Dear Colleagues,

It is my pleasure to present you the 113th issue of the Magellanic Clouds Newsletter. I am sure you will find something interesting among the submitted items, including possibly the no-less-than three papers discussing the emission bands from PAHs.

Check out the job advert for a postdoctoral position at Cornell to work with Greg Sloan, and the announcement of the FRUITY nucleosynthesis database.

We are delighted to announce the first (unofficial) translation into a foreign language of our newsletter’s website, viz. Romanian – http://webhostinggeeks.com/science/the-magellanic-rm Unfortunately the newsletter itself is not translated. Offers to host other translations are welcome.

Suggestions for pictures for the front cover also remain very welcome.

The next issue is planned to be distributed on the 1st of December 2011.

Editorially Yours,

Jacco van Loon
Mass segregation and fractal substructure in young massive clusters: (I) the McLuster code and method calibration

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By analysing models of the young massive cluster R\,136 in 30\,Doradus, set-up using the herewith introduced and publicly made available code McLuster, we investigate and compare different methods for detecting and quantifying mass segregation and substructure in non-seeing limited $N$-body data. For this purpose we generate star cluster models with different degrees of mass segregation and fractal substructure and analysen them.

We quantify mass segregation by measuring, from the projected 2d model data, the mass function slope in radial annuli, by looking for colour gradients in radial colour profiles, by measuring Allison’s Λ parameter, and by determining the local stellar surface density around each star. We find that these methods for quantifying mass segregation often produce ambiguous results. Most reliable for detecting mass segregation is the mass function slope method, whereas the colour gradient method is the least practical in an R\,136-like configuration. The other two methods are more sensitive to low degrees of mass segregation but are computationally much more demanding. We also discuss the effect of binaries on these measures.

Moreover, we quantify substructure by looking at the projected radial stellar density profile, by comparing projected azimuthal stellar density profiles, and by determining Cartwright & Whitworth’s $Q$ parameter. We find that only high degrees of substructure affect the projected radial density profile, whereas the projected azimuthal density profile is very sensitive to substructure. The $Q$ parameter is also sensitive to substructure but its absolute value shows a dependence on the radial density gradient of the cluster and is strongly influenced by binaries.

Thus, in terms of applicability and comparability for large sets of $N$-body data, the mass function slope method and the azimuthal density profile method seem to be the best choices for quantifying the degree of mass segregation and substructure, respectively. The other methods are computationally too demanding to be practically feasible for large data sets.

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The cold gas content of bulgeless dwarf galaxies

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We present an analysis of the neutral hydrogen (H\,i) properties of a fully cosmological hydrodynamical dwarf galaxy, run with varying simulation parameters. As reported by Governato et al., the high resolution, high star formation
density threshold version of this galaxy is the first simulation to result in the successful reproduction of a (dwarf) spiral galaxy without any associated stellar bulge. We have set out to compare in detail the H\textsc{i} distribution and kinematics of this simulated bulgeless disk with what is observed in a sample of nearby dwarfs. To do so, we extracted the radial gas density profiles, velocity dispersion (e.g., velocity ellipsoid, turbulence), and the power spectrum of structure within the cold interstellar medium from the simulations. The highest resolution dwarf, when using a high density star formation threshold comparable to densities of giant molecular clouds, possesses bulk characteristics consistent with those observed in nature, though the cold gas is not as radially extended as that observed in nearby dwarfs, resulting in somewhat excessive surface densities. The lines-of-sight velocity dispersion radial profiles have values that are in good agreement with observed dwarf galaxies, but due to the fact that only the streaming velocities of particles are tracked, a correction to include the thermal velocities can lead to profiles that are quite flat. The ISM power spectra of the simulations appear to possess more power on smaller spatial scales than that of the SMC. We conclude that unavoidable limitations remain due to the unresolved physics of star formation and feedback within pc-scale molecular clouds.

