HOW CHONDRITES AND COMETS INFORM ASTROPHYSICAL DUST EXPERIMENTS IN MICROGRAVITY (TEMPUS VOLA AND OTHERS).

J.-D. Bodénan[1,2], T. Mannel[3], L. Mayer[2], M. Schönbächler[1], A. Pommerol[4], and H. Capelo[4], [1]Institut für Geochemie und Petrologie, Departement Erdwissenschaften, ETH Zürich, Claussiustrasse 25, 8092 Zürich, Switzerland (jean-david.bodenan@erdw.ethz.ch) . [2]Institute for Computational Science, University of Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland. [3]Space Research Institute of the Austrian Academy of Sciences, Schmiedlstrasse 6, 8042 Graz, Austria. [4]Center for Space and Habitability, Universität Bern, Gesellschaftsstrasse 6, 3012 Bern.

Introduction: The research on the history of the solar system needs a multi-disciplinary approach. Meteorites and space missions to asteroids and comets provide essential clues and constraints on the reservoirs and processes that occurred during the early stages of the formation and evolution of planets. Complementarily, theoretical and experimental astrophysics allow to further constrain the processes that took place in the protoplanetary disk and controlled planetary compositions. Many astrophysical simulations simplify the dust present in the disk as a single phase with density ρ = 3 g/cm^3 [1]. While this is a reasonable first-order approximation, simulations are becoming increasingly refined [2] and the need arises for a more detailed input. Similarly, experimental setups can provide more refined results, if they take into account the diversity of dust present in the early Solar System. While particle-particle collisions are known to be the pathway to generating macroscopic solid bodies in the Solar System, growth by collisions is hindered via barriers such as bouncing, and catastrophic collisions. The hydrodynamic interactions between dust particles and nebular gas is therefore considered a critical aspect to facilitate the evolution of the dust component in protoplanetary discs, so that dust aggregates can form the basis and starting point for the core-accretion planet formation theory. We therefore constructed an experimental facility; called Timed Epstein Multi-Pressure-Vessel at Low Accelerations (TEMPus VoLA), that mimics space-like conditions in the absence of external gravitational force (microgravity). In the experiments, we can control the complex nature of dust aggregates, and directly study the effects of variation such as composition, size and density. Here, we present an effort to summarise grain distribution and diversity in the disk based on meteorite and cometary records and how it was used to inform the experiment.

Dust summary from meteorites and comets: To select appropriate dust sizes and compositions for experimental setups and simulations exploring early solar system processes, we compiled an overview of dust size and distribution based on new data and literature. Calcium-, Aluminium-rich Inclusions (CAIs) from a range of carbonaceous chondrites were measured in 28 thin sections of COs, CVs, CMs, and CRs for a total of 409 inclusions, resulting in an average size of 246.4 µm with a standard deviation of 359.4 µm. Chondrule sizes were essentially collected from the literature for 583 chondrules across all chondritic groups. We derived a chondrule average size of 600.0 µm with a standard variation of 986.0 µm over all meteorite groups. The averages of different chondrite classes are distinct in agreement with previous studies [3]. We extended the database to comets using previously published [4,5] and new MIDAS (Micro-Imaging Dust Analysis System) dust particles from 67P/Churyumov-Gerasimenkoto to obtain a larger picture of dust in the disk. Particles/subunits down to sizes between 30 nm and 5 µm were identified, comparable to chondrite matrices. This particle inventory from meteorites and comets was then used as a basis to choose the experimental dust samples for TEMPus VoLA.

The experiment: The TEMPusVoLA facility consists of three main low-pressure flow vessels, which are seeded with dust-particle analogue material. In each chamber, we monitor the variations in gas pressure and the dust-grain aerodynamics, using high-precision particle-tracking techniques. Each chamber can be operated and studied separately, while executing a carefully timed measurement sequence throughout a parabolic flight campaign (PFC; see [6] for details). A single PFC consists of up to 93 parabolas, and so a wide variety of dust and gas parameters have been addressed over the course of three PFCs. The separate papers addressing i) gas percolation through granular material, ii) two-phase granular shear-flow instability, iii) drag coefficients on porous dust aggregates, are now in the preparation and submission stages.

References: [1] Surville, C. and Mayer, L. (2019) *The Astrophysical Journal* 883:176. [2] Hutchison, M. A. et al. (2022) *Monthly Notices of the Royal Astronomical Society*, 512:5874–5894. [3] Jones, R.H. (2012) *Meteoritics and Planetary Science* 47:1176–1190. [4] Bentley, M. S. et al. (2016) *Nature* 537(7618):73–75. [5] Mannel, T. et al. (2019) *Astronomy and Astrophysics* 630:1–14. [6] Capelo et al. (2022) *Review of Scientific Instruments*, Under review.