

SPACE EXPLORATION SYMPOSIUM (A3)  
Mars Exploration - Part 2 (3B)

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MARS SAMPLE RETURN SCENARIOS REVISITED

**Abstract**

Mars Sample Return mission is still in the plan for future European exploration missions. After the end of the recent phase A2 study performed by ESA, the tree of possible concepts for this mission has been revisited in a way similar to the analysis performed by Connolly in 2002. However if the Connolly study was focusing on reliability and probability of mission success, our analysis is focusing on mass budget and technical issues. The first part deals with the tree of envisaged concept, from a direct entry-direct return similar to the Luna mission to a Mars rendezvous and return to an Earth orbit. These various combinations are analyzed in terms of mass budget with several technologies (storable propellant, aerocapture, electrical propulsion). Their feasibility is then analyzed in terms of the current or expected technologies. For instance, the Luna 24-like mission is only compatible with the use of ARES V, not for performance reasons but due to the large diameter of the spacecraft enabling the required aerobraking before deploying parachutes. In case of around Mars rendezvous, the identified driver is the mass of the Mars Ascent Vehicle, quite limited to a less than 100 kg performance in low Mars orbit, when using parachutes during the final descent. Using only retro rockets instead of parachutes allows to double this performance. The second part discuss more in detail the rendezvous scenario and proposes a new approach which eliminates the issue of long distance detection by providing a way that allows to resume a relative scenario beginning at a distance of a few kilometers, whatever could be the initial location of the two vehicles and the duration of the operations.