INAF – Osservatorio Astrofisico di Catania

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GREAT – ESF
Gaia Research for European Astronomy Training
European Science Foundation
Workshop report

Ground-based observations and theoretical analysis for the Gaia Science on Open Clusters and Young Associations

13 – 14 May 2010, Museo Diocesano di Catania, Italy

Summary

This workshop has gathered together scientists engaged in preparing the research field of stellar Open Clusters and Young Associations for the arrival of data from the ESA cornerstone mission Gaia. The main purpose of the meeting was to discuss scientific goals that can be fulfilled by combining Gaia data with existing or new surveys and the theoretical developments required to analyse and interpret this vast and detailed amount of observations.

Open clusters, OB associations, and low mass star forming regions represent fundamental tools to investigate how stars form and evolve, as well as the formation, structure, and evolution of the Milky Way. The Gaia mission will dramatically increase the sample of clusters and associations which can be studied in detail, allowing us to gather unprecedented and most valuable information on their global properties, along with the identification and characterization of their members down to the lowest masses.

Combining Gaia data with existing or new surveys will allow studying with unprecedented details topics like: the structure and internal kinematics of nearby clusters; the formation and evolution of the Galactic thin disk; the origin of young associations and of the Gould Belt; the environmental effects on the stellar angular momentum evolution; the star formation history; the initial mass function. The implications on our understanding of the Galaxy and its constituents will be enormous.

The workshop has been organised in six main sessions, plus a final open discussion on future activities. For each session, a key person in that area was invited to give an introductory talk, then contribution talks were given by participants. Each session closed with an open discussion on the subject. Interactions and informal discussions took also place during coffee, lunch, and dinner breaks. The structure of the workshop has proved very effectively in reinforcing existing collaborations and in stimulating new ones; new projects for ground-based observations have been discussed and the preparatory work initiated. The information flow was excellent and discussions very stimulating. Information and material presented at the workshop will be part of a document which will address issues related to the science on Open Clusters and Young Associations (OCYA) in the Gaia era and identify ground-based experiments in support of such research.

Information on the workshop (aims, rationale, list of participants, programme, abstracts, and talks' slides) is publicly available online (http://www.oact.inaf.it/ocya2010/).

Description of the scientific content of and discussion at the event

The six main sessions of the workshop covered the themes of interests that were identified during previous meetings of the GREAT-OCYA working group (GREAT Kickoff meeting in Cambridge, March 26 -27 2009; First exploratory workshop in Padova, October 29-30 2009; Second GREAT plenary meeting in Nice, November 19-20 2009).

Session 1, "*Stellar Structure and Evolution*", was introduced by Leo Girardi. In his talk on "*Calibrating stellar models with intermediate-age open clusters: present status and perspectives*", he focused on constraints to models of stellar structure and evolution from intermediate age open clusters, with ages typically between 100 Myr to 10 Gyr. Girardi gave an overview of open problems in stellar evolution that need to be addressed, and the data that will be available before Gaia. To-date, best perspective comes for studies of stellar evolution from rich clusters in SMC, LMC. M31, M33, for which HST ACS+WFC3 photometry is available. These allows us to obtain a calibration of the magnitudes and colours of the red clump, lower RGB and subgiant branch with age as distance ladder. The derivation of abundances of first dredge-up elements (Li, C, N, Na, O) in giants of low and intermediate mass allow us to probe the effects of the extra-mixing as function of age (thermohaline convection). Current observations of targets in the Corot and Kepler field provide a probe for mixing in red clump stars and mass loss as well as asteroseismology information. LMC rich clusters provide complementary scientific cases for multiple red clumps, extended turnoff, C stars and very short lived phases in general. An open question is whether comparable constraints from open clusters in the Milky Way will be available in the Gaia era.

