Open science **hardware**

for realising globally equitable knowledge production

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16 May 2023
Edinburgh Open Research Conference

@GOSHCommunity
#openscience
#openhardware

GOSH
Gathering for Open Science Hardware

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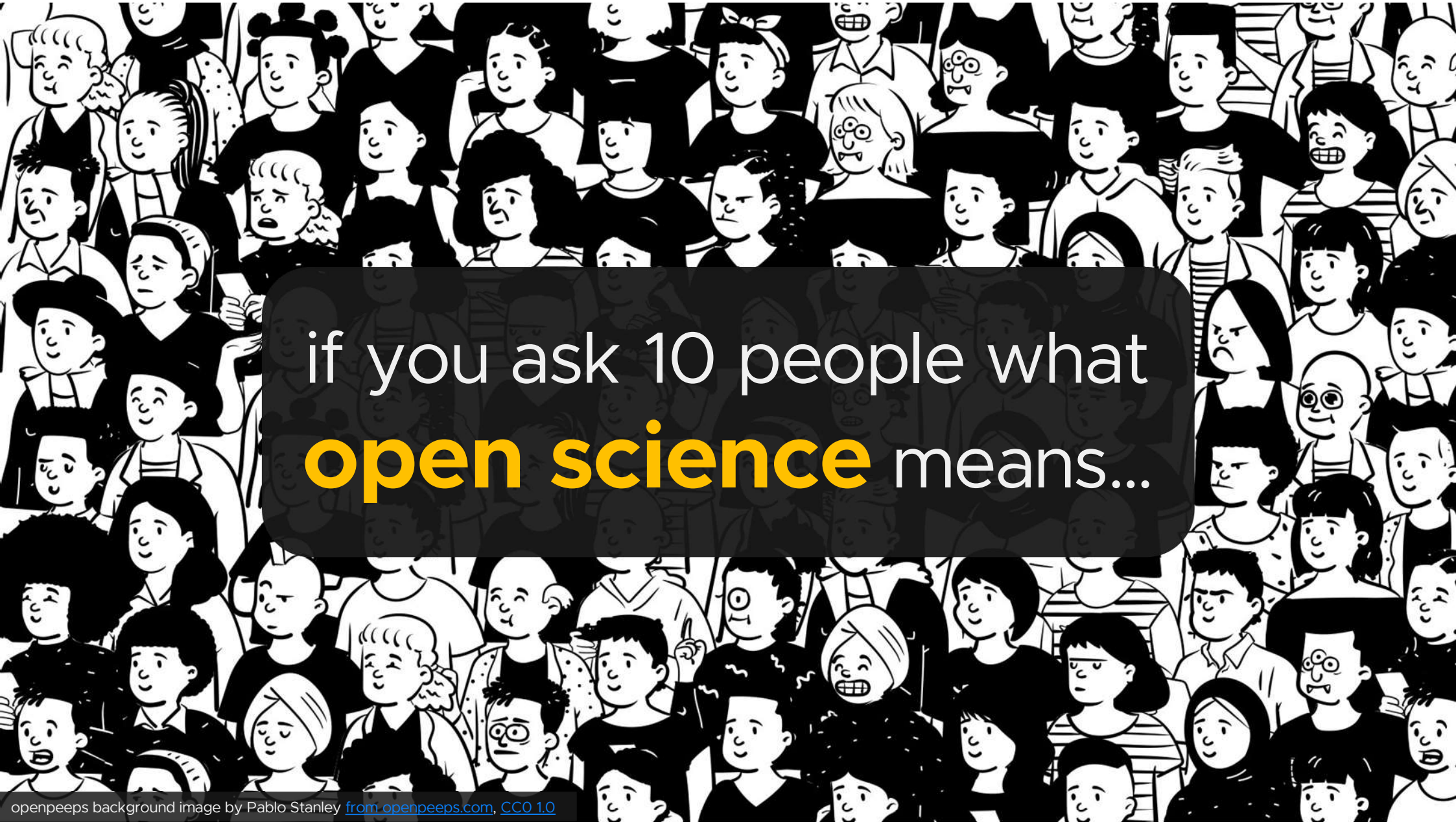

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The Alchemist Discovering Phosphorus by Joseph Write of Derby from Wikimedia Commons, public domain

Alchemists kept what

...and each of them learned in the hardest way possible that drinking mercury was a bad idea.

