



Z-2 Suit

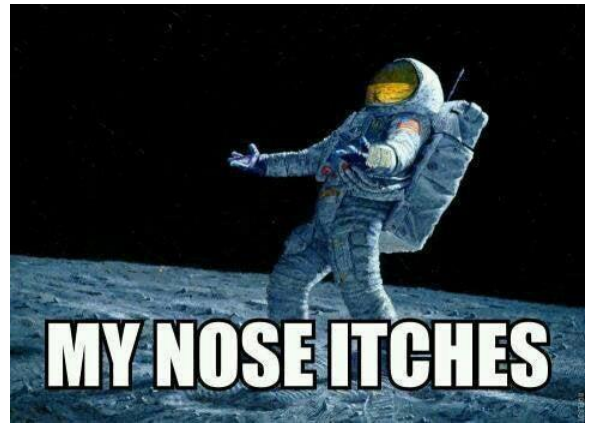


Facial Irritation Relief Device (nose scratcher)

Work in Progress



What kind of device could we develop that would allow astronauts to scratch various parts of their face when they are in their space suits for several hours in a day.



Glenn Johnson is working with the HUNCH Team to make improvements on this project and will be mostly done by August 1st 2026. Changes will be made during the school year as students ask questions and need clarifications.



Irritation Relief Device

Problem:

- There are few things as annoying and able to distract you from your work than an itch that you can't scratch. Imagine an itch on the side of your cheek or right next to your eye but you are unable to scratch it and it's making your eyelid twitch. What if you were in a helmet where it was not possible to touch your face for 8 hours? How many times in the 8 hours might you be distracted from your job because of an itch or a drop of sweat rolling down your brow?
- The new EVA helmet is a double paned, polycarbonate, hemisphere. There is no method of touching your face with your hands inside a helmet. There is not anyway to wipe a drop of sweat that is making its way to your eye. There is a piece of rubber inside the helmet that is used for pinching your nose to help when the pressure in the suit is changing and can be used for nose scratching. Unfortunately because of the size and location, that is about the only itch it can help with.

Objective:

- Develop some kind of 'finger' that is fairly rigid so the astronaut can scratch their nose and rub their forehead but weak enough so that they don't get hurt if they bump into it.

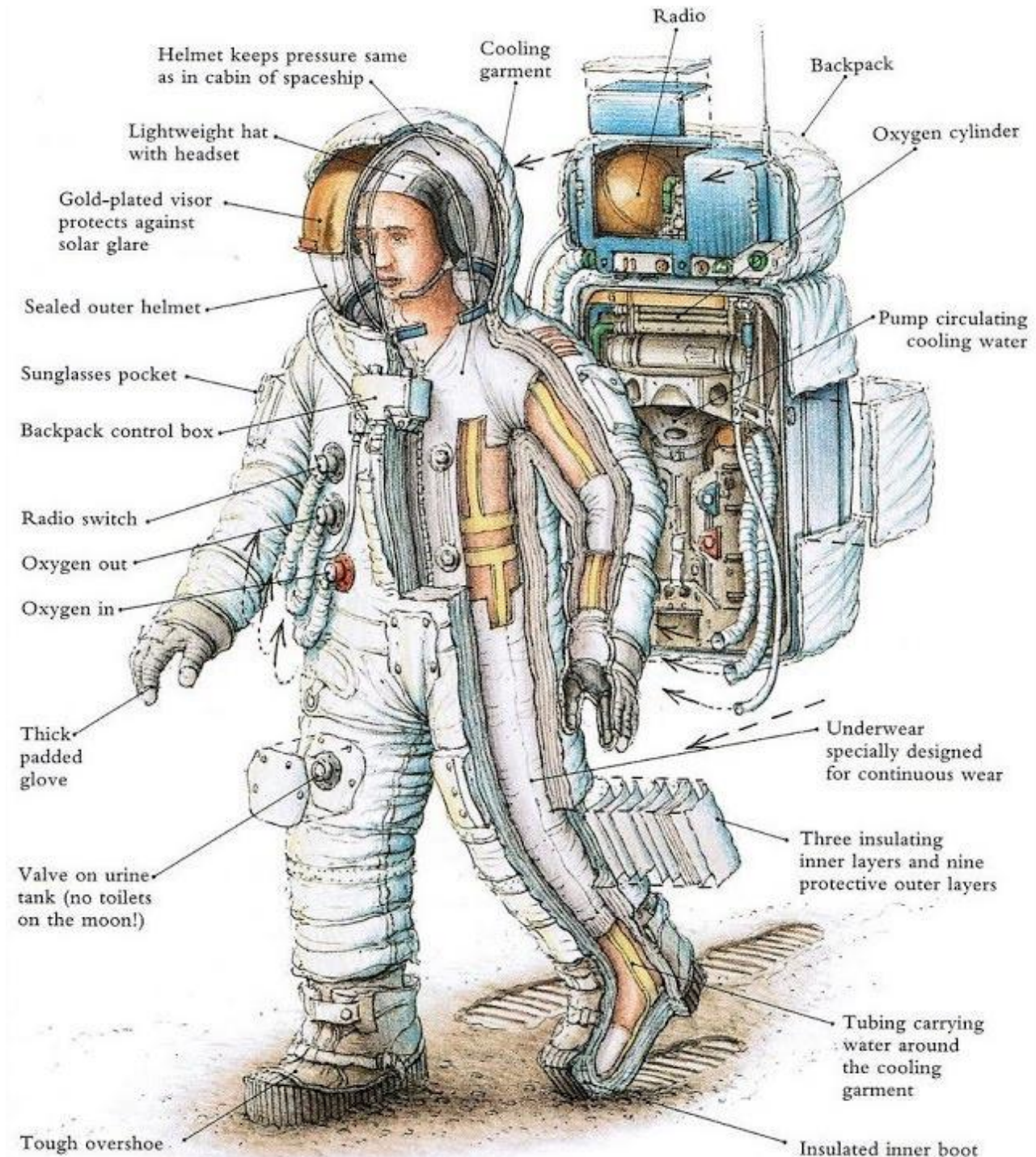
Tips:

- This could be done with a magnetic coupling—inside helmet, between panes of polycarbonate, outside of helmet. The component on the outside of the helmet is a handle so the astronaut can move the 'finger' on the inside of the helmet to other locations for scratching or dabbing sweat.
- The 'finger' needs to be of a length that the astronaut needs to move their head to get to it (not continuous poking). There will probably need to be different lengths that astronauts can pick from so it fits their size.
- The 'finger' might have a replaceable cloth tip so it can scratch an itch and wipe sweat from brow.
- If the 'finger' releases from the magnetic coupler the inside of the helmet, the astronaut will need to be able to manipulate the helmet and magnetics to re-attach it to the coupler of the helmet.
- The control magnet on the outside needs to be easy to grab with gloves but small enough that it doesn't obstruct the visor.
- The control magnet on the outside may need to have some felt to prevent dust from scratching the outer surface of the polycarbonate.



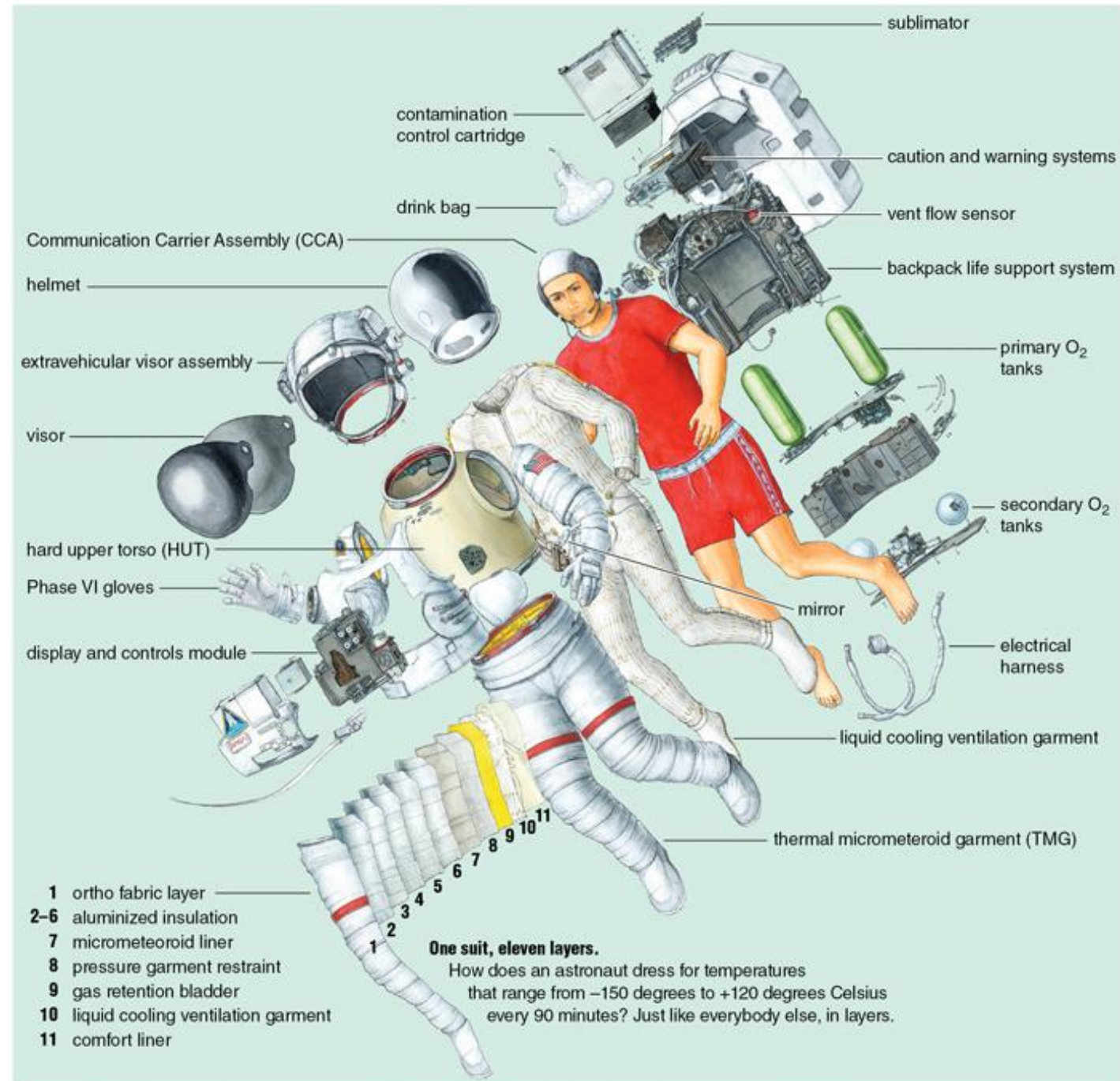
Space Suit Basics

- The Space Suit is much more complicated than a pair of pants and a jacket. It would be better to describe it as a small, personal space craft that holds one person. The suit's first job is to keep the air around the person so they can breathe while walking in both the cold and hot vacuum of space. It contains a whole life support system to help control the person's body temperature from getting too hot or cold, supplies oxygen, cleans the carbon dioxide from their air, provides communication with the ground, has lights and video systems so both the astronaut and the ground can see what they are doing. Space walks can be several hours long, so the suit has to be able to handle use of the toilet. Some suits even have thrusters to push them back to the Space Station if they start floating away. Suits for the moon also had to protect them from the dry, glass like lunar dust.
