

# THE MAGELLANIC CLOUDS NEWSLETTER

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*An electronic exchange on Magellanic Clouds research*

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## Letter From The Editor

Dear Colleagues,

The Magellanic Clouds Working Group is pleased to bring you issue 79 of the Magellanic Clouds Newsletter. In this issue, we present 6 submitted abstracts, an announcement for an upcoming meeting on high energy sources in galaxies, an opportunity for students you may be working with, and a collection of recent astro-ph listings of potential interest to Magellanic Clouds researchers. As always, this month's issue is available from the MC News Website in a variety of formats (PDF, HTML, PostScript, and L<sup>A</sup>T<sub>E</sub>X).

Best Regards,  
Bryan Dunne  
Editor, MC News

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## UPCOMING MEETING QUICKLIST

205th American Astronomical Society Meeting  
9-13 January 2005

Populations of High-Energy Sources in Galaxies  
15-19 August 2005

# Abstracts of Refereed Papers

## Optical properties of SMC X-ray binaries

M.J.Coe, W.R.T.Edge, J.L.Galache and V.A.McBride

School of Physics & Astronomy, University of Southampton, UK

This work represent the first major study of the optical and IR characteristics of the mass donor companions to the X-ray pulsars in the Small Magellanic Cloud (SMC). In this work several new counterparts have been identified, and possible ones confirmed, as companions to X-ray pulsars in the SMC giving a total of 34 such objects now identified. In addition this work presents three new binary periods and confirms two X-ray periods using optical data for objects in this group. This homogeneous sample has been studied as a group to determine important general characteristics that may offer insight into the evolution of such systems. In particular, the spectral class distribution shows a much greater agreement with those of isolated Be stars, and appears to be in some disagreement with the galactic population of Be stars in Be/X-ray binaries. Studies of the long term optical modulation of the Be star companions reveal an extremely variable group of objects, a fact which will almost certainly make a major contribution to the pronounced X-ray variability. The spatial distribution of these systems within the SMC is investigated and strongly suggests a link between massive star formation and the HI density distribution. Finally, studies of the circumstellar disk characteristics reveal a strong link with optical variability offering important clues into the long-term stability of such disks.

**Comments:** Accepted for publication in MNRAS

**WWW:** [www.astro.soton.ac.uk/~mjc/oid.ps.gz](http://www.astro.soton.ac.uk/~mjc/oid.ps.gz)

**e-mail:** [mjcoe@soton.ac.uk](mailto:mjcoe@soton.ac.uk)

## Near infrared imaging observations of the N159/N160 complex in the LMC: Large clusters of Herbig Ae/Be stars and sequential cluster formation

Yasushi Nakajima (1), Daisuke Kato (2), Tetsuya Nagata (3), Motohide Tamura (1), Shuji Sato (2), Koji Sugitani (4), Chie Nagashima (2), Takahiro Nagayama (3), Ikuru Iwata (1), Yoshifusa Ita (5), Toshihiko Tanabe (6), Mikio Kurita (2), Hidehiko Nakaya (7) and Daisuke Baba (2)

(1) National Astronomical Observatory of Japan

(2) Department of Astrophysics, Nagoya University

(3) Department of Astronomy, Kyoto University

(4) Institute of Natural Sciences, Nagoya City University

(5) Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency

(6) Institute of Astronomy, The University of Tokyo

(7) Subaru Telescope, National Astronomical Observatory of Japan

We carried out deep near-infrared imaging observations of the N159/N160 complex star forming region in the Large Magellanic Cloud (LMC). We observed an area of  $\sim 380$  arcmin<sup>2</sup> ( $\sim 80,000$  pc<sup>2</sup> at the distance of the LMC) in the *J*, *H*, and *Ks* bands. The observations are deep enough to detect down to  $\sim 3 M_{\odot}$  Herbig Ae/Be stars in the LMC. We discovered a total of 338 and 464 candidates of Herbig Ae/Be and OB stars, respectively, based on the near-infrared colors and magnitudes. The Herbig Ae/Be star candidates constitute 10 clusters, while the OB star candidates 13. We discovered an embedded Herbig Ae/Be cluster in the N159E giant molecular cloud (GMC) and a Herbig Ae/Be cluster at a north-east tip of the N159S GMC. Together with neighboring two H II regions, the Herbig Ae/Be cluster at a tip of the N159S GMC indicates a hint of the beginning of sequential cluster formation in N159S. Spatial distributions of the Herbig Ae/Be and OB clusters, in conjunction with previously known optical clusters and embedded massive stars, indicate (1) sequential cluster formation within each of the N159 and N160 star forming regions, and (2) large scale sequential cluster formation over the entire observed region from N160 to N159S. Possible triggers for the large scale sequential cluster formation are a supergiant shell SGS19 and an expanding superbubble. Some Herbig Ae/Be clusters in the N159/N160 complex are significantly larger in spatial scale than pre-main sequence clusters of similar age in the Galaxy. Highly turbulent gas motion in the LMC is probably responsible for forming the large young clusters.

