

# SMART Ground Based Magnetometer Array -- an Initial Look

The poster is titled "SMART Ground Based Magnetometer Array - an Initial Look" by Dr. Noel Petit and Dr. Peter Chi from Augsburg University, UCLA. It is divided into four panels:

- What is SMART?**: Describes the SMART network as a collection of 24 UCLA ground magnetometer systems across the US, with the main objective to investigate outstanding questions in both travel-time and normal-mode magnetotelluric tomographies. It also mentions broader impacts like training students in magnetic field measurements and geospace sciences, providing outreach activities to schools hosting SMART systems, and providing SMART magnetometer data collected in the contiguous US to the public.
- SMART Magnetometer System 3.02!**: A block diagram showing the system architecture. It includes an "SMART Ground Based Fluxgate Magnetometer" (with GFI receiver, RAM, and Micro SD), a "local Smart Linux Router" (with WiFi, Ethernet, and Power over Ethernet), a "Raspberry Pi Microcomputer" (with WiFi, Ethernet, and Power over Ethernet), and a "Programmable WiFi Router" (with WiFi, Ethernet, and Power over Ethernet). Data flows from the magnetometer to the local router, which then connects to the Raspberry Pi and the programmable WiFi router.
- Ground Based Magnetometers**: A map of the Northern Hemisphere showing the locations of SMART and SMART.2 magnetometer stations. The map spans from 45°N to 72°N latitude and 0° to 180° longitude. Stations are represented by various symbols (circles, triangles, squares) in different colors (blue, green, red).
- What do the data look like?**: Displays two plots. The top plot shows "Sample 24hr Day Magnetometer Z (vertical) Field measurements" with a graph of Magnetic Field (nT) over time. The bottom plot shows "24hr Z Frequency Power" with a graph of Magnetic Field (nT) over time.

At the bottom of the poster are buttons for "LIVE SESSION", "NARRATION", "AUTHOR INFORMATION", "ABSTRACT", "CONTACT AUTHOR", "PRINT", and "GET POSTER".

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PRESENTED AT:



## WHAT IS SMART?

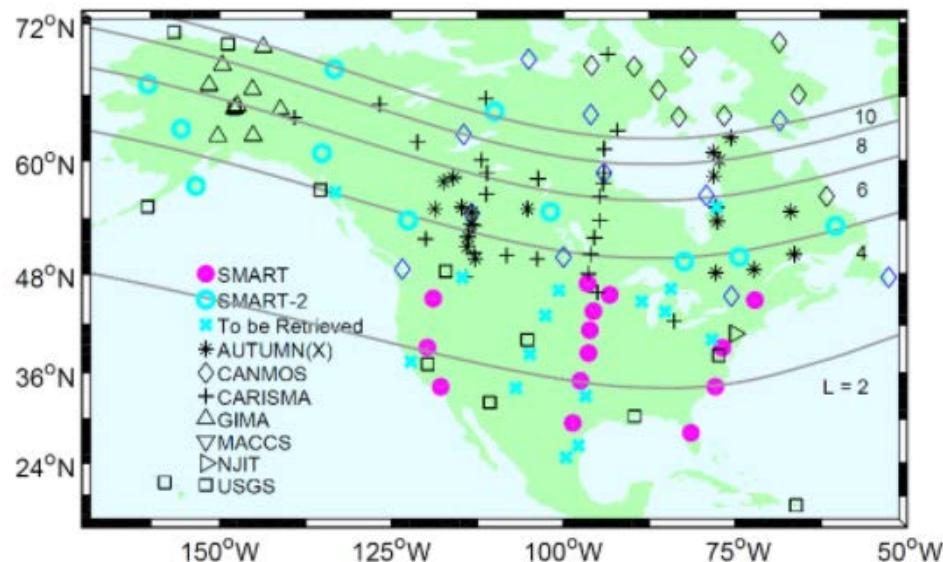
The SMART (Surface Magnetic Assessment in Real Time) Network: a collection of 14 UCLA ground magnetometer systems across the US. Our main objective is to investigate outstanding questions in both travel-time and normal-mode magnetoseismologies.

