$\mathcal{SCYON}$

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. 40 *20 October 2008*

EDITORIAL

Dear subscribers,

here is the 40th issue of the SCYON newsletter. Todays edition contains 21 abstracts from refereed journals and conference proceedings. It also contains job advertisements for postdoc positions at the universities of Amsterdam and Concepcion.

Thank you to all those who sent in their contributions.

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

Clustering of Emission-line Stars in the W5E HII Region

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We have made a new survey of emission-line stars in the W5E HII region to investigate the population of PMS stars near the OB stars by using the Wide Field Grism Spectrograph 2 (WFGS2). A total of 139 Hα emission stars were detected and their g'i'-photometry was performed. Their spatial distribution shows three aggregates, i.e., two aggregates near the bright-rimmed clouds at the edge of the W5E HII region (BRC 13 and BRC 14) and one near the exciting O7V star. The age and mass of each Hα star were estimated from an extinction-corrected color-magnitude diagram and theoretical evolutionary tracks. We found, for the first time in this region, that the young stars near the exciting star are systematically older (4 Myr) than those near the edge of the HII region (1 Myr). This result supports that the formation of stars proceeds sequentially from the center of HII region to the eastern bright rim. We further suggest a possibility that the birth of low-mass stars near the exciting star of the HII region precedes the production of massive OB stars in the pre-existing molecular cloud.

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For preprints, contact mnakano@cc.oita-u.ac.jp
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A discontinuity in the low-mass IMF – the case of high multiplicity

Ingo Thies, Pavel Kroupa
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The empirical binary properties of brown dwarfs (BDs) differ from those of normal stars suggesting BDs form a separate population. Recent work by Thies and Kroupa revealed a discontinuity of the initial mass function (IMF) in the very-low-mass star regime under the assumption of a low multiplicity of BDs of about 15 per cent. However, previous observations had suggested that the multiplicity of BDs may be significantly higher, up to 45 per cent. This contribution investigates the implication of a high BD multiplicity on the appearance of the IMF for the Orion Nebula Cluster, Taurus-Auriga, IC 348 and the Pleiades. We show that the discontinuity remains pronounced even if the observed MF appears to be continuous, even for a BD binary fraction as high as 60%. We find no evidence for a variation of the BD IMF with star-forming conditions. The BD IMF has a power-law index $\alpha_{\rm BD} \approx +0.3$ and about 2 BDs form per 10 low-mass stars assuming equal-mass pairing of BDs.

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Also available from the URL `http://arxiv.org/abs/0808.2644`
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2. Galactic Open Clusters

Open Clusters IC 4665 and Cr 359 and a Probable Birthplace of the Pulsar PSR B1929+10

V.V. Bobylev
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Based on the epicyclic approximation, we have simulated the motion of the young open star clusters IC 4665 and Collinder 359. The separation between the cluster centers is shown to have been minimal 7 Myr ago, 36 pc. We have established a close evolutionary connection between IC 4665 and the Scorpius-Centaurus association — the separation between the centers of these structures was ≈ 200 pc 15 Myr ago. In addition, the center of IC 4665 at this time was near two well-known regions of coronal gas: the Local Bubble and the North Polar Spur. The star HIP 86768 is shown to be one of the candidates for a binary (in the past) with the pulsar PSR B1929+10. At the model radial velocity of the pulsar $V_r = 2 \pm 50$ km s^{-1}, a close encounter of this pair occurs in the vicinity of IC 4665 at a time of -1.1 Myr. At the same time, using currently available data for the pulsar B1929+10 at its model radial velocity $V_r = 200 \pm 50$ km s^{-1}, we show that the hypothesis of Hoogerwerf et al. (2001) about the breakup of the ζOph—B1929+10 binary in the vicinity of Upper Scorpius (US) about 0.9 Myr ago is more plausible.

