Andreas Schultes

Radio air shower detector at Icecube
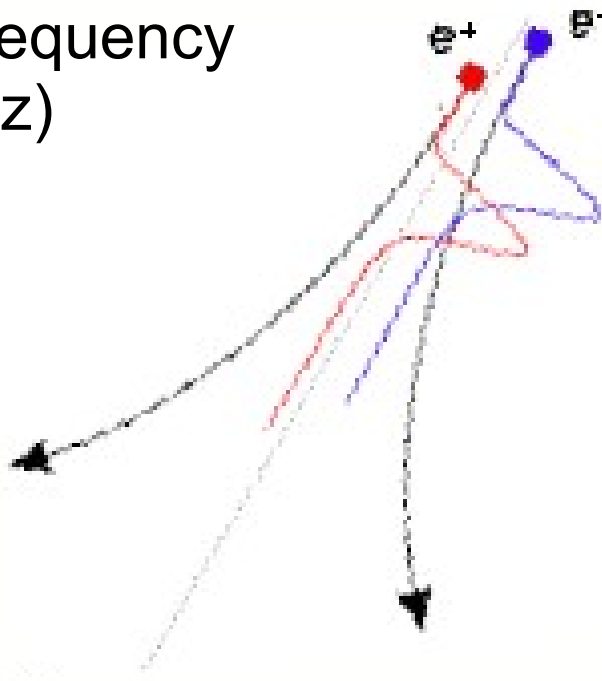
Astroteilchenschule
17.09.2009

Outline

Synchrotron effect in Earths magnetic field

three component air shower detector

Radio antenna

Voltage Standing Wave Ratio (VSWR)

Measurement of VSWR

Compare the VSWR with Simulation

Spectrum from Wuppertal

Outlook

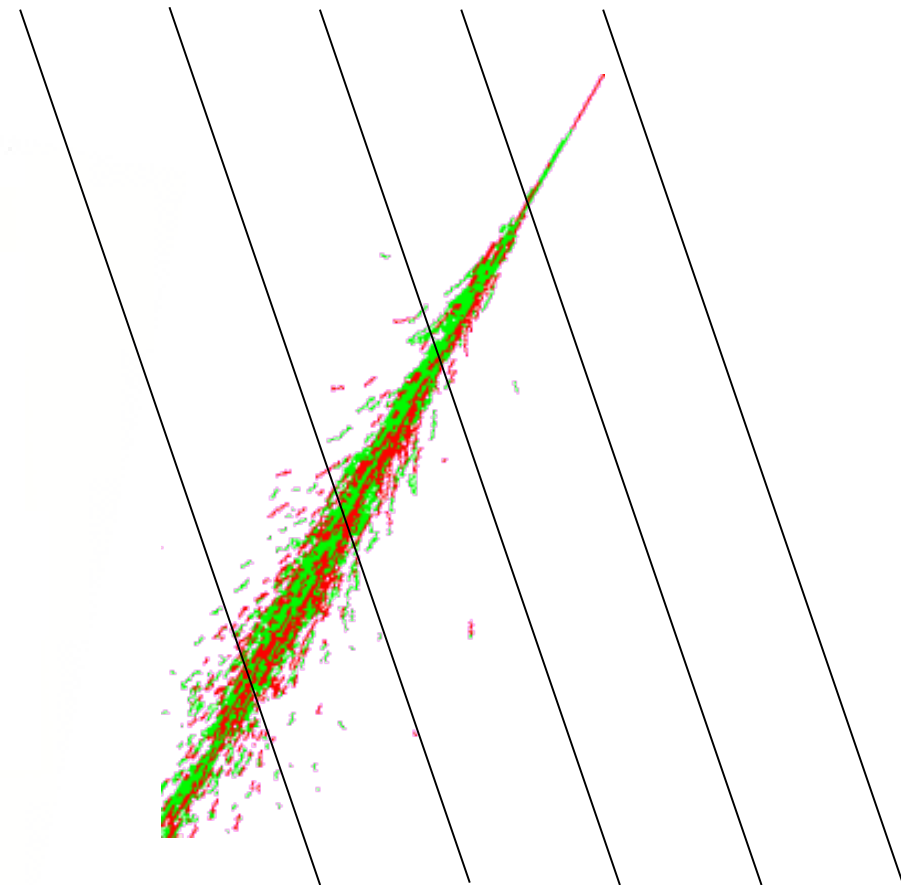# Synchrotron effect in Earth's magnetic field

