Figure 1: Rotation of the LMC based on Gaia proper motions, obtained by van der Marel & Sahlmann (2016).
Editorial

Dear Colleagues,

It is my pleasure to present you the 143rd issue of the Magellanic Clouds Newsletter. We have entered the Gaia era! The front cover shows a summary of the exciting results obtained by van der Marel & Sahlmann on the rotation of the LMC, a taste for more to come. Below is a zoom into the Magellanic Clouds region of the all-sky Gaia map that was published by ESA. Intriguing features, hitherto suspected or debated stand out in superb clarity.

![Figure 2: Gaia all-sky map, zoomed in on the LMC (left) and SMC (right). Credit: ESA/Gaia/DPAC](image)

Two conferences are announced for February 2017 – one in the United Arab Emirates and the other in La Réunion. Perhaps one could combine both, were it not for the overlap in time...

The next issue is planned to be distributed on the 1st of December 2016.

Editorially Yours,

Jacco van Loon
Carbon gas in SMC low-metallicity star-forming regions

M.A. Requena-Torres\textsuperscript{1,5}, F.P. Israel\textsuperscript{2}, Y. Okada\textsuperscript{3}, R. Güsten\textsuperscript{1}, J. Stutzki\textsuperscript{3}, C. Risacher\textsuperscript{1}, R. Simon\textsuperscript{3} and H. Zinnecker\textsuperscript{4}

\textsuperscript{1}MPIfR, Bonn, Germany
\textsuperscript{2}Sterrewacht Leiden, The Netherlands
\textsuperscript{3}I. Phys. Inst. Univ. Köln, Germany
\textsuperscript{4}SOFIA Science Center, Moffett Field, USA
\textsuperscript{5}STScI, Baltimore, USA

This paper presents [C\textsc{ii}], [C\textsc{i}] and CO emission line maps of the star-forming regions N\,66, N\,25+N\,26, and N\,88 in the metal-poor Local Group dwarf galaxy SMC. The spatial and velocity structure of the large H\textsc{ii} region N\,66 reveals an expanding ring of shocked molecular gas centered on the exciting star cluster NGC\,346, whereas a more distant dense molecular cloud is being eroded by UV radiation from the same cluster. In the N\,25+N\,26 and N\,88 maps, diffuse [C\textsc{ii}] emission at a relatively low surface brightness extends well beyond the compact boundaries of the bright emission associated with [C\textsc{ii}] regions. In all regions, the distribution of this bright [C\textsc{ii}] emission and the less prominent [C\textsc{i}] emission closely follows the outline of the CO complexes, but the intensity of the [C\textsc{ii}] and [C\textsc{i}] emission is generally anti-correlated, which can be understood by the action of photo-dissociation and photo-ionization processes. Notwithstanding the overall similarity of CO and [C\textsc{ii}] maps, the intensity ratio of these lines varies significantly, mostly due to changes in CO brightness. [C\textsc{ii}] emission line profiles are up to 50\% wider in velocity than corresponding CO profiles. A radiative transfer analysis shows that the [C\textsc{ii}] line is the dominant tracer of (CO-dark) molecular hydrogen in the SMC. CO emission traces only a minor fraction of the total amount of gas. The similarity of the spatial distribution and line profile shape, and the dominance of molecular gas associated with [C\textsc{ii}] rather than CO emission imply that in the low-metallicity environment of the SMC the small amount of dense molecular gas traced by CO is embedded in the much more extended molecular gas traced only by [C\textsc{ii}] emission. The contribution from neutral atomic and ionized hydrogen zones is negligible in the star-forming regions observed.

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Metallicity dependence of turbulent pressure and macroturbulence in stellar envelopes

L. Grassitelli\textsuperscript{1}, L. Fossati\textsuperscript{2,1}, N. Langer\textsuperscript{1}, S. Simón-Díaz\textsuperscript{3,4}, N. Castro\textsuperscript{5,1} and D. Sanyal\textsuperscript{8}

\textsuperscript{1}Argelander-Institut für Astronomie der Universität Bonn, Auf dem Hügel 71, 53121, Bonn, Germany
\textsuperscript{2}Space Research Institute, Austrian Academy of Sciences, Schmiedlstraße 6, A-8042 Graz, Austria
\textsuperscript{3}Instituto de Astrofísica de Canarias, 38200 La Laguna, Tenerife, Spain
\textsuperscript{4}Departamento de Astrofísica, Universidad de La Laguna, Avda. Astrofísico Francisco Sánchez, s/n, 38200 La Laguna, Tenerife, Spain
\textsuperscript{5}Department of Astronomy, University of Michigan, 1085 S. University Avenue, Ann Arbor, MI 48109-1107, USA

