MARS SAMPLE RETURN: A MISSION CAMPAIGN OF INTENSE SCIENTIFIC INTEREST

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Introduction. The transport to Earth of scientifically selected samples from Mars is of compelling scientific interest. This has led to the formulation of the MSR Campaign, which is planned to be carried out by means of a NASA-ESA partnership. This campaign, as it is currently envisioned, would result in the collection of martian samples by NASA's 2020 rover, and their return to Earth as early as 2031.

Technical. Several developments surrounding Mars Sample Return (MSR) have taken place over the past decade or so that have caused the scientific interest in martian samples to increase:
Advances in the study of martian meteorites. As the number of martian meteorites has now grown to well over 100, it has become apparent that of the types of samples which survive the ejection process and the absence of sample context will continue to constrain the insights that may be obtained using this pathway. New mission results from Mars. Fabulous new results have been obtained by the in-situ exploration program (of particular note, MSL and the expected results to come from ExoMars and M2020). These results have served to reinforce the additional value that would come from narrowing the spatial focus, and widening the diversity of instrumentation, both of which would happen by making Mars samples available to terrestrial laboratories. Human exploration. We have a greatly improved understanding of the ways in which the risks, performance, and cost of putting humans on Mars can be improved by acquiring advance information—especially sample-related information. Astrobiology. Although the search for extra-terrestrial life has been key driver of Mars exploration, we now have a much better understanding of the potential for preservation in the geologic record, the evolution of Mars as a planetary object, and (by means of the study of biochemistry on Earth) the details of biological processes. This allows for far more effective search strategies. Instrument developments. We are seeing unprecedented improvements in our collective ability to prepare and analyze very small samples in Earth laboratories. Highly visible examples are the work on Hayabusa asteroid samples (JAXA) and the Stardust comet samples (NASA). Engineering developments. Over the past decade there have been substantial improvements in the capability of the world's space agencies to acquire and preserve samples (most notably, the M-2020 sampling system), the development of the Mars Ascent Vehicle, and critical progress in breaking the chain of contact with Mars.

As recently summarized as the technical conclusion of the 2018 2nd International MSR Conference:

The scientific exploration of Mars and the search for extra-terrestrial life have advanced to the point Mars exploration. Capitalising on major engineering progress in recent years by the world's space agencies and industries, we are technically ready to start the development of the flight missions associated with retrieving the samples. In parallel, planning for the potential receipt and evaluation of the samples has started, and should accelerate, as well as for the processes associated with making the samples available to the world's science community. Given the nature and scope of the Mars Sample Return campaign, we expect that engaging the public early and keeping them involved throughout will be a particularly important component of this effort. We have the opportunity and the motivation to make the Mars Sample Return campaign an international endeavour and a reality for all humankind.

References: [1] iMOST (2018), The Potential Science and Engineering Value of Samples Delivered to Earth by Mars Sample Return. *Meteoritics & Planetary Science*. https://doi.org/ 10.1111/maps.13232

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