Air shower Radio for IceCube

Hardware Status at South Pole

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- Status and results 2009
- Status 2010

Time line of installations

- **2007**: First background measurements in Argentina (Auger site) and at South Pole
- **2008**: Cabling to SPASE building identified to connect to “quiet” place
- **2009**: winter setup with 4 antennas for long term noise behavior, installation of Fat Wire-Dipols (FWD)
- **2010**: Surface self trigger deployed
  – unfortunately on reduced footprint.

In 2009

- Min Bias trigger
- In ice threshold trigger

South Pole
Telescope

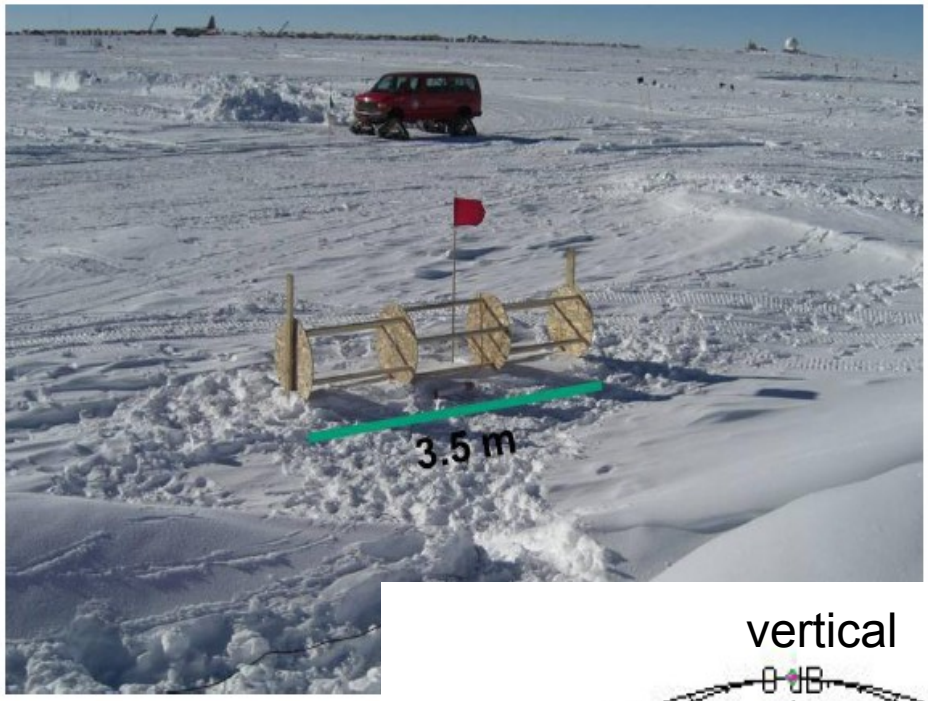
IceCube
Counting House

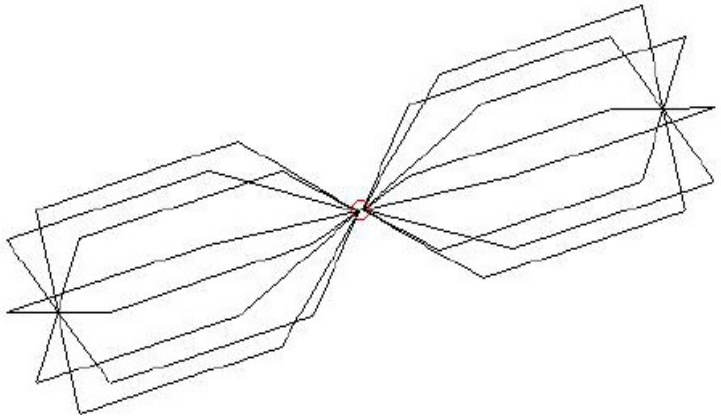
2 Cables
(SPASE)

