

# The ALBATROS Project

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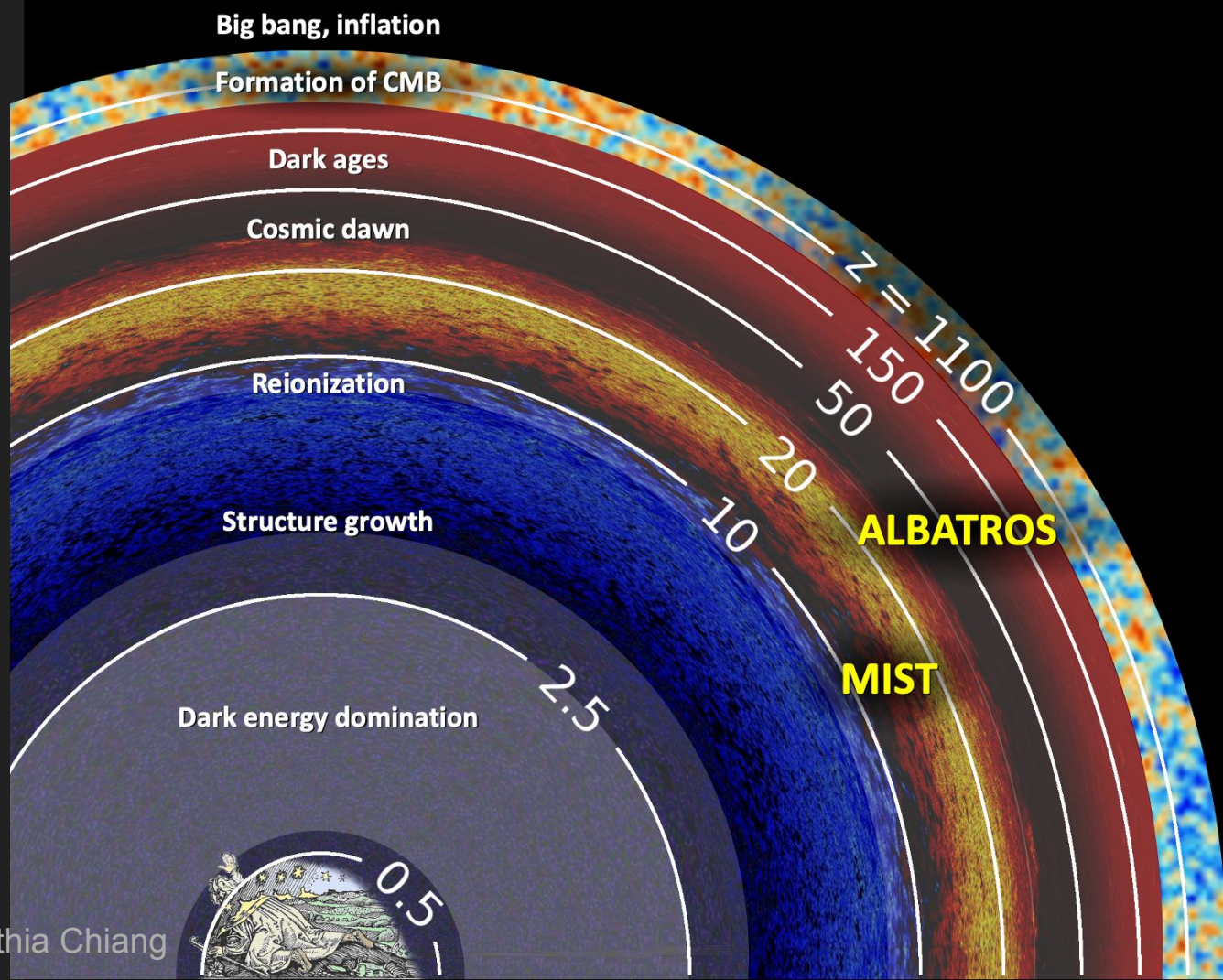


