WELCOME!

Parallax ADVANCED RESEARCH + Ohio Federal Research Network

Driving Innovation Through Strategic Partnerships

Join us for

Ohio Federal Research Network (OFRN)

Opportunity Days

Free Virtual Event

March 20 | 9:00 - 10:30 AM (ET)

Agenda

- **9:00 - 9:15 am** – OFRN/OnRamp Hub: Overview by Mark Bartman, Maj Gen (Ret.), VP for Advanced Development, Parallax Advanced Research
- **9:15 - 9:45 am** – Dr. Eric Brizes, Aerospace Materials Engineer, NASA Glenn Research Center
- **9:45 - 10:15 am** – Dr. Chad Waddington, Assistant Deputy Technology Executive Officer for Space, Air Force Research Laboratory
- **10:15 - 10:25 am** - Opportunity Review, Steven Price, OFRN Associate
- **10:25 - 10:30 am** - Wrap-up

Introductions & Thank you

Parallax Team & Event Volunteers

- **Emcee:** Mark Bartman, Maj Gen (Ret.), VP for Advanced Development, Parallax Advanced Research

- **Parallax Team:**
  - Becky Mescher
  - Lauren Jones
  - Jess Pacheco
  - John Jackson

- **Event Speakers:**
  - Dr. Eric Brizes, Aerospace Materials Engineer, NASA Glenn Research Center
  - Dr. Chad Waddington, Assistant Deputy Technology Executive Officer for Space, Air Force Research Laboratory

- **Opportunity Review:**
  - Steven Price, OFRN Associate

- **Government partners:** AFRL, NAMRU-D, NASA-GRC, NASIC, Ohio National Guard

OFRN Construct

Ohio Federal Research Network
Driving Innovation Through Strategic Partnerships

NASA Glenn Research Ctr (GRC) Priorities

Air Force Research Lab (AFRL) Priorities

National Air & Space Intelligence Ctr (NASIC) Priorities

State of Ohio

Industry Needs

PARALLAX & The Ohio State University

Naval Medical Research Unit (NAMRU) Priorities

Ohio National Guard Priorities

Executive Review Board

Technical Review Council

OFRN Program Impact – to date

22
Universities & colleges engaged

4+1
Government Partners

106
Business partners engaged

1,100+
Indirect jobs created

359
Direct jobs created

13
Spin out companies created

$61.8M
State of Ohio Investment - ODHE

$374+M
Follow-on Funding Awarded

$39M
Cost Share

OFRN: Round 6 Projects

Proj #	Project Title	AOI	Lead	Team	Government Partner
602	Quantum Sensor System using Rydberg Atoms	Quantum Sensing Technologies	GhostWave Inc.	OSU, UDRI, Converge Technologies, Infleqtion	AFRL
609	Structural Materials Joining in Space	Commercial Space in Low Earth Orbit	The Ohio State University	UD, Central State Univ., Agile Ultrasonics LCC, Lincoln Electric, Nanoracks	AFRL, NASA
619	High Bandwidth Light Weight Modular GaN Based Utility Interactive DC Emulator	High Power Energy Conversion	University of Akron	CWRU, PC Krause & Associates	AFRL
624	Ocular and Physio-Temporal Indicators of Cognitive State (OPTICS)	Human Performance	Kairos Research	WSU, Sinclair, The Entrepreneurs' Center	AFRL, NAMRU-D
625	Gradient Alloy Processing in Laser Powder Bed Fusion for Hypersonic Applications	Hypersonics	Arctos Technology Solutions	OU, UT, GoHypersonic, Hyphen Innovations	NASA
628	A Machine Learning Framework for Digital Engineering of Hypersonic Vehicles with Quantified Prediction Uncertainty (Hypersonic ML FW)	Digital Engineering Tools	CFD Research Corporation	AFIT, WSU	AFRL

Great Lakes Mission Acceleration Center (MAC)

Defense Innovation Unit (DIU) OnRamp Hub: Ohio

The MAC Network – What Makes Us Unique

Parallax ADVANCED RESEARCH

- ✓ Established existing ecosystems for entrepreneurs and small businesses that have experience working with federal agencies’
  - Great Lakes MAC (OH)
  - Great Plaines MAC (KS)
  - Southwest MAC (AZ)
  - Northwest MAC (WA)
  - IndoPacific MAC (HI)
- ✓ Robust networks of angel investors and venture capital
- ✓ Extensive State funding to help with startups (ESP, TVSF)
- ✓ Follows a systems engineering approach to reduce risk and speed transition
  - Ecosystems for prototyping and manufacturing (WBI, CDME, MEPs etc)
  - Test locations – AAM range in Springfield, National Guard locations, Tech Warrior experience
  - Airworthiness support from AFLCMC
  - Software Factory – Hanger 18 – DevSecOps, Cloud, AoA

The MAC Network in Ohio

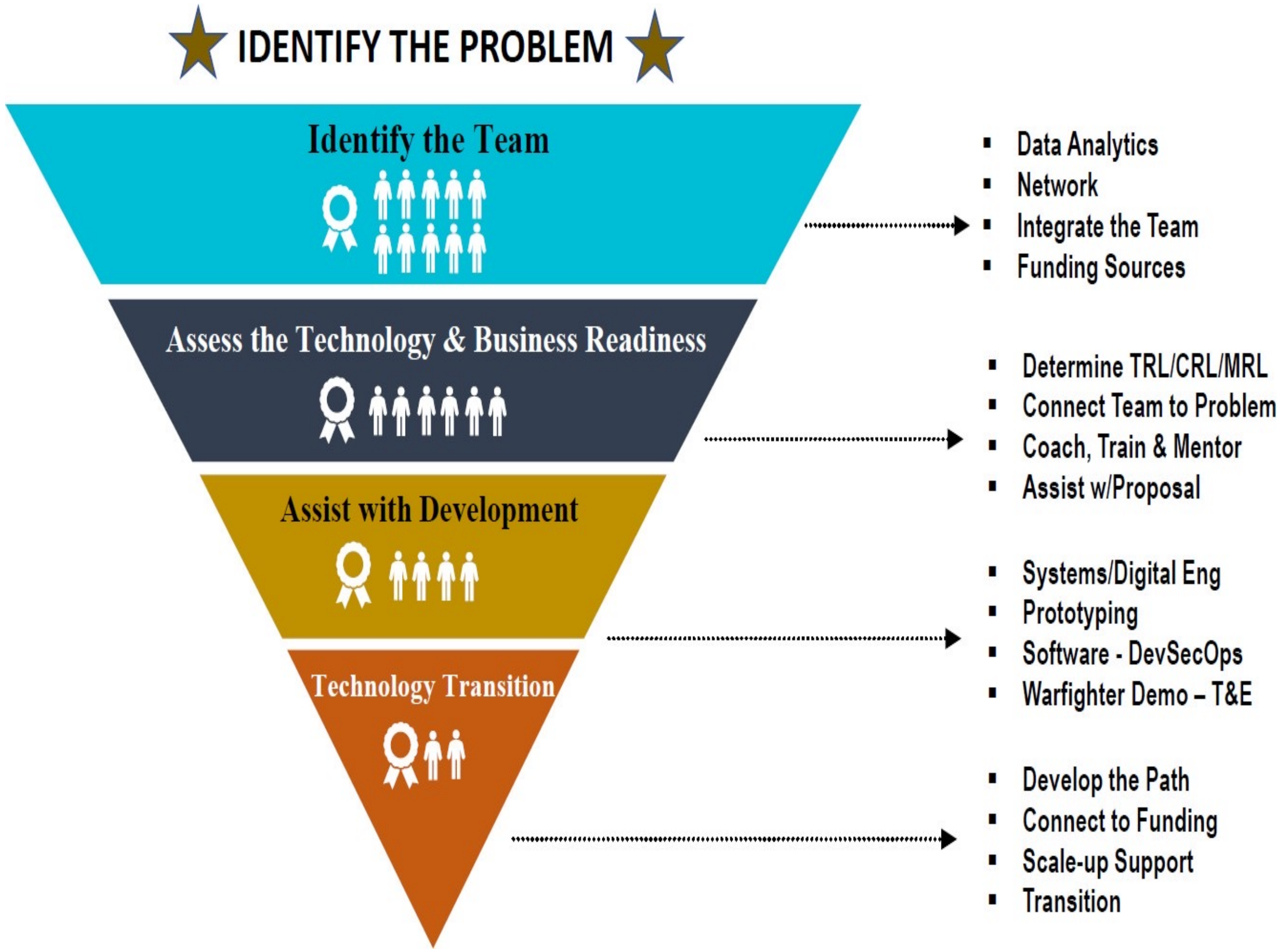
A network of networks to bring innovation to DoD and solve key problems to create an unfair fight

The MAC Team are Connectors to:

- Investors at every capital stage (angel, seed, growth, Federal and State R&D funding)
- Prospective customers including major Fortune 100 corporations
- Academic and State Innovation Ecosystems (i.e., OFRN) including the Ohio Research Universities
- S/W & H/W Prototyping
- Manufacturing Expertise and Capabilities
- Test and Evaluation Locations
- Digital Engineering Resources

Technology Positioning

The Great Lakes MAC leverages technology scouting to find the most advanced and promising technologies to meet the DOD's operational demands

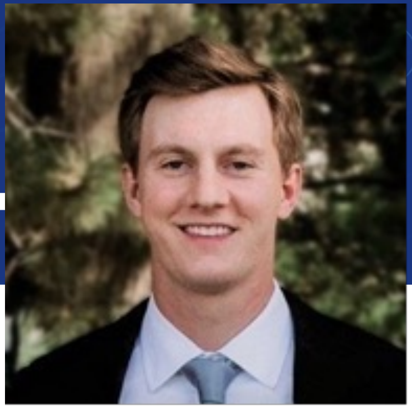


Parallax ADVANCED RESEARCH

Ohio Federal Research Network

Driving Innovation Through Strategic Partnerships

Dr. Eric Brizes
NASA GRC



National Aeronautics and Space Administration

Materials Joining Automation in Low Earth Orbit

Eric Brizes [a]

[a] NASA Glenn Research Center, Cleveland, OH

OFRN Opportunity Day. Virtual. March 20, 2024

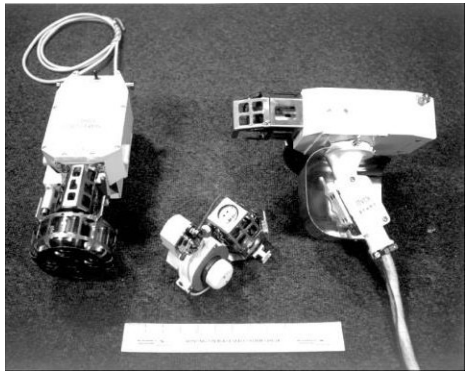
Introduction

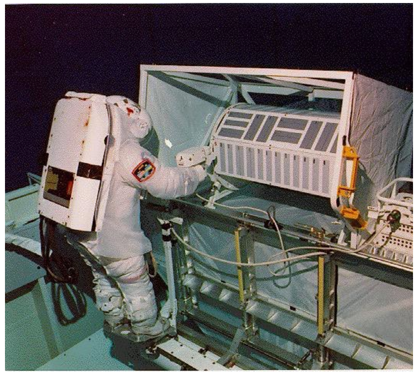
What does NASA envision for the future of materials joining in Low Earth Orbit?