Tim Naylor, in his talk on "*How will we measure the ages of pre-main-sequence clusters*" gave a comprehensive review on the critical issue of inferring the age of young stars. The determination of ages for clusters and associations younger than about 30Myr is highly problematical, and even for ages up to 100Myr there are significant problems. The pre-main-sequence (Pre-MS) fitting method is based on the fact that as stars contract towards the pre-MS their luminosity falls, and thus the absolute magnitudes of the pre-MS stars in a cluster are a measure of its age. However, it is well known that the isochrones do not fit the data well in the colour-magnitude plane, and different models can give significantly different ages. During this contraction phase the temperature in the cores of the pre-MS stars rise, until at around 3 MK they are hot enough to burn lithium. The low-mass stars are fully convective at this stage, and so lithium is depleted throughout the star, including its photosphere. The time to reach this temperature is a function of mass, with the lower mass stars taking longer to reach the critical temperature. Thus the position of the boundary in luminosity, below which the stars in a cluster have undepleted lithium is another measure of age. Unfortunately, the Li 670.8nm line used for measuring the Lithium abundance is rather weak, requiring good signal-to-noise spectra which can only be obtained for a small number of clusters. The most massive stars in a young cluster evolve through their main-sequence phase fast enough that, in principle, we can use classical post-MS fitting to determine the cluster age, but the initial mass function ensures that post-main-sequence stars are rare in young clusters, such that the ages derived often originate from a single star, and are thus unreliable. Even whilst the stars are on the main-sequence their nuclear evolution drives them from the zero-age main sequence (ZAMS) to the terminal age main sequence (TAMS), so we can fit the position of the more massive main-sequence stars to determine an age. The change in position of stars in colour-magnitude space between the ZAMS and the TAMS is small, and thus for individual clusters the uncertainty in age determination from this technique is poor. The only available method which will work for a large number of clusters is the contraction age. Currently the main obstacle to contraction ages is that distance and age are degenerate, but Gaia will solve this. The remaining problem therefore, is to calibrate the position of the PMS in optical colour-magnitude diagrams as a function of age. For this there are two obvious calibrators to use. The first is the lithium depletion boundary, which essentially consists of determining the mass of the lithium depletion boundary in the small number of clusters for which it is available. The second is the nuclear age scales represented by the ZAMS to TAMS ages and post-main-sequence evolution. This is a question of MS and post-MS fitting, which requires homogeneous photometry with a robust calibration for the brighter stars in a large sample of clusters.

For session 2, "*Star formation*", Francesco Palla was invited to give the introductory talk, but, at a very short notice, it was impossible for him to attend the meeting and his talk couldn't be replaced.

Richard Parker's contribution talk (*Tracing Dynamical Evolution in Clusters with GAIA*) reported N-body simulations carried out by the group he belongs to. The main conclusions that comes from these studies are that: (a) it seems not possible for stars to form from a single population; (b) clusters with different densities process populations differently; (c) field population is the sum of various star forming modes and regions.

Antonio Frasca reported on "*The RasTyc Survey of X-ray Stellar Sources*", which focuses on studies of young kinematical groups and "isolated" PMS Stars in the solar neighbourhood. These seem to be unrelated to any known association and represent challenges for our understanding of the star formation history in the solar neighbourhood. The survey's sample appears to be a mixture of quite young Pleiades-like and Hyades-like stars plus an older Li poor population probably born within the last 1-2 Gyr. Stars with a Lithium abundance compatible with the age of IC 2602 or even younger have been detected as well. Nearly all the super-Li rich stars found are good PMS candidates and probably new members of already known moving groups. Some Li-rich giant are also found in the sample and are not discernible from the PMS only on the basis of the Li content only; combined spectroscopy and high-precision astrometry (Gaia) is fundamental for identifying them. Perspectives for the Gaia era are: (a) all the Li-rich stars discovered will have accurate positions in the HR diagram thanks to Gaia very accurate parallaxes; (b) many new members of young associations among those stars spectroscopically identified as PMS stars will be identified thanks to Gaia accurate proper motions; (c) sub-samples with different kinematical and/or evolutionary properties (e.g. CTTs vs WTTs in the same SFR) will be identified using Gaia accurate parallaxes and proper motions; (d) accurate disk parameters (mainly sizes) will be derived thanks to the direct Gaia distance.

