

# MATLAB EXPO

## Moonshots: How Engineers and Scientists Are Achieving the Impossible

*Dr. Sameer Prabhu, MathWorks*





Courtesy of NASA



Courtesy of NASA



Courtesy of NASA

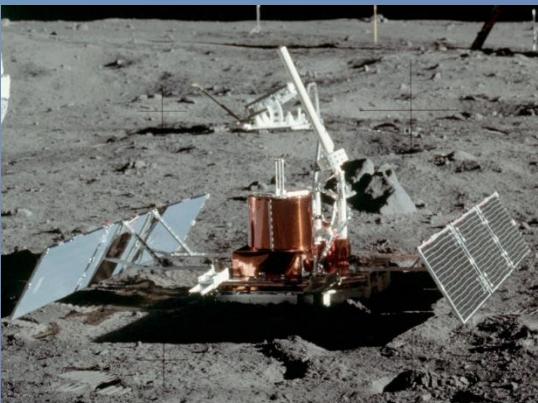
# Moonshots Foster Emerging Technologies

Heat-resistant alloys



Courtesy of NASA

Photovoltaic cells



Courtesy of NASA

Fireproof fabrics



Courtesy of NASA

Integrated circuits

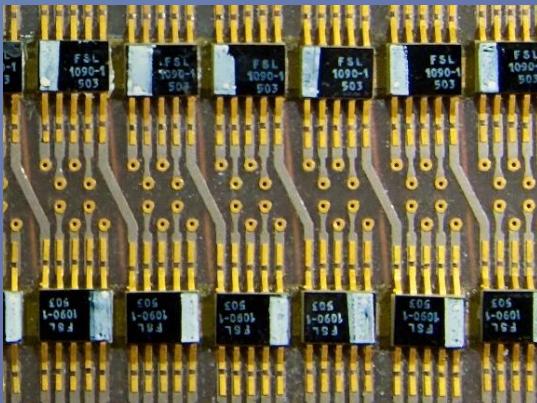


Photo by DDebold (flickr)  
<https://creativecommons.org/licenses/by/2.0/>

Freeze-dried foods



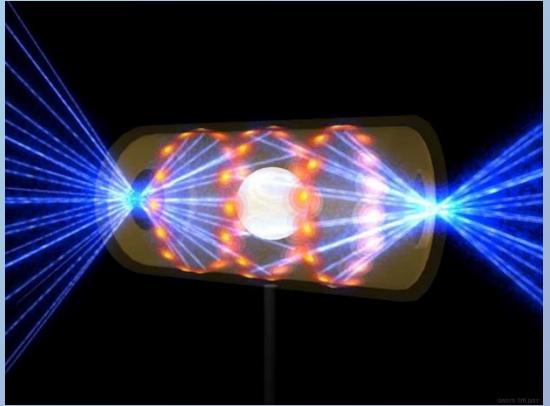
Photo by Jurvetson (flickr)  
<https://creativecommons.org/licenses/by/2.0/>

Computers



Photo by Jurvetson (flickr)  
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# Moonshots: Projects with lofty and seemingly impossible goals



# **Moonshot:** Unlimited Clean Energy

Global energy consumption will grow by almost 50% between 2020 and 2050

— **CNBC**





## **Fusion:** The ultimate clean energy source

- No CO<sub>2</sub> or other harmful atmospheric emissions
- Safer than traditional fission reactors
- Abundant fuels

# Moonshot: Unlimited Clean Energy



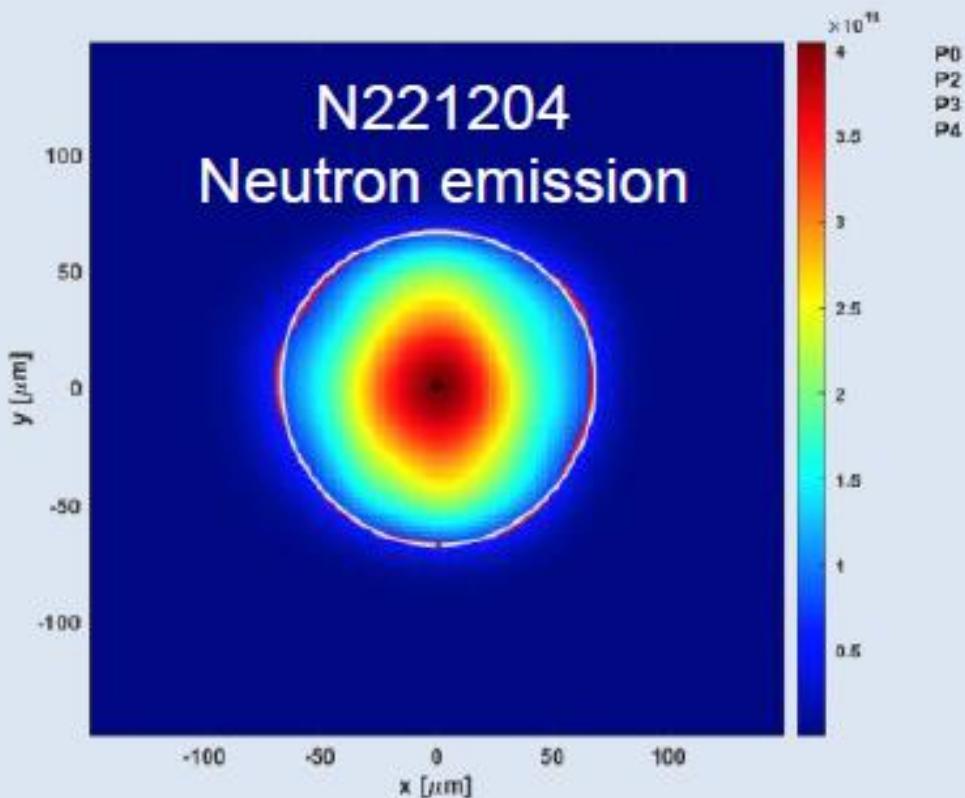
# Scientists Achieve Nuclear Fusion Breakthrough With Blast of 192 Lasers

— ***The New York Times***



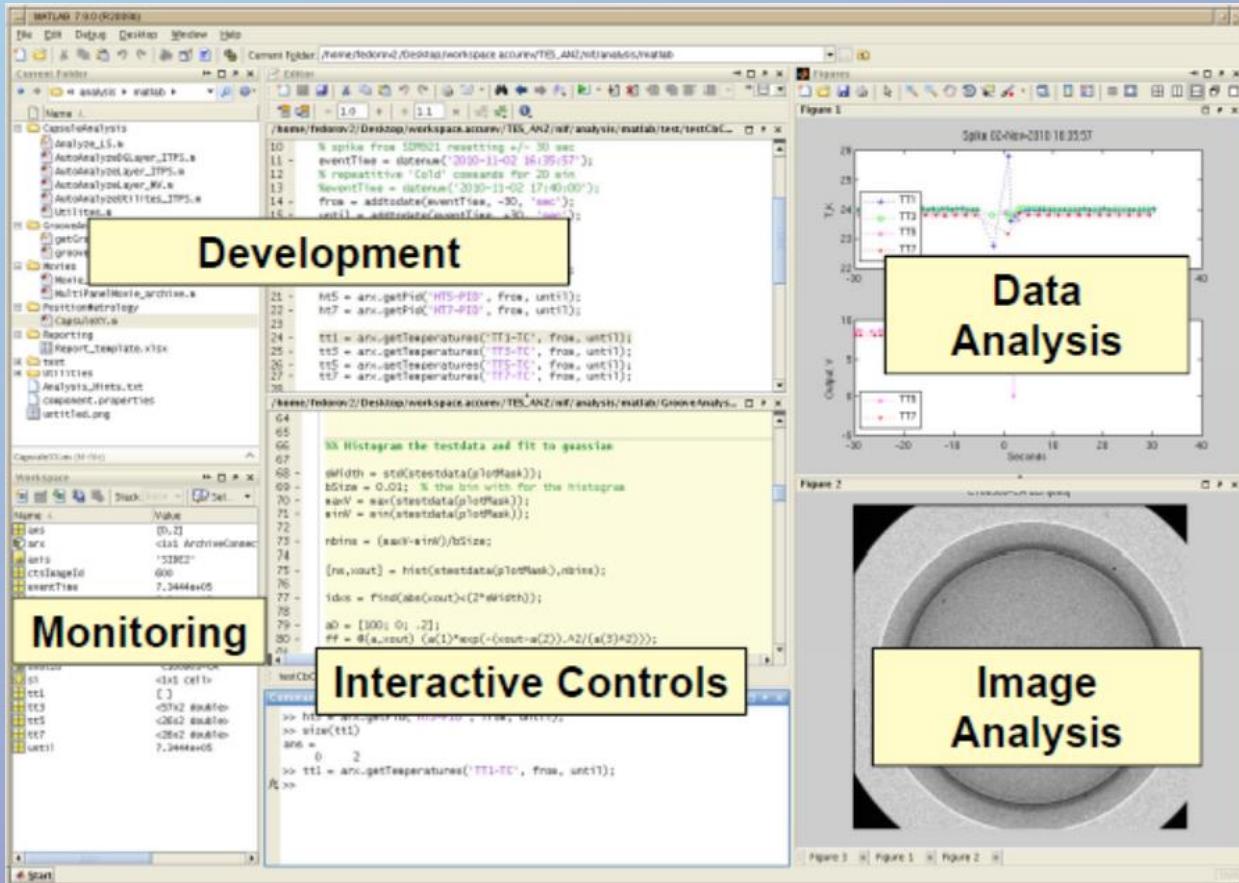
Courtesy of Lawrence Livermore National Laboratory

