Editorial

Dear Colleagues,

It is my pleasure to present you the 97th issue of the Magellanic Clouds Newsletter. It features abstracts of 23 journal papers, many of these dealing with the structure and content of young and old star clusters, with massive stars or variable stars, X-ray observations, or ISM processes and galactic structure. The latter category includes some exciting new work on the disruption of a dwarf galaxy in the Galactic tidal field, by Choi, Weinberg & Katz, and the cool gas content of the Magellanic Stream, by Deanna Matthews and collaborators. Don’t miss the nice reviews on FUSE observations of the Magellanic Clouds by Nicolas Lehner, and on the star formation process in the Magellanic Clouds by Joana Oliveira.

The University of Hertfordshire, near London UK, has a job opening for a postdoctoral researcher to work on Galactic and Magellanic studies. We would like to encourage you to apply, and wish you all the best if you do so.

The next issue will be distributed on the 1st of April 2009; the deadline for contributions is the 31st of March.

Editorially Yours,
Jacco van Loon
A New Diagnostic Method for Assessment of Stellar Stratification in Star Clusters

Dimitrios A. Gouliermis¹, Richard de Grijs² and Yu Xin²

¹Max-Planck-Institut für Astronomie, Königstuhl 17, D-69117 Heidelberg, Germany
²Department of Physics & Astronomy, The University of Sheffield, Hicks Building, Hounsfield Road, Sheffield S3 7RH, UK

We propose a new method for the characterization of stellar stratification in stellar systems. The method uses the mean-square radius (also called the Spitzer radius) of the system as a diagnostic tool. An estimate of the observable counterpart of this radius for stars of different magnitude ranges is used as the effective radius of each stellar species in a star cluster. We explore the dependence of these radii on magnitude as a possible indication of stellar stratification. This method is the first of its kind to use a dynamically stable radius, and though seemingly trivial it has never been applied before. We test the proposed method using model star clusters, which are constructed to be segregated on the basis of a Monte Carlo technique, and on Hubble Space Telescope observations of mass-segregated star clusters in order to explore the limitations of the method in relation to actual data. We conclude that the method performs efficiently in the detection of stellar stratification and its results do not depend on the data, provided that incompleteness has been accurately measured and the contamination by the field population has been thoroughly removed. Our diagnosis method is also independent of any model or theoretical prediction, in contrast to the ‘classical’ methods used so far for the detection of mass segregation.

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A New Feature in the Spectrum of the Superluminous LMC Supergiant HDE 269896

Mariela A. Corti¹,², Nolan R. Walborn³ and Christopher J. Evans⁴

¹Instituto Argentino de Radioastronomía (IAR), Centro Científico Tecnológico de La Plata (CCT–LP), CONICET, C.C. No. 5, 1894 Villa Elisa, Argentina
²Facultad de Ciencias Astronómicas y Geofísicas, Universidad Nacional de La Plata, Paseo del Bosque s/n, 1900 La Plata, Argentina
³Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA
⁴UK Astronomy Technology Centre, Royal Observatory Edinburgh, Blackford Hill, Edinburgh EH9 3HJ, UK

We have found strong selective emission of the N II 5000 Å complex in the spectrum of the LMC hypergiant HDE 269896, ON9.7 Ia +. Since this object also has anomalously strong He II λ4686 emission for its spectral type, an unusually wide range of ionization in its extended atmosphere is indicated. The published model of this spectrum does not reproduce these emission features, but we show that increased nitrogen and helium abundances, together with small changes in other model parameters, can do so. The morphological and possible evolutionary relationships of HDE 269896, as illuminated by the new spectral features, to other denizens of the OB Zoo are discussed. This object may be in an intermediate pre-WNVL (Very Late WN) state, which is in turn the quiescent state of at least some Luminous Blue Variables.

More generally, the N II spectrum in HDE 269896 provides a striking demonstration of the occurrence of two distinctly different kinds of line behavior in O-type spectra: normal absorption lines that develop P Cygni profiles at high wind densities, and selective emission lines from the same ions that do not. Further analysis of these features will advance understanding of both atomic physics and extreme stellar atmospheres.

Accepted for publication in PASP
We present evidence that the star-forming region NGC 346/N66 in the Small Magellanic Cloud is the product of hierarchical star formation, probably from more than one star formation event. We investigate the spatial distribution and clustering behavior of the pre-main sequence (PMS) stellar population in the region, using data obtained with Hubble Space Telescope’s Advanced Camera for Surveys. By applying the nearest neighbor and minimum spanning tree methods on the rich sample of PMS stars previously discovered in the region we identify ten individual PMS clusters in the area and quantify their structures. The clusters show a wide range of morphologies from hierarchical multi-peak configurations to centrally condensed clusters. However, only about 40 per cent of the PMS stars belong to the identified clusters. The central association NGC 346 is identified as the largest stellar concentration, which cannot be resolved into subclusters. Several PMS clusters are aligned along filaments of higher stellar density pointing away from the central part of the region. The PMS density peaks in the association coincide with the peaks of [O iii] and 8 μm emission. While more massive stars seem to be concentrated in the central association when considering the entire area, we find no evidence for mass segregation within the system itself.