- The Apollo suits were designed and built by Playtex who made women's undergarments along with other engineers familiar with pressure suits. The women who did the sewing on the suits knew the quality of their work could mean the life or death of their astronaut.
- Although this picture is a cut-a-way of the Apollo suit there are many similarities that can help you understand the new suits.
- This picture doesn't show it but the Apollo astronauts had a drink bag with Tang and an energy bar they could bite off while doing their moon walks.



ISS Space Suit

- Inside the space helmet there is a lot of room for air flow, visibility, shifting of head, communication gear.
- Unfortunately, you can't reach up and scratch your nose when you have an itch. In Zero-g, loose drops and crumbs could float around in the helmet and clog airflow or float into eyes, ears and nose causing discomfort and distractions at minimum. Imagine a piece of a peanut being inhaled into your nose or floating into your eye but you are unable to get your hands up to your face to remove it. This is a serious issue that currently prevents Space Station astronauts from having anything in their suits with them with the exception of a 32 oz drink bag of water with a camel bag style of straw. Any drinks with sweeteners could leave sticky droplets that clog or damage suit equipment
- Occasionally space walks can last between 6 to 8 hours. For these extended lengths of time outside, the astronauts will need refreshments to keep them hydrated and energized. This will require some kind of water or liquid refreshment like gator-aid or power aid and some kind of power bar.

