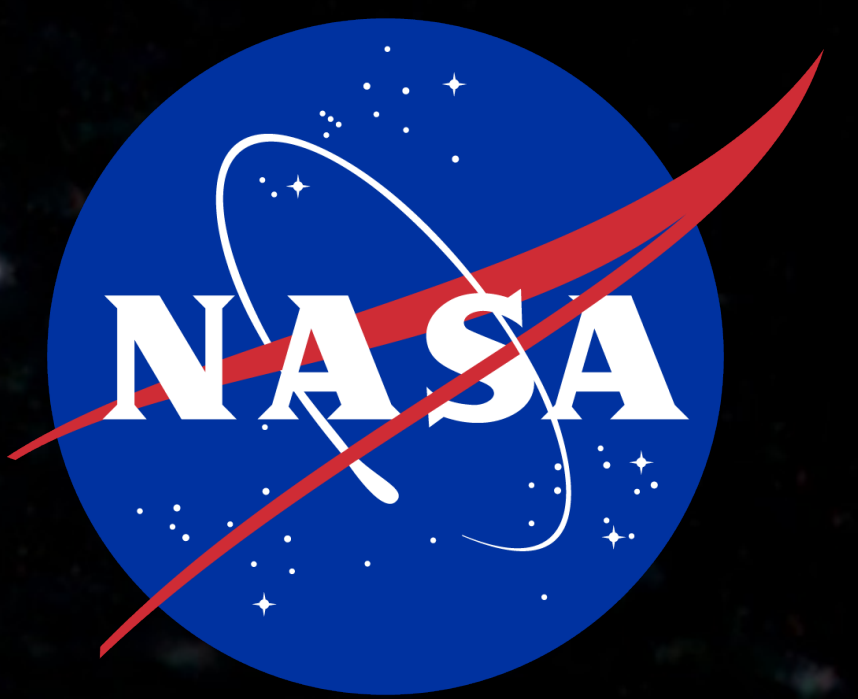




Designing Experiments for SpinSat, A Novel Variable-Gravity-and-Radiation Platform for Deep-Space Science



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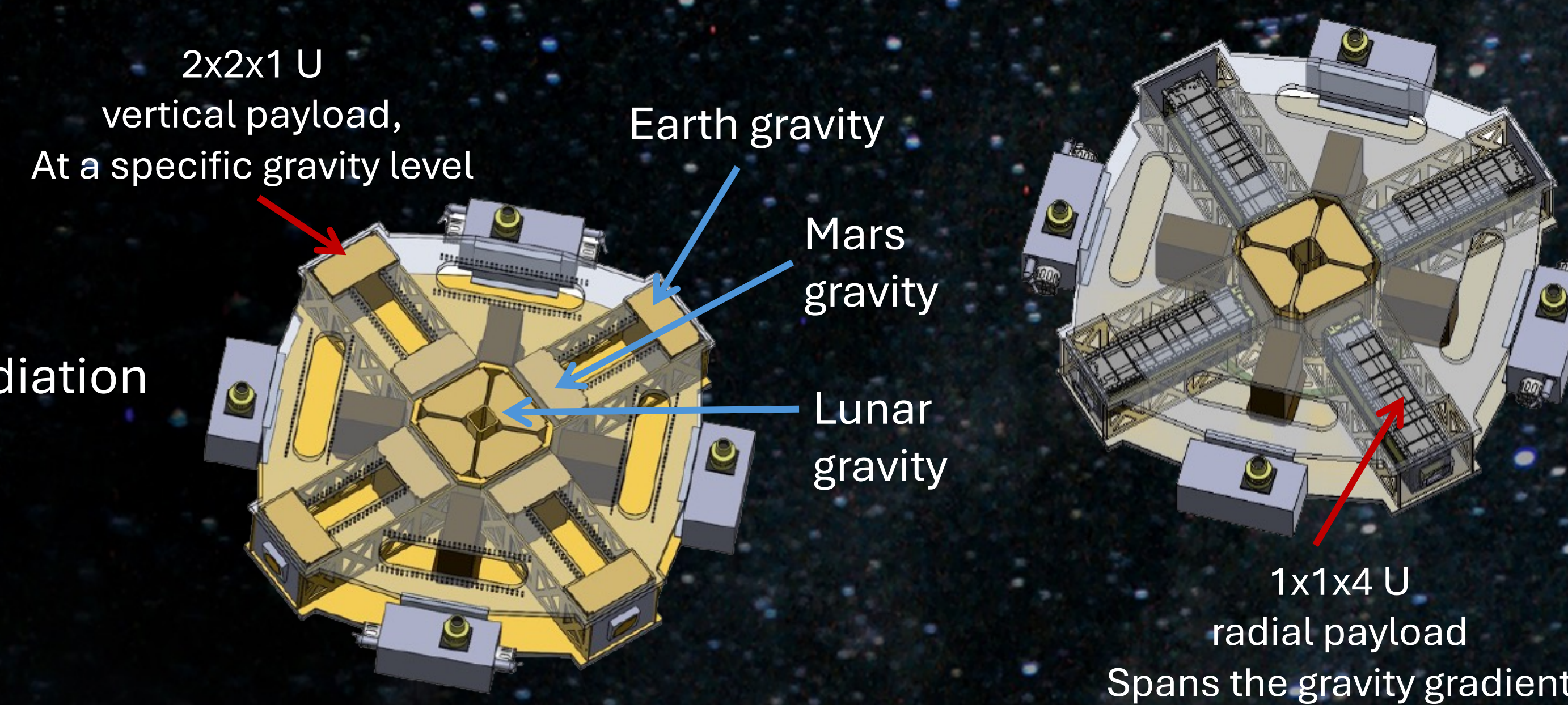
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TECHNOLOGY POSTER

