



THE OHIO STATE UNIVERSITY



German-US Partnerships in Spaceflight

Past, Present, and Future

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Hamburg Aerospace Lecture Series
Hamburg University of Applied Sciences
Hamburg, Germany, October 16, 2025



Wie oft haben Sie heute den Weltraum genutzt?

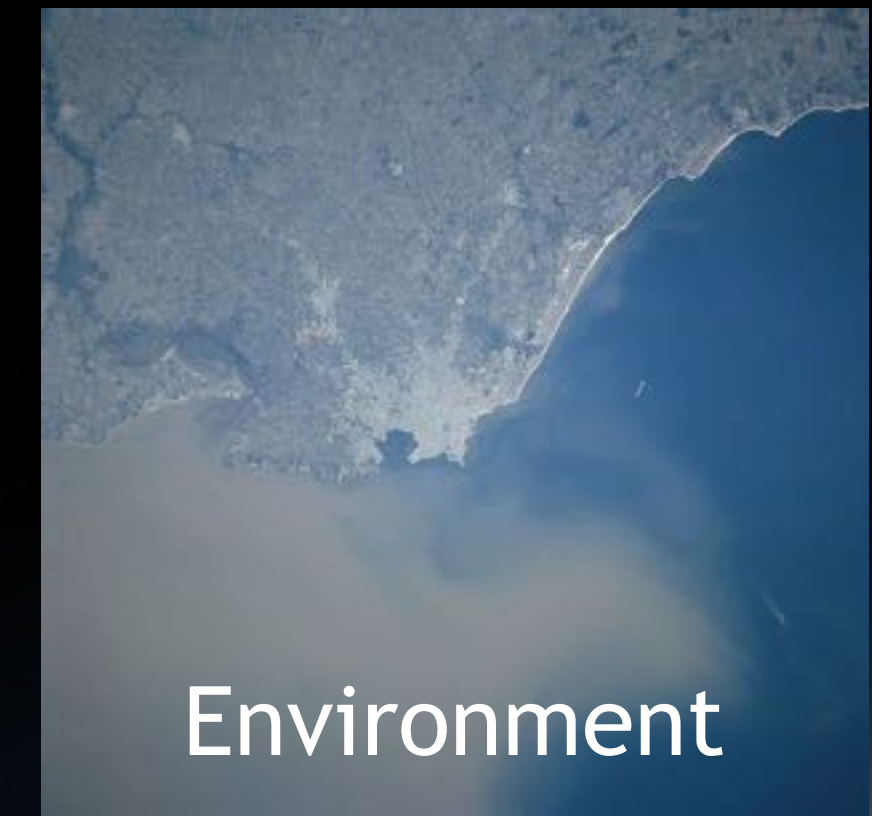


Können Sie sich ein Leben ohne vorstellen?



Space: A Vital National Choice

- *Develop the economy*
- *Fortify high-technology industry*
- *Educate for human-capital competitiveness*
- *Solve regional and global challenges*
- *Project strength, power, and capability*
- *Inspire citizens, promote positive morale*
- *Promote peaceful cooperation*
- *Enable productive collaboration*

