

- **Worlds and Suns in Context**

- “quest to understand the interconnected systems of stars and the worlds orbiting them, tracing them from the nascent disks of dust and gas from which they form, through the formation and evolution of the vast array of extrasolar planetary systems.”

- **New Messengers and New Physics**

- “The New Messengers and New Physics theme captures the key scientific questions associated with a broad range of inquiries, from astronomical constraints on the nature of dark matter and dark energy, to the new astrophysics enabled by combined observations with particles, neutrinos, gravitational waves, and light.”

- **Cosmic Ecosystems**

- “The universe is characterized by an enormous range of physical scales and hierarchy in structure, from stars and planetary systems to galaxies and a cosmological web of complex filaments connecting them. A major advance in recent years has been the realization that the physical processes taking place on all scales are intimately interconnected, and that the universe and all its constituent systems are part of a constantly evolving ecosystem.”

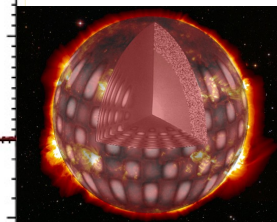
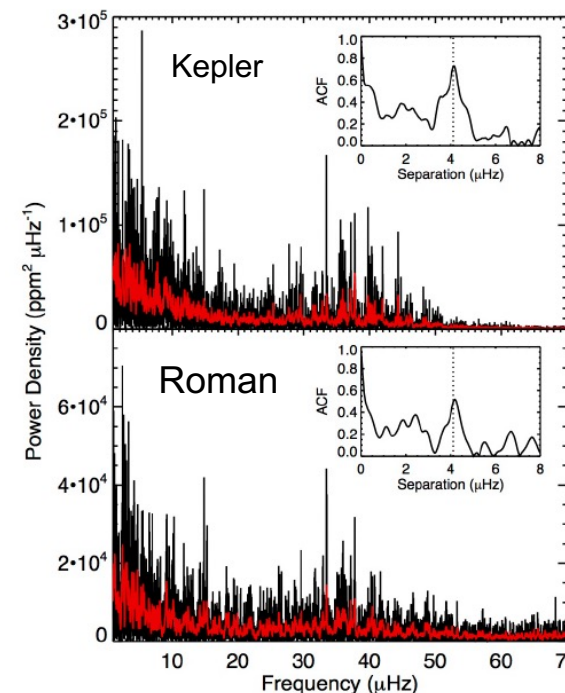
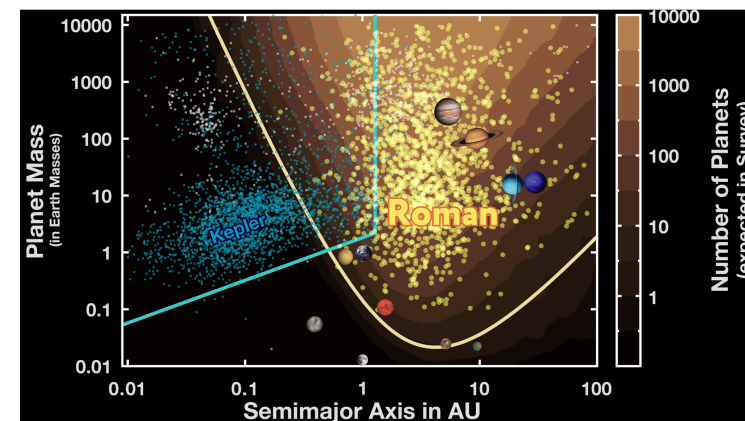
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- **Exoplanet demographics**

- Roman’s microlensing program with the **Galactic Bulge Time Domain (GBTD) Survey** will fill out the census of exoplanets by finding exoplanets in the outer reaches of planetary systems that are inaccessible by other detection techniques

