



ASKAP-FLASH: Research Highlights and Progress Updates from a wide-area HI 21-cm Absorption Survey

Elizabeth K. Mahony⁽¹⁾, Elaine M. Sadler^(1,2), Hyein Yoon^(3,4) on behalf of the ASKAP-FLASH team

(1) Australia Telescope National Facility, CSIRO, Space and Astronomy, PO Box 76, Epping, NSW 1710, Australia, email: elizabeth.mahony@csiro.au

(2) Sydney Institute for Astronomy, School of Physics A28, University of Sydney, NSW 2006, Australia

(3) Institute for Data Innovation in Science, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Korea

(4) Astronomy Program, Department of Physics and Astronomy, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Korea

Understanding the evolution of galaxies remains a fundamental challenge in modern astrophysics, with the cold neutral gas component playing a key role in shaping galaxy growth and transformation over cosmic time. The First Large Absorption Survey in HI (FLASH), one of the large, wide-area surveys currently underway with the Australian Square Kilometre Array Pathfinder (ASKAP), is designed to systematically explore the HI gas content of galaxies beyond the local Universe[1]. FLASH is an untargeted, wide-area survey searching for HI 21-cm absorption in the redshift range $0.4 < z < 1.0$, providing an independent probe of the cold neutral gas at intermediate redshifts.

Following the successful completion of the FLASH Pilot Surveys[2], the five-year Full Survey is now in progress. Covering 25,000 square degrees of the southern sky ($\text{DEC} < +15$ degrees, $|b| > 8.5$ degrees), FLASH will obtain approximately 150,000 radio spectra from 600 ASKAP pointings, with the goal of detecting hundreds of HI absorbers. These absorbers include both associated absorption, tracing the cold gas in active galactic nuclei (AGN) host galaxies, and intervening absorption, probing the diffuse gas in foreground galaxies along the line of sight.

In this talk, we will present highlights from the Pilot Surveys, showcase new HI absorption detections, and discuss the challenges of identifying and characterizing these systems in wide-field survey data. We will also provide an update on the progress of the Full Survey and its potential to transform our understanding of cold gas in galaxies across cosmic time. Additionally, we will examine how FLASH data can be combined with optical and UV data, as well as radio continuum imaging, to measure things like the kinematics and distribution of the absorbing gas and the approximate age of the radio source, providing a clearer picture of how radio jets interact with the cold gas and its role in galaxy evolution.

As a pathfinder for future HI absorption studies with the Square Kilometre Array (SKA), FLASH will provide a critical benchmark for understanding the evolution of cold neutral gas and its role in AGN feedback, galaxy quenching, and cosmic gas flows. The results from FLASH will not only advance our knowledge of neutral hydrogen at intermediate redshifts but also lay the groundwork for next-generation surveys with SKA and other upcoming radio telescopes.

1. J. R. Allison et al., “The First Large Absorption Survey in H I (FLASH): I. Science goals and survey design”, *Publications of the Astronomical Society of Australia (PASA)*, **39**, January 2022, pp. 10 doi: 10.1017/pasa.2022.3
2. H. Yoon et al., “The First Large Absorption Survey in HI (FLASH): II. Pilot Survey data release and first results”, *Publications of the Astronomical Society of Australia (PASA)*, submitted, doi: <https://doi.org/10.48550/arXiv.2408.06626>