McGill



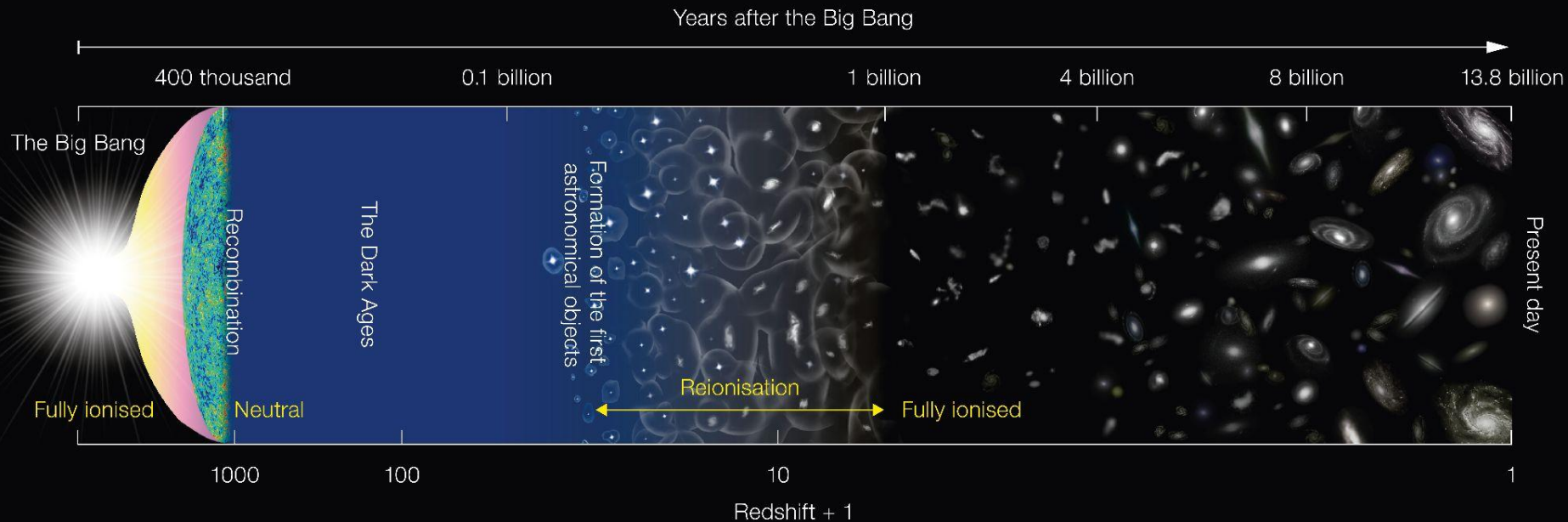
Trotter  
Space Institute  
at McGill

Institut spatial  
Trotter  
de McGill



Credit: Cynthia Chiang

# The Very Early Universe

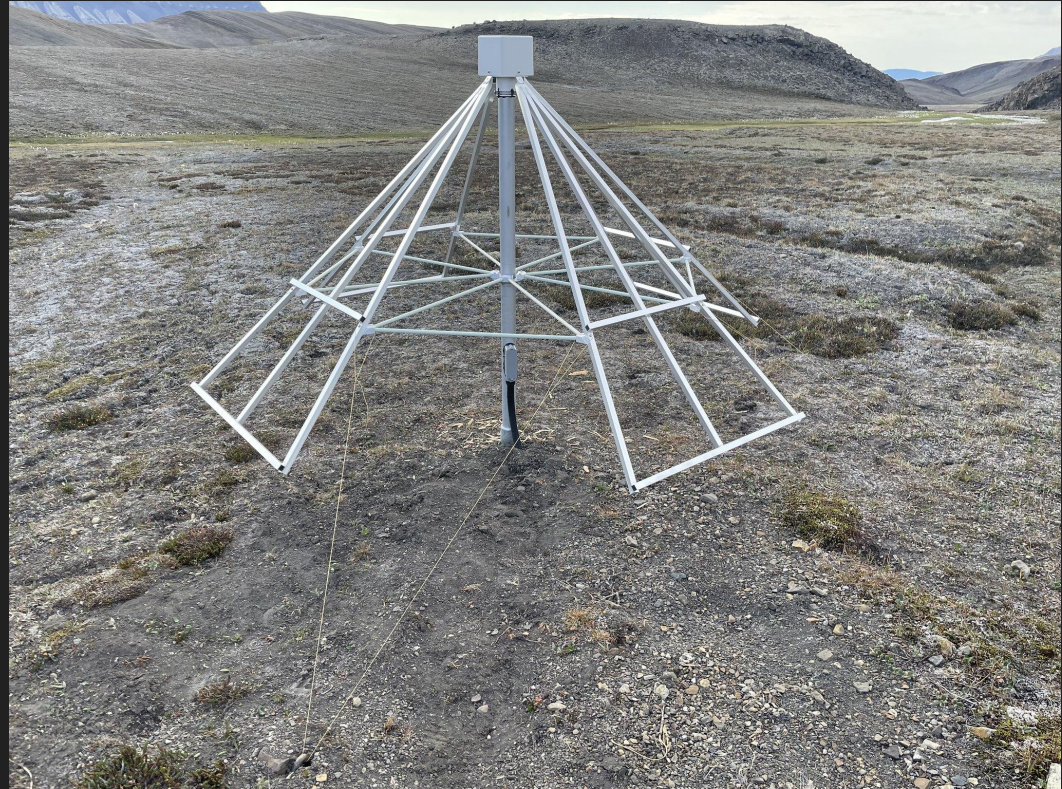


Credit: ESO

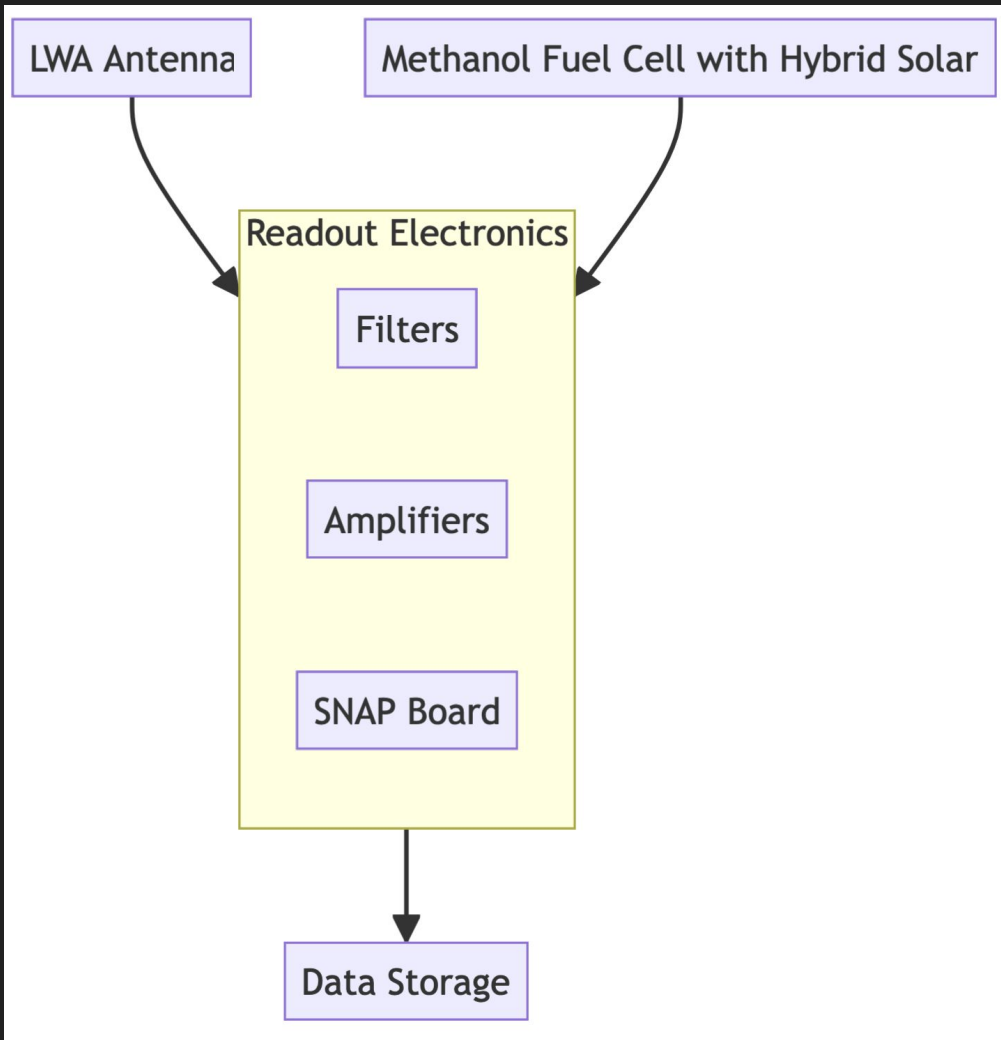