- **Stellar Astrophysics**

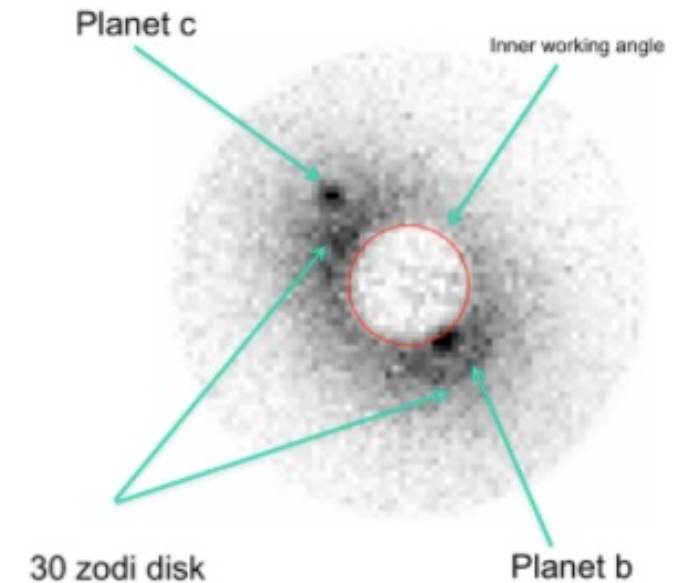
- **GBTD Survey** will monitor >200 million stars
 - Microlensing studies will reveal the population of neutron stars and stellar mass black holes in the galactic bulge
 - Astroseismology – use stellar oscillations to measure mass and radius of stars in the galactic bulge
 - and lots more – stellar flares, pulsating variable stars etc
- **GBTD Survey** will provide a deep image of 2 deg² region of the bulge
 - Identify unusual stellar populations down to very faint levels
 - measure positions, distances precisely
- **Roman General Astrophysics Surveys of nearby galaxies** open new windows in extragalactic stellar astrophysics



- **Priority Area: Pathways to Habitable Worlds**

- How to answer the question “Are we alone?”
- The planets around Sun-like stars are only accessible via an ultra-stable, space-based telescope equipped to block the star’s light and directly image the planet
 - The **Roman coronagraph instrument tech demo** is an important part of the path

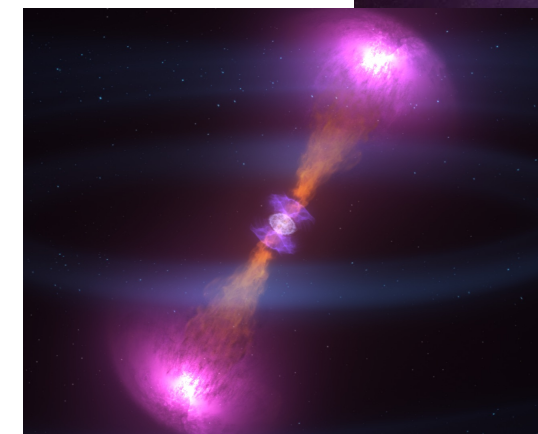
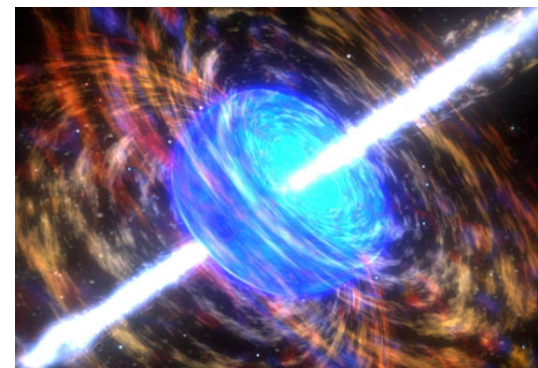
Simulated Roman Space Telescope coronagraph image of the star 47 Ursa Majoris



- **The unknown physical natures of dark matter and dark energy remain outstanding Grand challenges in physics and astronomy**
 - Exploring these on large scales by measuring galaxy shapes, distributions of galaxies on large scales and by detecting distant supernova was a prime motivation for the Roman mission with the **High Latitude Wide Area and Time Domain Surveys**
 - Roman can also map dark matter more locally, by measuring populations of stars in our Milkyway and nearby galaxies. (using **General Astrophysics surveys of the Milkyway and local galaxies**)

