

# The Star Clusters Young & Old Newsletter

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## EDITORIAL

Dear subscribers,

With the sixtieth SCYON issue (the 3<sup>rd</sup> one after the relaunch) it is time to strike a first balance. Currently, there are about 550 subscribers, with numerous new ones joining during the last months - *WELCOME!* Unfortunately, the number of abstract submissions stagnates. Thus, we are still not able to publish SCYON more often than on a quarterly basis. Please consider and use the Newsletter as a kind of portal to the stellar cluster community and submit your papers regularly also to SCYON – immediately after your paper is submitted to or is accepted by a Journal. There is no need to wait until the “Call for contributions” – your abstracts will be visible to the community on the SCYON webpage soon after the submission!

This new issue contains 19 refereed and proceedings abstracts, and announcements of upcoming conferences. We look forward to have everybody’s help to disseminate this Newsletter everywhere!

Please visit our webpage frequently for news and abstracts, which reach us between the SCYON issues!

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## About the Newsletter

SCYON publishes abstracts from any area in astronomy, which are relevant to research on star clusters. We welcome all kinds of submitted contributions (abstracts of refereed papers or conference proceedings, PhD summaries, and general announcements of e.g. conferences, databases, tools, etc.)

The mission of this newsletter is to help all the researchers in the field with a quick and efficient link to the scientific activity in the field. We encourage everybody to contribute to the new releases! New abstracts can be submitted *at any time* using the **webform** on the SCYON homepage.

<http://www.univie.ac.at/scyon>



## Star Forming Regions

### Orion revisited. II. The foreground population to Orion A

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Following the recent discovery of a large population of young stars in front of the Orion Nebula, we carried out an observational campaign with the DECam wide-field camera covering  $\sim 10$  deg<sup>2</sup> centered on NGC 1980 to confirm, probe the extent of, and characterize this foreground population of pre-main-sequence stars. We confirm the presence of a large foreground population towards the Orion A cloud. This population contains several distinct subgroups, including NGC1980 and NGC1981, and stretches across several degrees in front of the Orion A cloud. By comparing the location of their sequence in various color-magnitude diagrams with other clusters, we found a distance and an age of 380pc and 5~10Myr, in good agreement with previous estimates. Our final sample includes 2123 candidate members and is complete from below the hydrogen-burning limit to about  $0.3M_{\odot}$ , where the data start to be limited by saturation. Extrapolating the mass function to the high masses, we estimate a total number of  $\sim 2600$  members in the surveyed region. We confirm the presence of a rich, contiguous, and essentially coeval population of about 2600 foreground stars in front of the Orion A cloud, loosely clustered around NGC1980, NGC1981, and a new group in the foreground of the OMC-2/3. For the area of the cloud surveyed, this result implies that there are more young stars in the foreground population than young stars inside the cloud. Assuming a normal initial mass function, we estimate that between one to a few supernovae must have exploded in the foreground population in the past few million years, close to the surface of Orion A, which might be responsible, together with stellar winds, for the structure and star formation activity in these clouds. This long-overlooked foreground stellar population is of great significance, calling for a revision of the star formation history in this region of the Galaxy.

**Accepted by : Astronomy & Astrophysics**

<http://arxiv.org/abs/1402.1034>

## Galactic Open Clusters

### Apex determination and detection of stellar clumps in the open cluster M 67

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We determined the cluster apex coordinates, studied the substructures and performed membership analysis in the central part ( $34' \times 33'$ ) of the open cluster M 67. We used the individual stellar apices method developed earlier and classical technique of proper motion diagrams in coordinate system connected with apex. The neighbour-to-neighbour distance technique was applied to detect space details. The membership list was corrected and some stars were excluded from the most probable members list. The apex coordinates have been determined as:  $A_0 = 132.97^\circ \pm 0.81^\circ$  and  $D_0 = 11.85^\circ \pm 0.90^\circ$ . The 2D-space star density field was analysed and high degree of inhomogeneity was found.