Macroturbulence, introduced as a fudge to reproduce the width and shape of stellar absorption lines, reflects gas motions in stellar atmospheres. While in cool stars, it is thought to be caused by convection zones immediately beneath the stellar surface, the origin of macroturbulence in hot stars is still under discussion. Recent works established a correlation between the turbulent-to-total pressure ratio inside the envelope of stellar models and the macroturbulent velocities observed in corresponding Galactic stars. To probe this connection further, we evaluated the turbulent pressure that arises in the envelope convective zones of stellar models in the mass range 1–125 M\textsubscript{\odot} based on the mixing-length theory and computed for metallicities of the Large and Small Magellanic Cloud. We find that the turbulent pressure contributions in models with these metallicities located in the hot high-luminosity part of the
Hertzsprung–Russell (HR) diagram is lower than in similar models with solar metallicity, whereas the turbulent pressure in low-metallicity models populating the cool part of the HR-diagram is not reduced. Based on our models, we find that the currently available observations of hot massive stars in the Magellanic Clouds appear to support a connection between macroturbulence and the turbulent pressure in stellar envelopes. Multidimensional simulations of sub-surface convection zones and a larger number of high-quality observations are necessary to test this idea more rigorously.

Accepted for publication in A&A

An analysis of the population of extended main sequence turn-off clusters in the Large Magellanic Cloud

Andrés E. Piatti$^{1,2}$ and Nate Bastian$^3$

$^1$Observatorio Astronómico, Universidad Nacional de Córdoba, Laprida 854, 5000, Córdoba, Argentina
$^2$Consejo Nacional de Investigaciones Científicas y Técnicas, Av. Rivadavia 1917, C1033AAJ, Buenos Aires, Argentina
$^3$Astrophysics Research Institute, Liverpool John Moores University, 146 Brownlow Hill, Liverpool L3 5RF, UK

We combine a number of recent studies of the extended main sequence turn-off (eMSTO) phenomenon in intermediate age stellar (1–2 Gyr) clusters in the Large Magellanic Cloud (LMC) in order to investigate its origin. By employing the largest sample of eMSTO LMC clusters so far used, we show that cluster core radii, masses, and dynamical state are not related to the genesis of eMSTOs. Indeed, clusters in our sample have core radii, masses and age-relaxation time ratios in the range $\approx 2$–6 pc, 3.35–5.50 $(\log M_{\text{cls}}/M_\odot)$ and 0.2–8.0, respectively. These results imply that the eMSTO phenomenon is not caused by actual age spreads within the clusters. Furthermore, we confirm from a larger cluster sample recent results including young eMSTO LMC clusters, that the FWHM at the MSTOs correlates most strongly with cluster age, suggesting that a stellar evolutionary effect is the underlying cause.

Accepted for publication in MNRAS

On the new braking index of PSR B0540−69: further support for magnetic field growth of neutron stars following submergence by fallback accretion

Yavuz Eksi$^1$

$^1$Istanbul Technical University, Turkey

The magnetic fields of the nascent neutron stars could be submerged to the crust by rapid fallback accretion and could diffuse to the surface later in life. According to this field burial scenario young pulsars may have growing magnetic fields which is known to result in less-than-three braking indices; larger braking indices implying longer field-growth time-scales. A nascent neutron star with a larger kick velocity would accrete less amount of matter and would have a rapidly growing magnetic field, leading to a larger discrepancy with the braking index expected from a constant field. Such an inverse relation between the field growth time-scale inferred from the braking indices and space velocity of pulsars was claimed in the past as a prediction of the field-burial scenario. With a braking index of $n \sim 2$ and large space velocity PSR B0540−69 was then an outlier in the claimed relation. The recently measured small braking index of the object as $n \sim 0.03$ implies a much shorter time-scale for the field growth which is consistent with the high space velocity of the object, in agreement with the claimed relation. This observation lends support to the field burial scenario and implies that the growth of the magnetic field does not proceed at a constant pace but is slowed or completely halted at times. The slow spin down stage associated with the high braking index before 2011 which lasted for at least about 30 years was then such an episode of slowed-down field growth.

Submitted to MNRAS
New limits on the photon mass with radio pulsars in the Magellanic Clouds

Jun-Jie Wei\textsuperscript{1,2}, Er-Kang Zhang\textsuperscript{1}, Song-Bo Zhang\textsuperscript{1} and Xue-Feng Wu\textsuperscript{1,3}

\textsuperscript{1}Purple Mountain Observatory, Chinese Academy of Sciences, Nanjing 210008, China
\textsuperscript{2}Guangxi Key Laboratory for Relativistic Astrophysics, Nanning 530004, China
\textsuperscript{3}Joint Center for Particle, Nuclear Physics and Cosmology, Nanjing University–Purple Mountain Observatory, Nanjing 210008, China

A conservative constraint on the rest mass of the photon can be estimated under the assumption that the frequency dependence of dispersion from astronomical sources is mainly contributed by the nonzero photon mass effect. Photon mass limits have been earlier set through the optical emissions of the Crab Nebula pulsar, but we prove that these limits can be significantly improved with the dispersion measure (DM) measurements of radio pulsars in the Large and Small Magellanic Clouds. The combination of DM measurements of pulsars and distances of the Magellanic Clouds provide a strict upper limit on the photon mass as low as $m_{\gamma} \leq 2.0 \times 10^{-45}$ g, which is at least four orders of magnitude smaller than the constraint from the Crab Nebula pulsar. Although our limit is not as tight as the current best result ($\sim 10^{-47}$ g) from a fast radio burst (FRB 150418) at a cosmological distance, the cosmological origin of FRB 150418 remains under debate; and our limit can reach the same high precision of FRB 150418 when it has an extragalactic origin ($\sim 10^{-45}$ g).

