



Water Ice on the Moon

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About Us

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Overview

- There is strong evidence that water is on the Moon
- We want to send a robot with a mirror to reflect the sunlight onto the craters where we believe the water ice to be.
- We hope to see what exactly is in these craters by redirecting the sunlight.

Where is the Water?

- There is near-surface water trapped as ice in permanently shaded craters on the poles of the

Moon.

- Temperatures at these poles may be as low as 40 K.

- There may also be water through out the entire Moon. Chandrayaan-1, India's first-ever moon probe, NASA's Cassini spacecraft, and NASA's Deep Impact probe, all detected the spectral signal for either water or hydroxyl on various parts of the Moon's surface.

Prior Research

Behavior of Volatiles on Lunar Surface (Watson, Murray, and Brown, 1961) – proposed that water ice is likely to exist in the permanently shaded areas (PSAs) of the moon
Estimated a loss rate of $\sim 4\text{g/cm}^2/\text{billion years}$
>> 30 years to Clementine – Radio signals seemed to indicate presence of water ice, but it was still highly debated

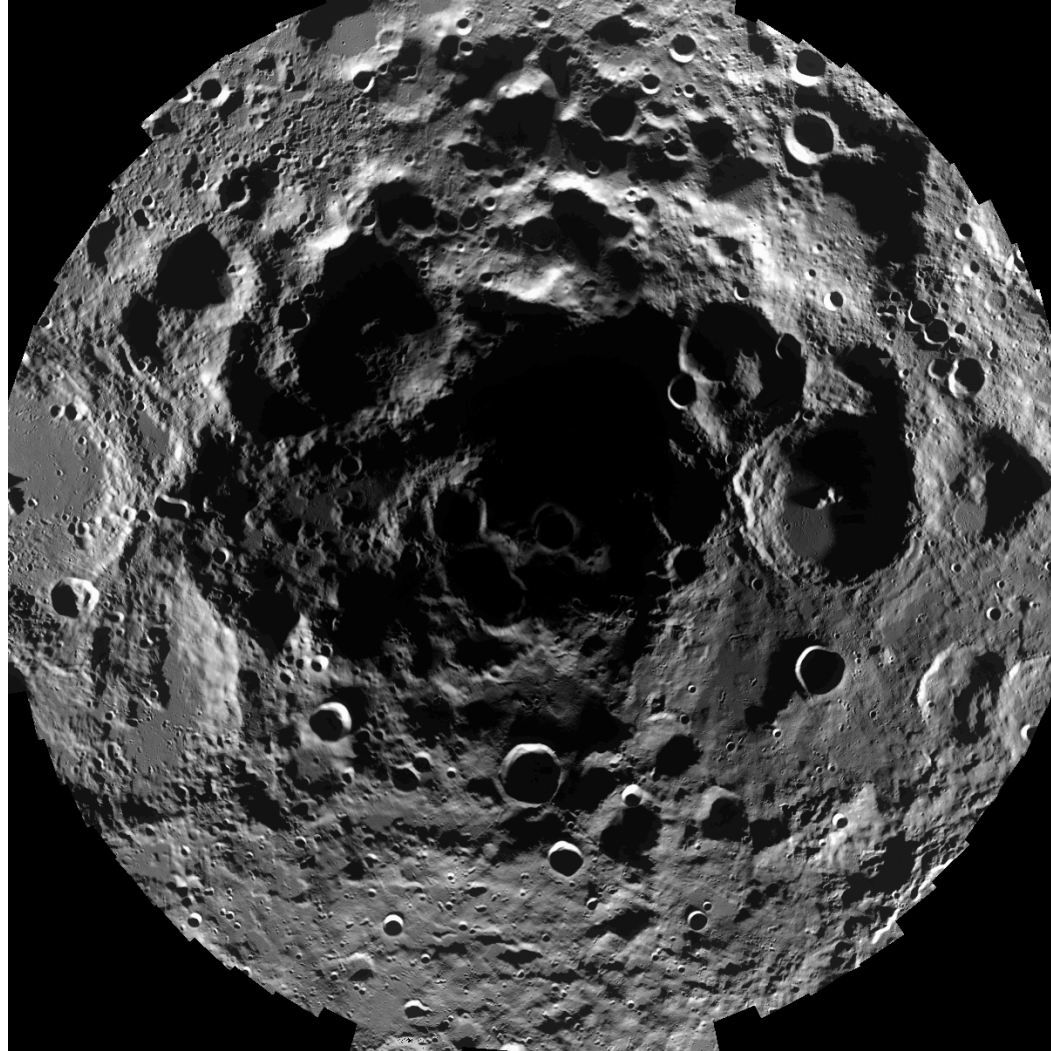
Prior Research (cont)