Geo-synchrotron effect: electro magnetic charged particles in earths magnetic field
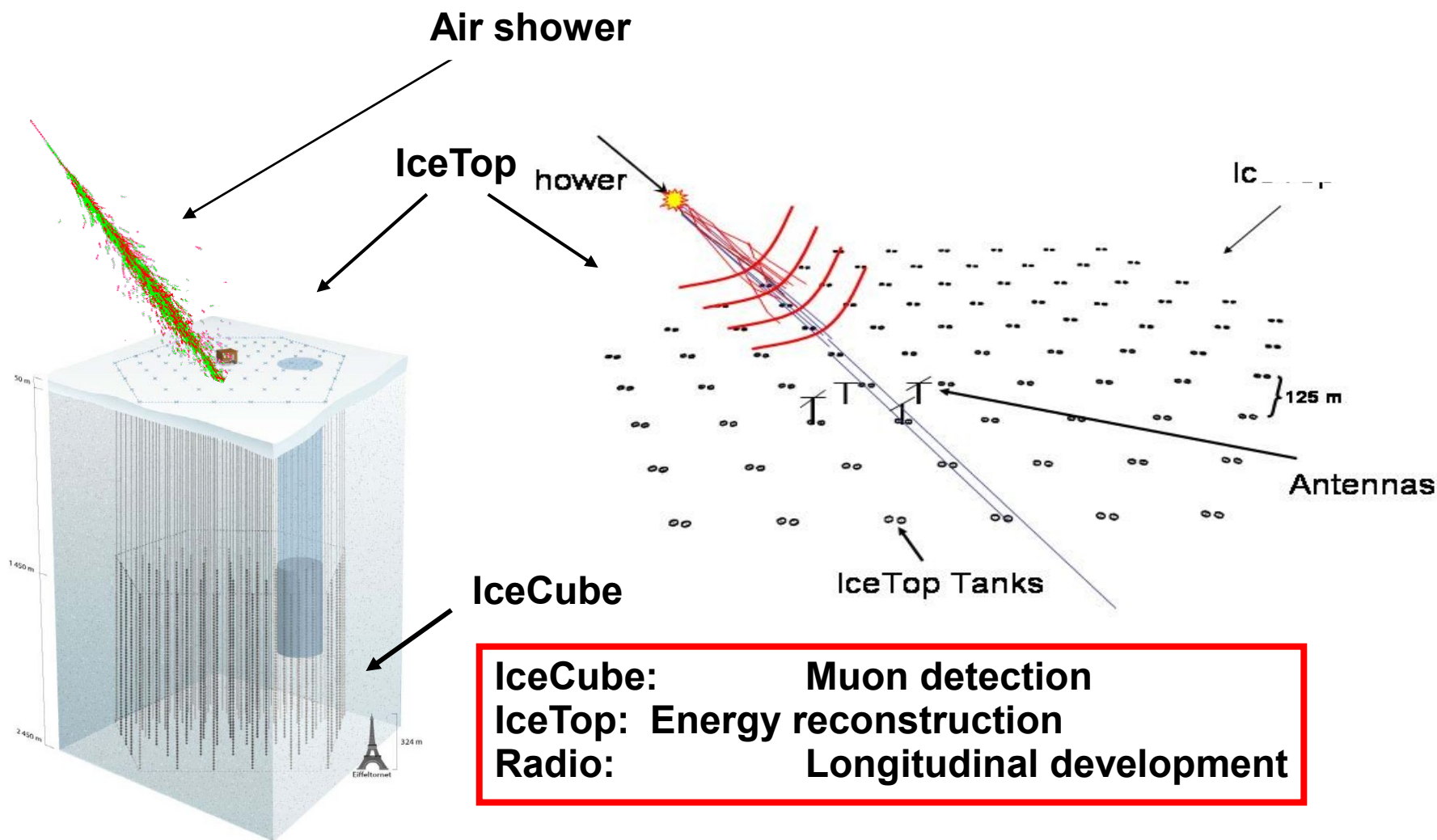
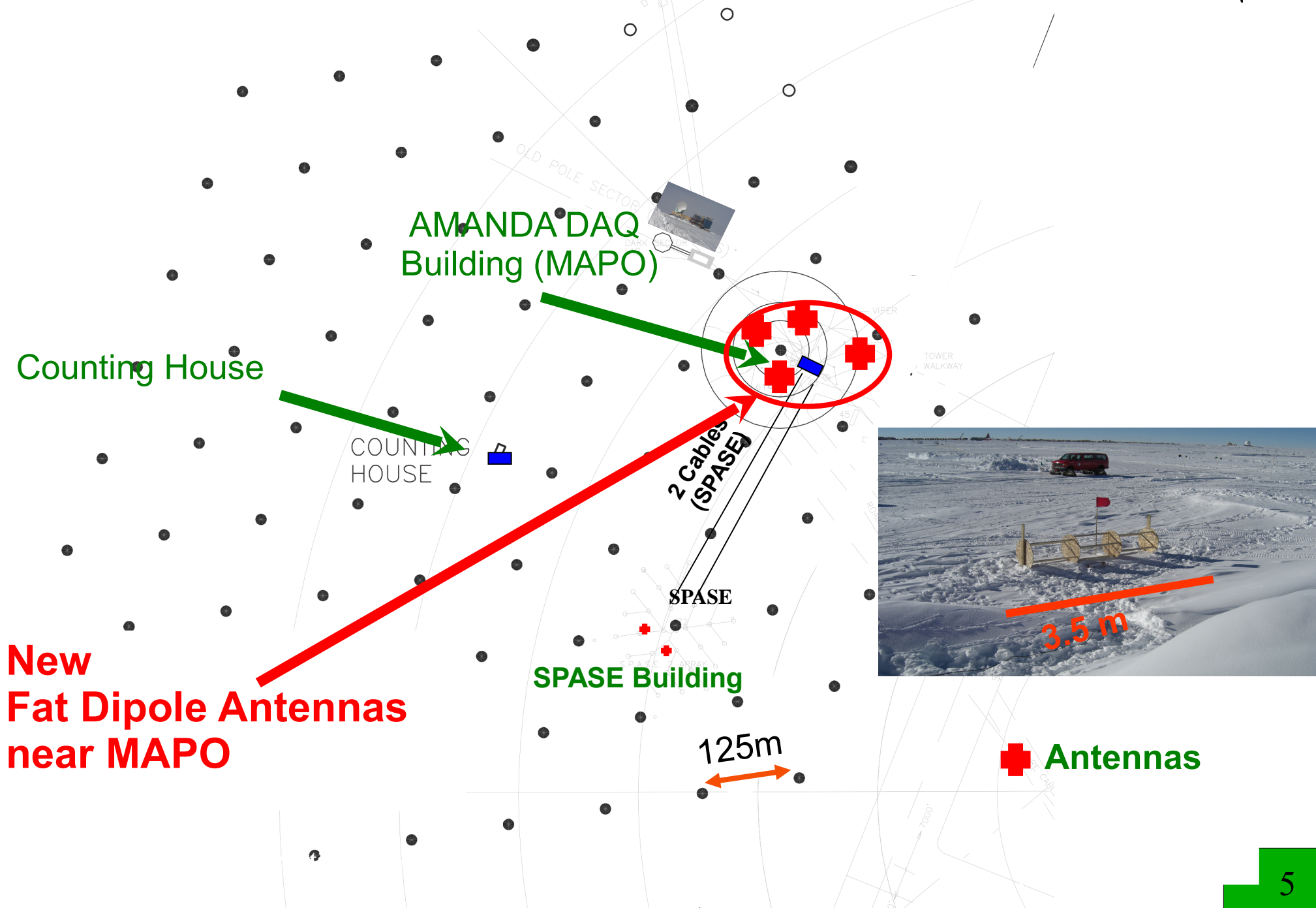Short radio pulses in time (length: few 10ns)