- Robotic arms with weld heads strategically placed for component assembly
- Spider-like robots that climb trusses of spacecraft to join modules and expand structures
- Dedicated ISAM craft with programmable fusion welding capabilities

Ideally, limit dependence on astronauts for safety/reliability

[1] J. Sowards

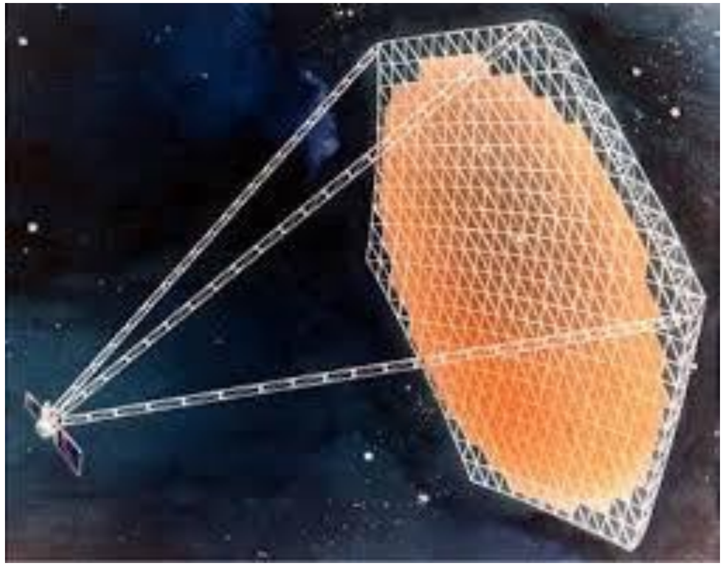


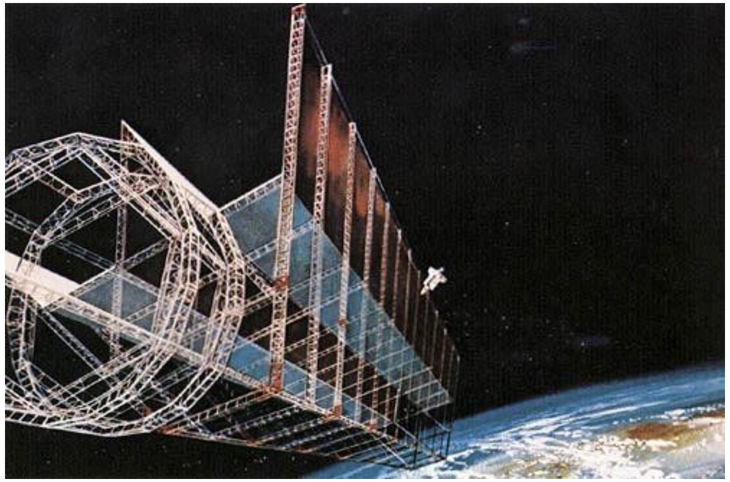


Benefits of In-Space Welding

- Faster than mechanical fastening
- Joint strength matches the parent material with no added mass
- Welds are less susceptible to thermo-mechanical fatigue
- Joints can produce hermitic seals
- Enables component repair and servicing
- **Welding is crucial to overcoming launch vehicle size and volume constraints for building of large and complex structures in LEO**

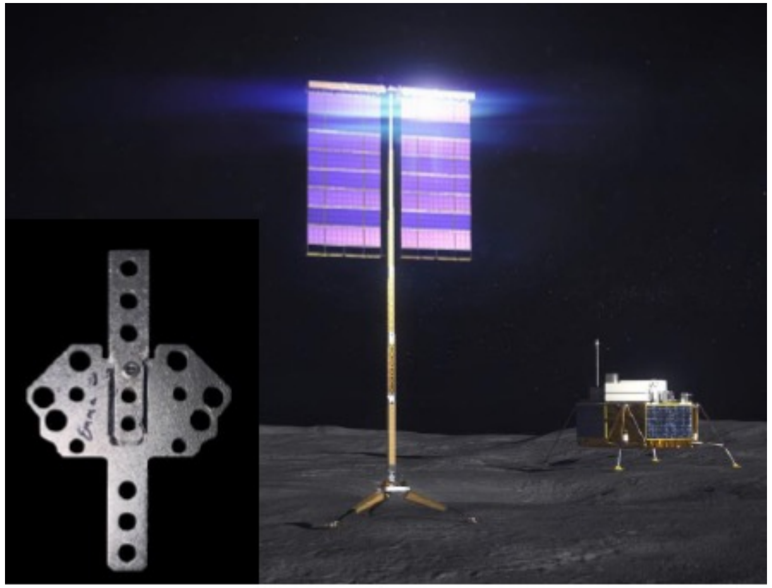
[1] J. Sowards



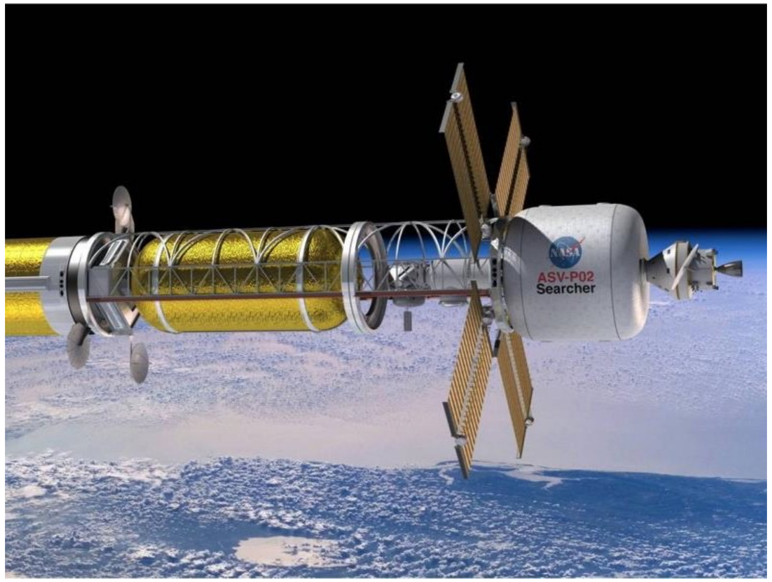


[1] J. Sowards

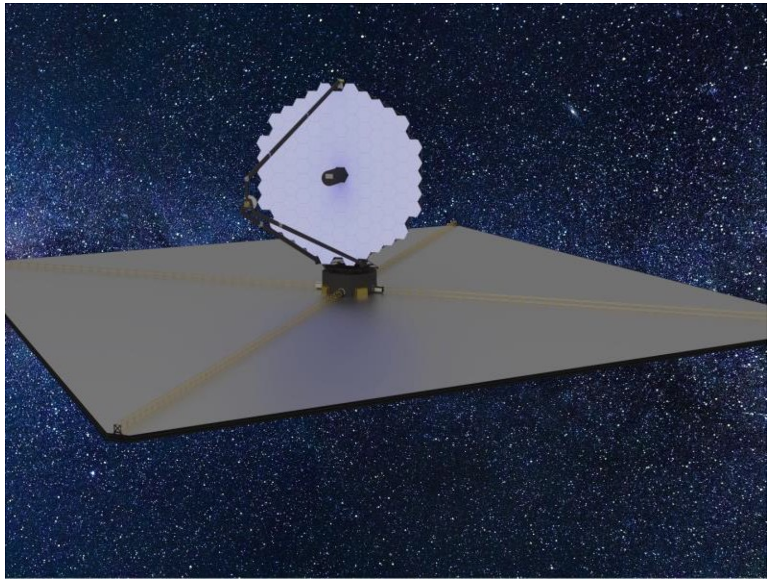
Future Applications



Welding is being considered for joining truss connections of lunar solar arrays and communication towers. Tower truss connection made with handheld laser beam spot weld and lap welds.



Concept nuclear powered spacecraft; distance between inhabitants and the reactor to ensure astronaut safety from radiation. Welding is a candidate assembly process for building the structure.



Next-generation telescopes could benefit from welding in space. Shown above is the proposed Large UV/Optical/IR Surveyor (LUVOIR) telescope with its large sunshield system and a truss structure.

[1] J. Sowards

Welding Process Considerations

Table-3
Candidate Processes for In-Space Applications

CRITERIA \ PROCESS	EBW	GTAW	PAW	LBW
OPERATOR/MISSION SAFETY	Satisfactory	Good	Poor	Poor
MICRO-G WELD QUALITY	Good	Good	Good	Good
IVA & EVA FLEXIBILITY	Poor	Good	Good	Good
WORKPIECE VARIETY	Satisfactory	Satisfactory	Good	Good
OPERATION MODE FLEXIBILITY	Good	Good	Good	Poor
TOLERANCE FLEXIBILITY	Satisfactory	Good	Good	Poor
POWER REQUIREMENTS	Good	Good	Good	Poor
ENERGY EFFICIENCY	Good	Good	Satisfactory	Poor
CONSUMABLES REQUIREMENTS	Good	Satisfactory	Poor	Poor
EQUIPMENT SERVICEABILITY	Satisfactory	Good	Satisfactory	Poor

LEGEND: ○ GOOD ◒ SATISFACTORY ● POOR

[1] J. Sowards

- What is the risk of malfunction and/or creation of reflected beams, weld spatter (micrometeoroids), or fumes?
- Can it be used both inside and outside of capsules/habitats?
- Is the process effective for a wide range of materials (aluminum, titanium, stainless steel, refractories) and joint designs?
- Will the equipment draw too much power?
- Does the joining process require an inert shielding gas or filler material?
- If the equipment breaks, will we be able to fix it?

