

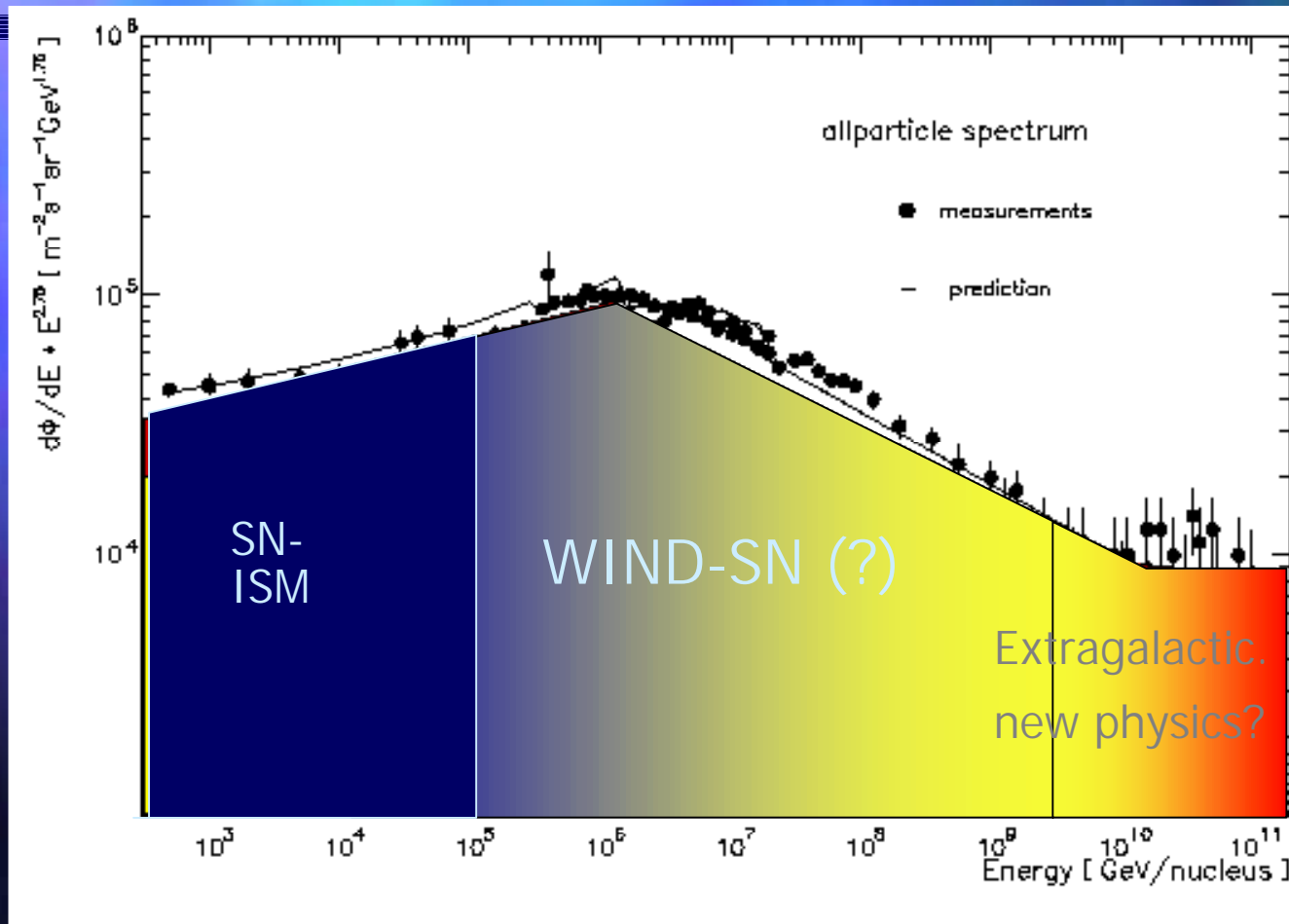


# SkyView

Search for UHECR  
in NRW and neighboring regions  
- fundamental science at schools-

W. Rhode, Universität Wuppertal

# Cosmic Ray Flux



Super Novae up to  $10^{14}$  eV

KASKADE, HEGRA  
( $< 10^{16/17}$  eV)

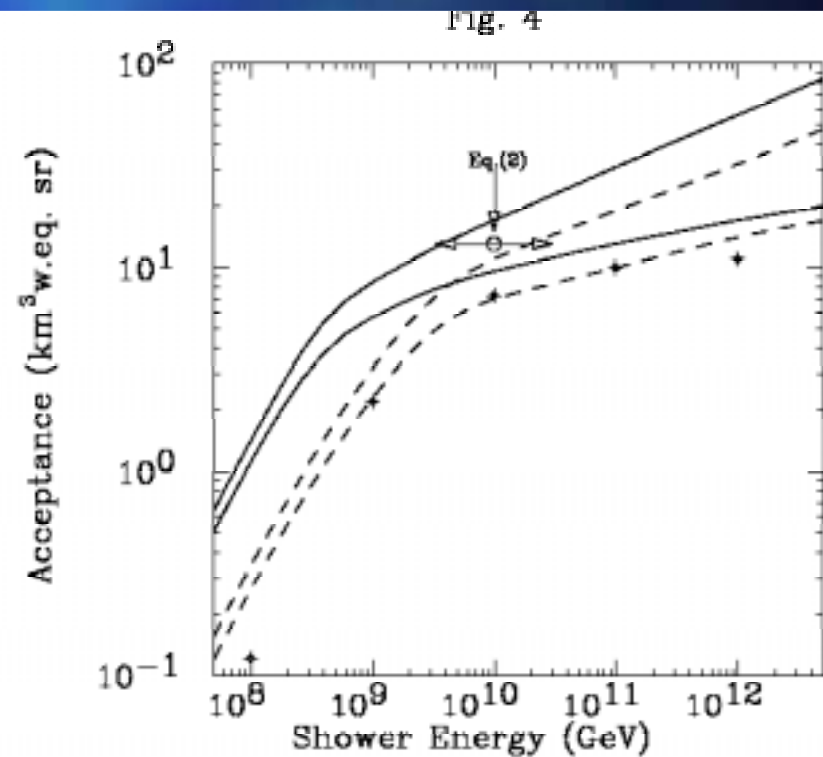
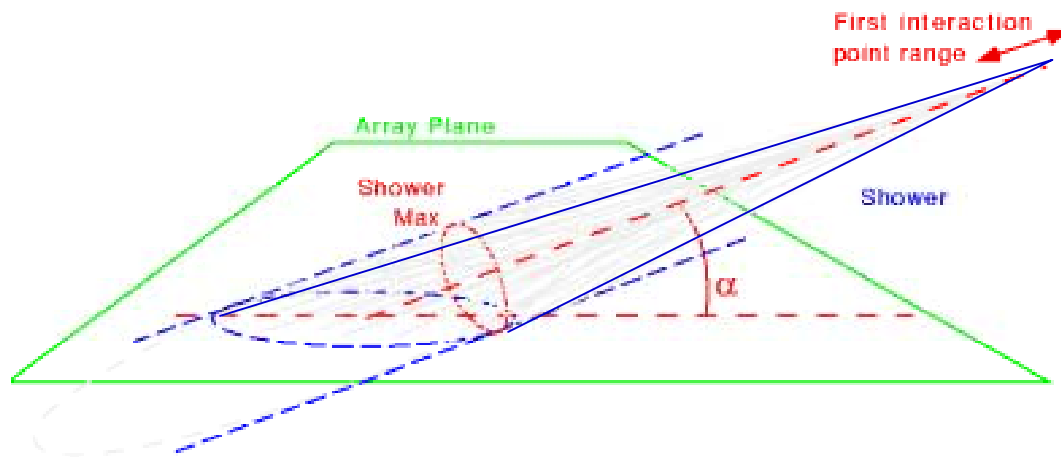
Galaxy up to  $3 \cdot 10^{18}$  eV (one quant. model)  
AGASA

