# Space Poop Challenge

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# Houston… We have a problem…

- We must assume that a catastrophe has occurred.
- **I propose the following scenario based on the challenges faced during Apollo 13, only worse:**

- Halfway to the moon space craft cabin pressure is lost
- The space craft has little to no power, possibly frozen
- The space craft is tumbling, enough to be annoying
- Astronauts are in their MACES, strapped in their chair for several hours at a time

# Waste Water Treatment System? Probably not…

- Miniaturized treatment plant inside suit would have too many “in series” processes to go wrong, for example:
  - Collect, Transport, Heat, Condense, Filter, Transport again, Store
- One process could interfere with another causing a catastrophe
- Little chance of “manual” control backup in case of low suit power

# Oil spill is the key!

- **I propose that we handle the waste like an oil spill**
  - Collect
  - Transport
  - Store
- In the process of transport provide:
  - Wiping
  - Disinfecting
  - Deodorizing

# Can we survive with a dirty bottom?

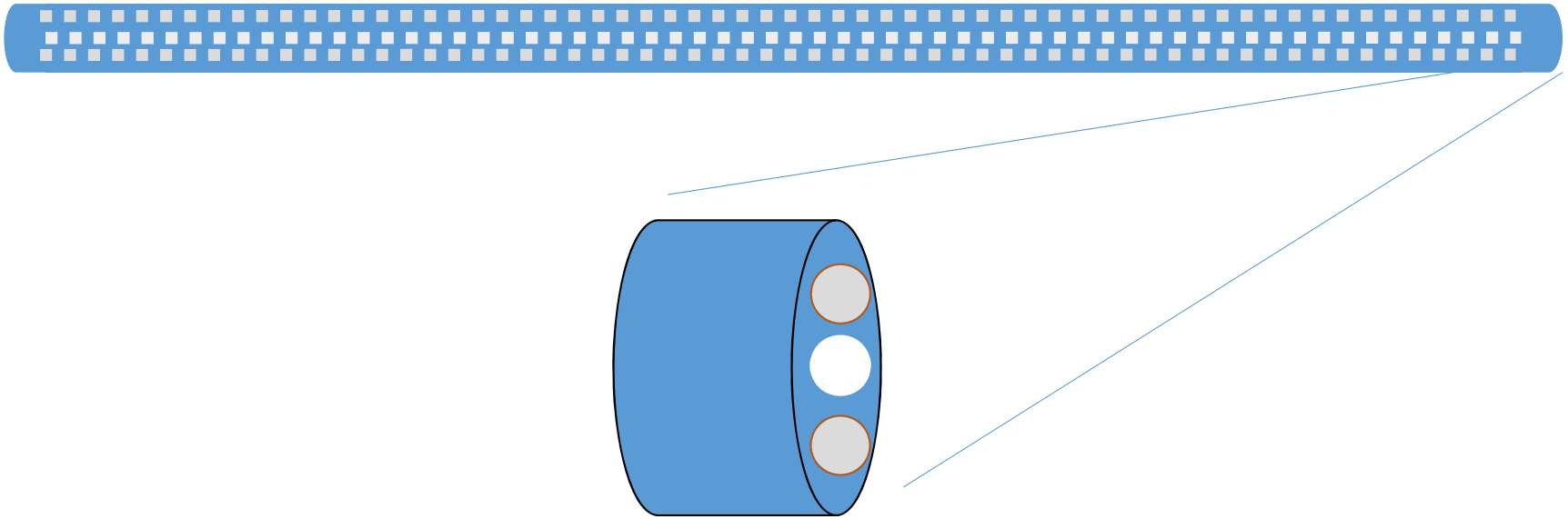
- YES, as best we wipe, there is always some residual waste on our bottoms and on our underwear after we
- Having 100% clean bottoms and underwear is not a key to survival.
- There is no need for an overly complex “washing process”
- **I propose that a little bit of remaining waste on the bottom - combined with germicide - will not kill or permanently harm an astronaut in 6 days**

# The solution: Space Sorbent Tubing (SST)

- SST is a material inspired by sorbent booms deployed during oil spills.

