

# Aeropropulsion & Power URETI Overview to Row Managers

Kim Pham

November 7, 2002



Glenn Research Center

Propulsion & Power Program



at Lewis Field

# *University Research Engineering Technology Institute (URETI)*

## *Mission*

Achieve National aeronautics objectives through:

- Innovative approaches far beyond present scenarios
- Use of emerging and technologies (bio, nano, IT)
- A balance of multi-disciplinary, conventional approaches

## *Budget*

- \$3.0M/yr for 5 years, with renewal provision for an additional 5 years
- Expected to be self-sufficient after 10 years

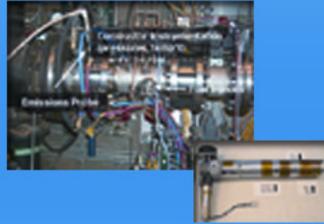
## *Seven Selected URETI's*

1. **Aeropropulsion & Power – Georgia Inst. of Technology**
2. Third Generation Reusable Launch Vehicles (2 selected) - U of Maryland and U of Florida
3. Bio-Nano-Info Tech. Fusion – U of California
4. Bio-Nano Matls. & Structures for Aerospace Vehicles (2 selected) - Princeton U and Texas A&M
5. Nanoelectronics Computing & Electronics – Purdue Univ.

# PROPULSION & POWER PROGRAM - Investment Areas & Projects



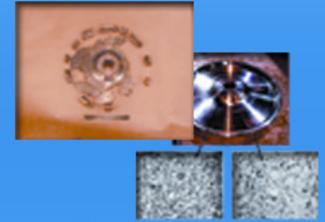
## Turbine Engine Technologies



Smart Efficient Components

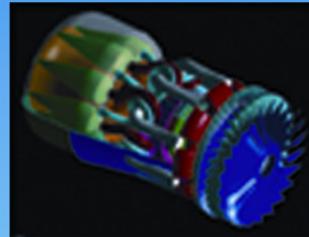


Oil-Free Turbine Engine Technology



UltraSafe Propulsion

## New Propulsion Concepts



Pulse Detonation Engine Technology

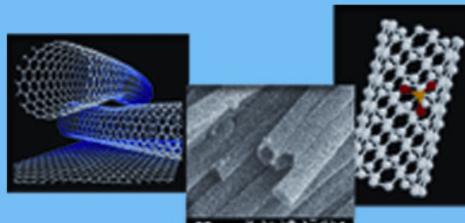


Revolutionary Aeropropulsion Concepts



ZERO CO2 Emission Technologies

## Foundation Technologies



High Temperature Nanotechnology

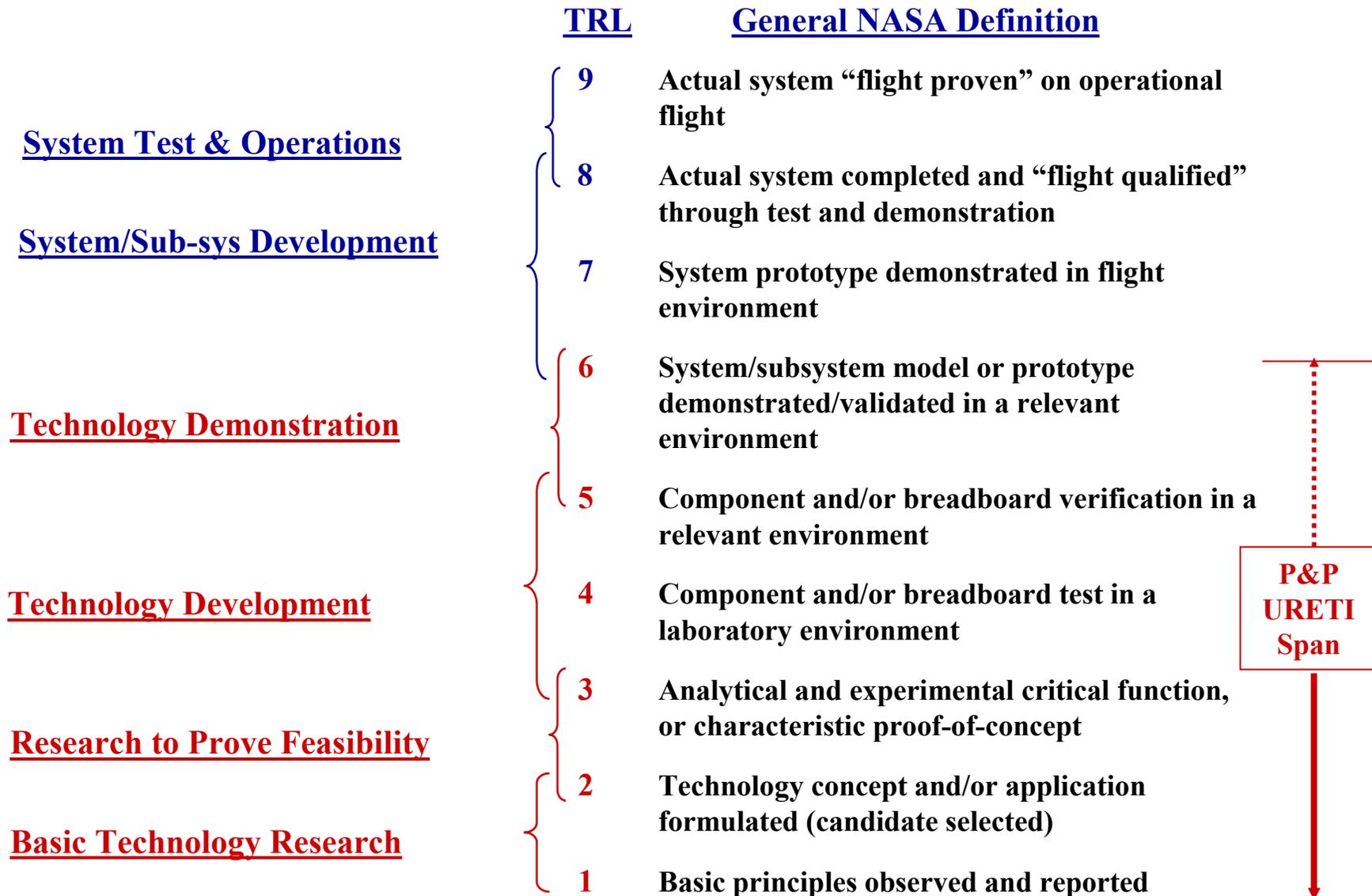


University Research, Engineering & Technology Institute (URETI)