Submitted to Research in Astronomy and Astrophysics

K-band integral field spectroscopy and optical spectroscopy of massive young stellar objects in the Small Magellanic Cloud

J.L. Ward\textsuperscript{1}, J.M. Oliveira\textsuperscript{1}, J.Th. van Loon\textsuperscript{1} and M. Sewiło\textsuperscript{2}

\textsuperscript{1}Physics and Astrophysics, Lennard-Jones Laboratories, Keele University, Keele, ST5 5BG, UK
\textsuperscript{2}NASA Goddard Space Flight Center, 8800 Greenbelt Rd., Greenbelt, MD 20771, USA

We present K-band integral field spectroscopic observations towards 17 massive young stellar objects (YSOs) in the low metallicity Small Magellanic Cloud (SMC) and two YSO candidates in the compact H\textsuperscript{II} regions N 81 and N 88A (also in the SMC). These sources, originally identified using Spitzer photometry and/or spectroscopy, have been resolved into 29 K-band continuum sources. By comparing Br\textsubscript{\gamma} emission luminosities with those presented for a Galactic sample of massive YSOs, we find tentative evidence for increased accretion rates in the SMC. Around half of our targets exhibit emission line (Br\textsubscript{\gamma}, He\textsubscript{I} and H\textsubscript{2}) morphologies which extend significantly beyond the continuum source and we have mapped both the emission morphologies and the radial velocity fields. This analysis also reveals evidence for the existence of ionized low density regions in the centre outflows from massive YSOs. Additionally we present an analysis of optical spectra towards a similar sample of massive YSOs in the SMC, revealing that the optical emission is photo-excited and originates near the outer edges of molecular clouds, and is therefore consistent with a high mean-free path of UV photons in the interstellar medium (ISM) of the SMC. Finally, we discuss the sample of YSOs in an evolutionary context incorporating the results of previous infrared and radio observations, as well as the near-infrared and optical observations presented in this work. Our spectroscopic analysis in both the K-band and the optical regimes, combined with previously obtained infrared and radio data, exposes differences between properties of massive YSOs in our own Galaxy and the SMC, including tracers of accretion, discs and YSO–ISM interactions.

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**Chandra and Swift X-ray observations of the X-ray pulsar SMC X-2 during the outburst of 2015**

K. L. Li\(^1\), C.-P. Hu\(^2\), L. C. C. Lin\(^3\) and Albert K. H. Kong\(^4\)

\(^1\)Michigan State University, USA  
\(^2\)The University of Hong Kong, China  
\(^3\)Academia Sinica Institute of Astronomy and Astrophysics, Taiwan  
\(^4\)National Tsing Hua University, Taiwan

We report the *Chandra*/HRC-S and *Swift*/XRT observations for the 2015 outburst of the high-mass X-ray binary (HMXB) pulsar in the Small Magellanic Cloud, SMC X-2. While previous studies suggested that either an O star or a Be star in the field is the high-mass companion of SMCX-2, our *Chandra*/HRC-S image unambiguously confirms the O-type star as the true optical counterpart. Using the *Swift*/XRT observations, we extracted accurate orbital parameters of the pulsar binary through a time of arrivals (TOAs) analysis. In addition, there were two X-ray dips near the inferior conjunction, which are possibly caused by eclipses or an ionized high-density shadow wind near the companion’s surface. Finally, we propose that an outflow driven by the radiation pressure from day \(\sim 10\) played an important role in the X-ray/optical evolution of the outburst.

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**The evolution of red supergiants to supernova in the LMC cluster NGC 2100**

Emma R. Beasor\(^1\) and Ben Davies\(^1\)

\(^1\)Liverpool John Moores University, UK

The mass loss rates of red supergiants (RSGs) govern their evolution towards supernova and dictate the appearance of the resulting explosion. To study how mass-loss rates change with evolution we measure the mass-loss rates (\(\dot{M}\)) and extinctions of 19 red supergiants in the young massive cluster NGC 2100 in the Large Magellanic Cloud. By targeting stars in a coeval cluster we can study the mass-loss rate evolution whilst keeping the variables of mass and metallicity fixed. Mass-loss rates were determined by fitting DUSTY models to mid-IR photometry from WISE and *Spitzer*/IRAC. We find that the \(\dot{M}\) in red supergiants increases as the star evolves, and is well described by \(\dot{M}\) prescription of de Jager, used widely in stellar evolution calculations. We find the extinction caused by the warm dust is negligible, meaning the warm circumstellar material of the inner wind cannot explain the higher levels of extinction found in the RSGs compared to other cluster stars. We discuss the implications of this work in terms of supernova progenitors and stellar evolution theory. We argue there is little justification for substantially increasing the \(\dot{M}\) during the RSG phase, as has been suggested recently in order to explain the absence of high mass Type II-P supernova progenitors. We also argue that an increase in reddening towards the end of the RSG phase, as observed for the two most evolved cluster stars, may provide a solution to the red supergiant problem.