# Fusion Breakthrough



Courtesy of Lawrence Livermore National Laboratory

# Fusion Breakthrough



Courtesy of Lawrence Livermore National Laboratory

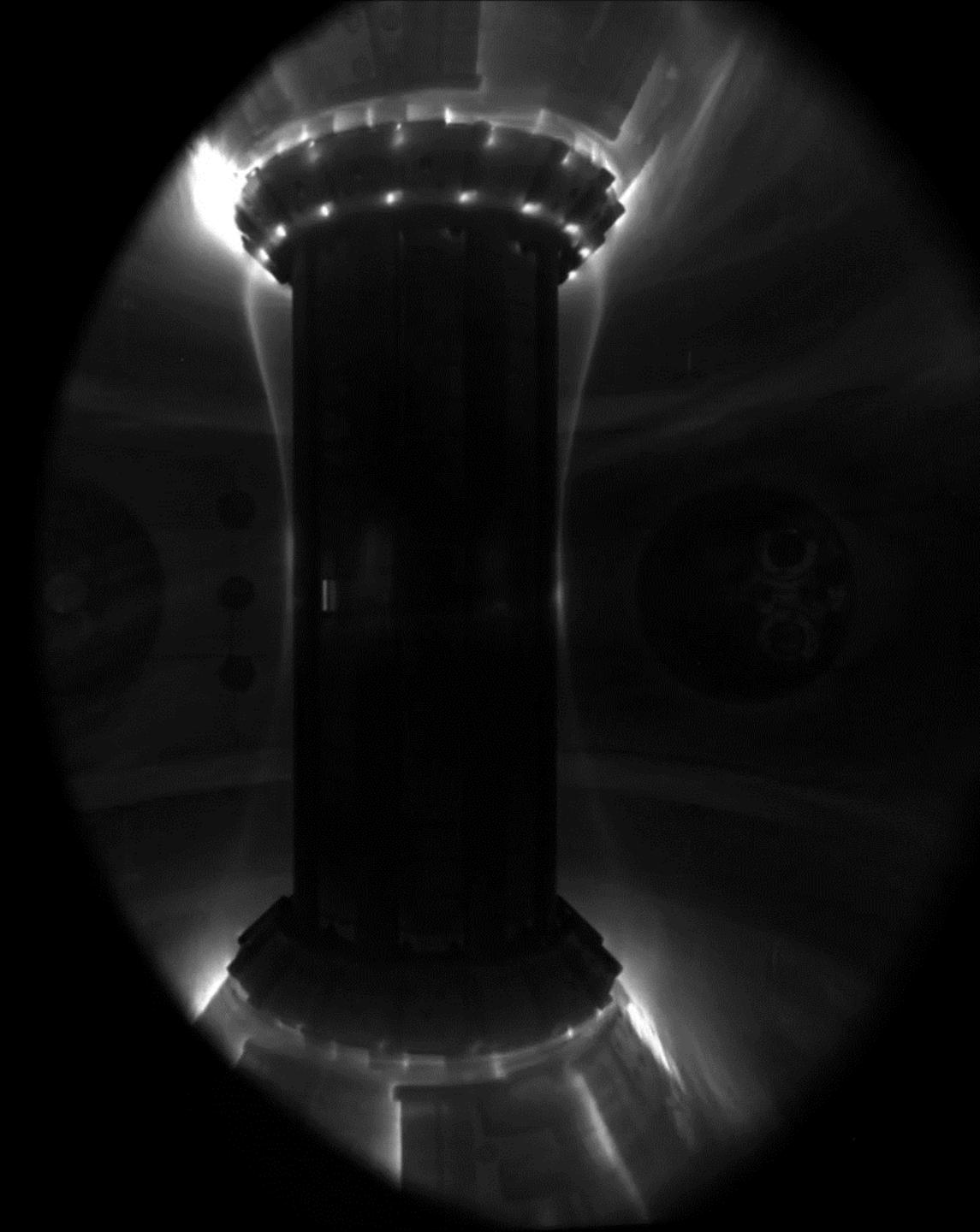
# This Compact Tokamak Is on the Verge of Commercial Energy Production

— ***Popular Mechanics***



Courtesy of Tokamak Energy

ST40 #10014



# Achieving 100M° Celsius

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Simulink and Simulink Coder for developing and deploying plasma control algorithms

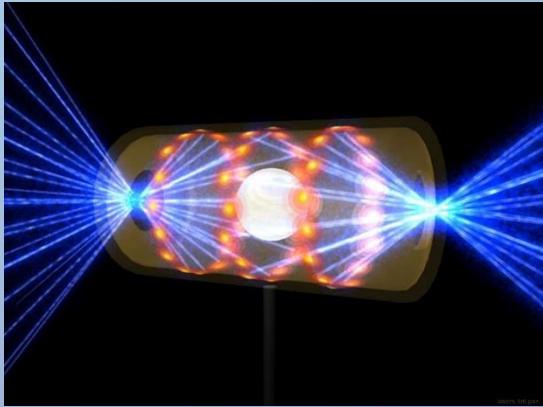
MATLAB for real-time and post-pulse data analysis

# Achieving 100M° Celsius

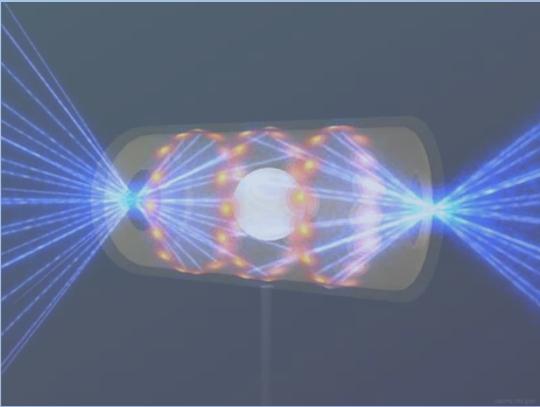


Courtesy of Tokamak Energy

# **Moonshots:** Projects with lofty and seemingly impossible goals



# **Moonshots:** Projects with lofty and seemingly impossible goals





# **Moonshot:** Improving Quality of Life through Healthcare

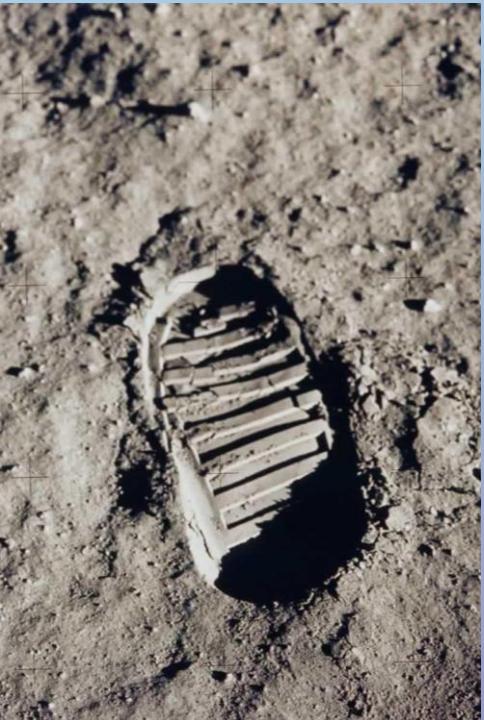


JUNIA HEI



National Research Institute in Poland (NASK)

# Empowering Children to Walk



Courtesy of NASA



# Empowering Children to Walk

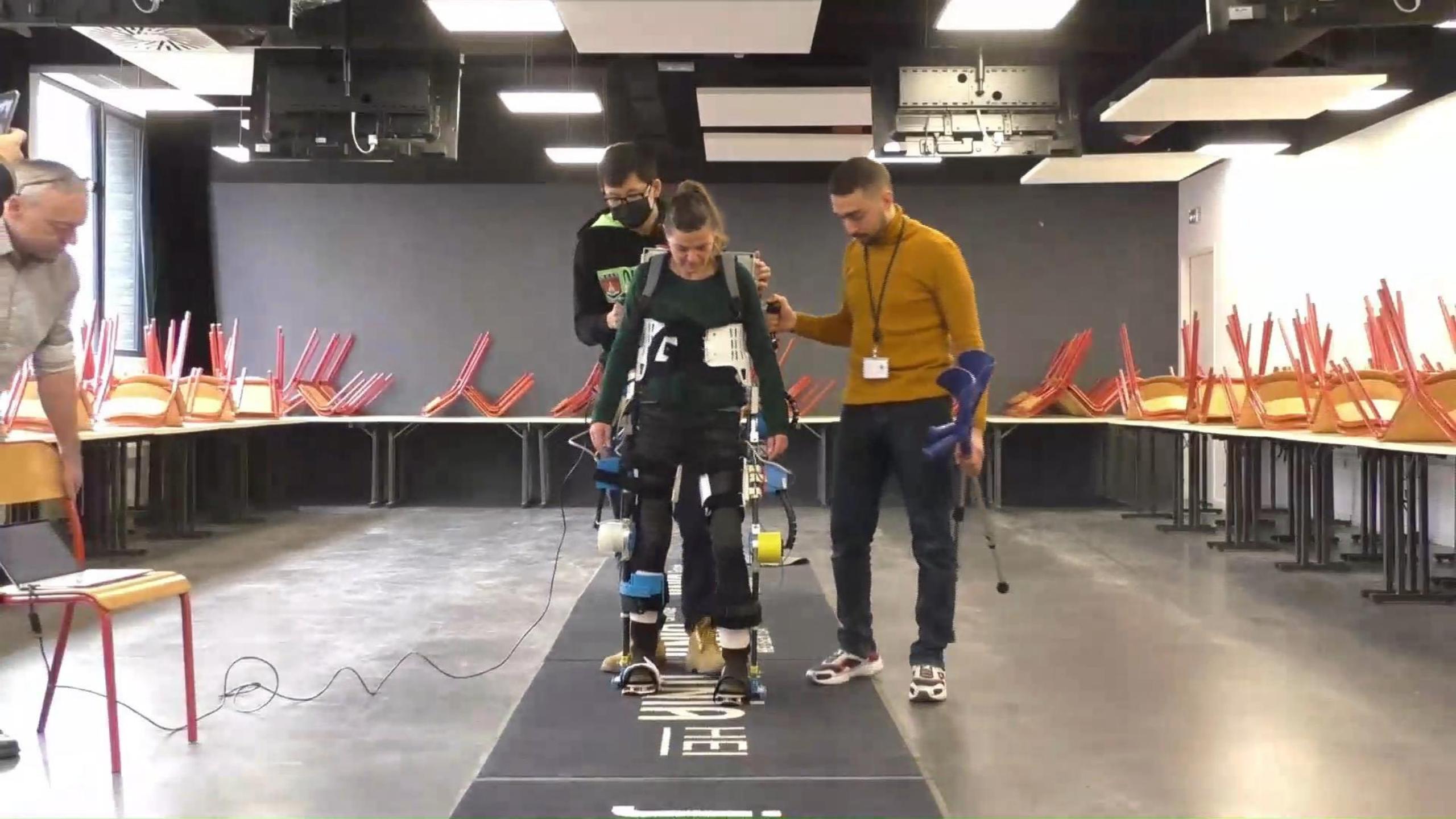
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# Empowering Children to Walk

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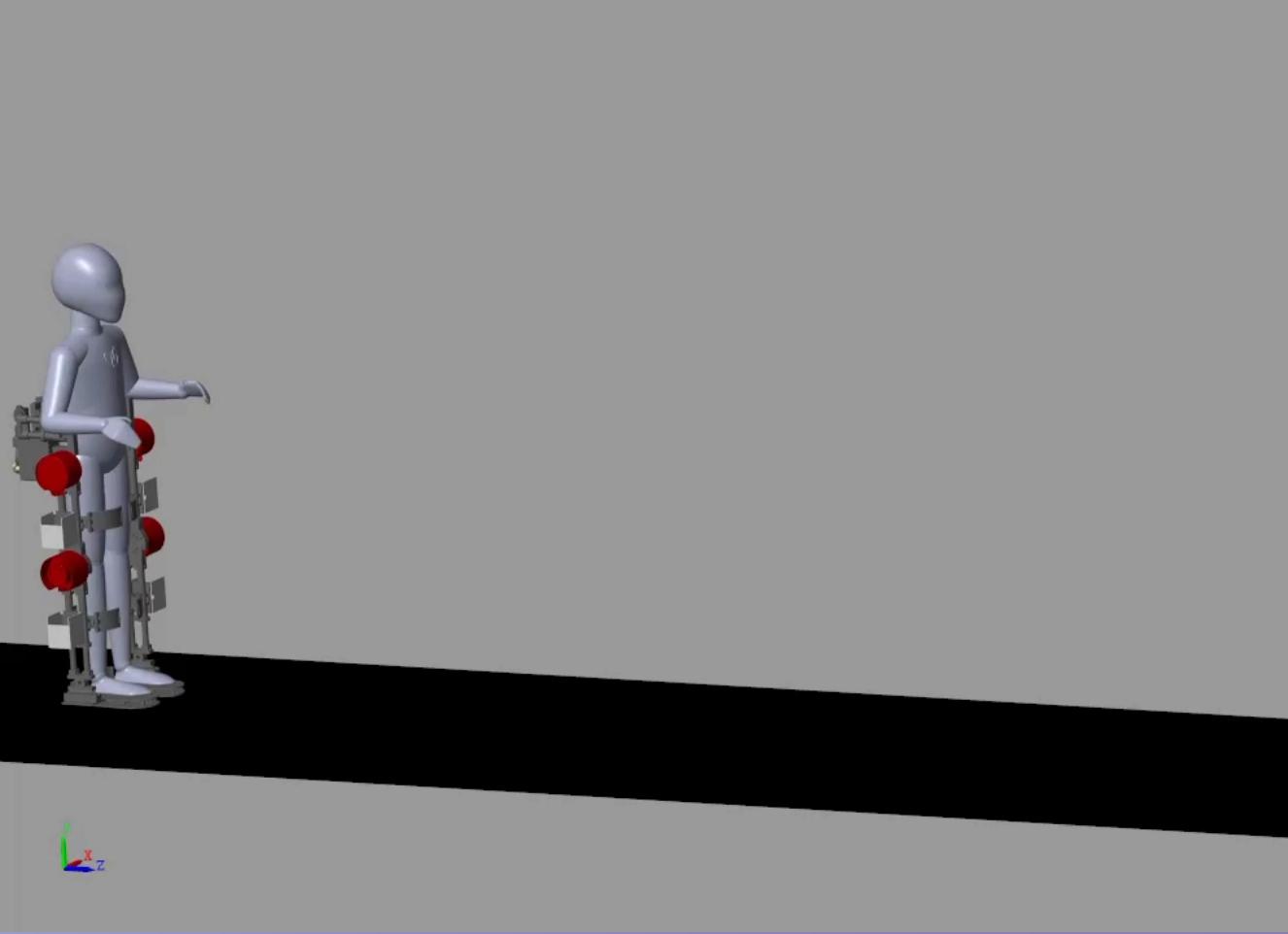