**Comments:** accepted by the Astronomical Journal

**WWW:** <http://optik2.mtk.nao.ac.jp/~yas/preprint/preprint0410.pdf>

**e-mail:** yas@optik.mtk.nao.ac.jp

## The ultraviolet and optical spectra of luminous B-type stars in the Small Magellanic Cloud

C. Evans (1), D. Lennon (1), N. Walborn (2), C. Trundle (1,3), S. Rix (1)

(1) Isaac Newton Group of Telescopes, La Palma, Spain

(2) Space Telescope Science Institute, Baltimore, MD

(3) Queen's University of Belfast, N. Ireland

We present ultraviolet spectra from the Space Telescope Imaging Spectrograph (STIS) of 12 early B-type stars in the Small Magellanic Cloud (SMC), comprising 9 supergiants and 3 giants. A morphological comparison with Galactic analogues is made using archival data from the *International Ultraviolet Explorer (IUE)*. In general, the intensity of the P Cygni emission in the UV resonance lines is greater, and seen to later spectral types, in the Galactic spectra than in their metal-deficient SMC counterparts; we attribute these effects as most likely arising from weaker stellar winds in the SMC targets, as predicted by radiatively driven wind theory. We also include unpublished STIS observations of two late O-type stars in the SMC. In combination with the B-type observations, and published O-type data, we now have an extensive ultraviolet spectral library of metal-deficient stars, of use in the study of unresolved starbursts and high redshift, star-forming galaxies. In this context, we present empirical measurements for the B-type spectra of the new '1978 index' suggested by Rix

et al. as a probe of metallicity in such systems.

**Comments:** Accepted by PASP

**WWW:** <http://www.ing.iac.es/~cje/bstars.ps.gz>

**e-mail:** [cje@ing.iac.es](mailto:cje@ing.iac.es)

## Surface Brightness and Stellar Populations at the Outer Edge of the Large Magellanic Cloud: No Stellar Halo Yet

C. Gallart (1), P.B. Stetson (2), E. Hardy (3), F. Pont (5) and R. Zinn (5)

(1) Instituto de Astrofísica de Canarias, Canary Islands. Spain

(2) Dominion Astrophysical Observatory, Herzberg Institute of Astrophysics, Victoria, BC, Canada

(3) National Radio Astronomy Observatory and Astronomy Dept. Universidad de Chile Santiago, Chile

(4) Observatoire de Genève, Sauverny, Switzerland

(5) Department of Astronomy, Yale University, New Haven, CT, USA

We present a high quality CMD for a  $36' \times 36'$  field located 8 degrees ( $\simeq 7$  kpc) from the LMC center, as well as a precise determination of the LMC surface brightness derived from the resolved stellar population out to this large galactocentric radius. This deep CMD shows for the first time the detailed age distribution at this position, where the surface brightness is  $V \simeq 26.5$  mag/"<sup>2</sup>. At a radius  $R \simeq 474'$  the main sequence is well populated from the oldest turnoff at  $I \simeq 21.5$  to the 2.5 Gyr turnoff at  $I \simeq 19.5$ . Beyond this radius, a relatively strong gradient in the density of stars with ages in the  $\simeq 2.5$ –4 Gyr range is apparent. There are some stars brighter and bluer than the main population, quite uniformly distributed over the whole area surveyed, which are well matched by a 1.5 Gyr isochrone and may be indicative of a relatively recent star formation, or merger, event. The surface brightness profile of the LMC remains exponential to this large galactocentric radius and shows no evidence of disk truncation. Combining the information on surface brightness and stellar population we conclude that the LMC disk extends (and dominates over a possible stellar halo) out to a distance of at least 7 kpc. These results confirm that the absence of blue stars in the relatively shallow off-center CMDs of dIrr galaxies is not necessarily evidence for an exclusively old stellar population resembling the halo of the Milky Way.

