Technical challenges and operational constraints in the search equipment (Vans and Airborne)

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Motivation for the use of search equipments

- context of potential terrorist threats

  → options for searching and detecting radioactive and nuclear material during transport and storage in hiding places are necessary

- screening of extended regions
- covert search scenarios

- large area search
- mobile detection systems are required carborne or airborne

German detection systems – carborne

- Germany is a federal country
  - ➡ the civil protection is a state matter
  - ➡ every Land (state) is differently positioned and equipped with respect to detection systems

nationwide:

- Federal Office for Radiation Protection (**BfS**) possesses several measurement vehicles
  - large number of measurement vehicles as part of the Integrated Measuring and Information System (IMIS), measurements: stationary with high resolution and on the move (NBR)
  - few, equipped with more sensitive and additional detectors, are operated by the working group defence against nuclear hazards

source: webside of the BfS

German detection systems – carborne

- Federal Office of Civil Protection and Disaster Assistance (**BBK**) provides measurement vehicle to the Laender (states)
  - approx. 500 CBRN-reconnaissance vehicles
  - located at **fire brigades**
  - nationwide equipping for threat prevention
  - measurement container radiological detection system:
    - NBR probe
    - dose rate measurement system FH 40 G

source: webside of the BBK

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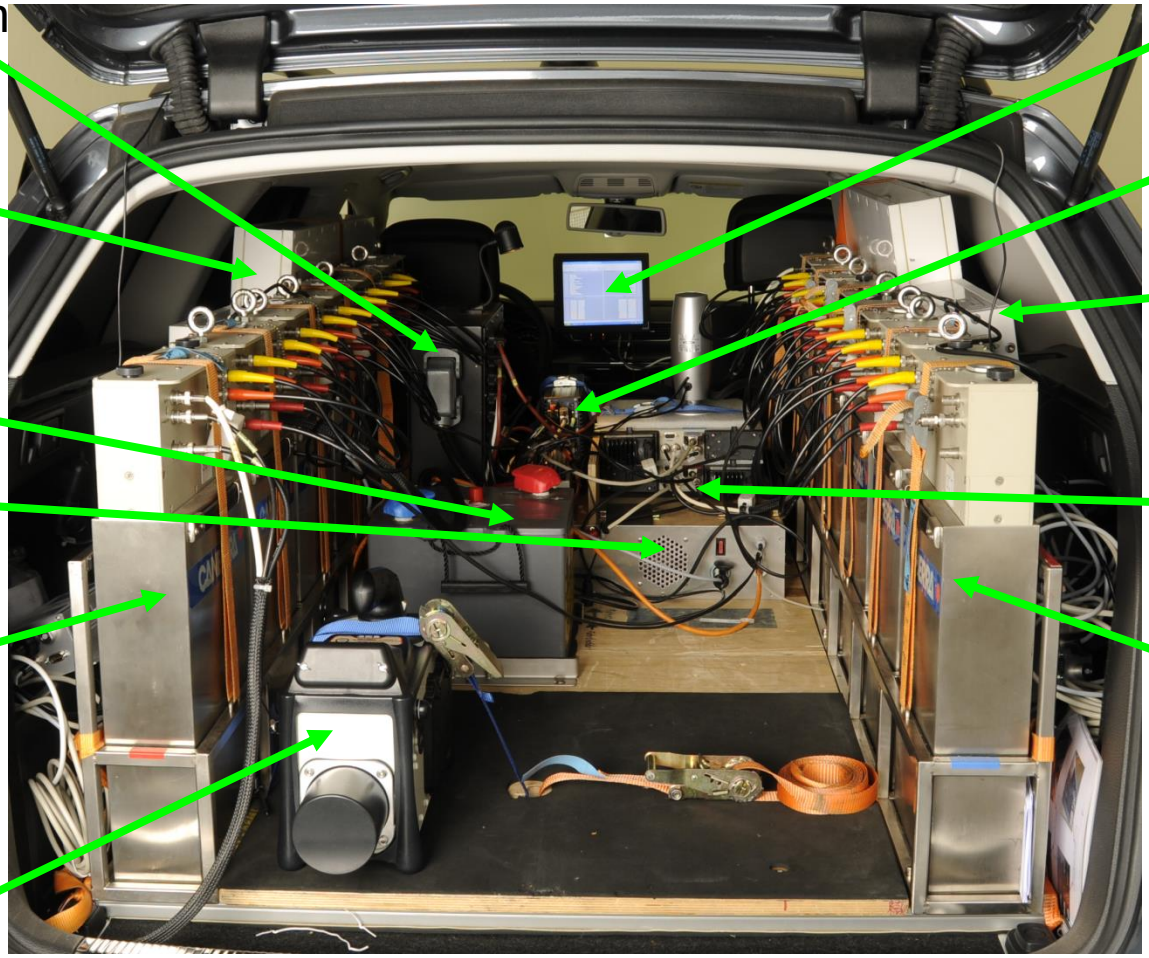
Fraunhofer INT Measurement Car DeGeN