“Designing in C++, you have a lot of code to enter to realize one functionality. Model-Based Design with MATLAB and Simulink was really a **timesaving tool** for us.”

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— Yang Zhang, postdoctoral researcher at JUNIA HEI

# Empowering Children to Walk



# **Moonshot:** Improving Quality of Life through Healthcare



JUNIA HEI



National Research Institute in Poland (NASK)



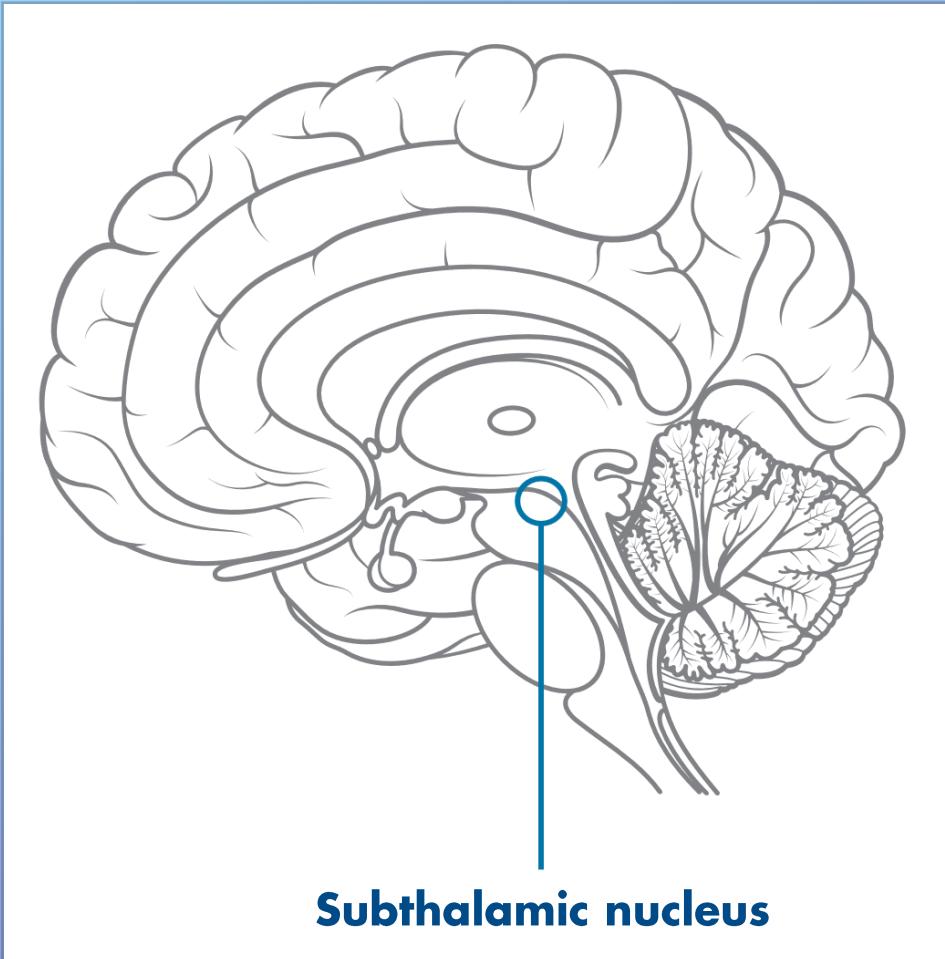
# Fighting Parkinson's Disease with AI

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More than 10 million people worldwide with  
Parkinson's disease



# Fighting Parkinson's Disease with AI



**“A neurological minefield surrounds the subthalamic nucleus. If you put the electrode in the wrong spot, it can severely alter the patient’s emotions.”**

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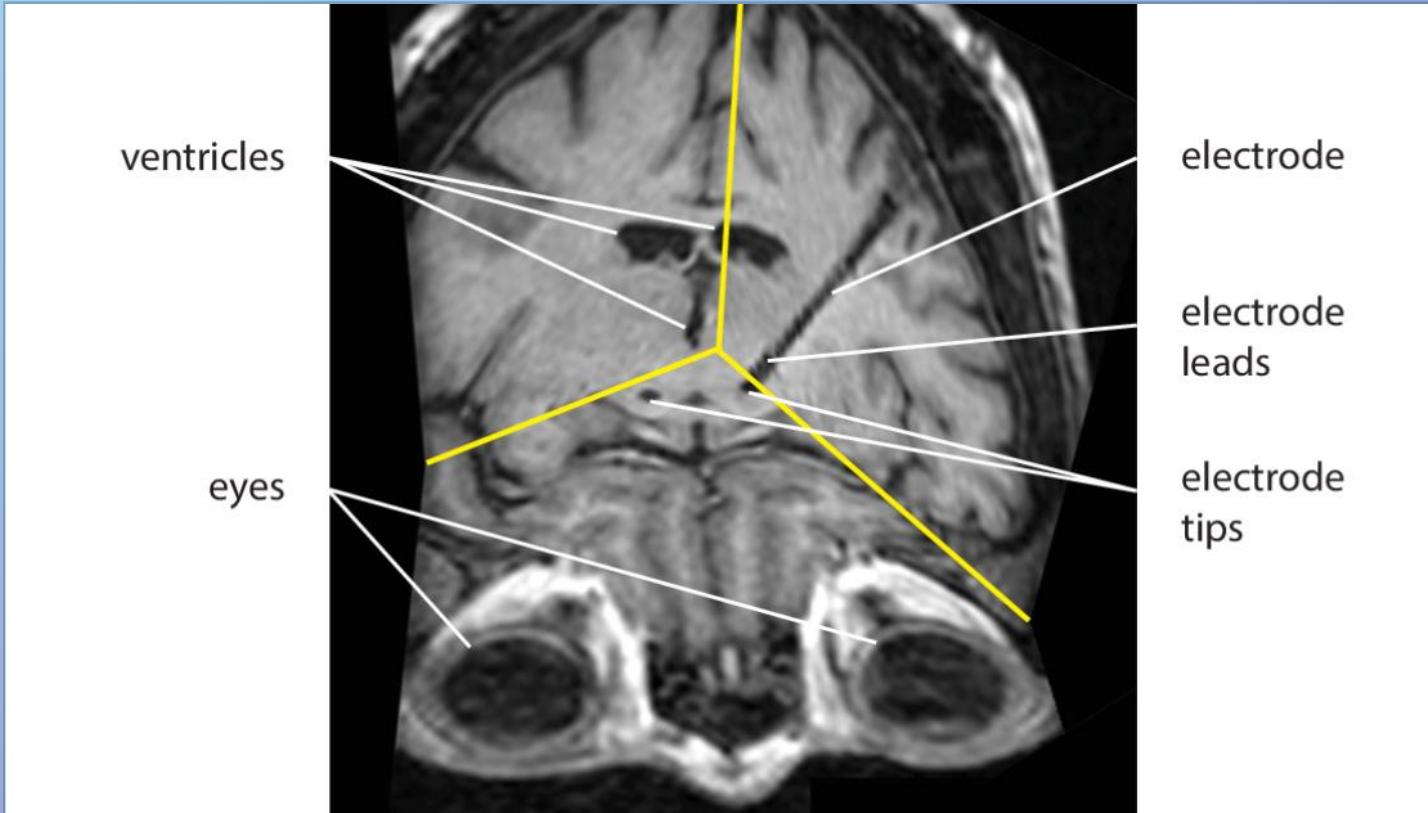
*—Dr. Konrad Ciecierski, assistant professor at NASK*

# Fighting Parkinson's Disease with AI

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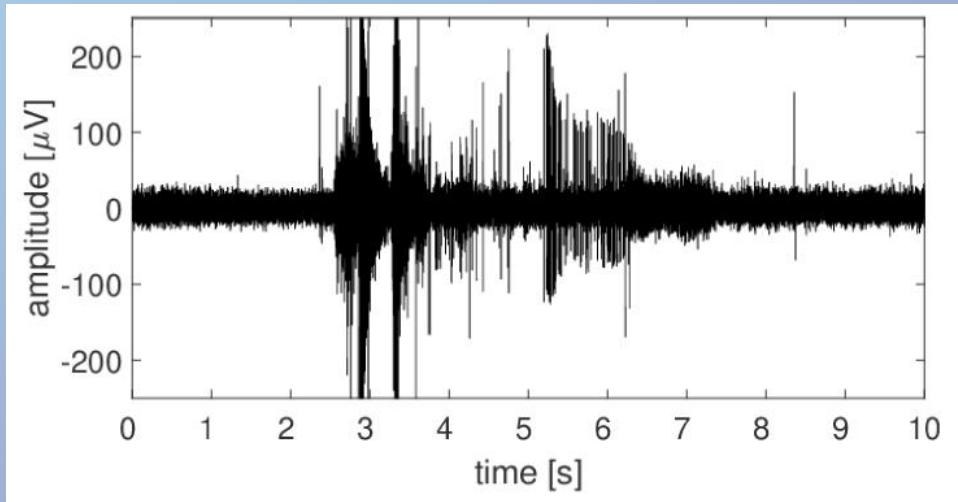