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NTT follow-up observations of star cluster candidates from the FSR catalogue

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(1) University of Kent, (2) Thueringer Landessternwarte Tautenburg, (3) University of St. Andrews

We are conducting a large program to classify newly discovered Milky Way star cluster candidates from the list of Froebrich, Scholz & Raftery (2007). Here we present deep NIR follow-up observations from ESO/NTT of 14 star cluster candidates. We show that the combined analysis of star density maps and colour-colour/magnitude diagrams derived from deep near-infrared imaging is a viable tool to reliably classify new stellar clusters. This allowed us to identify two young clusters with massive stars, three intermediate age open clusters, and two globular cluster candidates among our targets. The remaining seven objects are unlikely to be stellar clusters. Among them is the object FSR1767 which has previously been identified as a globular cluster using 2MASS data by Bonatto et al. (2007). Our new analysis shows that FSR1767 is not a star cluster. We also summarise the currently available follow-up analysis of the FSR candidates and conclude that this catalogue may contain a large number of new stellar clusters, probably dominated by old open clusters.

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Discovery of a young massive stellar cluster near HESS J1813-178

Maria Messineo, Donald F. Figer, Ben Davies, R. Michael Rich, E. Valenti, R.P. Kudritzki

Rochester Institute of Technology, UCLA, ESO, IfA

We present the serendipitous discovery of a young stellar cluster in the Galactic disk at l=12deg. Using Keck/NIRSPEC, we obtained high- and low-resolution spectroscopy of several stars in the cluster, and we identified one red supergiant and two blue supergiants. The radial velocity of the red supergiant provides a kinematic cluster distance of 4.7 ± 0.4 kpc, implying luminosities of the stars consistent with their spectral types. Together with the known Wolf-Rayet star located 2.4' from the cluster center, the presence of the red supergiant and the blue supergiants suggests a cluster age of 6-8 Myr, and an initial mass of 2000 Msun. Several stars in the cluster are coincident with X-ray sources, including the blue supergiants and the Wolf-Rayet star. This is indicative of a high binary fraction, and is reminiscent of the massive young cluster Westerlund 1. The cluster is coincident with two supernova remnants, SNR G12.72-0.0 and G12.82-0.02, and the highly magnetized pulsar associated with the TeV gamma-ray source HESS J1813-178. The mixture of spectral types suggests that the progenitors of these objects had initial masses of 20 - 30 Msun.

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Early-type objects in NGC 6611 and the Eagle Nebula

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Aims. An important question about Be stars is whether they are born as such or whether they have become Be stars during their evolution. It is necessary to observe young clusters to answer this question. Methods: To this end, observations of stars in NGC 6611 and the star-formation region of Eagle Nebula were carried out with the ESO-WFI in slitless spectroscopic mode and at the VLT-GIRAFFE (R $\approx$ 6400-17 000). The targets for the GIRAFFE observations were pre-selected from the literature and our catalogue of emission-line stars based on the WFI study. GIRAFFE observations allowed us to study the population of the early-type stars accurately both with and without emission lines. For this study, we determined the fundamental parameters of OBA stars thanks to the GIRFIT code. We also studied the status of the objects (main sequence or pre-main sequence stars) by using IR data, membership probabilities, and location in HR diagrams. Results: The nature of the early-type stars with emission-line stars in NGC 6611 and its surrounding environment is derived. The slitless observations with the WFI clearly indicate a small number of emission-line stars in M16. We observed with GIRAFFE 101 OBA stars, among them 9 are emission-line stars with circumstellar emission in Hα. We found that W080 could be a new He-strong star, like W601. W301 is a possible classical Be star, W503 is a mass-transfer eclipsing binary with an accretion disk, and the other ones are possible Herbig Ae/Be stars. We also found that the rotational velocities of main sequence B stars are 18% lower than those of pre-main sequence B stars, in good agreement with theory about the evolution of rotational velocities. Combining adaptive optics, IR data, spectroscopy, and radial velocity indications, we found that 27% of the B-type stars are binaries. We also redetermined the age of NGC 6611 found equal to 1.2-1.8 Myears, in good agreement with the most recent determinations.

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Stellar tracers of the Cygnus Arm. II: A young open cluster in Cam OB3

Ignacio Negueruela, Amparo Marco
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Cam OB3 is the only defined OB association believed to belong to the Outer Galactic Arm or Cygnus Arm. Very few members have been observed and the distance modulus to the association is not well known. We attempt a more complete description of the population of Cam OB3 and a better determination of its distance modulus. We present uvby photometry of the area surrounding the O-type stars BD +56 864 and LS I +57 138, finding a clear sequence of early-type stars that define an uncatalogued open cluster, which we call Alicante 1. We also present spectroscopy of stars in this cluster and the surrounding association. From the spectral types for 18 very likely members of the association and UBV photometry found in the literature, we derive individual reddenings, finding a extinction law close to standard and an average distance modulus DM=13.0 $\pm$ 0.4. This value is in excellent agreement with the distance modulus to the new cluster Alicante 1 found by fitting the photometric sequence to the ZAMS. In spite of the presence of several O-type stars, Alicante 1 is a very sparsely populated open cluster, with an almost total absence of early B-type stars. Our results definitely confirm Cam OB3 to be located on the Cygnus Arm and identify the first open cluster known to belong to the association.