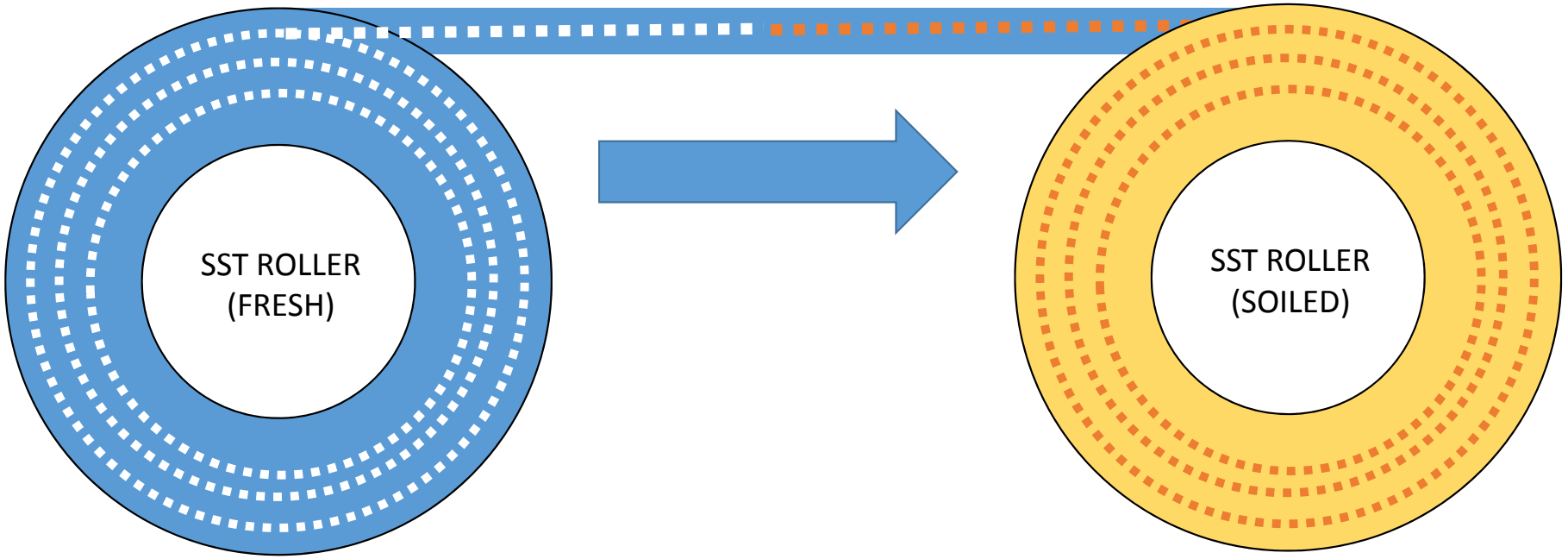
# Space Sorbent Tubing – look and feel

- SST is a 20 foot long tube with a diameter around 1 inch
- Diameter can be custom fit for each astronaut
- SST is filled with sorbent beads and deodorizers
- SST has a soft tactile feel like a long bean bag



