$\mathcal{SCYON}$

The Star Clusters Young & Old Newsletter

edited by Holger Baumgardt and Ernst Paunzen

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EDITORIAL

This is the 54th issue of the SCYON newsletter. Todays issue contains 14 abstracts from refereed publications and conference proceedings and a summary of Xiaoying Pang's PhD thesis on the stellar mass function and mass segregation in NGC 3603. We also have conference announcements for a Saas-Fee winter school on star clusters in March, a workshop on young star clusters in Italy in July this year, the MODEST 12 workshop in Kobe in August 2012 and IAU Symposium 239 on cosmic distance scales also in August 2012. We finally have a job offer for a postdoctoral position at the Pontificia Universidad Catolica de Chile.

As usual, we would like to thank all who sent us their contributions.

Holger Baumgardt and Ernst Paunzen

CONTENTS

SCYON POLICY

The SCYON Newsletter publishes abstracts from any area in astronomy which are relevant to research on star clusters. We welcome all contributions. Topics to be covered include

1. Abstracts from refereed articles
2. Abstracts from conference proceedings
3. PhD summaries
4. General announcements : Conferences, new databases, and the likes.

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SCYON will be published initially once every two months. If the number of contributions justifies monthly installments, we will move toward more frequent issues in order to keep the newsletter relatively short, manageable for us, and up-to-date.

Conference and journal abstracts can be submitted at any time either by web download, or failing this, we also accept abstracts typeset using the latest latex abstract template (available from the SCYON webpage). We much prefer contributors to use the direct download form, since it is mostly automated. Abstracts will normally appear on the website as soon as they are submitted to us. Other contributions, such as PhD summaries, should be sent to us using the LaTeX template. *Please do not submit postscript files, nor encoded abstracts as e-mail attachments.*

All abstracts/contributions will be processed, but we reserve the right to not post abstracts submitted in the wrong format or which do not compile. If you experience any sort of problems accessing the web site, or with the LaTeX template, please write to us at scyon@univie.ac.at.

A "Call for abstracts" is sent out approximately one week before the next issue of the newsletter is finalised. This call contains the deadline for abstract submissions for that coming issue and the LaTeX abstract template.

Depending on circumstances, the editors might actively solicit contributions, usually those spotted on a preprint server, but they do not publish abstracts without the author's consent.

We implicitly encourage further dissemination of the letter to institutes and astronomers who may benefit from it.

The editors

SCYON Mirrors

The official Scyon mirror site in Australia is hosted at the Centre for Astrophysics & Supercomputing of the University of Swinburne by Duncan Forbes and his team :

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1. Star Forming Regions

The clustered nature of star formation. Pre–main-sequence clusters in the star-forming region NGC 602/N90 in the Small Magellanic Cloud

Dimitrios A. Gouliermis ([1,2]), Stefan Schmeja ([3]), Andrew E. Dolphin ([4]), Mario Gennaro ([1]), Emanuele Tognelli ([5,6]), Pier Giorgio Prada Moroni ([5,6])

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Located at the tip of the wing of the Small Magellanic Cloud (SMC), the star-forming region NGC602/N90 is characterized by the HII nebular ring N90 and the young cluster of pre–main-sequence (PMS) and early-type main sequence stars NGC602. We present a thorough cluster analysis of the stellar sample identified with HST/ACS camera in the region. We show that apart from the central cluster, low-mass PMS stars are congregated in thirteen additional small compact sub-clusters at the periphery of NGC602. We find that the spatial distribution of the PMS stars is bimodal, with an unusually large fraction (60%) of the total population being clustered, while the remaining is diffusely distributed in the inter-cluster area. From the corresponding color-magnitude diagrams we disentangle an age-difference of $\sim$ 2.5 Myr between NGC602 and the compact sub-clusters which appear younger. The diffuse PMS population appears to host stars as old as those in NGC602. Almost all detected PMS sub-clusters appear to be centrally concentrated. When the complete PMS stellar sample, including both clustered and diffused stars, is considered in our cluster analysis, it appears as a single centrally concentrated stellar agglomeration, covering the whole central area of the region. Considering also the hot massive stars of the system, we find evidence that this agglomeration is hierarchically structured. Based on our findings we propose a scenario, according to which the region NGC602/N90 experiences an active clustered star formation for the last $\sim$ 5 Myr. The central cluster NGC602 was formed first and rapidly started dissolving into its immediate ambient environment, possibly ejecting also massive stars found away from its center. Star formation continued in sub-clusters of a larger stellar agglomeration, introducing an age-spread of the order of 2.5 Myr among the PMS populations.

