

Physical Sciences Inc.

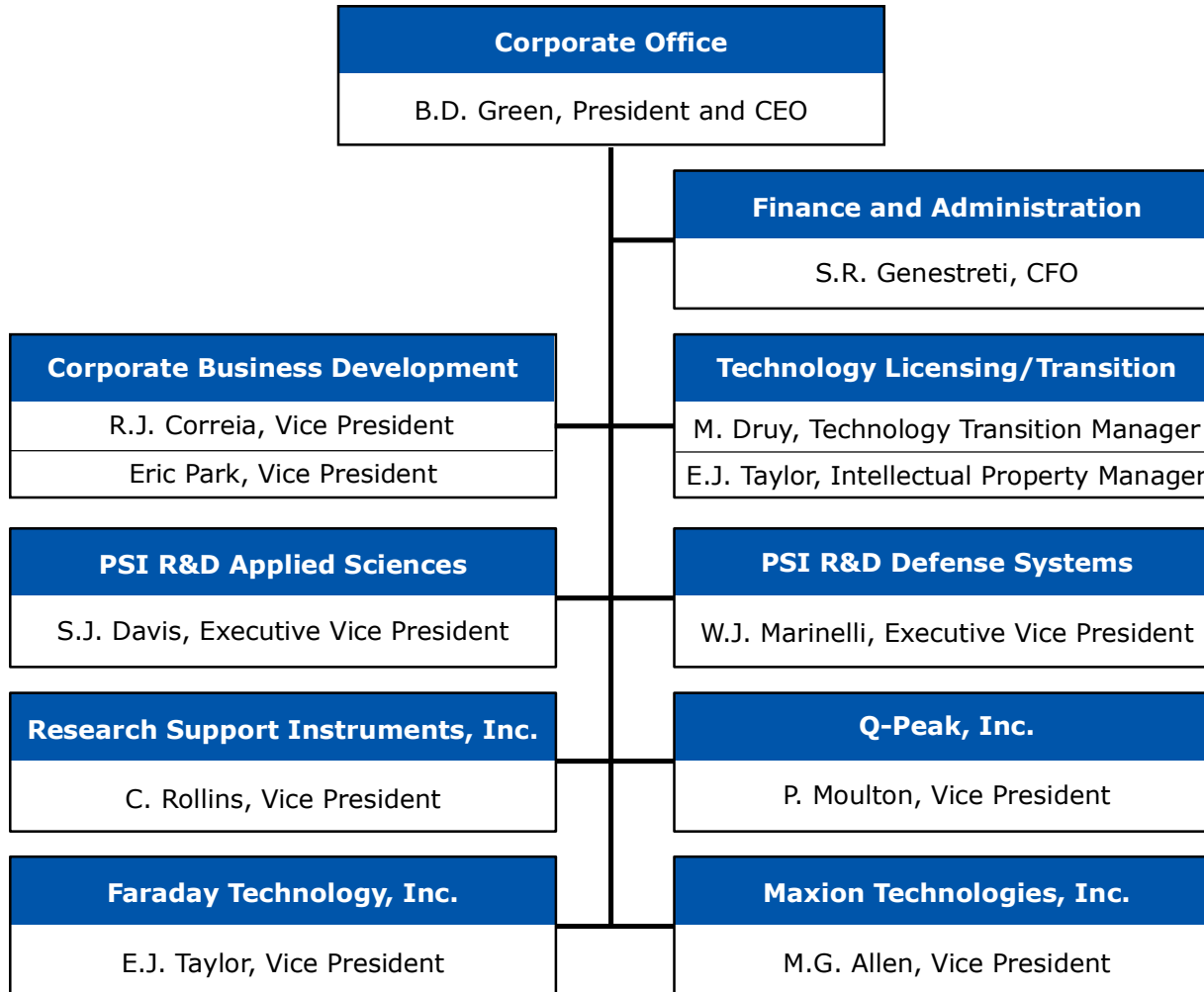
Corporate Overview

2012

Who we are

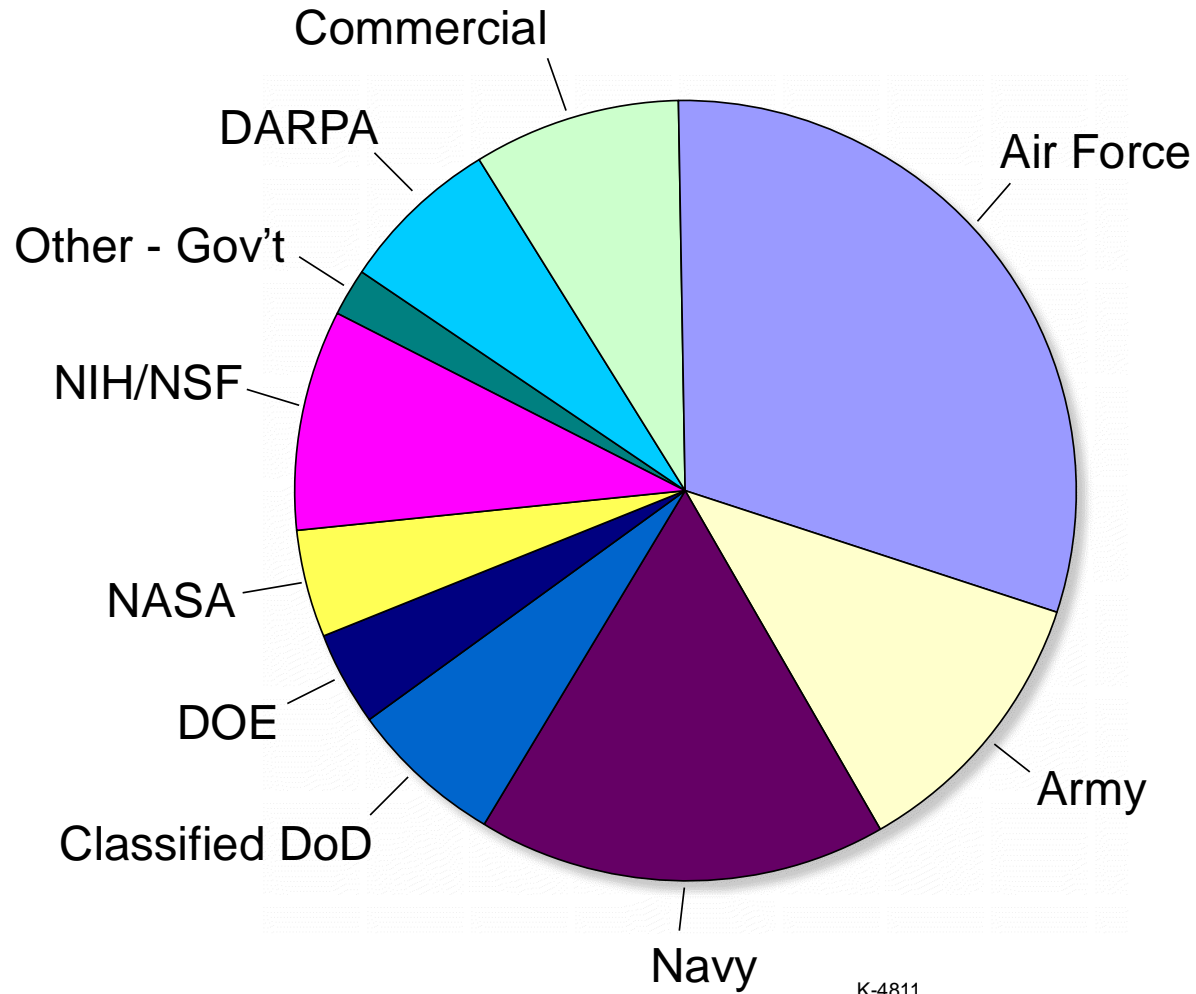
- **A growing 38 year-old company of 180 talented scientists, engineers and administrative personnel**
- **PSI** is headquartered in Andover, MA, with operations in Bedford, MA; College Park, MD; Dayton, OH; Lanham, MD; Princeton, NJ and Pleasanton, CA
- **Q-Peak** manufactures lasers and optical devices
- **Research Support Instruments** supports space ops
- **Faraday Technology** develops industrial processes
- **Maxion** manufactures semiconductor devices
- **Laser Light Engines** is our 4th commercial spin-out
- **PSI is a 100% employee owned company**

