$\mathcal{SCYON}$

The Star Clusters Young & Old Newsletter

edited by Holger Baumgardt, Ernst Paunzen and Pavel Kroupa

SCYON can be found at URL:
`http://astro.u-strasbg.fr/scyon`

SCYON Issue No. 44 *13 October 2009*

EDITORIAL

This is the 44th issue of the SCYON newsletter. Todays edition contains 22 abstracts from refereed publications and conference proceedings and an announcement for several postdoc positions at Northwestern University. We also have an announcement for the IAU Symposium 270, which will be held in Barcelona in June 2010.

As usual, we would like to thank everybody who sent us their contribution.

Holger Baumgardt, Ernst Paunzen and Pavel Kroupa

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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.

Concerning possible infringements to copyright laws, we understand that the authors themselves are taking responsibility for the material they send us. We make no claim whatsoever to owning the material that is posted at our url or circulated by email. The newsletter SCYON is a free service. It does not substitute for our personal opinions, nor does it reflect in any way the views of our respective institutes of affiliations.

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@astro.u-strasbg.fr.

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 :

HTTP://ASTRONOMY.SWIN.EDU.AU/SCYON/)

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1. Star Forming Regions

Young T-Dwarf Candidates in IC 348

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The determination of the lower-end of the initial mass function (IMF) provides strong constraints on star formation theories. We report here on a search for isolated planetary-mass objects in the 3 Myr-old star-forming region IC 348. Deep, narrowband CH4off and CH4on images were obtained with CFHT/WIRCam over 0.11 sq.deg. in the central part of IC 348 to identify young T-dwarfs from their 1.6 um methane absorption bands. We report three faint T-dwarf candidates with CH4on-CH4off colours > 0.4 mag. Extinction was estimated for each candidate and lies in the range Av $\sim$ 5-12 mag. Comparisons with T-dwarf spectral models, and colour/colour and colour/magnitude diagrams, reject two of the three candidates because of their extreme z' - J blueness. The one remaining object is not thought to be a foreground field dwarf because of a number density argument and also its strong extinction Av - 12 mag, or thought to be a background field T-dwarf which would be expected to be much fainter. Models and diagrams give this object a preliminary T6 spectral type. With a few Jupiter masses, the young T-dwarf candidate reported here is potentially amongst the youngest, lowest mass objects detected in a star-forming region so far. Its frequency is consistent with the extrapolation of current lognormal IMF estimates down to the planetary mass domain.

Accepted by : Astronomy & Astrophysics
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Also available from the URL `http://arxiv.org/abs/0909.0917`
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Debris Disks in the Upper Scorpius OB Association

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We present MIPS 24μm and 70μm photometry for 205 members of the Upper Scorpius OB Association. These data are combined with published MIPS photometry for 15 additional association members to assess the frequency of circumstellar disks around 5 Myr old stars with spectral types between B0 and M5. Twelve stars have a detectable 70μm excess, each of which also has a detectable 24μm excess. A total of 54 stars are identified with a 24μm excess more than 32% above the stellar photosphere. The MIPS observations reveal 19 excess sources – 8 A/F/G stars and 11 K/M stars – that were not previously identified with an 8μm or 16μm excess. The lack of short-wavelength emission and the weak 24μm excess suggests that these sources are debris systems or the remnants of optically thick primordial disks with inner holes. Despite the wide range of luminosities of the stars hosting apparent debris systems, the excess characteristics are consistent with all stars having dust at similar orbital radii after factoring in variations in the radiation blowout particle size with spectral type. The results for Upper Sco are compared to similar photometric surveys from the literature to re-evaluate the evolution of debris emission. After considering the completeness limits of published surveys and the effects of stellar evolution on the debris luminosity, we find that the magnitude of the 24μm excess around F-type stars increases between ages of 5 and 17 Myr as found by previous studies, but at $< 2.6\sigma$ confidence. For B7-A9 and G0-K5 stars, any variations in the observed 24μm excess emission over this age range are significant at less than 2σ confidence.

