Space Situational Awareness, Orbital Debris (SSA-OD)

Decadal Survey Supplemental Presentation

Dr. Nicola Fox

Heliophysics Division Director
Science Mission Directorate

Introduction

This input to the Decadal Survey presents high-level information on the current state of Space Situational Awareness/Orbital Debris (SSA/OD), as applicable to NASA. The intent of these slides is to assist the Committee in the beginning of their deliberations, and NASA welcomes the opportunity to speak further to the Committee on this topic.

The final slide of this presentation includes specific requests from NASA for the Decadal Survey Committee.

Decadal Survey Statement of Task, Study Approach

The survey should assess to what degree the Heliophysics programs should support Space Situational Awareness/Orbital Debris research and technology. NASA specifically invites input on the scientific and/or programmatic connection(s) with its Space Weather Science Application program.

Overview

- National Context, current and potential NASA activities
  - Role of Heliophysics Division
- Space Situational Awareness/Orbital Debris and heliophysics science
  - Fundamental plasma science
  - Improved scientific understanding to enhance operational capabilities
- Partnerships and relationships, intra-Governmental
- Request for the Decadal Survey

National Context, NASA Risks

- Office of Science and Technology Policy (OSTP) has published National plans
  - *National Orbital Debris Research And Development Plan* (Jan. 2021)
  - *National Orbital Debris Implementation Plan* (Jul. 2022)

- *NASA's Efforts to Mitigate the Risks Posed by Orbital Debris*, NASA OIG Report [IG-21-011]
  - Introduction: NASA's risk identification and mitigation approaches
  - Recommendation 4: "Prioritize obtaining direct measurements needed to fill smaller sized debris gap at the 600 to 1,000 km altitude in LEO"
    - See SMD's partial concurrence.

- The 117th Congress has taken up the topic of Space Situation Awareness, with hearings to inform potential legislation and assignment of responsibilities to federal agencies, including NASA.
  - Space Situation Awareness: Guiding the Transition to a Civil Capability [Congressional Hearing]
    - See also Chair's Opening Statement

NASA Orbital Debris, Heliophysics Role

SMD/HPD has partnered with NASA's Orbital Debris Program Office (ODPO) to help address the insufficient state of knowledge of the small (<3 cm) orbital debris population.

