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ABSTRACTS OF POSTERS

CURRENTS, FIELDS, AND POTENTIALS IN THE IONOSPHERE OF VENUS

D. M. Hurley[1] and P. A. Cloutier[1]

Law and Cloutier have developed a complete picture of the magnetic field in the dayside ionosphere of Venus. Their investigation is based upon observations from the Pioneer Venus Orbiter (PVO) magnetometer instrument. We embed the model magnetic field to a model ionosphere and perform several analyses. First of all, we determine the electric currents associated with the magnetic field configuration. We use the model atmosphere to transform the current into an electric field map of the region. Then, we examine the field aligned current and cross field current to investigate the potential drops along field lines. In doing so, we derive the map of the ionospheric electric potential for the dayside of Venus.

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SPECTRA AND NEURAL NETWORKS FOR THE SPECIFICATION OF STORM-TIME ENERGETIC ELECTRONS AT GEOSTATIONARY ORBIT

J. W. Freeman[1] and T. P. O'Brien[1]

Electrons whose energy is of the order MeV have been implicated in the failure and malfunction of Geostationary spacecraft. It is, therefore, important to be able to specify and even forecast the flux of these particles during and following geomagnetic storms. A first step is the understanding of their spectral properties and their relationship to lower energy electrons that can already be modeled.

At Geosynchronous orbit, the fluxes of electrons whose energies range from 100 keV to 2 MeV fall off with increasing energy according to a power-law. On a log-log plot, this spectrum appears as a line, with slope and offset parameters. We note that the spectrum parameters vary in time, but that the overall power-law persists. We present our preliminary efforts modeling these parameters with an Artificial Neural Network. We have begun our investigation with the geomagnetic storm in early November, 1993.

We report initial success using simultaneous input values from Dst, satellite local time, and satellite-measured flux in the 30–45 keV channel. The ANN performs reasonably well throughout most of the storm and during the recovery phase. However, we believe the simultaneous input to be insufficient for modeling the full behavior of the spectrum. We have not yet implemented any historical information as inputs to the ANN. With such additional inputs, we expect the accuracy to improve.

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SPECTROPHOTOMETRIC DATA OF THE CENTRAL STAR OF THE PLANETARY NEBULA LMC N66. QUANTITATIVE ANALYSIS OF ITS WN TYPE SPECTRUM[1]

M. Peña[2], W.-R. Hamann[3], L. Koesterke[3], J. Maza[4], R. H. Méndez[5], M. Peimbert[2], M. T. Ruiz[4], and S. Torres-Peimbert[2]

HST, *IUE* and ground-based observations of the central star of the LMC planetary nebula N66 (CS N66), obtained in different epochs, are presented. Since 1990 CS N66 has shown remarkable short- and long-term spectroscopic and photometric changes amounting to more than 3 magnitudes in the optical. Expanding model atmospheres have been constructed to fit observations from different epochs. Fits provide the chemical composition, the fundamental stellar parameters, L_*, T_*, R_*, the mass-loss rate and the wind velocity. From our best models we found that CS N66 is a very luminous He star ($X/Y \leq 0.1$), with a small amount of N, under-

going a violent and unstable mass loss event. The photospheric chemical abundances correspond to the equilibrium CNO nuclear burning values, while the nebula has a normal chemical composition. Models fitting data from different epochs show that the fundamental stellar parameters remain constant with time, with values $\log L_*/L_\odot = 4.53 \pm 0.10$, $T_* = 93\,300$ K, and $R_* = 0.71\ R_\odot$. The short- and long-term stellar variations are produced by large changes in the mass-loss rate, which varies by large factors, from $\dot{M} \leq 8 \times 10^{-7}\ M_\odot\ \mathrm{yr}^{-1}$ in 1983 (pre-outburst epoch) to $\dot{M} = 2.5 \times 10^{-5}\ M_\odot\ \mathrm{yr}^{-1}$ in early 1995 (maximum stellar brightness). No evidence to support the suggestion that the outburst was due to a late thermal pulse was found. We propose that the event taking place in CS N66 was produced by an atmospheric instability similar to those triggering the giant eruptions of Population I LBV stars. We briefly discuss an approach to the Eddington-limit due to changes in the opacity and a non-radial pulsational instability as two possible mechanism which could have caused the atmospheric outburst.