- Fraunhofer INT developed the carborne measurement system DeGeN
  - integration in a standard station wagon
  - built-in gamma and neutron detection techniques
  - portable detection devices
  - possibility of covert search

INT Measurement Car DeGeN



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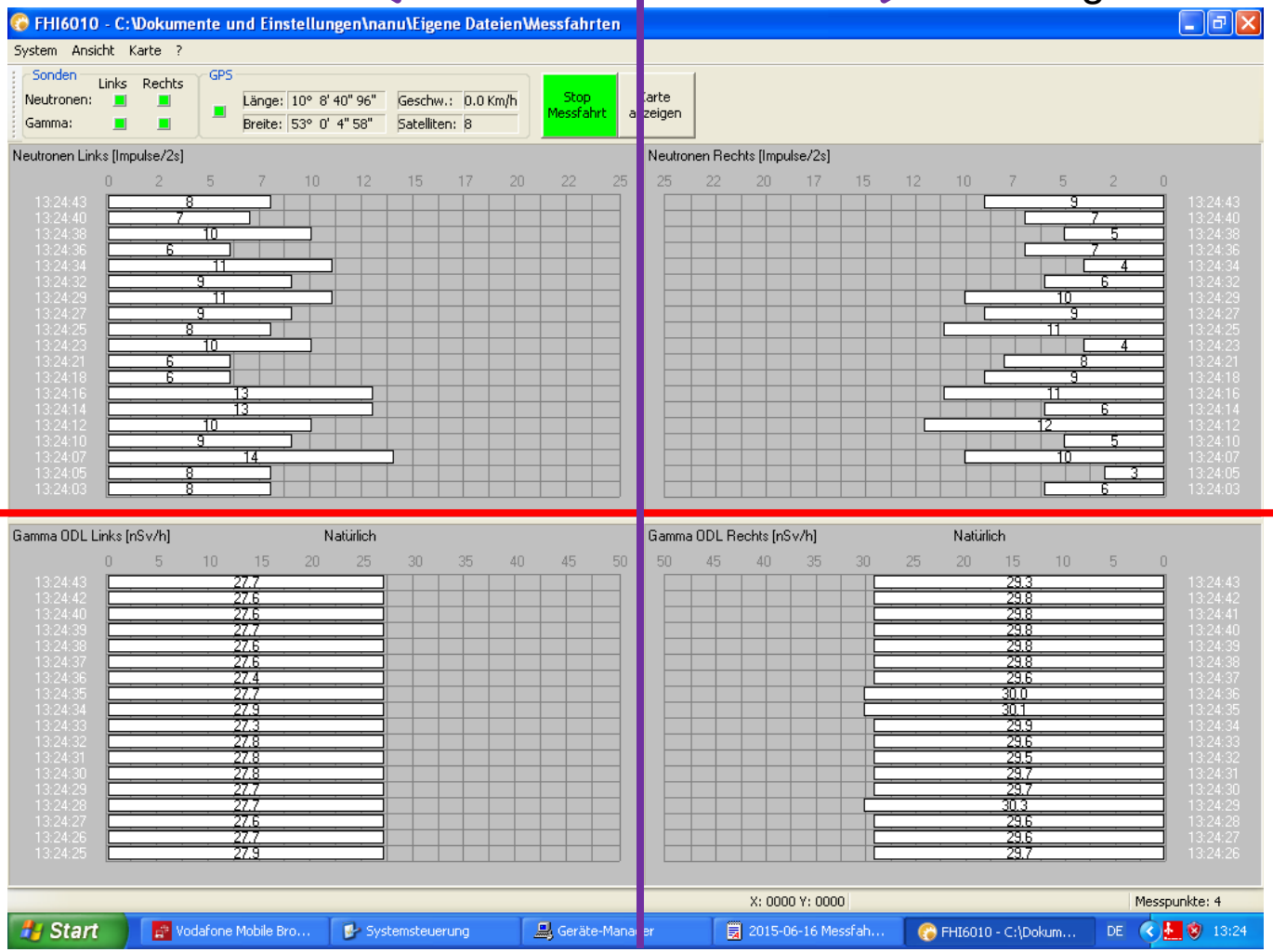
typical background – screen shot

