

Triple evolution and dynamics (TRENDY) II workshop – Lorentz center, Leiden 2018
workshop report

Triple systems are among the most frequent astrophysical phenomena, manifesting themselves in almost any given scale, from asteroids to massive black holes, from triple stars to planetary and satellite systems, including systems like our own Sun-Earth-moon system. Theoretical and observational studies suggest that triples can have a key role in the evolution of stellar and planetary systems. Some aspects of the rich and complex gravitational dynamics of such systems have been studied extensively (as evidenced by the well known 3-body problem). However, our understanding of the evolution of triple systems is fragmented and incomplete. Indeed, study of the realistic evolution of such systems, including the coupling of their dynamics with dissipative processes and/or the realistic treatment of the physical properties (e.g. stellar evolution, tidal interactions, mass transfer, gas interactions etc.) is still in its infancy, both in term of technical progress as well as in terms of structuring of a coherent scientific community working in this field. Given the mounting evidence for the importance of such systems, and their ubiquity in stellar and planetary systems, our poor understanding of these systems is quite disconcerting.

The study of the evolution of triples is important as triple systems can evolve differently than ordinary binary systems. The presence of a third object can have a strong effect on the evolution of the inner binary, on both short dynamical timescales up longer timescales through secular evolution; these may change the orbital/kinematic properties of the triple components and catalyze mergers and collisions. In particular, triples may play a key role in the formation of close interacting (and compact) binaries; structure the architecture of planetary and/or satellite systems; and catalyze production of transient phenomena, ranging from supernovae and gamma-ray bursts to the possible role of triple in producing gravitational wave (GW) sources. Triple systems are also the first level of multiplicity in which the coupling of non-trivial dynamics play a major role in stellar evolution. As such, triple systems add an important building block in the understanding of any higher multiplicity system.

The TRENDY II workshop was aimed to serve as a focal point for researchers working on triple systems on all scales, in order to connect theorists and observers as well as link together and share knowledge and tools between groups working on similar questions, both on same scales as well as completely different scales. One of the expected outcomes, beside the formation of a coherent community and the nurturing of scientific collaborations was to build a vision/road-map mapping the missing pieces in the understanding of triple systems and the ways to close these gaps by the community effort.

We believe the workshop was very successful, first in attracting and bringing together many of the leading researchers in the field, both theorists and observers, as well as many early career scientists. Second, the talks and discussions were done in a highly supporting and warm atmosphere, allowing for input from both senior and junior researchers. These gave rise to sharing of many new results, and new realizations (e.g. the observational input of regarding the alignment of compact stellar triple systems and its implications which was not sufficiently appreciated before in the community). Together these provided an important base for establishing the triple systems field as an independent subfield in astrophysics and building its research community. Third, the discussions throughout the workshop and its final discussion helped identify and focus the attention on the knowledge gaps, the tools and approaches taken to address them, and the various directions currently followed by different groups. These discussions serve as the building blocks for a road-map for further studies. We hope and plan to write a long workshop science summary report which would indeed serve as an actual written road map for the future study of triple based on the TRENDY workshop.

The workshop itself was organized in a somewhat unique form which turned out very beneficial for the scientific discussions. The novel scheme was that although every talk had its allocated time, there was no actual limit on question-time after every talk. In order to accommodate for that, the end of every session had an a priori allocated significant “overflow” time, to account for potentially long discussions that naturally arise following some of the talks. This scheme was indeed successful – people did not have to wait with their questions or raise important issues only in allocated discussion times later on (by which time, they might have forgot the questions, or focused mostly on the most recent talks), but rather the scientific discussions occurred naturally following the relevant talk, and catalyzed by it. Another somewhat novel aspect was to a priori allocate time for “spontaneous” informal talks, i.e. talks not formally part of the program which researchers suggested to give during the workshop, either as a response to other talks and discussions, or as an extra input on additional studies they wanted to share with the community. This turned out to highlight additional interesting results and gave rise to further interesting and important discussions.