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Laboratory Astrophysics Needs of the Herschel Space Observatory

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The science teams of the Herschel Space Observatory have identified a number of areas for laboratory study required for proper interpretation of Herschel observational data. The most critical is the collection and compilation of laboratory data on spectral line frequencies, transition probabilities and energy levels for the known astrophysical atomic and molecular species in 670 to 57 micron wavelength range of Herschel. The second most critical need is the compilation of collisional excitation cross sections for the species known to dominate the energy balance in the ISM and the temperature dependent chemical reaction rates. On the theoretical front, chemical and radiative transfer models need to be prepared in advance to assess calibration and identify instrument anomalies. In the next few years there will be a need to incorporate spectroscopists and theoretical chemists into teams of astronomers so that the spectroscopic surveys planned can be properly calibrated and rapidly interpreted once the data becomes available.

The science teams have also noted that the enormous prospects for molecular discovery will be greatly handicapped by the nearly complete lack of spectroscopic data for anything not already well known in the ISM. As a minimum, molecular species predicted to exist by chemical models should be subjected to detailed laboratory study to ensure conclusive detections. This has the greatest impact on any astrobiology program that might be proposed for Herschel. Without a significant amount of laboratory work in the very near future Herschel will not be prepared for many planned observations, much less addressing the open questions in molecular astrophysics.