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COVER ILLUSTRATION:

This picture, taken by the Advanced Camera for Surveys (ACS) on board the NASA/ESA Hubble Space Telescope, shows the centre of globular cluster Messier 4. The power of Hubble has resolved the cluster into a multitude of stars. M 4 is relatively close to us, lying 7200 light-years away. It contains several tens of thousand stars and is noteworthy in being home to many white dwarfs.

Credit: ESA/Hubble & NASA

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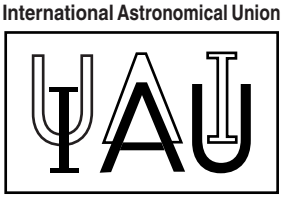

FORMATION, EVOLUTION, AND SURVIVAL OF MASSIVE STAR CLUSTERS

PROCEEDINGS OF THE 316th SYMPOSIUM OF THE INTERNATIONAL ASTRONOMICAL UNION HELD IN HONOLULU, HAWAII, UNITED STATES AUGUST 11–14, 2015

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Preface

Massive star clusters deserve special attention because they are one of the few bridges that connect the interstellar medium, star formation and evolution, mass and energy feedback to evolution of galaxies, and cosmology. These systems are ideal laboratories to probe very localized processes within interstellar gas clouds as well as large-scale dynamics of interstellar matter in interplay with the formation, evolution, and death of stars. Populous clusters are the key sites of high-mass star formation (i.e., the high-mass end of the initial mass function). They host large numbers of compact and exotic objects that form preferentially in dense environments, and they are fundamental benchmarks to study stellar physics and evolution and to explore dynamics in dense systems. They hold clues to how star formation and evolution as well as chemical and dynamical evolution of stellar systems influence each other and vary from one environment to another, from the present to the early Universe. They are the witnesses of the formation, assembly, and evolution of galaxies and of their substructures across time. They play a role in hierarchical cosmology as well as in the reionization of the intergalactic medium. These very complex systems are a prime example of astronomical objects currently being studied in every wavelength region, from radio to x-rays (and even gamma rays), and are also relevant for gravitational wave detectors.

A complete understanding of these systems and of their stellar populations is a challenging task. It requires the exchange of ideas and the collaboration of astrophysicists with observational, theoretical, and numerical expertise in stellar evolution, interstellar matter magnetohydrodynamics, stellar dynamics, formation and evolution of galaxies, cosmology, multidimensional numerical simulations, N-body simulations, and multi-wavelength high-precision photometry, spectroscopy, and astrometry.

In view of the impressive advances made by the various parties since the beginning of the 21st century, 2015 was the right time and the XXIX IAU General Assembly was the prime location to allow a wide community share necessary knowledge, discuss about remaining hot issues in the field, with the hope to come soon to the characterization of the physical processes that support the interpretation of the recent exquisite observations.

The following questions were addressed during IAU Symposium 316 "Formation, evolution, and survival of massive star clusters":

– Which physical properties determine the mode of star cluster formation? What are the initial and boundary conditions that will lead to massive and not-so-massive cluster formation? What is the relationship with the pre-cluster molecular cloud cores? Can we find pre-cluster molecular cloud cores of massive clusters?

– How important are early disruption processes and does their importance depend on environment?

– How, and what kind of stars form and evolve in very dense environments?

– How well do current models explain the presence of multiple populations in massive clusters, and how multiple generation stars are connected to the properties and evolution of the natal cloud cores?

– How important is the role of binary stars and what is the impact on cluster models? How does the binary mass fraction evolve with time during the life of the clusters? Do binary mergers play a role?

– What are the correlations between the presence of various compact objects in globular clusters and other structural parameters? Is there a correlation between the initial mass of a cluster and the mass of its most massive star?

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– Which fraction of stars form in bound clusters and how does this vary with environment, metallicity, and time?

All these aspects are addressed in the papers (reviews, oral contributions, and posters) gathered in this book, with observers, theoreticians, and modellers discussing controversial topics and planning the next steps to be tackled in some of the key open areas. This is particularly timely as we enter a golden age for observations and numerical multi dimensional simulations.

IAU Symposium 316 was supported by Division H (Interstellar Matter and Local Universe; coordinating division), Division G (Stars and stellar physics) and Division J (Galaxies and cosmology), and by the Commissions 25 (Astronomical photometry and polarimetry), 28 (Galaxies), 33 (Structure and dynamics of the Galactic system), 34 (Interstellar matter), 35 (Stellar constitution) and 37 (Star clusters and associations) as well as by the WG Massive stars. We wish to warmly thank them as well as the IAU Executive Committee to make IAU Symposium 316 happens. We thank the GA Organizing Committee, as well as our excellent SOC and all the participants for a lively and successful conference.

Corinne Charbonnel and Antonella Nota, chairs of IAU Symposium 316

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