left side of the vehicle

right side



neutron

gamma

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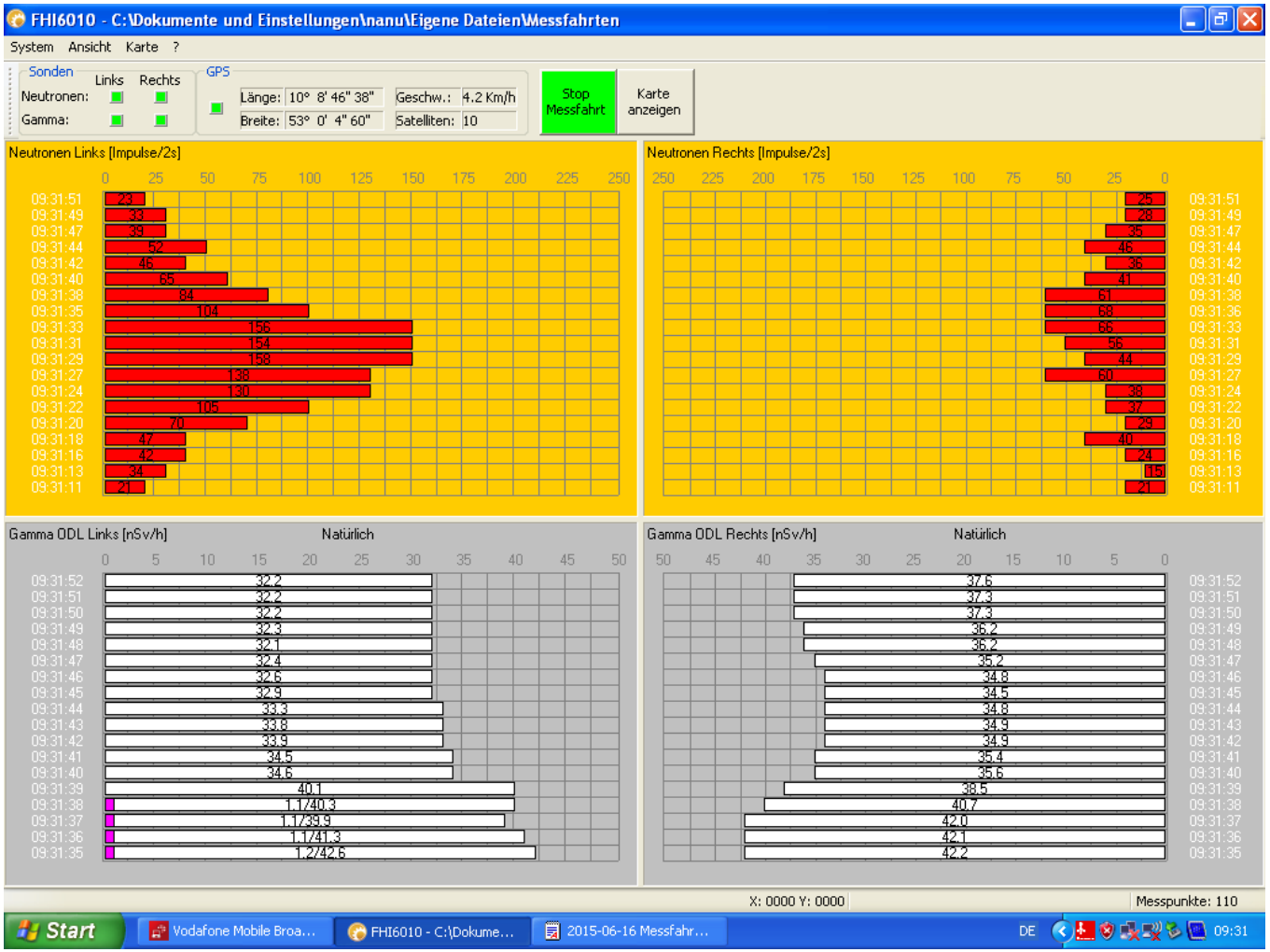
Operational constraints

- localizing sources in covert search scenarios
- changing background
- shielding effects