Higher Operating Temperature Propulsion Components

# *NASA's Technology Readiness Level (TRL) Span*

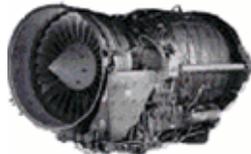


# *Ultra-Efficient Engine Technology and Propulsion and Power Programs - General Comparison*

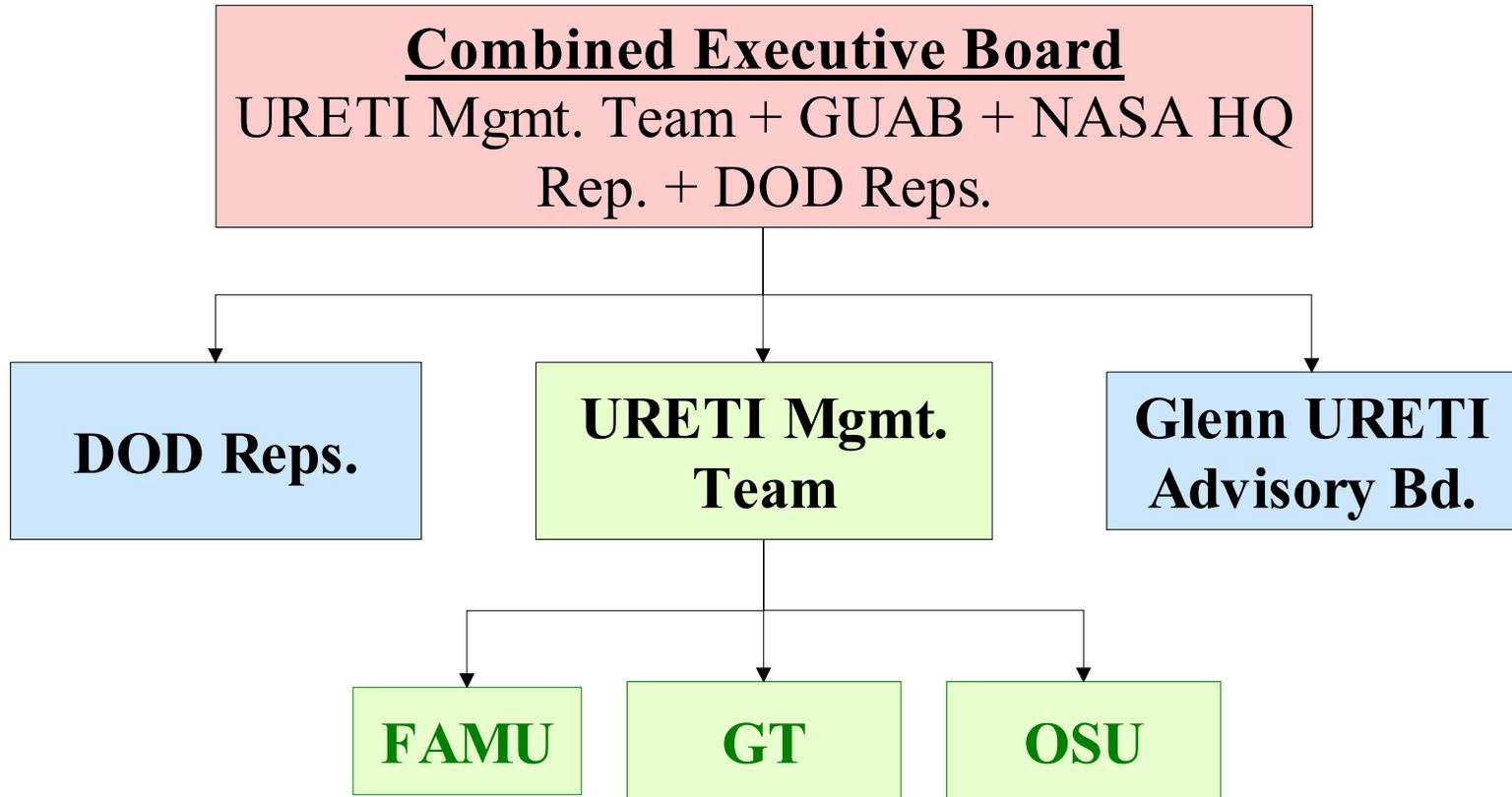
## UEET

## PROPULSION & POWER (P&P)

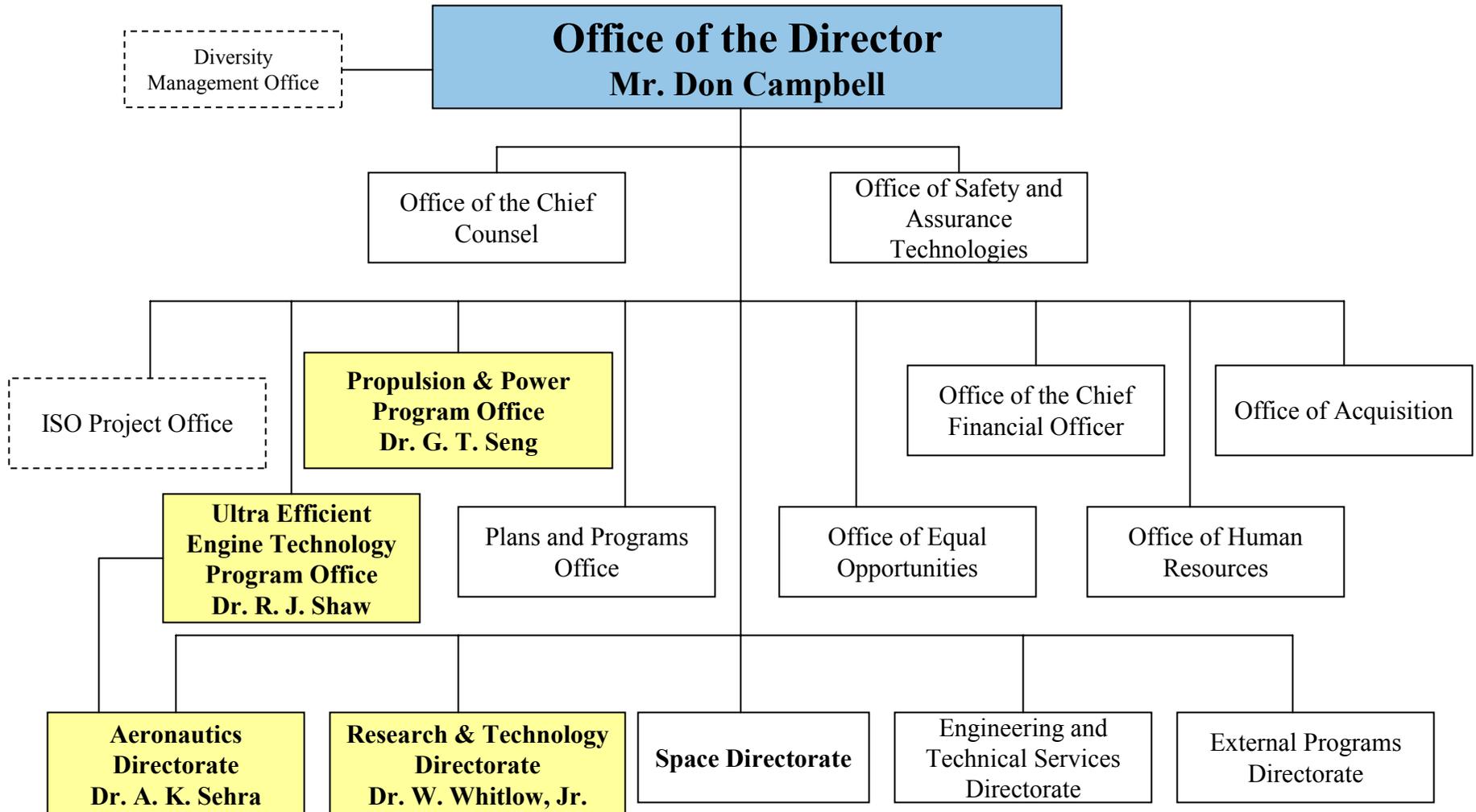
<b>TRL's</b>	Generally 3-6 (with cost share at 5 & 6)	Generally 1-3 (exceptions in both programs)
<b>Focus</b>	System level	Component or fundamental level
<b>Where Performed</b>	Primarily In-house plus contracts	Primarily in-house plus grants
<b>Goals</b>	Focused/specific (emissions)	Broader/more general (emissions, noise, power, new engine concepts...)
<p><b><u>Cooperation/collaboration:</u></b></p> <ul style="list-style-type: none"> <li>-facilities investments for common needs</li> <li>-external collaboration activities (IHPTET, Govt. Alliance, etc.)</li> <li>-some coordinated funding in areas of mutual interest</li> </ul>		



# *Aeropropulsion & Power URETI Team*



# NASA Glenn Research Center



# *Who's Who*

## **DOD Representative(s) For Aero propulsion & Power URETI**

- Dr. Walter Jones/AFOSR
- Dr. Alan Garscadden/AFRL
- Dr. Donald Paul/AFRL (Alternate)
- Dr. Kenneth E. Harwell/DDR&E

## **NASA Headquarters Representative**

- Dr. Michael M. Reischman

## **NASA Glenn URETI Advisory Board (GUAB)**

- Chair, APP Program Manager – Dr. Gary T. Seng
