THE H2020 PROJECT REDSHIFT: OVERVIEW, FIRST RESULTS AND PERSPECTIVES

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The ReDSHIFT (Revolutionary Design of Spacecraft through Holistic Integration of Future Technologies) project has been approved by the European Community in the framework of the H2020 Protec 2015 call, focused on passive means to reduce the impact of Space Debris by prevention, mitigation and protection. In ReDSHIFT these goals will be achieved through a holistic approach that considers, from the outset, opposing and challenging constraints for the space environment preservation, the spacecraft survivability in the harsh space environment and the safety of humans on ground. The main innovative aspects of the project concern a synergy between theoretical and experimental aspects, such as: long term simulations, astrodynamics, passive de-orbiting devices, 3D printing, design for demise, hypervelocity impact testing, legal and normative issues.

INTRODUCTION ReDSHIFT is structured in four main sections, striving to enhance possible synergies helping the space debris mitigation: (1) the analysis of the current mitigation measures perfroming long term projections, (2) a detailed study of the circumterrestrial space by mapping the phase space from LEO to GEO, (3) the experimental part, looking at the novel opportunities offered by 3D printing, (4) a comprehensive software package. The project entered the 2nd year of activities.

ANALYSIS OF THE CURRENT MITIGATION MEASURES AND LONG TERM SIMULATIONS

A critical analysis of the strength and weaknesses of the currently adopted mitigation measures was performed. All the details can be found in the **poster by Schaus et al.**
Some of the main results:

- LEO environment appears “unstable”;
- More aggressive mitigation measures can slow down but not stop the growth;
- Care is needed in use super-LEO storage zone
- Careful look to planned mega costellations
- Warning in handling the GEO graveyard zones.

DESIGN AND 3D PRINTING

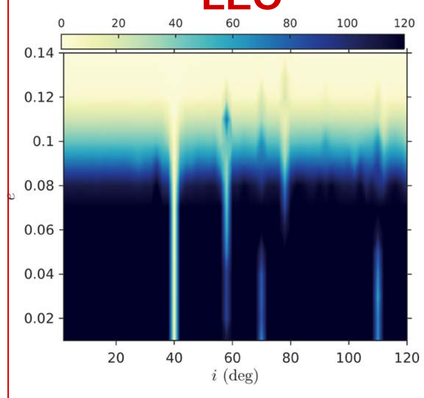
The design phase, including 3D printing, shielding and design for demise has started.
Outline of the main activities and findings:

- Review of : EoL concepts and technologies, common spacecraft designs, 3D printing technologies and material;
- Analysis of shielding concept for Non-Catastrofic and Catastrofic Impacts;
- Design for demise.

DYNAMICAL MAPPING FROM LEO TO GEO

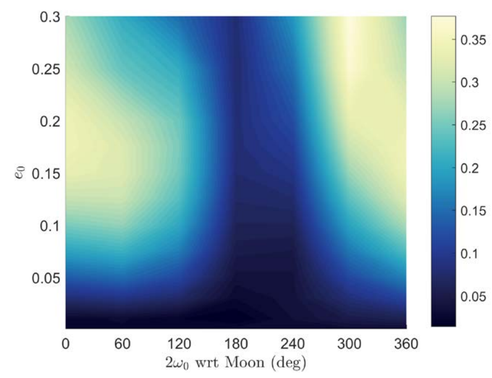
Iinnovative strategies for designing disposal trajectories by exploiting the existence of natural dynamical ”de-orbiting highways” in phase-space that could enhance orbit decay, taking advantage from SRP and luni-solar perturbations, were evaluated. A complete «cartography» of the LEO to GEO phase space was perfomed.

LEO



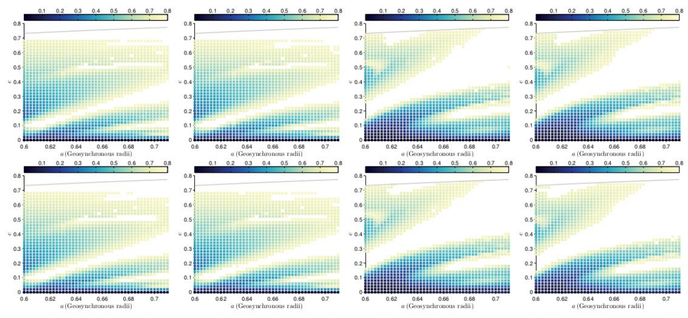
see **poster by Alessi et al.**

GEO



see **presentation by Colombo et al.**

MEO



see **poster by Skoulidou et al.**

SOFTWARE DEVELOPMENT

A complex software, encompassing all the findings of the project will be one of the final products. It will provide a complete debris mitigation analysis of a mission, using existing debris evolution models and lessons learned from theoretical and experimental work.
The functional design is now assessed and foresees the following interconnected SW modules:

- Environment projection;
- Flux and collision probability model;
- Disposal mapping;.
- Sail Dynamics;
- Design for Demise Assesment Tool;
- Space Debris Shielding.

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