The Magellanic Clouds Newsletter
An electronic exchange of Magellanic Clouds information
Edited by: You-Hua Chu and Dominik J. Bomans
MCnews@astro.uiuc.edu

Number: 2 January 18, 1996

Table of Contents
News and Views.............1
Paper Abstracts.............2

News and Views

Meeting Announcement
We are pleased to announce that our proposal to the AAS for a topical session on “New Views of the Magellanic Clouds” in the 188th AAS meeting at Madison, Wisconsin has been selected. The session is scheduled for June 12 (Wednesday), during which the invited talks on large-scale surveys of the MCs will be presented. Contributions to this meeting should follow the normal AAS meeting abstract submission process. Tentatively, the poster contributions will be exhibited on June 12, and oral contributions will be scheduled for June 13. Please check the www homepage of MCnews for further information in the near future. Hope to see you in Madison!
You-Hua Chu, Dominik Bomans, Bart Wakker

The LBV R 143
The star R 143 (HD 269929) is an LBV in the 30 Doradus region, and is located approximately 2 arcmin southeast of the core cluster R 136. As a part of a project for monitoring R 143, I am collecting data from observers who obtained it in their field of view when observing other parts of 30 Dor. If you have such data (recent or very old and sitting in the back of your file cabinet - historical data are particularly sparse) that you would like to contribute to this project, please contact me. R 143’s coordinates are: $\alpha=5:38:51.6$, $\delta=-69:08:06$ (epoch 2000.0). Finding charts for R 143 can be found in: 1993, ApJ, 409, 770 and 1993 AJ, 106, 560.
Joel Parker
Code 681, GSFC/NASA, Greenbelt, MD 20771
parker@kuylym.gsfc.nasa.gov
Neutral Hydrogen in the Magellanic System

John M. Dickey

Astronomy Department, University of Minnesota, 116 Church St. SE, Minneapolis, MN 55455 USA

The 21-cm line of neutral hydrogen is the preeminent tracer of interstellar gas in the Magellanic System, which consists of the Large and Small Magellanic Clouds, the Bridge between the Clouds, the halo around them, and the Magellanic Stream. It serves as both a dynamical tracer to show the gravitational potential shape in and around the Clouds, and as a thermodynamic tracer to show the physical conditions of density, temperature, and radiation field. The variety of environments in the Clouds, Bridge, and Stream are much more diverse than in the local interstellar medium of the Milky Way, so studies of the state of the atomic gas in the Magellanic System are of astrophysical significance going beyond questions of the Clouds themselves. Many questions about the past and future of the Clouds, such as their orbital history and gravitational stability, can be answered only by use of the 21-cm data because it is the only tracer available in many regions. The opportunities presented by new telescopes such as the Australia Telescope Compact Array will allow many advances in our understanding of the atomic gas in the Clouds. Some recent results from the Compact Array include a "mosaic" map of the entire SMC with 1.5' resolution, and a survey of 21-cm absorption by the LMC, which shows the mixture of warm and cool phases of H I gas.

Accepted by PASP Conference Series: The Minnesota Lectures on Extragalactic Neutral Hydrogen

For preprints, contact john@ast1.spa.umn.edu

http://ast1.spa.umn.edu/john/john.html

Structure and Kinematics of the Interstellar Medium in front of SN1987A

Jun Xu and Arlin P. S. Crotts

Department of Astronomy, Columbia University, New York, NY 10027

High resolution (10 km s\(^{-1}\)) [N II] echelle spectra, sampled every 13 arcsec in a 6 arcmin×6 arcmin region around SN1987A were obtained on the CTIO-4M telescope. The map shows a complicated velocity structure consistent with structure in the interstellar medium (ISM) reported before. Three components, \(V_{hel} = 265, 277\) and 285 km s\(^{-1}\) were identified as N157C or the R1170-complex (Xu, Crotts & Kunkel 1995). The radius of this 230- pc-diameter superbubble was found to expand at 10 km s\(^{-1}\), with a lifetime of 7 × 10\(^6\) years and a total energy of 3 × 10\(^51\) ergs determined from its radius and velocity according to superbubble theory (McCray & Kafatos 1987). The \(V_{hel} = 235\) km s\(^{-1}\) component correspond to the near side of 600 pc giant superbubble reported earlier. This bubble is 3 × 10\(^7\) years old, and has blown out of the LMC disk. Two other components, \(V_{hel} = 255\) and 245 km s\(^{-1}\) are identified as the inner major light echo ring (a double-shell structure) at about 130 pc in front of SN1987A. There are also two high velocity components, 300 and 313 km s\(^{-1}\), which are possibly the far side of a superbubble in which SN1987A exploded. We also noticed that there are two components at 259 and 301 km s\(^{-1}\) within 20 arcsec of SN1987A. These structures are probably
due to the emission from the progenitor star’s red supergiant wind. We find that the time it took the SN1987A progenitor to move to the current location 300 pc behind N157C is comparable to the lifetime of N157C as well as that of the progenitor itself.