Extending above  $5 \cdot 10^{19}$  eV  
(extragalactic, new physics?) AUGER, HIRES

Typical Detector Distance [m]      100    200    400    1000

# (Additional) Search for:

- Coincident Distant Shower Structures
- Horizontal Airshowers
  - Neutrino Telescope:



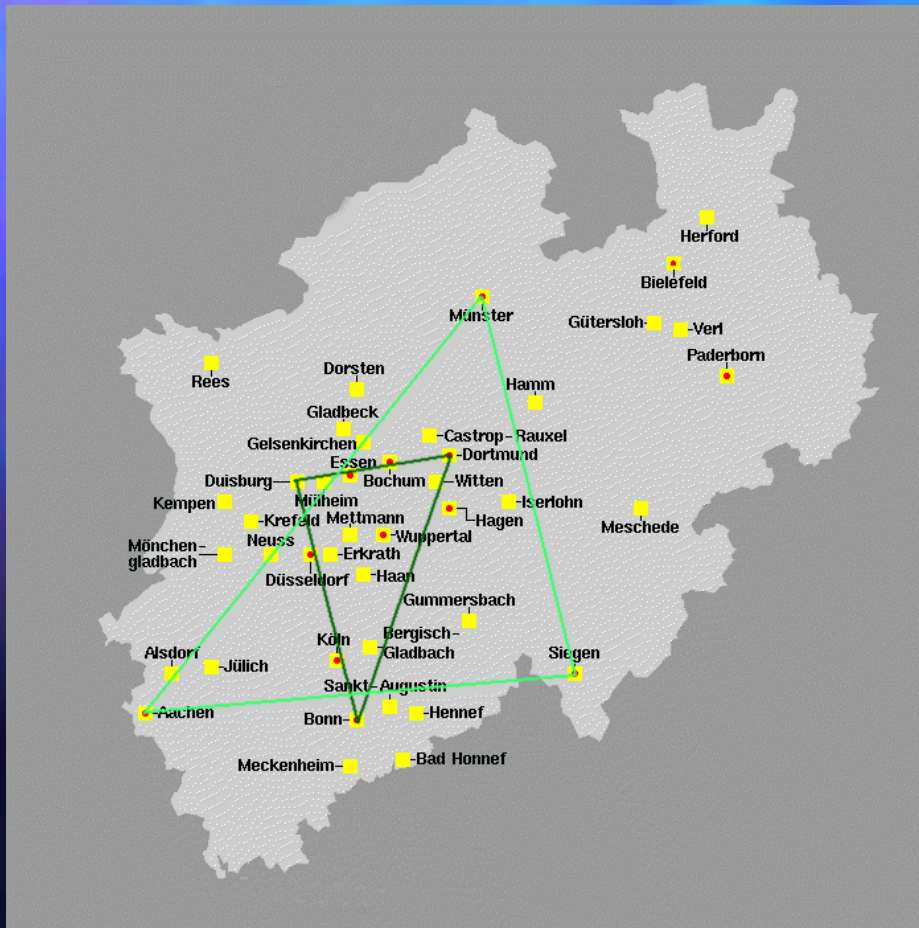
# The idea...

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- ...good public infrastructure in NRW...
- ...need to motivate pupils for physics...
- ... it is possible to build an air shower array of  $\sim 3000 \text{ km}^2$