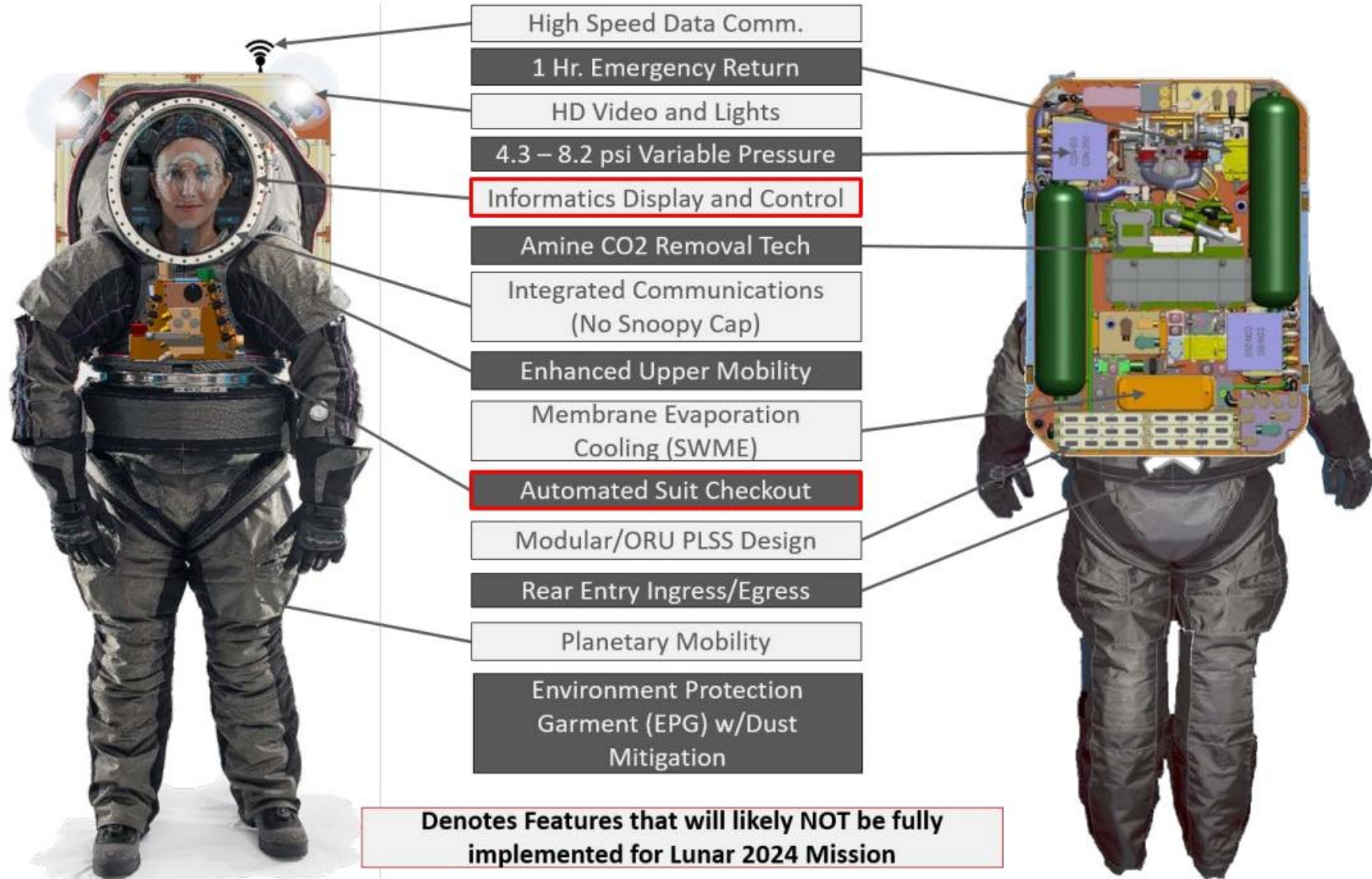


The New Suit

- NASA has worked with some of its business partners in developing a space suit for walking and working on the moon and Mars. This suit was designed specifically for dusty, lower gravity environments-- not for zero-g. Astronauts will be expected to do lunar and Mars walks for up to 6 to 8 hours in a day. In zero-g the crew was not allowed to have food or drinks other than water for any of their space walks since any floating particles of food or sticky drinks could cause damage to the electronics, impair visibility, clog airflow or even get inhaled by the crew. Now that the astronauts will be in gravity using the new suits, some of these issues are not as big of a concern. During Apollo missions on the moon they had energy bars and drinks in their suits that helped them get through the long moon walks. They did have a few problems with some of the foods in the Apollo suits. These new suit will need new food dispensers and new food and drinks.
- Having full food bars that are bitten off can leave crumbs in the helmet. We would like to have bite size pellets of food bars that can be dispensed without the crumbs but easy for crew to grab with their mouths. They won't be able to reach their faces through the helmets or up through the neck connections so any kind of manipulations must be done solely with their mouths.

Video of getting into new space suit.