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Abundances in the Galactic bulge: results from planetary nebulae and giant stars

C. Chiappini1,2, S.K. Gorny3, G. Stasińska4 and B. Barbuy5

1Observatoire de Genève, Université de Genève, 51 Chemins des Mailletes, CH-1290 Sauverny, Switzerland
2Osservatorio Astronomico di Trieste - OATs/INAF, Via G.B. Tiepolo 11, 34131 Trieste, Italy
3Copernicus Astronomical Center, Rabianska 8, PL-87-100, Torun, Poland
4LUTH, Observatoire de Paris, CNRS, Université Paris Diderot, Place Jules Janssen 92190 Meudon, France
5Universidade de São Paulo, IAG, Rua do Matão 1226, Cidade Universitaria, São Paulo 05508-900, Brazil

Our understanding of the chemical evolution of the Galactic bulge requires the determination of abundances in large samples of giant stars and planetary nebulae (PNe). We discuss PNe abundances in the Galactic bulge and compare these results with those presented in the literature for giant stars. We present the largest, high-quality data-set available for PNe in the direction of the Galactic bulge (inner-disk/bulge). For comparison purposes, we also consider a sample of PNe in the Large Magellanic Cloud (LMC). We derive the element abundances in a consistent way for all the PNe studied. By comparing the abundances for the bulge, inner-disk, and LMC, we identify elements that have not been modified during the evolution of the PN progenitor and can be used to trace the bulge chemical enrichment history. We then compare the PN abundances with abundances of bulge field giant. At the metallicity of the bulge, we find that the abundances of O and Ne are close to the values for the interstellar medium at the time of the PN progenitor formation, and hence these elements can be used as tracers of the bulge chemical evolution, in the same way as S and Ar, which are not expected to be affected by nucleosynthetic processes during the evolution of the PN progenitors. The PN oxygen abundance distribution is shifted to lower values by 0.3 dex with respect to the distribution given by giants. A similar shift appears to occur for Ne and S. We discuss possible reasons for this PNe-giant discrepancy and conclude that this is probably due to systematic errors in the abundance derivations in either giants or PNe (or both). We issue an important warning concerning the use of absolute abundances in chemical evolution studies.

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A spatially resolved study of photoelectric heating and \([\text{C}\,\text{II}]\) cooling in the LMC

D. Rubin\(^1\), S. Hong\(^3\), S.C. Madden\(^1\), A.G.G.M Tielens\(^2\), M. Meixner\(^3\), R. Indebetouw\(^4\), W. Reach\(^5\), A. Ginsburg\(^6\), S. Kim\(^7\), K. Mochizuki\(^8\), B. Babler\(^9\), M. Block\(^10\), S.B Brucker\(^9\), C.W. Engelbracht\(^10\), B.-Q. For\(^10\), K. Gordon\(^10\), J.L. Hora\(^11\), C. Leitherer\(^3\), M. Meade\(^9\), K. Misselt\(^10\), M. Sewilo\(^3\), U. Vijh\(^3\) and B. Whitney\(^12\)

\(^1\)Service d’Astrophysique, CEA/Saclay, l’Orme des Merisiers, F-91191 Gif-sur-Yvette, France
\(^2\)Kapteyn Institute, P.O. Box 800, NL-9700 AV Groningen, The Netherlands
\(^3\)Space Telescope Science Institute, 3700 San Martin Way, Baltimore, MD 21218, USA
\(^4\)Department of Astronomy, University of Virginia, PO Box 3818, Charlottesville, VA 22903, USA
\(^5\)Spitzer Science Center, California Institute of Technology, 220-6, Pasadena, CA, 91125, USA
\(^6\)Center for Astrophysics and Space Astronomy, University of Colorado, Boulder, CO, USA
\(^7\)Dept. of Astronomy & Space Science, Sejong University, KwangJin-gu, KunJa-dong 98, Seoul, 143-747, Korea
\(^8\)Institute of Space and Astronautical Science, Yoshinodai 3-1-1, Sagamihara, Kanagawa 229, Japan
\(^9\)University of Wisconsin, Madison, WI 53706, USA
\(^10\)Steward Observatory, University of Arizona, 933 North Cherry Ave., Tucson, AZ 85719, Steward Observatory, USA
\(^11\)Center for Astrophysics, 60 Garden St., MS 67, Harvard University, Cambridge, MA 02138, USA
\(^12\)Space Science Institute, 308 Morningside Ave., Madison, WI 53716, USA

We study photoelectric heating throughout the Large Magellanic Cloud. We quantify the importance of the \([\text{C}\,\text{II}]\) cooling line and the photoelectric heating process of various environments in the LMC and investigate which parameters control the extent of photoelectric heating. We use the BICE \([\text{C}\,\text{II}]\) map and the Spitzer/SAGE infrared maps. We examine the spatial variations in the efficiency of photoelectric heating: photoelectric heating rate over power absorbed by grains. We correlate the photoelectric heating efficiency and the emission from various dust constituents and study the variations as a function of H\(^\circ\) emission, dust temperatures, and the total infrared luminosity. From this we estimate radiation field, gas temperature, and electron density. We find systematic variations in photoelectric efficiency. The highest efficiencies are found in the diffuse medium, while the lowest coincide with bright star-forming regions (\(\sim 1.4\) times lower). The \([\text{C}\,\text{II}]\) line emission constitutes 1.32\% of the far infrared luminosity across the whole of the LMC. We find correlations between the \([\text{C}\,\text{II}]\) emission and ratios of the mid infrared and far infrared bands, which comprise various dust constituents. The correlations are interpreted in light of the spatial variations of the dust abundance and by the local environmental conditions that affect the dust emission properties. As a function of the total infrared surface brightness, \(S_{\text{TIR}}\), the \([\text{C}\,\text{II}]\) surface brightness can be described as: \(S_{\text[CII]} = 1.25 S_{\text{TIR}}^{0.69} \times 10^{-3} \text{ erg s}^{-1} \text{ cm}^{-2} \text{ sr}^{-1}\). The \([\text{C}\,\text{II}]\) emission is well-correlation with the 8 \(\mu\)m emission, suggesting that the polycyclic aromatic hydrocarbons play a dominant role in the photoelectric heating process.