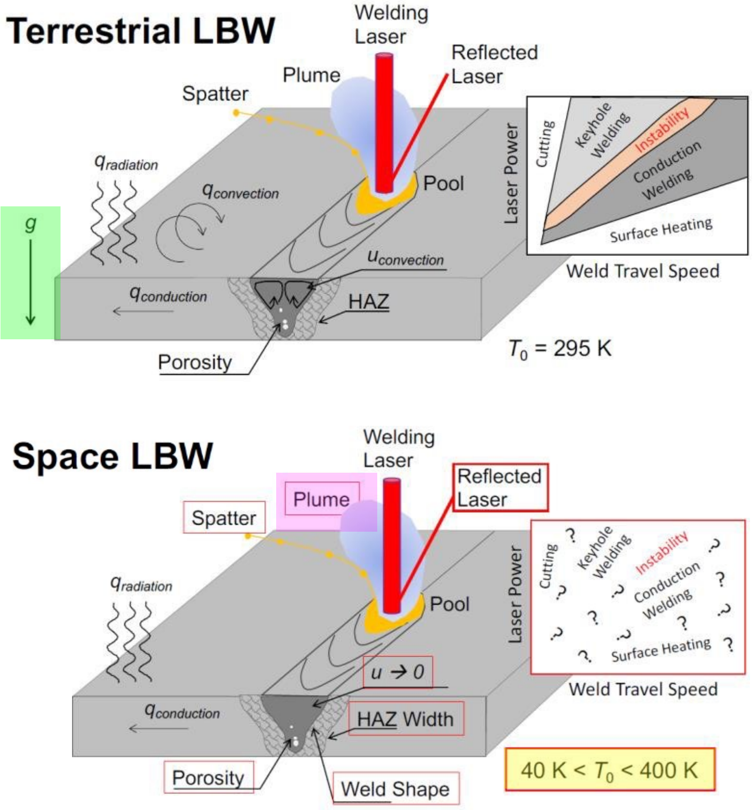
Welding Parameter/Metallurgy Considerations

The following issues need to be addressed:

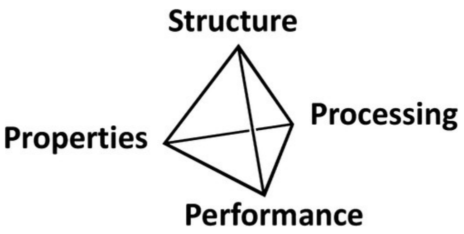
1. Temperature gradients and weld heat transport have profound effect on size of a weld and its metallurgical transformations and hence weld properties
2. Reduced gravity minimized buoyancy-induced convection which changes weld pool shape and porosity evolution
3. The vacuum of space promotes volatilization of light elements and modifies the dominant heat transport mode from convection to radiation.

How do these problems influence the materials tetrahedron?

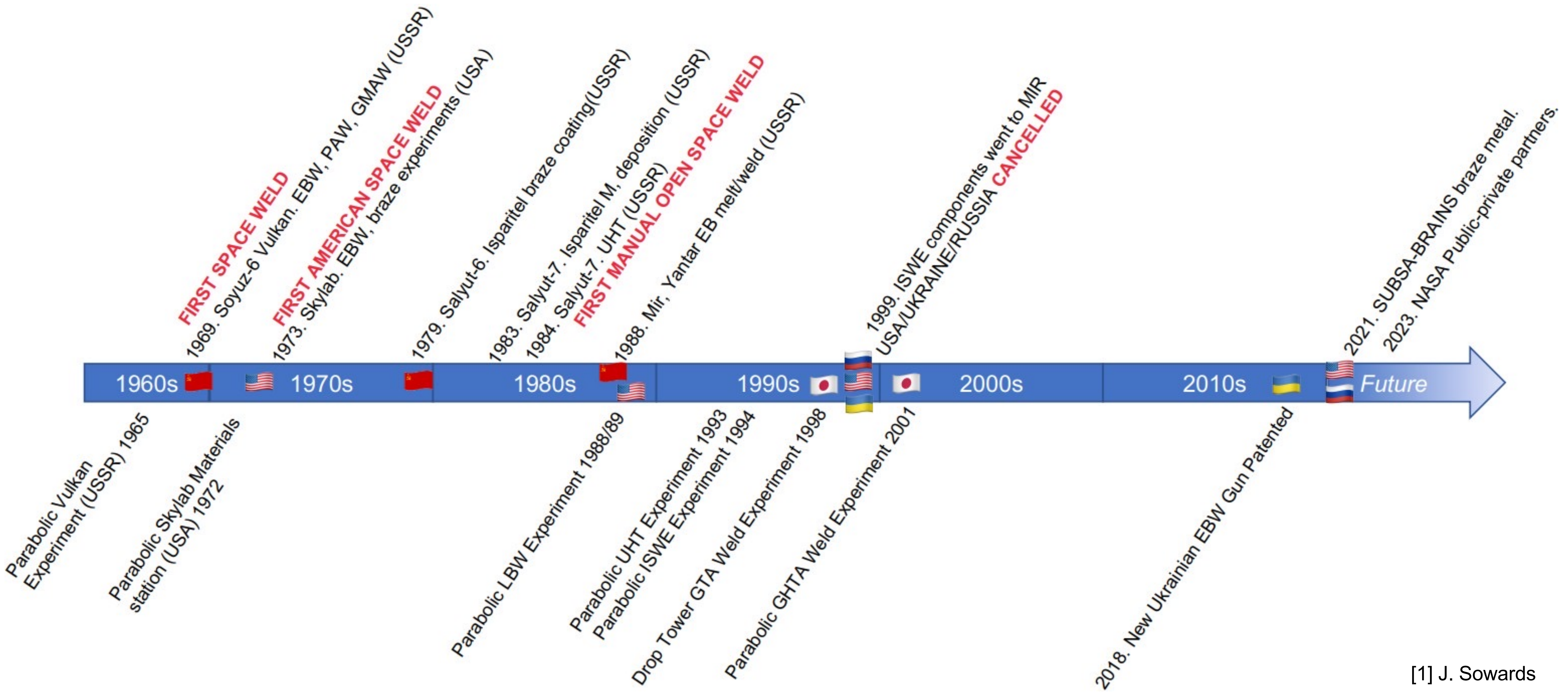
[1] J. Sowards



[1] J. Sowards



Timeline of In-Space Welding Activities



[1] J. Sowards

Key Findings from Historical Experiments

- Electron Beam Welding, Gas Tungsten Arc Welding, Plasma Arc Welding, and Gas Metal Arc Welding have been demonstrated in-space.
- Laser Beam Welding has been demonstrated under vacuum/microgravity
- The strength of in-space welds are comparable to terrestrial welds
- Need to reduce reliance on astronauts
- Need to carefully consider safety reflected energy beams, spatter, fumes

But it has been over 50 years since the last American in-space fusion weld…

New technologies like laser beam welding have significantly advanced.

[1] J. Sowards

[1] J. Sowards

OFRN Project: Structural Materials Joining in Space

ROUND 6 – AOI 5 Commercial Space in LEO

609 – Materials Joining and Automation in LEO

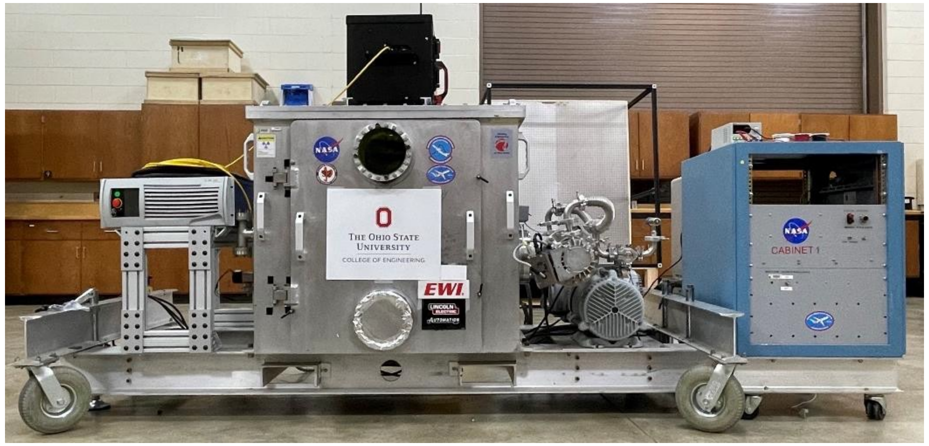
- In-person Kick-off meeting at NASA-GRC 12/5/2023
- Addressing NASA and AFRL need to develop joining of materials (metals, polymers, and composites) in LEO
- Hires to Date: 2 Engineers, 1 Graduate Research Associate, 11 Undergraduate Research Assistants, 1 Team Member at EWI

[2] E. Choi

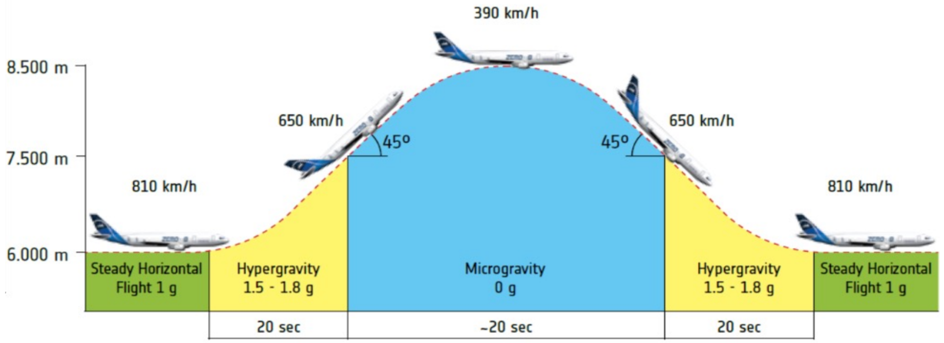
OFRN Project: Structural Materials Joining in Space

Objectives

1. Mature the technology readiness level of LEO laser beam welding
2. Data collection for Integration Computational Materials Engineering (ICME) and other parallel modeling efforts
3. Understand the weldability of common aerospace alloys in the LEO environment



[2] E. Choi



Performing joining processes in a self-contained vacuum chamber welding system aboard a parabolic variable gravity flight to reproduce in-space conditions.

