Open Grid Europe
The Gas Wheel

state of the art methane leak detection CHARM® and GasCam®

2011 October 13th

Dr. Axel Scherello

Overview

CHARM®
for buried pipelines
(active principle)

GasCam®
for above ground installations
(passive method)

Open Grid Europe at a glance

- 1st ITO in Germany
- Germany's leading natural gas transmission company
- About 1.800 employees
- Operates longest pipeline transmission system in Germany (12.000 km)

Open Grid Europe: The pipeline system

Length of the gas pipeline system

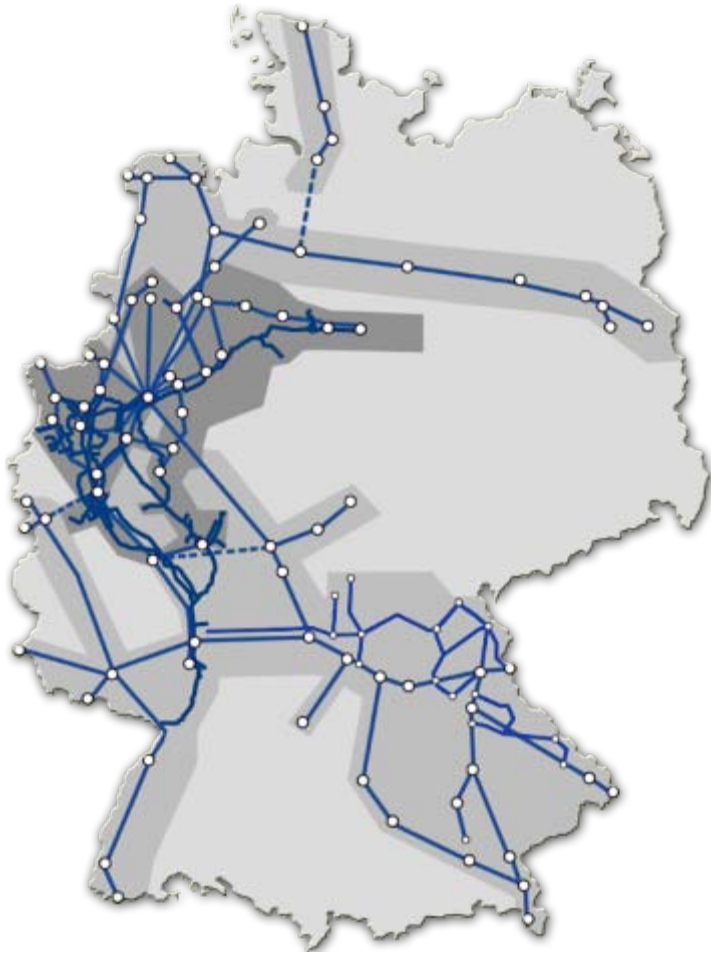
- ~12.000 km

Compressor stations, operated and monitored

- 29 stations
  105 units
  ≈ 1000 MW installed power

Underground Storages, provision of services

- 9 storage locations
  ~ 5,2 billion m³ process gas



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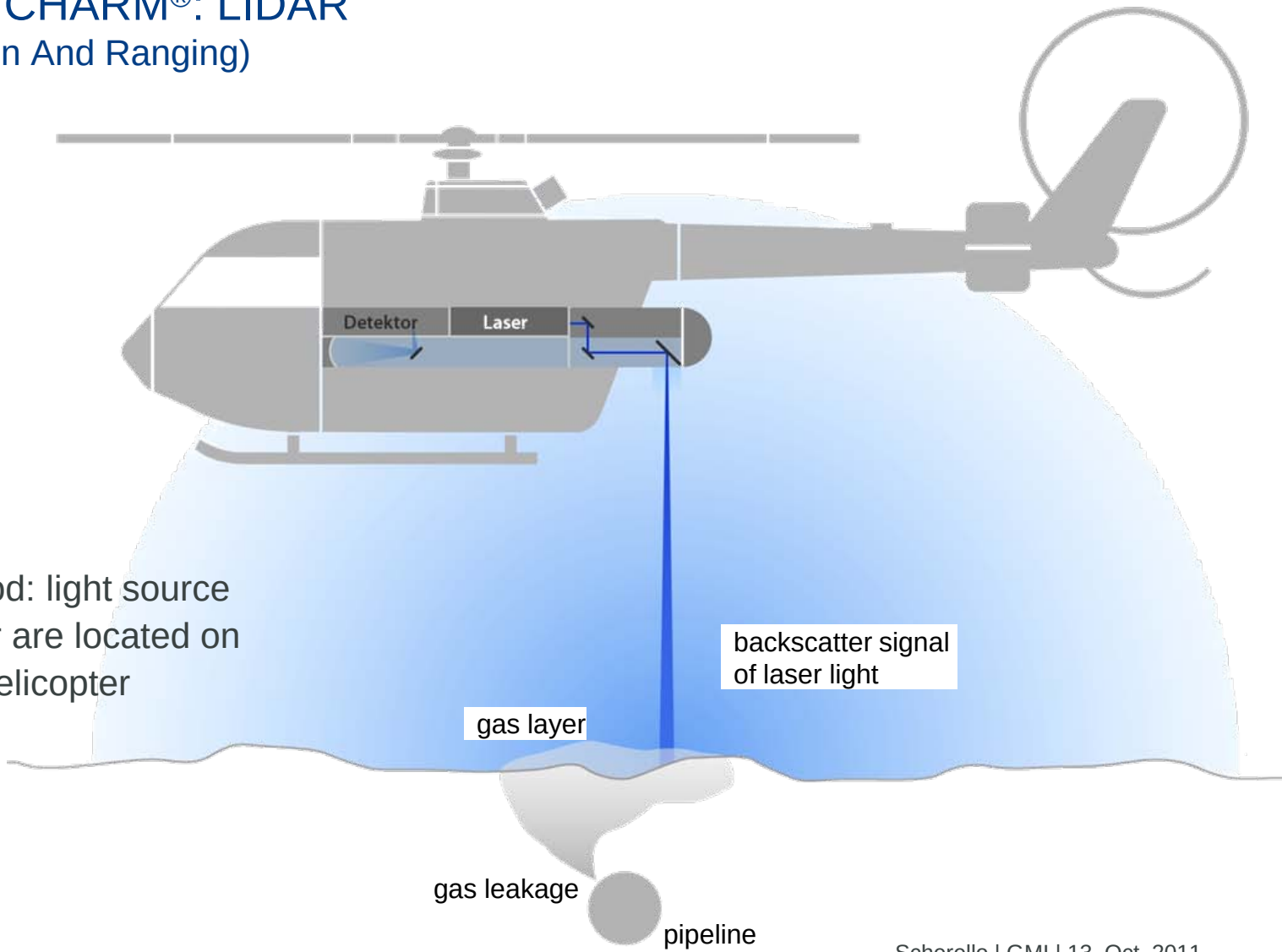
CHARM®

