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TAKING THE PULSE OF OUR PLANET FROM SPACE

Experimental tests for the detection and characterisation of Plastic Marine Litter by means of fluorescence LIDAR technique

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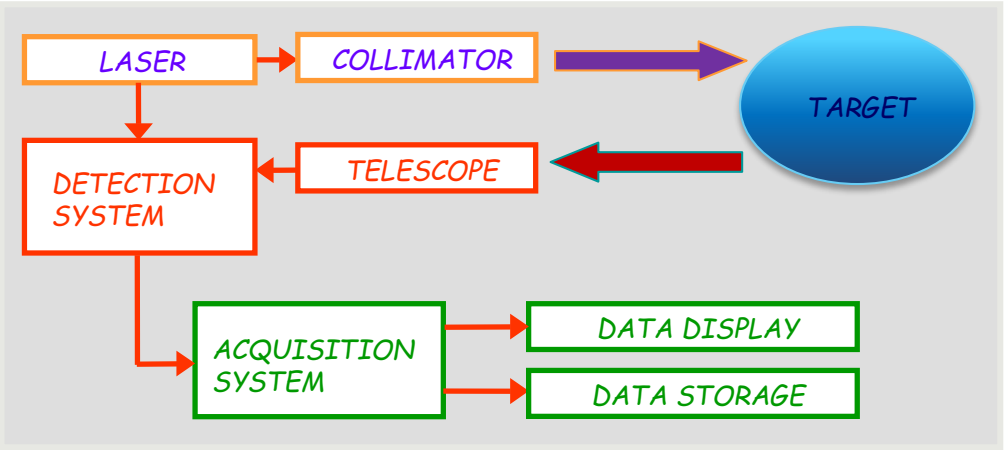
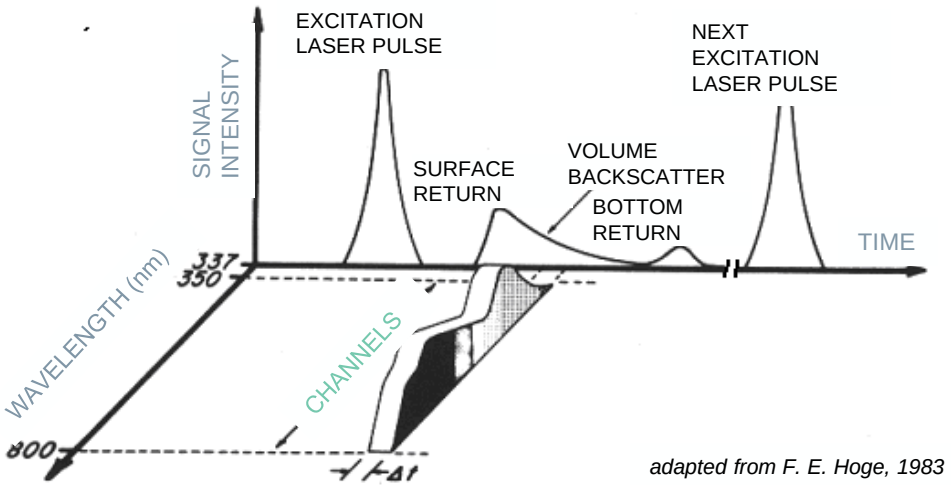
The LIDAR technique

- LIght Detection And Ranging
- Optical counterpart of the RADAR
- Active remote sensing technique
  - Water column penetration
  - Day and night operation
  - ➢ Low spatial / temporal resolution
  - ➢ Eye safety constraints
- Fluorescence LIDAR

LIDAR working principle





adapted from F. E. Hoge, 1983

The ESA-funded BLUE project

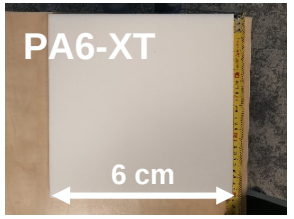
Aims and scope: Investigate the potential of diverse LIDAR techniques – **FLUORESCENCE**, elastic backscatter, Brillouin-Rayleigh, Raman - to address plastic litter issue at sea, with an emphasis on plastics under the water surface and the characterisation in terms of material.

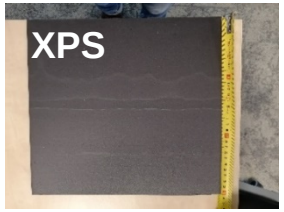
BLUE project:

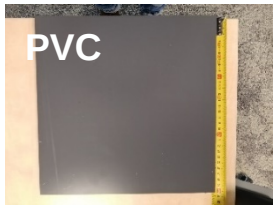
«Brillouin – backscatter - fluorescence LIDAR research for Underwater Exploration of marine litter» (Sept. 2020 – on going)

- Early technology development projects funded by ESA in the frame of Discovery campaign on Plastic Marine Litter
- **Prime**: Institute of Applied Physics of the National Research Council (CNR-IFAC)
- **Partners**:
  - The Ocean Cleanup,
  - University «La Sapienza» of Rome - Chemical Engineering Dept.