# Nordrhein-Westfalen



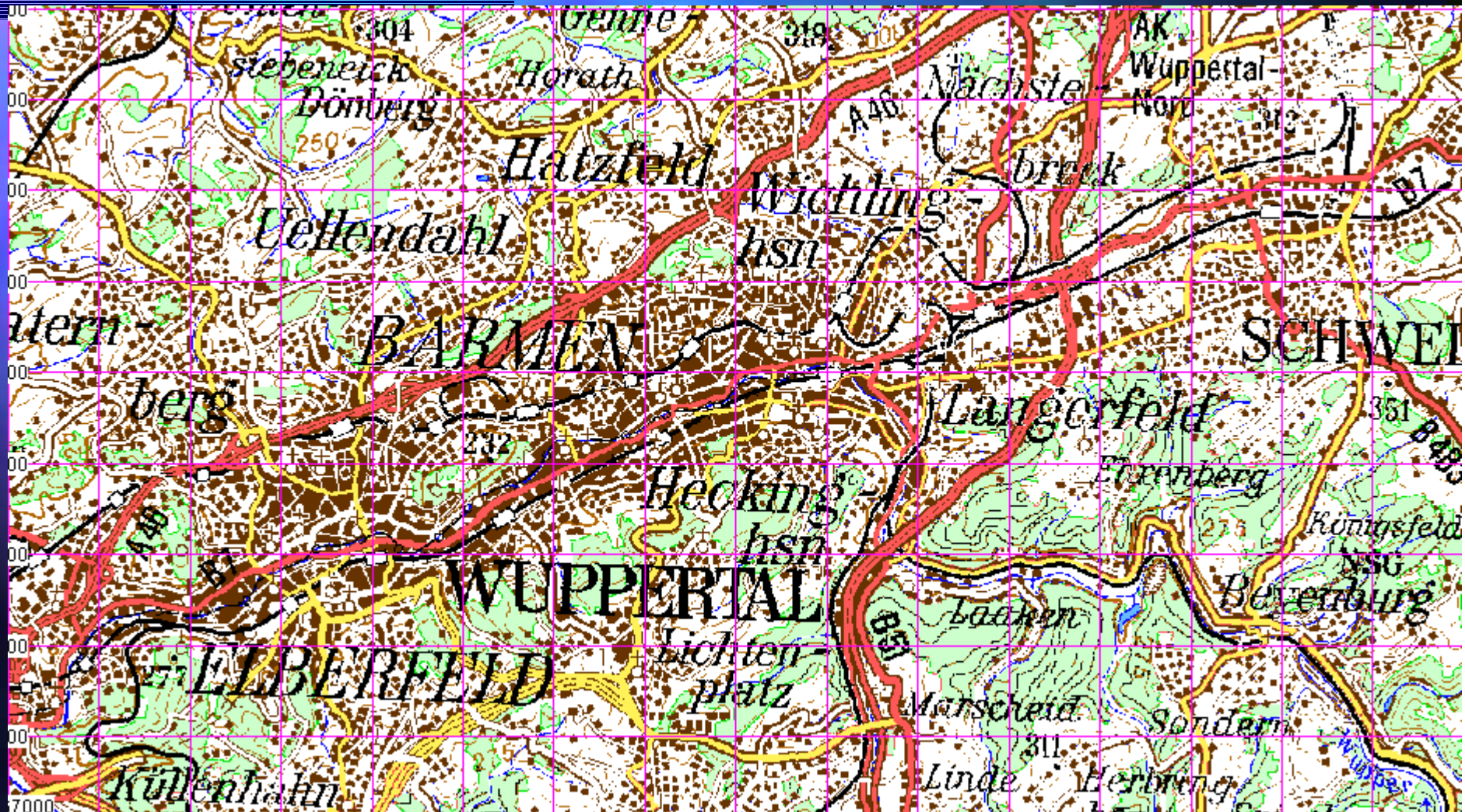
## ■ Triangle (1)

- Bonn
- Duisburg
- Dortmund: 4300 km<sup>2</sup>

## ■ Triangle (2)

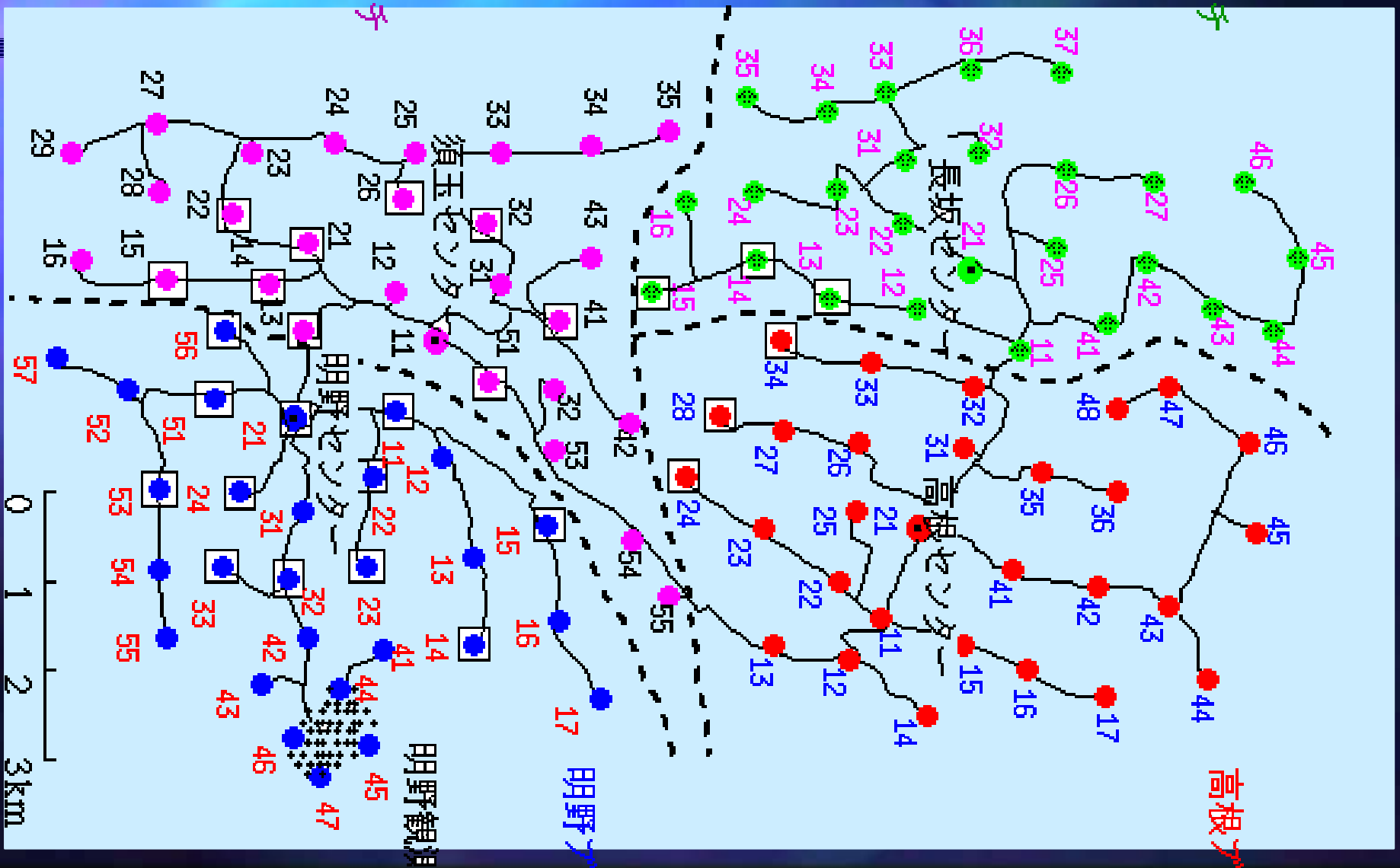
- Aachen
- Siegen
- Münster: 15000 km<sup>2</sup>