# The ALBATROS Project

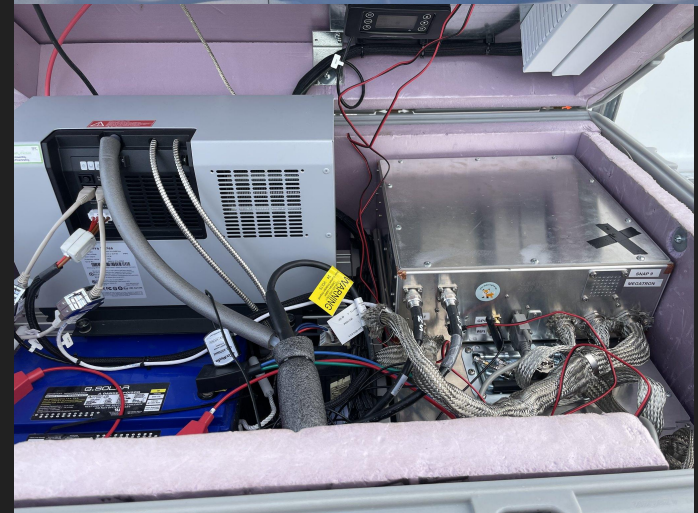
- The Array of Long Baseline Antennas for Taking Radio Observations from the Seventy-ninth parallel
- Probes the cosmic dark ages
- Designed with as many low cost off the shelf parts as possible



Credit: Ian + MIST Team



