

Auger@TA: An Auger-like surface detector micro-array embedded within the Telescope Array Project

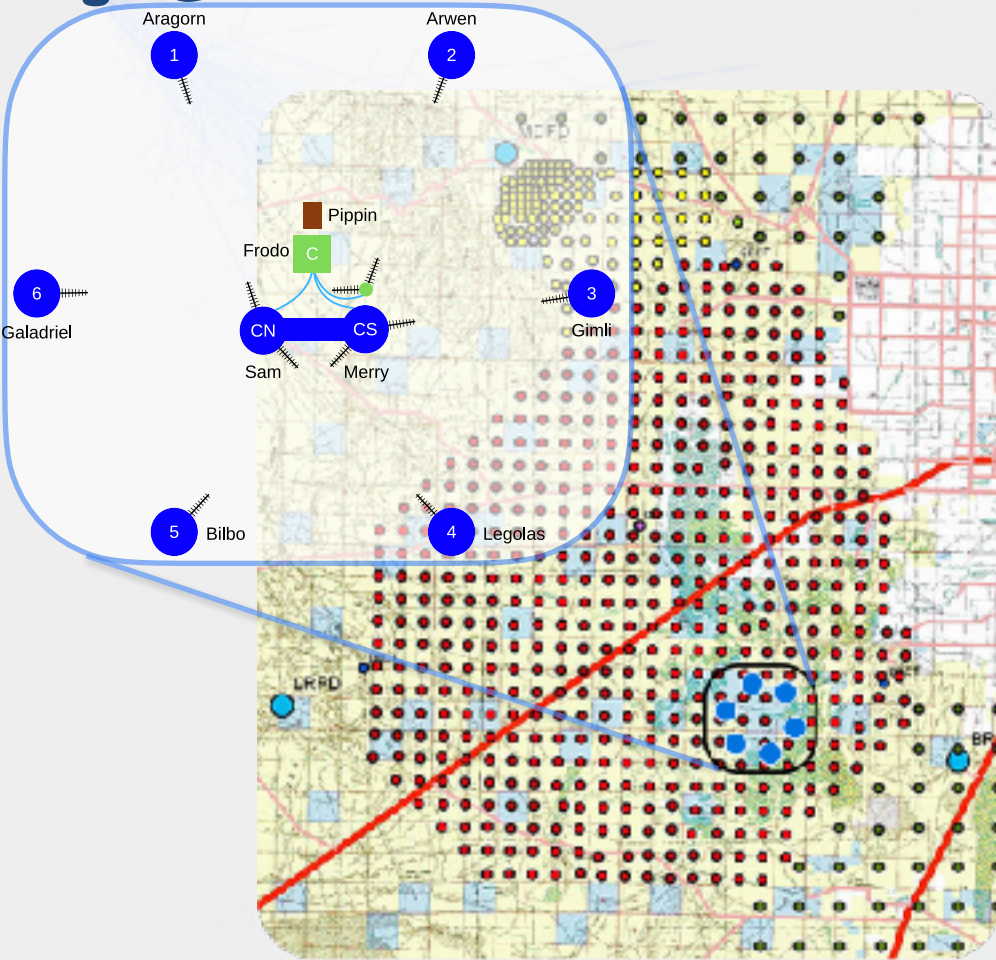
2nd PEPS Workshop

Friday, May 29th 2026

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for the Auger@TA working group
smayotte@mines.edu



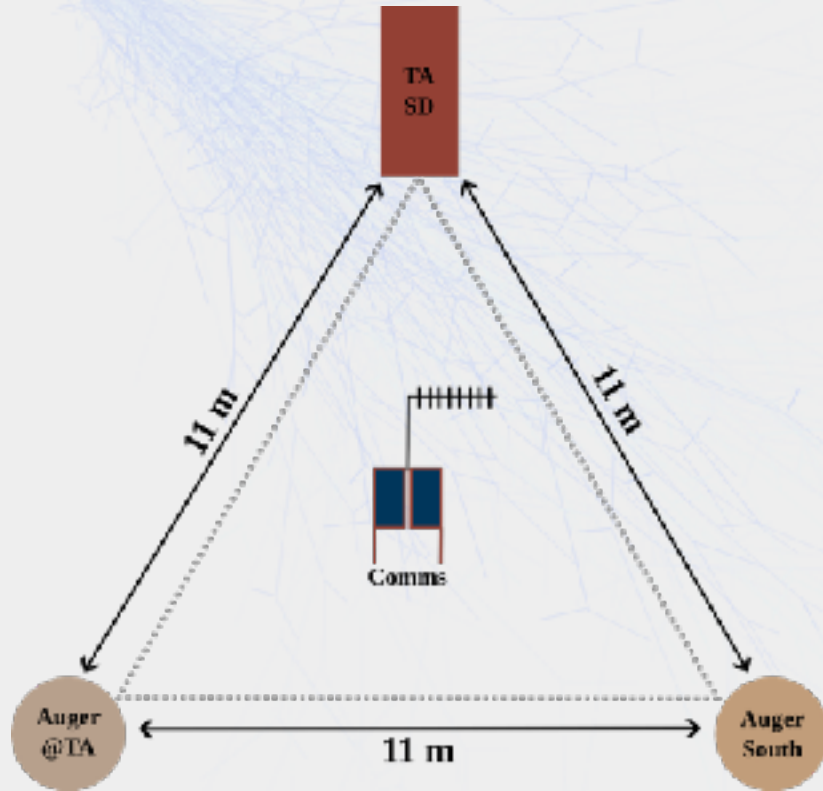
Auger@TA Overview



Cross-calibration of Auger and TA with an Auger-like SD Array consisting of 8 stations:

- Deployment in south-east corner of TA array
 - 7 Auger@TA (1 PMT) stations (full hexagon)
 - 1 AugerSouth (3 PMT) station (in center)
- Fully independent trigger and measurements
 - Feature: Auger@TA / Auger South / TA triplet
 - Comms station housing all equipment to talk to outer hexagon + local CDAS computer etc.

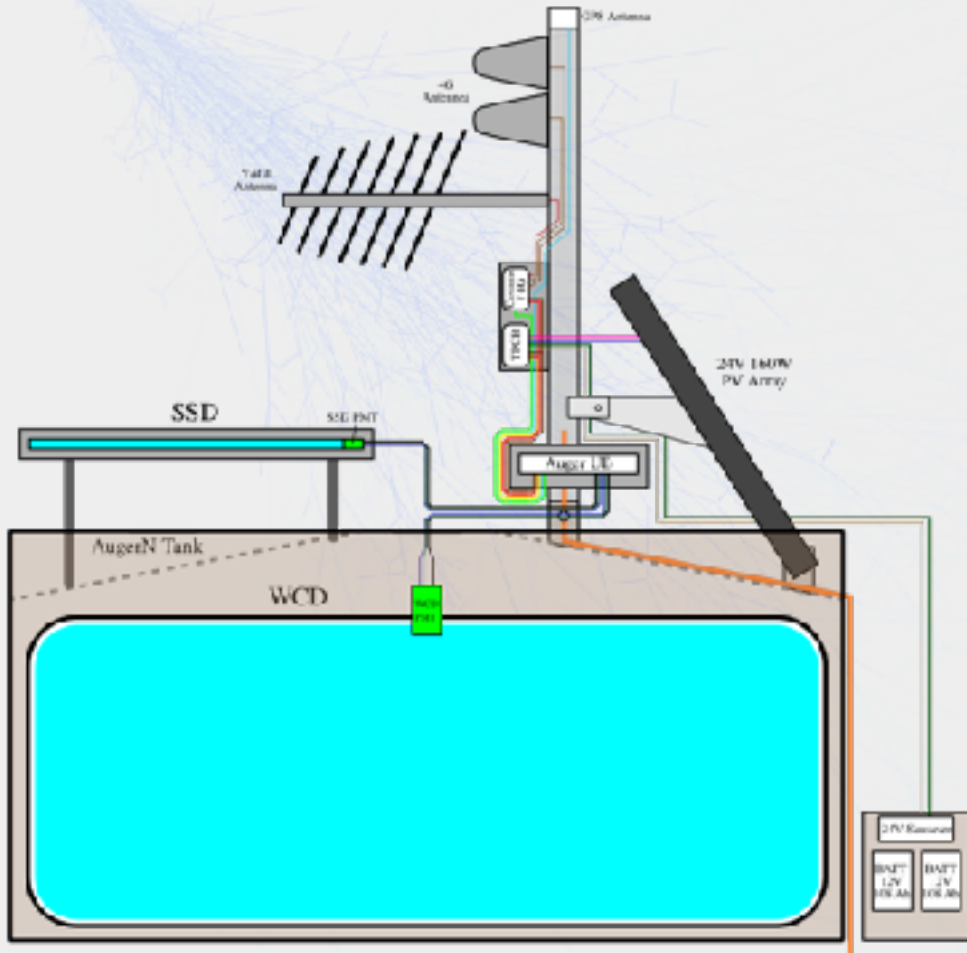
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The Auger@TA Station



Design and implementation

- Retrofit of AugerNorth hardware with standard Auger components
 - Prototype AugerN tank shell
 - Single central WCD PMT with Auger base
 - Auger UB and TPCB
- Thanks to efforts of KIT/BUW an SSD being mounted on every station
- Custom comms system
- Upgraded solar power system 24V/160W/216Ah



Real-life Deployment

September 2022 - Now

An Auger@TA Station Deployed



Solar and Battery Setup

- Two 80W solar panels wired in series → 160W
- Grounding rod
- Two 12V batteries wired in series → 24V
- Sun saver charge controller connected to
 - Tank Power Control Board (TPCB)
 - Batteries