Broad in frequency (1-150 MHz)

B-Field

Primary goal:
A three component air shower detector

Air shower

IceTop

IceCube

IceTop Tanks

Antennas

125 m

IceCube: Muon detection
IceTop: Energy reconstruction
Radio: Longitudinal development

Deployment Configuration

AMANDA DAQ Building (MAPO)

Counting House

New Fat Dipole Antennas near MAPO

2 Cables (SPASE)

SPASE

SPASE Building
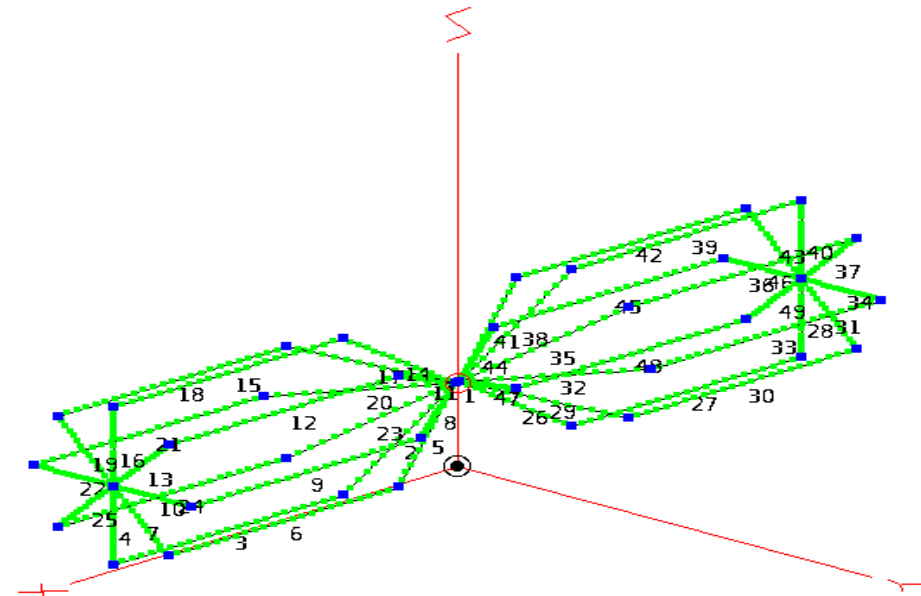
125m

3.5 m

Antennas

The Antenna

Fat wire dipole

Developed for a frequency range
from 25 to 100MHz
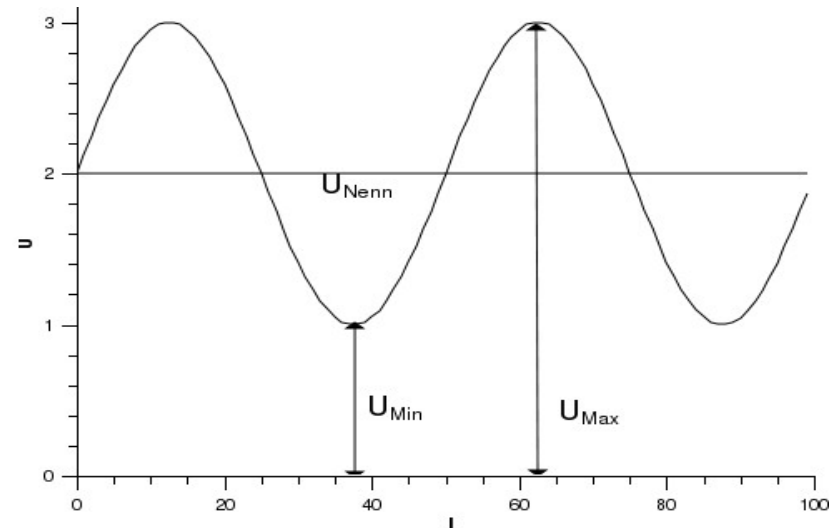
