MASTER'S PROJECT IN SPACE ARCHITECTURE

Do more with less: efficient furniture for Mars

ANASTASIA PROSINA

COMMITTEE MEMBERS

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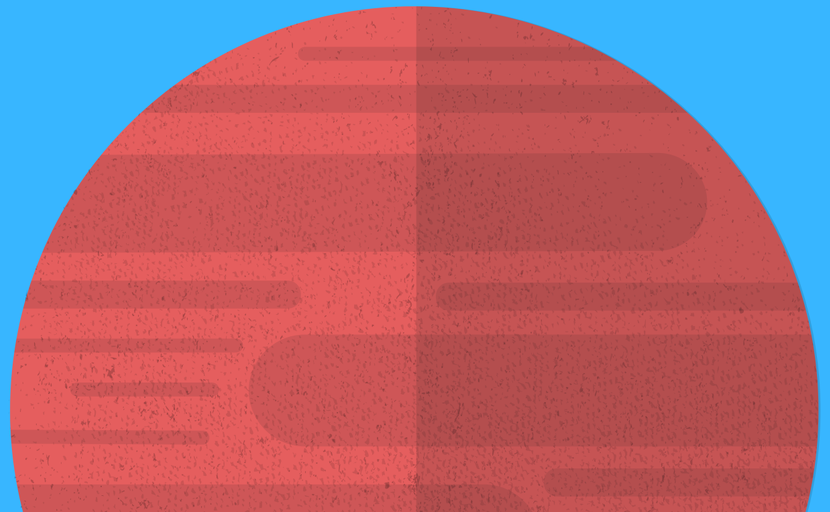
SICSA
Sasakawa International Center for Space Architecture

NASA aims to go to Mars in the 2030s

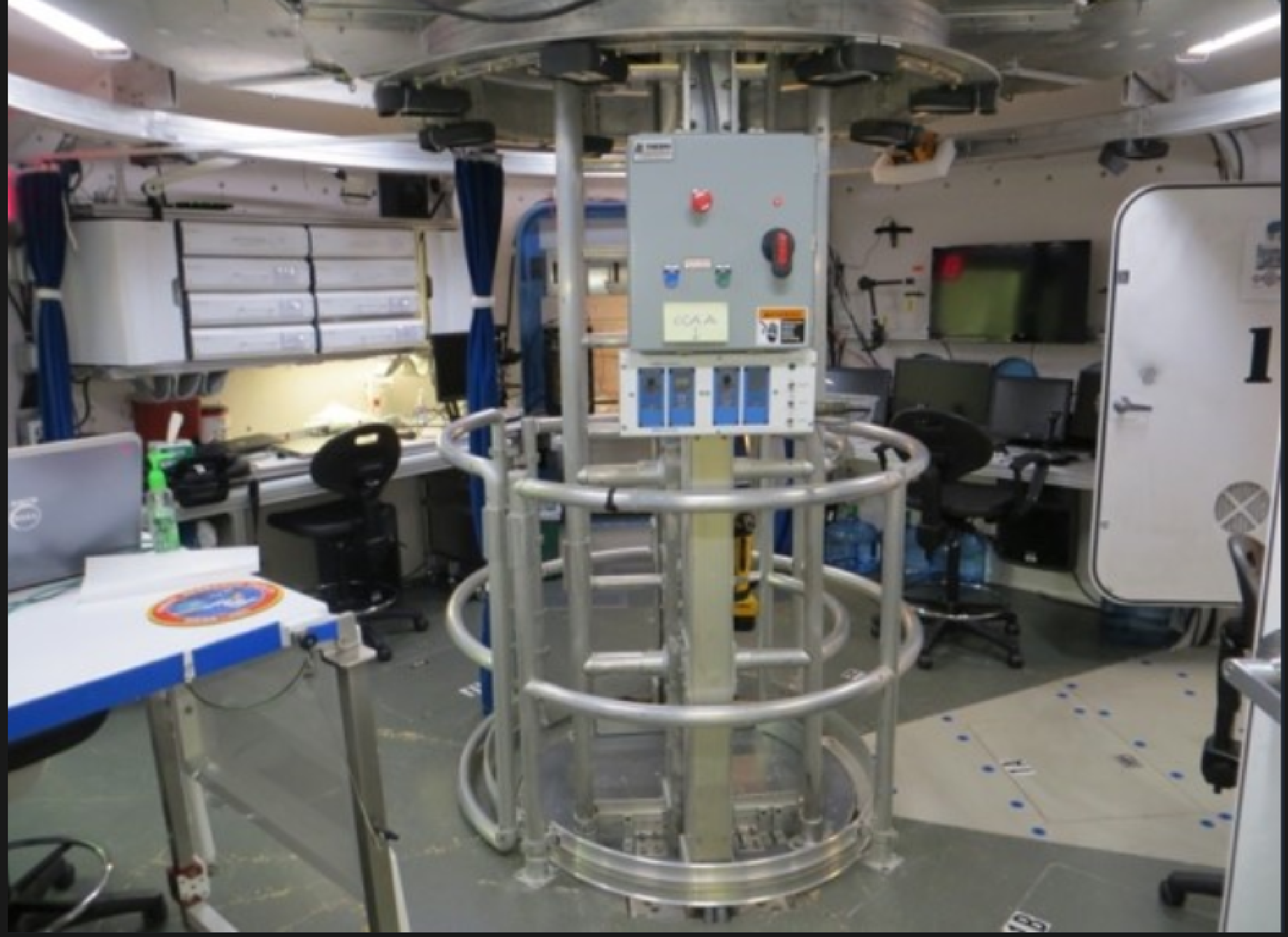
SpaceX aims to go to Mars in the mid-2020s



$783 000

To send an office chair to Mars

*Assuming a chair weights 6.6 pounds, and it cost 118.6k$ per pound to send a payload to Mars (An Atlas V 541 costs ~235M$)



Ground-based Analog HERA, NASA JSC


SpaceX's vision

VISION

To create flexible cost-effective furniture that can transform the habitat for various use-cases

MISSION

To design habitat elements that break the monotony of the small volume & adapt to conflicting modes:

+ independent work
+ conference tags-up
+ social gathering

GOALS

+ Evaluate requirements and optimize user experience
+ Complement engineeringly pre-integrated cylindrical habitat with human-centered furniture
+ Create a typology of using interiors in different modes

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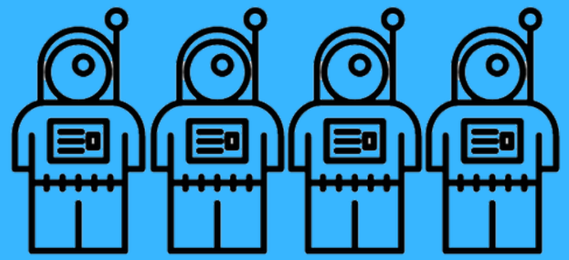
Context