NEMA Box - Power Distribution and Comms



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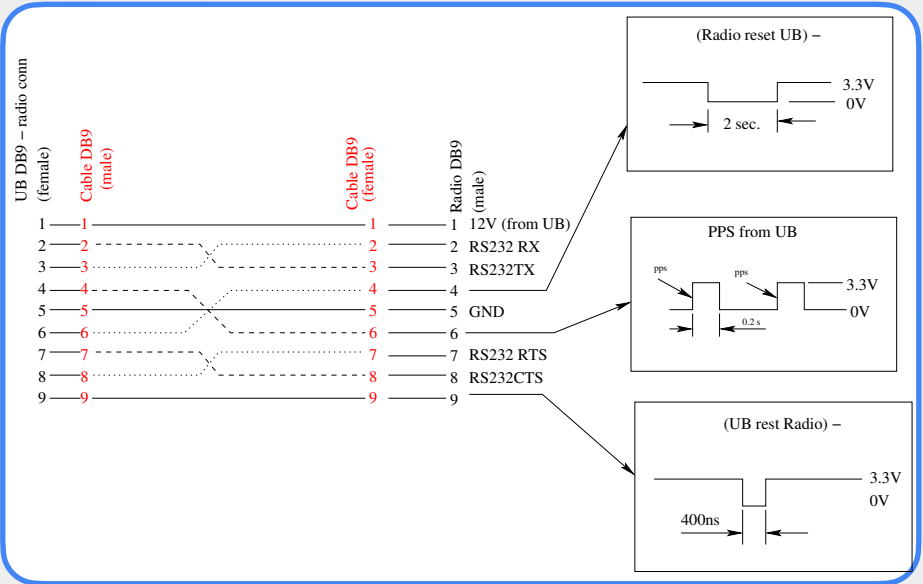
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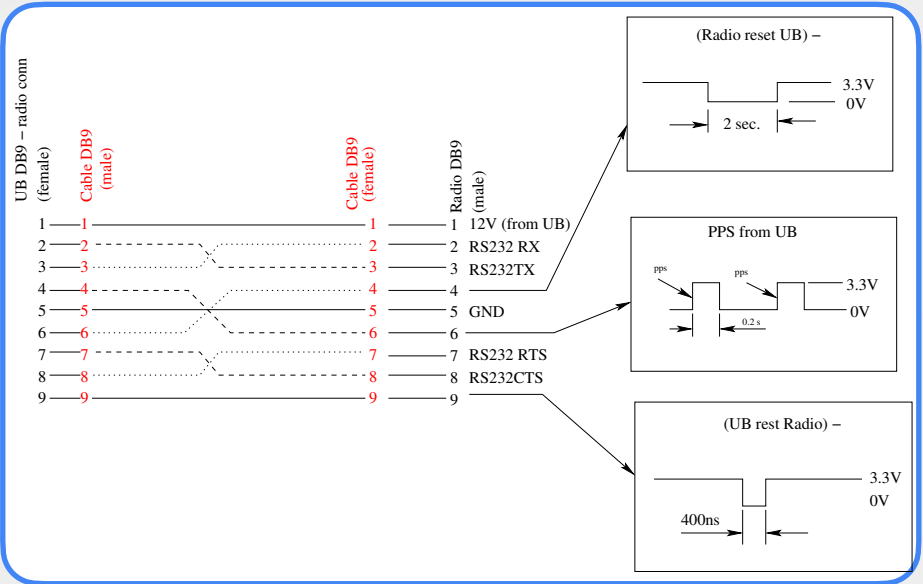
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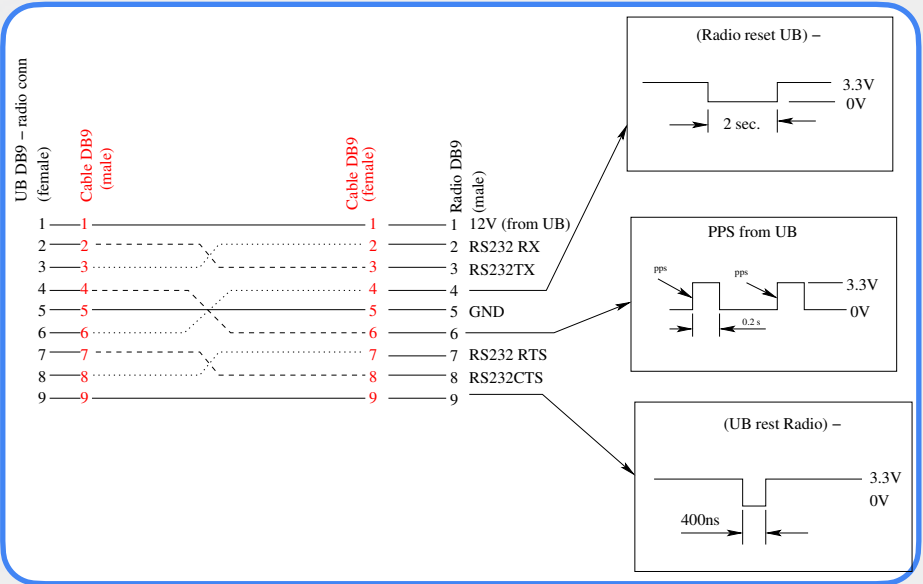
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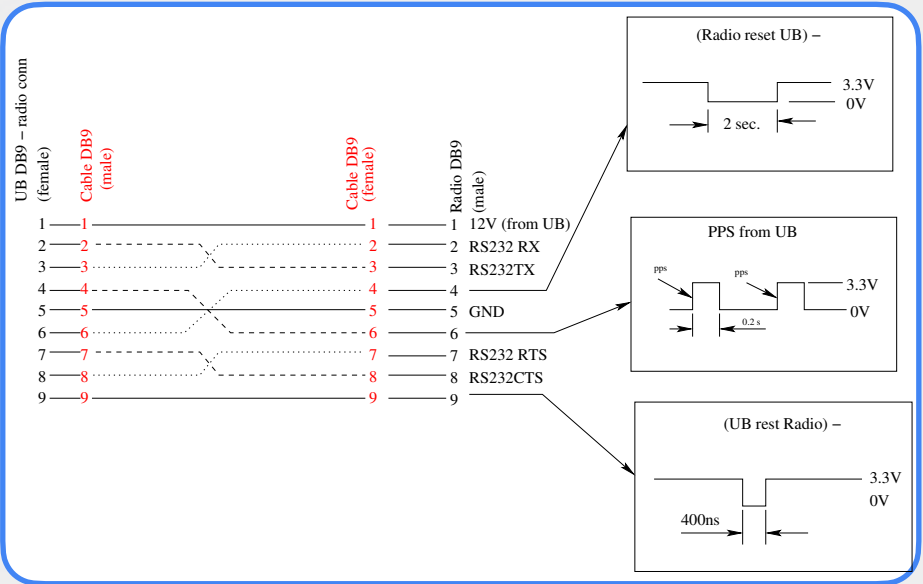
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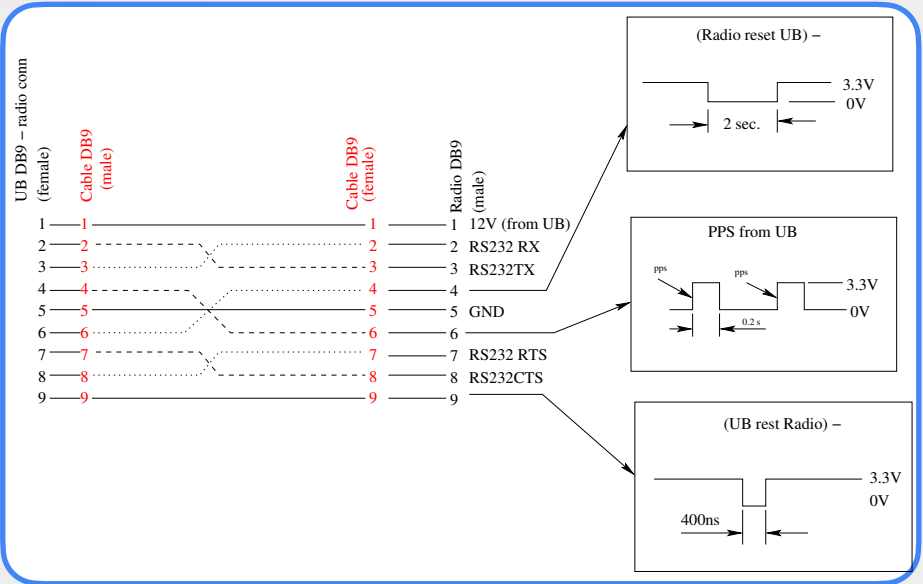
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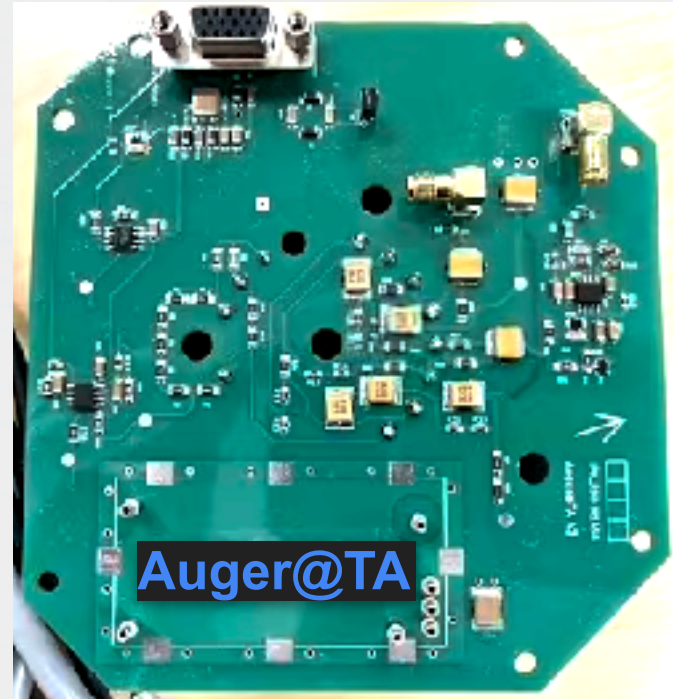
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 - In our experience really only 2↔3 pin switch is needed



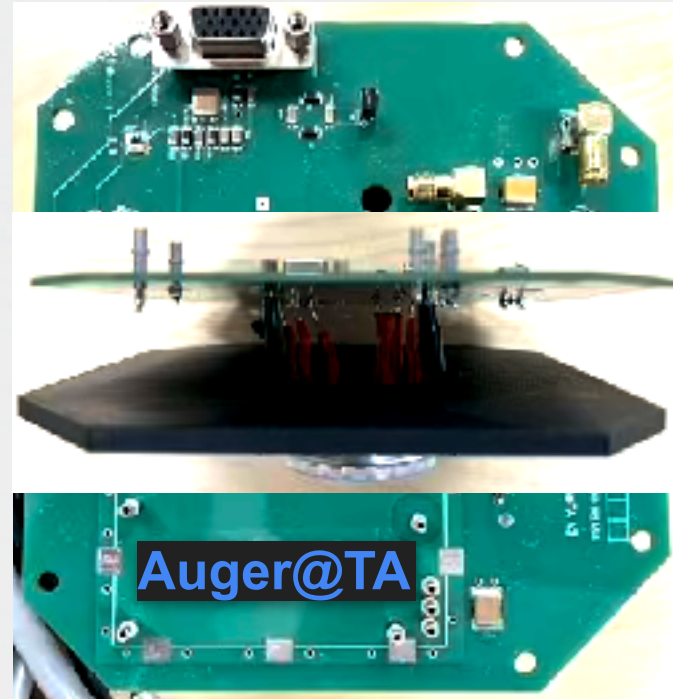
The PMT Base - Design and Comparison to Auger South

- Tried to keep design as close as possible to Auger South
- Main changes:
 - Directly soldered cables replaced by 15-pin and SMA connectors, cables now disconnect from base
 - Some components not buyable anymore, replaced by most similar component in specs and form factor



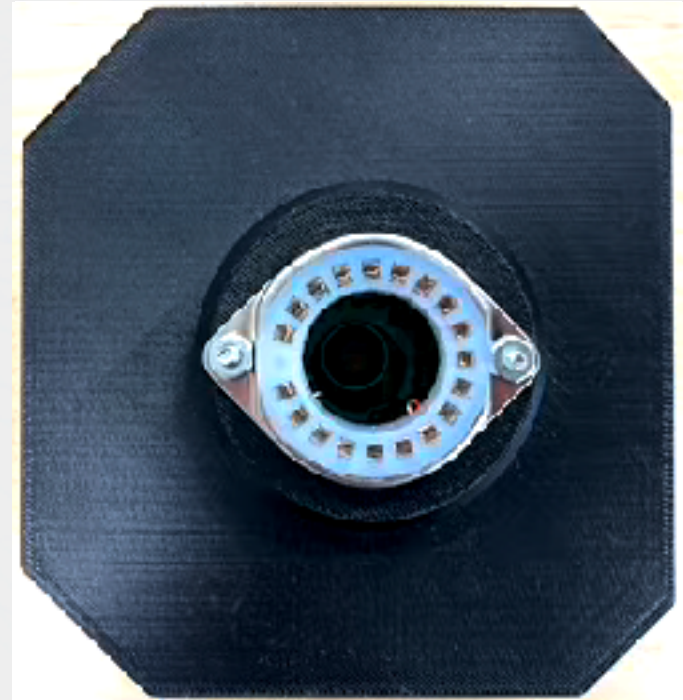
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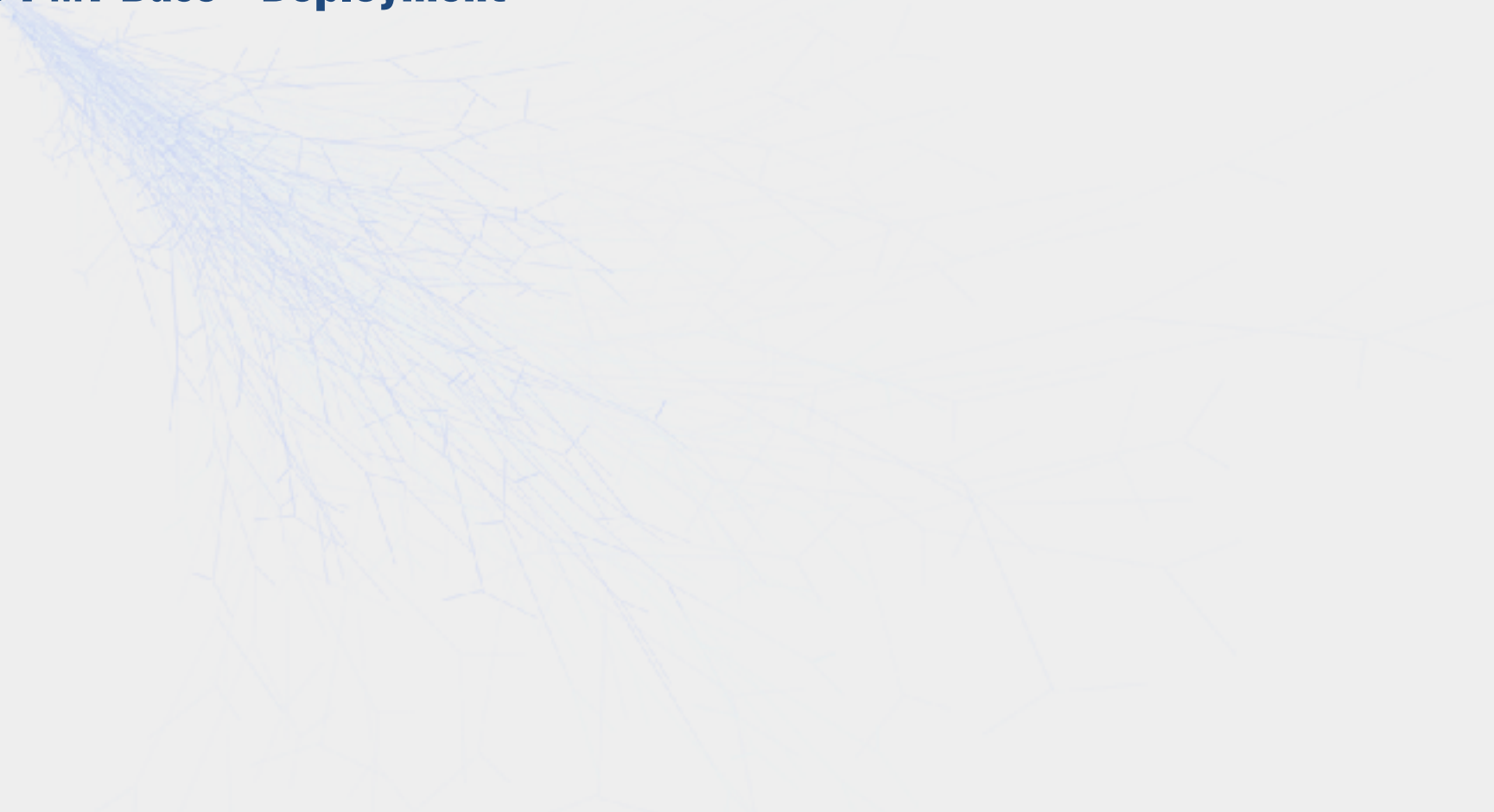