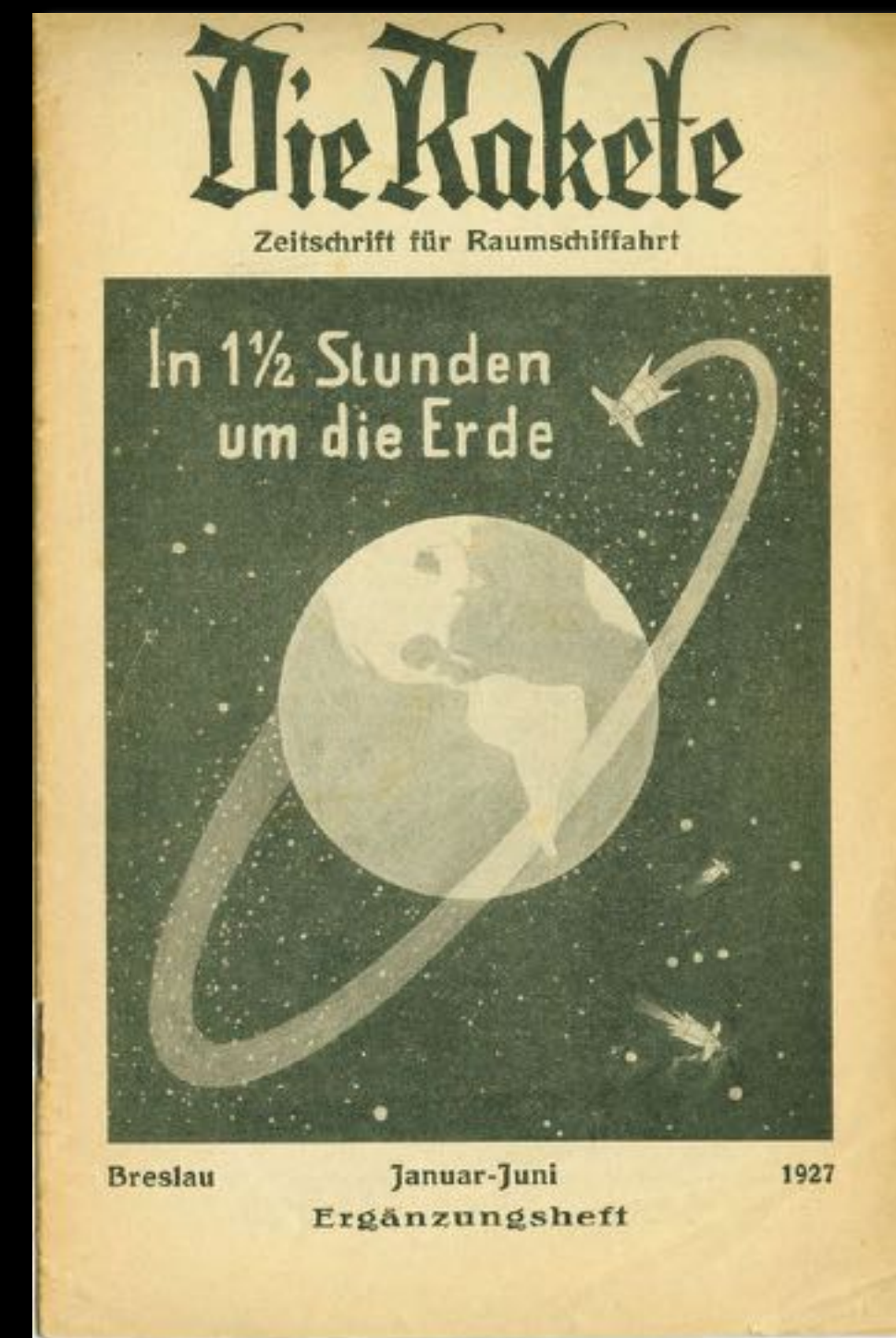




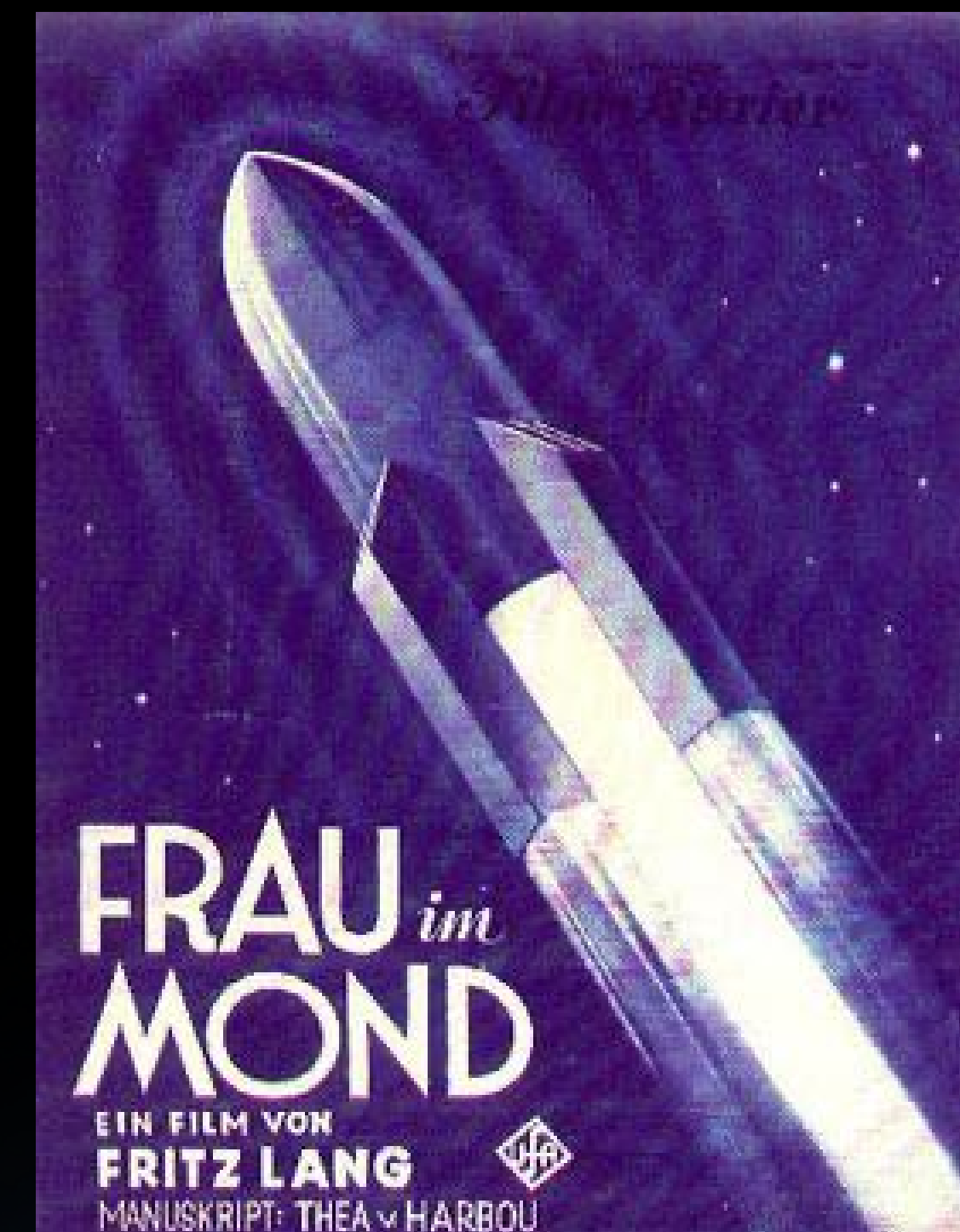
Hermann Oberth



**Oberth's
Popular Press
Publication
1923 - Based on
his (rejected)
PhD Thesis**



**“Verein für
Raumschiffahrt”
