

An Overview of The Johns Hopkins University Applied Physics Laboratory

2018

Eliza Bell-Andrews
TSX/TAS

APL in Brief

What are we?



Who are we?



Who are our sponsors?



What is our core purpose?



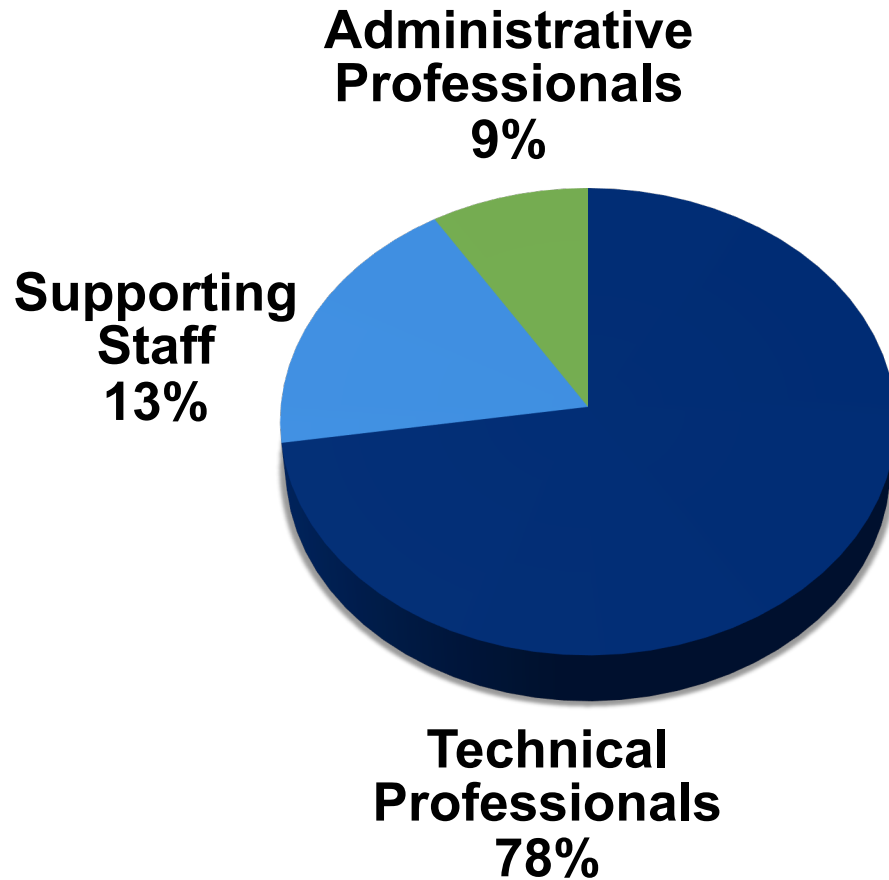
- Division of Johns Hopkins University
- University Affiliated Research Center (UARC)
- Non-Profit Organization

- Deep Technical and Operational Expertise

- DoD
- NASA
- DHS
- IC

- Critical Contributions to Critical Challenges

Staff Demographics



Technical Professionals

Degree Level	
19%	Doctorate
53%	Master
22%	Bachelor
6%	None

Technical Professionals

Degree Field	
46%	Engineering
25%	Math, Computer Science
23%	Physics, Chemistry, Other
6%	None

Example of APL's Defining Contributions

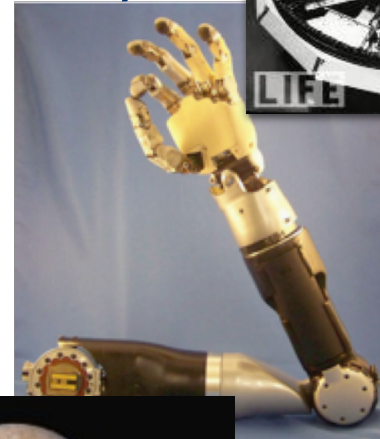
- Variable Time Proximity Fuze (VT Fuze)



- TRANSIT Satellite Navigation (precursor to GPS)