**Comments:** Accepted by: ApJ Letters: ApJ, 614, L109

**WWW:** <http://xxx.lanl.gov/abs/astro-ph/0409023>

**e-mail:** [carme@iac.es](mailto:carme@iac.es)

# Forty eclipsing binaries in the Small Magellanic Cloud: fundamental parameters and Cloud distance.

R.W.Hilditch (1), I.D.Howarth (2), and T.J.Harries (3)

(1) University of St Andrews, Scotland

(2) University College, London, England

(3) University of Exeter, England

We have conducted a programme to determine the fundamental parameters of a substantial number of eclipsing binaries of spectral types O and B in the Small Magellanic Cloud. New spectroscopic data, obtained with the two-degree-field multi-object spectrograph on the 3.9-m Anglo-Australian Telescope, have been used in conjunction with photometry from the Optical Gravitational Lens Experiment (OGLE-II) database of SMC eclipsing binaries. Previously we reported results for 10 systems; in this second and concluding paper we present spectral types, masses, radii, temperatures, surface gravities and luminosities for the components of a further 40 binaries. The full sample of 50 OB-type eclipsing systems is the largest single set of fundamental parameters determined for high-mass binaries in any galaxy. We find that 21 of the systems are in detached configurations, 28 are in semi-detached post-mass-transfer states, and one is a contact binary. Each system provides a primary distance indicator. We find a mean distance modulus to the SMC of  $18.91 \pm 0.03 \pm 0.1$  (internal and external uncertainties;  $D=60.6 \pm 1.0$  kpc). This value represents one of the most precise available determinations of the distance to the SMC.

**Comments:** paper accepted on 22 November 2004 for publication in MNRAS.

**WWW:** astro-ph/0411672

**e-mail:** rwh@st-andrews.ac.uk

## Evolutionary Stellar Population Synthesis at High Spectral Resolution: Optical Wavelengths.

R. González Delgado (1), M. Cerviño (1), L. Martins (2), C. Leitherer (2), and P.H. Hauschildt (3)

(1) Instituto de Astrofísica de Andalucía, Granada, Spain

(2) Space Telescope Science Institute, Baltimore, MD, USA

(3) Hamburger Sternwarte, Hamburg, Germany

We present the single stellar population (SSP) synthesis results of our new synthetic stellar atmosphere models library with a spectral sampling of 0.3 Å, covering the wavelength range from 3000 Å to 7000 Å for a wide range of metallicities (twice solar, solar, half and 1/10 solar). The stellar library is composed of 1650 spectra computed with the latest improvements in stellar atmospheres. In particular it incorporates non-LTE line-blanketed models for hot ( $T_{\text{eff}} \geq 27500$  K) and LTE line-blanketed models (Phoenix) for cool ( $3000 \text{ K} \leq T_{\text{eff}} \leq 4500 \text{ K}$ ) stars. Because of the high spectral resolution of this library, evolutionary synthesis models can be used to predict the strength of numerous weak absorption lines, and the evolution of the profiles of the strongest lines over a wide range of ages. The

SSP results have been calculated for ages 1 Myr to 17 Gyr using the stellar evolutionary provided by the Geneva and Padova-tracks groups. For young stellar populations, our results have a very detailed coverage of high-temperature stars with similar results for Padova and Geneva isochrones. For intermediate and old stellar populations, our results, once degraded to a lower resolution, are similar to the ones obtained by other groups apart from limitations imposed by the stellar evolutionary physics. The limitations and advantages of our library for the analysis of integrated populations are described. The full set of the stellar library and the evolutionary models are available here for retrieval or on request from authors.