Antennas

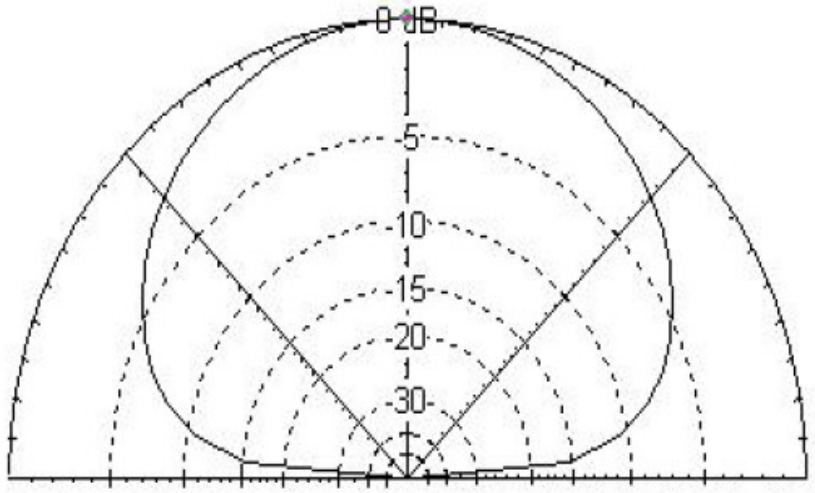
125m

Fat wire-dipole antennas



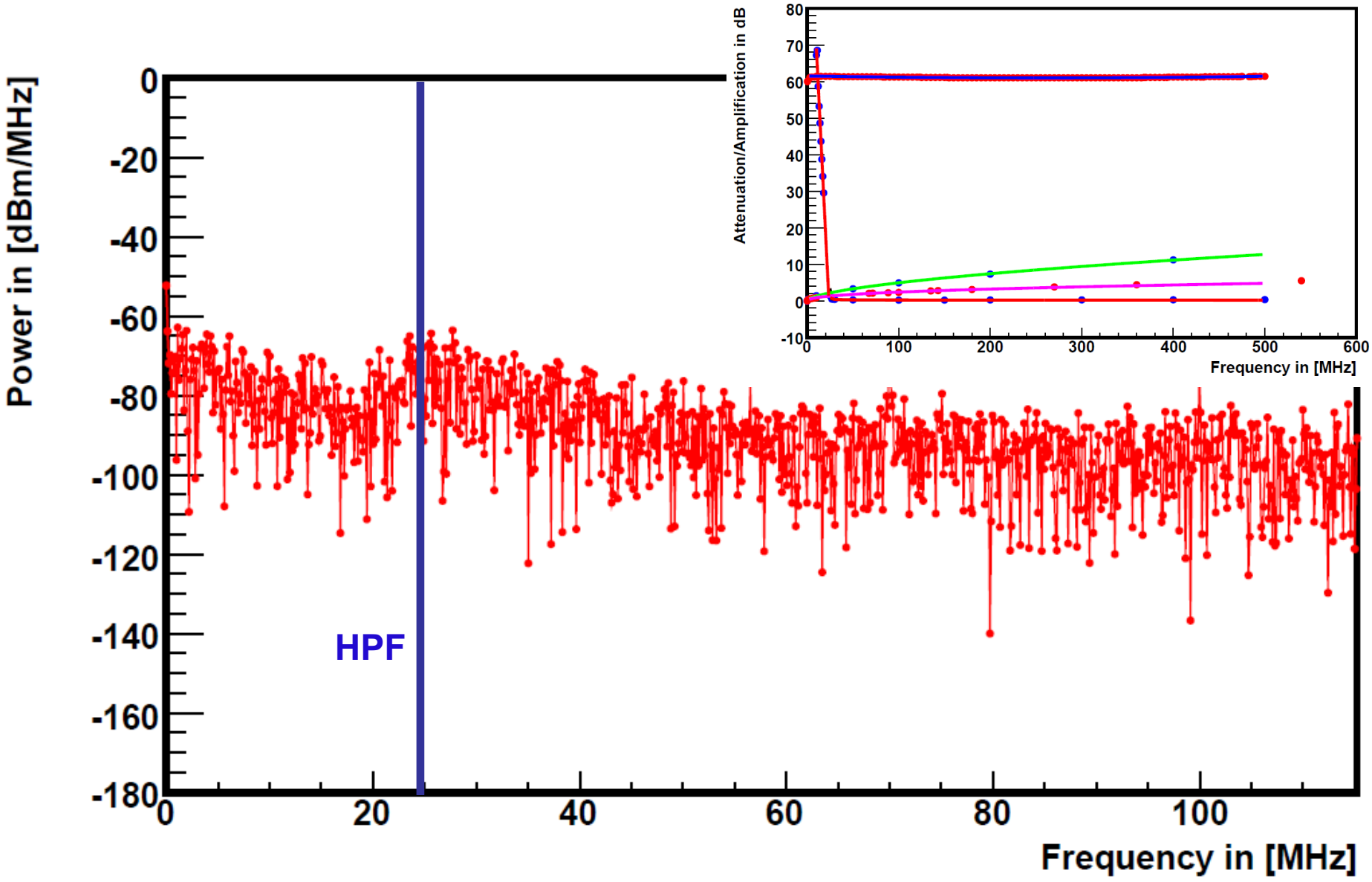


vertical

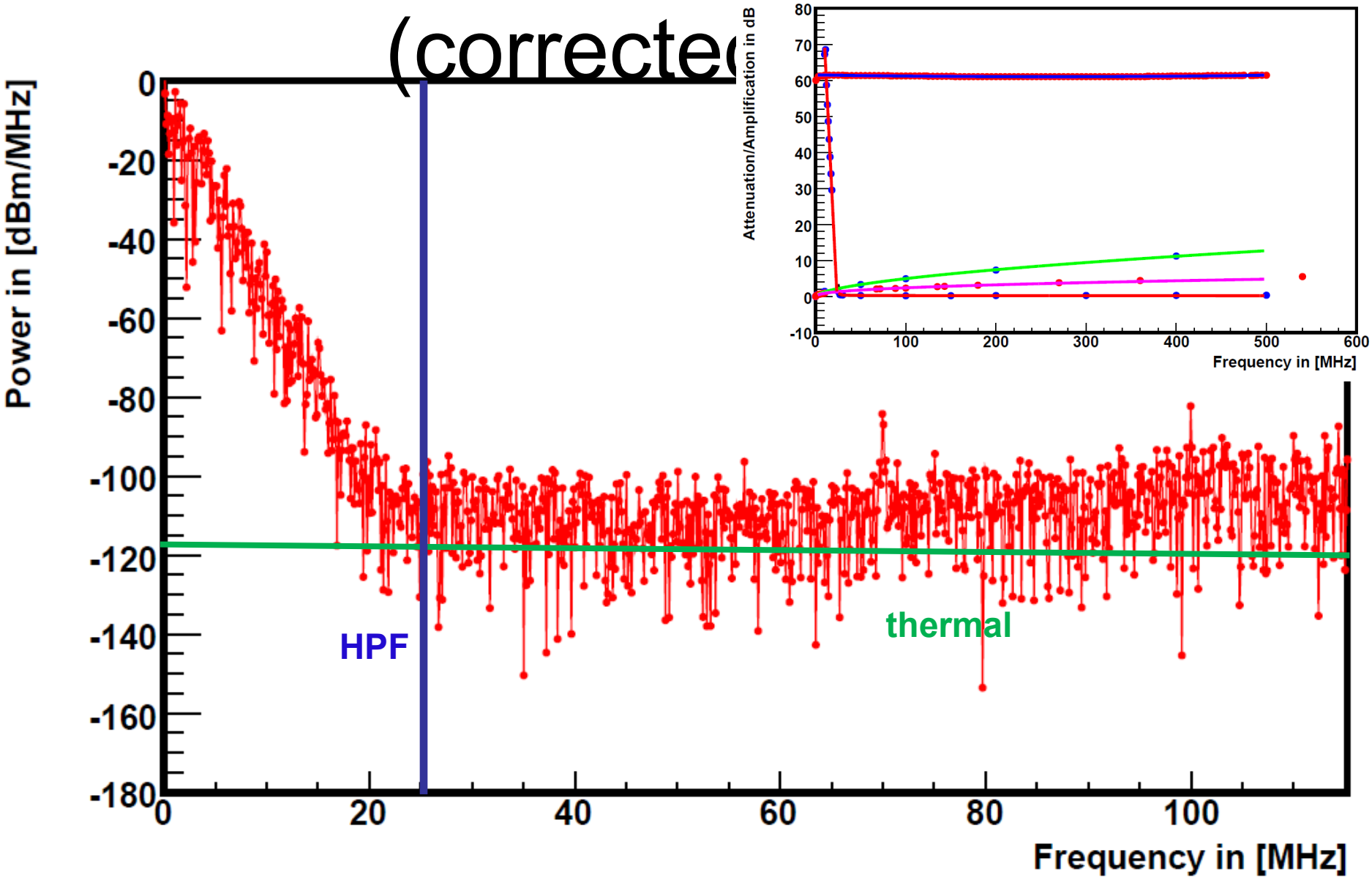


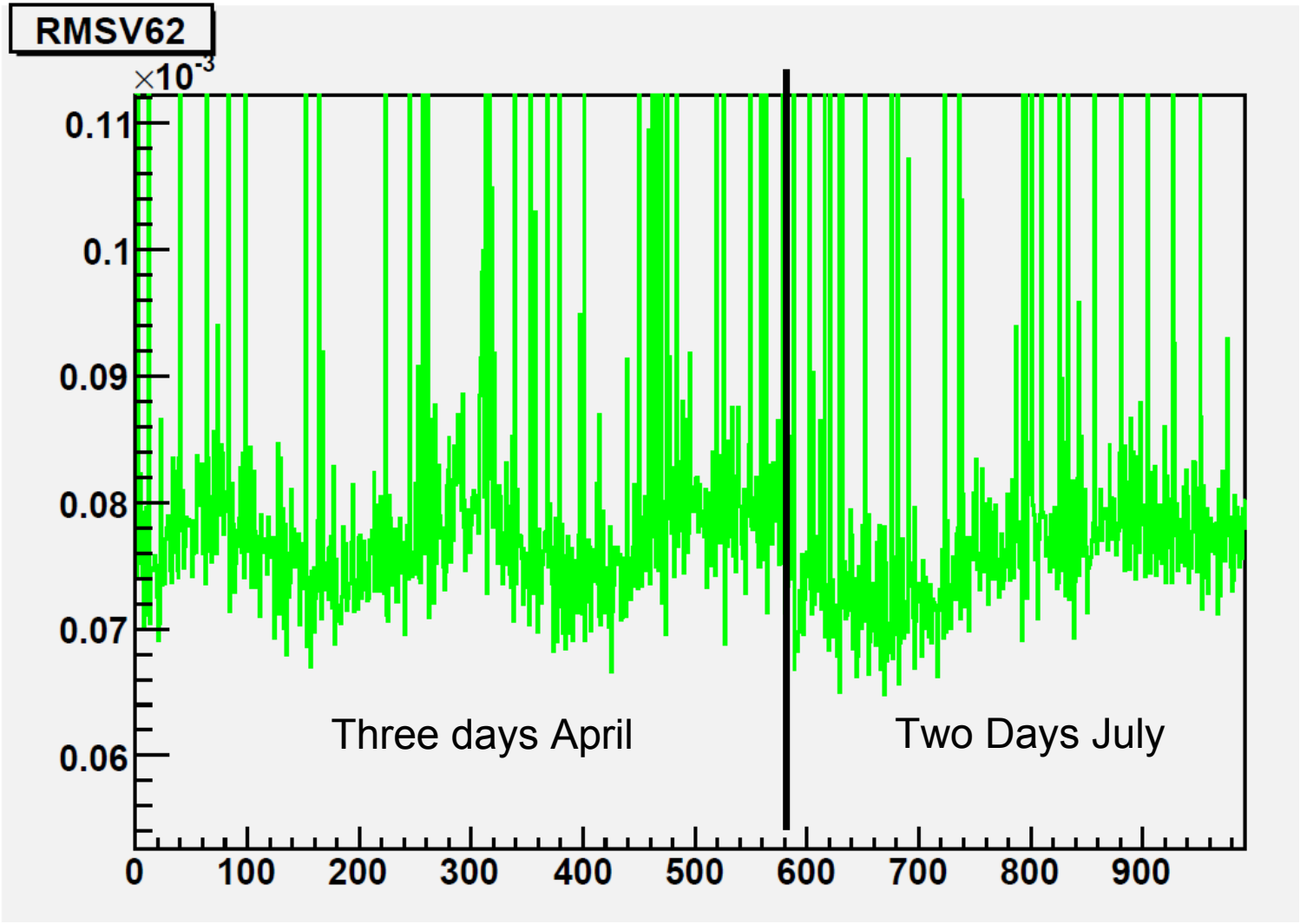