**Accepted by : New Astronomy**

<http://cdsads.u-strasbg.fr/abs/2014NewA...31...43V>

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### Towards a determination of definitive parameters for the long period Cepheid S Vulpeculae

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A new compilation of UBV data for stars near the Cepheid S Vul incorporates BV observations from APASS and NOMAD to augment UBV observations published previously. A reddening analysis yields mean colour excesses and distance moduli for two main groups of stars in the field: the sparse cluster Turner 1 and an anonymous background group of BA stars. The former appears to be  $1.07 \pm 0.12$  kpc distant and reddened by  $E(B - V) = 0.45 \pm 0.05$ , with an age of  $\log t = 9.0$ . The previously overlooked latter group is  $3.48 \pm 0.19$  kpc distant and reddened by  $E(B - V) = 0.78 \pm 0.02$ , with an age of  $\log t = 7.1$ . Parameters inferred for S Vul under the assumption that it belongs to the distant group, as also argued by 2MASS data, are all consistent with similar results for other cluster Cepheids and Cepheid-like supergiants.

**Accepted by : Odessa Astronomical Publications**

<http://cdsads.u-strasbg.fr/abs/2014arXiv1403.1968T>

## Photoelectric search for peculiar stars in open clusters. XV. Feinstein 1, NGC 2168, NGC 2323, NGC 2437, NGC 2547, NGC 4103, NGC 6025, NGC 6633, Stock 2, and Trumpler 2

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The chemically peculiar (CP) stars of the upper main sequence are mainly characterized by strong overabundances of heavy elements. Two subgroups (CP2 and CP4) have strong local magnetic fields which make them interesting targets for astrophysical studies. This star group, in general, is often used for the analysis of stellar formation and evolution in the context of diffusion as well as meridional circulation. In continuation of a long term study of CP stars (initiated in the 1980s), we present new results based on photoelectric measurements for ten open clusters that are, with one exception, younger than 235 Myr. Observations in star clusters are favourable because they represent samples of stars of constant age and homogeneous chemical composition. The very efficient tool of Delta-a photometry was applied. It samples the flux depression at 5200Å typically for CP stars. In addition, it is able to trace emission line Be/Ae and  $\lambda$  Bootis stars. Virtually all CP2 and CP4 stars can be detected via this tool, and it has been successfully applied even in the Large Magellanic Cloud. For all targets in the cluster areas, we performed a kinematic membership analysis. We obtained new photoelectric  $\Delta a$  photometry of 304 stars from which 207 objects have a membership probability higher than 50%. Our search for chemically peculiar objects results in fifteen detections. The stars have masses between 1.7  $M_{\odot}$  and 7.7  $M_{\odot}$  and are between the zero- and terminal-age-main-sequence. We discuss the published spectral classifications in the light of our  $\Delta a$  photometry and identify several misclassified CP stars. We are also able to establish and support the nature of known bona fide CP candidates. It is vital to use kinematic data for the membership determination and also to compare published spectral types with other data, such as  $\Delta a$  photometry. There are no doubts about the accuracy of photoelectric measurements, especially for stars brighter than 10th magnitude. The new and confirmed CP stars are interesting targets for spectroscopic follow-up observations to put constraints on the formation and evolution of CP stars.

**Accepted by : Astronomy & Astrophysics**

<http://cdsads.u-strasbg.fr/abs/2014A%26A...564A..42P>

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## A super lithium-rich red-clump star in the open cluster Trumpler 5

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The existence of lithium-rich low-mass red giant stars still represents a challenge for stellar evolution models. Stellar clusters are privileged environments for this kind of investigation. To investigate the chemical abundance pattern of the old open cluster Trumpler 5, we observed a sample of four red-clump stars with high-resolution optical spectrographs. One of them (# 3416) reveals extremely strong lithium lines in its spectrum. One-dimensional, local thermodynamic equilibrium analysis was performed on the spectra of the observed stars. A 3D-NLTE analysis was performed to derive the lithium abundance of star #3416. Results. Star #3416 is super Li-rich with  $A(\text{Li})=3.75$  dex. The lack of  $^6\text{Li}$  enrichment ( $^6\text{Li}/^7\text{Li}<2\%$ ), the low carbon isotopic ratio ( $^{12}\text{C}/^{13}\text{C}=14\pm 3$ ), and the lack of evidence for radial velocity variation or enhanced rotational velocity ( $v \sin i = 2.8 \text{ km s}^{-1}$ ) all suggest that lithium production has occurred in this star through the Cameron & Fowler mechanism. We identified a super Li-rich core helium-burning, red-clump star in an open cluster. Internal production

is the most likely cause of the observed enrichment. Given the expected short duration of a star's Li-rich phase, enrichment is likely to have occurred at the red clump or in the immediately preceding phases, namely during the He-flash at the tip of the red giant branch (RGB) or while ascending the brightest portion of the RGB.