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SHAPING BIPOLAR AND ELLIPTICAL PLANETARY NEBULAE: EFFECTS OF STELLAR ROTATION AND MAGNETIC FIELDS

G. García-Segura[1], N. Langer[2], M. Różyczka[3], and J. Franco[1]

We present hydrodynamical and magneto-hydrodynamical simulations for the evolution of planetary nebulae formed through the interaction of two succeeding constant stellar winds. The latitudal dependance of the wind parameters are described by a single wind function in our calculations. We explore various relevant parameters, including the effects of stellar rotation, ionizing radiation field and stellar magnetic field, and a catalogue of resulting nebula shapes is generated.

We find that strongly bipolar nebulae can be obtained when the stellar rotational velocity, v_{rot}, approaches the critical rotational velocity, v_{crit}, at the asymptotic giant branch (AGB) phase. As an example, the shape of the Hourglass Nebula (MyCn18) is obtained for the value of the ratio $\Omega = v_{\mathrm{rot}}/v_{\mathrm{crit}} \approx 0.98$. We estimate the evolution of the rotation rate and of the critical rotation rate in thermally pulsing AGB stars and find a plausible scenario which predicts critical rotation at the tip of the ABG for single stars with an initial mass of more than $\sim 1.3\ M_\odot$.

When a stellar magnetic field is combined with the effect of the rotation at the AGB phase, highly collimated bipolar nebulae can be obtained such as M2–9 or He 2–437. Provided that the field is sufficiently strong, the formation of ansae and jets in the polar regions of the nebula have also been found, such as IC 4593. On the other hand, weaker fields can account for classical elliptical nebulae such as NGC 6905 even in nonrotating (i.e., spherically symmetric) AGB winds.

Photoionization was found to be important in producing dynamical effects. It generates irregularities in the shape of the simulated nebulae, and may be responsible for the formation of irregularly shaped planetary nebulae, such as Sh 2-71 or WeSb 4. It also leads to the formation of cometary knots, preferentially at the equatorial region, similar to those seen in the Helix nebula (NGC 7293).

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CHEMODYNAMICAL MODEL OF THE GALAXY: ABUNDANCE GRADIENTS PREDICTED FOR H II REGIONS AND PLANETARY NEBULAE

C. Allen[1], L. Carigi[1], and M. Peimbert[1]

We present a chemodynamical evolution model of the Galaxy to determine chemical abundance gradients of different stellar populations. From this model we have determined the abundance gradients expected for H II regions as well as for planetary nebulae of different ages and different kinematical properties. We have compared the model predicted gradients with those derived from PNe of Types I, II and III. From this comparison we conclude that only about half of the stars evolving toward the white dwarf stage produce PNe and that the less massive stars are less likely to produce PNe. Other arguments supporting the previous conclusions are presented.

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ANALYTICAL MODELS OF PROTOPLANETARY DISKS IN THE ORION NEBULA

Peter Shull, Jr.[1]

We have constructed analytical models of the gaseous objects in the Orion Nebula variously referred to as partially ionized globules (PIGs), LV globules, and protoplanetary disks (proplyds). We are applying these models to the *HST* observations of proplyds published since 1993 by various groups, and finding that we can constrain certain structural parameters for the proplyds.

The proplyds are modeled as isothermal objects whose particles are in Keplerian orbit around the central stars, and whose structure normal to the orbital plane is due to hydrostatic equilibrium. Our use of the term "disk" does not mean that the proplyds are necessarily thin and flat.

We consider how the size of a proplyd can be limited by the effects of the radiation field of Theta1C Orionis, the principle ionizing star in the Orion Nebula. Making the assumption that certain subsets of the observed proplyds obey similar surface-density power laws allows us to constrain the parameters in those laws. This approach is also of interest because it does not require one to assume optical thicknesses for the proplyds.

Our detailed results will be published in the near future.