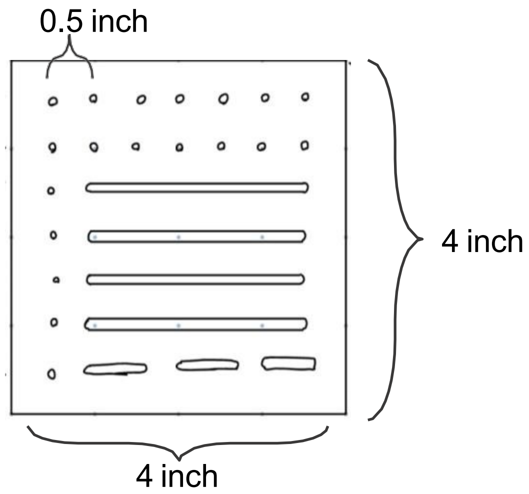
[2] E. Choi

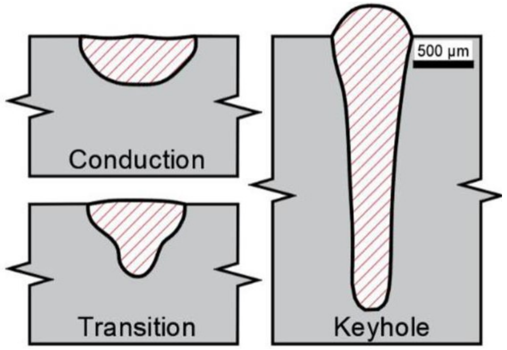
OFRN Project: Structural Materials Joining in Space

Test Plan

- Materials
  - AL 2219, 316L SS, TI-64
- Parabolic flight test conditions
  - Micro-gravity to hyper gravity
  - 0g ~ 1.8g
- Weld Parameters
  - Spot, bead on plate, lap-welds
  - Power, travel speed, focus, pulsing
- Temperature
  - Ambient temperature (293°K)
- Pressure
  - Weld Chamber: 10^{-6} Torr
  - Low Earth Orbit (LEO): 5×10^{-8} Torr

[2] E. Choi





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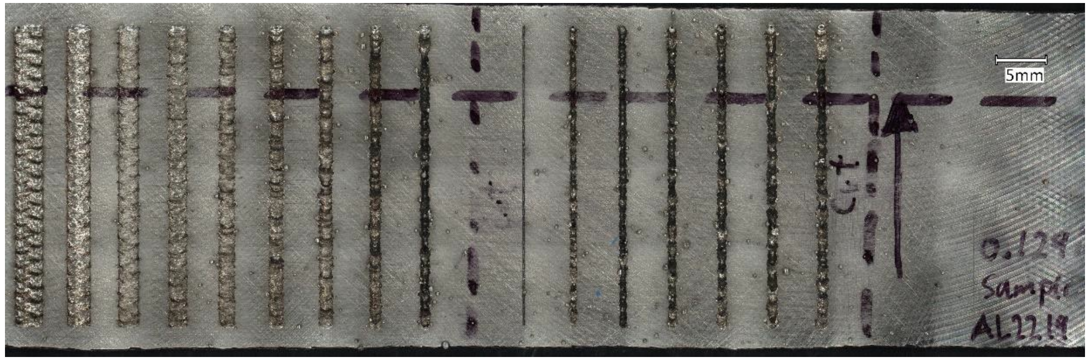


OFRN Project: Structural Materials Joining in Space

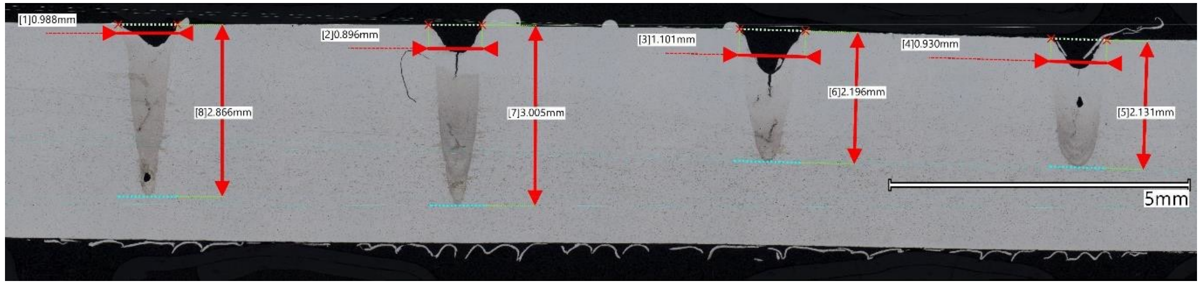
Post-Test

- Data Analysis
  - Thermal and optical video for heat flow & laser plume physics
  - Accelerometer for gravity
- Weld Characterization
  - Optical microscopy, SEM / EDS / EBSD
  - Microhardness mapping

Xiris XIR-1800 Thermal Camera

XVC-700 Weld Camera

[2] E. Choi



Determine:

- The root cause of physical & metallurgical differences of in-space welds
- New allowables for the mechanical performance of LEO welds

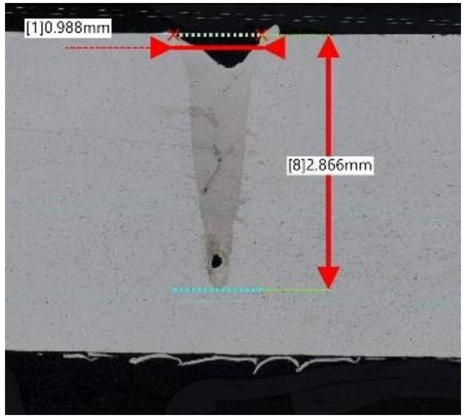
[2] E. Choi

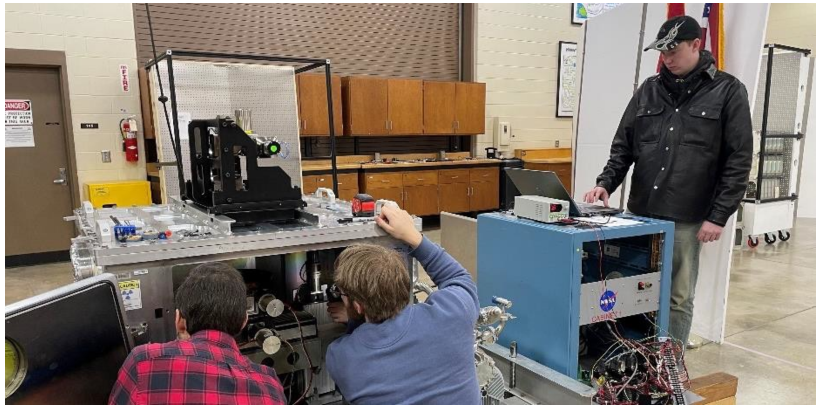
OFRN Project: Structural Materials Joining in Space

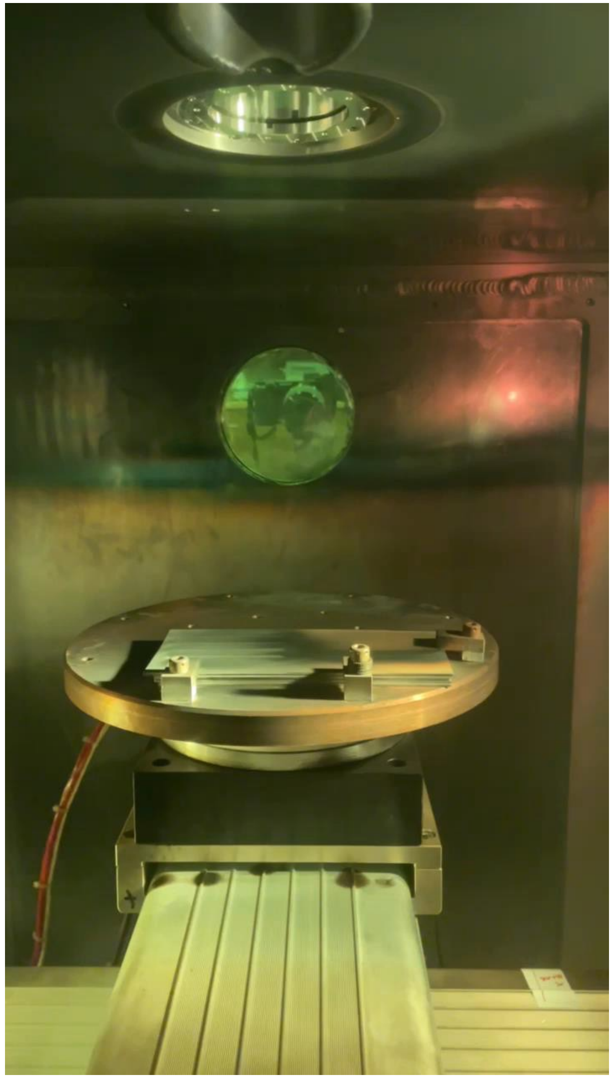
Current Status

- Analysis of terrestrial weld parameters in atmospheric & vacuum condition
- Parabolic flight test parameter development
- Zero-G payload integration package regulations
- Camera and sensor integration for data collection

[2] E. Choi







[2] E. Choi

OFRN Project: Structural Materials Joining in Space

Future Work

System Upgrades: Temp/Sens.

Adaptation to Other Processes: Ultrasonic Welding, Cold Welding

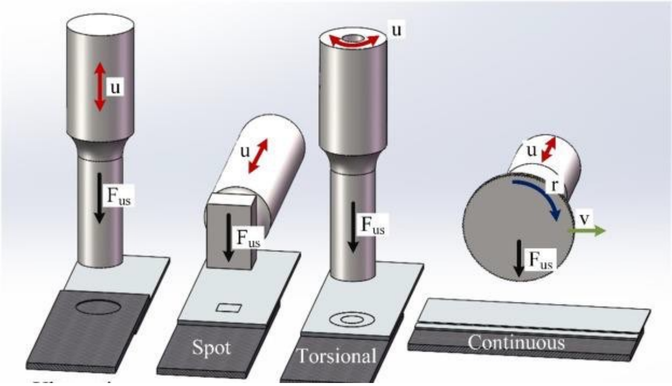
Low Earth Orbit Laser Beam Welding

1st Parabolic Flight (Jul. 2024)

2nd Parabolic Flight (Jan. 2025)

Development of In-Space Welding System

[2] E. Choi



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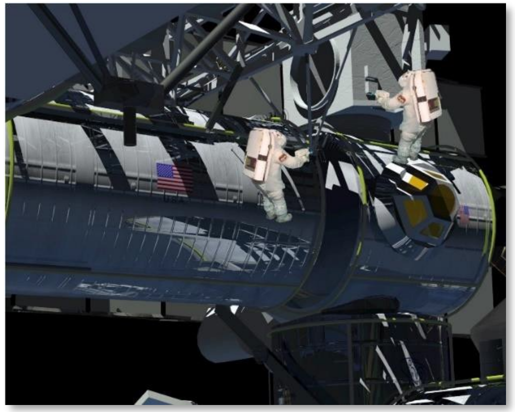

