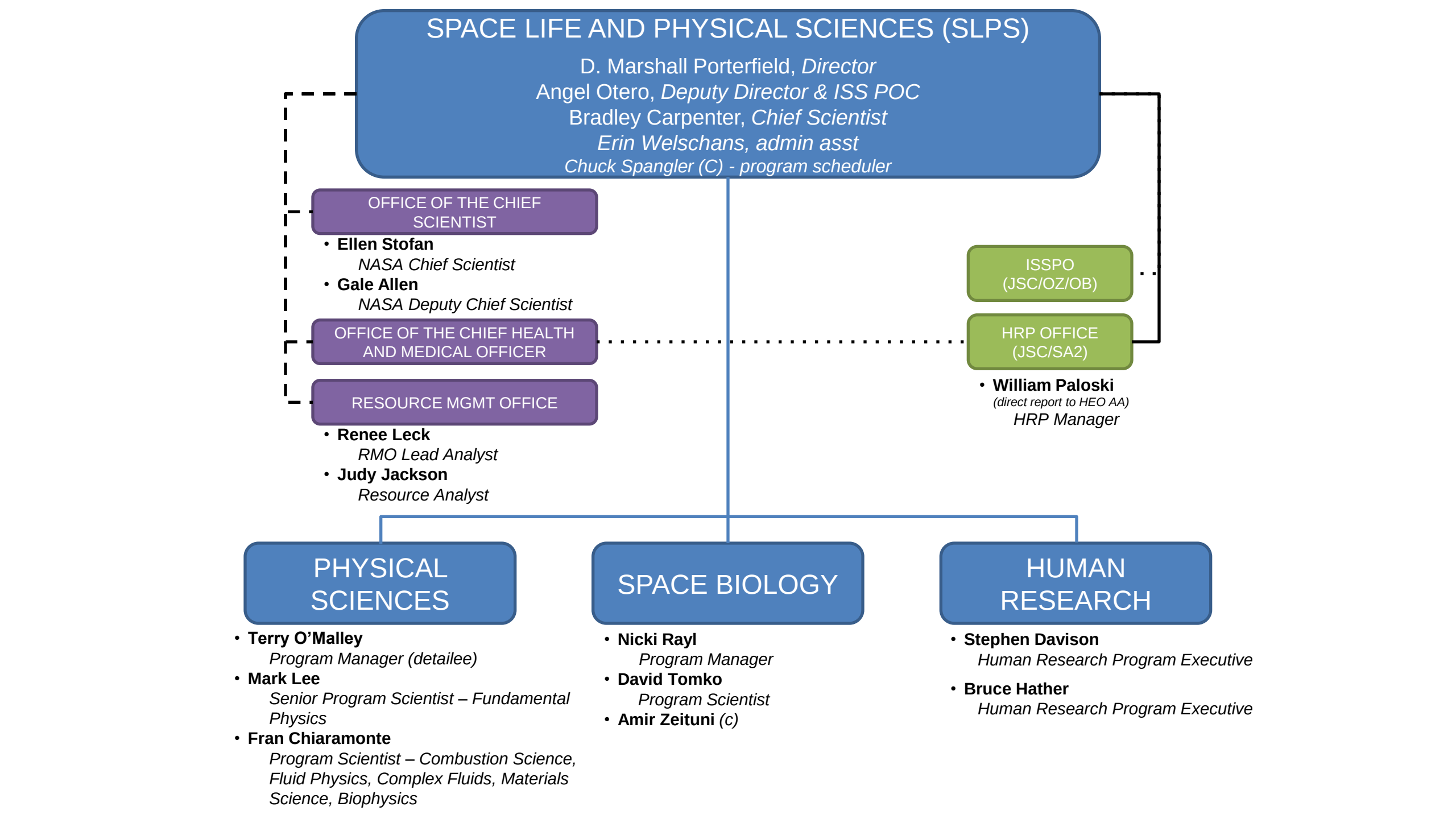
NASA Physical Science Informatics (PSI) System Overview

Presentation to:

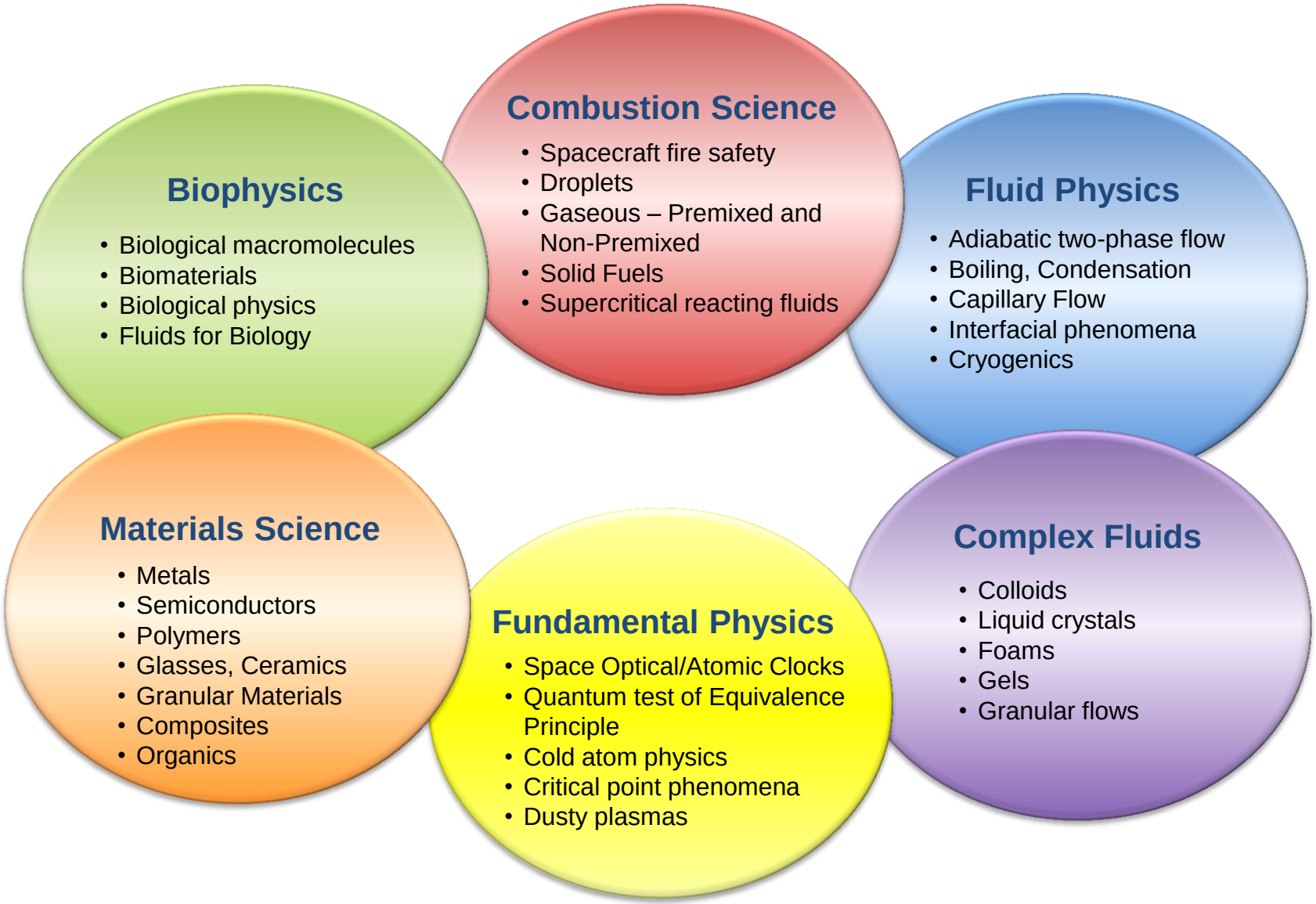
The National Academies of Science - Committee on Biological and Physical Sciences in Space

NRC Space Science Week, Spring 2015 Meeting
NASA Building
2101 Constitution Ave NW, Washington D.C.
April 1, 2015

Francis Chiaramonte,
Program Scientist for
Physical Sciences


SPACE LIFE AND PHYSICAL SCIENCES (SLPS)
D. Marshall Porterfield, Director
Angel Otero, Deputy Director & ISS POC
Bradley Carpenter, Chief Scientist
Erin Welschans, admin asst
Chuck Spangler (C) - program scheduler
OFFICE OF THE CHIEF SCIENTIST
• Ellen Stofan
NASA Chief Scientist
• Gale Allen
NASA Deputy Chief Scientist
OFFICE OF THE CHIEF HEALTH AND MEDICAL OFFICER
RESOURCE MGMT OFFICE
• Renee Leck
RMO Lead Analyst
• Judy Jackson
Resource Analyst
ISSPO (JSC/OZ/OB)
HRP OFFICE (JSC/SA2)
• William Paloski
(direct report to HEO AA)
HRP Manager
PHYSICAL SCIENCES
• Terry O'Malley
Program Manager (detailee)
• Mark Lee
Senior Program Scientist – Fundamental Physics
• Fran Chiaramonte
Program Scientist – Combustion Science, Fluid Physics, Complex Fluids, Materials Science, Biophysics
SPACE BIOLOGY
• Nicki Rayl
Program Manager
• David Tomko
Program Scientist
• Amir Zeituni (c)
HUMAN RESEARCH
• Stephen Davison
Human Research Program Executive
• Bruce Hather
Human Research Program Executive

SLPS Gravity-Dependent Physical Sciences Research



ISS Facilities for Physical Sciences Research

Astronaut Mike Fincke completing install of the CIR/MDCA insert prior to CIR activation in January 2009.

Astronaut Frank DeWinne completing installation in the MSRR prior to on-orbit commissioning October 2009

Astronaut Paolo Nespoli operating the ACE experiment in the FIR/LMM

Increment 26 commander Scott Kelly installing CCF in the Microgravity Science Glovebox on ISS

Astronaut Cady Coleman operating the CFE experiment in Maintenance Work Area on the ISS

Astronaut, Alex Gerst is installing MSL-EML (Courtesy of European Space Agency) 2014

Team

- Fran Chiaramonte – Program Scientist for Physical Sciences Research Program (HQ)
- Sharon Conover – ISS NASA Research Office Manager
- Leah Pate – ISS Research Portfolio Manager, Open Source Science (JSC)
- Robert Green – Science Data Coordinator (GRC)
- Ulf Israelsson – PSI Science Data POC (JPL)
- Jonathon Volk – PSI Science Data POC (CASIS)
- Teresa Miller – PSI Technical POC (MSFC)
- Ben Henrie – PSI IT Project Supervisor (MSFC)
- Cheryl Payne – PSI Data Architect (MSFC)
- Cynthia Frost – PSI Project Manager (MSFC)

White House Memo

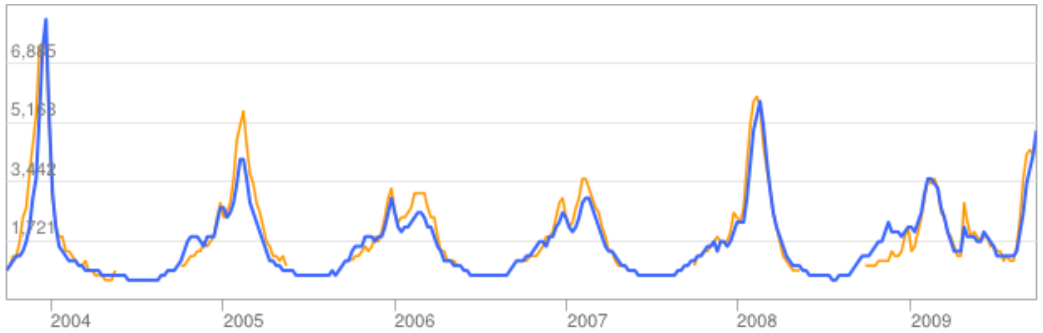
- **May 9, 2013 – Executive Order**
  - "Government information shall be managed as an asset throughout its life cycle to promote interoperability and openness, and, wherever possible and legally permissible, to ensure that data are released to the public in ways that make the data easy to find, accessible, and usable."
  - "…can fuel entrepreneurship, innovation, and scientific discovery that improves Americans' lives and contributes significantly to job creation."

Benefits of Open Science

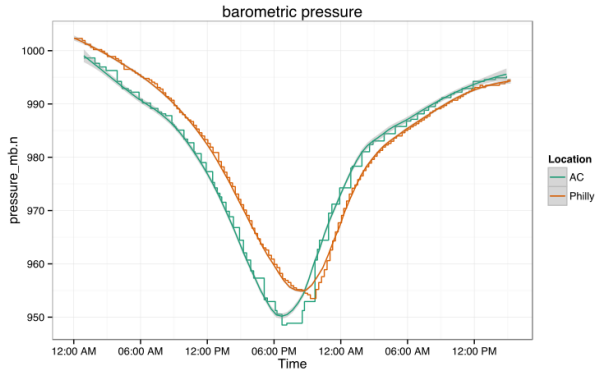
Marshall Porterfield, NASA's Director of Space Life and Physical Sciences – *Open Science "brings together the community of researchers to define an envelope of experiments that will be conducted and analyzed, leveraging modern high content analytics in the life and physical sciences. The resulting data from that envelope of experiments will then be used to create experimental informatics libraries that will support many more investigators and funded ISS-derived research. What that does is, it converts what would be normally a single [Principal Investigator] PI research opportunity into multiple PI research opportunities now and into the future."*

Open Science Examples

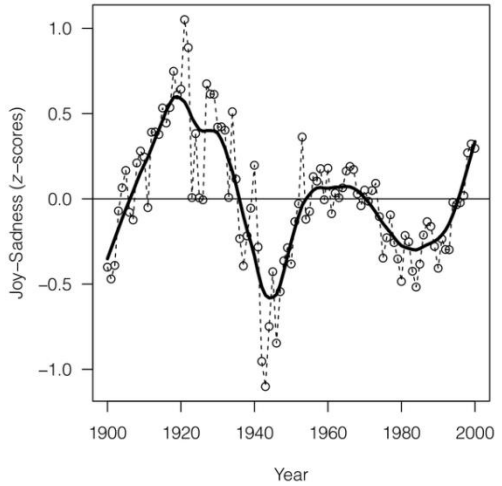
- **Data science:** A new emerging field with the goal of "extracting meaning from data and creating data products". [Wikipedia.]
- Has emerged as a new field to glean knowledge and new understanding from the large volume and diversity of data being published or available and accessible on the internet.
- **Examples:**