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Also available from the URL http://arxiv.org/abs/1201.3081
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Strongly star forming galaxies in the local universe with nebular He II 4686 emission

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We present a sample of 2865 emission line galaxies with strong nebular He II 4686 emissions in Sloan Digital Sky Survey Data Release 7 and use this sample to investigate the origin of this line in star-forming galaxies. We show that star-forming galaxies and galaxies dominated by an active galactic nucleus form clearly separated branches in the He II 4686/Hbeta versus [N II] 6584/Halpha diagnostic diagram and derive an empirical classification scheme which separates the two classes. We also present an analysis of the physical properties of 189 star forming galaxies with strong He II 4686 emissions. These star-forming galaxies provide constraints on the hard ionizing continuum of massive stars. To make a quantitative comparison with observation we use photoionization models and examine how different stellar population models affect the predicted He II 4686 emission. We confirm previous findings that the models can predict He II 4686 emission only for instantaneous bursts of 20% solar metallicity or higher, and only for ages of $\sim$ 4 - 5 Myr, the period when the extreme-ultraviolet continuum is dominated by emission from Wolf-Rayet stars. We find however that 83 of the star-forming galaxies (40%) in our sample do not have Wolf-Rayet features in their spectra despite showing strong nebular He II 4686 emission. We discuss possible reasons for this and possible mechanisms for the He II 4686 emission in these galaxies.

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2. Galactic Open Clusters

Unveiling hidden properties of young star clusters: differential reddening, star-formation spread and binary fraction

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We present a semi-analytical approach that, applied to the Hess diagram of a young star cluster, is able to retrieve the values of mass, age, star-formation spread, distance modulus, foreground and differential reddening, and binary fraction. The global optimisation method known as adaptive simulated annealing (ASA) is used to minimise the residuals between the observed and simulated Hess diagrams of a star cluster. The simulations are realistic and take the most relevant parameters of young clusters into account. Important features of the simulations are: a normal (Gaussian) differential reddening distribution, a time-decreasing star-formation rate, the unresolved binaries, and the smearing effect produced by photometric uncertainties on Hess diagrams. Free parameters are: cluster mass, age, distance modulus, star-formation spread, foreground and differential reddening, and binary fraction. Even for low-mass star clusters, our approach is sensitive to the values of cluster mass, age, distance modulus, star-formation spread, foreground and differential reddening and, to a lesser degree, binary fraction. Compared with simpler approaches, the inclusion of binaries, a decaying star-formation rate and a normally distributed differential reddening, appear to yield more constrained parameters, especially the mass, age and distance from the Sun.

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Discovery of the Host Cluster for the Fundamental Cepheid Calibrator Zeta Gem

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New and existing CORAVEL, UBVJHKs, HST, HIP/Tycho, ARO, KPNO, and DAO observations imply that the fundamental Cepheid calibrator Zeta Gem is a cluster member. The following parameters were inferred for Zeta Gem from cluster membership and are tied to new spectral classifications (DAO) established for 26 nearby stars (e.g., HD53588/B7.5IV, HD54692/B9.5IV): E(B-V)=0.02+-0.02, log t=7.85+-0.15, and d=355+-15 pc. The mean distance to Zeta Gem from cluster membership and six recent estimates (e.g., IRSB) is d=363+-9(se)+-26(sd) pc. The results presented here support the color-excess and HST parallax derived for the Cepheid by Benedict et al. (2007). Forthcoming precise proper motions (DASCH) and Chandra/XMM-Newton observations of the broader field may be employed to identify cluster members, bolster the cluster's existence, and provide stronger constraints on the Cepheid's fundamental parameters.

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Strengthening the Open Cluster Distance Scale via VVV Photometry

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Approximately 14% of known Galactic open clusters possess absolute errors $< 20\%$ as evaluated from $n > 3$ independent distance estimates, and the statistics for age estimates are markedly worse. That impedes such diverse efforts as calibrating standard candles and constraining masses for substellar companions. New data from the VVV survey may be employed to establish precise cluster distances with comparatively reduced uncertainties ($< 10\%$). This is illustrated by deriving parameters for Pismis 19 and NGC 4349, two pertinent open clusters which hitherto feature sizable uncertainties (60%). Fundamental parameters determined for Pismis 19 from new VVV JHKs photometry are d=2.40+-0.15 kpc, $< E(J-H) >= 0.34 \pm 0.04$, and log(t)=9.05+-0.10, whereas for NGC 4349 the analysis yielded d=1.63+-0.13 kpc, E(J-H)=0.09+-0.02, log(t)=8.55+-0.10. The results exhibit a significant ($> 5x$) reduction in uncertainties, and indicate that: i) existing parameters for the substellar object NGC 4349 127b require revision, in part because the new cluster parameters imply that the host is 20% less-massive (M*/Ms $\sim$ 3.1); ii) R Cru is not a member of NGC 4349 and should be excluded from period-Wesenheit calibrations that anchor the distance scale; iii) and results for Pismis 19 underscore the advantages gleaned from employing deep VVV JHKs data to examine obscured (Av$\sim$ 4) and differentially reddened intermediate-age clusters.

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A Cluster of Class I/f/II YSOs Discovered Near the Cepheid SU Cas

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Preliminary constraints are placed on a cluster of YSOs (J2000 02:54:31.4 +69:20:32.5) discovered in the field of the classical Cepheid SU Cas. WISE 3.4, 4.6, 12, and 22 um images reveal that the cluster deviates from spherical symmetry and exhibits an apparent diameter of 3x6'. SEDs constructed using 2MASS Ks (2.2 um) and WISE photometry indicate that 19 (36%) class I, 21 (40%) class f, and 13 (25%) class II objects lie $r < 3$' from the cluster center. Conversely, 11 (18%) class I, 13 (21%) class f, and 37 (61%) class II objects were detected for $r > 3$'. Approximately 50% of the class I sources within $r < 3$' were classified solely using WISE photometry owing to the absence of detections by 2MASS.