Get Involved

Please contact the team:

OSU

- Prof. Antonio Ramirez
- Prof. Boyd Panton
- Eugene Choi

NASA

- Jeff Sowards (MSFC)
- Eric Brizes (GRC)

AFRL

- Andrew Hamilton

Acknowledgements

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D. Mercer
GRC
B. Carter
S. Miller

Lincoln Electric
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EWI
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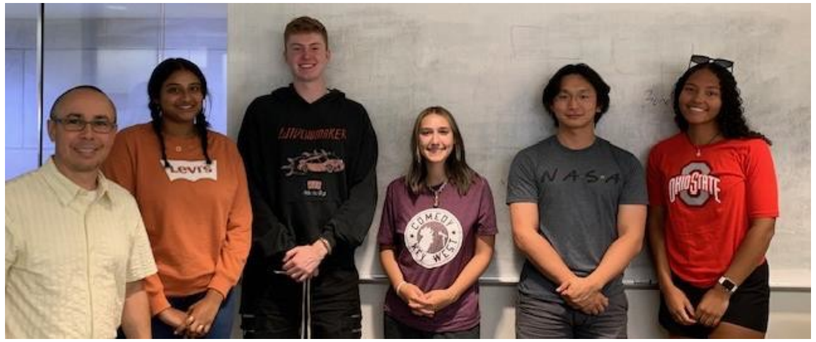
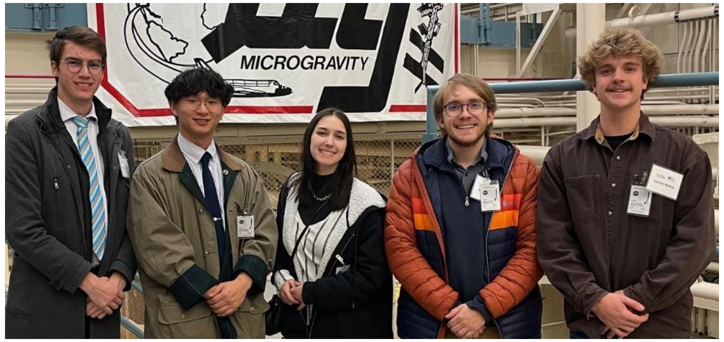
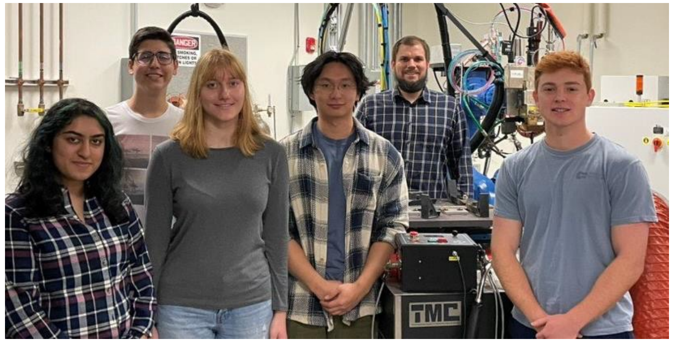
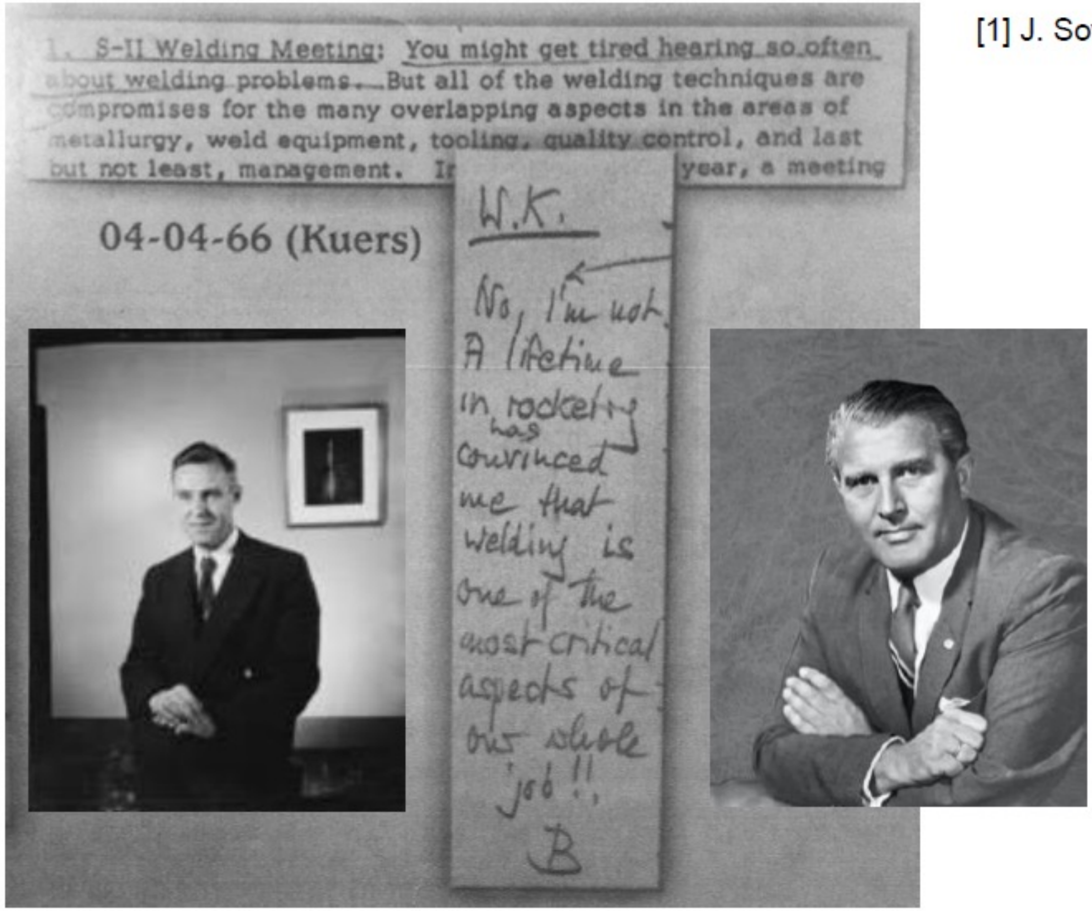








[1] J. Sowards

A lifetime in rocketry has convinced me that welding is one of the most critical aspects of our whole job!!

- Wernher von Braun (1966)

Werner Kuers
MSFC Manufacturing Laboratory Director

Wernher von Braun
MSFC Center Director, Deputy NASAAdmin

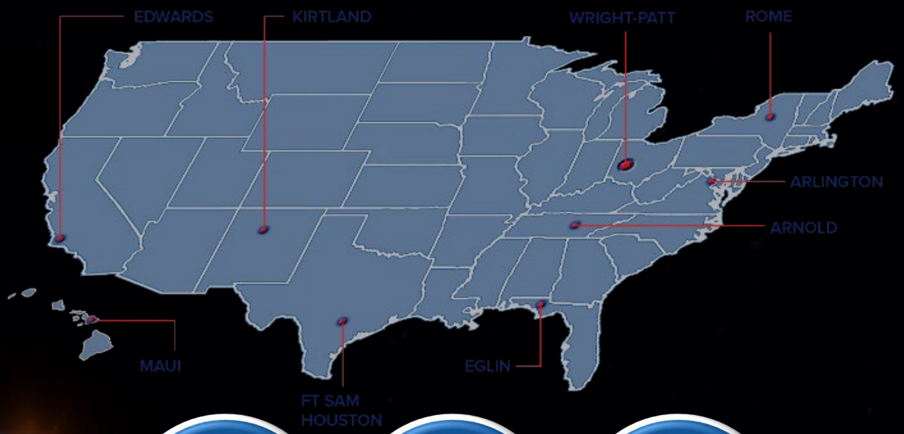
References

1. J. Sowards, “Welding in Space: Past, Present, and Future,” *2023 AWS Professional Program*, Chicago, IL, 2023.
2. E. Choi, A. Brimmer, W. McAuley, S. Huetter, G. Smith, A. Shajahan, R. Morton, K. May, B. Panton, A. J. Ramirez, “Integration and Ground Demonstration of Self-Contained Laser Welding System for Parabolic Microgravity Experiments,” *2024 Worldwide Advanced Manufacturing Symposium*, Orlando, FL, 2024.

Dr. Chad Waddington
AFRL

EXPANSIVE SPACE PORTFOLIO

One AFRL – works across vast technological areas, finding synergies that allow us to move faster to field critical space programs



Space Vehicles RV
- Space technologies
- Space experimentation

Directed Energy RD
- Space Domain Awareness
- Laser & high power microwave effects

Aerospace Propulsion RQ
- Space access
- In-space propulsion
- Space logistics

Computer Resources RC
- Super computing resources
- Digital transformation

Materials RX
- Materials & manufacturing
- Laser hardening
- Additive manufacturing

AFWERX RG/SB
- Innovation
- Tech and industrial base expansion

Classified Programs

SDPE RS
- Inform S&T Vector
- Experimentation
- Operational assessment
- MS&A and Studies

Information RI
- Networks & comms
- Cyber
- Multi-domain C2

Airman Systems RH
- Operator performance
- Autonomous systems
- Operator training

Munitions RW
- Small platform PNT, sensors, and components

Sensors RY
- Sensor & data exploitation
- Cognitive EW
- Position, Nav, & Timing

Basic Science AFOSR
- Basic science – materials, quantum, power, etc
- International research

AFRL

UNDERLYING TENETS FOR ***ONE AFRL-TWO SERVICES***

- Today's threat requires multi-disciplinary solutions
- Cross-discipline collaboration enhances outcome
- AFRL has deep, strong space history expertise
- Eliminates duplication and reduces overhead to optimize and stretch limited research funding
- Leverage shared lab facilities, test assets, tools
- Enables robust, multi-domain Digital Enterprise
- Established Deputy TEO for dedicated support
- Efficient, agile, and collaborative engagement

Best return on investment for limited Department of the Air Force resources

TEO vs AFRL/CC: Different Authorities, Responsibilities, Relationships, Expectations...

Hon Frank Kendall III

Secretary of the Air Force

Gen Brown

Chief of Staff, USAF

Gen Saltzman

Chief of Space Operations

Gen Richardson

Commander, Air Force Materiel Command

Hon Hunter

USAF Service Acquisition Executive

STRATEGIC / OPERATIONAL

TEO
Est. 1990

Plans and Executes the DAF S&T Portfolio. Reports Progress to SAEs. Drives DAF S&T Strategy development and implementation for SECAF/SAEs.