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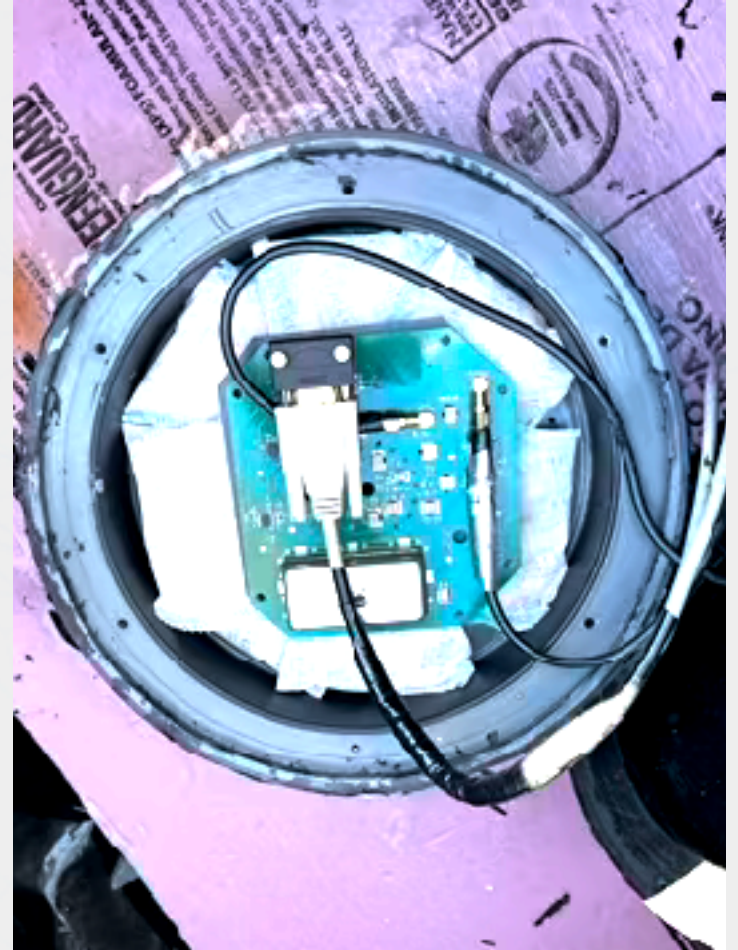
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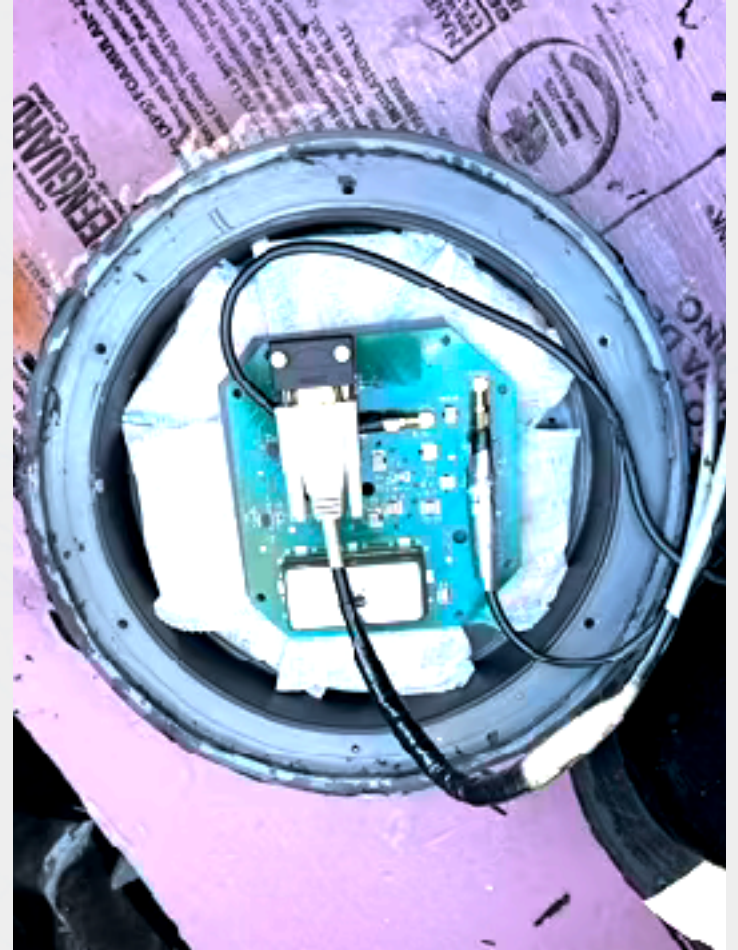
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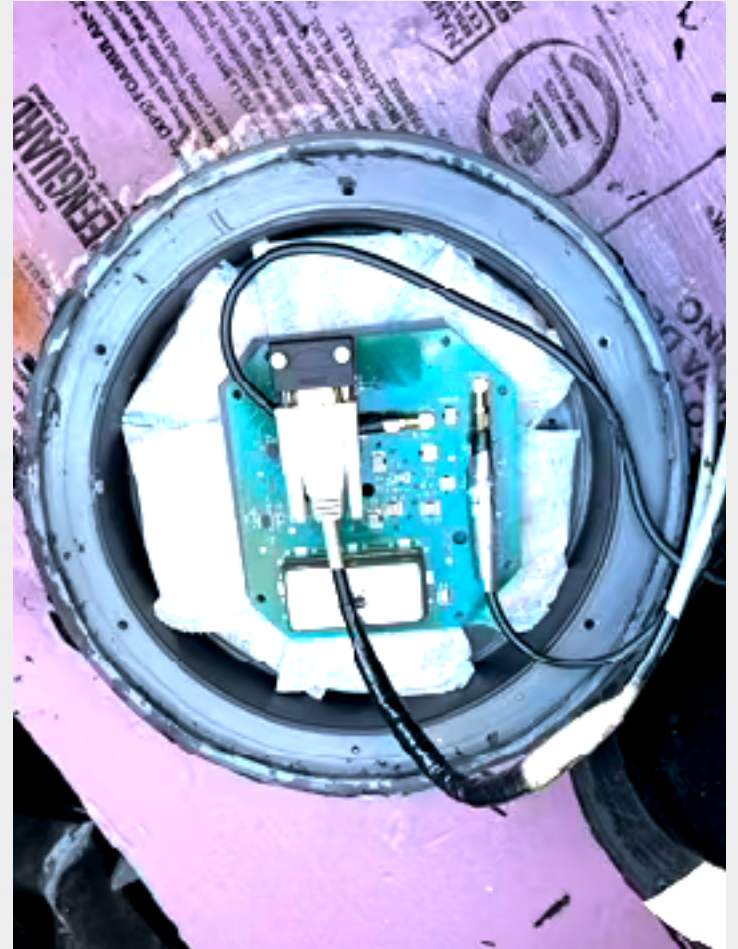
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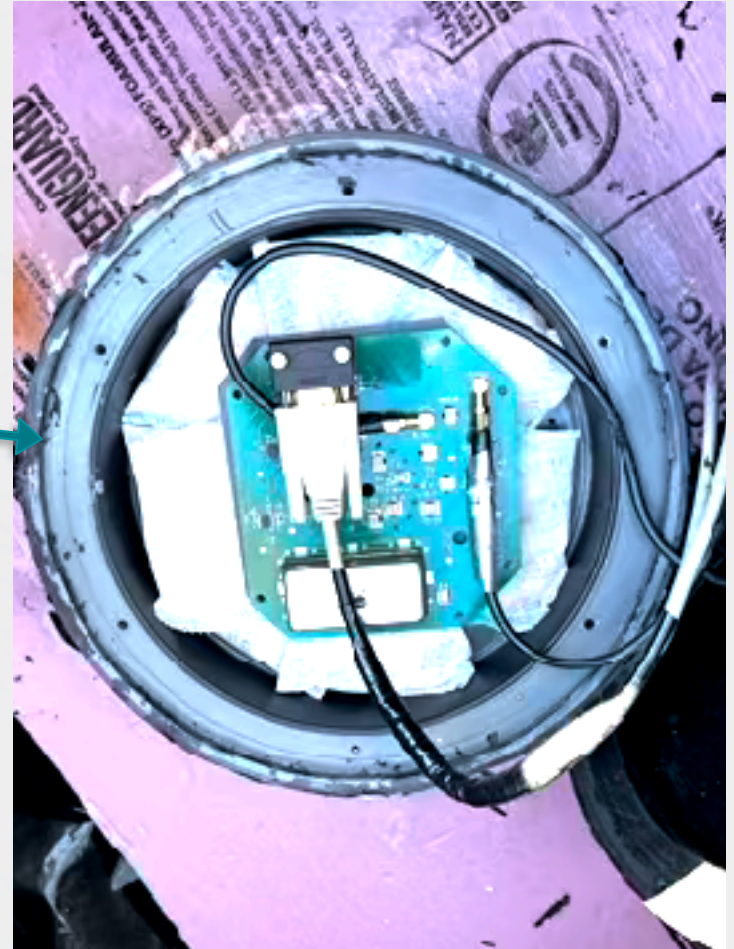
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- RTV everywhere!



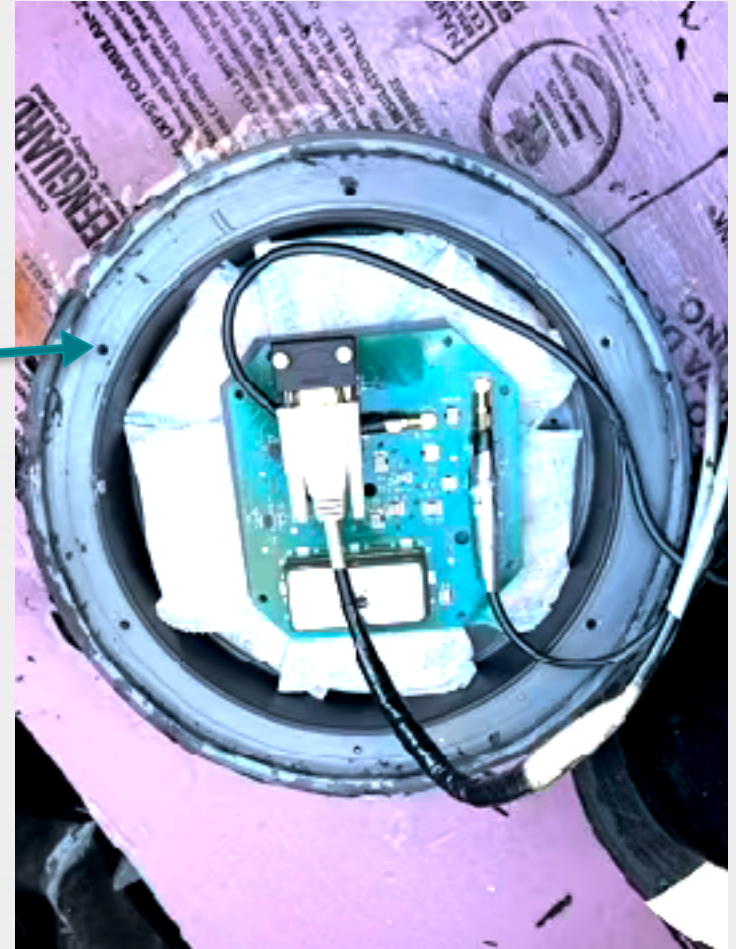
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The Central Comms Station - Version 3



The Comms Station - Solar and Battery



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- Very similar to station power system but 3 of everything