Corporate Structure

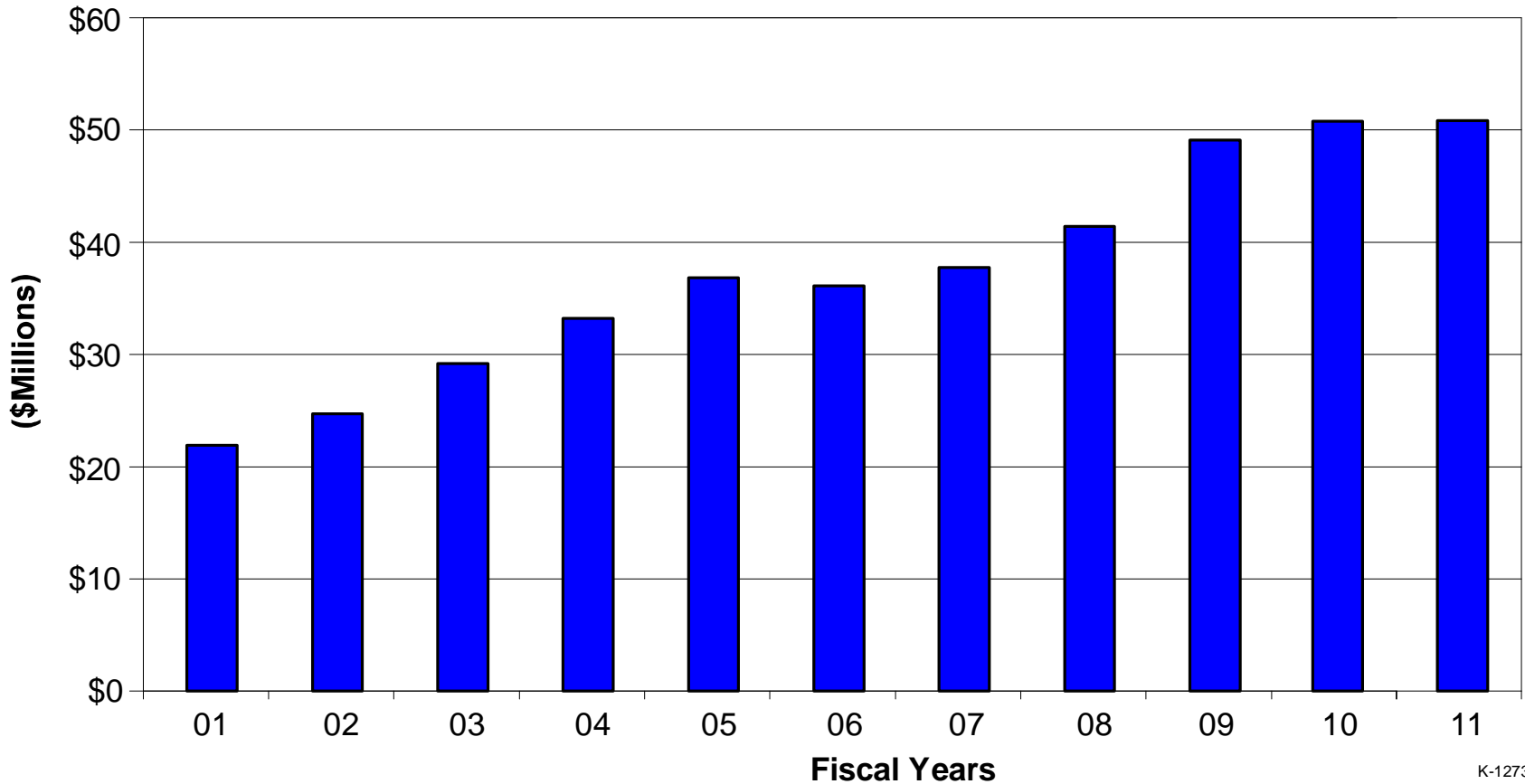


- **Applied research and development for all major agencies of the U.S. government**
- **Technology transition and product development for government and industrial customers**
- **Prototyping for commercial applications**
- **Limited production of special instruments**
- **Technology and product licensing to many strategic partners and four spin-outs to date**

PSI Customers



PSI Revenue History: FY01 – FY11

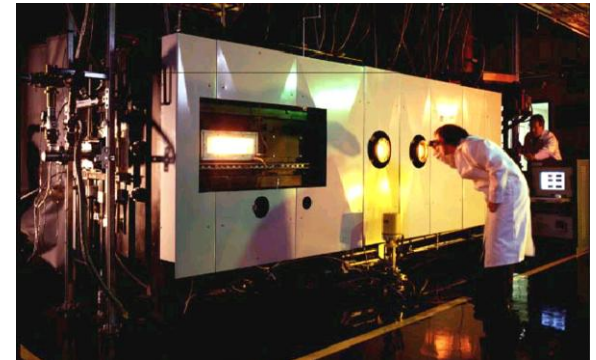
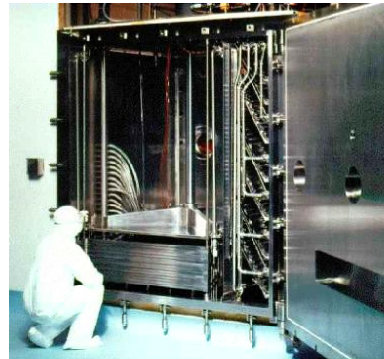


- **Tunable diode laser gas sensors**
- **Highly sensitive signal processing**
- **Laser ophthalmic diagnostics**
- **Aviation & diesel fuel contamination sensors**
- **Imaging hyper-spectral chemical sensors**
- **SONAR signal processor**
- **Infrasound infrastructure sensors**

