

# Applications of “Chernin” Four-Objective Multipass Matrix System

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# Abstract

Chernin multipass matrix systems were designed in the last quarter of 20-th century as further development of classical White system [1, 2]. Much greater amount of passes can be realized in matrix systems due to additional one field and one or two objective mirrors, which transform string of images on field mirror surface into matrix of images. That's why matrix systems are preferable to form long optical way in small volume.

Two long-way optical cells were designed at DLS-laboratory of A. M. Prokhorov General Physics Institute. The cells are based on Chernin four-objective multipass matrix system. 300 and 40 meters optical ways were realized in volumes of 14 and 2 liters. Both cells can be evacuated and then filled with gas mixture to be necessary for experiments.

The first field of those cells application at DLS-laboratory is tunable diode laser spectroscopy (TDLS). The cells are used as a part of sensitive TDLS gas-analyzers. Limits of detection at the level of 1...10 ppt can be achieved for a lot of atmosphere pollutions, which are of great interest (green-house, toxic gases). The gas-analyzers with Chernin system cells were successfully used for methane distribution measurements in atmosphere of Moscow and Baikal Lake regions. Those analyzers were mounted on a car and on a ship. Another branch of high-sensitive TDLS gas-analyzer application is isotope ratio measurements. Experimental prototype of the  $^{13}\text{C}/^{12}\text{C}$  analyzer is under investigation now at DLS-laboratory (see another abstract).

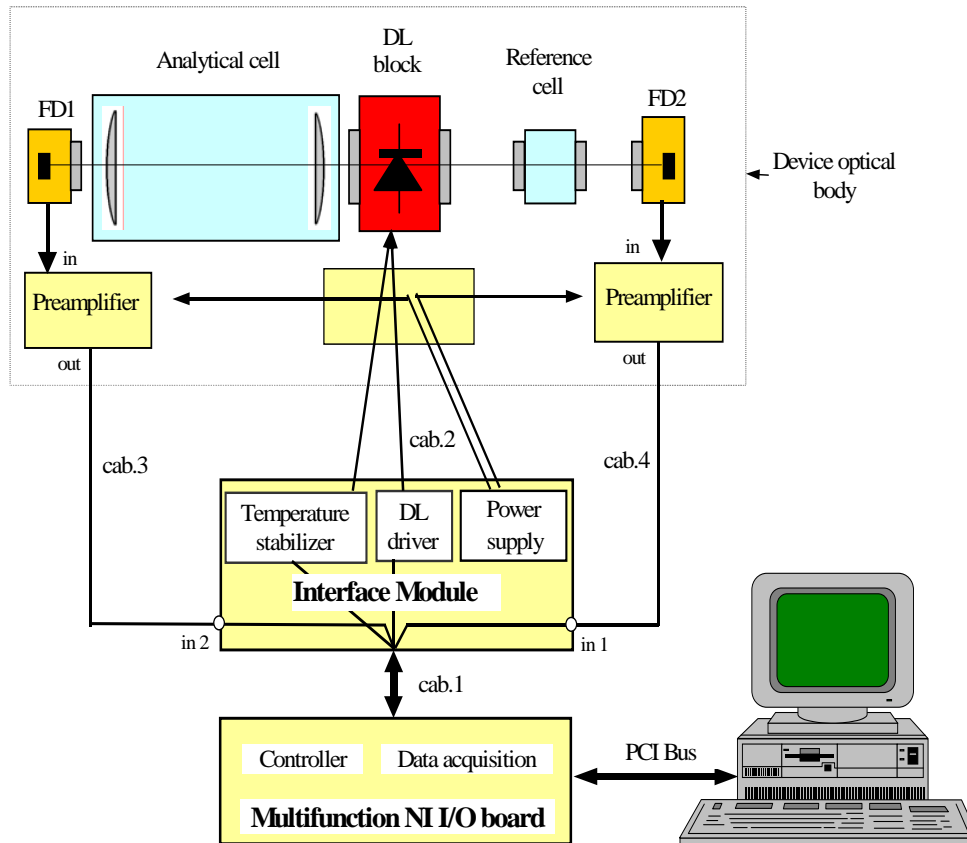
The second, unusual field of Chernin system cells application is the experimental test of the Universe optical isotropy. If the Universe is not isotropic, for example like anisotropic crystal, the fact of anisotropy can be stated in the experiment with light beams of different polarization. For sensitive measurements an extremely long optical way is desirable. 300 m cell (600 passes) was used to measure the limit of the Universe optical isotropy.

