscosity. When solving for the convective disk equations assuming electron scattering as the source for opacity, by matching Calluto and Goldman's (1984) prescription for the viscosity with the viscosity we have obtained, we were able to obtain an equation for the anisotropy factor, which is coupled to the solution for the growth rate. By solving for the growth rate in the limit of diverging Rayleigh numbers, the equation for the anisotropy factor is simplified and its structure is such that for m (the size of the convective region in units of the height scale) less than a minimum value there will be no steady solution for the turbulence. For m equal to the minimum value there will be only one solution and for m greater than this minimum value there will be two branches of solutions: the lower branch with anisotropy factor <0.5 and the upper branch with anisotropy factor >0.5. We have studied the nature of the turbulence in these branches using Dubrulle and Valdettaro's [2] approach for turbulence with rotation and have reached the conclusion that for $x < 0.5$, i.e., lower branch, there is an increase of the horizontal scale as compared to the longitudinal scale. In that branch the effects of rotation are such that there will be generation of inertial waves that will transport energy; as the dissipation is nonlocal the concept of effective viscosity loses its meaning. In the upper branch, i.e., $x > 0.5$, the horizontal scale will be smaller than the longitudinal scale and the turnover time is smaller than the Keplerian time: Turbulence manages to overcome the effects of rotation and the generation of waves is negligible. Dissipation of energy is local and we can assign the fluid an effective viscosity. It should be remarked that the structures formed with rotation are much smaller than those that would be formed in the absence of rotation. However, turbulence succeeds in overcoming the effects of rotation only in the upper branch. Using Dubrulle and Valdettaro [2] it is highly suggestive that, in the inertial zone, the spectrum will be $k^{-2.07}$, γ being equal to ≈1.3. We have obtained these solutions for both gas-pressure-dominated and radiation-pressure-dominated cases, the solutions being qualitatively similar: decrease of the size of the largest structures as compared to the largest structures formed for turbulence without rotation. The solution in the gas-pressure-dominated case does not depend on the mass of the compact object, nor on the accretion rate, nor on the radial distance. In the radiation-pressure-dominated case the solution will depend on these parameters. The higher the luminosity, the less split the turbulence will be, with higher values for the turbulent mach number and the viscosity parameter, which means higher efficiency for angular momentum transport. Although the rotation rate decreases as we go farther away from the inner radius, the efficiency of angular momentum transport decreases. This is probably due to the assumption of radiation pressure dominance as well as to the kind of opacity law we have used. We should remark that according to Dubrulle and Valdettaro [2] one should expect only one solution with the pattern of turbulence highly dependent on the Rossby number. What we have shown here is that, by a self-consistent calculation of the Rossby number or anisotropy factor, the solution for turbulence generated by convection in a rotation medium is not unique. Both these solutions are affected by rotation.

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S16-90 ABS ONLY 493

A CONSTRAINT ON THE PAIR-DENSITY RATIO (Z_+) IN AN ELECTRON-POSITRON PAIR WIND. M. D. Moscoso and J. C. Wheeler, Department of Astronomy, University of Texas at Austin, Austin TX 78712, USA.

We derive a constraint on the pair density ratio, $z_+ = n_+/n_p$, in an electron-positron pair wind flowing away from the central region of an accretion disk around a compact object under the assumption of a coupling between electrons, positrons, and protons. The minimum rate at which positrons are injected into the annihilation volume is given by the observed annihilation flux per unit volume. This rate is then used to determine a minimum mass loss rate per unit area, $\dot{M}$, for a given pair density ratio at the base of the streamline. The requirement that $\dot{M} < \dot{M}_{Edd}$ (the mean Eddington mass loss rate per unit area) then places a lower limit on the pair density ratio, $z_{+,min}$.

A positron annihilation line was observed in Nova Muscae 1991 by GRANAT/SIGMA. The narrow width and redshift of the line suggest that the pair production and annihilation regions are physically distinct. We hypothesize that an electron-positron pair wind transports the pairs from the production to the annihilation region and calculate $z_{+,min}$. We then determine constraints on the physical parameters on the pair production region by comparing $z_{+,min}$ with previous studies of two-temperature and one-temperature accretion disks with electron-positron pairs.

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CIRCUMSTELLAR MATERIAL AROUND YOUNG STARS IN ORION. C. R. O'Dell, Department of Space Physics and Astronomy, Rice University, P.O. Box 1892, Houston TX 77251, USA.

The star cluster associated with the Orion nebula is one of the richest known [1]. Lying at the nearside of the Orion Molecular cloud and at a distance of about 500 pc from us, it contains many pre-main-sequence stars with ages of about 300,000 yr [2]. The nebula itself is a blister type, representing a wall of material ionized by the hottest star in the Trapezium group (member C).

Although this is not the closest star formation region, it is probably the easiest place to detect circumstellar, possibly protoplanetary, material around these solar mass stars. This is because the same process of photoionization that creates the nebula also photoionizes these circumstellar clouds, thus rendering them easily visible. Moreover, their dust component is made visible by extinction of light from the background nebula.

