Mapper of the IGM Spin Temperature

Jonathan Sievers for the MIST Collaboration

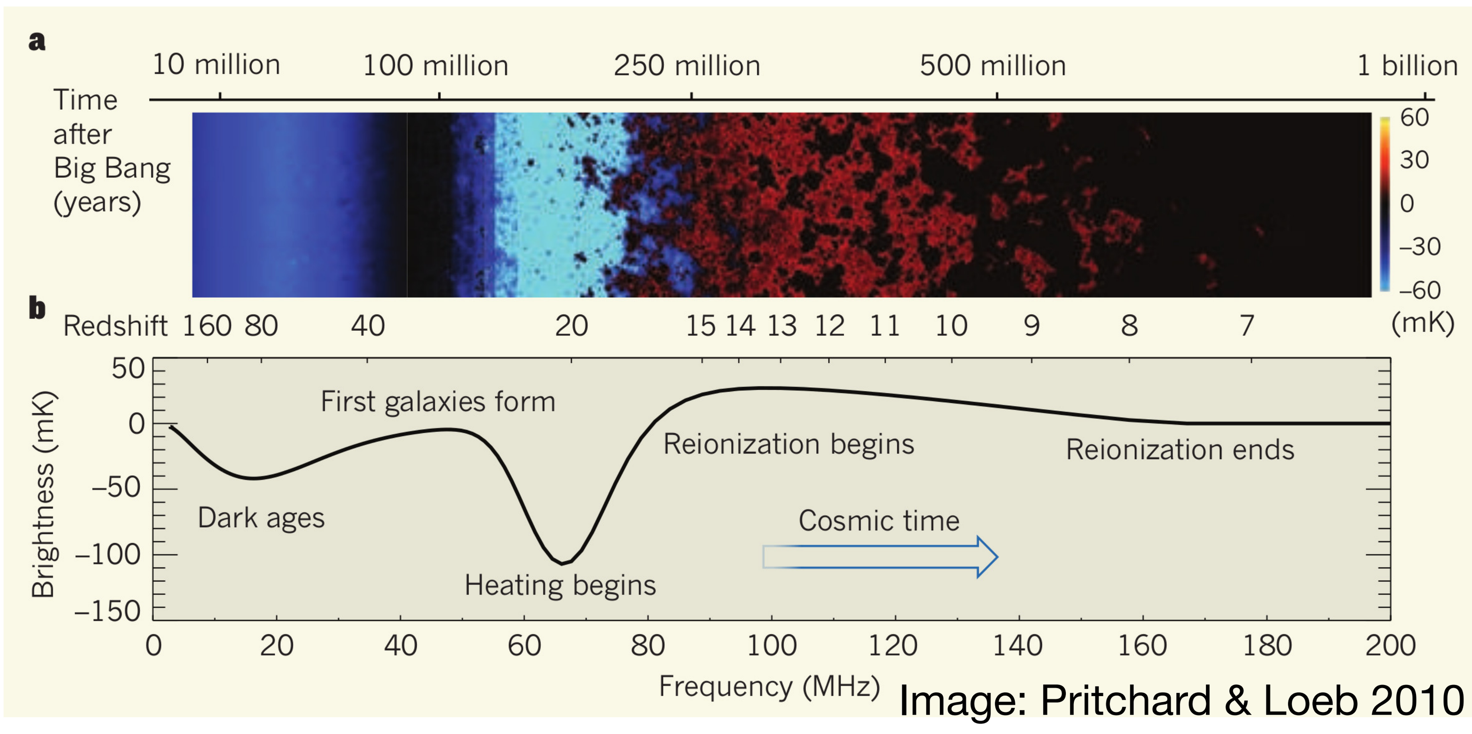
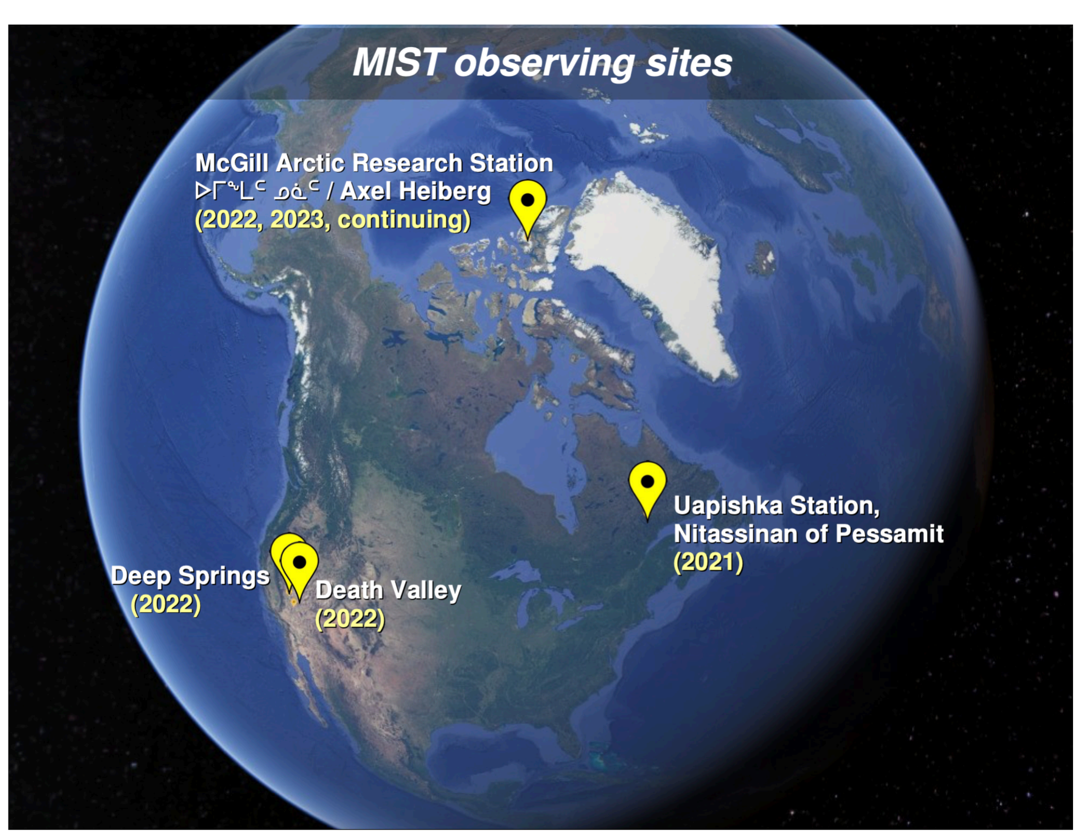