Katia Biazzo presented "*Ages and age spreads in young clusters: the case of 25 Ori*". An important issue is whether molecular clouds can sustain stellar production for times comparable to their lifetimes (> 10 Myr, longer than the free-fall time of dense gas). Current investigations are limited by uncertainties in placing stars in the HR diagrams, and Lithium is used as an independent age dating method. Gaia distances will make it possible to measure distances of individual stars and issues related to binarity and extinction can be solved in cases like 25 Ori.

The 3rd session on "*Open clusters as tracers of Galaxy formation and evolution of the thin disk*" was opened by Angela Bragaglia. OCs are ideal for studying the disk formation and its chemical enrichment since they cover the entire galactic disk lifespan and distances and ages and metallicities can be obtained with higher precision than field stars Current observations and analysis points to a change of slope in the metallicity gradient around 11-12 kpc, but the uncertainties are still quite large. Such a gradient has implications on identify the possible scenario of galaxy formation and evolution. Determining the abundance dependence on the galactocentric distance gives the possibility to discriminate between chemical evolution scenario. It has been recognised, however, that homogeneity of the analysis is an important issue and this requirement should be fulfilled in Gaia supporting ground-based observations.

Laura Magrini talked about "*Open Clusters in the Inner Galaxy*", illustrating the presence of outliers in the inner metallicity gradient that can be due to stellar population migration. Gaia will provide information of enough accuracy to locate the cluster birthplace, which will help in understanding the role of migration.

Elena Pancino explained the importance of new analysis tools in the analysis of large spectroscopic datasets. The determination of the disk metallicity gradient was taken as an example. Antonio Delgado summarised the structure and activities of his group in his talk "*Stellar Clusters as Probes of the Local Universe*". The activities relevant to Gaia research include; (a) birth and internal evolution of stellar clusters; (b) massive stars in the Milky Way; (c) PMS stars in clusters; the nuclear star cluster of the Milky Way; (d) methodology and tools.

Nestor Sanchez introduced session 4 "*Open clusters internal structure and interaction with the Galaxy*" with his talk "*Characterisation of Open Clusters' Structure*". A structure parameter was illustrated which allows a simple parameterization and discrimination between clumpy and fractal structure and a consistent analysis even on non-homogeneous samples. The application to old clusters shows that such a structure parameter depends on the ratio of the cluster's age with the cluster's crossing time. A lower ratio corresponds to clumpy structures and as the ratio increases the structure becomes increasingly fractal. Perhaps some clusters may develop some kind of substructure starting from an initially more homogeneous state. Another possibility is that the fractal dimension in the Galaxy does not have a universal value and therefore some regions form stars distributed following more clustered patterns. These results are to be compared with the clustering properties of young associations in metal poor environments (LMC and SMC) where the structure parameter is found to have little dependence on the age of the objects.

Alessandro Spagna presented a study on the Stock 2 cluster, which was illustrative of the difficulties and of the puzzles of OCs research. The CMD isochrones are consistent with ages of 200-500 Myr, the large scatter partly due to photometric errors (0.03-0.04 mag), residual differential extinction, intracluster extinction, binaries, and distance spread ($\sigma(m-M) \sim 0.1$). The few red-clump stars observed are themselves scattered in the CMD and therefore cannot help in selecting a unique theoretical isochrone for the cluster. Questions

remain as the contamination of the sample, a possible prolonged star formation, andhow the galactic field is affecting the cluster dynamical evolution.

Belen Vicente presented the "*Exploitation of the Carte du Ciel – San Fernando astrometric catalogue*". The case illustrated represents an example of usage and training of a proper motion database in preparation for Gaia. The determination of the luminosity function in the solar neighbourhood, of the stellar systems' structure and kinematics in the different subsets of the phase space, the membership discrimination in OCs, and the automated searching of moving groups was discussed. The method devised can be efficiently applied to the automated searching of structures like: Stellar Clusters (condensations in the position and proper motion spaces); OB associations (larger radius and youngest stars); Moving Groups (proper motion space); Tidal Streams (correlated bands between motion and position). Finally, the influence of the sampling radius on the uncertainties derived for the membership determination was discussed.

