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The LONSCAPE instrument, a Light Optical Nephelometer Sizer and Counter for Aerosols in Planetary Environments

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Liquid and solid particles are present in the atmosphere of many Solar System objects. Measuring aerosol properties can provide major constraints about both atmospheric composition and dynamics. While some bulk aerosol properties can be estimated using remote measurements, the size distributions and the typologies of the aerosols, which are related to their formation process, their origin and their evolution, are often poorly known. We propose a new concept of optical instrument dedicated to in situ measurements of aerosols as part of the science payload of an atmospheric entry probe or of a surface module. It relies the Earth atmospheric light aerosol counter LOAC used since 2013 under various types of balloons. This instrument measures the aerosol concentrations in 19 size classes between 0.2 and 50 micrometers, and estimates their typology

The LONSCAPE (Light Optical Nephelometer Counter Sizer and Counter for Aerosols in Planetary Environments) concept combines counter measurements and nephelometric measurements at several phase angles, particle by particle, to retrieve for all size classes the concentrations and the scattering functions. This approach is the novelty of the instrument concept. The scattering functions can be compared to results of theoretical calculations but also to laboratory databases obtained for levitating particles and from the microwave analogy technics, to retrieve the refractive indices of the liquid and solid particles to better identify their nature and origin. Up to 10 angles measurements for the scattering function and one angle measurement for the counting provide an optimal configuration to distinguish between liquid, icy and possibly solid particles in the Uranus or Neptune atmosphere. Such an instrument must be able to detect up to tens of particles greater than 0.1 micrometer within 1 cm^3.

For ice giants, the instrument must work for pressures up to 10 bars. No pumping system should be needed since the aerosols will be injected in the optical chamber by an inlet parallel to the descent motion of the probe under parachutes. Considering the relative velocity between the

atmosphere and the probe, the electronics must be able to detect particles crossing the laser beam up to several tens of m/s, which can be done by “conventional” electronics. Preliminary studies show that the instrument could have a total mass of about 2 kg and an electric consumption of about 2W.