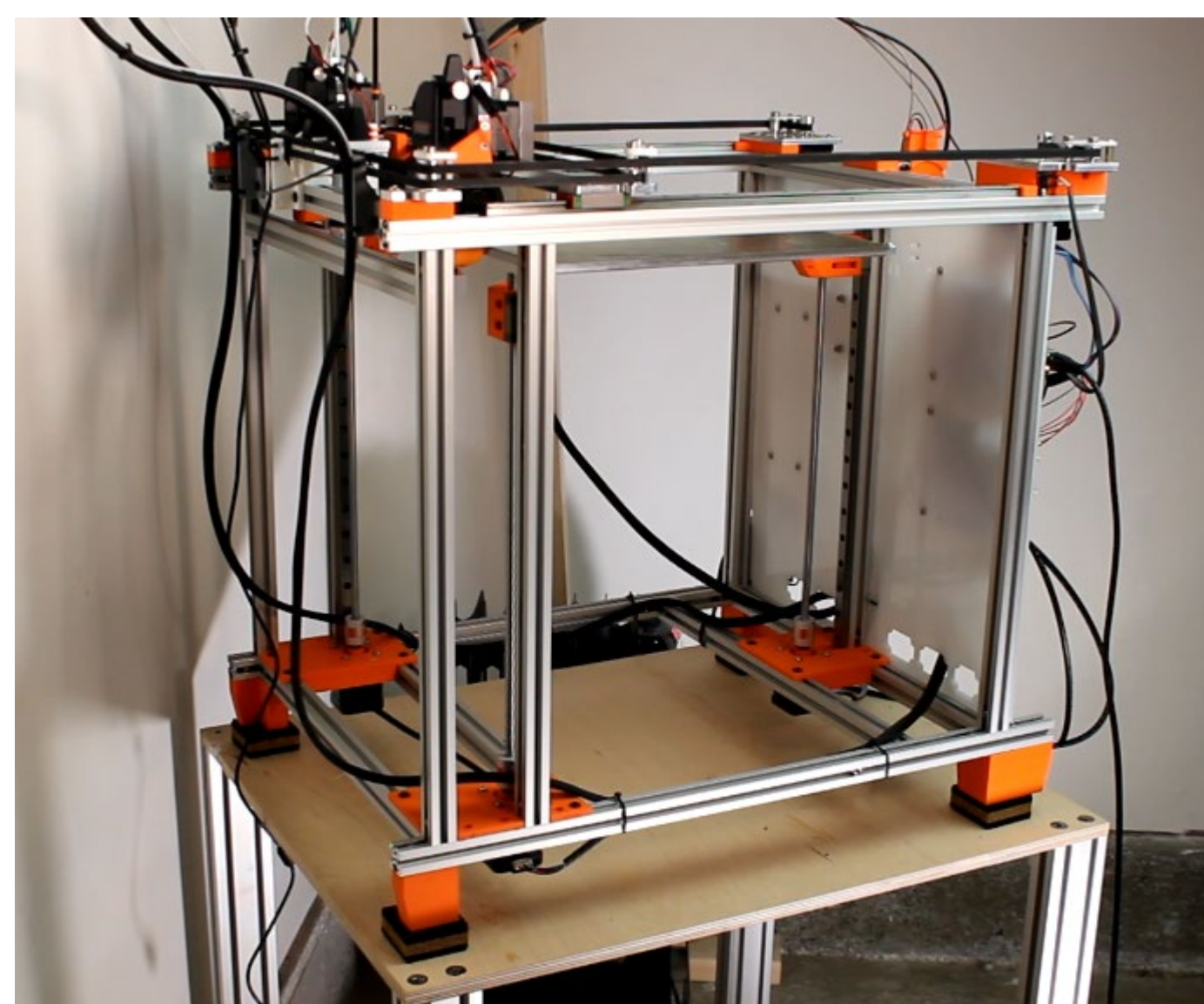


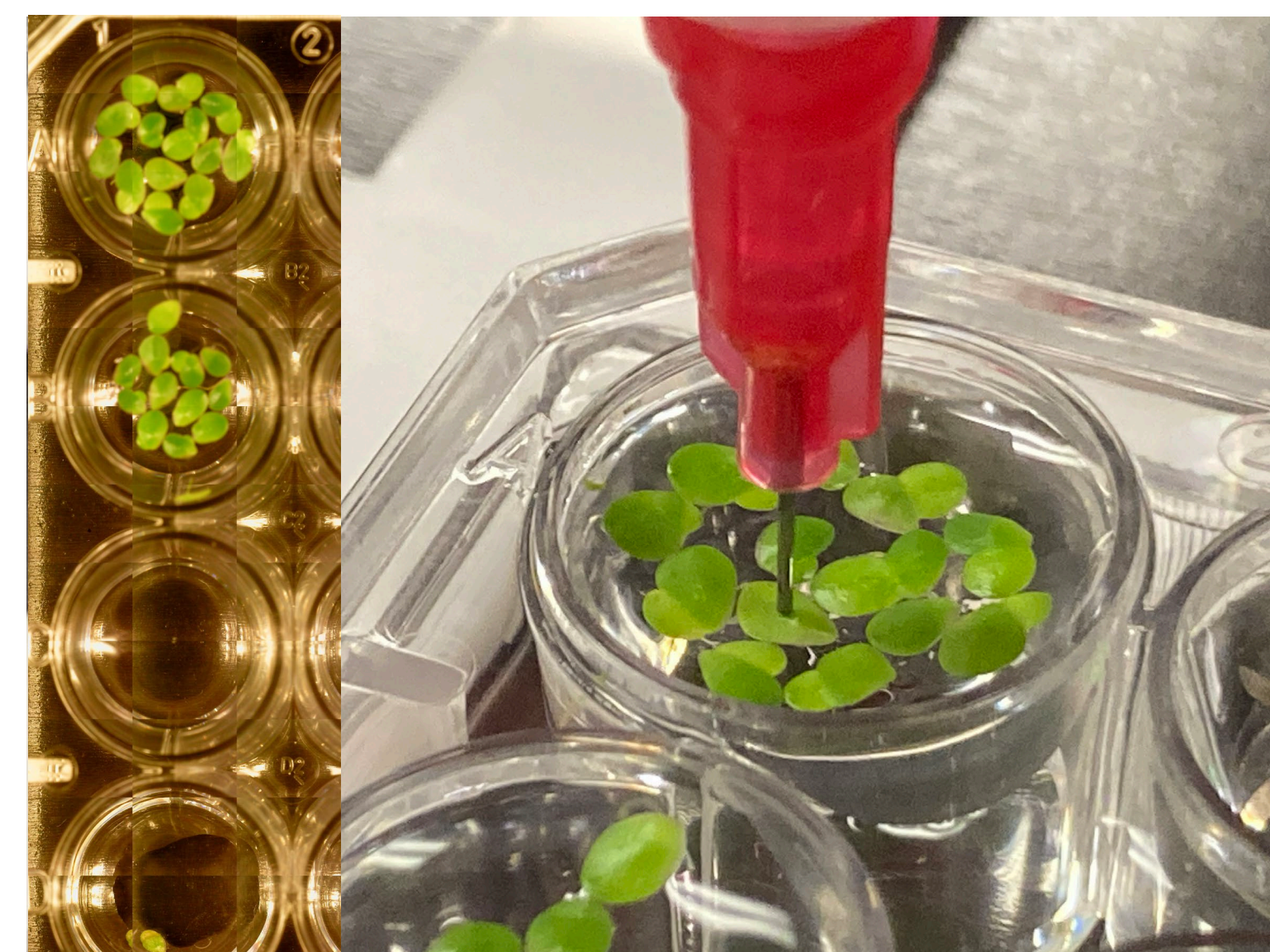
# Multi-Manipulator Extensible Robotic Platforms

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Robots have historically been used for dull, dirty, and dangerous tasks. We instead seek to develop robots that assist experts with scientific exploration, including iterative development of new processes and workflows. To do so, we will contribute open-source co-robotic automation and programming tools.