Accepted by : Astrophysical Journal

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2. Galactic Open Clusters

Model-Independent Diagnostics of Highly Reddened Milky Way Star Clusters: Age Calibration

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ESO - Chile

The next generation near- and mid-infrared Galactic surveys will yield a large number of new highly obscured star clusters. Detailed characterization of these new objects with spectroscopy is time-consuming. Diagnostic tools that will be able to characterize clusters based only on the available photometry will be needed to study large samples of the newly found objects. The brightness difference between the red clump and the main-sequence turn-off point have been used as a model-independent age calibrator for clusters with ages from a few 10^8 to 10^{10} yr in the optical. Here we apply for the first time the method in the near-infrared. We calibrated this difference in K-band, which is likely to be available for obscured clusters, and we apply it to a number of test clusters with photometry comparable to the one that will be yielded by the current or near-future surveys. The new calibration yields reliable ages over the range of ages for which the red clump is present in clusters. The slope of the relation is smoother than that of the corresponding V-band relation, reducing the uncertainty in the age determinations with respect to the optical ones.

Accepted by : Astronomy & Astrophysics
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Abstract

For Galactic open clusters fundamental parameters like age or reddening are usually determined independently of their integrated colours. For extragalactic clusters, on the other hand, they are essentially derived via a comparison of their integrated colours with predictions of simple stellar population (SSP) models. *Aims:* We have found a disagreement between the observed integrated colours of 650 local Galactic clusters and theoretical colours of present-day SSP models and seek an explanation for this discrepancy.
Methods: We check the hypothesis that the systematic offset between observed and theoretical colours, which is $(B-V) \approx 0.3$ and $(J-K_s) \approx 0.8$, is due to neglecting the discrete nature of the underlying mass function. Using Monte Carlo simulations we construct artificial clusters of coeval stars drawn from a mass distribution according to the Salpeter IMF and compare them with corresponding "continuous-IMF" SSP models.
Results: If the discreteness of the IMF is taken into account, the model fits the observations perfectly and is able to explain naturally a number of red "outliers" observed in the empirical colour-age relation. We find that the *systematic* offset between the continuous- and discrete-IMF colours reaches its maximum of about 0.5 in $(B-V)$ for a cluster mass $M_c = 10^2\,m_\odot$ at ages $\log t \approx 7$, and diminishes substantially but not completely to about one hundredth of a magnitude at $\log t > 7.9$ at cluster masses $M_c > 10^5\,m_\odot$. At younger ages, it is still present even in massive clusters, and for $M_c \leq 10^4\,m_\odot$ it is larger than 0.1 mag in $(B-V)$. Only for very massive clusters $(M_c > 10^6\,m_\odot)$ with ages $\log t < 7.5$ the offset is small (of the order of 0.04 mag) and falls below the typical observational error of colours of extragalactic clusters.

Accepted by : Astronomy & Astrophysics
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Open clusters in the Third Galactic Quadrant. III: Alleged binary clusters

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Aims. We aim to determine accurate distances and ages of eight open clusters in order to: (1) assess their possible binarity (2) provide probes to trace the structure of the Third Galactic Quadrant. Methods. Cluster reddenings, distances, ages and metallicities are derived from ZAMS and isochrone fits in UBVRI photometric diagrams. Field contamination is reduced by restricting analysis to stars within the cluster limits derived from star counts. Further membership control is done by requiring that stars have consistent positions in several diagrams and by using published spectral types. Results. The derived distances, ages and metallicities have shown that none of the analysed clusters compose binary/double systems. Of the four candidate pairs, only NGC 2383/NGC 2384 are close to each other, but have different metallicities and ages. Ruprecht 72 and Ruprecht 158 are not clusters but fluctuations of the field stellar density. Haffner 18 is found to be the superposition of two stellar groups at different distances: Haffner 18(1) at 4.5 kpc and Haffner 18(2) between 9.5 and 11.4 kpc from the Sun. The derived distances and ages have been used to situate the clusters in the Galactic context. In particular, young stellar groups trace the spiral structure at large Galactocentric radii. At least two clusters formed during the last few 10^8 yr in an interstellar medium with less than solar abundances. Conclusions. In contrast with the LMC, double clusters are apparently rare, or even non existent, in the undisturbed environment of the Third Galactic Quadrant. This leaves open the question of whether binary clusters form more easily toward denser and more violent regions of the Milky Way such as the inner Galaxy.

