

Weighing stars from birth to death: How to determine stellar masses?

19 – 23 November 2018 Lorentz Center @ Oort

The mass of a star is the most fundamental quantity defining its life and fate. The determination of the ages of stars, of central importance for several fields in astrophysics, is also intimately tied to accurate determinations of stellar masses. The workshop aimed at discussing the state-of-the-art of different techniques used for stellar mass determinations for different types of stars, confronting strengths and weaknesses, establishing the specific requirements for fields such as stellar physics, exoplanetary studies, supernova research, and galactic archaeology. A major specific goal was to establish a set of benchmark stars with accurately measured masses to serve as reference stars for the community.

We presented to *Astronomy & Astrophysics Review* our intention of publishing the results of the workshop in the form of a review article discussing the state of the art of mass determination methods, including the selection of benchmark stars. *A&A Rev* accepted this idea, and this review article will be a high impact tangible outcome of the workshop. All participants have been invited to contribute and to coauthor this work, provided that they deliver specified input prior to the end of 2018. The article is scheduled for publication approximately within one year.

During the workshop, a new dynamical method for the determination of very young stars with protoplanetary disks was presented. Here, the dynamics of the disk, determined through sub-millimeter and radio observations, is used as a probe of the mass of the central star. This technique, which was unknown to the majority of the participants of the workshop, opens up the possibility of mass determination for very young objects, and is a newcomer and especially important as it is applicable to evolutionary stages in which stellar models, upon which other more traditional techniques rely, are notoriously uncertain. We believe this is a very important new development that brings together radioastronomy, modeling of protoplanetary disks and stellar evolution in an unexpected way.

It was also emphasized that the currently operating Gaia satellite mission will discover a very large number of new astrometric binary systems. This will be a rich source for accurate dynamical mass determinations of stars in many different evolutionary stages. This is particularly the case because the same instruments that have been used to discover extra-solar planets by the miniscule Doppler-shift of the host star are now being applied to binary systems, allowing exceedingly precise dynamical masses.

The activities of the workshop included morning sessions that were focused on presentations of key aspects of mass determinations for different science cases and with different techniques. In the afternoons, two short “challenge” talks presented current challenges and need for accurate mass determinations as a teaser of the afternoon collaborative work. Working activities followed, during which people gathered in groups (from a few to about 10 persons) to discuss specific needs in different fields. Each day ended with a wrap up session in which groups summarized their activities. The last two days of the workshop were fully devoted to further working groups activities and to discussions on the main structure of the *A&A Rev* article and define basic guidelines for the individual contributions by participants to be sent to the organizers.

We believe the format of the workshop was engaging and fruitful. In particular, the interaction among participants within and across working groups was very lively and led to active discussions during the wrap up sessions. Also, the commitment of participants to contributing to the review article was very high.

Conny Aerts (Leuven, Belgium)

Marie Martig (Liverpool, UK)

Aldo Serenelli (Barcelona, Spain)

Victor Silva Aguirre (Aarhus, Denmark)

Achim Weiss (Garching, Germany)