Norris discussed the ensemble properties of UCDs in a statistical sense.

The fourth day concluded with a discussion session led by S. Mieske. It was noted that the frequency of UCDs is consistent with the hypothesis that they constitute the bright tail of the globular cluster luminosity function. UCDs can be explained as massive star clusters, whose elevated M/L ratios are due to a non-canonical initial mass function. On the other hand, the formation of UCDs via tidal stripping cannot be excluded as an additional channel, given the observational evidence of tidal disruption of dwarf galaxies. Another topic of discussion was whether star clusters would be expected to trace the M–σ relation to a lower value of σ. It was concluded that this would strongly depend on the formation mechanism of putative massive black holes in them.

The last day of the workshop was again dedicated to the interface between star clusters and galaxies. D. Forbes discussed the definition of a galaxy, showing that the presence of multiple stellar populations is considered the most defining feature for a galaxy, according to an online poll amongst astronomers. K. Woodley discussed the star cluster to UCD transition based on an extensive study of the globular cluster system of the nearby elliptical galaxy Centaurus A (NGC 5128). G. da Costa showed new results on the stellar dynamics in the outskirts of Omega Centauri, arguing that possible deviations from a Keplerian velocity dispersion profile are likely due to tidal effects and/or interlopers. P. Assmann and J. Hurley focused in their talks on dwarf galaxy formation via star cluster mergers. The last session was rounded off by presentations on nuclear and bright globular clusters in dwarf galaxies (I. Georgiev) and a discussion of cold halos and extended clusters in M31 (M. Collins).

Conference summary

An inspiring conference summary was delivered by G. Gilmore. He made a general point that the ΛCDM framework provides a very good description of the Universe from the largest scales down to galaxy size scales, and that, in particular, it describes the initial stages of the Universe very well. He also noted, however, that there are considerable problems with ΛCDM predictions at smaller (galaxy) scales. He argued that a possible avenue towards a reconciliation of theory with the observed Universe at small scales may be less massive (= warm) dark matter particles. He also made the point that in comparison with ΛCDM, the concept of MOND does not provide by itself an adequate description of the Universe as a whole, lacking a cosmological framework. He argued that the internal dynamics of Milky Way satellites within the radius of the Magellanic Stream are likely affected by tidal forces, and advocated caution in the interpretation of dynamical data of objects within that radius. He added that objects in the transition region between galaxies and star clusters — such as UCDs — can give fascinating insights into galaxy transformation processes and massive star cluster formation, while constraints on dark matter properties can only be obtained from objects with sizes above ~100 pc, which he considers as galaxies.

Acknowledgements

We warmly thank Maria Eugenia Gomez, Paulina Jiron, the team of ESO IT and General Services, and the entire Local Organising Committee.

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Report on the Workshop

The Evolution of Compact Binaries

held at Hotel San Martín, Viña del Mar, Chile, 6–11 March 2011

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The workshop, organised by ESO and the Universidad de Valparaíso, was held with the aim of bringing together people from different communities to concentrate on the specific problem of binary evolution. Compact binaries divide into many classes, but the evolution of all these objects is driven by a common mechanism: angular momentum loss. From the formation of compact binaries over the various phases of contact to their explosive deaths in a supernova Type Ia or gamma-ray burst, the measurement and understanding of the braking mechanisms was the main discussion point of the meeting.

In order to bring astronomers from the different communities to an understanding of the main problems in the evolution of compact binaries, the workshop began with thorough introductory review talks on the main types of compact binaries,

like cataclysmic variables (by Ch. Knigge), low-mass X-ray binaries (P. Charles) and high-mass X-ray binaries (S. Chaty). Further general reviews were given by G. Hussain who thoroughly explained the theory and observations of the magnetic braking mechanism in single stars and binaries, and by M. van der Sluys, who introduced the concept of gravitational radiation and the resultant braking effect.

The sessions themselves were organised following the evolution of compact binaries in chronological order. The full programme of the meeting can be found on the conference web page[1]. We started with close binary formation, which was summarised in a review by K. M. Kratter who gave an overview on the different channels to achieve a close binary configuration and compared the theoretical predictions with observational statistics on multiplicity. The contributed talks in this session concentrated on multiplicity as observed in certain star-forming regions or in certain classes of stars and both theory and observations agree that multiplicity increases strongly towards higher stellar masses.

If the binary components are sufficiently close, the evolving primary will at some point fill its Roche lobe and thus start unstable mass transfer towards the secondary, resulting in a common envelope phase. In her review, N. Ivanova introduced common envelope physics. Due to its short timescale, so far no direct observations exist of this phase. Therefore, the session was naturally dominated by simulations and theoretical discussions on the impact that the common envelope has on the final binary configuration. In particular, the efficiency of the common envelope in bringing stars together, and at the same time expelling the material of the envelope as a planetary nebula, seems to be finally understood, as was demonstrated by M. Zorotovic.

Planetary nebulae also played a major role in the contributions concerned with the post common envelope phase. Together with the hot subdwarfs, planetary nebulae represent the objects that arise directly out of common envelope evolution and no further evolutionary assumptions are needed to link them to this phase. H. Boffin and D. Jones presented good evidence that binarity is responsible for the aspherical morphology of most nebulae and also explained the details of the formation mechanisms. The subsequent discussions concentrated on the statistics of the observed binaries with respect to the expectations from stellar population synthesis, and the strong impact of the Sloan Digital Sky Survey (SDSS) on this field became evident.

Cataclysmic variables, novae, symbiotic stars and X-ray binaries in various flavours were discussed in the session on the contact phase. Since the evolution of any particular binary takes too long to observe, it is important to have homogeneous samples, as was pointed out by several speakers. Surveys like SDSS or selections on X-rays or variability seem to be examples of ways to deal with this problem. The importance of metallicity for binary evolution was stressed by F. Mirabel and F. Valsecchi in their talks about massive binaries and black holes.

“Graveyard or Boom?” was the title of the session about the final stages of binary evolution and both possibilities were introduced in the reviews: F. Röopke gave an overview on supernovae Type 1a and possible progenitors; T. Tauris introduced binary pulsars; and E. Ramirez explained gamma-ray bursts from the evolutionary point of view. Many other contributions dealt with the possible mass increase of white dwarfs in cataclysmic variables, symbiotic stars or double degenerate binaries to thus reach the Chandrasekhar limit and ignite the supernova.

The workshop ended with a short session on telescopes and instruments with talks concerning the latest about the E-ELT, the possibilities of optical interferometry, and the young field of gravitational-wave astronomy.

Intense and lively discussions took place during the whole week of the workshop. The idea of having specialists giving the introductions to the specific physics involved in binary evolution worked excellently. In this format, the experts were also present to answer any specific question that arose from the presentations and during the discussions. This helped to avoid fruitless speculations and to keep the discussions relevant to the subject. On the other hand, since the participants came from different scientific communities, many unorthodox ideas and suggestions came up and gave fresh input to some discussion.

From the feedback that we got during and after the workshop, it seems that everyone had learnt something new, but was also able to contribute to the general level of knowledge. Interaction between the participants was promoted not only by the space given in the individual sessions, but also by the various activities taking place outside the conference room (see the lower figure on the Astronomical News section page, p. 38). The welcome cocktail, a walk through the hills of Valparaíso, a boat trip in the harbour, the conference dinner itself, and the closing lunch helped to get people to talk to each other and thus to found new collaborations and friendships.

The proceedings of this workshop will be published in the Conference Series of the Astronomical Society of the Pacific.

Links

[1] Conference website: http://www.eso.org/sci/meetings/Binary_Evolution2011/