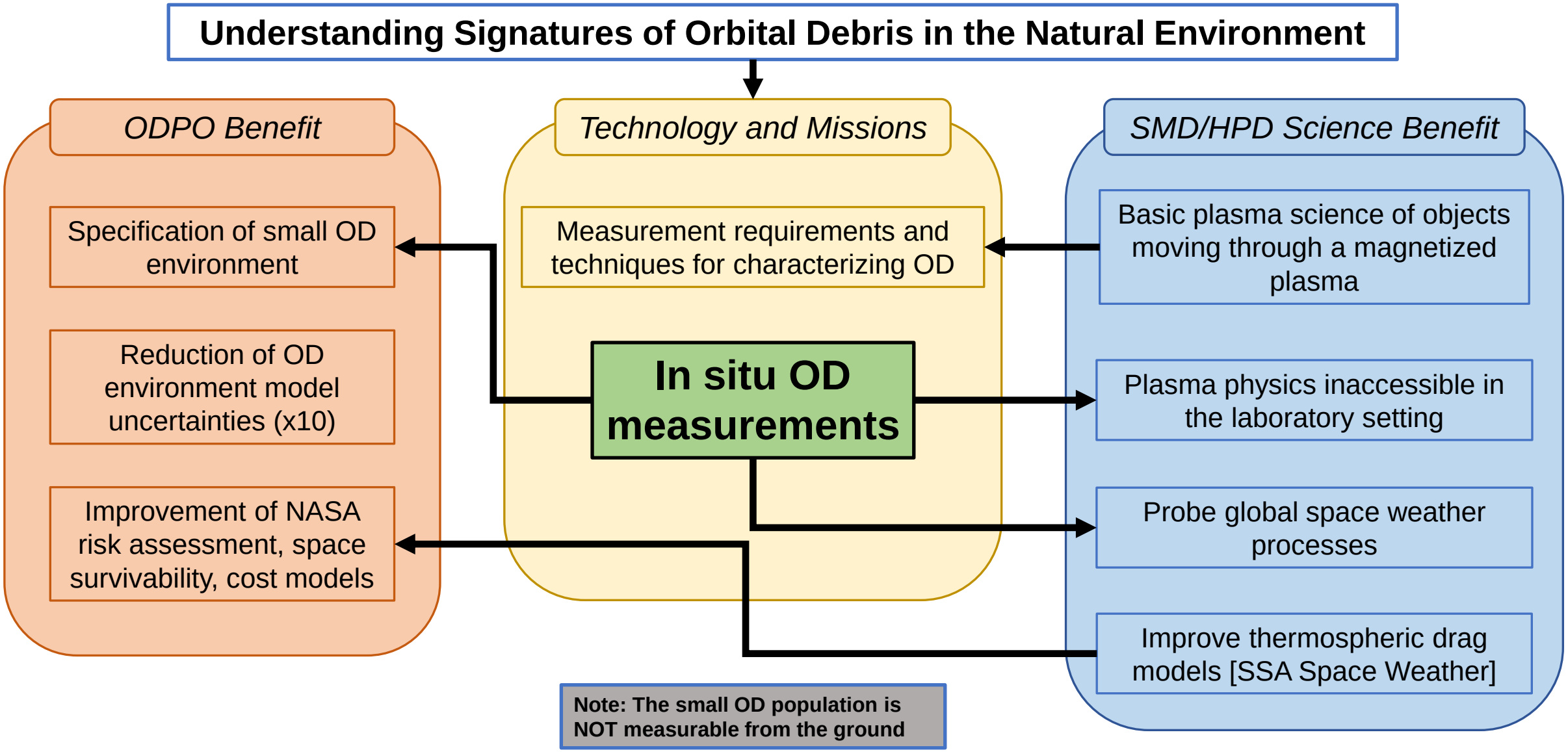
SMD/HPD:

- Provide the basic science elements around the detection of small space objects
- Explore the scientific utility that can be derived from small space objects
- Understand the space environment (space weather) that affect small space objects
- Determine the interaction of small space objects with the natural environment and the resulting signatures

ODPO:

- Provision of state-of-the-art models for OD environment, evolution, and assessment - primary for NASA risk assessment, but also to the broader community
- Development of measurement requirements and techniques to address the lack of information of the small OD environment.

Orbital Debris, Driving New Science



Orbital Debris, Enhancing Current Science

Populations of small space objects can be a sensitive tracer of space weather processes!

- Current monitoring of thermospheric density and modeling capabilities are constrained
  - Advantage
    - Uses existing infrastructure and satellites
  - Disadvantage
    - Limited number of objects for large temporal, spatial ranges

- Small objects (down to sub-millimeter sizes) provide a statistical ensemble for study
  - Advantages
    - Vastly larger number of such objects (100s of millions)
    - Increased role of electric and magnetic fields in orbital dynamics
    - Potential global coverage with high temporal resolution from a small constellation of measurements
  - Scientific frontier, growth opportunity
    - New research to use them to accurate characterize the changing plasma environment

New basic plasma physics, understanding of anthropogenic backgrounds, use of near-Earth space as a laboratory

As these artificial sources become more prevalent, distinguishing the source of observed phenomena becomes more important and more difficult