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<http://cdsads.u-strasbg.fr/abs/2014A%26A...564L...6M>

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## **The Gaia-ESO Survey: Abundance ratios in the inner-disk open clusters Trumpler 20, NGC 4815, NGC 6705**

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Open clusters are key tools to study the spatial distribution of abundances in the disk and their evolution with time. Using the first release of stellar parameters and abundances of the Gaia-ESO Survey, we analyse the chemical properties of stars in three old/intermediate-age open clusters, namely NGC 6705, NGC 4815, and Trumpler 20, which are all located in the inner part of the Galactic disk at Galactocentric radius  $R_{GC} \sim 7$  kpc. We aim to prove their homogeneity and to compare them with the field population. We study the abundance ratios of elements belonging to two different nucleosynthetic channels:  $\alpha$ -elements and iron-peak elements. For each element, we analyse the internal chemical homogeneity of cluster members, and we compare the cumulative distributions of cluster abundance ratios with those of solar neighbourhood turn-off stars and of inner-disk/bulge giants. We compare the abundance ratios of field and cluster stars with two chemical evolution models that predict different  $\alpha$ -enhancement dependences on the Galactocentric distance due to different assumptions on the infall and star-formation rates. The main results can be summarised as follows: i) Cluster members are chemically homogeneous within  $3\text{-}\sigma$  in all analysed elements; ii) the three clusters have comparable  $[\text{E}/\text{Fe}]$  patterns within  $\sim 1\text{-}\sigma$ , but they differ in their global metal content  $[\text{E}/\text{H}]$  with NGC 4815 having the lowest metallicity. Their  $[\text{E}/\text{Fe}]$  ratios show differences and analogies with those of the field population, in both the solar neighbourhood and the bulge/inner disk; iii) comparing the abundance ratios with the results of two chemical evolution models and with field star abundance distributions, we find that the abundance ratios of Mg, Ni, and Ca in NGC 6705 might require an inner birthplace, implying a subsequent variation in its  $R_{GC}$  during its lifetime, which is consistent with previous orbit determination. Using the results of the first internal data release, we show the potential of the Gaia-ESO Survey through a homogeneous and detailed analysis of the cluster versus field populations to reveal the chemical structure of our Galaxy using a completely uniform analysis of different populations. We verify that the Gaia-ESO Survey data are able to identify the unique chemical properties of each cluster by pinpointing the composition of the interstellar medium at the epoch and place of formation. The full dataset of the Gaia-ESO Survey is a superlative tool to constrain the chemical evolution of our Galaxy by disentangling different formation and evolution scenarios.

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<http://adsabs.harvard.edu/abs/2014A%26A...563A...44M>

## Proper motions of the optically visible open clusters based on the UCAC4 catalog

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We present a catalog of mean proper motions and membership probabilities of individual stars for optically visible open clusters, which have been determined using data from the UCAC4 catalog in a homogeneous way. The mean proper motion of the cluster and the membership probabilities of the stars in the region of each cluster were determined by applying the statistical method in a modified fashion. In this study, we applied a global optimization procedure to fit the observed distribution of proper motions with two overlapping normal bivariate frequency functions, which also take into account the individual proper motion errors. For 724 clusters, this is the first determination of proper motion, and for the whole sample, we present results with a much larger number of identified astrometric member stars. Furthermore, it was possible to estimate the mean radial velocity of 364 clusters (102 unpublished so far) with the stellar membership using published radial velocity catalogs. These results provide an increase of 30% and 19% in the sample of open clusters with a determined mean absolute proper motion and mean radial velocity, respectively.