Example Detection of a Neutron source
^{252}Cf 1 · 10^6 n/s – 10 m distance, walking speed



changed colour in the neutron part

➡ neutron alarm

higher count rate on the left side

➡ neutron source on the left side

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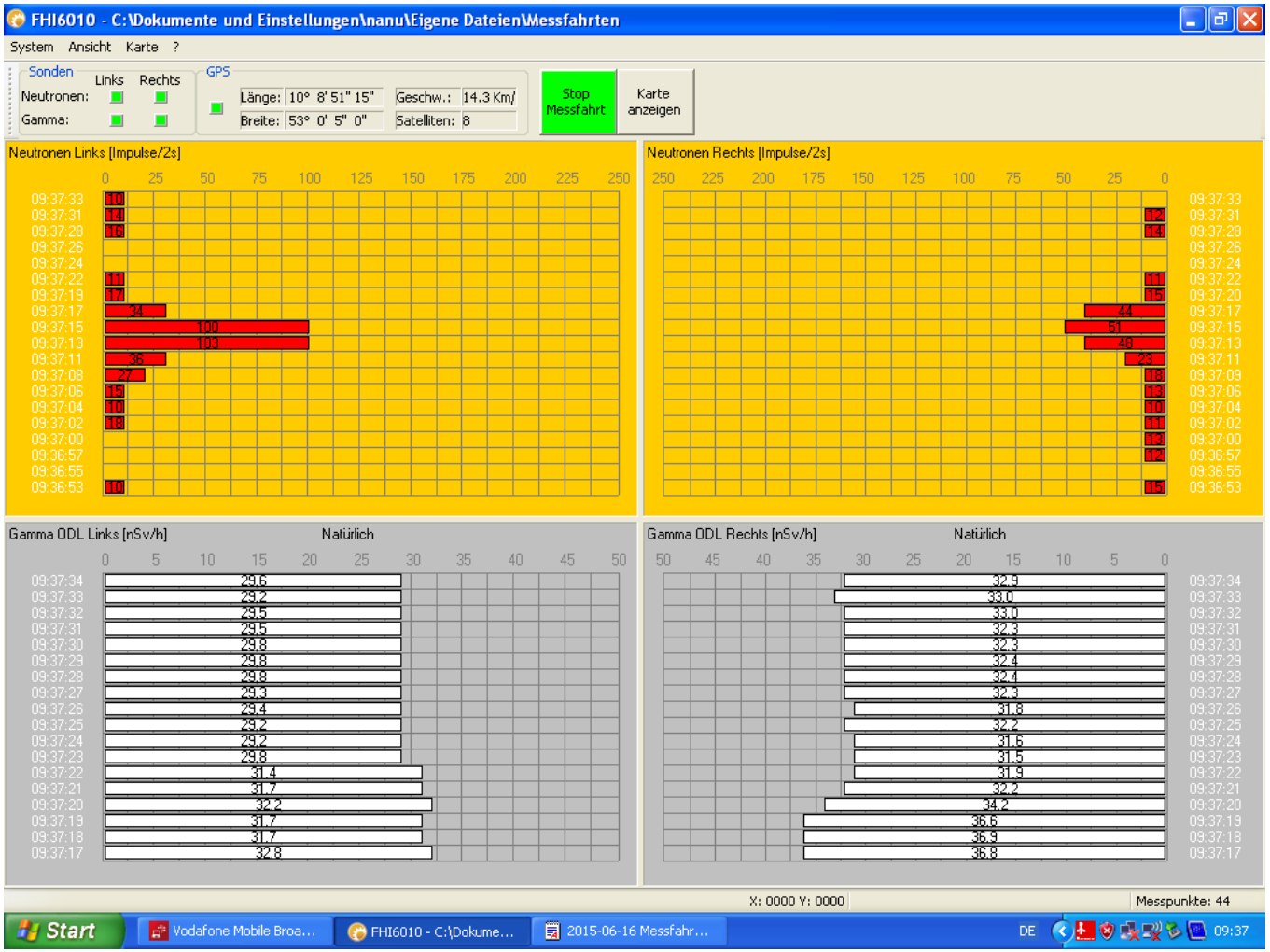
Example Detection of a Neutron source
^{252}Cf 1 · 10^6 n/s – 10 m distance, 20 km/h



