Union Radio-Scientifique Internationale · U.R.S.I. · International Union of Radio Science

Monthly Newsletter of International URSI Commission J – Radio Astronomy

April 2018

Officers

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Prepared by R. Bradley, Chair, Commission J, rbradley@nrao.edu

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News Items

Greetings Commission J Members!

The program for the 2018 URSI Atlantic Radio Science Conference (2018 AT-RASC) is now available at http://www.atrasc.com/content/booklet.pdf Please check the website periodically for updates. A summary of the Commission J program is given below. I did what I could to avoid schedule conflicts that were known to occur toward the end of the week, including travel to the AAS Meeting in Denver, CO that begins on June 3. While I don't advocate parallel sessions, running two Commission J sessions in parallel Monday – Wednesday was the compromise. I apologize, in advance, for any inconvenience this may cause. I hope to see you at the AT-RASC.

One of the topics in our Activities Spotlight series will be radio astronomy from space. This month we highlight low frequency opportunities targeting cosmology. David Rapetti and Jack Burns have written a nice synopsis of the activities with lots of links for further study.

It is my pleasure to bring this newsletter to you each month. I welcome your ideas, articles, news, photos, etc. - I need your help to keep it interesting and informative.

Submitted by R. Bradley

2018 URSI Atlantic Radio Science Conference (2018 AT-RASC)
Monday 28 May – Friday 1 June 2018, ExpoMeloneras Convention Centre, Gran Canaria
Abstract submission closed

Register at https://mailchi.mp/intec/at-rasc-2018-registration-is-now-open?e=6dc54cab9b
Complete program is available at http://www.atrasc.com/content/booklet.pdf

AT-RASC - Commission J Program

Monday	***Room 9***	***Room 12***
AM	J1-1 (5)	J6 (4)
PM1	J1-2 (6)	J8-1 (5)
PM2	J1-3 (4)	J8-2 (2)

Tuesday	***Room 9***	***Room 12***
AM	J5-1 (6)	S-JB-1 (5)
PM1	J5-2 (4)	S-JB-2 (4)
PM2	---------- Poster Session ---------	

Wednesday	***Room 9***	***Room 12***
AM	J2-1 (5)	J3 (6)
PM1	J2-2 (5)	J4 (6)
PM2	J2-3 (4)	S-J (5)

Thursday	***Room 9***
AM	J9-1 (6)

NOTE: Number in parenthesizes indicates the number of papers within a given session

AT-RASC Regular Sessions:
J1 Software Enabled Radio Astronomy (15)
J2 Large N Aperture Arrays (13)
J3 Pattern Recognition Applications in Radio Astronomy (6)
J4 Novel Instrument Concepts and Observational Challenges (6)
J5 Detecting Hydrogen Near and Far (10)
J6 Instruments for Education (4)
J7 Mm wave / sub-mm Wave Science and Technology (cancelled)
J8 Radio Telescopes (7)
J9 Radio Astronomy (6)

AT-RASC Special Sessions:
S-JACEFG – Applications for pattern recognition methodologies (now part of J3)
S-JB Polarimetry of Advanced Antenna Systems in Radio Astronomy (8)
S-J - Photonics in Radio Astronomy (5)
S-EACFJ - Spectrum Management and Utilization [see full program]

2019 URSI Pacific Radio Science Conference (2019 AP-RASC)
9 -15 March 2019, New Delhi, India
Plans are underway for the 2019 AP-RASC in New Delhi, India. Please see http://aprasc2019.com/ for details. A possible RFI mitigation workshop associated with this meeting is being discussed.

2020 URSI General Assembly and Scientific Symposium (2020 URSI GASS)
Rome, Italy
The site for the next URSI General Assembly and Scientific Symposium has been chosen! Stay tuned for details. If you like to organize a session or workshop at the 2020 URSI GASS please let me know.

Activities Spotlight - Low Radio Frequency Astronomy Opportunities from Space

After more than a decade searching for a signal from the Cosmic Dawn, the EDGES (Experiment to Detect the Global Epoch of reionization Signature) collaboration recently published a breakthrough observation of a 78 MHz absorption trough (Bowman, Rogers, Mozdzen, Monsalve & Mahesh, 2018, Nature 555, 67). In combination with NASA's renewed interest in lunar exploration, this result opens up an exciting landscape of opportunities for low radio frequency missions either in low lunar orbit or on the far side surface of the Moon. In addition to avoiding ionospheric contamination, the Moon would serve as an effective shield against Radio Frequency Interference (RFI) from the Earth and solar emissions (Burns et al., 2017, ApJ, 844, 33). Such radio telescopes would provide a new window to neutral hydrogen (HI) cosmology with precision and frequencies inaccessible from the ground.

The hyperfine spin-flip transition line of HI represents a powerful tool to study unexplored eras of the Early Universe such as the Dark Ages, when no astrophysical objects had yet formed, the Cosmic Dawn, when the first stars, galaxies and black holes appeared, and the Epoch of Reionization (EoR), before the vast majority of hydrogen became ionized by energetic photons from those first luminous objects. By observing the sky-averaged (global) 21-cm brightness temperature as a function of frequency (which through the expansion of the Universe can be directly translated into redshift or time), EDGES finds a profile consistent with these epochs. The Wouthuysen-Field effect, caused by the first stellar Lyman-alpha photons, coupled the spin with the gas temperature. According to the EDGES results, this process started about 180 million years after the Big Bang. When stars began dying, X-ray heating from the gas accreting into stellar remnants such as black holes and neutron stars reversed the absorption of CMB photons into emission, creating a well-predicted trough, with a width now measured by EDGES of about 100 million years.