- UEET Program Manager – Dr. Robert J. Shaw
- Director, R&T Directorate – Dr. Woodrow Whitlow, Jr.
- Director, Aeronautics Directorate – Dr. Arun K. Sehra
- **Executive Secretary, Acting Project Mgr. – Kimlan T. Pham**

## **Propulsion & Power URETI Management Team**

- Senior Research Officer – Dr. Jean Lou Chameau, GT's Provost
- Director – Dr. Ben T. Zinn
- Co-Director – Dr. Dimitri Mavris
- OSU Lead PI – Dr. James Williams
- FAMU Lead PI – Dr. Cesar Luongo

# Commitments from Our Partners and Industry Collaborators

## VISION

*The establishment of a world-class center for aeropropulsion and power that will develop revolutionary technologies and design methods, in a systems-oriented integration environment, and enable NASA and industry to close technology gaps that prevent deployment of high performance, intelligent, safe and environmentally compatible systems. Furthermore, the center's integrated, multidisciplinary education programs will prepare future graduates and NASA/industry engineers to develop the revolutionary engine systems that will be needed to ensure pre-eminence of the U.S. aerospace industry.*

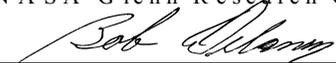
*We strongly support the above vision and are committed to the success of a GT/O SU/FAMU/CWRU URETI for Aeropropulsion and Power Technology (UAPT) by serving as technical advisors and promoting technology transition from the center to government and industry.*