- Lunar Prospector – 1998 (<http://lunar.arc.nasa.gov/results/ice/biradar.htm>)
 - Neutron spectrometer to measure amount of hydrogen present
- LCROSS – smashed a probe into a crater on the south pole and found conclusive evidence of water

We are looking at the water ice near the poles, specifically the south pole



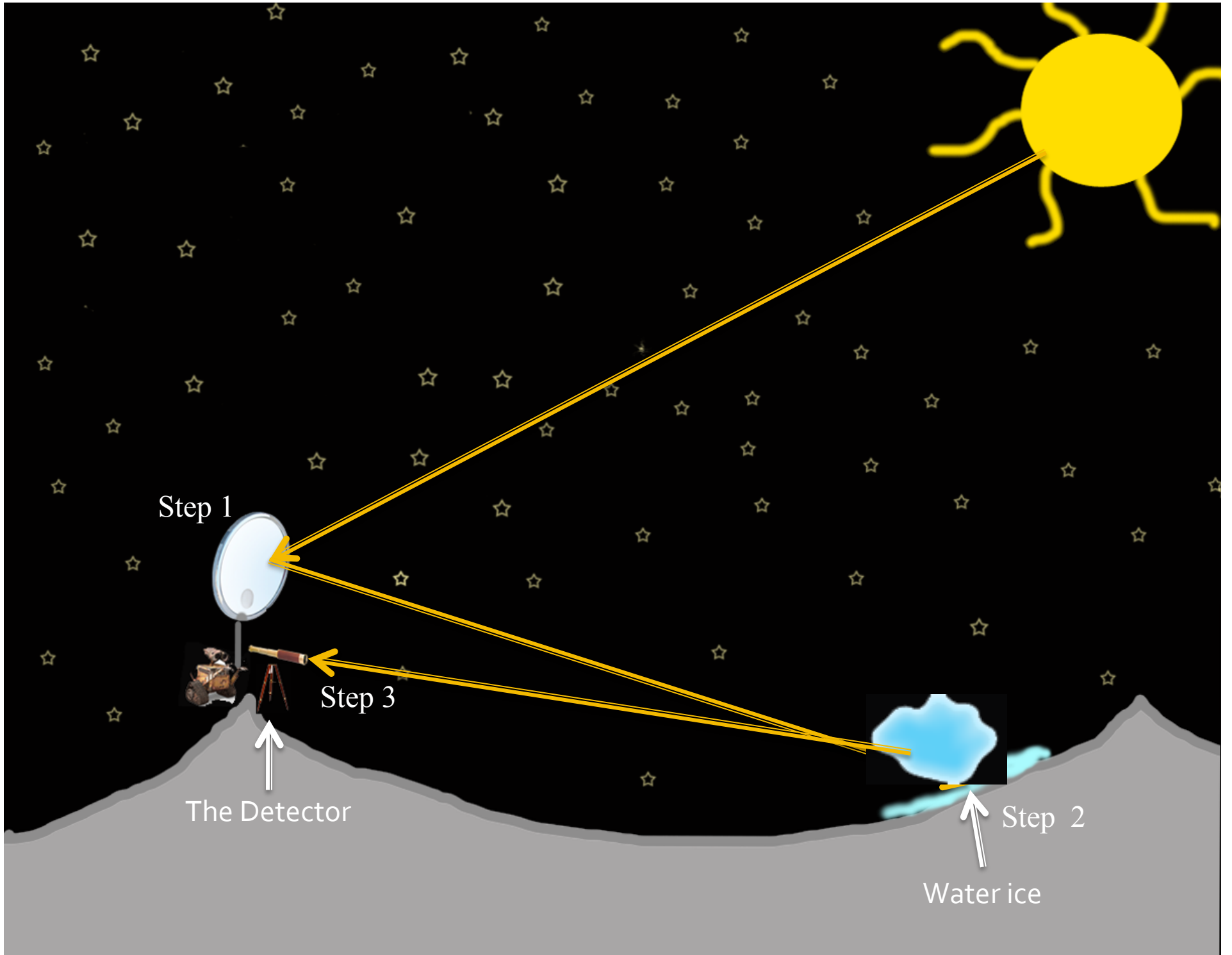
The South Pole



How Did it Get There?