Accepted by : Astronomy & Astrophysics
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The orbits of open clusters in the Galaxy

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We present and analyze kinematics and orbits for a sample of 488 open clusters in the Galaxy. The velocity ellipsoid for our present sample is derived as $(\sigma_U, \sigma_V, \sigma_W) = (28.7, 15.8, 11.0)$ km s^{-1} which represents a young thin disc population. We also confirm that the velocity dispersions increase with the age of cluster subsample. The orbits of open clusters are calculated with three Galactic gravitational potential models. The errors of orbital parameters are also calculated considering the intrinsic variation of the orbital parameters and the effects of observational uncertainties. The observational uncertainties dominate the errors of derived orbital parameters. The vertical motions of clusters calculated using different Galactic disc models are rather different. The observed radial metallicity gradient of clusters is derived with a slope of $b = -0.070 \pm 0.011$ dex kpc^{-1}. The radial metallicity gradient of clusters based on their apogalactic distances is also derived with a slope of $b = -0.082 \pm 0.014$ dex kpc^{-1}. The distribution of derived orbital eccentricities for open clusters is very similar to the one derived for the field population of dwarfs and giants in the thin disc.

Accepted by : Monthly Notices of the Royal Astronomical Society

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3. Galactic Globular Clusters

Dust Production and Mass Loss in the Galactic Globular Cluster NGC 362

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We investigate dust production and stellar mass loss in the Galactic globular cluster NGC 362. Due to its close proximity to the Small Magellanic Cloud (SMC), NGC 362 was imaged with the IRAC and MIPS cameras onboard the Spitzer Space Telescope as part of the Surveying the Agents of Galaxy Evolution (SAGE-SMC) Spitzer Legacy program. We detect several cluster members near the tip of the Red Giant Branch that exhibit infrared excesses indicative of circumstellar dust and find that dust is not present in measurable quantities in stars below the tip of the Red Giant Branch. We modeled the spectral energy distribution (SED) of the stars with the strongest IR excess and find a total cluster dust mass-loss rate of 3.0(+2.0/-1.2) x 10^{-9} solar masses per year, corresponding to a gas mass-loss rate of 8.6(+5.6/-3.4) x 10^{-6} solar masses per year, assuming [Fe/H] = -1.16. This mass loss is in addition to any dust-less mass loss that is certainly occurring within the cluster. The two most extreme stars, variables V2 and V16, contribute up to 45% of the total cluster dust-traced mass loss. The SEDs of the more moderate stars indicate the presence of silicate dust, as expected for low-mass, low-metallicity stars. Surprisingly, the SED shapes of the stars with the strongest mass-loss rates appear to require the presence of amorphous carbon dust, possibly in combination with silicate dust, despite their oxygen-rich nature. These results corroborate our previous findings in omega Centauri.

To appear in : astro-ph:0909.5154
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Evidence for two populations of Galactic globular clusters from the ratio of their half-mass to Jacobi radii

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We investigate the ratio between the half-mass radii r_h of Galactic globular clusters and their Jacobi radii r_J given by the potential of the Milky Way and show that clusters with galactocentric distances $R_{GC} > 8$ kpc fall into two distinct groups: one group of compact, tidally-underfilling clusters with $r_h/r_J < 0.05$ and another group of tidally filling clusters which have $0.1 < r_h/r_J < 0.3$. We find no correlation between the membership of a particular cluster to one of these groups and its membership in the old or younger halo population. Based on the relaxation times and orbits of the clusters, we argue that compact clusters and most clusters in the inner Milky Way were born compact with half-mass radii $r_h < 1$ pc. Some of the tidally-filling clusters might have formed compact as well, but the majority likely formed with large half-mass radii. Galactic globular clusters therefore show a similar dichotomy as was recently found for globular clusters in dwarf galaxies and for young star clusters in the Milky Way. It seems likely that some of the tidally-filling clusters are evolving along the main sequence line of clusters recently discovered by Küpper et al. (2008) and are in the process of dissolution.

Accepted by : Monthly Notices of the Royal Astronomical Society
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The influence of the C+N+O abundances on the determination of the relative ages of Globular Clusters: the case of NGC 1851 and NGC 6121 (M4)

F. D'Antona, P.B. Stetson, P. Ventura, A. Milone, G.P Piotto & V. Caloi
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The color magnitude diagram (CMD) of NGC 1851 presents two subgiant branches (SGB), probably due the presence of two populations differing in total CNO content. We test the idea that a difference in total CNO may simulate an age difference when comparing the CMD of clusters to derive relative ages. We compare NGC 1851 with NGC 6121 (M4), a cluster of very similar [Fe/H]. We find that, with a suitable shift of the CMDs that brings the two red horizontal branches at the same magnitude level, the unevolved main sequence and red giant branch match, but the SGB of NGC 6121 and its red giant branch "bump" are *fainter* than in NGC 1851. In particular, the SGB of NGC 6121 is even slightly fainter than the the faint SGB in NGC 1851. Both these features can be explained if the total CNO in NGC 6121 is larger than that in NGC 1851, even if the two clusters are coeval. We conclude by warning that different initial C+N+O abundances between two clusters, otherwise similar in metallicity and age, may lead to differences in the turnoff morphology that can be easily attributed to an age difference.