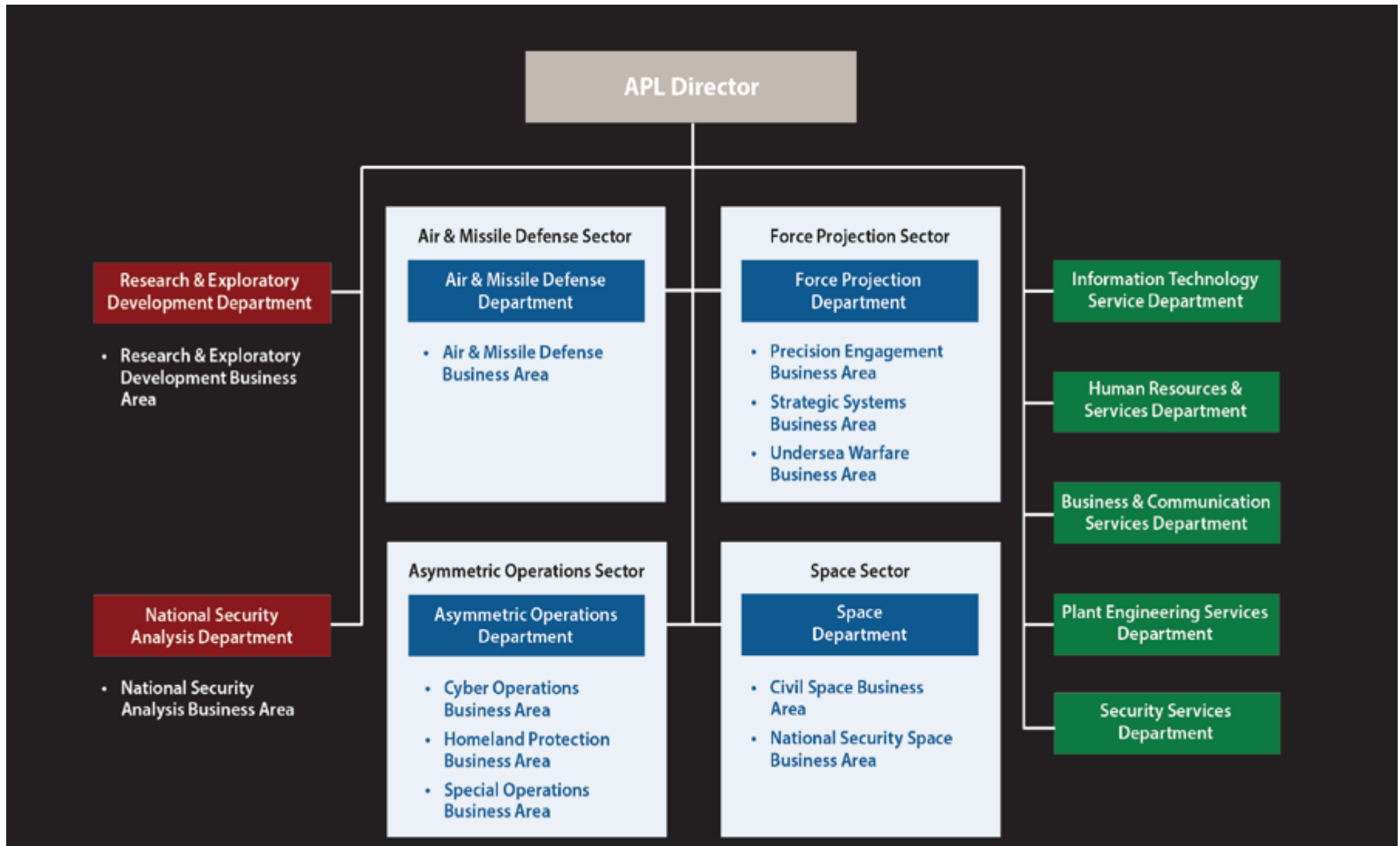
- Neurally controlled modular prosthetic arm



- New Horizons Flyby of Pluto



APL Organization



Air & Missile Defense Heritage



1980's
Deployment of Aegis
Cruisers and Destroyers



1960's & 1970's
Radar and Combat Systems
Development



Late 1940's & 1950's
AAW Missile Development

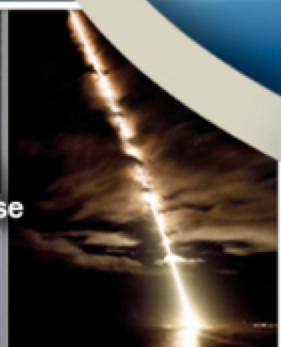
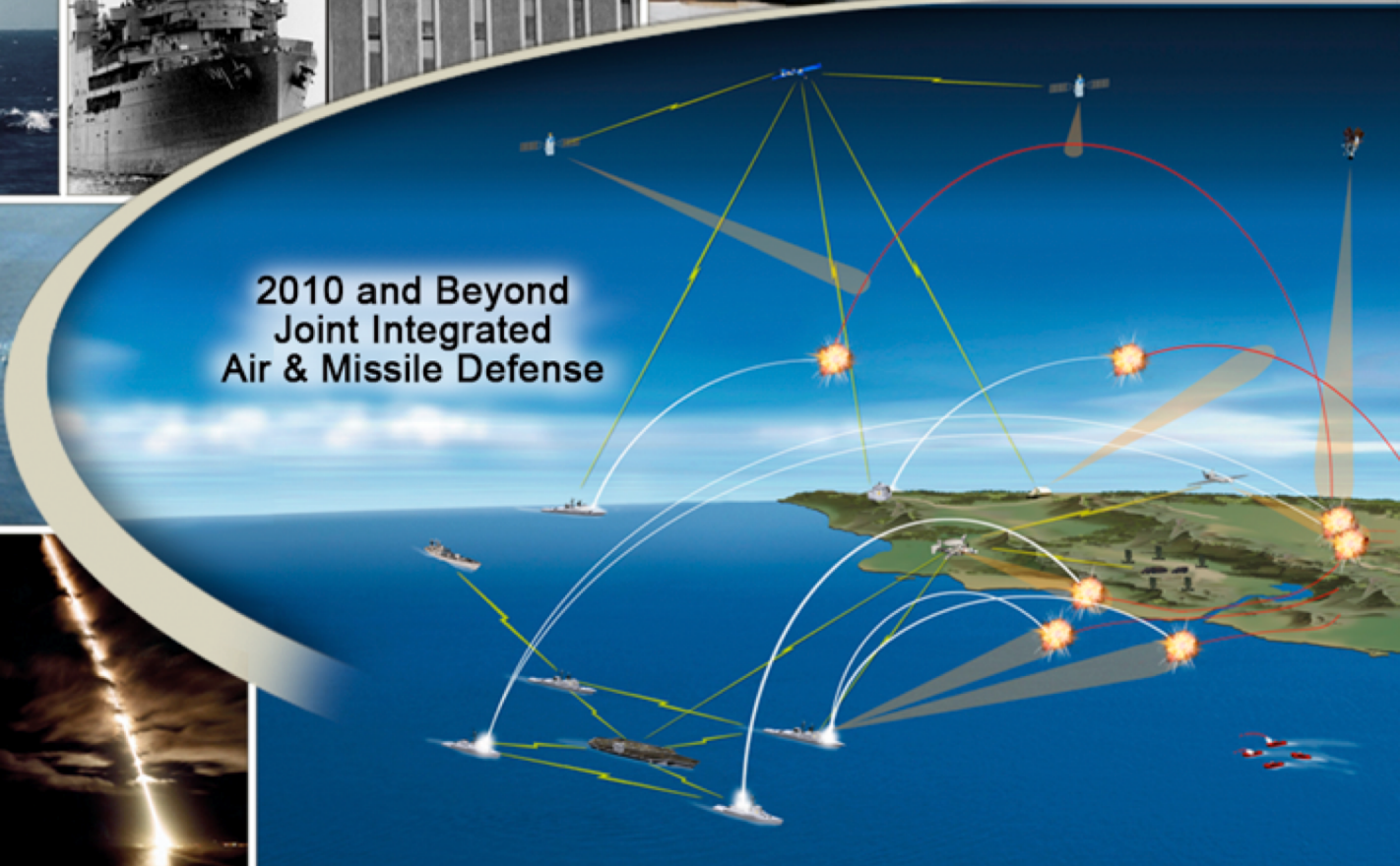