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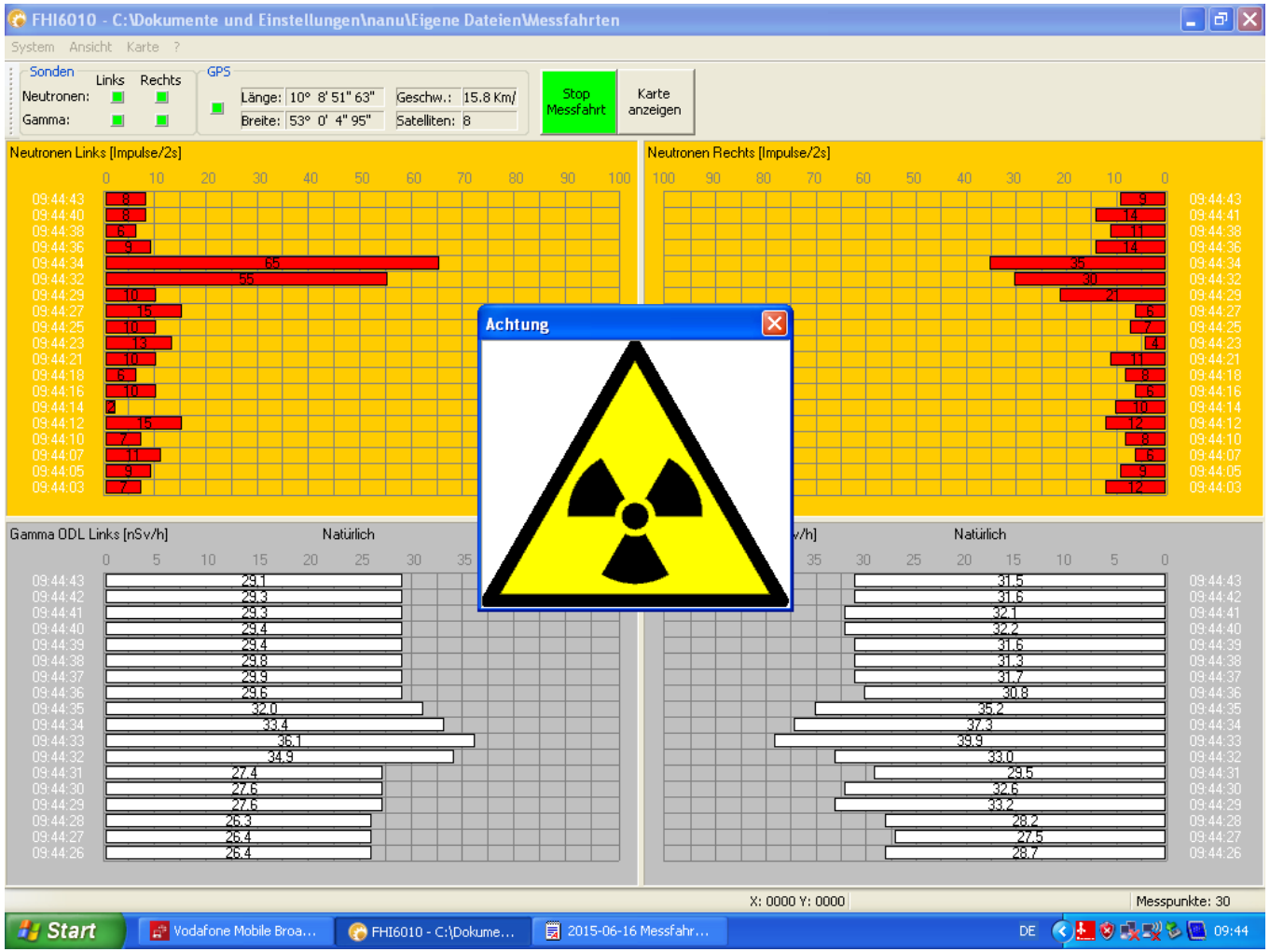
Example Detection of a Neutron source
^{252}Cf 1 · 10^6 n/s – 10 m distance, 60 km/h



