



Air Force Office of Scientific Research (AFOSR)

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Program Manager, Space Sciences



Air Force Research Laboratory



The Air Force Office of Scientific Research is the **only** Air Force directorate that supports **basic** research:

specifically, long-term broad-based research into aerospace-related science and engineering.

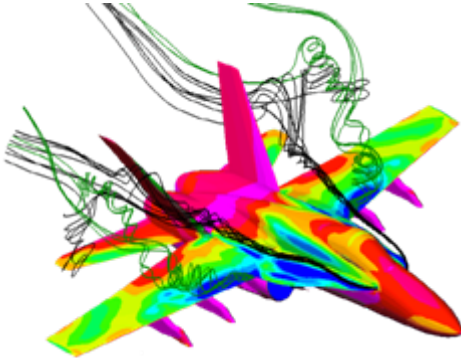
The Air Force's Corporate Research and Development Laboratory



AFOSR Basic Research Areas

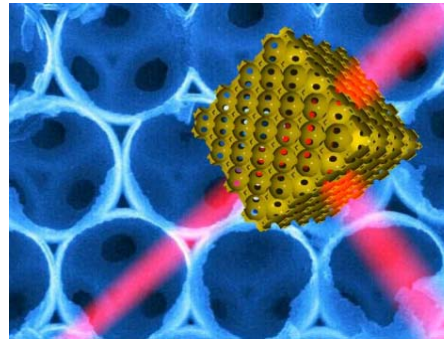


Aerospace, Chemical & Materials Sciences



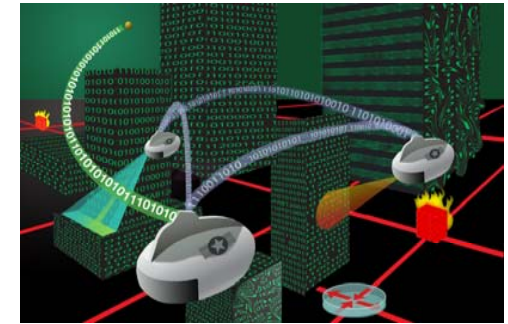
- Structural Mechanics
- Materials
- Chemistry
- Fluid Mechanics
- Propulsion

Physics & Electronics



- Physics
- Electronics
- Space Sciences
- Applied Math

Mathematics, Information & Life Sciences



- Info Sciences
- Human Cognition
- Mathematics
- Biomimetics



What we do...Programs



Optics, electromagnetics, communications, and signal processing

Optical Physics (Kent Miller)

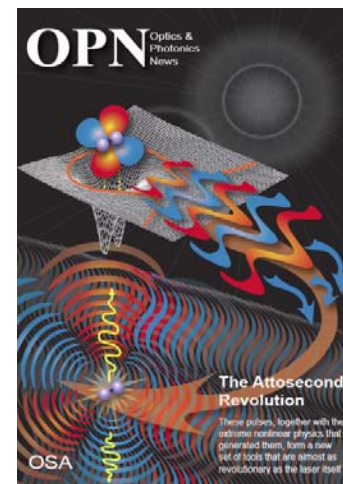
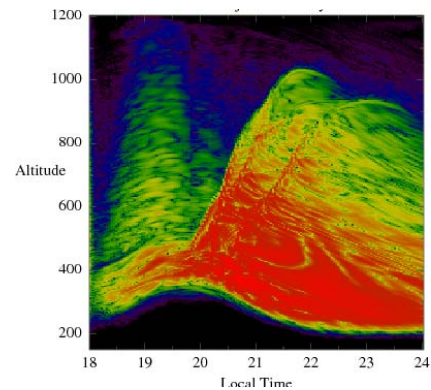
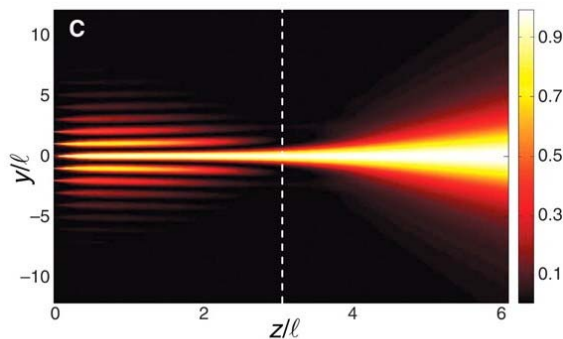
imaging physics, space object identification, adaptive optics

