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Laboratory set-up for optical property characterization of gases in extreme planetary conditions

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The observations of a planet in remote sensing, either to study the atmosphere or to study its surface when the atmosphere is not satisfactory transparent, require the accurate knowledge of the optical properties of the gases in physical conditions as close as possible to the environment. The databases provide a huge dataset of various gases typical for planetary atmospheres but at physical conditions sometime closer to the Earth and far from the real target. A typical example is Venus, where the pressure is about 100 times larger than the Earth and the temperature is more than 400K higher. Just the opposite is the case of Titan, where the temperature is about 200K lower. In addition, very faint absorptions are easily seen in long optical path, for example in limb geometry, while it is very difficult to measure in the lab such weak absorption features. We present here a new laboratory set-up, studied ad hoc for Venus and Titan which is however usable for other cases in planetary exploration. The set-up uses both the Cavity Ring Down (CRD) technique to measure weak absorption features, and an high pressure-temperature gas cell integrated in a FTIR instrument to measure broadening effects in extreme conditions. With this cell we can simulate the Venus conditions down almost to the surface. Also, another cell is able to simulate the cryogenic conditions of methane on the Titan atmosphere. By using the CRD technique, we can improve by 3-4 order of magnitude the overall sensitivity for the absorption coefficients and we are able to reproduce in the lab several tens of km of optical path from a 50cm only width cell.