measurement drives with higher speed

➡ search with realistic speed

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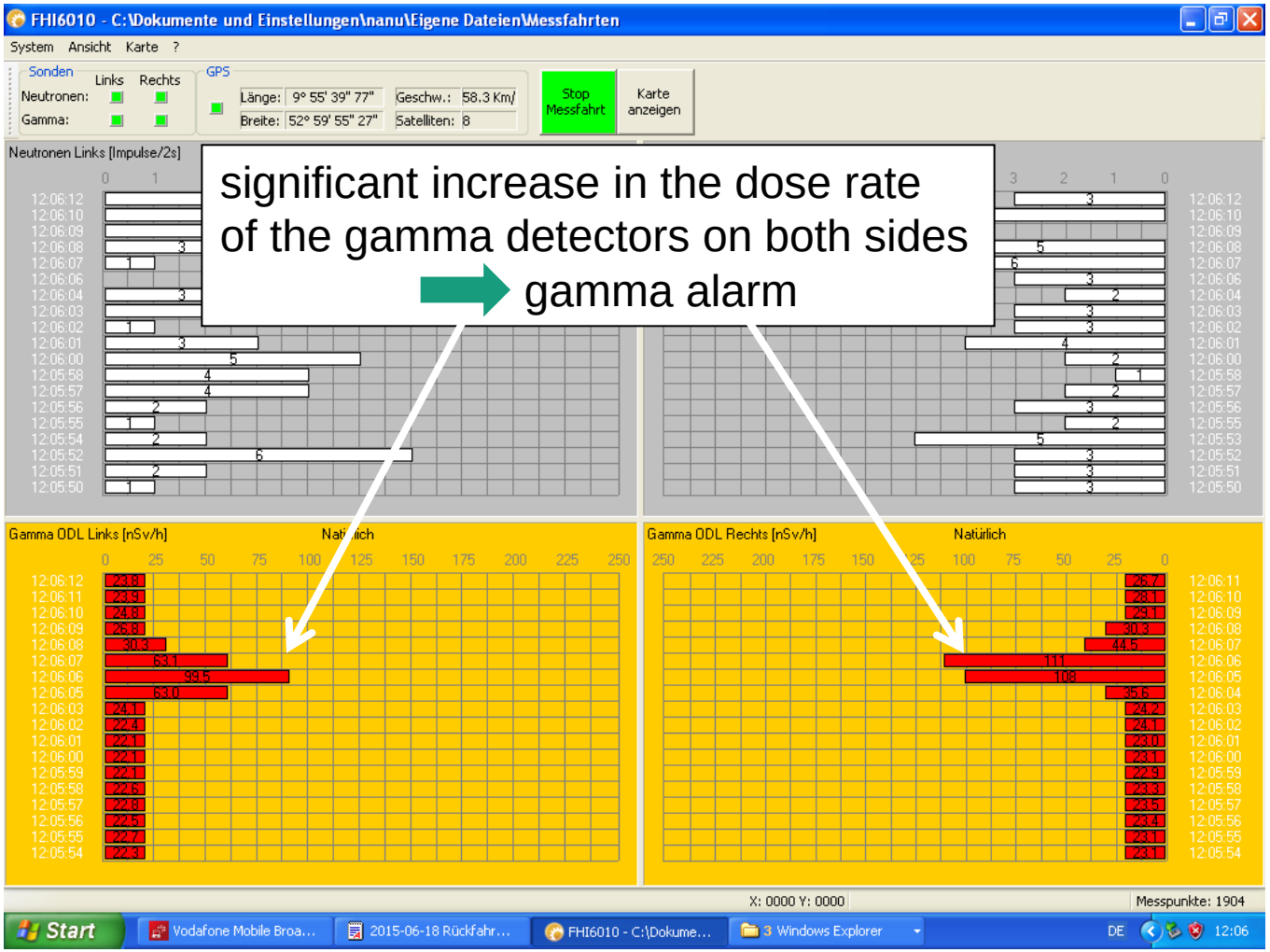
Information on the kind of radioactive source

- Measurement vehicle with neutron and gamma components distinguish between neutron and gamma sources
- Interpretation of generated alarms :
  additional radioactive source or change in the background?
- Gamma sources:
  - Background radiation and natural variations cannot be neglected
  - Use of NBR (natural background rejection) detectors:
    distinguish between natural and artificial radiation