Length about 3.5 meter

Diameter 76cm

Weight 32 Kg

Voltage Standing Wave Ratio - (V)SWR

The impedance of the antenna is different to the impedance of the transmission line.

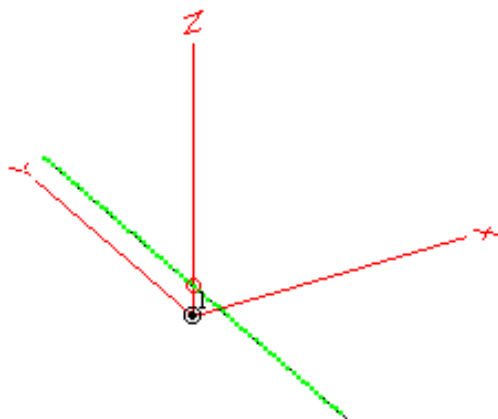The match of the antenna to the transmission line can expressed as voltage standing wave ratio

$$S = \frac{U_{Max}}{U_{Min}} = \frac{U_{forward} + U_{reflected}}{U_{forward} - U_{reflected}} = \frac{U_{forward}(1+R)}{U_{forward}(1-R)} = \frac{1+R}{1-R}$$
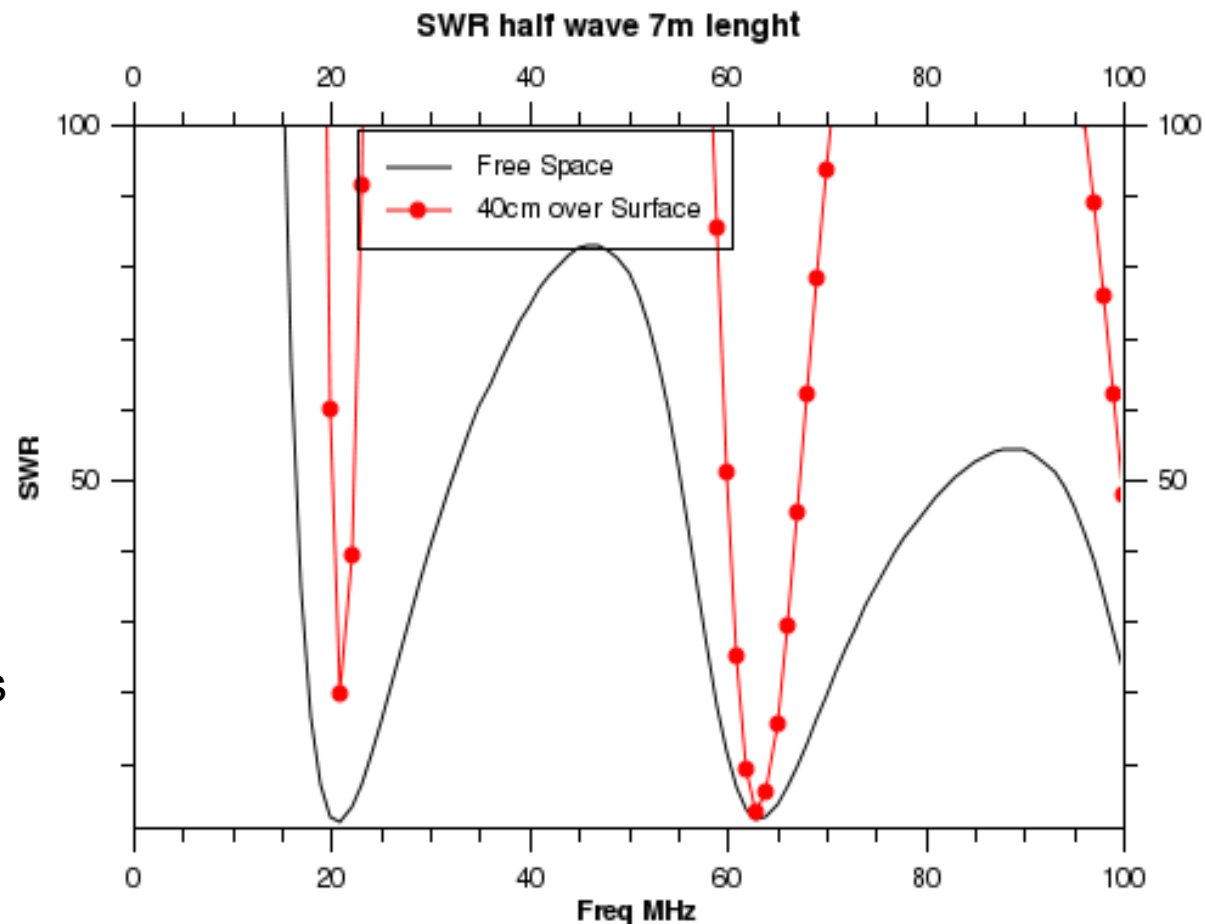
For SWR > 1 the impedance mismatch gets increasingly bad