Cory Doctorow*

* Doctorow, C. (2017) The fight for a free, fair and open Internet. 2017 National Bioneers Conference. https://youtu.be/2-CvOrDODds?t=678

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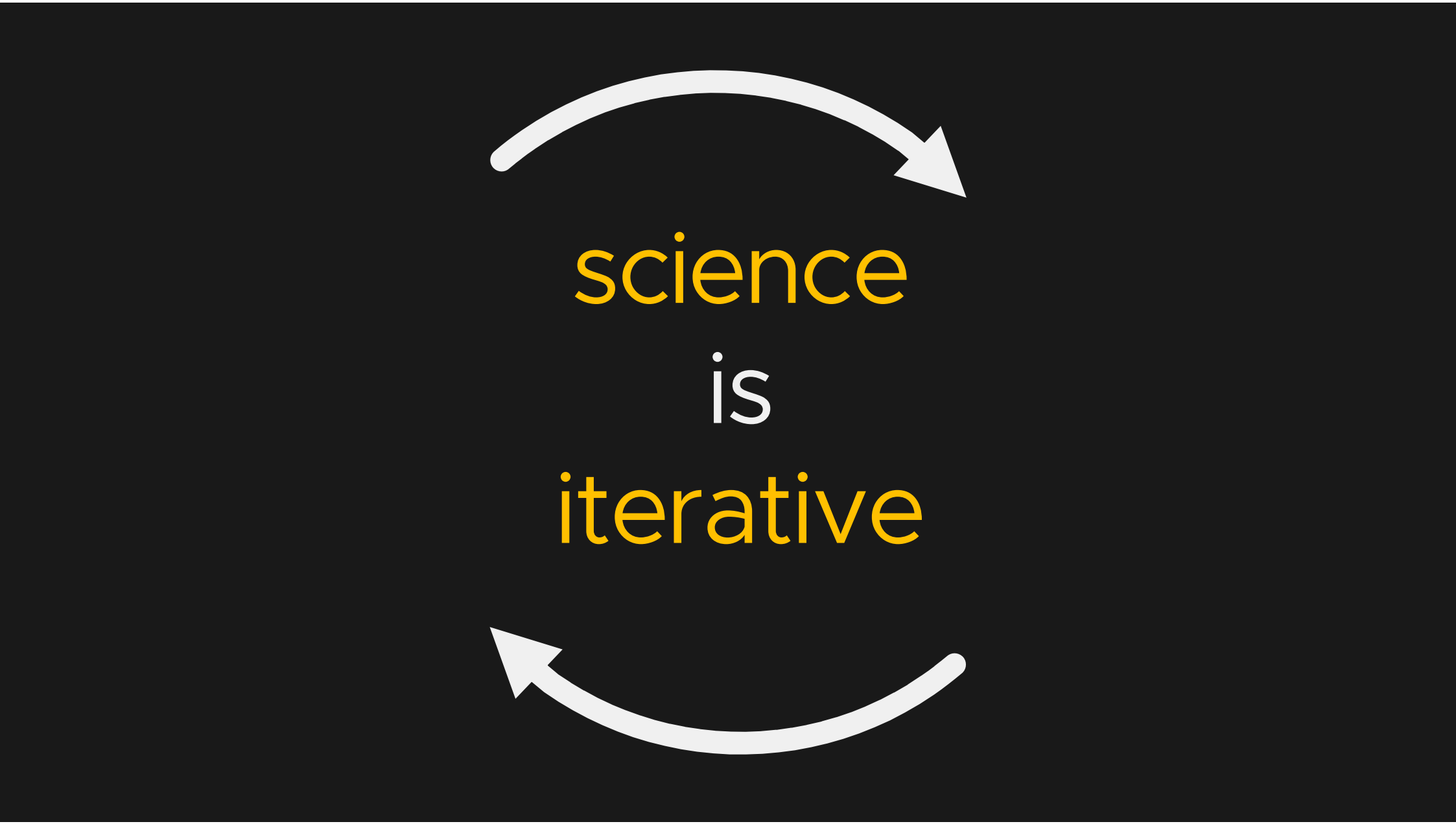
good
science
is
open
science


science
is
iterative

science
vs
alchemy

4 freedoms to use
study
modify
share

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United Nations
Educational, Scientific and
Cultural Organization

Recommendation on Open Science

ratified Nov 2021

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United Nations
Educational, Scientific and
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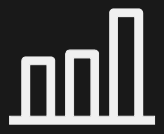
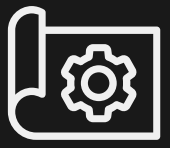
publications



data

educational resources

software code



hardware designs!