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**Dust evolution processes constrained by extinction curves in nearby galaxies**

Kuan-Chou Hou\(^1\,\,\,2\), Hiroyuki Hirashita\(^1\) and Michał J. Michalowski\(^3\)

\(^1\)Institute of Astronomy, and Astrophysics, Academia Sinica, P.O. Box 23-141, Taipei 10617, Taiwan  
\(^2\)Department of Physics, Institute of Astrophysics, National Taiwan University, Taipei 10617, Taiwan  
\(^3\)SUPA, Institute for Astronomy, University of Edinburgh, Royal Observatory, Blackford Hill, Edinburgh, EH9 3HJ, UK

Extinction curves, especially those in the Milky Way (MW), the Large Magellanic Cloud (LMC), and the Small Magellanic Cloud (SMC), have provided us with a clue to the dust properties in the nearby Universe. We examine
whether or not these extinction curves can be explained by well known dust evolution processes. We treat the dust production in stellar ejecta, destruction in supernova shocks, dust growth by accretion and coagulation, and dust disruption by shattering. To make a survey of the large parameter space possible, we simplify the treatment of the grain size distribution evolution by adopting the ‘two-size approximation’, in which we divide the grain population into small (≤0.03 µm) and large (>0.03 µm) grains. It is confirmed that the MW extinction curve can be reproduced in reasonable ranges for the time-scale of the above processes with a silicate–graphite mixture. This indicates that the MW extinction curve is a natural consequence of the dust evolution through the above processes. We also find that the same models fail to reproduce the SMC/LMC extinction curves. Nevertheless, this failure can be remedied by giving higher supernova destruction rates for small carbonaceous dust and considering amorphous carbon for carbonaceous dust; these modification fall in fact in line with previous studies. Therefore, we conclude that the current dust evolution scenario composed of the aforementioned processes is successful in explaining the extinction curves. All the extinction curves favor efficient interstellar processing of dust, especially, strong grain growth by accretion and coagulation.

Accepted for publication in PASJ

Star clusters in the Magellanic Clouds. I. Parameterisation and classification of 1072 clusters in the LMC
P.K. Nayak1, A. Subramaniam1, S. Choudhury1, 2, G. Indu1 and Ram Sagar1

1Indian Institute of Astrophysics, Bangalore 560034, India
2Indian Institute of Science, Bangalore 560012, India

We have introduced a semi-automated quantitative method to estimate the age and reddening of 1072 star clusters in the Large Magellanic Cloud (LMC) using the Optical Gravitational Lensing Experiment (OGLE) III survey data. This study brings out 308 newly parameterised clusters. In a first of its kind, the LMC clusters are classified into groups based on richness/mass as very poor, poor, moderate and rich clusters, similar to the classification scheme of open clusters in the Galaxy. A major cluster formation episode is found to happen at 125 ± 25 Myr in the inner LMC. The bar region of the LMC appears prominently in the age range 60–250 Myr and is found to have a relatively higher concentration of poor and moderate clusters. The eastern and the western ends of the bar are found to form clusters initially, which later propagates to the central part. We demonstrate that there is a significant difference in the distribution of clusters as a function of mass, using a movie based on the propagation (in space and time) of cluster formation in various groups. The importance of including the low mass clusters in the cluster formation history is demonstrated. The catalog with parameters, classification, and cleaned isochrone fitted CMDs of 1072 clusters, which are available as online material, can be further used to understand the hierarchical formation of clusters in selected regions of the LMC.

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and from http://mnras.oxfordjournals.org/cgi/content/abstract/stw2043?ijkey=zTrXeLqFNTxhHYn&keytype=ref

Studying relation between star formation and molecular clumps on subparsec scales in 30 Doradus
Omnarayani Nayak1, Margaret Meixner1, 2, Remy Indebetouw3, 4, Guido De Marchi5, Anton Koekemoer2, Nino Panagia2 and Elena Sabbi2

1Johns Hopkins University, USA
2Space Telescope Science Institute, USA
3University of Virginia, USA
4National Radio Astronomy Observatory, USA
5European Space Agency, The Netherlands