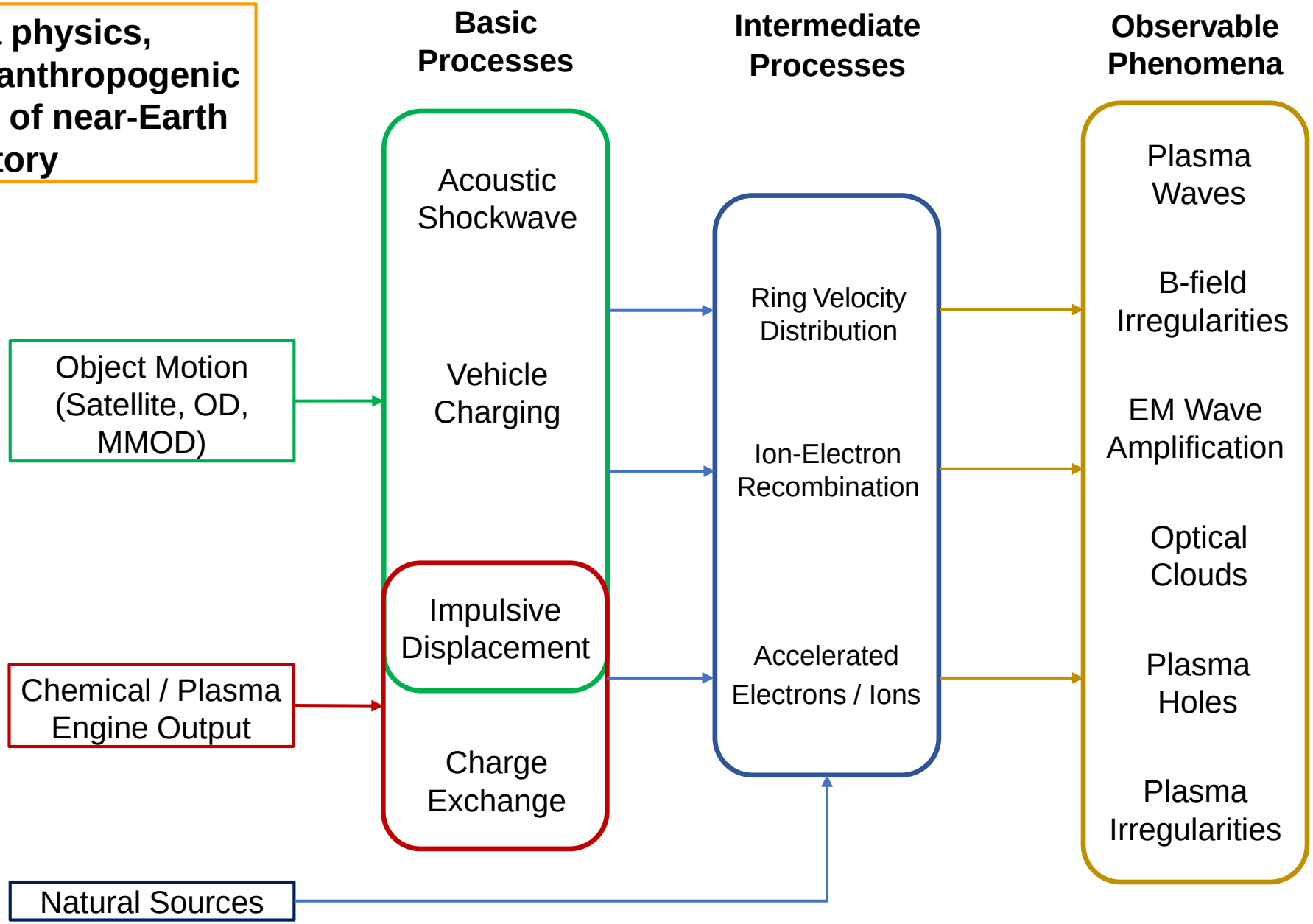
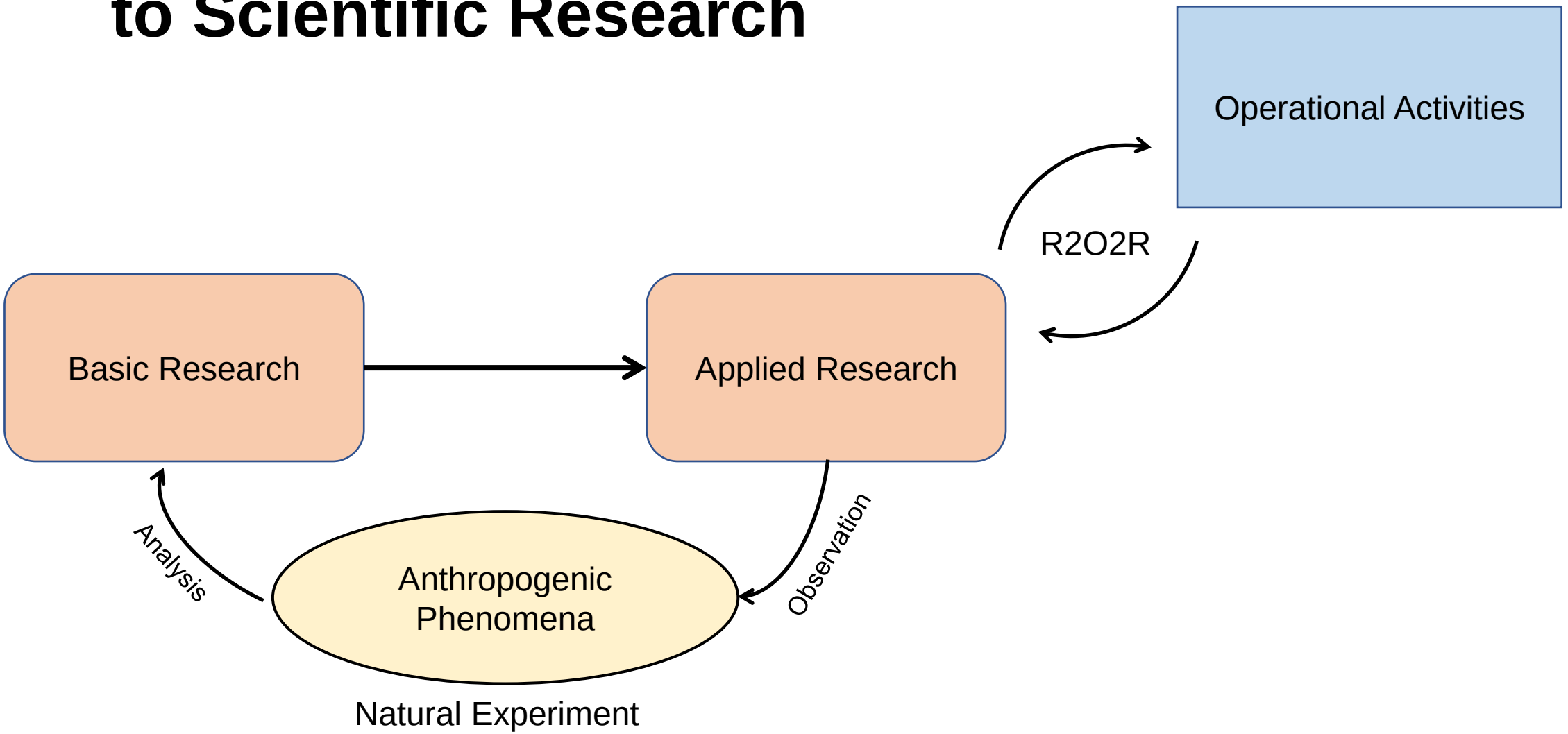
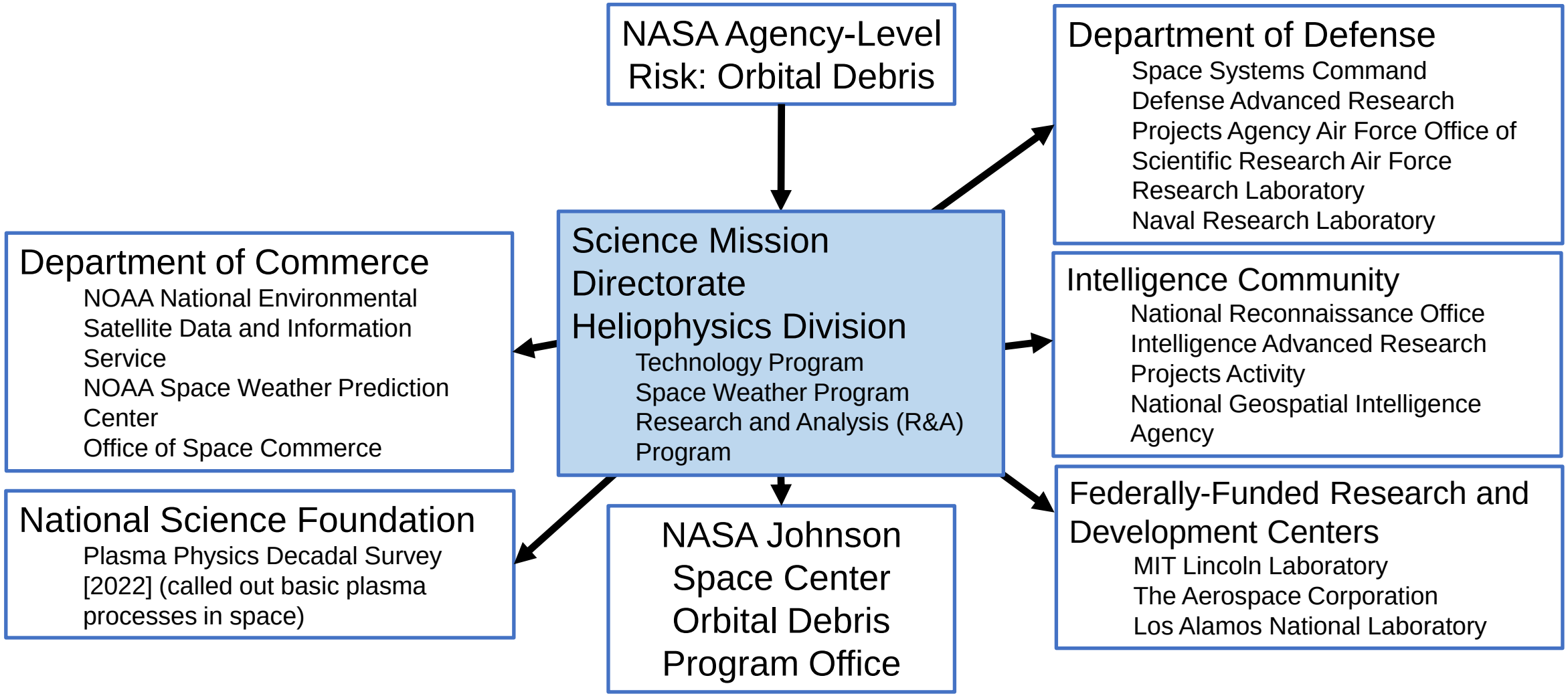


Diagram after original from Paul Bernhardt

Contribution of Artificial Sources to Scientific Research



Heliophysics Division Partners



Request for the Decadal Survey

Charge to the Decadal Survey Committee: *The survey should assess to what degree the Heliophysics programs should support Space Situational Awareness/Orbital Debris research and technology. NASA specifically invites input on the scientific and/or programmatic connection(s) with its Space Weather Science Application program.*

- Identify connections between Heliophysics Division and the SSA/OD domain, specifically
  - Programmatic connection(s) between SSA/OD research and the Space Weather Program
  - Potential contributions of heliophysics science to SSA/OD, including potential transitioning of capabilities to operational partners
  - Potential uses of SSA/OD activities to inform and advance heliophysics science
  - Potential collaborations between NASA and other agencies/organizations
- Recommend amount and types of SSA/OD support within the heliophysics research and technology portfolio, including but not limited to
  - Inclusion within the scope of competed research programs
  - Development of SSA/OD-relevant space flight technologies
- Prioritize new SSA/OD-focused mission(s) within the Heliophysics Division programs
- Clearly incorporate budget guidance for recommended SSA/OD activities

Questions?