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The Color-Magnitude Diagram of NGC 2264

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Existing photometry for NGC 2264 tied to the Johnson and Morgan (1953) UBV system is re-examined and, in the case of the original observations by Walker (1956), reanalyzed in order to generate a homogeneous data set for cluster stars. Color terms and a Balmer discontinuity effect in Walker's observations were detected and corrected, and the homogenized data were used in a new assessment of the cluster reddening, distance, and age. Average values of E(B-V)=0.075+-0.003 s.e. and $V_0 - M_V = 9.45 \pm 0.03$ s.e. (d=777+-12 pc) are obtained, in conjunction with an inferred cluster age of $\sim 5.5 \cdot 10^6$ yr from pre-main-sequence members and the location of the evolved, luminous, O7 V((f)) dwarf S Mon relative to the ZAMS. The cluster main sequence also contains gaps that may have a dynamical origin. The dust responsible for the initial reddening towards NGC 2264 is no more than 465 pc distant, and there are numerous, reddened and unreddened, late-type stars along the line of sight that are difficult to separate from cluster members by standard techniques, except for a small subset of stars on the far side of the cluster embedded in its gas and dust and background B-type ZAMS members of Mon OB2. A compilation of likely NGC 2264 members is presented. Only 3 of the 4 stars recently examined by asteroseismology appear to be likely cluster members. NGC 2264 is also noted to be a double cluster, which has not been mentioned previously in the literature.

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Alessi 95 and the Short Period Cepheid SU Cassiopeiae

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The parameters for the newly-discovered open cluster Alessi 95 are established on the basis of available photometric and spectroscopic data, in conjunction with new observations. Colour excesses for spectroscopically-observed B and A-type stars near SU Cas follow a reddening relation described by $E_{U-B}/E_{B-V} = 0.83 + 0.02E_{B-V}$, implying a value of $R = A_V/E_{B-V} \simeq 2.8$ for the associated dust. Alessi 95 has a mean reddening of $E_{B-V}(\mathrm{B0}) = 0.35 \pm 0.02$ s.e., an intrinsic distance modulus of $V_0 - M_V = 8.16 \pm 0.04$ s.e. (± 0.21 s.d.), $d = 429 \pm 8$ pc, and an estimated age of $10^{8.2}$ yr, from ZAMS fitting of available *UBV*, CCD *BV*, *NOMAD*, and 2MASS JHK_s observations of cluster stars. SU Cas is a likely cluster member, with an inferred space reddening of $E_{B-V} = 0.335 \pm 0.02$ and a luminosity of $\langle M_V \rangle = -3.15 \pm 0.07$ s.e., consistent with overtone pulsation, as also implied by the Cepheid's light curve parameters, rate of period increase, and *Hipparcos* parallaxes for cluster stars. There is excellent agreement of the distance estimates for SU Cas inferred from cluster ZAMS fitting, the infrared surface brightness technique, and *Hipparcos* parallaxes, which all agree to within a few percent.

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3. Galactic Globular Clusters

Evidence for top-heavy stellar initial mass functions with increasing density and decreasing metallicity

M. Marks ([1,2,3]), P. Kroupa ([1]), J. Dabringhausen ([1]), M.S. Pawlowski ([1])
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Residual-gas expulsion after cluster formation has recently been shown to leave an imprint in the low-mass present-day stellar mass function (PDMF) which allowed the estimation of birth conditions of some Galactic globular clusters (GCs) such as mass, radius and star formation efficiency. We show that in order to explain their characteristics (masses, radii, metallicity, PDMF) their stellar initial mass function (IMF) must have been top-heavy. It is found that the IMF is required to become more top-heavy the lower the cluster metallicity and the larger the pre-GC cloud-core density are. The deduced trends are in qualitative agreement with theoretical expectation. The results are consistent with estimates of the shape of the high-mass end of the IMF in the Arches cluster, Westerlund 1, R136 and NGC 3603, as well as with the IMF independently constrained for ultra-compact dwarf galaxies (UCDs). The latter suggests that GCs and UCDs might have formed along the same channel or that UCDs formed via mergers of GCs. A fundamental plane is found which describes the variation of the IMF with density and metallicity of the pre-GC cloud-cores simultaneously. The implications for the evolution of galaxies and chemical enrichment over cosmological times are expected to be major.