We present 12CO and 13CO molecular gas data observed by ALMA, massive early stage young stellar objects identified by applying color–magnitude cuts to Spitzer and Herschel photometry, and low-mass late stage young stellar objects
identified via Hα excess. Using dendrograms, we derive properties for the molecular cloud structures. This is the first time a dendrogram analysis has been applied to extragalactic clouds. The majority of clumps have a virial parameter equal to unity or less. The size–linewidth relations of 12CO and 13CO show the clumps in this study have a larger linewidth for a given size (by factor of 3.8 and 2.5, respectively) in comparison to several, but not all, previous studies. The larger linewidths in 30 Doradus compared to typical Milky Way quiescent clumps are probably due to the highly energetic environmental conditions of 30 Doradus. The slope of the size–linewidth relations of 12CO, 0.65 ± 0.04, and 13CO, 0.97 ± 0.12, are on the higher end but consistent within 3σ of previous studies. Massive star formation occurs in clumps with high masses (> 1.83 × 10^2 M⊙), high linewidths (v > 1.18 km s⁻¹), and high mass densities (> 6.67 × 10^2 M⊙ pc⁻²). The majority of embedded, massive young stellar objects are associated with a clump. However the majority of more evolved, low-mass young stellar objects are not associated with a clump.

Accepted for publication in ApJ

Core-collapse supernova progenitor constraints using the spatial distributions of massive stars in local galaxies

T. Kangas¹, L. Portinari¹, S. Mattila¹,²,³ M. Fraser³, E. Kankare⁴, R.G. Izzard⁵, P. James⁶, C. González-Fernández⁶, J.R. Maund⁶,⁷ and A. Thompson⁸

¹Tuorla Observatory, Department of Physics and Astronomy, University of Turku, Väisäläntie 20, FI-21500 Piikkiö, Finland
²Finnish Centre for Astronomy with ESO (FINCA), University of Turku, Väisäläntie 20, FI-21500 Piikkiö, Finland
³Institute of Astronomy (IoA), University of Cambridge, Madingley Road, Cambridge, CB3 0HA, United Kingdom
⁴Astrophysics Research Centre, School of Mathematics and Physics, Queen’s University Belfast, BT7 1NN, UK
⁵Astrophysics Research Institute, Liverpool John Moores University, IC2, Liverpool Science Park, 146 Brownlow Hill, Liverpool, L3 5RF, UK
⁶The Department of Physics and Astronomy, The University of Sheffield, Hicks Building, Hounsfield Road, Sheffield, S3 7RH, UK
⁷Royal Society Research Fellow

We study the spatial correlations between the Hα emission and different types of massive stars in two local galaxies, the Large Magellanic Cloud (LMC) and Messier 33. We compare these to correlations derived for core-collapse supernovae (CCSNe) in the literature to connect CCSNe of different types with the initial masses of their progenitors and to test the validity of progenitor mass estimates which use the pixel statistics method. We obtain samples of evolved massive stars in both galaxies from catalogues with good spatial coverage and/or completeness, and combine them with coordinates of main-sequence stars in the LMC from the SIMBAD database. We calculate the spatial correlation of stars of different classes and spectral types with Hα emission. We also investigate the effects of distance, noise and positional errors on the pixel statistics method. A higher correlation with Hα emission is found to correspond to a shorter stellar lifespan, and we conclude that the method can be used as an indicator of the ages, and therefore initial masses, of SN progenitors. We find that the spatial distributions of type II-P SNe and red supergiants of appropriate initial mass (≥ 9 M⊙) are consistent with each other. We also find the distributions of type Ic SNe and WN stars with initial masses ≥ 20 M⊙ consistent, while supergiants with initial masses around 15 M⊙ are a better match for type IIb and II-L SNe. The type Ib distribution corresponds to the same stellar types as type II-P, which suggests an origin in interacting binaries. On the other hand, we find that luminous blue variable stars show a much stronger correlation with Hα emission than do type IIn SNe.

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Dust grains from the heart of supernovae

M. Bocchio¹,², S. Marassi², R. Schneider², S. Bianchi¹, M. Limongi² and A. Chieffi³

¹INAF–Osservatorio Astrofisico di Arcetri, Largo Enrico Fermi 5, 50125 Firenze, Italy
²INAF–Osservatorio Astronomico di Roma, Via di Frascati 33, I-00040 Monteporzio, Italy
³INAF/IASF, Via Fosso del Cavaliere 100, 00133 Roma, Italy

Dust grains are classically thought to form in the winds of Asymptotic Giant Branch (AGB) stars. However, nowadays
there is increasing evidence for dust formation in Supernovae (SNe). In order to establish the relative importance of these two classes of stellar sources of dust it is important to know what is the fraction of freshly formed dust in SN ejecta that is able to survive the passage of the reverse shock and be injected in the interstellar medium. With this aim, we have developed a new code, sc GRASHRev, that allows to follow the dynamics of dust grains in the shocked SN ejecta and to compute the time evolution of the mass, composition and size distribution of the grains. We consider four well studied SNe in the Milky Way and Large Magellanic Cloud: SN 1987A, Cas A, the Crab Nebula, and N 49. These sources have been observed with both Spitzer and Herschel and the multiwavelength data allow to better assess the mass of warm and cold dust associated with the ejecta.