# Wuppertal: 1km-grid, 150km<sup>2</sup>





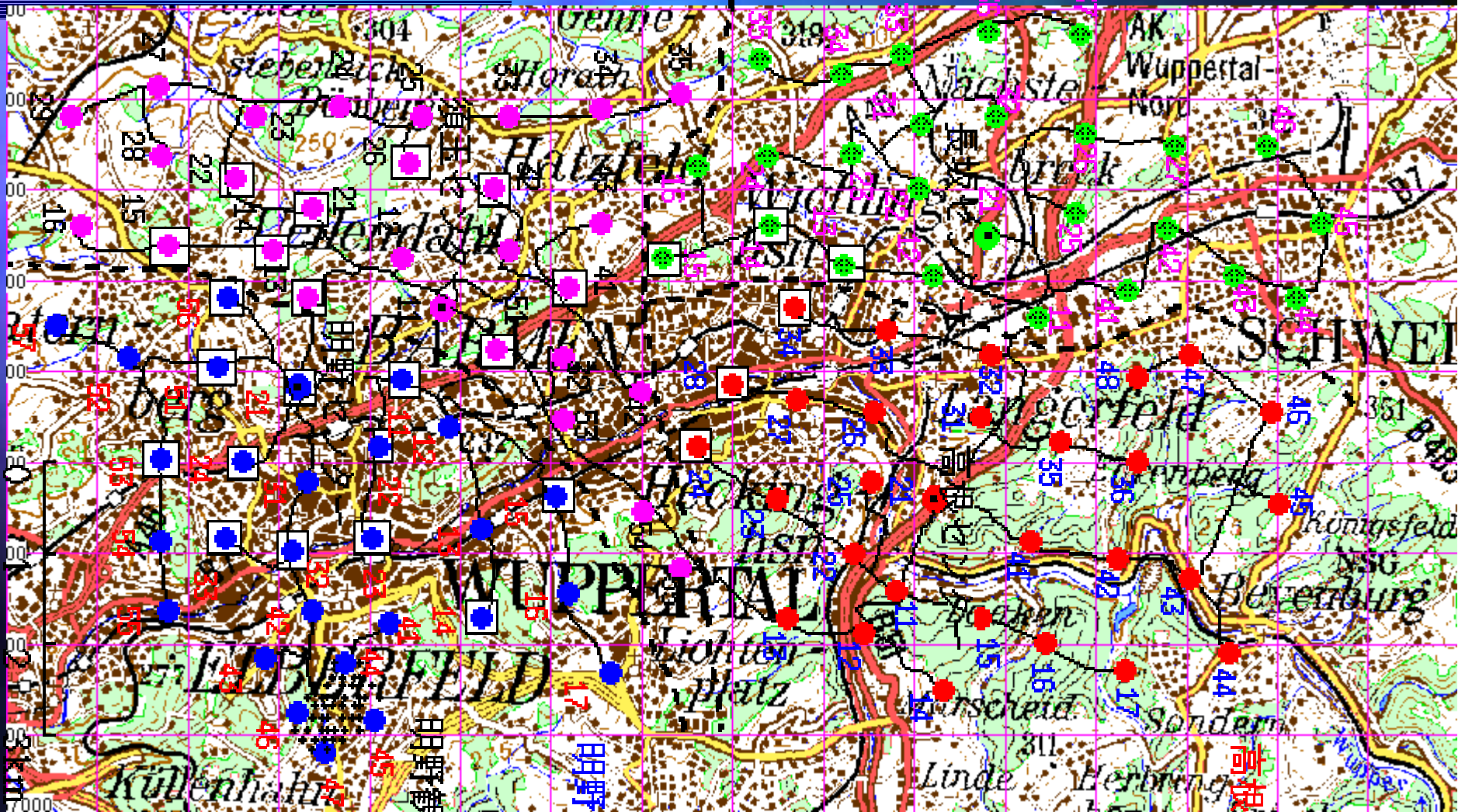
# AGASA: same scale...