Accepted by : Monthly Notices of the Royal Astronomical Society
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The C+N+O abundances and the splitting of the subgiant branch in the Globular Cluster NGC 1851

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Among the newly discovered features of multiple stellar populations in Globular Clusters, the cluster NGC 1851 harbours a double subgiant branch, that can be explained in terms of two stellar generations, only slightly differing in age, the younger one having an increased total C+N+O abundance. Thanks to this difference in the chemistry, a fit can be made to the subgiant branches, roughly consistent with the C+N+O abundance variations already discovered two decades ago, and confirmed by recent spectroscopic data. We compute theoretical isochrones for the main sequence turnoff, by adopting four chemical mixtures for the opacities and nuclear reaction rates. The standard mixture has Z=10^{-3} and α/Fe]=0.4, the others have C+N+O respectively equal to 2, 3 and 5 times the standard mixture, according to the element abundance distribution described in the text. We compare tracks and isochrones, and show how the results depend on the total CNO abundance. We notice that different initial CNO abundances between two clusters, otherwise similar in metallicity and age, may lead to differences in the turnoff morphology that can be easily attributed to an age difference. We simulate the main sequence and subgiant branch data for NGC 1851 and show that an increase of C+N+O by a factor $\sim$3 best reproduces the shift between the subgiant branches. According to spectroscopic data by Yong et al., the C+N+O abundance in this cluster appears correlated with the abundance of s-process elements, Na and Al, and this makes massive AGBs the best progenitors of the C+N+O enriched population. We compare the main sequence width in the color m_{F336W}-m_{F814W} with models, and find that the maximum helium abundance compatible with the data is Y$\simeq$0.29. We consider the result in the framework of the formation of the second stellar generation in globular clusters, for the bulk of which we estimate a helium abundance of Y$\leq$ 0.26. The precise value depends on which are the AGB masses from which the C+N+O enriched matter originates, and on the amount of dilution with the pristine gas.

Accepted by : Monthly Notices of the Royal Astronomical Society
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4. Extragalactic Clusters

The Nuclear Ring in the Barred Spiral Galaxy IC 4933

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We present infrared imaging from IRIS2 on the Anglo-Australian Telescope that shows the barred spiral galaxy IC 4933 has not just an inner ring encircling the bar, but also a star-forming nuclear ring 1.5 kpc in diameter. Imaging in the u′ band with GMOS on Gemini South confirms that this ring is not purely an artifact due to dust. Optical and near-infrared colours alone however cannot break the degeneracy between age, extinction, and burst duration that would allow the star formation history of the ring to be unraveled. Integral field spectroscopy with the GNIRS spectrograph on Gemini South shows the equivalent width of the Paβ line to peak in the north and south quadrants of the ring, indicative of a bipolar azimuthal age gradient around the ring. The youngest star-forming regions do not appear to correspond to where we expect to find the contact points between the offset dust lanes and the nuclear ring unless the nuclear ring is oval in shape, causing the contact points to lead the bar by more than 90°.

Accepted by: Publications of the Astronomical Society of Australia
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Also available from the URL `http://arxiv.org/abs/0909.1371`
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Star Clusters in Pseudo-bulges of Spiral Galaxies

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We present a study of the properties of the star-cluster systems around pseudo-bulges of late-type spiral galaxies using a sample of 11 galaxies with distances from 17 to 37 Mpc. Star clusters are identified from multiband HST ACS and WFPC2 imaging data by combining detections in 3 bands (F435W and F814W with ACS and F606W with WFPC2). The photometric data are then compared to population synthesis models to infer the masses and ages of the star clusters. Photometric errors and completeness are estimated by means of artificial source Monte Carlo simulations. Dust extinction is estimated by considering F160W NICMOS observations of the central regions of the galaxies, augmenting our wavelength coverage. In all galaxies we identify star clusters with a wide range of ages, from young (age $\sim<$ 8 Myr) blue clusters, with typical mass of 10^3 $M_\odot$ to older (age $>$ 100-250 Myr), more massive, red clusters. Some of the latter might likely evolve into objects similar to the Milky Way's globular clusters. We compute the specific frequencies for the older clusters with respect to the galaxy and bulge luminosities. Specific frequencies relative to the galaxy light appear consistent with the globular cluster specific frequencies of early-type spirals. We compare the specific frequencies relative to the bulge light with the globular cluster specific frequencies of dwarf galaxies, which have a surface-brightness profile that is similar to that of the pseudo-bulges in our sample. The specific frequencies we derive for our sample galaxies are higher than those of the dwarf galaxies, supporting an evolutionary scenario in which some of the dwarf galaxies might be the remnants of harassed late-type spiral galaxies which hosted a pseudo-bulge.