For each SN, we first identify the best explosion model, using the mass and metallicity of the progenitor star, the mass of $^{56}\text{Ni}$, the explosion energy and the circumstellar medium density inferred from the data. We then run a dust formation model to compute the properties of freshly formed dust (Marassi et al. 2015). Starting from these input models, GRASHRev self-consistently follow the dynamics of the grains considering the effects of the forward and reverse shock and allows to predict the time evolution of the dust mass, composition and size distribution in the shocked and unshocked regions of the ejecta.

For all the simulated models, we find good agreement with observations. Our study suggests that SN 1987A is too young for the reverse shock to have affected the dust mass. Hence the observed dust mass of $0.7-0.9\ M_\odot$ in this source can be safely considered as indicative of the mass of freshly formed dust in SN ejecta. Conversely, in the other three SNs, the reverse shock has already destroyed between 10 and 40% of the initial dust mass. However, the largest dust mass destruction is predicted to occur between $10^2$ and $10^5$ yr after the explosions. Since the oldest SN in the sample has an estimated age of 4800 yr, current observations can only provide an upper limit to the mass of SN dust that will enrich the interstellar medium, the so-called effective dust yields. We find that only between 1 and 8% of the currently observed mass will survive, resulting in an average SN effective dust yield of $(1.55 \pm 1.48) \times 10^{-2}\ M_\odot$. This is in good agreement with the values adopted in chemical evolution models which consider the effect of the SN reverse shock.

We discuss the astrophysical implications of our results for dust enrichment in local galaxies and at high redshift.

Published in Astronomy & Astrophysics

Orbits of massive satellites: I. A close look at the Large Magellanic Cloud and a new orbital history for M 33

Ekta Patel¹, Gurtina Besla¹ and Sangmo Tony Sohn²

¹University of Arizona, USA
²The Johns Hopkins University, USA

The Milky Way (MW) and M 31 both harbor massive satellite galaxies, the Large Magellanic Cloud (LMC) and M 33, which may comprise up to 10 per cent of their host’s total mass. Massive satellites can change the orbital barycentre of the host–satellite system by tens of kiloparsecs and are cosmologically expected to harbor dwarf satellite galaxies of their own. Assessing the impact of these effects depends crucially on the orbital histories of the LMC and M 33.

Here, we revisit the dynamics of the MW–LMC system and present the first detailed analysis of the M 31–M 33 system utilizing high precision proper motions and statistics from the dark matter-only Illustris cosmological simulation. With the latest Hubble Space Telescope proper motion measurements of M 31, we reliably constrain M 33’s interaction history with its host. In particular, like the LMC, M 33 is either on its first passage ($t_{\text{inf}} < 2\ \text{Gyr ago}$) or if M 31 is massive ($\geq 2 \times 10^{12}\ M_\odot$), it is on a long period orbit of about 6 Gyr. Cosmological analogs of the LMC and M 33 identified in Illustris support this picture and provide further insight about their host masses. We conclude that, cosmologically, massive satellites like the LMC and M 33 are likely completing their first orbits about their hosts. We also find that the orbital energies of such analogs prefer a MW halo mass $\sim 1.5 \times 10^{12}\ M_\odot$ and an M 31 halo mass $\geq 1.5 \times 10^{12}\ M_\odot$. Despite conventional wisdom, we conclude it is highly improbable that M 33 made a close (< 100 kpc) approach to M 31 recently ($t_{\text{pert}} < 3\ \text{Gyr ago}$). Such orbits are rare (< 1 per cent) within the 4σ error space allowed by observations. This conclusion cannot be explained by perturbative effects through four body encounters between the MW, M 31, M 33, and the LMC. This surprising result implies that we must search for a new explanation for M 33’s strongly warped gas and stellar discs.

Submitted to MNRAS
Galactic cosmic-ray induced production of lithium in the Small Magellanic Cloud

A. Ćiprijanović

1Faculty of Mathematics, University of Belgrade, Serbia

Recently, the first lithium detection outside of the Milky Way was made in low-metallicity gas of the Small Magellanic Cloud, which was at the level of the expected primordial value. Part of the observed lithium in any environment has primordial origin, but there is always some post-BBN (Big Bang Nucleosynthesis) contamination, since lithium can also be produced in cosmic-ray interactions with the interstellar medium. Using the fact that processes involving cosmic rays produce lithium, but also γ rays through neutral pion decay, we use the Small Magellanic Cloud γ-ray observations by Fermi–LAT to make predictions on the amount of lithium in this galaxy that was produced by galactic cosmic rays accelerated in supernova remnants. By including both fusion processes, as well as spallation of heavier nuclei, we find that galactic cosmic rays could produce a very small amount of lithium. In the case of 6Li isotope (which should only be produced by cosmic rays) we can only explain 0.16% of the measured abundance. If these cosmic rays are indeed responsible for such small lithium production, observed abundances could be the result of some other sources, which are discussed in the paper.