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<http://cdsads.u-strasbg.fr/abs/2014A%26A...564A..79D>

## Updated properties of the old open cluster Melotte 66: Searching for multiple stellar populations

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Multiple generations of stars are routinely encountered in globular clusters but no convincing evidence has been found in Galactic open clusters to date. In this paper, we use new photometric and spectroscopic data to search for multiple stellar population signatures in the old, massive open cluster, Melotte 66. The cluster is known to have a red giant branch wide in color, which could be an indication of metallicity spread. Also the main sequence is wider than what is expected from photometric errors only. This evidence might be associated with either differential reddening or binaries. Both hypothesis have, however, to be evaluated in detail before recurring to the presence of multiple stellar populations. New, high-quality, CCD UBVI photometry have been acquired to this aim with high-resolution spectroscopy of seven clump stars that are complemented with literature data; this doubles the number of clump star members of the cluster for which high-resolution spectroscopy is available. All this new material is carefully analyzed in search for any spectroscopic or photometric manifestation of multiple populations among the cluster stars. Our photometric study confirms that the width of the main sequence close to the turn off point is entirely accounted for by binary stars and differential reddening with no need to advocate more sophisticated scenarios, such as metallicity spread or multiple main sequences. By constructing synthetic color-magnitude diagrams, we infer that the binary fraction has to be as large as 30% and their mass ratio in the range 0.6-1.0. As a by-product of our simulations, we provide new estimates of the cluster fundamental parameters. We measure a reddening  $E(B-V)=0.15\pm 0.02$ , and confirm the presence of a marginal differential reddening. The distance to the cluster is  $4.7_{-0.1}^{+0.2}$  kpc and the age is  $3.4\pm 0.3$  Gyr, which is somewhat younger and better constrained than previous estimates. Our detailed abundance analysis reveals that, overall,

Melotte 66 looks like a typical object of the old thin disk population with no significant spread in any of the chemical species we could measure. Finally, we perform a photometric study of the blue straggler star population and argue that their number in Melotte 66 has been significantly overestimated in the past. The analysis of their spatial distribution supports the scenario that they are most probably primordial binaries.

**Accepted by : Astronomy & Astrophysics**

<http://cdsads.u-strasbg.fr/abs/2014arXiv1404.6748C>

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## **NGC 4337: an over-looked old cluster in the inner disc of the Milky Way**

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Galactic open clusters do not survive long in the high density regions of the inner Galactic disc. Inside the solar ring only 11 open clusters are known with ages older than one Gyr. We show here, basing on deep, high-quality photometry, that NGC 4337, contrary to earlier findings, is indeed an old open cluster. The cluster is located very close to the conspicuous star cluster Trumpler 20, as well mis-classified in the past, and that has received so much attention in recent years. NGC 4337 shows a significant clump of He-burning stars which was not detected previously. Its beautiful color-magnitude diagram is strikingly similar to the one of the classical old open clusters IC 4651, NGC 752, and NGC 3680, and this suggests similar age and composition. A spectroscopic study is much needed to confirm our findings. This, in turn, would also allow us to better define the inner disc radial abundance gradient and its temporal evolution. To this aim, a list of clump star candidates is provided.

**Accepted by : Monthly Notices of the Royal Astronomical Society**

<http://cdsads.u-strasbg.fr/abs/2014MNRAS.441L..36C>

## The most distant clusters

### Sampling methods for stellar masses and the mmax-Mecl-relation in the starburst dwarf galaxy NGC 4214

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It has been claimed in the recent literature that a non-trivial relation between the mass of the most-massive star, mmax, in a star cluster and its embedded star cluster mass (the mmax-Mecl-relation) is falsified by observations of the most-massive stars and the H $\alpha$  luminosity of young star clusters in the starburst dwarf galaxy NGC 4214. Here it is shown by comparing the NGC 4214 results with observations from the Milky Way that NGC 4214 agrees very well with the predictions of the mmax-Mecl-relation and with the integrated galactic stellar initial mass function (IGIMF) theory. The difference in conclusions is based on a high degree of degeneracy between expectations from random sampling and those from mmax-Mecl-relation, but are also due to interpreting mmax as a truncation mass in a randomly sampled IMF. Additional analysis of galaxies with lower SFRs than those currently presented in the literature will be required to break this degeneracy.