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3. Galactic Center Clusters

Self-consistent simulations of nuclear cluster formation through globular cluster orbital decay and merging.

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We present results of fully self-consistent N-body simulations of the motion of four globular clusters moving in the inner region of their parent galaxy. With regard to previous simplified simulations, we confirm merging and formation of an almost steady nuclear cluster, in a slightly shorter time. The projected surface density profile shows strong similarity to that of resolved galactic nuclei. This similarity reflects also in the velocity dispersion profile which exhibits a central colder component as observed in many nucleated galaxies.

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4. Galactic Globular Clusters

A Spitzer search for cold dust within globular clusters

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Globular cluster stars evolving off the main sequence are known to lose mass, and it is expected that some of the lost material should remain within the cluster as an intracluster medium (ICM). Most attempts to detect such an ICM have been unsuccessful. The Multiband Imaging Photometer for Spitzer on the Spitzer Space Telescope was used to observe eight Galactic globular clusters in an attempt to detect the thermal emission from ICM dust. Most clusters do not have significant detections at 70 microns; one cluster, NGC 6341, has tentative evidence for the presence of dust, but 90 micron observations do not confirm the detection. Individual 70 micron point sources which appear in several of the cluster images are likely to be background galaxies. The inferred dust mass and upper limits are ¡ 4e-4 solar masses, well below expectations for cluster dust production from mass loss in red and asymptotic giant branch stars. This implies that either globular cluster dust production is less efficient, or that ICM removal or dust destruction is more efficient, than previously believed. We explore several possibilities for ICM removal and conclude that present data do not yet permit us to distinguish between them.

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Also available from the URL `http://arxiv.org/abs/0810.1902`
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5. Extragalactic Clusters

On the Star Formation Rate - Brightest Cluster Relation: Estimating the peak SFR in post-merger galaxies

Nate Bastian
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We further the recent discussion on the relation between the star-formation rate (SFR) of a galaxy and the luminosity of its brightest star-cluster (SFR vs. $M_V^{\rm brightest}$). We first show that the observed trend between SFR vs. $M_V^{\rm brightest}$ is due to the brightest cluster in a galaxy being preferentially young ($<$ 15 Myr - for a constant SFR) and hence a good tracer of the current SFR, although we give notable exceptions to this rule. Archival HST imaging of high-SFR galaxies, as well as additional galaxies/clusters from the literature, are used to further confirm the observed trend. Using a series of Monte Carlo simulations we show that a pure power-law mass function with index, alpha=2, is ruled out by the current data. Instead we find that a Schechter function (i.e. a power-law with an exponential truncation at the high mass end) provides an excellent fit to the data. Additionally, these simulations show that bound cluster formation (in msun/yr) represents only $\sim$8+-3% of the total star-formation within a galaxy, independent of the star-formation rate. From this we conclude that there is only a single mode of cluster formation which operates over at least six orders of magnitude in the SFR. We provide a simple model of star/cluster formation feedback within dwarf galaxies (and star-forming complexes within spirals) which highlights the strong impact that a massive cluster can have on its surroundings.

Using this relation, we can extrapolate backwards in time in order to estimate the peak SFR of major merger galaxies, such as NGC7252, NGC1316, and NGC3610. The derived SFRs for these galaxies are between a few hundred and a few thousand solar masses per year. The inferred far infrared luminosity of the galaxies, from the extrapolated SFR, places them well within the range of Ultra-luminous galaxies (ULIRGs) and for NGC7252 within the Hyper-luminous infrared galaxy regime. Thus, we provide evidence that these post merger galaxies passed through a ULIRG/HLIRG phase and are now evolving passively. Using the current and extrapolated past SFR of NGC34, we infer that the ULIRG phase of this galaxy has lasted for at least 150 Myr.