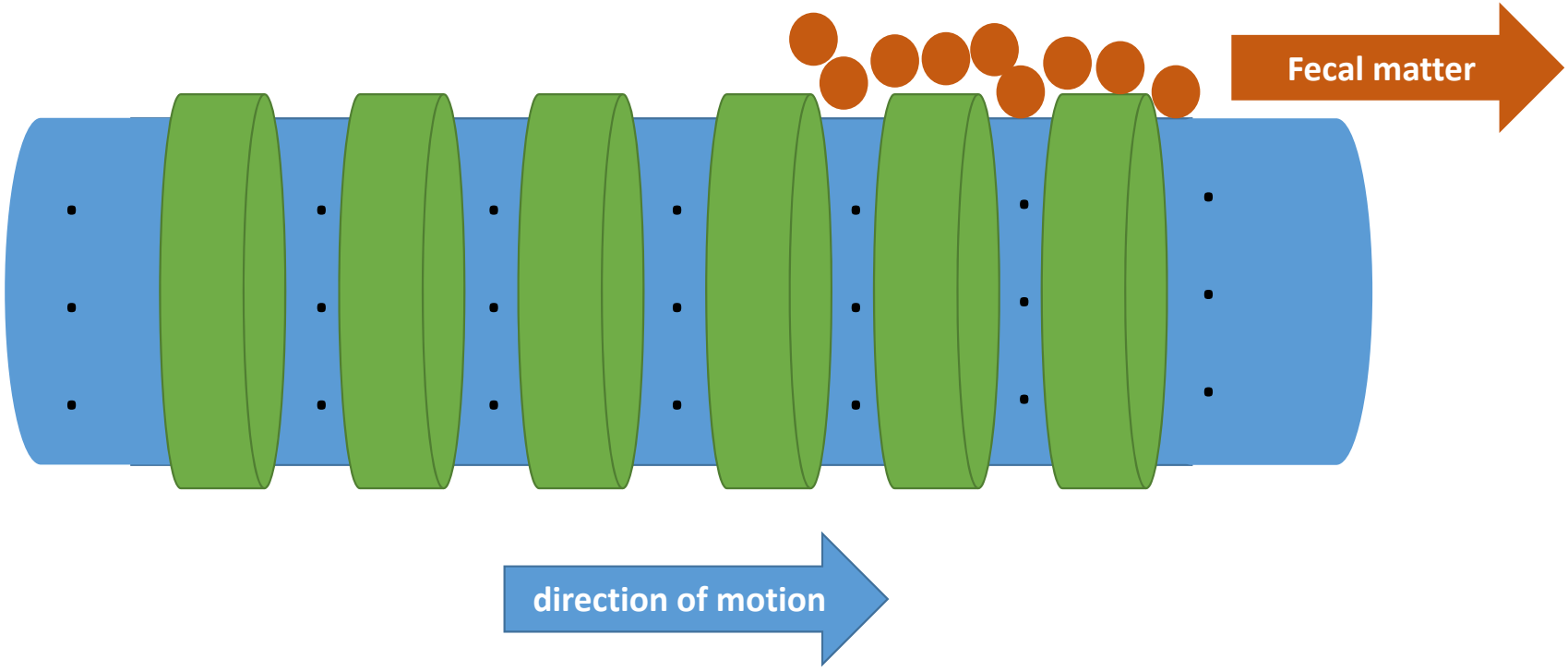
# Space Sorbent Tubing – Waste Transport

- SST is wound into a coil on a roller and is stored inside a semi-rigid pelvic encasement worn like a diaper.
- SST moves between the legs like a conveyor belt from front to rear, transporting soiled portions to a separate waste storage roller.
- An astronaut would presumably use up to 3 feet per day over 6 days



# Space Sorbent Tubing – Wipe while transporting

- SST has an abundance of ~1mm circular perforations all around the circumference to receive waste fluids from any direction
- SST casing is skin-friendly plastic with absorbent raised diaper pad ridges placed around the circumference of the tubing to provide a wiping action