**Accepted by : Monthly Notices of the Royal Astronomical Society**

<http://arxiv.org/abs/1404.1075>

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### Nuclear star clusters in 228 spiral galaxies in the HST/WFPC2 archive: catalogue and comparison to other stellar systems

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ESA ESTEC/STScI

We present a catalogue of photometric and structural properties of 228 nuclear star clusters (NSCs) in nearby late-type disk galaxies. These new measurements are derived from a homogeneous analysis of all suitable WFPC2 images in the HST archive. The luminosity and size of each NSC is derived from an iterative PSF-fitting technique, which adapts the fitting area to the effective radius ( $r_{\text{eff}}$ ) of the NSC, and uses a WFPC2-specific PSF model tailored to the position of each NSC on the detector. The luminosities of NSCs are  $\leq 10^8 L_{V,M_{\odot}}$ , and their integrated optical colours suggest a wide spread in age. We confirm that most NSCs have sizes similar to Globular Clusters (GCs), but find that the largest and brightest NSCs occupy the regime between Ultra Compact Dwarf (UCD) and the nuclei of early-type galaxies in the size-luminosity plane. The overlap in size, mass, and colour between the different incarnations of compact stellar systems provides a support for the notion that at least some UCDs and the most massive Galactic GCs, may be remnant nuclei of disrupted disk galaxies. We find tentative evidence for the NSCs'  $r_{\text{eff}}$  to be smaller when measured in bluer filters, and discuss possible implications of this result. We also highlight a few examples of complex nuclear morphologies, including double nuclei, extended stellar structures, and nuclear F606W excess from either recent (circum-)nuclear star formation and/or a weak AGN. Such examples may serve as case studies for ongoing NSC evolution via the two main suggested mechanisms, namely cluster merging and in situ star formation.

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<http://arxiv.org/abs/1404.5956>



## Hierarchical Star Formation in Nearby LEGUS Galaxies

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Hierarchical structure in ultraviolet images of 12 late-type LEGUS galaxies is studied by determining the numbers and fluxes of nested regions as a function of size from 1 to 200 pc, and the number as a function of flux. Two starburst dwarfs, NGC 1705 and NGC 5253, have steeper number-size and flux-size distributions than the others, indicating high fractions of the projected areas filled with star formation. Nine subregions in 7 galaxies have similarly steep number-size slopes, even when the whole galaxies have shallower slopes. The results suggest that hierarchically structured star-forming regions several hundred parsecs or larger represent common unit structures. Small galaxies dominated by only a few of these units tend to be starbursts. The self-similarity of young stellar structures down to parsec scales suggests that star clusters form in the densest parts of a turbulent medium that also forms loose stellar groupings on larger scales. The presence of super star clusters in two of our starburst dwarfs would follow from the observed structure if cloud and stellar subregions more readily coalesce when self-gravity in the unit cell contributes more to the total gravitational potential.

Accepted by : **Astrophysical Journal**

<http://cdsads.u-strasbg.fr/abs/2014arXiv1404.6001E>

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## Constraining globular cluster formation through studies of young massive clusters - II. A Single Stellar Population Young Massive Cluster in NGC 34

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Currently there are two competing scenarios to explain the origin of the stellar population in globular clusters (GCs). The main difference between them is whether or not multiple events of star formation took place within GCs. In this paper we present the star formation history (SFH) of Cluster 1, a massive young cluster in NGC 34 ( $\sim 10^7 M_{\odot}$ ). We use DynBaS, a spectrum fitting algorithm, to retrieve the SFH and find that Cluster 1 is consistent with a single stellar population of solar metallicity with an age of  $100 \pm 30$  Myr and a mass of  $1.9 \pm 0.4 \times 10^7 M_{\odot}$ . These results are in conflict with the expectations/predictions of the scenarios that invoke extended or multiple episodes within 30–100 Myr of the initial star-formation burst in young massive clusters.

Accepted by : **Monthly Notices of the Royal Astronomical Society**

<http://arxiv.org/abs/1404.4056>

# Dynamical evolution - Simulations

## Direct $N$ -body simulations of globular clusters - II. Palomar 4

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We use direct  $N$ -body calculations to study the evolution of the unusually extended outer halo globular cluster Palomar 4 (Pal 4) over its entire lifetime in order to reproduce its observed mass, half-light radius, velocity dispersion and mass function slope at different radii. We find that models evolving on circular orbits, and starting from a non-mass segregated, canonical initial mass function (IMF) can reproduce neither Pal 4s overall mass function slope nor the observed amount of mass segregation. Including either primordial mass segregation or initially flattened IMFs does not reproduce the observed amount of mass segregation and mass function flattening simultaneously. Unresolved binaries cannot reconcile this discrepancy either. We find that only models with both a flattened IMF and primordial segregation are able to fit the observations. The initial (i.e. after gas expulsion) mass and half-mass radius of Pal 4 in this case are about  $57000 M_{\odot}$  and 10 pc, respectively. This configuration is more extended than most globular clusters we observe, showing that the conditions under which Pal 4 formed must have been significantly different from that of the majority of globular clusters. We discuss possible scenarios for such an unusual configuration of Pal 4 in its early years.