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**Silicate features in Galactic and extragalactic post-AGB discs**

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**Aims.** In this paper we study the Spitzer and TIMMI2 infrared spectra of post-AGB disc sources, both in the Galaxy and the LMC. Using the observed infrared spectra we determine the mineralogy and dust parameters of the discs, and look for possible differences between the Galactic and extragalactic sources. Methods. Modelling the full spectral range observed allows us to determine the dust species present in the disc and different physical parameters such as grain sizes, dust abundance ratios, and the dust and continuum temperatures. Results. We find that all the discs are dominated by emission features of crystalline and amorphous silicate dust. Only a few sample sources show features due to CO\textsubscript{2} gas or carbonaceous molecules such as PAHs and C\textsubscript{60} fullerenes. Our analysis shows that dust grain processing in these discs is strong, resulting in large average grain sizes and a very high crystallinity fraction. However, we do not find any correlations between the derived dust parameters and properties of the central source. There also does not seem to be a noticeable difference between the mineralogy of the Galactic and LMC sources. Even though the observed spectra are very similar to those of protoplanetary discs around young stars, showing similar mineralogy and strong grain processing, we do find evidence for differences in the physical and chemical processes of the dust processing.

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Radiation-hydrodynamical modelling of core-collapse supernovae: light
curves and the evolution of photospheric velocity and temperature

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We have developed a relativistic, radiation-hydrodynamics Lagrangian code, specifically tailored to simulate the evolution of the main observables (light curve, evolution of photospheric velocity and temperature) in core-collapse supernova (CC-SN) events. The distinctive features of the code are an accurate treatment of radiative transfer coupled to relativistic hydrodynamics, a self-consistent treatment of the evolution of the innermost ejecta taking into account the gravitational effects of the central compact remnant, and a fully implicit Lagrangian approach to the solution of the coupled non-linear finite difference system of equations. Our aim is to use it as numerical tool to perform calculations of grid of models to be compared with observation of CC-SNe. In this paper we present some testcase simulations and a comparison with observations of SN 1987A, as well as with the results obtained with other numerical codes. We also briefly discuss the influence of the main physical parameters (ejected mass, progenitor radius, explosion energy, amount of $^{56}$Ni) on the evolution of the ejecta, and the implications of our results in connection with the possibility to “standardize” hydrogen-rich CC-SNe for using them as candles to measure cosmological distances.

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Time-frequency analysis of superorbital modulation of X-ray binary
SMC X-1 by Hilbert–Huang transform

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The high-mass X-ray binary (HMXB) SMC X-1 exhibits a superorbital modulation with a dramatically varying period ranging between $\sim 40$ d and $\sim 60$ d. This research studies the time-frequency properties of the superorbital modulation of SMC X-1 based on the observations made by the All-Sky Monitor (ASM) onboard the Rossi X-ray Timing Explorer (RXTE). We analyzed the entire ASM database collected since 1996. The Hilbert–Huang Transform (HHT), developed for non-stationary and nonlinear time series analysis, was adopted to derive the instantaneous superorbital frequency. The resultant Hilbert spectrum is consistent with dynamic power spectrum while it shows more detailed information in both the time and frequency domains. The RXTE observations manifest that the superorbital modulation period was mostly approximately $\sim 55$ d, whereas it changed to $\sim 45$ d around MJD 50,800 and MJD 54,000. Our analysis further indicates that the instantaneous frequency changed in a time scale of hundreds of days between $\sim$MJD 51,500 and $\sim$MJD 53,500. Based on the instantaneous phase defined by HHT, we folded the ASM light curve to derive a superorbital profile, from which an asymmetric feature and a low state with barely any X-ray emissions (lasting for $\sim 0.3$ cycles) were observed. We also calculated the correlation between the mean period and the amplitude of the superorbital modulation. The result is similar to the recently discovered relationship between the superorbital cycle length and the mean X-ray flux for Her X-1.