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- 3 pairs of solar panels



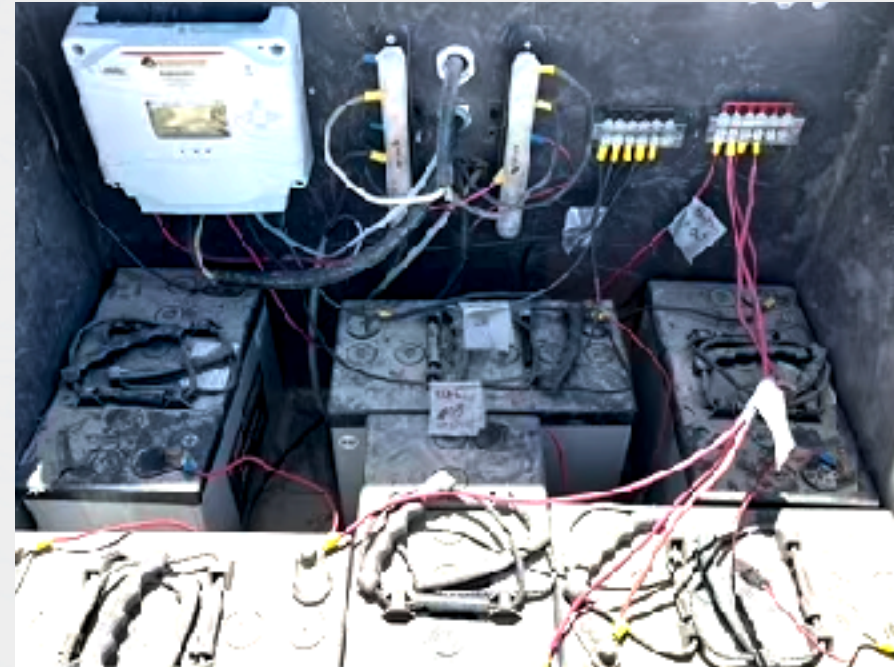
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 - Read out by CDAS PC



The Comms Station - Masts



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- Main Mast:



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- Last two YAGIs on Sam's mast (and controlled there)

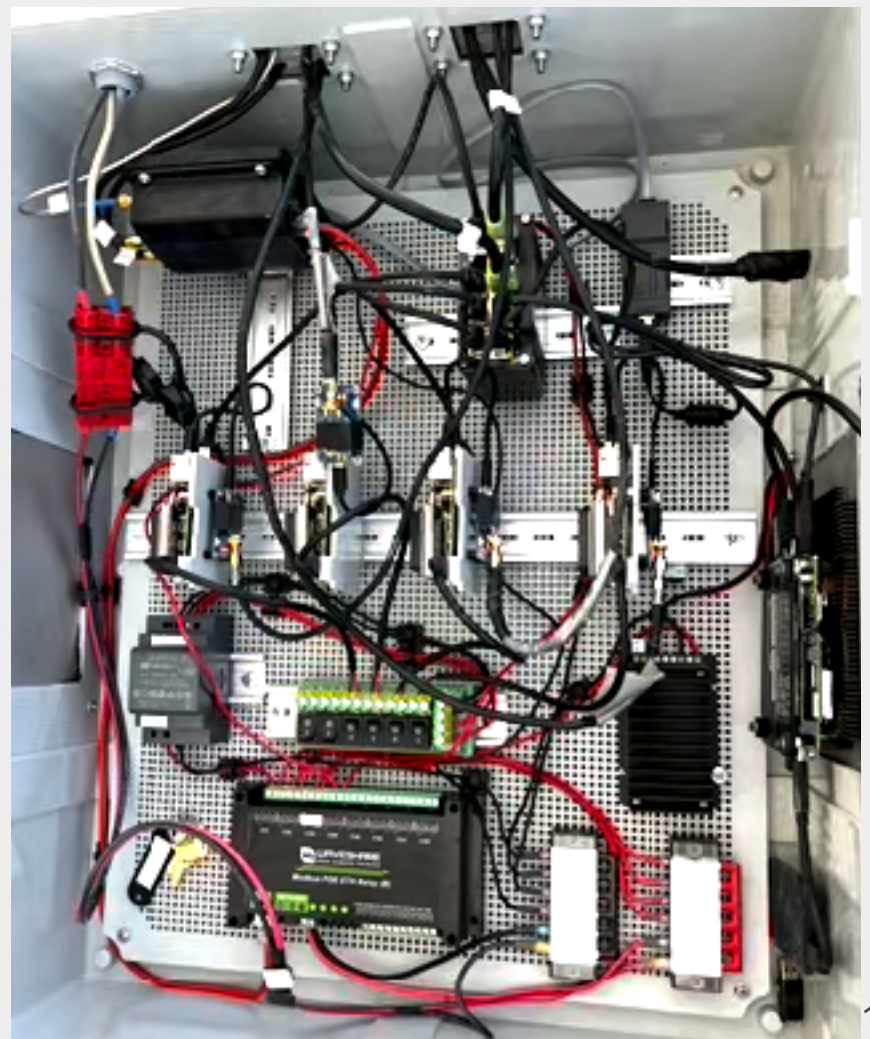


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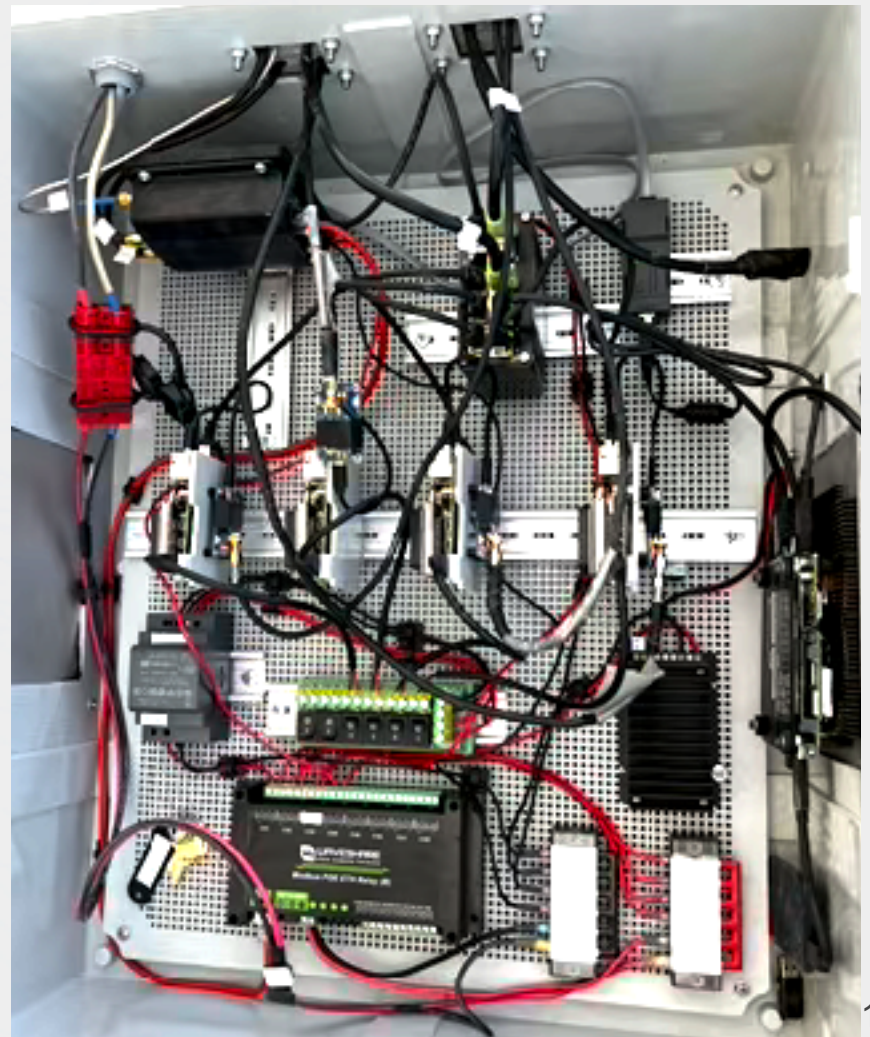


The Comms Station - Frodo Box



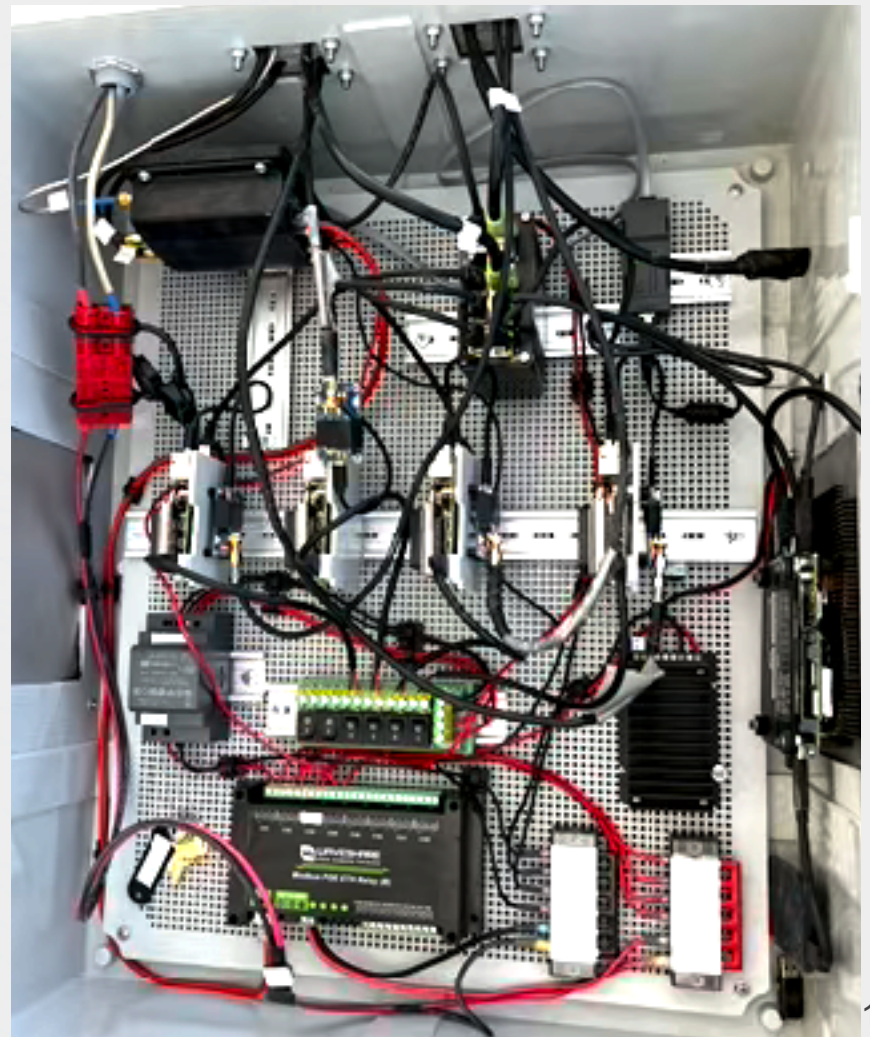
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- Weatherproof box placed under main solar panel