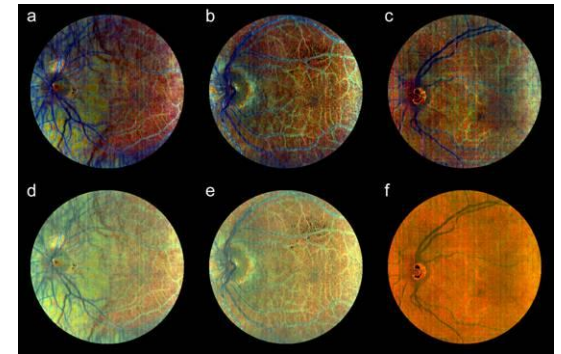


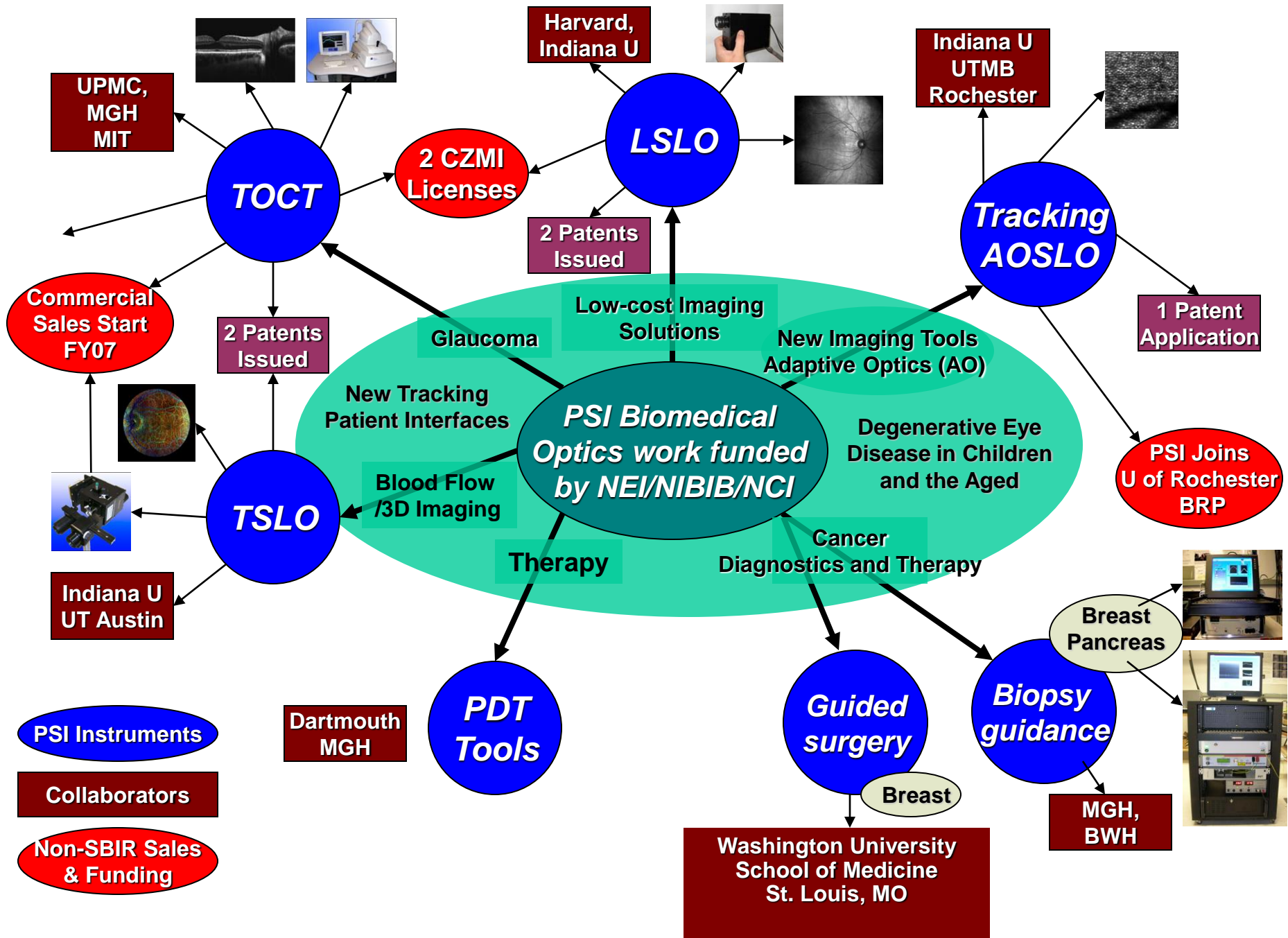
Natural Gas & Industrial Chemical Sensors

- **Battery-powered TDL LIDAR for methane detection**
- **Detection range up to 1,000 meters; PPM-M sensitivity**
- **Winner: 2006 R&D 100 Award**
- **800 units sold to pipeline industry to date**
- **Pharmaceutical process control monitors worldwide**
- **Industrial furnace sensors**



- **Revolutionary Ophthalmic Instrumentation**
 - TSLO: Tracking, Scanning Laser Ophthalmoscope
 - TOCT: Tracking Optical Coherence Tomography
 - LSLO: Line Scanning Laser Ophthalmoscope
 - AOSLO: Adaptive Optics SLO
- **Applications**
 - Diabetic retinopathy, macular degeneration
 - Degenerative eye diseases in children and aged
 - Research on the cellular basis of eye diseases
- **~10,000 units incorporating the LSLO sold by major ophthalmic instrument manufacturer**





Technology:

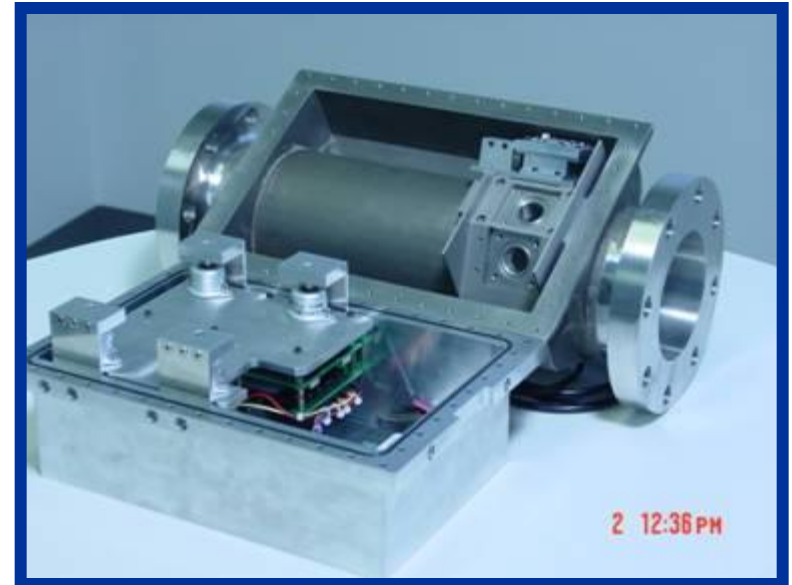
- Laser-based, in-line sensor to monitor sediment & free water in aviation fuel (JP5) & hydraulic fluids

Phase III Funding:

- NAVAIR

Government & Commercial Sales:

- \$8M from the Navy, shipbuilders, shipyards and commercial partners



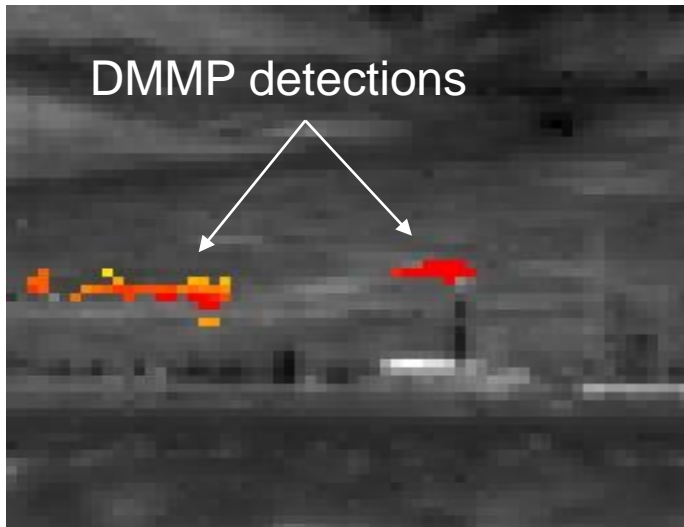
Need filled:

- Automated and timely JP-5, F-76 fuel quality
- Reduced workload
- \$10M /year saved



Long Wave Hyper-spectral Imaging Sensor

- **Chemical and biological agent warning systems**
- **Patented Passive IR imaging technology**
- **Applications in explosives detection**



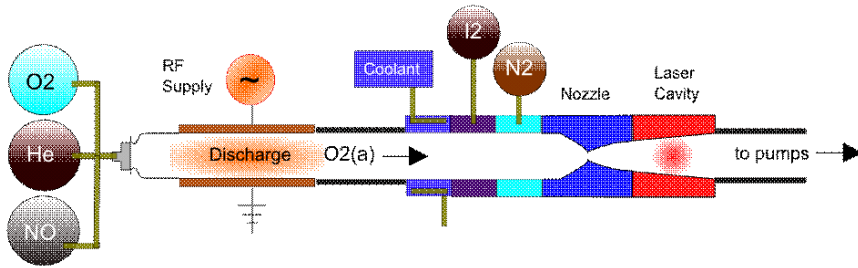
- **1000 – 1500 units may be required by DoD**
- **Joint development with Smiths Detection**
- **Over \$19M Phase III dollars awarded by US Army**
- **New collaboration with URI**

- **Very high power gas lasers**
- **High power, solid state lasers**
- **Laser machining systems**
- **Low cost ceramic matrix composites**
- **High energy oxidizers for propulsion**
- **Wideband antenna systems**
- **Miniature air vehicles**

Discharge-Excited Catalytic O-I Laser

• Technology

- High brightness, high power gas laser
- RF-pumped Oxygen-Iodine system
- Catalytic enhancement discovery

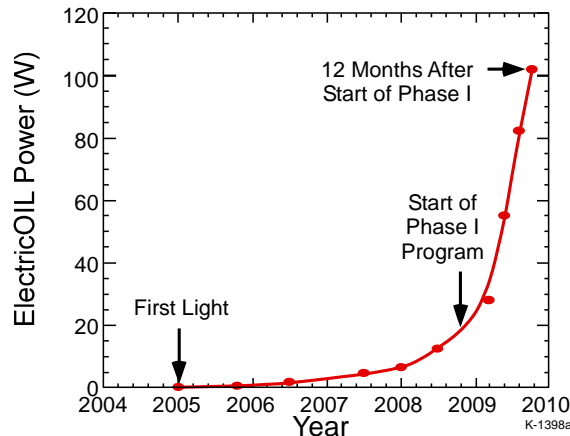


• Importance

Laser	Mass/Power	Electrical Efficiency/ Beam Quality
JHPSSL	~15 kg/kW	20%/(2) ² = 5%
HELLADS	5 kg/kW	16%/(2) ² = 4%
FIBER	≤ 5 kg/kW	30%/(1.4) ² = 15%
DECOIL	< 8 kg/kW	25%/(1.2) ² = 17%