SWR   1 ———————— 1.5 ———————— 2 ———————— 3 ———————— ∞

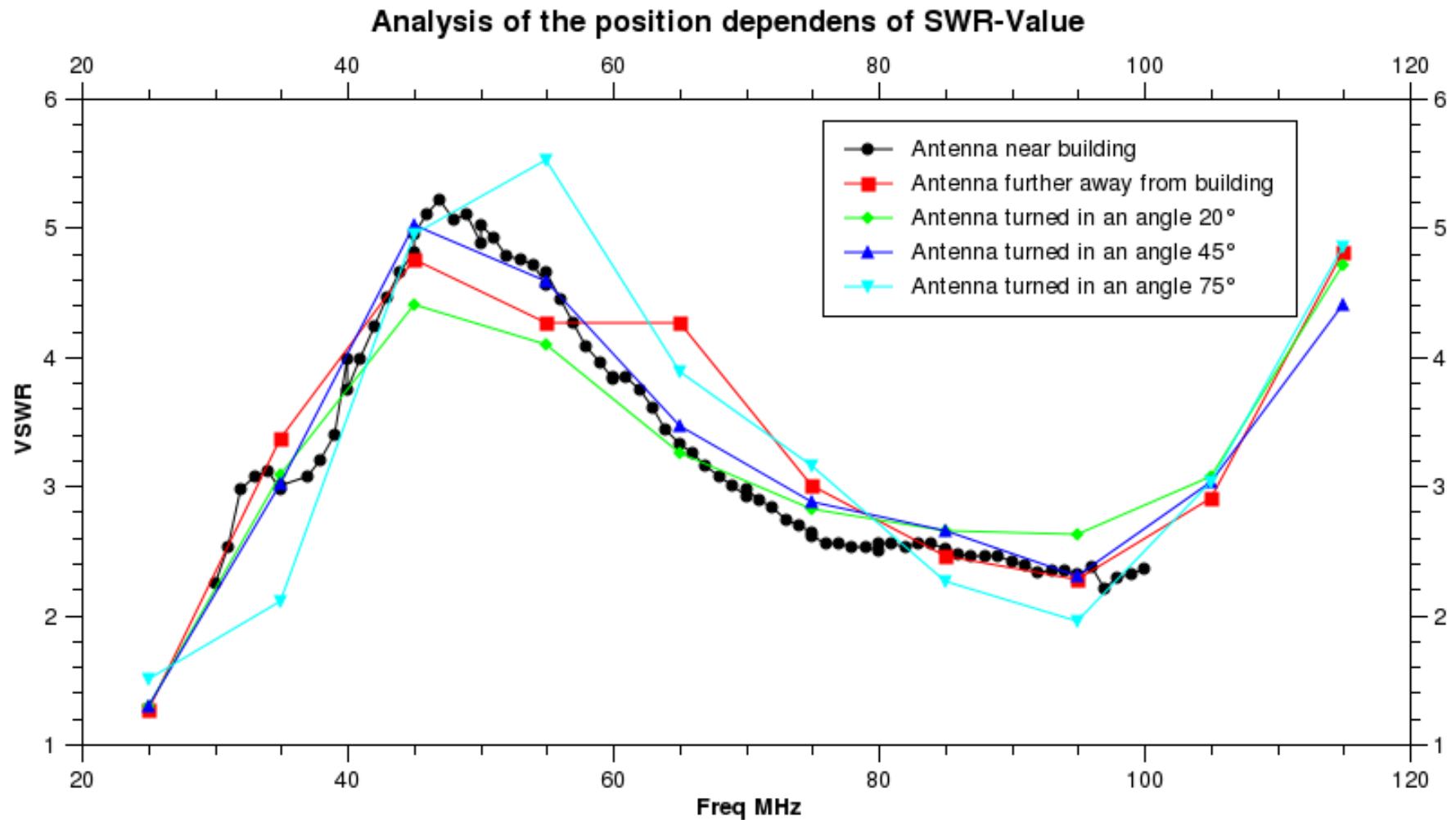ideal   Good match   Bad match

For Example: Dipole Antenna

Only useful for certain frequencies

SWR-Measurement

Analysis of the position dependens of SWR-Value

- Antenna near building
- Antenna further away from building
- Antenna turned in an angle 20°
- Antenna turned in an angle 45°
- Antenna turned in an angle 75°