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<http://cdsads.u-strasbg.fr/abs/2014MNRAS.440.3172Z>

## Miscellaneous

**The VLT-FLAMES Tarantula Survey XVI. The optical+NIR extinction laws in 30 Doradus and the photometric determination of the effective temperatures of OB stars****J. Maíz Apellániz <sup>1</sup>, C. J. Evans <sup>2</sup>, R. H. Barbá <sup>3</sup>, and 11 co-authors**( <sup>1</sup>) Instituto de Astrofísica de Andalucía-CSIC, Glorieta de la Astronomía s/n, E-18 008 Granada, Spain; ( <sup>2</sup>) UK Astronomy Technology Centre, Royal Observatory Edinburgh, Blackford Hill, Edinburgh, EH9 3HJ, UK; ( <sup>3</sup>) Departamento de Física, Universidad de La Serena, Av. Cisternas 1200 Norte, La Serena, Chile

The commonly used extinction laws of Cardelli et al. (1989) have limitations that, among other issues, hamper the determination of the effective temperatures of O and early B stars from optical+NIR photometry. We aim to develop a new family of extinction laws for 30 Doradus, check their general applicability within that region and elsewhere, and apply them to test the feasibility of using optical+NIR photometry to determine the effective temperature of OB stars. We use spectroscopy and NIR photometry from the VLT-FLAMES Tarantula Survey and optical photometry from HST/WFC3 of 30 Doradus and we analyze them with the software code CHORIZOS using different assumptions such as the family of extinction laws. We derive a new family of optical+NIR extinction laws for 30 Doradus and confirm its applicability to extinguished Galactic O-type systems. We conclude that by using the new extinction laws it is possible to measure the effective temperatures of OB stars with moderate uncertainties and only a small bias, at least up to E(4405-5495)  $\sim$  1.5 mag.

**Accepted by : Astronomy & Astrophysics**<http://cdsads.u-strasbg.fr/abs/2014A%26A...564A..63M>

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**Isolated massive stars in the Galactic center: The dynamic contribution from the Arches and Quintuplet star clusters****M. Habibi <sup>1,3</sup>, A. Stolte <sup>1</sup>, and S. Harfst <sup>2</sup>**( <sup>1</sup>) Argelander Institut für Astronomie, Universität Bonn, 53121 Bonn, Germany; ( <sup>2</sup>) Technische Universität Berlin, Zentrum für Astronomie und Astrophysik, 10623 Berlin; ( <sup>3</sup>) Member of the International Max Planck Research School (IMPRS) for Astronomy and Astrophysics at the Universities of Bonn and Cologne.

Recently, more than 100 Wolf-Rayet and OB stars were identified in the Galactic center. About a third of these sources are not spatially associated with any of the known star clusters in this region. We probe the distribution of drifted sources in numerical models of the massive clusters in the Galactic center and compare it to the observed distribution of isolated massive sources in this region. We find that stars as massive as 100 M<sub>⊙</sub> drift away from the center of each cluster by up to  $\sim$ 60 pc using the cluster models. Our best model reproduces  $\sim$ 60% of the known isolated massive stars out to 80 pc from the center of the Arches cluster. This number increases to 70%-80% when we only consider the region of  $\sim$ 20 pc from the Arches cluster.