Accepted for publication in Astroparticle Physics

First Gaia Local Group dynamics: Magellanic Clouds proper motion and rotation

Roeland P. van der Marel1 and Johannes Sahlmann2

1STScI, USA
2ESA/STScI, USA

We use the Gaia data release 1 (DR1) to study the proper motion (PM) fields of the Large and Small Magellanic Clouds (LMC, SMC). This uses the Tycho–Gaia Astrometric Solution (TGAS) PMs for 29 Hipparcos stars in the LMC and 8 in the SMC. The LMC PM in the West and North directions is inferred to be (µW, µN) = (−1.874 ± 0.039, 0.223 ± 0.049) mas yr−1, and the SMC PM (µW, µN) = (−0.876 ± 0.060, −1.227 ± 0.042) mas yr−1. These results have similar accuracy and agree to within the uncertainties with existing Hubble Space Telescope (HST) PM measurements. Since TGAS uses different methods with different systematics, this provides an external validation of both data sets and their underlying approaches. Residual D1 systematics may affect the TGAS results, but the HST agreement implies this must be below the random errors. Also in agreement with prior HST studies, the TGAS LMC PM field clearly shows the clockwise rotation of the disk, even though it takes the LMC disk in excess of 108 years to complete one revolution. The implied rotation curve amplitude for young LMC stars is consistent with that inferred from line-of-sight (LOS) velocity measurements. Comparison of the PM and LOS rotation curves implies a kinematic LMC distance modulus m − M = 18.53 ± 0.42, consistent but not yet competitive with photometric methods. These first results from Gaia on the topic of Local Group (LG) dynamics provide an indication of how its future data releases will revolutionize this field.

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and from http://www.cosmos.esa.int/web/gaia/iow_20160916
A classical and a relativistic law of motion for SN 1987A

Lorenzo Zaninetti

1Department of Physics, Via Pietro Giuria 1, Torino, Italy

In this paper we derive some first order differential equations which model the classical and the relativistic thin layer approximations in the presence of a circumstellar medium with a density which is decreasing in the distance $z$ from the equatorial plane. The circumstellar medium is assumed to follow a density profile with $z$ of hyperbolic type, power law type, exponential type or Gaussian type. The first order differential equations are solved analytically, or numerically, or by a series expansion, or by Padé approximants. The initial conditions are chosen in order to model the temporal evolution of SN 1987A over 23 years. The free parameters of the theory are found by maximizing the observational reliability which is based on an observed section of SN 1987A.

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OGLE collection of star clusters. New objects in the outskirts of the Large Magellanic Cloud

M. Sitek1, M.K. Szymański1, D.M. Skowron1, A. Udalski1, Z. Kostrzewa-Rutkowska2,3, J. Skowron1, P. Karczmarek1, M. Cieslar1, L. Wyrzykowski1, S. Kołowski1, P. Pietrukowicz1, I. Soszyński1, P. Mróz3, M. Pawlak1, R. Poleski1,4 and K. Ulaczyk1,5

1Warsaw University Observatory, Poland
2SRON Netherlands Institute for Space Research, The Netherlands
3Department of Astrophysics/IMAPP, Radboud University Nijmegen, The Netherlands
4Department of Astronomy, Ohio State University, USA
5Department of Physics, University of Warwick, UK

The Magellanic System (MS), consisting of the Large Magellanic Cloud (LMC), the Small Magellanic Cloud (SMC) and the Magellanic Bridge (MBR), contains diverse sample of star clusters. Their spatial distribution, ages and chemical abundances may provide important information about the history of formation of the whole System. We use deep photometric maps derived from the images collected during the fourth phase of The Optical Gravitational Lensing Experiment (OGLE-IV) to construct the most complete catalog of star clusters in the Large Magellanic Cloud using the homogeneous photometric data. In this paper we present the collection of star clusters found in the area of about 225 square degrees in the outer regions of the LMC. Our sample contains 679 visually identified star cluster candidates, 226 of which were not listed in any of the previously published catalogs. The new clusters are mainly young small open clusters or clusters similar to associations.

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Identifying the chemistry of the dust around AGB stars in nearby galaxies

Sundar Srinivasan¹, Ciska Kemper¹ and Ronny Zhao-Geisler¹,²

¹Institute of Astronomy & Astrophysics, Academia Sinica, Taipei, Taiwan
²National Taiwan Normal University, Taipei, Taiwan