SWR-Simulation

Measurement und Simulation
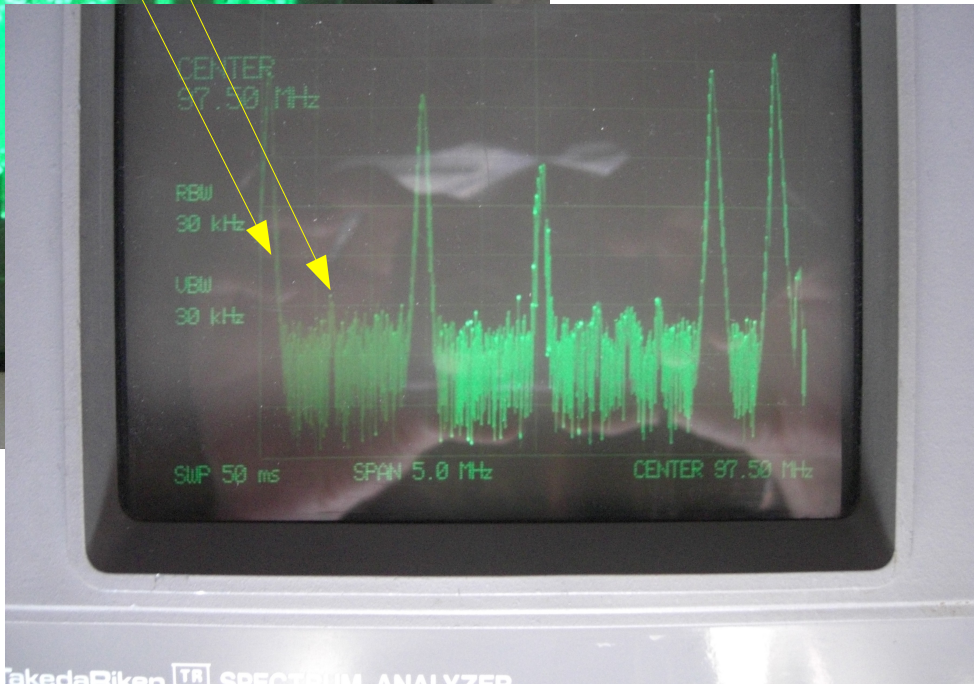
Legend:
- Simulation with sandground
- Simulation without ground
- Average from 4 measurement
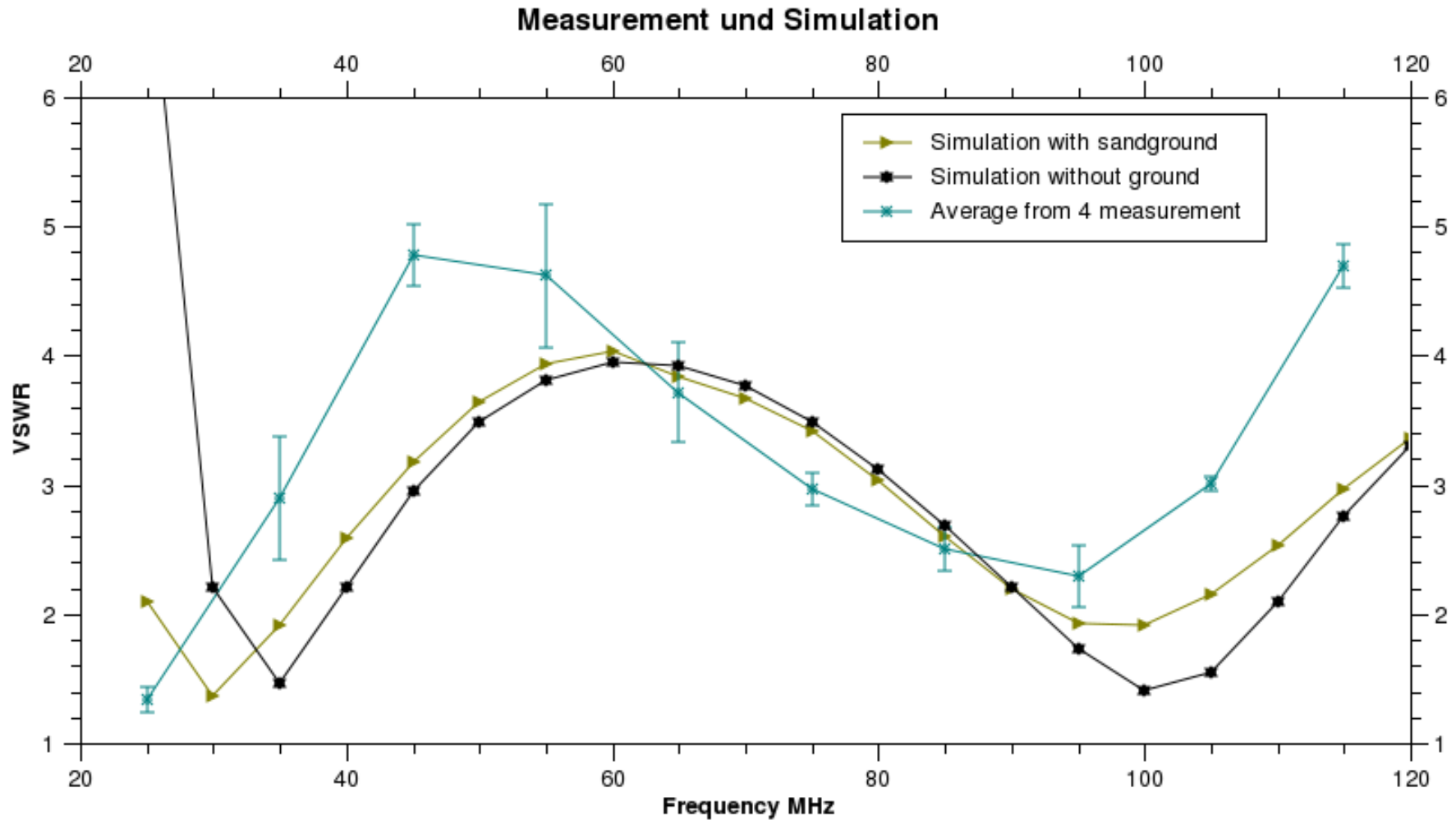
The ground have an effect on frequency shift of the VSWR value