In introducing session 5 on "*Stellar angular momentum and magnetic fields*", Ansgar Reiners focused on the rotation/activity evolution in very low mass stars, for which a weaker braking at the threshold to full convection has been witnessed. Observations show that braking is gradually disappearing towards the brown dwarf regime. This behaviour has been modelled assuming temperature-dependent wind braking. Braking is probably weaker because of low fractional ionization in very cool atmospheres. Gaia main contribution is expected in investigating variability (indicator for activity), finding suitable low-mass objects (with follow-up needed), and provide robust age-estimates for brown dwarfs. Rotation periods could also be recovered in certain ranges and long-term activity trends in connection with other photometric surveys.

Jerome Bouvier presented "*Young stellar clusters as tracers of stellar angular momentum evolution*". Stellar rotation represents a window into fundamental physical processes like: star formation (initial angular momentum distribution - collapse, fragmentation); star-disk interaction during the PMS; rotational braking by magnetized winds; angular momentum transfer in stellar interiors; binary system evolution; stellar dynamos and magnetic activity; chemical mixing; etc. Gaia will contribute by discovering new clusters, filling the age gaps in current observations (5-40 Myr, 0.5-5 Gyr), remove field contaminants by improving membership assessments, identify synchronized binaries, as well as revising clusters' age, age spread, metallicity, etc. The analysis based on current data indicates that on the ZAMS fast rotators have little differential rotation while slow rotators have strong differential rotation. Since the presence of slow rotation at ZAMS requires long disk lifetimes it is inferred that the presence of a disk (which leads to the development of an extra-solar planetary system) augment the internal differential rotation, which in turn causes the extra lithium depletion observed in planet-hosting stars.

Sergio Messina presented a recent work on "*Evolution of angular momentum and magnetic activity from ONC to the Pleiades*". This is part of the RACE-OC Project (Rotation and ACtivity Evolution in Open Clusters) which aims at covering missing age ranges in rotational history of solar to low-mass stars. The recent investigation presented complemented and compared OCs' data with new measurements made on young associations. The ASAS database was exploited to investigate new sampled ages at 8, 10, and 30 Myr and to provide new additional rotation periods at 1 and 110 Myr. Measurements of accurate rotation period were carried out, with an accurate mass determination and a fine mass binning. The application of a two-sided Kolmogorov-Smirnov test outlined a statistically significant spin-up in the 0.8 – 1.2 solar masses sample between 10 and 30 Myr, which is consistent with the estimated lifetime of the disk (which imposes angular velocity conservation), and a statistically significant spin-down between 70 and 100 Myr, which is consistent with the dominance of the wind-braking mechanism after the ZAMS.

In his talk, entitled "*Inferring angular momentum transport processes from rotational periods*", Federico Spada presented a methodology to exploit the complete statistical information encoded in the available rotational period distributions. Taking the Orion Nebula Cluster (ONC) rotation period distribution on as initial conditions, this was evolved to solar age using a two-zone model for describing the stellar angular momentum evolution. A Monte Carlo Markov Chain fit method was devised to determine the model's parameters that best reproduce the observed rotation period distribution in cluster at different age. The comparison of synthetic/observed distribution was based on the Kolmogorov-Smirnov test. Difficulties in reproducing the rotational evolution around the ZAMS are found, which may be due to uncertainties in age determination, age spread, and lack of completeness of the samples (not necessarily around the ZAMS). The theoretical models for the angular momentum transfer may also be oversimplified.