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Two pairs of interacting EBs towards the LMC in the OGLE database

Aviv Ofir\(^1\)

\(^1\)School of Physics and Astronomy, Raymond and Beverly Sackler Faculty of Exact Sciences, Tel Aviv, Israel

A single point source on the OGLE LMC database shows the characteristics of two superimposed eclipsing binaries (EBs). The two EBs happen to have periods very close to the 3:2 resonance. The telescope’s small PSF and the apparent resonance between the two EBs raises the suspicion that this is not chance alignment but rather a compact hierarchical system of two pairs of interacting EBs in 3:2 resonance.

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On the origin of double main-sequence turn-offs in star clusters of the Magellanic Clouds

K. Bekki$^1$ and A.D. Mackey$^2$

$^1$UNSW, Australia
$^2$University Edinburgh, Scotland

Recent observational studies of intermediate-age star clusters (SCs) in the Large Magellanic Cloud (LMC) have reported that a significant number of these objects show double main-sequence turn-offs (DMSTOs) in their color–magnitude diagrams (CMDs). One plausible explanation for the origin of these DMSTOs is that the SCs are composed of two different stellar populations with age differences of $\sim 300$ Myr. Based on analytical methods and numerical simulations, we explore a new scenario in which SCs interact and merge with star-forming giant molecular clouds (GMCs) to form new composite SCs with two distinct component populations. In this new scenario, the possible age differences between the two different stellar populations responsible for the DMSTOs are due largely to secondary star formation within GMCs interacting and merging with already-existing SCs in the LMC disk. The total gas masses being converted into new stars (i.e., the second generation of stars) during GMC-SC interaction and merging can be comparable to or larger than the masses of the original SCs (i.e., the first generation of stars) in this scenario. Our simulations show that the spatial distributions of new stars in composite SCs formed from GMC-SC merging are more compact than those of stars initially in the SCs. We discuss both advantages and disadvantages of the new scenario in explaining fundamental properties of SCs with DMSTOs in the LMC and in the Small Magellanic Cloud (SMC). We also discuss the merits of various alternative scenarios for the origin of the DMSTOs.

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The dynamics of satellite disruption in cold dark matter haloes

Jun-Hwan Choi$^{1,2}$, Martin D. Weinberg$^1$ and Neal Katz$^1$

$^1$Department of Astronomy, University of Massachusetts, Amherst, MA 01003, USA
$^2$Department of Physics & Astronomy, University of Nevada, Las Vegas, 4505 S. Maryland Pkwy, Las Vegas, NV, 89154-4002, USA

We investigate the physical mechanisms of tidal heating and satellite disruption in cold dark matter host haloes using N-body simulations based on cosmological initial conditions. We show the importance of resonant shocks and resonant torques with the host halo to satellite heating. A resonant shock (torque) couples the radial (tangential) motion of a satellite in its orbit to its phase space. For a satellite on a circular orbit, an ILR-like resonance dominates the heating and this heating results in continuous satellite mass loss. We estimate the requirements for simulations to achieve these dynamics using perturbation theory. Both resonant shocks and resonant torques affect satellites on eccentric orbits. We demonstrate that satellite mass loss is an outside-in process in energy space: a satellite’s stars and gas are thus protected by their own halo against tidal stripping. We simulate the evolution of a halo similar to the Large Magellanic Cloud (LMC) in our Galactic dark matter halo and conclude that the LMC stars have not yet been stripped. Finally, we present a simple algorithm for estimating the evolution of satellite mass that includes both shock heating and resonant torques.

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A first orbital solution for the very massive 30Dor main-sequence WN6h+O binary R 145

O. Schnurr1,2, A. F. J. Moffat1, A. Villar-Sba±1, N. St-Louis1 and N. I. Morrell3

1Université de Montréal, Canada
2University of Sheffield, UK
3Las Campanas Observatory, Chile

We report the results of a spectroscopic and polarimetric study of the massive, hydrogen-rich WN6h stars R144 (HD 38282 = BAT 99-118 = Brey 89) and R 145 (HDE 269928 = BAT 99-119 = Brey 90) in the LMC. Both stars have been suspected to be binaries by previous studies (R 144: Schnurr et al. 2008b; R 145: Moffat 1989). We have combined radial-velocity (RV) data from these two studies with previously unpublished polarimetric data. For R145, we were able to establish, for the first time, an orbital period of 158.8 days, along with the full set of orbital parameters, including the inclination angle $i$, which was found to be $i = 38 \pm 9$ deg. By applying a modified version of the shift-and-add method developed by Demers et al. (2002), we were able to isolate the spectral signature of the very faint-line companion star. With the RV amplitudes of both components in R145, we were thus able to estimate their absolute masses. We find minimum masses $M_{WR}\sin^3i = 116 \pm 33$ M$_\odot$ and $M_O\sin^3i = 48 \pm 20$ M$_\odot$ for the WR and the O component, respectively. Thus, if the low inclination angle were correct, resulting absolute masses of the components would be at least 300 and 125 M$_\odot$, respectively. However, such high masses are not supported by brightness considerations when R145 is compared to systems with known, very high masses such as NGC 3603-A1 or WR 20a. An inclination angle close to 90° would remedy the situation, but is excluded by the currently available data. More and better data are thus required to firmly establish the nature of this puzzling, yet potentially very massive and important system. As to R 144, however, the combined data sets are not sufficient to find any periodicity.