33 MHz

Continuous Background



Continuous Background (correcte

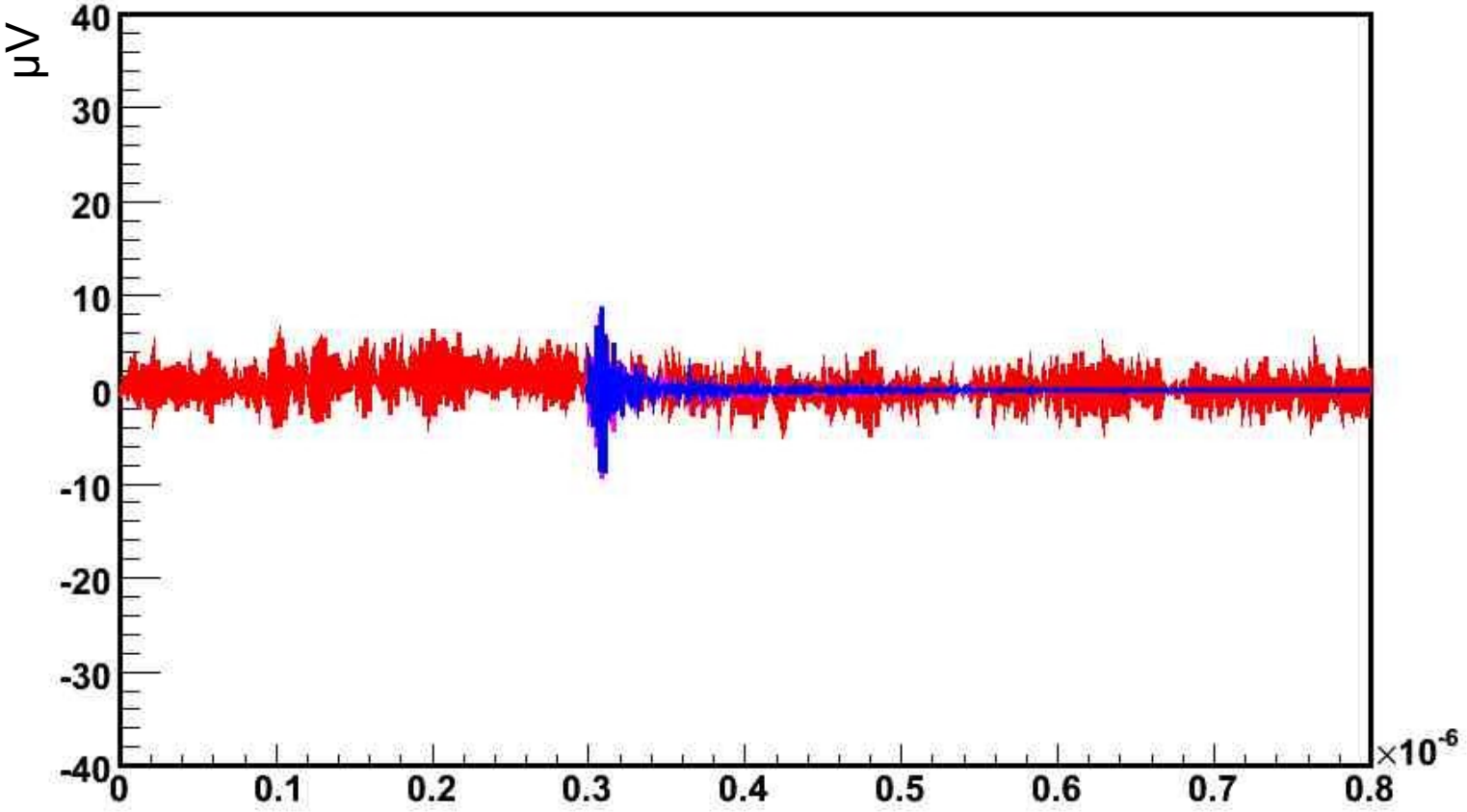




Daily variations or Galactic noise?

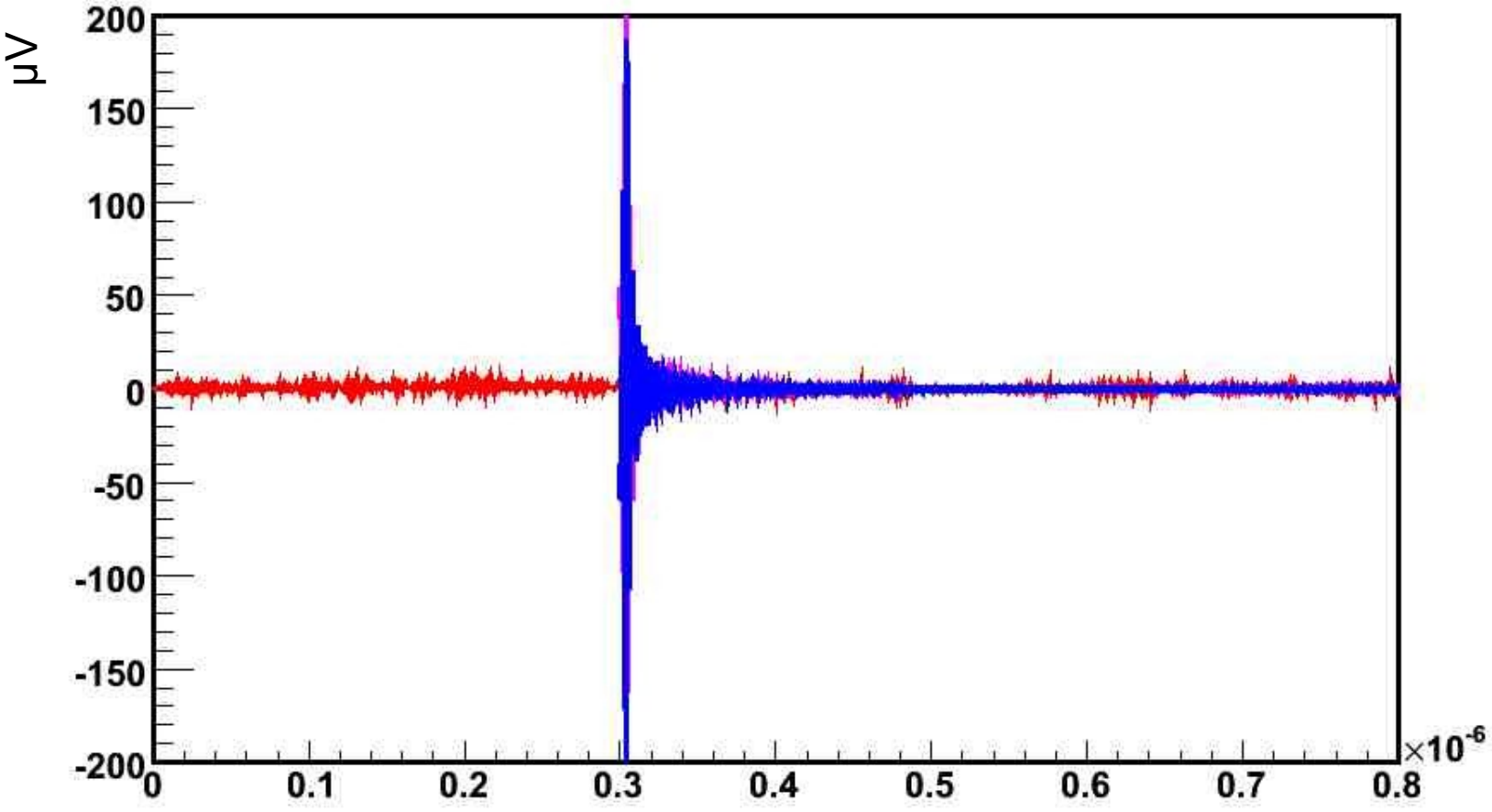
… work in progress ...