# "Wuppertal-Array"

須賀マサシ

長坂マサシ



田野 幸三

明野

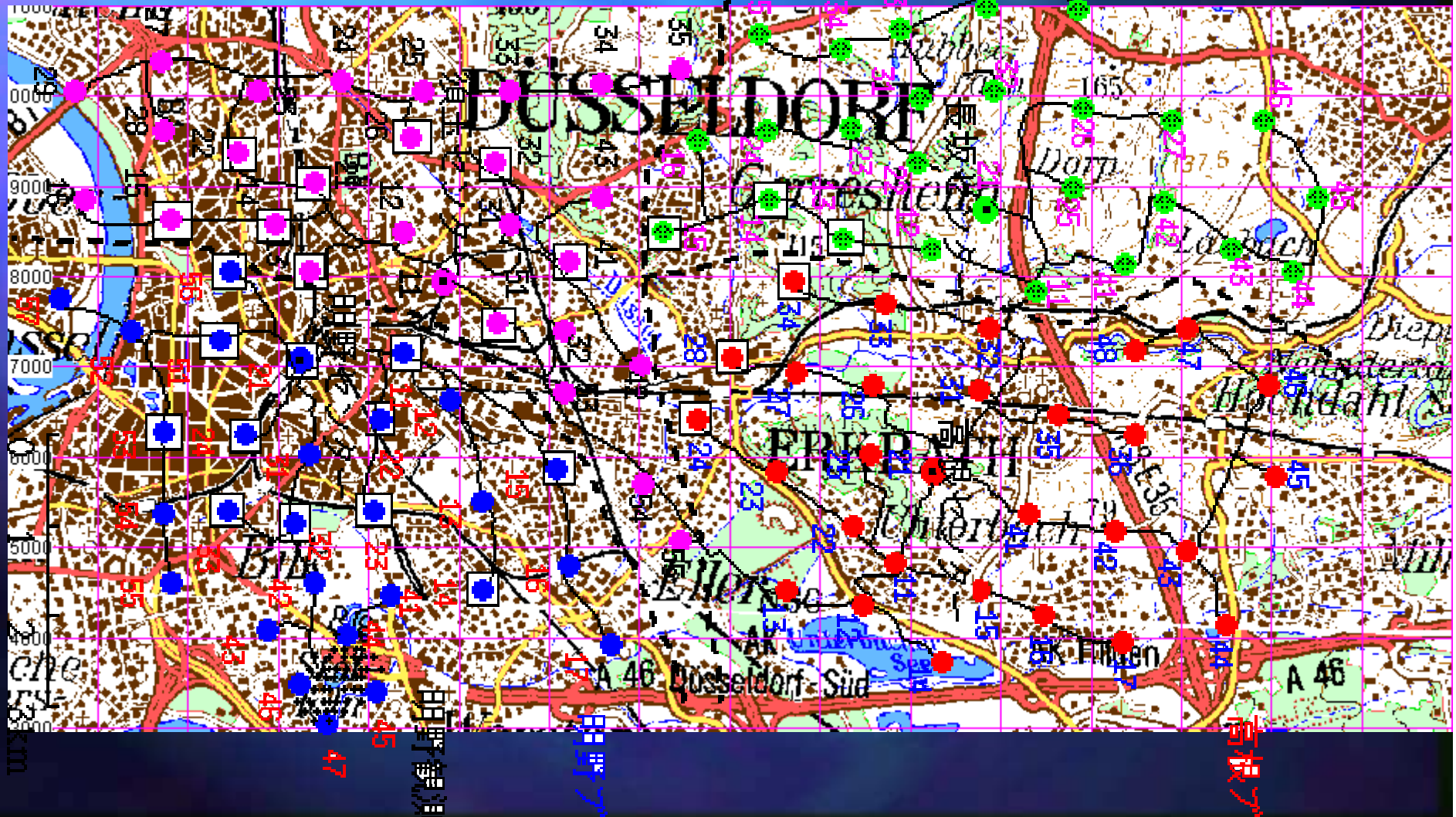
高根



# "Düsseldorf-Array"

須王マッシュ

長坂マッシュ



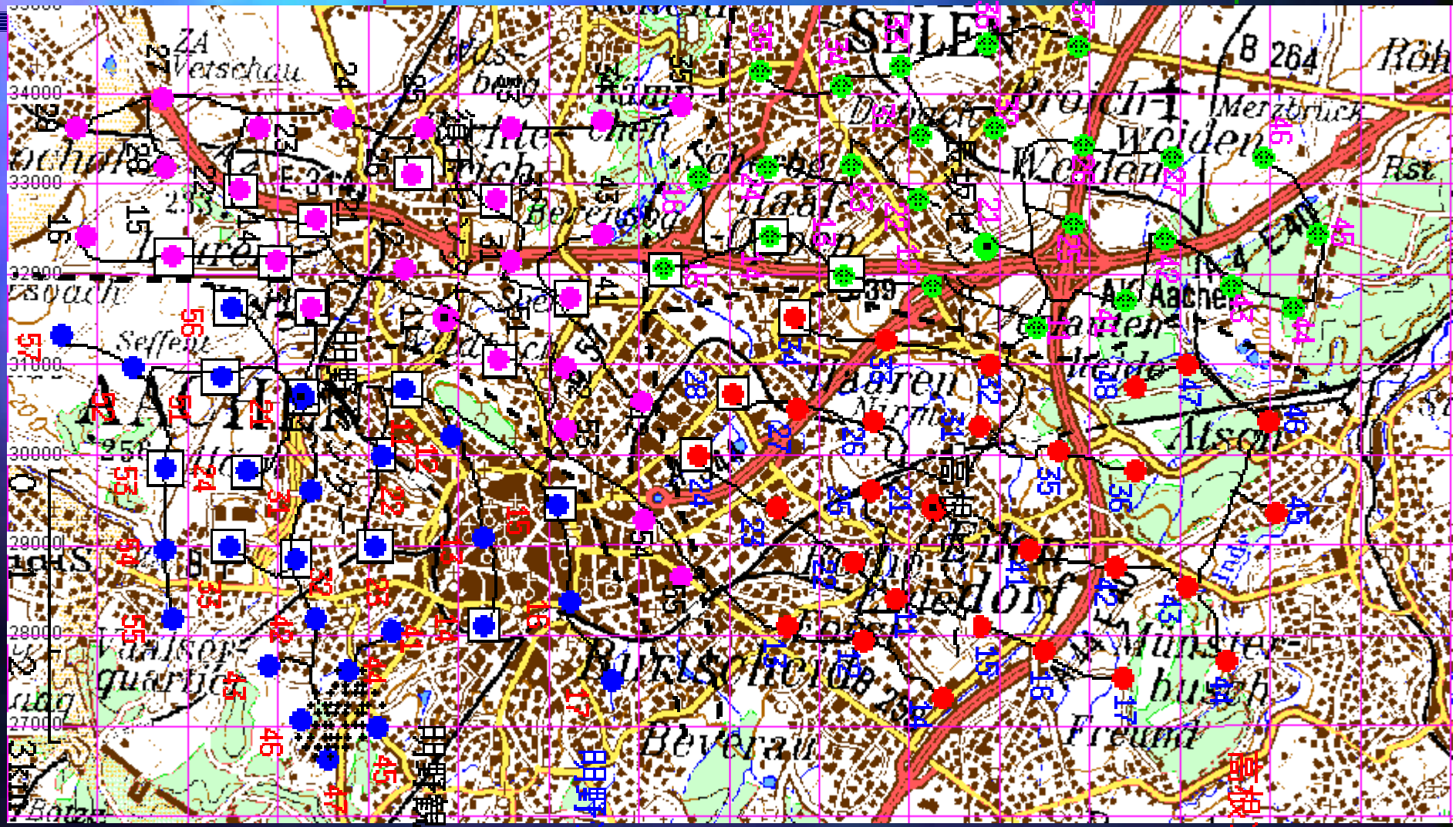
高根マッシュ

高根マッシュ

須玉のまち

# "Aachen-Array"

長坂のまち



中野

長坂



# LOFAR

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- LOw Frequency radio ARray
- Phased array in northern Netherlands
- Highly flexible radio beam formed in Computer through phasing
- Ideal for coincidences on very short time scales
- Detection of Air Showers in Radio Waves
