

Laser SpaceApps Workshop Summary Report

This document aims to briefly summarize the **Laser SpaceApps Workshop** held at HiLase in Dolní Břežany and the Ministry of Foreign Affairs in Prague on 25-27 September 2019 and point towards the next steps for the community.



technical challenges

From the technical standpoint, challenges differ for various concepts, between space-based or ground-based laser systems, between pulsed or continuous wave lasers and in many aspects between different discussed applications (space debris removal, asteroid deflection & analysis, interstellar travel). Some of the technical obstacles include but are not limited to cost of laser diodes, cost of optics, propagation over large distances, propagation through the atmosphere, power generation, storage and transportation, cooling, phasing, transmitting and cooling of mirrors, with specific challenges for space-based lasers also including battery source with high energy-to-mass ration and efficient cooling and reradiating systems. Focusing on quickly achievable laser technology applications (i.e. space debris removal and maneuvering), identification of possible spin-offs of laser technology development can secure financial support with economies of scale reducing costs of critical components like diodes and optics.

policy challenges

The policy questions can be summarized through three interconnected aspects. Firstly, there are the **practical aspects** that concern the sharing of high economic costs, division of labor as well as pooling of expertise between participating parties. The solutions and formats for facilitating the cooperation vary and carry different implications of other aspects. Secondly, the **security aspect** of such powerful technology with clear dual-use raises questions about its control, authority, decision-making process and overall hierarchy. Thirdly, the nature of issues ranging from search for life in the universe (interstellar propulsion), human flourishing (space debris removal) and protection of life on Earth (asteroid deflection), its propagation to the universe or expansion into other parts of the Solar System (space resources utilization) requires adequate degree of global governance, accountability and legitimacy, representing the **legitimacy aspect**.

precedents

One of the approaches to these questions discussed at the workshop was the use of appropriate precedents. The useful precedents included ITER, CERN, ITU, SERC or the Laser Clearinghouse as potential sources of inspiration for global scientific cooperation. The lessons learned from ITER and CERN included standardization of knowledge sharing, reliance on in-kind contribution and innovative funding, multi-polar decision-making structures as well as the importance of narratives. Further, technical aspects of existing international standards were usually not negotiated by governments but rather emerged from acting actors that have the knowledge for the needed protocols and technical aspects of cooperation. These precedents are useful for the **practical aspects** of global governance. However, while any actors with appropriate technical knowledge and experience can be ideal for proposing and suggesting the parameters of technical cooperation, they are not the source of legitimacy on issues with ethical, normative or value dimensions. The UN COPUOS was mentioned as a source of international legitimacy and an appropriate body to deal with the **legitimacy aspects**. This discussion, however, also featured weaknesses in decision-making, consensus-building and overall legitimacy of international organizations, given the absence of any international authority, the role of inherently contested national interests and low global accountability. The danger of securitization and threat perceptions of a powerful laser system highlighted the **security aspects**. As initial ideas, institutions, values and structure can

define the social world that governs the new technology, inclusive decision-making process, and a normative and ethical governance framework are required. The foundation of CERN emerged at a critical point of global power re-configuration, the giant laser system cooperation is also starting at the time of great power shifts between national, supranational and local governance models as well as the empowerment of non-state actors. Therefore, the practical, legitimacy and security aspects require an innovative cooperation model combining private (commercial, philanthropist), public (local, city, regional, national) and global (UN COPUOS, ITU, Inter-Parliamentary Union) actors.

governance challenges

The **practical aspects** stress the need to share costs and expertise but at the same time make decision-making effective to avoid slowing or hindering research and development. The inclusion of powerful actors with adequate epistemic and financial means can increase effectivity but does not automatically deal with security and legitimacy aspects. The **security aspects** require inclusivity and shared collaborative practices to build confidence, avoid securitization of the system and prevent misuse by a specific group of actors for their undeniable self-interests. However, with a higher number of decision-makers also grows the challenge of collective action and reaching consensus. Therefore, a solid normative and ethical framework based on peaceful, civilian and legal use and exploration of the Outer Space should be one of the core principles for the way forward. In this way, such a framing of the governance model, institutional setup and practices can construct a peaceful social reality around the large technical system from the beginning. The **Legitimacy aspects** at the global level represent a significant challenge, even on the theoretical level. Legitimacy derived by effective problem-solving can be addressed by specifying and limiting areas in which the laser systems can provide solutions, such as space debris removal, planetary defense or scientific exploration. However, the means of deriving legitimacy by popular acceptance and approval on the global level are non-existing, yet critical for the sustainability of such a long-term project. Novel forms of supranational legitimacy that derive from the so-called public reason rather than from state-like citizens' participation at the global level should be further discussed and explored. Similarly, narratives are a critical tool for gaining support and legitimacy. They serve as a tool to construct shared visions and reality and justify the necessary steps to reach a goal. Social narratives/discursive structures are critical for LTS. Socio-technical imaginaries embed values and priorities that gather support and impact decision-making. Different narratives are relevant to different audiences, especially on the complex global level, where they can be a source of legitimizing action. Catastrophic narrative (planetary defense) and civilizational progress narrative (space exploration, space-resource utilization, daily lives impact from spin-offs) have been highlighted in some of the discussions.

Opportunities

Incremental small steps can be more effective to gather support. Therefore, small steps in research and development of the closest space applications of laser technology should be identified based on the above-mentioned main technical obstacles. To this end, developing various narratives and identifying area-specific spin-offs will be key for gaining political and financial support. Sources of legitimacy, decision-making formats, financing models, ethical-normative pillars, types of narratives are among the key areas in need of further discussions.

The European Union as a source of supranational political and financial support carries significant opportunity with a favorable wider context. This includes new European External Action Service Space Diplomacy efforts, the new ambitious and expanded EU Space Program 2021-2027 with the new EU Agency for Space Program and the new Horizon Europe €100 billion funding scheme for research, with an emphasis on breakthrough innovation, as well as the search for a new European long-term large-scale space projects to follow up on Galileo and Copernicus satellite systems. EU's H2020 and Horizon Europe represent an important source of funding within Europe for relevant laser research. Similarly, the European Space Agency's Space Safety Program, which is requesting a budget of nearly one billion euros with ongoing laser ranging and laser momentum transfer projects, represents another relevant leverage for the development of laser space applications.

Next Steps

Technical and policy discussions require continuous elaboration with the focus on specific topics, concrete policy recommendations and identification of the next steps for the community.

- 1) Another conference covering technical and policy aspects will be held in May 2020 in the Czech Republic to strengthen the momentum of the community.
- 2) The main organizers, Institute of International Relations in Prague, Breakthrough Initiatives and Charles University will together with the UN COPUOS set up the policy working groups and chairs for the conference. HiLase, Eli Beamlines and Breakthrough Initiatives will set up the technical working groups.
- 3) A paper compendium for each working group will be organized to deepen the discussions and identify leadership in specific areas for further work.
- 4) A working charter of the community focused on the peaceful use of lasers in outer space will be drafted during the next meeting based on the outcomes of each specific groups.
- 5) The community will establish long-term meeting and work plans and identify funding opportunities and joint research proposals.



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