Credit: Ian Hendricksen + Albatros Team







Credit: Cynthia Chiang

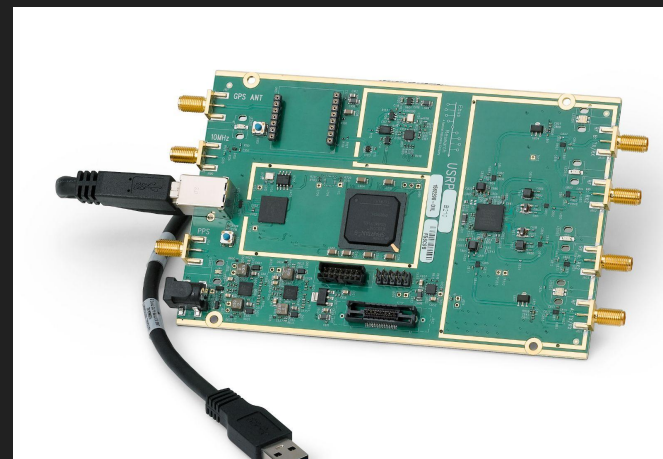
# Mapper of the IGM Spin Temperature (MIST)

- Probes the Cosmic Dark Ages, Cosmic Dawn, and Epoch of Reionization
- No antenna backplane
- Soil parameters very important!