# Fighting Parkinson's Disease with AI



# Fighting Parkinson's Disease with AI

Original  
Signal



# Fighting Parkinson's Disease with AI

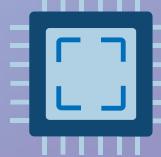
Data Cleansing  
and Preparation



AI Modeling  
and Tuning

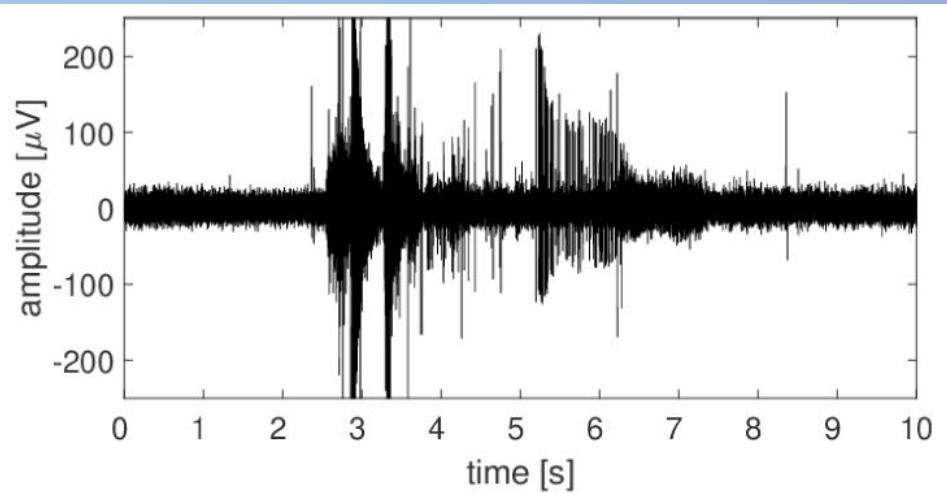


Deployment

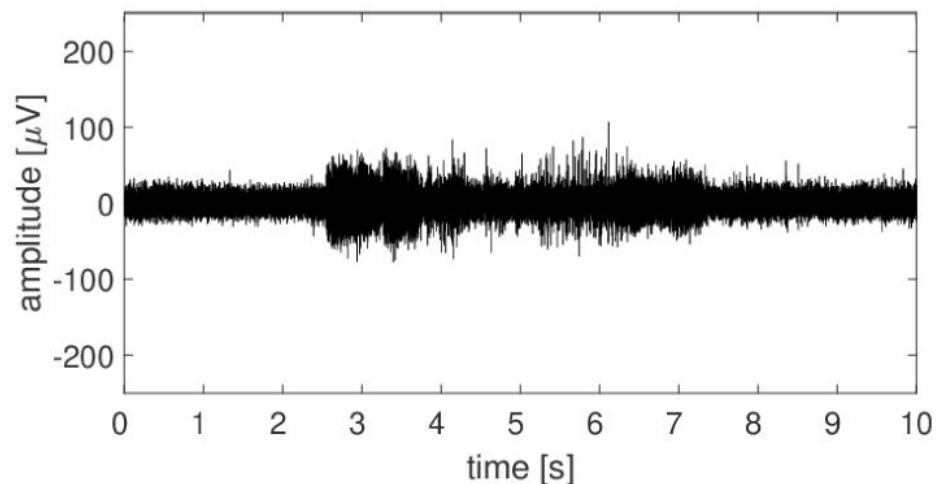


# Fighting Parkinson's Disease with AI

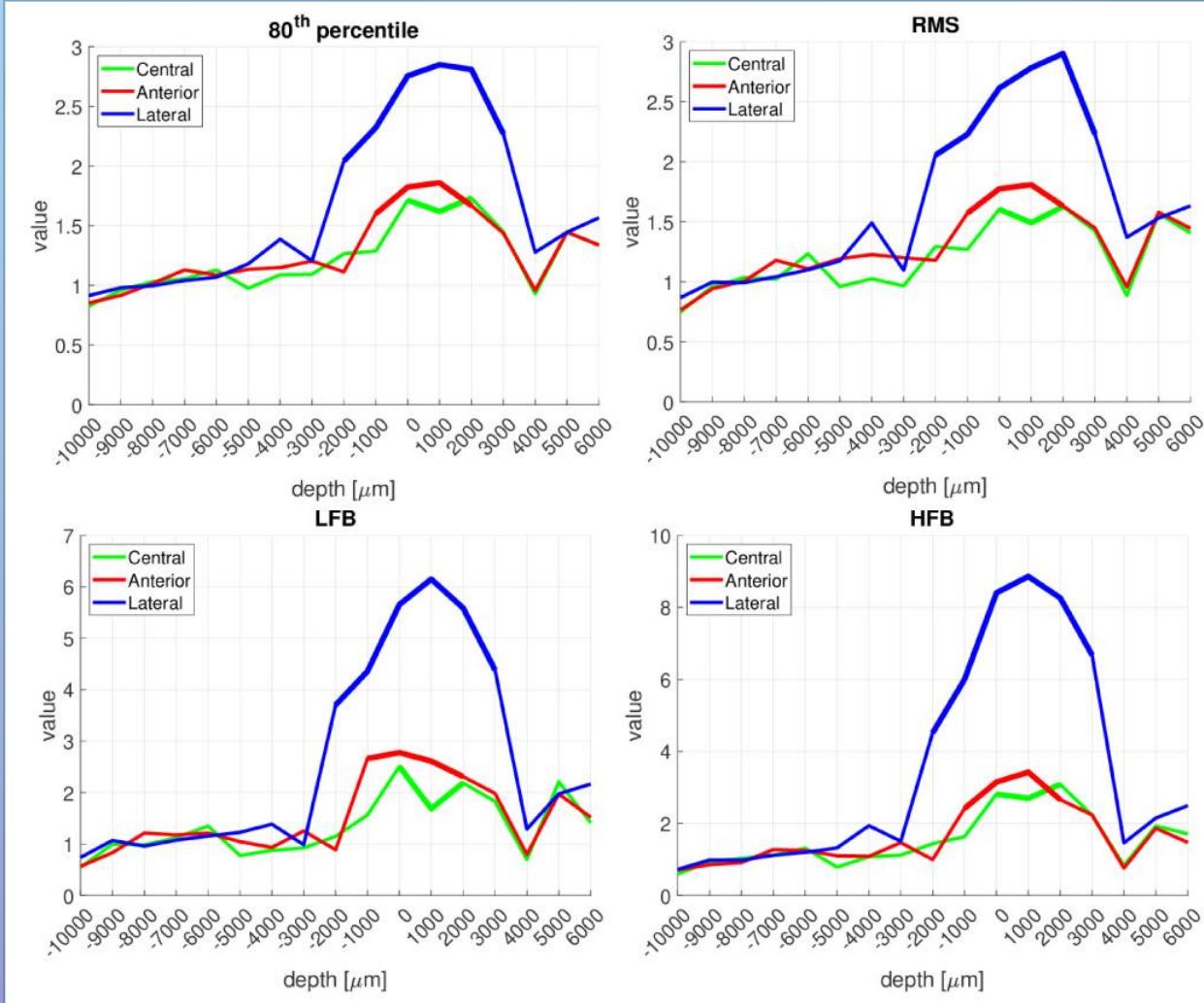
Original  
Signal



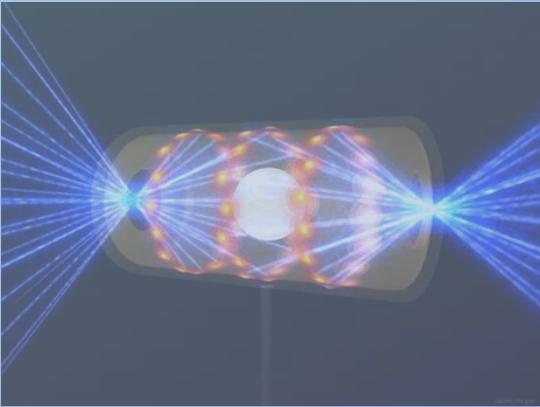
Filtered  
Signal



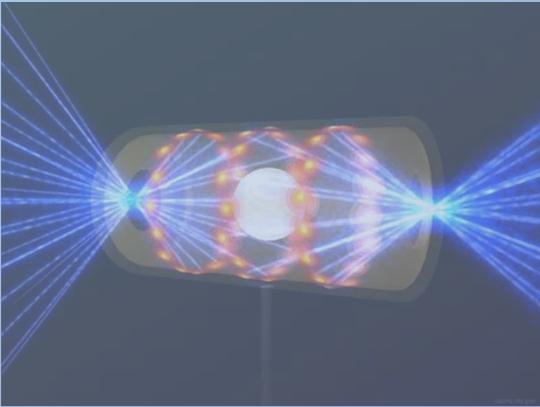
Entire process takes only 2 minutes  
and is 97% accurate



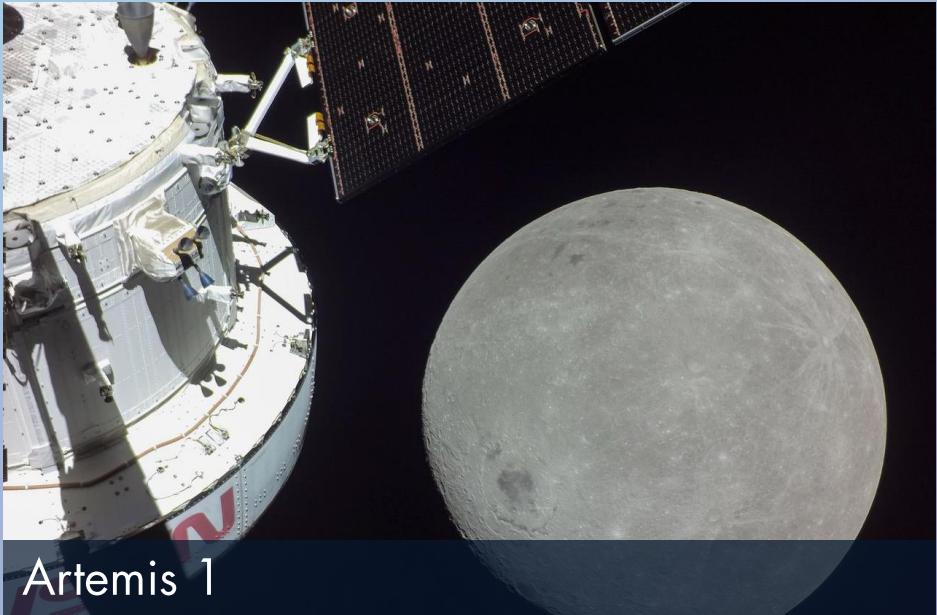
# **Moonshots:** Projects with lofty and seemingly impossible goals



