Figure 1: Reddening map of a large portion of the LMC (Haschke et al.). Easily recognised are the 30 Doradus region and the molecular ridge extending Southwards, as well as a region of enhanced reddening diametrically opposite with respect to the LMC centre and bar (denoted by the white star and parallel white strokes, respectively).
Dear Colleagues,

It is my pleasure to present you the 111th issue of the Magellanic Clouds Newsletter. The twenty refereed journal publications advertised in this issue again showcase the rich variety of astrophysical phenomena that are studied in these extraordinary (or ordinary?) galaxies. Especially their star clusters feature prominently this time; they also seem to have become larger each time we look at them again...

Suggestions for pictures for the front cover remain very welcome.

The next issue is planned to be distributed in early August 2011.

Editorially Yours,
Jacco van Loon
Oxygen- and carbon-rich variable red giant populations in the Magellanic Clouds from EROS, OGLE, MACHO, and 2MASS photometry

M. Wiśniewski¹, J.B. Marquette²,³, J.P. Beaulieu²,³, A. Schwarzenberg-Czerny¹,⁴, P. Tisserand⁵,⁶ and É. Lesquoy⁵,²,³

¹Nicolaus Copernicus Astronomical Centre, Bartycka 18, 00-716 Warsaw, Poland
²UPMC Université Paris 06, UMR7095, Institut d’Astrophysique de Paris, F-75014, Paris, France
³CNRS, UMR7095, Institut d’Astrophysique de Paris, F-75014, Paris, France
⁴Adam Mickiewicz University Observatory, ul. Słoneczna 36, PL 60-286, Poznań, Poland
⁵Research School of Astronomy & Astrophysics, Mount Stromlo Observatory, Cotter Road, Weston ACT 2611, Australia
⁶CEA, DSM, DAPNIA, Centre d’Études de Saclay, 91191 Gif-sur-Yvette Cedex, France

The carbon-to-oxygen (C/O) ratio of asymptotic giant branch (AGB) stars constitutes an important index of evolutionary and environment/metallicity factor. We develop a method for mass C/O classification of AGBs in photometric surveys without using periods. For this purpose we rely on the slopes in the tracks of individual stars in the colour–magnitude diagram. We demonstrate that our method enables the separation of C-rich and O-rich AGB stars with little confusion. For the Magellanic Clouds we demonstrate that this method works for several photometric surveys and filter combinations. As we rely on no period identification, our results are relatively insensitive to the phase coverage, aliasing, and time-sampling problems that plague period analyses. For a subsample of our stars, we verify our C/O classification against published C/O catalogues. With our method we are able to produce C/O maps of the entire Magellanic Clouds. Our purely photometric method for classification of C- and O-rich AGBs constitutes a method of choice for large, near-infrared photometric surveys. Because our method depends on the slope of colour–magnitude variation but not on magnitude zero point, it remains applicable to objects with unknown distances.

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Spitzer characterization of dust in the ionized medium of the Large Magellanic Cloud

Deborah Paradis¹, Roberta Paladini³, Alberto Noriega-Crespo¹, Guilaine Lagache², Akiko Kawamura³, Toshikazu Onishi¹ and Yasuo Fukui³

¹Spitzer Science Center, California Institute of Technology, Pasadena, CA 91125, USA
²Institut d’Astrophysique Spatiale, 91405 Orsay, France
³Department of Astrophysics, Nagoya University, Chikusa-ku, Nagoya 464-8602, Japan
⁴Department of Physical Science, Osaka Prefecture University, Gakuen 1-1, Sakai, Osaka 599-8531, Japan

A systematic investigation of dust emission associated with the ionized gas has so far been performed only in our Galaxy and for wavelengths longer than 60 μm. Newly available Spitzer data now offer the opportunity to carry out a similar analysis in the Large Magellanic Cloud (LMC). By cross-correlating Spitzer SAGE (Surveying the Agents of a Galaxy’s Evolution) data with the ATCA/Parkes H I 21-cm data, the NANTEN ¹²CO (J = 1 − 0) data, and both the SHASSA Hα and the Parkes 6-cm data, we investigate the physical properties of dust associated with the different phases of the gas (atomic, molecular and ionized). In particular, we study the presence and nature of dust from 3.6 to 160 μm and for various regimes of the ionized gas, spanning emission measures (EM) from ~1 pc cm⁻⁶ (diffuse component) to ~ 10³ pc cm⁻⁶ (H I regions). Using a dust emission model, and testing our results with several radiation field spectra, we show that dust in the ionized gas is warmer than dust associated with other phases (atomic and molecular). We also find a decrease of the polycyclic aromatic hydrocarbons (PAH) relative abundance.
with respect to big grains (BGs), as well as an increase of the near infrared (NIR) continuum. These three results (e.g., warmer temperature, decrease of PAH abundance and increase of the NIR continuum) are found consistently for all regimes of the ionized gas. On the contrary, the molecular phase appears to provide favorable conditions for the survival of PAHs. Furthermore, the very small grain (VSG) relative abundance tends to increase in the ionized phase, especially in bright HII regions. Last but not least, our analysis shows that the emissivity of dust associated with the ionized gas is lower in the LMC than in our Galaxy, and that this difference is not accounted for by the lower metallicity of the LMC.