Accepted by : Astronomical Journal
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Also available from the URL `http://adsabs.harvard.edu/abs/2009AJ....138.1296D`
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A slitless spectroscopic survey for Hα emission-line objects in SMC clusters

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Context: A fair fraction of all single early-type stars display emission lines well before the supergiant phase. Very rapid rotation is necessary for such stars to form rotationally supported decretion disks. But it is unknown whether and which other parameters may be important. Aims: This paper checks on the roles of metallicity and evolutionary age in the appearance of the so-called Be phenomenon. Results: Slitless CCD spectra were obtained covering the bulk (about 3 square degrees) of the Small Magellanic Cloud. For Hα line emission twice as strong as the ambient continuum, the survey is complete to spectral type B2/B3 on the main sequence. About 8,120 spectra of 4,437 stars were searched for emission lines in 84 open clusters. 370 emission-line stars were found, among them at least 231 near the main sequence. For 176 of them, photometry could be found in the OGLE database. For comparison with a higher-metallicity environment, the Galactic sample of the photometric Hα survey by McSwain & Gies (2005) was used. Conclusions: Among early spectral sub-types, Be stars are more frequent by a factor $\sim$3-5 in the SMC than in the Galaxy. The distribution with spectral type is similar in both galaxies, i.e. not strongly dependent on metallicity. The fraction of Be stars does not seem to vary with local star density. The Be phenomenon mainly sets in towards the end of the main-sequence evolution (this trend may be more pronounced in the SMC); but some Be stars already form with Be-star characteristics. In small sub-samples (such as single clusters), even if they appear identical, the fraction of emission lines stars can deviate drastically from the mean. In all probability, the fractional critical angular rotation rate, Ω/Ω_c, is one of the main parameters governing the occurrence of the Be phenomenon. If the Be character is only acquired during the course of evolution, the key circumstance is the evolution of Ω/Ω_c, which not only is dependent on metallicity but differently so for different mass ranges. As the result, even if the Be phenomenon is basically single-parametric (namely (Ω/Ω_c), it takes on a complex multi-parametric appearance. The large cluster-to-cluster differences, which seem stronger than all other variations, serve as a caveat that this big picture may undergo significant second-order modulations (pulsations, initial angular momentum, etc).

Accepted by: Astronomy & Astrophysics
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Compact Star Clusters in the M31 Disk

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We have carried out a survey of compact star clusters (apparent size < 3 arcsec) in the southwest part of the M31 galaxy, based on the high-resolution Suprime-Cam images (17.5 arcmin x 28.5 arcmin), covering $\sim$15% of the deprojected galaxy disk area. The UBVRI photometry of 285 cluster candidates (V$<$ 20.5 mag) was performed using frames of the Local Group Galaxies Survey. The final sample, containing 238 high probability star cluster candidates (typical half-light radius $r_h \sim 1.5$ pc), was selected by specifying a lower limit of $r_h > 0.15$ arcsec (> 0.6 pc). We derived cluster parameters based on the photometric data and multiband images by employing simple stellar population models. The clusters have a wide range of ages from ~ 5 Myr (young objects associated with 24 μm and/or Ha emission) to 10 Gyr (globular cluster candidates), and possess mass in a range of $3.0 < \log(\mathrm{m/M_\odot}) < 4.3$ peaking at m ~ 4000 $\mathrm{M_\odot}$. Typical age of these intermediate-mass clusters is in the range of 30 Myr $< t <$ 3 Gyr, with a prominent peak at ~ 70 Myr. These findings suggest a rich intermediate-mass star cluster population in M31, which appears to be scarce in the Milky Way galaxy.