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Uniting Old Stellar Systems: from globular clusters to giant ellipticals

Duncan Forbes, Paul Lasky, Alister Graham, Lee Spitler
Swinburne University

Elliptical galaxies and globular clusters (GCs) have traditionally been regarded as physically distinct entities due to their discontinuous distribution in key scaling diagrams involving size, luminosity and velocity dispersion. Recently this distinctness has been challenged by the discovery of stellar systems with mass intermediate between those of GCs and dwarf ellipticals (such as Ultra Compact Dwarfs and Dwarf Galaxy Transition Objects). Here we examine the relationship between the virial and stellar mass for a range of old stellar systems, from GCs to giant ellipticals, and including such Intermediate Mass Objects (IMOs). Improvements on previous work in this area include the use of (i) near-infrared magnitudes from the 2MASS survey, (ii) aperture corrections to velocity dispersions, (iii) homogeneous half light radii and (iv) accounting for the effects of non-homology in galaxies. We find a virial-to-stellar mass relation that ranges from $\sim 10^4$ $M_\odot$ systems (GCs) to $\sim 10^{11}$ $M_\odot$ systems (elliptical galaxies). The lack of measured velocity dispersions for dwarf ellipticals with $-16 > M_K > -18$ ($\sim 10^8$ $M_\odot$) currently inhibits our ability to determine how, or indeed if, these galaxies connect continuously with GCs in terms of their virial-to-stellar mass ratios. We find elliptical galaxies to have roughly equal fractions of dark and stellar matter within a virial radius; only in the most massive (greater than 10^{11} $M_\odot$) ellipticals does dark matter dominate the virial mass. Although the IMOs reveal slightly higher virial-to-stellar mass ratios than lower mass GCs, this may simply reflect our limited understanding of their IMF (and hence their stellar mass-to-light ratios) or structural properties. We argue that most of these intermediate mass objects have similar properties to massive GCs, i.e. IMOs are essentially massive star clusters. Only the dwarf spheroidal galaxies exhibit behaviour notably distinct from the other stellar systems examined here, i.e. they display a strongly increasing virial-to-stellar mass ratio (equivalent to higher dark matter fractions) with decreasing stellar mass. The data used in this study is available in electronic format.

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Evolution of stellar structure in the Small Magellanic Cloud

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The projected distribution of stars in the Small Magellanic Cloud (SMC) from the Magellanic Clouds Photometric Survey is analysed. Stars of different ages are selected via criteria based on V magnitude and V-I colour, and the degree of 'grouping' as a function of age is studied. We quantify the degree of structure using the two-point correlation function and a method based on the Minimum Spanning Tree and find that the overall structure of the SMC is evolving from a high degree of sub-structure at young ages (10 Myr) to a smooth radial density profile. This transition is gradual and at 75 Myr the distribution is statistically indistinguishable from the background SMC distribution. This time-scale corresponds to approximately the dynamical crossing time of stars in the SMC. The spatial positions of the star clusters in the SMC show a similar evolution of spatial distribution with age. Our analysis suggests that stars form with a high degree of (fractal) sub-structure, probably imprinted by the turbulent nature of the gas from which they form, which is erased by random motions in the galactic potential on a time-scale of a galactic crossing time.

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ACS imaging of star clusters in M51 II The luminosity function and mass function across the disk

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Whether or not there exists a physical upper mass limit for star clusters is as yet unclear. For small cluster samples the mass function may not be sampled all the way to the truncation, if there is one. Data for the rich cluster population in the interacting galaxy M51 enables us to investigate this in more detail. Using HST/ACS data, we investigate whether the cluster luminosity function (LF) in M51 shows evidence for an upper limit to the mass function. The variations of the cluster luminosity function parameters with position on the disk are addressed. We determine the cluster LF for all clusters in M51 falling within our selection criteria, as well as for several subsets of the sample. In that way we can determine the properties of the cluster population as a function of galactocentric distance and background intensity. By comparing observed and simulated LFs we can constrain the underlying cluster initial mass function and/or cluster disruption parameters. A physical upper mass limit for star clusters will appear as a bend dividing two power law parts in the LF, if the cluster sample is large enough to sample the full range of cluster masses. The location of the bend in the LF is indicative of the value of the upper mass limit. The slopes of the power laws are an interplay between upper mass limits, disruption times and evolutionary fading. The LF of the cluster population of M51 is better described by a double power law than by a single power law. We show that the cluster initial mass function is likely to be truncated at the high mass end. We conclude from the variation of the LF parameters with galactocentric distance that both the upper mass limit and the cluster disruption parameters are likely to be a function of position in the galactic disk. At higher galactocentric distances the maximum mass is lower, cluster disruption slower, or both.