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Spitzer View of Young Massive Stars in the LMC H II Complex N 44

C.-H. Rosie Chen1,2, You-Hua Chu2, Robert A. Gruendl2, Karl D. Gordon3 and Fabian Heitsch4

1University of Virginia, USA
2University of Illinois, USA
3Space Telescope Science Institute, USA
4University of Michigan, USA

The H II complex N 44 in the Large Magellanic Cloud (LMC) provides an excellent site to perform a detailed study of star formation in a mild starburst, as it hosts three regions of star formation at different evolutionary stages and it is not as complicated and confusing as the 30 Doradus giant H II region. We have obtained Spitzer Space Telescope observations and complementary ground-based 4m $uBV1JK$ observations of N 44 to identify candidate massive young stellar objects (YSOs). We further classify the YSOs into Types I, II, and III, according to their spectral energy distributions (SEDs). In our sample of 60 YSO candidates, ~ 65% of them are resolved into multiple components or extended sources in high-resolution ground-based images. We have modeled the SEDs of 36 YSOs that appear single or dominant within a group. We find good fits for Types I and I/II YSOs, but Types II and II/III YSOs show deviations between their observed SEDs and models that do not include PAH emission. We have also found that some Type III YSOs have central holes in their disk components. YSO counterparts are found in four ultracompact H II regions and their stellar masses determined from SED model fits agree well with those estimated from the ionization requirements of the H II regions. The distribution of YSOs is compared with those of the underlying stellar population and interstellar gas conditions to illustrate a correlation between the current formation of O-type stars and previous formation of massive stars. Evidence of triggered star formation is also presented.

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and from http://www.astro.virginia.edu/~cc5ye/n44yso.pdf
The beat Cepheids in the Magellanic Clouds: an analysis from the EROS-2 database

J.B. Marquette¹, J.P. Beaudieu¹, J.R. Buchler², R. Szabó³, P. Tisserand⁴, S. Belghith¹, P. Fouqué⁶, É. Lesquoy⁵, A. Milsztajn⁵, A. Schwarzenberg-Czerny⁵, C. Afonso⁶, J.N. Albert¹⁰, J. Andersen¹¹, R. Ansari¹⁰, É. Aubouy⁷, P. Barette⁸, X. Charlot⁵, C. Coutures⁵, R. Ferlet¹, J.F. Glicenstein⁵, B. Goldman⁵, F. Gould², D. Graff¹², M. Gros⁵, J. Haissinski¹⁰, C. Hamadache³, J. de Kat³, L. Le Guillou¹³, C. Loup¹, M. Magneville⁵, É. Maurice¹⁶, A. Maury¹⁷, M. Moniez¹⁰, N. Palanque-Delabrouille⁵, O. Perdereau¹⁵, Y.R. Rahaf¹⁰, J. Rich⁵, M. Spiro⁵ and A. Vidal-Madjar¹

¹Institut d’Astrophysique de Paris, UMR7095 CNRS, Université Pierre & Marie Curie, 98 bis Boulevard Arago, 75014 Paris, France
²Physics Department, University of Florida, Gainesville, FL 32611-8440, USA
³Konkoly Observatory, Budapest, P.O. Box 67, H-1525, Hungary
⁴Research School of Astronomy & Astrophysics, Mount Stromlo Observatory, Cotter Road, Weston ACT 2611, Australia
⁵CEA, DSM, DAPNIA, Centre d’Études de Saclay, 91191 Gif-sur-Yvette Cedex, France
⁶Observatoire Midi-Pyrénées, Laboratoire d’Astrophysique (UMR 5572), 14 av. E. Belin, 31400 Toulouse, France
⁷Centrum Astronomiczne im. M. Kopernika, Bartycka 18, 00-716 Warszawa, Poland
⁸Observatorium Astronomiczne, Uniwersytet A. Mickiewicza, Sloneczna 36, 60-286 Poznan, Poland
⁹Max-Planck-Institut für Astronomie, Königstuhl 17, D-69117 Heidelberg, Germany
¹⁰Laboratoire de l’Accélérateur Linéaire, IN2P3 CNRS, Université de Paris-Sud, 91405 Orsay Cedex, France
¹¹The Niels Bohr Institute, Copenhagen University, Juliane Maries Vej 30, DK2100 Copenhagen, Denmark
¹²Department of Astronomy, Ohio State University, Columbus, OH 43210, USA
¹³Division of Medical Imaging Physics, Johns Hopkins University, Baltimore, MD 21287-0859, USA
¹⁴LPNHE, CNRS-IN2P3 and Universités Paris 6 & Paris 7, 4 place Jussieu, 75252 Paris Cedex 05, France
¹⁵Observatoire Astronomique de Strasbourg, UMR 7550, 11 rue de l’Université, 67000 Strasbourg, France
¹⁶Observatoire de Marseille, 2 Place Le Verrier, 13248 Marseille Cedex 04, France
¹⁷European Southern Observatory (ESO), Casilla 19001, Santiago 19, Chile
¹⁸San Pedro de Atacama Celestial Exploration, Casilla 21, San Pedro de Atacama, Chile

A number of microlensing dark-matter surveys have produced tens of millions of light curves of individual background stars. These data provide an unprecedented opportunity for systematic studies of whole classes of variable stars and their host galaxies. We aim to use the EROS-2 survey of the Magellanic Clouds to detect and study the population of beat Cepheids (BCs) in both Clouds. BCs pulsating simultaneously in the first overtone and fundamental modes (FO/F) or in the second and first overtone modes (SO/FO) are of particular interest. Using special software designed to search for periodic variables, we have scanned the EROS-2 data base for variables in the typical period range of Cepheids. Metallicities of FO/F objects were then calculated from linear nonadiabatic convective stellar models. We identify 74 FO/F BCs in the LMC and 41 in the SMC, and 173 and 129 SO/FO pulsators in the LMC and SMC, respectively; 173 of these stars are new discoveries. For nearly all the FO/F objects we determine minimum, mean, and maximum values of the metallicity. The EROS data have expanded the samples of known BCs in the LMC by 31%, in the SMC by 110%. The FO/F objects provide independent measures of metallicities in these galaxies. The mean value of metallicity is 0.0045 in the LMC and 0.0018 in the SMC.