Image: Pritchard & Loeb 2010

When the first stars in the universe turn on at z~15-20 (we think), the initial effect is to decrease the average brightness of the sky. This happens because adiabatic expansion cools gas faster than radiation, and the first Lyman-α photons couple the hydrogen spin temperature to the gas kinetic temperature via the Wouthuysen-Field effect. The frequency of the dip tells us when the first luminous objects turned on, and its depth/shape tells us about the nature of the first luminous objects (in particular, X-ray vs. Lyman-α fluxes)



MIST is designed to be lightweight and portable. RFI is a major challenge for global-signal experiments because constant RFI is indistinguishable from our signal. To avoid RFI, we have deployed MIST to multiple sites in the US and Canada. Our main science site, with the lowest interference, is at the McGill Arctic Research Station (MARS), high in the Canadian Arctic.

Berkeley UCSC McGill CSIRO ECCI Universidad de Chile

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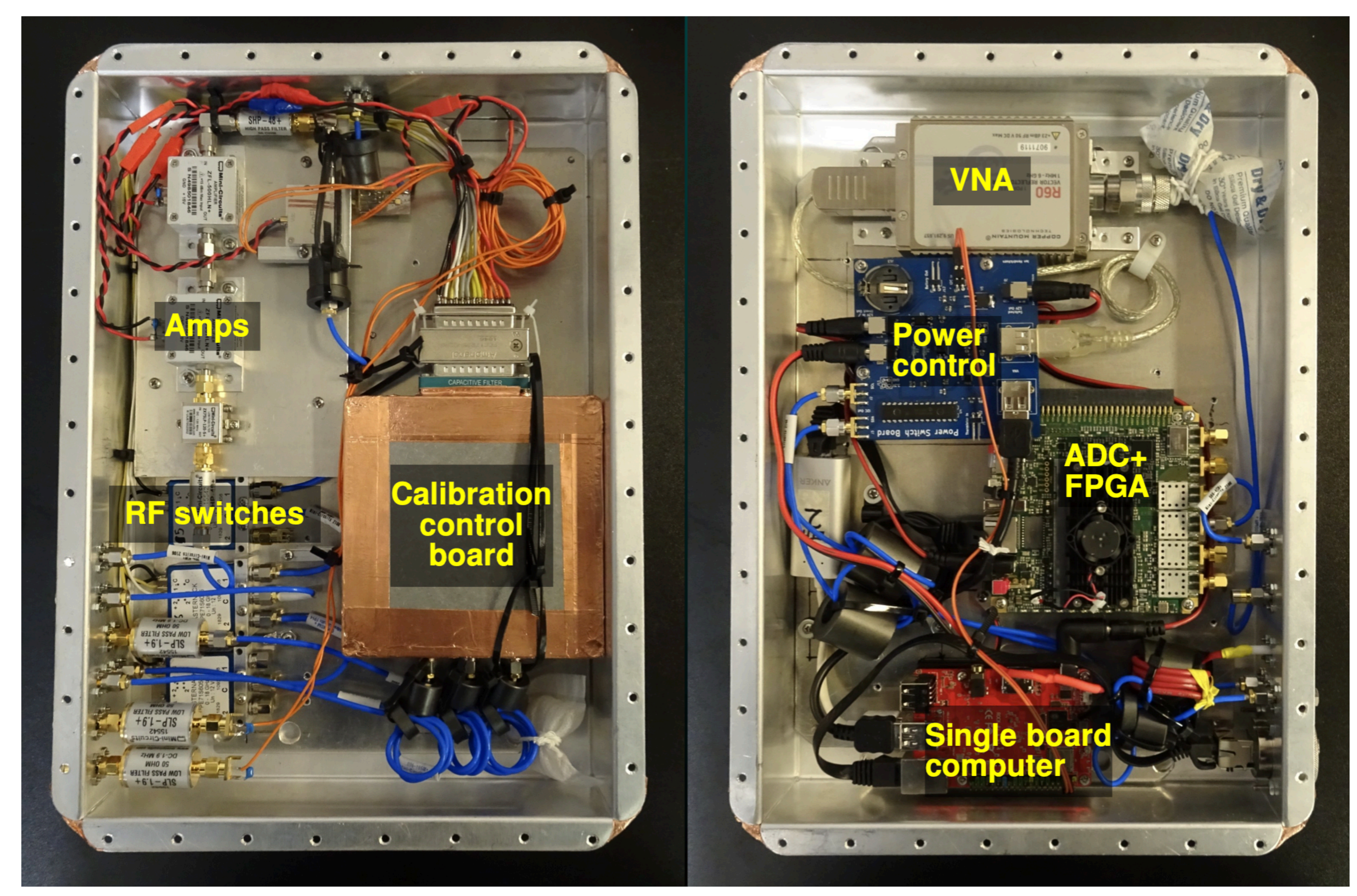
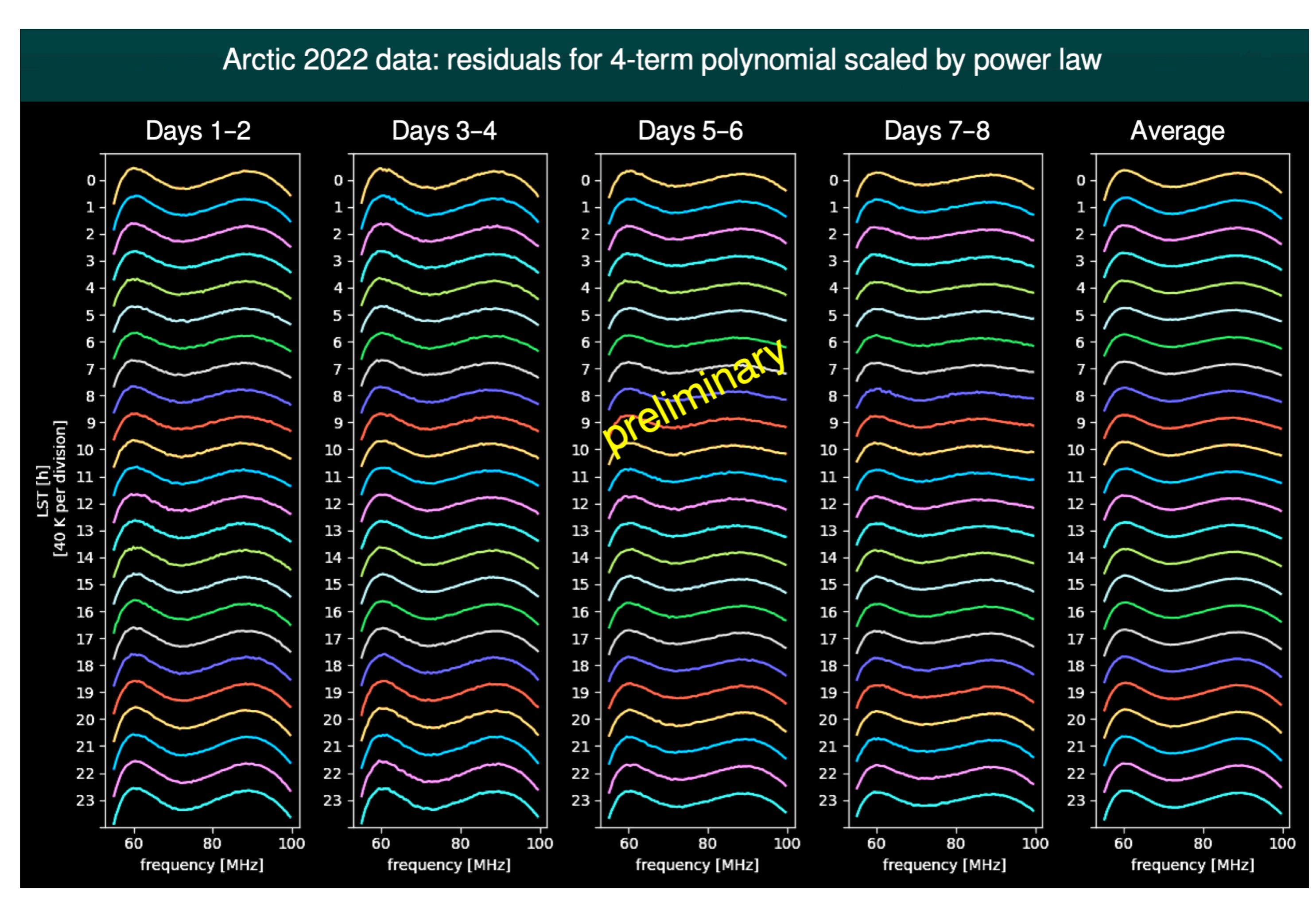
MIST is a portable blade dipole experiment to measure the global signal from cosmic dawn. It does not use a ground plane, which avoids spectral structure induced by reflections from the edge of the ground plane. The tradeoff is the ground underneath the antenna becomes part of the system, and needs to be modelled.



MIST electronics. The system has been designed to be self contained, to need very little power, and to have many internal calibration sources.



MIST data from the 2022 deployment. An (overly) simple 4-term foreground model has been subtracted from hourly spectra. The data repeatability is extremely high, with no interference apparent in the FM band. Full analysis, with a complete foreground model is underway. Stay tuned for MIST results!