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Two new tests of the metallicity sensitivity of the Cepheid Period–Luminosity relation (the Leavitt Law)

Wendy L. Freedman1 and Barry F. Madore1

1The Observatories, Carnegie Institution for Science, USA

We undertake a new test of the metallicity sensitivity of the Leavitt Law for Classical Cepheids. We derive an empirical calibration of the apparent luminosities of Cepheids as measured from the optical through the mid-infrared (0.45–8.0 \( \mu m \)) as a function of spectroscopic \([Fe/H]\) abundances of individual Cepheids in the Large Magellanic Cloud from Romaniello et al. (2008). The cumulative trend over the entire wavelength range shows a nearly monotonic behavior. The sense of the trend is consistent with differential line-blanketing in the optical, leading to stars of high metallicity being fainter in the optical. This is followed by a reversal in the trend at longer wavelengths, with the cross-over occurring near the K band at about 2.2 \( \mu m \), consistent with a subsequent redistribution of energy resulting in a mild brightening of Cepheids (with increased metallicity) at mid-infrared wavelengths. This conclusion agrees with that of Romaniello et al. based on a differential comparison of the mean V- and K-band Leavitt Laws for the Galaxy, SMC and LMC, but is opposite in sign to most other empirical tests of the sensitivity of Cepheid distances to mean [O/H] HII region abundances. We also search for a correlation of Cepheid host-galaxy metallicity with deviations of the galaxy’s Cepheid distance from that predicted from a pure Hubble flow. Based on Cepheid distances to 26 nearby galaxies in the local flow, only a very weak signal is detected giving \( \delta \mu_o = -0.17(\pm0.31)([O/H]-8.80) - 0.21(\pm0.10) \). This is in agreement with previous determinations, but statistically inconclusive.

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New optical reddening maps of the Large and Small Magellanic Clouds

Raoul Haschke1, Eva K. Grebel6 and Sonia Duffau1

1Astronomisches Rechen-Institut, Zentrum für Astronomie der Universität Heidelberg, Mönchhofstraße 12–14, D-69120 Heidelberg, Germany

We present new reddening maps of the Small and Large Magellanic Cloud based on the data of the third phase of the Optical Gravitational Lensing Experiment (OGLE III). We have used two different methods to derive optical reddening maps. We adopt a theoretical mean unreddened colour for the red clump in the SMC and LMC, respectively. We subdivide the photometric data for both Clouds into subfields and calculate the difference between the observed red clump position and the theoretical value for each field, which provides us with the reddening value in \((V-I)\). Furthermore reddening values are obtained for 13490 LMC RR Lyrae ab and 1529 SMC RR Lyrae ab stars covering the whole OGLE III region of the MCs. The observed colours \((V-I)\) of the RR Lyrae stars are compared with the colour from the absolute magnitudes. The absolute magnitude of each RR Lyrae star is computed using its period and metallicity derived from Fourier decomposition of its lightcurve.
In general we find a low and uniform reddening distribution in both Magellanic Clouds. The red clump method indicates a mean reddening of the LMC of \( E(V-I) = 0.09 \pm 0.07 \) mag, while for the SMC \( E(V-I) = 0.04 \pm 0.06 \) mag is obtained. With RR Lyrae stars a median value of \( E(V-I) = 0.11 \pm 0.06 \) mag for the LMC and \( E(V-I) = 0.07 \pm 0.10 \) mag for the SMC is found. The LMC shows very low reddening in the bar region, whereas the reddening in the star-forming leading edge and 30 Doradus is considerably higher. In the SMC three pronounced regions with higher reddening are visible. Two are located along the bar, while the highest reddening is found in the star-forming wing of the SMC.

In general the regions with higher reddening are in good spatial agreement with infrared reddening maps as well as with reddening estimations of other studies. The position-dependent reddening values from the red clump method are available via the German Astrophysical Virtual Observatory interface at http://dc.zah.uni-heidelberg.de/mcx

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The optically bright post-AGB population of the LMC

E. van Aarle\(^1\), H. Van Winckel\(^1\), T. Lloyd Evans\(^2\), T. Ueta\(^3\), P.R. Wood\(^4\) and A.G. Ginsburg\(^5\)

\(^1\)Instituut voor Sterrenkunde, K.U. Leuven, Celestijnenlaan 200D bus 2401, B-3001 Leuven, Belgium
\(^2\)SUPA, School of Physics & Astronomy, University of St. Andrews, North Haugh, St. Andrews KY16 9SS, Scotland, UK
\(^3\)Department of Physics and Astronomy, University of Denver, 2112 E. Wesley, Denver, CO 80208, USA
\(^4\)Mount Stromlo Observatory, Cotter Road, Weston Creek, ACT 2611, Australia
\(^5\)Department of Astrophysical and Planetary Sciences, University of Colorado, Boulder, CO 80309, USA

The detected variety in chemistry and circumstellar shell morphology of the limited sample of Galactic post-AGB stars is so large that there is no consensus yet on how the different objects are linked by evolutionary channels. The evaluation is complicated by the fact that their distances and hence luminosities remain largely unknown. Via cross-correlation of the Spitzer SAGE catalogue with optical catalogues we selected a sample of LMC post-AGB candidates based on their [8]–[24] colour index and estimated luminosity. We determined the fundamental properties of the central stars of 105 of these objects using low-resolution, optical spectra that we obtained at Siding Spring Observatory and SAAO, and constructed a catalogue of 70 high probability and 1337 candidate post-AGB stars that is available at the CDS. The sample forms an ideal testbed for stellar evolution theory predictions of the final phase of low- and intermediate-mass stars, because the distance and hence luminosity and also the current and initial mass of these objects is well constrained. About half of the objects in our sample of post-AGB candidates show a spectral energy distribution (SED) that is indicative of a disc rather than an expanding and cooling AGB remnant. Like in the Galaxy, the disc sources are likely associated with binary evolution. Important side products of this research are catalogues of candidate young stellar objects, candidate supergiants with circumstellar dust, and discarded objects for which a spectrum was obtained. These too are available at the CDS.