Natural background – example 1



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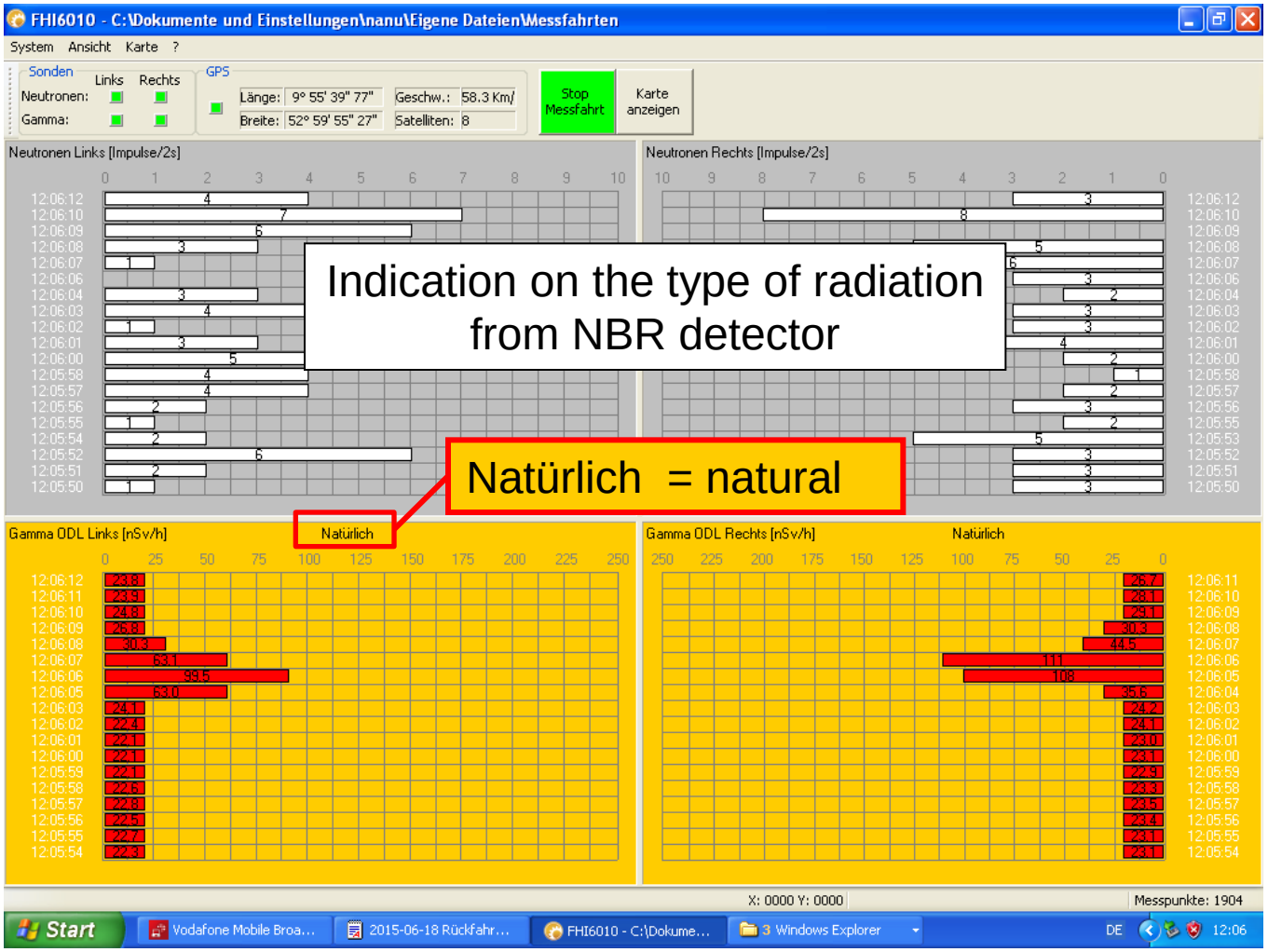
Natural background – example 1

Situation:
Passing under a bridge

source: Fraunhofer INT

increase due to the material of the bridge,
no additional radioacitve source



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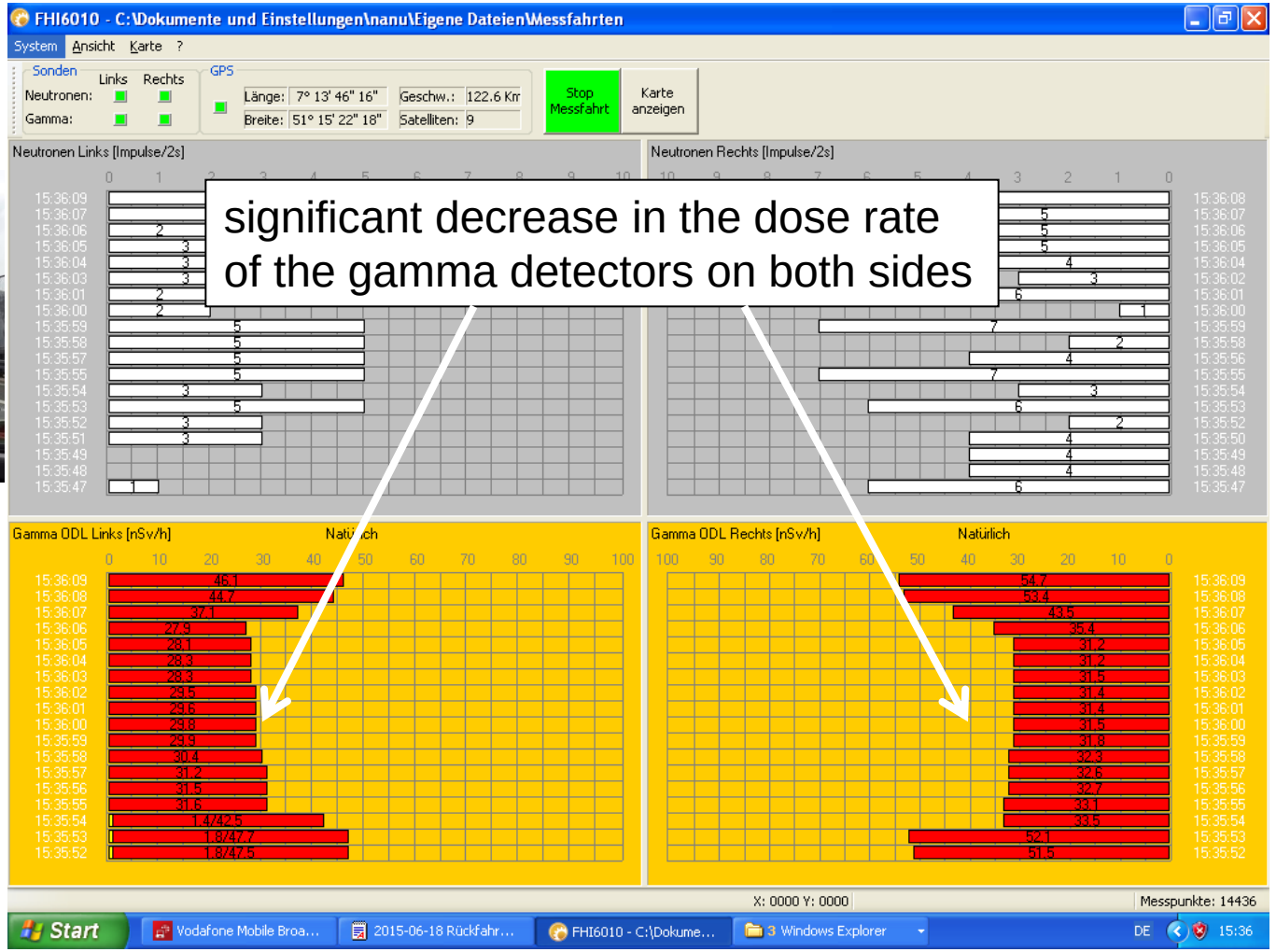
Natural background – example 2

