Advanced LASER Mining Array (ALMA)

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1 Abstract

The overall goal and mission for **ALMA** is to show the feasibility of using a Fiber LASER (FBL) for mining water ice in space. This includes ice on the moon, Near-earth Objects, and asteroids in the asteroid and Kuiper belt. The reasoning behind the use of a FBL and not an nd:YAG or CO_2 gas LASER is for the efficiency and accessibility the FBL has over the other designs. The FBL uses less electricity, thus becomes more cost-efficient [3], it has a higher power output, uses a simpler design and is more compact [3], and is reliable and maintenance-free [1]. Most high powered FBL's have a recorded 30% - 50% power efficiency, much greater than any other option [2].

The basic design of a FBL utilizes: coupled diodes, a combiner from diode to fiber cable, a Ytterbium doped fiber cable, Bragg gratings, and protection gratings (*Fig. 1*). The mining technique being researched is a helical shape and is called helical mining, covering the entire surface area of which you are trying to mine. This allows you to cover a larger surface area with a smaller beam diameter. There is also a means of cooling the LASER to protect the components and maintain efficiency. Because ALMA is researching means of mining in space, where temperatures are slightly larger than absolute zero, there would be no use for cooling. For instance, the temperatures at the lunar ice caps can range from 20K-140K [4]. Temperatures are not consistent on the surface of the moon, other celestial bodies, or within deep space. Because of this inconsistency in temperature, there will be a need to upgrade and change the FBL used based on the environment it is mining in. The question will be if it is going to the moon, a nearby asteroid with little or no atmosphere, or a planet with temperatures up to 300K?

The above items cannot be afforded with the SPARK, therefore the money will go towards feasibility testing and working preliminary models. The ALMA team will build a downsized model using a very basic LASER and prisms to generate the mining pattern described above that will be used in the simulations.

2 Appendix

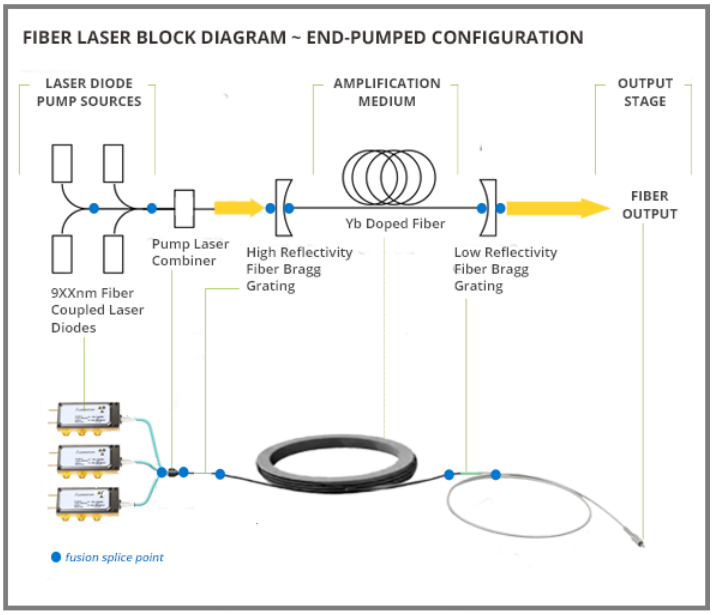

Figure 1: *Basic setup of a FBL*

3 References

[1] Butterfly, B. (2022, March 15). Fiber Laser: 7 advantages and differences. FindLight Blog. Retrieved October 3, 2022, from https://www.findlight.net/blog/2022/03/15/7-advantages-of-fiber-laser/

[2] Lovett, R. A. (2021, January 8). From the vault: Icy asteroids? Cosmos. Retrieved October 3, 2022, from https://cosmosmagazine.com/space/icy-asteroids/

[3] Photonic frontiers: High-efficiency optical pumping: 'going green ... (n.d.). Retrieved October 3, 2022, from https://www.laserfocusworld.com/lasers-sources/article/16547048/photonic-frontiers-highefficiency-optical-pumping-going-green-cranks-up-the-laser-power

[4] Sharp, T., amp; Urrutia, D. E. (2022, February 28). What is the temperature on the Moon? Space.com. Retrieved January 31, 2023, from https://www.space.com/18175-moon-temperature.html