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News and Views

New URL for European Mirror of MCNews

Please note that the European mirror of MCNews has been moved to the Astronomical Institutes at the University of Bonn, Germany and is now accessible at the following URL:
http://www.astro.uni-bonn.de/~mcnews/

The University of Bonn hosts a large research initiative on the Magellanic Clouds and is therefore a fitting location for the European mirror. We would like to thank the Astronomical Institutes for making their resources available to us.

We are planning to make the abstracts in MCNews available as HTML documents with links to the postscript files of the articles. Preliminary versions will be included in
http://www.astro.uiuc.edu/mcnews/MCissues.html and
Abstracts of Refereed Papers

Extinction of H II regions in the Large Magellanic Cloud

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The extinction properties of H II regions in the Large Magellanic Cloud are investigated using the radio continuum data obtained from the Molonglo Observatory Synthesis Telescope, digitised and calibrated Hα data and published Balmer decrement measurements. The resulting extinction-color excess diagram suggests 1. most H II regions in the Magellanic Clouds have similar extinction properties to the Galactic ones, 2. all imaginable gas/dust configurations are possible, 3. the extinction of some highly reddened H II region cores originates externally in cocoon shells.

The 30 year old puzzle of different extinction-color excess ratios of Galactic and extragalactic H II regions is explained to be due to the different populations of observed H II regions rather than any intrinsic differences. The extinction of the observed Galactic H II regions produced by foreground dust overwhelms the internal extinction while the situation in the observed extragalactic H II regions is just opposite.

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For preprints, contact tye@lai.ncsa.uiuc.edu

Multi-Wavelength View of the Interstellar Medium in the Large Magellanic Cloud

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The Large Magellanic Cloud (LMC) has been surveyed in optical emission lines, X-rays, radio continuum, H1, and CO lines. These surveys provide unprecedentedly clear views of the interstellar medium (ISM) in the LMC, allowing us to study astrophysical processes and to examine the relationship among the different phases of the ISM. Multi-wavelength images are used to illustrate the physical structures of supernova remnants, superbubbles, and supergiant shells, as well as the global interstellar structure of the LMC.

Submitted to: Publications of the Astronomical Society of Australia
For preprints, contact chu@astro.uiuc.edu
Also available from the URL http://www.astro.uiuc.edu/~chu/preprints/LMC_ISM.ps
A Comparison of Discrete Sources in Radio and H\alpha surveys of the Magellanic Clouds – and the Potential for the New H\alpha Survey

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We present a comparison between the latest Parkes radio surveys (Filipović et al. 1995; 1996; 1997) and H\alpha surveys of the Magellanic Clouds (Kennicutt & Hodge 1986). We have found 180 discrete sources in common for the Large Magellanic Cloud (LMC) and 40 in the field of the Small Magellanic Cloud (SMC). Most of these sources (95\%) are H\II regions and supernova remnants (SNRs).

A comparison of the radio and H\alpha flux densities shows a very good correlation and we note that the many of the Magellanic Clouds SNRs are embedded in H\II regions.

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For preprints, contact fica@st.nepean.uws.edu.au

X-Rays from Superbubbles in the Large Magellanic Cloud.
V. The H\II Complex N11

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The large H\II complex N11 in the Large Magellanic Cloud contains OB associations at several different stages in their life histories. We have obtained ROSAT PSPC and HRI X-ray observations, Curtis Schmidt CCD images, echelle spectra in H\alpha and [N II] lines, and IUE interstellar absorption line observations of this region. The central bubble of N11 has an X-ray luminosity a factor of only 3-7 brighter than predicted for an energy-conserving superbubble, making this the first detection of X-ray emission from a superbubble without a strong X-ray excess. The region N11 B contains an extremely young OB association analogous to the central association of the Carina nebula, apparently still embedded in its natal molecular cloud. We find that N11B emits diffuse X-ray emission, probably powered by stellar winds. Finally, we compare the tight cluster HD32228 in N11 to R136 in 30 Dor. The latter is a strong X-ray source, while the former is not detected, showing that strong X-ray emission from compact objects is not a universal property of such tight clusters.