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4. Galactic Center Clusters

The present-day mass function of the Quintuplet cluster based on proper motion membership

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Context: The stellar mass function is a probe for a potential dependence of star formation on the environment. Only a few young clusters are known to reside within the central molecular zone and can serve as testbeds for star formation under the extreme conditions in this region. Aims: We determine the present-day mass function of the Quintuplet cluster, a young massive cluster in the vicinity of the Galactic centre. Methods: We use two epochs of high resolution near infrared imaging data obtained with NAOS/CONICA at the ESO VLT to measure the individual proper motions of stars in the Quintuplet cluster in the cluster reference frame. An unbiased sample of cluster members within a radius of 0.5 pc from the cluster centre was established based on their common motion with respect to the field and a subsequent colour-cut. Initial stellar masses were inferred from four isochrones covering ages from 3 to 5 Myr and two sets of stellar evolution models. For each isochrone, the present-day mass function of stars was determined for the full sample of main sequence cluster members using an equal number binning scheme. Results: We find the slope of the present-day mass function in the central part of the Quintuplet cluster to be $\alpha = -1.68^{+0.13}_{-0.09}$ for an approximate mass range from 5 to 40 $M_{\odot}$, which is significantly flatter than the Salpeter slope of $\alpha = -2.35$. The flattening of the present-day mass function may be caused by rapid dynamical evolution of the cluster in the strong Galactic centre tidal field. The derived mass function slope is compared to the values found in other young massive clusters in the Galaxy.

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5. Extragalactic Clusters

A kinematic study of the giant star-forming region 30 Doradus

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We present, for the first time, an optical spectroscopic data cube of the giant star-forming region 30 Doradus, obtained with the GIRAFFE on the VLT at Paranal Observatory. The main emission lines present in this data cube correspond to Halpha, [NII] 6548 A and [NII] 6584 A. By using this data set, we found that Halpha presents from simple to multiple profiles, which suggests that different physical mechanisms act in different ways on the excited gas in 30 Doradus. We found, at least, three unclassified large expanding structures. These structures correlate with peaks in the X-ray distribution. Given the excellent signal-to-noise ratio and the large spatial coverage of this data cube, we have studied in detail the kinematics of 30 Doradus, showing the importance of the small scale phenomena on the integrated properties of 30 Doradus.

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6. Dynamical evolution - Simulations

Simulations of the Hyades

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Context: Using the recent observational data of Röser et al. we present N-body simulations of the Hyades open cluster. Aims: We make an attempt to determine initial conditions of the Hyades cluster at the time of its formation in order to reproduce the present-day cumulative mass profile, stellar mass and luminosity function (LF). Methods: We performed direct N-body simulations of the Hyades in an analytic Milky Way potential that account for stellar evolution and include primordial binaries in a few models. Furthermore, we applied a Kroupa (2001) IMF and used extensive ensemble-averaging. Results: We find that evolved single-star King initial models with King parameters $W_0 = 6 - 9$ and initial particle numbers $N_0 = 3000$ provide good fits to the observational present-day cumulative mass profile within the Jacobi radius. The best-fit King model has an initial mass of 1721 $M_\odot$ and an average mass loss rate of -2.2 $M_\odot$/Myr. The K-band LFs of models and observations show a reasonable agreement. Mass segregation is detected in both observations and models. If 33% primordial binaries are included the initial particle number is reduced by 5% as compared to the model without primordial binaries. Conclusions: The present-day properties of the Hyades can be well reproduced by a standard King or Plummer initial model when choosing appropriate initial conditions. The degeneracy of good-fitting models can be quite high due to the large dimension of the parameter space. More simulations with different Roche-lobe filling factors and primordial binary fractions are required to explore this degeneracy in more detail.

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How well do STARLAB and NBODY compare? II: Hardware and accuracy

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Most recent progress in understanding the dynamical evolution of star clusters relies on direct N-body simulations. Owing to the computational demands, and the desire to model more complex and more massive star clusters, hardware calculational accelerators, such as GRAPE special-purpose hardware or, more recently, GPUs (i.e. graphics cards), are generally utilised. In addition, simulations can be accelerated by adjusting parameters determining the calculation accuracy (i.e. changing the internal simulation time step used for each star). We extend our previous thorough comparison (Anders et al. 2009) of basic quantities as derived from simulations performed either with STARLAB/KIRA or NBODY6. Here we focus on differences arising from using different hardware accelerations (including the increasingly popular graphic card accelerations/GPUs) and different calculation accuracy settings. We use the large number of star cluster models (for a fixed stellar mass function, without stellar/binary evolution, primordial binaries, external tidal fields etc) already used in the previous paper, evolve them with STARLAB/KIRA (and NBODY6, where required), analyse them in a consistent way and compare the averaged results quantitatively. For this quantitative comparison, we apply the bootstrap algorithm for functional dependencies developed in our previous study. In general we find very high comparability of the simulation results, independent of the used computer hardware (including the hardware accelerators) and the used N-body code. For the tested accuracy settings we find that for reduced accuracy (i.e. time step at least a factor 2.5 larger than the standard setting) most simulation results deviate significantly from the results using standard settings. The remaining deviations are comprehensible and explicable.

