Initiative for the Peaceful Use of Lasers in Space

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Abstract: This paper outlines an initiative to enable peaceful global development and deployment of laser technology for orbital safety, exploration of Celestial bodies, space travel at relativistic speeds, and planetary defense against dangerous near-Earth objects.

The technological possibilities of the high-energy laser technology for space applications have been explored for many years. The use of lasers for maneuvering and removing orbital debris has been theoretically and practically developed for ground-based photon pressure systems [1–5] as well as space-based ablation methods [6,7]. Close-distance laser-induced breakdown spectroscopy (LIBS) has been already deployed for chemical analysis on Mars [8] while parameters for its long-distance use to analyze the physical and chemical properties of Celestial bodies have been further explored by many [9–11]. The most futuristic uses, large-scale laser arrays for asteroid deflection [12–14] and interstellar travel [15,16] are theoretically proven, while the non-profit philanthropic organization Breakthrough Initiatives fully funds research and development of such technology [17].

The mentioned laser uses have the potential not only to address several significant global challenges humanity faces, including impacts of asteroids and comets or cascading collisions between satellites and space debris on growingly congested and important Earth's orbit, but also to advance global human flourishing by making humanity a multi-planetary species through space resource utilization and space travel at relativistic speeds. However, these highly desirable uses of lasers for space applications are hindered by several issues that all have a common denominator, the lack of global cooperative and governance framework. The dual-use nature of lasers in space and the absence of a legitimate global governance regime to ensure their safe and peaceful use in space for benefit of humanity and not a particular actor are among the main obstacles, which stand against the full realization of the lasers' potential in space as argued in the Bulletin of Atomic Scientists [18].

Reacting to these dynamics, a group of state and non-state institutions organized (Breakthrough Initiatives, Charles University, Czech Ministry of Transport, Czech Academy of Sciences, Institute of International Relations in Prague) the Prague Laser SpaceApps Workshop 2019 in the Czech Republic, on September 25-27 2019, which brought in together an international cohort of top laser and optics scientists from Russia, United States, Europe and Australia to discuss main technical and policy challenges for the development and deployment of lasers in space [19]. The momentum led to the establishment of the Peaceful Use of Lasers in Space initiative, a multi-stakeholder global effort aimed at establishing global cooperation and governance regime for the development and deployment of lasers in space [20]. The initiative revolves on scientific and diplomatic levels, with the later one focusing on an establishment of international scientific community focused on the peaceful development and deployment of lasers in space and the former aimed at initiating discussions at international diplomatic fora about adequately safe and secure norms of behavior for laser use in space.

The 2019 workshop identified three concrete follow-up steps for the initiative. Firstly, it is the drafting of a declaration to inspire and motivate global scientific and diplomatic participation and put forward non-binding objectives and visions. Secondly, it is an establishment of scientific working groups to review the state of research, define main challenges and bottlenecks, and outline the discussion about solutions and steps forward. Thirdly, it is the organization of a series of international conferences on the Peaceful Use of Lasers in Space with adequate support and coordination from the United Nations, national governments, and scientific bodies to enable safe and accountable use of lasers in space to address global challenges and advance human flourishing.

The Declaration for the Peaceful Use of Lasers in Space [21] manifests the core ideas and purpose of the initiative on behalf of the scientific community. The main objectives are the establishment of a grassroots framework for international cooperation of governmental, non-governmental and commercial actors for civilian development of the space-related laser technology as well as initiating an open discussion about inclusive and legitimate global regime for safe and secure deployment of high-power lasers in space. The Declaration, open for an endorsement, is to represent the collective interests of the engaged scientific community to the international actors and has been backed up by Nobelist Gérard Mourou.

The planned working groups are based on the summary report of the 2019 Laser SpaceApps Workshop [22]. The groups are split between technical and governance pillars, where discussions on their scope and focus are expected to continue until the planned international PULS conference in 2021 as a follow-up for the first 2019 meeting. The purpose of the groups is to initiate the discussion about the identified challenges of the PULS and establish an inclusive dialogue about the way forward in addressing the technical and governance issues for the development as deployment. The technical working groups can be divided by the laser applications (photon propulsion, space debris removal, and maneuvering, asteroid prospecting, and deflection) or relevant topics of high-power laser systems for space (propagation, beam combining, optics, support systems, etc.). Within the governance pillar there are three identified working groups that include a) Security Regime, b) Legal and Regulatory Aspects, and c) Global Legitimacy, Framing, and Narratives for Peaceful Use of Lasers in Space.

The first international PULS conference, which was originally planned for fall 2020, has been scheduled for September 2021. It follows up on the similar format of the 2019 Laser SpaceApps Workshop, which has engaged both technical and policy areas in an interdisciplinary discussion between physicists, social scientists, policymakers, and government officials. The conference has four main aims. Firstly, to bring together all interested stakeholders on the level of governments, international organizations, scientists, and the private sector. Secondly, to provide the first meeting for each working group of PULS. Thirdly, to generate a global momentum in diplomatic terms and identify leadership among nation-states as well as non-government organizations. Lastly, to agree on sufficiently ambitious and globally plausible objectives of PULS and establish a roadmap for its advancement.

3. References

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