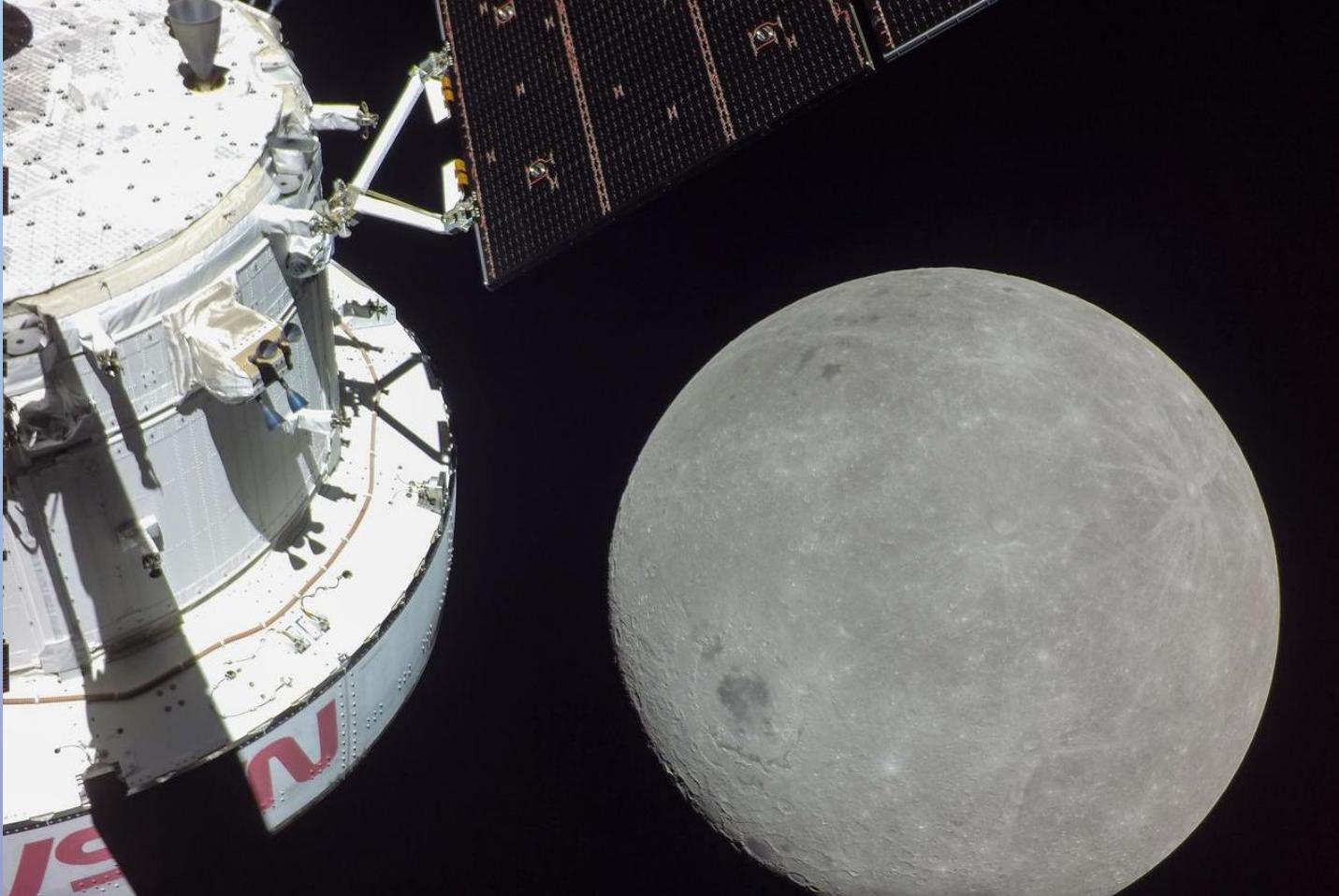
# **Moonshots:** Projects with lofty and seemingly impossible goals