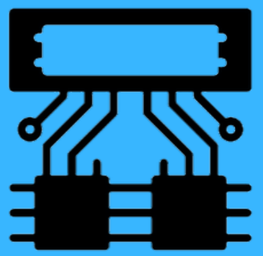
FIRST MISSION TO MARS

CREW OF FOUR

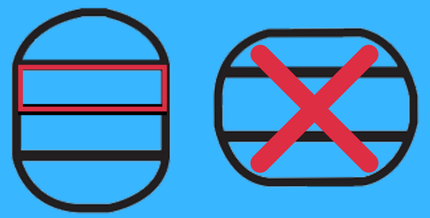


26'DIAMETER HARD SHELL MODULE

PRE-INTEGRATED STRUCTURES & SYSTEMS



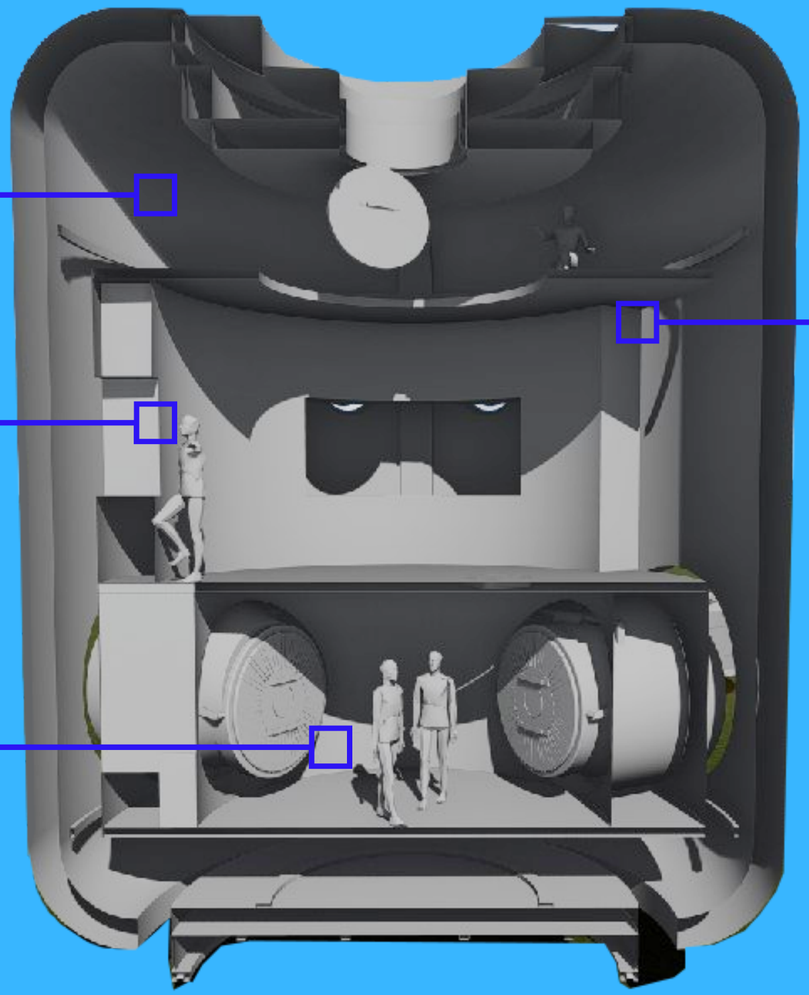
VERTICAL ORIENTATION



Sleeping quarters

ECLSS

EVA+ Hygiene



Galley

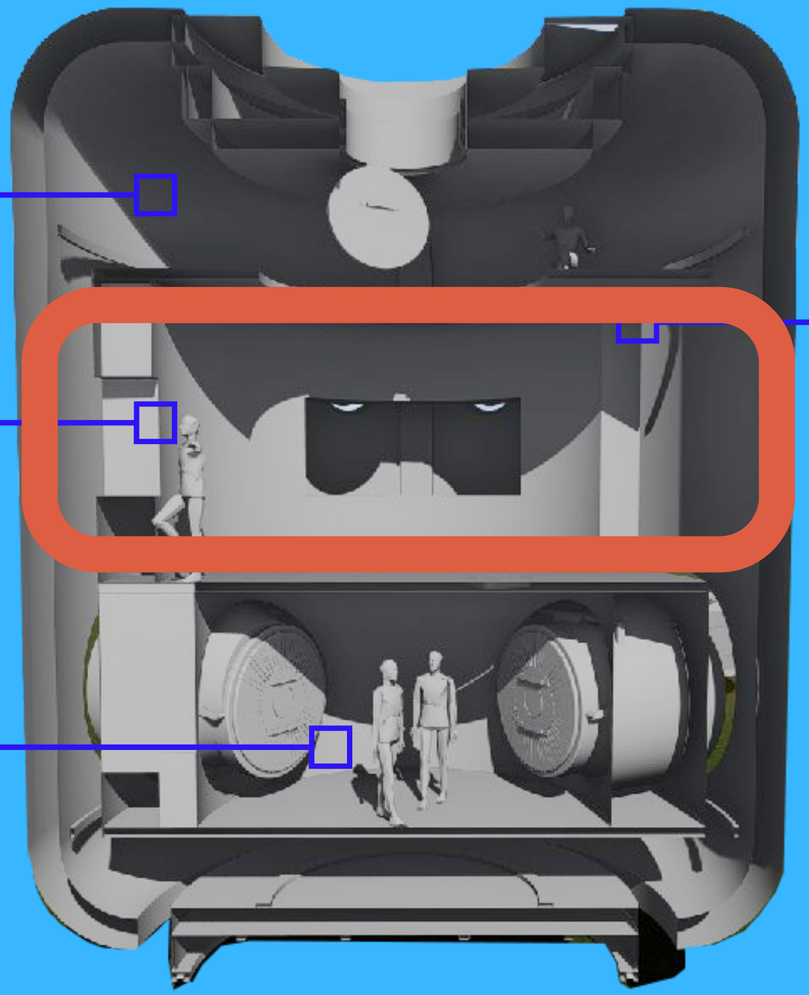
9.5 m (31 ft)

8 m (26.2 ft) diameter

Sleeping quarters

ECLSS

EVA+ Hygiene

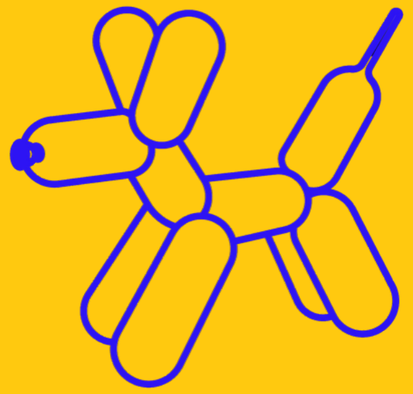


Galley

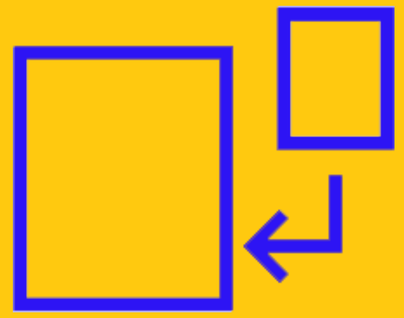
9.5 m (31 ft)