- 5 July 1927**

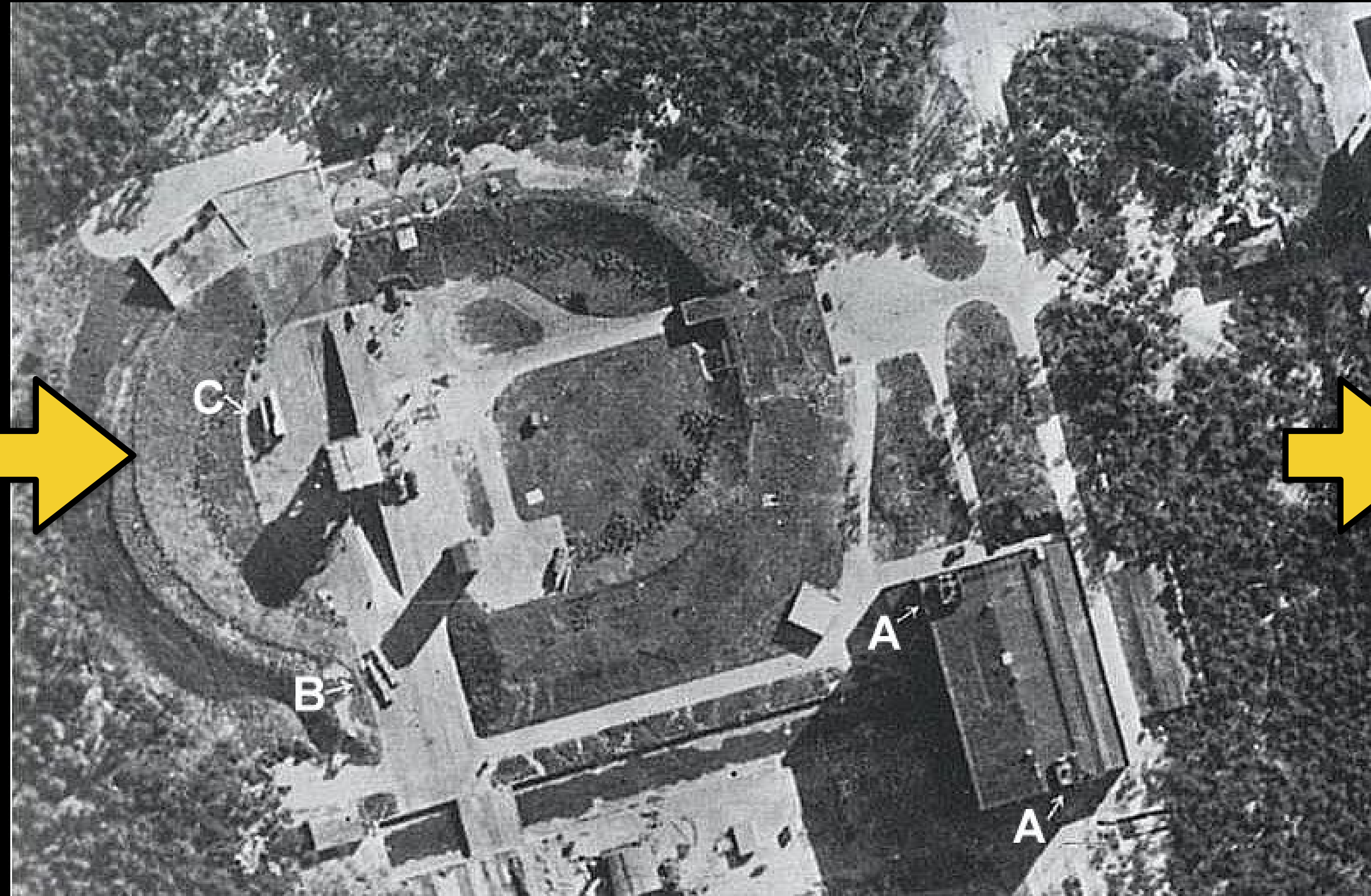


**1929 - Advisor to
the Movie by
Fritz Lang**

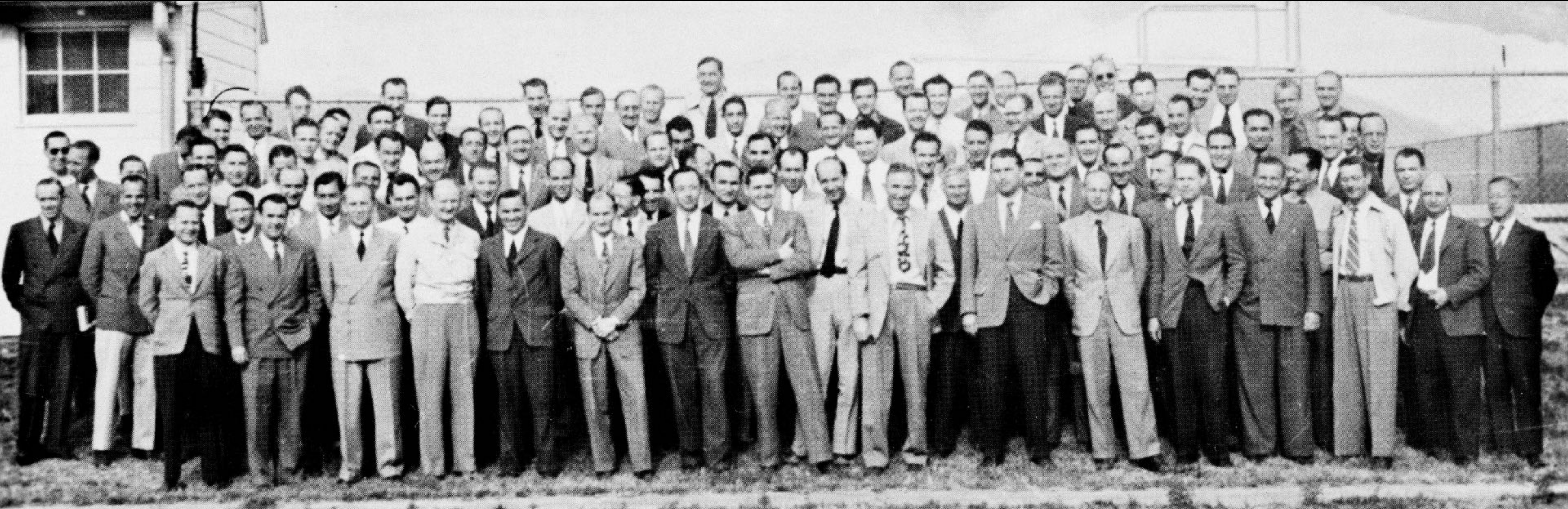
Largely starting from science, experimentation, and public enthusiasm.