# Constraints

- Minimum resolution =  $c/(2 \cdot \text{Bandwidth})$
- Need bandwidth as high as possible
- Rough arctic terrain
- As open source as possible
- Multiple sites, multiple deployments



Ettus B210 SDR



# Commercial Ground Penetrating Radar



- Bulky
- Fixed frequency
- Proprietary software
- Not great in rough terrain

Credit: MALA GPR

# Our Drones



Credit: Larry Herman + Cynthia Chiang

# GNURadio Testing

## Chirp Creation

**Signal Source**  
Sample Rate: 8M  
Waveform: Saw Tooth  
Frequency: 1  
Amplitude: 1  
Offset: 0  
Initial Phase (Radians): 0

Note  
Note:

**VCO**  
Sample Rate: 8M  
Sensitivity: 6.28M  
Amplitude: 1

**Float To Complex**

## Transmit

**File Sink**  
File: ...pr/gnu\_log/chirp\_log  
Unbuffered: Off  
Append file: Overwrite

**UHD: USRP Sink**  
Stream args: num s...s = 1024  
Stream channels: 0, 1  
Device Address: ser...326F639  
Sync: Unknown PPS  
Samp rate (Sps): 8M  
Ch0: Center Freq (Hz): 100M  
Ch0: Gain Value: 500m  
Ch0: Antenna: TX/RX  
Ch0: Bandwidth (Hz): 4M  
Ch0: LO Source: internal  
Ch0: LO Export: False  
Ch1: Center Freq (Hz): 100M  
Ch1: Gain Value: 0  
Ch1: Antenna: TX/RX  
Ch1: Bandwidth (Hz): 4M  
Ch1: LO Source: internal  
Ch1: LO Export: False

## Receive

**UHD: USRP Source**  
Stream args: num s...s = 1024  
Stream channels: 0, 1  
Device Address: ser...326F639  
Sync: No Sync  
Samp rate (Sps): 8M  
Ch0: Center Freq (Hz): 100M  
Ch0: AGC: Disabled  
Ch0: Gain Value: 500m  
Ch0: Antenna: RX2  
Ch0: Bandwidth (Hz): 4M  
Ch0: LO Source: internal  
Ch0: LO Export: False  
Ch1: Center Freq (Hz): 100M  
Ch1: AGC: Disabled  
Ch1: Gain Value: 500m  
Ch1: Antenna: RX2  
Ch1: Bandwidth (Hz): 4M  
Ch1: LO Source: internal  
Ch1: LO Export: False