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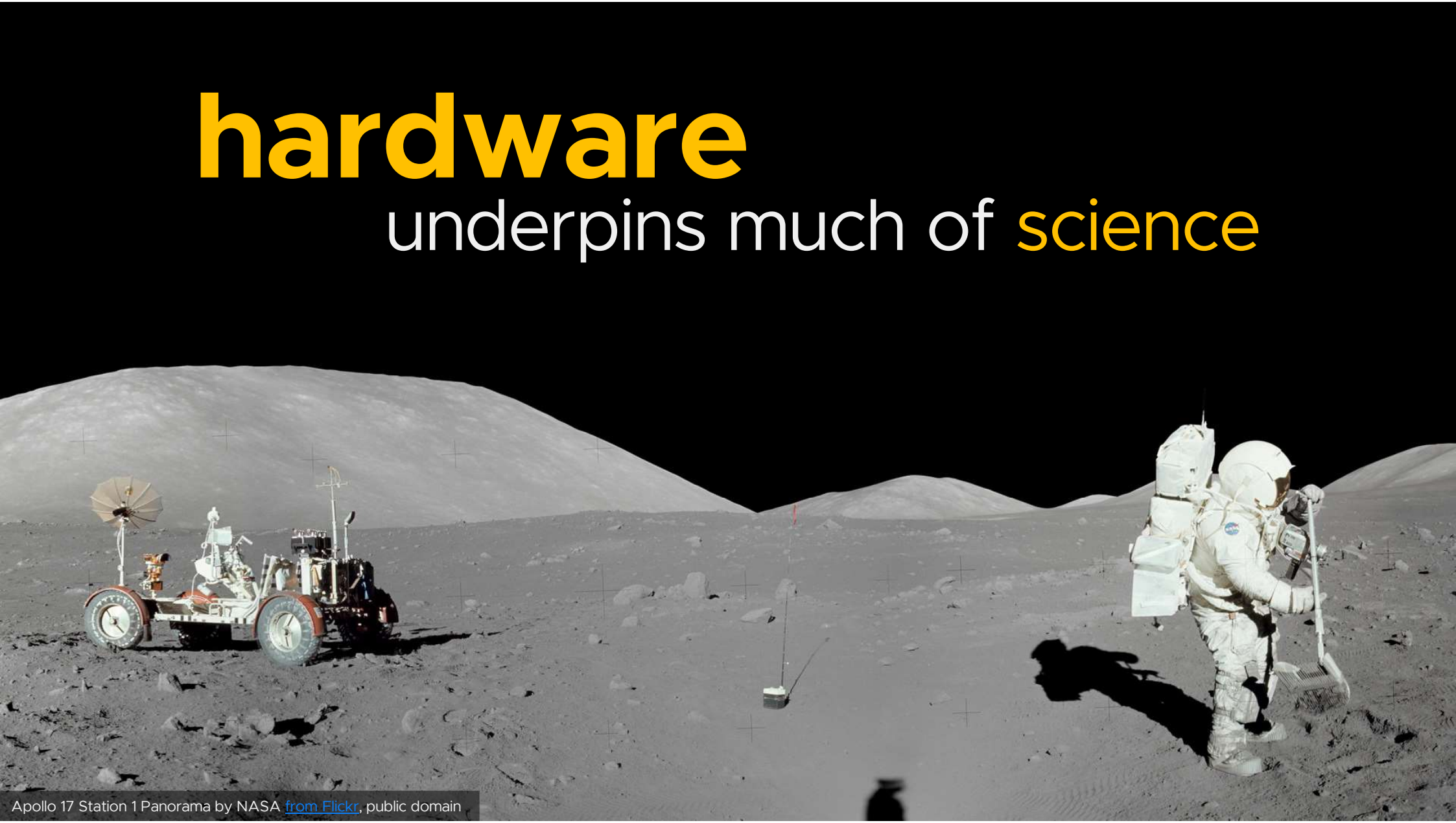
hardware
underpins much of science