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The spectroscopic properties of the nebulae around seven Galactic and LMC Wolf–Rayet stars

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We have obtained spectroscopic observations of the nebulae around seven Wolf–Rayet (WR) stars, four in the Milky Way (WR 8, 16, 18 and 40) and three in the LMC (BAT 99-2, -11 and -38). They were observed using the ESO NTT with the EFOSC-2 instrument, except for one nebula, NGC3199, which was observed using the UVES echelle spectrometer on the VLT. The aims of these observations were to (a) quantify the degree of chemical enrichment in WR nebulae which had previously been suggested to have abundances reflecting nucleosynthetic processing; and (b) to attempt to detect the far-red lines of neutral carbon (e.g., \([\text{C}\text{I}] 9850\text{ Å}\)) in the nebulae around WC stars. Nebular densities, temperatures and elemental abundances were derived using standard emission line diagnostics. Our high spectral resolution UVES dataset for NGC3199 allowed the determination of line broadening temperatures using lines from several different species. These showed consistent patterns and fair agreement with the nebular temperatures derived from diagnostic line ratios. Amongst the Galactic WR nebulae, the nebulae around WR 8, 16 and 40 were found to be strongly nitrogen-enriched while NGC3199 displayed abundances which were similar to those of Galactic \(\text{H}^\text{II}\) regions. Amongst the LMC WR nebulae, none displayed an N/O ratio that significantly exceeded LMC \(\text{H}^\text{II}\) region values. The far-red \([\text{C}\text{I}]\) lines were detected from NGC3199, with the strength of the 8727 Å line indicating that at least part of it was produced by \(\text{C}^+\) recombination rather than collisional excitation. The line widths of the \([\text{C}\text{I}]\) 9824 and 9850 Å lines were however the same as those of collisionally excited nebular lines, indicating that those lines originated largely from ionized regions within the nebula.

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The Carnegie Hubble Program: The Leavitt Law at 3.6 \(\mu\text{m}\) and 4.5 \(\mu\text{m}\) in the Large Magellanic Cloud

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The Carnegie Hubble Program (CHP) is designed to improve the extragalactic distance scale using data from the post-cryogenic era of \textit{Spitzer}. The ultimate goal is a determination of the Hubble constant to an accuracy of 2\%. This paper is the first in a series on the Cepheid population of the Large Magellanic Cloud, and focuses on the period–luminosity relations (Leavitt laws) that will be used, in conjunction with observations of Milky Way Cepheids, to set the slope and zero-point of the Cepheid distance scale in the mid-infrared. To this end, we have obtained uniformly-sampled light curves for 85 LMC Cepheids, having periods between 6 and 140 days. Period–luminosity and period–color relations are presented in the 3.6 \(\mu\text{m}\) and 4.5 \(\mu\text{m}\) bands. We demonstrate that the 3.6 \(\mu\text{m}\) band is a superb distance indicator. The cyclical variation of the [3.6]–[4.5] color has been measured for the first time. We attribute the amplitude and phase of the color curves to the dissociation and recombination of CO molecules in the Cepheid’s atmosphere. The CO affects only the 4.5 \(\mu\text{m}\) flux making it a potential metallicity indicator.

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The Magellanic Mopra Assessment (MAGMA). I. The molecular cloud population of the Large Magellanic Cloud

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We present the properties of an extensive sample of molecular clouds in the Large Magellanic Cloud (LMC) mapped at 11 pc resolution in the CO(1–0) line. Targets were chosen based on a limiting CO flux and peak brightness as measured by the NANTEN survey. The observations were conducted with the ATNF Mopra Telescope as part of the Magellanic Mopra Assessment (MAGMA). We identify clouds as regions of connected CO emission, and find that the distributions of cloud sizes, fluxes and masses are sensitive to the choice of decomposition parameters. In all cases, however, the luminosity function of CO clouds is steeper than \( \frac{dN}{dL} \propto L^{-2} \), suggesting that a substantial fraction of mass is in low-mass clouds. A correlation between size and linewidth, while apparent for the largest emission structures, breaks down when those structures are decomposed into smaller structures. We argue that the correlation between virial mass and CO luminosity is the result of comparing two covariant quantities, with the correlation appearing tighter on larger scales where a size–linewidth relation holds. The virial parameter (the ratio of a cloud’s kinetic to self-gravitational energy) shows a wide range of values and exhibits no clear trends with the CO luminosity or the likelihood of hosting young stellar object (YSO) candidates, casting further doubt on the assumption of virialization for molecular clouds in the LMC. Higher CO luminosity increases the likelihood of a cloud harboring a YSO candidate, and more luminous YSOs are more likely to be coincident with detectable CO emission, confirming the close link between giant molecular clouds and massive star formation.