**Michael Benzakein**  
General Manager, Adv. Engineering Programs Department  
General Electric Aircraft Engines



**Robert J. Shaw**  
Program Manager, UEET Program  
NASA Glenn Research Center



**Bob Delaney**  
Chief, Design Methods and Technology  
Rolls-Royce Corporation



**John Harper**  
Vice President, Corporate Technology Development  
American Electric Power



**Leslie Southall**  
General Manager, Gas Turbine Engineering  
Siemens Westinghouse Power Corporation



**Edward Crow**  
Senior Vice President, Engineering  
Pratt & Whitney



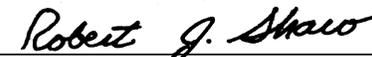
**John Meier**  
Director, Advanced Technology Programs  
Honeywell



**Ron York**  
Chief Operating Officer  
Allison Advanced Development Center



**G. Scott Cruzen**  
Director, Advanced Technology  
Williams International

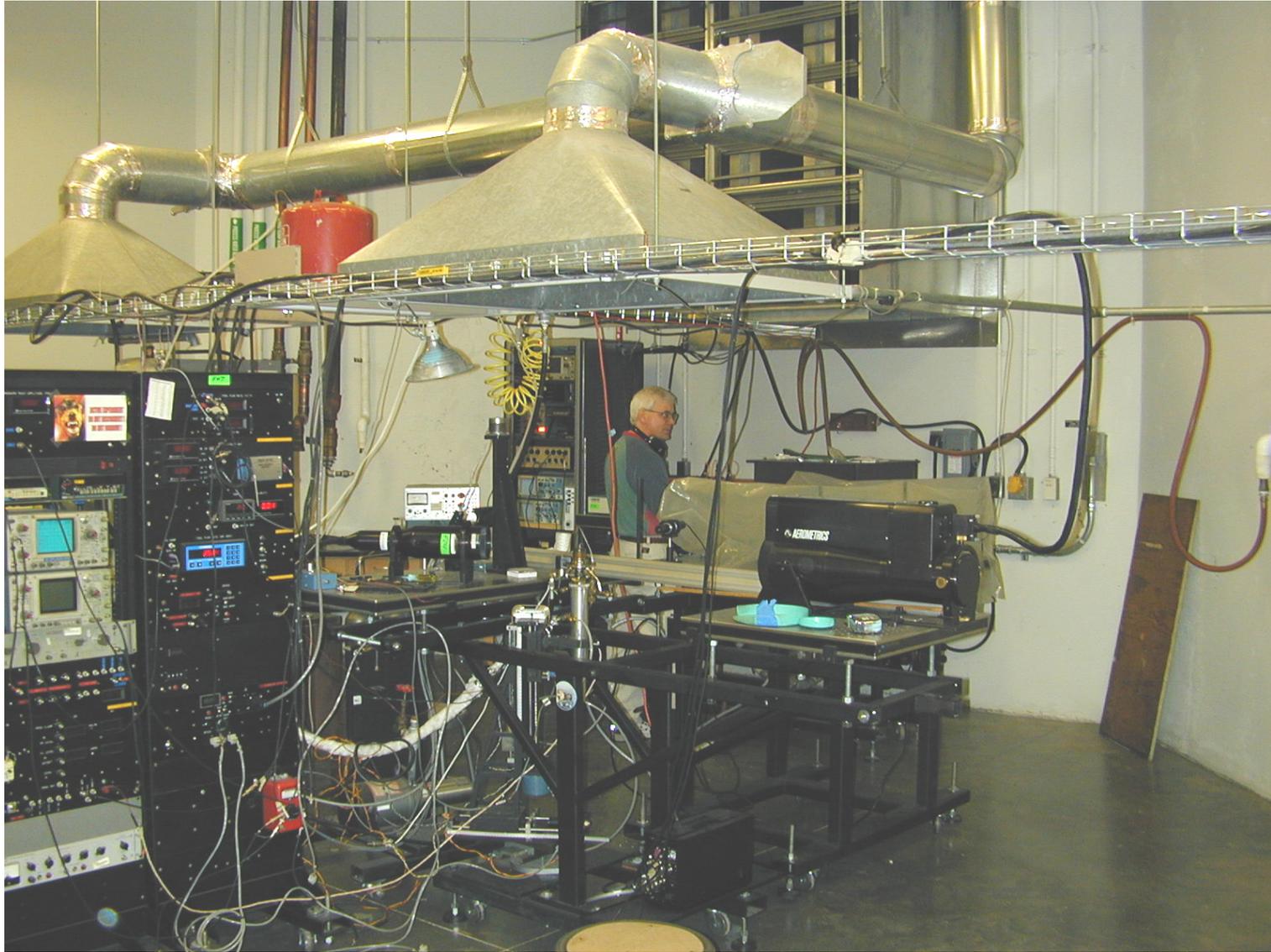


**Robert J. Shaw**  
Program Manager, TBCC Program  
NASA Glenn Research Center

# UAPT Research Team

<u>Name</u>	<u>School</u>	<u>Dept.</u>	<u>Research Area</u>
• Jean-Lou Chameau	GT	Provost	Senior Research Officer
• Ben T. Zinn	GT	AE/ME	Intelligent Engine Systems/Comb.
• Dimitri Mavris	GT	AE	Systems Analysis & Tech. Integration
• James Williams	OSU	Dean	Enabling Technologies/Materials
• Cesar Luongo	FAMU	ME	Advanced Power Technology
• Maurice G. Adams CWRU		ME	Materials
• Krish Ahuja	GT	GTRI	Engine Noise Control
• Mark G. Allen	GT	ECE	Wireless MEMS Sensors
• Mike Dunn	OSU	AE	Engine Turbo machinery
• Somnath Ghosh	OSU	ME	Materials
• Ari Glezer	GT	ME	Gas dynamics/actuators
• Jeff Jagoda	GT	AE	Combustion/Educational Program
• Meilin Liu	GT	MSE	Fuel Cells
• Suresh Menon	GT	AE	Large Eddy Simulations
• Michael J. Mills	OSU	MSE	Materials
• Yedidia Nemeier	GT	AE	Intelligent combustors & Compressors
• J.V.R. Prasad	GT	AE	Intelligent Engine Systems/Comp.
• Lakshmi Sankar	GT	AE	CFD
• Jerry Seitzman	GT	AE	Intelligent Comb./Nano Fuel Additives
• Jimmy Tai	GT	AE	Systems Analysis & Tech. Integration
• Zhong Lin Wang	GT	MSE	Nanotechnology