- The water could have existed since the Moon formed.
- It could be deposited when comets strike the craters of the Moon.
- It could form when solar-wind protons interact with oxygen in the minerals near the surface of the Moon.



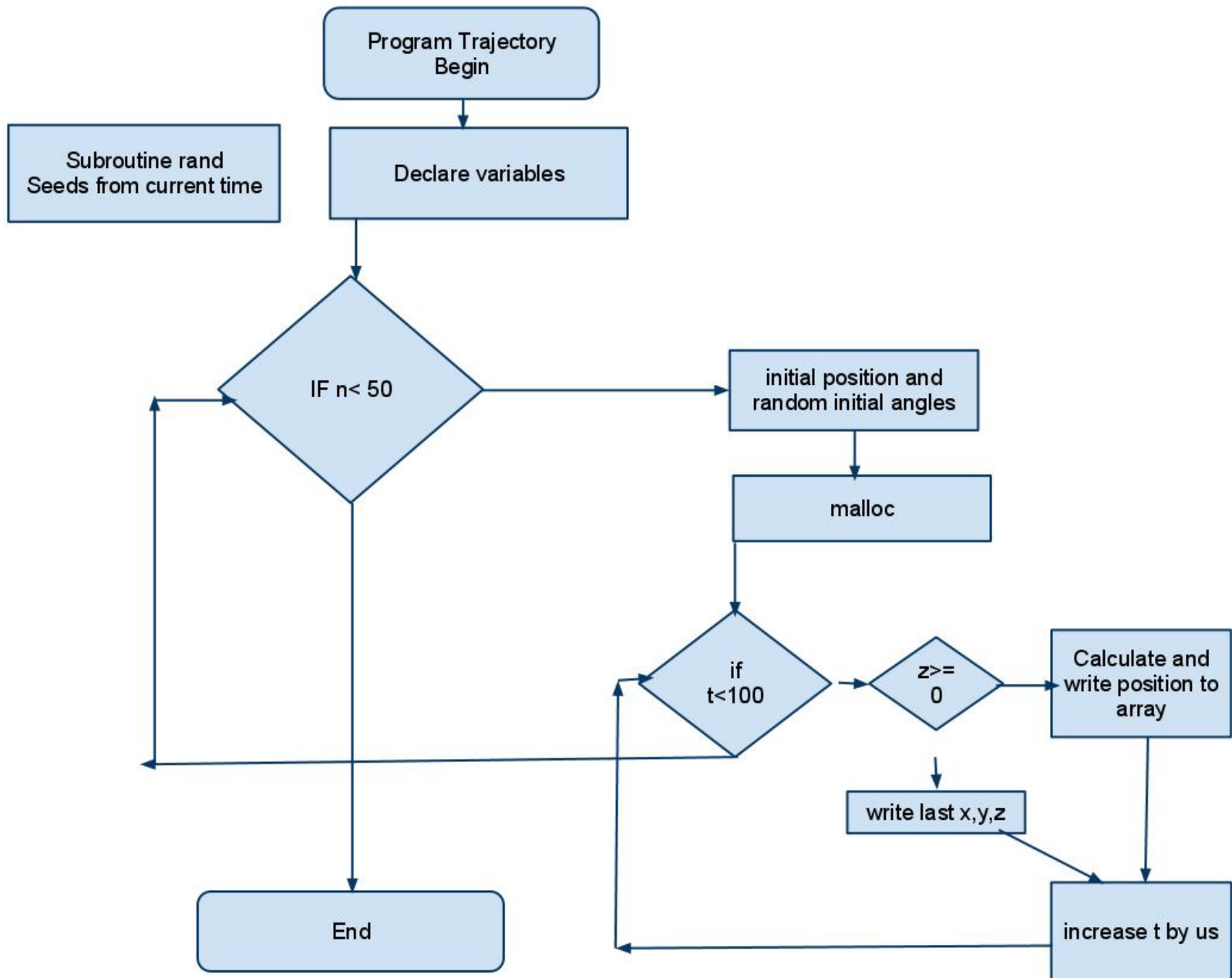


Our Project

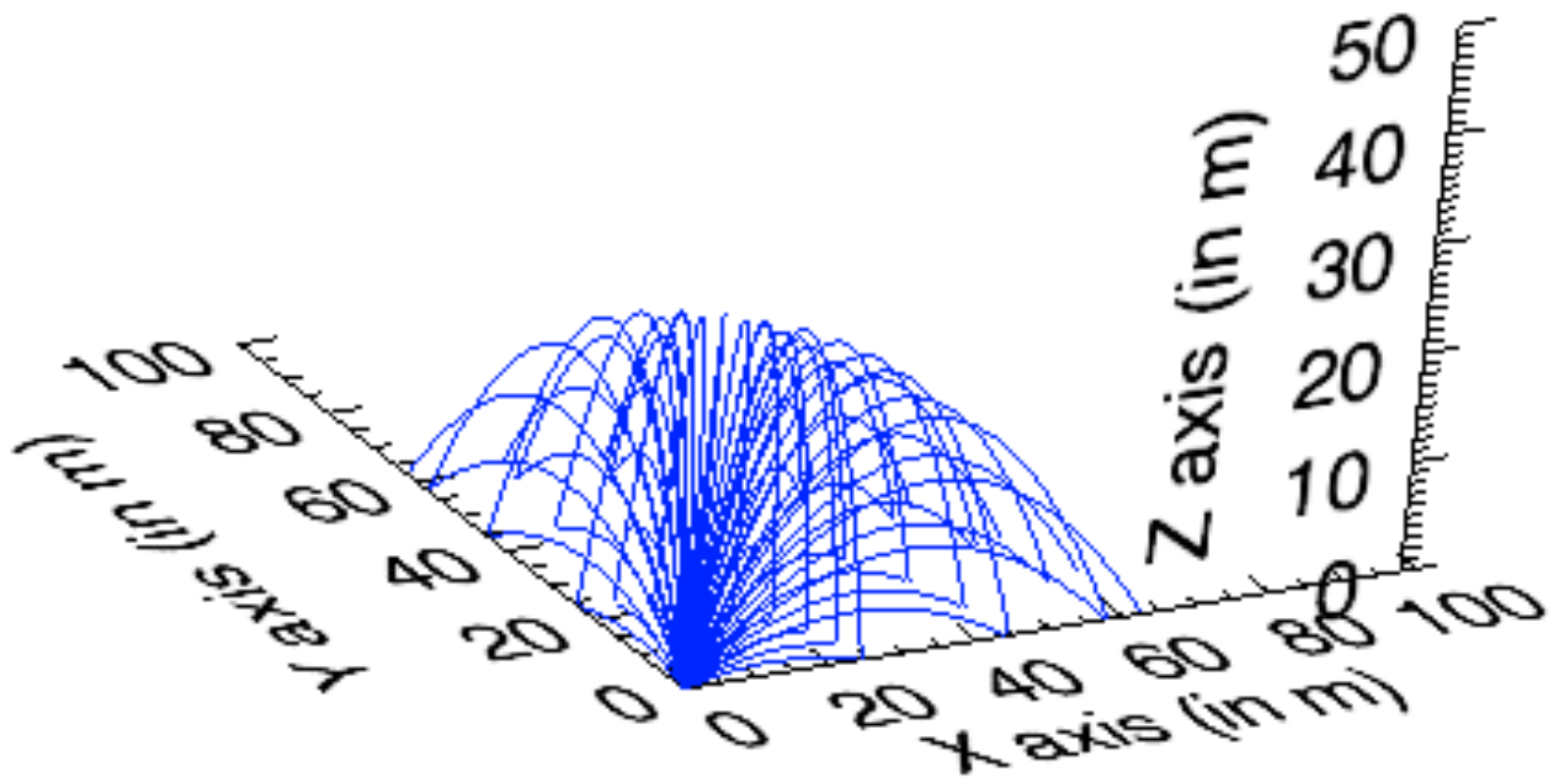
- We are mainly concerned with Step 2 of the previous picture.
- We are simulating trajectories to find out if it is possible to get enough molecules together for a sufficient read from the detector.

Why not another LCROSS?

- We know there is water on the moon, but we don't know where exactly it is or how much there is.
- With this robot we can clearly see where the ice is located in the craters, the amount in the craters, and if the water ice is pure or mixed with regolith and other contaminants.
- Lastly, with this robot we can see what else is located in these craters.