Raumfahrt begeistert Menschen – damals wie heute



..including a young Wernher von Braun and Col. Walter Dornberger.



- Over 1,600 German scientists and engineers eventually brought to the US
- The first group worked to recreate the V2 and test flights from Ft. Bliss, TX and White Sands, NM
- Relocated in 1950 to Redstone Arsenal, Huntsville, Alabama as part of the US Army Ballistic Missile Effort



REDSTONE MISSILE

- “Direct Descendent” of V2
- 2,860 kg payload capacity
- Ethyl Alcohol, LOX, H₂O₂
- Range: ~60 - 200 miles
- Max Altitude: ~60 miles



REDSTONE / JUPITER C MISSILE

- Added third stage
- 31 January 1958, launches the first US Satellite (following Sputnik)
- *Explorer 1*
- Discovered the Van Allen Radiation Belts



Yuri Gagarin



Kennedy



NASA



Von Braun



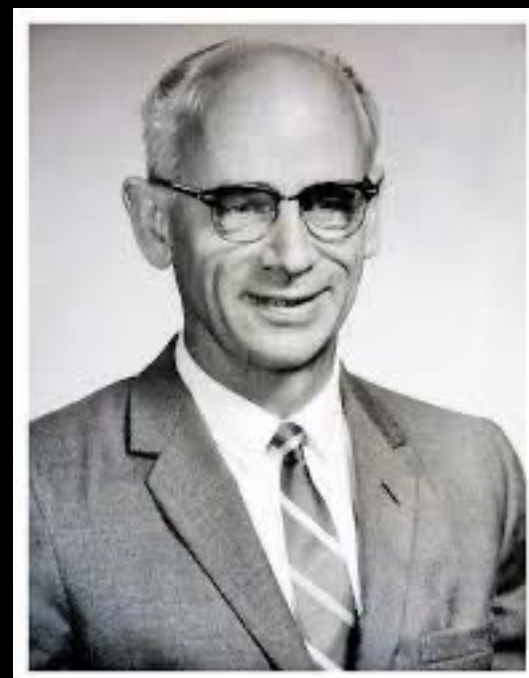
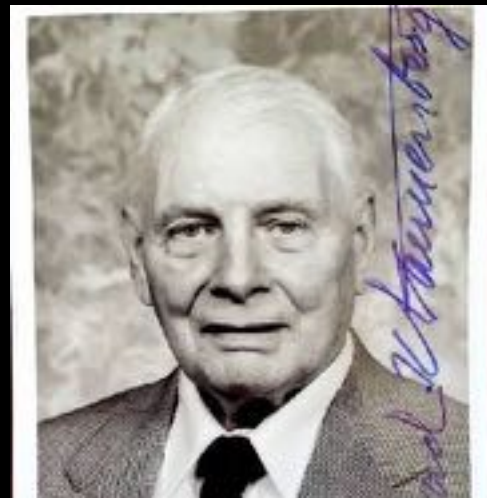
Saturn V



Apollo 11



But it is not ANCIENT history...



Von Braun Team Members

National Aeronautics and Space Administration



2006 Von Braun Forum
Education Training Facility at the
U.S. Space and Rocket Center
May 11, 2006
2 to 4 p.m.



The Visionaries
Featuring Special Guest
Apollo Astronaut Charles Duke

Von Braun Team Members	Marshall Space Flight Center Team Members
Konrad Dannenberg	Dr. John Horack
Hans Fichtner	Robert Lightfoot
Dr. Walter Haeusselman	Mike Rudolphi
Dr. Joachim Kuettnr	Phil Sumrall
Dr. Ernst Stuhlinger	