CH_4 Airborne Remote Monitoring

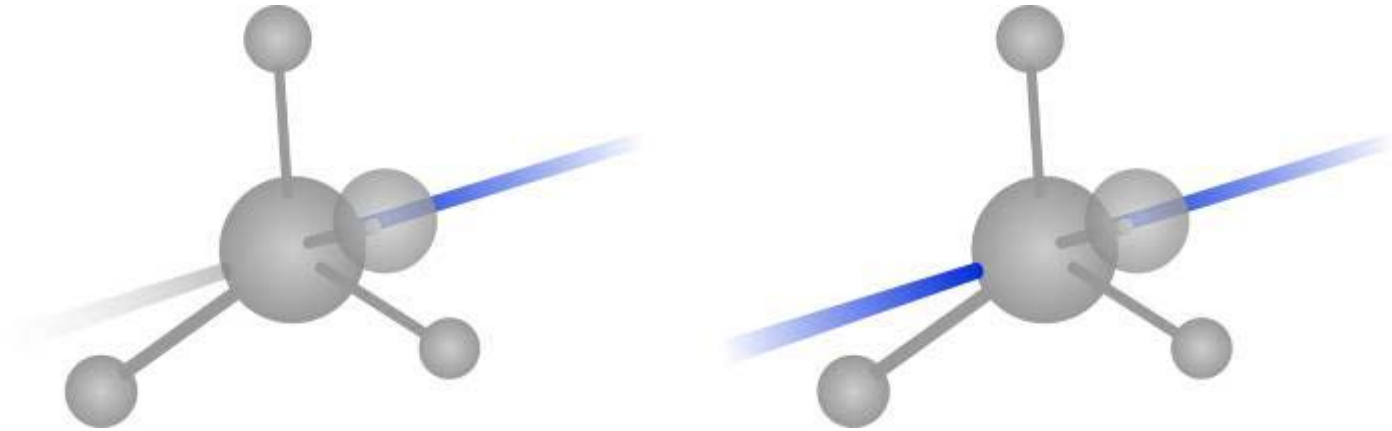
Principle of CHARM®: LIDAR
(Light Detection And Ranging)

- active method: light source and detector are located on board of a helicopter



CHARM® - measurement principle

Differential Absorption LIDAR (Light Detection And Ranging)
Laser Light Absorption at CH_4 molecules



- λ_{on}
  measurement wavelength – light is absorbed by methane
- λ_{off}
  reference wavelength – which is not absorbed – CH_4 is transparent for this wavelength

- both pulses are scattered back from the same spot of the ground surface. If there is a difference it will be due to methane