Pulse prediction with REAS2



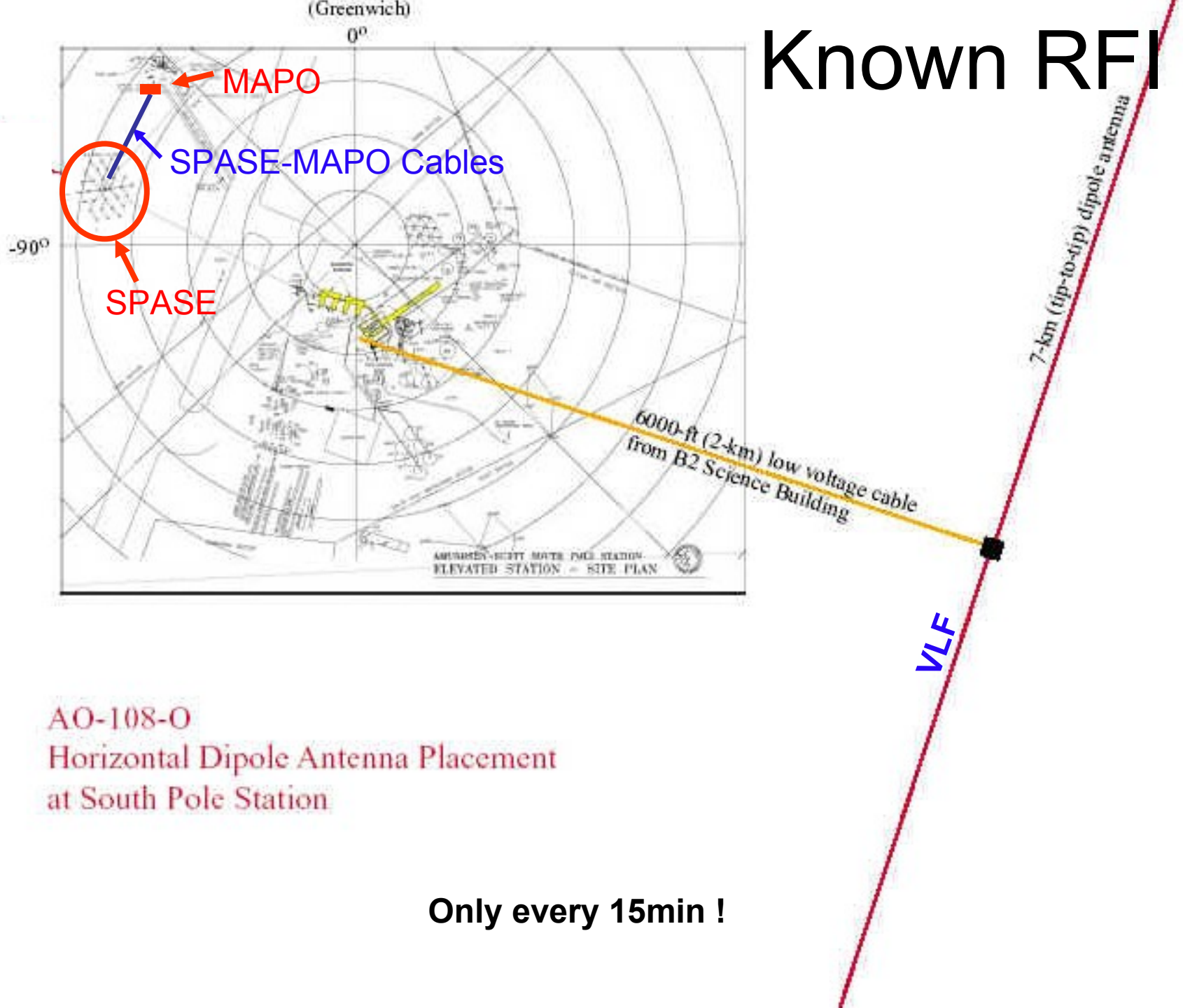
25-100 MHz band pass in FWD 10^{17} eV in 225m from shower core and 45° incl