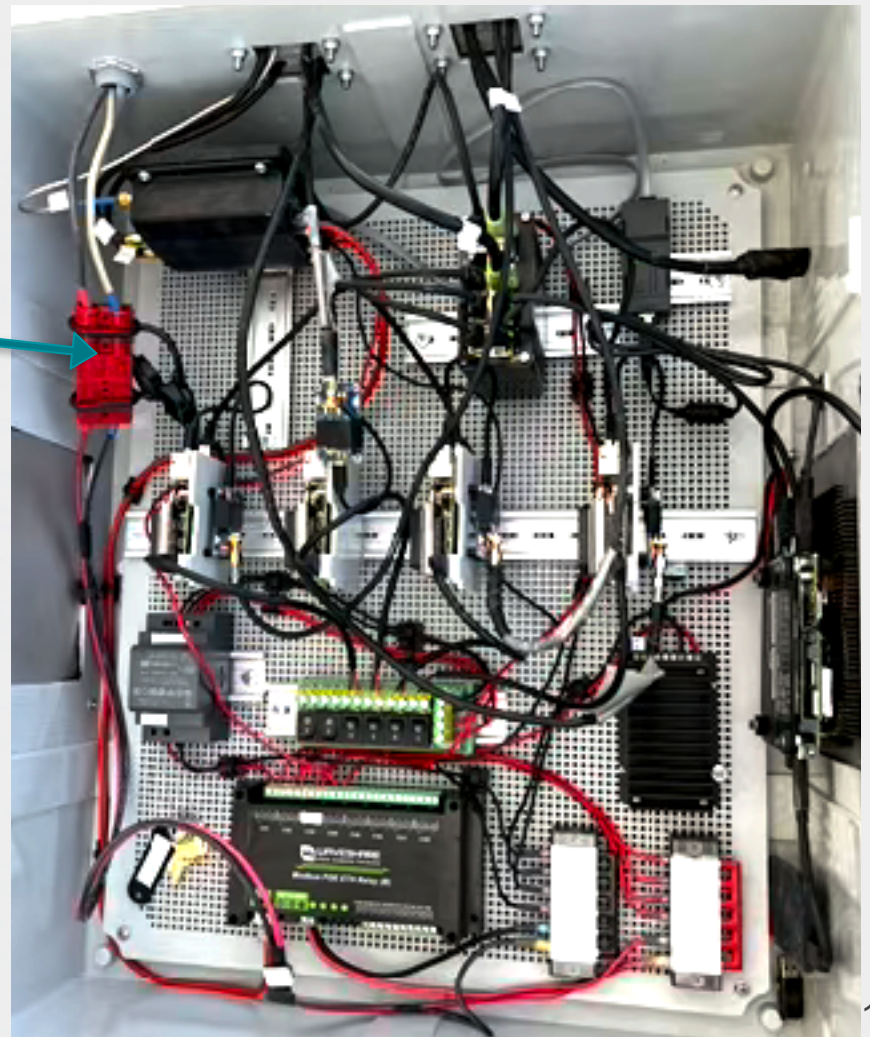
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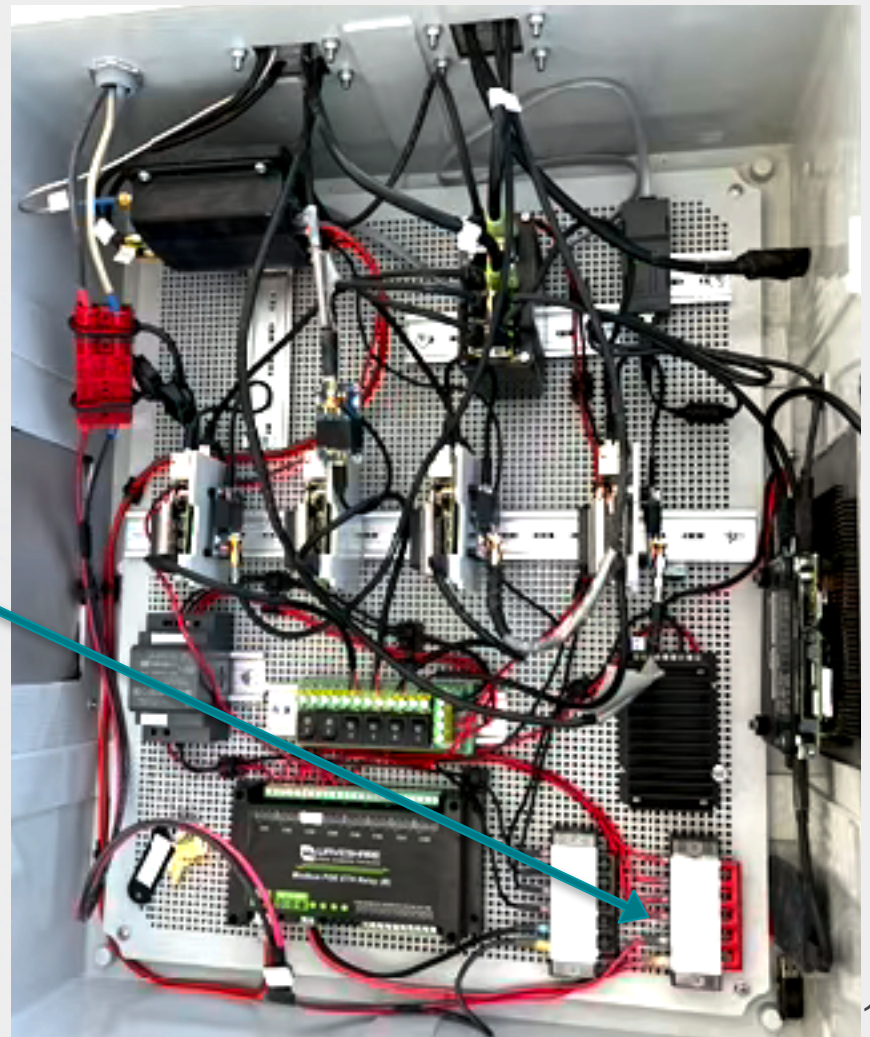
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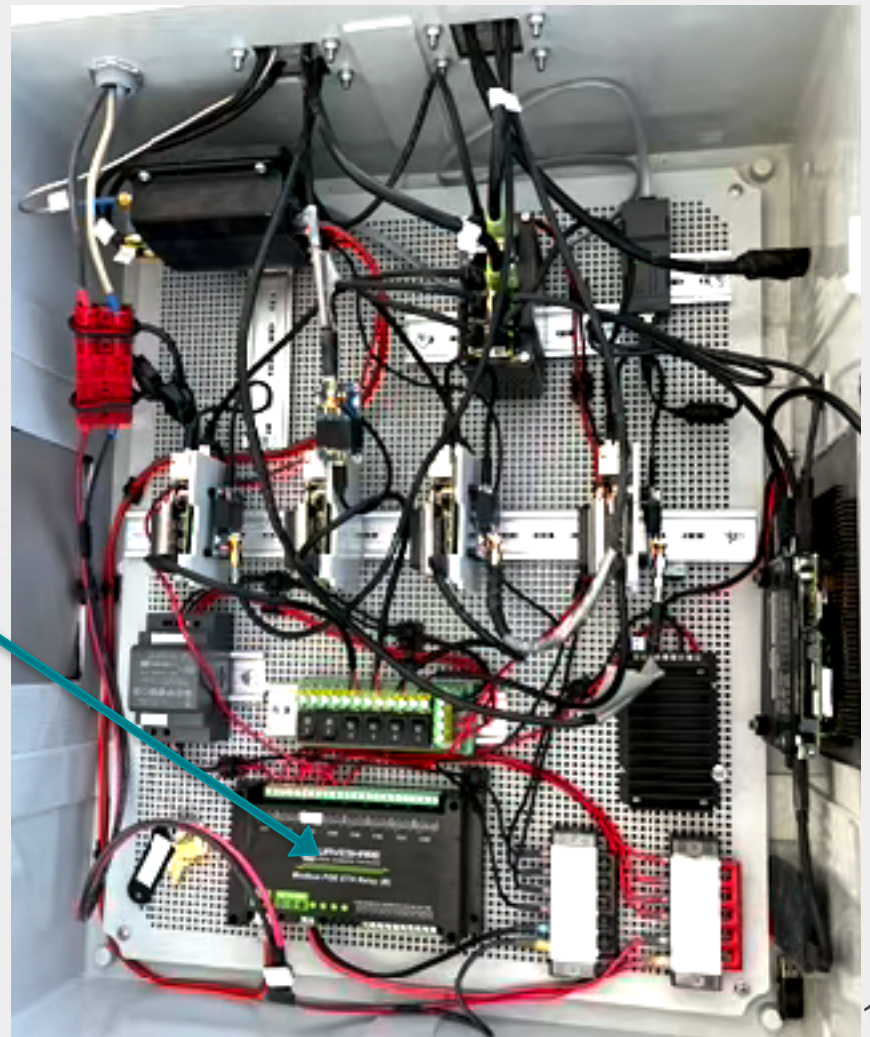
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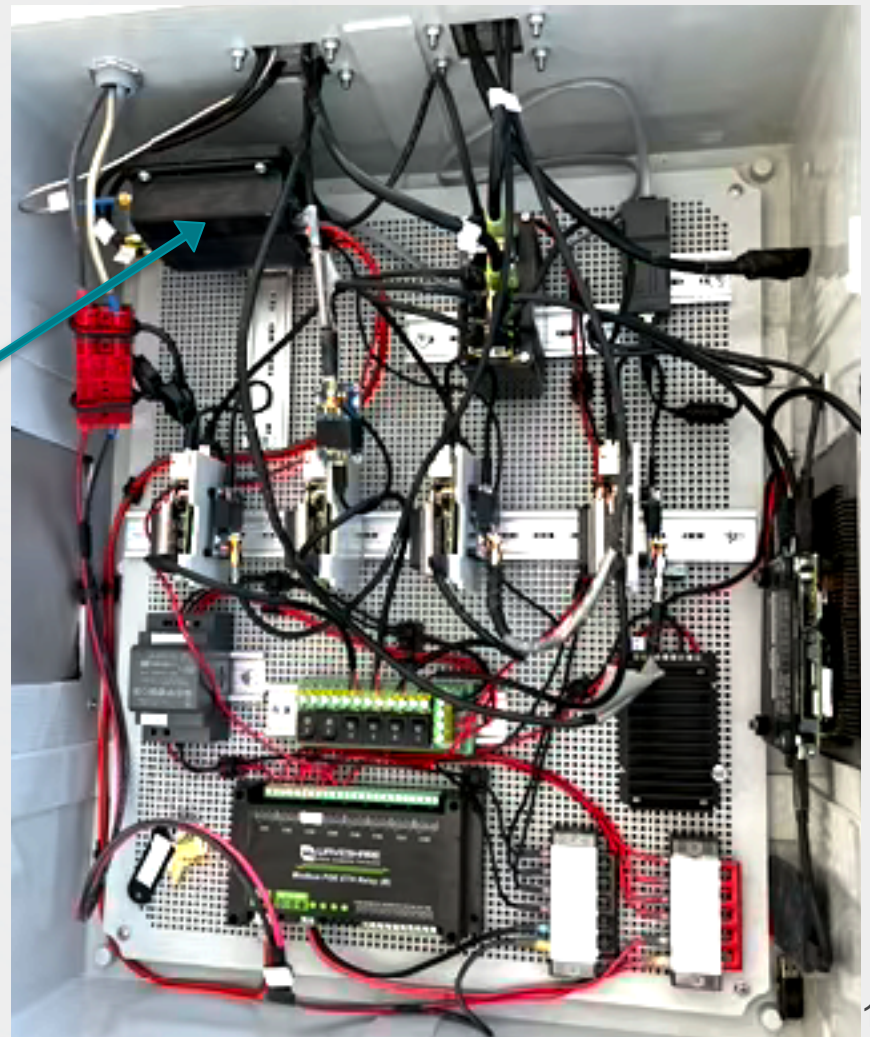
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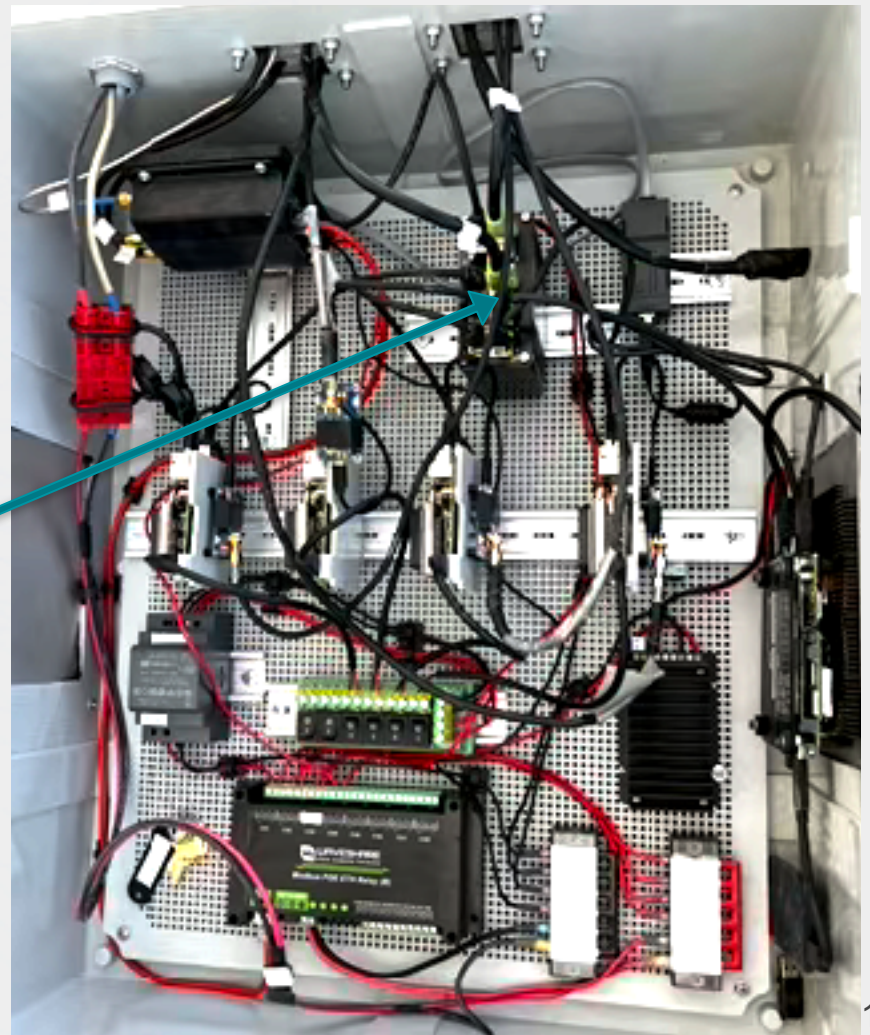
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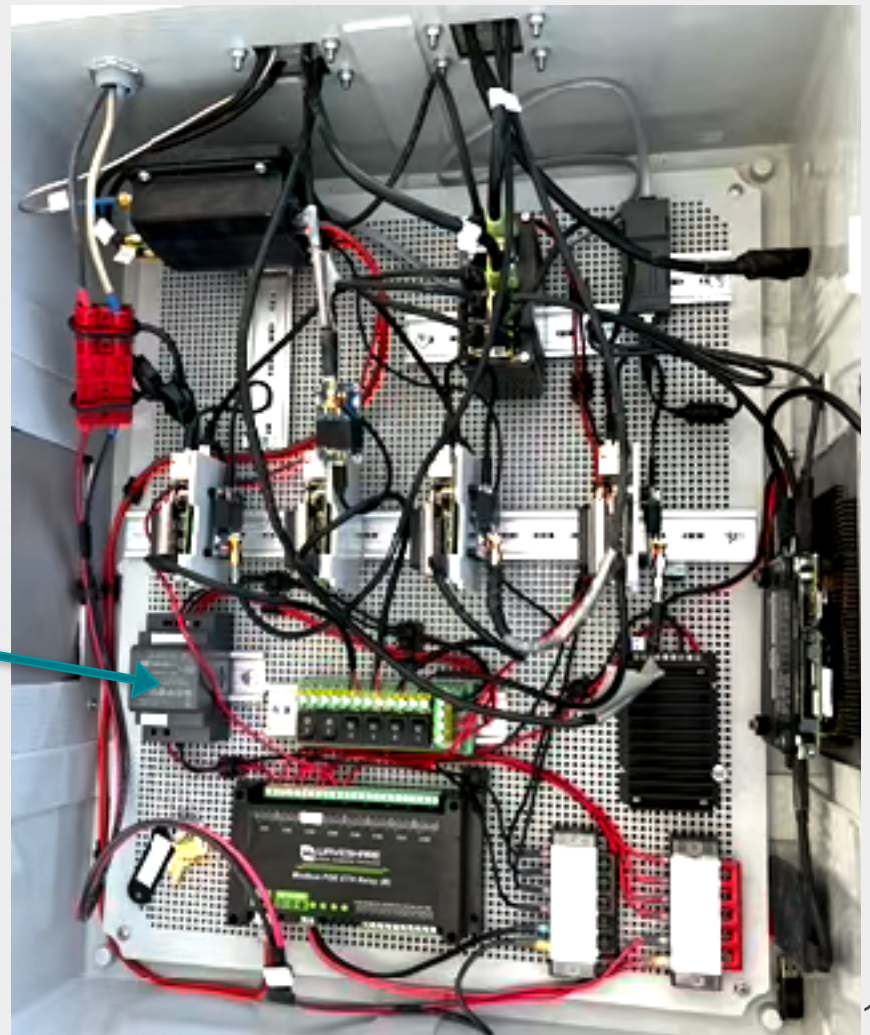
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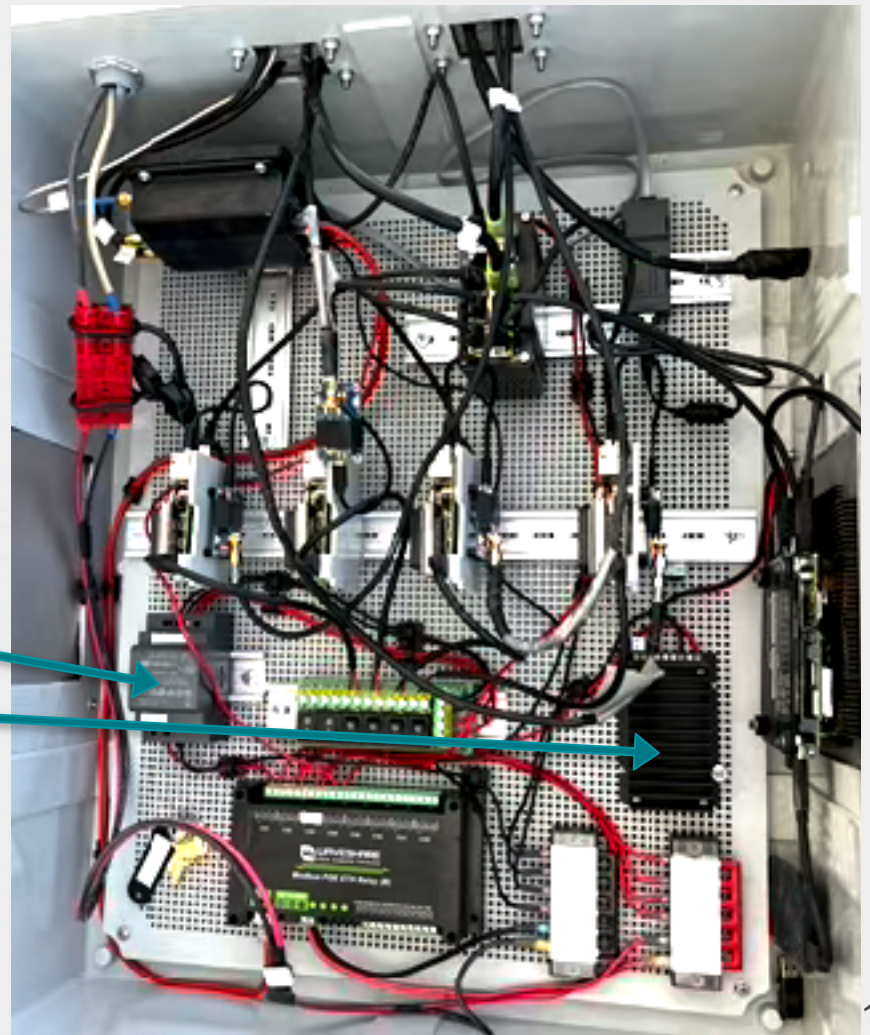
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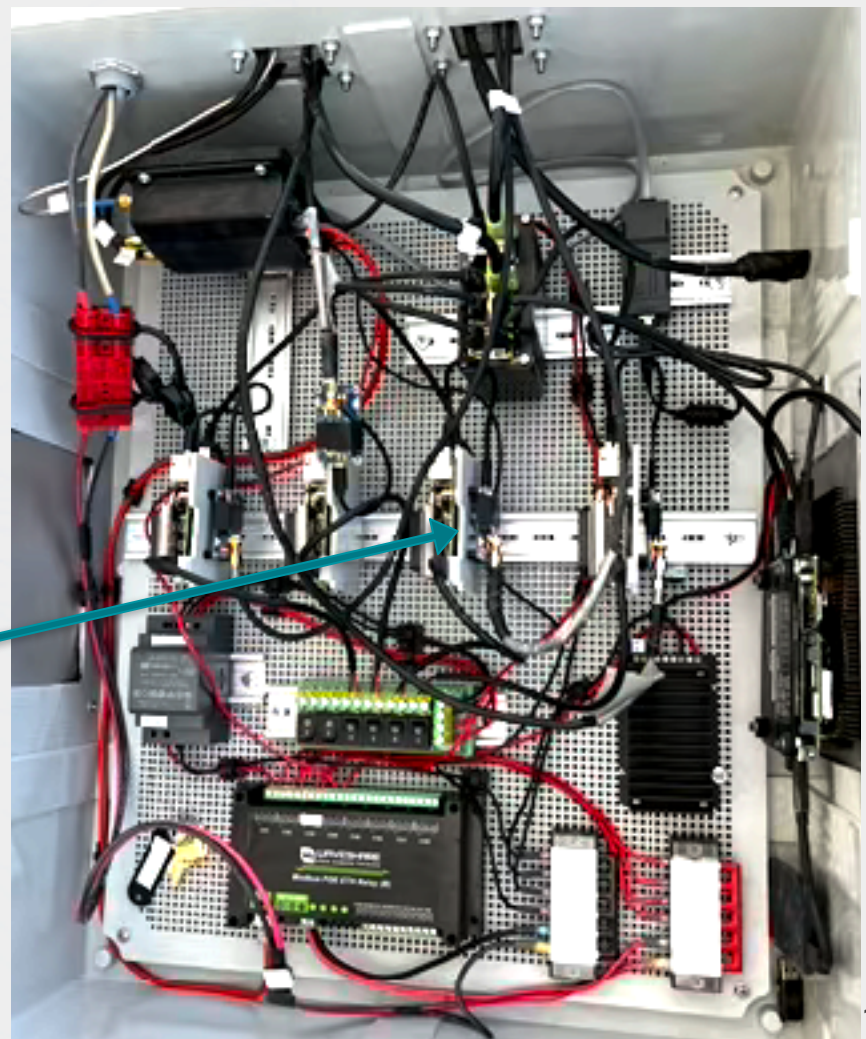