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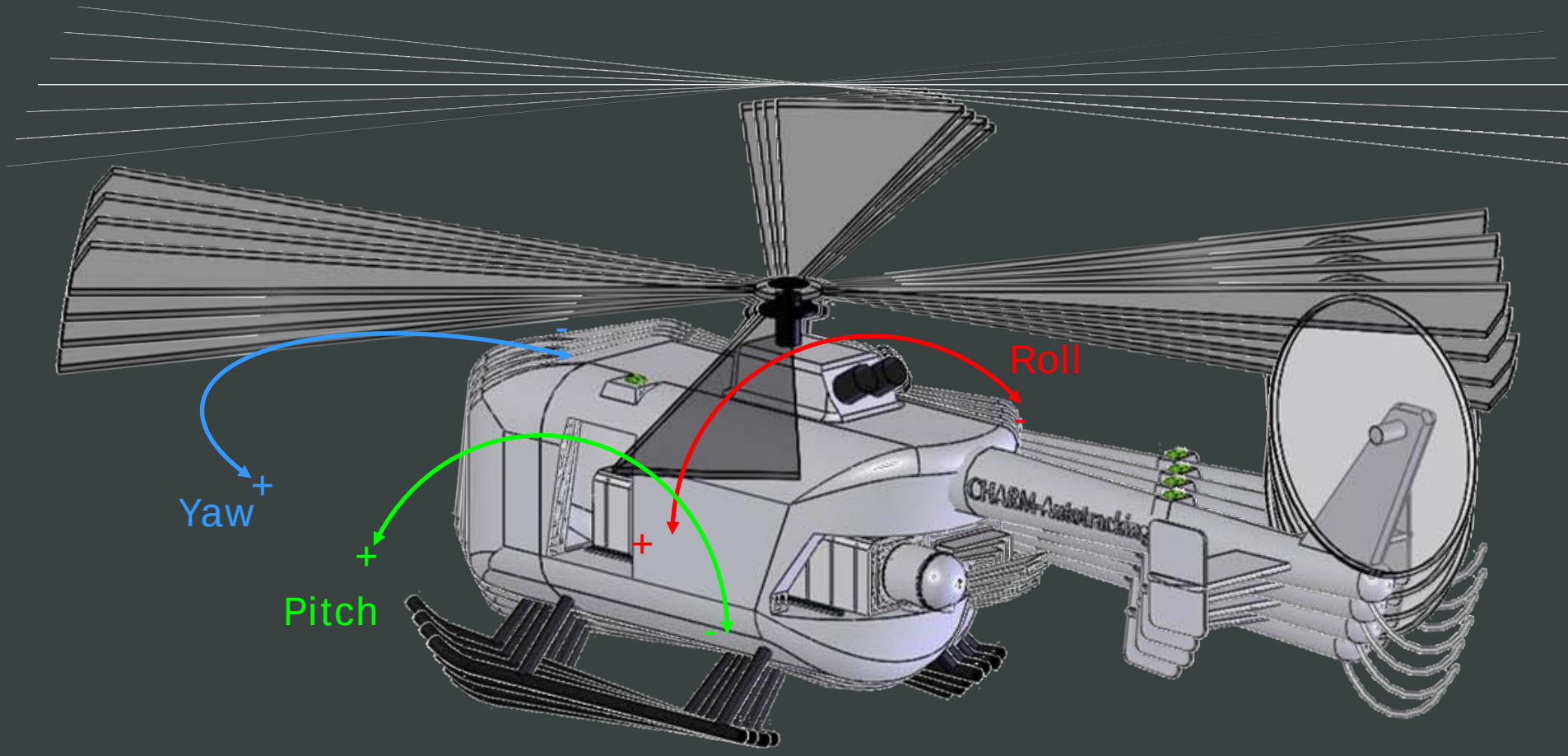
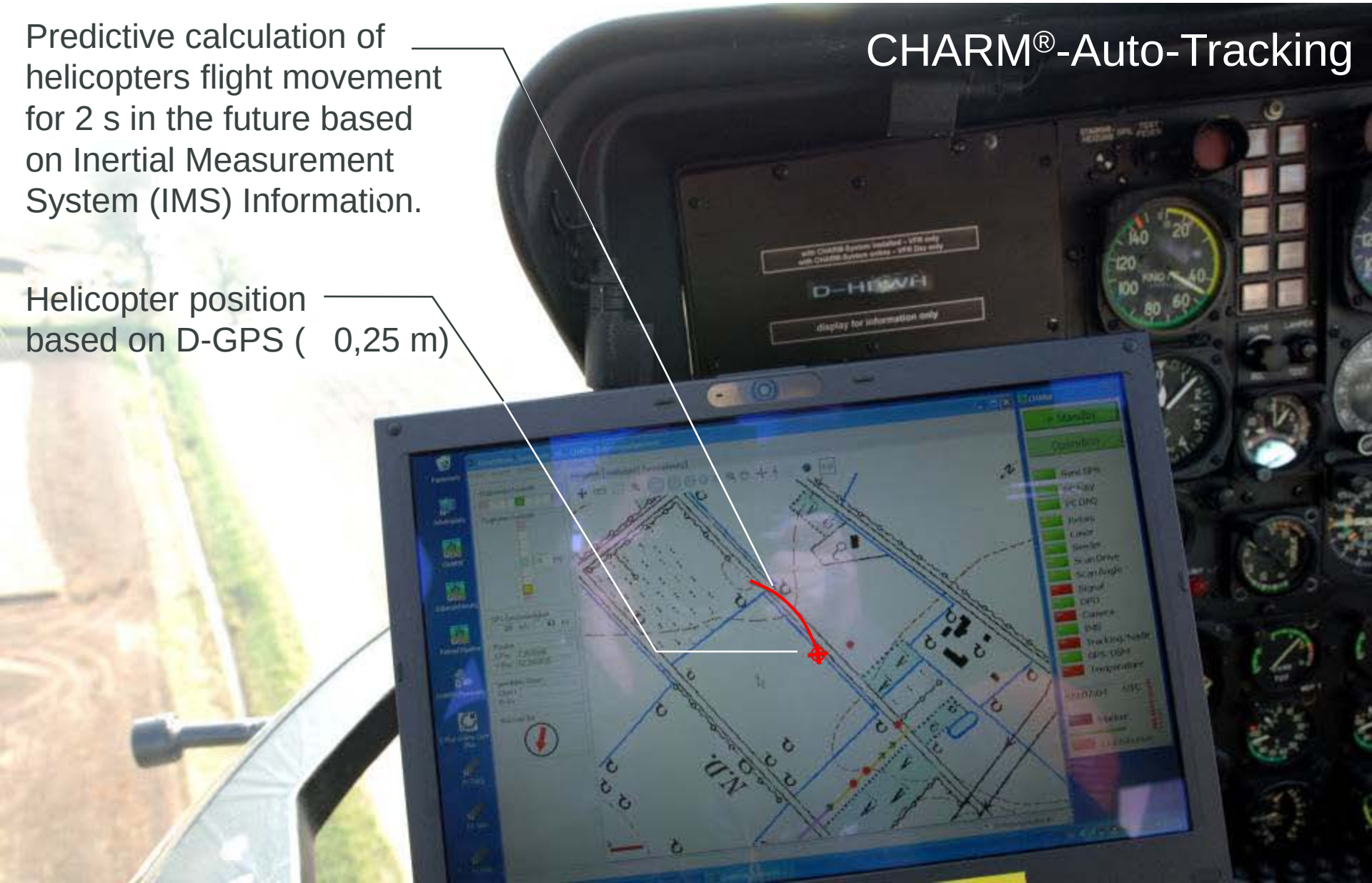
3 dimensional helicopter movement



CHARM®-Auto-Tracking

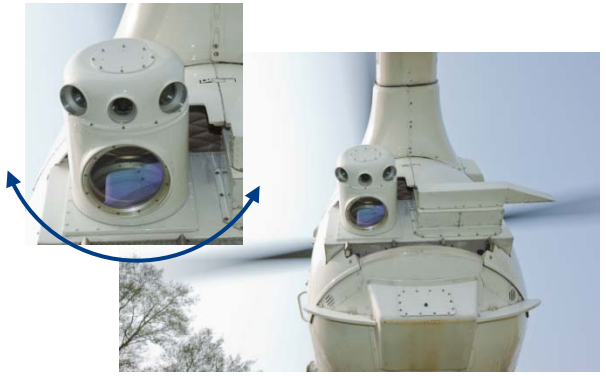
Predictive calculation of helicopters flight movement for 2 s in the future based on Inertial Measurement System (IMS) Information.