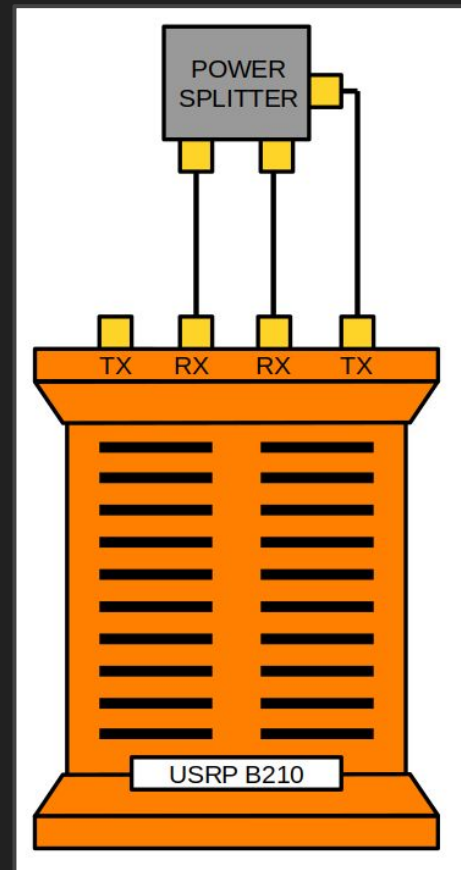
## File Storage

**File Sink**  
File: ...gnu\_log/out0dump\_log  
Unbuffered: Off  
Append file: Overwrite

**File Sink**  
File: ...gnu\_log/out1dump\_log  
Unbuffered: Off  
Append file: Overwrite



# Test Setup

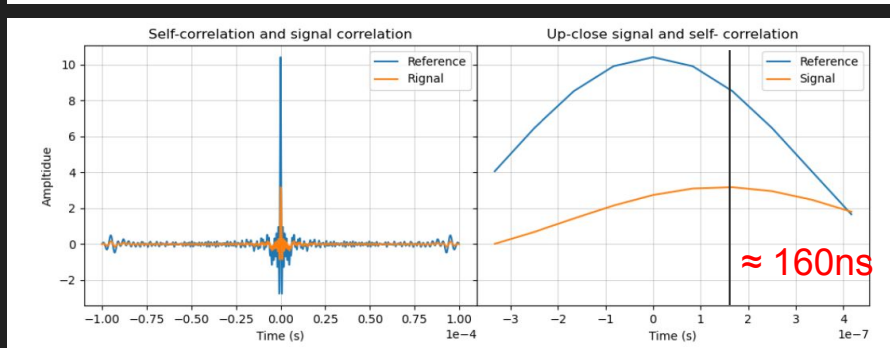
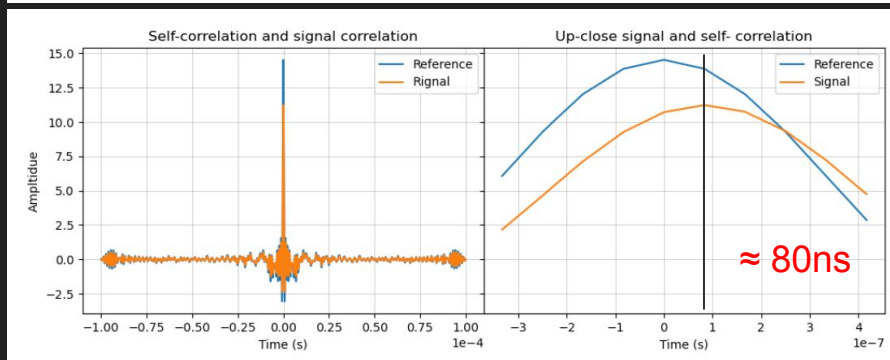
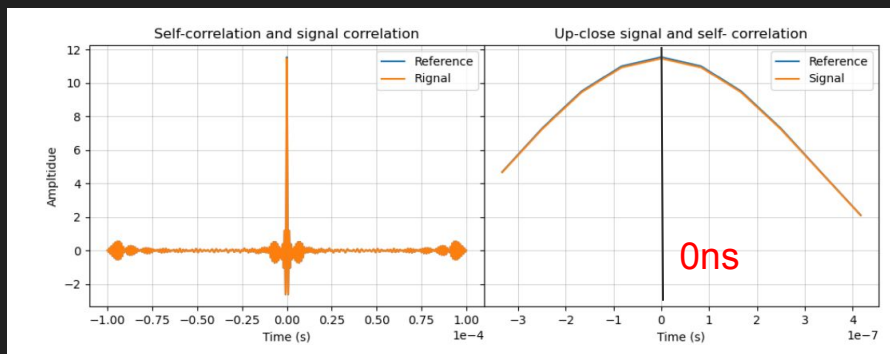


Loopback Test Setup

Credit: Michael Hetu

# First Results

- Loopback tests match with expectations
- Limited speed of computer severely limits bandwidth
- Fundamentals are sound, but a lot of work to be done



# Thank You!

Francis McGee

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## Next Steps

- Permittivity and conductivity extraction
- Miniaturization of the system on to a drone
- Implementation of more sophisticated algorithms (SFCW)
- Field testing