www.nasa.gov



Charlie Duke - Apollo 16



eine andere zufällige Person



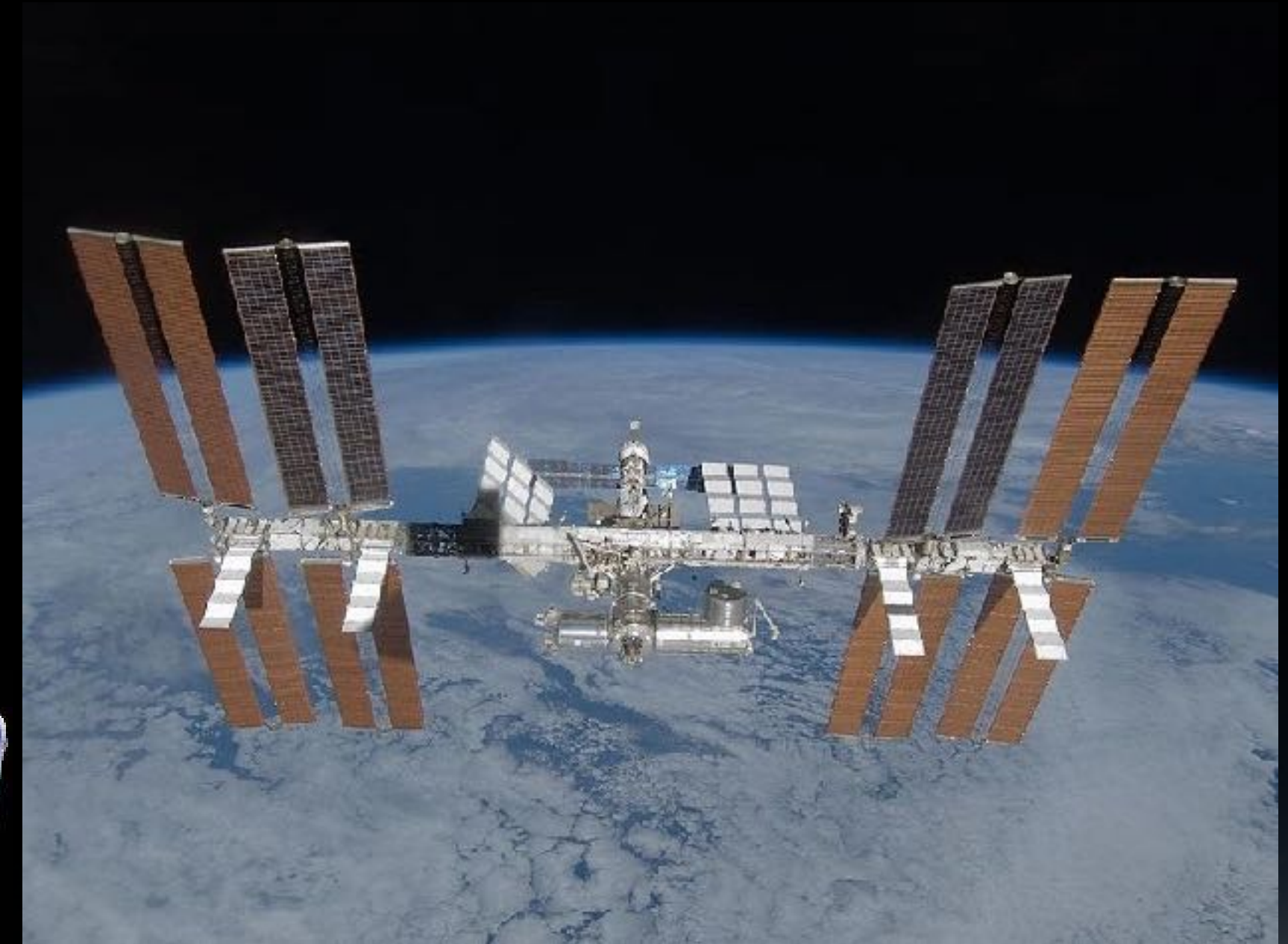
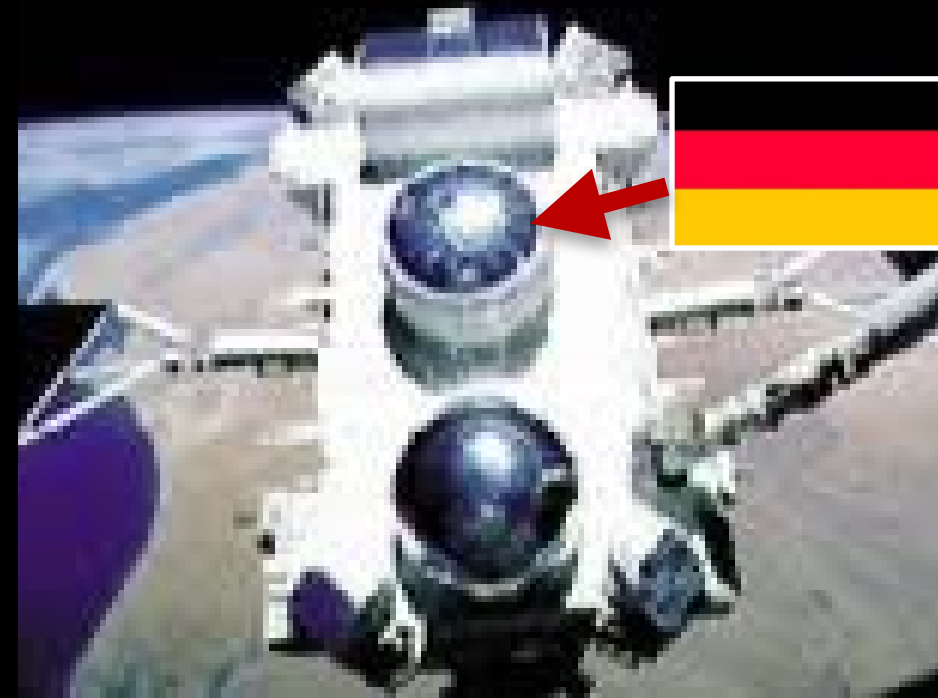
William Faulkner

“The past is never dead. It’s not even past.”



Carl Sandburg

“I believe more than I can ever prove of the future of the human race and the importance of illusions, the value of great expectations.”



Germany is one of the United States' most vital partners in Europe — In Spaceflight, and indeed everywhere else.



Brücken zur Weltraumkooperation wurden gebaut...



...aber sie sind zerbrechlich, und müssen gepflegt werden.



Wir werden zum Mond fliegen, und zwar gemeinsam.





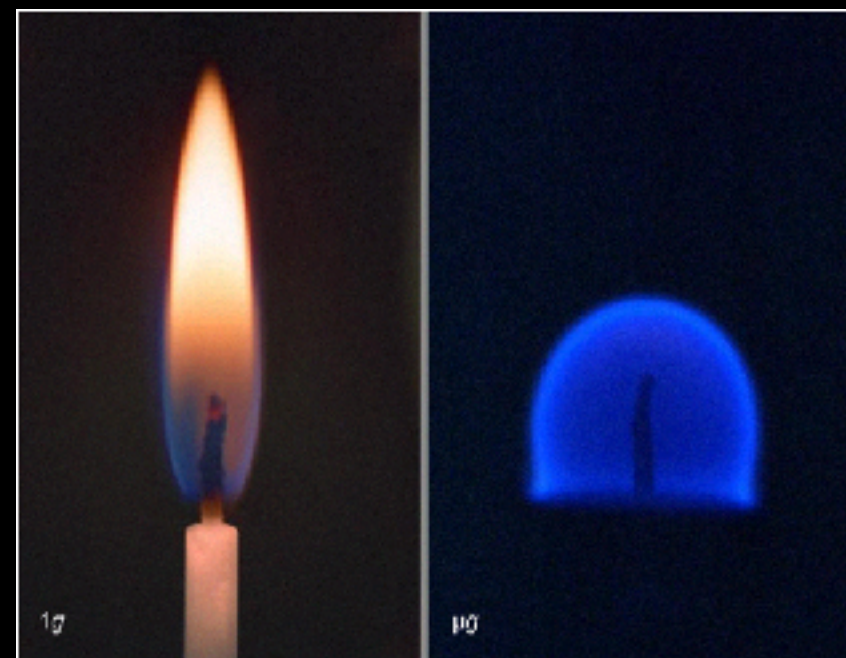
- *Starlab-Space: US/European/Japanese/Canadian partnership, includes Airbus GmbH, in Bremen and Friedrichshafen*
- *Hardware and Payload Development*
- *Research in low-Earth orbit:*
 - *Biotechnology*
 - *Materials and Manufacturing*
 - *Human biology*
 - *Pharmaceuticals*
- *4-person crew, 24/7/365*
- *University, Government, Private-sector engagement.*