- Google researchers discovered close relationship between searches on flu-related topics and spread of influenza. Published in *Nature* Vol 457, 19 February 2009, doi:10.1038/nature07634

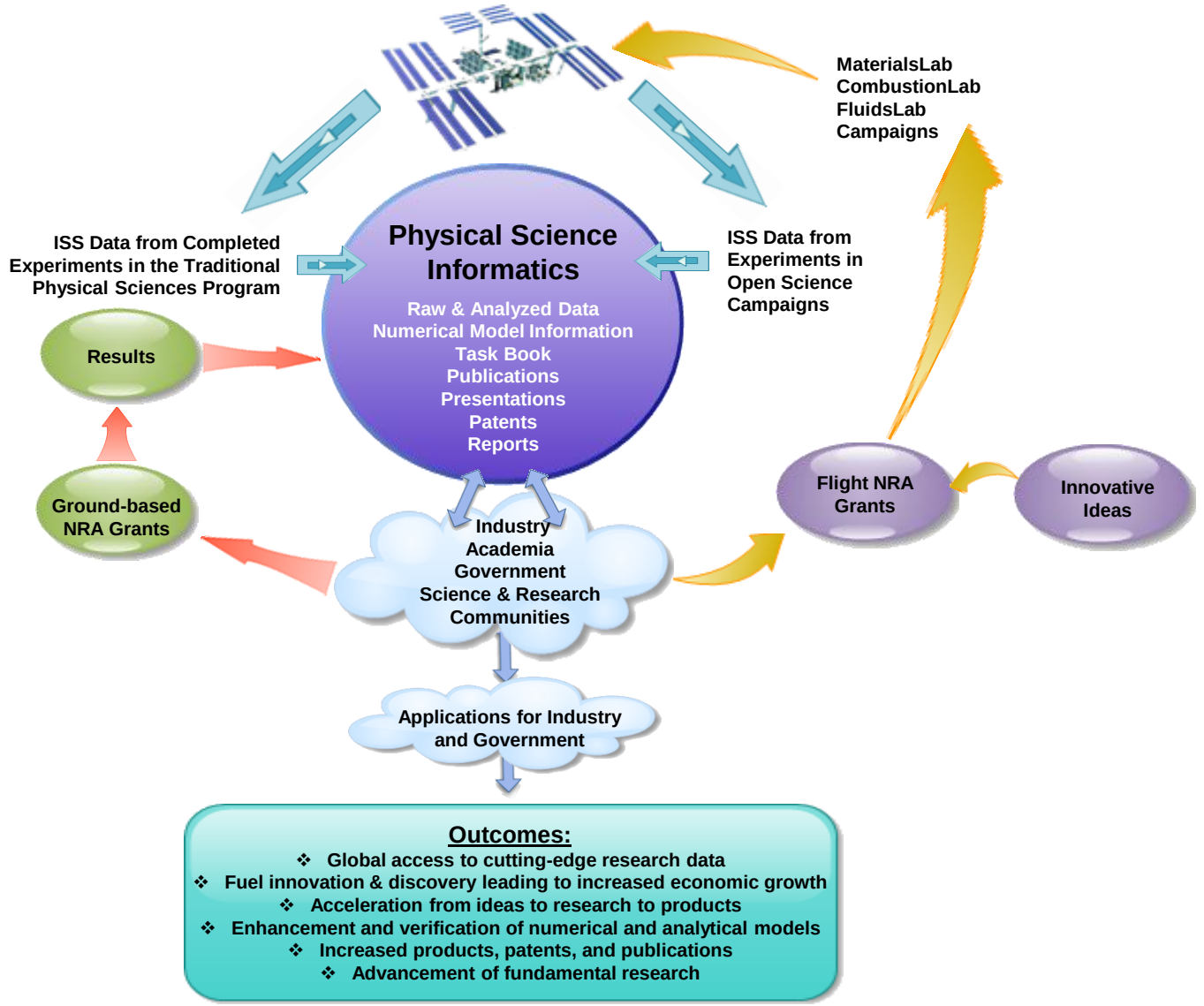


- Tracking Hurricane Sandy: Barometric pressure data from local weather stations, available on-line, accurately track the storm's path.

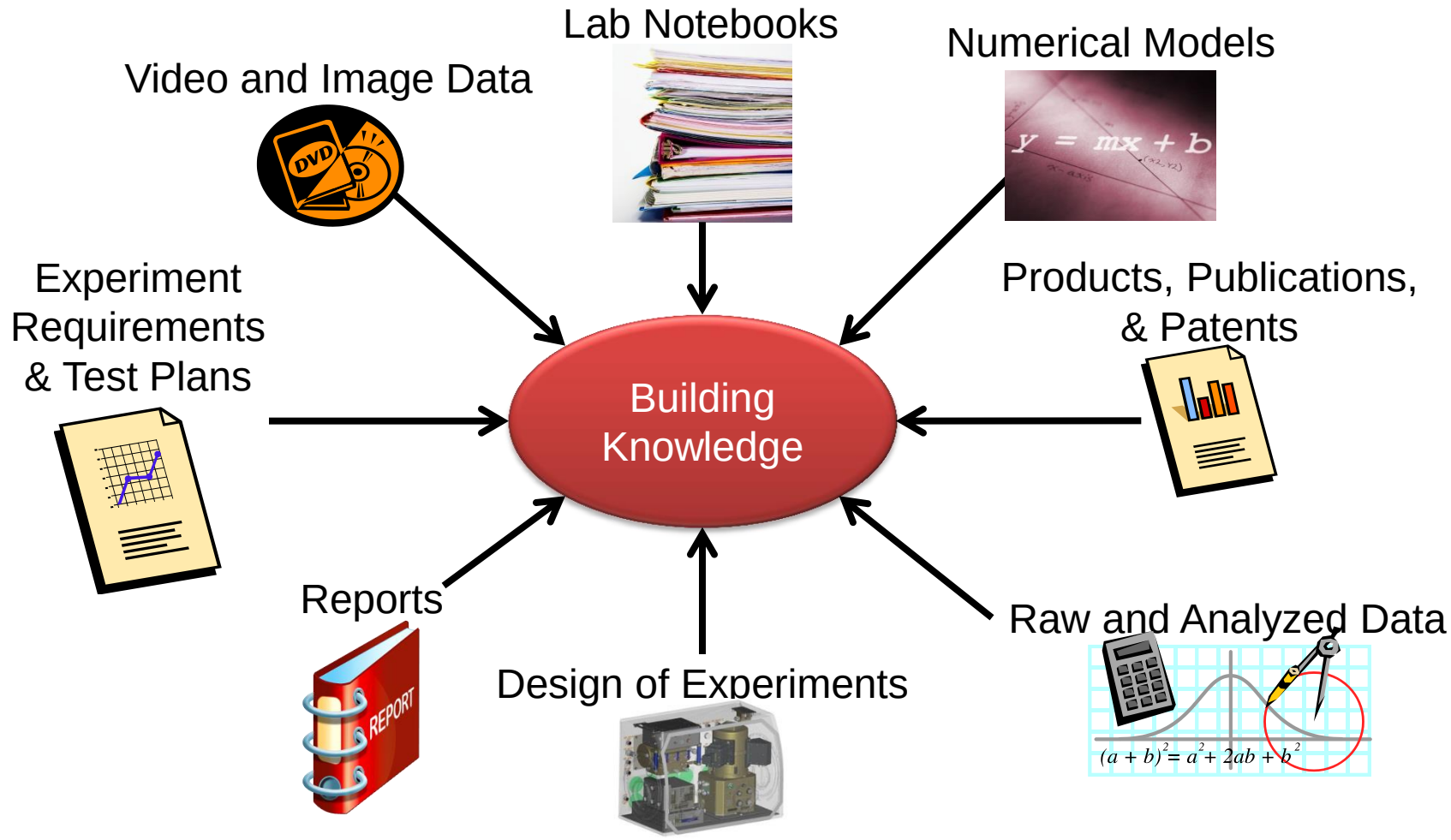


- Human behavior researchers using Google n-gram database (data from Project Gutenberg) found evidence for distinct historical periods of positive and negative moods in 20th century books.

ISS Physical Sciences Informatics: Overall Approach



Elements of PSI – Turning Data into Knowledge



Scope

- **Physical Science Informatics System – Past, Present and Future experiments**
  - Prior completed Physical Science experiments and ongoing investigations represent a $100M+ investment over 12 years by SLPS Division and its predecessors
  - 31 completed PI Investigations
  - 14 current PI Investigations in FY13
  - 63 PI Investigations awarded for FY14 – FY20
  - Open Source Science Campaigns
    - First Open Source Campaign has been awarded, Cool Flames FY15
    - MaterialsLab and FluidsLab Open Science NRA with awards in FY16
  - Future Science Definition Team Investigations

31 Completed ISS Physical Science Investigations

(2001 - June 1, 2013)

- **Combustion Science (MSG)**
  - Dust and Aerosol Measurement Feasibility Test (DAFT)
  - Dust and Aerosol Measurement Feasibility Test-2 (DAFT-2)
  - Smoke Aerosol Measurement Experiment (SAME)
  - Smoke Aerosol Measurement Experiment Reflight (SAME-R)
  - Smoke Point in Coflow Experiment (SPICE)
  - Structure and Liftoff in Combustion Experiment (SLICE)
  - Burning and Suppression of Solids (BASS)
- **Complex Fluids (FIR, MSG, MWA)**
  - Physics of Colloids in Space (PCS)
  - Investigating the Structures of Paramagnetic Aggregates from Colloidal Emulsions (InSPACE)
  - Investigating the Structures of Paramagnetic Aggregates from Colloidal Emulsions-2 (InSPACE-2)
  - Investigating the Structure of Paramagnetic Aggregates from Colloidal Ellipsoids–3 (InSPACE-3)
  - Shear History Extensional Rheology Experiment (SHERE)
  - Shear History Extensional Rheology Experiment Reflight (SHERE-R)
  - Shear History Extensional Rheology Experiment II (SHERE II)
  - Binary Colloidal Alloy Test-5 (BCAT- 5)
- **Fluid Physics (FIR, MWA)**
  - Capillary Flow Experiments (CFE)
  - Constrained Vapor Bubble (CVB)
  - Microheater Array Heater Boiling Experiment (MABE)
  - Nucleate Pool Boiling Experiment (NPBX)
- **Fundamental Physics (EPM)**
  - Gradient Driven Fluctuation Experiment(GRADFLEX) [Free Flyer]
  - Dusty Plasma (PK-3)
  - Dusty Plasma (PK-3+)
- **Materials Science (MSRR/MSL, MSG)**
  - Solidification Using a Baffle in Sealed Ampoules (SUBSA)
  - Pore Formation and Mobility Investigation (PFMI)
  - Coarsening in Solid-Liquid Mixtures (CSLM)
  - Coarsening in Solid-Liquid Mixtures-2 (CSLM-2)
  - Coarsening in Solid-Liquid Mixtures-2 Reflight (CSLM-2R)
  - Coarsening in Solid Liquid Mixtures-3 (CSLM-3)
  - Comparison of Structure and Segregation in Alloys Directionally Solidified in Terrestrial and Microgravity Environments (MICAST/CSS)
  - DECLIC, Directional Solidification Experiment (DSI)
  - In-Space Soldering Investigation (ISSI)

14 Current ISS Physical Science Investigations*

- **Combustion Science (CIR)**
  - Flame Extinguishment Experiment (FLEX)
  - Flame Extinguishment Experiment–2 (FLEX-2)
- **Complex Fluids (FIR, MSG, MWA)**
  - Binary Colloidal Alloy Test-3 (BCAT-3)
  - Binary Colloidal Alloy Test-4 (BCAT-4)
  - Binary Colloidal Alloy Test-6 (BCAT-6)
  - Investigating the Structure of Paramagnetic Aggregates from Colloidal Ellipsoids–3+ (InSPACE-3+)
  - Advanced Colloids Experiment-M1 (ACE-M1)
- **Fluid Physics (EXPRESS, FIR, MSG, MWA)**
  - Capillary Flow Experiment-2 (CFE-2)
  - Capillary Channel Flow (CCF)
  - Constrained Vapor Bubble-2 (CVB-2)
  - DEvice for the study of Critical LIquids and Crystallization - High Temperature Insert-Reflight (DECLIC HTI-R or SCWM/HTI-R)
- **Fundamental Physics (EXPRESS)**
  - DEvice for the study of Critical LIquids and Crystallization - Alice Like Insert (DECLIC-ALI)
- **Materials Science (EXPRESS, MSRR/MSL)**
  - DEvice for the study of Critical LIquids and Crystallization - Directional Solidification Insert-Reflight (DECLIC DSI-R)
  - Comparison of Structure and Segregation in Alloys Directionally Solidified in Terrestrial and Microgravity Environments (MICAST/CSS) batch 2A set 2

* Experiment and/or samples are on-orbit and operating (or operations planned) in CY2013

Planned Work: 60+ awarded or planned (FY14-20) ISS Physical Science Investigations

- **Biophysics (FIR, EPM)**
  - Macromolecular Biophysics – MB1 (MMB-MB1)
  - Macromolecular Biophysics – MB3 (MMB-MB3)
  - Macromolecular Biophysics – B1 (MMB-B1)
  - Macromolecular Biophysics – B2 (MMB-B2)
  - Macromolecular Biophysics – B3 (MMB-B3)
  - Protein Nucleation and Growth Kinetics Experiment (PROTEIN)

- **Combustion Science (CIR, MSG, MSPR, EXPRESS)**
  - Adv. Combustion via Microgravity Expt (ACME) (5 Experiments)
  - Burning and Suppression of Solids (BASS-2)
  - Chamber for Combustion Experiment/Group Combustion Experiment (CCE/GCE)
  - FLame Extinguishment eXperiment-2J (FLEX-2J)
  - FLame Extinguishment eXperiment ICE GA (FLEX ICE- GA)
  - Smoke Aerosol Measurement Experiment (SAME-3)
  - Supercritical Water Mixture (SCWM-2)
  - Solid Fuel Ignition and Extinction (SoFIE) (5 Experiments)
  - Flamability Limits at Reduced Gravity Expt. (FLARE)
  - Solid Combustion Experiment (SCE)