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A New Method for Estimating Dark Matter Halo Masses using Globular Cluster Systems

Lee R. Spitler and Duncan A. Forbes
Swinburne University

All galaxies are thought to reside within large halos of dark matter, whose properties can only be determined from indirect observations. The formation and assembly of galaxies is determined from the interplay between these dark matter halos and the baryonic matter they host. Although statistical relations can be used to approximate how massive a galaxy's halo is, very few individual galaxies have direct measurements of their halo masses. We present a method to directly estimate the total mass of a galaxy's dark halo using its system of globular clusters. The link between globular cluster systems and halo masses is independent of a galaxy's type and environment, in contrast to the relationship between galaxy halo and stellar masses. This trend is expected in models where globular clusters form in early, rare density peaks in the cold dark matter density field and the epoch of reionisation was roughly coeval throughout the Universe. We illustrate the general utility of this relation by demonstrating that a galaxy's supermassive black hole mass and global X-ray luminosity are directly proportional to their host dark halo masses, as inferred from our new method.

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6. Dynamical evolution - Simulations

Hypercompact Stellar Systems Around Recoiling Supermassive Black Holes

David Merritt, Jeremy Schnittman, Stefanie Komossa
RIT, JHU, MPE

A supermassive black hole ejected from the center of a galaxy by gravitational wave recoil carries a retinue of bound stars - a "hypercompact stellar system" (HCSS). The numbers and properties of HCSSs contain information about the merger histories of galaxies, the late evolution of binary black holes, and the distribution of gravitational-wave kicks. We relate the structural properties of HCSSs to the properties of their host galaxies, in two regimes: collisional, i.e. short nuclear relaxation times; and collisionless, i.e. long nuclear relaxtion times. HCSSs are expected to be similar in size and luminosity to globular clusters but in extreme cases their stellar mass can approach that of UCDs. They differ from all known classes of compact stellar system in having very high internal velocity dispersions. We show that the kick velocity is encoded in the velocity dispersion of the bound stars. Given a large enough sample of HCSSs, the distribution of gravitational wave kicks can therefore be empirically determined.We combine a hierarchical merger algorithm with stellar population models to compute the rate of production of HCSSs over time and the probability of observing HCSSs in the local universe as a function of their apparent magnitude, color, size and velocity dispersion, under two assumptions about the star formation history prior to the kick. We predict that roughly 100 HCSSs should be detectable within 2 Mpc of the center of the Virgo cluster and that many of these should be bright enough that their high internal velocity dispersions could be measured with reasonable exposure times.

Submitted to : Astrophysical Journal
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Also available from the URL `http://arxiv.org/abs/0809.5046`
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High mass-to-light ratios of UCDs - Evidence for dark matter ?

Holger Baumgardt, Steffen Mieske
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Ultra-compact dwarf galaxies (UCDs) are stellar systems with masses of around 10^7 to 10^8 $M_\odot$ and half mass radii of 10-100 pc. They have some properties in common with massive globular clusters, however dynamical mass estimates have shown that UCDs have mass-to-light ratios which are on average about twice as large than those of globular clusters at comparable metallicity, and tend to be larger than what one would expect for old stellar systems with standard mass functions. One possible explanation for elevated high mass-to-light ratios in UCDs is the existence of a substantial amount of dark matter, which could have ended up in UCDs if they are the remnant nuclei of tidally stripped dwarf galaxies. Tidal stripping of dwarf galaxies has also been suggested has the origin of several massive globular clusters like Omega Cen, in which case globular clusters could have also formed with substantial amounts of dark matter. In this paper, we present collisional N-body simulations which study the co-evolution of a system composed out of stars and dark matter. We find that the dark matter gets removed from the central regions of such systems due to dynamical friction and mass segregation of stars. The friction timescale is significantly shorter than a Hubble time for typical globular clusters, while most UCDs have friction times much longer than a Hubble time. Therefore, a significant dark matter fraction remains within the half-mass radius of present-day UCDs, making dark matter a viable explanation for the elevated M/L ratios of UCDs. If at least some globular clusters formed in a way similar to UCDs, we predict a substantial amount of dark matter in their outer parts.