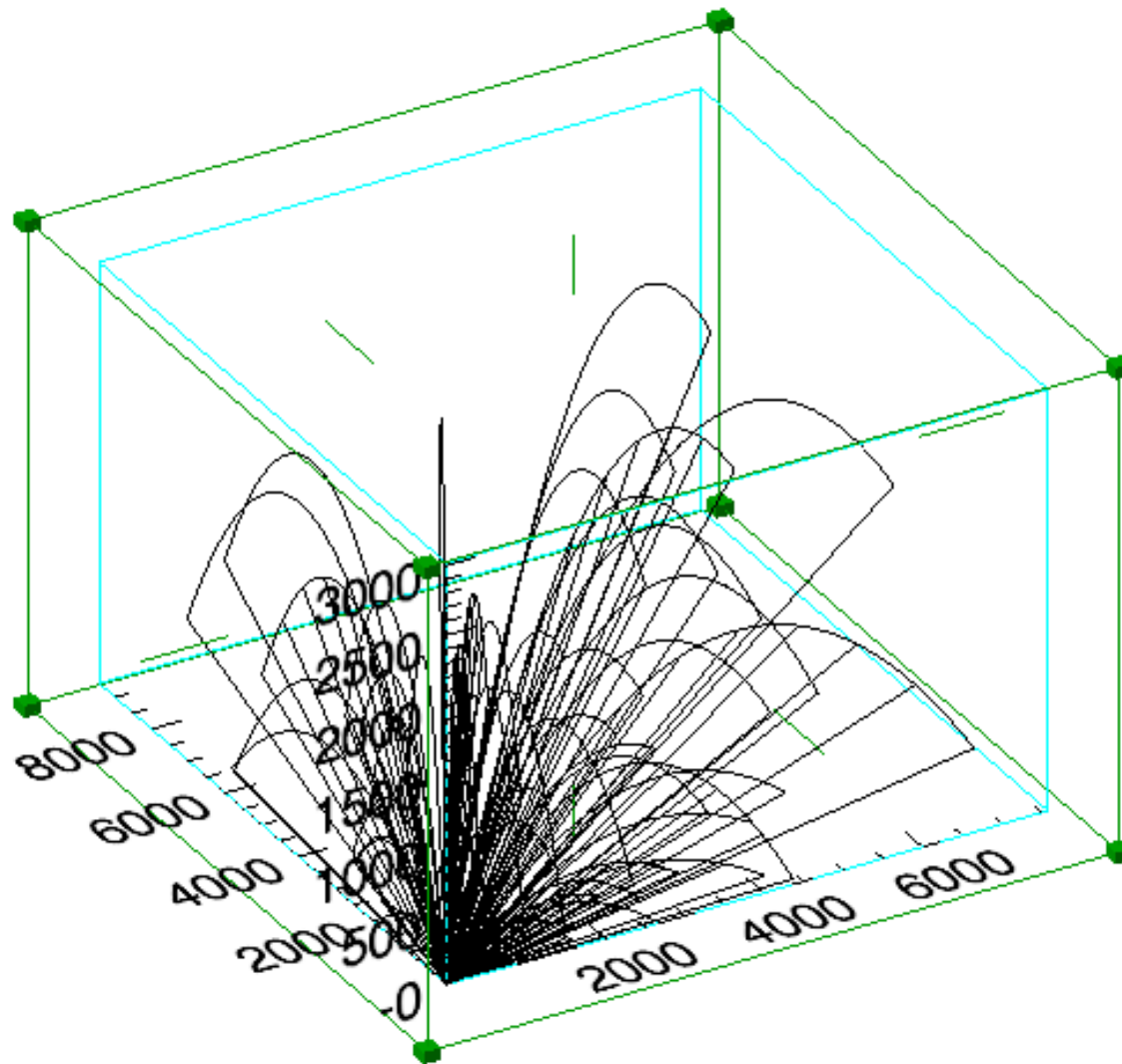
Trajectory on Moon Surface



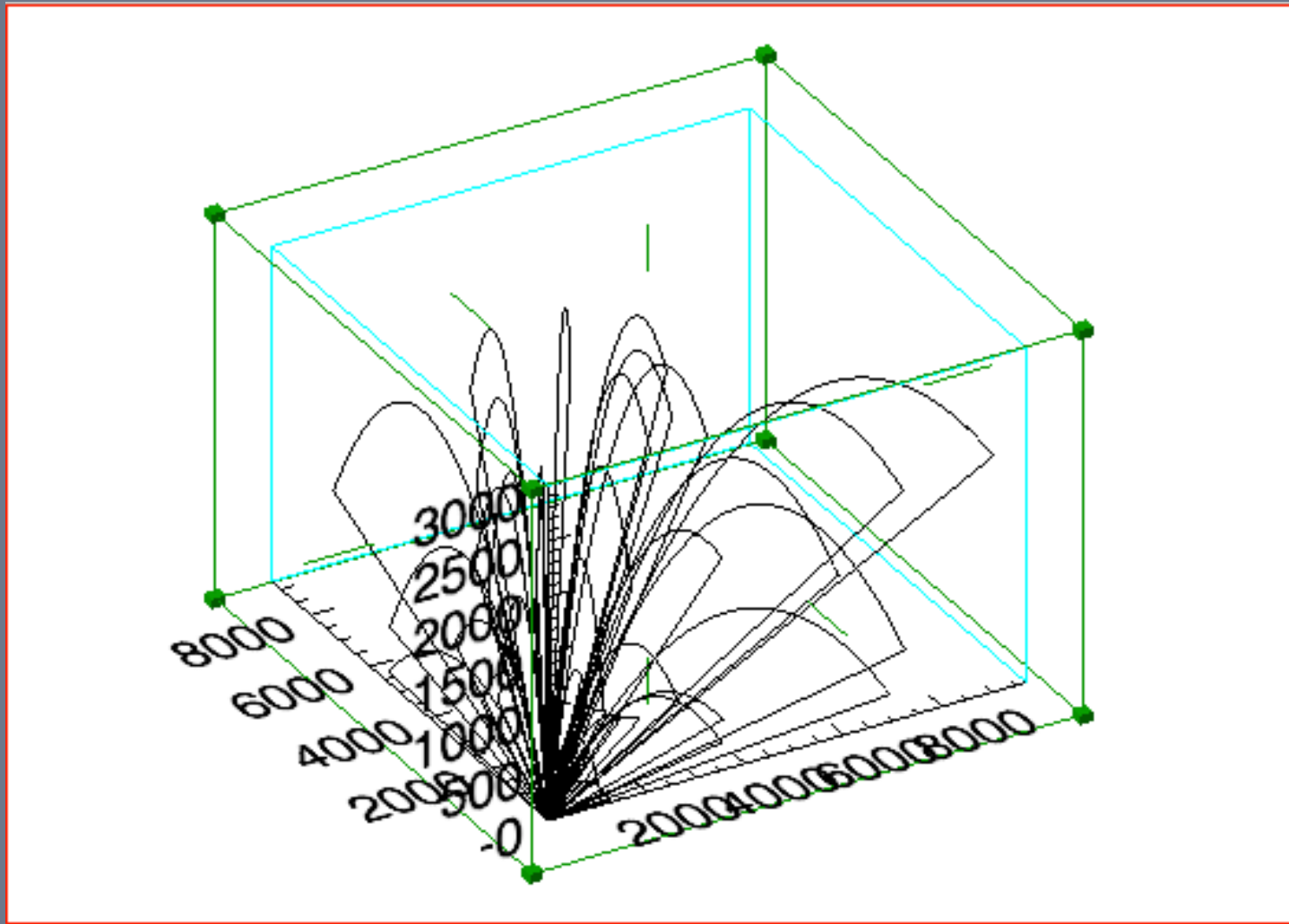


IDL iPlot

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So What?

- If sufficient water is found on the Moon, the idea of a lunar base could become reality.
- The water could be used as a drinking source
- Also Helium 3, which can be used as an energy source, is thought to be located in the craters on the Moon. Helium 3 can be used as a fuel source for Lunar bases

Helium 3

- The potential of Helium 3 is great.
- Through nuclear fusion Helium 3 fuses with deuterium and yields Helium 4, a proton, and energy.
- 25 tons of Helium 3, the amount a Space Shuttle cargo bay could hold, could power the entire United States for one year.
- Russia has plans to go to the Moon and establish a moon base by 2015. They hope to be mining Helium 3 by 2020.
- China has similar ideas hoping to send a man to the moon by 2017.



What's Next?

- Trajectories with more data points
 - We are limited by the disk quota of our super computer accounts
- Find out if there are any collisions.
- Implement MPI

What we learned

- Fortran
- Unix
- Thermodynamics basics
- Probability distributions
- Monte Carlo Methods
- C programming
- MPI basics
- Gas Dynamics on the Moon
- How to work the supercomputer

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