- **Complex Fluids (FIR, EPM, FSL, MSG)**
  - Advanced Colloids Experiments – E1 (ACE-E1)
  - Advanced Colloids Experiments – E2 (ACE-E2)
  - Advanced Colloids Experiments – E3 (ACE-E3)
  - Advanced Colloids Experiments – E4 (ACE-E4)
  - Advanced Colloids Experiments – H1 (ACE-H1)
  - Advanced Colloids Experiments – H2 (ACE-H2)
  - Advanced Colloids Experiments – M1 (ACE-M1)
  - Advanced Colloids Experiments – M2 (ACE-M2)
  - Advanced Colloids Experiments – M3 (ACE-M3)
  - Advanced Colloids Experiments – T1 (ACE-T1)
  - Advanced Colloids Experiments – T2 (ACE-T2)
  - Advanced Colloids Experiments – T3 (ACE-T3)
  - Advanced Colloids Experiments – T4 (ACE-T4)
  - Advanced Colloids Experiments – T5 (ACE-T5)
  - Advanced Colloids Experiments – T6 (ACE-T6)
  - Advanced Colloids Experiments – T7 (ACE-T7)
  - Advanced Colloids Experiments – T8 (ACE-T8)
  - Advanced Colloids Experiments – T9 (ACE-T9)
  - Advanced Colloids Experiments – T10 (ACE-T10)
  - Colloidal Solids
  - Foam Optics and Mechanics Experiment – C (FOAM-C)
  - Observation and Analysis of Smectic with Electromagnetic Convection (OASIS)

Planned Work: 60+ awarded or planned (FY14-20)
ISS Physical Science Investigations (continued)

- **Fluid Physics (FIR, MSG)**
  - ElectroHydroDynamic Flow (EHD)
  - Flow Boiling and Condensation Experiment (FBCE)
  - Multiphase Flow with Heat Transfer (MFHT)
  - Packed Bed Reactor Experiment (PBRE)
  - Two-Phase Flow Separator Experiment – Annular Injection (TPFSE-AI)
  - Two-Phase Flow Separator Experiment – Conical Injection (TPFSE-CI)
  - Zero Boil-Off Tank Experiment (ZBOT)
  - Zero Boil-Off Tank Experiment – 2 (ZBOT-2)
  - Zero Boil-Off Tank Experiment – 3 (ZBOT-3)
- **Fundamental Physics (CEPF, EPM, EXPRESS)**
  - Atomic Clock Ensemble in Space (ACES)
  - Alice Like Insert – R (ALI-R)
  - Plasma Crystal – 4 (PK-4)
  - Cold Atom Laboratory (CAL) - Zero-G Studies of Few and Many Body Physics
  - Cold Atom Laboratory (CAL) - Atom interferometry Will Pave the Way for Definitive Space-based Tests of Einstein's Theory of General Relativity
  - Cold Atom Laboratory (CAL) - Microgravity dynamics of bubble-geometry Bose-Einstein condensates
  - Cold Atom Laboratory (CAL) -Fundamental Interactions of Atom Interferometry with Ultracold Quantum Gases in a Microgravity Environment
  - Cold Atom Laboratory (CAL) - Development of Atom Interferometry Experiments for the International Space Station's Cold Atom Laboratory
- **Material Science (EDR-EML, MSG, MSRR/MSL)**
  - Cadmium Telluride (CdTe)
  - Columnar-to-Equiaxed Transition in Solidification (CETSOL)
  - Coarsening in Solid-Liquid Mixtures – 4 (CSLM-4)
  - DEvice for the study of Critical LIquids and Crystallization, Directional Solidification Experiments – 2R (DECLIC DSI-2R)
  - Formulation of Amorphous Metals in Space (FAMIS)
  - Formation of Gasrites (FOG)
  - Gravitational Effects on Distortion in Sintering (GEDS)
  - Influence of Containment on the growth of Silicon-GErmanium (ICESAGE)
  - ICOPROSOL – Nucleation in quasicrystal- and glass-forming alloys
  - Peritectic Alloy Rapid Solidification with Electromagnetic Convection (PARSEC)
  - Solidification along an Eutectic path in Ternary Alloys (SETA)
  - THERMOLAB – Thermophysical properties of industrial alloys
  - THERMOPROP – Thermodymanics of glass forming alloys
  - Interfacial Energy – (IE)

Athena Platform

- PSI use of an existing data management system provides a **lower cost of ownership**
- Athena allowed PSI to immediate start collecting data and release **eleven months ahead of schedule**
- Multiple NASA projects use Athena which yields **economy of scale**
- Athena is a **fully modular and flexible data management system** capable of collecting, storing, and disseminating a wide variety of information

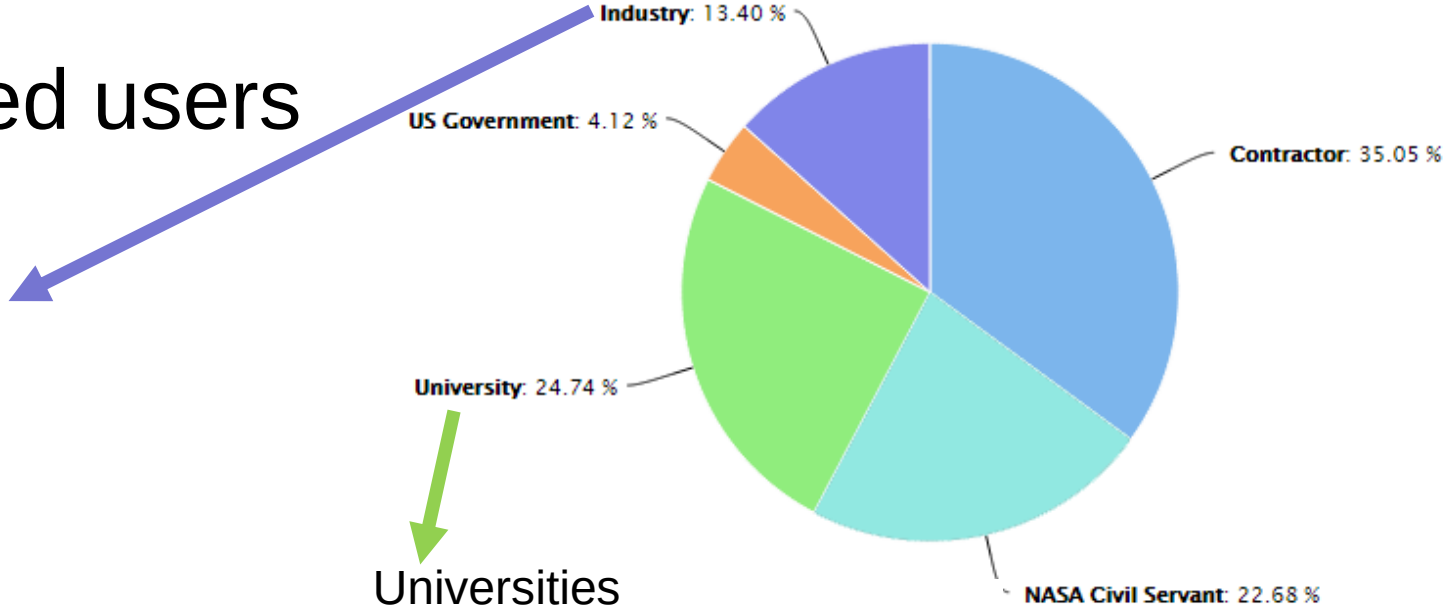
PSI Status

- **Data loading status**
  - 11 payloads have been completed
  - 6 payloads are nearing completion (at least 75% complete)
  - 36 payloads will be complete by end of September (at least some data has been received)
  - As current and future investigations are completed, they will be loaded (both open science and traditional)

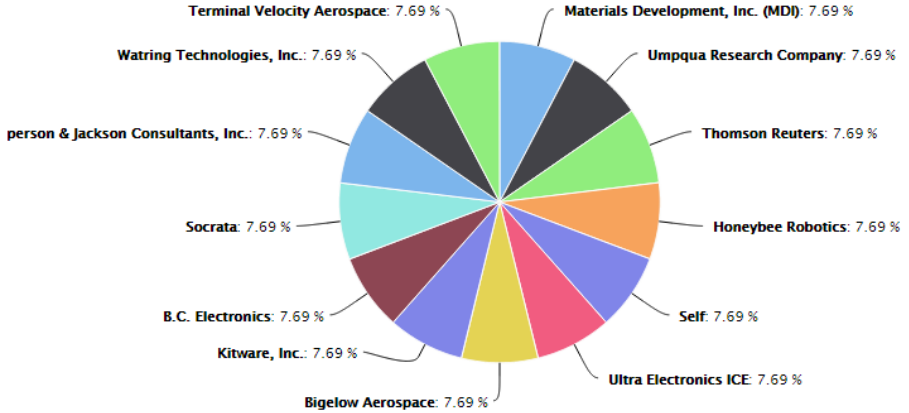
- **PSI announcements**
  - PSI was demonstrated and made available to the public at the American Society for Gravitational and Space Research (ASGSR) conference in late October 2014
    - This was a stretch goal, released almost 1 year ahead of schedule
  - NASA Research and Education Support Services (NRESS) announcement was distributed to approximately 18,000 researchers on February 2, 2015
  - PSI was presented on February 18, 2015 at Stanford University as part of the Destination Station series
  - Official NASA Press release was issued on March 30, 2015
  - PSI currently has 231 Registered Users
  - **NASA Research Announcement (NRA) for PSI to be released summer, 2015.**

PSI Users

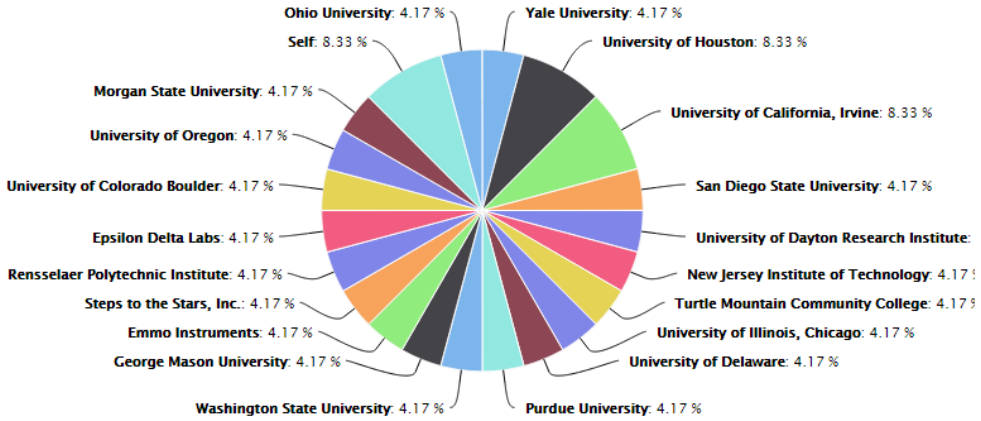
- PSI has 228 registered users



Industry



Universities

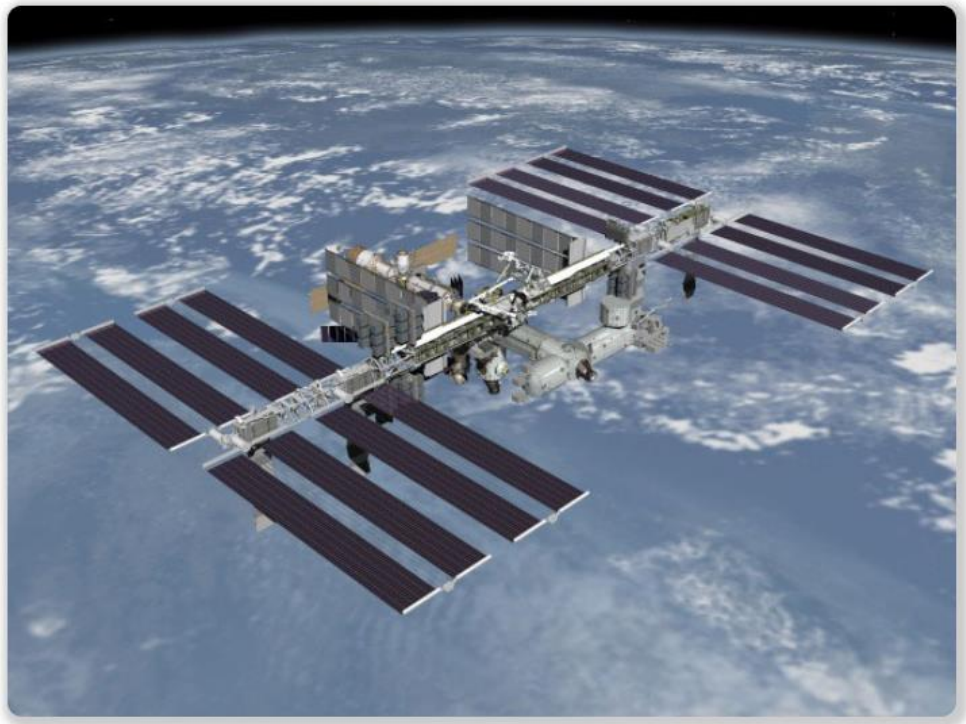


Introduction Page

search here.. searches all records and documents.

Welcome to ISS Physical Science Informatics System (PSI)

Facilities | Investigations | Publications | Reports | Research Area | Researchers | more... | New Record | home | help



Office of Biological and Physical Research Program 1998-2004
Microgravity Research Program 1984-1998

Overview:

NASA's Physical Sciences Research Program, along with its predecessors, has conducted significant fundamental and applied research, which has led to improved space systems and produced new products offering benefits on Earth. NASA's experiments in the various disciplines of physical science reveal how physical systems respond to the near absence of gravity. They also reveal how other forces that on Earth are small compared to gravity can dominate system behavior in space. The International Space Station (ISS) is an orbiting laboratory that provides an ideal facility to conduct long-duration experiments in the near absence of gravity and allows continuous and interactive research similar to Earth-based laboratories. This enables scientists to pursue innovations and discoveries not currently achievable by other means. NASA's Physical Sciences Research Program also benefits from collaborations with several of the ISS international partners—Europe, Russia, Japan, and Canada—and foreign governments with space programs, such as France, Germany and Italy. The scale of this research enterprise promises new possibilities in the physical sciences; some of these possibilities are already being realized both in the form of innovations for space exploration and in new ways to improve the quality of life on Earth.