Accepted by : Astrophysical Journal

For preprints, contact `donatas.narbutis@ff.vu.lt`

Also available from the URL `http://arxiv.org/abs/0909.1912`

or by anonymous ftp at `ftp://`

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5. Dynamical evolution - Simulations

Evolution of the Binary Fraction in Dense Stellar Systems

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Using our recently improved Monte Carlo evolution code, we study the evolution of the binary fraction in globular clusters. In agreement with previous N-body simulations, we find generally that the hard binary fraction in the core tends to increase with time over a range of initial cluster central densities for initial binary fractions $<\sim 90\%$. The dominant processes driving the evolution of the core binary fraction are mass segregation of binaries into the cluster core and preferential destruction of binaries there. On a global scale, these effects and the preferential tidal stripping of single stars tend to roughly balance, leading to overall cluster binary fractions that are roughly constant with time. Our findings suggest that the current hard binary fraction near the half-mass radius is a good indicator of the hard primordial binary fraction. However, the relationship between the true binary fraction and the fraction of main-sequence stars in binaries (which is typically what observers measure) is non-linear and rather complicated. We also consider the importance of soft binaries, which not only modify the evolution of the binary fraction, but can drastically change the evolution of the cluster as a whole. Finally, we describe in some detail the recent addition of single and binary stellar evolution to our cluster evolution code.

Submitted to : Astrophysical Journal
For preprints, contact `fregeau@kitp.ucsb.edu`
Also available from the URL `http://arxiv.org/abs/0907.4196`
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Tidal Tails of Star Clusters

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Based on recent findings of a formation mechanism of substructure in tidal tails by Küpper, Macleod & Heggie (2008) we investigate a more comprehensive set of N-body models of star clusters on orbits about a Milky-Way-like potential. We find that the predicted epicyclic overdensities arise in any tidal tail no matter which orbit the cluster follows as long as the cluster lives long enough for the overdensities to build up.

The distance of the overdensities along the tidal tail from the cluster centre depends for circular orbits only on the mass of the cluster and the strength of the tidal field, and therefore decreases monotonically with time, while for eccentric orbits the orbital motion influences the distance, causing a periodic compression and stretching of the tails and making the distance oscillate with time. We provide an approximation for estimating the distance of the overdensities in this case.

We describe an additional type of overdensity which arises in extended tidal tails of clusters on eccentric orbits, when the acceleration of the tidal field on the stellar stream is no longer homogeneous. Moreover, we conclude that a pericentre passage or a disk shock is not the direct origin of an overdensity within a tidal tail. Escape due to such tidal perturbations does not take place immediately after the perturbation but is rather delayed and spread over the orbit of the cluster. All observable overdensities are therefore of the mentioned two types. In particular, we note that substructured tidal tails do not imply the existence of dark-matter sub-structures in the haloes of galaxies.

Accepted by: MNRAS
For preprints, contact akuepper@astro.uni-bonn.de
Also available from the URL http://de.arxiv.org/abs/0909.2619

6. Miscellaneous

The relation between the most-massive star and its parental star cluster mass

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We present a thorough literature study of the most-massive star, m_{max}, in several young star clusters in order to assess whether or not star clusters are populated from the stellar initial mass function (IMF) by random sampling over the mass range $0.01 < m < 150$ $M_\odot$ without being constrained by the cluster mass, M_{ecl}. The data reveal a partition of the sample into lowest mass objects ($M_{ecl} < 10^2$ $M_\odot$), moderate mass clusters (10^2 $M_\odot < M_{ecl} < 10^3$ $M_\odot$) and rich clusters above 10^3 $M_\odot$. Additionally, there is a plateau of a constant maximal star mass ($m_{max} \sim 25$ $M_\odot$) for clusters with masses between 10^3 $M_\odot$ and $4 \cdot 10^3$ $M_\odot$. Statistical tests of this data set reveal that the hypothesis of random sampling from the IMF between 0.01 and 150 $M_\odot$ is highly unlikely for star clusters more massive than 10^2 $M_\odot$ with a probability of $p \sim 2 \cdot 10^{-7}$ for the objects with M_{ecl} between 10^2 $M_\odot$ and 10^3 $M_\odot$ and $p \sim 3 \cdot 10^{-9}$ for the more massive star clusters. Also, the spread of m_{max} values at a given M_{ecl} is smaller than expected from random sampling. We suggest that the basic physical process able to explain this dependence of stellar inventory of a star cluster on its mass may be the interplay between stellar feedback and the binding energy of the cluster-forming molecular cloud core. Given these results, it would follow that an integrated galactic initial mass function (IGIMF) sampled from such clusters would automatically be steeper in comparison to the IMF within individual star clusters.