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7. Miscellaneous

Galactic Rotation Curve and the Effect of Density Waves from Data on Young Objects

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Based on currently available data on the three-dimensional field of space velocities of young ($\leq$50 Myr) open star clusters and the radial velocities of HI clouds and star-forming (HII) regions, we have found the Galactic rotation curve in the range of Galactocentric distances 3 kpc $< R <$ 12 kpc using the first six terms of the Taylor expansion of the angular velocity of Galactic rotation in Bottlinger's equations. The Taylor terms found at the Galactocentric distance of the Sun $R_0 = 7.5$ kpc are: $\omega_0 = -27.7 \pm 0.6$ km s^{-1} kpc^{-1}, $\omega_0^1 = 4.13 \pm 0.07$ km s^{-1} kpc^{-2}, $\omega_0^2 = -0.912 \pm 0.065$ km s^{-1} kpc^{-3}, $\omega_0^3 = 0.277 \pm 0.036$ km s^{-1} kpc^{-4}, $\omega_0^4 = -0.265 \pm 0.034$ km s^{-1} kpc^{-5}, $\omega_0^5 = 0.104 \pm 0.020$ km s^{-1} kpc^{-6}. In this case, the Oort constants are $A = 15.5 \pm 0.3$ km s^{-1} kpc^{-1} and $B = -12.2 \pm 0.7$ km s^{-1} kpc^{-1}. We have established that the centroid of the sample moves relative to the local standard of rest along the Galactic Y axis with a velocity of -6.2 ± 0.8 km s^{-1}. A Fourier spectral analysis of the velocity residuals from the derived rotation curve attributable to density waves reveals three dominant peaks with wavelengths of 2.5, 1.4, and 0.9 kpc and amplitudes of 4.7, 2.6, and 3.6 km s^{-1}, respectively. These have allowed us to estimate the distances between the density wave peaks, 1.9, 2.4, and 3.2 kpc as R increases, in agreement with the description of the density weave as a logarithmic spiral. The amplitude of the density wave perturbations is largest in the inner part of the Galaxy, ≈ 9 km s^{-1}, and decreases to ≈ 1 km s^{-1} in its outer part. A spectral analysis of the radial velocities of young open star clusters has confirmed the presence of periodic perturbations with an amplitude of 5.9 ± 1.1 km s^{-1} and a wavelength $\lambda = 1.7 \pm 0.5$ kpc. It shows that the phase of the Sun in the density wave is close to $-\pi/2$ and the Sun is located in the interarm space near the outer edge of the Carina-Sagittarius arm.

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Lithium depletion and the rotational history of exoplanet host stars

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Israelian et al. (2004) reported that exoplanet host stars are lithium depleted compared to solar-type stars without detected massive planets, a result recently confirmed by Gonzalez (2008). We investigate whether enhanced lithium depletion in exoplanet host stars may result from their rotational history. We develop rotational evolution models for slow and fast solar-type rotators from the pre-main sequence (PMS) to the age of the Sun and compare them to the distribution of rotational periods observed for solar-type stars between 1 Myr and 5 Gyr. We show that slow rotators develop a large degree of differential rotation between the radiative core and the convective envelope, while fast rotators evolve with little core-envelope decoupling. We suggest that strong differential rotation at the base of the convective envelope is responsible for enhanced lithium depletion in slow rotators. We conclude that Li-depleted exoplanet host stars were slow rotators on the zero-age main sequence (ZAMS) and argue that slow rotation results from a long-lasting star-disk interaction during the PMS. Altogether, this suggests that long-lived disks ($\geq$ 5 Myr) may be a necessary condition for massive planet formation/migration.