Broader impacts include training students in magnetic field measurements and geospace science, providing outreach activities to schools hosting SMART systems, and providing SMART magnetometer data collected in the contiguous US to the public.

### Scientific Goals of SMART:

1. How does the annual variation of equatorial plasma mass density depend on the L-value? How does the result compare with the annual variation in the ionosphere?
2. Does the plasmaspheric density truly have a clear local time dependence over a short time scale? If so, is it controlled by the ionospheric density?
3. What is the profile of SI arrival time across the two-dimensional magnetometer array based on event statistics? Is this arrival time profile consistent with the predictions by the Tamao travel time in the 3D magnetosphere?
4. What is the statistical profile of nightside transient arrival time on the ground? How does this profile vary with the solar wind input or geomagnetic activity?

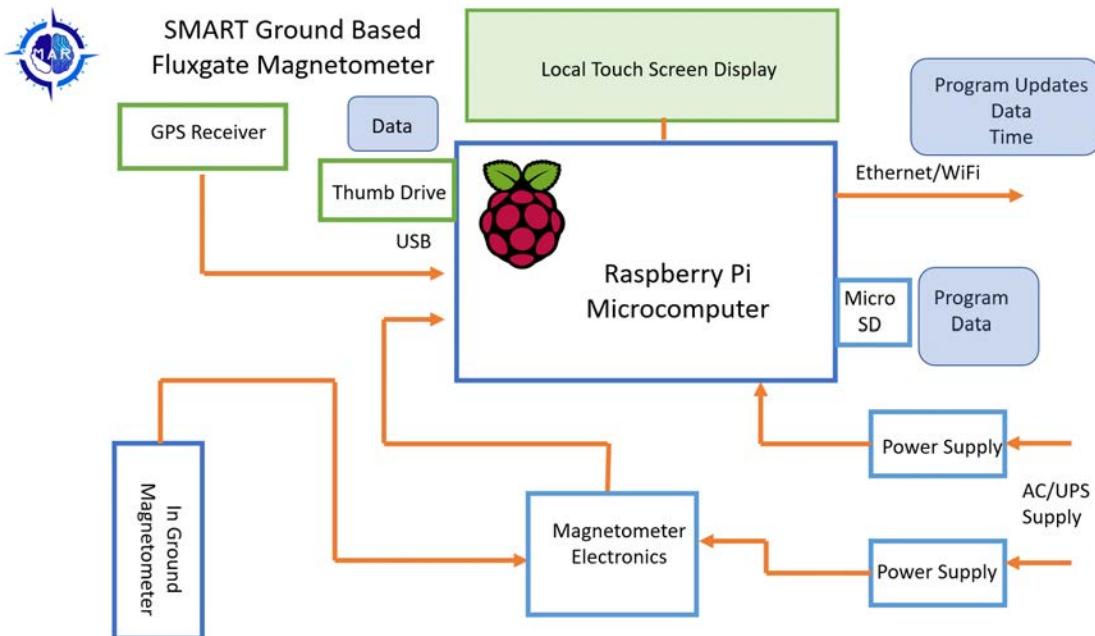
## GROUND BASED MAGNETOMETERS



Some of the ground based magnetometers in the North American Continent. Purple dots make up the initial SMART array. Other magnetometers perform similar functions with different instruments:

- 1) Search Coils -- coils of wire around a magnetic core to measure the change in mangetneic field
- 2) Magnetoresistive Circuits -- measure the change in resistance as the magnetic field changes
- 3) Flux Gates -- offset the earth's magnetic field with magnetic coils to null the field through material
- 4) Micro Coils -- measure the change in inductance through sub millimeter coils and convert the inductance into field strength
- 5) Hall Effect -- directly measure the change in resistance of a semiconductor as the field changes

# SMART MAGNETOMETER SYSTEM 2021



Blue boxes are mandatory

Green boxes are optional

Some source of time must be used (either GPS or Internet NTP)