AFRL/CC
Est. 1997

Manages the laboratory infrastructure and personnel.

OPERATIONAL / TACTICAL

Hon Calvelli

USSF Service Acquisition Executive

Lt Gen Garrant

Commander, Space Systems Command

TEO & DEPUTY TEO FOR SPACE – FOCAL POINTS FOR USSF S&T EXECUTION

Emphasizing the path for space-focused science and technology programs

- Determining Space S&T needs and priorities
- Developing and maintaining Space S&T strategic plan
- Providing direction and oversight of the Space S&T portfolio across executing organizations
- Developing the Space S&T element of the USSF POM
- Interacting, coordinating, collaborating, and partnering across the larger Space S&T community within the DoD, industry, private sector, other government agencies, and international

Integrate and execute the Space S&T portfolio across AFRL

U.S. AIR FORCE USSF

ONE AFRL

TEO
Major General (S)
Scott Cain

Deputy TEO for Space S&T
Dr. Andrew Williams

OFFICE OF THE DEPUTY TEO ORGANIZATION

Deputy TEO for Space S&T
Dr. Andrew Williams

Space Mission Area Lead
Deputy to DTEO for Space S&T
Dr. Andrew 'AJ' Metcalf

Chief of Staff
Mr. Barry Bunn

Space Domain Awareness
Ms. Laura Durr

Space Information Mobility
Dr. Wellesley Pereira

Space Mobility & Logistics
Dr. Robert Antypas

Space Security & Intl Partnerships
Mr. Ron Caton

Space Superiority
Lt Col Michael "Peewee" Sherman

Technical Integration Lead
Capt Greg Anderson

Space Engagement Lead
Ms. Jessica Brueggeman

Finance Lead
Mr. Alec Kirbabas

Assistant Deputy TEO
Dr. Chad Waddington

Chief, Management Ops
Ms. Saje Taylor

SPACE MAL ROLES AND RESPONSIBILITIES

- Advance customer engagement and serve as the primary AFRL interface to external stakeholders
- Coordinate across the Space Force and partner organizations to develop prioritized tech needs and capability gaps
- Work with AFRL Chief Technologist and Deputy TEO to develop a cross-directorate investment strategy and roadmap to meet USSF needs

Kirtland AFB

Space Domain Awareness
Ms. Laura Durr

Kirtland AFB

Space Information Mobility
Dr. Wellesley Pereira

Edwards AFB

Space Mobility & Logistics
Dr. Robert Antypas

Kirtland AFB

Space Security & Intl Partnerships
Mr. Ron Caton

Wright-Patterson AFB

Space Superiority
Ms. Rebecca Rothstein

SPACE MAL TECHNICAL AREA BREAKDOWN

Space Domain Awareness

- Terrestrial and on-orbit Space Domain Awareness, Space Environment Monitoring

Space Mobility and Logistics

- Launch, In-Space Propulsion, In-Space Servicing and Logistics, In-Space Assembly and Manufacturing

Space Information Mobility

- Comm, Position Navigation and Timing, ISR, Missile Warning

Space Security & International Partnerships

- International Agreements/Partnerships, Space Policy

Space Superiority

- Space Control, Battle Management, Cyber

Technical areas aligned to
Space power: Doctrine for Space Forces

AFRL

DTEO CONTACT INFORMATION

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Space Superiority MAL

Ms Rebecca Rothstein (937) 255-5676

Rebecca.rothstein@spaceforce.mil

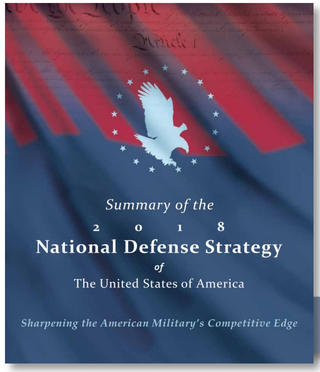
TCO Overview

AFRL Transformational Capabilities Office

AFRL.TCOPartnering@us.af.mil

AFRL PA Case Number: AFRL-2021-1621

AF Recognizes the Need for Two Components of S&T Investment



<u>Strategic Capabilities</u> driving future Air Force technological advantage

- Global Persistent Awareness
- Resilient Information Sharing
- Rapid, Effective Decision-making
- Complexity, Unpredictability and Mass
- Speed and Reach of Disruption and Lethality

<u>Foundational Air Force S&T Missions</u>

- Discovering new technology of Air Force relevance
- Identifying solutions to established Air Force mission gaps
- Maturing technology into Air Force systems
- Responding to urgent needs

Air Force S&T Portfolio

Transformational Component 20%

- Focused on driving FUTURE FORCE DESIGN
- Disruptive "first in class" system innovations
- Vanguard programs

Enabling & Enduring Component 80%

- Focused on foundational Air Force S&T missions
- Broad-based around technology opportunities and capability gaps
- Organized around technical disciplines

Integrated Capabilities Mission & Vision

Four Offices Unified Within One Directorate

Est. 2020

Transformational Technology Demonstrations (6.2-6.3)

Leading Technical Achievements That Demonstrate The Viability of Leap-Ahead Capabilities

Rapid Operational Innovation (FLEX 4)

Rapidly Develop And Deliver Solutions That Address Select Near-Term Warfighter Needs

Inc. 2022

Est. 2016

Operational Experimentation & Prototyping (6.4)

Delivering Decision Quality Military Utility And Effectiveness Data of Capability Concepts

Strategic Development Planning (6.6)

Enabling Long-Term Transition Through System of Systems Concepts Fueled By Robust MS&A

Architecture Design & Integration (6.4)

Designing and Integrating Warfighting Architectures at Systems-of-Systems Level

Est. 2021

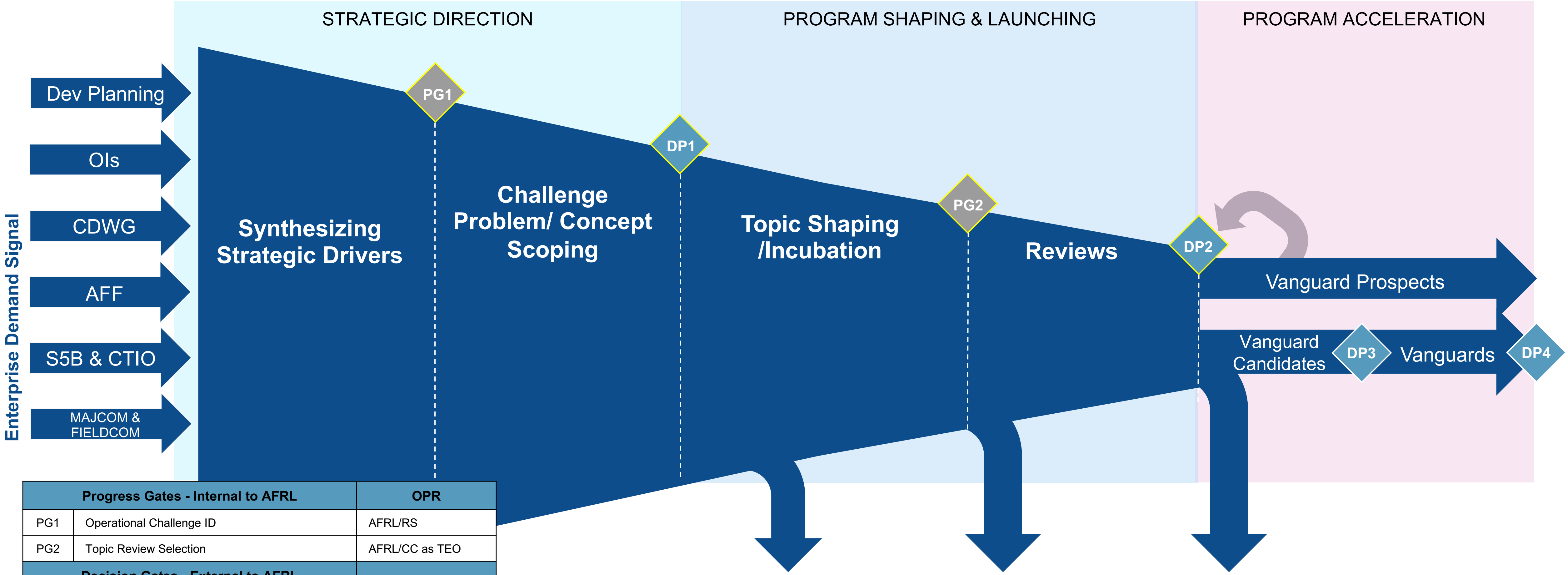
WARTECH Overview

AFRL Transformational Capabilities Office

AFRL.TCOPartnering@us.af.mil

AFRL PA Case Number: AFRL-2021-1621

WARTECH 23 Process Overview



Progress Gates - Internal to AFRL		OPR
PG1	Operational Challenge ID	AFRL/RS
PG2	Topic Review Selection	AFRL/CC as TEO
Decision Gates - External to AFRL		
DP1	Operational Challenge/Concept(s) Endorsement	EXCOM
DP2	Large Scale Investments	EXCOM
DP3	Vanguard Commissioning	DAF Top 6
DP4	Transition to PoR	PEO

WARTECH Handoff

- AFRL Tech Directorates
- SDPE
- Watch Industry

STOP

Vanguard Overview

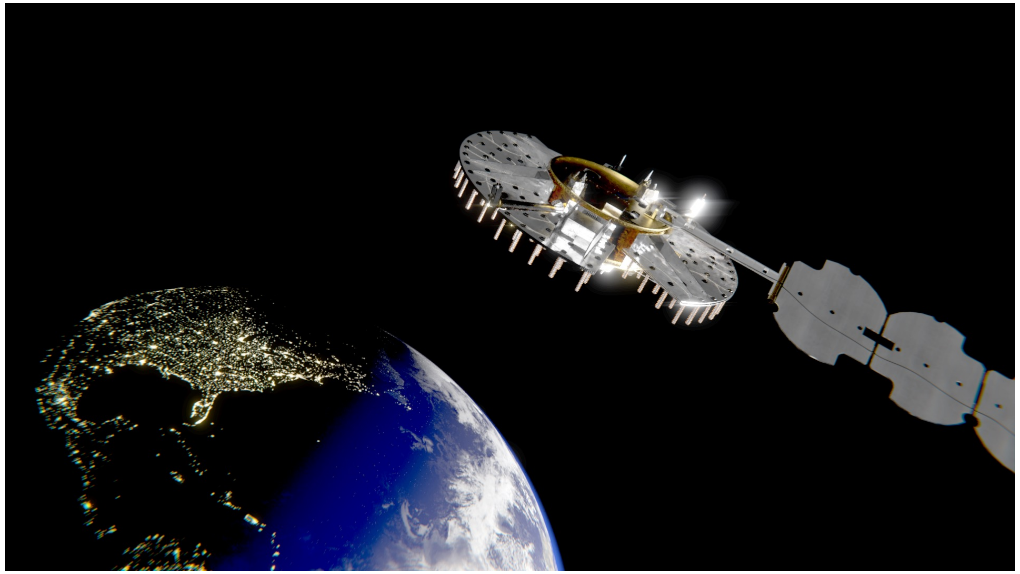
AFRL Transformational Capabilities Office