Situation:
Driving over a bridge

source: Fraunhofer INT

decrease due to
less material beside
the bridge,
no additional
radioacitve sources



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Shielding

shielding:

- low dose rate at position of detection
- compton scattering ➡ nuclide specific information gets lost

- nuclide identification is rather difficult
- information natural/artificial (e.g. from NBR detector) is possible and therefore valuable

nuclide identification in the presence of shielding

➡ field of further investigation

German detection systems – airborne

- large or hard-to-access areas
  - airborne solution is most favorable
  - quickly assess the radioactive contamination in case of an incident
  - detects sources

- BfS equips helicopter from the Federal Police with radiation detection systems:
  aero gamma spectrometry

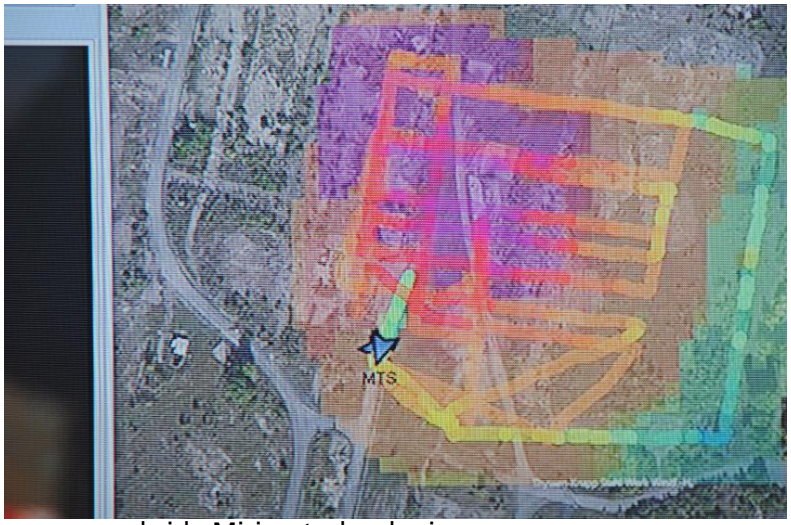
source: webside of the BfS

Fraunhofer INT – airborne – UAVs

- Constraints:
  - small and lightweight
  - long battery operation duration
  - relay station for long range
  - usable in difficult environments electromagnetic or radioactive radiation

source: webside Mirion technologies

- **ANCHORS** project
  UAV-Assisted Ad Hoc Network
- autonomous swarm of UAVs
- radiation detector is mounted underneath
- result is a real time mapping display of the dose rate and spectroscopic results



source: webside Mirion technologies

Summary

- In order to meet the needs for an event including RN material various detection systems should be prepared and used
- Carborne and airborne measurement systems are proved to be suitable for extended search tasks
- Scientific experience and competence is important for the evaluation of measurement results (e.g. taking the environment into account)
- The possibility of distinction between natural and artificial radioactive gamma sources is extremely useful
- Continuous exercise with all participants is essential for a reliable good result in case of a real situation