Young stars with circumstellar material were found in Orion on the second set of HST images and were called proplyds, indicating their special nature as circumstellar clouds caused to be luminous by being in or near a gaseous nebula [3]. The brightest objects in the field had previously been seen in the optical [4] and radio [5], and although their true nature had been hypothesized [6,7] it was the HST images that made it clear what they are. The forms vary from cometlike when near the Trapezium to elliptical when further away, with the largest being 1000 AU and the bright portions of the smallest, which are found closest to the Trapezium, being about

100 AU in diameter.

We now have a second set of HST observations made immediately after the refurbishment mission that provides even greater detail and reveals even more of these objects. About half of all the low-luminosity stars are proplyds. The poster paper describes quantitative tests about their fundamental structure and addresses the question of whether the circumstellar material is a disk or shell. One object (HST16) is seen only in silhouette against the nebula and is easily resolved into an elliptical form of optical depth monotonically increasing toward the central star.

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A STUDY OF ANGULAR MOMENTUM LOSS IN BINARIES USING THE FREE LAGRANGE METHOD. A. M. Rajasekhar, Department of Physics and Astronomy, Louisiana State University, Baton Rouge LA 70803, USA.

The evolution of a binary star system depends greatly on the angular momentum losses in the system brought about by gravitational radiation and mass outflow (e.g., evaporating winds and magnetic braking) from the secondary component of the binary. Using a three-dimensional hydrodynamic fluid code based on the free Lagrange method, we study the loss of specific angular momentum from a binary system due to an evaporative wind from the companion of a millisecond pulsar. We consider binaries of different mass ratios and winds of different initial velocities and in particular attempt to model the system PSR 1957+20. We are in the process of incorporating the effect of the radiation force from the pulsar and the magnetic field of the companion on the mass outflow. The latter effect would also enable us to study magnetic braking in cataclysmic variables and low-mass X-ray binaries.

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EVOLUTION OF PROTOPLANETARY DISKS WITH DYNAMO MAGNETIC FIELDS. M. Reyes-Ruiz[1] and T. F. Stepinski[2], [1]Department of Space Physics and Astronomy, Rice University, Houston TX 77251, USA, [2]Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston TX 77058, USA.

The notion that planetary systems are formed within dusty disks is certainly not a new one; the modern planet formation paradigm is based on suggestions made by Laplace more than 200 years ago. More recently, the foundations of accretion disk theory where initially developed with this problem in mind by von Weizsäcker [1], and in the last decade astronomical observations have indicated that many young stars have disks around them. Such observations support the generally accepted model of a viscous Keplerian accretion disk for the early stages of planetary system formation. However, one of the major uncertainties remaining in understanding the dynamical evolution of protoplanetary disks is the mechanism, or mechanisms, responsible for the transport of angular momentum and subsequent mass accretion through the disk. This is a fundamental piece of the planetary system genesis problem since such mechanisms will determine the environment in which planets are formed.

Among the mechanisms suggested for this effect is the Maxwell stress associated with a magnetic field treading the disk. Due to the low internal temperatures, and resulting low degree of thermal ionization, through most of the disk, even the question of the existence of a magnetic field must be seriously studied before including magnetic effects in the disk dynamics. On the other hand, from meteoritic evidence it is believed that magnetic fields of significant magnitude existed in the earliest, PP-disk-like, stage of our own solar system's evolution. Hence, the hypothesis that PP disks are magnetized is not made solely on the basis of theory. Previous studies have addressed the problem of the existence of a magnetic field in a steady-state disk and have found that the low conductivity results in a fast diffusion of the magnetic field on timescales much shorter than the evolutionary timescale ($\sim 3\times 10^6$–10^7 yr from astronomical observations). Hence the only way for a magnetic field to exist in PP disks for a considerable portion of their lifetimes is for it to be continuously regenerated. Levy [2] has suggested this could be accomplished by an α–ω dynamo mechanism working within the disk. Stepinski and Levy [3] derived a criterion to determine the ability of the dynamo to regenerate the magnetic field, and Stepinski et al. [4] have shown that a magnetic field may exist in certain parts of the disk depending on the disk properties. Because the dynamo mechanism depends on the turbulence for its excitation, the generated magnetic field will supplement, rather than replace, the turbulent viscosity in transporting angular momentum. In the present work, we present results on the self-consistent evolution of a turbulent PP disk, including the effects of a dynamo-generated magnetic field.

For our calculations, to include the effects of the large-scale dynamo magnetic field, we redefine the Shakura and Sunyaev dimensionless turbulence parameter, α_{ss}, to

$$\alpha_{eff} = \alpha_{ss}\left(1 + \frac{6}{\beta\alpha_{ss}^{1/2}}\right)$$

where β is the ratio of gas to magnetic pressure and we have assumed that $B \sim B_\phi$ and $B_r \approx \alpha^{1/2} B_\phi$. The magnetic pressure is also taken into account by writing

$$P = P_{gas}\left(1 + \frac{1}{\beta}\right)$$

With these we solve the standard set of time-dependent α disk equations. The opacity of nebular material is considered to be given by the piecewise continuous power laws used by Ruden and Pollack [5]. The self-consistent solution of disk structure in the presence of a magnetic field is calculated as follows. At each timestep, we compute the structure of a uniform α_{ss} nonmagnetic disk. The ionization degree profiles of such disks are calculated from equilib-