Die Zukunft der Forschung im erdnahen Orbit



- Convection.
- Hydrostatic Pressure.
- Diffusion.
- Capillary Action.
- Surface Tension.
- Radiation.
- Atomic Oxygen.
- Hard Vacuum.
- Human factors, health, and physiology.
- Endothermic/Exothermic behaviors.
- Two phase (e.g., liquid-gas) separation
- Mechanical/vibrational impacts.



Spaceflight - a UNIQUE LABORATORY to fortify research, addressing key questions across nearly all domains.



- Pharmaceuticals
- Medical Devices
- Household Products
- Advanced Materials
- Semiconductors
- Plant and Agriculture
- Advanced Communications
- BioManufacturing
- Life Sciences and Human Health

Published Results From Crystallization Experiments on the ISS Could Help Merck Improve Cancer Drug Delivery

DECEMBER 2, 2019 • BY AMELIA WILLIAMSON SMITH, STAFF WRITER

New Space-Based Study Shows Promising Results for Treating, Preventing Post-Traumatic Osteoarthritis

MAY 28, 2024

ISS National Lab-Sponsored Study Tests a Novel Gene Therapy for Vision Loss

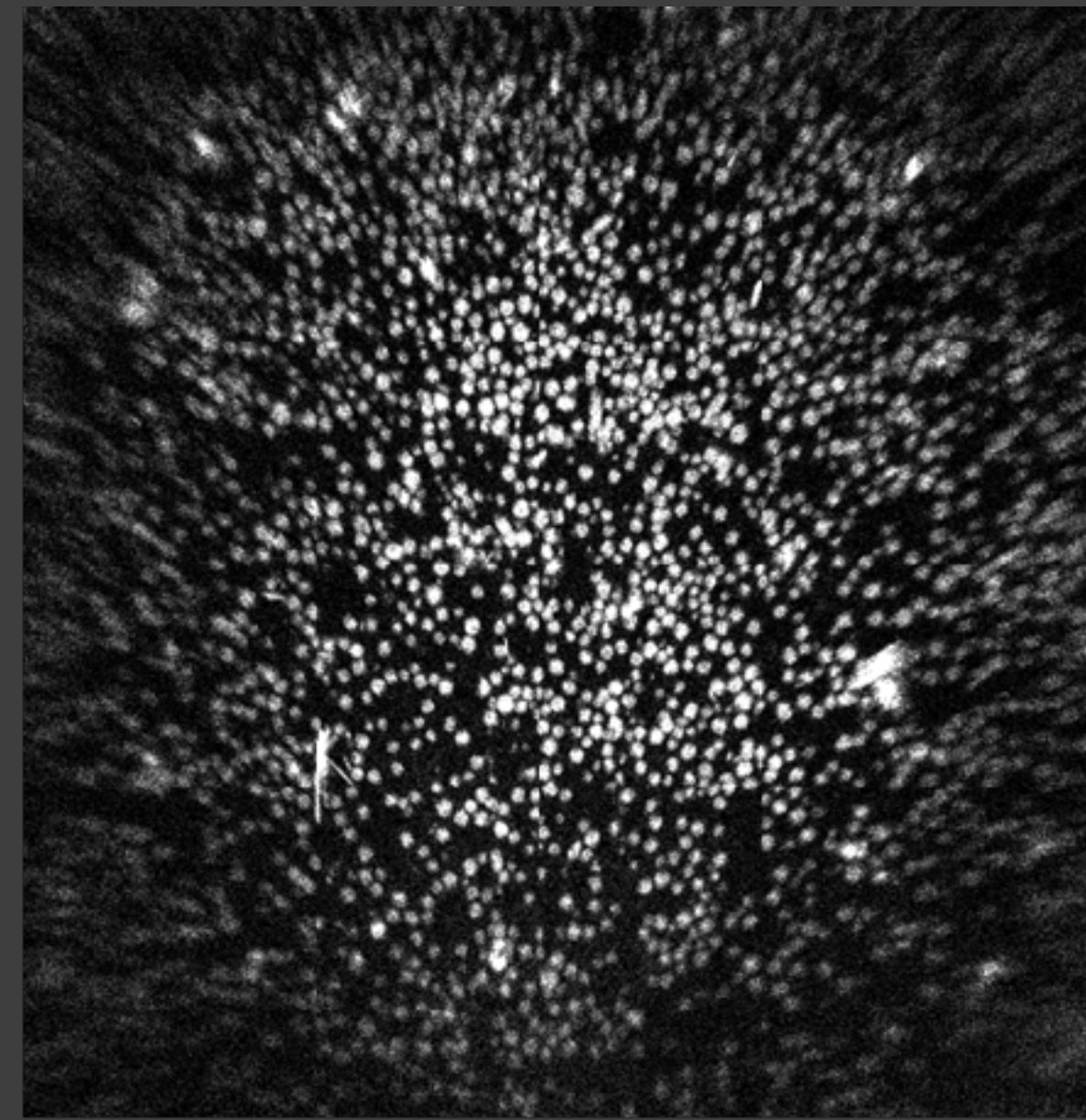
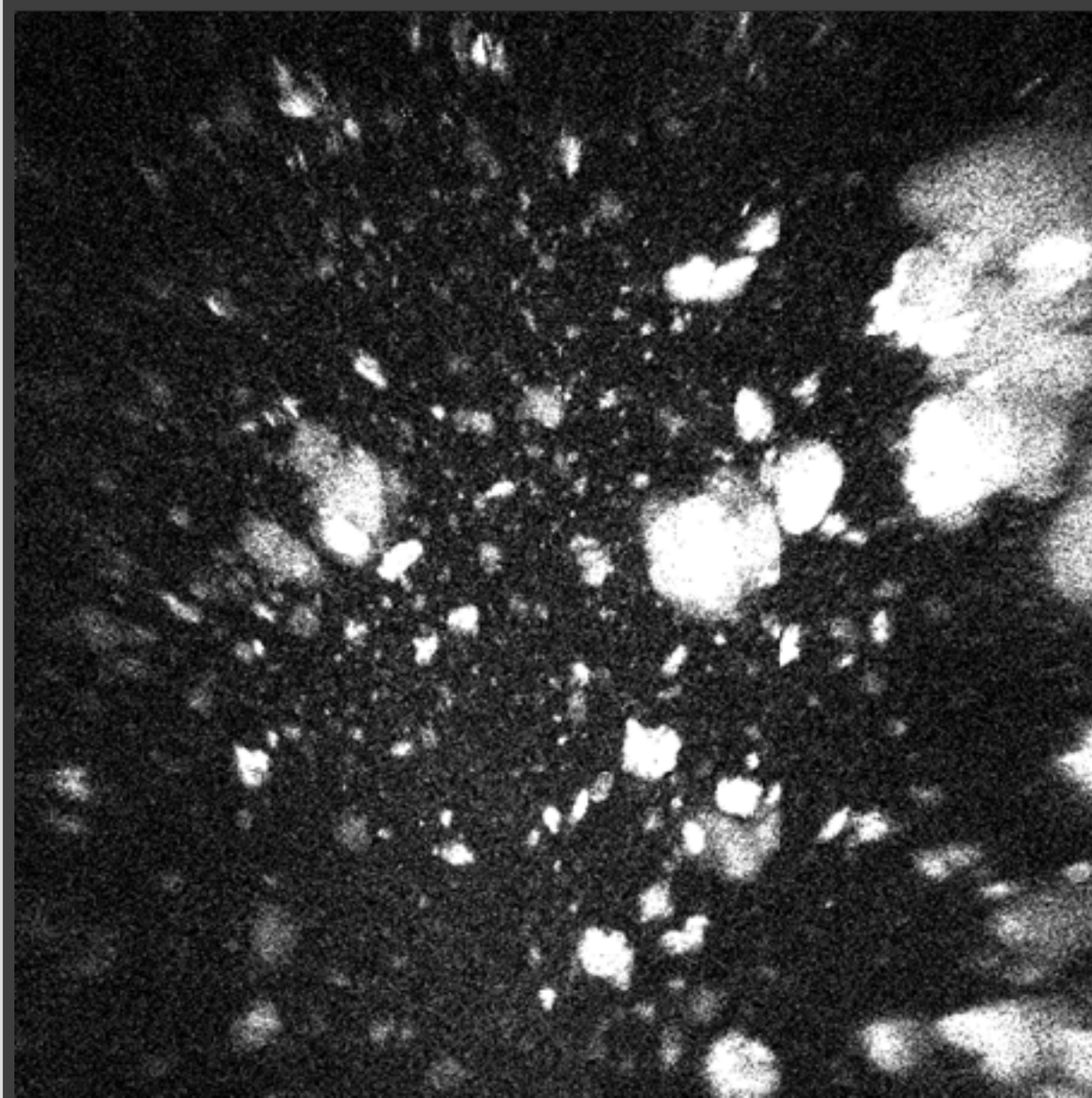
MARCH 14, 2024

LambdaVision Aims to Refine Process for In-Space Manufacturing of Artificial Retinas Through ISS National Lab-Sponsored Investigation

JANUARY 22, 2024

Cultivating the Cosmos: Decoding Crop Resilience Through Space-Grown Cotton

SEPTEMBER 29, 2023 • BY STEPHENIE LIVINGSTON, STAFF WRITER



Ground (left) and Space (right) -based crystallization of Pembrolizumab.

Learnings from spaceflight transformed ground-based processing, enabled a patent renewal, and boosted clinical outcomes of this ~\$28B per year cancer medicine (4x Q1-2024 reported sales).

npj | Microgravity www.nature.com/npjmgrav

ARTICLE OPEN

Pembrolizumab microgravity crystallization experimentation

Paul Reichert^{1*}, Winifred Prorise¹, Thierry O. Fischmann¹, Giovanna Scapin¹, Chakravarthy Narasimhan², April Spinale³, Ray Polniak⁴, Xiaoyu Yang⁵, Erika Walsh², Daya Patel⁵, Wendy Benjamin², Johnathan Welch⁵, Denarra Simmons⁶ and Corey Strickland¹