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The stellar and sub-stellar IMF of simple and composite populations

Pavel Kroupa([1]), Carsten Weidner([2]), Jan Pflamm-Altenburg([1]), Ingo Thies([1]), Joerg Dabringhausen([1]), Michael Marks([1]), Thomas Maschberger([3])

1. Bonn, 2. La Laguna, 3. Grenoble

The current knowledge on the stellar IMF is documented. It is usually described as being invariant, but evidence to the contrary has emerged: it appears to become top-heavy when the star-formation rate density surpasses about 0.1 Msun/(yr pc pc pc) on a pc scale and it may become increasingly bottom-heavy with increasing metallicity. It ends quite abruptly below about 0.1 Msun with brown dwarfs (BDs) and very low mass stars having their own IMFs. The most massive star of mass mmax formed in an embedded cluster with stellar mass Mecl correlates strongly with Mecl being a result of gravitation-driven but resource limited growth and fragmentation induced starvation. There is no convincing evidence whatsoever that massive stars do form in isolation. Massive stars form above a density threshold in embedded clusters which become saturated when mmax approx. 150 Msun which appears to be the canonical physical upper mass limit of stars. Super-canonical massive stars arise naturally due to stellar mergers induced by stellar-dynamical encounters in very young dense clusters. Various methods of discretising a stellar population are introduced: optimal sampling leads to a mass distribution that perfectly represents the exact form of the desired IMF and the mmax-Mecl relation, while random sampling results in statistical variations of the shape of the IMF. The observed mmax-Mecl correlation and the small spread of IMF power-law indices together suggest that optimally sampling the IMF may be the more realistic description of star formation than random sampling. Composite populations on galaxy scales, which are formed from many pc scale star formatiom events, need to be described by the integrated galactic IMF. This IGIMF varies systematically in dependence of galaxy type and star formation rate, with dramatic implications for theories of galaxy formation and evolution.

To appear in : Stellar Systems and Galactic Structure, Vol.V, Springer (major review)
For preprints, contact `pavel@astro.uni-bonn.de`
Also available from the URL `http://xxx.uni-augsburg.de/abs/1112.3340`
or by anonymous ftp at `ftp://`

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A comprehensive study of the young star cluster HD 97950 in the giant H II region NGC 3603

Xiaoying Pang
Astronomisches Rechen-Institut, Mönchhofstr. 12-14, 69120 Heidelberg, Germany

In this thesis, I study the young massive ($10^4\,M_\odot$) star cluster HD 97950 located in the giant H II region NGC 3603 in the Carina spiral arm. My goals are (1) to estimate the survival probability of the cluster, (2) to investigate the origin of its mass segregation, and (3) to investigate the interplay between the cluster and the surrounding interstellar medium (ISM). I determine the cluster membership of stars in the area of HD 97950 based on individual relative proper motions from data of the Hubble Space Telescope's (HST) Wide Field and Planetary Camera 2 (WFPC2) obtained in 1997 and 2007. Comparing the virial mass of the cluster derived from the velocity dispersion obtained from the relative proper motions to the total cluster luminosity, I estimate the cluster star formation efficiency (SFE) to be above 50%. Such a high SFE suggests a high probability of survival of the HD 97950 cluster after its gas expulsion phase and its capability to re-establish equilibrium. I confirm that significant mass segregation exists in the cluster within $20''$, detected by the radially varying mass function of members. The Λ minimum spanning tree technique quantifies the segregation down to $30\,M_\odot$. I find that the high-mass stars are more segregated than low-mass stars. This implies that dynamical mass segregation is probably the dominant process for mass segregation in the cluster. I derive an age of $\sim 1 - 3$ Myr for main-sequence and pre-main-sequence stars from the resulting color-magnitude diagram. To improve the age determination for the cluster stars that are severely reddened by the surrounding dusty ISM, I compute a pixel-to-pixel distribution of the color excess of the gas, $E(B-V)_\mathrm{g}$, associated with the cluster. The radial profiles of $E(B-V)_\mathrm{g}$, which are obtained from the Hα/Paβ flux ratio by using HST Wide Field Camera 3 images show significant spatial variations. Thus there is clearly significant differential reddening across the area of 4.9×4.3 pc around the HD 97950 cluster. Using UBV photometry from the high resolution channel of the Advanced Camera for Surveys and RI photometry from WFPC2, I investigate the stellar reddening in the region. The extinction curves in the $UBVRI$ filters both inside and outside the cluster core are greyer than the average Galactic extinction laws from Cardelli et al. and Fitzpatrick et al. They are close to the extinction law for starburst galaxies from Calzetti et al. in the UBV filters, indicating similar dust properties around the HD 97950 cluster as in starburst galaxies, where stellar feedback affects the surrounding dusty ISM.

PhD thesis written at Heidelberg University under supervision of Prof. Dr. Eva Grebel. Date of submission is the 12th of March, 2012.

MODEST 12

Douglas C. Heggie[1] (for the SOC)
[1]University of Edinburgh, School of Mathematics, King's Buildings, Edinburgh EH9 3JZ, UK

The next MODEST workshop will take place in Kobe, Japan, from 15-17 August 2012 (just before the Beijing IAUGA). There will be three days of talks and discussion devoted broadly to the three topics of (i) algorithms, (ii) AMUSE and (iii) observations. The meeting also provides an opportunity to celebrate the 60th birthday of Piet Hut, who inspired the creation of MODEST. The SOC consists of Piet Hut, Douglas Heggie, Steve McMillan, Jun Makino and Simon Portegies Zwart. The nascent website is linked from the MODEST web page http://www.manybody.org/modest/workshops.html .