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The Optical Gravitational Lensing Experiment. The OGLE-III catalog of variable stars. XIII. Long-period variables in the Small Magellanic Cloud

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The thirteenth part of the OGLE-III Catalog of Variable Stars (OIII-CVS) contains 19384 long-period variables (LPVs) detected in the Small Magellanic Cloud. The sample is composed of 352 Mira stars, 2222 semi-regular variables (SRVs)
and 16,810 OGLE Small Amplitude Red Giants (OSARGs). Sources are divided into oxygen-rich and carbon-rich stars. The catalog includes time-series $V/I$ photometry obtained between 1997 and 2009.

Methods used to select and classify variable stars are described. We show some statistical properties of the sample, and compare it with LPVs in the Large Magellanic Cloud. Additionally, we present objects of particular interest, e.g., a SRV with outbursts, and a Mira star with the longest known pulsation period $P = 1860$ days.

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The 3D structure of the Small Magellanic Cloud

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The 3D structure of the inner Small Magellanic Cloud (SMC) is investigated using the red clump (RC) stars and the RR Lyrae stars (RRLS), which represent the intermediate-age and the old stellar populations of a galaxy. The $V$ and $I$ bands photometric data from the Optical Gravitational Lensing Experiment (OGLE III) catalogue are used for our study. The mean dereddened $I_0$ magnitude of the RC stars and the RRLS are used to study the relative positions of the different regions in the SMC with respect to the mean SMC distance. This shows that the north eastern part of the SMC is closer to us. The line of sight depth (front to back distance) across the SMC is estimated using the dispersion in the $I_0$ magnitudes of both the RC stars and the RRLS and found to be large ($\sim 14$ kpc) for both the populations. The similarity in their depth distribution suggest that both these populations occupy a similar volume of the SMC. The surface density distribution and the radial density profile of the RC stars suggest that they are more likely to be distributed in a nearly spheroidal system. The tidal radius estimated for the SMC system is $\sim 7–12$ kpc. An elongation along the NE–SW direction is seen in the surface density map of the RC stars. The surface density distribution of the RRLS in the SMC is nearly circular.

On the spherical–axial transition in supernova remnants

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A new law of motion for supernova remnant (SNR) which introduces the quantity of swept matter in the thin layer approximation is introduced. This new law of motion is tested on 10 years observations of SN 1993J. The introduction of an exponential gradient in the surrounding medium allows to model an aspherical expansion. A weakly asymmetric
Recent star formation history of the Large and Small Magellanic Clouds

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Aims. Recent interactions between the Large and the Small Magellanic Clouds (LMC and SMC) and the Milky Way can be understood by studying their recent star formation history. This study aims to detect any directional or propagating star formation in the last 500 Myr.

Methods. We traced the age of the last star formation event (LSFE) in the inner Large & Small Magellanic Cloud (L\&SMC) using the photometric data in \( V \) and \( I \) pass bands from the Optical Gravitational Lensing Experiment (OGLE-III) and the Magellanic Cloud Photometric Survey (MCPS). The LSFE is estimated from the main-sequence turn off point in the color–magnitude diagram (CMD) of a sub-region. After correcting for extinction, the turn off magnitude is converted to age, which represents the LSFE in a region.