Helicopter position based on D-GPS (0,25 m)

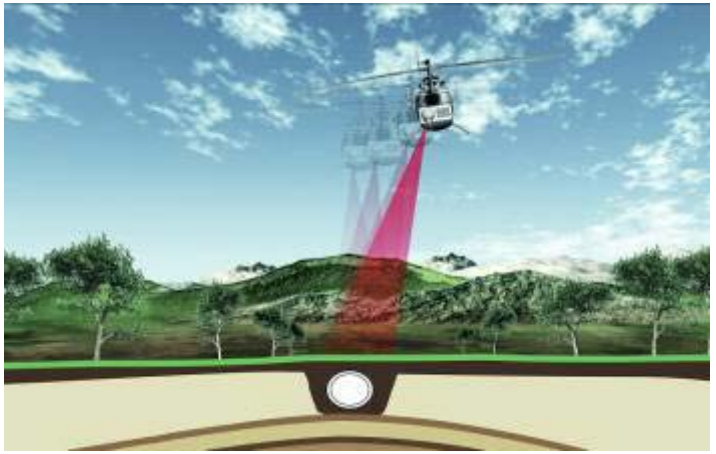


CHARM® - Auto Tracking

- a rotating Scan Head with in- and outlet window for the laser pulses and three camera windows for photo documentation



- automatic and precise targeting of laser beam towards the pipeline corridors centre line (CHARM® Auto Tracking) with an accuracy ≤ 0.5 meter



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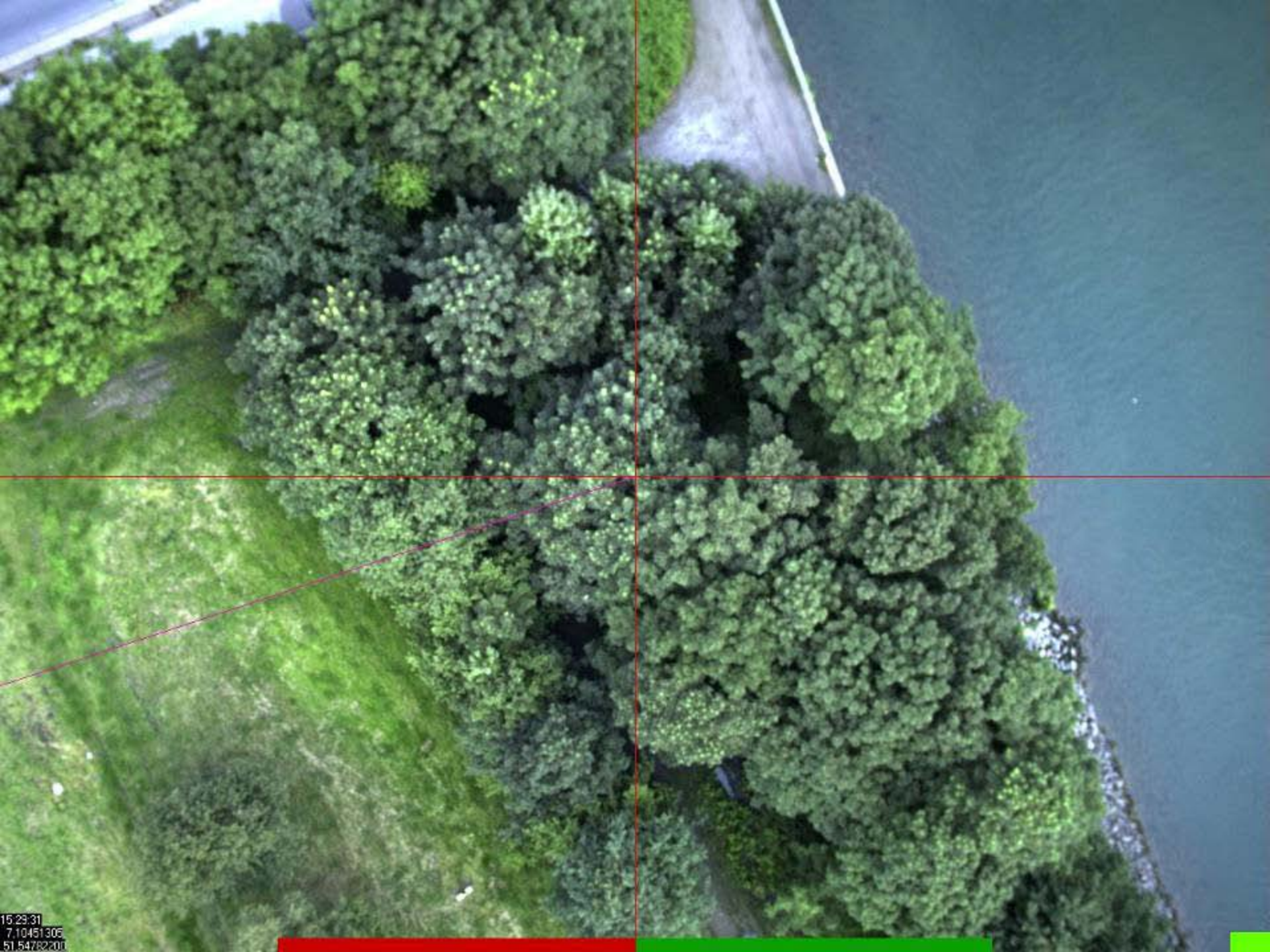
CHARM®-Auto-Tracking