WWII
Proximity Fuze

1990's & 2000's
Cooperative Engagement Capability
& Ship Self Defense System



2010 and Beyond
Joint Integrated
Air & Missile Defense



Mid-1990's & 2000's
Ballistic Missile Defense

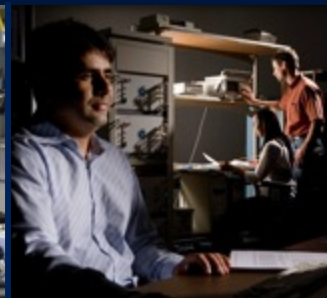
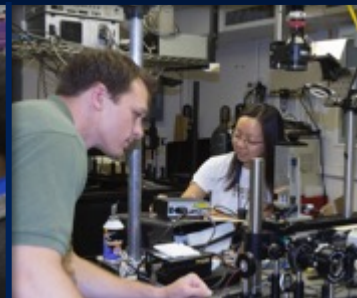
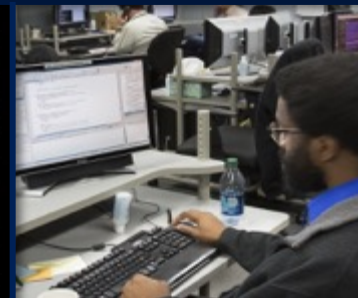
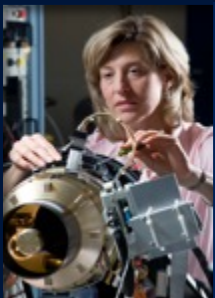
A Continuing Challenge: Staying Several Steps Ahead Of Our Adversaries



APL Air & Missile Defense Mission

Our mission is to advance the ability of our nation & its military services to defend themselves & others against cruise & ballistic missiles & threat aircraft.

We will achieve this through innovative, effective, & affordable system solutions to the most difficult challenges posed by evolving air & missile threats.





We Make This Happen ...



... So This Doesn't Happen!

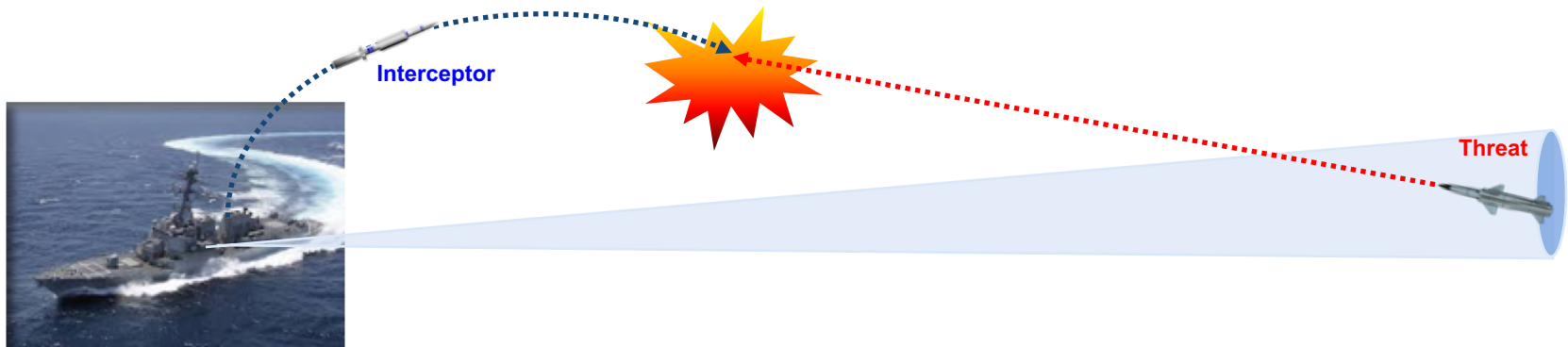
What's the Challenge?