8 m (26.2 ft) diameter

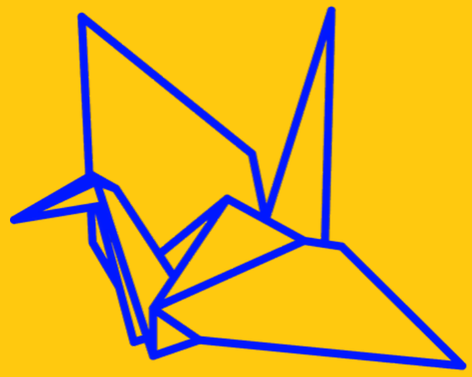
LIGHTWEIGHT



RECONFIGURABLE



DEPLOYABLE



NON-FLAMMABLE

EASY MAINTANABLE

OFF GASSING

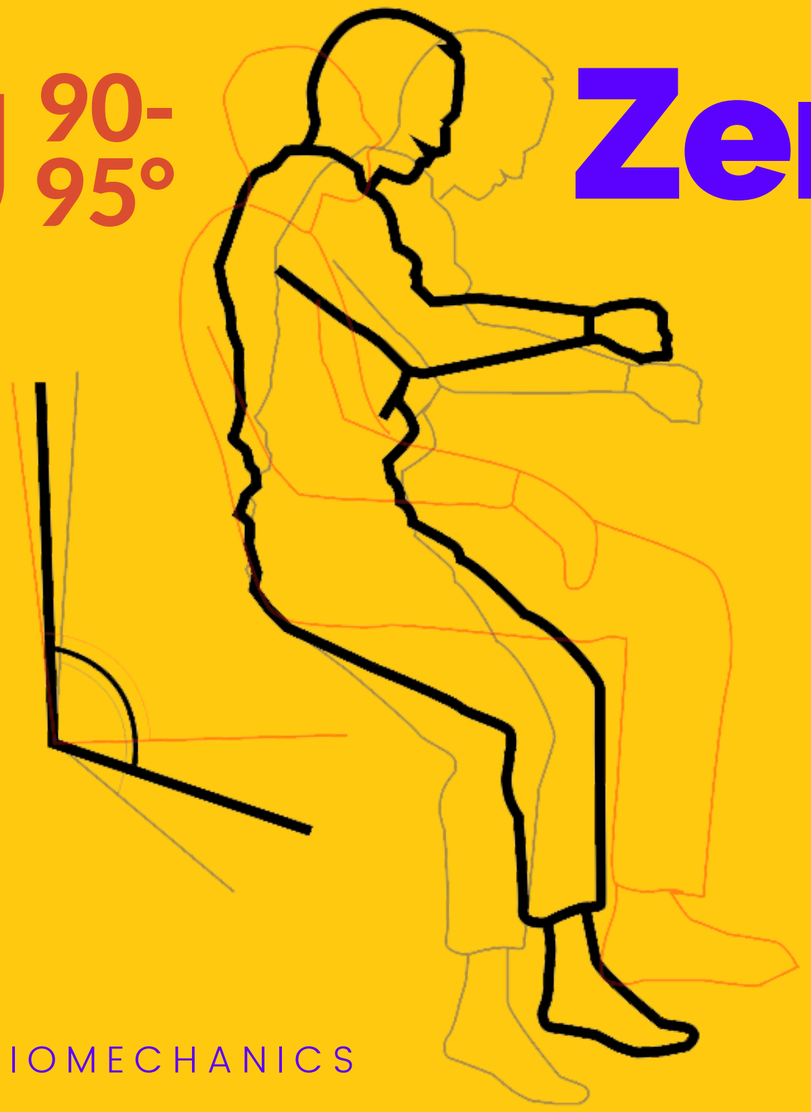
Biomechanics of sitting posture

Mars g

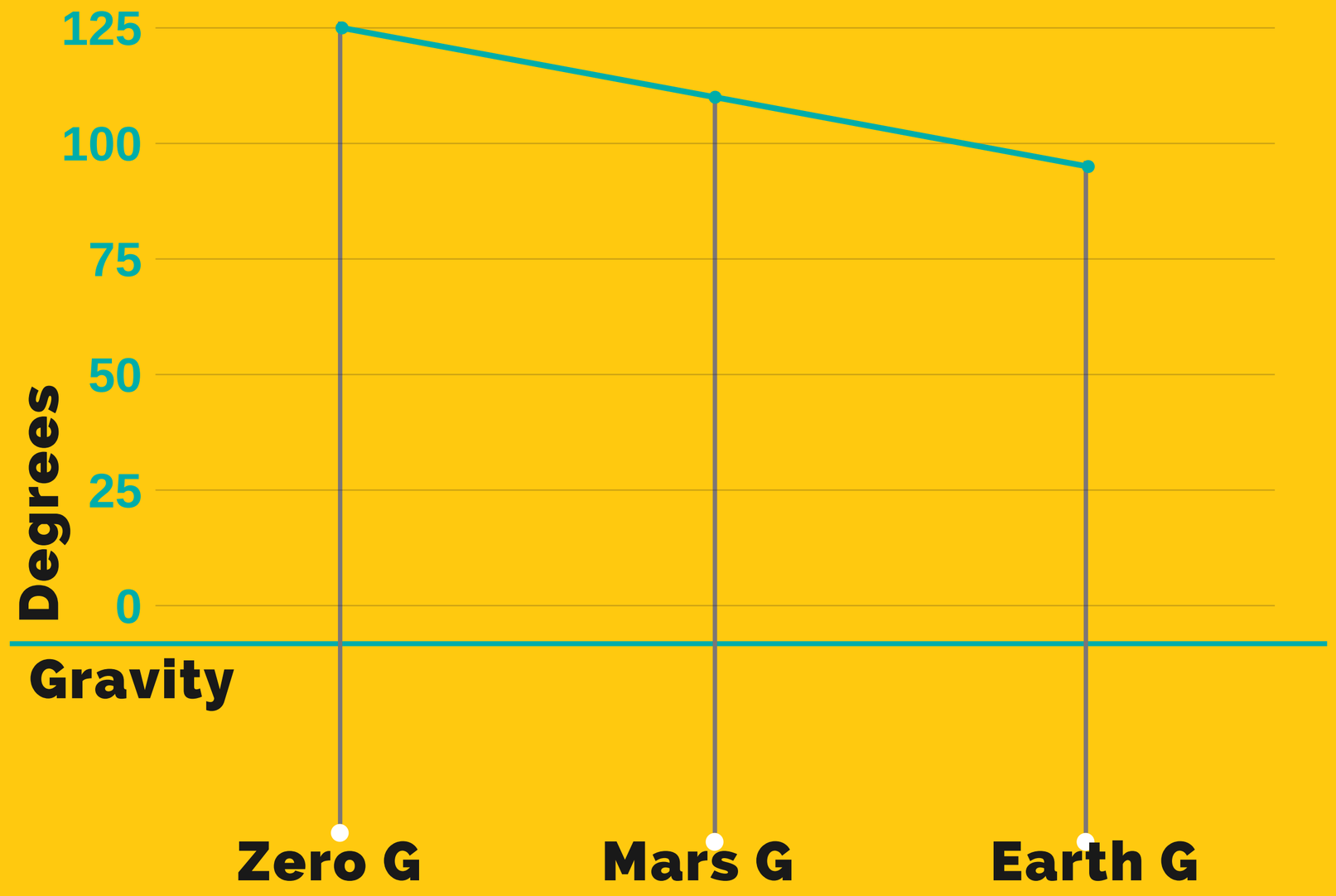
~110°

Earth g 90-95°

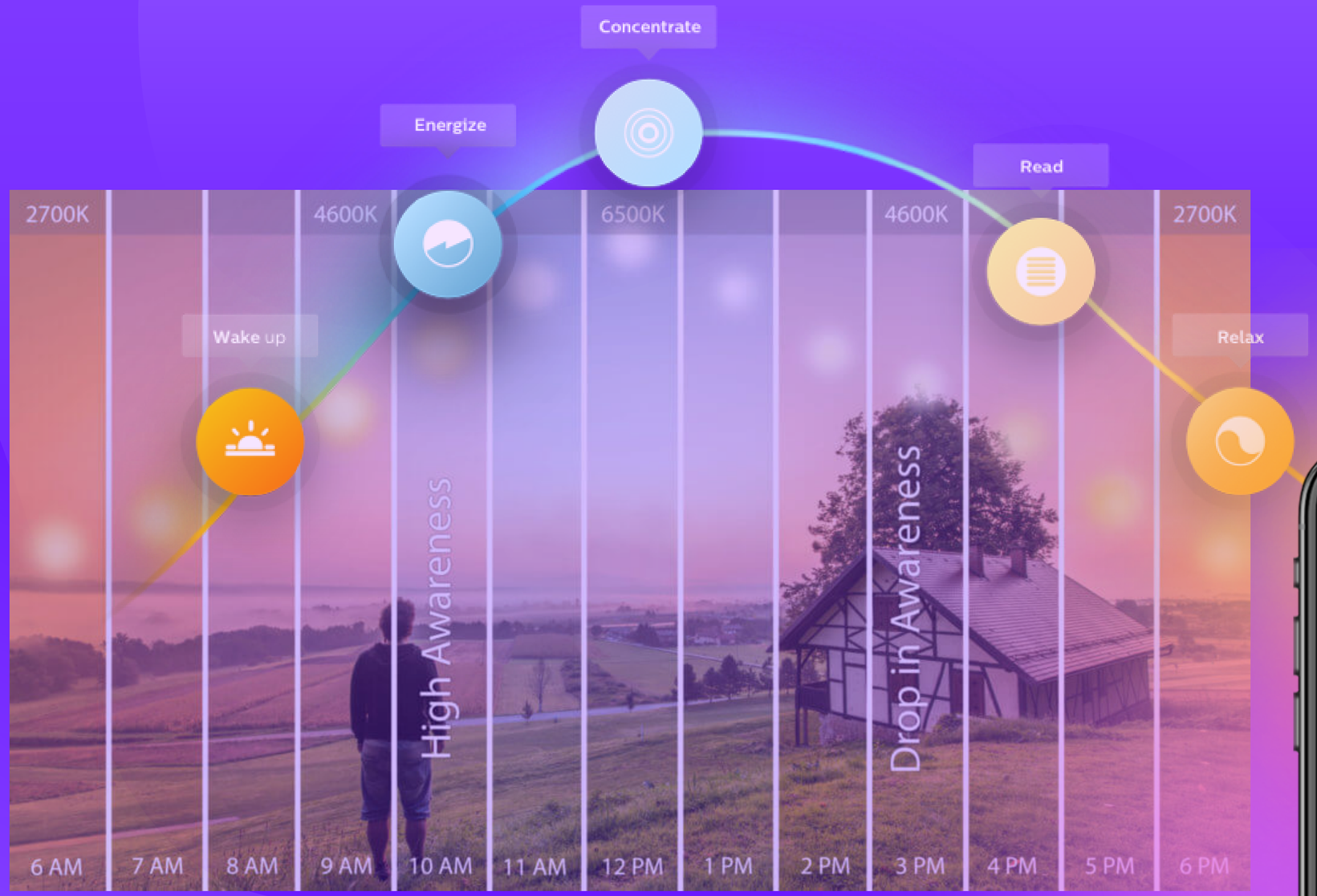