[1] Chernin, S.M., *J. Mod. Opt.*, 2001, **48**, 619.

[2] White, J. U., 1942, *J. Opt. Soc. Am.*, **32**, 285.

# METHANE DETECTION, BAIKAL 2003, 2004

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Institute of Atmospheric Optics, Tomsk



**Methane Detector Block Diagram and View**

**Chernin multipass cell**

# v.VERESHAGIN

## air bleeding position

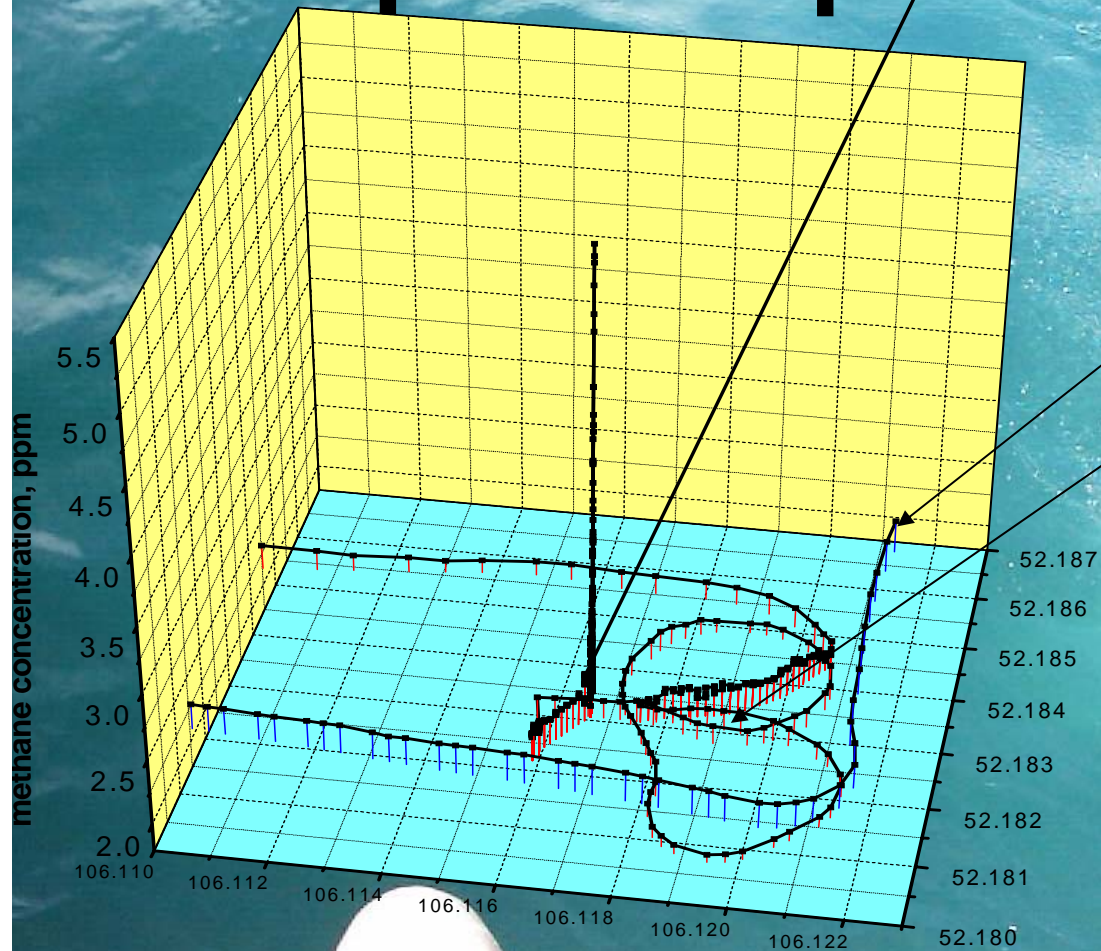




# METHANE SEEP LOCATION

## open seep near Selenga

**11.08.03**  
**15.08.03**



methane concentration, ppm

106.110

106.112

106.114