Results. The spatial distribution of the age of the LSFE shows that the star formation has shrunk to the central regions in the last 100 Myr in both the galaxies. The location as well as age of LSFE is found to correlate well with those of the star cluster in both the Clouds. The SMC map shows two separate concentrations of young star formation, one near the center and the other near the wing. We detect peaks of star formation at 0–10 Myr, 90–100 Myr in the LMC, and 0–10 Myr, 50–60 Myr in the SMC. The quenching of star formation in the LMC is found to be asymmetric with respect to the optical center such that most of the young star forming regions are located to the north and east. On deprojecting the data on the LMC plane, the recent star formation appears to be stretched in the north-east direction and the H\textsc{i} gas is found to be distributed preferentially in the North. The centroid is found to shift to north in 200–40 Myr, whereas it is found to shift to north-east in the last 40 Myr. In the SMC, we detect a shift in centroid of the population younger than 500 Myr and up to 40 Myr in the direction of the LMC.

Conclusions. We propose that the H\textsc{i} gas in the LMC is pulled to the north of the LMC in the last 200 Myr due to the gravitational attraction of our Galaxy at the time of perigalactic passage. The shifted H\textsc{i} gas is preferentially compressed in the north during 200–40 Myr and in the north–east in the last 40 Myr, due to the motion of the LMC in the Galactic halo. The recent star formation in the SMC is due to the combined gravitational effect of the LMC and the perigalactic passage.

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Observations of the near- to mid-infrared unidentified emission bands in the interstellar medium of the Large Magellanic Cloud

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We present the results of near- to mid-infrared slit spectroscopic observations (2.55–13.4 \( \mu \)m) of the diffuse emission toward nine positions in the Large Magellanic Cloud with the Infrared Camera (IRC) on board AKARI. The target positions are selected to cover a wide range of the intensity of the incident radiation field. The unidentified infrared bands at 3.3, 6.2, 7.7, 8.6 and 11.3 \( \mu \)m are detected toward all the targets, and ionized gas signatures: hydrogen...
recombination lines and ionic forbidden lines toward three of them. We classify the targets into two groups: those without the ionized gas signatures (Group A) and those with the ionized signatures (Group B). Group A includes molecular clouds and photo-dissociation regions, whereas Group B consists of H\textsc{ii} regions. In Group A, the band ratios of I(3.3)/I(11.3), I(6.2)/I(11.3), I(7.7)/I(11.3) and I(8.6)/I(11.3) show positive correlation with the IRAS and AKARI colors, but those of Group B do not follow the correlation. We discuss the results in terms of the polycyclic aromatic hydrocarbon (PAH) model and attribute the difference to the destruction of small PAHs and an increase in the recombination due to the high electron density in Group B. In the present study, the 3.3 \textmu m band provides crucial information on the size distribution and/or the excitation conditions of PAHs and plays a key role in the distinction of Group A from B. The results suggest the possibility of the diagram of I(3.3)/I(11.3) vs. I(7.7)/I(11.3) as an efficient diagnostic tool to infer the physical conditions of the interstellar medium.

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Evolution, nucleosynthesis and yields of low mass AGB stars at different metallicities (II): the FRUITY database

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By using updated stellar low mass stars models, we systematically investigate the nucleosynthesis processes occurring in AGB stars. In this paper we present a database dedicated to the nucleosynthesis of AGB stars: FRUITY (FRANEC Repository of Updated Isotopic Tables & Yields). An interactive web-based interface allows users to freely download the full (from H to Bi) isotopic composition, as it changes after each third dredge-up episode and the stellar yields the models produce. A first set of AGB models, having masses in the range 1.5 < M/M\odot < 3.0 and metallicities 10\textsuperscript{−3} < Z < 0.02, is discussed. For each model, a detailed description of the physical and the chemical evolution is provided. In particular, we illustrate the details of the s-process and we evaluate the theoretical uncertainties due to the parametrization adopted to model convection and mass loss. The resulting nucleosynthesis scenario is checked by comparing the theoretical [hs/ls] and [Pb/h\textsuperscript{s}] ratios to those obtained from the available abundance analysis of s-enhanced stars. On the average, the variation with the metallicity of these spectroscopic indexes is well reproduced by theoretical models, although the predicted spread at a given metallicity is substantially smaller than the observed one. Possible explanations for such a difference are briefly discussed. An independent check of the third dredge-up efficiency is provided by the C-stars luminosity function. Consequently, theoretical C-stars luminosity functions for the Galactic disk and the Magellanic Clouds have been derived. We generally find a good agreement with observations.