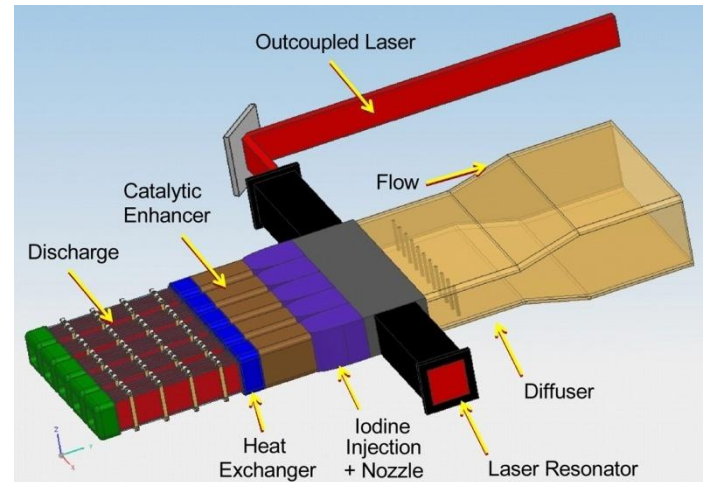
• Accomplishments

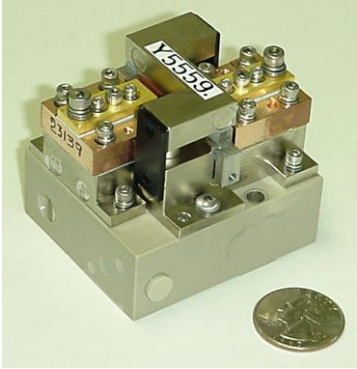
- Factor of 10 power scaling achieved in 1 year
- Demonstrated high brightness: M₂ = 1.09



• Transition

- Scale to 1 kW, then to 12-20 kW module





- **Scaleable to 100 W module**
- **Applications to LADAR and LIDAR sources**
- **RGB laser for digital cinema**
- **CW and ultra-short pulse**
- **High power, eye-safe fiber lasers from 1 – 10 kW per fiber**



Laser-based Machining of Ceramics

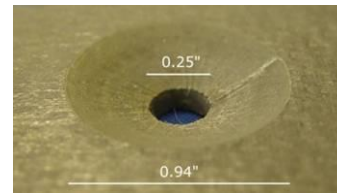
- **Transition Target**
 - JSF F135 Ceramic Component Manufacturing Line

- **Status**
 - Verified laser machining does not degrade material properties
 - 5-axis CNC Laser Machine Tool Specifications and Design Complete
 - NavAir SBIR II+ in place
 - Phase III contract in place

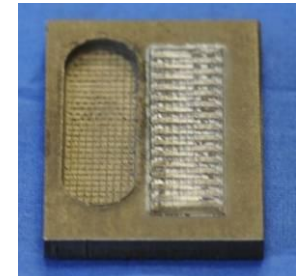
- **Next Steps**
 - Integrate fiber laser, machine tool and software
 - Delivered to JSF manufacturing line spring 2011
 - Qualify in LRIP2 manufacturing



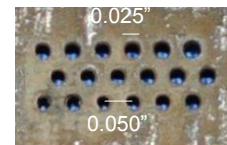
Countersinks



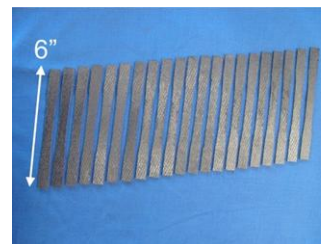
Most Ceramic Materials and Features



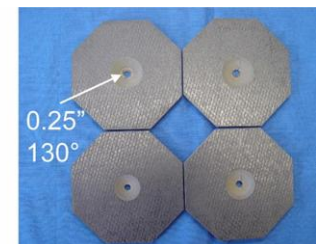
Through Holes



Tensile Bars



Pull Test

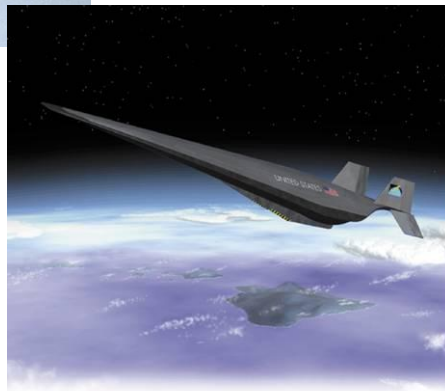
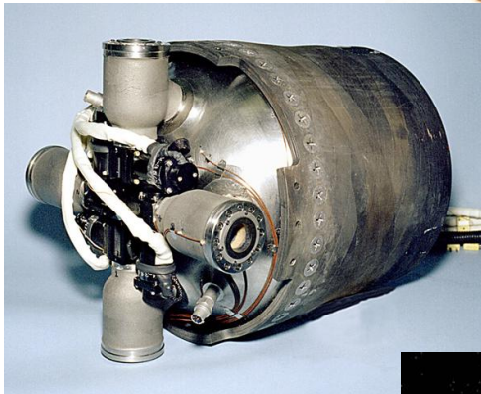