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C\(^+\) emission from the Magellanic Clouds. II. [C\(\text{II}\)] maps of star-forming regions LMC-N 11, SMC-N 66, and several others

Frank P. Israel\(^6\) and Philip R. Maloney\(^2\)

\(^6\)Sterrewacht Leiden, The Netherlands
\(^2\)CASA, University of Colorado, USA

We study the 158 \(\mu\)m [C\(\text{II}\)] fine-structure line emission from star-forming regions as a function of metallicity. We have measured and mapped the [C\(\text{II}\)] emission from the very bright H\(\text{II}\) region complexes N11 in the LMC and N66 in the SMC, as well as the SMC H\(\text{II}\) regions N25, N27, N83/N84, and N88, with the FIFI instrument on the Kuiper
Airborne Observatory. In both the LMC and SMC, the ratio of the [C\textsc{ii}] line to the CO line and to the far-infrared continuum emission is much higher than seen almost anywhere else, including Milky Way star-forming regions and whole galaxies. In the low metallicity, low dust-abundance environment of the LMC and the SMC, UV mean free path lengths are much greater than those in the higher-metallicity Milky Way. The increased photoelectric heating efficiencies cause significantly greater relative [C\textsc{ii}] line emission strengths. At the same time, similar decreases in PAH abundances have the opposite effect, by diminishing photoelectric heating rates. Consequently, in low-metallicity environments the relative [C\textsc{ii}] strengths are high but exhibit little further dependence on actual metallicity. Relative [C\textsc{ii}] strengths are slightly higher in the LMC than in the SMC, which has both lower dust and lower PAH abundances.

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Discovery of a large stellar periphery around the Small Magellanic Cloud

David L. Nidever\textsuperscript{1}, Steven R. Majewski\textsuperscript{1}, Ricardo R. Muñoz\textsuperscript{2}, Rachael L. Beaton\textsuperscript{1}, Richard J. Patterson\textsuperscript{1} and William E. Kunkel\textsuperscript{3}

\textsuperscript{1}University of Virginia, USA
\textsuperscript{2}Universidad de Chile, Santiago, Chile
\textsuperscript{3}Las Campanas Observatory, Chile

The Magellanic Clouds are a local laboratory for understanding the evolution and properties of dwarf irregular galaxies. To reveal the extended structure and interaction history of the Magellanic Clouds we have undertaken a large-scale photometric and spectroscopic study of their stellar periphery (the MAgnellanic Periphery Survey, MAPS). We present first MAPS results for the Small Magellanic Cloud (SMC): Washington M, T\textsubscript{2} + DDO51 photometry reveals metal-poor red giant branch stars in the SMC that extend to large radii (\(\sim 11\) kpc), are distributed nearly azimuthally symmetrically (ellipticity = 0.1), and are well-fitted by an exponential profile (out to \(R \approx 7.5^\circ\)). An \(\sim 6\) Gyr old, [Fe/H]\(\approx -1.3\) main-sequence turnoff is also evident to at least \(R = 7.3^\circ\), and as far as 8.4\(^\circ\) in some directions. We find evidence for a ”break” population beyond \(\sim 8\) radial scalelengths having a very shallow radial density profile that could be either a bound stellar halo or a population of extratidal stars. The distribution of the intermediate stellar component (3\(\lesssim R \lesssim 7.5^\circ\)) contrasts with that of the inner stellar component (\(R \lesssim 3^\circ\)), which is both more elliptical (\(\epsilon = 0.3\)) and offset from the center of the intermediate component by 0.59\(^\circ\), although both components share a similar radial exponential scale length. This offset is likely due to a perspective effect because stars on the eastern side of the SMC are closer on average than stars on the western side. This mapping of its outer stellar structures indicates that the SMC is more complex than previously thought.

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Globular cluster abundances from high-resolution, integrated-light spectroscopy. III. The Large Magellanic Cloud: Fe and ages

J.E. Colucci\textsuperscript{1}, R.A. Bernstein\textsuperscript{1}, S.A. Cameron\textsuperscript{2} and A. McWilliam\textsuperscript{3}

\textsuperscript{1}UCSC, UC Observatories, USA
\textsuperscript{2}Science Department, Cerro Coso Community College, USA
\textsuperscript{3}OCIW, USA

In this paper we refine our method for the abundance analysis of high resolution spectroscopy of the integrated light of unresolved globular clusters (GCs). This method was previously demonstrated for the analysis of old (> 10 Gyr) Milky Way GCs. Here we extend the technique to young clusters using a training set of 9 GCs in the Large Magellanic Cloud (LMC). Depending on the signal-to-noise ratio of the data, we use 20–100 Fe lines per cluster to successfully
constrain the ages of old clusters to within a ∼ 5 Gyr range, the ages of ∼ 2 Gyr clusters to a 1–2 Gyr range, and the ages of the youngest clusters (0.05–1 Gyr) to a ∼ 200 Myr range. We also demonstrate that we can measure [Fe/H] in clusters with any age less than 12 Gyrs with similar or only slightly larger uncertainties (0.1–0.25 dex) than those obtained for old Milky Way GCs (0.1 dex); the slightly larger uncertainties are due to the rapid evolution in stellar populations at these ages. In this paper, we present only Fe abundances and ages. In the next paper in this series, we present our complete analysis of the ∼ 20 elements for which we are able to measure abundances. For several of the clusters in this sample, there are no high resolution abundances in the literature from individual member stars; our results are the first detailed chemical abundances available. The spectra used in this paper were obtained at Las Campanas with the echelle on the du Pont Telescope and with the MIKE spectrograph on the Magellan Clay Telescope.

