The Nexus for Exoplanet System Science
Research Coordination Network
A Cross-division Initiative
https://nexss.info

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What is a Coordination Network?

A virtual structure to support groups of investigators to communicate and coordinate their research, training and educational activities across disciplinary, organizational, divisional, and geographic boundaries.
Objectives

To further our joint strategic objective to explore exoplanets as potential habitable and inhabited worlds outside our solar system.

• Exoplanet research cuts across divisions in SMD including Planetary Science (PSD), Heliophysics (HPD), Earth Science (ESD) and Astrophysics (APD)

To leverage existing Programs in SMD to advance the field of Exoplanet Research, specifically research in comparative planetology, biosignature and habitat detection, and planet characterization.

Establish a mechanism to break down the barriers between, divisions, disciplines and stove piped research activities.
What Research Coordination Networks have accomplished?

Provided opportunities to share information and ideas, foster new collaborations, including international partnerships, and address interdisciplinary topics.

Provided innovative ideas for implementing novel networking strategies, collaborative technologies.

Supported the development of community standards for data and meta-data.

Supported the means by which investigators can

- coordinate ongoing or planned research activities,
- and in other ways advance science and education through communication and sharing of ideas.
Example Activities

Host a workshop (not mini symposium) to define the Habitable zone to include factors optimal orbit, size, distance from star, star type, radiation, magnetopsheres, etc.

• Process is just as important as product

Develop an understanding of what future observations are needed to determine if exoplanets are habitable and inhabited
Measure of Success

Investigators carry out and propose interdisciplinary research through new collaborations

Produces a plan for utilization of current space telescopes

Spawns ideas for new and exciting missions

Identifies new targeted technologies needed not yet reported elsewhere

Influences Decadals for both PSD and APD

Enhances International engagement
Our Fundamental Requirement for Habitability

Liquid Surface Water
Habitability is an outcome of the interactions between a planet, its star, and its planetary system.

These interactions modify the planet’s environment and evolution and can increase or decrease the probability that life’s requirements will be met.
Planets are Hard!

Habitability Assessment is a multiparameter, interdisciplinary process.

As a community, we want to understand the interplay of these many influences on habitability, and how they evolve with time.

The ultimate goal is the determination of a planet’s “Habitability Factor”, which will allow ranking of targets for follow-up.
Implementation

Astrophysics
- Exoplanet Detection
- Star Characterization
- Existing Mission Data Analysis
- JWST

PSD Astrobiology
- Comparative Planetology
- Planetary atmospheres
- Exoplanet Detection
- Biosignatures
- Habitability

PSD Exoplanet Research Program (XRP)
- Exoplanet characterization
- Protoplanetary Disks
- Planet Formation
- Comparative Planetology

Earth Sciences

Heliophysics
- Detection of planetary magnetospheres
- Stellar winds
- Radiative Habitability
The Radiative Habitable Zone

That region around a star where life’s requirements are most likely to be met, and be detectable.

Kopparapu et al., (2013)
http://depts.washington.edu/naivpl/content/hz-calculator
How We Do It

Theoretical/Modelling

Observational

Statistical

Laboratory

Diverse methodological approaches. Plenty of cross-over, inter- and intra-team.

$n = 207$
Getting Started

Kickoff Meeting April, 2015
Charge to the Teams from Jim Green and Paul Hertz
Facilitated working groups

Monthly webinars since June 2015
Getting to know you and your science

Monthly PI telecons
Brainstorming on workshop, communication and education activities in support of the NExSS goals
NExSS white paper: Laboratory Work for Understanding Exoplanet Atmospheres (led by J. Fortney, >30)

- Needs for future measurements
  - Pressure-induced line broadening parameters (self-, foreign)
  - Optical properties of particles, haze formation
  - Reaction rate constants
  - Photoabsorption cross-sections at high T
  - Lab spectroscopy of continuum absorption
  - Oxygen absorption by early magma ocean

- Draft released for community comment
- Relevant to APDA ROSES NRA highlighting timeliness of Laboratory Astrophysics research in support of JWST
Workshops:

Upstairs Downstairs: Consequences of Internal Planet Evolution for the Habitability and Detectability of Life on Extrasolar Planets
- Tempe, AZ, Feb. 17-19 (led by PSD)
- Joint NExSS-NAI-NSF effort, in-person + virtual participation (Workshop Without Walls) + winter school for students/postdocs

Biosignatures workshop (led by PSD, APD), July 2016
- Joint NExSS-NAI-ExEP effort
- Partnering with tentatively approved ExoPAG SAG-16 in support of JWST, WFIRST, HabEx/LUVOIR studies

Exoplanetary Space Weather, Climate and Habitability Workshop
- Dec 2016
Identifying which stars the are best place to search for habitable planets and life
NExSS Face to Face (May 2016) and Exoplanet Talk Show on NASA TV
Other activities, collaborations:

- Other workshop ideas (priorities identified by poll of teams)
  - How to identify potentially habitable planets (ESD, PSD)
  - Space weather constraints on habitability (HPD, APD)
  - Stellar, disk histories favoring habitability (APD, PSD)

- Cross-team, cross-discipline collaborations occurring in NExSS
  - Planetary scientists and astrophysicists to characterize short-period rocky planets
  - Statistical and machine learning approaches to detect low-mass planets in presence of stellar activity
  - Heliophysicists and astrophysicists to estimate mass loss in young Sun-like stars
Breaking Down Exoplanet Stovepipes

The search for life beyond our solar system requires unprecedented cooperation across scientific disciplines. NASA’s NExSS collaboration includes those who study Earth as a life-bearing planet (lower right), those researching the diversity of solar system planets (left), and those on the new frontier, discovering worlds orbiting other stars in the galaxy (upper right). (NASA)
Many Worlds Blog Traffic

![Graph showing blog traffic over time from Dec 2015 to Feb 2016. The x-axis represents the months, and the y-axis represents the traffic in thousands. Peaks in traffic are observed in late December 2015, January 2016, and February 2016.]
NASA's Habitable Worlds Program includes elements of the Astrobiology Program, the Mars Exploration Program, the Outer Planets Program (all in the Planetary Science Division) and Exoplanet research in the Astrophysics Division. A common goal of these programs is to identify the characteristics and the distribution of potentially habitable environments in the Solar System and beyond.
RELAX ON KEPPLER-16b
WHERE YOUR SHADOW ALWAYS HAS COMPANY

EXPERIENCE THE GRAVITY OF HD 40307g A SUPER EARTH

Questions??
Questions??