Samples: raw, used and ocean-harvested plastics

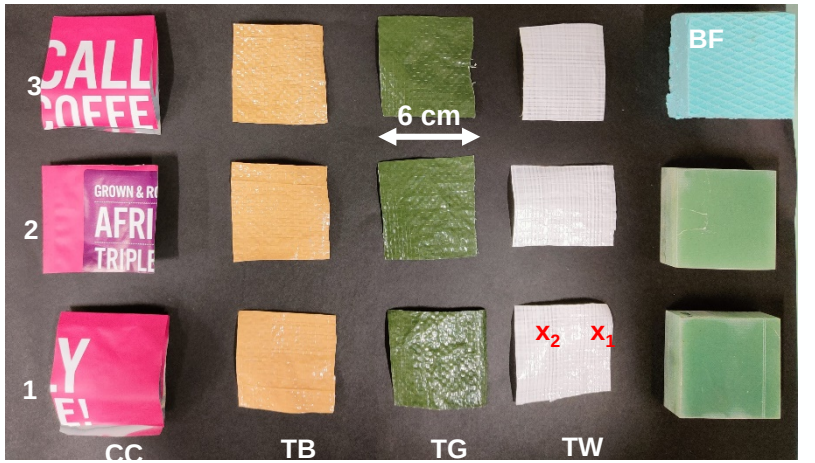






Used/weathered plastics

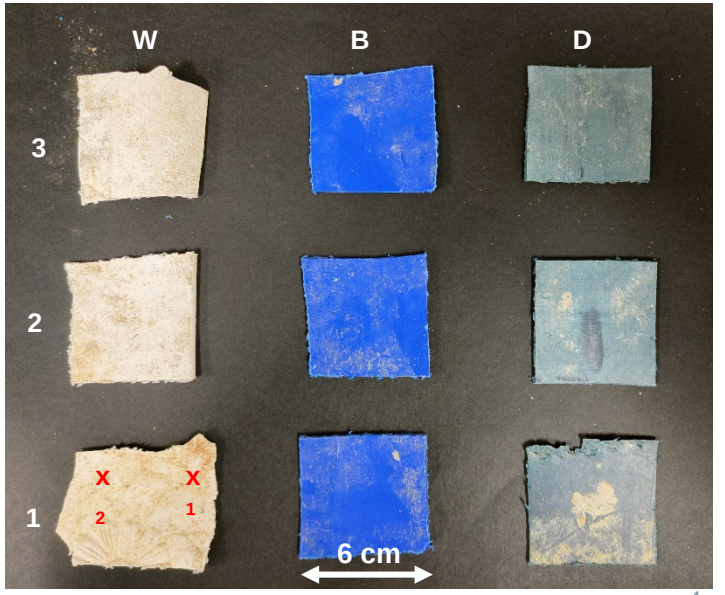
HDPE fabric with LDPE coating,
coffee bag, foam



Raw plastic samples

- HDPE (High Density PolyEthylene)
- PA6-XT (PolyAmide 6 (Nylon))
- XPS (eXtruded Polystyrene)
- PET (PolyEthylene Terephthalate)
- PVC (PolyVinylChloride)
- PP (PolyPropylene)

Ocean-harvested macroplastics (HDPE)



Beach-harvested plastic debris (< 5 cm) and plastics fibers

Conclusions

- Raw plastics, weathered and ocean-harvested plastics showed meaningful fluorescence emission, which was detected by using an in-house developed fluorescence LIDAR (under controlled conditions in the laboratory, ambient light, from 11-m distance)
- Fluorescence signal can be easily detected also when plastics is not floating on the surface and decoupled from both water Raman signal and CDOM fluorescence contribution
- Plastics fluorescence spectral behaviour lays the basis for the characterisation of different types of plastics, even ocean- and beach-harvested plastics (not pre-treated)
- Preliminary tests on microplastics (< 1 mm) and plastics fibers suspended in water provided very promising results for their detection
- LIDAR measurement campaign at sea planned in June 2022
- ***See also poster on airborne backscatter LIDAR data acquired over the Great Pacific Garbage Patch (DAY 3 - 25/05/2022 – Board #334) !!***

Thank you!

Any question welcome …

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