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Photometric determination of the mass accretion rates of pre-main sequence stars. II. NGC 346 in the Small Magellanic Cloud

Guido De Marchi1, Nino Panagia2,3,4, Martino Romaniello5, Elena Sabbì2, Marco Sirianni1, Pier Giorgio Prada Moroni6,7 and Scilla Degl’Innocenti6,7

1European Space Agency, Space Science Department, Keplerlaan 1, 2200 AG Noordwijk, The Netherlands
2Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA
3INAF–CT, Osservatorio Astrofisico di Catania, Via S. Sofia 78, 95123 Catania, Italy
4Supernova Limited, OYV #131, Northsound Rd., Virgin Gorda, British Virgin Islands
5European Southern Observatory, Karl-Schwarzschild-Str. 2, 85748 Garching, Germany
6Dipartimento di Fisica “Enrico Fermi”, Università di Pisa, Largo Pontecorvo 3, 56127 Pisa, Italy
7INFN – Sezione di Pisa, Largo Pontecorvo 3, 56127 Pisa, Italy

We have studied the properties of the stellar populations in the field of the NGC 346 cluster in the Small Magellanic Cloud, using a novel self-consistent method that allows us to reliably identify pre-main sequence (PMS) objects actively undergoing mass accretion, regardless of their age. The method does not require spectroscopy and combines broadband V and I photometry with narrow-band Hα imaging to identify all stars with excess Hα emission and derive the accretion luminosity Lacc and mass accretion rate Ṁacc for all of them. The application of this method to existing HST/ACS photometry of the NGC 346 field has allowed us to identify and study 680 bona-fide PMS stars with masses from ∼ 0.4 M⊙ to ∼ 4 M⊙ and ages in the range from ∼ 1 Myr to ∼ 30 Myr. Previous investigations of this region, based on the same data, had identified young (∼ 3 Myr old) candidate PMS stars on the basis of their broadband colours. In this study we show that there are at least two, almost equally numerous, young populations with distinct ages of respectively ∼ 1 and ∼ 16 Myr. We provide for all of them accurate physical parameters. We take advantage of the unprecedented size of our PMS sample and of its spread in mass and age to study the evolution of the mass accretion rate as a function of stellar parameters. We find that, regardless of stellar mass, the mass accretion rate decreases with roughly the square root of the age, or about three times slower than predicted by current models of viscous disc evolution, and that more massive stars have systematically higher mass accretion rate in proportion to their mass. A multivariate linear regression fit reveals that log Ṁacc ∼ −0.6 log t + log m + c, where t is the age of the star, m its mass and c a quantity that is higher at lower metallicity. This result is consistent with measurements of the mass accretion rate in the 30 Dor region and in the Milky Way and suggests that longer duration for mass accretion could be related to lower metallicity. The high mass accretion rates that we find suggest that a considerable amount of mass is accreted during the PMS phase, of order ∼ 0.2 M⊙ or possibly ∼ 20% of the final mass for stars with mass m < 1 M⊙ if their discs are eroded by 20 Myr, i.e. before they reach the main sequence. Therefore, PMS evolutionary models that do not account for this effect will systematically underestimate the true age when compared with the observations.

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and from www.starformation.eu
The XMM-Newton survey of the Small Magellanic Cloud: A new X-ray view of the symbiotic binary SMC 3

R. Sturm\textsuperscript{1}, F. Haberl\textsuperscript{1}, J. Greiner\textsuperscript{1}, W. Pietsch\textsuperscript{1}, N. La Palombara\textsuperscript{2}, M. Ehle\textsuperscript{3}, M. Gilfanov\textsuperscript{4}, A. Udalski\textsuperscript{5}, S. Mereghetti\textsuperscript{2} and M. Filipović\textsuperscript{6}

\textsuperscript{1}Max-Planck-Institut für extraterrestrische Physik, Giessenbachstraße, 85748 Garching, Germany
\textsuperscript{2}INAF, Istituto di Astrofisica Spaziale e Fisica Cosmica Milano, via E. Bassini 15, 20133 Milano, Italy
\textsuperscript{3}XMM-Newton Science Operations Centre, ESAC, ESA, P.O. Box 50727, 28080 Madrid, Spain
\textsuperscript{4}Max-Planck-Institut für Astrophysik, Karl-Schwarzschild-Str. 1, 85748 Garching, Germany
\textsuperscript{5}Warsaw University Observatory, Aleje Ujazdowskie 4, 00-478 Warsaw, Poland
\textsuperscript{6}University of Western Sydney, Locked Bag 1797, Penrith South DC, NSW1797, Australia

The XMM-Newton survey of the Small Magellanic Cloud (SMC) was performed to study the population of X-ray sources in this neighbouring galaxy. During one of the observations, the symbiotic binary SMC 3 was found at its highest X-ray luminosity as observed until now. In SMC 3 wind accretion from a giant donor star onto a white dwarf is believed to cause steady hydrogen burning on the white dwarf surface, making such systems candidates for supernova type Ia progenitors. It was suggested that the X-ray source is eclipsed every $\sim 4.5$ years by both the companion star and its stellar wind to explain the large X-ray variability seen in ROSAT data. We use the available X-ray data to test this scenario. We present the $\sim 20$ year X-ray light curve of SMC 3 and study the spectral evolution as seen with XMM-Newton/EPIC-pn to investigate possible scenarios which can reproduce the high X-ray variability. We did not find any significant variations in the photo-electric absorption, as would be expected during eclipse ingress and egress. Instead, the X-ray spectra from different intensity levels, when modelled by black-body emission, can be better explained by variations either in normalisation (by a factor of $\sim 50$) or in temperature ($kT$ between 24 eV and 34 eV). The light curve shows maxima and minima with slow transitions between them. To explain the gradual variations in the X-ray light curve and to avoid changes in absorption by neutral gas, a predominant part of the stellar wind must be ionised by the X-ray source. Compton scattering with variable electron column density (of the order of $5 \times 10^{24}$ cm$^{-2}$) along the line of sight could then be responsible for the intensity changes. The X-ray variability of SMC 3 could also be caused by temperature changes in the hydrogen-burning envelope of the white dwarf, an effect that could even dominate if the stellar wind density is not sufficiently high.