- **Priority area: New windows on the Dynamic Universe**

- Exploring the Universe in the time domain is a discovery machine
 - Gamma-ray bursts, tidal disruption events, supernovae, fast radio bursts, etc were all discovered, and can only be studied by observatories monitoring large areas of the sky on a variety of timescales.
 - Roman will study all these, and almost certainly make new discoveries of our own
 - The **Galactic Bulge and High Latitude Time Domain Surveys** will be the engine of these discoveries
- Observing/identifying the counterparts to gravitational wave and neutrino events
 - Connecting the whole new world revealed by GW and neutrinos to things we know from the rest of astronomy
 - Using the **High Latitude Time Domain Survey and TOO observations** to identify/follow up interesting events

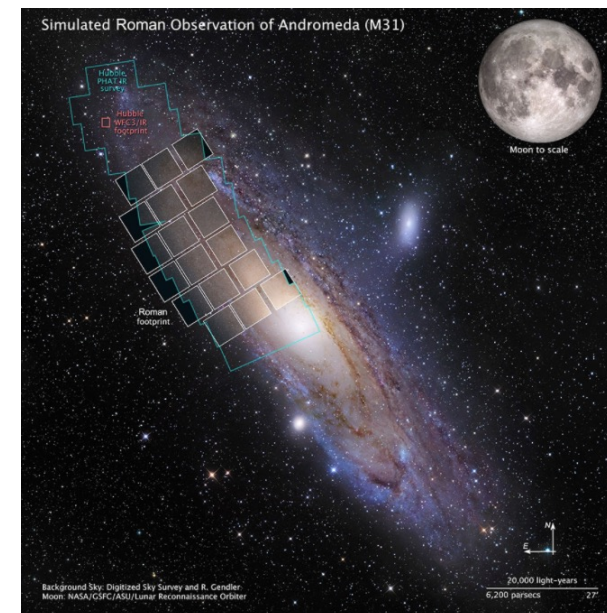
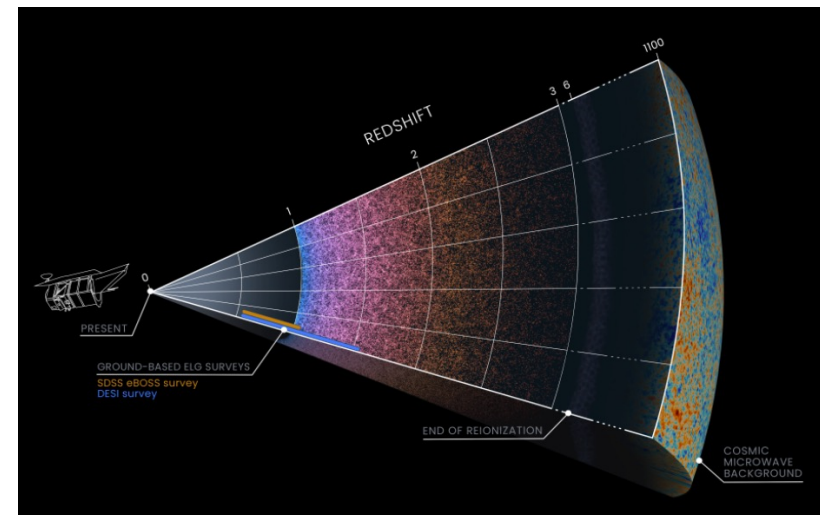


- **Cosmic structure**

- How the seeds of galaxies planted during the first moments of the big bang become the structures and galaxies seen today
- Roman's galaxy redshift survey (from the **High Latitude Wide Area Survey**) has a major role to play

- **Galaxies are ecosystems of their own**

- Balance between formation of stars and planets and feedback from stellar winds, outflows and supernovae
- What is the role of the supermassive black holes that reside at the center of most galaxies
- **General Astrophysics surveys of Milkyway and nearby galaxies** will provide insight into this