**Accepted by : Astronomy & Astrophysics**<http://arxiv.org/abs/1403.2047>

## Populations of rotating stars III. SYCLIST, the new Geneva Population Synthesis code

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Constraints on stellar models can be obtained from observations of stellar populations, provided the population results from a well defined star formation history. We present a new tool for building synthetic colour-magnitude diagrams of coeval stellar populations. We study, from a theoretical point of view, the impact of axial rotation of stars on various observed properties of single-aged stellar populations: magnitude at the turnoff, photometric properties of evolved stars, surface velocities, surface abundances, and the impact of rotation on the age determination of clusters by an isochrone fitting. One application to the cluster NGC 663 is performed. Stellar models for different initial masses, metallicities, and zero-age main sequence (ZAMS) rotational velocities are used for building interpolated stellar tracks, isochrones, and synthetic clusters for various ages and metallicities. The synthetic populations account for the effects of the initial distribution of the rotational velocities on the ZAMS, the impact of the inclination angle and the effects of gravity and limb darkening, unresolved binaries and photometric errors. Interpolated tracks, isochrones, and synthetic clusters can be computed through a public web interface. For clusters with a metallicity in the range [0.002,0.014] and an age between 30 Myr and 1 Gyr, the fraction of fast rotators on the main sequence (MS) band is the largest just below the turnoff. This remains true for two different published distributions of the rotational velocities on the ZAMS. This is a natural consequence of the increase in the MS lifetime due to rotation. The fraction of fast rotators one magnitude below the turnoff also increases with the age of the cluster between 30 Myr and 1 Gyr. The most nitrogen-rich stars are found just below the turnoff. There is an increase in the fraction of enriched stars when the metallicity decreases. We show that the use of isochrones computed from rotating stellar models with an initial rotation that is representative of the average initial rotation of the stars in clusters provides a reasonable estimate of the age, even though stars in a real cluster did not start their evolution with an identical initial rotation.

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<http://arxiv.org/pdf/1404.6952v1.pdf>

**Proceedings abstracts****The Spectrum of Turbulent Velocities Fluctuations in the Open star cluster M67****S. V. Vereshchagin and N. V. Chupina**

Institute of Astronomy Russian Academy of Sciences (INASAN), Moscow, Russia

From data on M67 member stars the turbulent spectra in coordinate internal dispersion of star velocities and the sizes for the groups of stars inside the cluster corona was determined. With these spectra we tried to test the hypotheses of star groups origin due to of protocluster gas turbulence (or gravitational fragmentation as an alternative).

**To appear in : Modern Stellar Astronomy 2014, Rostov-Don, Russia, 28-30 may 2014****Gamma-Rays from Millisecond Pulsar Population in the Galactic Centre****W. Bednarek and T. Sobczak**

Department of Astrophysics, University of Lodz, 90-236 Lodz, Poland

The central dense stellar cluster in the Galactic Center (GC) contains the mass of 4 times larger than that of the central black hole. It is expected to be formed as a result of a merging process of several massive globular clusters which provided a large number of millisecond pulsars (MSPs). We propose that the GeV-TeV  $\gamma$ -ray emission observed from GC is in fact a cumulative effect of the emission from several globular clusters captured by the GC black hole. We calculate the expected TeV  $\gamma$ -ray emission produced by leptons, injected by pulsars, by the Inverse Compton Scattering process in the diffusive radiation field. It is shown that this emission can be responsible for the multi-TeV  $\gamma$ -rays observed by the Cherenkov telescopes from GC if about a thousand of MSPs are present in the central cluster in GC.

**To appear in: International Journal of Modern Physics: Conference Series, Volume 28**  
<http://cdsads.u-strasbg.fr/abs/2014IJMPS..2860171B>

## Conferences

### **IAU Symposium 307: New windows on massive stars**

23-27 June, 2014

Geneva (Switzerland)

<http://obswww.unige.ch/Conferences/IAU307/index.html>

early/late registration deadline: May 15 / June 15, 2014

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### **Mass assembly from clouds to clusters**

7-11 July, 2014

Sexten (Italy)

[http://www.sexten-cfa.eu/en/conferences/2014/details/  
44-mass-assembly-from-clouds-to-clusters](http://www.sexten-cfa.eu/en/conferences/2014/details/44-mass-assembly-from-clouds-to-clusters)

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### **Gaia data visualization workshop**

9-11 July, 2014

Vienna (Austria)

<http://gaiaviz.univie.ac.at/>

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### **A Critical Look at Globular Cluster Formation Theories: Constraints from Young Massive Clusters**

14-18 July, 2014

Sexten (Italy)

[http://www.sexten-cfa.eu/en/conferences/2014/details/  
41-a-critical-look-at-globular-cluster-formation-theories-testing-p](http://www.sexten-cfa.eu/en/conferences/2014/details/41-a-critical-look-at-globular-cluster-formation-theories-testing-p)

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### **The Early Life of Stellar Clusters: Formation and Dynamics**

3-7 November, 2014

Copenhagen (Denmark)

<http://www.nbia.dk/nbia-clusters-2014>

registration/abstract deadline: July 15, 2014