A Solar System Perspective on Laboratory Astrophysics

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Solar System bodies are observed from ground-based observatories, airborne and space-borne telescopes, and from spacecraft, using the full range of techniques and wavelengths (X-rays to the far infrared) in which other astronomical bodies are studied. In addition to these remote sensing observations, physical samples of various Solar System bodies can be studied directly in the laboratory. Examples include meteorites, interplanetary dust particles, and the Apollo lunar samples; more are coming from various missions in progress and under development or study. Despite the similarities to data on astrophysical sources, Solar System data impose special requirements on the supporting information that comes from the lab. The interpretation of the remote sensing observations requires data on gases, plasmas, ices, minerals, and organic materials, often at particular spectral resolution and in special temperature regimes and other physical conditions. In addition, support is needed for the development of new techniques for the handling and analysis of exceedingly small samples of planetary materials. Laboratory supporting data have failed to keep pace with the exploration of Solar System bodies. Examples of the unmet needs of Solar System science for lab data include (1) measurement of spectral properties (complex refractive indices) of organic solids synthesized under realistic planetary conditions, (2) complex refractive indices of ices of various compositions in amorphous and crystalline states, and in matrix isolation, (3) development of techniques for the extraction and analysis of picoliter samples of fluids included in meteorites, and (4) development of techniques for remote determination of composition and age of planetary surface materials. Supporting laboratory studies are not normally included in mission budgets.