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Searching for spiral features in the outer Galactic disk. The field towards WR38 and WR38a

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The detailed spiral structure in the outer Galactic disk is still poorly kno wn, and for several Galactic directions we still have to rely on model extrapolations. One of these regions is the fourth Galactic quadrant, in the sector comprise d between Vela and Carina ($270^o \leq l \leq 300^o$) where -apart from the conspicuous Carina branch of the Carina Sagittarius arm- no spiral arms have been detected so fa r in the optical beyond $l \sim 270^o$. By means of deep $UBVI$ photometry, we search for spiral features in known l ow absorption windows. U photometry, although observationally demanding, constitutes a p owerful tool to detect and characterize distant aggregates of young stars, and allows to derive firmer distance estimates. We have studied a direction close to the tangent ($l \sim 290^o$) to the Carina arm, in an attempt to detect optical spiral tracers far beyond the Carina branch, where radio observations and models predictions seem to indicate the presence of the extension of the Perseus and Norma-Cygnus spiral arms in the fourth quadrant. Along this line of sight, we detect three distinct groups of young stars. Two of them, at distances of 2.5 and 6.0 kpc, belong to the Carina spiral arm (wh ich is crossed twice in this particular direction). Interestingly, the latter is here detected for the first time. The third group, at a distance of ∼12.7 kpc, is likely a part of the Perseus arm which lies beyond the Carina arm, and constitutes the first optical detection of this arm in the fourth Galactic quadrant. The position of this f eature is compatible both with HI observations and model predictions. We furthermore present evide nce that this extremely distant group, formerly thought to be a star cluster (Shorlin 1), i s in fact a diffuse young population typical of spiral features. In addition, our data-set does not support, as claimed in the literature, the possible presence of the Monoceros Ring toward this direction. This study highlights how multicolor optical studies can be effective to pro be the spiral structure in the outer Galactic disk. More fields need to be studied in this region of the Galaxy to better constrain the spiral structure in the fourth Galactic quadrant, in particular the shape and extent of the Perseus arm, and, possibly, to detect the even more distant Norma-Cygn us arm.

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Assessing potential cluster Cepheids from a new distance and reddening parameterization and 2MASS photometry

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A framework is outlined to assess Cepheids as potential cluster members from readily available photometric observations. A relationship is derived to estimate colour excess and distance for individual Cepheids through a calibration involving recently published HST parallaxes and a cleaned sample of established cluster Cepheids. Photometric (V-J) colour is found to be a viable parameter for approximating a Cepheid's reddening. The non-universal nature of the slope of the Cepheid PL relation for BV photometry is confirmed. By comparison, the slopes of the VJ and VI relations seem relatively unaffected by metallicity. A new Galactic Cepheid confirmed here, GSC 03729-01127 (F6-G1 Ib), is sufficiently coincident with the coronal regions of Tombaugh 5 to warrant follow-up radial velocity measures to assess membership. CCD photometry and O–C diagrams are presented for GSC 03729-01127 and the suspected cluster Cepheids AB Cam and BD Cas. Fourier analysis of the photometry for BD Cas and recent estimates of its metallicity constrain it to be a Population I overtone pulsator rather than a Type II s-Cepheid. AB Cam and BD Cas are not physically associated with the spatially-adjacent open clusters Tombaugh 5 and King 13, respectively, the latter being much older (log t 9) than believed previously. Rates of period change are determined for the three Cepheids from archival and published data. GSC 03729-01127 and AB Cam exhibit period increases, implying fifth and third crossings of the instability strip, respectively, while BD Cas exhibits a period decrease, indicating a second crossing, with possible superposed trends unrelated to binarity. More importantly, the observed rates of period change confirm theoretical predictions. The challenges and prospects for future work in this area of research are discussed.

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The sub-solar IMF in the Large Magellanic Cloud

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The Magellanic Clouds offer a unique variety of star forming regions seen as bright nebulae of ionized gas, related to bright young stellar associations. Nowadays, observations with the high resolving efficiency of the Hubble Space Telescope allow the detection of the faintest infant stars, and a more complete picture of clustered star formation in our dwarf neighbors has emerged. I present results from our studies of the Magellanic Clouds, with emphasis in the young low-mass pre-main sequence populations. Our data include imaging with the Advanced Camera for Surveys of the association LH 95 in the Large Magellanic Cloud, the deepest observations ever taken with HST of this galaxy. I discuss our findings in terms of the Initial Mass Function, which we constructed with an unprecedented completeness down to the sub-solar regime, as the outcome of star formation in the low-metallicity environment of the LMC.