Missiles are a big business and plentiful, ... fast, highly maneuverable, stealthy ... and effective!

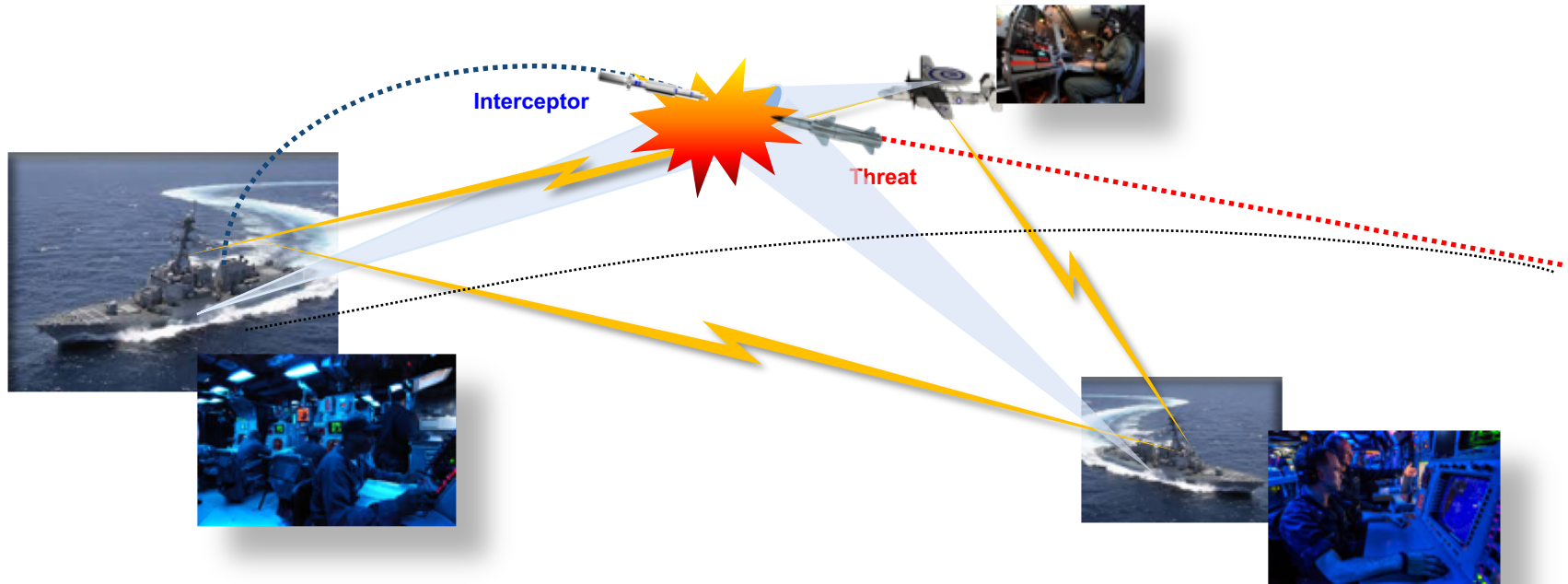
How Do We Negate Threats Before They Can Do Damage?

General Problem: Shoot Down the Threat



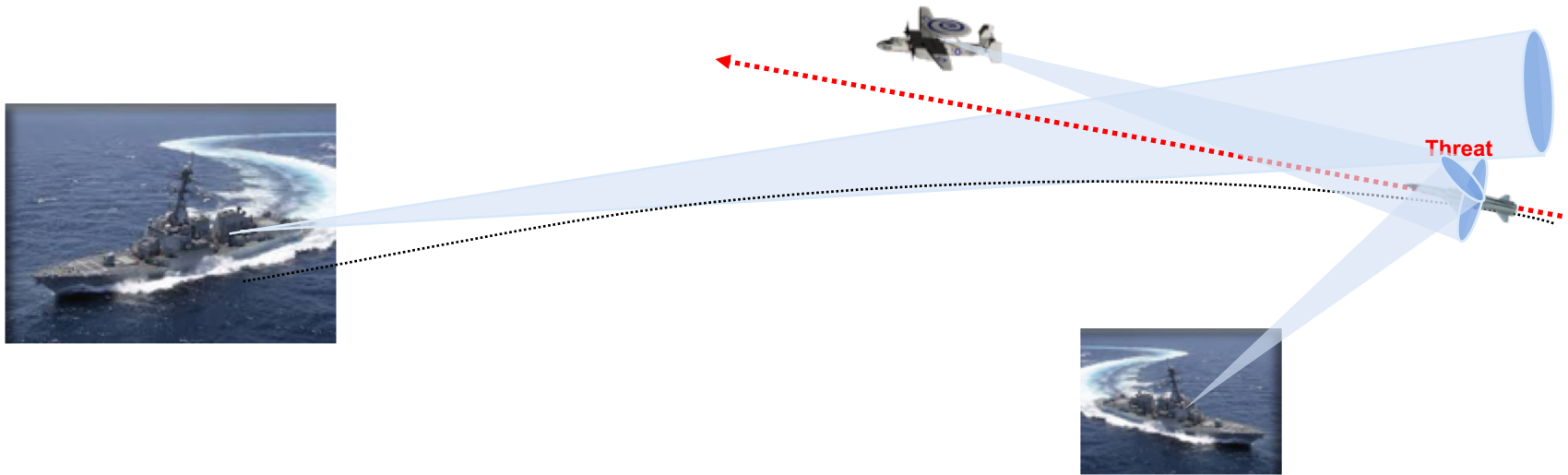
Basic steps: Detect, Control, Engage, Intercept