# Moonshot: Space Exploration



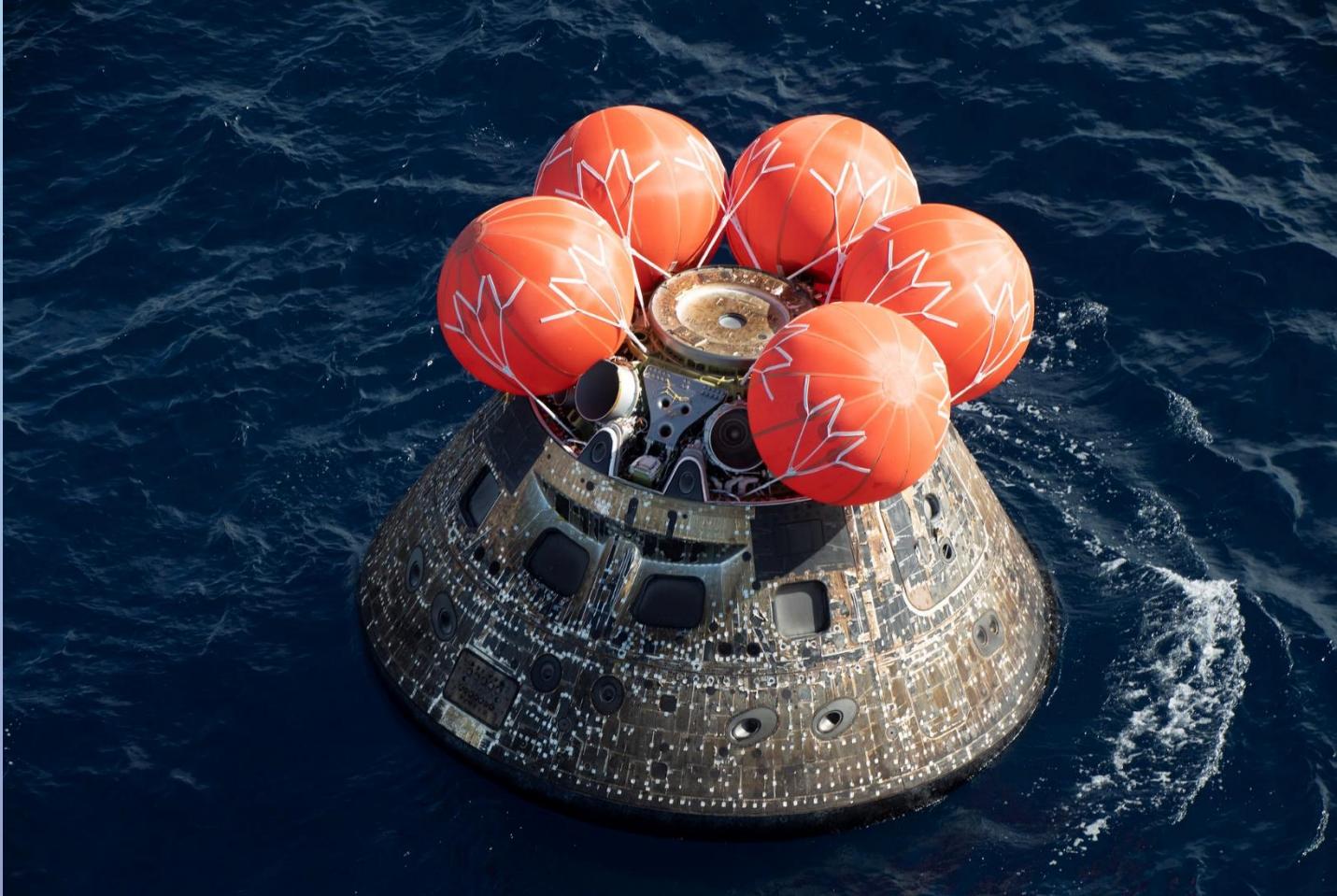
# To the Moon and Beyond



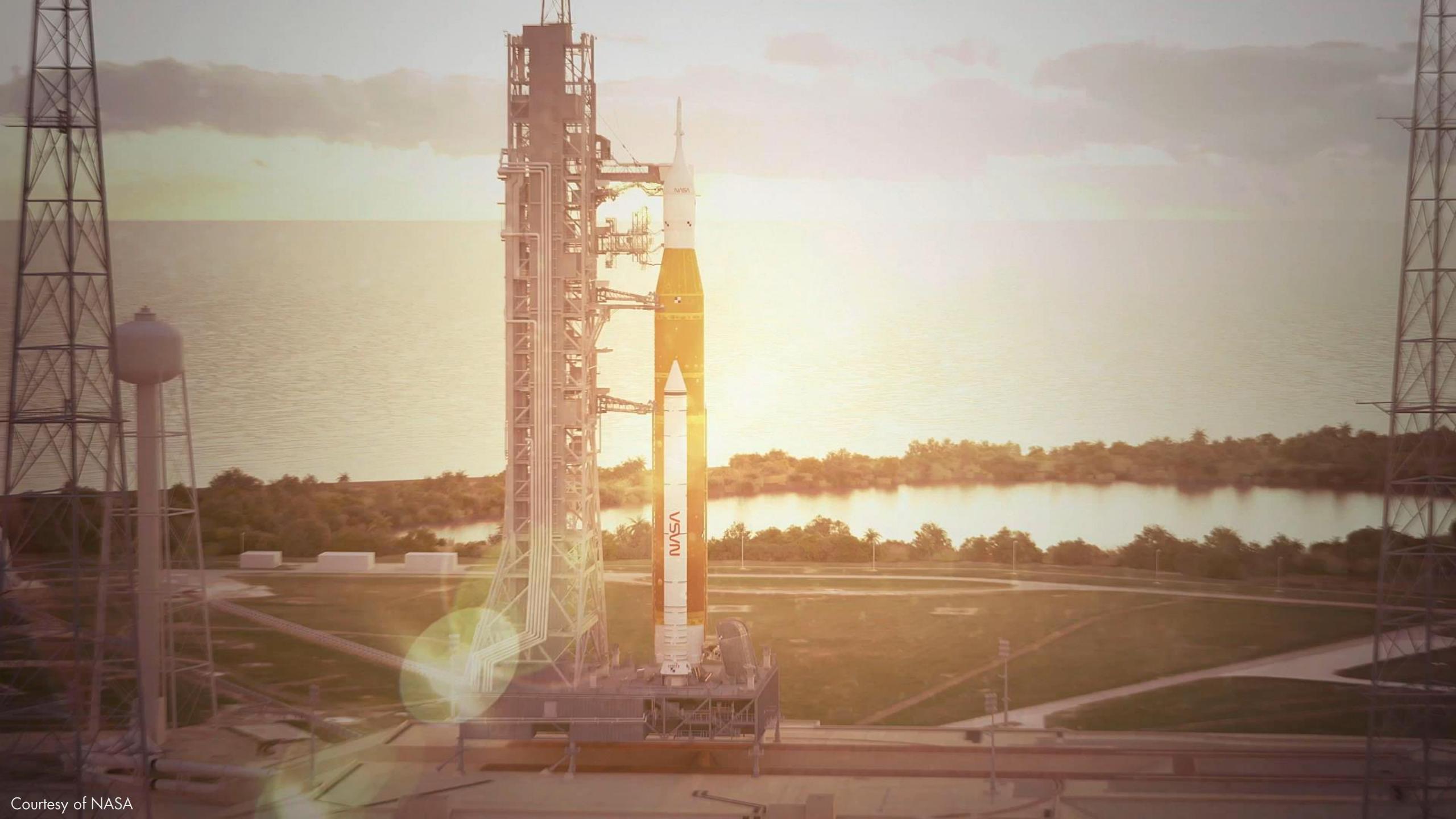
Courtesy of NASA

# To the Moon and Beyond

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Courtesy of NASA



Courtesy of NASA



Courtesy of NASA



Courtesy of NASA

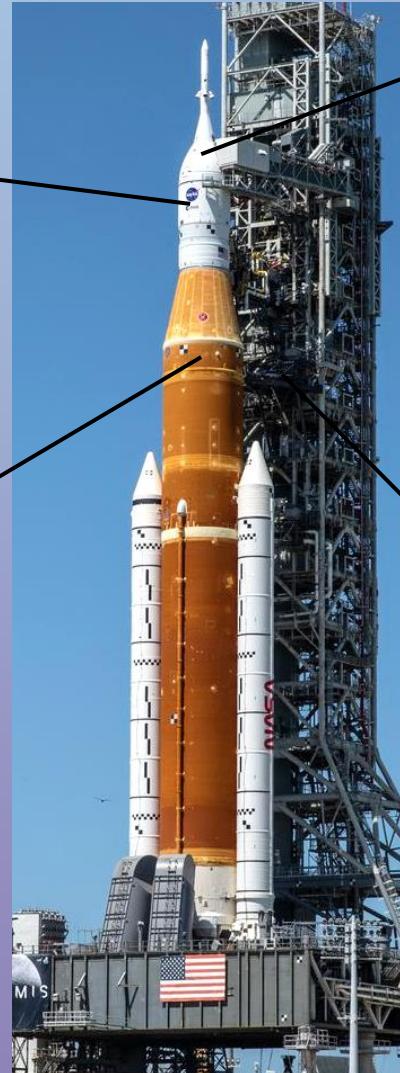


Orion Power System  
Analysis

Simscape Electrical

Mission Management  
Algorithm Validation

Stateflow



Orion Guidance, Navigation  
and Controls Design

MATLAB  
Simulink  
Embedded Coder

Launch Tower Modeling

Simscape  
Simscape Fluids

Courtesy of NASA



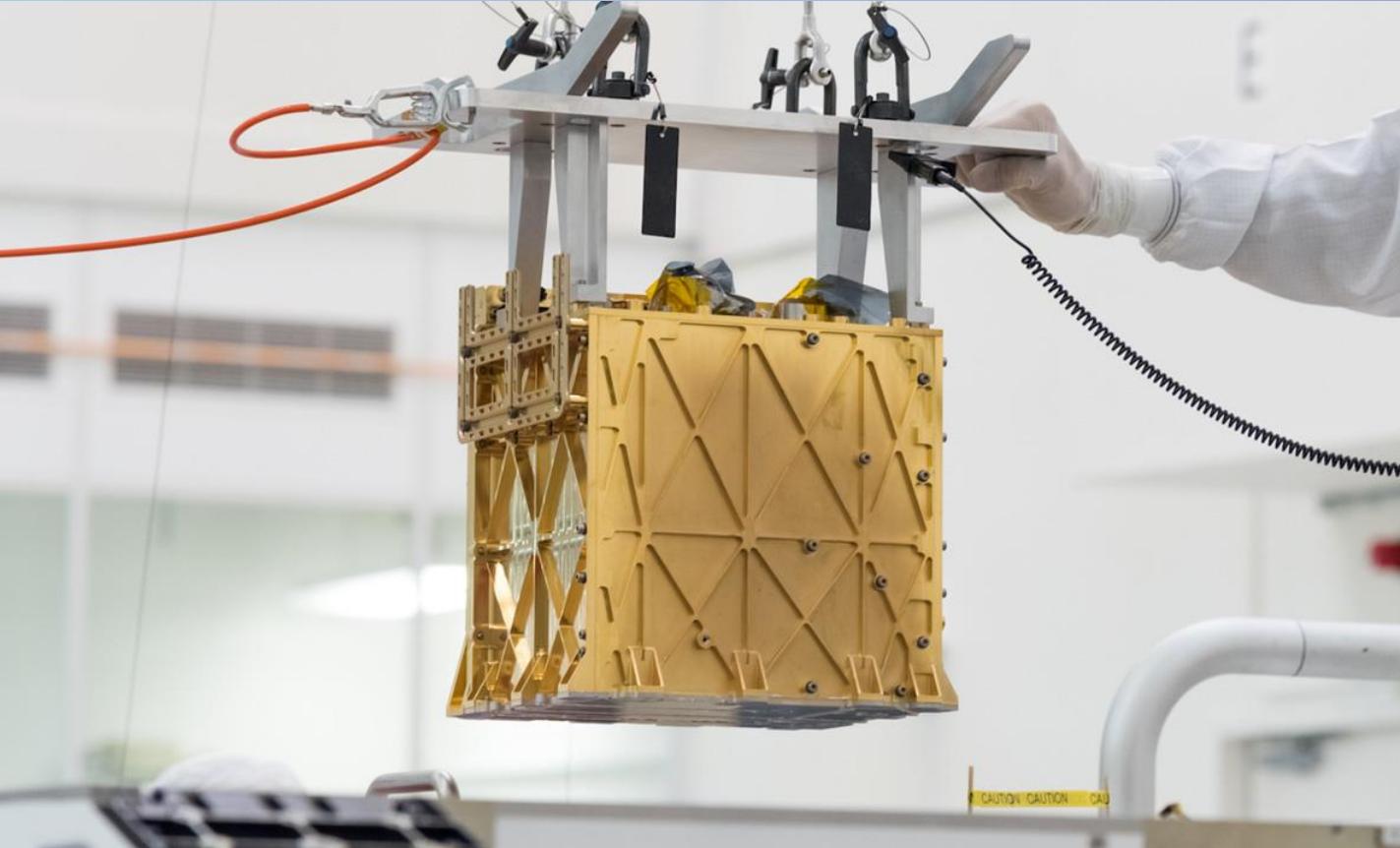
# Making Oxygen on Mars

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**Challenge:** 25 metric tons of oxygen required to support a four-person crew, costing billions

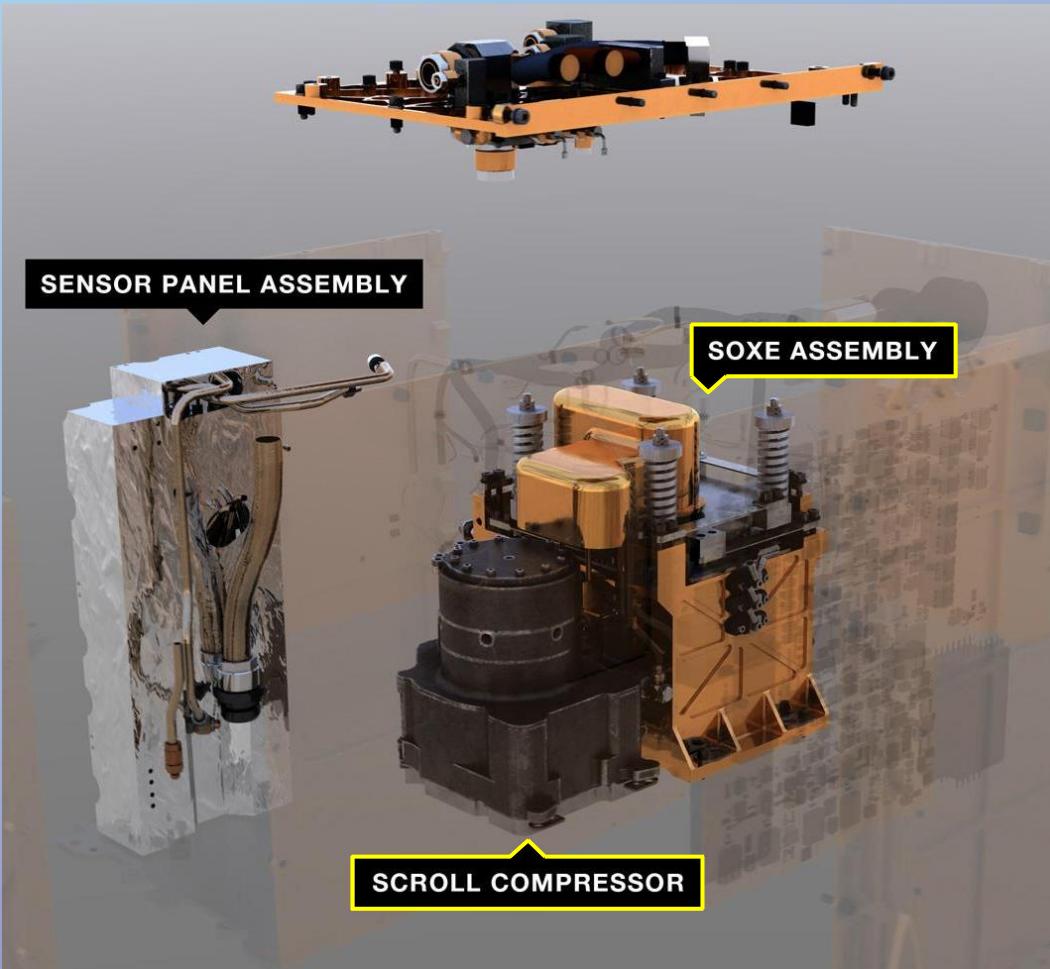
**Solution:** Extract oxygen from the atmosphere by separating it from carbon dioxide