Session 6 on "*Ground-based surveys on Open Clusters and Young Associations*" was introduced by Janet Drew with a talk on "*European OIR Galactic Plane Surveys*". The optical European GAlactic Plane Surveys (EGAPS) is joint collaboration of different surveys: IPHAS, UVEX, and VPHAS+. IPHAS is a INT/WFC Photometric Halpha Survey of the Northern Galactic Plane. UVEX is a UV excess survey of the northern

Galactic plane. In the North hemisphere, IPHAS is now complete and a uniform calibration is expected to be available within one year approximately. UVEX and UKIDSS/GPS are ongoing. In the South hemisphere, the VVV survey is just beginning, while the VPHAS+ is expected to start in 2011. Halpha adds much value to these otherwise broadband digital surveys. They will allow a 3D extinction mapping, the determination of stellar density gradients by intrinsic colour, the identification of new clusters. They represent an enormous, homogeneous (Delta(m) ~ 0.02) photometric data sets that will be available in time for Gaia intermediate data products in 2015.

Caroline Soubiran presented "*A comprehensive census of OC metallicities*", a compilation of OC's [FeH] based on HRS observations. Even with high quality data and rigorous analysis, metallicity determinations from HRS may differ significantly from one study to another due to observational characteristics (wavelength range, resolution), the line lists and line data used, and the analysis methods. [Fe/H] determinations are not homogeneous and should not be simply averaged for most applications e.g. radial metallicity gradient or calibration of photometric or low resolution methods. A need to adopt a common scale for metallicity determinations has been recognised, which leads to a standardisation of the HRS. For this is necessary to define a set of standard stars, to adopt a standard line database (VALD), and to identify standard methods. This process is essential for future combinations of spectroscopic surveys and the underlying issue represent an argument in favour of a large homgeneous spectroscopic survey of OCs.

David Montes presented ongoing and future high resolution spectroscopic surveys of possible late-type stars members of stellar kinematic groups (stellar streams, moving groups, and associations). The surveys aim at deriving; kinematics; age (from Lithium abundance);
chromospheric activity; the projection of rotational velocity (v *sin* i), elemental abundances.

Ronny Blomme discussed on the relevance of massive stars for the Gaia science on OCs. They play an important role in the galactic evolution, lose prodigious amounts of mass, momentum and energy (stellar winds, supernova) with a strong influence on the ISM via the chemical enrichment, ionization, heating, turbulence and mixing. Massive stars influence also star- and planet-formation processes, and are progenitors of long-duration gamma-ray bursts. Regarding clusters their importance is also in wind-wind collisions, superbubbles, and runaway stars. Main actors in the re-ionization of the Universe, they are visible over great distances and identify the location of star-forming regions as well as the spiral arm structure. Science drivers in the Gaia context are: improving the Galactic census of massive stars; crucial quantitative tests of massive star evolution; surface abundances; binarity; mass loss. A number of research programmes are currently running, among which: the Galactic O-Star Spectral Survey (GOSSS); an observational programme with FLAMES; the photometric surveys IPHAS, UVEX, VPHAS+, UKIDSS, and VVV public survey.

Marc David presented "*Methods of Doppler-shift measurements*". Radial velocities from Gaia reach a precision of approximately 1 km/sec for late-type single stars and errors up to 10 km/sec and more for early-type stars. On the other hand, for OCs studies, it is required a precision of 1-2 km/sec to establish membership and less than 1 km/sec to study clusters' internal dynamics. The RVS pipeline is devised in order to give the best possible radial velocity , given that it has to be fully automated and that it has to work for all kinds of spectra. However, when studying a specific system, objects can be treated individually and methods can be fine-tuned to each spectrum. The strategy proposed is to perform fine-tuned spectra analysis on limited sample after end-of mission spectra analysis.

Francesco Damiani presented "*Young open cluster spectroscopy: complementing Gaia*". Ground-based medium-high resolution spectroscopy is highly needed to complement and fully exploit the potential of Gaia data. The VLT FLAMES multi-fiber spectrograph is ideally suited for a study of a representative sample of young clusters and star-forming regions; a survey will take full advantage of FLAMES capabilities, with good-statistics stellar samples down to low masses in every cluster. Substantial advances are expected in: improved membership, ages, reddenings; full space dynamics and cluster evolution; star-formation processes in different environments (timescales, triggering); disks and rotational evolution, etc. An initial cluster sample of ~180 clusters have been selected; a further selection of 30 best targets is ongoing, based on available (membership) data and parameter space coverage.