You design the experiment and payload – Leave the spacecraft to us!

Why fly with SpinSat?

- Low-cost, reliable, frequent access to space
- Generates a gradient of artificial gravity levels
- Orbit-agnostic; can accommodate short- or long-term experiments
- Allows exposure to deep-space radiation or simulated lunar/Martian radiation
- Provides power, communication, and a benign thermal environment
- Includes radiation metadata from spacecraft sensors
- Will allow late load (future capability)



SpinSat is ideal for payloads that...

- Fit a cubesat form factor (but others can be accommodated)
- Can be automated
- Include their own environmental control and life support system
- Do not need sample return
- Aim to study combined radiation / gravity effects

Three examples of the innumerable biology experiments that could be conducted on SpinSat

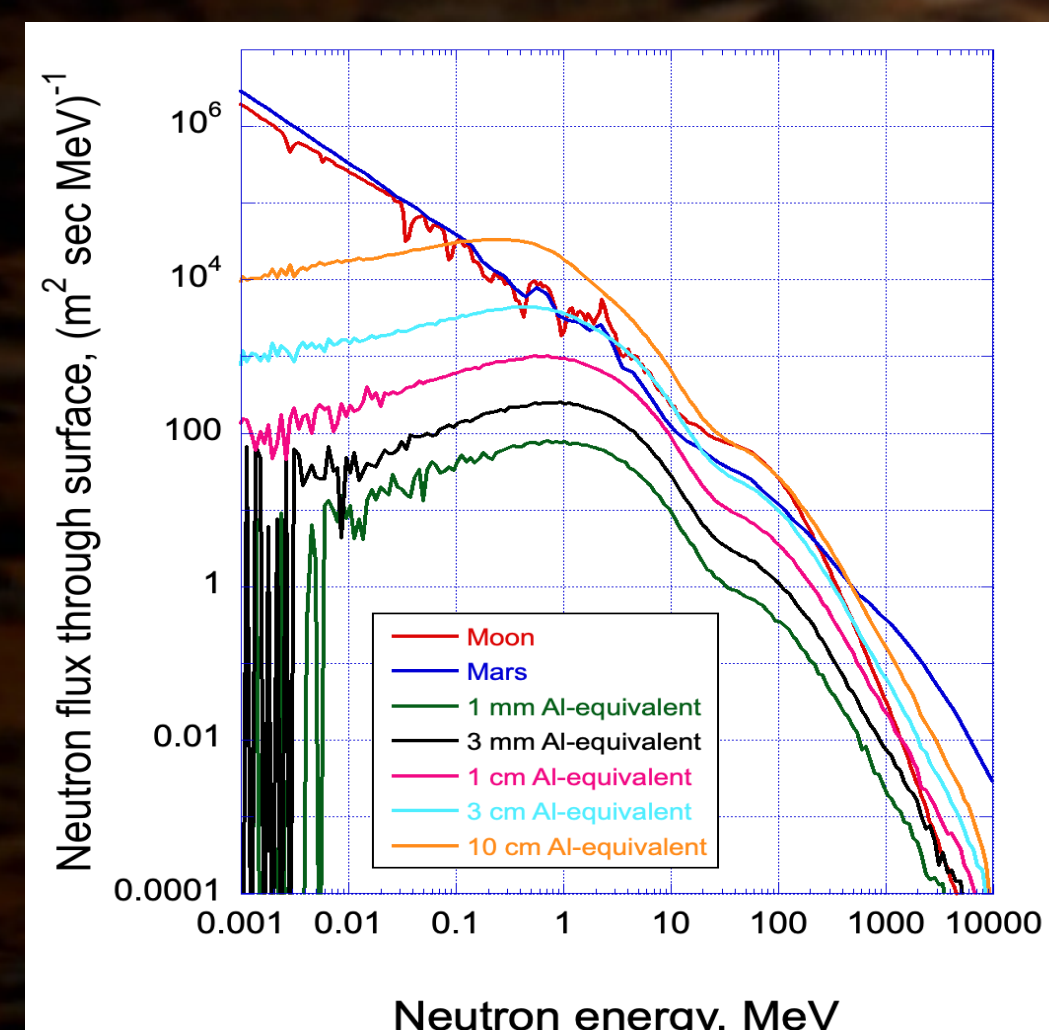
Experiment #1:

