The Most Massive Stars in the Local Universe

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The *Most Massive Stars Survey* observationally probed the upper limit on the stellar mass and provided data to constrain theoretical models of massive star formation and evolution, as a function of metallicity and environment. The goal of the research program was to measure accurate fundamental parameters (i.e. masses and radii to ~10% or better) for a number of massive eclipsing binary systems discovered in a variety of environments, for the first time providing data with which to test stellar atmosphere models, wind models, stellar evolution models for both single and binary stars as a function of metallicity, and the theoretical predictions on the upper limit of the stellar mass. A further goal was to provide statistics on early-type contact binaries, the binary fraction and "binary twins", thus constraining massive star formation models. Additionally, many new variable stars were discovered. The study of the most massive stars has the potential to provide insight into the progenitors of high mass X-ray binaries, core-collapse supernovae, magnetars, neutron stars, the connection between supernovae and gamma-ray bursts, and Population III stars.

The targets of this study included massive eclipsing binaries in our Galaxy and nearby galaxies, specifically, the Westerlund 1 super star cluster, the Arches cluster at the Galactic Center, the Danks 1 & 2 clusters, the Small Magellanic Cloud, the dwarf irregular galaxy IC 1613 and the Triangulum galaxy (M33). The team members consisted of a postdoctoral researcher (N. Castro) and three masters students (E. Koumpia, M. Kourniotis, K. Markakis), who carried out their M.Sc. theses in the framework of the *MostMassiveStars* project. The main results include:

- An accurate distance measurement to a massive eclipsing binary in the Large Magellanic Cloud of 50.6+/-1.6 kpc. We therefore demonstrated the suitability of early-type O-type eclipsing binaries as distance indicators (Bonanos, Castro, Macri & Kudritzki 2011, ApJ, 729, L9).

- Measurement of parameters of four massive eclipsing systems in Westerlund 1. The eight component stars were found to have masses that span a range of 10−40 Mo. We contributed accurate fundamental parameters for one additional very massive star and provided a second dynamical constraint on the mass of the progenitor of the magnetar known in the cluster. We also estimated the first, direct, eclipsing binary distance to Westerlund 1 (Koumpia & Bonanos 2012, A&A, 547, 30).

- The first near-infrared variability study of the Arches cluster in the Galactic Center. Discovery of a spectroscopic binary with near-infrared spectroscopy. Publications for both projects are in preparation.

- We conducted the first variability survey of the massive Danks clusters using the 1m Swope telescope at Las Campanas Observatory, Chile. We have discovered 20 new eclipsing binaries that are candidate cluster members with massive components and obtained follow up spectra for 6 of these with the 8m VLT, at Paranal Observatory, Chile. Publications for both projects are in preparation.

- Measurement of the parameters of two massive eclipsing binaries, in the nearby galaxy IC 1613 and M33. Additional photometry is currently being obtained to improve the light curve and finalize the measurements. A direct distance measurement will also result from this work and will impact the calibration of the extragalactic distance scale.

- Characterization of 4646 massive stars in the Small Magellanic Cloud, using 8 yrs of data available from the OGLE-III project. We doubled the number of known massive eclipsing binary systems and identified 189 new candidate early-type Be and 20 Oe stars in the galaxy. In addition, we found that ~80% of Be stars are photometrically variable in the OGLE-III time domain. This variability survey of massive stars with known spectral types is larger than any previous survey by a factor of 7 (Kourniotis, Bonanos, Soszynski et al. 2013, A&A, in press).

The dissemination activities of the *MostMassiveStars* project include: 4 refereed publications (Bonanos et al. 2011, Castro et al. 2012, Koumpia & Bonanos 2012, Kourniotis et al. 2013), 6 publications that are in preparation and 6 conference proceedings. The team members attended 6 international and 2 national conferences, as well as 2 international workshops related to the project, having 4 invited talks, 3 contributed talks and 6 poster presentations.

The Marie Curie IRG allowed the PI to form a medium-sized group at the National Observatory of Athens, which assisted in her intergration and in obtaining tenure at the National Observatory of Athens in December 2012. Finally, the PI with the help of her team members undertook (as SOC and LOC co-chair) the organization of the 10th Symposium on Massive Stars titled "Massive Stars: From α to Ω" (June 2013, Rhodes, Greece). The website is: http://a2omega-conference.net