Asymptotic giant branch (AGB) stars are significant contributors to the chemical enrichment of the interstellar medium (ISM) of galaxies. It is therefore essential to constrain the AGB contribution to the dust budget in galaxies. Recent estimates of the total dust injection rate to the Large and Small Magellanic Clouds (LMC and SMC; Riebel et al. 2012, Boyer et al. 2012, Srinivasan et al. in prep) have used data from the Spitzer Space Telescope SAGE (Surveying the Agents of Galaxy Evolution; Meixner et al. 2006) and SAGE-SMC (Gordon et al. 2011) surveys. When sorted by dust chemistry, the data allow for a comparison of O-rich and carbonaceous dust-production rates. In the LMC, for instance, the rate of dust production from carbon stars is about two and a half times that from oxygen-rich AGBs. A reliable determination of the fractional contributions of the two types of dust would serve as input to models of chemical evolution. However, the Spitzer IRAC photometric bands do not sufficiently probe the characteristic mid-infrared spectral features that can distinguish O-rich AGBs from carbon stars – namely, the 9.7-µm silicate feature and the 11.3-µm silicon carbide feature. With the continuous spectral coverage in the 4–30-µm range, SPICA has the potential to distinguish these two types of chemistries. In this contribution, synthetic photometry from the model grid of AGB stars, GRAMS (Sargent et al. 2011; Srinivasan et al. 2011) will be used to discuss the science possibilities that SPICA might offer this study.

Poster contribution, published in ”SPICA Science Conference 2013, From Exoplanets to Distant Galaxies: SPICA’s New Window on the Cool Universe”, ASP Conference Series


The mass of the black hole in LMC X-3

A.K.F. Val Baker¹, A.J. Norton¹ and I. Negueruela²

¹Department of Physics and Astronomy, The Open University, Milton Keynes MK7 6AA, UK
²DFISTS, Universidad de Alicante, Apartado de Correos 99, E03080 Alicante, Spain

New high resolution, optical spectroscopy of the high mass X-ray binary LMC X-3, shows the spectral type of the donor star changes with phase due to irradiation by the X-ray source. We find the spectral type is likely to be B5 V, and only appears as B3 V when viewing the heated side of the donor. Combining our measurements with those previously published, and taking into account the effects of X-ray irradiation, results in a value for the donor star radial velocity semi-amplitude of $256.7 \pm 4.9$ km s$^{-1}$. We find the mass of the black hole lies in the range 9.5–13.6 M$_\odot$.

Poster contribution, published in AIPC, 924, 530 (2007)


IAUS 331: "SN 1987A, 30 years later – Cosmic Rays and Nuclei from Supernovæ and their aftermaths"
(20–24 February 2017, St. Gilles, La Réunion Island, France)

Dear colleague,

The Symposium from the International Astronomical Union IAUS 331: "SN 1987A, 30 years later – Cosmic Rays and Nuclei from Supernovæ and their aftermaths"

Where? Saint-Gilles-Les-Bains, La Réunion Island (Indian Ocean), France

When? February 20–24, 2017

It aims at making the link between the stellar progenitors and the multi-wavelength/multi-messenger manifestation of core-collapse (cc-)Supernovæ (SNe) and their remnants (SNRs) in terms of extreme sources of high-energy particles and nuclei, at the occasion of the 30th anniversary of the unique event SN 1987A. Through an interdisciplinary approach, the Symposium will span a broad spectrum of interconnected, topics within this rapidly evolving research field of cc-SNe and SNRs.

We invite contributions on the following topics:

- Latest evolutionary stages of massive stars as cc-SN progenitors
- cc-SNe as stellar explosive outcomes
- cc-SN explosion mechanisms
- cc-SN remnants and impacts
- Particle acceleration & Origin of cosmic rays
- SN 1987A, 30 years later
- Non-thermal multi-wavelength/multi-messenger data on SNe and SNRs

Confirmed invited speakers are:

- Poonam Chandra (NCRA–TIFR, India)
- You-Hua Chu (ASIAA, Taiwan)
• Anne Decourchelle (CEA/SAp, France)
• Fiorenza Donato (Univ. Torino, Italy)
• Claes Fransson (OKC, Sweden)
• Christopher L. Fryer (LANL, USA)
• Brian Grefenstette (SRL, Caltech, USA)
• Alexander Heger (MoCA, Monash Univ., Australia)
• Raphaël Hirschi (Keele Univ., UK)
• Robert P. Kirshner (CfA Harvard, USA)
• Kei Kotake (Fukuoka Univ., Japan)
• Shiu-Hang Lee (ISAS/JAXA, Japan)
• Julie McEnery (NASA/GSFC, USA)
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• Salvatore Orlando (INAF/OAPa, Italy)
• Georg Raffelt (MPP, Germany)
• Irene Tamborra (NBIA, Denmark)
• Stefano Valenti (UC Davis, USA)
• Giovanna Zanardo (ICRAR, Australia)

Request for IAU Financial Support is open until October, 20\textsuperscript{th} 2016. IAU grants are meant to support qualified scientists to whom only limited means of support are available, e.g., colleagues from economically less privileged countries and young scientists. Deadline for Early registration (250 EUR) and abstract submission is set to November, 10\textsuperscript{th} 2016. Late registration (300 EUR) is possible until December, 20\textsuperscript{th} 2016.

For more information, please visit the website at the following (new!) URL: https://iaus331.lupm.in2p3.fr

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Looking forward to welcoming you in La Réunion Island!

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