Assessment of the results and impact of the event on the future direction of the field

This workshop aimed at discussing key science themes in the field of Open Clusters and Young Associations research on which the Gaia mission, eventually supplemented by other surveys, will have a major impact. The discussion was meant to help in the completion of a white-book, which will represent a guidance for future activities and planning of the GREAT working group on Open Clusters and Young Associations. Plans for new ground based surveys were to be discussed, as well as the linkage and exploitation of existing ones, and requests for new instrumentation. Purposes of the workshop included the consolidation of existing collaborations and the stimulation of new ones.

All these goals have been met beyond expectations. All participants expressed their satisfaction for what they described as lively, interesting and stimulating discussions. The scientific content of talks and discussions was judged excellent. Satisfaction was also expressed on the structure of the workshop, which allowed an excellent stream of information both through formal talks and informal discussions. The expressed interest in participating to the group's activity was very high and enthusiastic. Contributions to the white-book and to ground-based observational projects were given during the event and after.

The workshop was very successful in identify key issues on the Gaia science on Open Clusters and Young Associations. It was particularly useful in identifying fundamental problems that can be addressed by combining Gaia data with ground-based observations especially devised for the purpose. Our understanding on star formation in the Milky Way, the structuring and evolution of Open Cluster, Open Clusters' evaporation, the origin of field stars, the evolution of angular momentum from clouds fragmentation to stellar rotation and activity, the structure and evolution of stars including magnetic field generation, the origin of moving groups and young loose association, the formation and evolution of the galactic disk and the interstellar medium enrichment, to name a few, can enormously be improved by means of combined approaches that can be carried out by the collaborations which are going to take shape.

Another very important aspect was the identification of difficulties that the planned research will face, such as the analysis and interpretation of poor cluster, the age determination of young stars, the effects of age spread, the identification of stars in the clusters' outskirt and membership in general. Many of these difficulties may also represent challenges and opportunities for some major scientific breakthrough.

This event will surely have major impact on the short-, medium-, and long-term. On the short-term (one-year), issues discussed during the meeting will lead to a first version of the GREAT-OCYA white-book. This document will collect ideas on the main scientific issues on which Gaia and combined ground-based observations can give a major impact. The first version of this document is expected to be released before the end of July 2010 and will be made accessible through the GREAT web pages. The scientific cases and technical issues discussed will be used to propose a large spectroscopic survey on Open Cluster. On the medium-term (two-years) the question of homogenisation of the HRS analysis will be tackled in detail in order to combine effectively such large spectroscopic survey (hopefully successful) with other existing and ongoing surveys. Recommendations for new instrumentation, in particular wide-field MOS spectroscopy, will be put forward. The issue of accuracy and homogenisation of photometric data will be tackled and the use of existing surveys and databases assessed. On the long-term, (three-years onward) a major effort will be put in the preparation of the early release of Gaia data and on the exploitation of the final Gaia catalogue combined with the supplementing information collected by ground-based experiments.

This workshop will be followed by a major conference in Granada, 23-27 May 2011, on "Stellar Clusters and Associations: a GREAT conference on Gaia". Other workshops and meetings are planned on a yearly base to report on advances, assess the activities, and plan future actions.

