MASSIVE: Massive stAr asteroSeIsmology, Variability, and Evolution with K2: OB-type Supergiants in Field 0

The proposing consortium consists of scientists from Leuven University (B), Paris-Meudon Observatory (F), Liège University (B), CEA-Saclay Site (F), and Royal Observatory of Belgium, all within KASC WG3: Conny Aerts, Evelyne Alecian, Maryline Briquet, Jonas Debosscher, Peter De Cat, Pieter Degroote, Pablo Marcos-Arenal, Stéphane Mathis, Ehsan Moravveji, Coralie Neiner, Péter Pápics, Anne Thoul, Andrew Tkachenko, Santiago Andres Triana, Konstanze Zwintz

Our goal is to perform in-depth ensemble asteroseismology and variability studies of the most massive stars, with the aim to cover the full evolutionary path from the birthline to the supernova explosion. While the nominal *Kepler* mission already implied a revolution in stellar physics for solar-type stars and red giants, it was not possible to perform high-precision studies of massive OB stars or of pre-main sequence (pre-MS) stars because such targets were not sufficiently available in *Kepler's* original FoV, while CoRoT only observed a few of them, several of which during less than one month. We shall remedy this lack of data for the metal factories of the Universe, for which stellar evolution theory is least adequate while its impact on life cycles and on chemical enrichment of galaxies is dominant. The science cases that we shall address were already extensively described in the white paper by Aerts et al. (2013, arXiv:1309.3042) taking the young open cluster NGC 2244 as a case study, but this cluster cannot be observed due to the restriction of the pointing of K2 to the ecliptic. Instead, we seek to observe stars in the fields of K2 to meet the same aims but for various metallicities. This requires that we consider different classes of stars to cover the entire evolutionary path. For each sub-class of stars, we recall briefly the science case in 7 sub-proposals, including the target list for each of them.

Based on the experience of Aerts' and Neiner's teams, who were responsible for the CoRoT OB star target selection, ground-based follow-up and CoRoT data exploitation (cf. ADS since 2009), we have carefully selected the best K2 targets for our aims, as summarized in the Table below for Field 0. Each of the targets was assigned a priority according to its rarity and expected S/N following simulations with our software (Marcos-Arenal et al., 2014, submitted to A&A; in the data files, a blank line was introduced to separate stars of subsequent priority). We plan to adopt the same strategy for all future K2 fields until we have light curves of sufficient quality for at least 100 members in each sub-class, to guarantee that we can place the stars in evolutionary sequences, for various masses and metallicities. For the rare objects, we request all accessible stars. Spectroscopic and spectro-polarimetric follow-up will be performed with the NARVAL, ESPADONS, and HERMES instruments for the stars brighter than 11; for fainter targets we shall apply for competitive time at ESO/IAC/OHP, where the MASSIVE consortium has high success rates. The lead PIs indicated per sub-class are members of KASC WG3, while Alecian, Debosscher, De Cat, Degroote, Marcos-Arenal, Mathis, Thoul, and Triana deliver expertise in magnetism as well as in data and theoretical modelling. The MASSIVE consortium has large expertise in analysing *Kepler* and CoRoT data.

Sub-class	PI	Prio 1	Prio 2	Prio 3	Sub-class	PI	Prio 1	Prio 2	Prio 3
Be stars	Neiner	34	0	0	O stars	Aerts	14	0	0
magnetic stars	Briquet	35	0	0	single B stars	Pápics	66	307	636
pre-MS stars	Zwintz	24	0	0	binary OB stars	Tkachenko	51	5	0
OB supergiants	Moravveji	82	31	0					

OB Supergiants are in a transient evolutionary phase between the core H burning on the main sequence and the formation of neutron stars or black holes as their fate through a supernova explosion. Multiplicity, fast rotation and line-driven wind are common phenomena among this class of stars, impacting their evolution. Their pulsation periods range from hours to days. MASSIVE stars after core H depletion evolve fast and theoretical models predict that some stars have an excursion back to the blue supergiant phase after igniting He in the core on the red supergiant phase.

OB supergiants, giants and subgiants are *Rosetta Stones* to address critical questions on the internal structure and evolution of stars in the upper HR diagram. We shall (1) test the theory of pulsation excitation through the ϵ-mechanism (Moravveji et al. 2012, ApJ, 749, 74), κ-mechanism, and strange-mode variability (e.g. Saio et al. 2013, MNRAS, 433, 1246), or their simultaneous combination, (2) examine the interaction between radial/non-radial pulsation and line-driven mass loss, (3) address whether core He burning/depletion occurs in the blue or red supergiant phases, since evolutionary models predict both, (4) determine the size of the He core before and during the core He burning from the high sensitivity of pulsation frequencies to core size/mass, and (5) explore the impact of extra mixing (by rotation and/or overshooting) on advanced evolutionary phases which determine the mass of the supernova type-II collapsing core. Since *Kepler* did not observe any OB (super)giants, we request such targets in Field 0 of K2, all in long cadence mode, i.e., 23 OB supergiants and 59 giants and subgiants ($< 11^{\rm th}$ mag) in priority 1, as well as 31 faint giants and subgiants ($> 11^{\rm th}$ mag) in priority 2.