Yeast in lunar/Martian radiation and gravity

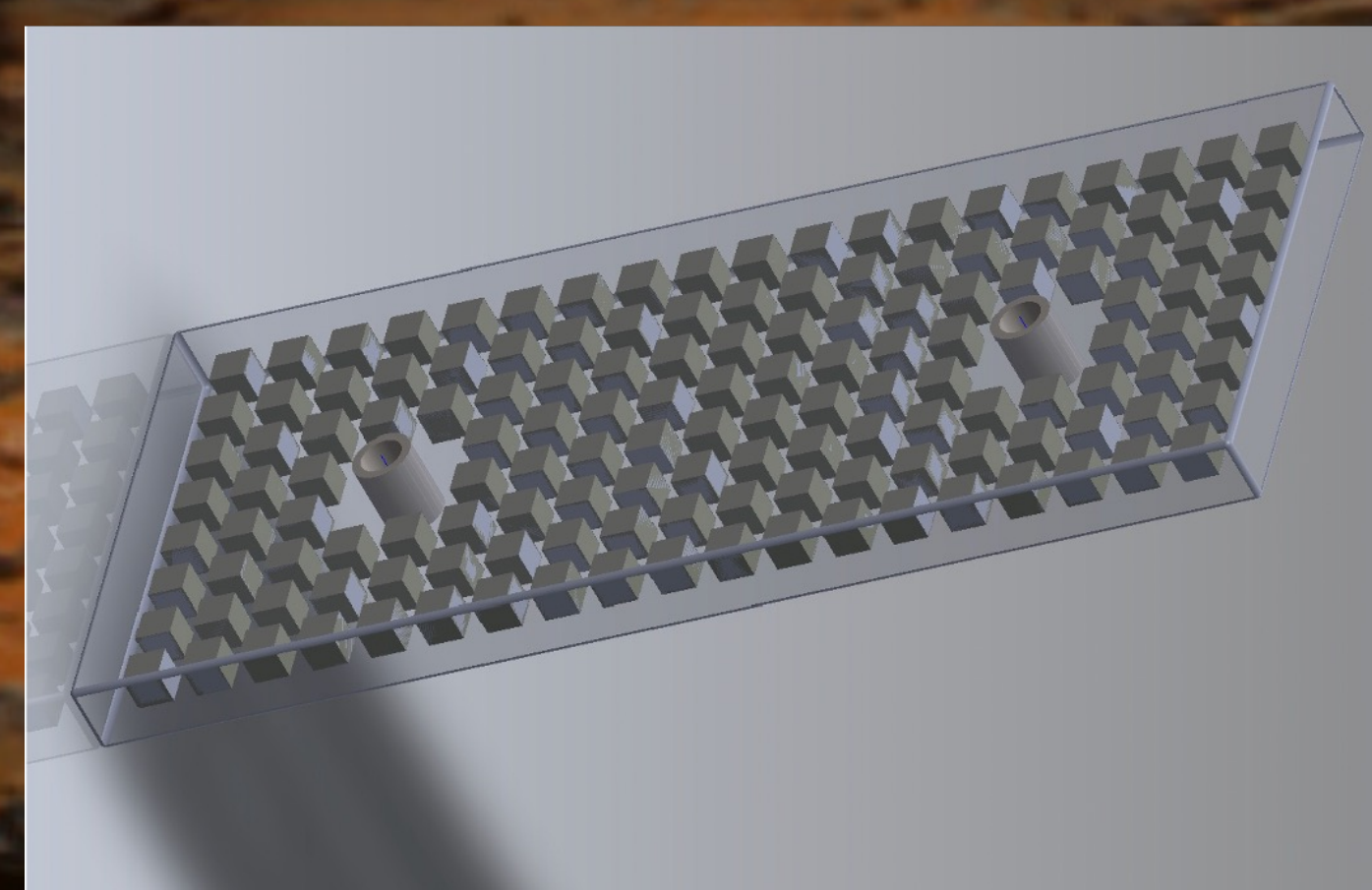
- A lunar surface environment... without a trip to the Moon!
- Payloads designed for Commercial Lunar Payload Services (CLPS) or bioCubeSats can be easily repurposed for SpinSat.
- Simultaneous lunar/Mars g experiment and 1 g control.
- Replicate experiments for increased statistical power, or several different experiments on one spacecraft.

Configuration

- Microfluidic cards house yeast cells in 3mm wells; experiment activated by hydration. Optical absorbance or fluorescence to measure growth and metabolic activity in each well.
- 2x2 U payloads oriented vertically. “Bottom” of culture wells is at outside of SpinSat.
- Tungsten composite target blocks surrounding payloads generate secondary neutron radiation from GCR approximating lunar and Martian environment.
- Neutron detectors flown alongside biological payloads provide empirical measurement.



Neutron spectra inside tungsten boxes of various thicknesses; desired flux at 1 – 3 cm Al-equivalent (~2 mm tungsten thickness)



Design of a neutron-producing panel made of 6-mm tungsten cubes embedded in 3D-printed polymer matrix

Experiment #2:

Plants in gravity as a continuum

- Observe plant growth along a continuous gradient of gravity levels, simultaneously – including Earth/Moon/Mars and levels in between
- Measure the combined impact of gravity and radiation, study interactions
- Beyond-LEO SpinSat missions can support the high data rates necessary for imaging-based experiments

Configuration

- A 1x4 U payload spans the radius of SpinSat. Culture vessels hold seeds at different positions for different gravity levels.
- Seeds activated by hydration – may be simultaneous or not; long-duration experiments accommodated if necessary.
- Automated imaging inside payload captures plant morphology and/or multispectral data on plant health; modulated fluorometry can track photosynthetic efficiency.
- If desired, higher rotation rates can achieve up to 2 x g.
- Microgravity experiments possible before spacecraft spin-up.
- Radiation may be introduced as an additional variable, using shielding or lunar/Martian regolith simulant.

Do you see your experiment on SpinSat?



Submit a response to our RFI!