AFRL.TCOPartnering@us.af.mil

AFRL PA Case Number: AFRL-2021-1621

Expectations for FY21 Navigation Technology Satellite -3 (NTS-3)

- Developing advanced techniques and technologies to detect and mitigate interference to PNT capabilities
- Increase system resiliency for military, civilian and commercial users
- NTS-3 will operate in GEO and will identify key aspects for new GPS receivers that incorporate multiple signals and readily adapt to warfighter needs



- Prototype will involve space-based test vehicle, ground based C2 and agile software defined radios for the user
- NTS-3 will test a new digital signal generator that can be reprogrammed on-orbit, enabling it to broadcast new signals, improve performance by avoiding and defeating interference, and adding signatures to counter spoofing

AFRL PA Case Number: AFRL-2021-1621

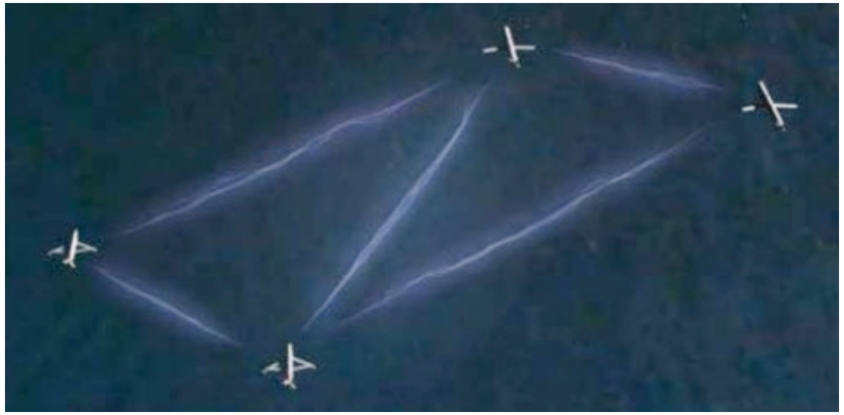
Distribution A

USSF AFRL

Skyborg

- Skyborg is an autonomy-focused capability that will enable the Air Force to operate and sustain low-cost, teamed aircraft that can thwart adversaries with quick, decisive actions in contested environments.
- The program will enable airborne combat mass by building a transferable autonomy foundation for a family of layered, unmanned vehicles
- Complex algorithms and cutting edge sensors enable the autonomy to make decisions based on established rules of engagement set by manned teammates
- With small, fast-moving UAV flight experiments AFRL is collaborating across DoD to increase warfighter trust in autonomous systems
- Skyborg focuses on flexibility, openness, modularity, and expandability

Golden Horde (GH)



- Golden Horde is an S&T program demonstrating a networked collaborative and autonomous (NCA) capability and developing a multi-tier digital weapons ecosystem called the Colosseum. The Colosseum is a live, virtual and constructive tool to accelerate delivery of the NCA technologies.
- Networked collaborative weapons share data, interact, develop and execute coordinated actions or behaviors
- Networked collaboration has been demonstrated on inventory weapons utilizing Small Diameter Bombs (SDB)
- The Colosseum will provide a full digital toolkit to provide weapon engineering, mission simulation, software and hardware in the loop integration. This architecture will provide the government owned building blocks for industry to be utilized by traditional and non-traditional solution providers.

AF Explore 1.0 Overview

AFRL Transformational Capabilities Office

AFRL.TCOPartnering@us.af.mil

AFRL PA Case Number: AFRL-2021-1621

What is AF Explore?

- **AF Explore is a pathfinder to boldly address the strategy principles of broad competition, capability-solution focus, tech investment leveraging, and technologist-operator partnership.**
- **A technology portfolio with aggressive, short-duration applied R&D efforts to assess the operational viability and demonstrate feasibility of promising technology solutions**
- **Identify Operational Challenges → Evaluate and execute best disruptive technology solutions → Use results to inform future development / transition**
- **Significant investment in analytics provides more robust information to decision makers**
- **"Experimental Mindset" - Lessons learned will feed back to TCO and future Explore investments**

Statement of Strategic Intent: Demonstrate an approach for market calls that is broadly accessible by the entire national technology ecosystem and is driven toward future force capability challenges

Air Force Explore Challenge 1 Overview

http://afexplore.com/in-flight-rearming-and-refueling

In-Flight Rearming and Refueling

The Air Force envisions future scenarios in which runways on their forward main operating bases are destroyed shortly after aircraft have been sent on missions. One approach to keep operations flowing while the runways are being repaired may be to re-arm and refuel aircraft in flight. This may be required several times before landing at another operating location with functioning runways. The Air Force is interested in transformational Capability Ideas for in-flight rearming and refueling to preserve a competitive advantage and maintain operations in the future battlefield.

Neff Aeronautics

General Atomics

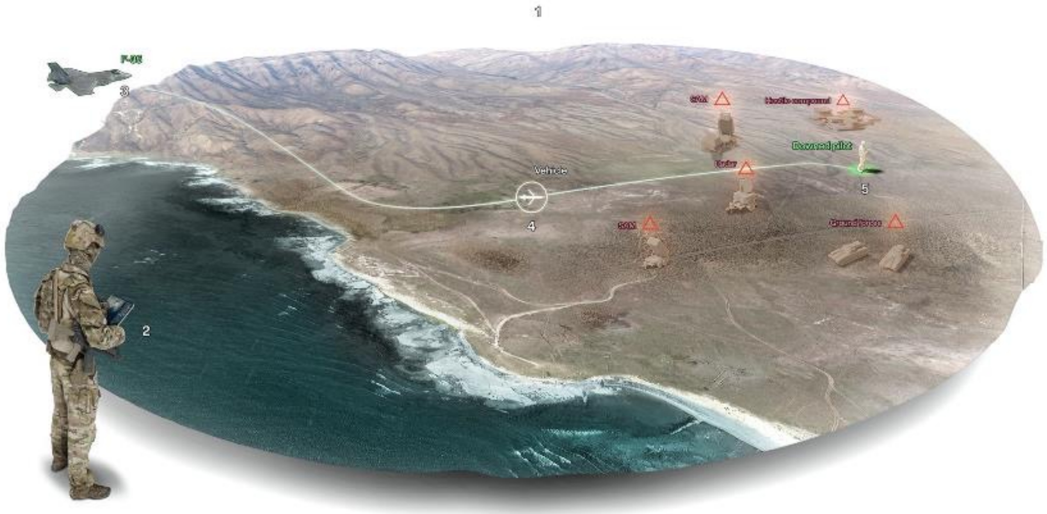
DAR Corporation

Vital Statistics:

- TCO Owned, RQ Managed and Executed, 12-18 month POP
- Explore technical and cost benefits of In-Flight Rearming strategies for different aerospace system classes
- Leverages TCO Ops Analysis teams to quantify military utility to justify downstream demos

Air Force Explore Challenge 2 Overview

- **<u>Scenario:</u>** Inside an A2/AD region or due to mission limitations, an Isolated Personnel (IP) may spend hours or days on the ground waiting for rescue teams with only limited on-hand supplies for evasion & survival (e.g., equipment found with the aircraft ejection-seat).
- Air Force Explore Objective: develop transformational capability ideas for delivery of an on-demand package/medical kit, ranging from the size of a box of band-aids to a small refrigerator, from a stand-off aerial vehicle, over tactical distances to any location in under two hours.
- Constraints: strictly air domain challenge, utilizing existing or custom air-to-air missile boost, restricted to the deceleration and delivery phase (i.e., only the post-missile separation), & release slower than Mach 6 and below 70'K in attitude.
- Stakeholder injects: leverage 5th-Gen Fighter internal carriage or palletization for deployment; and limit the kit to 50lbs with emphasis on long term survival and reconfigurable based on mission specific needs and biome
- **TCO AF Explore Challenge #2 Team:**
  - RW TCO Liason: Ron Taylor (RW)
  - Challenge Lead/Project Lead #1: Dr. Sean Gibbons (RW)
  - Project Lead #2: Cayley Dymond
  - AFWIC Advisor: Col "BB" Bris-Bois (AFWIC/ISD)
- **Contract Performers:**
  - Anduril Industries, Irvine, CA: slender high-speed vehicle
  - SpaceWorks Enterprises, Atlanta, GA: capsule deployed drone



AFEX Challenge 3 Overview

<u>Challenge Overview</u> – Vehicle tracking using commercial satellites
<u>Challenge Statement</u> – Perform vehicle tracking in an urban environment for up to 6 hours

Overview

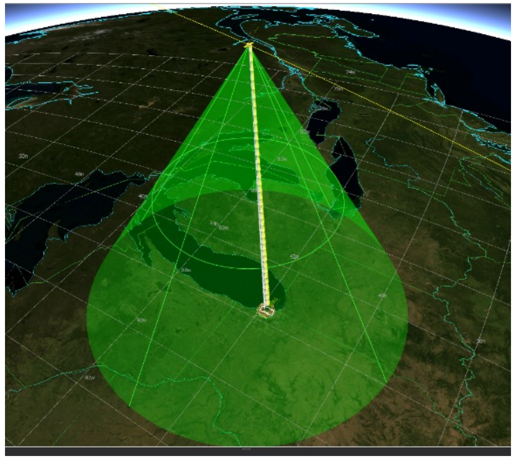
- Two technical performers awarded – Maxar & Areté
- 18 month efforts

Technical Performer – Areté

- Novel, predictive tracking algorithm using state of the art neural network
- Vehicle tracking framework is sensor-agnostic and can perform machine learning across wide range of commercial data
- Large data collection and algorithm development

Technical Performer – Maxar

- Assessing how future proliferation of satellites can pair with predictive AI for AF mission effectiveness
- Owns and operates largest constellation of commercial satellites, including high resolution Worldview and GeoEye