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Also available from the URL
A Digital Photometric Survey of the Magellanic Clouds: First Results From One Million Stars

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We present the first results from, and a complete description of, our ongoing UBVI digital photometric survey of the Magellanic Clouds. In particular, we discuss the photometric quality and automated reduction of a CCD survey (magnitude limits, completeness, and astrometric accuracy) that covers the central 8 by 8 degrees of the Large Magellanic Cloud (LMC) and 4 by 4 degrees of the Small Magellanic Cloud (SMC). We discuss photometry of over 1 million stars from the initial survey observations (an area northwest of the LMC bar covering 2 by 1.5 degrees) and present a deep stellar cluster catalog that contains about 45% more clusters than previously identified within this region. Of the 68 clusters found, only 12 are also identified as concentrations of “old”, red clump stars. Furthermore, only three clusters are identified solely on the basis of a concentration of red clump stars, rather than as a concentration of luminous (V < 21) main sequence stars. Extrapolating from the current data, we expect to obtain B and V photometry for 25 million stars, and U and I photometry for 10 and 20 million stars, respectively, over the entire survey area.

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For preprints, contact dennis@ucolick.org
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HIPPARCOS Parallaxes and the Cepheid Distance Scale

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HIPPARCOS parallaxes have recently become available for a sample of Galactic Cepheids, and we have used these new distances to calibrate the Cepheid period-luminosity (PL) relation at six wavelengths (BVIJHK). Comparing these calibrations with previously published multiwavelength PL relations we find agreement to within 0.07 ± 0.14 mag, or 4 ±7% in distance. Unfortunately, the current parallax errors for the fundamental pulsators (ranging in signal-to-noise = \(\pi/\sigma_\pi\) from 0.3 to 5.3, at best) preclude an unambiguous interpretation of the observed differences, which may arise from a combination of true distance modulus, reddening and/or metallicity effects. We explore these effects and discuss their implications for the distance to the Large Magellanic Cloud (LMC) and the Cepheid-based extragalactic distance scale. These results suggest a range of LMC moduli between 18.44 ±0.35 and 18.57 ±0.11 mag; however, other effects on the Cepheid PL relation (e.g., extinction, metallicity, statistical errors) are still as significant as any such reassessment of its zero point.

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On the Deficiency of 8–10 Day Galactic Cepheids

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The Galactic Cepheid period histogram has a strong dip between 8 and 10 days that has defied an explanation based on evolutionary and linear pulsation studies. We show here that this deficiency is caused by the instability of the nonlinear fundamental pulsation cycle in this period range. The strong metallicity dependence of this instability is consistent with the absence of a corresponding minimum in the Magellanic Cloud data. Our results also suggest that the Galactic Cepheids must have a large spread in metallicity.

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Spectrophotometric data of the central star of the planetary nebula LMC N66. Quantitative analysis of its WN type spectrum

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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, \( L_s, T_s, R_s \), 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, undergoing 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 \( L_s/L_\odot = 4.53 \pm 0.10 \), \( T_s = 93300 \) K, and \( R_s = 0.71 R_\odot \). The short- and long-term stellar variations are produced by large changes in the mass-loss rate, which varies by large factors, from \( \dot{M} \leq 8 \times 10^{-7} M_\odot \) yr\(^{-1}\) in 1983 (pre-outburst epoch) to \( \dot{M} = 2.5 \times 10^{-5} M_\odot \) 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. The possible mechanism causing the atmospheric instability is briefly discussed.
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The SMC Supersoft X-Ray Binary 1E 0035.4–7230 (SMC 13)

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Details of simultaneous photometric and spectroscopic observations of the optical counterpart of the “supersoft” X-ray source in the Small Magellanic Cloud 1E 0035.4–7230 (‘SMC 13’) are presented. Although the spectrum is dominated by emission lines of He \textsc{ii}, the Balmer series of hydrogen is also present in emission with a strong decrement, and Balmer lines are seen as broad absorptions. Several high ionization emission features are also present including O \textsc{vi} (3811, 3834, and 5290 Å). Radial velocities and photometry confirm that the binary period is \(~0.1719\) d, and an improved value of the period is derived from four years of photometry and analysis of \textit{ROSAT}-HRI X-ray data. The orbital light variation is primarily due to an eclipse of the extensive accretion disk. X-ray and optical minima occur together. The $UBV$ light curves are similar to each other, and no clear phase-related color variations are found. He \textsc{ii} emission-line velocities show a semi-amplitude of $K\sim100$ km s\textsuperscript{-1}, and maximum velocity occurs when the light curve indicates the compact star would be moving away from the observer, suggesting this emitting region may trace the orbital motion of the compact star. The range of possible masses implied for the X-ray source lies between 0.5 and $1.5M_\odot$ if the mass donor is a main sequence star filling its Roche lobe. The light curve suggests values at the high end of this range. The broad H absorption lines appear to have a much larger velocity amplitude and lower systemic velocity, making it difficult to understand their origin. We discuss possible models for the system.