<https://www.nasa.gov/spinsat-rfi/>

Deadline: Dec 16

Experiment #3:

Human organoids in response to multiple stressors

- With late-load capability, SpinSat can host experiments probing human cellular responses to radiation, altered gravity, and additional stressors like lunar regolith; and test countermeasures.
- Data types will include imaging, embedded chemical sensors, or biochemical assays on culture medium or lysed cells (e.g. sequencing).
- Engineered reporter strains (e.g. fluorescence reporters of gene expression) are ideal candidates for SpinSat.

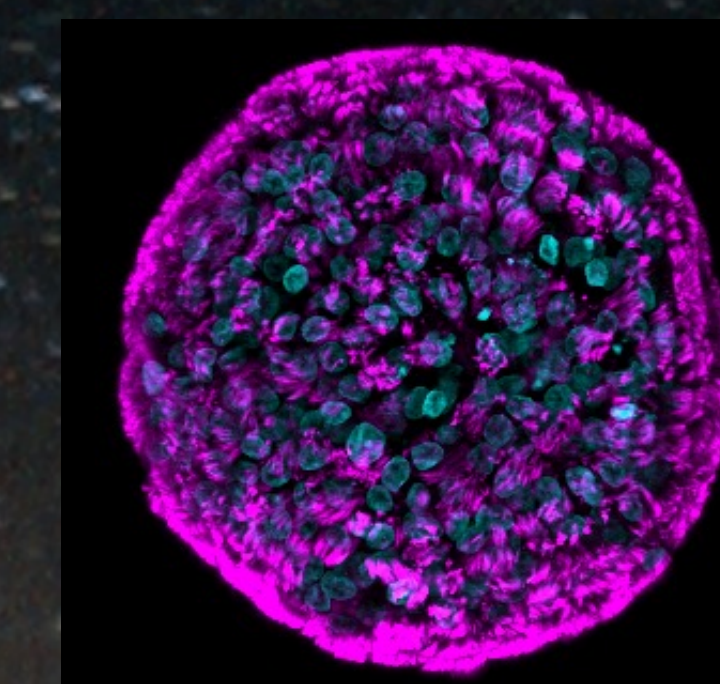


Image credit: RadBioLab, NASA Ames

SpinSat also offers opportunities for non-biological experiments

Experiments may take advantage of SpinSat's micro-g, gravity gradient, radiation environment, or any combination thereof. Examples:

- Regolith particle and dust dynamics at multiple g levels with radiation-induced electrostatic charging
- Flame propagation
- Protein crystallization, drug production
- Hardware demonstration for smallsat or CLPS concepts
- Radiation tolerance testing
- Radiation measurements for heliophysics

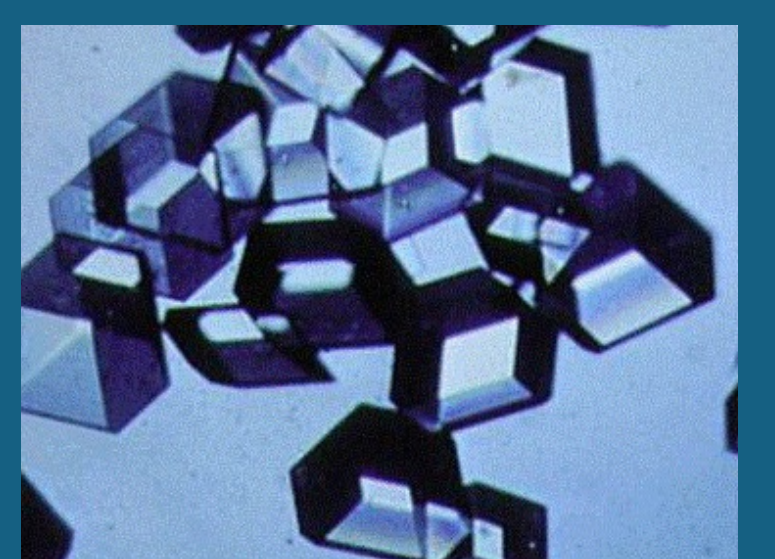


Image credit: NASA

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