Participation of the Institute of Geophysics Polish Academy of Sciences in the PLASMON project

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Institute of Geophysics
Polish Academy of Sciences
(IGFPAS)

IGFPAS – main departments

- **Seismology**
- **Physics of Atmosphere**
- **Hydrology and Hydrodynamics**
- **Polar Research**
- **Geomagnetism**
  - modelling of electromagnetic induction processes within the Earth
  - paleomagnetic investigations
  - geomagnetic observations

Belsk (BEL)
1965 - as magnetic observatory
1992 – INTERMAGNET
2005 – MM100 network (pulsations study)

Hel (HLP)
(1932) 1957 - as magnetic observatory
1999 – INTERMAGNET

Hornsund (HRN)
1978 - as magnetic observatory
1993 – IMAGE network
2002 – INTERMAGNET

Suwalki (SUW)
Recording of changes of magnetic field without absolute control
2007 – MM100 (pulsations study)

Full title of project:

A new, ground based data-assimilative modeling of the Earth's plasmasphere - a critical contribution to Radiation Belt modeling for Space Weather purposes (PLASMON)

Project details:

Project Acronym: PLASMON
Project Reference: 263218
Start Date: 2011-02-01
Duration: 42 months
Contract Type: Collaborative project (generic)
End Date: 2014-07-31
Project Status: Execution

Research area: SPA.2010.2.3-1 Security of space assets from space weather events

The research leading to these results has received funding from the European Community's Seventh Framework Programme ([FP7/2007-2013]) under grant agreement nr° 263218

Introduction

All space weather models and forecasting methods are dependent on data input for either boundary conditions or the specification of parameters needed by the model.

In-situ observations (satellite measurements) suffer from inherent weaknesses:

1) Very few platforms give comprehensive measurements of particles, waves and fields.
2) The data availability is very often limited in space and time
3) With very few exceptions the data are not generally available in real or even near-real time, limiting their use for forecasting.
4) High costs fabrication and launch of satellites.

The project will primarily use ground-based networks of observing stations, operating in the ULF and VLF ranges, deployed on a worldwide level.

There is a complementary or alternative approach to provide data sources for space weather models. Generally, ground-based measurements are cheap, and they can produce continuous temporal and spatial coverage.

List of participants:

Participant no.	Participant organisation name	Country
1 ELTE	Eötvös Loránd University (COORDINATOR)	Hungary
2 NERC-BAS	British Antarctic Survey	UK
3 ELGI	Eötvös Loránd Geophysical Institute	Hungary
4 UNIVAQ	University of L'Aquila	Italy
5 SGO	Sodankyla Geophysical Observatory	Finland
6 UO	University of Otago	New Zealand
7 HMO	Hermanus Magnetic Observatory	South Africa
8 NMT	New Mexico Institute of Mining and Technology	USA
9 IGFPAS	**Institute of Geophysics, Polish Academy of Sciences**	**Poland**
10 UW	University of Washington	USA
11 LANL	Los Alamos National Laboratory	USA

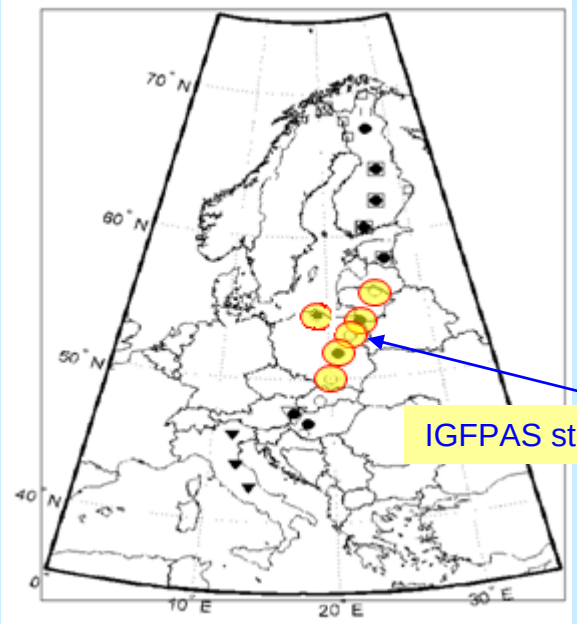
Main objective of the PLASMON project

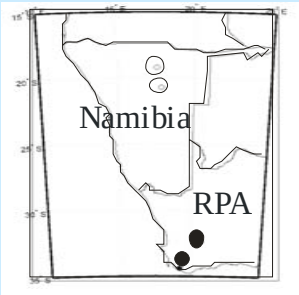
Developing a method to determine density of the plasmasphere in real time based on::

- registration waves VLF (Very Low Frequency)
- registration of magnetic pulsations ULF (Ultra Low Frequency)