- https://www.youtube.com/watch?v=snSBqfRxX_U





a) Small Composite HUT



b) Small Aluminum HUT

Figure 3: Composite and Aluminum xPGS HUTs

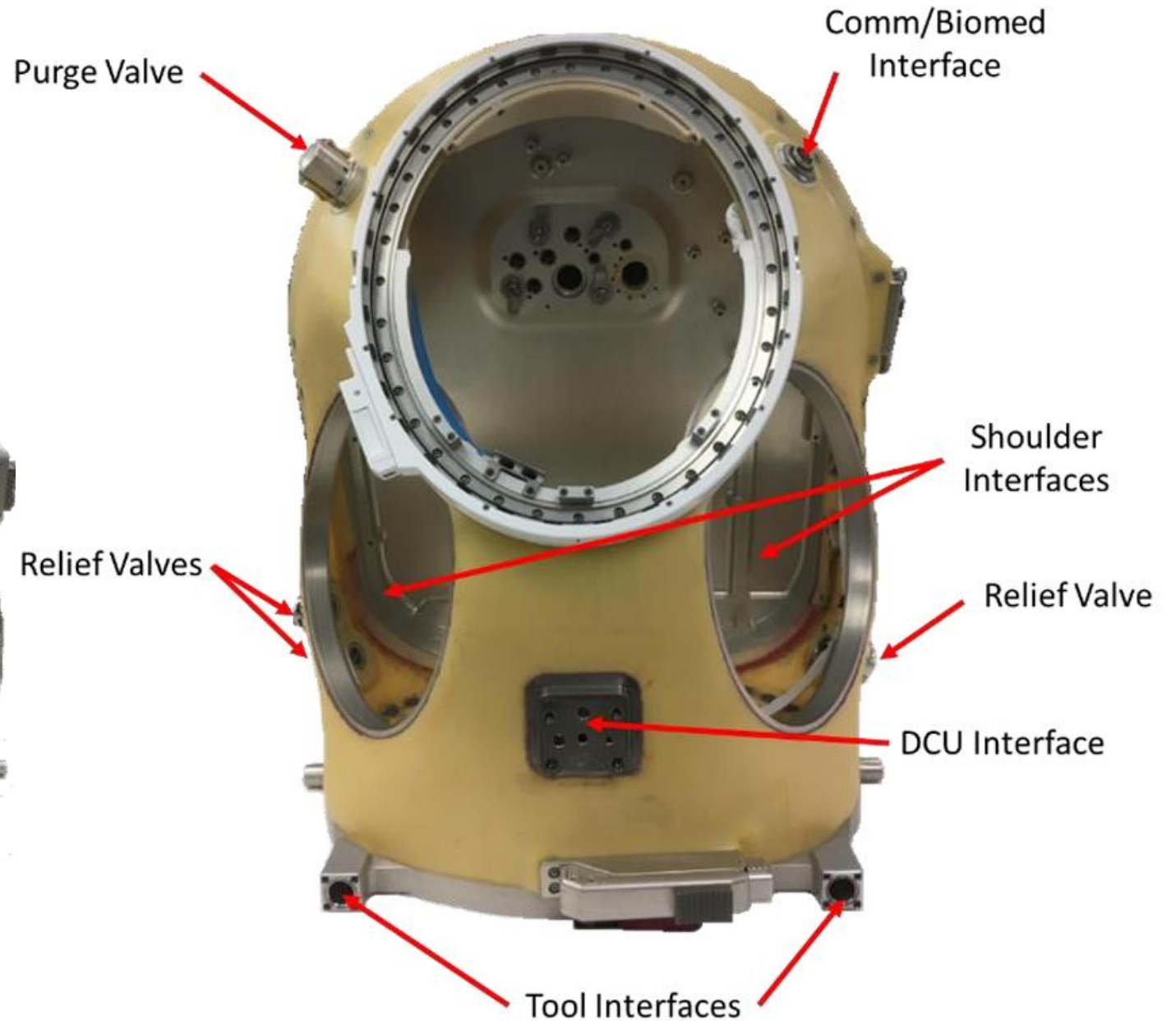


Figure 7: xEMU HUT External Interfaces

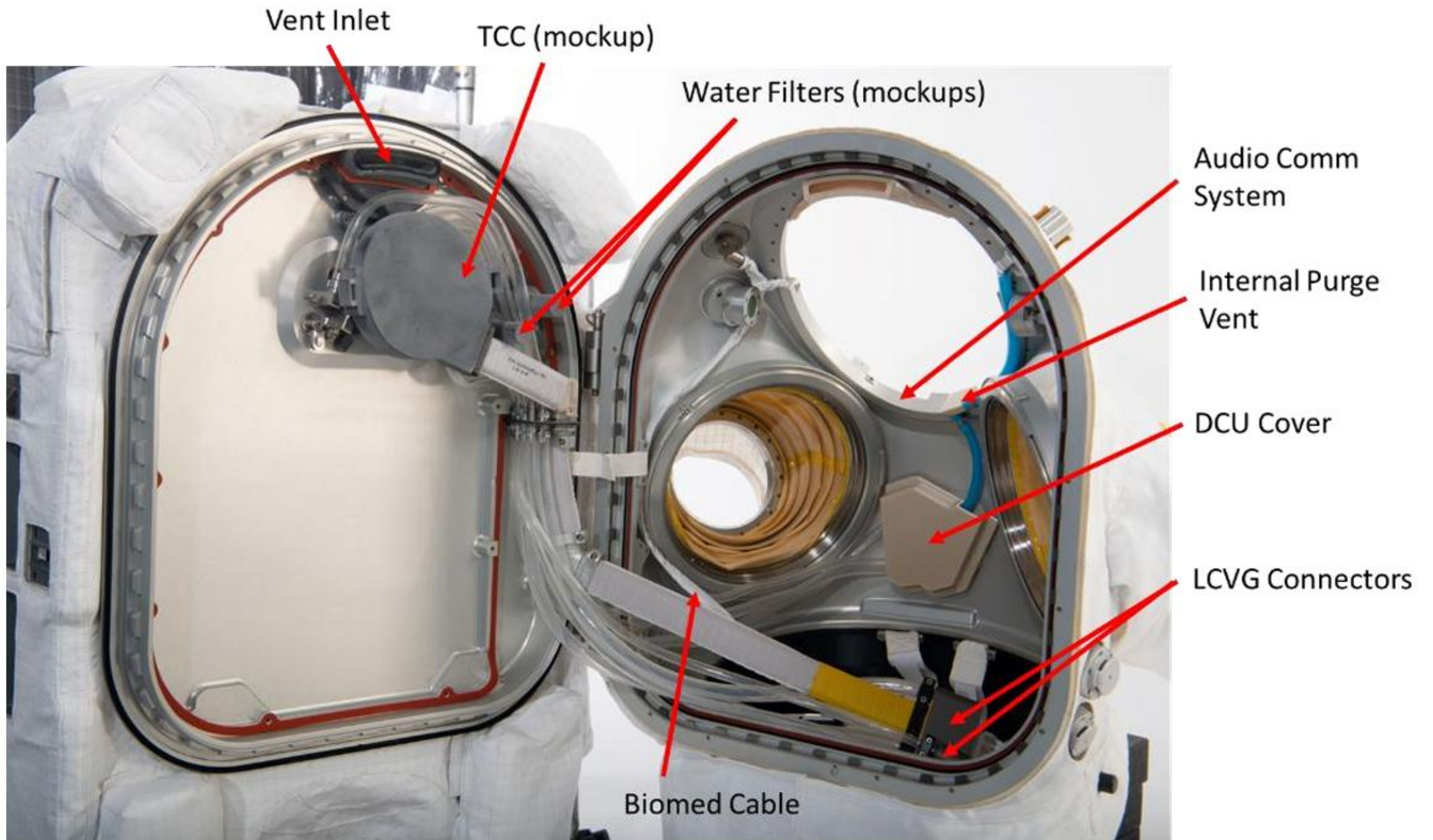


Figure 8: Internal HUT Interfaces

Testing

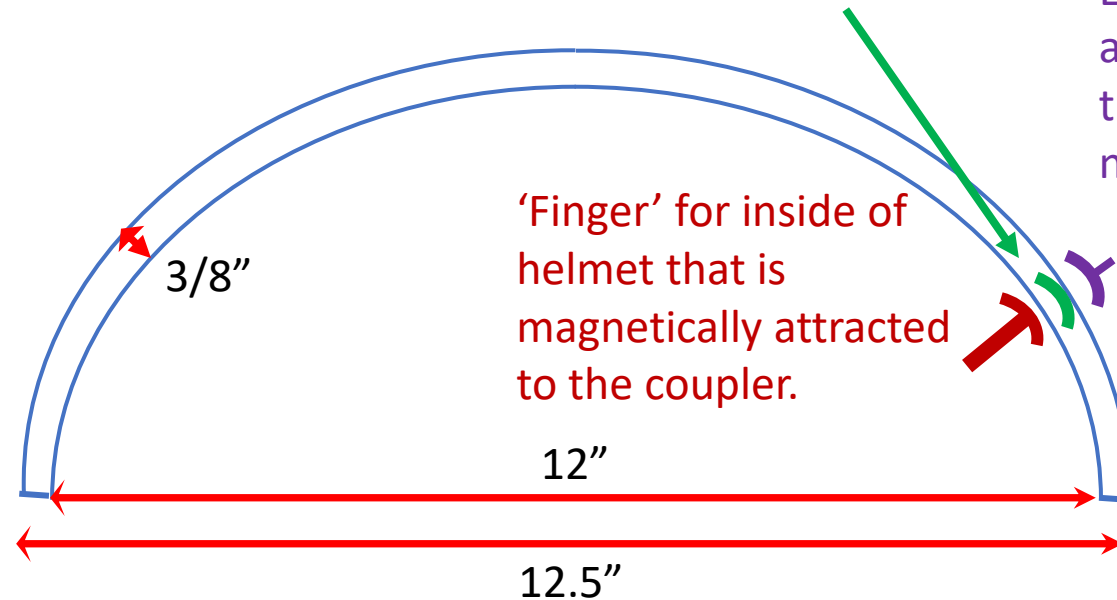
- Initial testing might be with two flat, parallel panes of glass or plastic but eventually it would be much