Project Elara

A technical introduction

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What is (and why) space-based solar power?

Motivation and overview

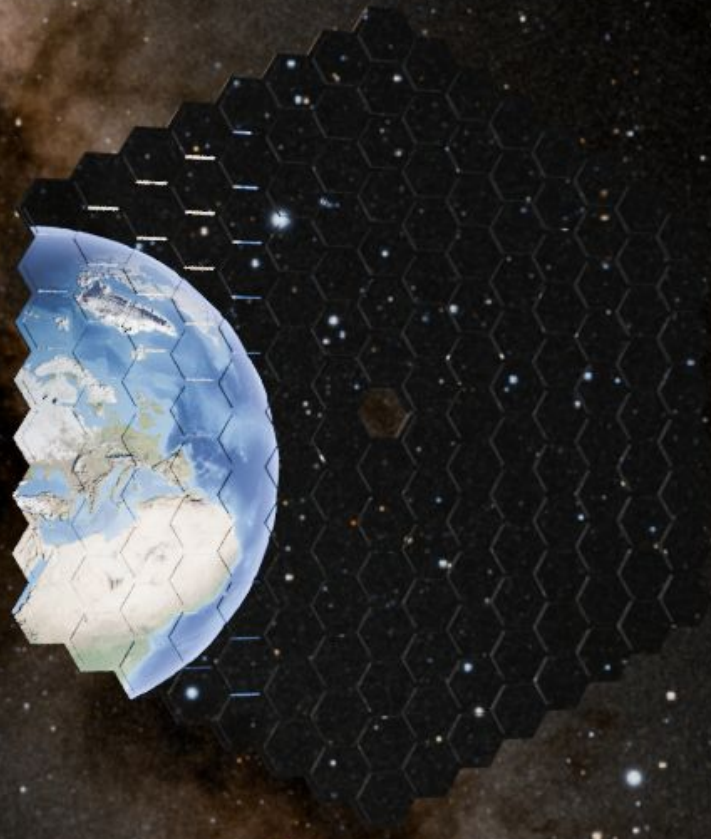
- At orbit, the Sun provides a consistent power output of 1.36 kW/m^2
  - Near-continuous sunlight 24 hours/day for most days in the year
  - Massive source of free and untapped energy!
- Advantages:
  - Reliable (unaffected by weather, available even at night and during storms)
  - High power potential (full exposure to sunlight, no cloudy days)
  - Can be made huge without taking up space/land on Earth (and the associated problems with displacing people/destroying habitats)

Motivation and overview

- One 16-meter radius (ideal) solar collector mirror can provide 1 MW of power
  - Not a new technology – *Znamya* satellite (by former USSR) demonstrated a 10-meter radius solar mirror (but for a different purpose) in 1992!
- A (vast) constellation of solar power satellites can provide more than enough energy to power the Earth!

Top: Znamya satellite, fully deployed

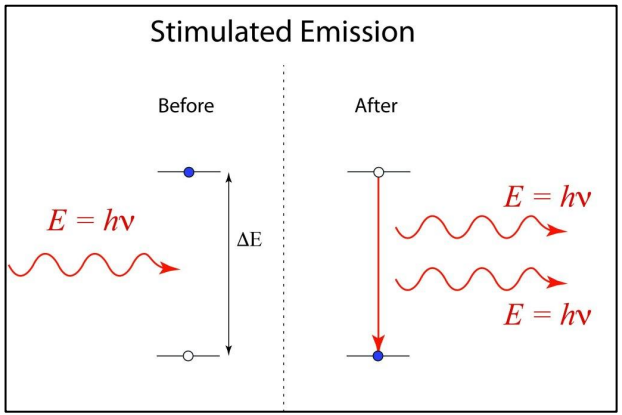
Our preliminary design



Credit: Milo Schnack

Our concept design

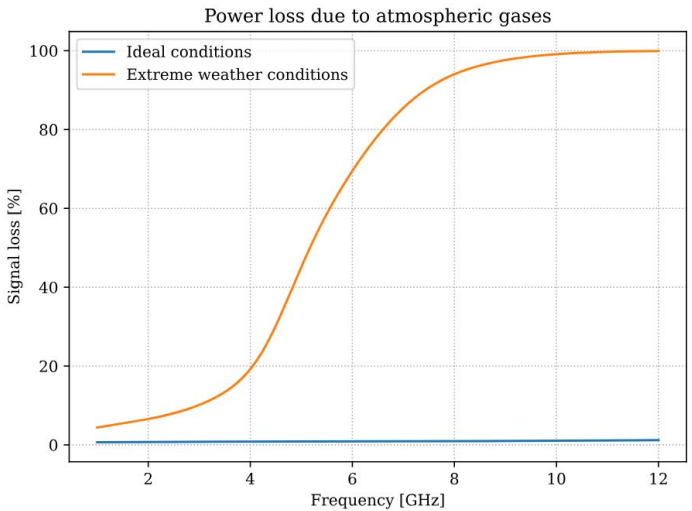
- Large but thin and non-rigid solar mirror concentrates sunlight
- Concentrated sunlight is used to optically-pump laser (excite atoms to emit microwaves)