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HST PARALLEL WFPC2 IMAGERY OF THE CARINA NEBULA: EGGS(?) AND PROPLYDS(?) IN DARK CLOUD RIMS AND BOK GLOBULES

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J. J. Hester[4], and D. G. Currie[5]

As part of the *HST* GO-6042 program, parallel WFPC2 images of locations in the large Carina H II region were taken during a series of FOS spectra of several ejecta of Eta Carinae (see Glover et al., these proceedings). The observations were scheduled during two CVZ (continuous viewing zone) visits in 1995 October, enabling deep WFPC2 exposures to be taken in ten filters. The "serendipitous" target was an area which included the Cr 232 star cluster and surrounding H II region, about 8 arcmin to the NW of Eta Carinae itself. Images of the nebula were obtained in the filters F656N (Hα), F673N ([S II] 6717+31 Å), F658N ([N II] 6583 Å), F502N ([O III] 5007 Å), and F547M (continuum) to study the ionization structure. In addition, relatively long ($\sim$ 1000 sec) exposures were obtained though the wide-band filters F336W, F439W, and F555W for purposes of obtaining UBV magnitudes and colors of stars down to a limiting magnitude of V$\sim$ 25.

We present the results of this imagery in the form of (*a*) color-coded emission line ratio maps of the nebulosity in the various lines noted above, and (*b*) color-magnitude (CMD) and color-color diagrams of stars in the field. At a distance of 2500 pc for the nebula and cluster, the spatial resolution of 0.1 arcsec on the WFPC2 imagery corresponds to 250 AU per pixel, a scale that resolves numerous Bok globules not previously seen from ground-based imagery. These globules are seen in absorption in the [O III] images and with bright rims in [S II] and [N II], indicating their proximity to the cluster OB stars and location in the ionized volume of the nebula. Our CMDs, (very preliminary) reach $M_V \sim +11$ for stars at the distance of the Cr 232 cluster. A prominent reflection nebula is also seen around one of the stars in the cluster.

This study is made possible by grants from AURA/STScI related to GO-6042 and the *HST* Cycle 5 TAC, which supported our expectations regarding science that would result from the parallel imagery.

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COROTATION RADII IN SPIRAL GALAXIES

Ivânio Puerari[1] and Horacio A. Dottori[2]

Shock induced star formation in a stellar density wave scenario produces an azimuthal gradient of ages across the spiral arms which has opposite signs on either side of the corotation resonance (CR). Schweizer (1976) and Beckman & Cepa (1990) have previously discussed what would be the behavior of the colors across spiral arms when the shock generated by a spiral density wave (SDW) induces star formation. The main azimuthal observable characteristics of this scenario are steeper azimuthal profiles and bluer color indexes on the side where the shock front is located. Elmegreen, Elmegreen, & Montenegro (1992) also pointed out that such evidence for the CR is clear in gas-rich galaxies in the form of sharp

endpoints to star formation ridges and dust lanes in two-armed spirals. In a previous paper (Puerari & Dottori 1992), we proposed a method to determine the leading or trailing character of the density wave perturbation in spiral galaxies by analyzing the distribution of H II regions. We idealize a new method based on the Fourier analysis of azimuthal profiles, to locate the CR and determine the arm character (trailing or leading) in spiral galaxies. Basically, we compare the behavior of the phase angle of the two-armed spiral in blue and infrared colors that pick out, respectively, young and older disk stellar population. The full paper of this poster contribution was published elsewhere (Puerari & Dottori 1997) and the reader can get more information on that paper. With our new method we confirm for NGC 7479 the existence of the leading pattern with CR at the extreme of the bar. We found in this galaxy the existence of a internal CR, indicating a trailing pattern. NGC 1832 presents three CRs, the inner and the outer ones indicate leading pattern and the intermediate CR, a trailing one. The most plausible physical interpretation for this situation is the existence of two pattern speeds.

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NASA 3.0-M LIQUID MIRROR TELESCOPE

M. K. Mulrooney[1,2]

We have constructed a 3.0-meter aperature zenith-staring telescope of an unusual nature. This Liquid Mirror Telescope (LMT) has as its primary mirror a spinning container of elemental mercury (Hg). We rely on the well-known principle that the equillibrium surface configuration of a rotating fluid is a paraboloid (if the axis of rotation is parallel to a uniform gravitational field). In our configuration, the primary container supports a 1.8 mm film of Hg and rotates on an air bearing spindle at 10 rpm, yielding a focal length of 4.5 m (f/1.5). A Wynne-type corrector removes aberrations and produces a 6 cm diameter, 0.64 deg focal plane at prime focus. Optical throughput is 65% allowing for the 78% reflectivity of Hg at visible wavelengths. Corrector distortion has limited resolution to 0.95 arcsec FWHM. Atmospheric seeing at the telescope's location (National Solar Observatory, Sunspot, NM) yields a nominal resolution of 1.3 arcsec (″) FWHM. After a corrector fix in late 1997, we expect to obtain 0.5″ FWHM images with good seeing.