Research Areas:

Biophysics:	biological macromolecules, biomaterials, biological physics and fluids for biology
Combustion Science:	spacecraft fire safety, droplets, gaseous - premixed and non-premixed, solid fuels and supercritical reacting fluids
Complex Fluids:	colloids, liquid crystals, foams, gels and granular flows
Fluid Physics:	adiabatic two-phase flow, boiling, condensation, capillary flow, interfacial phenomena and cryogenics
Fundamental Physics:	space optical/atomic clocks, quantum test of equivalence principle, cold atom physics, critical point phenomena and dusty plasmas
Materials Science:	metals, semiconductors, polymers, glasses, ceramics, granular materials, composites and organics

Implementing Centers:

NASA's Physical Sciences Research Program is carried out at the Glenn Research Center (GRC), Jet Propulsion Laboratory (JPL) and Marshall Space Flight Center (MSFC).

Heritage:

Space Life and Physical Sciences Division 2012 - present
ISS Research Project 2006-2012
Advanced Life Support - Life Support and Habitation Program 2004-2006

http://psi.nasa.gov

Demo

MSFC Live PSI Demo

Cheryl Payne

Teresa Miller

Ben Henrie

Backup

Backup Slides

http://psi.nasa.gov

search here.. searches all records and documents.

Welcome to ISS Physical Science Informatics System (PSI)

Facilities | Investigations | Publications | Reports | Research Area | Researchers | more... | New Record | home | help

Overview:

NASA's Physical Sciences Research Program, along with its predecessors, has conducted significant fundamental and applied research, which has led to improved space systems and produced new products offering benefits on Earth. NASA's experiments in the various disciplines of physical science reveal how physical systems respond to the near absence of gravity. They also reveal how other forces that on Earth are small compared to gravity can dominate system behavior in space. The International Space Station (ISS) is an orbiting laboratory that provides an ideal facility to conduct long-duration experiments in the near absence of gravity and allows continuous and interactive research similar to Earth-based laboratories. This enables scientists to pursue innovations and discoveries not currently achievable by other means. NASA's Physical Sciences Research Program also benefits from collaborations with several of the ISS international partners—Europe, Russia, Japan, and Canada—and foreign governments with space programs, such as France, Germany and Italy. The scale of this research enterprise promises new possibilities in the physical sciences; some of these possibilities are already being realized both in the form of innovations for space exploration and in new ways to improve the quality of life on Earth.

Research Areas:

Biophysics: biological macromolecules, biomaterials, biological physics and fluids for biology

Combustion Science: spacecraft fire safety, droplets, gaseous - premixed and non-premixed, solid fuels and supercritical reacting fluids

Complex Fluids: colloids, liquid crystals, foams, gels and granular flows

Fluid Physics: Adiabatic two-phase flow, boiling, condensation, capillary flow, interfacial phenomena and cryogenics

Fundamental Physics: space optical/atomic clocks, quantum test of equivalence principle, cold atom physics, critical point phenomena and dusty plasmas

Materials Science: metals, semiconductors, polymers, glasses, ceramics, granular materials, composites and organics

Implementing Centers:

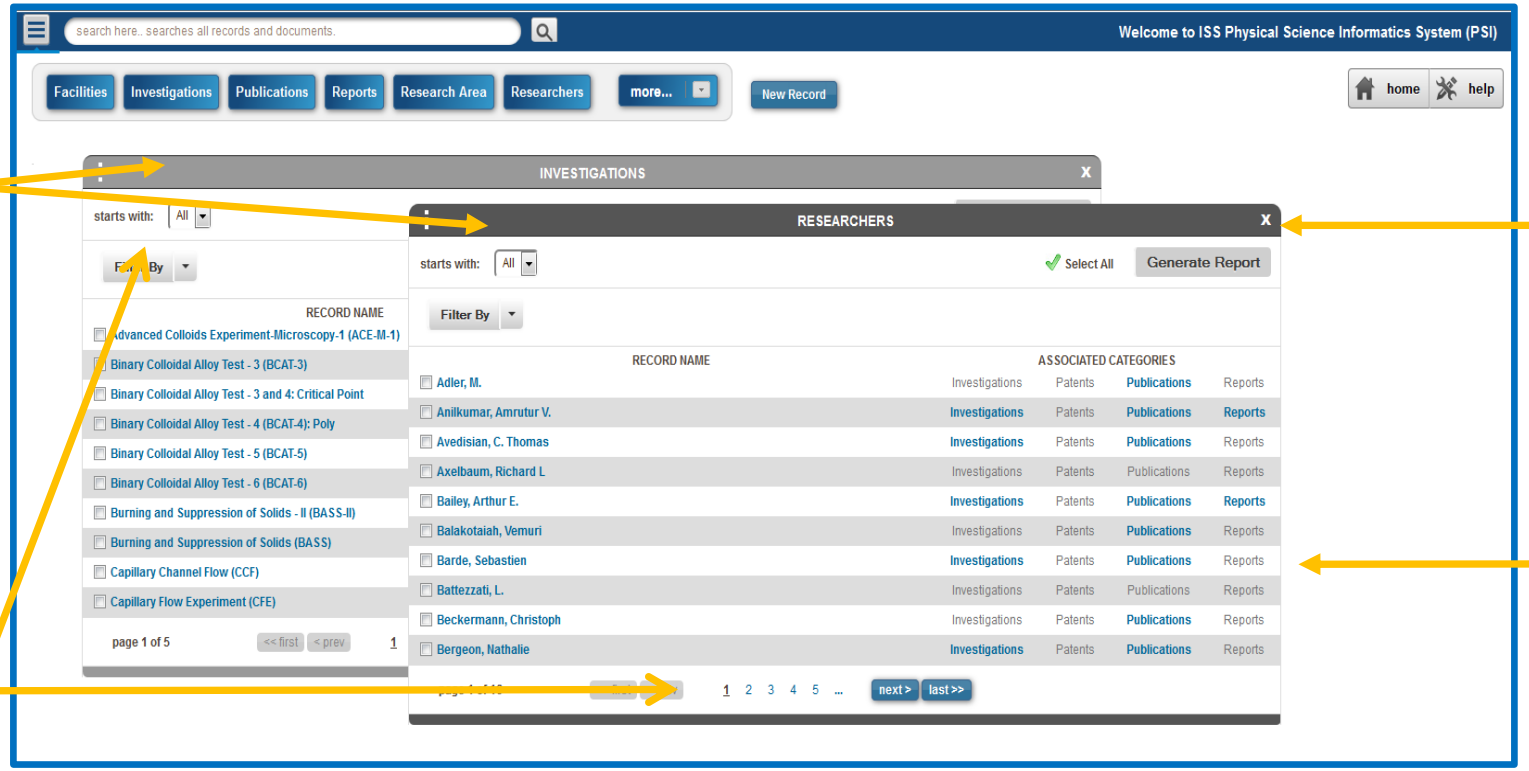
NASA's Physical Sciences Research Program is carried out at the Glenn Research Center (GRC), Jet Propulsion Laboratory (JPL) and Marshall Space Flight Center (MSFC).

Heritage:

Space Life and Physical Sciences Division 2012 - present
ISS Research Project 2006-2012
Advanced Life Support - Life Support and Habitation Program 2004-2006
Office of Biological and Physical Research Program 1998-2004
Microgravity Research Program 1984-1998

Data Visualization

Draggable panels for easier navigation mimicking the Windows/Mac user experience



Ability to independently close unused windows

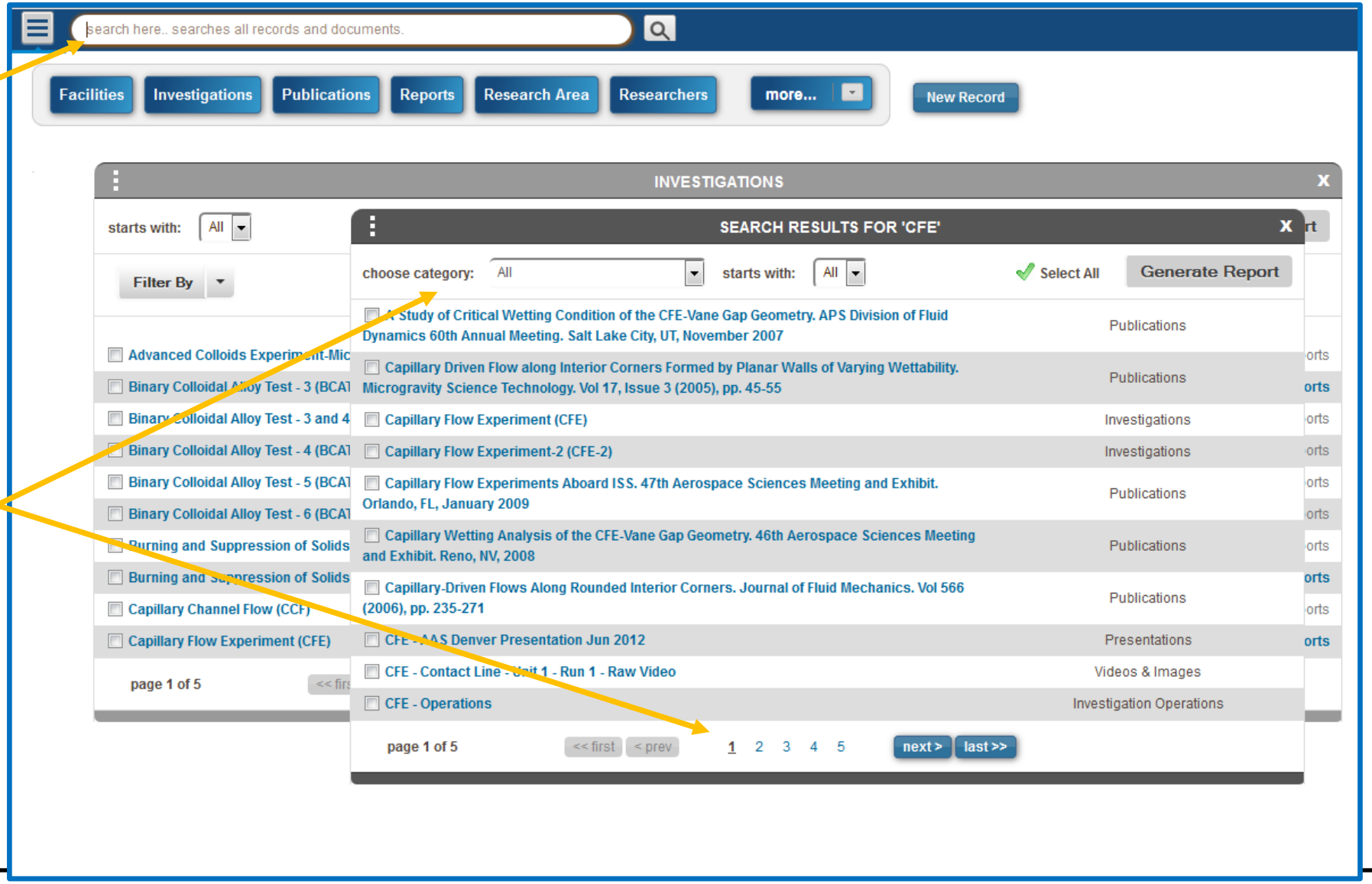
Quickly identify data gaps

Data filtering and paging

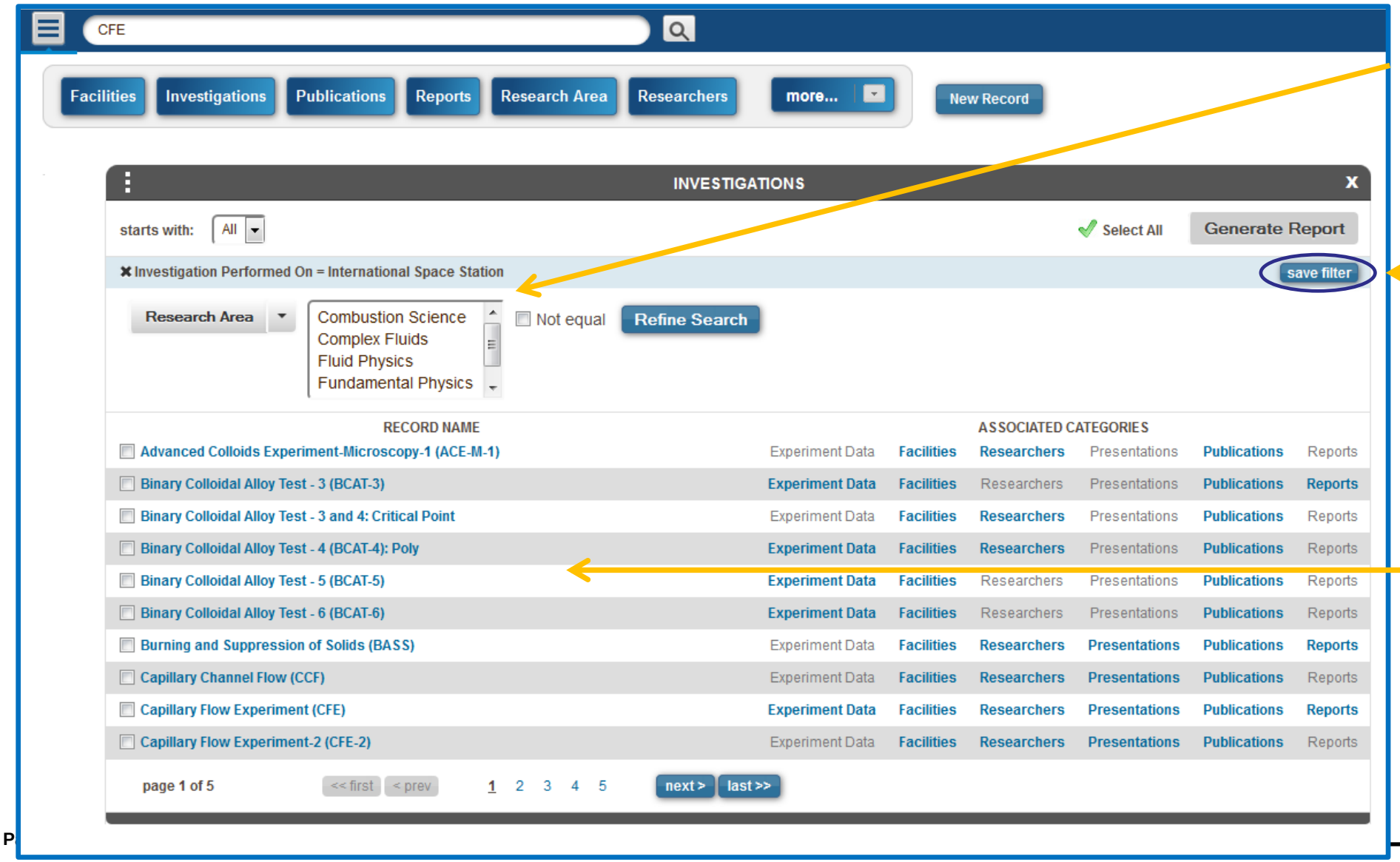
Search Capability

General search – searches all metadata and within attached files (Word, excel, PDF, etc.)