# UAPT FACILITY



**One of Ga. Tech's Laboratories for Active Control of Combustion Instabilities**

# UAPT FACILITY

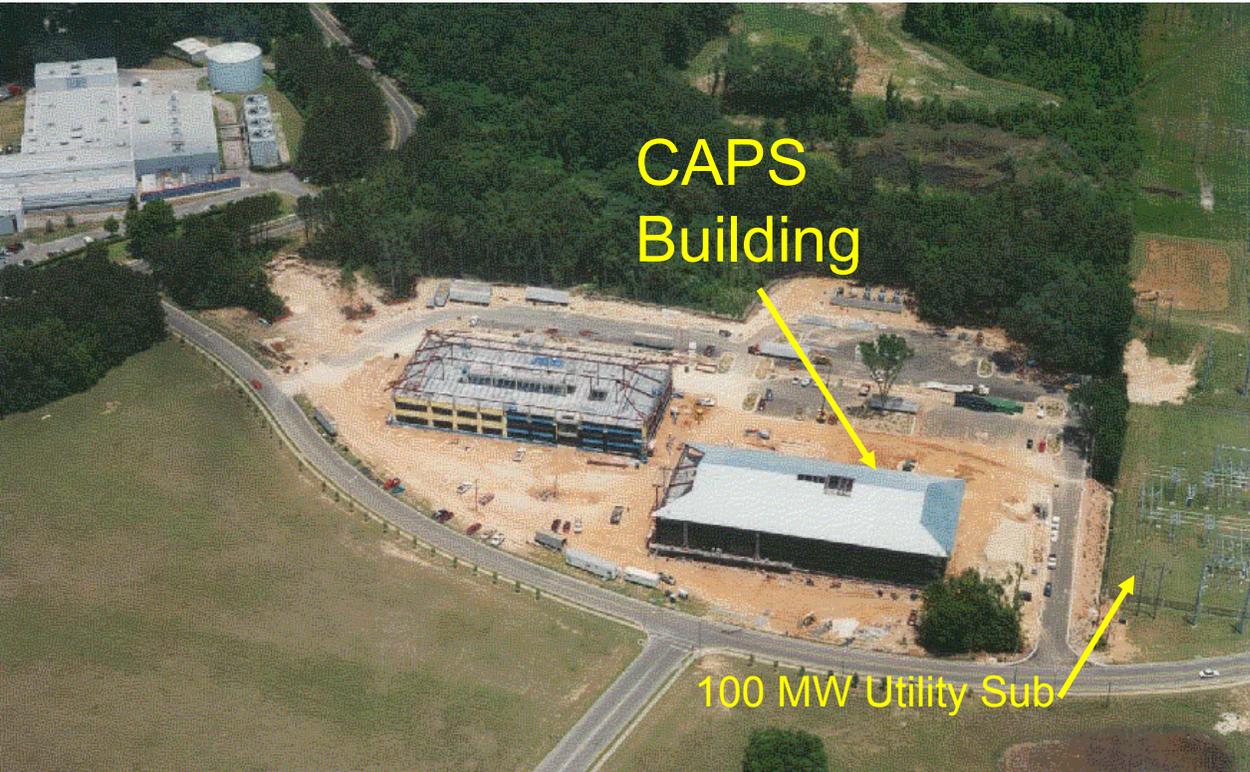


**OSU's  
Large  
Shock  
Tunnel  
Facility**

## Some FAMU Facilities



FAMU's National High Magnetic Field Laboratory

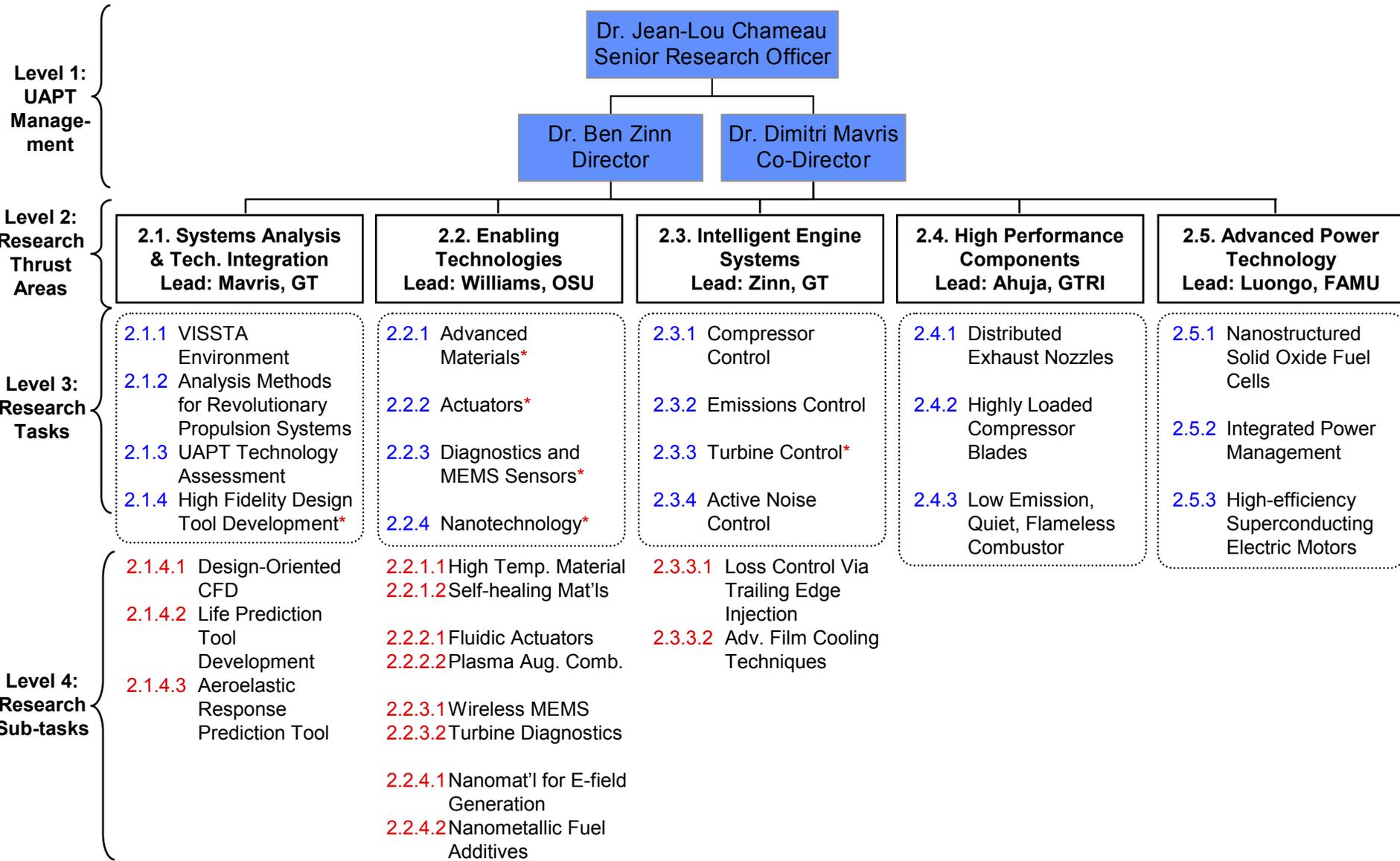


CAPS Building

100 MW Utility Sub

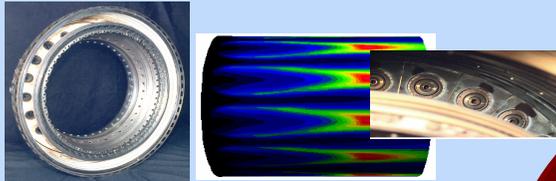
CAPS-Center for Advanced Power Systems

# NASA/DoD UAPT Research Tasks Organization



# NASA/DoD UAPT Alliance Relationships

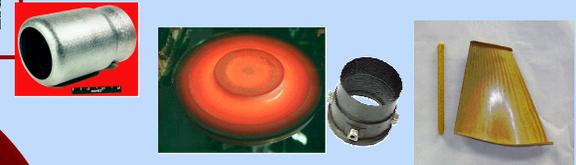
**Emissions & Combustion  
Control Technologies**  