**Comments:** Accepted by: M.N.R.A.S. **WWW:** <http://www.iaa.es/~rosa/>  
**e-mail:** [rosa@iaa.es](mailto:rosa@iaa.es), [mcs@iaa.es](mailto:mcs@iaa.es)

## Meeting Announcements

### IAU Symposium No.230: 1st Announcement

At its meeting in Mexico City on 25 May 2004, the Executive Committee of the International Astronomical Union accepted the proposal for an IAU Symposium on "Populations of High-Energy Sources in Galaxies", to be held 15-19 August 2005 in Dublin, Ireland. This will be IAU Symposium No. 230. The venue will be Dublin Castle, in the centre of town.

With currently operational high-energy satellite observatories the potential for conducting detailed studies of individual sources of high-energy radiation in other galaxies as well as in our own Milky Way has greatly increased.

The primary objectives for this Symposium are:

- Overview of key source categories in our Galaxy (X-ray and gamma-ray, the latter notably referring to INTEGRAL results)
- Review of the results on individual high-energy sources in galaxies that have been obtained with Chandra and XMM-Newton
- Derivation of global descriptions of high-energy source populations in galaxies
- Assessment of the evolutionary status of stellar populations, derived from the X-ray investigations
- Discussion of the high-redshift context of the source populations

Information on IAU Symposium number 230 is available via <http://www.dunsink.dias.ie/IAUS230/index.html>

The Scientific Organizing Committee is composed of: E.J.A. Meurs (Ireland, Chair), G. Fabbiano (USA, Co-Chair), L. Bassani (Italy), B. McBreen (Ireland), H.-Y. Chu (USA), C. Done (UK), G. Hasinger (Germany), G. Koenigsberger (Mexico), K. Koyama (Japan), V. Lipunov (Russia), M. Mas-Hesse (Spain), Th. Montmerle (France), G. Romero (Argentina), Z. Wang (China).

The Local Organizing Committee consists of: B. McBreen (Chair), C. del Burgo, C. Handley, L. Norci, C. Melody, C. Woods.

The anticipated time timetable is:

October 2004 : 1st Announcement  
15 December 2004 : deadline for pre-registration  
January 2005 : 2nd Announcement  
April 2005 : Final Announcement  
1 June 2005 : Registration Deadline  
15 August 2005 : Symposium programme starts

The purpose of the pre-registration is to gauge the interest in this Symposium, so as to assist SOC and LOC with their organization. The 2nd Announcement will contain the call for registration, information about hotel reservations, abstract submission, posters, proceedings, IAU travel grants, invited speakers and sponsorship.

Please circulate this 1st Announcement in your Institute or University Department and to colleagues elsewhere that may be interested. We try to avoid this notice being sent more than once to you, but occasionally your e-mail address might occur in more than one of our mailing lists.

With best regards,  
Evert Meurs and Pepi Fabbiano (SOC Co-Chairs)  
Brian McBreen (LOC Chair)

## **Student Opportunity**

### **Invitation for PhD Program Applications**

The recently founded International Max-Planck Research School for Astronomy and Cosmic Physics (IMPRS) at the University of Heidelberg invites applications for its Ph.D. program.

The school is located in Heidelberg (Germany) which is one of the most beautiful old university towns in Europe. We offer outstanding research and training opportunities with excellent instrumental, observational, and theoretical research facilities at five first-rate institutes, namely

- the Max-Planck Institute for Astronomy (MPIA),
- the Max-Planck Institute for Nuclear Physics (MPIK),
- the Institute for Theoretical Astrophysics (ITA),
- the Astronomisches Recheninstitut (I.f. Astronomical Computing, ARI),
- the Landessternwarte (State Observatory) Heidelberg (LSW).

The main research topics at these five institutions are: Planet and star formation - extrasolar planets and substellar objects - astrometry - formation, evolution and dynamics of galaxies - active galactic nuclei and massive black holes - gravitational lensing - cosmology and structure formation - high energy astrophysics, cosmic rays and the search for non-baryonic dark matter - state-of-the-art instrumentation for astronomy and astroparticle physics.

IMPRS for Astronomy and Cosmic Physics at the University of Heidelberg has established a comprehensive curriculum including regular lectures, seminars, invited guest lectures, and advanced summer schools. Ph.D. research projects will be defined and supervised by scientists at one of the participating institutes.

