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Abstract of recently accepted papers

How Mira Variables Change Visual Light by a Thousand-fold

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Mira variables change visual light by up to 8 magnitudes over their roughly yearly cycle. Here we present a simple explanation for the extremely large amplitudes of light curves of oxygen-rich Mira variables. Metallic oxides, such as TiO, form throughout the stellar atmosphere as the star cools when approaching minimum light. When this happens, the visual light can be almost completely absorbed at large radii, extending the visual photosphere to nearly twice its nominal size. At these large radii, temperatures can fall to $\approx$ 1400 K and essentially all of the star's radiation emerges in the infrared. Since almost no optical light is emitted at these low temperatures, Mira variables can decrease their visual light by more than a thousand-fold and almost "disappear" to the human eye.

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Preprints can be obtained from astro-ph/0106571 or contacting reid@cfa.harvard.edu or via WWW on or via anonymous ftp on

VLBI Monitoring Observations of Water Masers Around the Semi-Regular Variable Star R Crateris

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We monitored water-vapor masers around the semi-regular variable star R Crateris with the Japanese VLBI Network (J-Net) at the 22 GHz band during four epochs with intervals of one month. The relative proper motions and Doppler-velocity drifts of twelve maser features were measured. Most of them existed for longer

than 80 days. The 3-D kinematics of the features indicates a bipolar expanding flow. The major axis of the asymmetric flow was estimated to be at P.A. = 136°. The existence of a bipolar outflow suggests that a Mira variable star had already formed a bipolar outflow. The water masers are in a region of apparent minimum radii of 1.3×10^{12} m and maximum radii of 2.6×10^{12} m, between which the expansion velocity ranges from 4.3 to 7.4 km s^{-1}. These values suggest that the water masers are radially accelerated, but still gravitationally bound, in the water-maser region. The most positive and negative velocity-drifting features were found relatively close to the systemic velocity of the star. We found that the blue-shifted features are apparently accelerated and the red-shifted apparently decelerated. The acceleration of only the blue-shifted features seems to be consistent with that of the expanding flow from the star.

PASJ 53 No.6, (2001, December issue) in press.

Preprints can be obtained by contacting pepe@chianti.c.u-tokyo.ac.jp
or via WWW on http://www.nro.nao.ac.jp/library/report/list.html
or via anonymous ftp on ftp://ftp.nro.nao.ac.jp/nroreport/

The very slow wind from the pulsating semiregular red giant, L_2 Pup

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We have obtained 11.7 μm and 17.9 μm images at the Keck I telescope of the circumstellar dust emission from L_2 Pup, one of the nearest ($D = 61$ pc) mass-losing, pulsating, red giants that has a substantial infrared excess. We propose that the star is losing mass at a rate of $\sim 3 \times 10^{-7}$ $M_\odot$ yr^{-1}. Given its relatively low luminosity ($\sim$ 1500 $L_\odot$), relatively high effective temperature (near 3400 K), relatively short period ($\sim$ 140 days), and the inferred gas outflow speed of 3.5 km s^{-1}, standard models for dust-driven mass loss do not apply. Instead, the wind may be driven by the stellar pulsations with radiation pressure on dust being relatively unimportant, as described in some recent calculations. L_2 Pup may serve as the prototype of this phase of stellar evolution where it could lose $\sim$15% of its initial main sequence mass. **Accepted by ApJ**

Preprints can be obtained at astro-ph/0112230

Radiative transfer models of dust shells around Post-AGB stars

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We present a radiative transfer analysis of circumstellar dust shells around the Post-AGB stars HD 179821, HD 56126, HD 101584 and early R star HD 100764, using the code DUSTY. Parameters like mass-loss, shell inner radius, dust temperature, outflow velocity etc., are derived for HD 179821 and HD 56126 whose observed SED could be reproduced by our models.