Zero g 125-130°



~110°

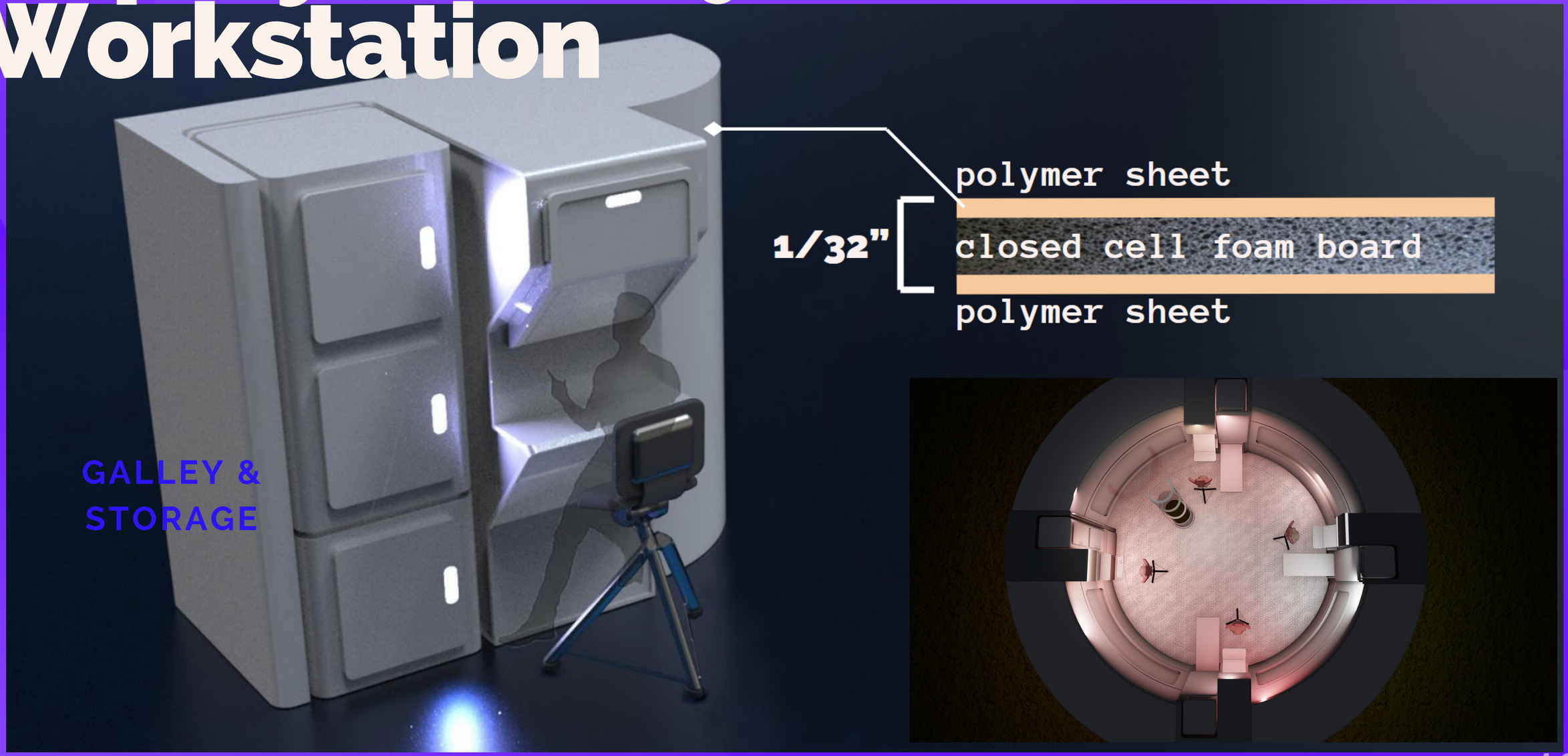

125
100
75
50
25
0
Degrees
Gravity
Zero G
Mars G
Earth G


Concentrate
Energize
Read
Wake up
Relax
Go to sleep
2700K
4600K
6500K
4600K
2700K
High Awareness
Drop in Awareness
6 AM
7 AM
8 AM
9 AM
10 AM
11 AM
12 PM
1 PM
2 PM
3 PM
4 PM
5 PM
6 PM