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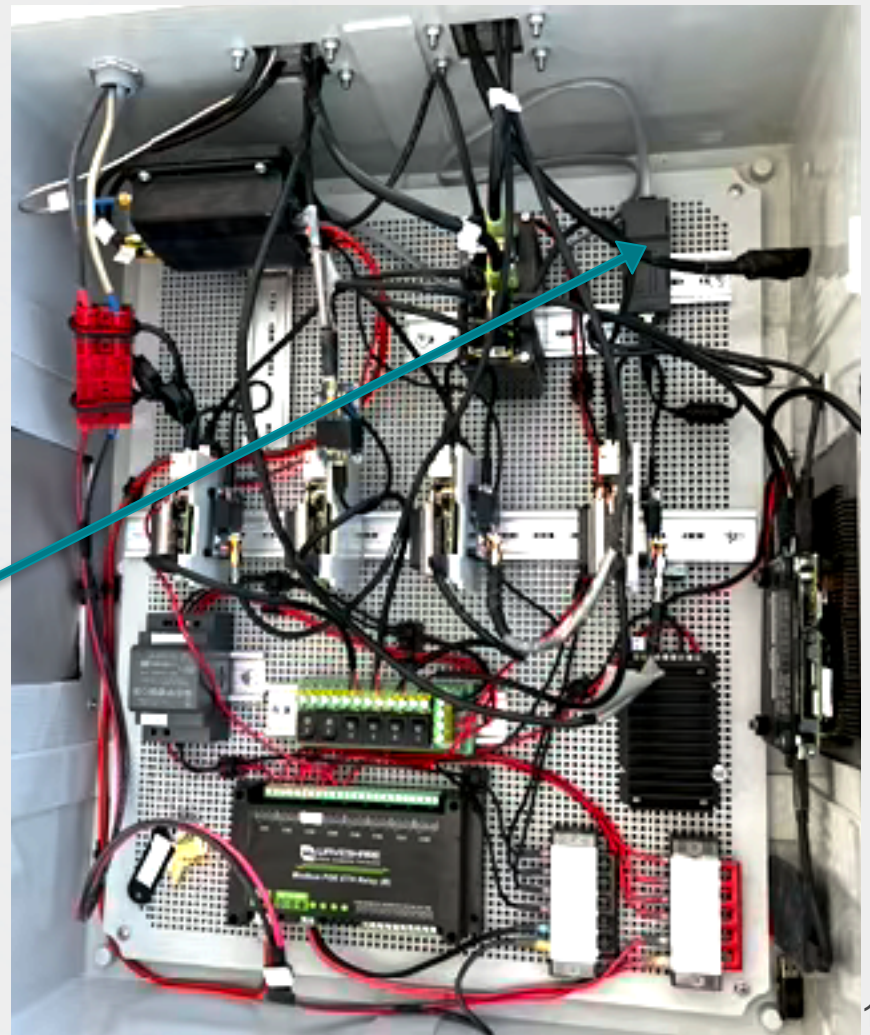
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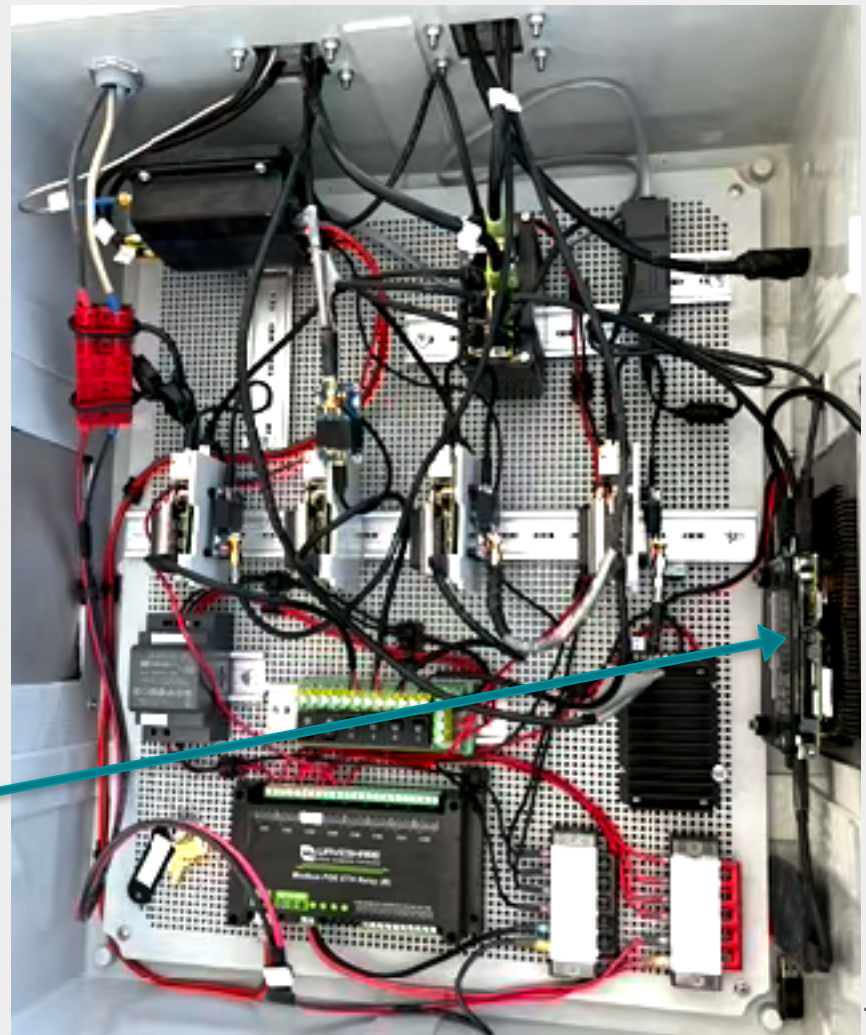
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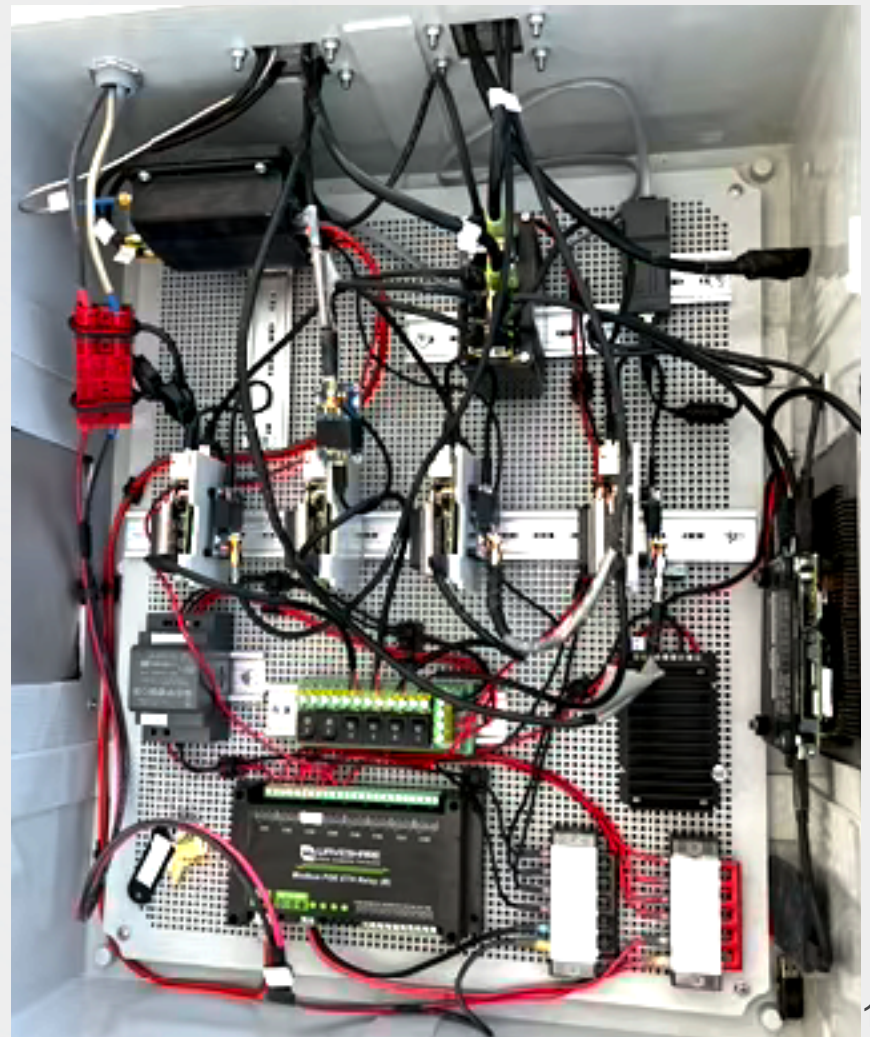
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 - Power breakout boards - Bring power to each component
 - Ethernet power relay - Intermediate device to power cycle components over the internet
 - 4G LTE Router - Comms to outside
 - Ethernet switch - Internet to CDAS PC/Pi's
 - DC-DC converters - To tune Voltage to Pi's (5V) and NUC (19V)
 - Raspberry Pi's + Xbee's
 - Battery monitoring adapter
 - CDAS PC (Faramir - Intel NUC 10 i5)