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Saas-Fee 2012: Dynamics of Young Star Clusters & Associations
25. - 31.3.2012, Villars-sur-Ollon, Switzerland
http://www.astro.phys.ethz.ch/sf2012/

Dear Colleagues,

This is the final announcement for the Saas-Fee Winter Course 2012. The program is a series of lectures concerning the theory and observational constraints on the dynamics of young star clusters and associations. With the proliferation of large area photometric, radial velocity, and astrometric surveys from ground-based telescopes, the launch of Gaia planned for 2013, and the explosive increase in our capacity to simulate the dynamics of these complex systems, the time is right to visit this topic. The school will attempt to address such questions as:

1. How common are star-forming events of varying richness?
2. What are the dynamical states of these events?
3. In what sort of star-forming event did the Sun form?
4. How can we use answers to these questions to constrain predictive theories of star formation?

These questions will be addressed by the following distinguished international faculty:

Prof. Cathie Clarke (Institute of Astronomy, University of Cambridge)
Prof. Robert Mathieu (Dept. of Astronomy, University of Wisconsin)
Dr. Neill Reid (Space Telescope Science Institute)

Additionally, we are pleased to announce that Dr Timo Prusti, Gaia Project Scientist, will present a talk on the latest news and status of the Gaia mission. Gaia will revolutionise our understanding of the kinematics of young star clusters and associations, and Dr Prusti's lecture will be a timely introduction to our winter school, which will not only summarise the current state of the field, but also look forward to future research in light of new observational and computational developments.

These schools, which began over 40 years ago, are intended for graduate students, post-doctoral fellows, and senior researchers interested in learning more about the topic. Registration is now open, and the places on the school are rapidly filling up. We recommend that interested persons register as soon as possible, **before the final deadline of March 15, 2012.** The school is limited to 100 participants. Villars-sur-Ollon, Switzerland is located in the heart of the Alpes Vaudoises and provides a range of winter sport and other activities. It will provide an excellent setting for this school. We will also host several social events in the venue, including the conference banquet and a Konzert des Cors des Alpes - alphorn concert and Apro Fromage d'Etivaz vin blanc.

Individuals requiring financial assistance to attend the meeting are encouraged to contact the LOC directly, where their request will be evaluated on a case-by-case basis. Please email:
saas-fee-course-2012@phys.ethz.ch

More information is available on the website: http://www.astro.phys.ethz.ch/sf2012/

Best wishes,
Michael Meyer (on behalf of the LOC)

The Formation and Early Evolution of Stellar Clusters
July, 23rd - 27th, 2012, Sexten, Italy

Description

The past decade has seen enormous progress in cataloguing and characterizing both the embedded cluster population (through IR and Xray mapping) and the proto-cluster clouds (through the use of dense molecular gas tracers) that set the initial conditions of cluster formation within the Galaxy. In addition, the discovery and detailed study of many massive young clusters in the Galaxy and advances in our understanding of the huge populations of massive clusters in extragalactic systems represent considerable steps forward.

This workshop aims at bringing together various communities in order to push the boundaries of our understanding of the formation and early evolution (∼10 Myr) of stellar clusters.

Each day of the workshop will focus on a specific subject, for which we will have a number of invited and contributed talks along with a keynote talk on the current state of the field and open questions. Additionally, there will be one to two hours set aside each afternoon for discussion sessions led by a panel of experts.

The five specific subjects to be addressed are

- "Defining clusters and associations - is infant mortality needed?",
- "Current State of Cluster Formation Simulations",
- "Finding and Characterising Massive Proto-cluster Molecular Clouds",
- "The Duration of Star Formation in Clusters/Associations",
- "The Influence of the Environment on Cluster Formation and Evolution".

Organizers: Nate Bastian (Excellence Cluster, Munich, Germany), Robert Gutermuth (U Mass/Amherst, USA), Linda Smith (STScI, USA)

For inquiries concerning the conference, please contact Nate Bastian (`bastian at usm.lmu.de`)

More information is available on the conference website:
`http://www.sexten-cfa.eu/it/conferenze/conferences2012/details/20-stellar-cluster`

F I R S T A N N O U N C E M E N T

International Astronomical Union Symposium 289

"Advancing the Physics of Cosmic Distances"

IAU General Assembly, National Convention Centre, Beijing (China), 27-31 August 2012

http://www.mporzio.astro.it/IAUS289/www/Home.html, iaus289@gmail.com

(For practical information, scroll to the bottom of this announcement.)

SOUNDBITE:

Knowing the distance of an astrophysical object is key to understanding it. However, at present, comparisons of theory and observations are hampered by precision (or lack thereof) in distance measurements or estimates. Putting the many recent results and new developments in relevant subareas into the broader context of the physics driving cosmic distance determination is the next logical step, which will benefit from the combined efforts of theorists, observers and modellers working on a large variety of spatial scales, and spanning a wide range of expertise. This Symposium will focus on the physics underlying methods of distance determinations across the Universe, exploring on the way the various methods employed to define the milestones along the road. We aim to provide a snapshot of the field of distance measurement, offering not only up-to-date results and a cutting-edge account of recent progress, but also full discussion of the pitfalls encountered and the uncertainties that remain. We aim to provide a roadmap for future efforts in this field, both theoretically and observationally.