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Mid-IR period-magnitude relations for AGB stars

I.S. Glass¹, M. Schultheis², J.A.D.L. Blommaert³, R. Sahai¹, M. Stute³ and S. Uttenthaler³

¹SAAO, Republic of South Africa
²Observatoire de Besançon, France
³Instituut voor Sterrenkunde, Leuven, Belgium
⁴NASA-JPL, USA
⁵Department of Physics, University of Athens, Greece

Asymptotic Giant Branch variables are found to obey period-luminosity relations in the mid-IR similar to those seen at $K_s$ (2.14 μm), even at 24 μm where emission from circumstellar dust is expected to be dominant. Their loci in the
log $P$ diagrams are essentially the same for the LMC and for NGC 6522 in spite of different ages and metallicities. There is no systematic trend of slope with wavelength. The offsets of the apparent magnitude vs. log $P$ relations imply a difference between the two fields of 3.8 in distance modulus. The colours of the variables confirm that a principal period with log $P > 1.75$ is a necessary condition for detectable mass-loss. At the longest observed wavelength, 24 $\mu$m, many semi-regular variables have dust shells comparable in luminosity to those around Miras. There is a clear bifurcation in LMC colour–magnitude diagrams involving 24 $\mu$m magnitudes.

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Discovery of two distinct red clumps in NGC 419: a rare snapshot of a cluster at the onset of degeneracy

Léo Girardi$^1$, Stefano Rubele$^{1,2}$ and Leandro Kerber$^3$

$^1$Oss. Astron. Padova, Italy
$^2$Dip. Astron. Padova, Italy
$^3$IAG-USP, São Paulo, Brazil

Colour-magnitude diagrams (CMD) of the SMC star cluster NGC 419, derived from HST/ACS data, reveal a well-delineated secondary clump located below the classical compact red clump typical of intermediate-age populations. We demonstrate that this feature belongs to the cluster itself, rather than to the underlying SMC field. Then, we use synthetic CMDs to show that it corresponds very well to the secondary clump predicted to appear as a result of He-ignition in stars just massive enough to avoid electron-degeneracy settling in their H-exhausted cores. The main red clump instead is made of the slightly less massive stars which passed through electron-degeneracy and ignited He at the tip of the RGB. In other words, NGC 419 is the rare snapshot of a cluster while undergoing the fast transition from classical to degenerate H-exhausted cores. At this particular moment of a cluster’s life, the colour distance between the main sequence turn-off and the red clump(s) depends sensitively on the amount of convective core overshooting, $\alpha_c$. By coupling measurements of this colour separation with fits to the red clump morphology, we are able to estimate simultaneously the cluster mean age ($1.35^{+0.11}_{-0.04}$ Gyr) and overshooting efficiency ($\alpha_c = 0.47^{+0.14}_{-0.04}$). Therefore, clusters like NGC 419 may constitute important marks in the age scale of intermediate-age populations. After eye inspection of other CMDs derived from HST/ACS data, we suggest that the same secondary clump may also be present in the LMC clusters NGC 1751, 1783, 1806, 1846, 1852, and 1917.

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LMC Cepheids Periods Changes in the OGLE and MACHO data

Radoslaw Poleski$^3$

$^3$University of Warsaw Observatory, Poland

Periods of Cepheids should change as stars evolve through the instability strip. Rates of these changes found by other authors based on the decades-long O–C diagrams show rather good agreement with theoretical predictions. We have checked the variability on the scale of a few years on the data recently published by the Optical Gravitational Lensing Experiment for the Large Magellanic Cloud Cepheids and found period changes for 18% of fundamental mode and 41% of first overtone pulsators. It suggest the overtone pulsations are less stable than the fundamental ones. For stars which had the cross-references in the MACHO catalog we have checked if the period change rates derived from the OGLE and the MACHO data are consistent. It was found there is no correlation and opposite signs of changes in both data sets are more common than the same ones. For some stars O–C diagrams derived from the OGLE data only (spanning up to 4100 days) show random fluctuations. These fluctuations are common on the long-term O–C diagrams
and we conclude they dominate the diagrams for the timescales of few thousand of days. The distributions of periods and colors for all Cepheids and for those with statistically significant period changes are the same. Times of maximum light obtained using the MACHO and the OGLE data as well as the exemplary O–C diagrams are presented.

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**An X-ray and optical study of the new SMC X-ray binary pulsar system SXP 7.92 and its probable optical counterpart, AzV 285**

M.J. Coe¹, M. Schurch¹, V.A. McBride¹, R.H.D. Corbet², L.J. Townsend¹, A. Udalski³ and J.L. Galache⁴

¹Southampton University, UK
²UMBC/NASA GSFC, USA
³Warsaw University, Poland
⁴CfA/Harvard, USA

Optical and X-ray observations are presented here of a newly reported X-ray transient system in the Small Magellanic Cloud — SXP 7.92. A detailed analysis of the X-ray data reveal a coherent period of 7.9s. A search through earlier X-ray observations of the SMC reveal a previously unknown earlier detection of this system. Follow-up X-ray observations identified a new transient source within the error circle of the previous observations. An optical counterpart, AzV 285, is proposed which reveals clear evidence for a 36.8d binary period.