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For preprints, contact crampton@dao.nrc.ca
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Simultaneous HST/ASCA Observations of LMC X-4: X-ray Ionization Effects on a Stellar Wind

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We present first results from simultaneous ultraviolet (HST/GHRS) and X-ray (ASCA) observations of the 13.5s pulsar LMC X-4 taken in 1996 May. The ASCA observations covered 1.12 binary orbits (1.58 days) and the HST observations were centered on this object for roughly 0.4 orbital phase
coverage (0.56 days). The GHRS data are the highest resolution (both temporal and spectral) ultraviolet spectra ever taken of LMC X-4. With generally-accepted parameters for the source, fits to the UV continuum using a model that incorporates X-ray heating of the companion star and the accretion disk yields a mass accretion rate $\dot{M} = 4.0 \times 10^{-8} M_\odot \ \text{yr}^{-1}$; the X-ray luminosity implied by this value is consistent with the X-ray flux measured during simultaneous observations ($3.2 \times 10^{-10} \ \text{ergs cm}^{-2} \ \text{s}^{-1}$). The model accurately predicts observed B magnitude and ultraviolet variations over both orbital and long-term periods. The ultraviolet P-Cygni lines show dramatic changes with orbital phase with strong broad absorption near X-ray eclipse and narrow absorption when the X-ray source is in the line-of-sight. We interpret this as a result of X-ray photoionization of the stellar wind; when the neutron star is in front of the normal star, the wind absorption disappears and mainly the photospheric absorption lines are visible. The X-ray pulse period measured during our observations, 13.5090±0.0002s, is consistent with steady spin-down over the past 10 years. No pulsations were detected in the ultraviolet observations with upper limits to the pulsed fraction around NV and CIV of 1.8% and 2.7% in the continuum and 12.4% and 7% in the absorption troughs.

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Optical identification of the LMC supersoft source RX J0527.8-6954 from MACHO Project photometry

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We identify the likely optical counterpart to the LMC supersoft X-ray source RX J0527.8-6954, and hence recover HV 2554. This identification is based on an analysis of ~ 4 years of optical photometry obtained serendipitously via the MACHO project. We see a steady fading of the star of ~ 0.5 mag over the duration of the observations. Evidence is also presented for an orbital modulation of ~ 0.05 mag semi-amplitude on a period of $P = 0.39262 \pm 0.00015 \ \text{d}$. Our optical observations are consistent with the suggestion that the X-ray decline in this system is caused by cooling after a weak shell flash.

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For preprints, contact Karen Southwell kas@astro.ox.ac.uk
Is the LMC Microlensing Due to an Intervening Dwarf Galaxy?

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The recent suggestion that the microlensing events observed towards the Large Magellanic Cloud are due to an intervening Sgr-like dwarf galaxy is examined. A search for foreground RR Lyrae in the MACHO photometry database yields 20 stars whose distance distribution follow the expected halo density profile. Cepheid and red giant branch clump stars in the MACHO database are consistent with membership in the LMC. There is also no evidence in the literature for a distinct kinematic population, for intervening gas, or for the turn-off of such a hypothetical galaxy. We conclude that if the lenses are in a foreground galaxy, it must be a particularly dark galaxy.

Submitted to: Astrophysical Journal Letters

For preprints, contact Dante Minniti at dminniti@lanl.gov
Also available from the URL http://xxx.lanl.gov/list/astro-ph/9707310
Abstracts of Non-Refereed Papers

Nonlinear Pulsations

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We review some of the recent advances in nonlinear pulsation theory, but also insist on some of the major extant shortcomings.

Editor’s note: This paper discusses, among other things, different types of pulsating stars in the Magellanic Clouds, in particular different types of metal-poor Cepheids.