- see talk Heino Falcke

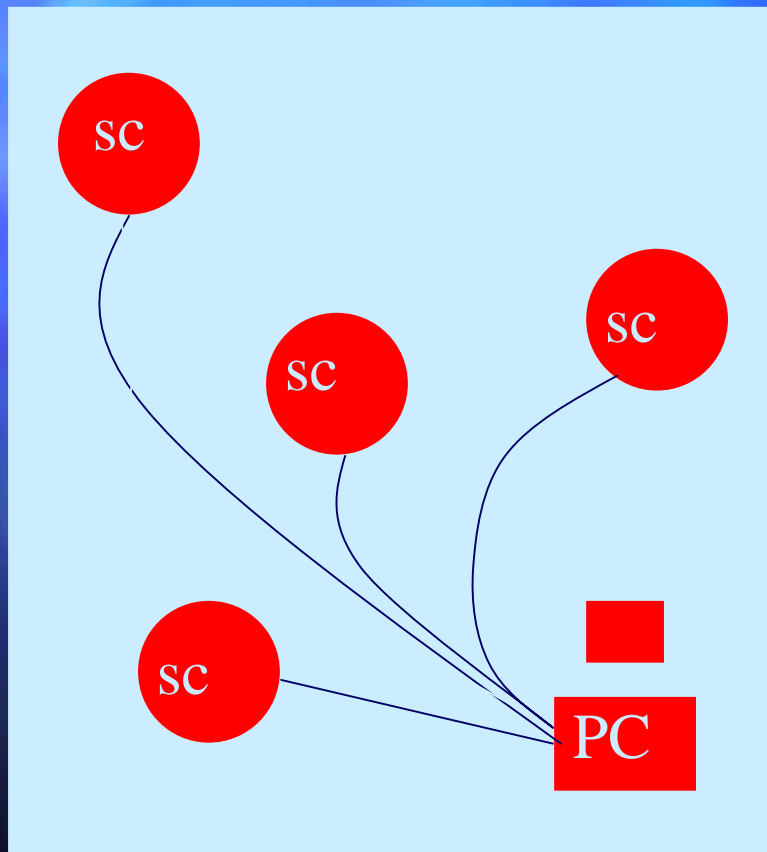


# Instrumentation Strategy

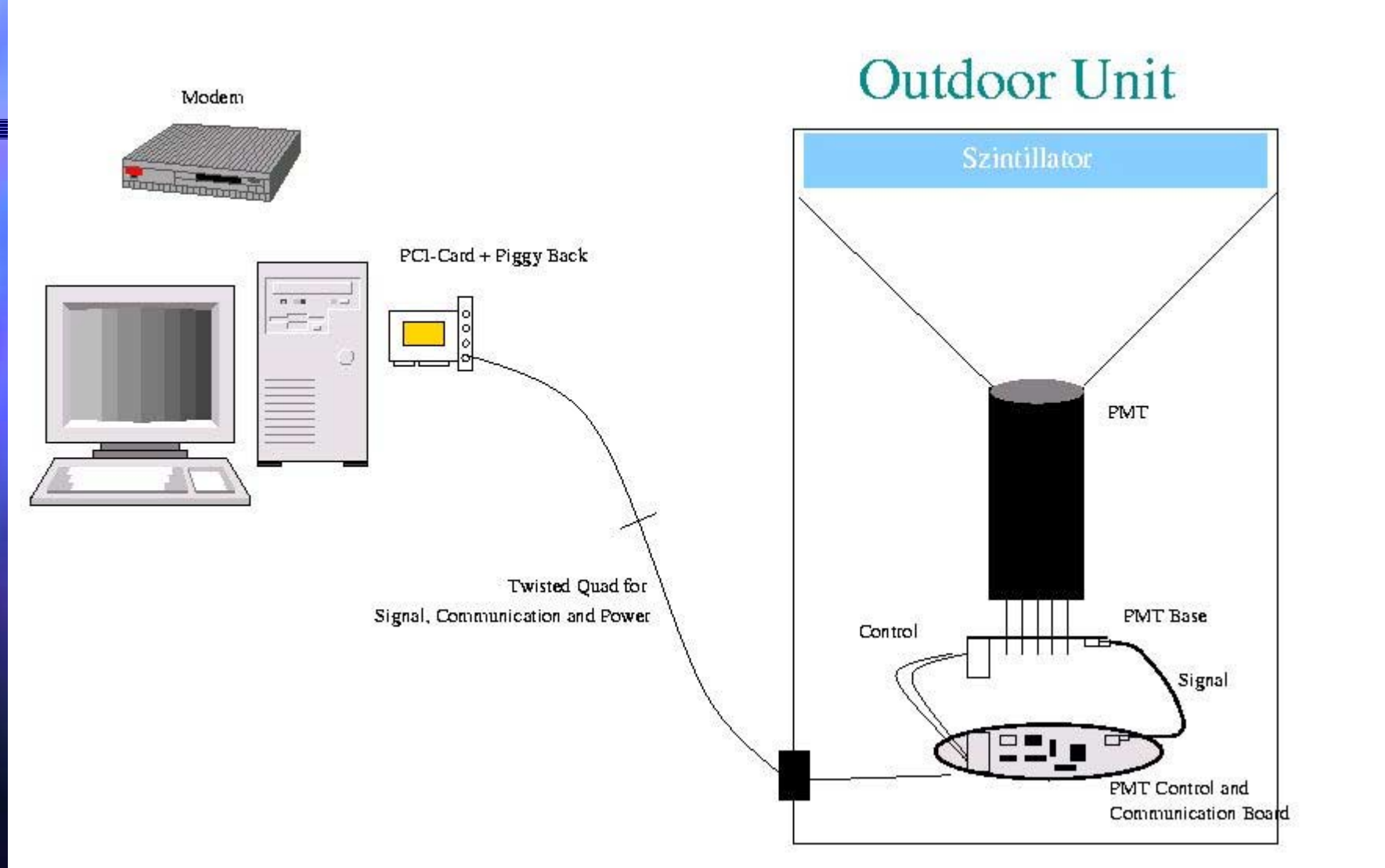
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- (0) small test setups around the contributing universities
  - test of LOFAR coincidences
- (1) dense instrumentation of a few towns
  - n times 150 km<sup>2</sup>
  - physics below the ankle
- (2) large area instrumentation ...3000 km<sup>2</sup>
  - with LOFAR 15000 km<sup>2</sup> possible