The LMT was constructed with the purpose of characterizing the orbital space debris environment for NASA and conducting very wide/deep field astronomical surveys. Project costs were 1.2 M$ or 5% of the estimated cost for a conventional (glass/pointable) 3.0-m telescope. Since March 1996, we have obtained 100+ hrs of orbital debris observations with various image intensifiers. The present debris detection size is < 4 cm at 1000 km assuming a 0.1 albedo spherical reflector. For the astronomical survey, we are using a Ford 2K thick CCD with 15 um pixels yielding a 0.6″ pix^{-1} plate scale. The CCD is used in Time Delay Integration (TDI) mode wherein we drift scan at the sidereal rate to yield a 97.0 sec exposure time over a 20 arcminute FOV. To date, we have obtained (BVRI) and narrowband (400–1000 nm; 10–30 BW) photometry over 40+ sq. degrees of sky at high galactic latitude centered on +33° Dec. The accumulating data set (200+GB) is being used primarily to generate a wedge diagram extending to a redshift of 0.5 over 10 hrs of Right Ascension and containing approximately 1.5 million galaxies/QSOs; the largest survey of its kind by any telescope to date.

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EVIDENCE FOR SATURATED INVERSE COMPTON SCATTERING IN GAMMA-RAY BURSTS

A. Crider[1], E. Liang[1], and I. Smith[1]

Early studies of gamma-ray bursts found that the low-energy (30–100 kev) asymptotic spectral slope was typically 0 to −1.5 (Band et al. 1993). However, we examined the time-resolved low-energy GRB spectra measured with the Burst and Transient Source Experiment (BATSE) and found that the asymptotic power slope is often positive (as high at 1.6 ± 0.3) near the beginning of a burst and becomes negative as the burst progresses (Crider et al. 1997). These findings rules out many proposed emission mechanisms but can naturally be explained with saturated Comptonization as an emission mechanism in GRBs. By running Monte Carlo simulations, we

find that a simple decrease in the Thompson depth is all that is required to explain the observed change in the low-energy slope (Liang et al. 1997). Further evidence may be provided by recently discovered counterparts to GRB970228, observed with the Italian X-ray satellite *BeppoSAX* (Costa et al. 1997) and *Hubble Space Telescope* (Sahu et al. 1997). These counterparts fade at a rate that is consistent with saturated Comptonization. If this is indeed the emission mechanism, these observations place limits on the rate at which the spectral break energy decreases.

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IS THE EGRET SOURCE 2EG2020+4026 A GEMINGA-LIKE PULSAR?

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The error box of the EGRET source 2EG2020+4026, inside the γ-Cygni supernova remnant, has been found to contain a point-like X-ray source, denoted as RX J2020.2+4026. Through optical observations, we consider unlikely the association of the X-ray source with the only coincidental star, a $m_v \approx 15$ star of type K0V with no signs of coronal activity. The most direct interpretation of the data available is that 2EG2020+4026 is a young pulsar: the γ-ray emission shows no time variability and the spectrum is similar to that of Geminga; there is an X-ray point source inside the error box and SNR, and the F_γ/F_X is higher than in all objects apart from pulsars; and the lack of a credible optical counterpart is also consistent with a γ-ray emitting neutron star.

The proof that 2EG2020+4026 is a pulsar would be the detection of pulsations. We searched for these in a sample of EGRET data corresponding to GCRO observation 203 containing 1129 photons events with $E > 200$ MeV. The search comprise most of the range of timing parameters of known pulsars, $\nu \lesssim 30$ Hz and $\dot{\nu} \lesssim 2.2 \times 10^{-11}\,\mathrm{Hz}^{-2}$, and no coherent pulsations of sufficient statistical significance were found after 3.78×10^9 tries. Its sensitivity was hampered by the high background in the source region and it does not constrain the pulsed fraction of the γ-ray flux. A thorough search requires higher S/N X-ray or γ-ray data.

Brazier K. T. S. et al. 1996, MNRAS, 281, 1033

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