Top: Uzbekistan solar furnace, whose design served as an inspiration for the concept space mirror
Left: Diagram of laser emission process

Our concept design

- Laser is tuned to create 1-2 GHz microwaves to transmit to Earth
- This frequency minimizes power loss to <10% (even in really bad weather) and passes relatively easily through the atmosphere regardless of weather conditions
- Earth receivers convert received microwaves to AC power

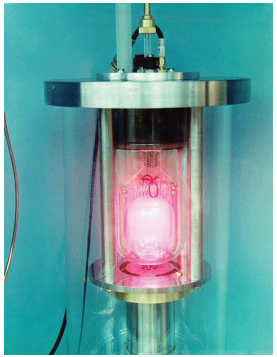


Top: plot of signal loss through the atmosphere across varying frequencies

Our concept design

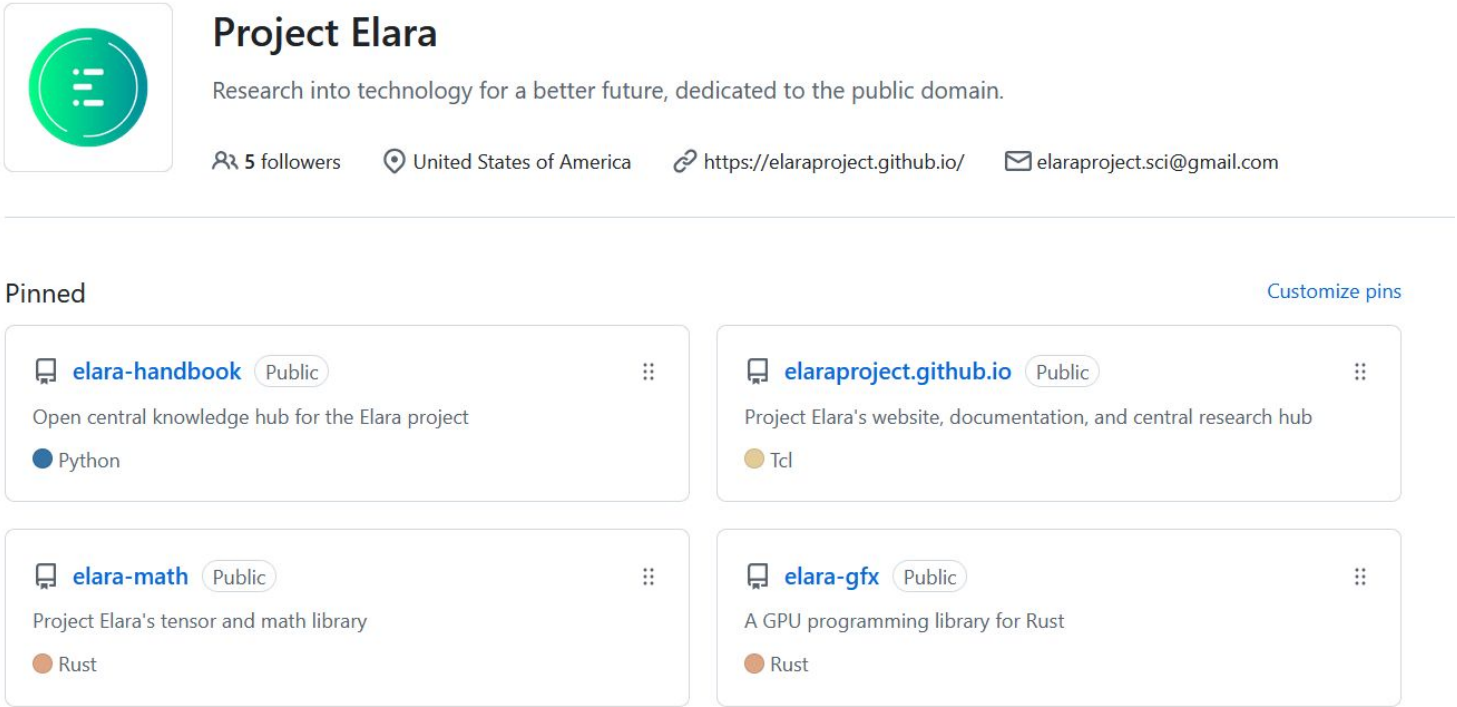
- We plan to develop molecular gas lasers that are specialized for high-power microwave transmission
- Mirrors are adapted from the technology used in sunshields e.g. from JWST
- All technologies developed (both software and hardware) will be **open-sourced**
- **We hope to build a prototype to launch into space with the RPI Spaceflight Society**