Published in Astronomy & Astrophysics

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A new evolutionary phase of supernova remnant 1987A

Sangwook Park\textsuperscript{1}, Svetozar A. Zhekov\textsuperscript{2}, David N. Burrows\textsuperscript{3}, Judith L. Racusin\textsuperscript{4}, Daniel Dewey\textsuperscript{5} and Richard McCray\textsuperscript{6}

\textsuperscript{1}University of Texas at Arlington, USA
\textsuperscript{2}Space and Solar-Terrestrial Research Institute, Bulgaria
\textsuperscript{3}The Pennsylvania State University, USA
\textsuperscript{4}NASA/Goddard Space Flight Center, USA
\textsuperscript{5}MIT Kavli Institute, USA
\textsuperscript{6}JILA, University of Colorado, USA

We have been monitoring the supernova remnant (SNR) 1987A with Chandra observations since 1999. Here we report on the latest change in the soft X-ray light curve of SNR 1987A. For the last $\sim 1.5$ yr (since day $\sim 8000$), the soft X-ray flux has significantly flattened, staying (within uncertainties) at $f_X \sim 5.7 \times 10^{-12}$ erg cm$^{-2}$ s$^{-1}$ (corresponding to $L_X \sim 3.6 \times 10^{36}$ erg s$^{-1}$) in the 0.5–2 keV band. This remarkable change in the recent soft X-ray light curve suggests that the forward shock is now interacting with a decreasing density structure, after interacting with an increasing density gradient over $\sim 10$ yr prior to day $\sim 8000$. Possibilities may include the case that the shock is now propagating beyond a density peak of the inner ring. We briefly discuss some possible implications on the nature of the progenitor and the future prospects of our Chandra monitoring observations.

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Present-day mass function of six SMC intermediate-age and old star clusters

Katharina Glatt¹, Eva K. Grebel¹, Katrin Jordi¹, John S. Gallagher III², Gary Da Costa³, Gisella Clementini⁴, Monica Tosi⁴, Antonella Nota⁵, Elena Sabbi⁵ and Marco Sirianni⁵

¹ARI, Mönchhofstraße 12–14, 69120 Heidelberg, Germany
²Department of Astronomy, University of Wisconsin, 475 North Charter Street, Madison, WI 53706-1582, USA
³Research School of Astronomy & Astrophysics, The Australian National University, Mt. Stromlo Observatory, via Cotter Rd., Weston, ACT 2611, Australia
⁴INAF – Osservatorio Astronomico di Bologna, Via Ranzani 1, 40127 Bologna, Italy
⁵Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA

We determined the present-day mass functions (PDMFs) of the five intermediate-age star clusters Lindsay 1, Kron 3, NGC 339, NGC 416, and Lindsay 38 and the old star cluster NGC 121 in the Small Magellanic Cloud (SMC) based on observations with the Hubble Space Telescope Advanced Camera for Surveys (ACS). The global PDMFs are well matched by Salpeter-like power laws from their main-sequence turnoffs to \( \sim 0.6 \, M_\odot \) with a power law exponent \( \alpha \) ranging from 1.51 ± 0.11 (Lindsay 1) to 2.29 ± 0.15 (NGC 339). We derive total stellar masses of \( \sim 10^5 \, M_\odot \), except for Lindsay 38, whose mass is of the order of \( \sim 10^4 \, M_\odot \). Differences between the PDMFs most likely reflect the varying stages of dynamical evolution of the clusters. These SMC clusters do not follow the \( \alpha \) vs. concentration parameter \( c \) correlation as found for Galactic globular clusters (GGCs) of similar mass. This might be an age effect or due to their location in a galaxy where bulge and disk crossings do not play a role. No correlation is found between \( \alpha \) and the cluster core and tidal radii (\( r_c \) and \( r_t \), respectively), the half-light radii \( r_h \), age, central surface brightness, metallicity, and galactocentric radius \( r_{gc} \). All six clusters mass-segregated to different degrees. The two clusters Lindsay 1 and Kron 3 barely show signs for mass segregation, but have low-mass star deficient global PDMFs and might be the remnants of star clusters whose outer parts were stripped. A trend exists between the degree of mass-segregation and the ratio age/relaxation time \( t_{r,h} \), which indicates the stage of dynamical evolution for a cluster. Our data thus suggest that the SMC clusters in the present sample had a range of initial densities and presumably different amounts of mass loss that led to different rates of dynamical evolution. The clusters’ positions in the \( r_{h,m}/r_t \) vs. \( r_0/r_{h,m} \) plane imply that all of the clusters are tidally filled. Our SMC clusters with projected distances larger than 3 kpc from the SMC center should have Jacobi radii significantly larger than their observed King tidal radii. The clusters also have higher mean densities than the estimated central density of the SMC. Possibly these clusters formed in a denser overall environment of the younger SMC, or that the cluster structures were unusually strongly influenced by encounters with giant molecular clouds.