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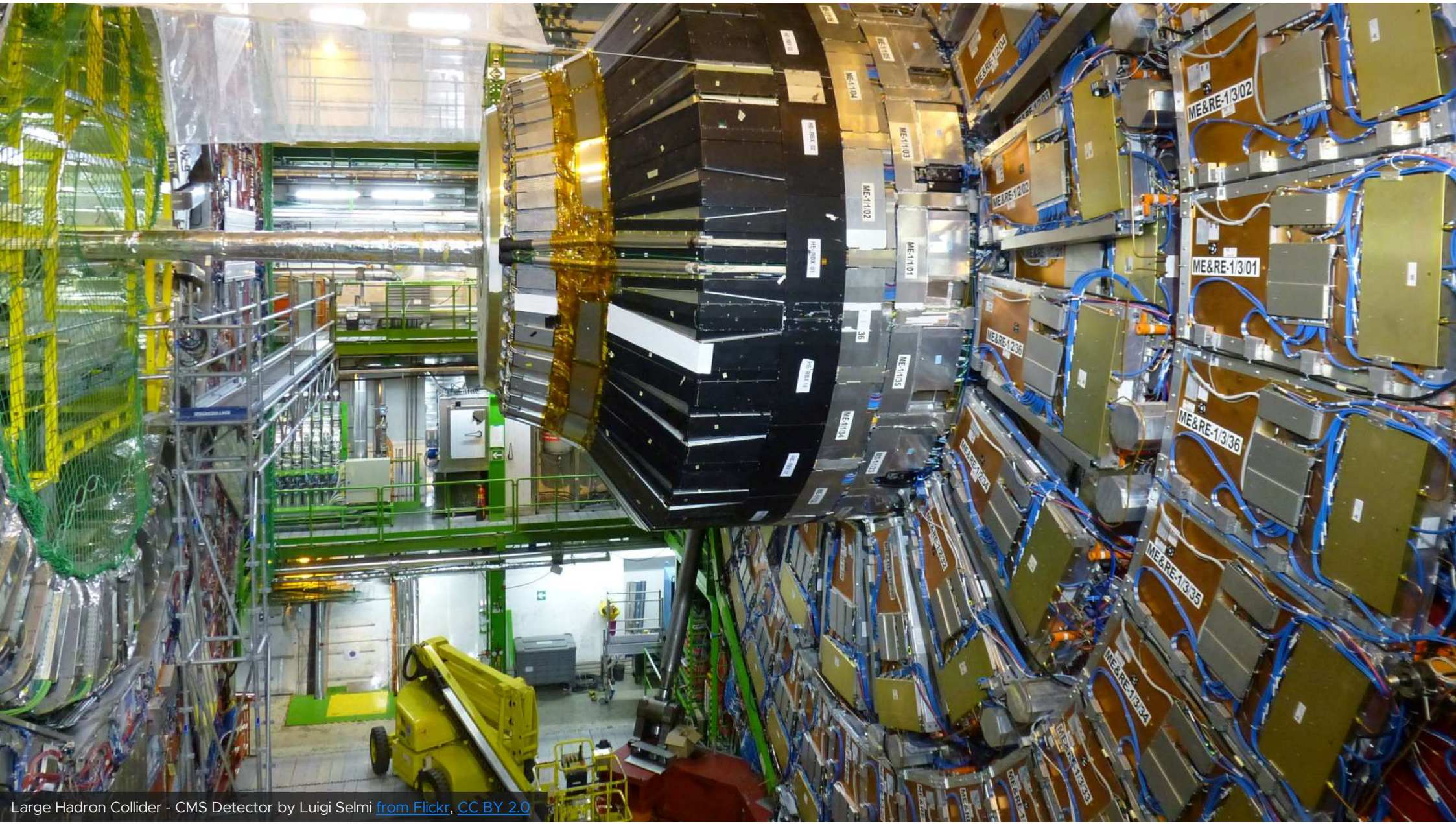

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The 12" Powerbook G4 is timeless! by RVVL5 from Reddit, CC0

hardware

is often closed source

(like software!)

hardware

is often closed source

(like software!)

no reproducibility

vendor lock-in

forced obsolescence

high costs

reinforce
global inequities

Earth by Kevin Gill from Flickr, CC BY 2.0

...Instead of tools being enablers of your creativity and what local needs are telling you what to explore, **you are doing what the available tech lets you do**...

Dr Julieta Arancio*

* quote from "Often Overlooked Sharing of Hardware is a Missing Link in Open Science Puzzle" (2023), from SPARC Impact Stories
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Open source hardware

is hardware whose design is made publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design.

Open Source Hardware Definition maintained by the Open Source Hardware Foundation

Open source hardware

has many examples

OPENPCR

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OpenPCR is a low-cost yet accurate thermocycler you build yourself, capable of reliably controlling PCR reactions for DNA detection, sequencing, and limitless other applications.