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Detection of 3.3 micron aromatic feature in the supernova remnant N 49 with AKARI

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We present an infrared study of the supernova remnant (SNR) N 49 in the Large Magellanic Cloud with the near-infrared (NIR; 2.5–5 \textmu m) spectroscopic observations performed by AKARI. The observations were performed as a coarse spectral mapping to cover most of the bright region in the east, which enables us to compare the distribution of
various line emission and to examine their correlation. We detect the 3.3 µm aromatic feature in the remnant, which is for the first time to report the presence of the 3.3 µm aromatic feature related to a SNR. In the line maps of H$_2$ 1–0 O(3), 3.3 µm feature, and Br$_\alpha$, the distribution of the aromatic feature shows overall correlation with those of other emissions together with regional differences reflecting the local physical conditions. By comparison with other archival imaging data at different wavelengths, the association of the aromatic emission to other ionic/molecular emission is clarified. We examine archival Spitzer IRS data of N 49 and find signatures of other polycyclic aromatic hydrocarbon (PAH) features at 6.2, 7.7, and 11.3 µm corresponding to the 3.3 µm aromatic feature. Based on the band ratios of PAHs, we find that PAHs in N 49 are not only dominantly neutral but also small in size. We discuss the origin of the PAH emission in N 49 and conclude that the emission is either from PAHs that have survived the shock or PAHs in the preshock gas heated by radiative precursor.

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Distance scale zero-points from Galactic RR Lyrae star parallaxes

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We present new absolute trigonometric parallaxes and proper motions for seven Pop II variable stars: five RR Lyr variables; RZ Cep, XZ Cyg, SU Dra, RR Lyr, UV Oct; and two type 2 Cepheids; VY Pyx and κ Pav. We obtained these results with astrometric data from Fine Guidance Sensors, white-light interferometers on Hubble Space Telescope. We find absolute parallaxes in milliseconds of arc: RZ Cep, 2.12 ± 0.16 mas; XZ Cyg, 1.67 ± 0.17 mas; SU Dra, 1.42 ± 0.16 mas; RR Lyr, 3.77 ± 0.13 mas; UV Oct, 1.71 ± 0.10 mas; VY Pyx, 6.44 ± 0.23 mas; and κ Pav, 5.57 ± 0.28 mas; an average $\sigma_\pi/\pi = 5.4\%$. With these parallaxes we compute absolute magnitudes in $V$ and $K$ bandpasses corrected for interstellar extinction and Lutz–Kelker–Hanson bias. Using these RRL absolute magnitudes, we then derive zero-points for $M_V$–[Fe/H] and $M_K$–[Fe/H]–log $P$ relations. The technique of reduced parallaxes corroborates these results. We employ our new results to determine distances and ages of several Galactic globular clusters and the distance of the LMC. The latter is close to that previously derived from Classical Cepheids uncorrected for any metallicity effect, indicating that any such effect is small. We also discuss the somewhat puzzling results obtained for our two type 2 Cepheids.

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Resolved young stellar populations in star-forming regions of the Magellanic Clouds

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The Magellanic Clouds (MCs), our neighboring dwarf galaxies, offer an outstanding variety of stellar systems, ranging from compact star clusters in various stages of evolution to open clusters and young stellar associations. The latter, being the loci where stars are still forming, are considered the best tracers of recent star formation. In this paper, I present collective observational results on the detection of stellar associations in different galaxies and discuss the issue of these stellar concentrations representing a specific scale of star formation in space and time. I also review previous results on the intermediate- and high-mass stellar content of associations in the MCs, and discuss them in terms of their initial mass function. Finally, I present the latest findings on the low-mass pre-main sequence stellar content of associations in the MCs, achieved with the Hubble Space Telescope and I discuss the detection of candidate young stellar objects in the vicinity of these systems achieved with Spitzer Space Telescope. These developments offer an exceptionally detailed picture of the star formation process and its products in our neighboring galaxies. As a consequence, star-forming regions and their stellar associations in the MCs are certainly the best local templates of extragalactic star formation, providing the basis for star formation studies in other distant dwarf galaxies.