Submitted to The Astrophysical Journal
For preprints, contact arlin@eureka.phys.columbia.edu

Erratum: Three-Dimensional Study of the ISM in front of SN1987A using Light Echoes

Jun Xu1, Arlin P. S. Crotts1 and William E. Kunkel2
1Department of Astronomy, Columbia University, New York, NY 10027 2Las Campanas Observatory, Casilla 601, La Serena, Chile

Unfortunately, an error appeared in the ordering of captions for four of the figures from Xu, Crotts and Kunkel 1995, ApJ, 451, 806. The caption for Figure 10 appears beneath Figure 7, the caption for Figure 7 beneath Figure 8, and the caption for Figure 8 beneath Figure 9. The three dimensional map of the interstellar medium in front of SN1987A appears in Figure 10 (Plate 11), unfortunately with the caption for Figure 9.

C+ Emission from the Magellanic Clouds
I. The bright HII region complexes N159 and N160

F.P.Israel1, P.R.Maloney2,3, N.Geis4, F.Hermann5, S.C.Madden5,2, A.Poglitsch5, G.J.Stacey4,6

1Sterrewacht Leiden, P.O. Box 9513, 2300 RA Leiden, the Netherlands
2NASA Ames Research Center, Moffett Field, CA 94035, USA
3Joint Institute for Laboratory Astrophysics, University of Colorado, Bouldor, CO 80309, USA
4Department of Physics, University of California, Berkeley, CA 94720, USA
5Max Planck Institut für extraterrestrische Physik, Garching bei München, Germany
6Department of Astronomy, Cornell University, Ithaca, NY 14853-6801

We have mapped the C[II] 158 micron line towards the bright LMC HII regions N160 and N159. Both HII region/molecular cloud complexes are associated with extended clouds of C+. Comparison with CO observations of similar resolution shows that in both complexes peak 158μm emission occurs at the interfaces of the HII region and the associated molecular clouds, while more diffuse extended 158μm emission covers the entire molecular cloud complexes.

Including the results on 30 Doradus, published elsewhere (Poglitsch et al. 1995) the ratio of C[II] to CO intensities differs from cloud to cloud over three orders of magnitude, presumably reflecting evolutionary differences in cloud structure. The ratio of 158μm to far-infrared intensities also shows some variation, but over a much smaller range. It is typically around one per cent and considerably higher than in Galactic Clouds and in most galactic nuclei. Thus, at least on spatial scales of tens of parsecs, the intensity of 158μm emission correlates reasonably well, but not perfectly, with the infrared continuum intensity and very poorly with the CO intensity.

The observed 158μm emission appears to be optically thin, implying minimum column densities $N_{HI}^{min} = 3 \times 10^{21}$ cm$^{-2}$. In contrast to Galactic objects, in three of the four clouds observed, the total
mass of the PDR-zone is a significant fraction of the total complex mass, although not to the extreme extent deduced for 30 Doradus.

The relative morphologies of C[II], CO and far-infrared emission, as well as derived properties such as the high PDR-to-molecular-mass ratios and the high photoelectric heating efficiencies characterizing the observed clouds, can be understood as the result of the lower metallicity and lower dust-to-gas ratio in the Large Magellanic Cloud relative to those in the Galaxy. This causes the cloud volume in which CO is abundant to shrink while simultaneously increasing the PDR volume; in addition it produces a lower mean UV radiation field in the PDR zone by increasing the UV photon mean free path lengths, resulting in greater geometric dilution of the radiation field.