Top: JWST sunshield, bottom: ammonia gas maser (maser = microwave laser)

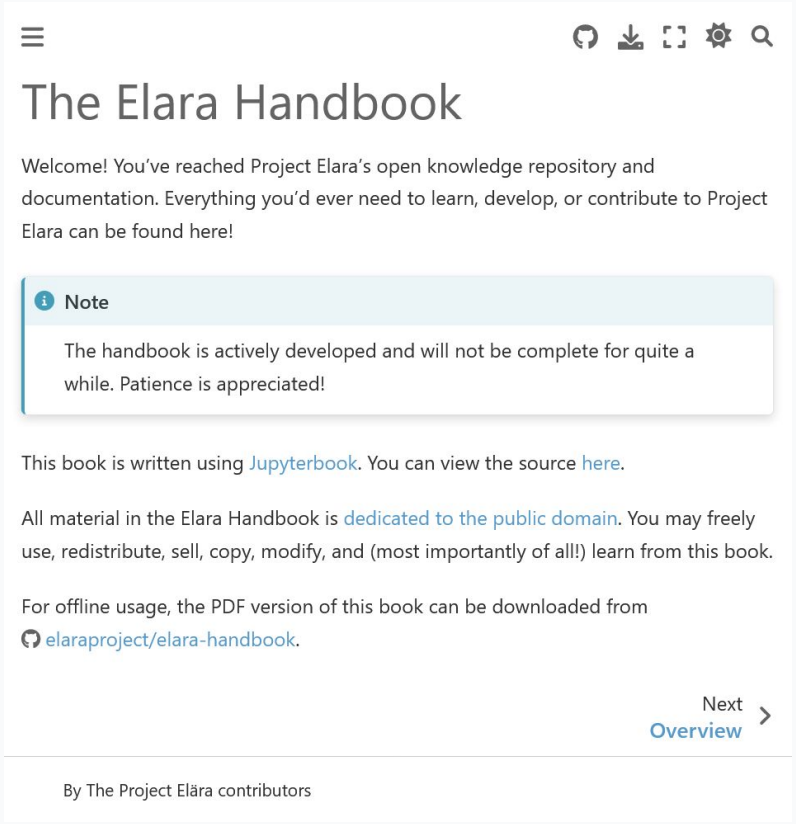


All source code and documentation is available on our GitHub:

github.com/elaraproject



We have a free online book to document our work:



The Elara Handbook

Welcome! You've reached Project Elara's open knowledge repository and documentation. Everything you'd ever need to learn, develop, or contribute to Project Elara can be found here!

Note

The handbook is actively developed and will not be complete for quite a while. Patience is appreciated!

This book is written using Jupyterbook. You can view the source here.

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Next
Overview

By The Project Elära contributors

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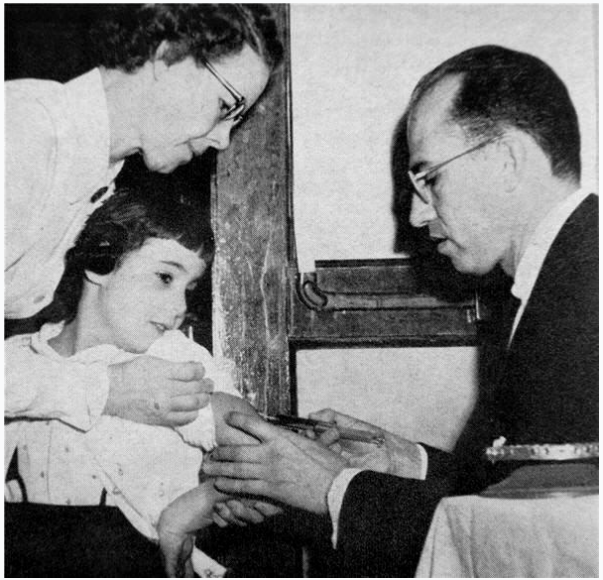
Inspire.

Hope.

Dream.



Jonas Salk (1914 - 1995)

inventor of the polio vaccine, who gave it away for free for all humankind - **our inspiration**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Note: Project Elara is not an official project of Rensselaer Polytechnic Institute.
Credit: NASA Deep Space Network