Pulse prediction with REAS2



25-100 MHz band pass in FWD 10^{17} eV in 125m from shower core and 45° incl

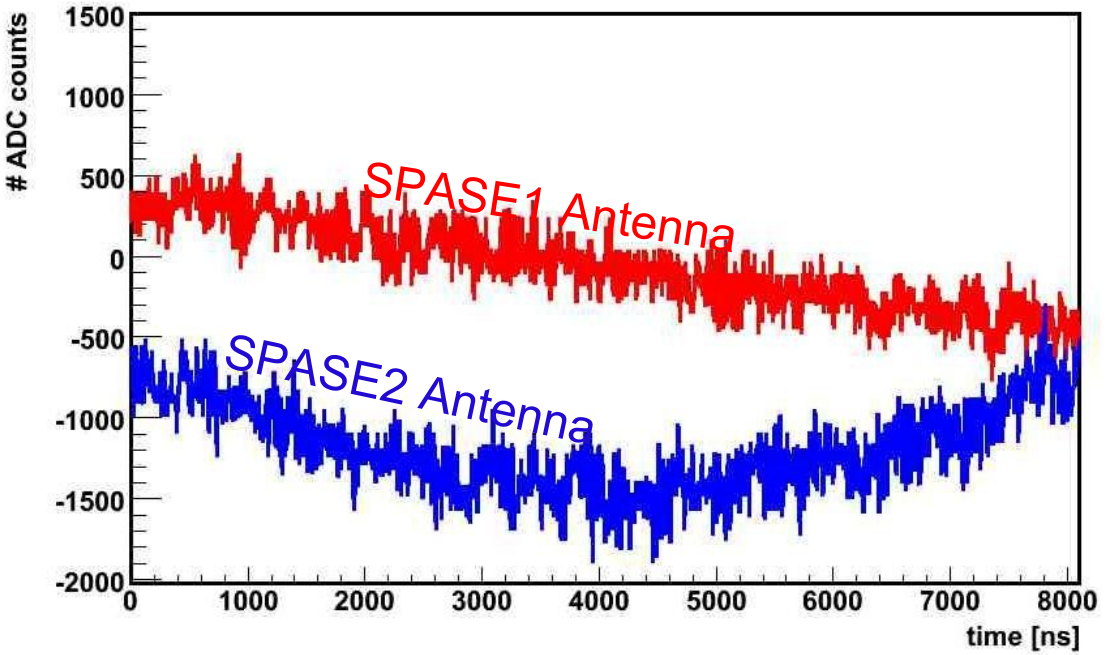
Known RFI



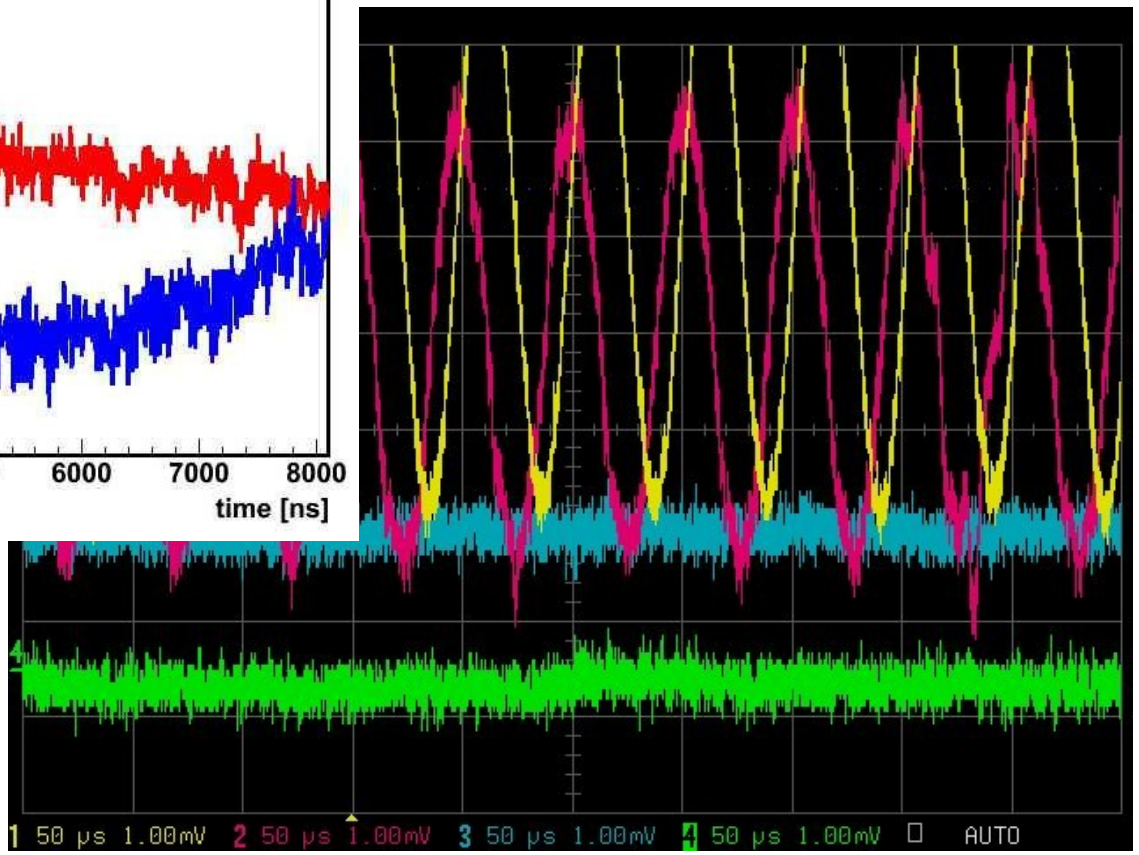
AO-108-O
Horizontal Dipole Antenna Placement
at South Pole Station

Only every 15min !