Programme

Thursday 13 May 2010

09:00 – 09:10 *Welcome address by the Director of the Catania Astrophysical Observatory, Prof. Gianni Strazzulla*

09:10 – 09:30 Alessandro Lanzafame *GREAT WGB1 status and activities*

Session 1: Stellar structure and evolution *Chair: Nuccio Lanza*

09:30 – 10:10 Introductory talk: Leo Girardi, *Calibrating stellar models with intermediate-age open clusters: present status and perspectives*

10:10 – 10:45 Tim Naylor, *How will we measure the ages of pre-main-sequence clusters?*

10:45 – 11:00 Discussion

11:00 – 11:30 Coffee

Session 2: Star formation *Chair: Timo Prusti*

11:30 – 11:45 Richard Parker, *Tracing Dynamical Evolution in Clusters with GAIA*

11:45 – 12:00 Antonio Frasca et al., *The RasTyc survey of X-ray stellar sources. Young kinematic groups and "isolated" pre-main sequence stars in the solar neighbourhood*

12:00 – 12:15 Katia Biazzo et al., *Ages and age spreads in young clusters: the case of 25 Ori*

12:15 – 12:30 Discussion

Session 3: Open clusters as tracers of the formation and evolution of the thin disk *Chair: Rob Jeffries*

12:30 – 13:00 Introductory talk: Angela Bragaglia, *Open Cluster as tracers of the Galactic disk*

13:00 – 14:00 Lunch

14:00 – 14:15 Laura Magrini, *Open Clusters in the inner Galaxy*

14:15 – 14:30 Elena Pancino, *DAOSPEC and the abundance patterns of five open clusters*

14:30 – 14:45 Antonio Delgado, *Stellar clusters as probes of the local universe*

14:45 – 15:00 Discussion

Session 4: Open clusters internal structure and interaction with the Galaxy *Chair: Sofia Randich*

15:00 – 15:30 Introductory talk: Nestor Sanchez, *Characterization of open cluster structure.*

15:30 – 16:00 Contribution talks and discussion

15:30 – 15:45 Alessandro Spagna et al., *The age of the nearby reddened cluster Stock 2*

15:45 – 16:00 Belen Vicente, *Exploitation of the astrometric catalogue CdC-SF as a training for GAIA*

16:00 – 16:30 Tea

16:30 – 16:45 Discussion

16:45 – 17:30 Discussion on the GREAT-WGB1 white book and future activities

17:30 End first day

20:00 **Dinner at Hotel Royal**

Friday 14 May 2010

Session 5: Stellar angular momentum evolution and magnetic fields *Chair: Antonella Vallenari*

09:00 – 09:30 Introductory talk: Ansgar Reiners, *Stellar angular momentum evolution and magnetic activity*

09:30 – 09:45 Jerome Bouvier, *Young stellar clusters: a probe to the rotational evolution of low-mass stars*

09:45 – 10:00 Sergio Messina et al., *The evolution of angular momentum and magnetic activity from ONC to the Pleiades*

10:00 – 10:15 Federico Spada et al., *Inferring angular momentum transport processes in solar-like stellar interiors from rotational periods in OCs and stellar associations*

10:15 – 10:45 Discussion

10:45 – 11:15 Coffee

Session 6: Ground-based surveys on Open Clusters and Young Associations *Chair: Alessandro Lanzafame*

11:15 – 11:45 Introductory talk: Janet Drew, *European OIR Galactic Plane Surveys*

11:45 – 12:45 Contribution talks

11:45 – 12:00 Caroline Soubiran, *A comprehensive census of OC metallicities from high-resolution spectroscopy*

12:00 – 12:15 David Montes, *Stellar kinematic groups (stellar streams, moving groups, and associations): ongoing and future high resolution spectroscopic surveys of possible late-type stars members*

12:15 – 12:30 Ronny Blomme, *Massive Stars*

12:30 – 12:45 Marc David, *Methods of Doppler-shift measurement*

12:45 – 13:00 Francesco Damiani, *Young open cluster spectroscopy: complementing GAIA studies*

13:00 – 14:00 Lunch

14:00 – 15:00 Discussion (plans for a large public survey with FLAMES)

Session 7: Future activities

15:00 – 15:45	Discussion on the GREAT-WGB1 white book and future activities
15:45 – 16:15	Tea
16.15 – 17:00	Small groups discussions
17:00	End of the meeting

Participants

1	Richard	ANDERSON	Geneva Observatory - Switzerland
2	Lola	BALAGUER-NUNEZ	Universitat de Barcelona - Spain
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