MASSIVE: Massive stAr aSteroSeIsmology, Variability, and Evolution with K2: pre-main sequence stars in Fields 2 & 3

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 Fields 2 & 3. 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, A&A in press (arXiv:1404.1886). For these particular Fields, all our targets have highest 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	Field 2	Field 3	Sub-class	PI	Field 2	Field 3
Be stars	Neiner	1	0	O stars	Aerts	0	0
magnetic stars	Briquet	5	0	single B stars	Pápics	34	6
pre-MS stars	Zwintz	15	0	binary OB stars	Tkachenko	10	1
OB supergiants	Moravveji	14	3				

Pre-main sequence (pre-MS) stars have recently been formed from molecular clouds and are contracting towards the zero-age main sequence. Pre-MS stars gain their energy mostly from gravitational contraction and have not started nuclear fusions in full equilibrium in their cores yet. The inner structures of such young objects are significantly different to those of their (post-) main sequence counterparts and can be probed by asteroseismology. Recent studies show that the pulsational properties of pre-MS stars are direct indicators for the stars' relative evolutionary stages (Zwintz et al. 2014, under review by the journal Science).

Currently three types of pulsations were discovered to act in pre-MS stars: while about 60 δ Scuti type pre-MS stars are known, only two candidates for pre-MS γ Doradus pulsators (Zwintz et al. 2013, A&A 550, 121), one pre-MS δ Scuti – γ Doradus hybrid (Ripepi et al. 2011, MNRAS, 416, 1535) and two candidates for pre-MS Slowly Pulsating B (SPB) stars (Gruber et al. 2012, MNRAS, 420, 291) have been reported so far. Although CoRoT dedicated two short runs of 23 and 39 days to observe the very young open cluster NGC 2264, these relatively short time bases were insufficient to improve stellar models of pre-MS SPB and PMS γ Doradus stars which have periods of 0.3 to 3 days in more detail. K2 observations of these pre-MS pulsators will overcome this problem.

There are 15 pre-MS stars known in Field 2 of K2 which are all long cadence priority 1 targets of the MASSIVE consortium. There are no pre-MS stars in Field 3.