Real time combination of GIS-, D-GPS and IMS-Data based on a on-board computer network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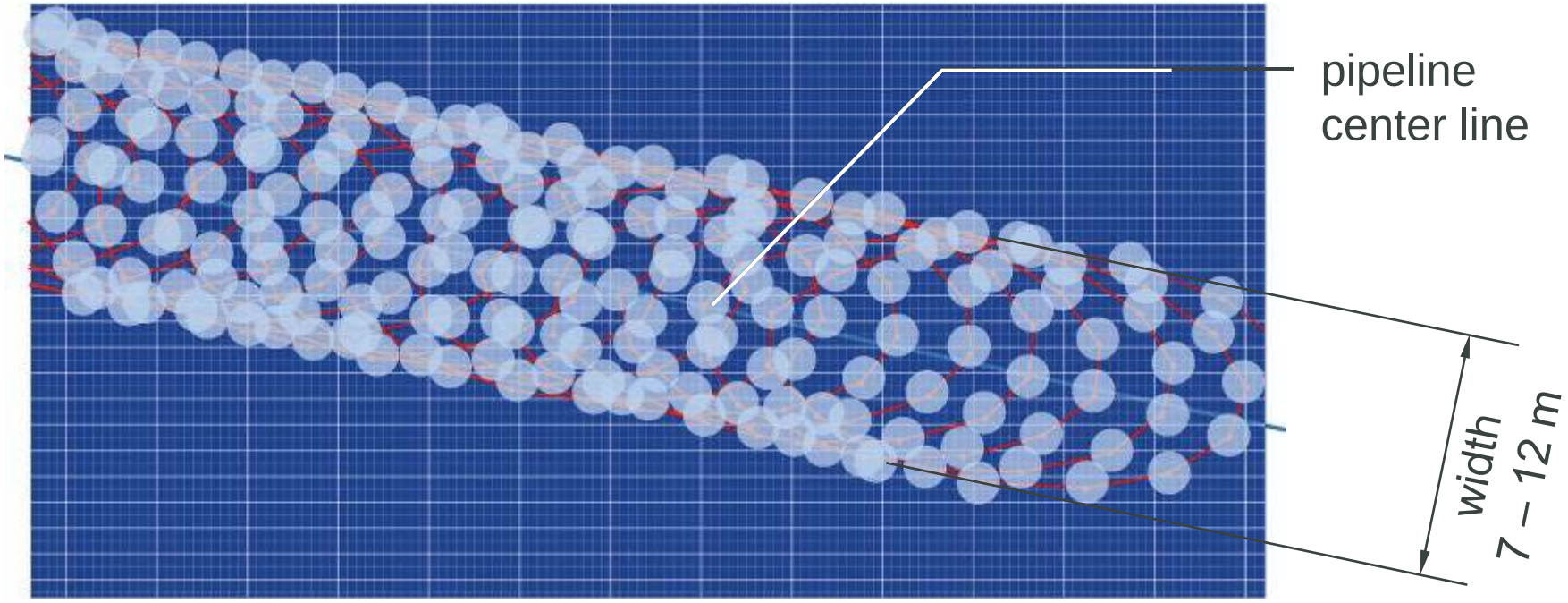
Areal Scanning of
Right of Way (Pipeline Corridor)