High Temperature Ceramic Matrix Composites

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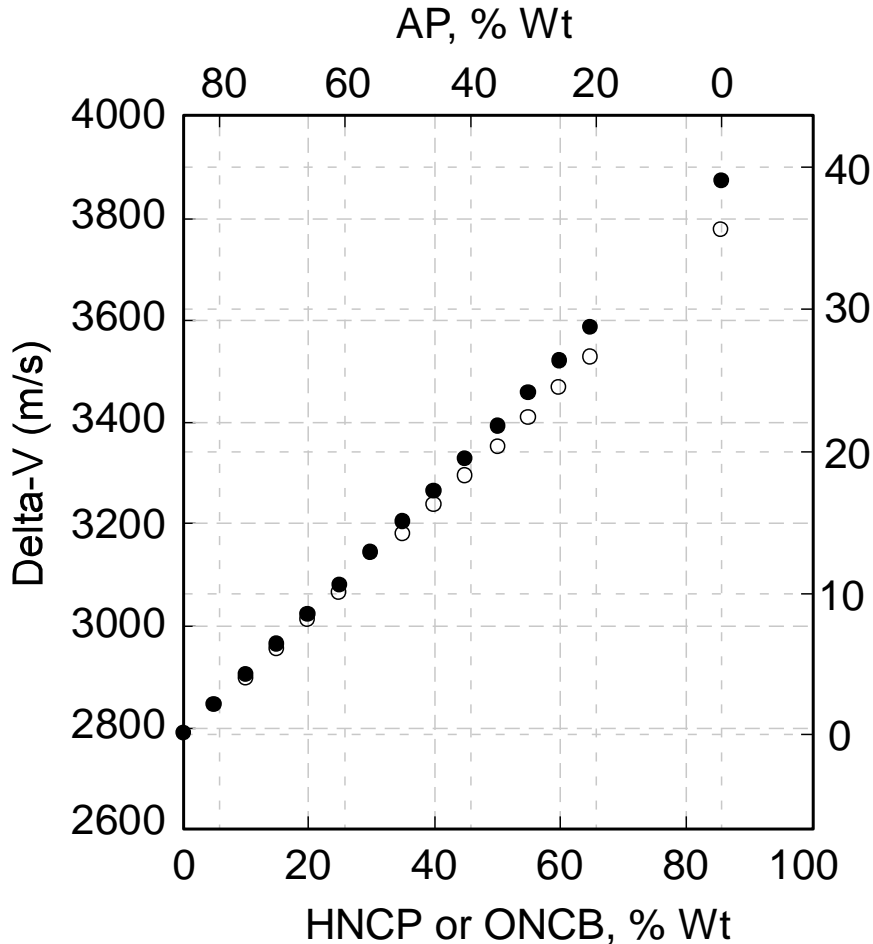
Corporate Overview 2012-16



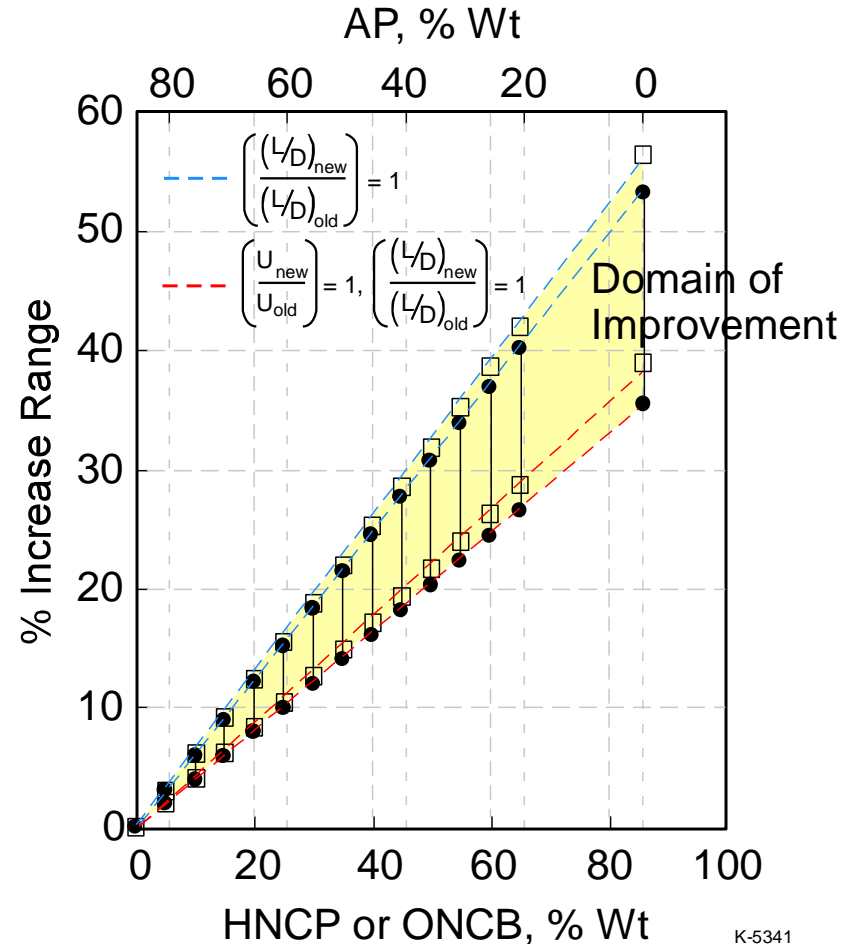
- **Advanced metal - ceramic composites**
- **Survives to 4750 degrees F**
- **Fabricated for SM-3 components and scramjet flow path**
- **Hypersonic aircraft leading edge candidate**
- **Manufactured in dedicated PSI facility in Haverhill, MA**