Crystallization processes have been widely used in the pharmaceutical industry for the manufacture, storage, and delivery of small-molecule and small protein therapeutics. However, the identification of crystallization processes for biologics, particularly monoclonal antibodies, has been prohibitive due to the size and the flexibility of their overall structure. There remains a challenge and an opportunity to utilize the benefits of crystallization of biologics. The research laboratories of Merck Sharp & Dohme Corp. (MSD) in collaboration with the International Space Station (ISS) National Laboratory performed crystallization experiments with pembrolizumab (Keytruda™) on the SpaceX-Commercial Resupply Services-10 mission to the ISS. By leveraging microgravity effects such as reduced sedimentation and minimal convection currents, conditions producing crystalline suspensions of homogeneous monomodal particle size distribution (39 µm) in high yield were identified. In contrast, the control ground experiments produced crystalline suspensions with a heterogeneous bimodal distribution of 13 and 102 µm particles. In addition, the flight crystalline suspensions were less viscous and sedimented more uniformly than the comparable ground-based crystalline suspensions. These results have been applied to the production of crystalline suspensions on earth, using rotational mixers to reduce sedimentation and temperature gradients to induce and control crystallization. Using these techniques, we have been able to produce uniform crystalline suspensions (1–5 µm) with acceptable viscosity (<12 cP), rheological, and syringeability properties suitable for the preparation of an injectable formulation. The results of these studies may help widen the drug delivery options to improve the safety, adherence, and quality of life for patients and caregivers.

npj Microgravity (2019)5:28; <https://doi.org/10.1038/s41526-019-0090-3>

“...widen the drug delivery options to improve the safety, adherence, and quality-of-life for patients and caregivers.”



- *Continue (Enhance!) meaningful and purposeful dialog and conversation, especially when it is difficult.*
- *Set and pursue common goals.*
- *Doing small things is more important than talking about big things. Wherever there is a chance to “do,” make it happen!*
- *Education, Education, Education (...and Education).*
- *Connect our young people and encourage meaningful personal relationships.*
- *Engage in person wherever possible. Travel is hard, but face-to-face collaboration is essential.*
- *Nurture the emergence of new space-related companies and industries.*





THE OHIO STATE UNIVERSITY

Von Bremen aus fanden die Menschen eine neue Welt





Mars ist nicht unsere Hoffnung.



Ernst Stuhlinger

Dr Ernst Stuhlinger



“...large areas of land could be utilized far better if efficient methods of watershed control, fertilizer use, weather forecasting, fertility assessment, plantation programming, field selection, planting habits, timing of cultivation, crop survey and harvest planning were applied. **The best tool for the improvement of all these functions, undoubtedly, is the artificial Earth satellite.**”

“...Efficient relief from hunger, I am afraid, will not come before the boundaries between nations have become less divisive than they are today. I do not believe that space flight will accomplish this miracle over night. **However, the space program is certainly among the most promising and powerful agents working in this direction.**”

“...As a stimulant and catalyst for the development of new technologies, and for research in the basic sciences, it is unparalleled by any other activity. **In this respect, we may even say that the space program is taking over a function which for three or four thousand years has been the sad prerogative of wars.**”

“...I believe that none of these celestial objects will find as much attention and study by space scientists as our Earth. **It will become a better Earth**, not only because of all the new technological and scientific knowledge which we will apply to the betterment of life, but also **because we are developing a far deeper appreciation of our Earth, of life, and of man.**”



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Vielen Dank für die Einladung!



Danke!

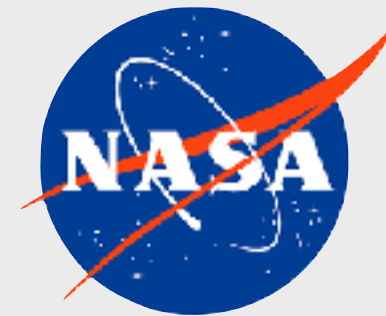


Entrepreneur
2000-2005



- ✱ Co-founder and President
- ✱ Financial Services, Compliance S/W
- ✱ Product design, coding.
- ✱ Raised the 1st Deutsche-Banc private equity investment in AL, (US\$5M in 2000).

Government
2005-2009



- ✱ Senior Executive Service
- ✱ Director, Science & Mission Systems
- ✱ All science and non-launch vehicle programs/projects and hardware
- ✱ ~\$300M portfolio, >300 CS/Contractor team.

Academia
2009-2012



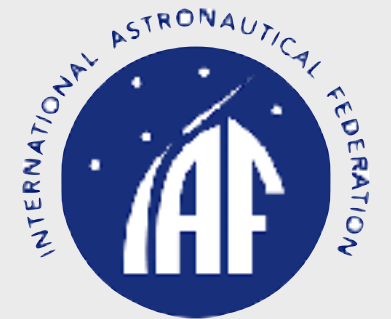
- ✱ VP for Research, Tenured Professor of Physics
- ✱ 5 colleges, 14 centers, sponsored programs, research security.
- ✱ \$65M -> ~\$100M
- ✱ Carnegie "Tier 1 research ranking

Private Sector
2012-2015



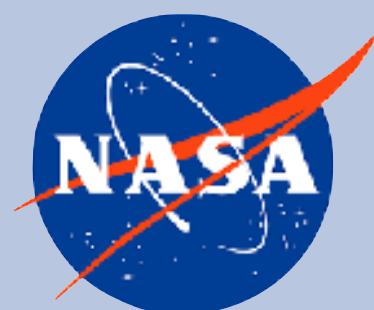
- ✱ Vice President, Space Systems
- ✱ Payloads, flight hardware, ISS commercial imaging.
- ✱ \$48M -> ~\$70M
- ✱ Reversed 7-year revenue decline.

Not-for-Profit
2006 -



- ✱ Vice President, Technical
- ✱ One of twelve, two Americans.
- ✱ Largest global group of space professionals.
- ✱ Technical content and Congress Evolution
- ✱ Advisor to President

Government
1987-2000



- ✱ High Energy Astrophysics Research
- ✱ Compton Gamma Ray Observatory
- ✱ Burst and Transient Source Experiment

- ✱ Gamma-ray bursts are cosmological
- ✱ Gamma-ray flashes from thunderstorms
- ✱ GRBs most consistent with accelerating universe