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Population parameters of intermediate-age star clusters in the Large Magellanic Cloud. II. New insights from extended main sequence turnoffs in 7 star clusters

Paul Goudfrooij¹, Thomas H. Puzia²,³, Vera Kozharina-Platais¹ and Rupali Chandar⁴

¹STScI, USA
²PUC, Santiago, Chile
³HIA, Canada
⁴U. Toledo, USA

We discuss new photometry from high-resolution images of 7 intermediate-age (1–2 Gyr) star clusters in the Large Magellanic Cloud taken with the Advanced Camera for Surveys on board the Hubble Space Telescope. We fit color–magnitude diagrams (CMDs) with several different sets of theoretical isochrones, and determine systematic uncertainties for population parameters when derived using any one set of isochrones. The cluster CMDs show several interesting features, including extended main sequence turnoff (MSTO) regions, narrow red giant branches, and clear sequences of unresolved binary stars. We show that the extended MSTOs are not caused by photometric uncertainties, contamination by field stars, or the presence of binary stars. Enhanced helium abundances in a fraction of cluster
stars are also ruled out as the reason for the extended MSTOs. Quantitative comparisons with simulations indicate
that the MSTO regions are better described by a spread in ages than by a bimodal age distribution, although we can
not formally rule out the latter for the three lowest-mass clusters in our sample (which have masses lower than about
$3 \times 10^4 \, M_\odot$). This conclusion differs from that of some previous works which suggested that the age distribution in
massive clusters in our sample is bimodal. This suggests that any secondary star formation occurred in an extended
fashion rather than through short bursts. We discuss these results in the context of the nature of multiple stellar
populations in star clusters.

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Population parameters of intermediate-age star clusters in the Large
Magellanic Cloud. III. Dynamical evidence for a range of ages being
responsible for extended main sequence turnoffs

Paul Goudfrooij\textsuperscript{1}, Thomas H. Puzia\textsuperscript{2}, Rupali Chandar\textsuperscript{3} and Vera Kozhurina-Platais\textsuperscript{1}

\textsuperscript{1}STScI, USA
\textsuperscript{2}PUC, Santiago, Chile
\textsuperscript{3}U. Toledo, USA

We present new analysis of 11 intermediate-age (1–2 Gyr) star clusters in the Large Magellanic Cloud based on Hubble
Space Telescope imaging data. Seven of the clusters feature main sequence turnoff (MSTO) regions that are wider
than can be accounted for by a simple stellar population, whereas their red giant branches indicate a single value of
[Fe/H]. The star clusters cover a range in present-day mass from about $1 \times 10^4 \, M_\odot$ to $2 \times 10^5 \, M_\odot$. We compare
radial distributions of stars in the upper and lower parts of the MSTO region, and calculate cluster masses and escape
velocities from the present time back to a cluster age of 10 Myr. Our main result is that for all clusters in our sample
with estimated escape velocities $v_{\text{esc}} \geq 15 \, \text{km s}^{-1}$ at an age of 10 Myr, the stars in the brightest half of the MSTO
region are significantly more centrally concentrated than both the stars in the faintest half and more massive red giant
branch and asymptotic giant branch stars. This is not the case for clusters with $v_{\text{esc}} \leq 10 \, \text{km s}^{-1}$ at an age of 10 Myr.
We argue that the wide MSTO region of such clusters is mainly caused by a $\sim 200$–500 Myr range in the ages of
cluster stars due to extended star formation within the cluster from material shed by first-generation stars featuring
slow stellar winds. Dilution of this enriched material by accretion of ambient interstellar matter is deemed plausible if
the spread of [Fe/H] in this ambient gas was very small when the second-generation stars were formed in the cluster.

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Magnetic fields in Local Group dwarf irregulars

K.T. Chyży\textsuperscript{1}, M. Wężowiec\textsuperscript{1,2}, R. Beck\textsuperscript{2} and D.J. Bomans\textsuperscript{3}

\textsuperscript{1}Astronomical Observatory, Jagiellonian University, Kraków, Poland
\textsuperscript{2}Max-Planck-Institut für Radioastronomie, Bonn, Germany
\textsuperscript{3}Ruhr-Universität Bochum, Germany

We wish to clarify whether strong magnetic fields can be effectively generated in typically low-mass dwarf galaxies and
to assess the role of dwarf galaxies in the magnetization of the Universe. We performed a search for radio emission
and magnetic fields in an unbiased sample of 12 Local Group (LG) irregular and dwarf irregular galaxies with the
100-m Effelsberg telescope at 2.64 GHz. Three galaxies were detected. A higher frequency (4.85 GHz) was used to
search for polarized emission in five dwarfs that are the most luminous ones in the infrared domain, of which three
were detected. Magnetic fields in LG dwarfs are weak, with a mean value of the total field strength of $< 4.2 \pm 1.8$
$\mu G$, three times lower than in the normal spirals. The strongest field among all LG dwarfs of 10 $\mu G$ (at 2.64 GHz)
is observed in the starburst dwarf IC10. The production of total magnetic fields in dwarf systems appears to be regulated mainly by the star-formation surface density (with the power-law exponent of $0.30 \pm 0.04$) or by the gas surface density (with the exponent $0.47 \pm 0.09$). In addition, we find systematically stronger fields in objects of higher global star-formation rate. The dwarf galaxies follow a similar far-ultraviolet relationship (with a slope of $0.91 \pm 0.08$) to that determined for high surface brightness spiral galaxies. The magnetic field strength in dwarf galaxies does not correlate with their maximum rotational velocity, indicating that a small-scale rather than a large-scale dynamo process is responsible for producing magnetic fields in dwarfs. If magnetization of the Universe by galactic outflows is coeval with its metal enrichment, we show that more massive objects (such as Lyman break galaxies) can efficiently magnetize the intergalactic medium with a magnetic field strength of about 0.8 nG out to a distance of 160–530 kpc at redshifts 5–3, respectively. Magnetic fields that are several times weaker and shorter magnetization distances are observed only in dwarfs of extreme characteristics (e.g., NGC4449, NGC 1569, and the LG dwarf IC10). They are all starbursts and more evolved objects of statistically much higher metallicity and global star-formation rate than the majority of the LG dwarf population. Typical LG dwarfs are unsuitable objects for the efficient supply of magnetic fields to the intergalactic medium.