better to have two plexiglass hemispheres with where one fits inside the other with a $3/8$ " spacing between. It would be nice if it was this was a full hemisphere, but a significant segment is all that is really required. Detailed information about the helmet is restricted but we don't need to be exact at this point since we are attempting to show the main concept—scratching an itch. Let's assume the outer diameter of the helmet is 12.5 " and the inside surface of the helmet is 12 ". Each pane of plastic is $1/16$ " thick. That leaves a spacing between the two hemispheres as $3/8$ ". (I am estimating from the picture and I am open to suggestions. There could be more space between but I'm allowing for some distortion from the multiple transparent surfaces.)



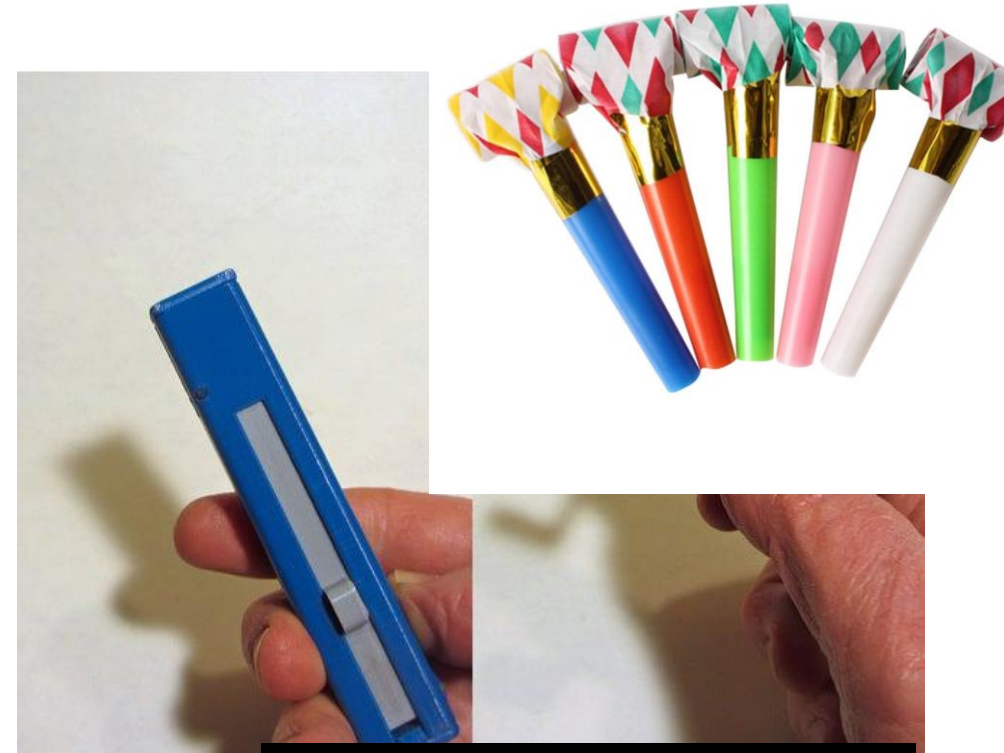
Double pane

Coupler magnets between the shells to connect between outside control and the interior 'finger'.