Electromagnetics (Arje Nachman)

wave propagation, physical mathematics, antennas

Sensing, Surveillance, Navigation (Jon Sjogren)

communications, non-GPS navigation





What we do...Programs



Plasma physics and high energy/non-equilibrium processes

Electro-Energetic Physics (Bob Barker)

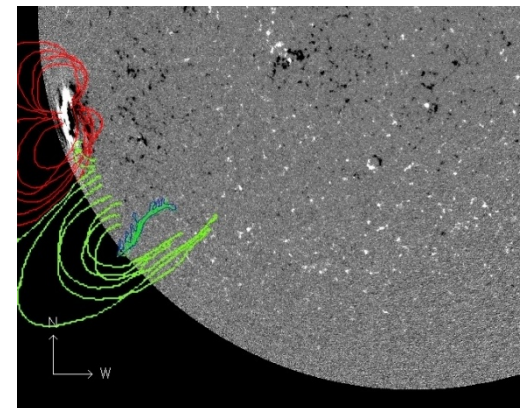
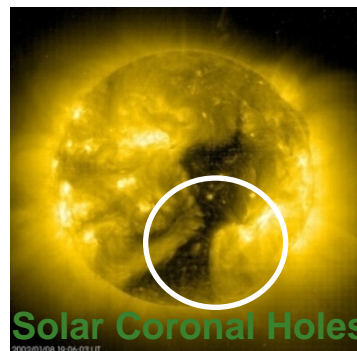
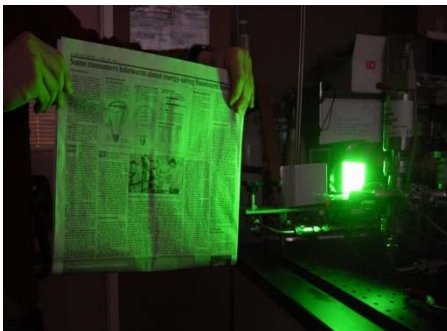
high power microwave, pulsed power, cold plasmas

Space Sciences (Cassandra Fesen)

space weather, space plasma physics- Heliospheric, Magnetospheric, Ionospheric, Thermospheric physics

Lasers (Howie Schlossberg)

high power lasers, micro plasmas



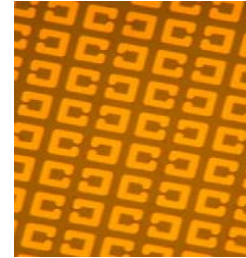


What we do...Programs



Complex electronics and fundamental quantum processes

Quantum Electronic Solids (Harold Weinstock)
superconductors, metamaterials, nanoelectronics,
graphene

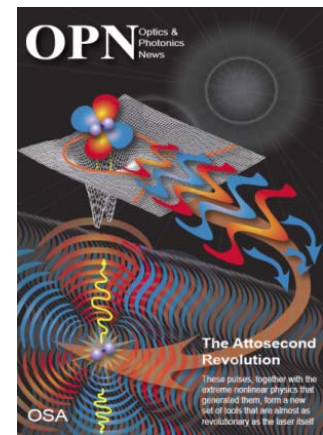


Sensors & High Speed Electronics (Kitt Reinhardt)
multi-modal sensing, RF power materials & devices,
high-speed computation, ultra-high bandwidth communication



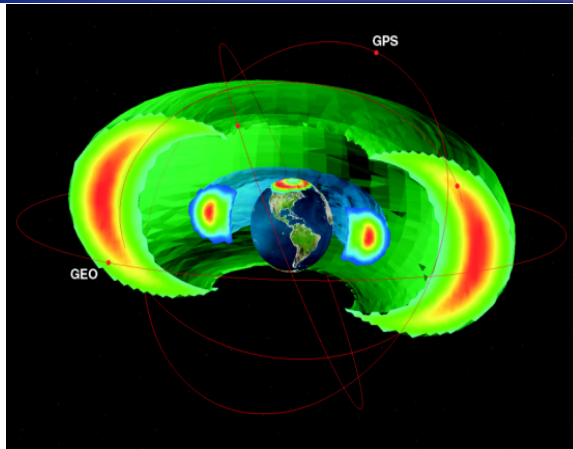
Photonics & Solid State Optics (Gernot Pomrenke, Howie Schlossberg)
optoelectronics, Terahertz, non-linear materials,
fiber lasers