Accepted by : Monthly Notices of the Royal Astronomical Society
For preprints, contact `Carsten.Weidner@st-andrews.ac.uk`
Also available from the URL `http://arxiv.org/abs/0909.1555`
or by anonymous ftp at `ftp://`

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Star cluster disruption

Mark Gieles
European Southern Observatory

Star clusters are often used as tracers of major star formation events in external galaxies as they can be studied up to much larger distances than individual stars. It is vital to understand their evolution if they are used to derive, for example, the star formation history of their host galaxy. More specifically, we want to know how cluster lifetimes depend on their environment and structural properties such as mass and radius. This review presents a theoretical overview of the early evolution of star clusters and the consequent long term survival chances. It is suggested that clusters forming with initial densities of $> 10^4$ Msun pc^{-3} survive the gas expulsion, or "infant mortality", phase. At $\sim$10 Myr they are bound and have densities of $10^{3\pm1}$ Msun pc^{-3}. After this time they are stable against expansion by stellar evolution, encounters with giant molecular clouds and will most likely survive for another Hubble time if they are in a moderate tidal field. Clusters with lower initial densities (< 100 Msun pc^{-3}) will disperse into the field within a few 10s of Myrs. Some discussion is provided on how extra galactic star cluster populations and especially their age distributions can be used to gain insight in disruption.

To appear in : Invited review talk. To appear in the proceedings of IAU Symp. 266 (Star clusters), eds. R. de Grijs and J. Lepine.
For preprints, contact `mgieles@eso.org`
Also available from the URL `http://arxiv.org/abs/0909.4317`
or by anonymous ftp at `ftp://`

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Young massive star clusters: Achievements and challenges

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In spite of significant recent and ongoing research efforts, most of the early evolution and long-term fate of young massive star clusters remain clouded in uncertainties. Here, I discuss our understanding of the initial conditions of star cluster formation and the importance of initial substructure for the subsequent dynamical-evolution and mass-segregation timescales. I also assess our current understanding of the (initial) binary fraction in star clusters and the shape of the stellar initial mass function at the low-mass end in the low-metallicity environment of the Large Magellanic Cloud. Finally, I question the validity of our assumptions leading to dynamical cluster mass estimates. I conclude that it seems imperative that observers, modellers and theorists combine efforts and exchange ideas and data freely for the field to make a major leap forward.

To appear in : Proc. IAU Symp. 266, Rio de Janeiro, August 2009; eds. R. de Grijs and J. Lépine
For preprints, contact `grijs@kiaa.pku.edu.cn`
Also available from the URL `http://www.arxiv.org/abs/0909.2322`
or by anonymous ftp at `ftp://`

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A Bayesian Approach Accounting for Stochastic fluctuations in Stellar Cluster Properties

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The integrated spectro-photometric properties of star clusters are subject to large cluster-to-cluster variations. They are distributed in non trivial ways around the average properties predicted by standard population synthesis models. This results from the stochastic mass distribution of the finite (small) number of luminous stars in each cluster, stars which may be either particularly blue or particularly red. The color distributions are broad and usually far from Gaussian, especially for young and intermediate age clusters, as found in interacting galaxies. When photometric measurements of clusters are used to estimate ages and masses in conjunction with standard models, biases are to be expected. We present a Bayesian approach that explicitly accounts for stochasticity when estimating ages and masses of star clusters that cannot be resolved into stars. Based on Monte-Carlo simulations, we are starting to explore the probability distributions of star cluster properties obtained given a set of multi-wavelength photometric data.

To appear in : Galaxy Wars: Stellar Populations and Star Formation in Interacting Galaxies Conference
For preprints, contact `morgan.fouesneau@astro.u-strasbg.fr`
Also available from the URL `http://arxiv.org/abs/0908.2742v1`
or by anonymous ftp at

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Galactic consequences of clustered star formation

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[2]Astronomical Institute, Utrecht University

If all stars form in clusters and both the stars and the clusters follow a power law distribution which favours the creation of low mass objects, then the numerous low mass clusters will be deficient in high mass stars. Therefore, the mass function of stars, integrated over the whole galaxy (the Integrated Galactic Initial Mass Function, IGIMF) will be steeper at the high mass end than the underlying IMF of the stars. We show how the steepness of the IGIMF depends on the sampling method and on the assumptions made for the star cluster mass function. We also investigate the O-star content, integrated photometry and chemical enrichment of galaxies that result from several IGIMFs, as compared to more standard IMFs.

