Propulsion Directorate

Propulsion & Power for the 21st Century Warfighter

Opportunities For Innovative Collaboration
Propulsion Directorate

Our Mission

Create and transition advanced air breathing and rocket propulsion and power technologies for military dominance of air and space

Our Vision

We will continue to be the world leaders in military propulsion and power technology
Propulsion Directorate

Our Legacy & Our Future


R&D ↔ S&T

Rocket Propulsion

Aero Propulsion

Powerplants

Propellers

Power

Space Power
513 Government People
(plus 477 on-site contractors)

- **86%** Civilians
- **19%** Others
- **16%** Techs
- **65%** S&Es

- **36%** BS
- **35%** MS
- **29%** PhD

- **27%** > 20 yrs
- **41%** 11-20 yrs
- **11%** 6-10 yrs
- **6%** < 6 yrs
- **8%** Enl.
- **6%** Officers

- **29 yrs+**
- **< 6 yrs**
Propulsion Directorate Funding

FY99
Science & Technology $198.7 M
Other Funding $  73.8 M
Total $272.5 M

FY00
Science & Technology $203.7 M
Other Funding $  48.0 M
AFRL’s PR-East Facilities

- Supersonic Research
- Ramjet Combustion Research
- Turbine Research
- Lubricant Qualification
- Battery Research
- "G" Forces on Heat Pipes
- Vortex-Flame Visualization
- Scramjet Combustor Research
- High Pressure Combustion Research
- Altitude Simulation Compressor
- High Temperature Combustor
AFRL’s PR-West Facilities

- X-33 Sub-scale Engine
- Arcjet Engine
- Advanced Liquid Engine Research
- X-33 Launch Complex
- Solid Rocket Motors
- Advanced Liquid Engine Research
- National Hover Test Facility
- Space Environmental Propulsion
- Solid/Liquid Propellant Research
- Solar Propulsion

AFRL's PR-West Facilities
Three Integrating Technology Thrusts
Advanced Propulsion and Power For:

**AIR**
- Aircraft Turbine Engines
- Fuels / Lubes / Combustion
- Aircraft Power
- UAV Propulsion & Power

**SPACE**
- High Performance Boost
- High Energy Upper Stages
- Highly Maneuverable Spacecraft
- Space Power
- Combined Cycles

**WEAPONS**
- Hypersonic Missiles
- Directed Energy Power
- ICBM
- Tactical
Propulsion Directorate

Opportunities for Innovative Collaboration
### OPPORTUNITIES FOR COLLABORATION

**AFRL’s Propulsion Directorate**

<table>
<thead>
<tr>
<th>Description</th>
<th>Vision</th>
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<tbody>
<tr>
<td>• Technical opportunities:</td>
<td>• Near term applications:</td>
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<tr>
<td>– Pulse Power Modeling &amp; Simulation</td>
<td>– Flight weight pulse power systems for tactical aircraft directed energy weapons</td>
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<td>– Hybrid Thermal Management</td>
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<td>– Pulse Forming Network technologies</td>
<td>• Longer term applications</td>
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<tr>
<td>– Pulse Power Turbogenerators</td>
<td>– Pulse power technologies for spacecraft propulsion, space based sensors and weapons</td>
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<td>– Pulse Power Caps, Batteries, Switches</td>
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<td>– Pulse Power Space Systems</td>
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**Title**

Pulse Power Technologies For Aerospace Applications
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| • Develop, maintain, and distribute air-breathing and rocket pulsed propulsion information:  
  – Performance data  
  – Research and performance models  
  – Analysis tools  
  – Proprietary and classified information | • Provide benchmark data  
• Make R&D capability available to promote technology  
• Develop and maintain in-house research competency |

**Title**

Pulsed Detonation Engines  
at PR east & west
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**Title**

Advanced Solid Propellants for Tactical Missiles

**Description**

- Enhance international program to develop advanced tactical propellants
  - Higher energy
  - Low observables

**Vision**

- In cooperation with the world’s premier propellant chemists, develop the next generation tactical missile propellant.
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</table>
| Hall Thruster Modeling to enable high-power testing in current AF ground facilities | • Validated model to correct high-power Hall thruster data perturbed by ground facility effects  
• Save AF >$20M in facility costs needed to perform IHPRPT phase III testing. |

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<td>• Develop better fluid models</td>
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<td>• Develop better understanding of low-energy Xe sputtering yields &amp; cross sections</td>
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<td>• Expand effort in charge exchange physics</td>
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<td>• Model sensor contamination</td>
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<td>• Validate model by tests in ground facilities</td>
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### OPPORTUNITIES FOR COLLABORATION

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<td>• Host faculty, students, NRC’s, post doc’s, industry, small business</td>
<td>• Develop “Maintenance-Free” hot section</td>
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<td>• Do research on better performance, durability by active and passive flow control, new diagnostics, studying combustor-turbine interactions</td>
<td>– Turbine system lasting full engine life</td>
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<tr>
<td>• More effort on math modeling to guide experiments in Turbine Research Facility</td>
<td>• Raise performance &amp; improve cooling</td>
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<td>– Smaller, lighter, higher loaded turbines</td>
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# SUMMARY

Augmenting PR’s workforce is important to quality Air Force S&T

PR’s front office is now reviewing *all* S&E vacancies to see if they are best filled by

- NRC (National Research Council) fellows
- IPAs (Intergovernmental Personnel Agreements) Exchange S&Es
- Term and temporary S&Es
- Permanent S&Es

STW-21 collaboration searches for new mechanisms that mutually benefit both parties