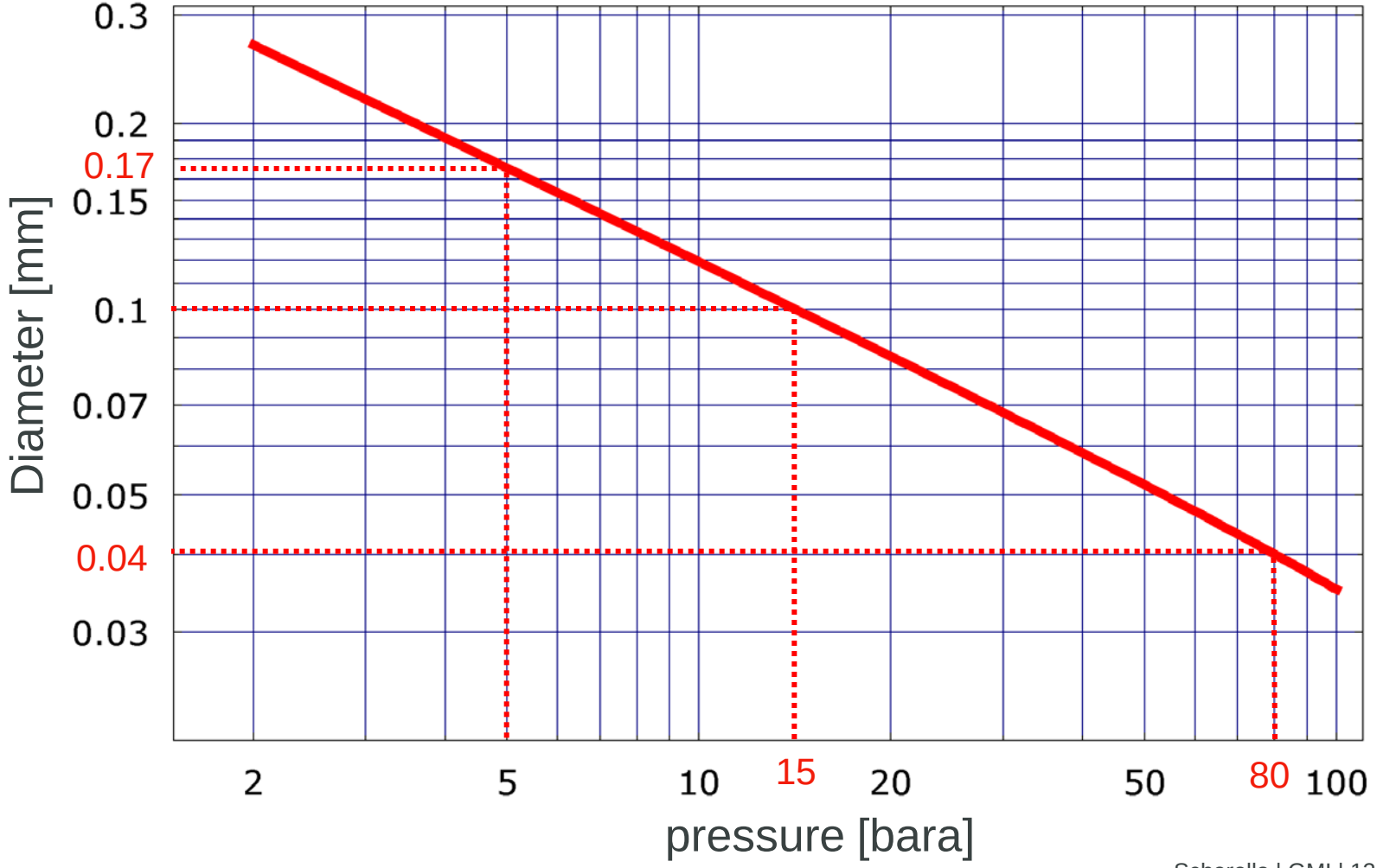


Integration of airborne Gas Remote Detection into the German Gas Guidelines (DVGW-Regelwerk - G501)

Based on the results of several test flights DVGW took the decision to approve CHARM® for tightness checks of gas pipelines with MOP > 16 bar.

- Flight Speed: 50 - 90 km/h
- Altitude: 80 - 140 Meter
- Frequency: 100 Hz Double Pulse
- Leak Rates: ≥ 100 l/h (20 l/h)
- Wind Speed: ≤ 3,5 m/s (low wind speeds)
- Accuracy: theoretically: 1,03 ppm·m
  typically: 5 – 10 ppm·m
  always: ≤ 25 ppm·m

CHARM® – Leak Diameter at 100 l/h Leak Rate



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Official aviation approval for CHARM®

European Aviation Safety Agency

SUPPLEMENTAL TYPE CERTIFICATE

EASA.R.S.01006

This certificate, established in accordance with Regulations (EC) No 1592/2002 and (EC) No 1702/2003 and issued to:

Aviation Support GmbH
Flughafen
34379 Calden
Germany

certifies that the change in the type design for the product listed below with the limitations and conditions specified meets the applicable type certification basis and environmental protection requirements when operated within the conditions and limitations specified below:

Original Product Type Certificate number: *LBA TCDS No. 3025*
Manufacturer: *Eurocopter*
Model: *BO 105 CBS-4, CBS-5*

Description of Design Change:

Installation of a Gas Detection System CHARM with a laser scanner

European Aviation Safety Agency

Associated Technical Documentation:

- Flight Manual Supplement "Ergänzung zum Flughandbuch FMS-ASE-90411, Rev. -" or later approved revisions.
- Installation Instructions "Installationsanleitung REP-ASE-90411-12, Rev. 3" dated 29-11-2006 or later approved revisions
- "Installationsanleitung Systemeinbau REP-ASE-90411-13, Rev. -" dated 03-08-2006 or later approved revisions.
- Instructions for Continued Airworthiness: "Anhang A zur Installationsanleitung REP-ASE-90411-12, Rev. 3" dated 29-11-2006 or later approved revisions.

Limitations and Conditions:

This STC is approved only for the product configuration as defined in the approved design data referred to in the paragraphs "Description" and "Associated Technical Documentation". Compatibility with other aircraft/engine configurations shall be determined by the installer.

This certificate shall remain valid unless otherwise surrendered or revoked.

For the European Aviation Safety Agency,
Date of Issue: 13 February 2007

Massimo Mazzoletti
Certification Manager
Rotorcraft, Balloons & Airships

STC- EASA.R.S.01006 - Aviation Support GmbH

Summary

- high detection sensitivity
- automatic targeting and laser beam steering
- areal scanning of pipeline corridor
- function controls secure reliability

- 3.2 µm instead 1.6 µm
- other devices: laser fixed
- others: only line scanning

