

Fluorescence Life-Time (FLiT) instrument for space missions

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While we detail the design of the Life-Detection Microscope (LDM), a high spatial resolution fluorescence microscope, alternative ways of detecting extraterrestrial life have been under consideration. One of such is the "fluorescence life-time (FLT)" measurement. FLT has been widely used in biophysical studies of proteins as FLT by its nature is one of the most robust fluorescence parameters. To examine the possibility of applying the FLT measurement to the space missions, we have developed a Bread Board Model (BBM), called FLiT. The method we use is the "time-domain" method in which the sample is illuminated with a short pulse laser and the decay time of the fluorescence is measured.

The pulse laser of FLiT is a 488-nm laser diode (Nichia NDS4116) to which pulses of 1-ns full width at half maximum is fed by the driver electronics. One pulse may excite just one fluorophore and the photon from it will be detected by an avalanche photo diode (APD) in the photon-counting mode (MPPC C13001-01 from Hamamatsu Photonics). The time delay from the start trigger (1-ns pulse) to the stop trigger (photon detection in MPPC) is measured by the time-to-digital converter (TDC7200 from TI). Such measurement will be repeated and a histogram of delays is obtained from which the fluorescence life-time of the sample material is inferred. This potentially allows us to distinguish organisms from minerals in the Martian soil. The FLiT BBM is now under the characterization phase, to evaluate possible delays in the electronics (including cables) and their stability. Details of the FLiT BBM as well as results of initial tests will be presented.

Keywords: Fluorescence life-time, Martian life, Life-detection microscope