Capability to refine search results and/or page through results set



Advanced Search



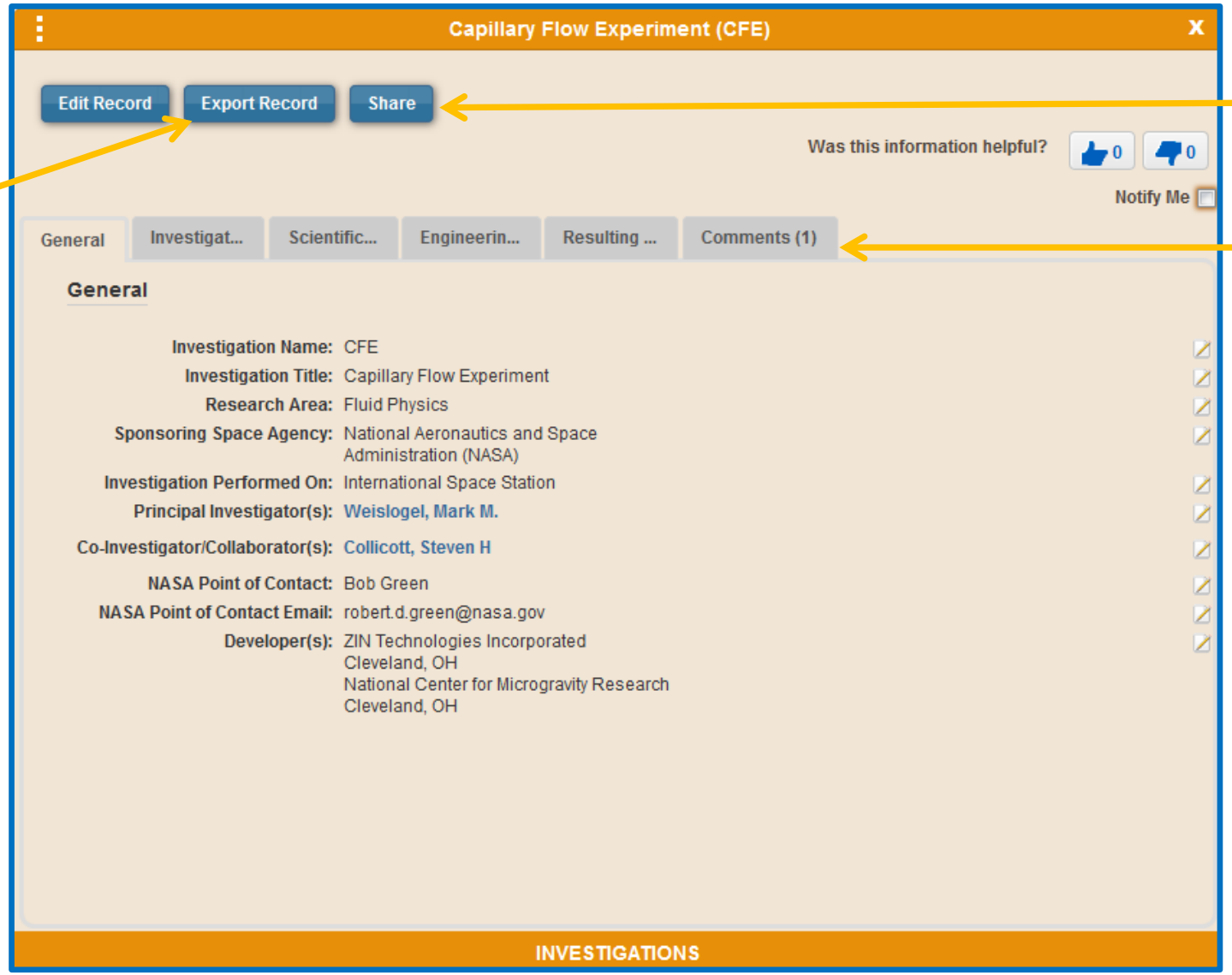
Mix and match metadata to refine your search result set

Save customized search filter for future use

Instantly see your results

View Records

Download the whole record including attached files and images OR generate a PDF of the record. The user can chose which attributes to include in the report including images and plots.

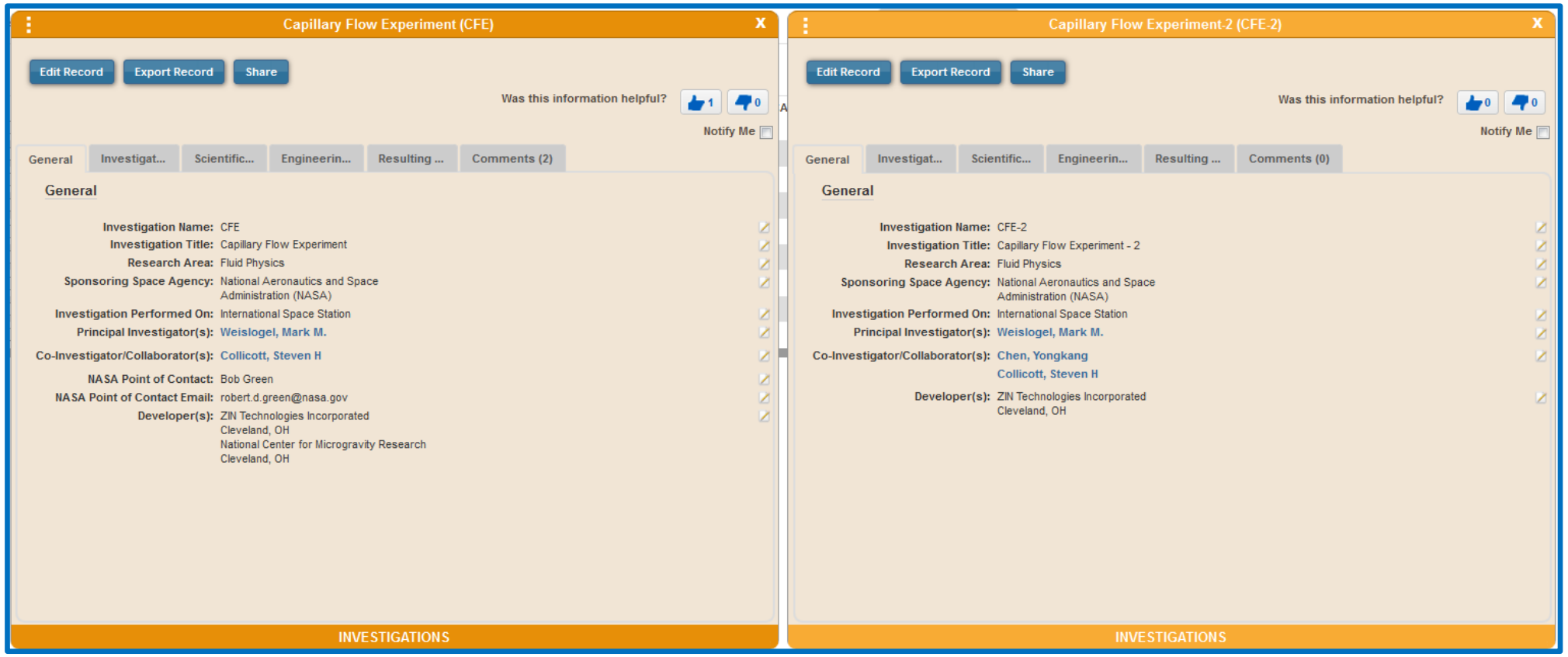


Share direct link to a record with others

Data category tabs:

- **General**
- **Investigation Overview**
- **Scientific Data and Information**
- **Engineering Data and Information**
- **Resulting Products**
- **Comments**

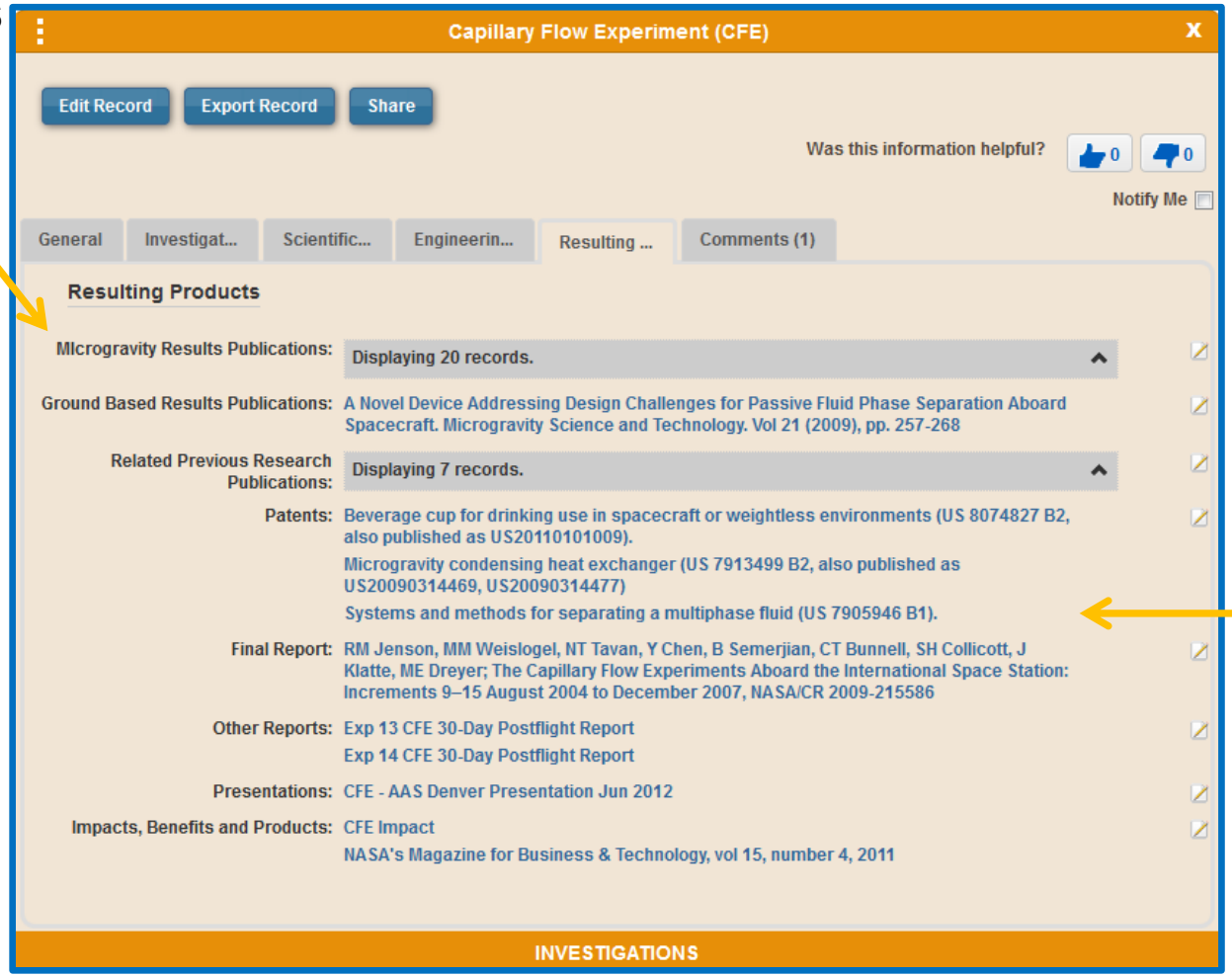
View Multiple Records



Analyze multiple records at the same time

Custom Data

Records and metadata configured according to project specific data requirements

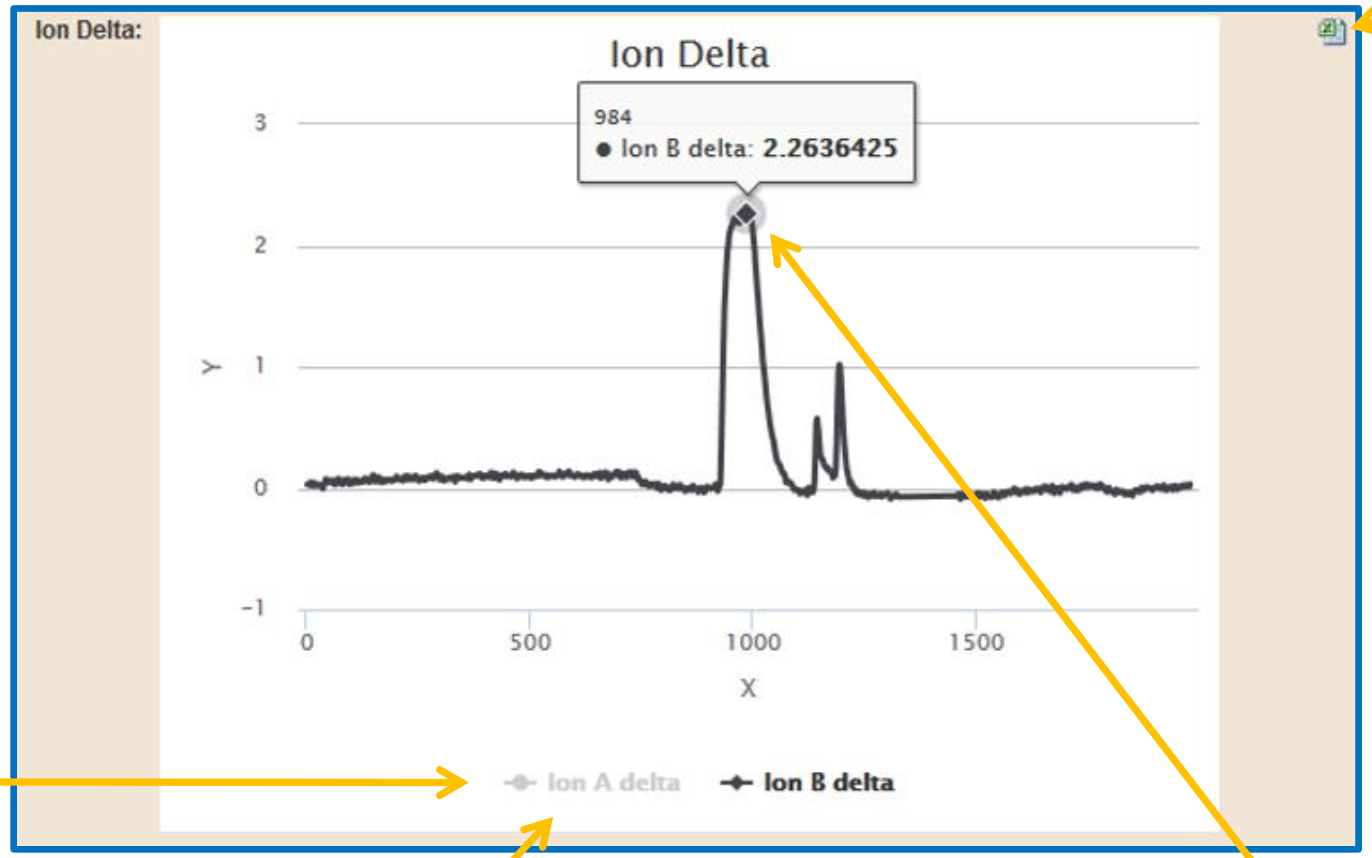


Metadata Types:

Text
Numbers
Pictures & Videos
Tables & Plots
Files

Interactive Plots

Export plot data to Excel

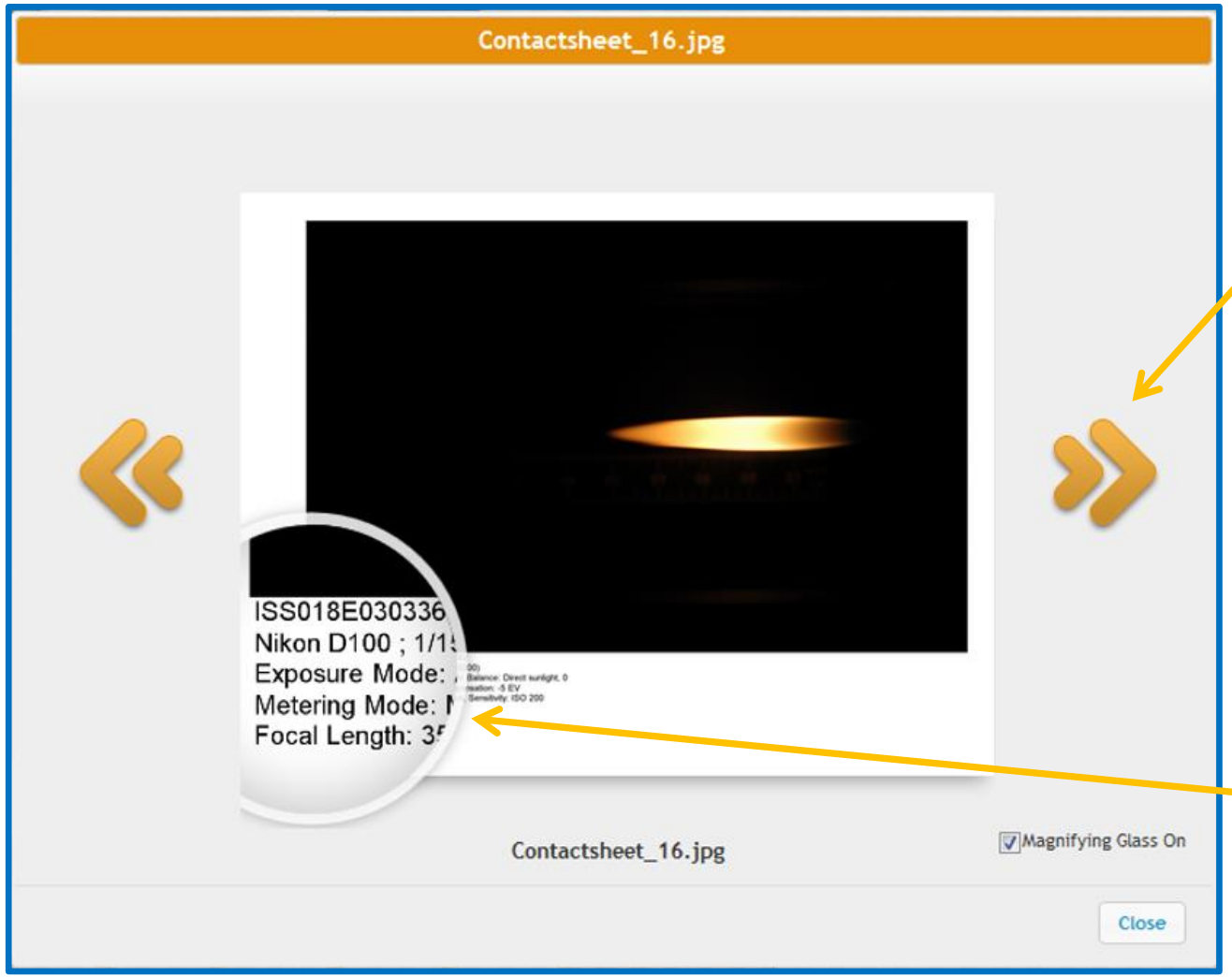


Turn on/off series

Series not displayed

Interact with plot to find specific point data

Image Galleries

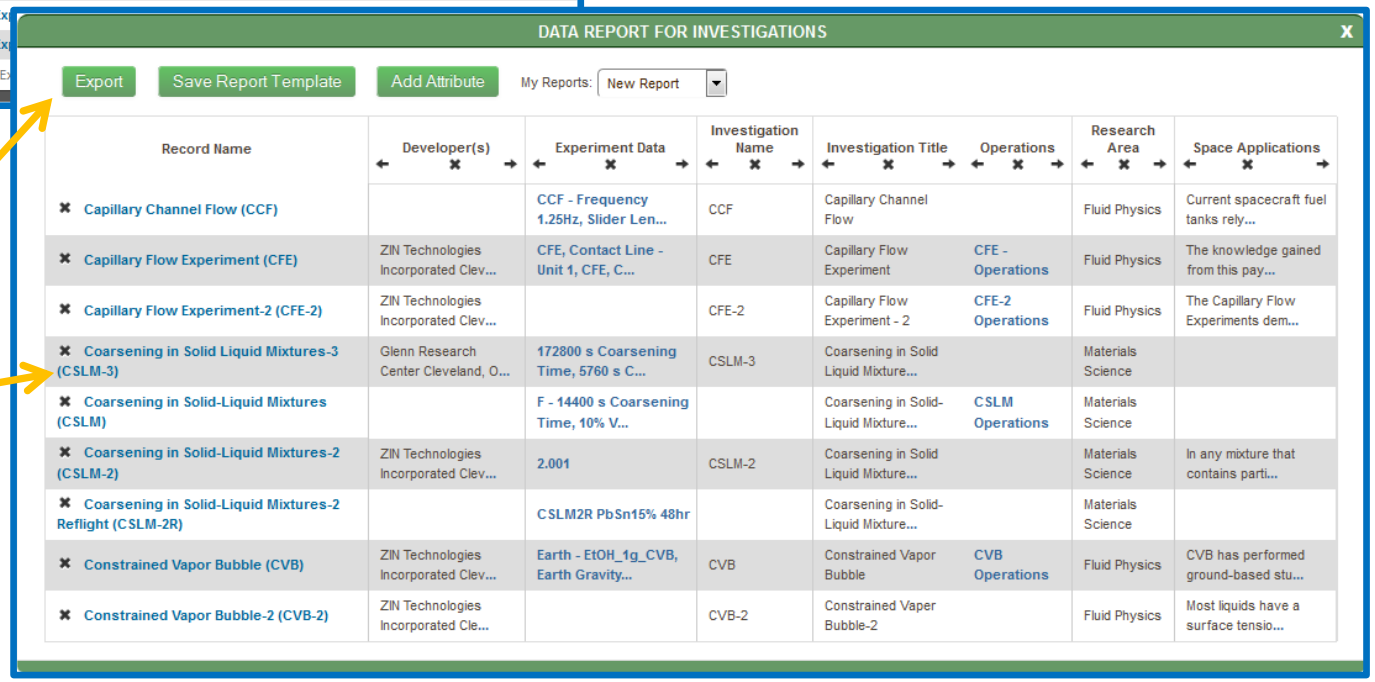


Quickly move between images

Magnify Image

Generate Reports

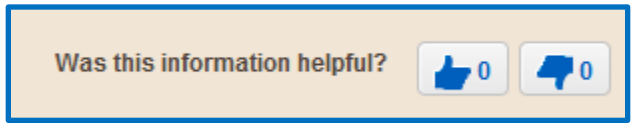
Generate reports from multiple records



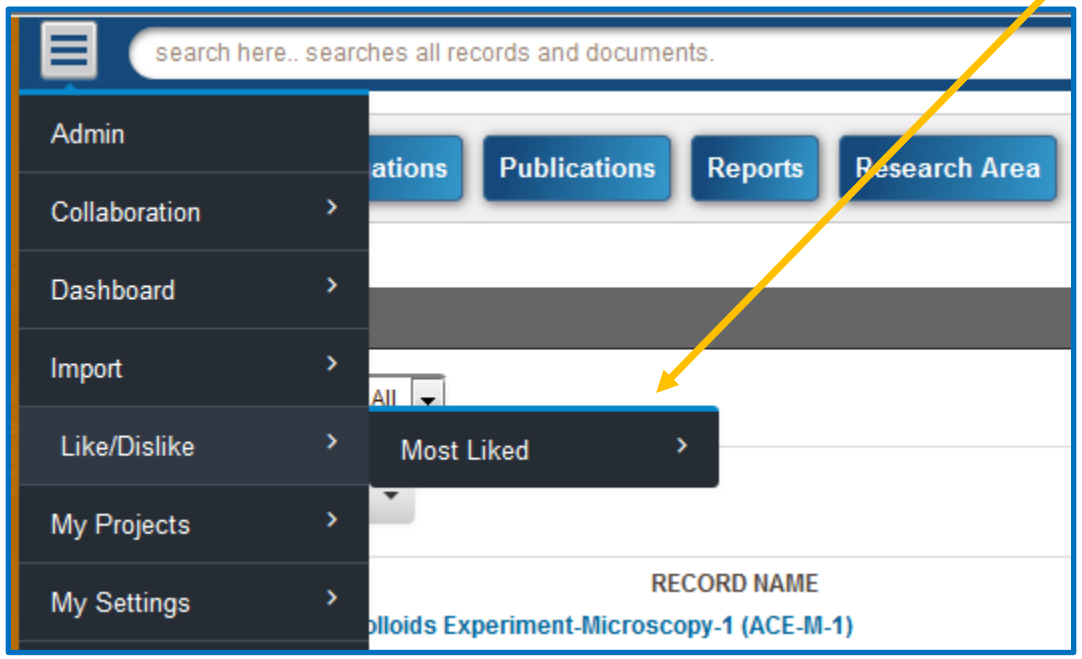
Quickly compare data

Export reports to Excel or PDF

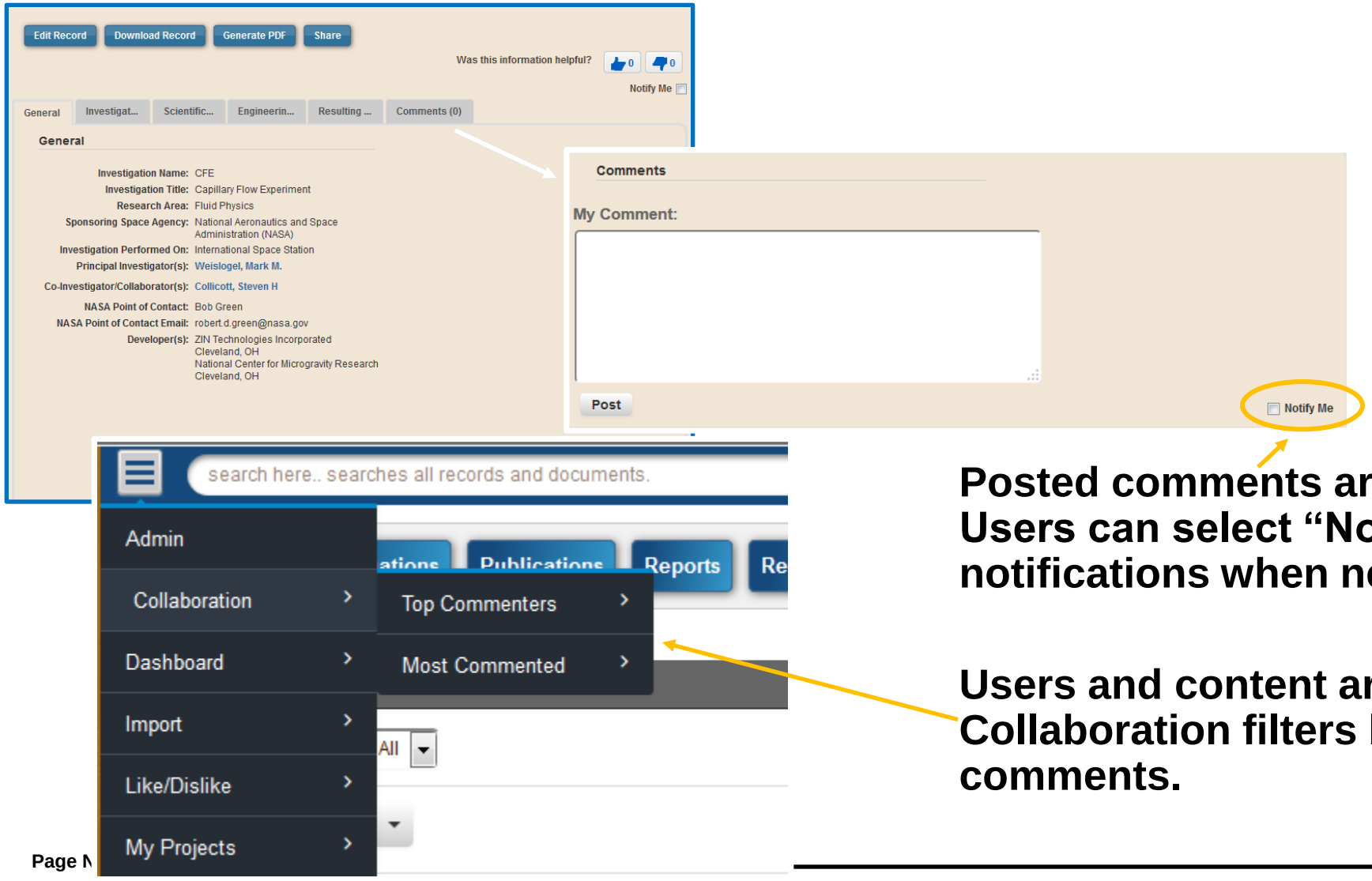
Using the “Like” feature



Each record has the “like” and “dislike” feature. Using this feature can promote content within the Like/Dislike filters.