- high accuracy – DVGW approved

- others: cheaper but of no use


13:36:15 UTC
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50.670423 N

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GasCam®

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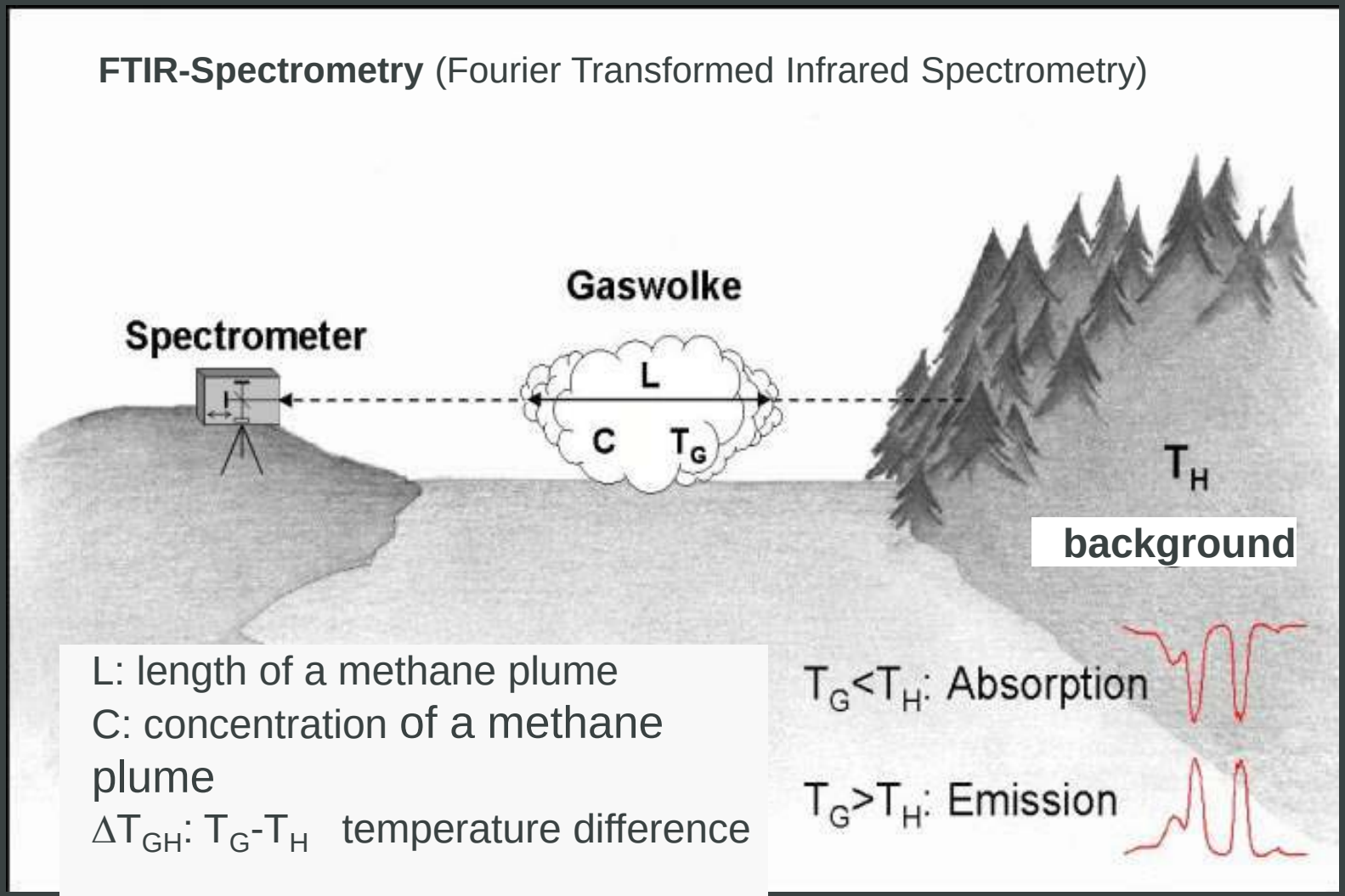
GasCam® - detection principle

FTIR-Spectrometry (Fourier Transformed Infrared Spectrometry)



L: length of a methane plume
C: concentration of a methane plume
ΔT_{GH}: T_G-T_H temperature difference

passive method: GasCam® operates only with a detector
light source is the background

GasCam® - system basics

measuring in front of different backgrounds possible

- sky
- buildings
- landscape

GasCam® - components

- **detection lense** focussing the light
- **Focal Plane Array** (sensor chip with light sensitive detection elements) equipped with a Sterling cooler
- **filter wheel** with interference filter, reference filter and calibration unit
- **digital camera** in order to display the background scenario
- connectors ro **data acquisition unit** incl. Software

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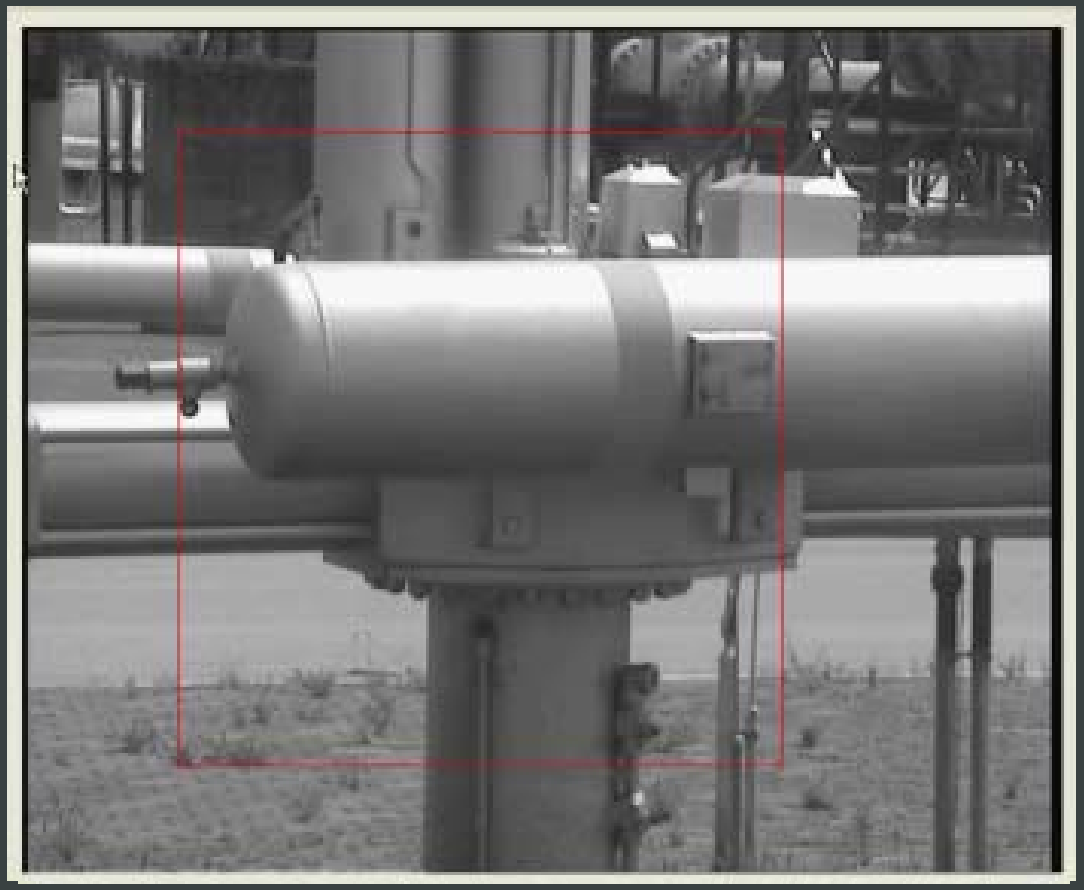
visualisation of gas releases