## WHAT DO THE DATA LOOK LIKE?



Sample Quite Day  
Magnetometer Z (vertical)  
field measurements  
Time – Local CST  
Magnetic Field -- nanoTesla

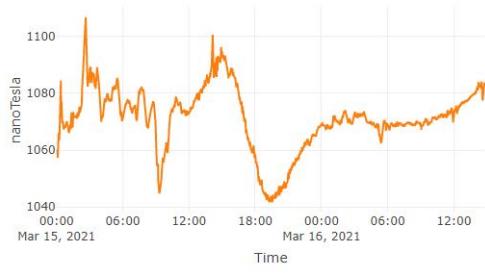


This displays the limits of the solid state LSM303 (micro coil detector) and LIS3MDL (magnetoresistive) detectors.

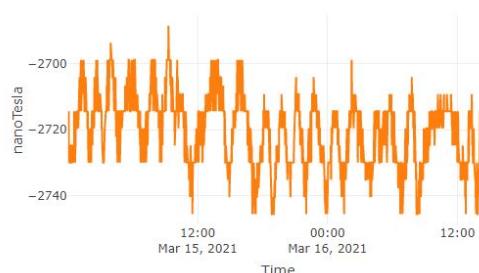
The Falcon Magnetometer clearly shows changes in the range of +/- 30 nanoTesla.

The noise on the LSM303 and LIS3MDL is on the range of +/- 50 nanoTesla and changes observed on this quiet day are not visible in the lower plots. Most of the change in the lower two graphs is the change in temperature as the day warms and cools.

Plots of Moderate activity (K-5 peak)

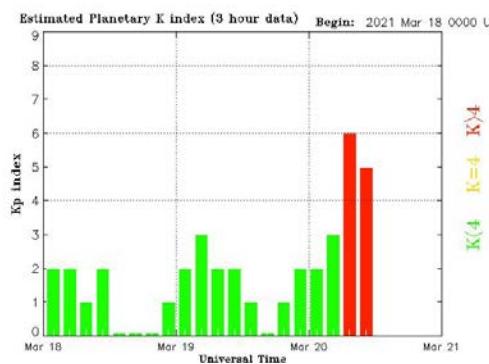
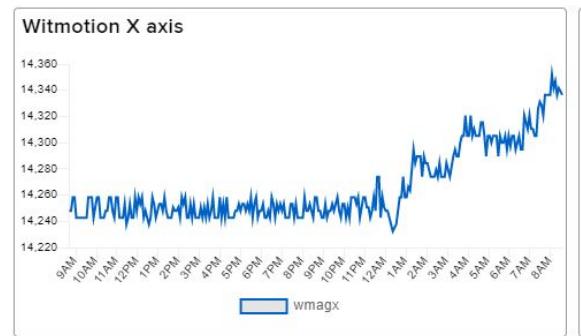
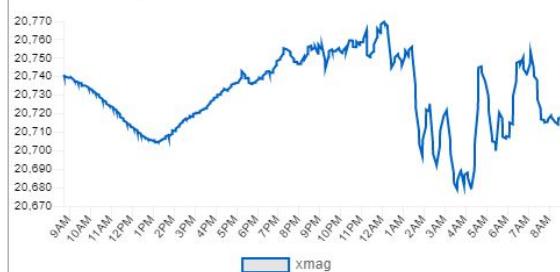


Falcon Fluxgate



RM9100 Witmotion

20 March 2021 (Today) is active\

**Falcon X Magnetic Field****Live Data on Adafruit.com Cloud Server**

(https://io.adafruit.com/petitnoel/dashboards)

**More Information at****<http://smartmagnet.org>** (<http://smartmagnet.org>)

## AUTHOR INFORMATION

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## ABSTRACT

SMART is the renewal of an existing ground based magnetometer array. This array stretches from Hudson Bay to the Gulf of Mexico. The sites will all be upgraded with new computing and data storage. Additionally data will be available locally for students to monitor the magnetic environment and use the data for studies.