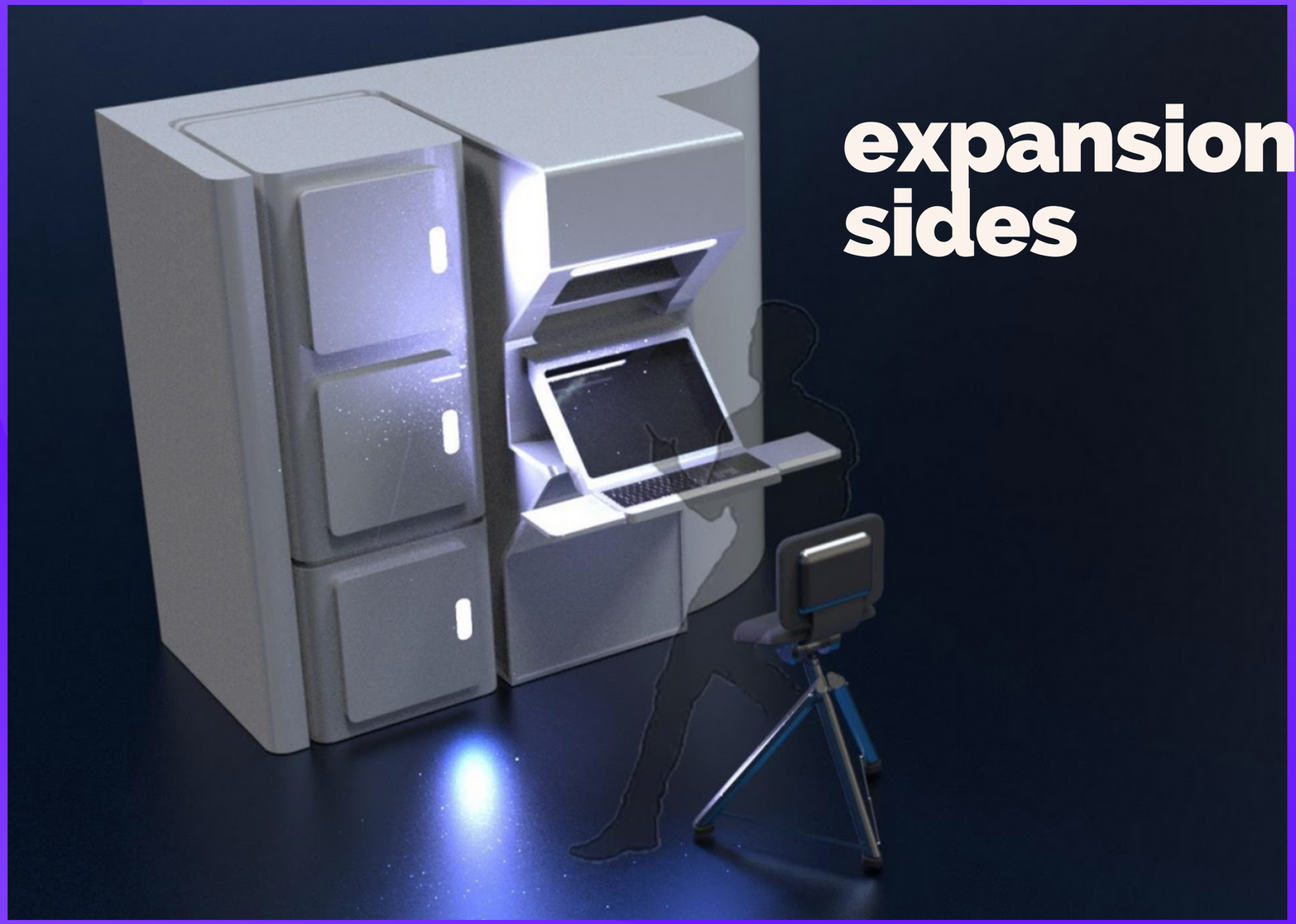


DESIGN PRINCIPLES TO SUPPORT PSYCHOLOGICAL HABITABILITY

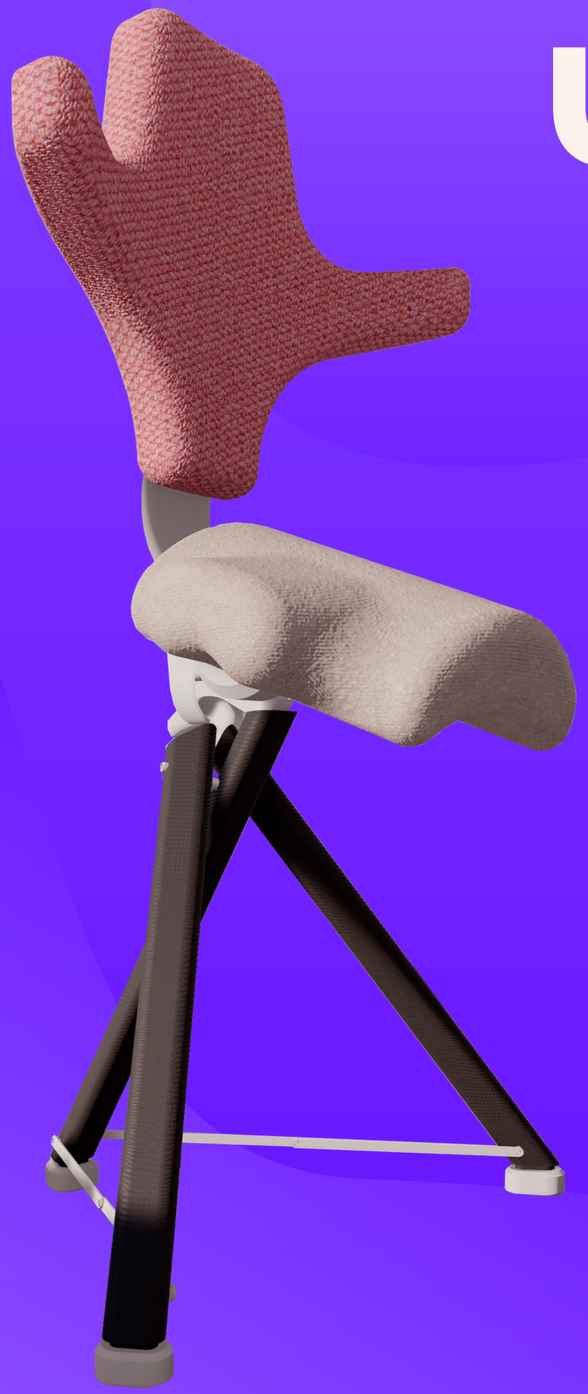
Deployable Adjustable Workstation



easily reconfigurable



expansion of the desk sides



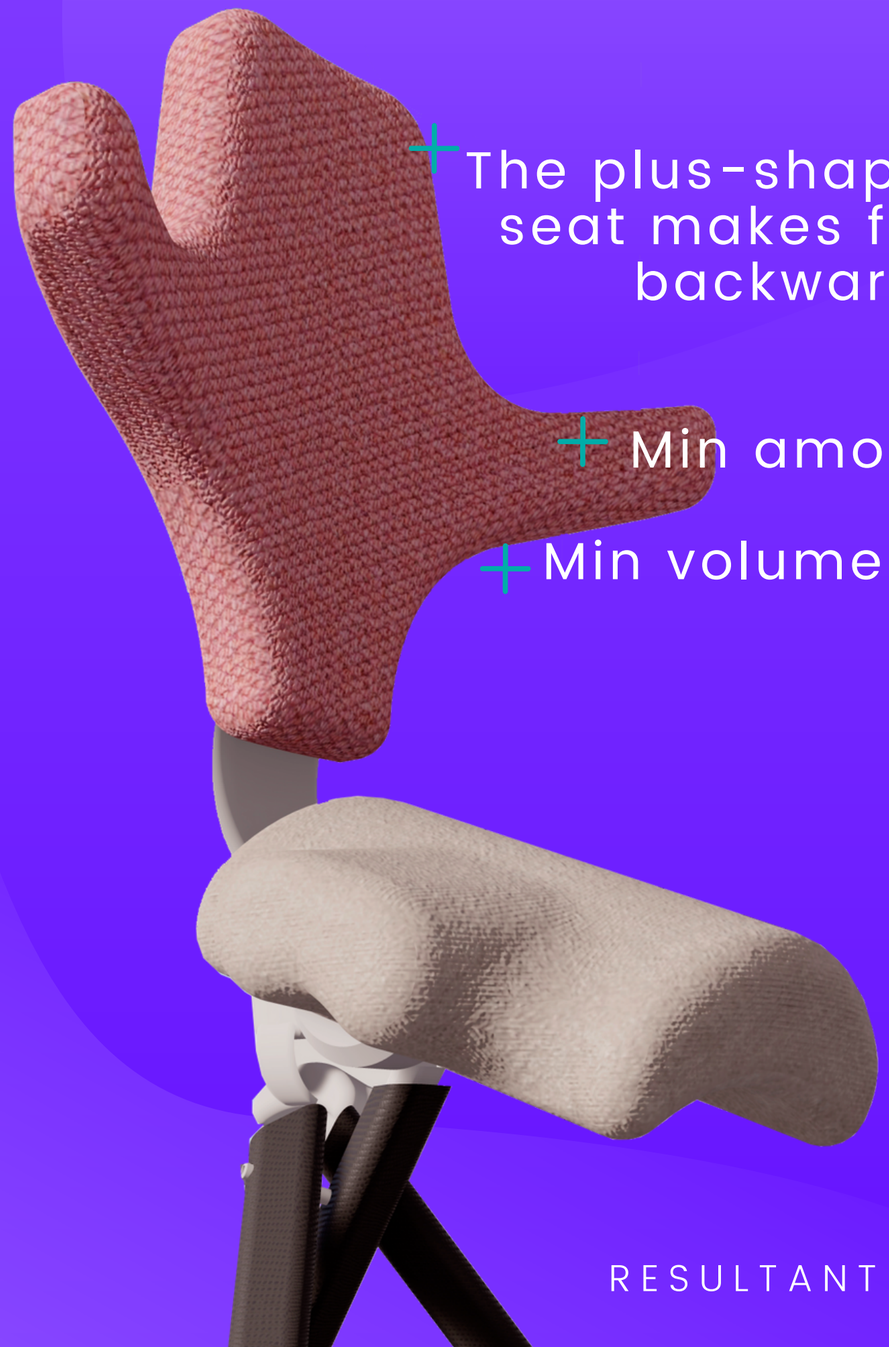
Ultralight Collapsible Extendable Chair

4 TIMES

LIGHTER THAN AN OFFICE CHAIR
(6.6 lbs vs 1.5 lbs)

Ultralight Collapsible Extendable Chair

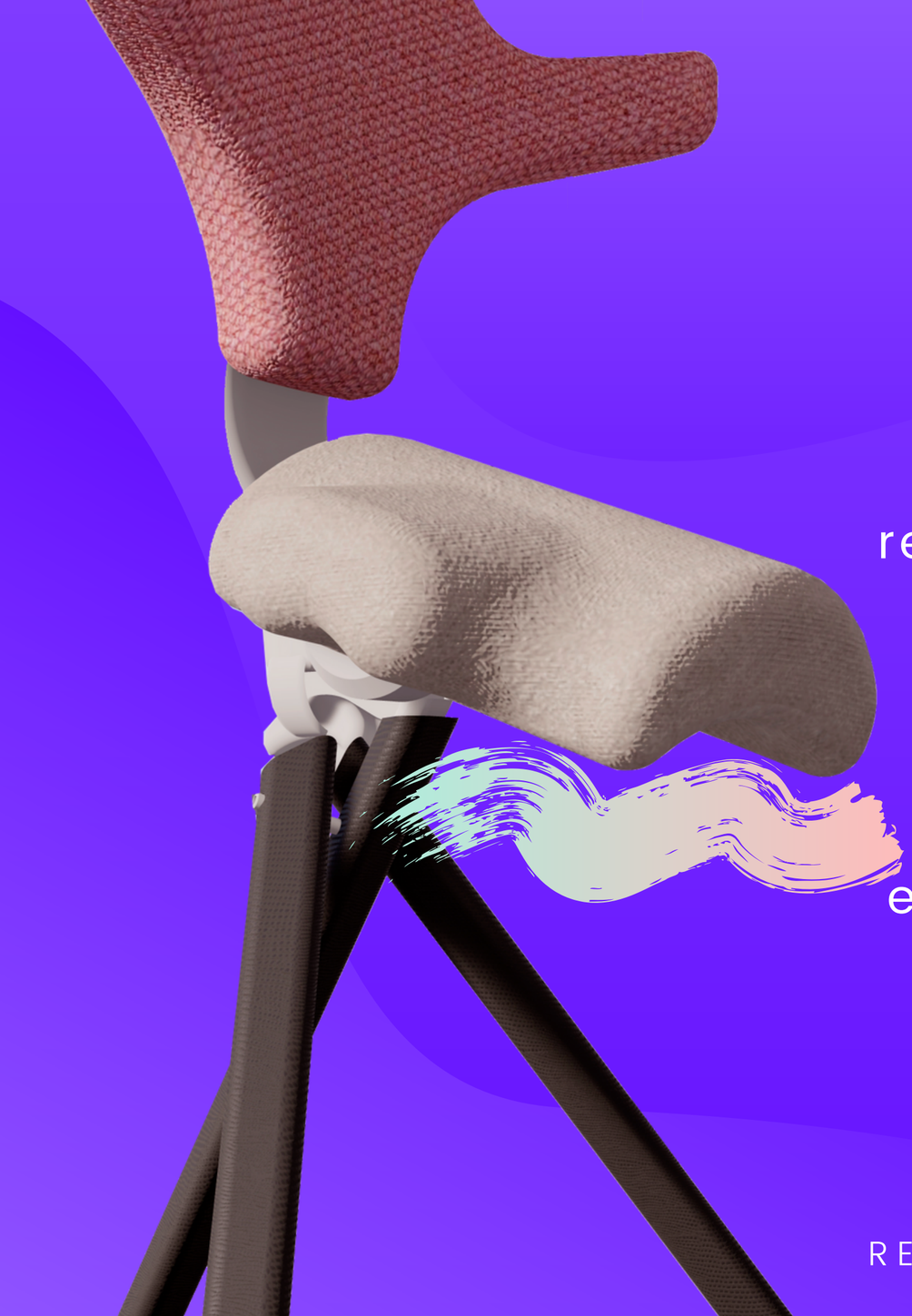
- polyurethane foam back
- nylon fabric upholstery
- polyurethane foam seat
- carbon fiber poles
- silicone foot pads
- UHMWPE cords