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**The XMM-Newton X-ray emission of the supernova remnant N 120 in the Large Magellanic Cloud**

Jorge Reyes Iturbide¹, Margarita Rosado¹ and Pablo F. Velázquez²

¹Instituto de Astronomía, Universidad Nacional Autónoma de México, Apdo. Postal 70-264, C.P. 04510, México D.F., México

We present new XMM-Newton observations of the supernova remnant (SNR) N 120 in the Large Magellanic Cloud, and numerical simulations on the evolution of this supernova remnant which we compare with the X-ray observations. The SNR N 120, together with several H II regions, forms a large nebular complex (also called N 120) whose shape resembles a semicircular ring. From the XMM-Newton data we generate images and spectra of this remnant in the energy band between 0.2 to 2.0 keV. The images show that the X-ray emission is brighter towards the east (i.e., towards the rim of the large nebular complex). The EPIC/MOS1 and MOS2 data reveal a thermal spectrum in soft X-rays. 2D axisymmetric numerical simulations with the Yguazú-a code were carried out assuming that the remnant is expanding into an inhomogeneous ISM with an exponential density gradient and showing that thermal conduction effects are negligible. Simulated X-ray emission maps were obtained from the numerical simulations in order to compare them with the observations. We find good agreement between the XMM-Newton data, previous optical kinematic data, and the numerical simulations; the simulations reproduce the observed X-ray luminosity and surface brightness distribution. We have also detected more extended diffuse X-ray emission probably due to the N 120 large H II complex or superbubble.

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A Determination of the Spin of the Black Hole Primary in LMC X-1

Lijun Gou, Jeffrey E. McClintock, Jifeng Liu, Ramesh Narayan, James F. Steiner, Ronald A. Remillard, Jerome A. Orosz and Shane W. Davis

1Harvard-Smithsonian Center for Astrophysics, 60 Garden street, Cambridge, 02143, USA
2Kavli Institute for Astrophysics and Space Research, Massachusetts Institute of Technology, Cambridge, MA 02139, USA
3Department of Astronomy, San Diego State University, 5500 Companile Driver, San Diego, CA 92182, USA
4Institute For Advanced Study, Einstein Drive, Princeton, NJ 08540, USA

The first extragalactic X-ray binary, LMCX-1, was discovered in 1969. In the 1980s, its compact primary was established as the fourth dynamical black-hole candidate. Recently, we published accurate values for the mass of the black hole and the orbital inclination angle of the binary system. Building on these results, we have analyzed 53 X-ray spectra obtained by the Rossi X-ray Timing Explorer (RXTE) and, using a selected sample of 18 of these spectra, we have determined the dimensionless spin parameter of the black hole to be $a_\ast = 0.90^{+0.04}_{-0.09}$. This result takes into account all sources of observational and model-parameter uncertainties. The standard deviation around the mean value of $a_\ast$ for these 18 X-ray spectra, which were obtained over a span of several years, is only $\Delta a_\ast = 0.02$. When we consider our complete sample of 53 RXTE spectra, we find a somewhat higher value of the spin parameter and a larger standard deviation.

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The VLT-FLAMES survey of massive stars: constraints on stellar evolution from the chemical compositions of rapidly rotating Galactic and Magellanic Cloud B-type stars


1Astrophysics Research Centre, School of Mathematics & Physics, The Queen’s University of Belfast, Belfast, BT7 1NN, Northern Ireland, UK
2Astronomical Institute, Utrecht University, Princetonplein 5, NL-3584CC, Utrecht, The Netherlands
3Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA
4Department of Physics and Astronomy, University College London, Gower Street, London WC1E 6BT, UK
5UK Astronomy Technology Centre, Royal Observatory, Edinburgh, Blackford Hill, Edinburgh, EH9 3HJ, UK
6Astronomical Institute Anton Pannekoek, University of Amsterdam, Kruislaan 403, 1098 SJ Amsterdam, The Netherlands

Aims. We have previously analysed the spectra of 135 early B-type stars in the Large Magellanic Cloud (LMC) and found several groups of stars that have chemical compositions that conflict with the theory of rotational mixing. Here we extend this study to Galactic and Small Magellanic Cloud (SMC) metallicities.

Methods. We provide chemical compositions for ~ 50 Galactic and ~ 100 SMC early B-type stars and compare these to the LMC results. These samples cover a range of projected rotational velocities up to ~ 300 km s$^{-1}$ and hence are well suited to testing rotational mixing models. The surface nitrogen abundances are utilised as a probe of the mixing process since nitrogen is synthesized in the core of the stars and mixed to the surface.

Results. In the SMC, we find a population of slowly rotating nitrogen-rich stars amongst the early B type core-hydrogen burning stars, which is comparable to that found previously in the LMC. The identification of non-enriched rapid rotators in the SMC is not possible due to the relatively high upper limits on the nitrogen abundance for the fast rotators. In the Galactic sample we find no significant enrichment amongst the core hydrogen-burning stars, which appears to be in contrast with the expectation from both rotating single-star and close binary evolution models. However, only a small number of the rapidly rotating stars have evolved enough to produce a significant nitrogen enrichment, and these may be analogous to the non-enriched rapid rotators previously found in the LMC sample. Finally, in each metallicity regime, a population of highly enriched supergiants is observed, which cannot be the immediate descendants of core-hydrogen burning stars. Their abundances are, however, compatible with them having gone through a previous red supergiant phase. Together, these observations paint a complex picture of the nitrogen
enrichment in massive main sequence and supergiant stellar atmospheres, where age and binarity cause crucial effects. Whether rotational mixing is required to understand our results remains an open question at this time, but could be answered by identifying the true binary fraction in those groups of stars that do not agree with single-star evolutionary models.