The Comms Station - Frodo Box

- Weatherproof box placed under main solar panel
- Contains
 - Main power disconnect
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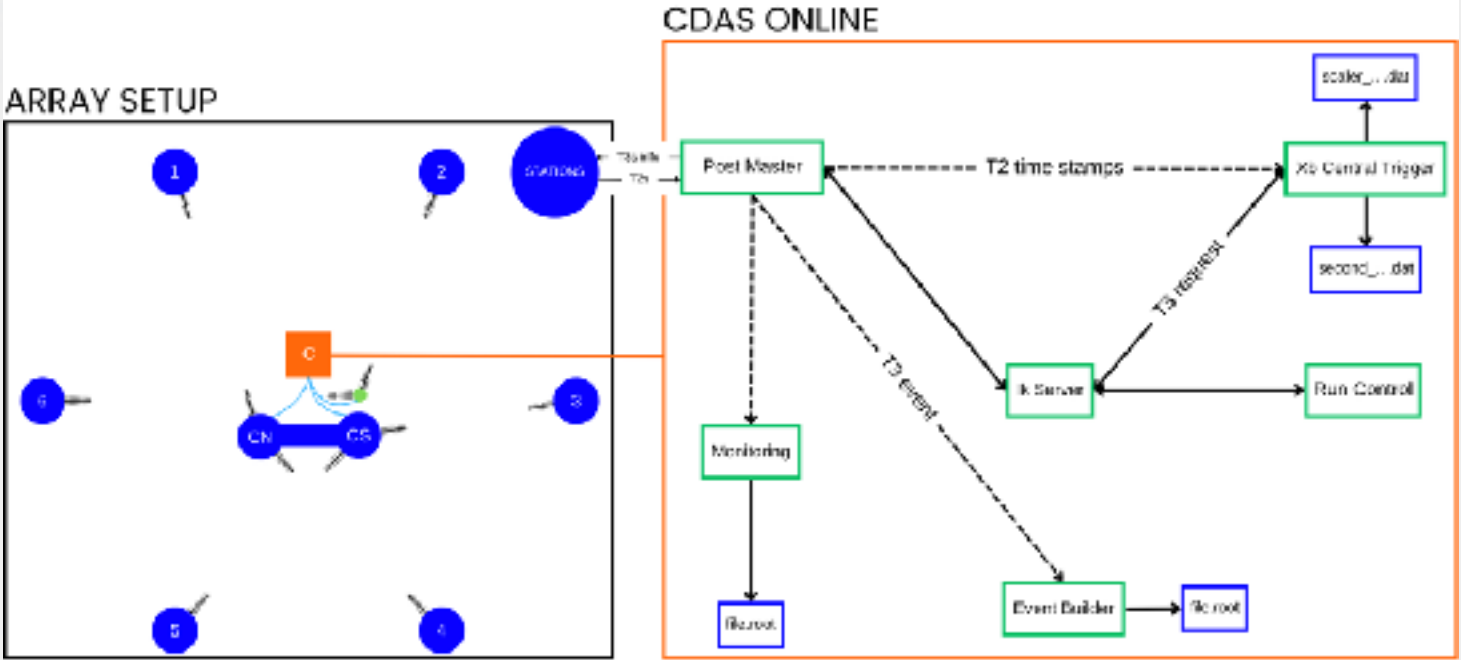




CDAS Implementation And First Events

CDAS Setup

- Very similar to regular AugerSouth CDAS slightly scaled down for micro-array
 - Key processes: Pm (Post Master), Xb (Central Trigger), Eb (Event Builder), Ik (Internal routing)
 - Much smaller CDAS database (only 7 stations)
 - Still need to look into doublet readout
 - Still need to figure out interfacing with triplet TA station



Radio Emulator

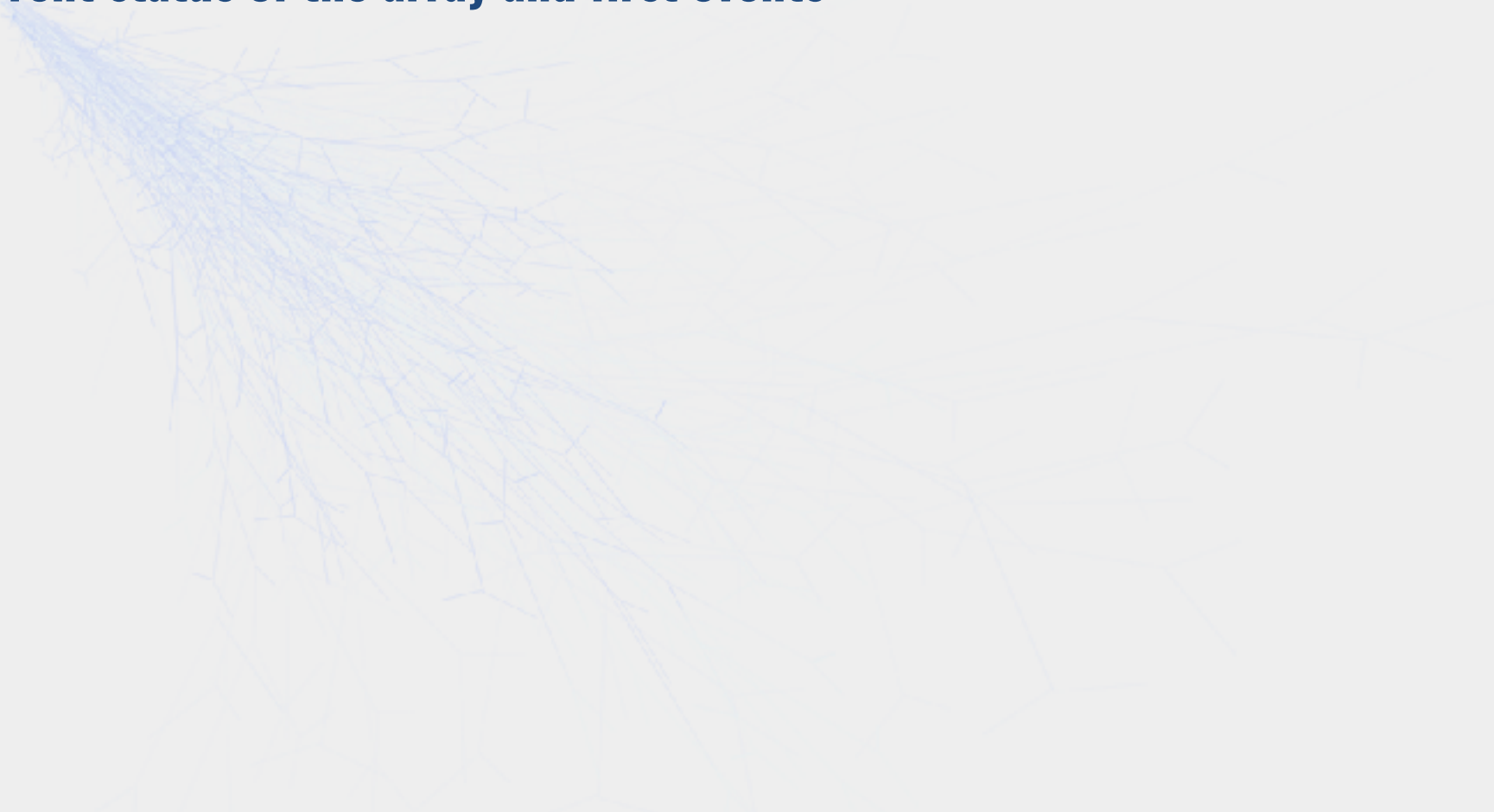
- Radio emulator (can be found here [Radio Emulator](#)) is run on the Pi's of each station
- Input parameters are: IP address of PM (here Faramir), PM Port, BSU ID, Radio ID, serial port device
- Connects UB to CDAS PM, shows T2s being sent

```
pi@Sam:~/CDAS_Station_emulator/bin $ sudo ./su_bsu 10.8.0.140 10600 77 3000 /dev/ttySC0 /dev/ttySC0
Connected to the server: Doing Negotiation...
Correctly written Gs connection message
PM Started ...
connection with UB ... 4 4
passing ...
passing ...
--->PM -> UB: 120
ub_send_packet
passing ...
passing ...
passing ...
passing ...
passing ...
passing ...
passing ...
passing ...
```

Parameters

```
cdas@frodo:~/Raid/var/Ct/2025/04$ tail second_2025_04_30_00h00.dat
1430012443 117 23 118 21 116 23 115 28 -1 -1
1430012444 117 17 118 25 116 26 115 23 -1 -1
1430012445 116 18 118 12 117 15 115 26 -1 -1
1430012446 117 31 118 19 116 26 115 24 -1 -1
1430012447 117 14 118 14 116 23 115 30 -1 -1
1430012448 117 13 118 17 116 19 115 30 -1 -1
1430012449 118 15 117 15 116 20 115 23 -1 -1
1430012450 118 20 117 20 116 28 115 30 -1 -1
1430012451 118 21 117 16 116 36 115 31 -1 -1
1430012452 118 15 117 25 116 28 115 28 -1 -1
cdas@frodo:~/Raid/var/Ct/2025/04$
```

Current status of the array and first events

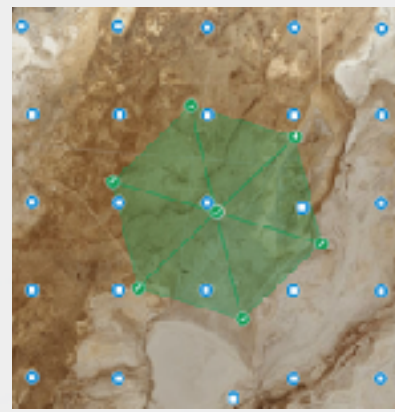


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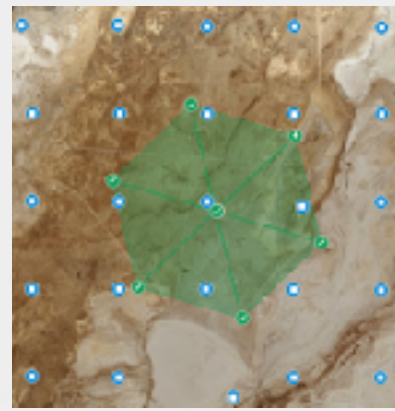
Current status of the array and first events

- Current status of the array:
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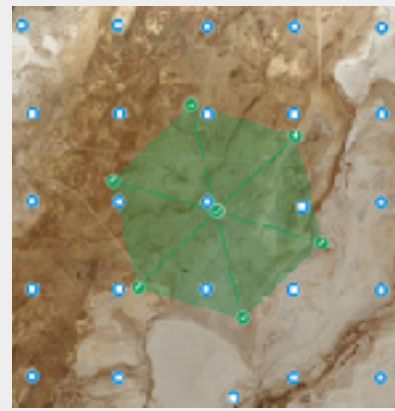
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 - Still need to deploy SSDs → Next trip!