# Making Oxygen on Mars



Courtesy of NASA

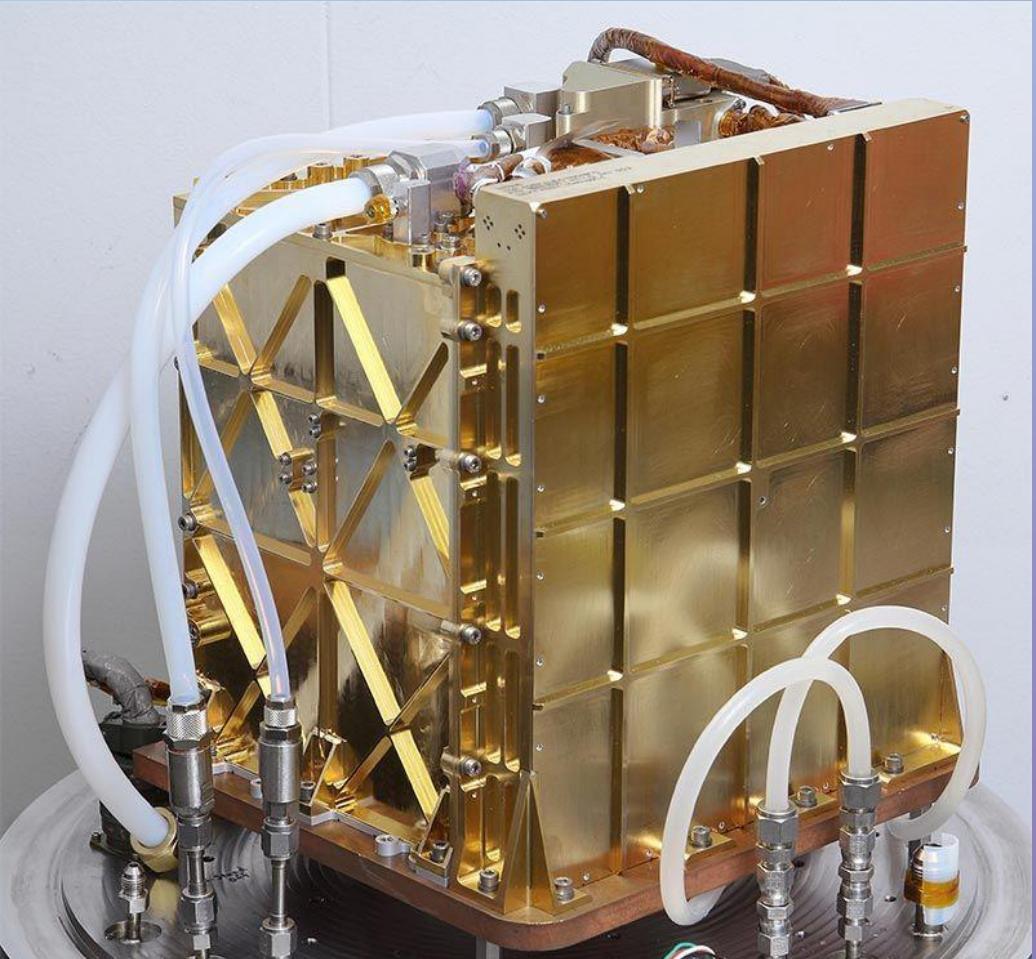
# Making Oxygen on Mars



Courtesy of NASA

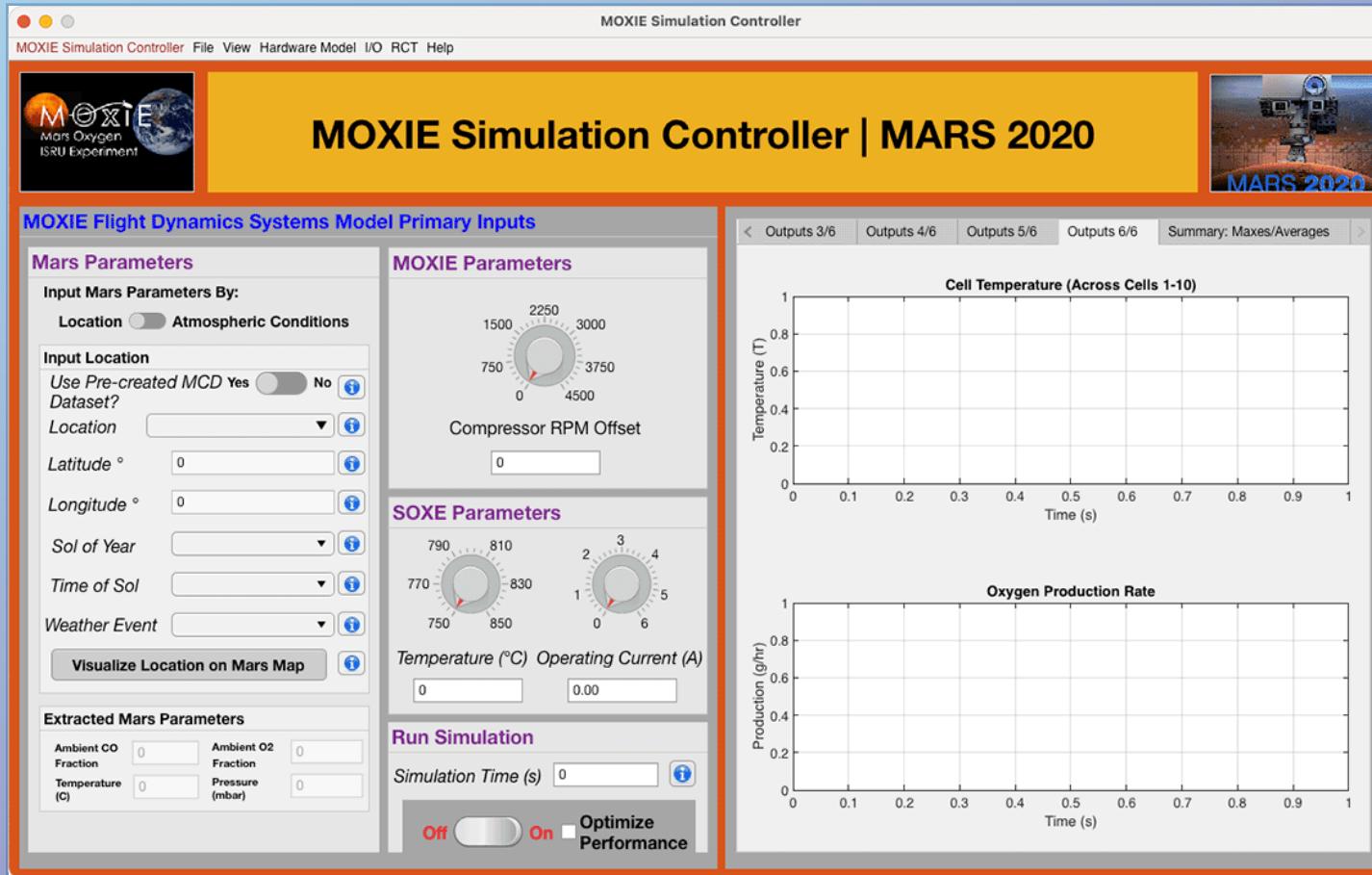
# Making Oxygen on Mars

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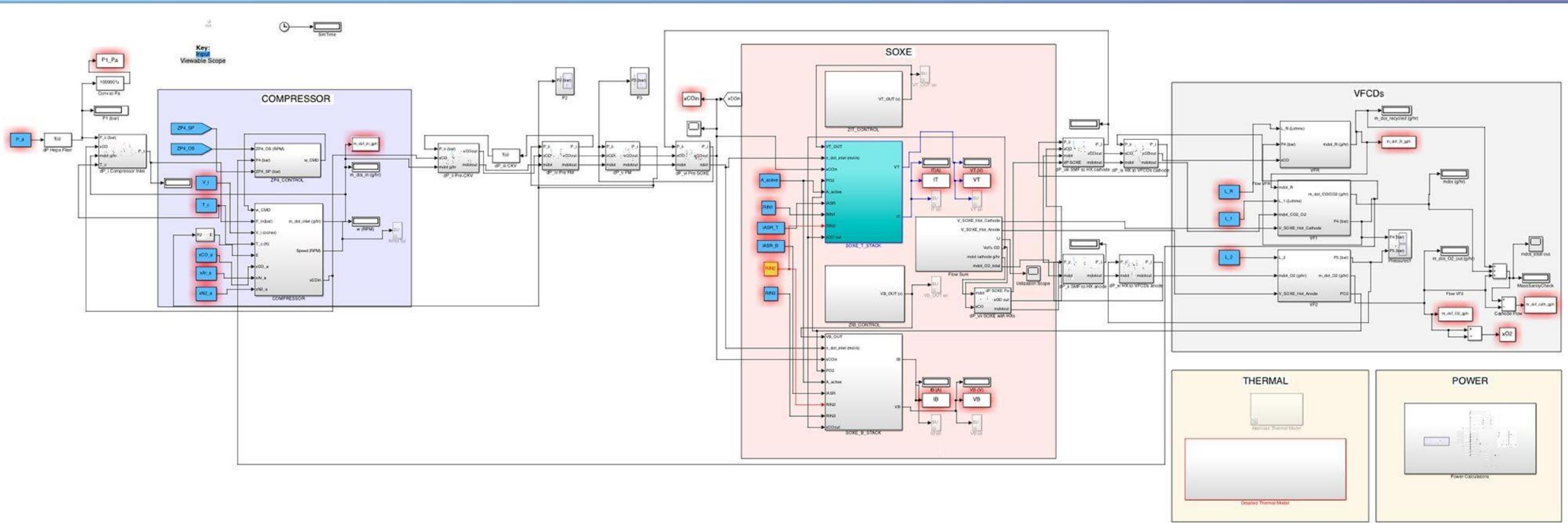