Georgia Tech  
Dr. Ben Zinn, Lead



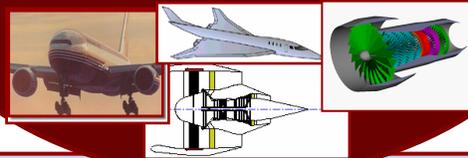
**Highly Loaded  
Turbomachinery  
Technologies**  
Ohio State University  
Dr. Mike Dunn, Lead



**Materials and Structures**  
Ohio State University  
Dr. Jim Williams, Lead



**Propulsion Systems  
Integration & Assessment**  
Georgia Tech  
Dr. Dimitri Mavris, Lead



**Fuel Cell & Hybrid Power  
Technologies**  
Georgia Tech  
Dr. David Parekh, Lead

**Acoustics/Noise Technologies**  
Georgia Tech  
Dr. Krishan Ahuja, Lead



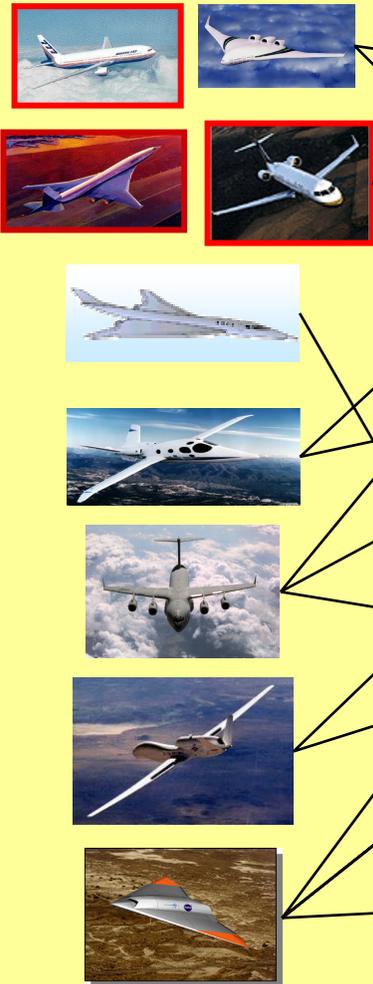
**Compressor Performance and  
Control, Georgia Tech**  
Prof. Sankar, Lead