Measurement at south pole

Comparsion with VSWR-Measurement at southpole
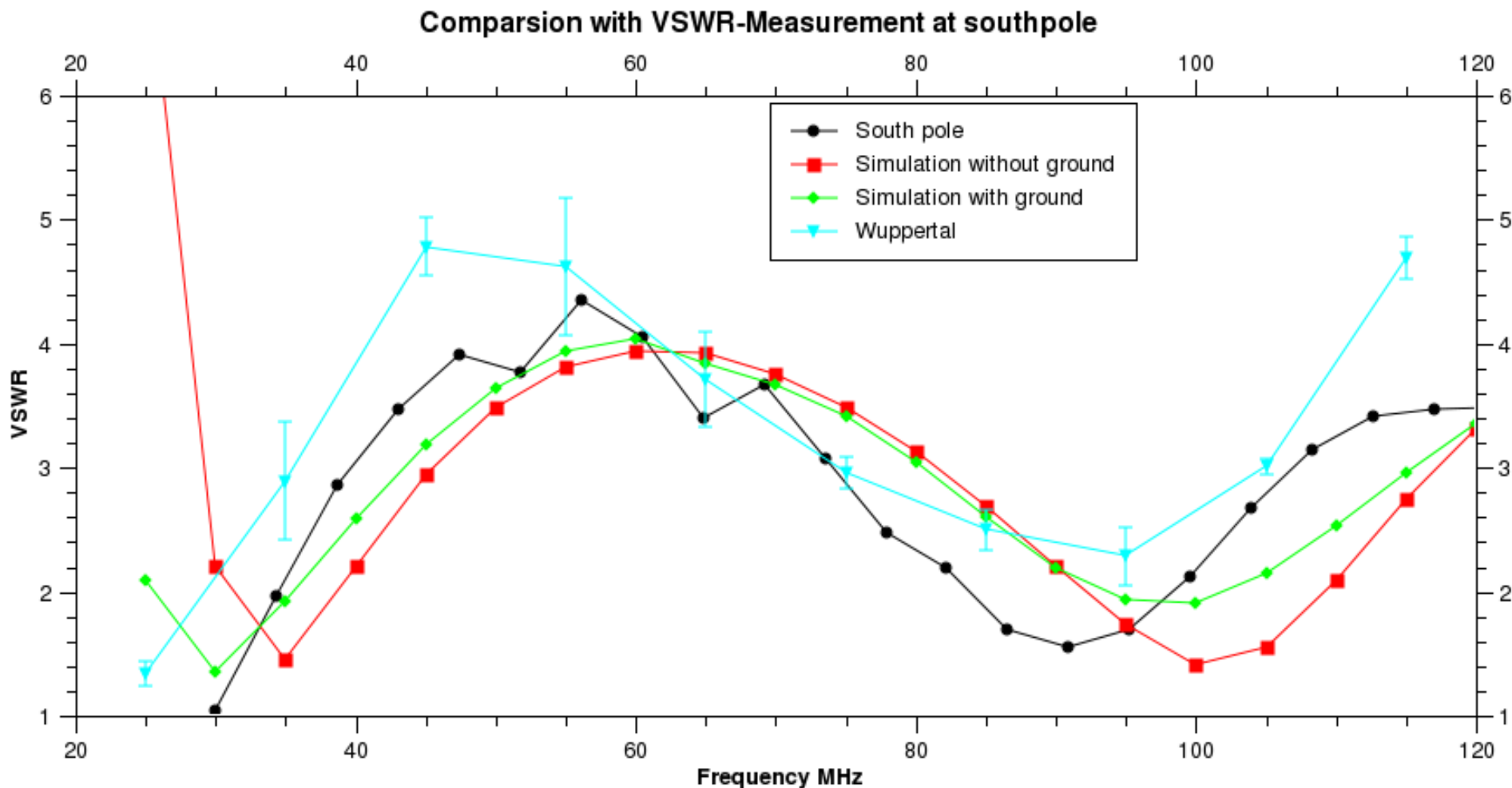
Ground effects is an important point