+ The plus-shaped back of the seat makes for comfortable backwards or sideways sitting

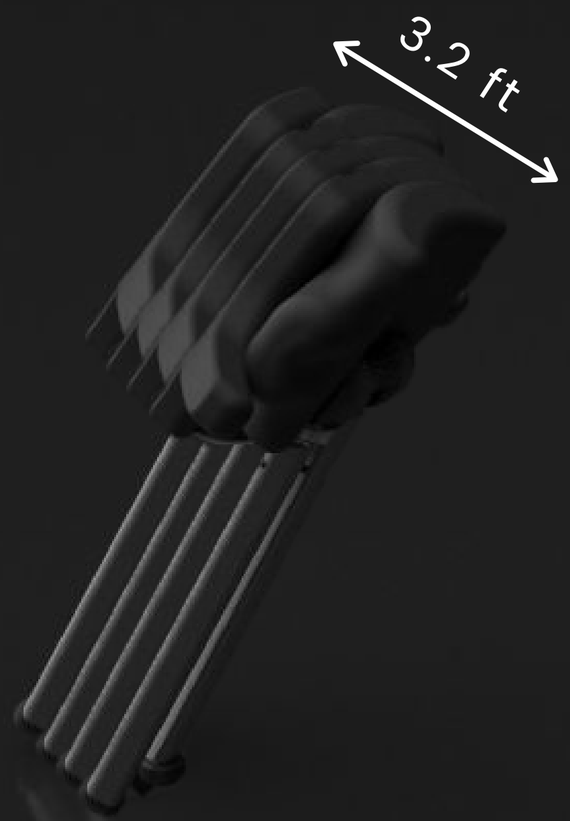
+ Min amount of material

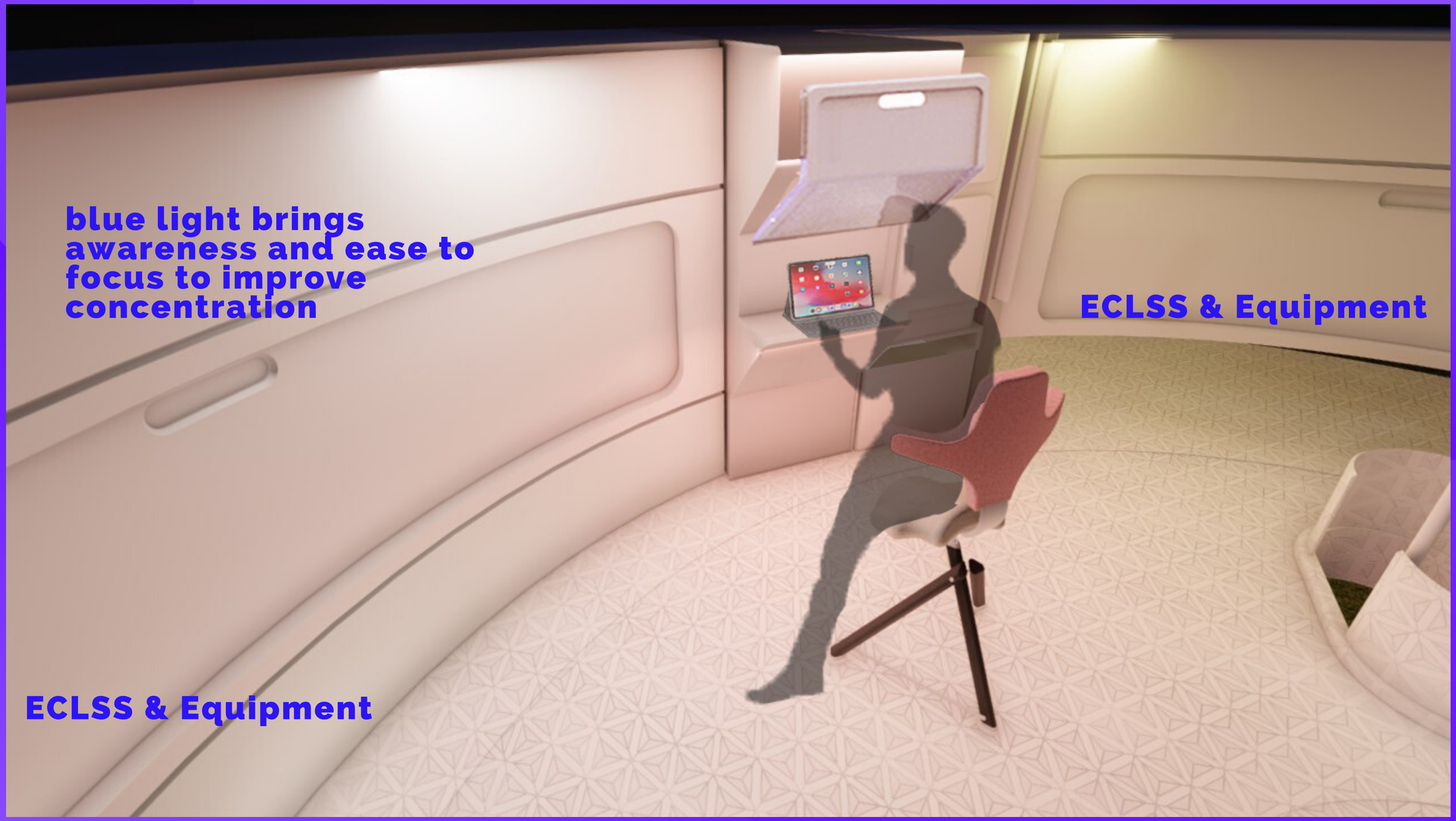
+ Min volume when stowed



+ By utilization the 110 degrees trunk-thigh angle, its resting position keep a slight unbalance forcing the use of the back muscles and legs and thus preserving their integrity

+Even if this system is more subtle than active exercises and electrical impulsions, it is a noninvasive additional solution