Science and Engineering to the Rescue



Missiles are fast and lethal, so we need sensors to **DETECT** the threat as far away as possible
Radar is often used to detect the threat – but the physics may not be there
So sometimes we need a little help from our buddies
Communications and information sharing is a necessity
A **CONTROL** structure allows for efficient coordination between platforms
ENGAGE the threat with the best options
INTERCEPT with effective weapons

Science and Engineering to the Rescue



Missiles are fast and lethal, so we need sensors to **DETECT** the threat as far away as possible
Radar is often used to detect the threat – but the physics may not be there
So sometimes we need a little help from our friends

What Do We Do?

Optimize the development and integration of multiple
Sensor, Command & Control, Communication and Weapon Systems



Radar
Electro-Optics
Infra-Red
Electronic Support



Naval Combat Systems
Joint Tactical Systems
Intelligence, Surveillance &
Reconnaissance



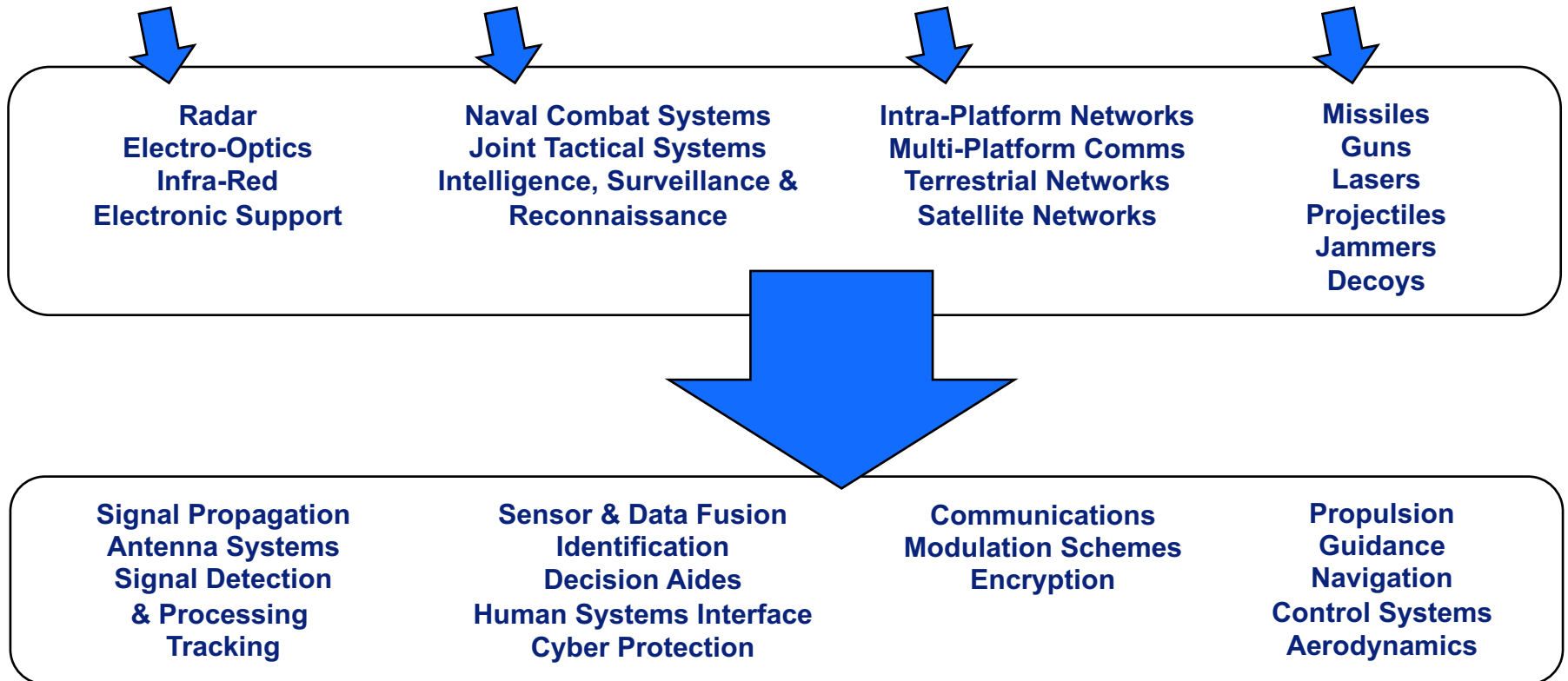
Intra-Platform Networks
Multi-Platform Comms
Terrestrial Networks
Satellite Networks