Exterior handle so astronaut can move the 'finger' to the needed location



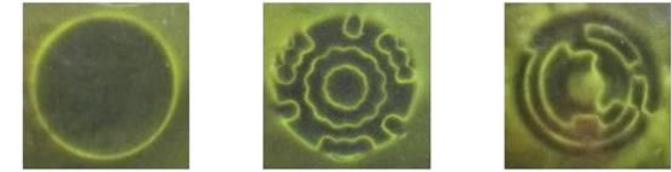
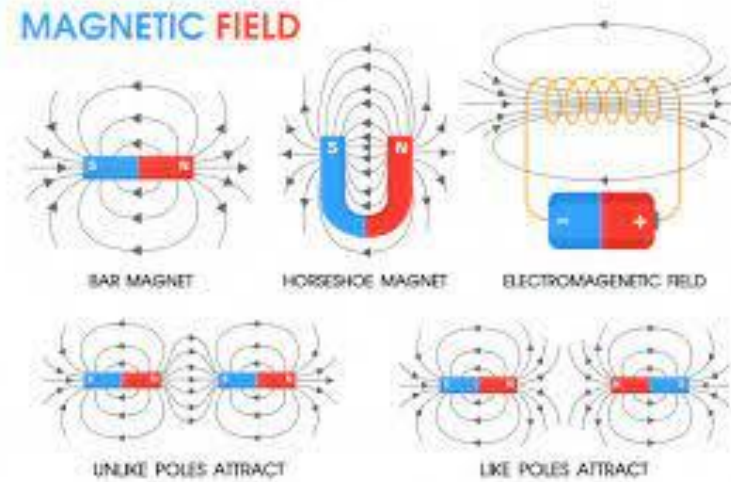
- What will the scratching surface look like?



Multiple N-S poles

My first impression is that this can be done with solid magnets that can be bought from the hardware store or from special sized rare earth magnets that can be bought on line. However, Polymagnets and others are doing some very interesting things where they are designing with solid magnets and magnetic fields similar to how people are printing objects with 3D printers. I am not suggesting that you have to design and purchase magnets from these companies but it may be valuable to study their ideas.

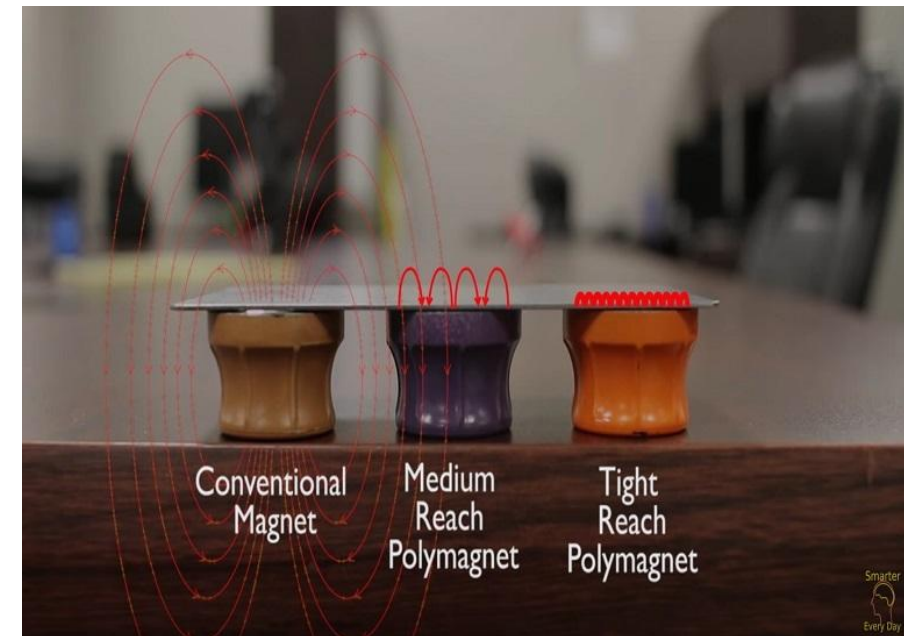
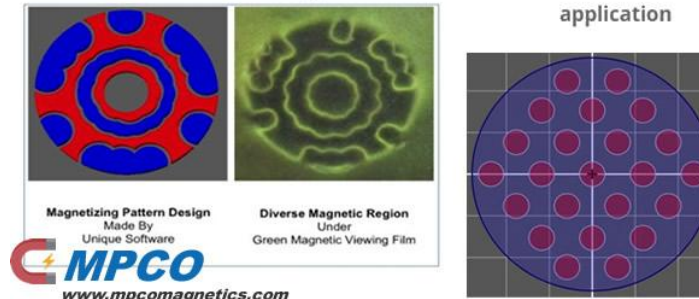
- <https://www.youtube.com/watch?v=IANBoybVApQ>
- Polymagnets
- <http://www.polymagnet.com/polymagnets/>
- <https://www.youtube.com/watch?v=9T26k2iFyNM>



Standard magnet

Rotate-release with alignment feature

Magnet for Hall effect sensor application





Suni Williams wearing her 'snoopy cap' with headphones and two microphones. Some of the size of the snoopy cap is to catch any sweat that builds up.