For preprints, contact buchler@phys.ufl.edu
Also available from the URL http://xxx.lanl.gov/abs/astro-ph/9707274

AGB stars in the Magellanic Clouds

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Some recent results on AGB research in the Magellanic Clouds are reviewed. Discussed are optical and IRAS based surveys, and recent results from the near-infrared DENIS survey, and ISO observations.

Invited Review at the “ISO’s view on Stellar Evolution” conference, July 1997, Noordwijkerhout, The Netherlands

For preprints, contact groen@mpa-garching.mpg.de
Also available from the URL http://www.mpa-garching.mpg.de/~groen/groen.html
**Thesis Abstracts**

A Far-Infrared – Millimeter-Wave Study of Star Formation in the Magellanic Clouds

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Stars form primarily in giant molecular clouds; therefore, the conditions within these clouds must be understood in any study of star formation. I present far-infrared and carbon monoxide (CO) line emission data from star-forming giant molecular clouds located in two nearby dwarf galaxies: the Large Magellanic Cloud (LMC), and the Small Magellanic Cloud (SMC). These galaxies differ considerably from the Milky Way in heavy element content, dust to gas ratio, and interstellar radiation field strength. The effects of these variations on star formation in 21 clouds in the LMC and 9 in the SMC are investigated. The CO data are used to delineate the molecular clouds and determine their masses using the virial theorem. Far-infrared data from the IRAS and COBE satellites are used to measure the cloud temperatures and luminosities, and to provide an estimate of the stellar content of each molecular cloud.

The 30 clouds range in mass from $2.7 \times 10^4 M_\odot$ to $1.0 \times 10^6 M_\odot$, and from $1.7 \times 10^4 L_\odot$ to $2.8 \times 10^6 L_\odot$ in far-infrared luminosity. Dust temperatures calculated from the 60$\mu$m and 100$\mu$m IRAS data are between 15 and 43 K with some dependence on the assumed dust emissivity. External heating due to the interstellar radiation field is estimated to account for anywhere from 2% to 100% of the far-infrared emission from each cloud. The brightest cloud contains from 1–3 O4 stars, the least bright from 6 B0 to 1 O8 stars. The clouds exhibit a wide range of star formation activity, as measured by the ratio of far-infrared luminosity to mass, with little correlation between this quantity and cloud mass. The star formation activity of both the LMC and SMC clouds is similar in range and magnitude to that of inner and outer Milky Way molecular clouds, in spite of a difference of up to an order of magnitude in the heavy element abundance, dust to gas ratio, and radiation field strength between the galaxies. The lack of dependence on these environmental properties has implications for several theories of star formation.


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*Also available from the URL* http://www.rpi.edu/~caldwd/
Meeting Announcements

The Magellanic Clouds and other Dwarf Galaxies

Workshop at the Physik-Zentrum Bad Honnef
January 18 – 22, 1998

The workshop is intended to combine the knowledge from the research on the well-resolved Magellanic Clouds with that from more distant galaxies. It will take place in the frame of our Graduiertenkolleg (research or graduate school) with the same name, which is jointly run by the Universities of Bonn and Bochum and supported by DFG. More information about this Graduiertenkolleg can be found in our homepage: http://www.astro.uni-bonn.de/~webgk.

Small meetings of our research school are being held at regular intervals. The workshop in January will be the 25th meeting, this time a large and international one. The Physik-Zentrum at Bad Honnef, located some 10 km south of Bonn, on the right side of the river Rhine, provides a fine venue for all participants. We invite interested scientists and advanced graduate students working in this field of research to participate in this workshop. Short oral contributions as well as posters are welcome. As soon as we have a first schedule, we’ll post it to you via e-mail and include it in our home page.

Scientific organization:
K.S. de Boer, R. Chini, R.-J. Dettmar, U. Klein (Chairman),
U. Mebold, T. Richtler, W. Seggewiss

Invited review speakers:
H. Böhringer, E. Brinks, Y.-H. Chu, J.S. Gallagher, D.A. Hunter,
J. Köppen, M.L. Mateo, J. Palouš, E.D. Skillman, T.X. Thuan

We ask you to send your application by September 30 to

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Please note that the number of outside participants has to be limited to about 40, due to accommodation constraints in the venue building. The conference fee of DM 250.– includes board and lodging and a copy of the proceedings.