3.2 ft


blue light brings awareness and ease to focus to improve concentration
ECLSS & Equipment
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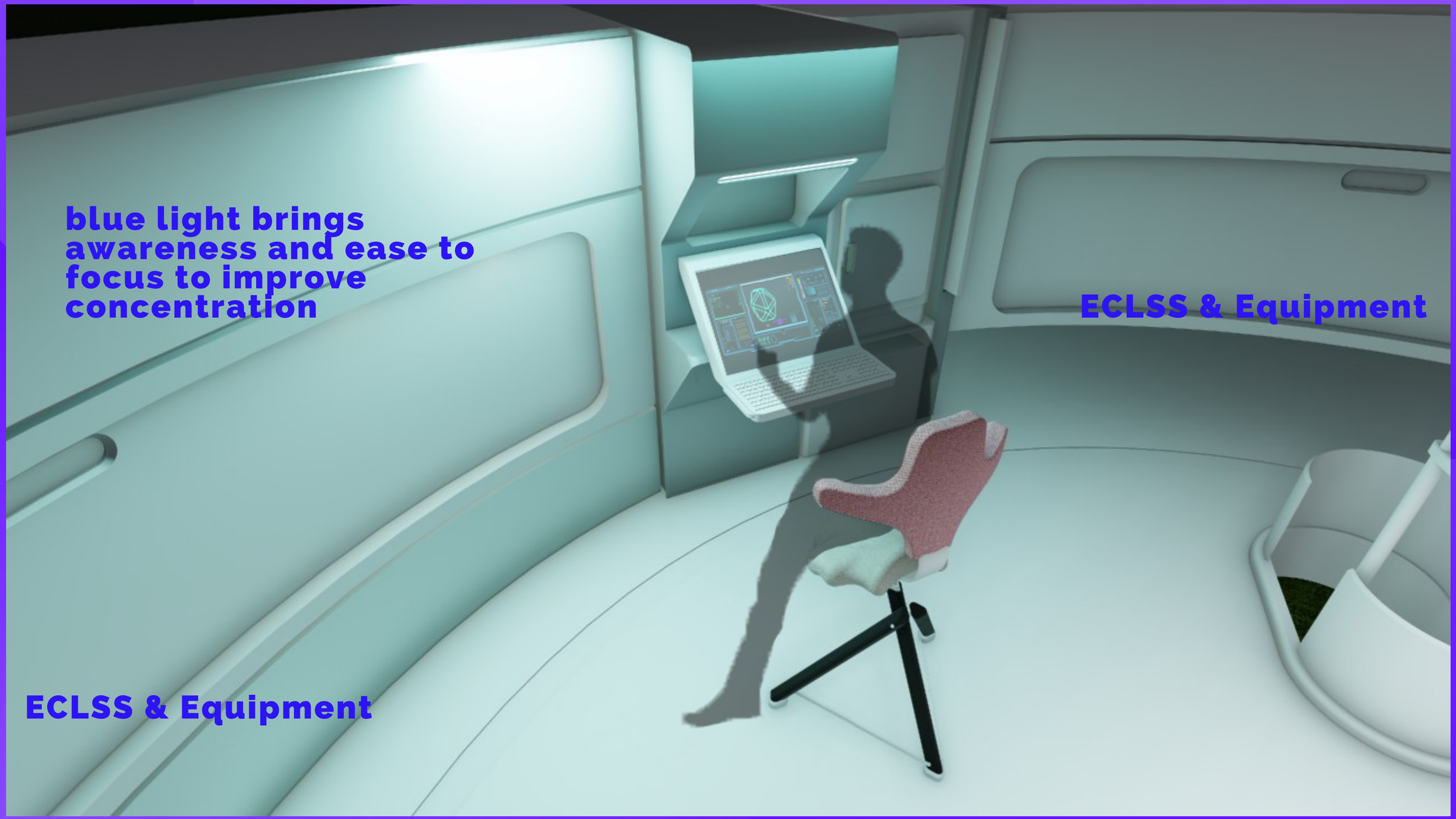
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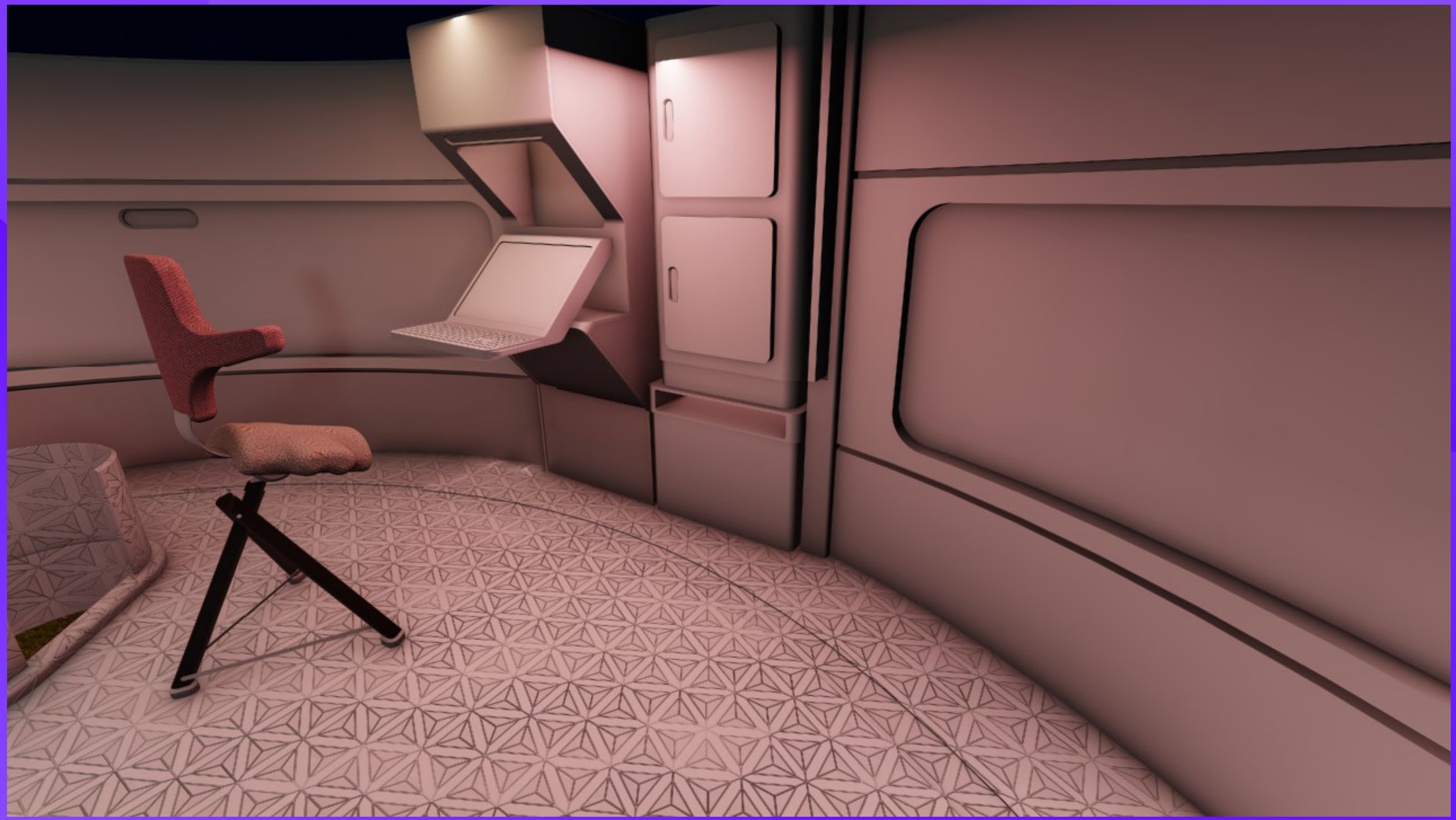