Accepted by Astrophysics and Space Science *Preprints can be obtained by contacting nath@iiap.ernet.in*

Diffraction-limited speckle interferometry and modeling of the circumstellar envelope of R CrB at maximum and minimum light

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We present the first speckle interferometric observations of R CrB, the prototype of a class of peculiar stars which undergo irregular declines in their visible light curves. The observations were carried out with the 6 m telescope at the Special Astrophysical Observatory near maximum light ($V = 7$, 1996 Oct. 1) and at minimum light ($V = 10.61$, 1999 Sep. 28). A spatial resolution of 75 mas was achieved in the K-band. The dust shell around R CrB is partially resolved, and the visibility is approximately 0.8 at a spatial frequency of 10 cycles/arcsec. The two-dimensional power spectra obtained at both epochs do not show any significant deviation from circular symmetry. The visibility function and spectral energy distribution obtained near maximum light can be simultaneously fitted with a model consisting of the central star and an optically thin dust shell with density proportional to r^{-2}. The inner boundary of the shell is found to be 82 $R_\star$ (19 mas) with a temperature of 920 K. However, this simple model fails to simultaneously reproduce the visibility and spectral energy distribution obtained at minimum light. We show that this discrepancy can be attributed to thermal emission from a newly formed dust cloud.

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Preprints can be obtained by contacting kohnaka@mpifr-bonn.mpg.de

Relation of SiO maser emission to IR radiation in evolved stars based on the MSX observation

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Based on the space MSX observation in bands A(8μm), C(12μm), D(15μm) and E(21μm), and the ground SiO maser observation of evolved stars by the Nobeyama 45-m telescope in the v=1 and v=2 J=1-0 transitions, the relation between SiO maser emission and mid-IR continuum radiation is analyzed. The relation between SiO maser emission and the IR radiation in the MSX bands A, C, D and E is all clearly correlated. The SiO maser emission can be explained by a radiative pumping mechanism according to its correlation with infrared radiation in the MSX band A.

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Turbulent planetary nebulae around [WC]–type stars

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Through a high-resolution spectroscopic survey, we analyze the velocity field of 16 planetary nebulae with [WC]- or *wels*-type nuclei in comparison with 8 nebulae having other central star types. We found spectral evidence for finite turbulent velocities in [WC]-type planetary nebulae superimposed on an essentially constant expansion velocity pattern. The nebulae around O-type stars show no evidences for significant turbulence while their expansion velocity if found to increase outwards. Both types of nebulae show the same mean expansion velocity. Our results support the earlier suggestions that nebulae surrounding [WC] central stars are likely related to long lasting momentum-driven phase bubbles. Turbulence in the nebulae can be either triggered, or enhanced, by stellar wind inhomogeneities which appear ubiquitous in Wolf-Rayet nuclei.

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Preprints can be obtained via WWW on `http://www.astri.uni.torun.pl/~gesicki/AGGD2002.ps.gz`

Crystalline silicates in the envelopes and disks around oxygen-rich asymptotic giant branch stars

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We have modeled dust envelopes and disks around oxygen-rich asymptotic giant branch (AGB) stars using optical properties of amorphous and crystalline silicate dust grains paying close attention to the infrared observations of the stars including the Infrared Space Observatory (*ISO*) data. Using the opacity functions for various mixtures of amorphous and crystalline silicates, we have calculated the radiative transfer model spectral energy distributions (SEDs) for the dust envelopes and disks. We have compared the model results with the observed SEDs of the stars. Using the averaged single grain population model for mixed amorphous and crystalline silicates, we find that spherical envelope models with about 10 % to 20 % of crystalline silicates produce the observed crystalline emission features for high mass-loss rate AGB stars and there is virtually no evidence of the existence of crystalline silicates for low mass-loss rate stars. This would confirm the idea that crystalline silicates form only in dense envelopes around high mass-loss rate O-rich AGB stars. Additionally, we find that the crystalline content is higher for more dusty stars. For a spherical dust envelope, we argue that a fraction of silicates initially condensed in amorphous form may subsequently be annealed to become crystalline form in the inner region of the outflowing envelope. If dust formation temperature is 1000 K, the inner region of the envelope is hot (about 900-1000 K) during an extended period of time (several hundred days) for a known crystallization process - annealing. The process may not be effective for low mass-loss rate stars because the dust formation temperature is believed to be lower for weaker stellar winds. We have investigated the model SEDs produced by the geometrically thin and optically thick dust disk heated by a spherical dust envelope as well as a central star. We find that the crystalline silicate emission features are produced by the spherical envelope not by the dust disk. And the crystalline absorption features at the same wavelengths are produced by the dust disk.

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Preprints can be obtained by contacting kwsuh@cbucc.chungbuk.ac.kr,

or via WWW on http://ast.chungbuk.ac.kr/~kwsuh/kwsuh.htm