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Cool Gas in the Magellanic Stream

Deanna Matthews\(^1,2\), Lister Staveley-Smith\(^3\), Peter Dyson\(^1\) and Erik Muller\(^4\)

\(^1\)Department of Physics, La Trobe University, Bundoora VIC 3086 Australia
\(^2\)ATNF - CSIRO, PO Box 76, Epping NSW 1710 Australia
\(^3\)School of Physics, University of Western Australia, Crawley, WA 6059, Australia
\(^4\)Physics and Astrophysics, Nagoya University, Chikusa-ku, Nagoya 464-8602 Japan

We present the first direct detection of cold atomic gas in the Magellanic Stream, through 21\,cm line absorption toward a background radio source, J0119\,−\,6809, using the Australia Telescope Compact Array. Two absorption components were identified at heliocentric velocities 218.6 km s\(^{-1}\) and 227.0 km s\(^{-1}\), with optical depths of \(\tau \approx 0.02\). The corresponding H\,i emission region has a column density in excess of \(2 \times 10^{20}\) cm\(^{-2}\). The inferred spin temperature of the emitting gas is \(\approx 70\) K. We failed to find cool gas in observations of three other radio continuum sources. Although we have definitely detected cool gas in the Stream, its spin temperature is higher than similar components in the LMC, SMC and Bridge, and its contribution to the total H\,i density is probably lower. No corresponding 12\,CO(\(J = 1 \rightarrow 0\)) or dust appears to be associated with the cool gas, suggesting that the cloud is not forming stars.

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On the Recovery of the Star Formation History of the LMC from the VISTA Survey of the Magellanic System

L. Kerber\(^1,2\), L. Girardi\(^1\), S. Rubele\(^1,3\) and M.-R. Cioni\(^4\)

\(^1\)Oss. Astron. Padova, Italy
\(^2\)IAG-USP, São Paulo, Brazil
\(^3\)Dip. Astron. Padova, Italy
\(^4\)University of Hertfordshire, UK

The VISTA near infrared survey of the Magellanic System (VMC) will provide deep YJK\(_s\) photometry reaching stars in the oldest turn-off point all over the Magellanic Clouds (MCs). As part of the preparation for the survey, we aim to access the accuracy in the Star Formation History (SFH) that can be expected from VMC data, in particular for the LMC. To this aim, we first simulate VMC images containing not only the LMC stellar populations but also the foreground MW stars and background galaxies. We perform aperture photometry over these simulated images, access the expected levels of photometric errors and incompleteness, and apply the classical technique of SFH-recovery based on the reconstruction of colour–magnitude diagrams (CMD) via the minimization of a chi-squared-like statistics. We then evaluate the expected errors in the recovered star formation rate as a function of stellar age, SFR(t), starting from models with a known Age–Metallicity Relation (AMR). It turns out that, for a given sky area, the random errors for ages older than \(\approx 0.4\) Gyr seem to be independent of the crowding. For a spatial resolution of \(\approx 0.1\) sqdeg, the random errors in SFR(t) will be below 20\% for this wide range of ages. On the other hand, due to the smaller stellar statistics for stars younger than \(\approx 0.4\) Gyr, the outer LMC regions will require larger areas to achieve the same level of accuracy in the SFR(t). If we consider the AMR as unknown, the SFH-recovery algorithm is able to accurately recover the input AMR, at the price of an increase of random errors in the SFR(t) by a factor of about 2.5. Experiments of
SFH-recovery performed for varying distance modulus and reddening indicate that the propagation of the errors in these parameters in the SFR(t) implies systematic errors below 30%.

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Depth estimation of the Large and Small Magellanic Clouds

Smitha Subramanian\(^1\) and Annapurni Subramaniam\(^1\)

\(^1\)Indian Institute of Astrophysics, Bangalore, India

We used the red clump stars from the photometric data of the Optical Gravitational Lensing Experiment (OGLE II) survey and the Magellanic Cloud Photometric Survey (MCPS) for both the Clouds to estimate the depth. The observed dispersion in the magnitude and colour distribution of red clump stars is used to estimate the depth, after correcting for population effects, internal reddening within the Clouds and photometric errors. The observed dispersion due to the line of sight depth ranges from 0.023 mag to 0.45 mag (a depth of 500 pc to 10.4 kpc) for the LMC and, from 0.025 to 0.34 magnitude (a depth of 670 pc to 9.53 kpc) for the SMC. The minimum value corresponds to the dispersion that can be estimated due to errors. The depth profile of the LMC bar indicates that it is flared. The average depth in the bar region is 4.0 ± 1.4 kpc. The northern disk is found to have depth (4.17 ± 0.97 kpc) larger than the southern part of the disk (2.63 ± 0.8 kpc). There is no indication of depth variation between the eastern and the western disk. The average depth for the disk is 3.44 ± 1.16 kpc. In the case of SMC, the bar depth (4.90 ± 1.23 kpc) and the disk depth (4.23 ± 1.48 kpc) are found to be within the standard deviations. A prominent feature in the SMC is the increase in depth near the optical center. The average depth in the bar region is 4.90 ± 1.23 kpc and in the disk region is 4.23 ± 1.48 kpc. The halo of the LMC (using RR Lyrae stars) is found to have larger depth compared to the disk/bar, which supports the existence of an inner halo for the LMC. On the other hand, the estimated depths for the halo (RR Lyrae stars) are found to be similar, for the SMC bar region. Thus, increased depth and enhanced stellar as well as H\(_\text{I}\) density near the optical center suggests that the SMC may have a bulge.