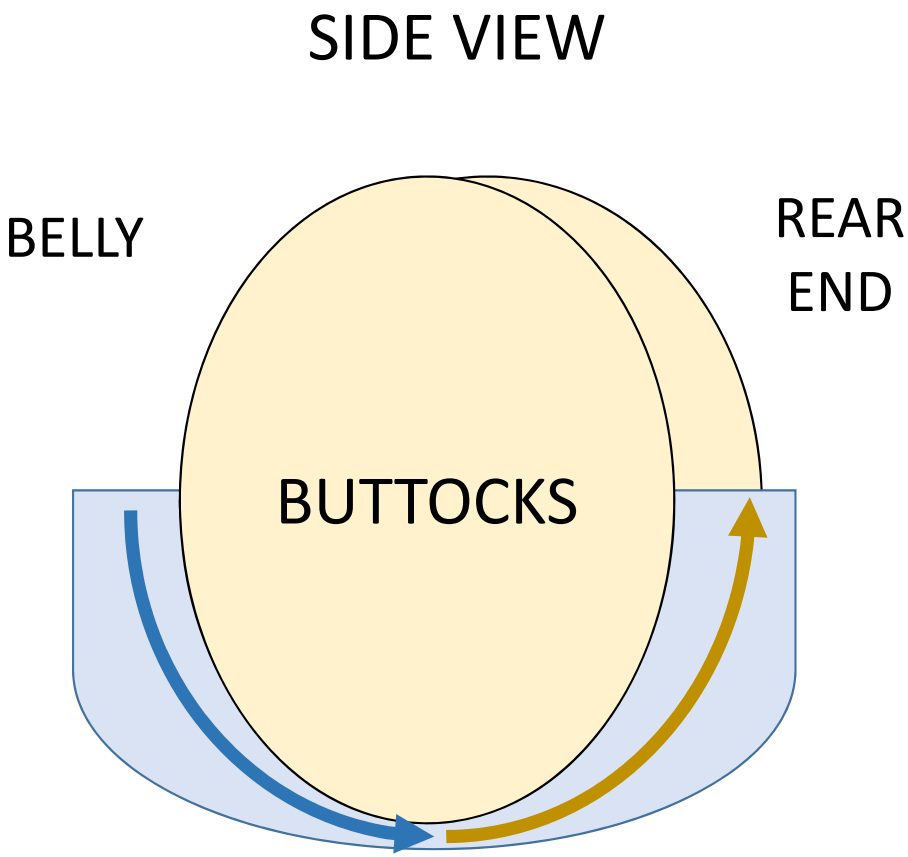


# Space Sorbent Tubing – Cleaning properties

- The MACES highly aerobic 100% oxygen environment can provide some support against bacterial infection
- To provide extra defense and comfortable use, the SST outer casing is coated intermittently with a warming germicidal lubricant
- KY is used as a familiar example but is <u>not</u> germicidal, this feature would need to be created and tested

# Space Sorbent Tubing – Guide Channel

- The guide channel is a tunnel attached to the pants that the SST travels through from roller to roller
- The guide channel is enclosed for most of the path
- A portion of the guide channel is open (U-shaped) between the legs so that SST can come into gentle contact with the body.



