First Daylight Laser Measurements of a Space Debris Object

The constantly growing space debris population is posing an ever-increasing threat for spacecraft, including manned missions. Unfortunately, the accuracy of the current orbit catalogues is insufficient to identify close conjunctions and to devise and execute efficient avoidance maneuvers.

Measuring distances to space objects using satellite laser ranging is a powerful technique to improve the orbit accuracy. However, until now, powerful lasers were needed to range to space debris and measurements restricted to nighttime.

On June 24 2020, AIUB acquired the first ever daylight observations of a space debris object using a geodetic laser at the Swiss Optical Ground station and Geodynamics Observatory Zimmerwald (Figure 1). Geodetic laser systems are at least one order of magnitude less powerful than dedicated space debris lasers and the discrimination of the single laser photons diffusely reflected by the debris object within the sea of background photons from the bright daylight sky is particularly challenging (see Figure 2). The success was only possible thanks to the combination of active tracking using a highly sensitive scientific CMOS camera and real-time image processing, and a real-time digital filter to identify the photons from the debris object.

Figure 1: The Zimmerwald Laser and Astrometry telescope ZIMLAT used to range to the space debris object.

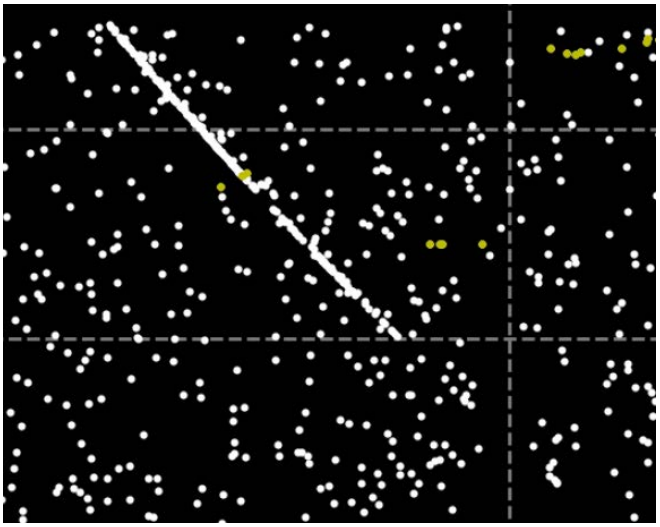

Figure 2: Example of a "string of pearls" of photons reflected by the target debris object in the "sea of sky background photos".