Questions

AFRL Transformational Capabilities Office

AFRL.TCOPartnering@us.af.mil

AFRL PA Case Number: AFRL-2021-1621

Opportunity Review

Format of the Opportunity Review slides

Solicitation #

- **Who**
  - *Gov't*: the agency hosting the solicitation
  - *Eligibility*: who may apply
- **What**
  - The type of solicitation (BAA, grant, etc.)
- **When**
  - The release and due date
- **Where**
  - Webpage to find the solicitation info
  - Contact information
- **Why**
  - *Funding*
    - Award information – dollar figures, length of time
  - *Technical*
    - The nuts and bolts of the solicitation – what the government agency is looking for from a potential proposer

In Space Production Applications (InSPA)
Research Opportunities for ISS Utilization

Funding Opportunity #: 80JSC023InSPA
NNJ13ZBG001N

- **Who**
  - *Gov't*: NASA
  - *Eligibility*
    - U.S. entities
    - Foreign entities may participate under a no-exchange-of-funds basis
- **What**
  - NASA Research Announcement (NRA)
- **When**
  - *Release*: 1 September 2023
  - *Due*: 31 December 2024
- **Where**
  - sam.gov/opp/17ee362c34c34566b2517c503189ac36/view
  - POC: Colleen Corbett, colleen.corbett@nasa.gov
  - Alternate: Audrey Montgomery, audrey.c.montgomery@nasa.gov
- **Why**
  - *Funding*
    - No set amount, but historical Phase I awards:
      - Requiring hardware development: ~$2-3M
      - Not requiring hardware (can use ISS facilities): <$2M
  - *Technical*
    - Submit research or hardware addressing one of three areas:
      - In space production applications
      - Purchase of resources for commercial purposes
      - Private astronaut missions to the ISS

Space Environment Technologies and Science (SETS)

Solicitation #: FA9453-23-R-X001

- **Who**
  - *Gov't*: AFRL
  - *Eligibility*: All
- **What**
  - BAA
- **When**
  - *Release*: 18 December 2023
  - *Due*: 17 December 2028
- **Where**
  - sam.gov/opp/bebdf56ac5e14e94bb7187774f594f9a/view
  - Technical POC: Capt Tyler Hussey, tyler.hussey.1@us.af.mil
  - BAA POCs: Jessica Perez, jessica.perez.23@us.af.mil
    Ever Orozco-Perea, ever.orozco-perea@spaceforce.mil
- **Why**
  - *Funding*
    - Individual awards not set, but program funding per year:
      - FY24: $6M
      - FY25: $12.3M
      - And so on (see link above for attachment with award info)
  - *Technical*
    - Address research across one of five technical areas:
      - Solar, solar wind, and ionospheric effects
      - Thermosphere, satellite drag and the reentry environment
      - Plasma physics and chemistry
      - Particle effects and radiation belt environment
      - Cislunar environment

Redefining Possible - 2023

Solicitation #: HR001123S0042

- **Who**
  - *Gov't*: DARPA
  - *Eligibility*: All
- **What**
  - BAA
- **When**
  - *Release*: 16 June 2023
  - *Due*: 14 June 2024
- **Where**
  - sam.gov/opp/7ac5f3da391441e9ba060502c469683a/view
  - BAA POC: HR001123S0042@darpa.mil
- **Why**
  - *Funding*
    - Multiple awards
    - Awards anticipated to be <$1M and 18 months duration
  - *Technical*
    - TTO seeks R&D that redefines warfighting across the air, ground, maritime, and space domains
    - Space domain topics of interest include technologies that:
      - Reduce reliance on large orbit assets and proliferate simpler assets at low earth orbit (LEO)
      - Exploit AI and DL that enable evaluation of data collected from LEO constellations
      - Advance material science and manufacturing to reduce size/weight and cost

Research Opportunities in Space and Earth Science (ROSES) 2024

Funding Opportunity #: NNH24ZDA001N

- **Who**
  - *Gov't*: NASA
  - *Eligibility*: All
- **What**
  - NRA
- **When**
  - *Release*: 14 February 2024
  - *Due*: Each program has a unique due date (follow link for attachment with due dates)
- **Where**
  - grants.gov/search-results-detail/352349
  - POC: Max Bernstein, sara@nasa.gov
- **Why**
  - *Funding*
    - No set amount, but awards expected to range from ~$5k, 3-year period to multi-million, multi-year
  - *Technical*
    - Address one or more of a wide host of research topics concerning space and/or Earth-based investigations
    - Some space topics:
      - Flight-based projects in the Solar System
      - Flight-based projects in Earth orbit
      - Suborbital projects (aircraft, small satellites, commercial suborbital launch vehicles)

Faculty Development in geoSpace Science (FDSS)

Solicitation #: NSF 23-577

- **Who**
  - *Gov't*: NSF
  - *Eligibility*: 2- and 4-year STEM IHEs
    - Someone with authority to implement (dean, provost, director, etc.)
- **What**
  - Continuing grant
- **When**
  - *Release*: 10 April 2023
  - *Due*: 3 March 2025
- **Where**
  - grants.gov/search-results-detail/347508
  - POC: Mangala Sharma, IntegrativeGeospace@nsf.gov
- **Why**
  - *Funding*
    - ~$3M per award
  - *Technical*
    - Submit proposal to create a tenure-track faculty position bearing research, teaching, and service in geospace science
    - Proposal must address one of the NSF geospace programs:
      - Aeronomy
      - Geospace facilities
      - Magnetospheric physics
      - Solar-terrestrial
      - Space weather research

Future Manufacturing (FM)

Solicitation #: NSF 24-525

- **Who**
  - *Gov't*: NSF
  - *Eligibility*: All U.S. entities
- **What**
  - Standard or continuing grant
- **When**
  - *Release*: 10 January 2024
  - *Due*: 11 April 2024
- **Where**
  - grants.gov/search-results-detail/351760
  - POCs: Andrew Wells, awells@nsf.gov
    William Olbricht, wolbrich@nsf.gov
    Jordan Berg, jberg@nsf.gov
- **Why**
  - *Funding*
    - Estimated 16 awards
    - Two award tracks
      - FM research grants: up to $3M for 4 years
      - FM seed grants: up to $500k for 2 years
  - *Technical*
    - Submit a proposal addressing one of three thrust areas:
      - Future cyber manufacturing research
      - Future eco manufacturing research
      - Future biomanufacturing research

Micrometeoroid/Object Debris (MMOD) Impact Detection and Location

Notice ID #: T2P-LaRC-00116
LAR-TOPS-245

- **Who**
  - *Gov't*: NASA
  - *Eligibility*
    - Primarily U.S. businesses
    - For foreign-owned businesses:
      - Must pay additional patent cost in foreign country
      - Must manufacture in U.S.
- **What**
  - Technology transfer
- **When**
  - *Release*: 6 October 2023
  - *Due*: 6 October 2024
- **Where**
  - sam.gov/opp/7e882dc3dac5438e89015c4479bd2320/view
  - Tech transfer POC: Agency-Patent-Licensing@mail.nasa.gov
- **Why**
  - *Funding*
    - N/A
  - *Technical*
    - Obtain license rights to commercialize NASA technology
    - The technology
      - Strain sensors encoded into optical fibers affixed to MMOD structure
      - Sensors collect time signature and plastic strain data to inform strike location
    - Benefits and applications
      - Can be manufactured from COTS components
      - Could become one element in a suite to assure return-ready condition for manned spacecraft
      - Of particular importance to UAVs/satellites

Origami-based Deployable Fiber Reinforced Composites

Notice ID #: T2P-LaRC-138
LAR-TOPS-372

- **Who**
  - *Gov't*: NASA
  - *Eligibility*
    - Primarily U.S. businesses
    - For foreign-owned businesses:
      - Must pay additional patent cost in foreign country
      - Must manufacture in U.S.
- **What**
  - Technology transfer
- **When**
  - *Release*: 7 December 2023
  - *Due*: 7 December 2024
- **Where**
  - sam.gov/opp/5834681624d74c4a86adf96ee587a3bf/view
  - Tech transfer POC: Agency-Patent-Licensing@mail.nasa.gov
- **Why**
  - *Funding*
    - N/A
  - *Technical*
    - Obtain license rights to commercialize NASA technology
    - The technology
      - Composite material solidifies under UV light
      - Material is added to origami-like structure that can fold or deploy using polymer shape effect
      - Currently at TRL 4
    - Benefits and applications
      - High strength: can support 600 kg load in Earth gravity
      - Simple: origami structure only needs heat to deploy
      - In-space use: replace metal support structures

Helpful Links

1. SAM.gov – Contract opportunities
2. GRANTS.gov – Federal funding opportunities
3. SBIR.gov – SBIR/STTR information and solicitations
4. defensesbirsttr.mil – DoD-specific solicitation information
5. dodsbirsttr.mil – DoD-specific solicitations
6. sbir.nasa.gov – NASA-specific solicitations
7. ohiofrn.org – Help with identifying opportunities, matchmaking, and proposal development
8. apex-innovates.org – Help with SBIR/STTR process navigation and matchmaking

Upcoming Events

- **Navigating SBIR STTRT Grant Opportunities with USDA –** virtual, March 27, 2024
- **OnRamp Hub: Ohio/Great Plains Showcase**
- **LaunchHack Startup Weekend –** in-person @ Launch Dayton, April 5-7, 2024
- **UDSL - Government Contracting Perspectives Workshop** – hybrid @ University of Dayton School of Law, April 9, 2024
- **39th Annual Space Symposium** - in-person @ The Broadmoor, Colorado Springs, CO, April 8-11, 2024
- **BRIDGEOhio tech innovation, IP and business development seminar –** in-person @ the Ohio University Dublin Integrated Education Center, Dublin OH, April 16, 2024
- **Great Lakes Biomimicry: Aligning Sustainability Strategies with Customer Expectations –** hybrid @OAI in Cleveland, April 16, 2024
- **AUVSI XPONENTIAL 2024** – in person @ San Diego Convention Center, CA, April 25, 2024
- **OAI/SAE Webinar: Next Generation Aircraft Technology** – virtual, April 26, 2024
- **Conrad Summit** – in-person @ Space Center Houston, April 23-26 2024
- **DDC Space Forum** – in-person @ The Westin Downtown Cleveland, April 29-30, 2024
- **Digital Transformation Summit** – in-person @ Sinclair College, May 10, 2024
- **SAE training - Safety Mgmt Systems**– in-person @ OAI in Cleveland, May 15-16, 2024
- **Int'l Aerospace Innovation Forum** – in-person @ Palais des congrès de Montréal, May 21-22, 2024
- **(MOSA) & Tech Connect World Industry & Government Innovation Summit** – in-person @ Gaylord National Convention Center, Washington DC, June 17,2024

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OHIO AEROSPACE INSTITUTE

Thank you