VLF signal in the SPASE antennas

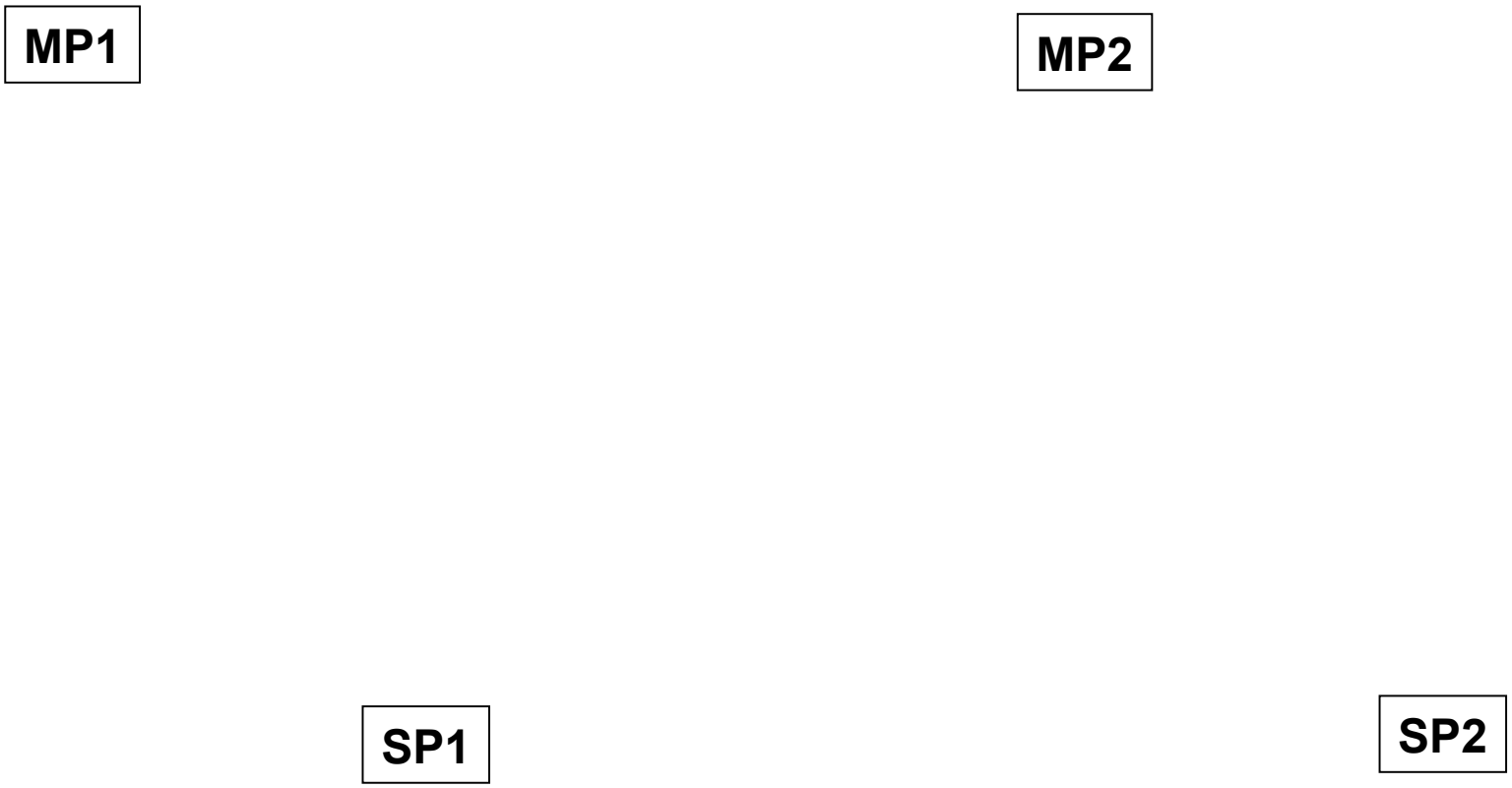


VLF pickup by coax cables running out to antennas

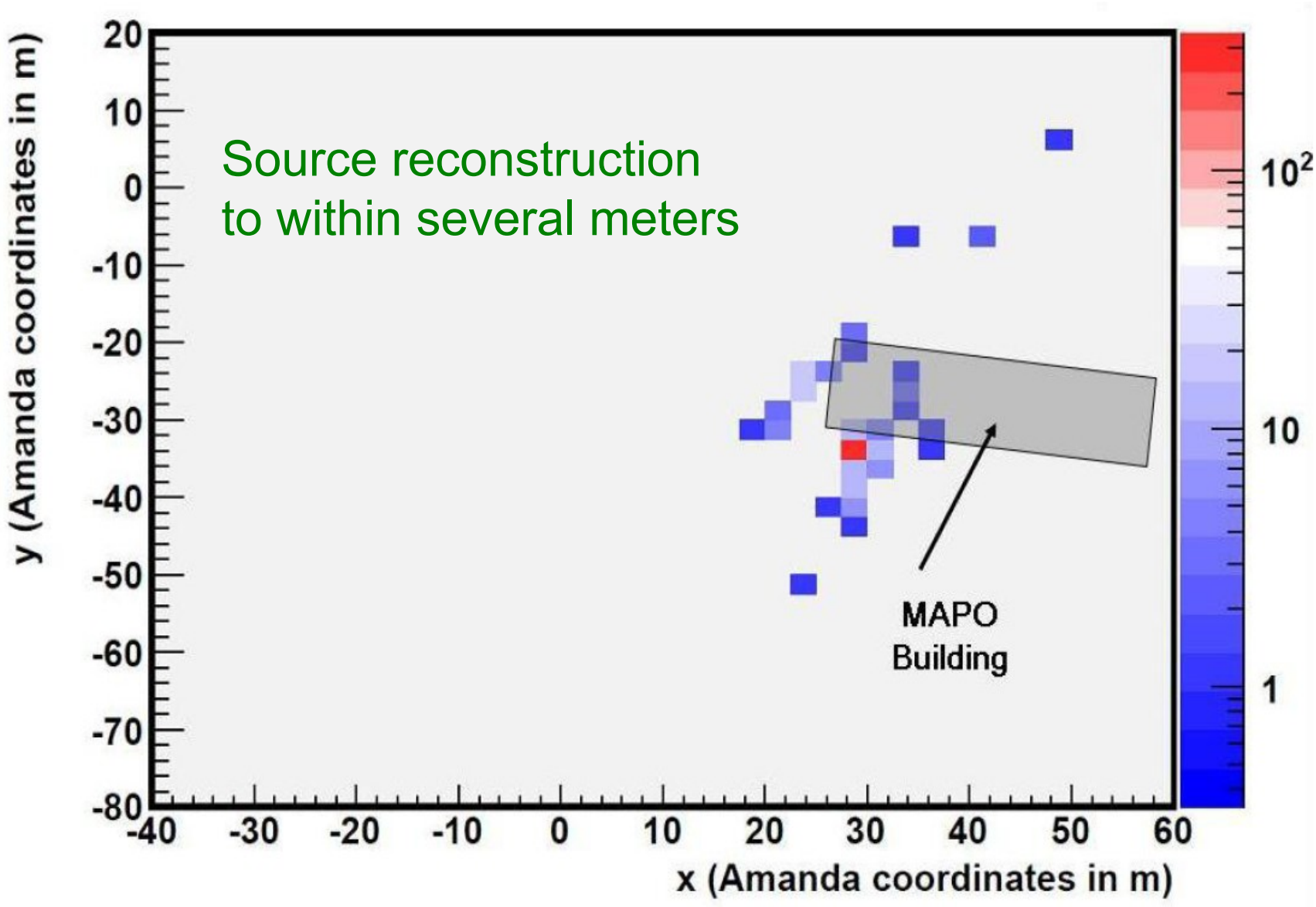


Meteor radar has also been seen!

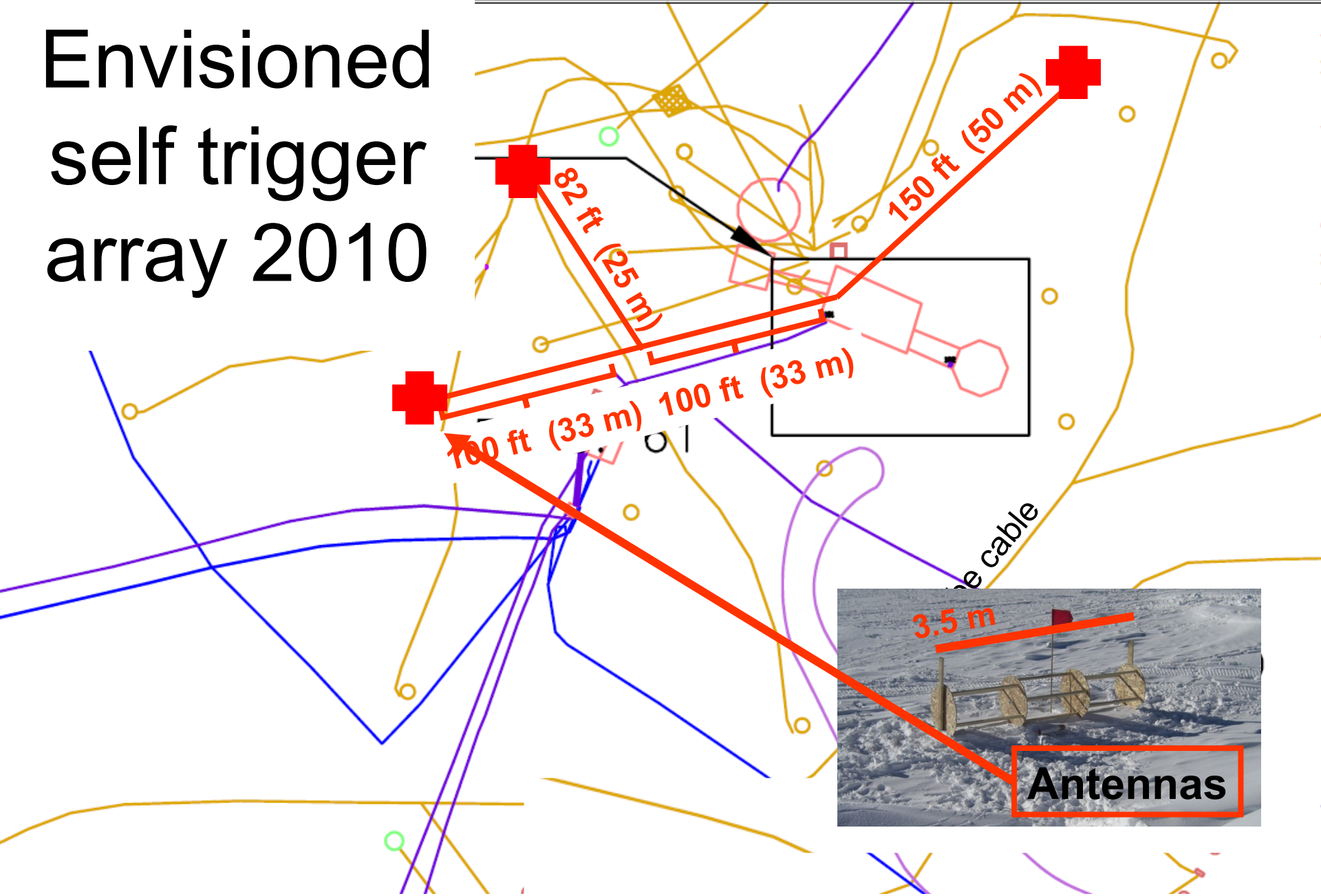
Pinger observation



Pinger reconstruction



Envisioned self trigger array 2010



Trenches near MAPO

Simple rate estimate

1. I cut away vertical events phi < 30°. I call it MAPO veto.
I cut away events with phi > 60°. Nobody knows about horizontal air showers are detectable.
This gives us about 36.6% of the sky.