106.116

106.118

106.120

106.122

52.180

52.181

52.182

52.183

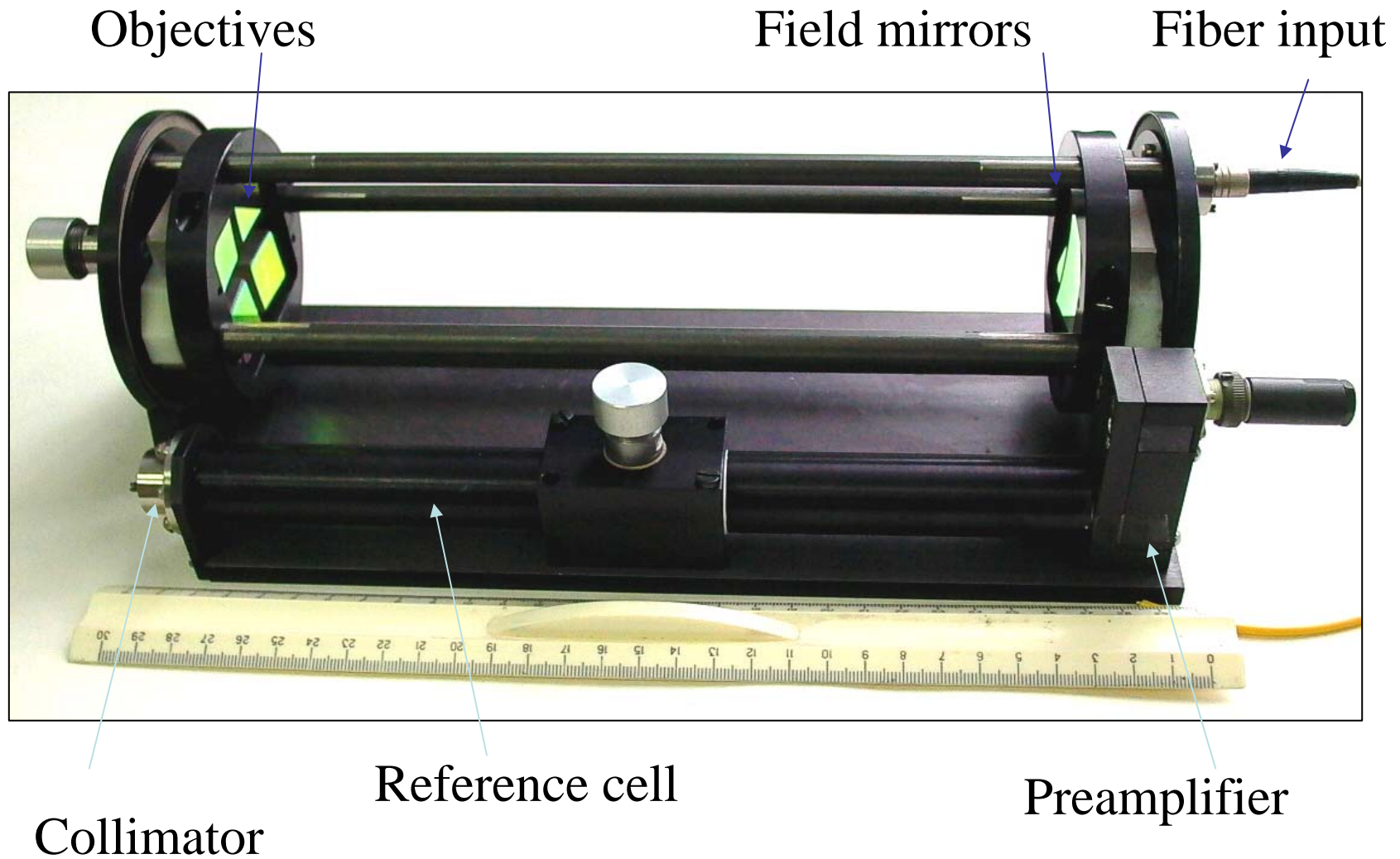
52.184

52.185

52.186

52.187

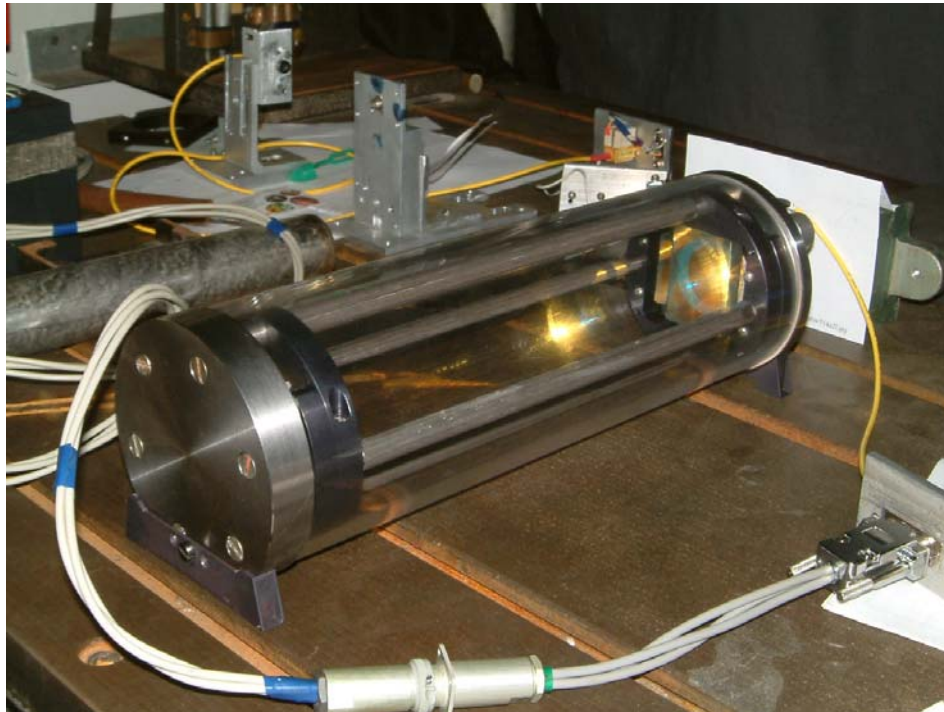




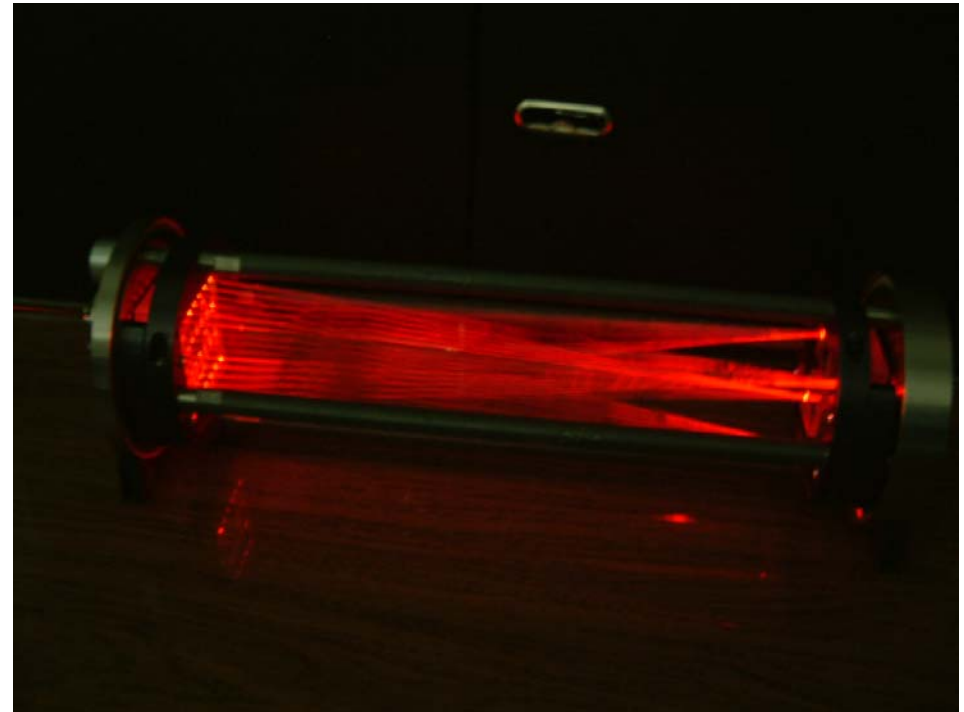
The sight of multipass cell without housing