valuable support in order to localise gas emission sources

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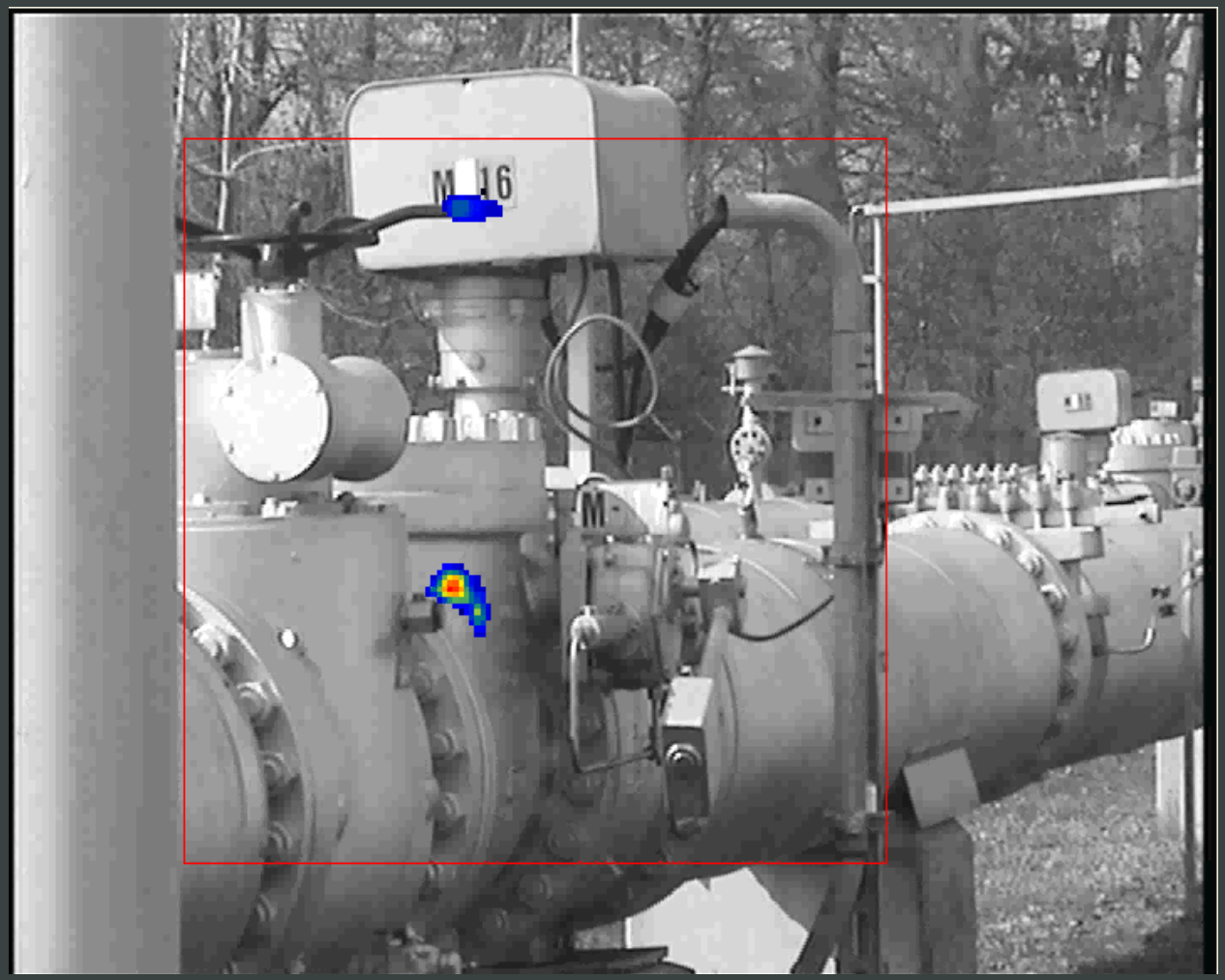
visualisation of gas releases



detection of very small leakages possible (here approximately 5 l/h)

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visualisation of gas releases

detection over great distances (here approx. 170 m)

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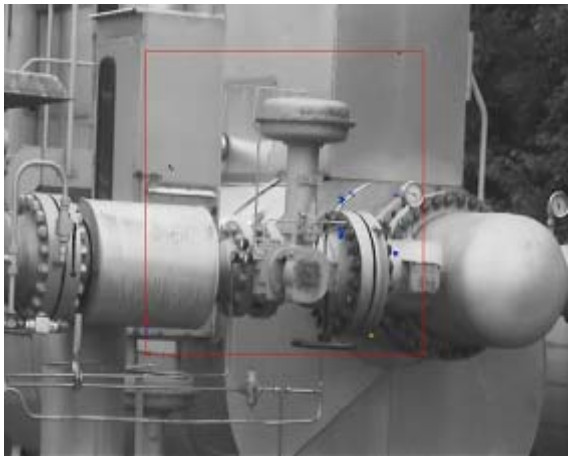
visualisation of gas releases

measurement at locations difficult to reach

leakages to be identified

- gas releases from
  - flanges
  - screwed connections
  - valves
  - blowers



- leakages cannot be heard nor felt
- usage of leak detection spray is not allowed for high pressure applications

GasCam® - tightness check

- **fast and direct judgment on site** due to a real time visualisation of the leak situation similar to a thermo camera
- **simple check** at locations difficult to reach or at areas with complex piping e. g. metering stations.
- **reliable approval** of the tightness of facilities within every year inspection or during the set into operation procedure.
- **strong reduction** of the duration of a tightness check in comparison with standard methods

Conclusions

CHARM®

GasCam®

Both methods realise a more simple methane detection and shorter processing times

→ higher checking frequencies can be realised

→ CH_4 emissions can be decreased significantly

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I am pleased to answer further questions:

E.: axel.scherello@open-grid-europe.com
T.: +49 201 3642 18704
M.: +49 151 1262 3495

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