**Power Electronics, Electrical  
Systems, High Energy  
Magnets**  
Florida A&M, Prof. Luongo,  
Lead

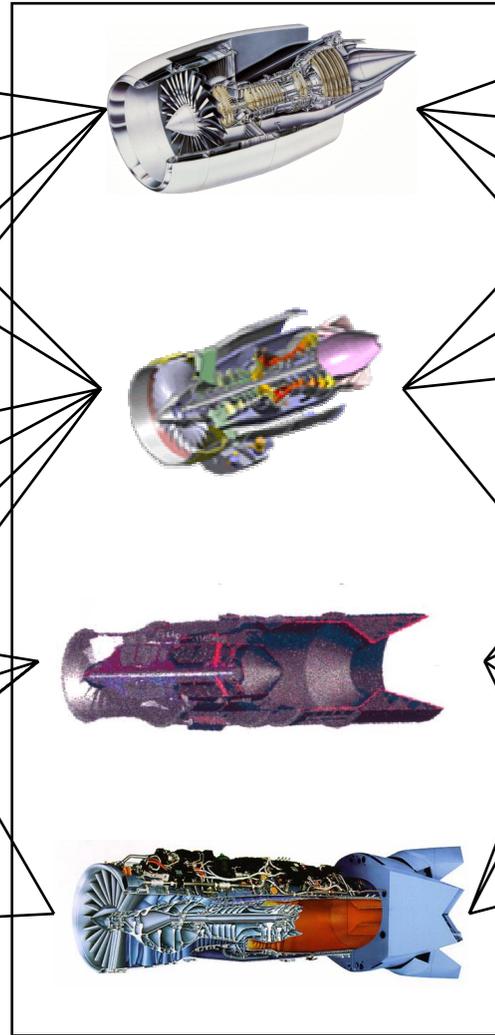
**Sciences: Nanotechnology,  
MEMS, CFD/LES, Information  
Technology, GT/OSU/FAMU**

# Virtual System Integration & Evaluation

## Vehicle Concepts



## Propulsion Concepts



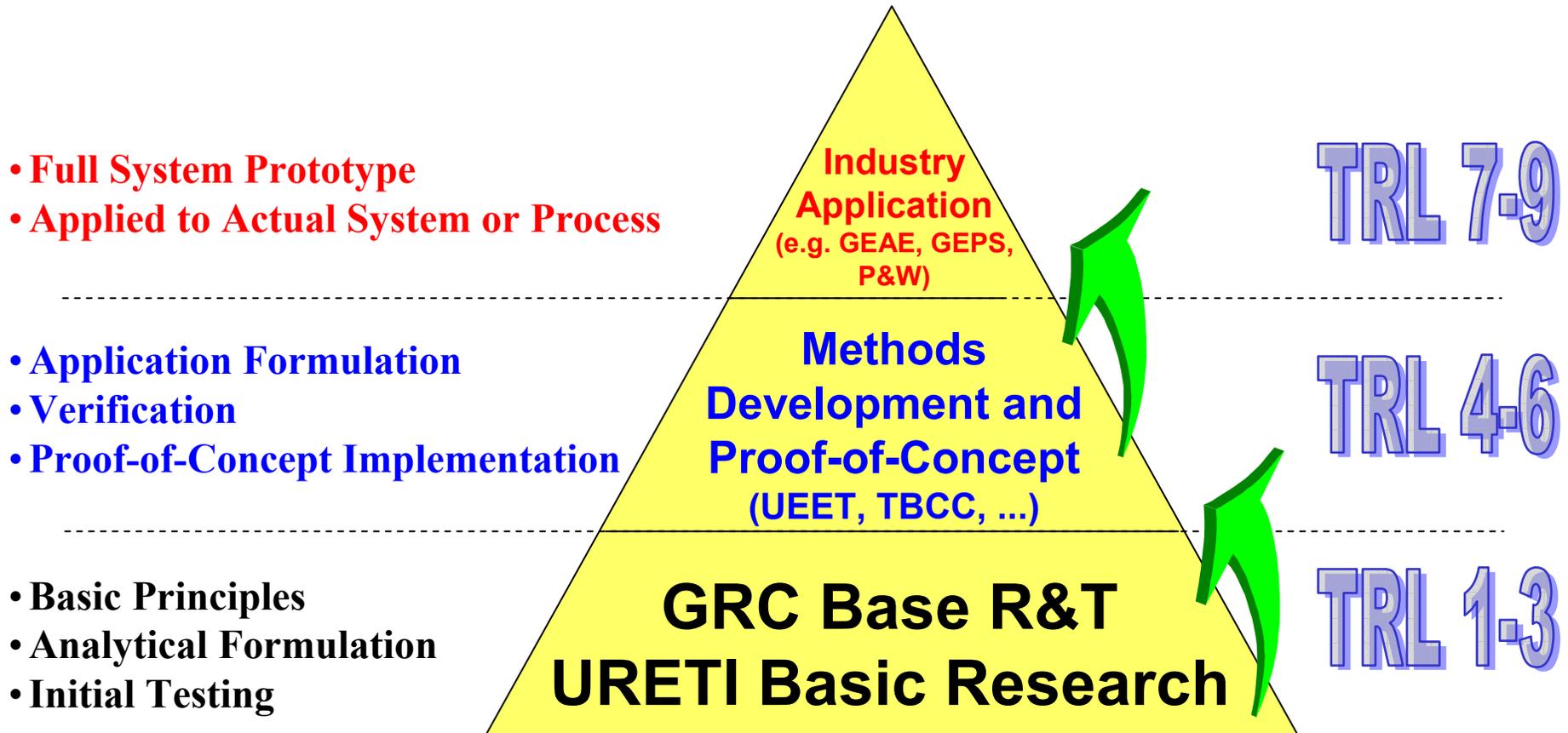
## Technology Concepts

Active Compressor Control	Fuel Cells
Active Emissions Control	High Temperature Materials
Active Turbine Pressure Loss Control	Thermal Barrier Coatings
Advanced Turbine Film Cooling	Refractory Inter-Metallic Composites
Active Noise Control	Co-Continuous Composites
Distributed Exhaust Nozzles to Reduce Noise	Combustion Driven Actuators
Compressor CFD	Plasma Augmented Combustion
Flameless Combustion	Passive, Wireless MEMS Sensors
Wireless MEMS Sensors	Nano Sensors
Self Healing Turbine Blade Tip Materials	Nano Fuel Additives
	Turbulence and Hot Streaks Diagnostics