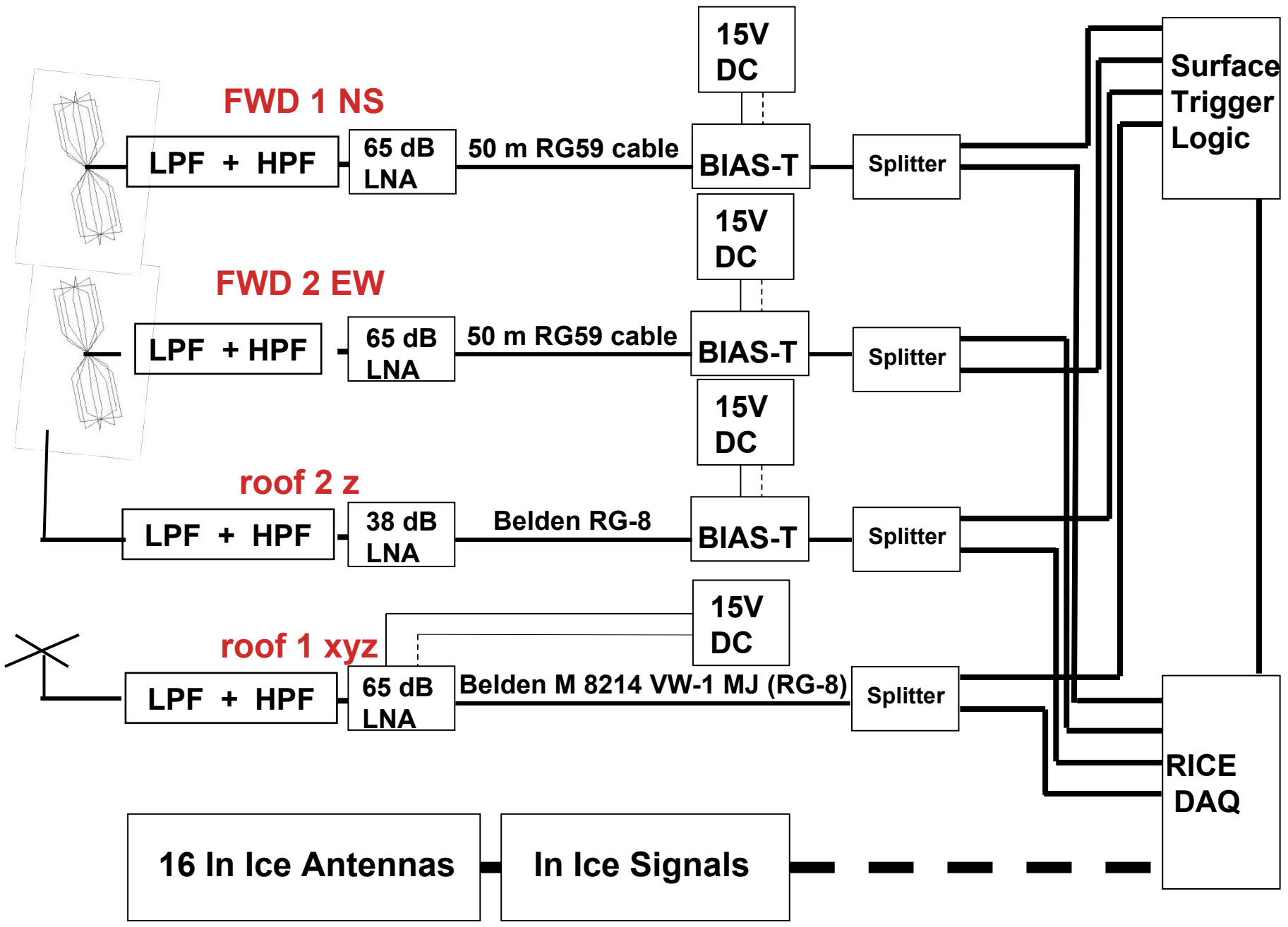
2. The energy threshold will be about 100PeV in about 125m distance. For larger distances the Energy threshold is rising.

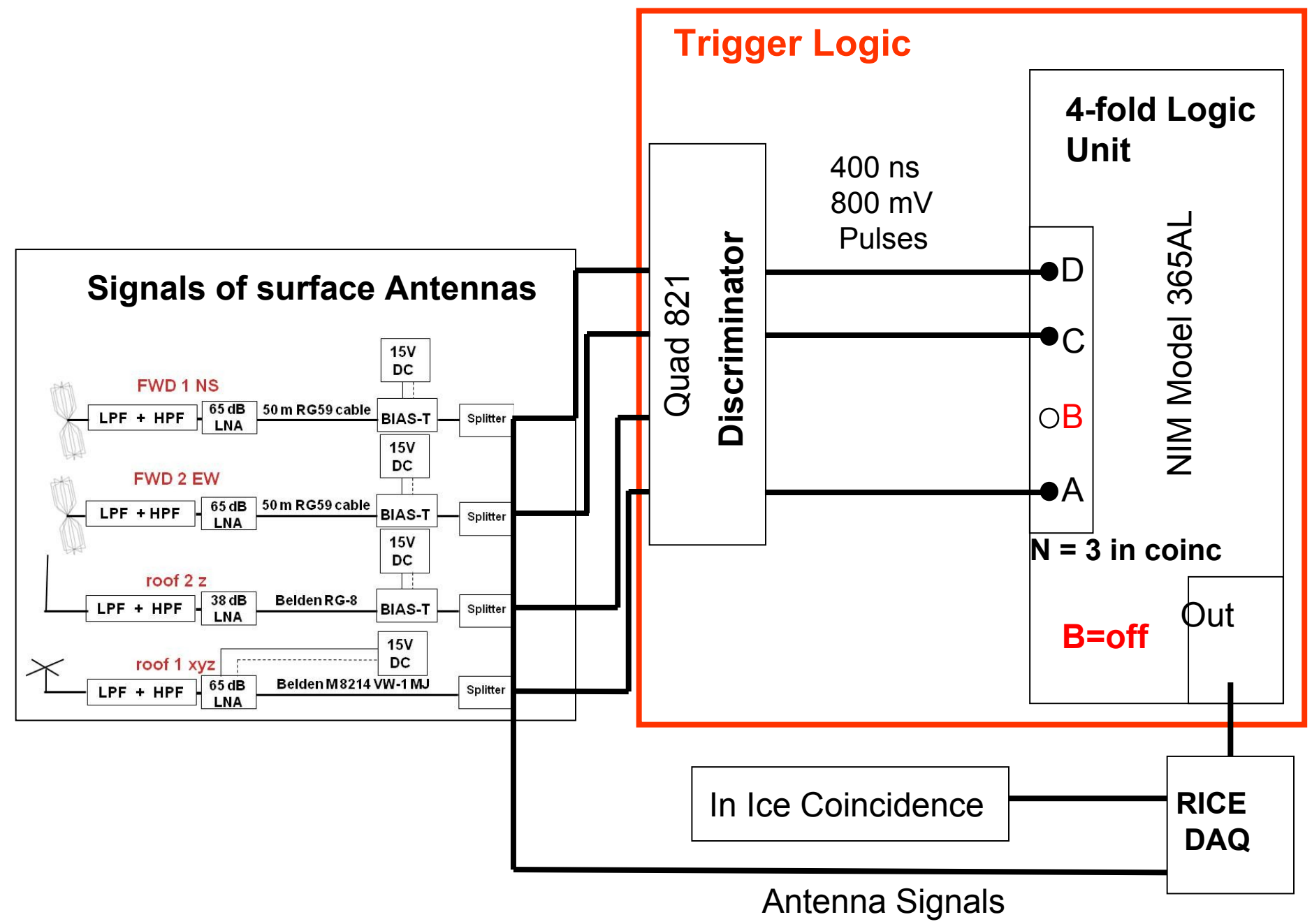
3. The 125m radius around the antennas lead to a detection plane of about 30000 m^2

4. Assuming a E^{-3} spectrum after the knee and taking the values from KASKADE:
The flux at $8.91*10^6$GeV is 6.41 +/- 2 10^{-15} $(s\ sr\ m^2\ Gev)^{-1}$
The integral flux leads to 2.27 $*10^{-10}$ $(m^2\ sr\ s)^{-1}$ with energy threshold 10^8GeV

This together leads to about **1 events/day** with 70% detector “efficiency”.