Spectrum
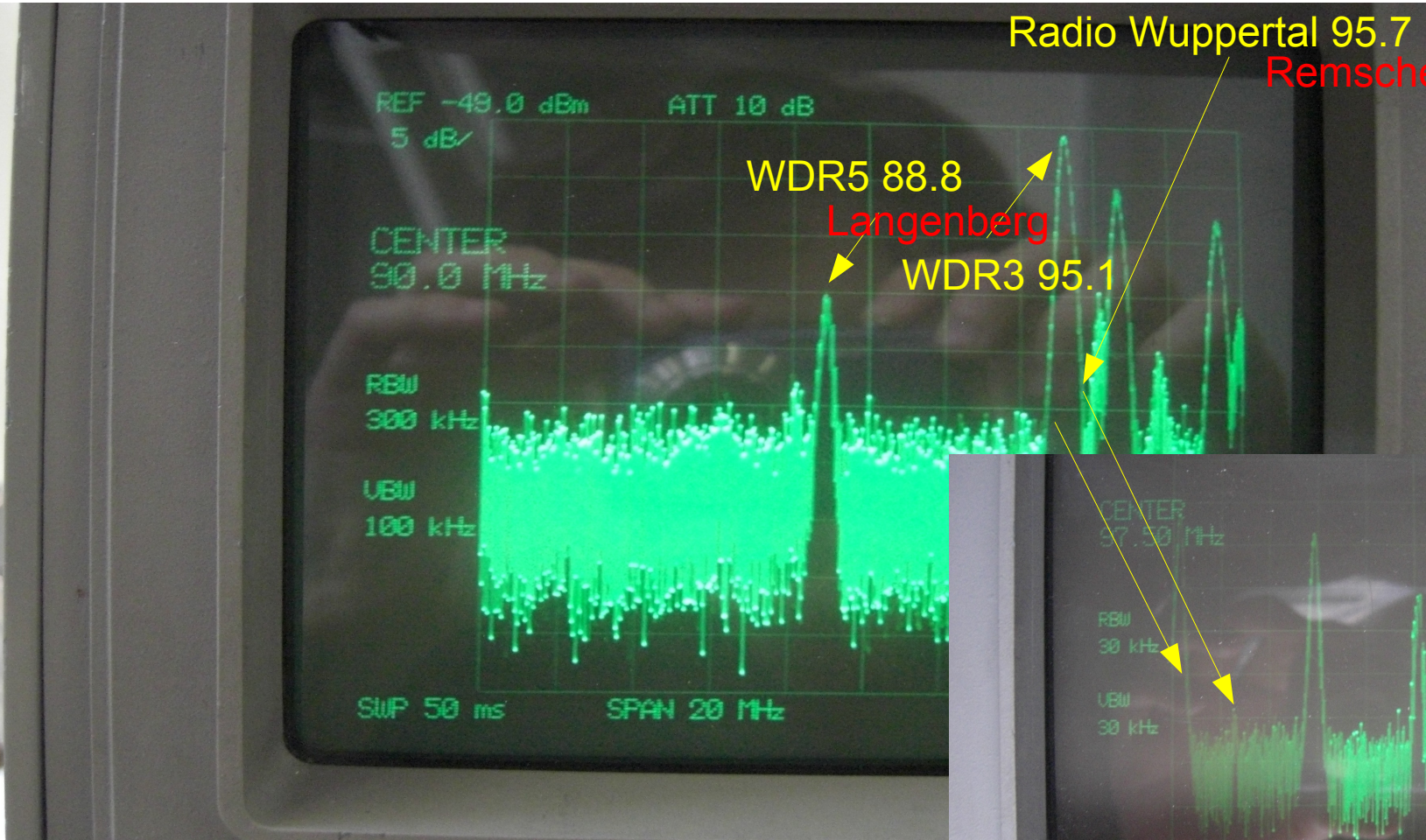
2 different radio sender station
Langenberg and Remscheid

Outlook

Deployment of 6 new antenna at south pole

Measurement without disturbing near field

Antenna connect to Sky-View

Simulation

Ground-Effects

Group-Delay

Impedance match