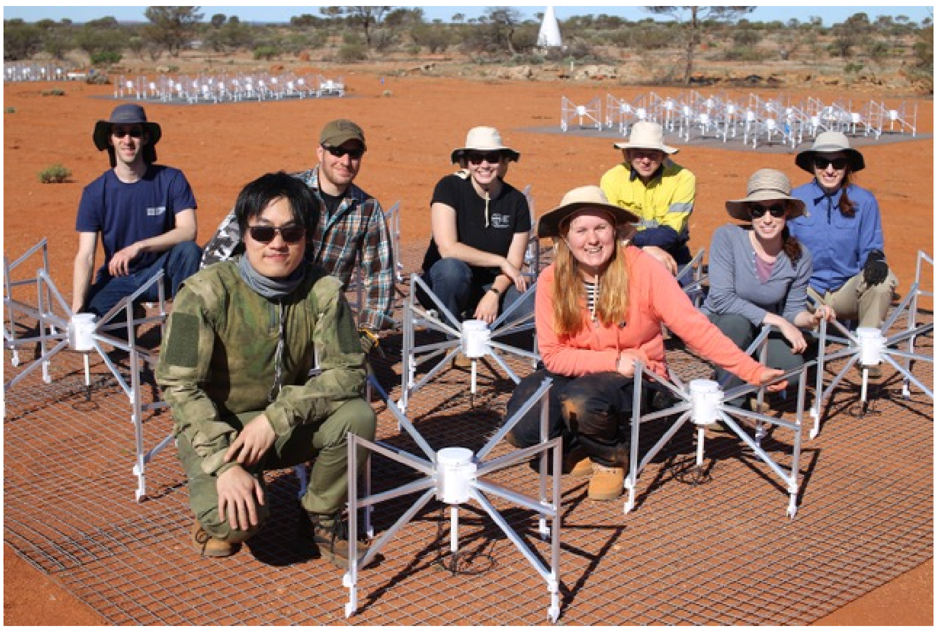
However, the shape of the EDGES spectrum and its large amplitude cannot be fit by current standard astrophysical models. For this reason, the confirmation of these measurements from ground and space-based experiments is now even more crucial. A companion paper to that of EDGES (Barkana, 2018, Nature 555, 71) proposes interactions between baryons and dark matter particles (see also Tashiro, Kadota & Silk, 2014, PRD 90, 083522, and Muñoz, Kovetz & Ali-Haïmoud, 2015, PRD 92, 083528) to explain the size of the amplitude. For velocity-dependent, Rutherford-like interactions, this possibility has recently been shown to be strongly constrained by multiple observations and experiments, with only a small fraction (below ~1%) of a millicharged dark matter subcomponent being still viable to produce the observed signal (see e.g. Muñoz & Loeb, 2018, arXiv:1802.10094; Barkana, Outmezguine, Redigolo & Volansky, 2018, arXiv:1803.03091; Berlin, Hooper, Krnjaic & McDermott, 2018, arXiv:1803.02804). In addition to Barkana (2018), a detailed analysis combining 21-cm astrophysics and dark matter modelling (Fialkov, Barkana & Cohen, 2018, arXiv:1802.10577) calculated a wide range of spectral shapes including an additional, associated smoking-gun feature for baryonic-dark matter scattering at lower frequencies ($\lesssim$10 MHz). Being in the Dark Ages, this is a predicted purely cosmological signal, unaltered by astrophysical objects.

Since such a low-frequency range is unavailable from the ground (below Earth's ionospheric cutoff of $\lesssim$15MHz), this critical signature to distinguish models of exotic physics is planned to be sought from space. For such a detection, the SmallSat mission concept DAPPER (Dark Ages Polarimeter PathfindER), to be located in a low frozen lunar orbit, is being designed to take advantage of a novel technique developed for and tentatively tested with the prototype of the Cosmic Twilight Polarimeter (CTP). The latter is a ground-based dual radio antenna experiment that utilizes the rotation of the earth to induce and measure polarization of the foregrounds, due to their anisotropy compared with the large beam (Nhan, Bradley & Burns, 2017, ApJ, 836, 1). This allows a clean separation between the isotropic, unpolarized 21-cm signal and large beam-weighted induced polarized foregrounds, as demonstrated using realistically simulated data, a pattern recognition plus information criteria code (pylinex), and a likelihood including Stokes parameters (Tauscher, Rapetti, Burns & Switzer, 2018, ApJ, 853, 187).

NASA’s SSERVI Network for Exploration and Space Science (NESS) team is developing lunar mission concepts such as DAPPER, and single or array of radio telescopes to be telerobotically deployed from NASA’s planned Lunar Orbital Platform-Gateway in the Moon’s orbit. In addition to Dark Ages and Cosmic Dawn observations, NESS also is researching low radio frequency arrays to image Coronal Mass Ejections as well as for investigations of the magnetospheres and space weather environments in extrasolar planets (see for instance the upcoming AAS meeting-in-a-meeting on “Low Radio Frequency Observations from Space” organized by NESS).

Submitted by David Rapetti and Jack O. Burns

Photo from the Field



This month's photo is of the students who helped build the Murchison Widefield Array (MWA-II) upgrade. Lots of information, images, and videos of the instrument and research are available at http://www.mwatelescope.org/

Submitted by Miguel Morales

If you have an interesting photograph that you wouldn’t mind sharing with others in the public domain I encourage you to please send a copy to me along with a brief caption and the person’s name or organization to whom I should credit.