Report on identified key reactions, on technical ideas, on the coordination, and on experimental and/or theoretical verification of the key features

The contents and aims of task 1 as well as the participating institutes had a huge overlap with the collaborative research projects MASCHE (MAssive Stars as agents of CHemical Evolution) and EXNUC (physics of compact objects: EXplosive NUCleosynthesis and evolution) of the ESF funded project EuroGENESIS. Therefore, the necessity of additional meetings and workshops organized within ATHENA was little before EuroGENESIS ended in 2013.

Afterwards, there were efforts to include the communities organized within MASCHE and EXNUC in task 1 of ATHENA. At the ATHENA Brussels Workshop on Astrophysics (January 27th to 28th, 2014), three sessions addressed experimental and theoretical research related to "Explosive astrophysics". In addition, the majority of the presentations allocated to sessions entitled "Other topics" was contributed by former participants of EuroGENESIS. Therefore, the transfer of the profits achieved within EuroGENESIS to ATHENA started successfully.

This progress was further underlined during the ATHENA Final workshop held at Villa Vigoni, Lake Como, Italy (May 13th to 16th, 2014). One third of the participants was previously also organized within EuroGENESIS. The presented ideas and suggestions – especially during the discussions about future applications for funding on a European level – were very helpful.

Concerning key reactions, there is a common agreement that the most important reactions related to nova explosions were successfully investigated experimentally during the last years. In cases with still missing data, the theoretical descriptions are well understood. The situation is different for X-ray bursts and supernova explosions. Due to the higher amount of available energy, more exotic nuclei are involved which are not available in sufficient amounts at currently existing radioactive ion beam (RIB) facilities. Another challenge is the production of sufficiently pure and intense beams like, *e.g.*, in the case of the reaction $^{15}O(\alpha,\gamma)$ triggering X-ray bursts.

With the upcoming generation of RIB facilities in Europe, it will be possible to cover a broader part of the reaction networks relevant for X-ray bursts and supernova explosions. However, there is still a need for further progress especially if the request of modellers for reaction rates instead of nuclear properties like masses and half-lives continues to spread towards more and more exotic nuclei. Continuous efforts on the development and, on a long-term time scale, on the construction of a facility like EURISOL is mandatory to fulfil these requirements.