Courtesy of NASA

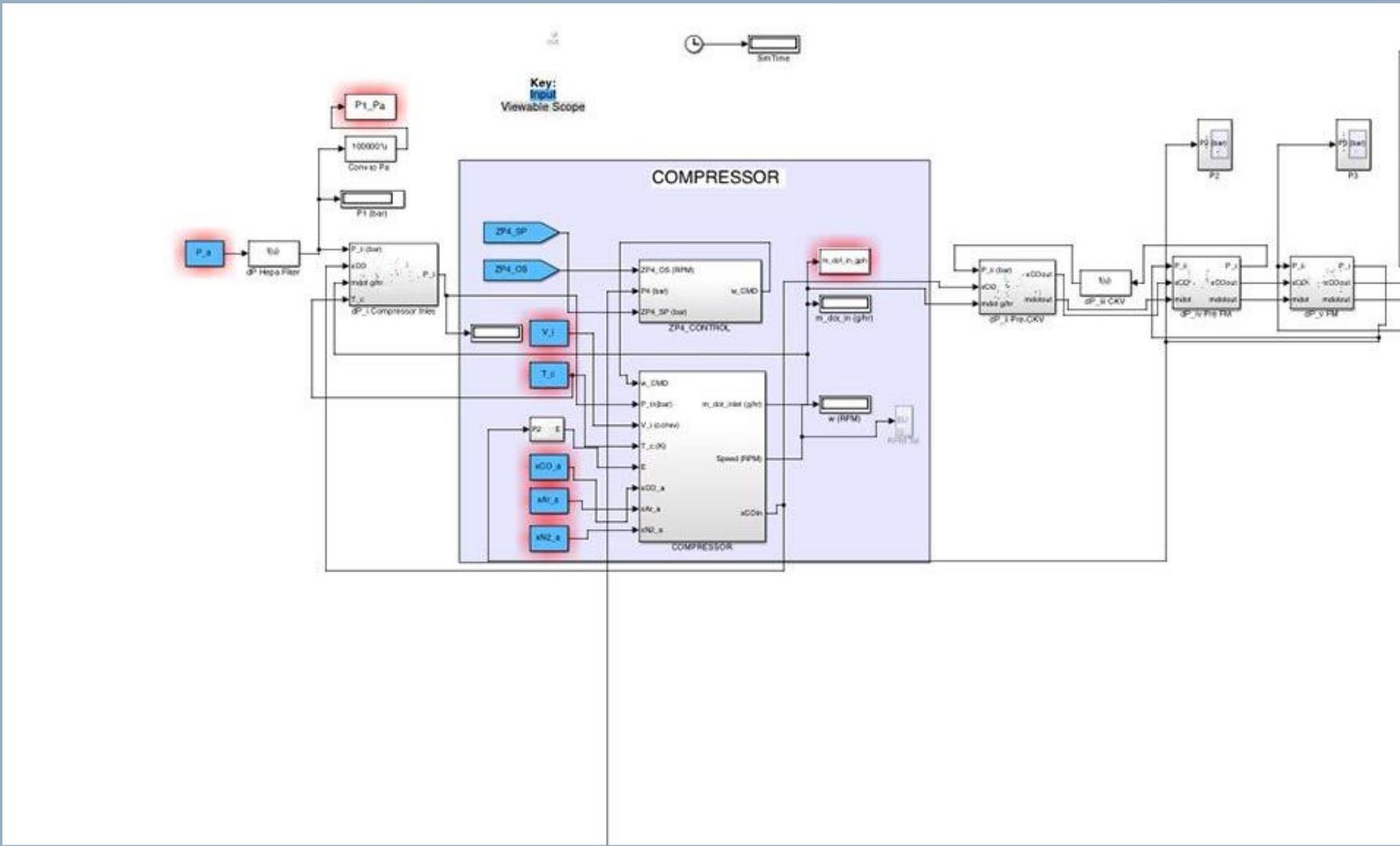
# Making Oxygen on Mars



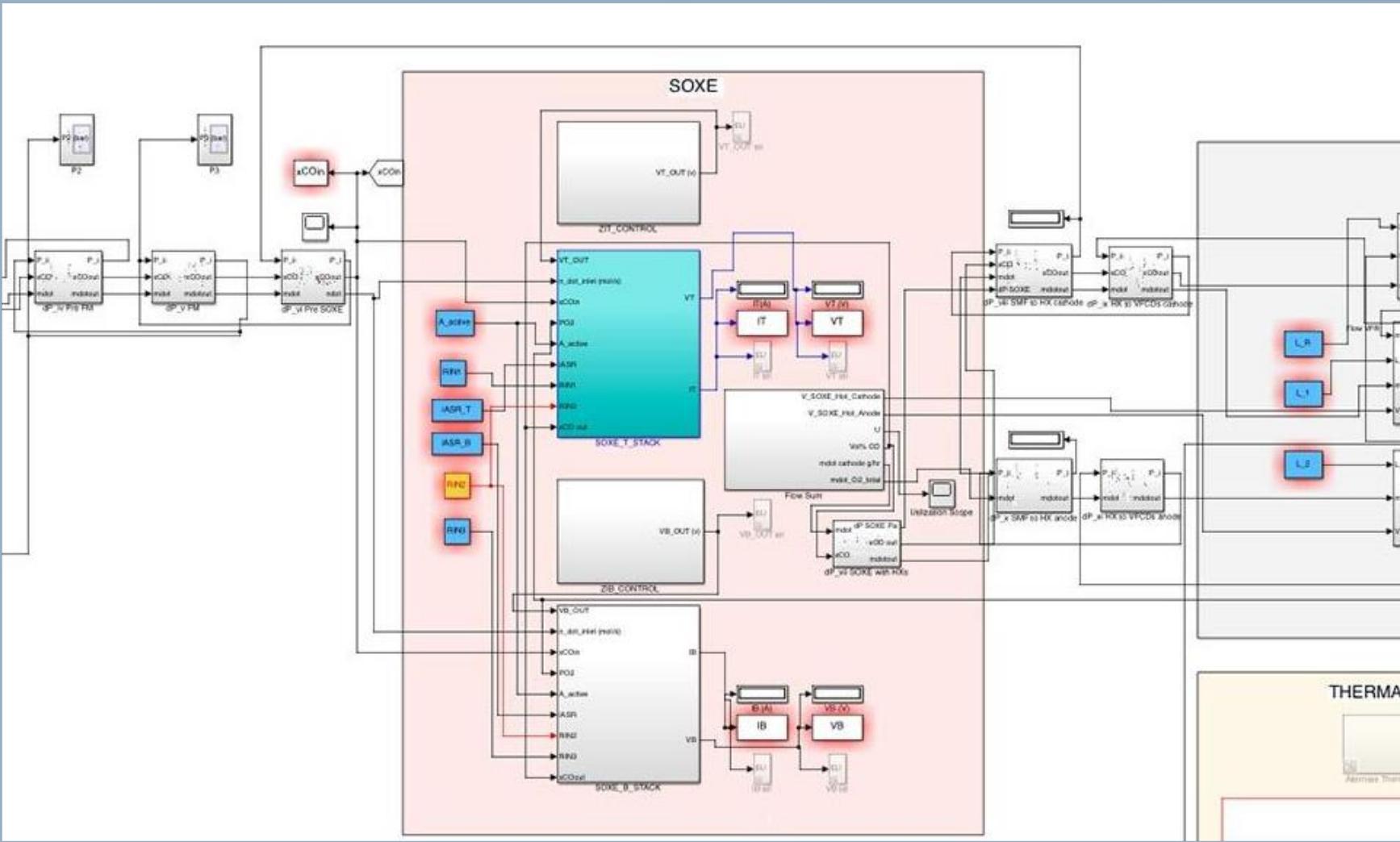
# Simulink Model for MOXIE



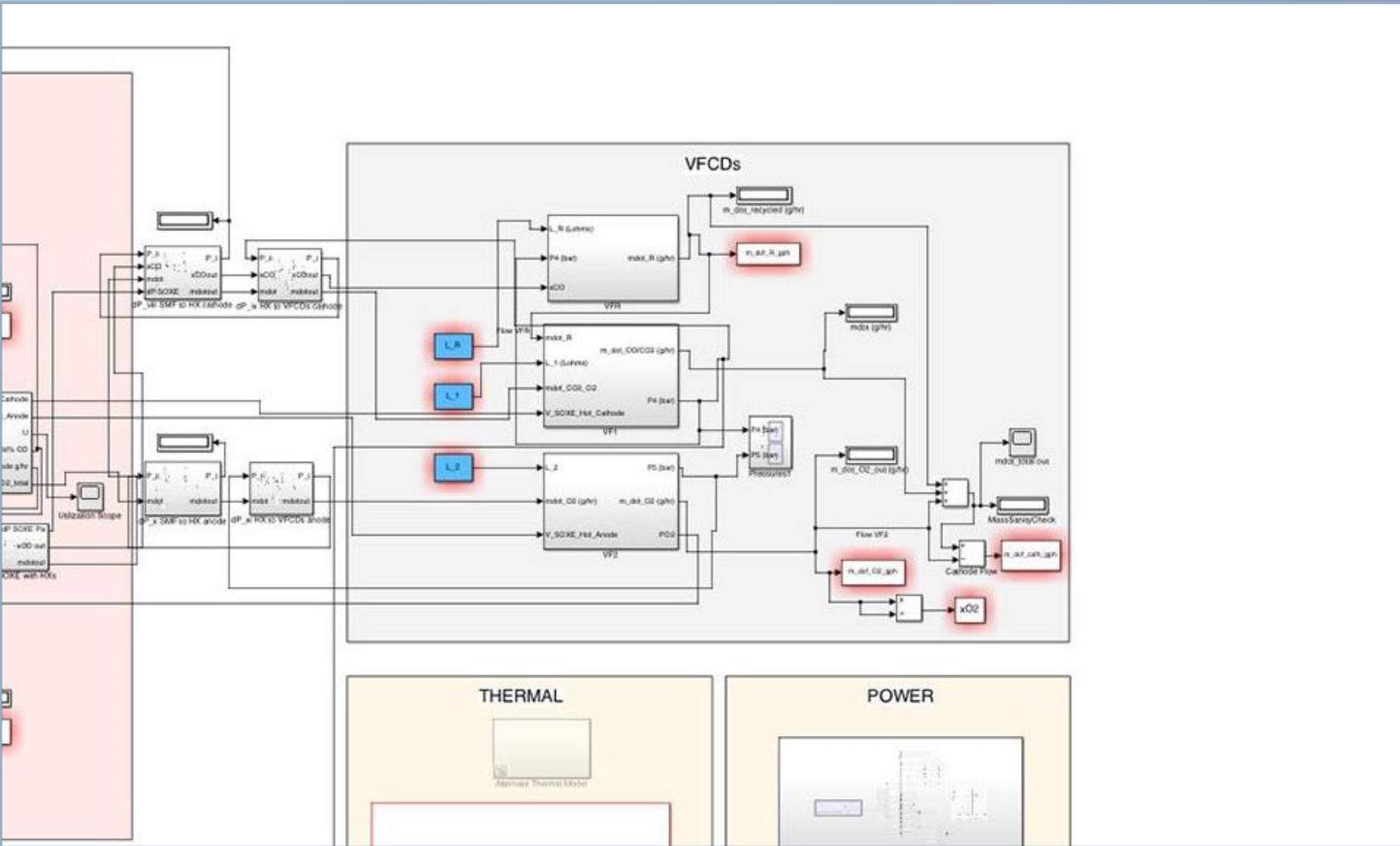
# Simulink Model for MOXIE



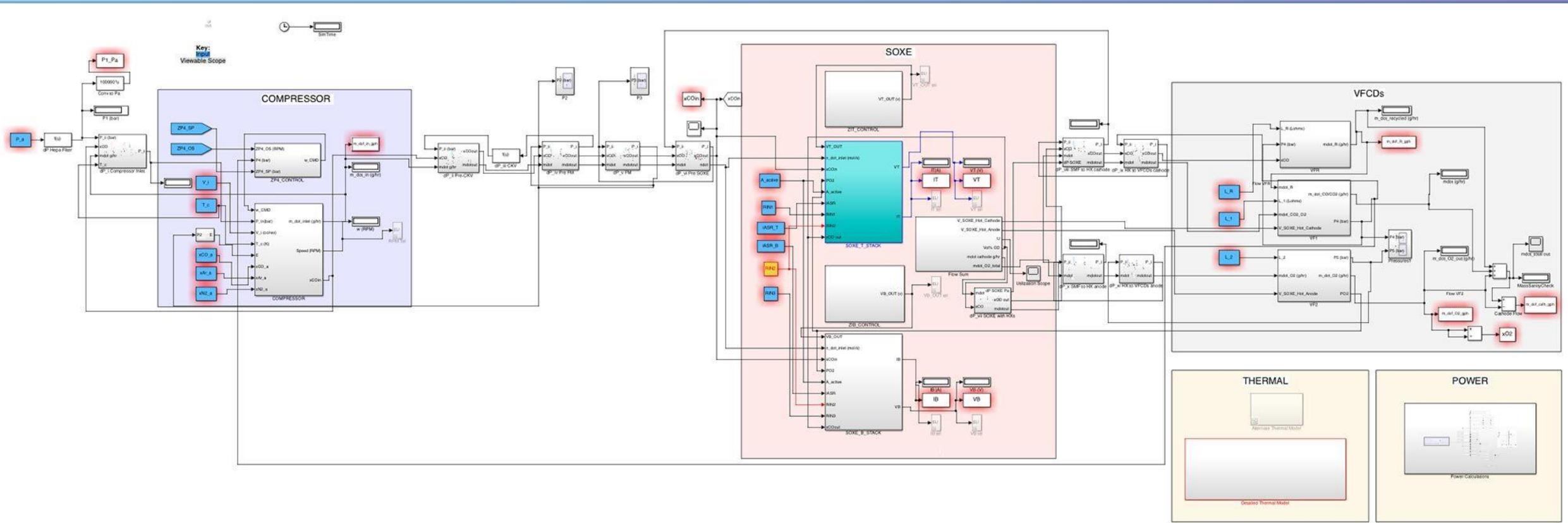
# Simulink Model for MOXIE



# Simulink Model for MOXIE



# Simulink Model for MOXIE



# Perseverance rover just made oxygen on Mars

— CNN



# Making Oxygen on Mars

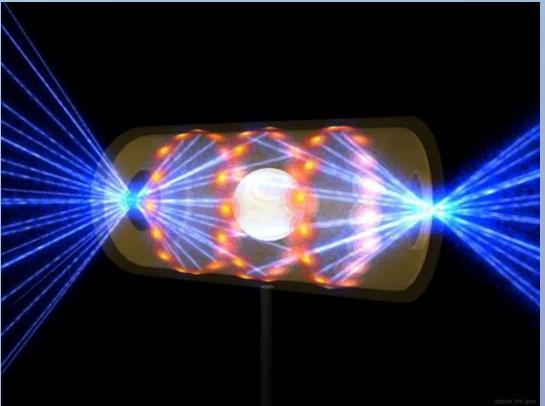
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Simulink for modeling three control loops: internal pressure, temperature, and voltage

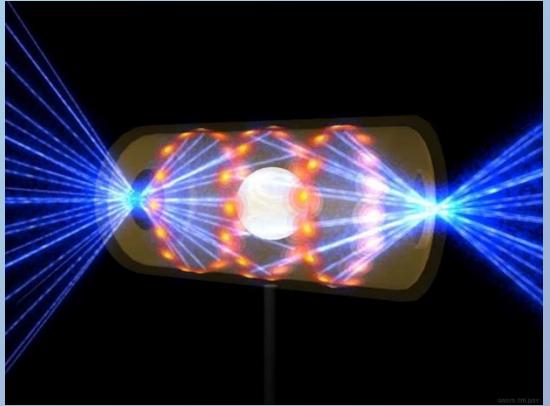
MATLAB for optimizing hardware layout, minimizing mass, and simulating conditions



# **Moonshots:** Projects with lofty and seemingly impossible goals



# Moonshots: Projects with lofty and seemingly impossible goals



# MATLAB EXPO



AI



Algorithm Development  
and Data Analysis



Autonomous Systems and  
Robotics



Cloud, Enterprise, and  
DevOps



Electrification



Modeling, Simulation,  
and Implementation



Preparing Future Engineers  
and Scientists



Wireless Connectivity  
and Radar

# MATLAB EXPO

Thank you



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