SCIENTIFIC ORGANISING COMMITTEE:

Richard de Grijs (KIAA, Peking University, China) - co-chair
Giuseppe Bono (Universit?? Roma Tor Vergata, Italy) - co-chair

Susan Cartwright (University of Sheffield, UK)
Robin Ciardullo (Pennsylvania State University, USA)
Andrei Dambis (Sternberg Astronomical Institute, Russia)
Michael Feast (University of Cape Town, South Africa)
Wendy Freedman (Carnegie Observatories, USA)
Wolfgang Gieren (Universidad de Concepcion, Chile)
Martin Groenewegen (Royal Observatory of Belgium, Belgium)
Jeremy Mould (Swinburne University of Technology, Australia)
Carme Jordi (Universitat de Barcelona, Spain)
Mark Reid (Harvard-Smithsonian Center for Astrophysics, USA)
Myung-Hyun Rhee (Yonsei University, Republic of Korea)
Don VandenBerg (University of Victoria, Canada)
Rogier Windhorst (Arizona State University, USA)
Ye Xu (Purple Mountain Observatory, China)

SCIENTIFIC RATIONALE:

Knowing the distance of an astrophysical object is key to understanding it: without an accurate distance we do not know how bright it is, how large it is, or even (for long distances) when it existed. But astronomical distance measurement is a challenging task. Distances to stars were first measured in 1838 by Bessel, Struve and Henderson, and accurate distances to other galaxies – even the nearest –

date only from the 1950s. This is not really surprising, since the only information we have about any object beyond our Solar System is its position (perhaps as a function of time) and its brightness (as a function of wavelength and time). Yet, from this unpromising starting point, modern astronomers have developed methods of measuring distances which can take us from the nearest star to the most distant galaxy, using techniques that vary from the mundane (the astronomical equivalent of the surveyor's theodolite) to the exotic (the bending of light in general relativity, wiggles in the spectrum of the cosmic microwave background). Nevertheless, the most accurate optical and near-infrared methods of distance determination, from the solar neighbourhood to the highest redshifts, in use today rely heavily on having access to accurate spectroscopy, supplemented by astrometric measurements in the Milky Way (and slightly beyond).

In 1997, the Hipparcos space mission provided (for the first time) a significant number of absolute trigonometric parallaxes at milliarcsec-level precision across the whole sky, which had a major impact on all fields of astrophysics. In addition, during the past ten years, the use of ground-based 8-10mclass optical and near-infrared telescopes (Keck, VLT, Gemini, Subaru) and space observatories (HST, Spitzer, Chandra, XMM-Newton) have provided an unprecedented wealth of accurate photometric and spectroscopic data for stars and galaxies in the local Universe. Radio observations, particularly with the VLBA and the Japanese VERA arrays, have achieved 10 micro-arsecond astrometric accuracy. Moreover, stellar models and numerical simulations are now providing accurate predictions of a broad range of physical phenomena, which can now in principle be tested using accurate spectroscopic and astrometric observations (including measurements of, e.g., line ratios and shapes, spectral slopes, radial velocities and velocity dispersions). However, at present, comparisons of theory and observations are mainly hampered by precision (or lack thereof) in distance measurements/estimates.

While a number of past IAU Symposia have addressed individual aspects of the methods and physics underlying the fundamentals of distance determination, at the present time there is a need for a new, interdisciplinary Symposium encompassing the broad range of techniques and theories. Rather than focusing on historical perspectives, we will truly highlight the tremendous amount of recent and continuing research into a myriad of exciting and promising aspects of accurately pinning down the cosmic distance scale. Putting the many recent results and new developments in the relevant subareas into the broader context of the physics driving cosmic distance determination is the next logical step, which will benefit from the combined efforts of theorists, observers and modellers working on a large variety of spatial scales, and spanning a wide range of expertise.

This is a very exciting time. VLBI sensitivity is being expanded allowing, for example, direct measurement of distances throughout the Milky Way and even to Local Group galaxies. The field will benefit from expert input to move forward into the era of Gaia, optical-interferometer and ELT-driven science, which (for example) will allow us to determine Coma-cluster distances without having to rely on secondary distance indicators, thus finally making the leap to accurate distance measurements well beyond the Local Group of galaxies. With the launch of Gaia imminent at the time of the IAU GA in Beijing, this is a really opportune time to be looking forward to the first Gaia catalogues, and understand how the science areas touched upon in this Symposium will be fundamentally changed by the Gaia results, what the big open questions are that Gaia can address in the Symposium's context, and what the future of complementary techniques and observational approaches will be once the Gaia catalogues become available.