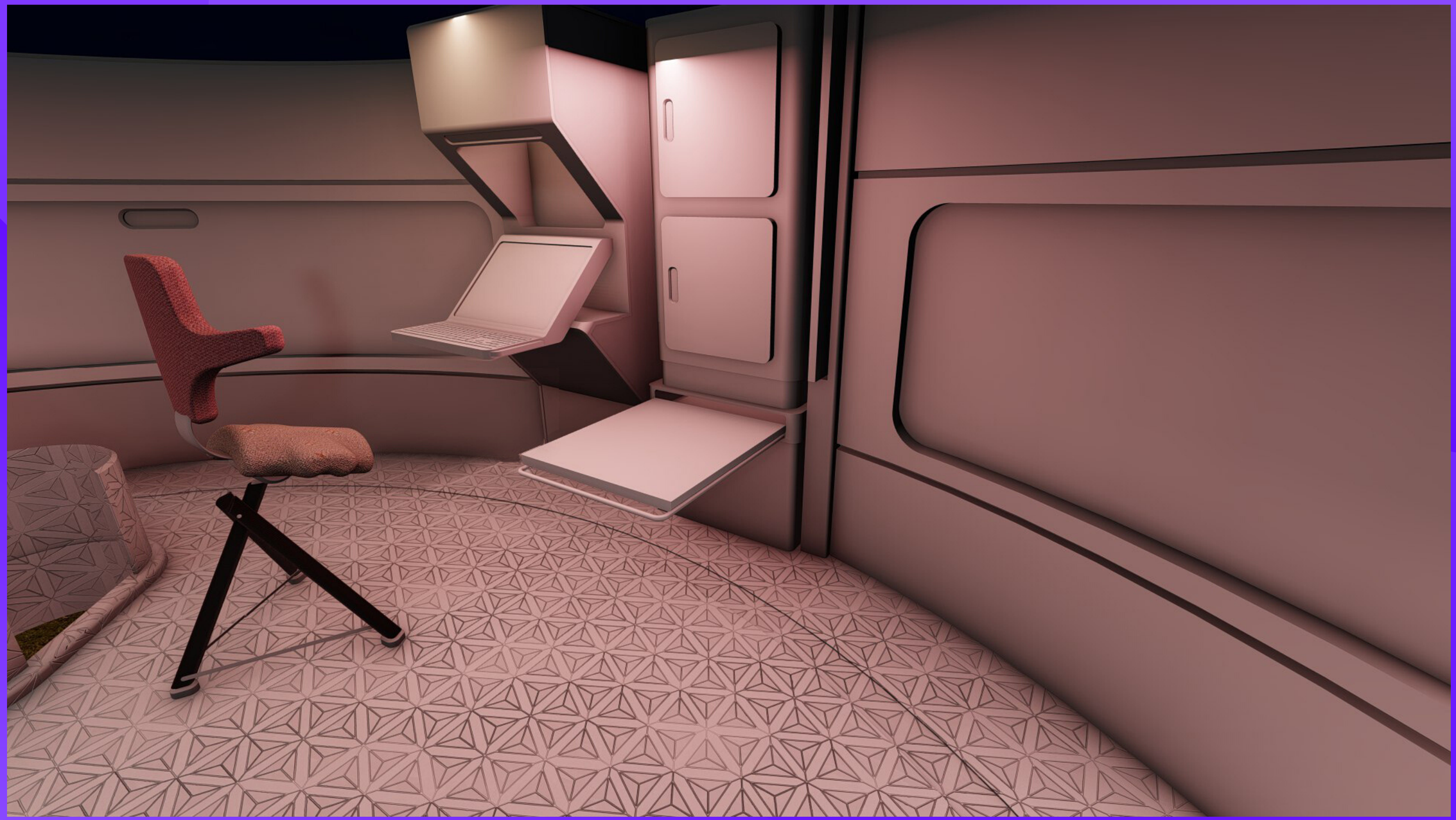

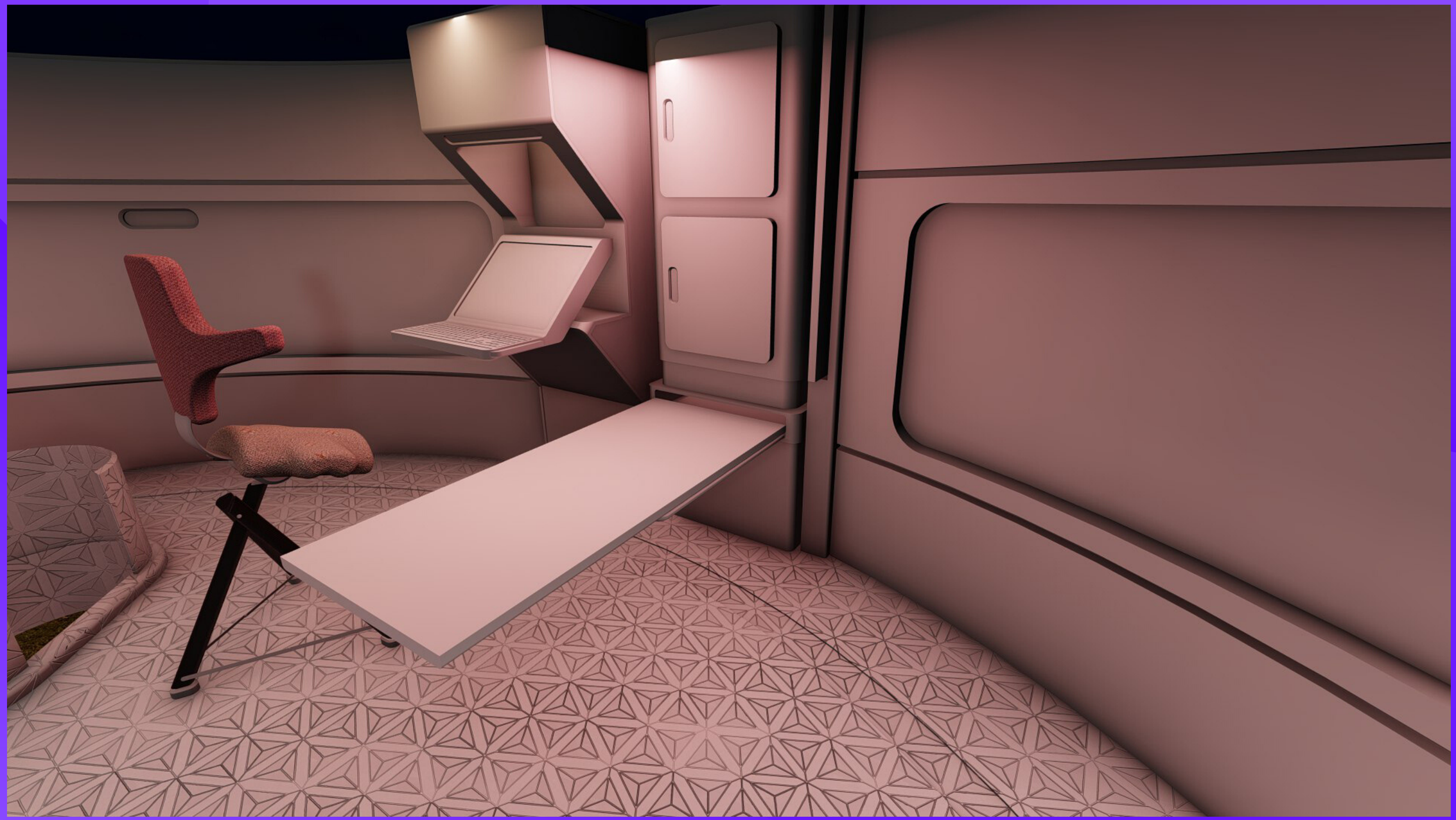

helping crew to unwind with warmer white light

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$195 000

To send the Matian chair to Mars!

JANUARY 2021 TO INFINITY

Providing efficient furniture for space habitats

AUGUST-DECEMBER 2020

Test & Production

JANUARY-JULY 2020

Futher design & Prototyping

NOVEMBER 2019

Applied to The Engine interview is next

SEPTEMBER 2019

Graduation from Y Combinator Startup School 2019

THE ENGINE
Built by MIT

Y STARTUP SCHOOL

Connect

Humature.

humature.xyz

hello@humature.xyz

@humature.xyz

linkedin.com/company/humature

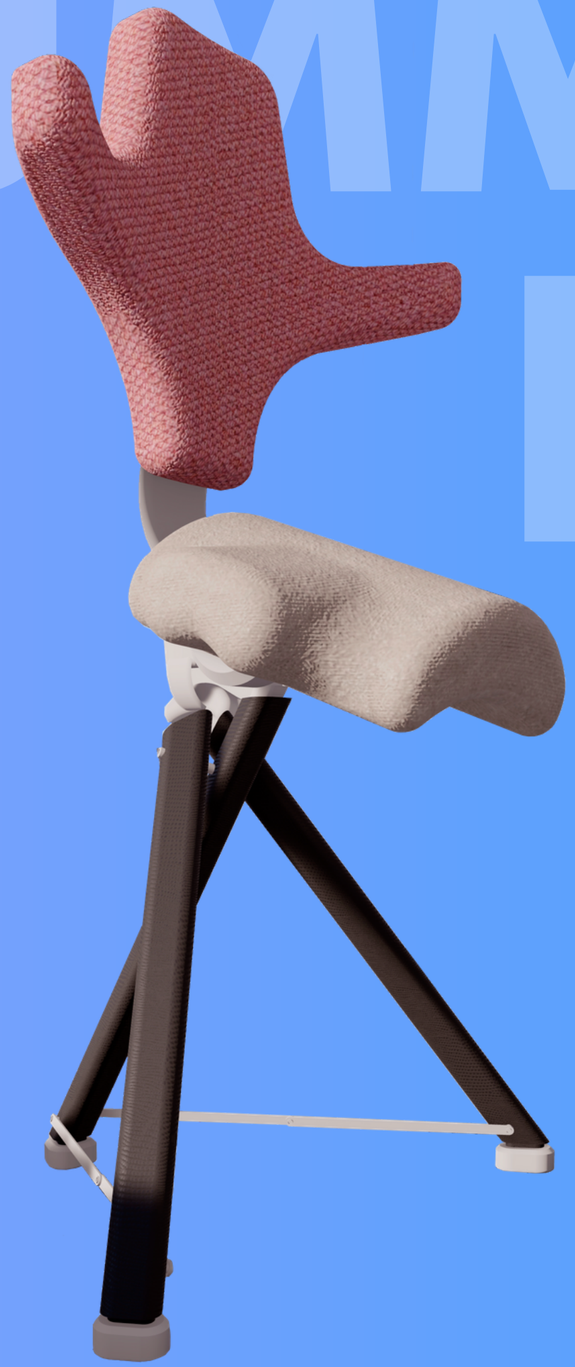
SUMMARY

INSIGHTS

+ **LIGHTWEIGHTNESS**
+ **RECONFIGURATION**
+ **DEPLOYABILITY**

VISION

To create flexible cost-effective furniture that can transform the habitat for various-use-cases



THANK YOU!

Q&A

ACKNOWLEDGMENTS

The completion of this undertaking would not have been possible without the feedback and assistance of Dr. Olga Bannova, support of Larry Bell, Larry Toups and Kriss Kennedy. Special thanks to Robert Salazar for his advice on deployable structures, professor Gordon Vos for our fruitful discussion on biomechanical body for designing on Mars, and Chiara Carucci, a lighting designer at Tengbom Architects, for her presentation on light perception in architectural design within the Light Workshop at Rice University in November 2019.

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