Virtual Integrated Stochastic System and Technology Assessment Environment

Technology Identification, Evaluation, and Selection Methods

# Transition Pyramid for NASA/DoD UAPT Research



# *URETI Technical Areas & Responsible Universities*

- System Level Engineering (GTI)
- Enabling Technologies (OSU)
- Intelligent Engine Systems (GTI)
- High Performance Components (GTI)
- Advanced Aeropower Technology (FAMU)
- Educational Program Plan (GTI)

**Budget: GTI - \$1.9M, OSU = \$0.8M, FAMU = \$0.3M**

# *Review & Reporting (NCC3-982)*

- NASA-DoD will interact collaboratively with the GT URETI Management Team to provide oversight, advice, and recommendation..
- The Combined Executive Board (CEB), comprised of the GT URETI Mgmt. Team, GUAB, and NASA-DoD Steering Committee, will make key strategic and programmatic decisions.
- NASA-DoD Steering Committee and members will also serve on the Independent Advisory Board to perform the required annual reviews (~ in September) and the renewal review (at end of 5 years).
- The CEB will meet at six-month intervals via teleconference, videoconference, or site visit. **Next meeting in March – April timeframe.**
- Quarterly Progress Reports to all CEB members. **1<sup>st</sup> Quarterly Report covers progress between 8/02-11/02, due 12/15/02.**

# *Information & Knowledge Management*

- 👉 **STI Process/Database** – maintain inventory of technical publications (public available and limited distribution), forms C-22 and DAA F-1676.
- 👉 **Proprietary** – access by authorized members only, must be labeled and protected.
- 👉 **Export Control** – TRL-4 and up, access by U.S. citizens only; must be labeled and limit distribution.
- 👉 **Fundamental Research** – TRL 0-3, non-proprietary, is publicly available.

**Aeropropulsion & Power  
University Research Engineering Technology Institute**

*VISION*

*The establishment of a world-class center for aeropropulsion and power that will develop revolutionary technologies and design methods, in a systems-oriented integration environment, and enable NASA and industry to close technology gaps that prevent deployment of high performance, intelligent, safe and environmentally compatible systems. Furthermore, the center's integrated, multidisciplinary education programs will prepare future graduates and NASA/Industry engineers to develop the revolutionary engine systems that will be needed to ensure pre-eminence of the U.S. industry.*

**Advancing Science, Engineering, & Technology**

High Performance Disk Alloys	Superconducting Electric Motors	LEADS: GIT, OSU, FAMU
Advanced High-Temp. Materials	High Work Turbine	
LENS Fab. Refract Composites	Integrated Power Management	Wireless MEMS Sensors
Co-Continuous Composites	Solid Oxide Fuel Cell	Nano Fuel Additives
Smart Compressor Materials	Distributed Exhaust Nozzles	Intelligent Compressor Controls
Emission Control	Active Noise Control	Interstage Turbine Combustion

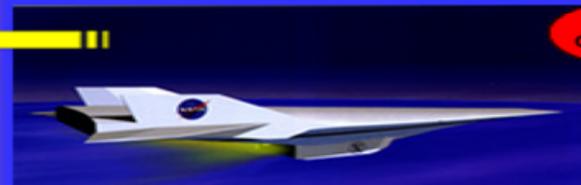
**System Level Engineering, Analysis, & Technology Integration**



**Revolutionary and Innovative Aeropropulsion Concepts**



**NASA Aerospace Enterprise Goals & Objectives**



**NASA Goals  
Goal 1: Revolutionize Aviation**

- Reduce Accident Rate 10X
- Reduce Emissions 80%
- Reduce Noise 4X
- Triple System Capacity
- Decrease Door to Door Time 2/3

**Goal 2: Advance Space Transp**

- Mission Safety
- Mission Affordability
- Mission Reach

**Goal 3: Pioneer Tech Innov.**

- Engineering Innovation
- Technology Innovation

**Goal 4: Commercialize Tech.**

- URETI Plans
- Team Directory
- Calendar - Events
- Presentations Reports
- News
- Education Programs
- Propulsion & Power

# *Events & Activities*

## **Events**

- ✓ Cooperative Agreement, NCC3-982 – awarded, 8/19/02
- ✓ DoD-NASA Interagency Agreement – signed, 8/22/02
- ✓ DoD-NASA Partnership Meeting – in-process, 10/8/02
- ✓ Aeropropulsion & Power URETI web page – posted 10/18/02
- ✓ **A&P URETI Kick-Off at GIT w/ Draft Work Plan – 10/25/02**
- **A&P URETI Technical Forum at GRC – 11/18/02**
- **A&P URETI Work Plan – Baseline Approved 12/16/02**

## **Other Parallel Activities**

- ❖ Establish Review and Decision Making process
- ❖ Establish Operating Guidelines for Information & Knowledge Management
- ❖ Establish Agreements/License for Tools/Codes Sharing; e.g. NPSS, Glenn HT, Materials Modeling.
- ❖ Formulate Collaborative Educational Program

# *Aeropropulsion & Power URETI Team*

Cobined Executive Board  
NASA-DOD-GT/OSU/FAMU

Kim Pham

URETI Director/  
Co-Director