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The VLT-FLAMES Tarantula Survey III: A very massive star in apparent isolation from the massive cluster R 136


1 Armagh Observatory, College Hill, Armagh BT61 9DG, United Kingdom
2 Centro de Astrobiología (CSIC-INTA), Ctra. de Torrejón a Alcalá km-4, E-28850 Torrejón de Ardoz, Madrid, Spain
3 UK Astronomy Technology Centre, Royal Observatory Edinburgh, Blackford Hill, Edinburgh, EH9 3HJ, UK
4 Excellence Cluster Universe, Boltzmannstr. 2, 85748 Garching, Germany
5 School of Physics, University of Exeter, Stocker Road, Exeter EX4 4QL, UK
6 Institute of Astronomy & Astrophysics, National Observatory of Athens, I. Metaxa & Vas. Pavlou Street, P. Penteli 15236, Greece
7 European Southern Observatory, Karl-Schwarzschild-Straße 2, D87654, Garching bei München, Germany
8 Harvard-Smithsonian CfA, 60 Garden Street, Cambridge, MA 02138, USA
9 Dept. of Physics & Astronomy, Hounsfield Road, University of Sheffield, S3 7RH, UK
10 Argelander-Institut für Astronomie der Universität Bonn, Auf dem Hügel 71, 53121 Bonn, Germany
11 SUPA, IFA, University of Edinburgh, Royal Observatory Edinburgh, Blackford Hill, Edinburgh, EH9 3HJ, UK
12 Departamento de Astrofísica, Universidad de La Laguna, E-38205 La Laguna, Tenerife, Spain
13 European Southern Observatory, Alonso de Córdova 1367, Casilla, 19001, Santiago 19, Chile
14 Astronomical Institute Anton Pannekoek, University of Amsterdam, Kruislaan 403, 1098 SJ, Amsterdam, The Netherlands
15 Astronomical Institute, Utrecht University, Princetonplein 5, 3584CC, Utrecht, The Netherlands
16 ESA, Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA
17 Instituto de Astrofísica de Andalucía-CSIC, Glorieta de la Astronomía s/n, E-18008 Granada, Spain
18 Warsaw University Observatory, Aleje Ujazdowskie 4, 00-478 Warsaw, Poland

VFTS682 is located in an active star-forming region, at a projected distance of 29 pc from the young massive cluster R136 in the Tarantula Nebula of the Large Magellanic Cloud. It was previously reported as a candidate young stellar object, and more recently spectroscopically revealed as a hydrogen-rich Wolf–Rayet (WN5h) star. Our aim is to obtain the stellar properties, such as its intrinsic luminosity, and to investigate the origin of VFTS 682. To this purpose, we model optical spectra from the VLT-FLAMES Tarantula Survey with the non-LTE stellar atmosphere code cmfgen, as well as the spectral energy distribution from complementary optical and infrared photometry. We find the extinction properties to be highly peculiar ($R_V \sim 4.7$ mag), and obtain a surprisingly high luminosity $\log(L/L_\odot) = 6.5 \pm 0.2$, corresponding to a present-day mass of $\sim 150 M_\odot$. The high effective temperature of $52.2 \pm 2.5$ kK might be explained
by chemically homogeneous evolution – suggested to be the key process in the path towards long gamma-ray bursts. Lightcurves of the object show variability at the 10% level on a timescale of years. Such changes are unprecedented for classical Wolf–Rayet stars, and are more reminiscent of Luminous Blue Variables. Finally, we discuss two possibilities for the origin of VFTS 682: (i) the star either formed in situ, which would have profound implications for the formation mechanism of massive stars, or (ii) VFTS 682 is a slow runaway star that originated from the dense cluster R 136, which would make it the most massive runaway known to date.

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Nearby galaxies in distant contexts

Michael Eskew\textsuperscript{1} and Dennis Zaritsky\textsuperscript{1}

\textsuperscript{1}University of Arizona, USA

We use published reconstructions of the star formation history (SFH) of the Large Magellanic Cloud (LMC), Small Magellanic Cloud, and NGC 300 from the analysis of resolved stellar populations to investigate where such galaxies might land on well-known extragalactic diagnostic plots over the galaxies’ lifetime (assuming that nothing other than their stellar populations change). For example, we find that the evolution of these galaxies implies a complex evolution in the Tully–Fisher relation with look-back time and that the observed scatter is consistent with excursions these galaxies take as their stellar populations evolve. We find that the growth of stellar mass is weighted to early times, despite the strongly star-forming current nature of the three systems. Lastly, we find that these galaxies can take circuitous paths across the color-magnitude diagram. For example, it is possible, within the constraints provided by the current determination of its SFH, that the LMC reached the red sequence at intermediate age prior to ending back up on the blue cloud at the current time. Unfortunately, this behavior happens at sufficiently early times that our resolved SFH is crude and insufficiently constraining to convincingly demonstrate that this was the actual evolutionary path. The limited sample size precludes any general conclusions, but we present these as examples how we can bridge the study of resolved populations and the more distant universe.