# New Generation of Chernin Multipass Cell with Monolith Mirrors Ensemble



Multipass cell in experimental set up



Beams propogation in Chernin multipass cell

# Portable Instrument with Chernin Cell

Instrument view

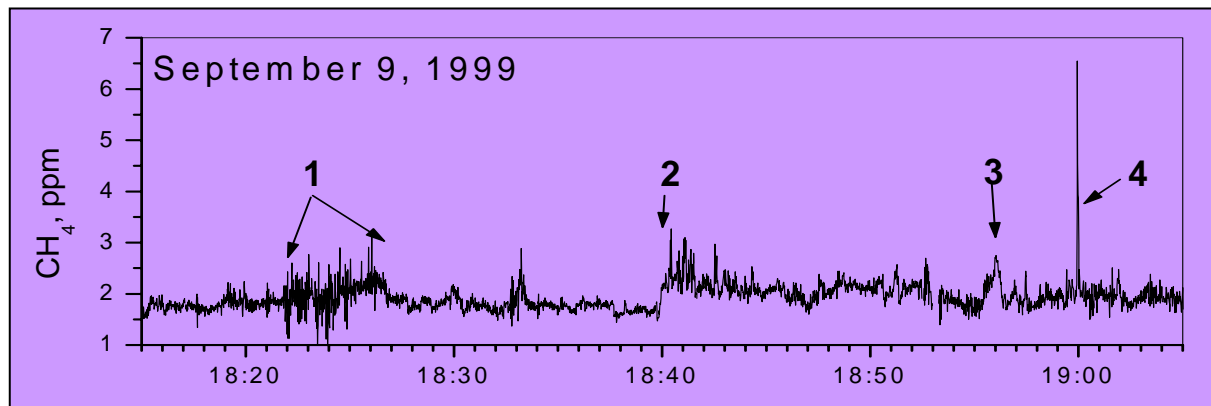
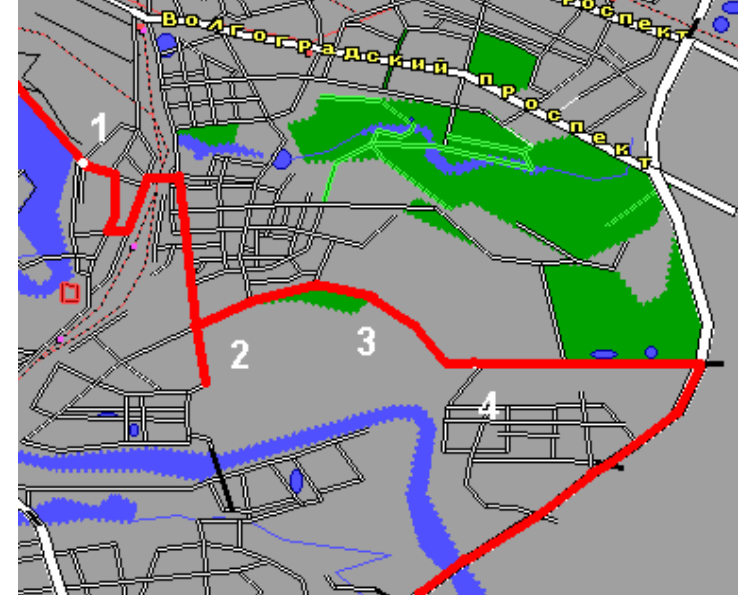
Removable Chernin  
multipass cell





# METHANE MONITORING IN MOSCOW

## Using Mobile TDL Based Analyzer



9.09.99 early morning apartment building in PECHATNIKI (1) was destroyed after terrorists action. Fragment of monitoring campaign:

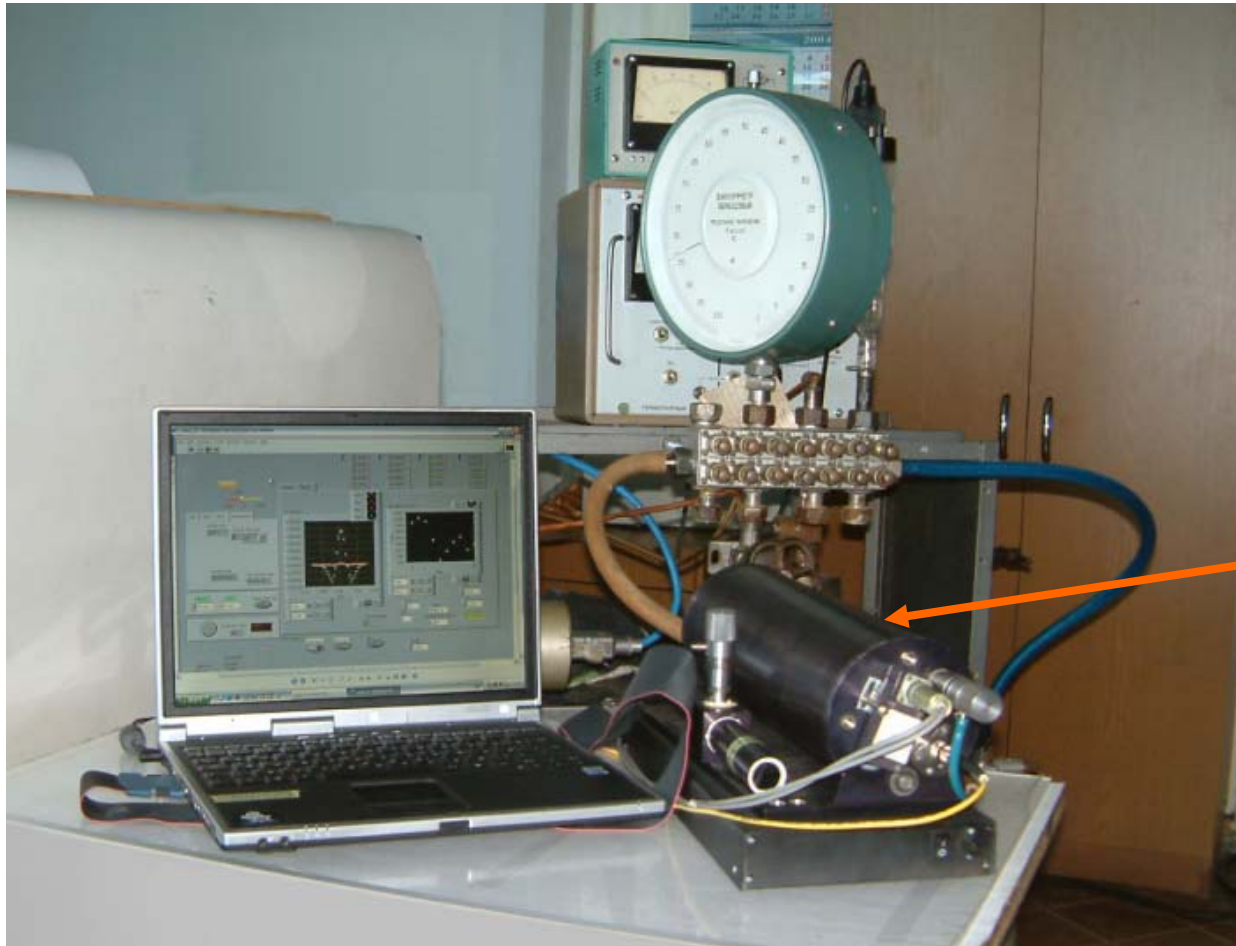
1 - Analyzer measures methane concentration near destroyed building.

2 - Entering wetland area

3 - Waster field

4 - Gas leakage

# Instrument to Measure $^{13}\text{CO}_2/^{12}\text{CO}_2$



"Chernin"  
multipass cell

Instrument view