Using Comments



Posted comments are saved within the record. Users can select “Notify Me” to receive email notifications when new comments are added.

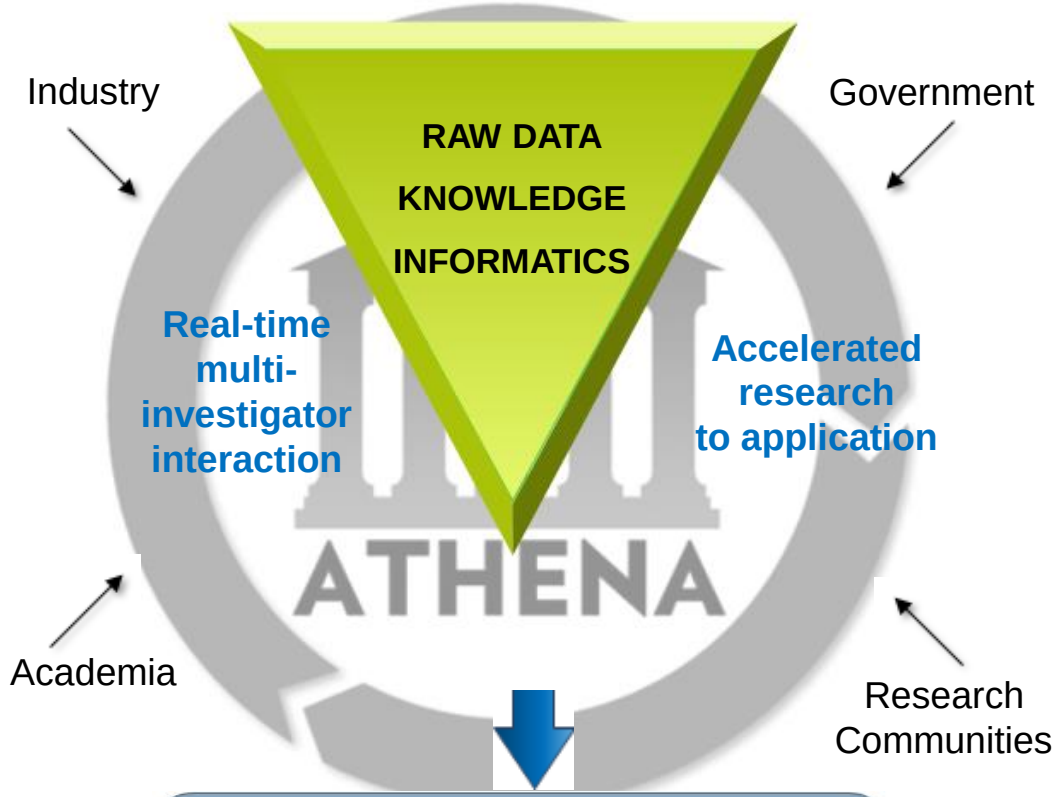
Users and content are promoted within the Collaboration filters based on the number of comments.

Using the “Notify Me” feature

Each record has the “Notify Me” feature to allow users to receive email notification when any changes are made to the record.

ISS Physical Sciences Informatics: Overall Approach

- ISS physical sciences data contains knowledge that has the potential of high return on Agency investments.
- An **informatics system** is needed to realize return on ISS investments.
- The **informatics system** transforms the raw data obtained from ISS experiments into knowledge.
- The open-source **informatics system** enables real-time interactions among multiple investigators leading to research build-up, applications, and possibilities not yet realized.
- **Athena** is an informatics-ready platform



Benefit to ISS, the Nation, and the World

- ✓ New use of ISS data
- ✓ Cost Avoidance*
- ✓ Research build-up & Scientific discoveries

*Materials International Space Station Experiment (MISSE): MISSE data saved $150M for predicting environmental impacts on missions. *"2003 Annual Report of the NASA Inventions & Contributions Board"*

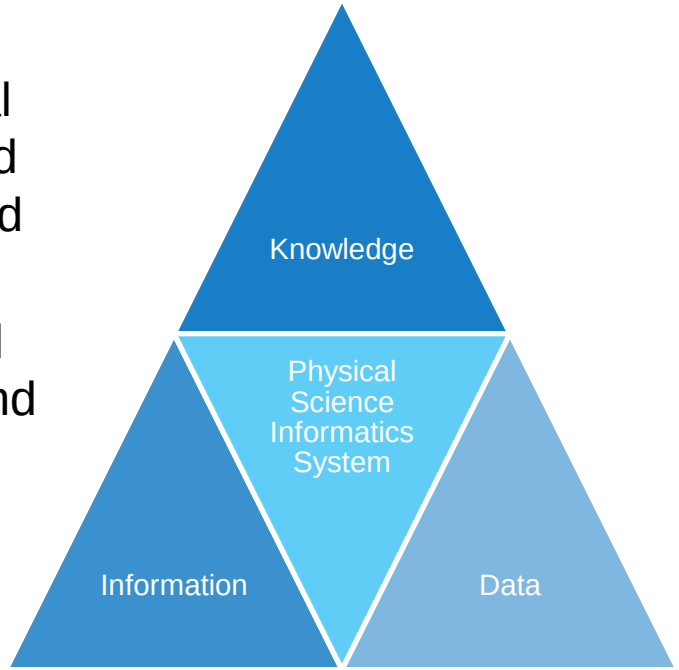
Purpose

- The decadal survey committee strongly recommends that NASA **intensify the utilization of the ISS** as a world-class research laboratory engaged in both basic and applied research that enables space exploration and is enabled by the microgravity environment of the ISS

- The goal should be to maximize the utilization of existing facilities and to **engage world-class scientists** and engineers to carry out research that leads to the development of space-related technologies. Ground-based experimental and theoretical work should form a significant component of the overall activity

Objective

- Physical Science Informatics system implements Office of Science and Technology Policy (OSTP) memorandum, Feb. 22, 2013 entitled “Increasing Access to the Results of Federally Funded Scientific Research” by enabling multiple researchers simultaneous, **open-science,** access to synergistically build upon ISS data.
- Maximize the value of this important data by mass disseminating past, current, and future ISS physical science data to the broad science, engineering, and STEM community including industry, academia, and government.
- Accelerate from ideas to state-of-the-art of physical sciences research and to products, publications, and patents.



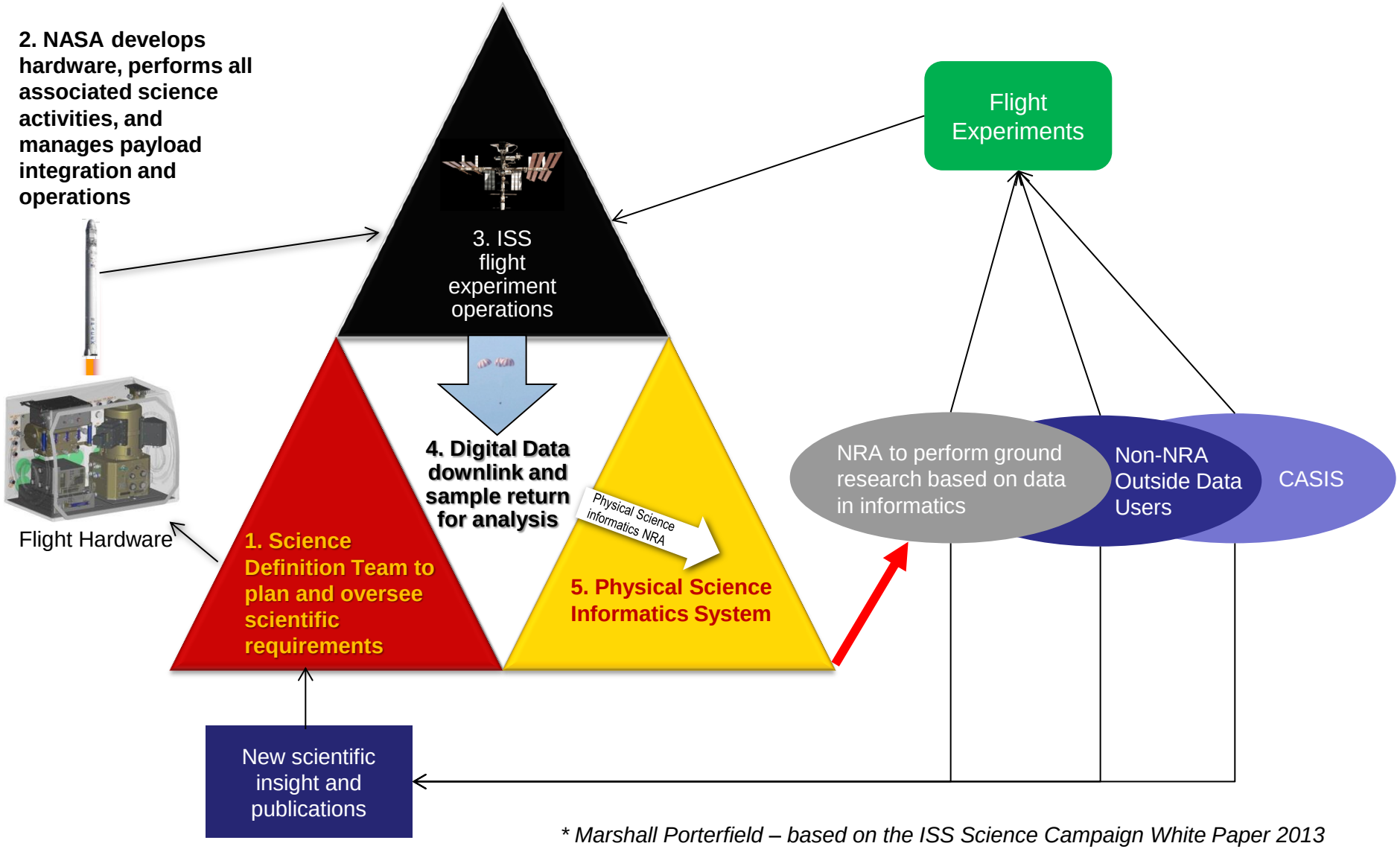
Paradigm Change – Open Science Informatics
The Engine That Drives the Plans

Basic unifying characteristics of ISS Science Campaign include:

- Initiation of ISS Science Campaign (ISS SC) programs will be **branded and promoted** in order to be linked to ISS increments **to increase public visibility of ISS utilization**.
- Scientific themes can be **broad** or focused **based on the need**.
- Existing science efforts can be re-organized as ISS SC programs.
- Future efforts can develop science around new ISS SC concepts that are NRA specific.
- ISS SC themes can also help to define hardware development needs in order **to maximize ISS cooperation and utilization by all member countries.**
- **ISS SC programs allow for more direct public dissemination and will feed the development of educational and outreach materials.**
- **K-12 outreach projects and materials will bring knowledge and awareness of ISS science utilization activities to the public domain.**
- **ISS SC programs will be mechanisms to organize new science initiatives that are in alignment of recommendations outlined in the NRC Decadal Survey.** An example of such a science campaign is geneLAB which satisfies recommendations for expanded multi-investigator experiments on the ISS, and expands the use of **new high-throughput** biomolecular research **technologies.**

From an Article by Dr. Marshall Porterfield

Open Science Campaign Platform*



** Marshall Porterfield – based on the ISS Science Campaign White Paper 2013*

PSI Data Set Status

Data Sets Completed

Investigation	Research Area	Center	Project Scientist	Informatics Data Load Approx. Completion Status
CFE	Fluid Physics	GRC	Bob Green	100%
CSLM	Materials Science	GRC	Walter Duval	100%
CVB	Fluid Physics	GRC	Dave Chao	100%
DAFT/DAFT-2	Combustion Science	GRC	David Urban	100%
GRADFLEX	Fundamental Physics	GRC	Bill Meyer	100%
PCS	Complex Fluids	GRC	Bill Meyer	100%
SAME	Combustion Science	GRC	David Urban	100%
SHERE	Complex Fluids	GRC	Nancy Hall	100%
SHERE II	Complex Fluids	GRC	Nancy Hall	100%
SHERE-R	Complex Fluids	GRC	Nancy Hall	100%

Data Sets Nearing Completion

Investigation	Research Area	Center	Project Scientist	Informatics Data Load Approx. Completion Status
FLEX-1	Combustion Science	GRC	Dan Dietrich	90%
InSPACE-3	Complex Fluids	GRC	Bob Green	98%
InSPACE-3+	Complex Fluids	GRC	Bob Green	80%
NPBX	Fluid Physics	GRC	Dave Chao	98%
SAME-R	Combustion Science	GRC	David Urban	90%
SPICE	Combustion Science	GRC	David Urban	75%

Representative of the 45 completed and current investigations identified in initial scope.
The 63 awarded investigations are not represented in these listings.