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OpenPCR screenshot, fair use

OreSat

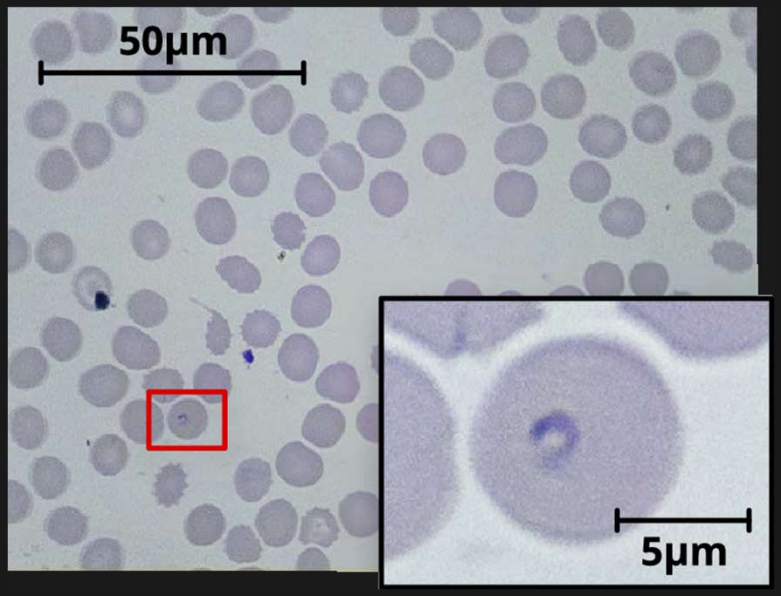
open source satellite

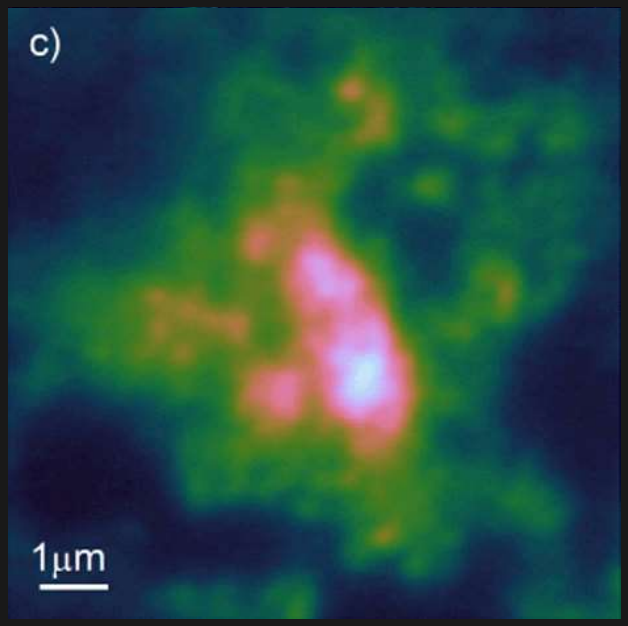
OreSat image [from oresat.org](), fair use