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Microlensing towards the LMC revisited by adopting a non-Gaussian velocity distribution for the sources

Luigi Mancini\(^1\)

\(^1\)Department of Physics, University of Salerno, Italy

We discuss whether the Gaussian is a reasonable approximation of the velocity distribution of stellar systems that are not spherically distributed. By using a non-Gaussian velocity distribution to describe the sources in the Large Magellanic Cloud (LMC), we reinvestigate the expected microlensing parameters of a lens population isotropically distributed either in the Milky Way halo or in the LMC (self-lensing). We compare our estimates with the experimental results of the MACHO collaboration. An interesting result that emerges from our analysis is that, moving from the Gaussian to the non-Gaussian case, we do not observe any change in the form of the distribution curves describing the rate of microlensing events for lenses in the Galactic halo. The corresponding expected timescales and number of expected events also do not vary. Conversely, with respect to the self-lensing case, we observe a moderate increase in the rate and number of expected events. We conclude that the error in the estimate of the most likely value for the MACHO mass and the Galactic halo fraction in form of MACHOs, calculated with a Gaussian velocity distribution for the LMC sources, is not higher than 2%.

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The Strongest 100 Point Radio Sources in the LMC at 1.4 GHz

J.L. Payne$^1$, L.A. Tauber$^1$, M.D. Filipović$^2$, E.J. Crawford$^2$ and A.Y. De Horta$^2$

$^1$Centre for Astronomy, James Cook University, Townsville QLD, 4811, Australia
$^2$University of Western Sydney, Locked Bag 1797, Penrith South, DC, NSW 1797, Australia

We present the 100 strongest 1.4 GHz point sources from a new mosaic image in the direction of the Large Magellanic Cloud (LMC). The observations making up the mosaic were made over a ten year period and were combined with Parkes single dish data at 1.4 GHz to complete the image for short spacing. An initial list of co-identifications within 10" at 0.843, 4.8 and 8.6 GHz consisted of 2682 sources. Elimination of extended objects and artifact noise allowed the creation of a refined list containing 1988 point sources. Most of these are presumed to be background objects seen through the LMC; a small portion may represent compact H II regions, young SNRs and radio planetary nebulae. We find an average spectral index of $-0.53$ and present a 1.4 GHz image showing source location in the direction of the LMC.

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Conference Papers

The Ages, Masses, Evolution and Kinematics of Mira Variables

Michael Feast$^1$

$^1$University of Cape Town, Republic of South Africa

Evidence on the ages and masses of Mira variables is reviewed. Period increases with increasing initial mass. Miras of log $P \sim 3.0$ have initial masses near 4 $M_\odot$. It is suggested that the apparent gap in the LMC Mira PL relation at about this period may be due to the onset of hot bottom burning and that this adds about 15 to 20 percent to the stellar energy production. Shorter period HBB stars are probably overtone pulsators. T Lep may be an example of cool bottom processing.

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Available from arXiv:0812.0250

The Magellanic System: What have we learnt from FUSE?

N. Lehner$^1$

$^1$University of Notre Dame, USA

I review some of the findings on the Magellanic System produced by the Far Ultraviolet Spectroscopic Explorer (FUSE) during and after its eight years of service. The Magellanic System with its high-velocity complexes provides a nearby laboratory that can be used to characterize phenomena that involve interaction between galaxies, infall and outflow of gas and metals in galaxies. These processes are crucial for understanding the evolution of galaxies and the intergalactic medium. Among the FUSE successes I highlight are the coronal gas about the LMC and SMC, and beyond in the Stream, the outflows from these galaxies, the discovery of molecules in the diffuse gas of the Stream and the Bridge, an extremely sub-solar and sub-SMC metallicity of the Bridge, and a high-velocity complex between the Milky Way and the Clouds.


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The star formation process in the Magellanic Clouds

Joana Oliveira

1Keele University, UK

The Magellanic Clouds offer unique opportunities to study star formation both on the global scales of an interacting system of gas-rich galaxies, as well as on the scales of individual star-forming clouds. The interstellar media of the Small and Large Magellanic Clouds and their connecting bridge, span a range in (low) metallicities and gas density. This allows us to study star formation near the critical density and gain an understanding of how tidal dwarfs might form; the low metallicity of the SMC in particular is typical of galaxies during the early phases of their assembly, and studies of star formation in the SMC provide a stepping stone to understand star formation at high redshift where these processes can not be directly observed. In this review, I introduce the different environments encountered in the Magellanic System and compare these with the Schmidt-Kennicutt law and the predicted efficiencies of various chemo-physical processes. I then concentrate on three aspects that are of particular importance: the chemistry of the embedded stages of star formation, the Initial Mass Function, and feedback effects from massive stars and its ability to trigger further star formation.

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Job Advert

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Applications are invited for a postdoctoral position in the area of the Galaxy and Magellanic Clouds. In particular, we are seeking someone to help exploit our optical and infrared survey data from IPHAS, UKIDSS, VISTA and VST. Staff working in this area are Janet Drew, Maria-Rosa Cioni, Ralf Napiwotzki, Phil Lucas and Sean Ryan. The group are engaged in a wide range of research mapping the structure, current stellar densities, star formation and star formation history in our Galaxy and Magellanic Clouds.

The position is available for 3 years. Subsequent funding for additional years will depend on performance. Candidates should have a PhD, or expect to be awarded a PhD before the start date. The starting salary will be circa £28k but might be higher for exceptional candidates or those with extensive experience.

Applications should be submitted online via the recruitment website (http://recruitment.herts.ac.uk/Recruit) and should be accompanied by a CV, list of publications and research summary (in Word or PDF format) emailed to jobs@herts.ac.uk. For informal enquiries please contact Hugh Jones by email to h.r.a.jones@herts.ac.uk or by telephone +44 1707 284426.

Applicants should also arrange for 2 references to be sent to the Human Resources Department by the closing date.