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The star clusters of the Large Magellanic Cloud: Structural parameters

Felicia Werchan\textsuperscript{1} and Dennis Zaritsky\textsuperscript{1}

\textsuperscript{1}University of Arizona, USA

We present and analyze the radial luminosity profiles of a sample of 1066 stellar clusters in the Large Magellanic Cloud. By design, this study closely follows the compilation by Hill & Zaritsky of the structural parameters of stellar clusters in the Small Magellanic Cloud. Both King and Elson–Fall–Freeman (EFF) model profiles are fit to V-band surface brightness profiles measured from the Magellanic Cloud Photometric Survey images. We tabulate the concentration, central surface brightness, tidal radii, 90\% enclosed luminosity radii ($r_{90}$), and local background luminosity density. Over two thirds of the clusters in the sample are adequately fit by one or both of these models. One notable and systematic exception, as in the SMC, are those clusters that lack a central brightness concentration, the “ring” clusters. While the bulk properties of the clusters are similar between the LMC and SMC populations, we find that the LMC lacks clusters that are as large, either in terms of core radii or $r_{90}$, as the largest in the SMC, perhaps a signature of larger tidal stresses in the LMC.

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Near-contemporaneous optical spectroscopic and infrared photometric observations of candidate Herbig Ae/Be stars in the Magellanic Clouds  

Bradley W. Rush\textsuperscript{1}, John P. Wiśniewski\textsuperscript{2} and Karen S. Bjorkman\textsuperscript{1}  

\textsuperscript{1}University of Toledo, USA  
\textsuperscript{2}University of Washington, USA  

We present near-IR (J,H,Ks) photometry for 27 of the 28 candidate Herbig Ae/Be stars in the Small and Large Magellanic Clouds identified via the EROS1 and EROS2 surveys as well as near-contemporaneous optical (H\alpha) spectroscopy for 21 of these 28 candidates. Our observations extend previous efforts to determine the evolutionary status of these objects. We compare the IR brightness and colors of a subset of our sample with archival ground-based IR data and find evidence of statistically significant photometric differences for ELHC 5, 7, 12, 18, and 21 in one or more filter. In all cases, these near-IR photometric variations exhibit a grey color as compared to earlier epoch data. The $\sim$1 magnitude IR brightening and minimal change in the H\alpha emission strength we observe in ELHC 7 is consistent with previous claims that it is a UX Ori type HAe/Be star, which is occasionally obscured by dust clouds. We also detect a $\sim$1 magnitude IR brightening of ELHC 12, but find little evidence of a similar large-scale change in its H\alpha line strength, suggesting that its behavior could also be caused by a UX Ori-like event. The $\sim$0.5 magnitude IR variability we observe for ELHC 21, which also exhibited little evidence of a change in its H\alpha emission strength, could conceivably be caused by a major recent enhancement in the density of the inner disk region of a classical Be star. We also report the first near-IR photometry for two ESHC stars and the first H\alpha spectroscopy for one ELHC and five ESHC stars. Although H\alpha emission is detected in all of these new observations, they do not exhibit a strong near-IR excess. It is therefore possible that many of these objects may be classical Be stars rather than Herbig Ae/Be stars.  

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The VMC survey. II. A multi-wavelength study of LMC planetary nebulae and their mimics  

B. Miszalski\textsuperscript{1,2,3}, R. Napiwotzki\textsuperscript{1}, M.-R.L. Cioni\textsuperscript{1,4}, M.A.T. Groenewegen\textsuperscript{5}, J.M. Oliveira\textsuperscript{6} and A. Udalski\textsuperscript{7}  

\textsuperscript{1}Centre for Astrophysics Research, STRI, University of Hertfordshire, College Lane Campus, Hatfield AL10 9AB, UK  
\textsuperscript{2}South African Astronomical Observatory, P.O. Box 9, Observatory, 7935, South Africa  
\textsuperscript{3}Southern African Large Telescope Foundation, P.O. Box 9, Observatory, 7935, South Africa  
\textsuperscript{4}University Observatory Munich, Scheinerstraße 1, D-81679, München, Germany  
\textsuperscript{5}Royal Observatory of Belgium, Ringlaan 3, 1180 Ukkel, Belgium  
\textsuperscript{6}School of Physical & Geographical Sciences, Lennard-Jones Laboratories, Keele University, Staffordshire ST5 5BG, UK  
\textsuperscript{7}Warsaw University Observatory, Al. Ujazdowskie 4, PL-00-478, Warsaw, Poland  

The VISTA Magellanic Cloud (VMC) survey is assembling a deep, multi-epoch atlas of YJKs photometry across the Magellanic Clouds. Prior to the VMC survey only the brightest Magellanic Cloud PNe (MCPNe) were accessible at near-infrared (NIR) wavelengths. It is now possible for the first time to assemble the NIR properties of MCPNe and to identify contaminating non-PNe mimics which are best revealed at NIR wavelengths (e.g., H\ II regions and symbiotic stars). To maintain the unique scientific niche that MCPNe occupy these contaminants must be removed. Here we conduct a VMC-led, multi-wavelength study of 102 objects previously classified as PNe that are located within the first six VMC tiles observed. We present images, photometry, lightcurves, diagnostic colour–colour diagrams and spectral energy distributions used to analyse the entire sample. At least five PNe have newly resolved nebula morphologies, a task previously only possible with the HST. A total of 45/67 (67\%) objects catalogued by Reid & Parker (RP) were reclassified as non-PNe, most of which were located in the vicinity of 30 Doradus. This sample included 16 field stars, 5 emission line stars, 19 H\ II regions, 4 symbiotic star candidates and 1 young stellar object. We discuss possible selection effects responsible for their inclusion in the RP catalogue and the implications for binary central star surveys targeting LMC PNe. A total of five new LMC symbiotic star candidates were identified, compared to eight previously known, underlining the important role the VMC survey will have in advancing Magellanic symbiotic star studies.  

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