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Vacancy for a Research and development team – PostDoc, Programmer and Software Engineer – Astronomical Multipurpose Software Environment

Institution: Astronomical Institute 'Anton Pannekoek' and Section Computational Science, University of Amsterdam

Description:

Join our research team and help us shape the future of the Astronomical Multipurpose Software Environment (AMUSE). Our work deals with simulating dense stellar systems using AMUSE; a component library in which a wide variety of existing numerical codes that will be incorporated into a single framework. We develop a research software framework for large scale simulations in which at least two of the application domains are incorporated (stellar dynamics, stellar evolution, hydrodynamics and radiative processes).

The successful candidate will participate in the design, implementation and testing of the AMUSE framework. This position requires frequent interaction with the research and development teams.

Position requirements:

We are looking for: 1 software engineer, 2 programmers, 1 Postdoctoral researcher. Each candidate should have an advanced degree in computational science, astrophysics or a related field. Experience in software development and programming in Python or C/C++ are an advantage. You will be working as a problem solver in an international research team. The candidate need to perform on a scientific level.

An interest in astrophysics and numerical applications is an advantage, as is experience in any of the astronomical applications (stellar dynamics, stellar evolution, hydrodynamics or radiative transfer). Are you interest in research and would like to use your unique skills to support the development of our problem solving environments this may be the job for you.

Organization:

The University of Amsterdam (UvA) is a university with an internationally acclaimed profile, located at the heart of the Dutch capital. As well as a world center for business and research, Amsterdam is a hub of cultural and media activities. The University of Amsterdam is a member of the League of European Research Universities.

The Faculty of Science at the Universiteit van Amsterdam is one of Europe's foremost institutions of higher education and research in its chosen fields of specialization. It plays an active role in international science networks and collaborates with universities and industry. The Faculty has approximately 2,000 students and 1,500 staff members spread over four departments and ten research institutes. Each institute has its own research program, a substantial part of which is externally funded by the Netherlands Organization for Scientific Research (NWO), the Dutch government, the EU and various private enterprises.

Details of appointment:

The appointment will be on a temporary basis for a period of two years. The salary will be in accordance with the University regulations for academic personnel (Collective Labor Agreement)

and will range from 2.379,- to a maximum of 4.374,- Euros gross per month based on a full-time appointment and depending on qualifications and previous experience. The salary will be increased with 8 allowance and 8,3 % end-of-year bonus.

Interested candidates should send their resume, cover letter and three letters of recommendation (Postdoc and Software engineer only) to the above address or email to application-science@uva.nl (write AMUSE in the subject heading).

Submit resumes to:

Drs. S.H.M. Jongerius
Universiteit van Amsterdam,
Faculty of Science (Office of Personnel)
Kruislaan 403
1098 SM Amsterdam
the Netherlands
email: application-science@uva.nl

For more information:

Dr. S. Porteiges Zwart
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Tel.: +31 20 525 7491/7492
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URL1: http://muse.li (AMUSE predecessor project page)
URL3: http://modesta.science.uva.nl/ (Modeling Dense Stellar Systems project page)
URL2: http://staff.science.uva.nl/∼spz/ (P.I. Homepage)

The closing date for receipt of applications: **1 December 2009**

One-Year Post-doc Position in Numerical Stellar Dynamics

Departamento de Astronomia
Universidad de Concepcion
Casila 160-C
Concepcion
Chile

Attention: Dr. Michael Fellhauer
e-mail: mfellhauer@astro-udec.cl
URL: http://www.astro-udec.cl

The department of astronomy at the university of Concepcion, Chile hosts a very lively group interested in Galactic and extragalactic stellar dynamics with a good observational expertise. Recently a theoretical group in stellar dynamics was added. Therefore, the astronomy department is seeking to fill a post-doc position in theoretical and numerical stellar dynamics. The focus of this position should be in the field of dwarf galaxies, star clusters and tidal tails, to work with Dr. Michael Fellhauer.

In addition to a PhD in astronomy the successful candidate should have experience with N-body and/or SPH simulations and should show interest in the modeling of dwarf galaxies (both Galactic and extragalactic) and star clusters.

Funding is available for one year with the possibility of an extension for a second year. The salary is paid in Chilean pesos but amounts to approximately 30,000 US$ per year.

Please send a CV, a list of publications, a statement of research interests and two letters of reference (preferentially via e-mail) to Dr. Michael Fellhauer (mfellhauer@astro-udec.cl). Deadline for the submission is January, 31st but review of applications will start earlier.

Starting date for this position should be April, 2009. The university of Concepcion is an equal opportunity employer.