IMPRS Heidelberg is open for students from all countries and offers several 3-year Ph.D. fellowships for both international and national students. Interested students are invited to apply by 15 January 2005 for the academic year starting in September 2005. In general, applicants should have a Masters or Diploma in Physics or Astronomy (or equivalent) including a corresponding thesis. Successful applicants will receive financial support through a PhD fellowship.

For further details on IMPRS Heidelberg and the application procedure, we refer to our web-site at <http://www.mpia-hd.mpg.de/imprs-hd/>

Under /poster2.html you will also find a poster of IMPRS Heidelberg. We would be happy if you further distribute it among other colleagues and interested students. Thank you in advance for your support.

With kind regards,

Christian Fendt  
Coordinating Scientist

International Max Planck School for Astronomy and Cosmic Physics at the University of Heidelberg

## Recent astro-ph Listings

astro-ph/0412389

**Title:** Spectroscopy of Red Giants in the LMC Bar: Abundances, Kinematics, and the Age-Metallicity Relation

**Authors:** Andrew A. Cole (1), E. Tolstoy (1), J.S. Gallagher III (2), T.A. Smecker-Hane (3) ((1) Kapteyn Institute, (2) U. Wisconsin-Madison, (3) U. California, Irvine)

**Comments:** Accepted for publication in AJ; 54 pages, 14 figures (3 color), 5 tables

astro-ph/0412367

**Title:** B-type Supergiants in the SMC: Chemical compositions and comparison of static and unified models

**Authors:** P.L. Dufton, R.S.I. Ryans, C. Trundle, D.J. Lennon, I. Hubeny, T. Lanz, C. Allende Prieto

**Comments:** Submitted to astronomy and astrophysics

astro-ph/0412318

**Title:** Formation and evolution of the Magellanic Clouds. I. Origin of structural, kinematical, and chemical properties of the Large Magellanic Cloud

**Authors:** K. Bekki, M. Chiba

**Comments:** 26 pages, 26 figures, MNRAS in press (For clearer figures: See jpeg figures for fig5, 6, 7, 11, and 22)

astro-ph/0412312

**Title:** The gravitational and hydrodynamical interaction between the LMC and the Galaxy

**Authors:** Chiara Mastropietro (1), Ben Moore (1), Lucio Mayer (1), James Wadsley (2), Joachim Stadel (1) ((1) University of Zurich, (2) McMaster University)

**Comments:** 12 pages, 15 figures. Submitted to MNRAS. Movies and high resolution images are available at this <http> URL Corrected typos

astro-ph/0411672

**Title:** Forty eclipsing binaries in the Small Magellanic Cloud: fundamental parameters and Cloud distance

**Authors:** R. W. Hilditch, I. D. Howarth, T. J. Harries

**Comments:** paper accepted on 22 November 2004 for publication by MNRAS; 26 pages, 6 tables, 12 figures

astro-ph/0411631

**Title:** Space telescope Imaging Spectrograph ultraviolet spectra of LMC planetary nebulae. A study of carbon abundances and stellar evolution

**Authors:** L. Stanghellini, R. A. Shaw, D. Gilmore

**Comments:** Ap. J., in press

astro-ph/0411453

**Title:** The Parkes HI Survey of the Magellanic System

**Authors:** C. Bruens (1), J. Kerp (1), L. Staveley-Smith (2), U. Mebold (1), M.E. Putman (3), R.F. Haynes (2), P.M.W. Kalberla (1), E. Muller (4), M.D. Filipovic (2 and 5) ((1) Radioastronomisches Institut, University of Bonn, (2) Australia Telescope National Facility, CSIRO, (3) Department of Astronomy, University of Michigan, (5) University of Western Sydney)