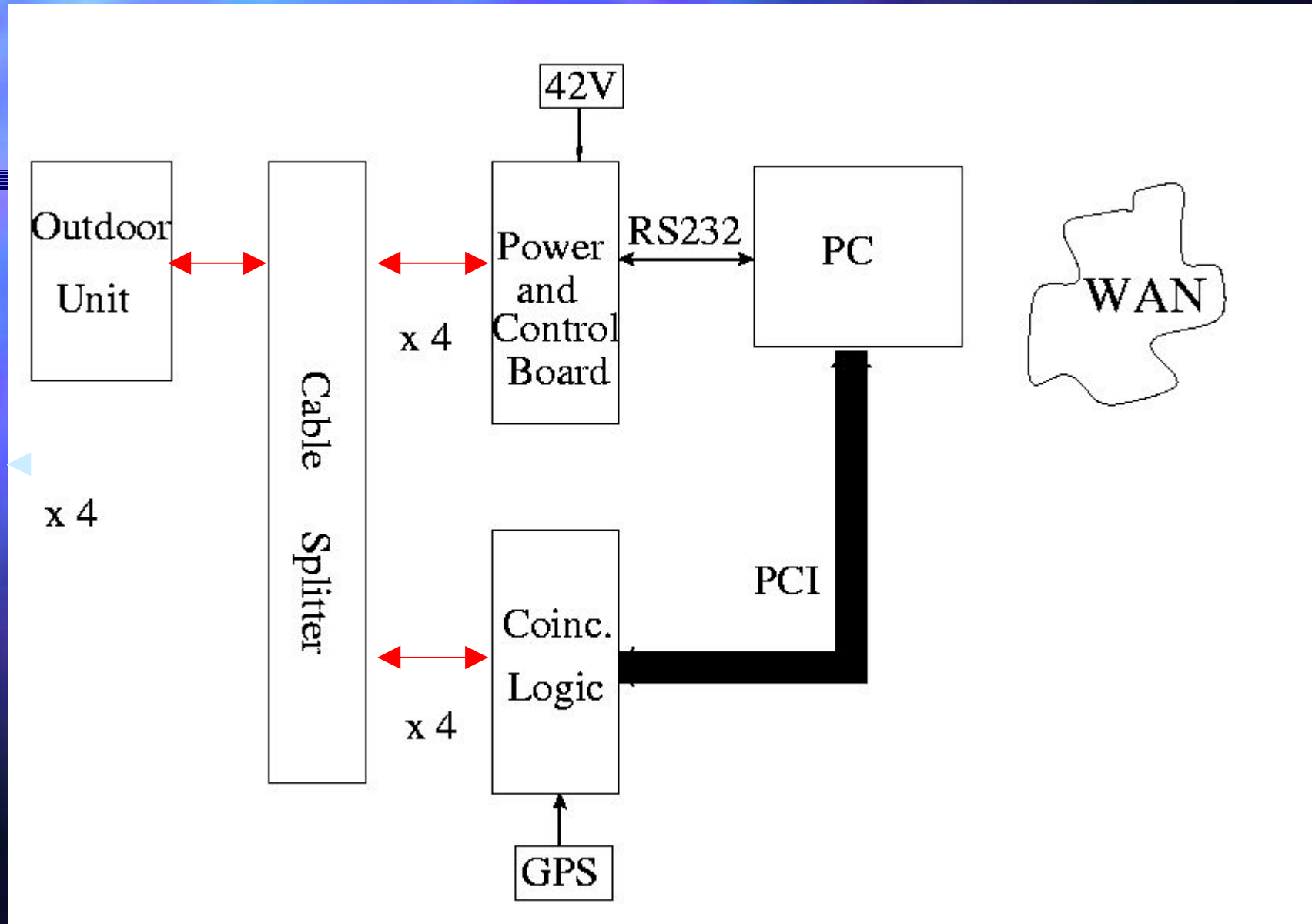
# Basic Unit



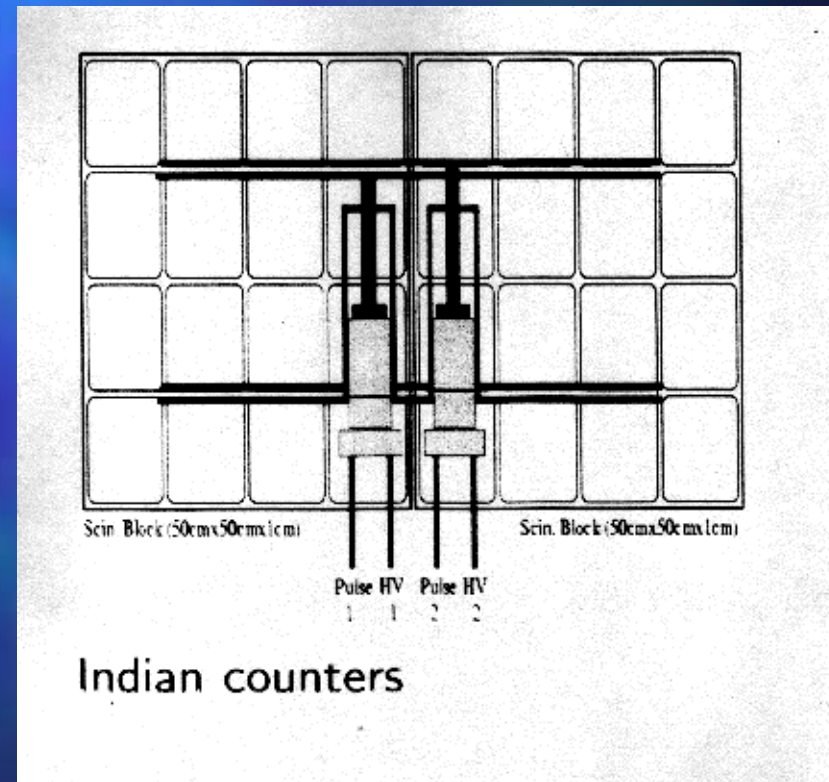
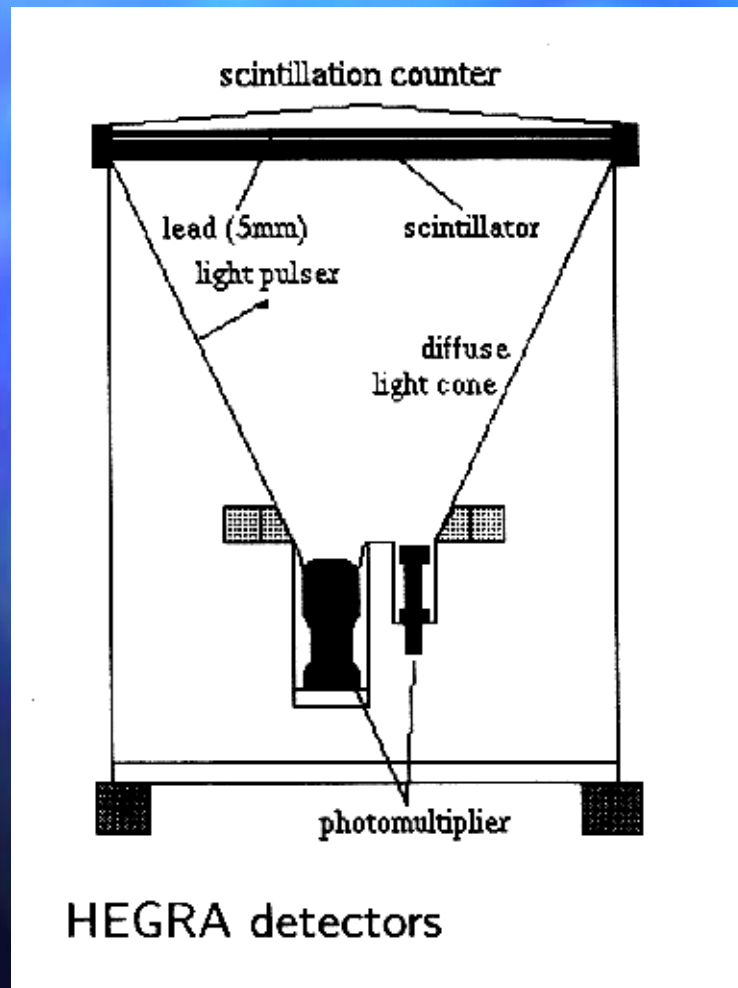
- 3 or 4 Counters
  - coincidences 2 of 3 or 3 of 4
- Distance 5-10 m
- .5 - 1 m<sup>2</sup> Scintillator
- viewed by 1 or 2 PM
- connected to a PC
- GPS
- ...Internet....Univ....







# Scintillator counter design



# Technical Numbers

- Noise Rates (e.g. 3 of 4, 1 m<sup>2</sup>) :

- Random Rates:  $\sim 10^{-4}$  Hz
- Muon Rates: 0.1 Hz
- Shower Rates (e): 0.5 Hz

- Coincidence rates:

- 2 of 1000: 2.5 Hz
- 3 of 1000:  $10^{-3}$  Hz

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- Angular Resolution  $\sim 5$  deg.

- Energy Resolution  $\sim 30\%$



# Costs (new design)

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- 4 x Scintillator, Photomultiplier, Base, Box
- 1 x Electronics, GPS, PC
- Station Number "2 to 100": 20 kDM
- Cost Minimization necessary !!!

# Conclusions

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- A large Air shower array mainly based on public infrastructure in NRW is possible
- Energy Range:  $> 10^{17}$  eV
  - precision measurements below AUGER
- Detector area: 3000 km<sup>2</sup>
- Starting with O(100) Stations:
  - (dense instr.) interesting physics below the ankle
- Full instrumentation:
  - international collaboration advisable
- LOFAR: quantitative and qualitative new possibilities
- Necessary: design and setup of working sample stations
- Outreach information: <http://skyview.uni-wuppertal.de>

# Contributing:

- RTWH Aachen: T. Hebbeker
- MPIfR Bonn: P. Biermann, H. Falcke
- CERN: V. Avati, K. Eggert
- DESY: H. Meyer, C. Spiering
- FH Düsseldorf: Born, G. Franke, Kameier , J. Prochetta
- Universität Duisburg: G. Born, H. Litschke
- Universität Karlsruhe, K.H. Kampert
- Universität Münster: D. Frekers
- Universität Nijmegen: C. Timmermans
- GH Siegen: C. Grupen, A. Mailov, N.Pavel
- BUGH Wuppertal: K.H. Becker, R. Frahm, W. Rhode

Friendly Support through:

Wissenschaftszentrum NRW: A. Claussen

Digitale Stadt Düsseldorf: R. Gross

Many interested teachers