PSI Data Set Status

Data Sets To Be Completed by Oct 2015

Investigation	Research Area	Center	Project Scientist	Informatics Data Load Approx. Completion Status
ACE-M1	Complex Fluids	GRC	Bill Meyer	5%
BASS	Combustion Science	GRC	Paul Ferkul	15%
BCAT-3	Complex Fluids	GRC	Bill Meyer	15%
BCAT-4	Complex Fluids	GRC	Bill Meyer	10%
BCAT-5	Complex Fluids	GRC	Bill Meyer	10%
BCAT-6	Complex Fluids	GRC	Bill Meyer	10%
CCF	Fluid Physics	GRC	Lauren Sharp	10%
CFE-2	Fluid Physics	GRC	Bob Green	25%
CVB-2	Fluid Physics	GRC	Dave Chao	15%
FLEX-2	Combustion Science	GRC	Dan Dietrich	15%
InSPACE	Complex Fluids	GRC	Bob Green	15%
InSPACE-2	Complex Fluids	GRC	Bob Green	5%
ISSI	Materials Science	MSFC	Richard Grugel	20%
MABE	Fluid Physics	GRC	John McQullen	20%
MICAST/CSS B1	Materials Science	MSFC	Richard Grugel	5%
MICAST/CSS B2A	Materials Science	MSFC	Richard Grugel	5%
PFMI	Materials Science	MSFC	Richard Grugel	55%
SLICE	Combustion Science	GRC	Dennis Stocker	20%
SUBSA	Materials Science	MSFC	Martin Volz	5%

Representative of the 45 completed and current investigations identified in initial scope.
The 63 awarded investigations are not represented in these listings.

PSI Data Set Status

Data Sets To Be Completed in 2016

Investigation	Research Area	Center	Project Scientist	Informatics Data Load Approx. Completion Status
CSLM-2	Materials Science	GRC	Walter Duval	5%
CSLM-2R	Materials Science	GRC	Walter Duval	20%
CSLM-3	Materials Science	GRC	Walter Duval	5%
DECLIC-ALI*	Fundamental Physics	JPL	Inseob Hahn	5%
DSI-DSIP*	Materials Science	MSFC	Louise Strutzenberg	5%
DSI-R/SPADES*	Materials Science	MSFC	Louise Strutzenberg	5%
HT1-R/SCWM*	Fluid Physics	GRC	Mike Hicks	5%
PK-3*	Fundamental Physics	JPL	Inseob Hahn	5%
PK-3+*	Fundamental Physics	JPL	Inseob Hahn	10%

*Identified as International flight experiments.

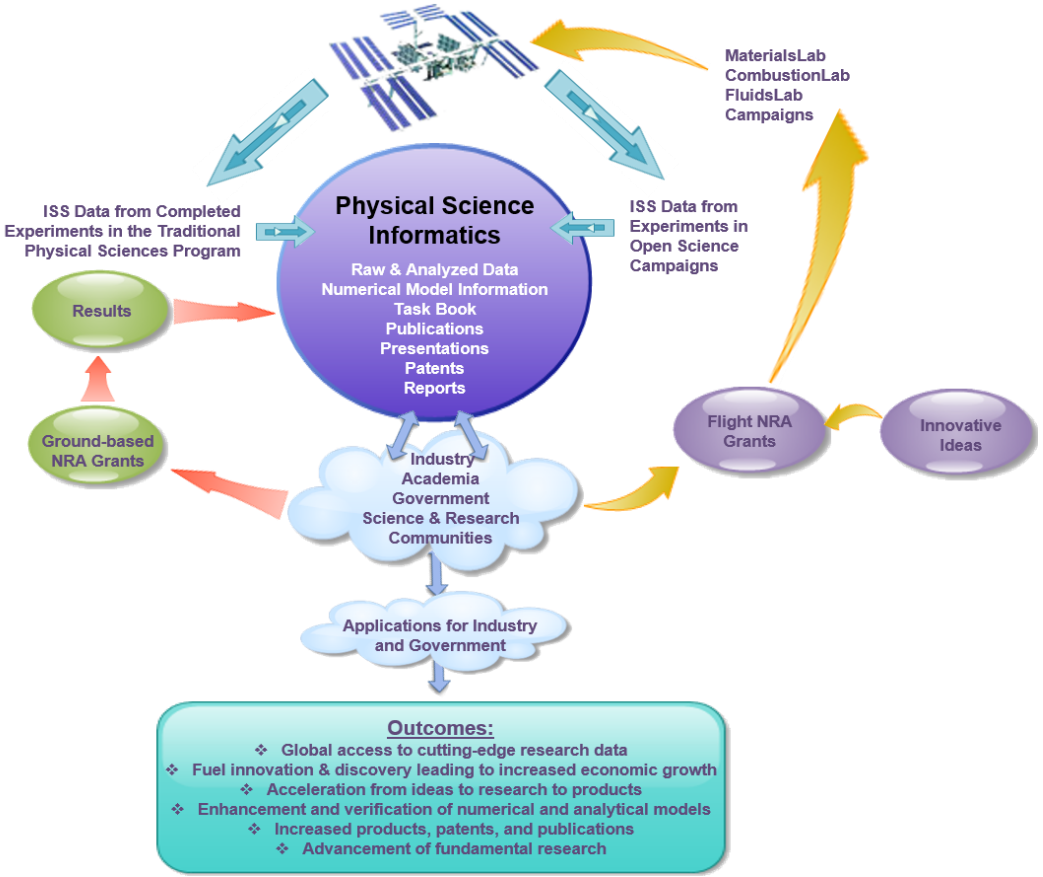
- CSLM-2, -2R, -3 data cannot be provided before FY16 due to delays in processing the data.
- DECLIC-ALI, DSI-DSIP, DSI-R/SPADES and HT1-R/SCWM are French CNES experiment and the data will have to be provided from those project teams.
- PK-3 and PK-3+ were Russian experiments and the data will have to be provided from those project teams.

Representative of the 45 completed and current investigations identified in initial scope.
The 63 awarded investigations are not represented in these listings.

Physical Science Vision

From Microgravity Science to Open Science Informatics

Fully utilize ISS as national laboratory to conduct microgravity materials science and disseminate data into open source informatics, to accelerate revelation of materials science mysteries, develop engineering need-driven higher-performing materials for NASA and the nation, and enhance STEM education.



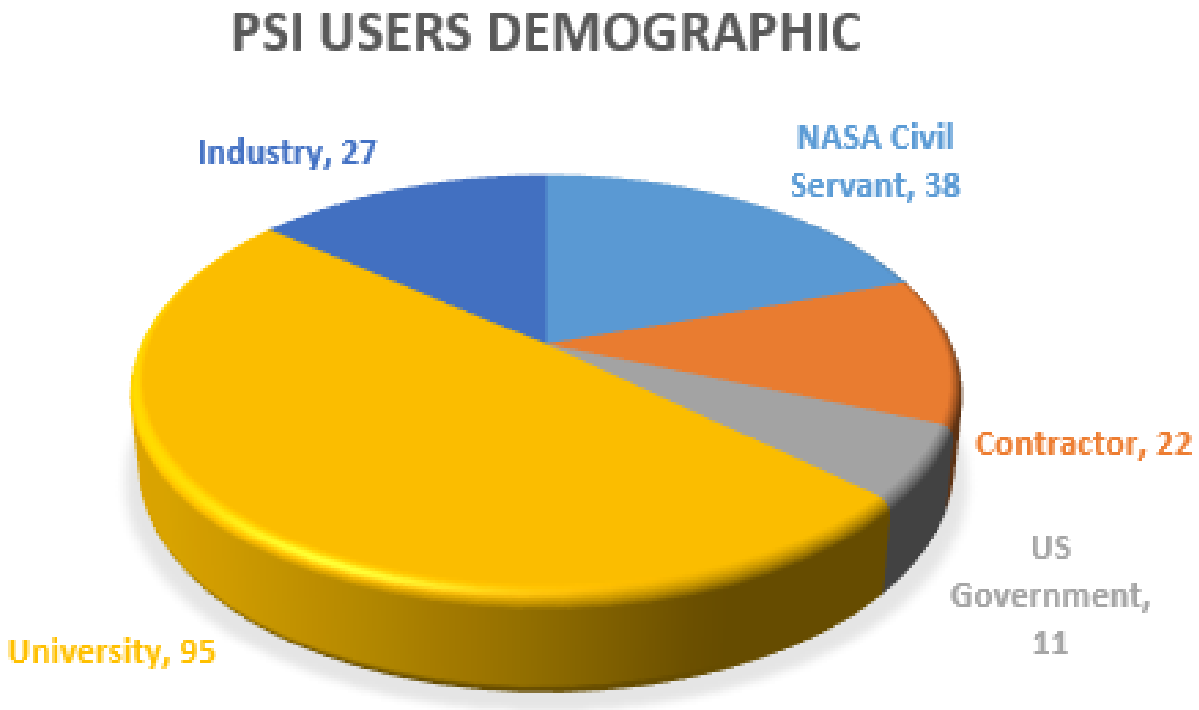
- **Access to global science/engineering community**
- **Simultaneous rapid multiplicative investigations**
- **Break-through scientific advance of real value**
- **World-wide STEM education opportunity**
- **Low cost and high-throughput research**
- **Use of existing facilities as much as possible**
- **Minimum Astronaut intervention and time**
- **Visible, applicable, and high return on investment**
- **Industry-driven engineering fulfillment**
- **Potential of discovering higher-performing material**

<u>Goal:</u> Provide needed physical science data and knowledge to enable advanced technologies and application on Earth and for space exploration

<u>Open Science and Informatics:</u> Inspire new areas of research, educate students, enhance discovery and multiply innovation

PSI User Demographics

- TBE, Watring Technologies Inc, USRA, Terminal Velocity Aerospace, Materials development, Inc., University Space Research Association, Yale and University of Houston are using the data.



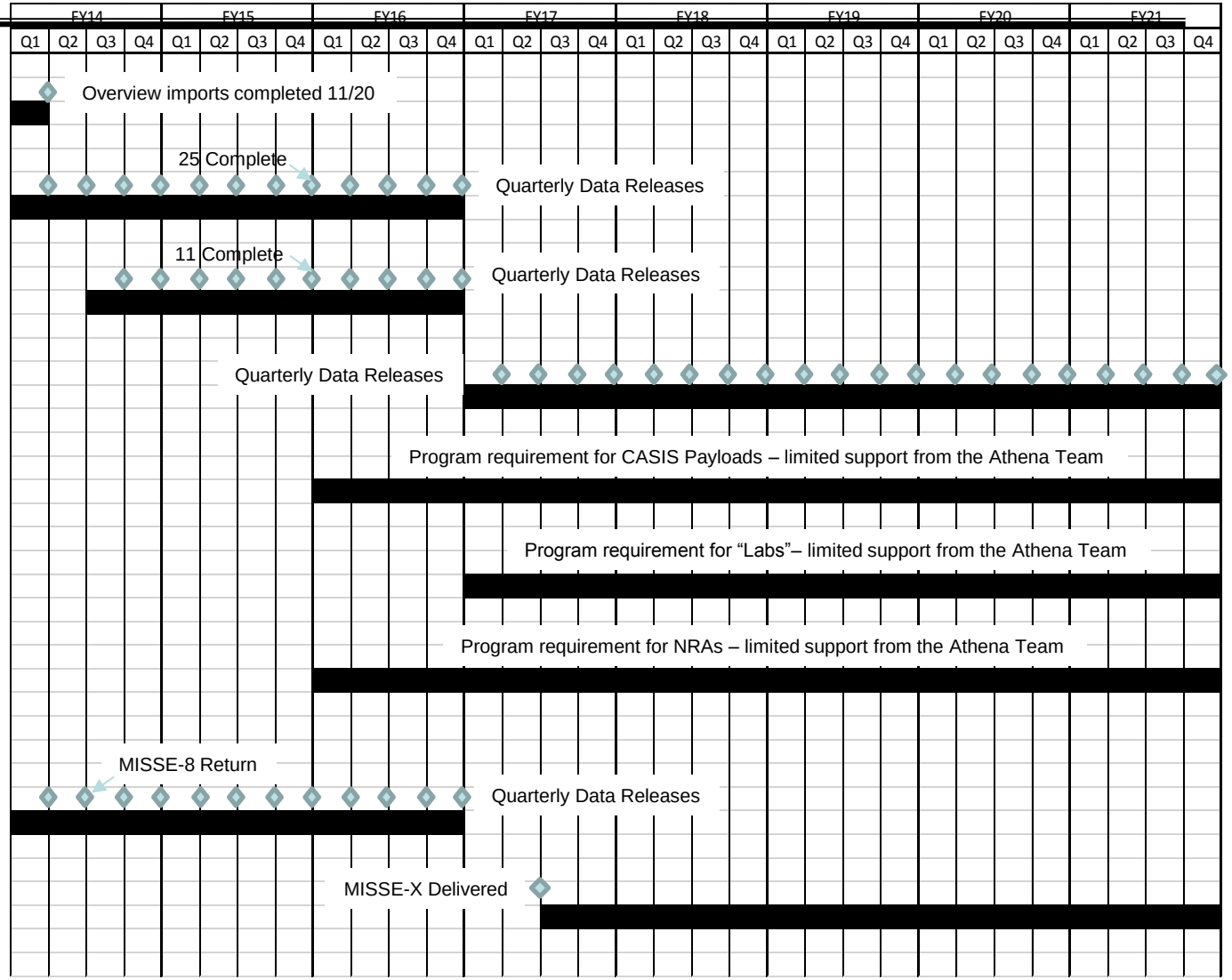
Total Users = 193

PSI went live at the ASGSR Conference in October 2014

- 11 months ahead of schedule
- Stretch Goal
- First PSI NRA to be released in FY15; award in FY16
- MaterialsLab Phase 1 NRA to be released in FY15; award in FY1
- CASIS has expressed interest in using PSI for their physical sciences data

PSI URL - psi.nasa.gov/

Schedule


FY14
FY15
FY16
FY17
FY18
FY19
FY20
FY21
Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4
Import of overview of 45 PSI Investigations from ISS Scientist Toolbox
Overview imports completed 11/20
31 Past PI Investigations, acquire and Process scientific data
25 Complete
Quarterly Data Releases
14 Current PI Investigations (FY13), acquire and process scientific data
11 Complete
Quarterly Data Releases
63 Awarded PI Investigations (FY14-20), acquire and process scientific data
Quarterly Data Releases
Center for the Advancement of Science in Space (CASIS)
Program requirement for CASIS Payloads – limited support from the Athena Team
MaterialsLab/FluidsLab & CombustionLab
Program requirement for “Labs”– limited support from the Athena Team
NASA Research Announcements (NRAs)
Program requirement for NRAs – limited support from the Athena Team
MISSE 1-8, acquire and process data
MISSE-8 Return
Quarterly Data Releases
Configure for MISSE-X data
MISSE-X Delivered