In this Symposium, we will bring together experts on various aspects of distance determinations and (most importantly) the underlying physics enabling this (without being restrictive in areas where

statistical and observational approaches are more relevant), from the solar neighbourhood to the edge of the Universe, exploring on the way the various methods employed to define the milestones along the road. We will emphasise, where possible, the physical bases of the methods and recent advances made to further our physical insights. We aim to provide a snapshot of the field of distance measurement, offering not only up-to-date results and a cutting-edge account of recent progress, but also full discussion of the pitfalls encountered and the uncertainties that remain. We aim to provide a roadmap for future efforts in this field, both theoretically and observationally, and in particular will consider the key question as to whether the field is best served by having access to the nextgeneration of extremely large telescopes and the Square Kilometer Array (as well as the James Webb Space Telescope) and/or if significant progress can still be made with dedicated 2-4m-class optical telescopes as well as upgraded radio interferometers.

Although our focus is techniques of distance determination, this is intimately linked to many other aspects of astrophysics and cosmology. On our journey from the solar neighbourhood to the edge of the Universe, we shall encounter stars of all types, alone, in pairs and in clusters, their life cycles, and their explosive ends: binary stars, in particular, play an important role in this context, e.g. in pinning down accurate distances to the Pleiades open cluster and Local Group galaxies, as well as in future ground- and space-based surveys (including Gaia, RAVE, and others); the stellar content, dynamics, and evolution of galaxies and groups of galaxies; the gravitational bending of starlight; and the expansion, geometry and history of the Universe. As a result, the Symposium will offer not only a comprehensive study of distance measurement, but a tour of many recent and exciting advances in astrophysics.

REGISTRATION/TRAVEL GRANTS:

Registration for this Symposium must be done via the IAU General Assembly's registration process: http://www.astronomy2012.org/dct/page/65611

Note that the early registration deadline is **29 February 2012.**

All participants, INCLUDING INVITED AND REVIEW SPEAKERS, must register via the IAU GA website.

If you are not an IAU member, the IAU's Paris Office will issue an official invitation once your status as professional astronomer has been verified. To aid this process, please register as usual and also send an email to the Symposium's organisers (iaus289@gmail.com), including:

- your name and gender (important!)
- your full institute address
- your professional status (student, postdoc, faculty, etc.)

Students also need to ask their adviser to send an endorsement letter directly to the IAU's secretariat; see http://www.astronomy2012.org/dct/page/65611 (note 1).

If you want to qualify for partial TRAVEL SUPPORT, the deadline for travel grant applications is also 29 February. See for more details: `http://www.iau.org/grants_prizes/iau_grants/ga_events/` – we cannot provide firm guarantees of travel support before 8 May 2012, and there is no need to follow up any enquires prior to that date (we won't have the answers).

We hope to see many of you at IAU Symposium 289 in Beijing this summer!

Postdoctoral Fellowship in Astronomy and Astrophysics

Pontificia Universidad Catolica de Chile

The Department of Astronomy and Astrophysics of Pontificia Universidad Catolica de Chile (DAA-PUC) invites applications for a Postdoctoral Fellowship in Astronomy and Astrophysics in the area of simple and composite stellar populations modeling. The successful candidate will pursue projects with Prof. Thomas H. Puzia related to the interpretation of data from the Next Generation Virgo Cluster Survey-IR (http://tiny.cc/ngvs-ir) and the Panchromatic High-Resolution Spectroscopic Survey of Local-Group Star Clusters using the ESO/X-SHOOTER spectrograph. The postdoctoral fellow will also be expected to contribute actively to the scientific exploitation of these data. The focus of possible projects could be on the population of star clusters and other compact objects detected in the NGVS-IR field and/or on high spectral resolution SED modeling. However, other topics can be considered based on the experience of the candidate.

DAA-PUC provides a stimulating and vibrant international environment with 16 faculty, about a dozen postdocs, and over 30 graduate students (www.astro.puc.cl). While resident at DAA-PUC, the postdoctoral fellow will have direct access to 10% of observing time on all telescopes in Chile, including ESO/ALMA, ESO/Paranal's 4x8m VLT and 4m VISTA, La Silla's 3.5m NTT and the 3.6m and 2.2m telescopes, Gemini-South 8m, Carnegie's 2.5m and Magellan 2x6.5m, CTIO's 4m (Blanco), SOAR 4m, as well as ASTE and APEX. Additionally, DAA-PUC hosts a supercomputer which is used for numerical simulations and analysis work on large datasets, to which the candidate will have full access.

The offered position is tenable for an initial appointment of two years with the possibility of an extension for one further year subject to performance and availability of funds. In addition to their salary and benefit package, the fellow will receive support for conference travel, publication page charges, and computer equipment.

Candidates must have acquired their PhD in astronomy or closely related field or must be expecting to complete their doctoral degree requirements before taking up their postdoctoral fellowship in late 2012. Applicants should prepare a cover letter, curriculum vitae, a publication list, and a statement of research interests (max. three pages) and send the materials electronically and in pdf format to tpuzia@astro.puc.cl **by March 15th, 2012.** In addition, applicants should arrange for three letters of recommendation to be sent before the application deadline directly by email to the above address.

More information is availabel at the following URL: `http://jobregister.aas.org/node/41461`