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Wind structure and luminosity variations in the WR/LBV HD 5980

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Over the past 40 years, the massive LBV/WR system HD 5980 in the Small Magellanic Cloud has undergone a long-term S Doradus type variability cycle and two brief and violent eruptions in 1993 and 1994. In this paper we analyze a collection of UV and optical spectra obtained between 1979 and 2009 and perform cmfgen model fits to spectra of 1994, 2000, 2002 and 2009. The results are as follows: a) The long term S Dor-type variability is associated with changes of the hydrostatic radius; b) The 1994 eruption involved changes in its bolometric luminosity and wind structure; c) the emission-line strength, the wind velocity and the continuum luminosity underwent correlated variations in the sense that a decreasing $v_{\infty}$ is associated with increasing emission line and continuum levels; and d) The spectrum of the third star in the system (Star C) is well-fit by a $T_{\text{eff}} = 32$ K model atmosphere with SMC chemical abundances. For all epochs, the wind of the erupting star is optically thick at the sonic point and is thus driven mainly by the continuum opacity. We speculate that the wind switches between two stable regimes driven by the “hot” (during the eruption) and the “cool” (post-eruption) iron opacity bumps as defined by Lamers & Nugis (2002) and Gräfener and Hamann (2008), and thus the wind may undergo a bi-stability jump of a different nature from that which occurs in OB-stars.

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The Spitzer Spectroscopic Survey of the Small Magellanic Cloud (S4MC): Probing the physical state of polycyclic aromatic hydrocarbons in a low-metallicity environment


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We present results of mid-infrared spectroscopic mapping observations of six star-forming regions in the Small Magellanic Cloud from the Spitzer Spectroscopic Survey of the SMC (S4MC). We detect the mid-IR emission from polycyclic aromatic hydrocarbons (PAHs) in all of the mapped regions, greatly increasing the range of environments where PAHs have been spectroscopically detected in the SMC. We investigate the variations of the mid-IR bands in each region and compare our results to studies of the PAH bands in the SINGS sample and in a sample of low-metallicity starburst galaxies. PAH emission in the SMC is characterized by low ratios of the 6–9 µm features relative to the 11.3 µm feature and weak 8.6 and 17.0 µm features. Interpreting these band ratios in the light of laboratory and theoretical studies, we find that PAHs in the SMC tend to be smaller and less ionized than those in higher metallicity galaxies. Based on studies of PAH destruction, we argue that a size distribution shifted towards smaller PAHs cannot be the result of processing in the interstellar medium, but instead reflects differences in the formation of PAHs at low metallicity. Finally, we discuss the implications of our observations for our understanding of the PAH life-cycle in low-metallicity galaxies – namely that the observed deficit of PAHs may be a consequence of PAHs forming with smaller average sizes and therefore being more susceptible to destruction under typical interstellar medium conditions.

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Stellar evolution with pulsation-driven mass loss: The case of LMC Cepheids

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The Cepheid mass discrepancy, the difference between mass estimates from stellar pulsation and stellar evolution models, is a long standing challenge for the understanding of stellar astrophysics. We discuss the current state of the mass discrepancy and test the role of pulsation-driven mass loss in state-of-the-art stellar evolution calculations of Large Magellanic Cepheids in resolving it. We find that Cepheid mass loss is a significant contributor to the mass discrepancy, but it is not clear if the metallicity dependence of Cepheid mass loss is consistent with the measured metallicity dependence of the mass discrepancy.

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Obscuring supersoft X-ray sources in stellar winds

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We investigate the possibility of obscuring supersoft X-ray sources in the winds of companion stars. We derive limits on the amount of circumstellar material needed to fully obscure a 'canonical' supersoft X-ray source in the Large Magellanic Cloud, as observed with the Chandra X-ray Observatory.