Atomic, Molecular & Optical Physics (Tatiana Curcic)
ultra cold atoms & molecules, ultra fast lasers





Space Science Goals

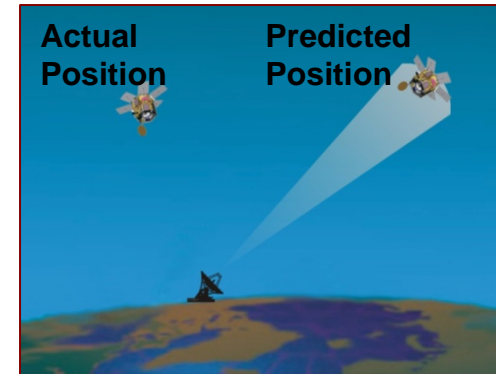


Forecasting changes in particle energy and flux in the Radiation Belts

- Understand how the belts are populated and depleted
- Understand how to predict energetic particle flux and transients at satellite

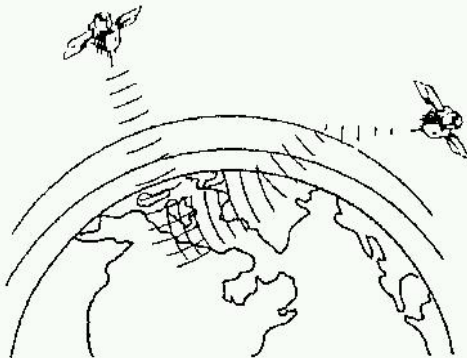
Forecasting satellite drag & atmospheric density

- Predict solar forcing
- Understand energy flow
- Understand role of winds and waves



Forecasting communication, navigation outages

- Understand triggering of instabilities → plasma bubbles
- Understand spatial & temporal distribution of Equatorial Spread-F



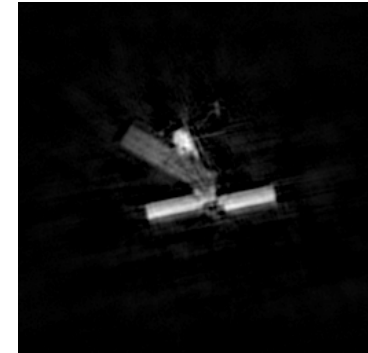


Optics and Remote Sensing Goals



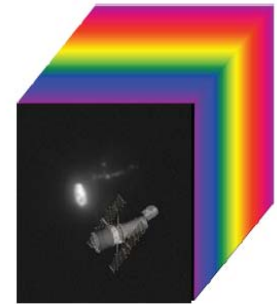
- **Identification of space objects**

- Forward modeling is possible, but not inverse modeling
- Need to enable new elements in
 - Polarimetry
 - Spectroscopy
 - Photometry



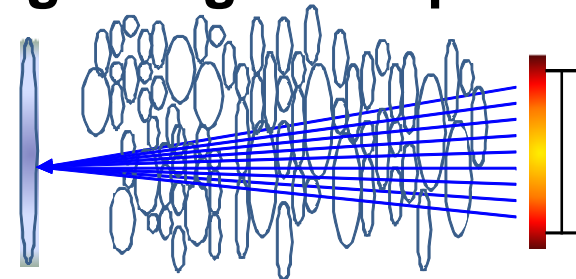
- **Imaging objects in LEO and detecting small objects near space assets**

- Determination of limits, Diffraction limit/Super-Resolution
- Determination of image “goodness” (information content)
- Active imaging to extend resolution and interrogate unresolved objects



- **Imaging through turbulence and through long atmospheric paths**

- Extreme turbulence
- Long horizontal paths
- Extended or non-localized beacons





Planning for the Future, cont'd



Some things the Air Force might encounter in 2030...

5. Direct connections between humans and machines
 - **Electronics – Photonics, Sensors, Superconductors**
6. Extremely small, capable, networked machines
 - **Electronics – Photonics, Nano**
7. Significantly increased presence in space
 - **Physics – Optics, Space Weather**
8. Increased use of directed energy weapons
 - **Electronics – Photonics, Electromagnetics**
 - **Physics – Lasers**