OpenFlexure microscope

OpenFlexure microscopes from openflexure.org, fair use

bright-field imaging of stained blood smear

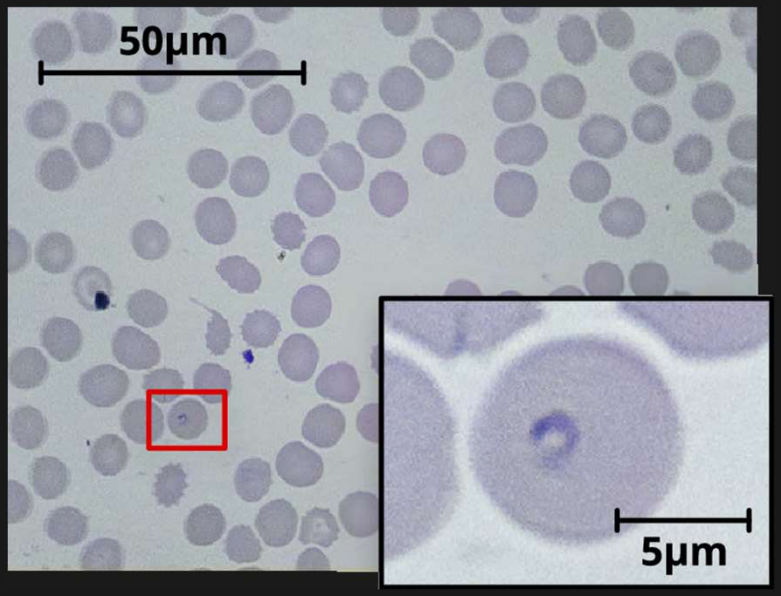


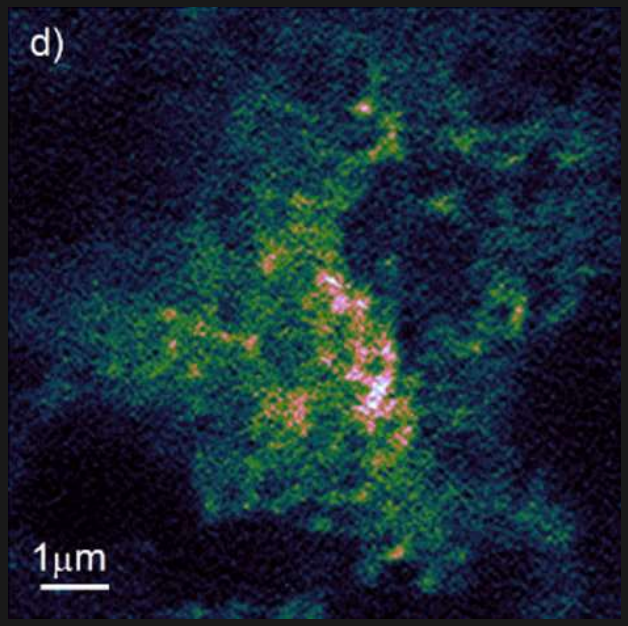


adapted for higher resolution florescence imaging

Figure 2c, d from Grant et al. (2019) in *F1000Research*, 8:2003, CC BY 4.0

Figure 3a from Collins et al. (2020) in *Biomedical Optics Express* 11 (5), 2447-2460, CC BY 4.0





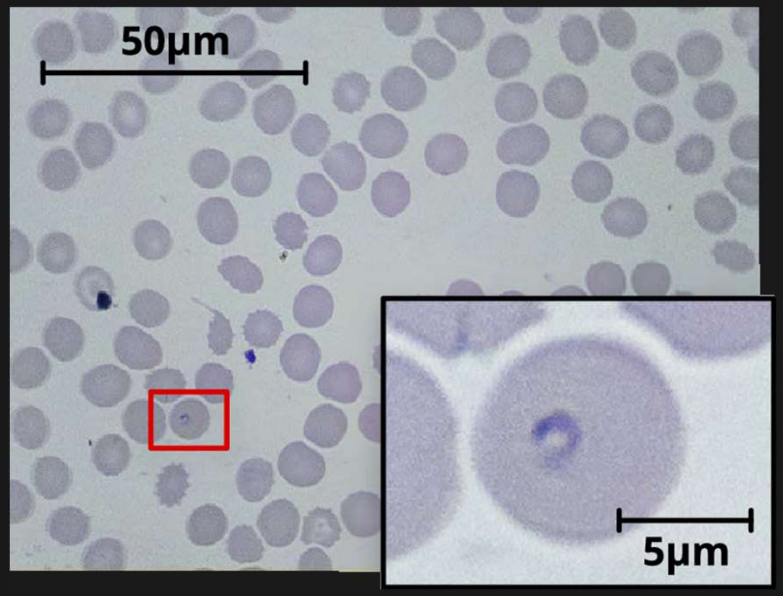
all this and more...