Missiles
Guns
Lasers
Projectiles
Jammers
Decoys

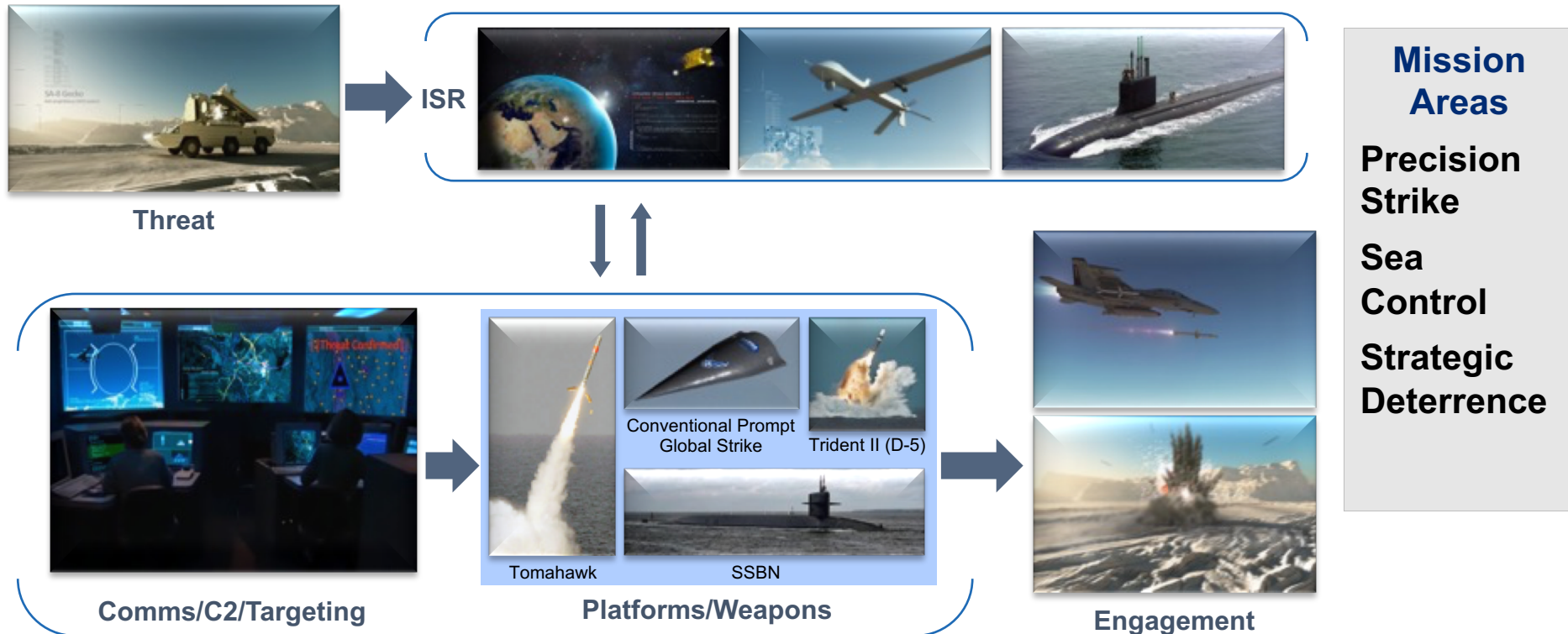
What Type of Expertise Do We Need?

Optimize the development and integration of multiple
Sensor, Command & Control, Communication and Weapon Systems



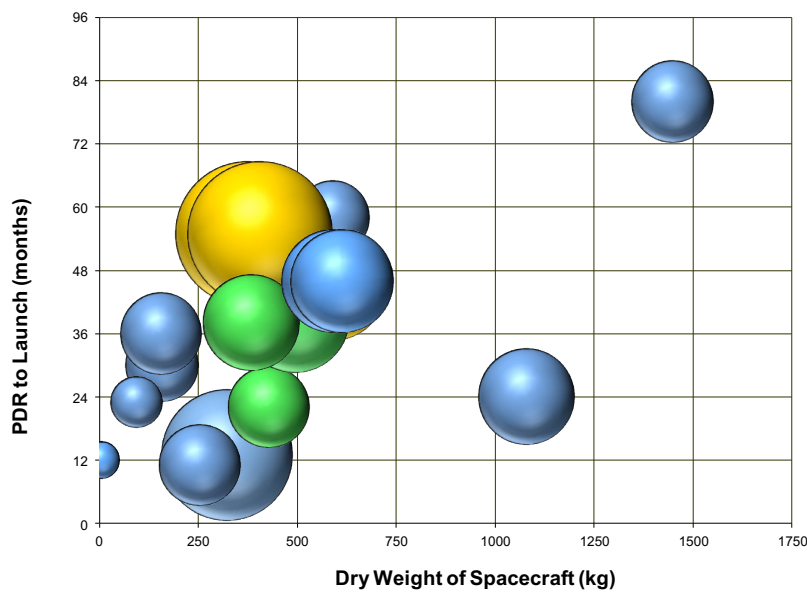
Force Projection Sector

Provide decisive offensive capabilities enabled by timely, assured response for deterring, engaging, and defeating adversaries in the maritime domain