High Energy Oxidizer Performance

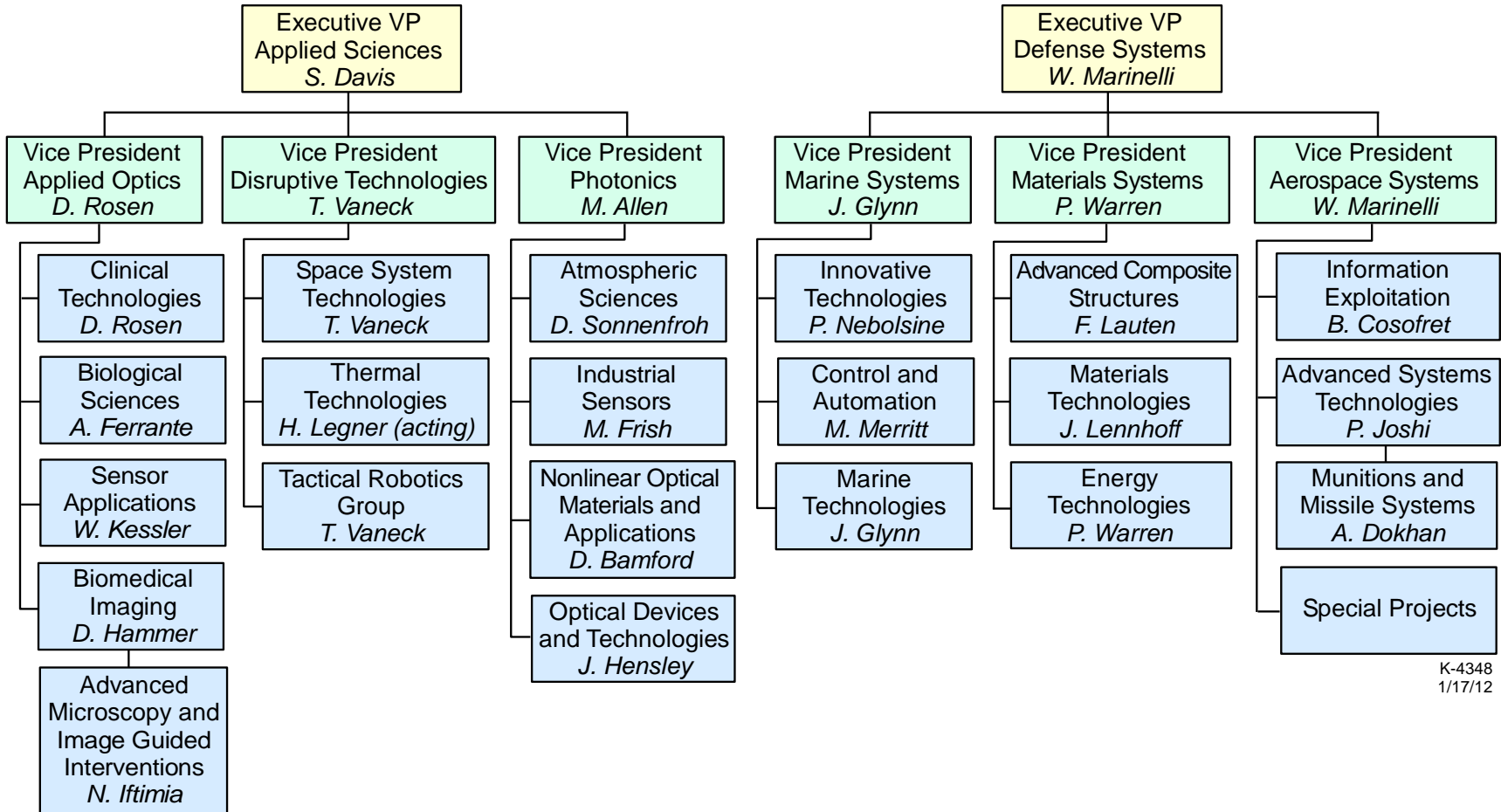
ΔV improvement up to 39%



Range improvements up to 56%



PSI R&D Management



PSI Staff Capabilities