Oral contribution, published in IAU Symposium 281 "Binary Paths to type Ia Supernovae", 5–10 July 2011, Padova, Italy
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Observing brown dwarfs in the Magellanic Cloud star-forming regions with the E-ELT

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We present the results of near-infrared imaging simulations of young star-forming regions in the Magellanic Clouds to be observed with the European Extremely Large Telescope (E-ELT). The simulated J, H, K-band images show that we should be able to obtain nearly complete samples of young brown dwarfs above the deuterium burning limit \((M > 13 \ M_{\text{Jup}})\) in low-mass star-forming regions in the Clouds. Moreover, very young giant planet-mass objects in the Clouds should be detectable with the E-ELT under favourable conditions.

Available from arXiv:1109.6235
Job Advert

Research Associate

The Spitzer Infrared Spectograph Science Team at Cornell University invites applications for a post-doctoral fellowship to collaborate with Dr. Greg Sloan on an NSF-funded research program entitled "An ALMA Reconnaissance of Distant Dying Stars." By studying the evolved stellar populations in Galactic globular clusters and nearby Local Group galaxies, this program will investigate the broader question of how evolved stars lose mass and enrich the heavy-element abundances in their host galaxies. It will also help address the unsolved problem of what drives the mass-loss process. The successful candidate will join the IRS Science Team and have access to all data products generated as part of the Team’s ongoing efforts to support the IRS.

This position will provide a choice of challenges in a wide-ranging project. Components include (1) optical and near-infrared imaging to characterize the evolved stellar populations in targeted systems, (2) ALMA observations to measure the mass-loss properties of individual stars, (3) synthesizing the results with existing infrared spectroscopic databases, (4) the planning of future infrared spectroscopy, and (5) ongoing technical support of IRS data at Cornell.

We are interested in innovative individuals who are well prepared for a multi-wavelength approach to observational astronomy. The candidate should also have experience with IDL, Python, and Linux platforms, or the demonstrated ability to learn these skills. They should be able to work well on group activities and have the desire to contribute to the scientific end products. A Ph.D. in astronomy, physics, or a closely related field is required. The appointment will initially be for one year, renewable for a second. Competitive salary will depend on experience.

To apply, please send a copy of your vita, research interests and the names of three individuals who are willing to write reference letters to Ms. Laurie McCall, Cornell University, 228 Space Sciences Building, Ithaca, NY 14853. Applications via email to 1m19@cornell.edu are encouraged. For full consideration, applications should be received by December 15, 2011, but they will be accepted until the position is filled. The appointment will begin on July 1, 2012. Cornell University is an Equal Opportunity/Affirmative Action Employer.

Announcement

The FRUITY database on AGB nucleosynthesis

We announce the creation of the FRUITY (Franee Repository of Upgraded Isotopic Tables & Yields) database dedicated to AGB stars nucleosynthesis. Its electronic platform is hosted at the web pages of the Teramo Observatory (INAF): www.oa-teramo.inaf.it/fruity. FRUITY contains nucleosynthesis features of our AGB theoretical models, directly calculated with a full nuclear network (from H to Pb). Surface elements enhancements ([El/Fe]) and isotopic compositions after First dredge Up and after each Third Dredge Up episode are available. Moreover, net yields can be downloaded. The database currently contains models with masses $1.5 \leq M/\text{M}_\odot \leq 3.0$ and metallicities $10^{-3} \leq Z \leq 0.02$ (Cristallo et al. ApJS in press, arXiv:1109.1176) and it will be expandend soon with very low metallicity models ($Z \leq 10^{-4}$) and Intermediate Mass Stars models ($M \geq 5 \text{ M}_\odot$). People interested in receiving infos on FRUITY upgrades and implementations can register to the FRUITY mailing list by filling all the requested fields (name, institution and e-mail address) in the dedicated window on the database home page.

Sergio Cristallo on behalf of the FRUITY Collaboration