Space Exploration Sector

Support of civil and national security programs



Recent Examples

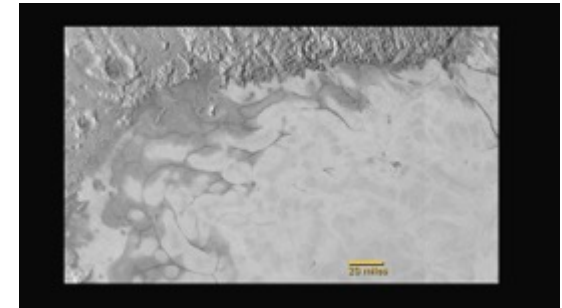
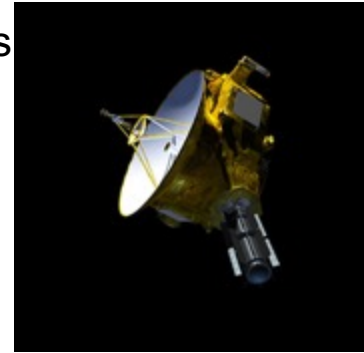


- 68 spacecraft
- More than 150 sensors and payloads
- Short time to space
 - Tight requirements process
 - Disciplined development
 - Unparalleled cost/schedule performance
- 150 science grants in progress continuously
- Trusted-agent studies in support of NASA, NOAA, and DoD

New Horizons Flyby of Pluto

- Launched on January 19, 2006
 - Fastest ever manmade object
- Gravity assist from Jupiter on February 28, 2007
- Flew by Pluto on July 14, 2015 travelling at > 30,000 mph
- During closest approach, the S/C, by design, halted communication with the Earth for 22 hours
- S/C flawlessly executed a >30,000 command autonomous command sequence that included ~150,000 thruster firings to collect the maximum amount of data
- Data will be returned to Earth over following 16 months
- Will require rewriting the book on Pluto

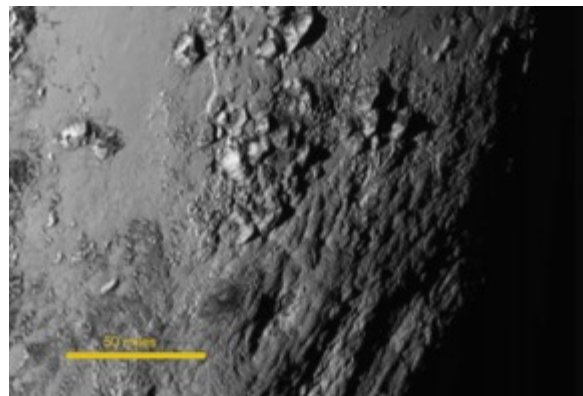
New Horizons
Spacecraft



Flowing nitrogen ice



Enhanced color image of Pluto



Pluto's water ice mountains



Charon's youthful terrain

Asymmetric Operations Sector

Protect against and employ asymmetric operations for national security in a post-9/11 world



Sample Lab—LIVELab

- APL's LIVE Lab provides direct access to real-time cyber data, enabling enterprise scale experiments and a live environment for experimentation and prototyping.



- **Situational awareness for Mission Readiness**

National Security Analysis Department

Identifying the Critical Challenges of the Future

Lead studies and analyses, and develop areas of research and collaborative and gaming tools for innovative and affordable solutions to critical challenges

Studies, analyses, and systems engineering efforts for national security



- Hard kill and soft kill for OPNAV N81
- Countering anti-access area-denial (A2/AD) capabilities for OUSD(AT&L)
- Comprehensive review of the future role of the Reserves for SECDEF

Developing new areas of research



- Health care process efficiency for naval medicine
- National leadership command and control systems engineering for processes and capabilities

Applying new collaborative and gaming tools



- Competitive influence gaming to explore multi-organizational solutions to regional challenges in NORTHCOM, AFRICOM, and NATO
- Cyber technical exchange for 10th Fleet

Research and Exploratory Development Department

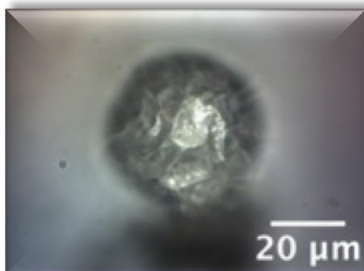
Science and Technology Breakthroughs for APL's Future