To appear in the proceedings of the conference/workshop Star clusters: basic galactic building blocks throughout time and space (IAU S266), held in Rio de Janeiro 10/08 – 14/08/2009, Cambridge University Press ed. Richard de Grijs & Jacques Lepine

A shorter version is to appear in the proceedings of the conference/workshop Population synthesis: planning for the next decade (IAU S262), held in Rio de Janeiro 03/08 – 07/08/2009, Cambridge University Press ed. Gustavo Bruzual & Stéphane Charlot

For preprints, contact `haas@strw.leidenuniv.nl`
Also available from the URL `http://arxiv.org/abs/0909.4410`

Young open clusters in the Milky Way and Small Magellanic Cloud

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NGC6611, Trumpler 14, Trumpler 15, Trumpler 16, Collinder 232 are very young open clusters located in star-formation regions of the Eagle Nebula or the Carina in the MW, and NGC346 in the SMC. With different instrumentations and techniques, it was possible to detect and classify new Herbig Ae/Be stars, classical Be stars and to provide new tests / comparisons about the Be stars appearance models. Special stars (He-strong) of these star-formation regions are also presented.

To appear in: Proceedings of the IAUS266
For preprints, contact `christophe.martayan@eso.org`
Also available from the URL `http://adsabs.harvard.edu/abs/2009arXiv0909.3029M`
or by anonymous ftp at `ftp://`

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IAU Symposium 270

Computational Star Formation

Barcelona, Spain, 31 May - 4 June 2010

Computational Astronomy is a relatively new branch of research that spans a wide range of skills, including the theory of gaseous and stellar dynamics, computational and algorithmic science, and visualization. It is also usually accompanied by serious comparisons with observations. Simulations of star formation and young cluster evolution have now reached a level of sophistication where they can reproduce the initial stellar mass function, the binary distribution as a function of stellar mass and period, the spatial distribution of stars in young clusters, the evolution of clusters, and the structure and evolution of galaxies. At the same time, there are large differences in techniques, algorithms, and computer hardware, and equally large differences in the assumptions about initial and boundary conditions and what physical processes to include.

The IAU Symposium 270 will be the forum to discuss simulations and observations of star formation in 2010. The result of this Symposium will be a better understanding of the similarities and differences between computational techniques, and a recognition of the successes and shortcomings in matching the simulation results to detailed observations of star formation.

SOC: T. Abel, J. Alves (co-chair), J. Ballesteros-Paredes, I. Bonnell, F. Bournaud, A. Burkert, C. Dobbs, B. Elmegreen (co-chair), J. Girart, G. Hensler, W. Kim, R. Klessen, M. Krumholz, J. Makino, F. Nakamura, Å. Nordlund, R. Pudritz, V. Trimble (co-chair), A. Tutukov

LOC: J. Alves, F. Alves, A. Bertolin, R. Estalella, P. Frau, J. Girart, J. Isern

Invited speakers include: T. Abel, J. Alves, P. André, J. Ascenso, J. Bally, S. Basu, M. Bate, I. Bonnell, F. Bournaud, L. Deharveng, C. Dobbs, N. Evans, S. Glover, A. Goodman, S. Goodwin, E. Grebel, P. Hennebelle, G. Hensler, R. Klessen, P. Kroupa, M. Krumholz, C. Lada, R. Larson, M. Mac Low, M. Machida, J. Makino, F. Nakamura, M. Norman, E. Ostriker, P. Padoan, D. Price, R. Pudritz, A. Raga, E. Tasker, R. Teyssier, E. Vázquez-Semanedi, K. Wada

More information available at: `www.iaus270.org`

Several postdoc positions available at the new Center for Interdisciplinary Exploration and Research in Astrophysics (CIERA) at Northwestern University

A number of postdoc positions, including several new fellowships have been created in conjunction with the new Center for Interdisciplinary Exploration and Research in Astrophysics (CIERA) at Northwestern University. More details are available online at the following websites:

Theory Postdocs:
http://members.aas.org/JobReg/JobDetailPage.cfm?JobID=25868

Lindheimer Fellowship:
http://members.aas.org/JobReg/JobDetailPage.cfm?JobID=25870

CIERA Fellowships:
http://members.aas.org/JobReg/JobDetailPage.cfm?JobID=25871

The closing date for submissions to any of the above positions is the 31st of December 2009. Submissions should be send by email to ciera@northwestern.edu.