The new array 2010


FWD 1 NS
LPF + HPF
65 dB LNA
50 m RG59 cable
15V DC
BIAS-T
Splitter
FWD 2 EW
LPF + HPF
65 dB LNA
50 m RG59 cable
15V DC
BIAS-T
Splitter
roof 2 z
LPF + HPF
38 dB LNA
Belden RG-8
15V DC
BIAS-T
Splitter
roof 1 xyz
LPF + HPF
65 dB LNA
Belden M 8214 VW-1 MJ (RG-8)
15V DC
Splitter
Surface Trigger Logic
RICE DAQ
16 In Ice Antennas
In Ice Signals



Threshold at 900mV Amplitude -> 0.7mV in the FWD Antenna

Rate estimate revised

1. I cut away vertical events phi < 30°. I call it MAPO veto.
I cut away events with phi > 60°. Nobody knows about horizontal air showers are detectable.
This gives us about ~~36.6%~~ of the sky.
18%

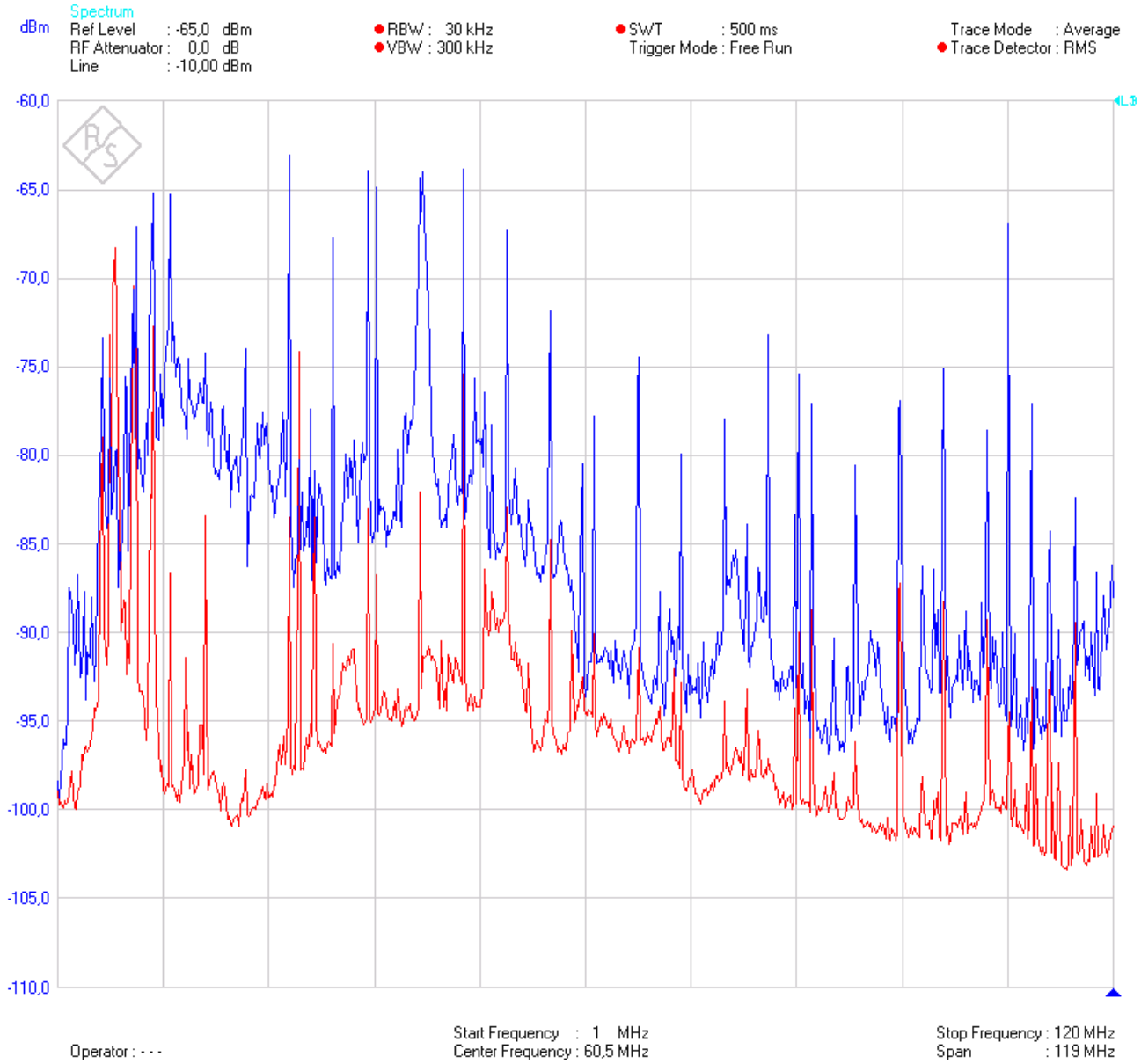
2. The energy threshold will be about 100PeV in about ~~125m~~ distance. For larger distances the Energy threshold is rising. **80m**

3. The 125m radius around the antennas lead to a detection plane of about ~~30000 m^2~~
10000m^2

4. Assuming a E^{-3} spectrum after the knee and taking the values from KASKADE:
The flux at $8.91*10^6$GeV is 6.41 +/- 2 10^{-15} (s sr m^2 Gev)$^{-1}$
The integral flux leads to 2.27 *10^{-10} (m^2 sr s)$^{-1}$ with energy threshold 10^8GeV

This together leads to about ~~**1 events/day**~~ with 70% detector "efficiency".
maybe 1 event/week?

The ghost signal



Measurement Setup		
Name	fwd e-w 004	aachen n-s 003
Date	7 / 2 / 2010	7 / 2 / 2010
Time	4:09:55	4:03:11
Instrument	FSH4 - 100268/024	FSH4 - 100268/024
Firmware Version	V1.21	V1.21
Instrument Mode	Spectrum	Spectrum
Meas Mode	Spectrum	Spectrum
Channel Table	- - -	- - -
Channel	- - -	- - -
Center Frequency	60,5 MHz	60,5 MHz
Frequency Offset	0 Hz	0 Hz
Span	119 MHz	119 MHz
Ref Level	-65,0 dBm	-65,0 dBm
Ref Offset	0,0 dB	0,0 dB
Range	50 dB	50 dB
RF Attenuation	Auto Low Distortion	Auto Low Distortion
RF Attenuator	0,0 dB	0,0 dB
Preamplifier	Off	Off
RF Input	50 Ohm	50 Ohm
RBW	30 kHz	30 kHz
VBW	300 kHz	300 kHz
SWT	500 ms	500 ms
Trigger Mode	Free Run	Free Run
Trigger Level	- - -	- - -
Trigger Delay	- - -	- - -
Trace Mode	Average	Average
Trace Math	Off	Off
Trace Detector	RMS	RMS
Limit Line 1	- - -	- - -
Limit Line 2	- - -	- - -
Primary Transducer	- - -	- - -
Secondary Transducer	- - -	- - -

Is gone by now!