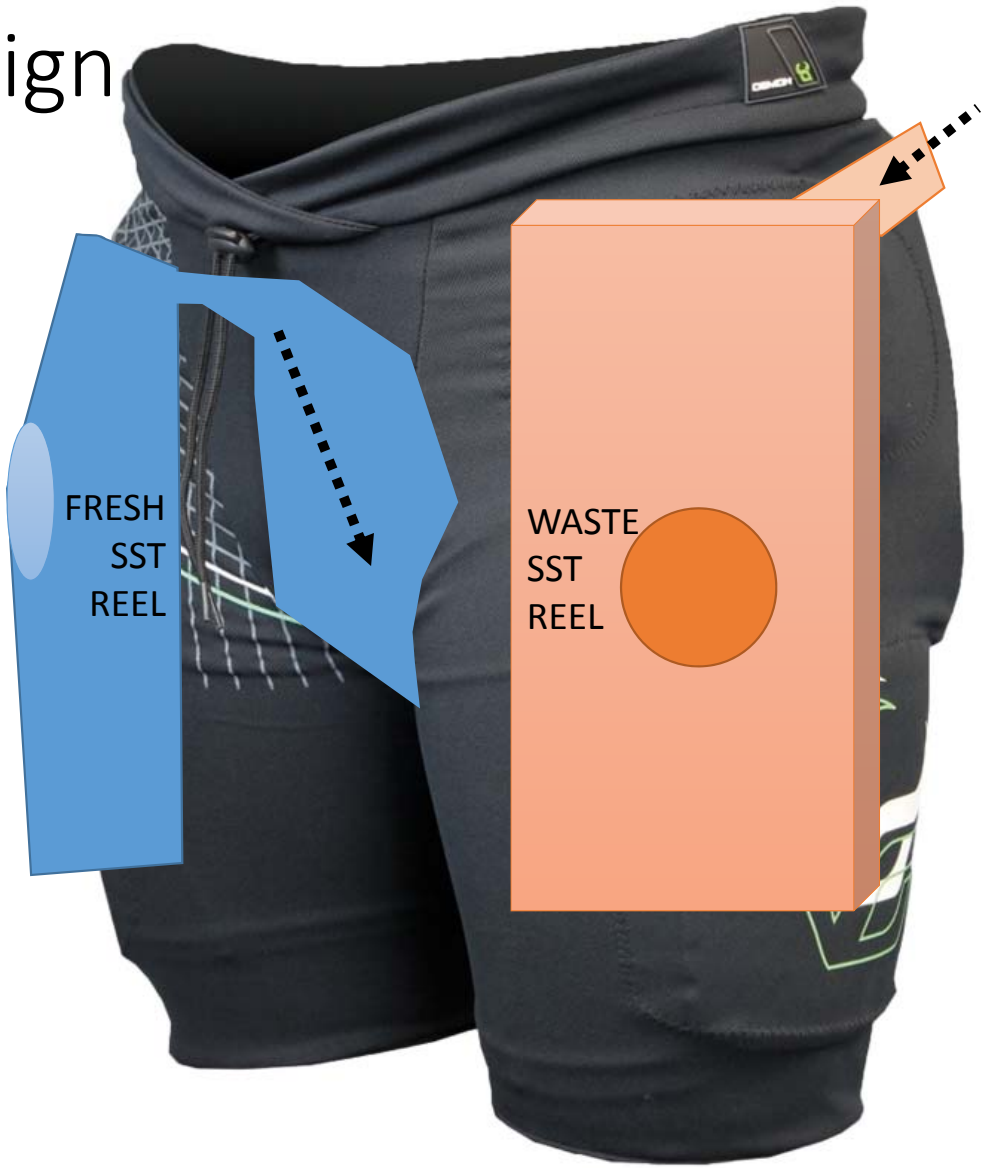
# SST integrated pants design

- The SST system is integrated into a pair of padded pants that extend below the crotch and hugging legs and abdomen
- The SST pants can be worn and adjusted quickly for comfort and position much like a climbing belt
- Adjustments can be made on the thighs, the crotch, buttocks and abdomen
- The pants would need to be fitted for each astronaut prior to launch

Shown: Demon Flex Force Pro V2 Padded Snowboard Shorts

# SST integrated pants design FRONT

- Front area will hold the SST reels
- SST tubing will travel from Fresh Reel, down the front expansion, between the legs and then under the genitals

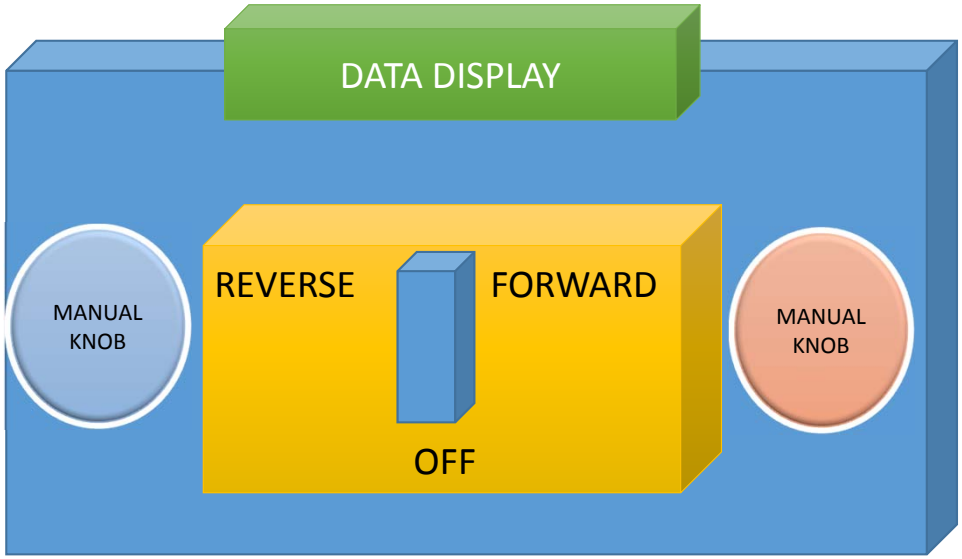


# SST integrated pants design REAR

- Once passing under the anus the SST material will continue along the guide channel upwards and turn around the hip to the waste reel for storage.
- The SST will not be smearing along the skin after the anus, it will be inside an enclosed portion of the guide channel.

# Electric and Manual Controls

- A control area will be placed on the abdomen of the MACES below the O2 intake or backpressure regulator
- Controls include a safety switch, a data display and two manual control knobs (one for each reel)
- The astronaut will flip a switch on the MACES to trigger motion.  They can use as little or as much SST as they need
- An upward-facing backlit LCD data display shows system status and the amount of fresh SST remaining.



# SST control box location

# Modes of Use

- Controls would allow for front to rear and reverse motion.
- Pulsed “forward and reverse” motion could be used to provide forward backward wiping action.
- A vibrating effect of both motors rapidly pulsing could also prove useful in removing waste from the skin.

# Manual connection detail

- Manual connectors function like flexible drill extensions attached from the MACES onto the reel housing of each reel.
- As our astronaut turns the manual control knob, the flexible joint rotate a gear connected to that particular reel motor.

# Connections and Order inside MACES

- There are 3 connections when donning the SST shorts, done in this order:
- Waste SST reel manual control connector
- Fresh SST reel manual control connector
- 20V, 1A capable power-data cable plugged into the outlet located on the Fresh SST reel

# Why this is a good solution:

- Uses existing technology
- Easy to manufacture in various sizes, shapes
- Parallel processes reduce complexity
- No nonsense reel-to-reel system
- Minimal impact on MACES
- Manual control backup
- Quick and easy to put on
- Wide range of motion
- Prevents serious infection
- Available for both male and female