Accepted by Astrophysical Journal
for preprints, contact israel@strw.LeidenUniv.nl

Hubble Space Telescope Observations of the Role of Planetary Nebulae in the Chemical Evolution of the Large Magellanic Cloud

M.A. Dopita

1 Mount Stromlo and Siding Spring Observatory, Institute of Advanced Studies, The Australian National University, Private Bag, Weston Creek P.O., ACT 2611, Australia

The latest Hubble Space Telescope results on the chemical evolution of Planetary Nebulae (PN) in the Large Magellanic Cloud (LMC) are given. It is shown that the results are consistent with the (mass-dependent) operation of the various chemical dredge-up processes predicted by theory. Dredge up of C appears to be most important during the thermal pulsing stage, and "hot bottom burning" transforms much of this C to N in the more massive stars. We show that the variation in the α-process element abundances can be understood as being due to the age: metallicity relationship for stars in general, and we derive, for the first time, the chemical history of the LMC using PN as tracers. There is clear evidence that a major burst of star formation occurred 2 Gyr ago, which almost doubled the base metallicity of the LMC.

For preprints, contact Michael.Dopita@anu.edu.au

Star Formation in the Large Magellanic Cloud. II. Evidence of an Old Intermediate-Age Burst of Stellar Activity

A. Vallenari, C. Chiosi, G. Bertelli, S. Ortolani

1 Astronomical Observatory of Padua, Vicolo Osservatorio 5, 35122 Padua, Italy
2 Department of Astronomy, Vicolo Osservatorio 5, 35122 Padua, Italy

In this paper, we present the BV-CCD photometry of three stellar fields in the Large Magellanic Cloud (LMC). The color-magnitude diagrams (CMD) and the luminosity functions (LF) are studied with the aim of reconstructing the past history of star formation. These fields are located outside the main body of the LMC. The existence of an enhancement in the star formation at ages as old as 6 – 8 Gyr is suggested by the observational data in the regions East of the Bar. In contrast, West of the center, in the direction of the SMC, the bulk of star formation appears to have occurred as recently as 2 – 3 Gyr ago. The past history of the star formation is discussed with particular attention to the possible dynamical interaction between the three galaxies LMC, SMC and Milky Way.
Star Formation in the Large Magellanic Cloud.
III. A study of the regions LMC-30, LMC-45 and LMC-61

A. Vallenari¹, C. Chiosi², G. Bertelli², A. Aparicio³, S. Ortolani²
¹Astronomical Observatory of Padua, Vicolo dell’Osservatorio 5, 35122 Padua, Italy
²Department of Astronomy, Vicolo dell’Osservatorio 5, 35122 Padua, Italy
³Instituto de Astrofísica de Canarias, La Laguna, Tenerife, Spain

In this paper, we present the BV-CCD photometry of three stellar fields of the Large Magellanic Cloud (LMC). They are taken at the center of V-charts of the Hodge & Wright (1967) catalog after which they are named. The fields under examination are LMC-30 (2°North-West of the Bar), LMC-45 (2°North of the Bar) and LMC-61 (3°North-East of the Bar). Their color-magnitude diagrams (CMD) and luminosity functions (LF) are studied using the R-method of Bertelli et al. (1992) with the aim of reconstructing the past history of star formation in these regions. We find that the bulk of star formation took place at different epochs in the three regions: about 2 Gyr ago in LMC-30, about 2.5 Gyr ago in LMC-45, and about 4 Gyr ago in LMC-61. These results are combined with those obtained by Bertelli et al. (1992) and Vallenari et al. (1995) for other areas of the LMC and a preliminary cartography of the star formation history across the LMC is attempted.

A radio continuum study of the Magellanic Clouds
Part IVa: Catalogue of radio sources in the Large Magellanic Cloud at 2.30 GHz (λ=13cm)

M. D. Filipović¹,², G. L. White¹, R. F. Haynes²,¹, P. A. Jones¹, D. Meinert³, R. Wielebinski⁴, U. Klein⁵
¹University of Western Sydney Nepean, P.O. Box 10, Kingswood, NSW 2747, Australia
²Australia Telescope National Facility, CSIRO Radiophysics, P.O. Box 76, Epping, NSW 2121 Australia
³Institut für Atmosphärenphysik, Max-Planck-Straße, D-21502 Geesthacht-Tescherhude, Germany
⁴Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-53121 Bonn, Germany
⁵Radioastronomisches Institut der Universität Bonn, Auf dem Hügel 71, D-53121 Bonn, Germany

We present a new catalogue of radio sources in the Large Magellanic Cloud based on observations at 2.30 GHz with the Parkes radio telescope. A total of 119 sources have been detected. We compare positions and flux densities of these sources with previously published radio results and find no significant positional displacement or flux discrepancies.

Submitted to Astronomy and Astrophysics Supplement
For preprints, contact fica@st.nepean.uws.edu.au