**Comments:** 23 pages, 18 figures, accepted for publication in A&A

astro-ph/0411448

**Title:** The Initial Mass Function toward the low-mass end in the Large Magellanic Cloud with HST/WFPC2 Observations

**Authors:** D. Gouliermis, W. Brandner, Th. Henning

**Comments:** 16 pages, 11 figures, Submitted to ApJ

astro-ph/0411203

**Title:** Cepheid Period-Luminosity Relations: Galactic vs. LMC and the Results from t-Test

**Authors:** C. Ngeow (UMASS), S. Kanbur (UMASS)

**Comments:** 4 pages, 2 figures, submitted to the "Gaia: Three Dimension Universe", will be published by ESA

astro-ph/0411201

**Title:** Discovery of an OH(1720 MHz) Maser in the LMC

**Authors:** D.A. Roberts, F. Yusef-Zadeh

**Comments:** 11 pages, two figures, AJ, in press

astro-ph/0410708

**Title:** Spitzer IRAC Observations of Star Formation in N159 in the LMC

**Authors:** Terry J. Jones, Charles E. Woodward, Martha L. Boyer, Robert D. Gehrz, Elisha Polomski

**Comments:** 14 figures

astro-ph/0410683

**Title:** A 4.8- and 8.6-GHz Survey of the Large Magellanic Cloud: I The Images

**Authors:** J. R. Dickel (1), V. J. McIntyre (2), R. A. Gruendl (1), D. K. Milne (2) ((1) UIUC and (2) CSIRO/ATNF)

**Comments:** 28 pages, 10 figures, 2 tables, accepted for publication in the Feb 2005 AJ

astro-ph/0410539

**Title:** Phase-dependent changes in the wind lines in the HMXRB's SMC X-1 and 4U1700-37

**Authors:** R.C. Iping (1), G. Sonneborn (1), L. Kaper (2), G. Hammerschlag-Hensberge (2) ((1) NASA's GSFC, (2) University of Amsterdam)

**Comments:** 3 pages, 3 figures

astro-ph/0410495

**Title:** Phase Variation in the Pulse Profile of SMC X-1

**Authors:** J. Neilsen (1 and 2), R.C. Hickox (2), S.D. Vrtilik (2) ((1) Kenyon College, (2) Harvard-Smithsonian Center for Astrophysics)

**Comments:** 4 pages, 4 figures, accepted for publication in ApJL; v2 minor corrections, as will appear in ApJL

astro-ph/0410398

**Title:** Long Period Variables in the LMC: Results from MACHO and 2MASS

**Authors:** Oliver J. Fraser, Suzanne L. Hawley, Kem H. Cook, Stefan C. Keller

astro-ph/0410393

**Title:** Eclipsing Binaries in the Young LMC Cluster NGC 1850

**Authors:** Stuart F. Taylor

**Comments:** 27 pages, 11 figures; Accepted for publication in December 2004 PASP. (No changes in paper from original submitted version; only this comment reflecting acceptance by the Proceedings of the Astronomical Society of the Pacific has been added.)

astro-ph/0410318

**Title:** Chemical compositions of Four B-type Supergiants in the SMC Wing

**Authors:** J.-K. Lee, W.R.J. Rolleston, P.L. Dufton, R.S.I. Ryan

**Comments:** 11 pages, 2 figures, A&A accepted

astro-ph/0410271

**Title:** An Unbiased Far Ultraviolet Survey of Magellanic Cloud Supernova Remnants

**Authors:** Parviz Ghavamian, William P. Blair, Ravi Sankrit, Charles Danforth, Kenneth Sembach

**Comments:** 3 pages, 4 figures, to appear in Astrophysics in the Far Ultraviolet: Five Years of Discovery with FUSE, ASP Conf. series, eds. G. Sonneborn, W. Moos & B.-G. Andersson

astro-ph/0410227

**Title:** Third Dredge-up in Low Mass Stars: Solving the LMC Carbon Star Mystery

**Authors:** Richard J. Stancliffe (1), Robert G. Izzard (2), Christopher A. Tout (1) ((1) Institute of Astronomy, Cambridge, (2) CIQuA)

**Comments:** 6 pages, 5 figures. Accepted for publication in MNRAS

astro-ph/0410093

**Title:** NLTE Model Atmosphere Analysis of the LMC Supersoft X-ray Source CAL 83

**Authors:** Thierry Lanz, Gisela A. Telis, Marc Audard, Frits Paerels, Andrew P. Rasmussen, Ivan Hubeny

**Comments:** 32 pages; 7 figures; accepted for publication in the Astrophysical Journal (2005 January 20 issue)

astro-ph/0410074

**Title:** Optical properties of SMC X-ray binaries

**Authors:** M.J.Coe, W.R.T.Edge, J.L.Galache, V.A.McBride (Southampton University)

**Comments:** 15 pages, 11 figures, accepted for publication in MNRAS. A gzipped PS version of this paper with higher resolution figures is available from this <http> URL