



SSERVI Monthly Report

NESS/PI Burns - July, 2018



Progress Report

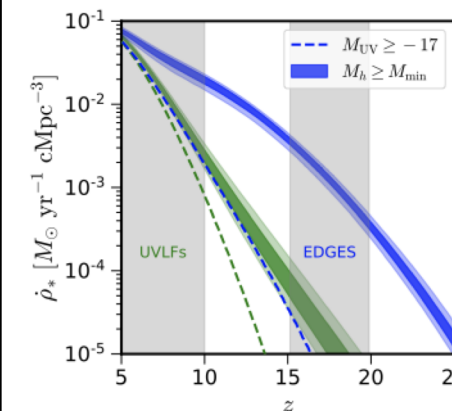
- **Research highlights:** **Mirocha & Furlanetto** are exploring astrophysical scenarios to explain the recent EDGES detection of the global 21-cm signal, which have important implications for low-frequency radio telescopes on the Moon.
- **News/Media:** Denver Post Op-Ed by Joseph Silk and **Jack Burns** on [“Seeking our cosmic origins on the far side of the Moon”](#).
- **Outreach:** (1) **Burns** presented the Fiske Planetarium show entitled “Our Future in Space” to 45 high school STEM students participating in the national Summer Science Program (SSP) at CU-Boulder on July 24. (2) **Burns** along with Scott Pace (Executive Director of the National Space Council) did a panel on Space Policy for the 60th anniversary alumni symposium of the SSP at CU-Boulder on July 28.
- **Talks:** **Monsalve** presented in: (1) 13th CIPANP Conference, June 2, Palm Springs, USA, “Fingerprints of the First Stars in the Sky-Averaged Radio Spectrum”; (2) Physics Seminar, June 12, University of Kwazulu-Natal, Durban, South Africa, “EDGES Detection of an Absorption Feature at 78 MHz in the Sky-Averaged Radio Spectrum”; (3) Rise and Shine Reionization Conference, June 18, Strasbourg, France, “Measuring the Global 21-cm Signal with EDGES”.
- **Meetings:** AAS Meeting-in-a-Meeting: June 5-6, Denver, (1) **Kasper** presented on “Sun Radio Interferometer Space Experiment (SunRISE)”, (2) **Falcke** on “The Netherlands-China Low Frequency Explorer on the Chinese Chang’e 4 Lunar Mission”, (3) **MacDowall** on “Low frequency Radio Observatory on the Lunar Surface (LROLS)”, (4) **Hallinan** on “Optimized Strategies for Detecting Extrasolar Space Weather”, (5) **Burns** on “Space-based Observational Strategy for Characterizing the First Stars and Galaxies Using the Redshifted 21-cm Global Spectrum”, (6) **Rapetti** on “Pattern Recognition and Experimental Design for Hydrogen Cosmology”, (7) **Bowman** on “Toward a Cosmic Dawn Mapper”; (8) **Pober** on “Design Optimization for Interferometric Space-Based 21-cm Power Spectrum Measurements”. NESS Steering Committee meeting: June 7-8, Denver. Exploration Science Forum: June 26-28, NASA Ames, NESS talks and posters: (1) **Fong** on “The Gateway - Enabling Infrastructure for a New Era of Lunar Robotics”; (2) **Walker** on “VR Simulation Testbed: Improving Surface Telerobotics For The Deep Space Gateway”; (3) **Mirocha** on “Low-Frequency

Radio Observations from the Moon: The Essential Next Step for Particle Physics, Cosmology, and Galaxy Formation”; (4) **Burns** on “Science On The Lunar Far Side Facilitated By Low Latency Telerobotics from the Lunar Orbiting Platform-Gateway”; (5) **Hegedus** on “Tracking Solar Type II Bursts to 0.5 AU with Radio Interferometers on the Lunar Surface”; (6) **Tauscher** on “Towards a lunar farside hydrogen cosmology telescope: characterizing the absorption trough observed by EDGES”; (7) **Rapetti** on “Global 21-cm Data Analysis Pipeline to Constrain Physical Parameters using Lunar-based Observations”; (8) **Sandoval/Kumar** on “Integration of a COTS Robotic Arm and Rover for Future Low-Latency Telerobotic Assembly Experiments”; (9) **MacDowall** on “Low-frequency Radio Observatory Pathfinder on the Near-side Lunar Surface”. COSPAR 42nd Scientific Assembly: July 14-22, Caltech, Pasadena, (1) **Burns** presented on “A Unity of Purpose in Exploration and Space Science: Highlights from the SSERVI NESS Team”; (2) **Falcke** on “Radio Astronomy on and around the moon”. Identification of Dark Matter: July 23-27, Brown University, **Burns** presented on “Dark Cosmology: Searching for Dark Matter in the Dark Ages using the Global 21-cm Spectrum”.

Upcoming Events

- **Meeting:** “Workshop on 21-cm systems” at MIT Haystack, Aug 23-24: **Bradley** will present on the Cosmic Twilight Polarimeter and analysis of EDGES observations.

Moment of Science:



Prior to the recent detection of the global 21-cm signal reported by EDGES, the cosmic history of star formation (left) was expected to rise rapidly between redshifts $z=10$ and $z=6$ (green). However, the EDGES signal at 78 MHz ($z\sim 18$) requires more star formation at $z>10$ (blue) than is implied by galaxy luminosity functions measured with Hubble at $z<10$. This suggests more-efficient-than-expected star formation in small objects, or entirely new objects forming in the early Universe, establishing a concrete prediction to be tested by the James Webb Space Telescope. From **Mirocha & Furlanetto** (arXiv:1803.03272).