starts at just **$200!**

Figure 2c, d from Grant et al. (2019) in *F1000Research*, 8:2003, CC BY 4.0

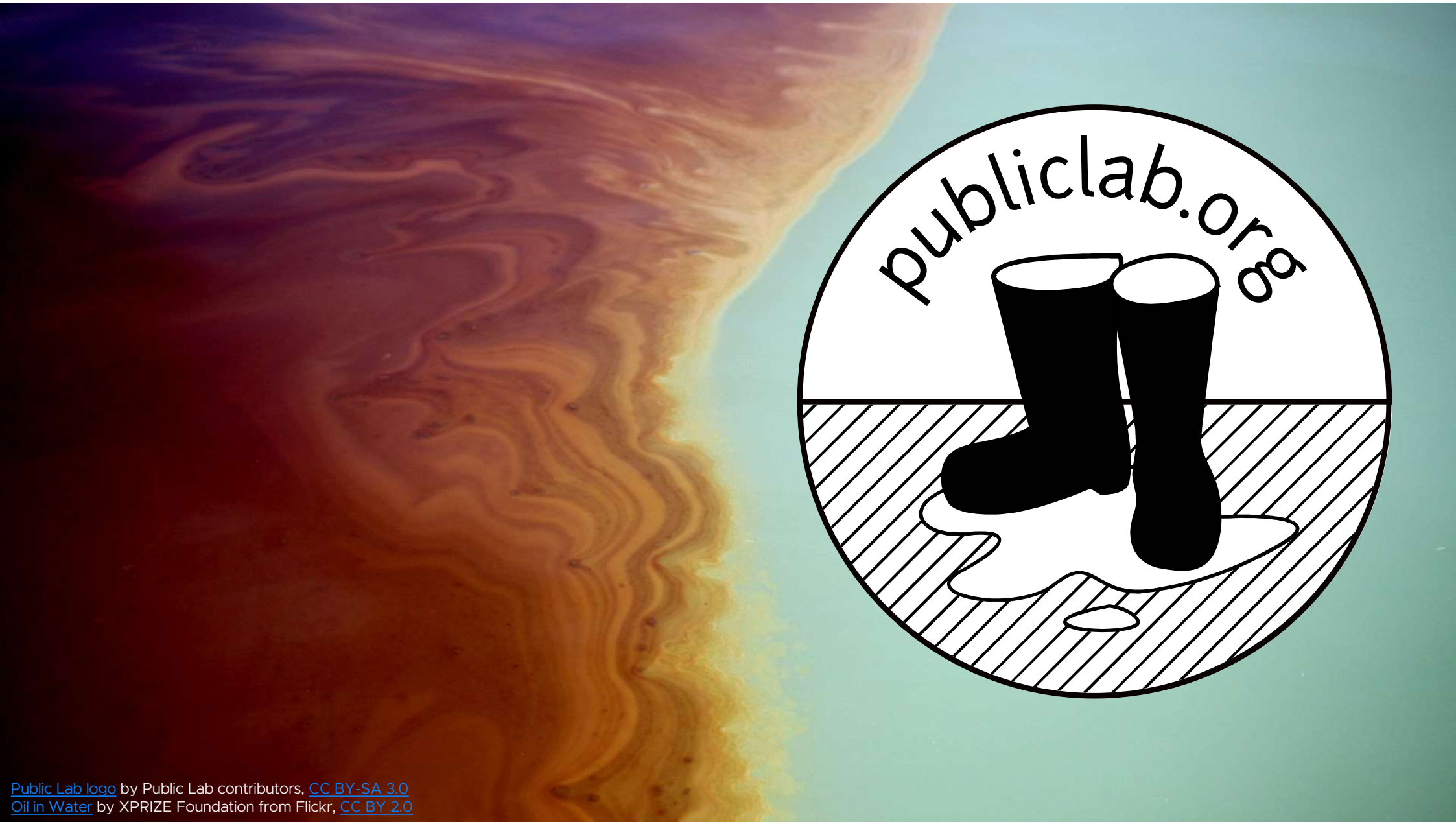
Figure 3a from Collins et al. (2020) in *Biomedical Optics Express* 11 (5), 2447-2460, CC BY 4.0

malaria diagnoses



with locally-produced and maintained microscopes in Sub-Saharan Africa

Figure 3a from Collins et al. (2020) in *Biomedical Optics Express* 11 (5), 2447-2460, CC BY 4.0



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Deepwater Horizon oil spill

Deepwater Horizon Offshore Drilling Platform on Fire by Ideum from Flickr, CC BY 2.0

Public Lab Balloon Mapping Kit

Once assembled, this open source kit -- developed by community researchers from the Public Laboratory for Open Technology and Science -- enables you to collect your own aerial photos from up to 1000 ft. Use it to tell a different story from the "official" map!