- **Priority Area: Unveiling the Drivers of Galaxy Growth**
 - Roman’s **High Latitude Wide Area and High Latitude Time Domain** will greatly expand our sampling of the structure, colors and spectra of galaxies over a significant fraction of cosmic time
 - **General Astrophysics Survey of an Ultra Deep Field** would provide additional depth
 - Track the growth of normal galaxies as a function of environment
 - Enable discoveries of rare galactic objects

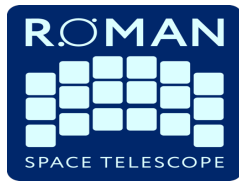


All three of our Core Community Surveys and the CGI Tech Demo have central roles to play in the science priority areas identified by Astro2020

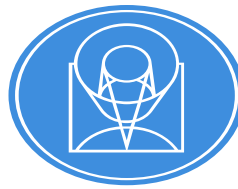
- **AAS Town Hall Monday,**
 - Focus on Roman opportunities: ROSES call, Astrophysics Survey RFI etc
- **AAS Splinter: Cosmology with the Roman Space Telescope**
 - Talks will include an overview of cosmology including weak lensing, baryon acoustic oscillations, and supernovae with Roman
 - Discussion of new ideas to explore in Roman cosmology
- **AAS Splinter: Testing Hierarchical Models of Galaxy Evolution with the Roman Space Telescope**
 - Discuss science prospects in this area and how to optimize observing and simulation strategies to best address this science
- **Workshop Feb 8-10: Exploring the Transient Universe with the Nancy Grace Roman Space Telescope**
 - All aspects of time domain astrophysics from our Solar system to high redshift galaxies

Within the next two months Roman will have workshops/sessions addressing two of the three Astro2020 priority areas (and all the ones related to WFI)

- **Conclusion:** The scientific landscape and the Roman Space Telescope's capabilities have changed significantly since it was first envisioned by New Worlds, New Horizons, and the currently planned balance of surveys and guest investigator-led observations may not be optimally suited to take advantage of new scientific opportunities.
- **Recommendation:** NASA Astrophysics Division should hold a non-advocate review of the Roman Space Telescope's science program to set the appropriate mix of survey time devoted to the weak lensing, baryon acoustic oscillations, supernovae, and microlensing programs relative to guest investigator-led observing programs during the primary 5 year mission.



Roman Data Systems in light of ASTRO2020



- Section 4.5: The Data Foundation
 - “In the coming decade the Vera Rubin and Nancy Grace Roman Observatories, the highest-priority ground and space projects in the 2010 decadal survey, respectively, will provide comparably rich data sets, which promise to revolutionize time domain astronomy and promise breakthrough discoveries across a wide range of astrophysical disciplines. They will also bring unprecedented volumes of data ... Progress in astronomy requires fully preparing for the next phase of the on-going transition away from targeted observations to large public data sets, in order to maximize the science returns from current and upcoming facilities.”
- Section 4.5.1: Data Archiving, Curation, and Pipelines
 - “the general trend is for an increasing role of archival data in scientific pursuits”
 - **Recommendation:** NASA and the National Science Foundation should explore mechanisms to improve coordination among U.S. archive centers
- Section 4.5.2: Software Development
 - **Finding:** Software development has become an essential part of every sub-field of astronomy. However, software developers and large software development efforts are not adequately funded or supported by existing structures
- Section 4.5.4: Data Science and Machine Learning
 - **Finding:** Data science, including applications of machine learning, will play an increasing role in astronomical research over the coming decade ...

- General thoughts on Astro2020
- Mix of time devoted to community defined core surveys vs General Astrophysics surveys
- Mix of science goals towards which core surveys are optimized

Next RSIG Meeting



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- **Scheduled for Jan 17, but this is a federal holiday – move to Jan 24?**
- **Draft Roman ROSES solicitation released on Jan 7, final version expected to be released in mid-February**
 - Discuss solicitation at next RSIG meeting