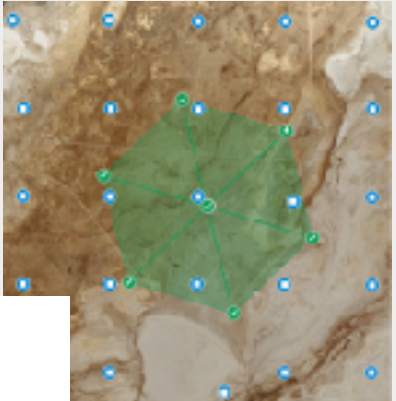
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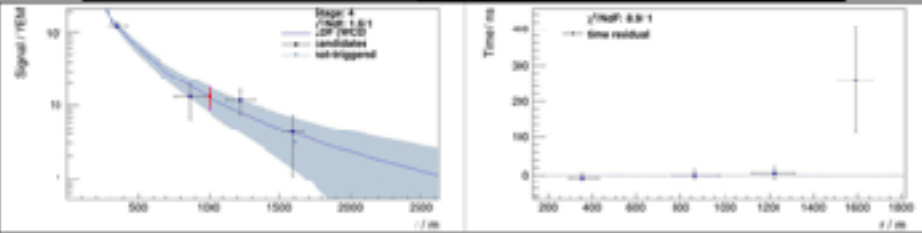
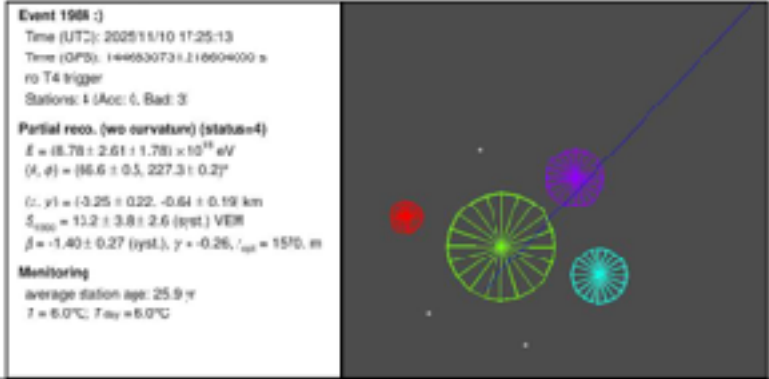
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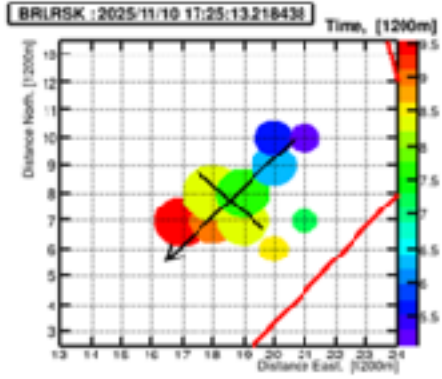


PRELIMINARY

Auger@TA reconstruction



TA reconstruction



Zenith: 66°
 Azimuth: 227°

TA core contained within our hexagon

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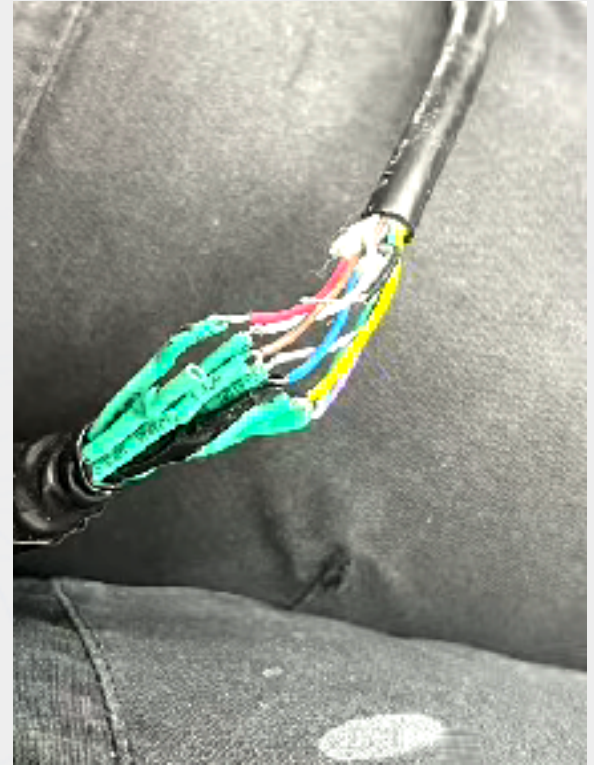
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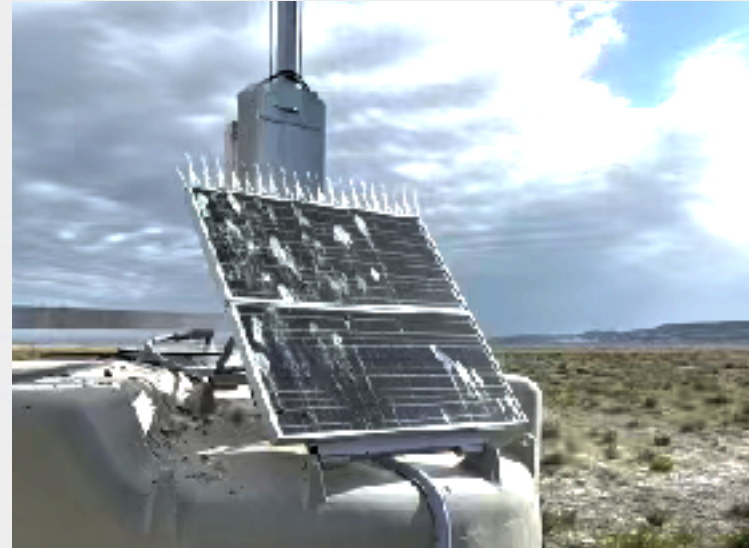
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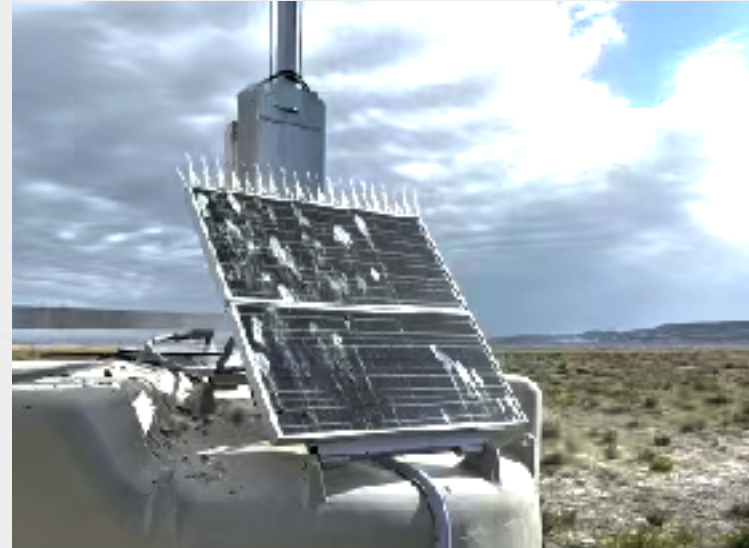
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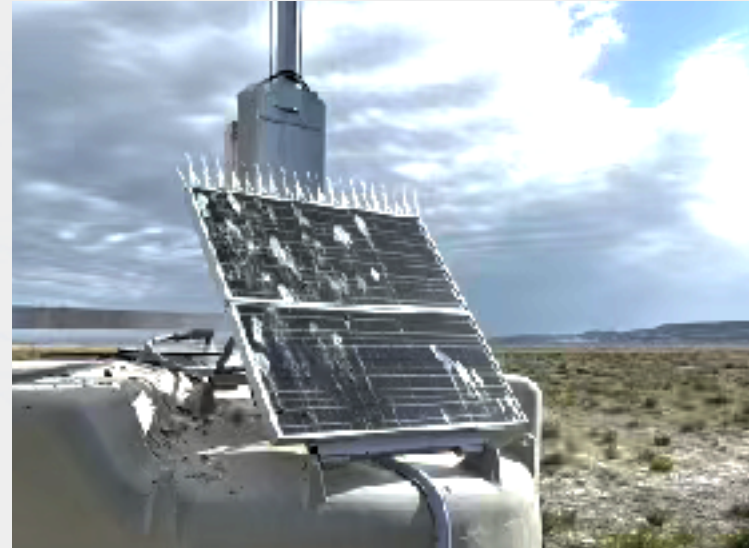
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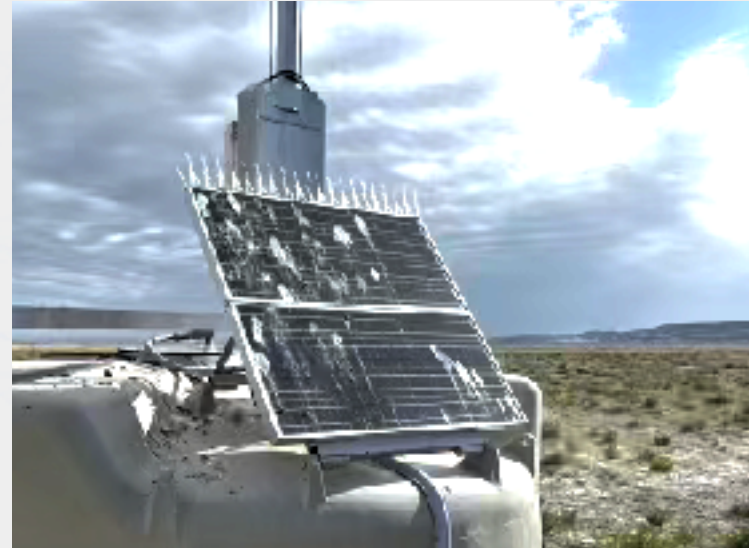
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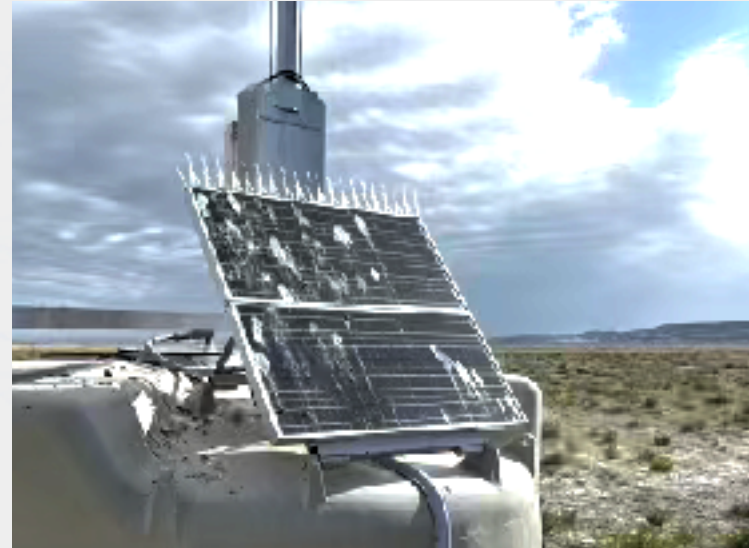
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- The list goes on ...





Backup

Early Deployment - Prep, Tank Placement, Water Delivery