http://publiclaboratory.org/tool/balloon-mapping

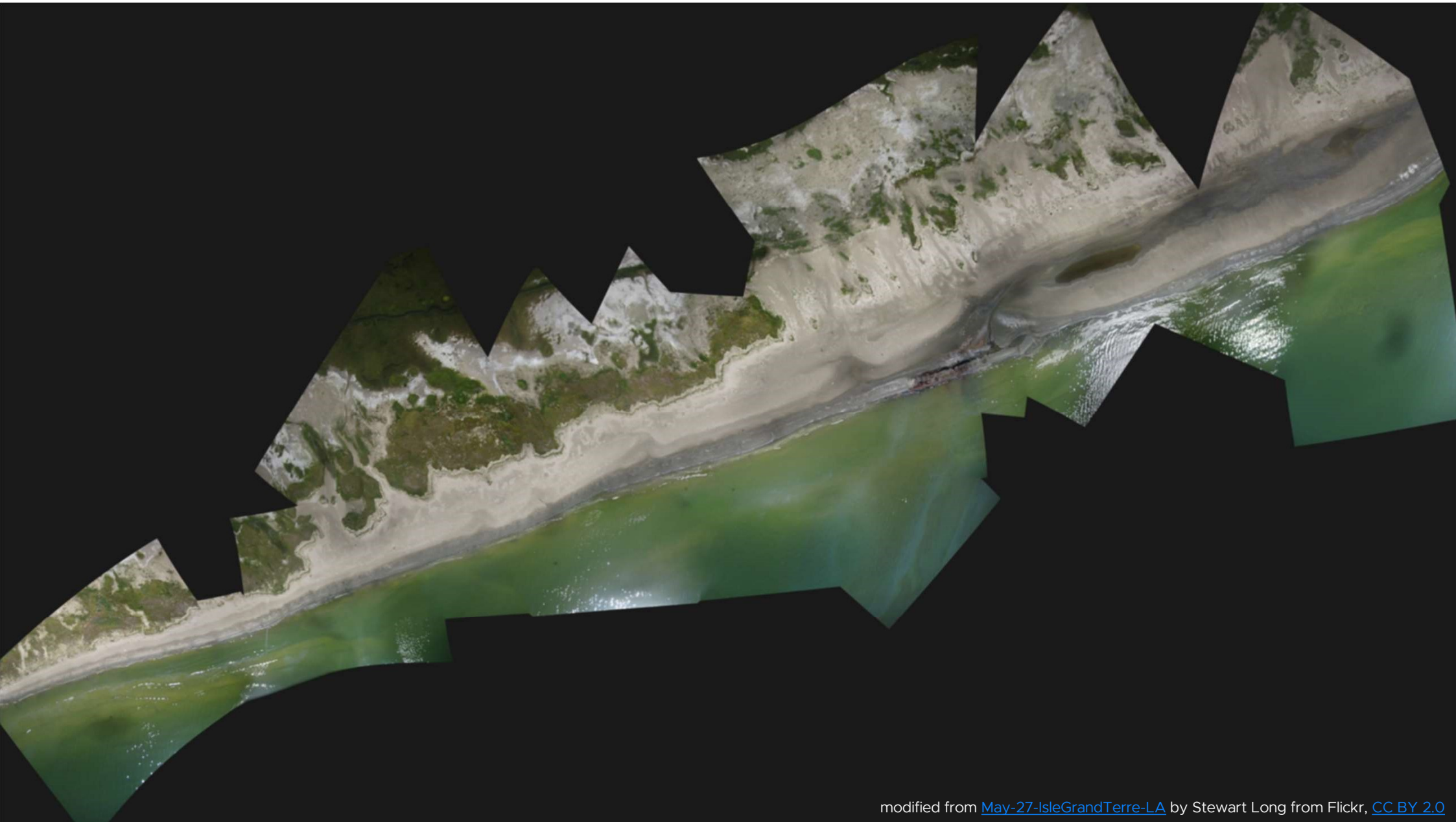
In addition to this kit, you'll need a camera that can do continuous shooting and a soda or juice bottle.

Each kit includes:
- A 5.5 foot (170cm) reusable balloon made of a latex/chloroprene (neoprene) mix
- 1000 feet (305m) of 110lb test (55 kilo) Dacron line, pre-wound on an 8" hoop winder
- Leather gloves for handling the line.
- Three high-strength (270lb) swivel clips
- Two mini-carabiners for attaching the camera
- Twenty rubber bands for making a camera cradle
- Ten zip ties. for closing the balloon
- One 1" ring. for attaching the balloon to the line

All PLOTS content is open source; CC-BY-SA and CERN OHL 1.1. Join Public Lab now at: PublicLaboratory.org/join

Public Lab Balloon Mapping Kit 1.5 by Jeff Warren from Flickr CC BY-SA 2.0

air balloon mapping photo by Public Lab from store.public.org, CC BY-SA 3.0



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open science
enables rapid innovation
to address
urgent global issues

image of Earth by NASA DISCOVR, public domain

we don’t have **time** to be alchemists!

image of Earth by NASA DISCOVR, public domain

publish your hardware designs!

open source software licenses

e.g. GNU GPLv3, Apache, MIT

open source hardware licenses

e.g. CERN Open Hardware Licenses 2.0 (CERN OHL-S, OHL-W, OHL-P)

Open Know-How 1.0

open source hardware best practices

DIN SPEC 3105

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GOSH

Gathering for Open Science Hardware

https://**openhardware.science/**

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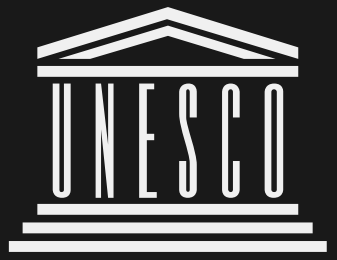

United Nations
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policy toolkit for open source hardware in science

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https://www.**ukrn.org/primers**/

open source hardware primer

(*coming soon*)

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https://**openhardware.space**/

mentoring and training

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thank you

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https://**openhardware.science**/

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#OpenScience #OpenHardware

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