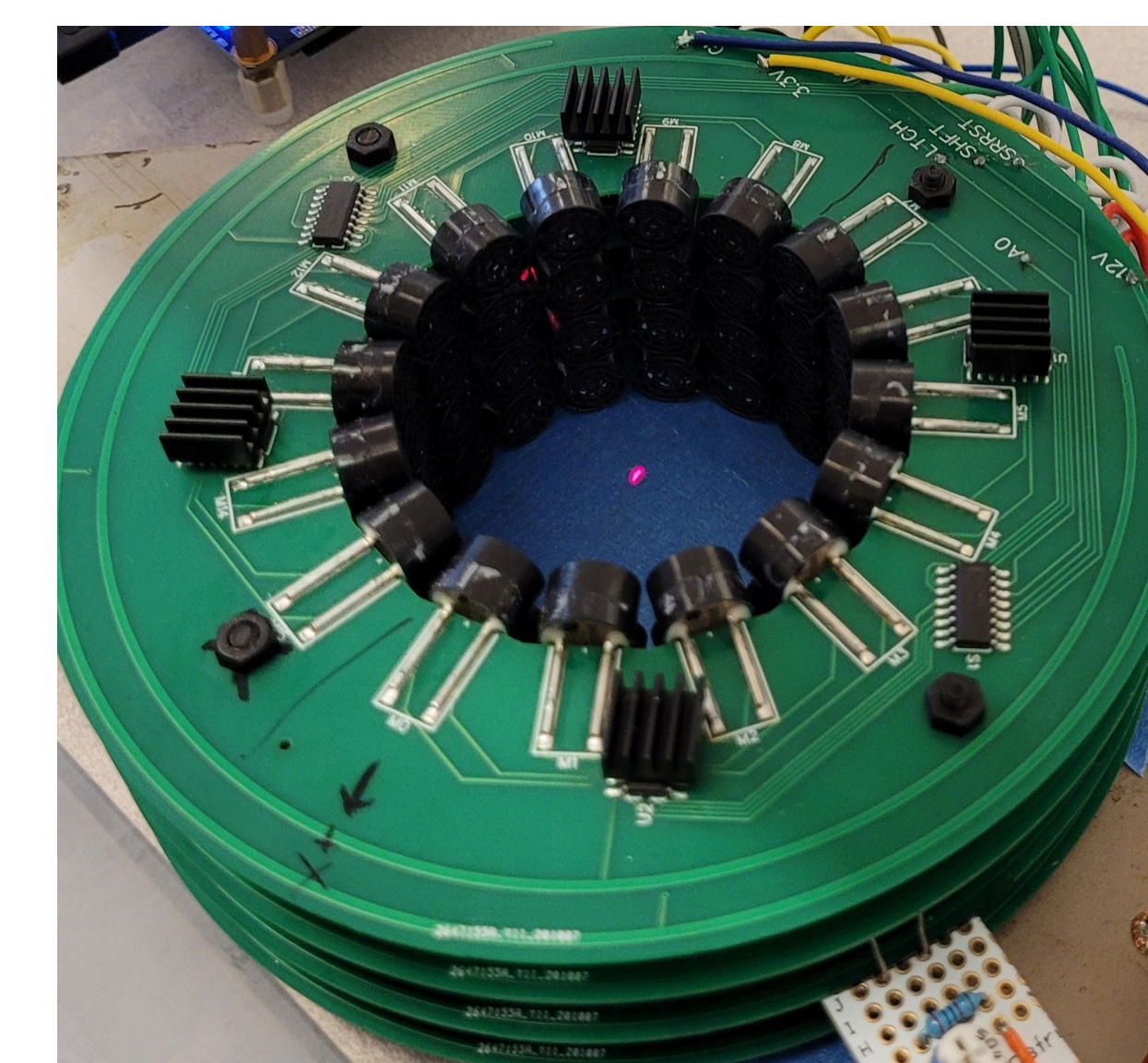
Tool-changing motion platform



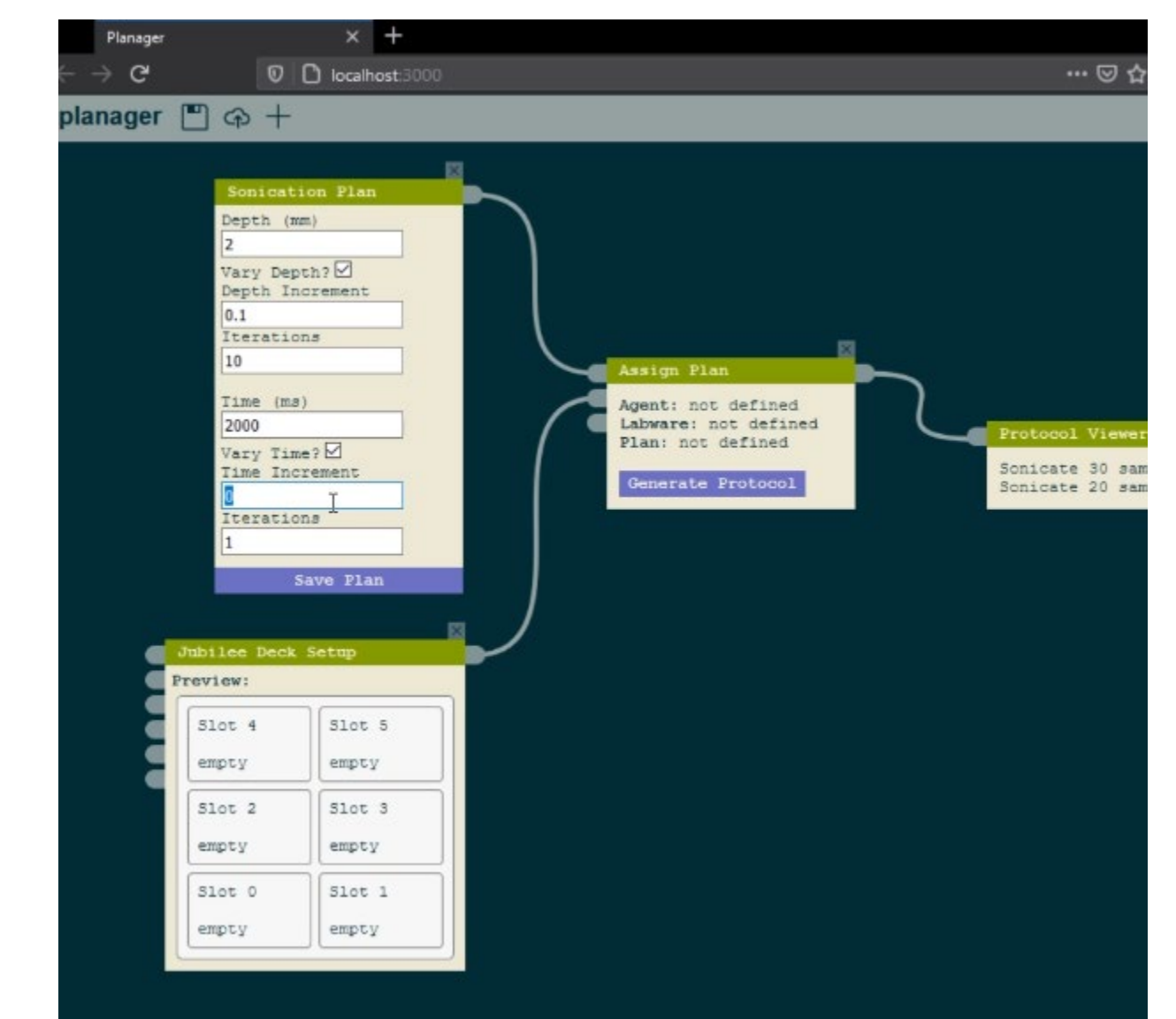
Manipulating and Imaging Duckweed



Automatically sonicated samples



Ultrasonic manipulator weighing a levitated test mass



Browser-based end-user programming environment

1. Open-source extensible motion platforms with automated tool-changing
2. Novel ultrasonic manipulators enable contact-less weighing of levitated objects
3. End-user programming environments for authoring automation workflows

## Intellectual Challenges:

- High speed control of motion platform and end effectors
- Novel ultrasonic manipulation capabilities
- Open-source systems that can be built and customized by non-experts

## Broader Impacts:

- Enabling scientists to use co-bots in their own experiment workflows and applications
- Teaching students machine design and customization with a low-cost but highly precise platform
- Lowering the threshold to developing computer-controlled processes