Imagine: The Possibilities

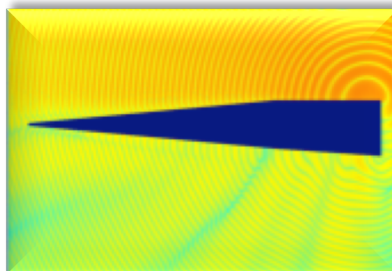
Solve: The Science Problems

Design: The Systems

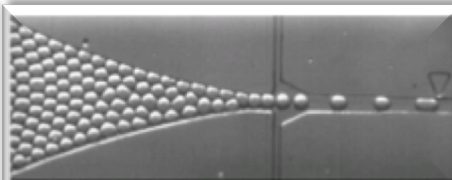
Build: The Prototypes



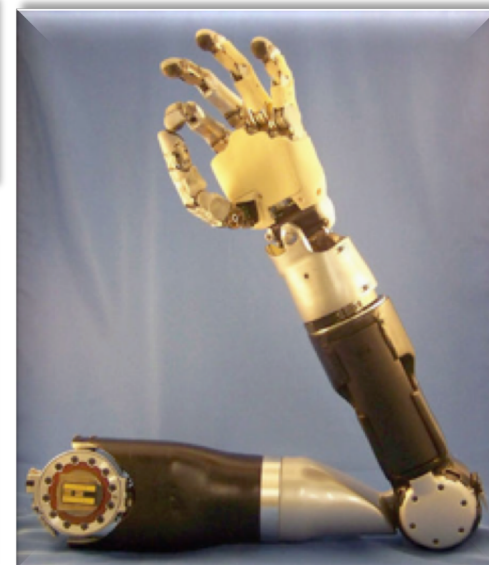
New Materials



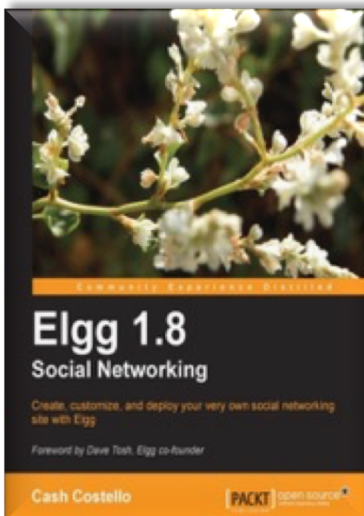
Computational Physics



Synthetic Biology



Neuroscience and Robotics



Information Sciences



Hyperspectral Imaging



Biomechanics



Design and Fabrication

The People We Hire

Problem Solvers and Independent Thinkers

APL prizes leadership and dedication as personal attributes.

Team Players

Thinking outside the box is an asset, but teaming to accomplish objectives is how we get things done.

Hands-on Technologists

We build prototypes in our own facilities, and we test equipment where it has to operate.

Good Communicators

Staff members forge close working relationships with their program sponsors and peers from other organizations. Communications skills are highly valued at APL.

Note: Security clearances are necessary for many positions. Holding U.S. citizenship is part of the requirements for obtaining a clearance.

Discovery Program – Overview

- **Participants reside in a central home group in REDD**
 - Concentration on networking, early professional skills, and guided career development
 - Fixed program length of 2 years, starting in early July
 - Recent college graduates only
 - Participants rotate through 4 groups
 - Selection process for final placement



- **Six month assignments in groups across APL**
 - Collaborate with people from multiple groups
 - Learn about technology and applications in different sectors/ departments
 - Experience group culture

Summer Internship Program

- **Over 460 Summer Interns/Co-ops in 2018**
- **Interns work in diverse projects in every technical department working with scientists and engineers, conducting research, developing leadership skills, and growing professionally.**
- **Interns have the opportunity to network throughout the summer at lab-wide receptions, social events, tours of the lab and workshops.**
- **Competitive pay rates/holiday pay**
- **8-12 weeks, flexible start & end dates**
- **Transportation to MD is paid to students who are not local.**

Program Requirements

- Minimum overall GPA of 3.0
 - Technical major or major related to your internship
 - US Citizenship / Able to get DOD clearance
 - Typically interns are rising Juniors and Seniors; however, freshman to PhD students are eligible
- **Apply after 9/1 – Application closes March 31, 2019**

APL Benefits

Work/Life Balance



Pension Plan

Beneflex Program

Paid Leave

Fitness/Wellness

Health Coverage Options

Scholarship Program

Continuing Education

APL Environment

In many respects, APL is a self-contained community. We often refer to our 400-acre facility as a "campus." We have more than 40 buildings, including the following:

- ✓ More than **400** state-of-the-art laboratories and technical facilities
- ✓ APL's Innovation Space "**Central Spark**" includes a maker space, design thinking, communities, augmented and virtual reality, and more.
- ✓ **Classrooms** and computer labs for the on-site JHU graduate programs
- ✓ **Full-service cafeterias, several smaller snack bars and visiting food trucks!**
- ✓ **A 500-seat** auditorium and conference facility
- ✓ **Our own medical office, fire station, rescue squad, and security force**
- ✓ **An employee-owned credit union**
- ✓ **Recreation areas including an exercise facility, a picnic pavilion, baseball fields, volleyball courts, and tennis courts**



Activities & Interest Groups

Our staff members have diverse interests, and the Laboratory offers a number of activities to appeal to those interests:

- African American Culture Club
- Allies in the Workplace
- Hispanic Awareness Club
- Astronomy
- APL Gospel Choir
- Basketball
- Cycling
- Asian Heritage Club
- Chess
- Softball
- Musical Arts
- Drama Club
- Poetry Reading
- Tennis
- Volleyball
- Women's Club
- Young Professionals Network
- SWE Chapter
- Allies in the Workforce
-and others





JOHNS HOPKINS
APPLIED PHYSICS LABORATORY