ULF network

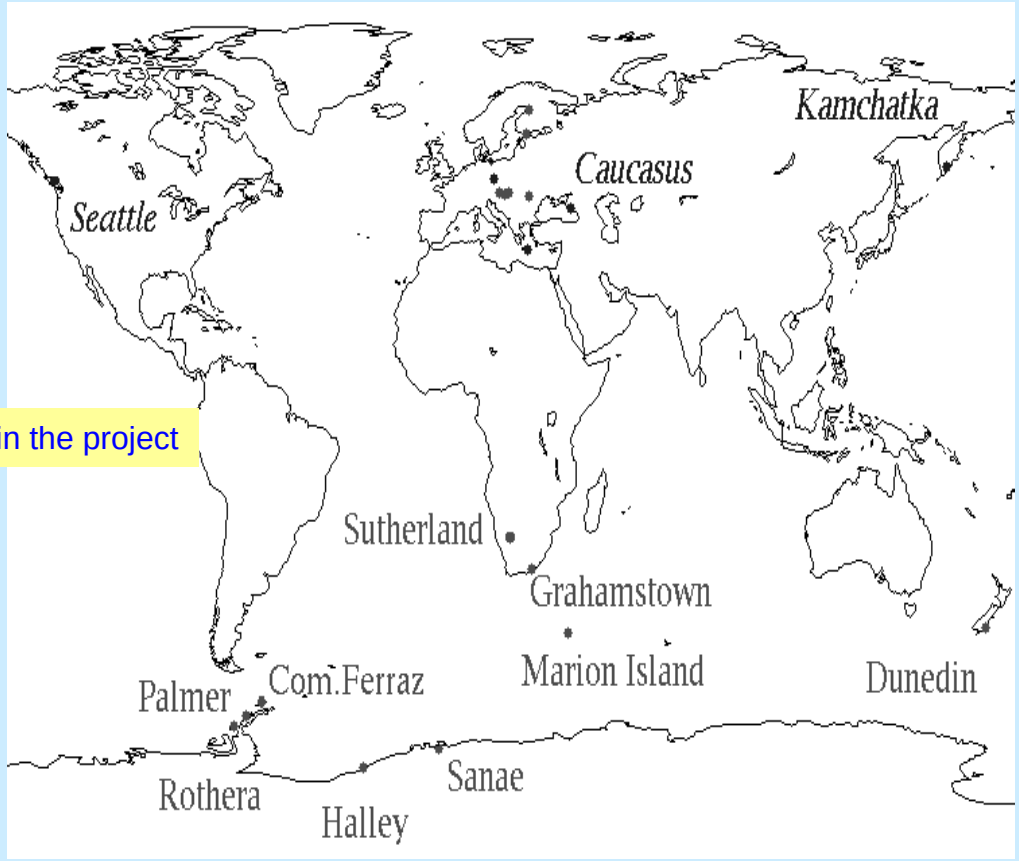
to capture and analyze FLR



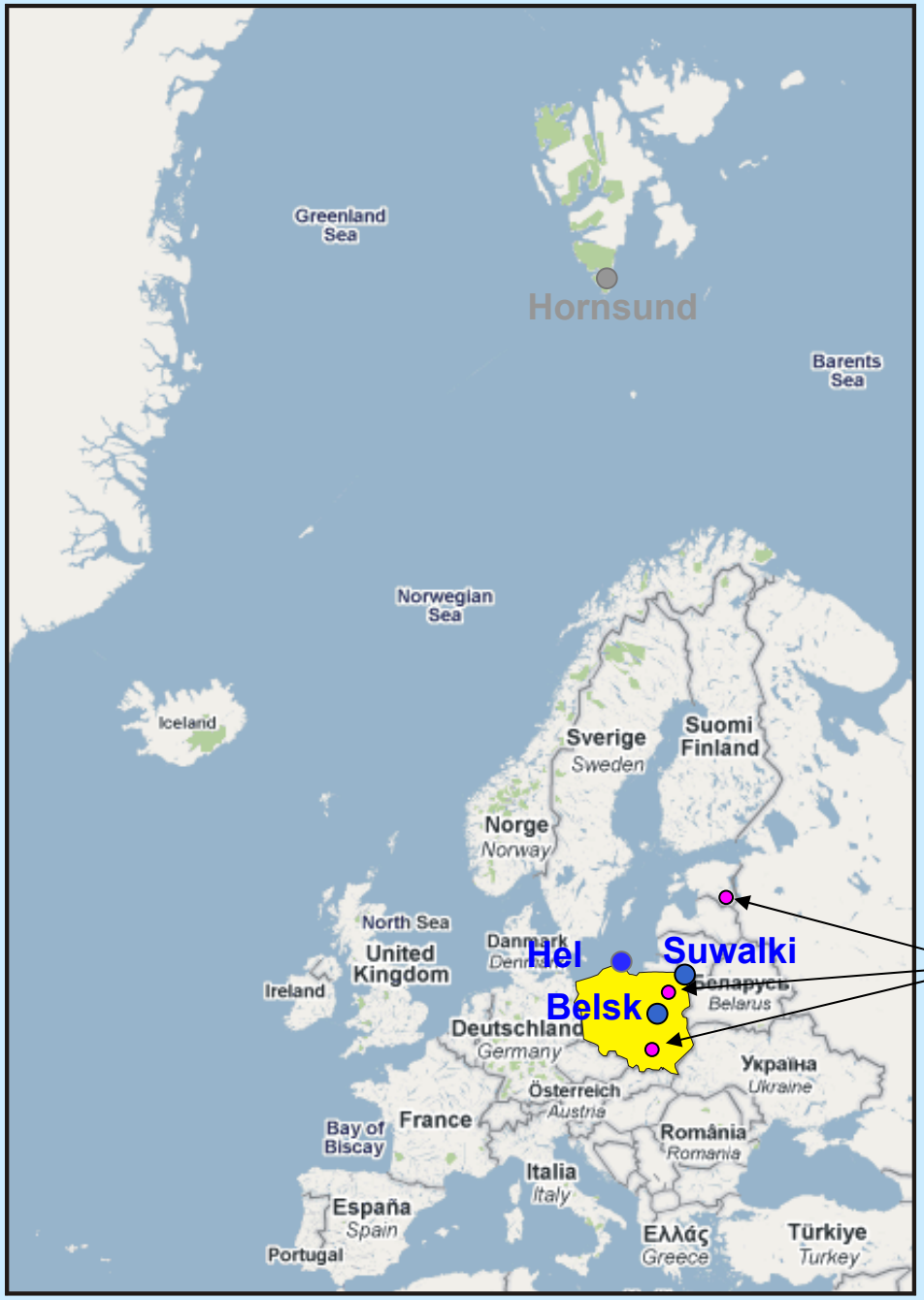


VLF network

to capture and analyze whistlers



IGFPAS stations in the project



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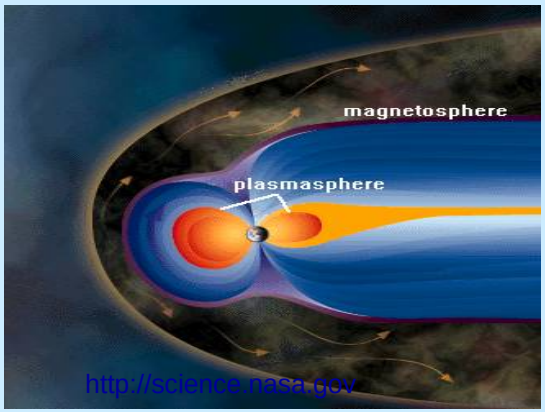
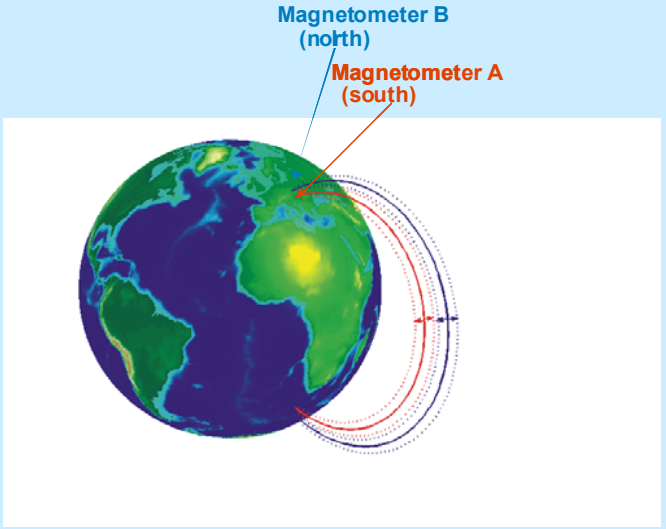
Planned 3 new ULF stations in frame of PLASMON

Plasmasphere and Field Line Resonance (FLR)





Plasmasphere is a region of the Earth's magnetosphere consisting of plasma. It is located above the ionosphere.

In the theory, standing Alfvén waves can be excited on geomagnetic field lines, forming so called field line resonances (FLR).

FLR phenomena has many parallels to the oscillations of string musical instrument.

$$f_{FLR} = \frac{V_A}{2l} \qquad V_A = \frac{B}{\sqrt{\mu \cdot \rho}}$$

V_A - Alfven velocity on the field line

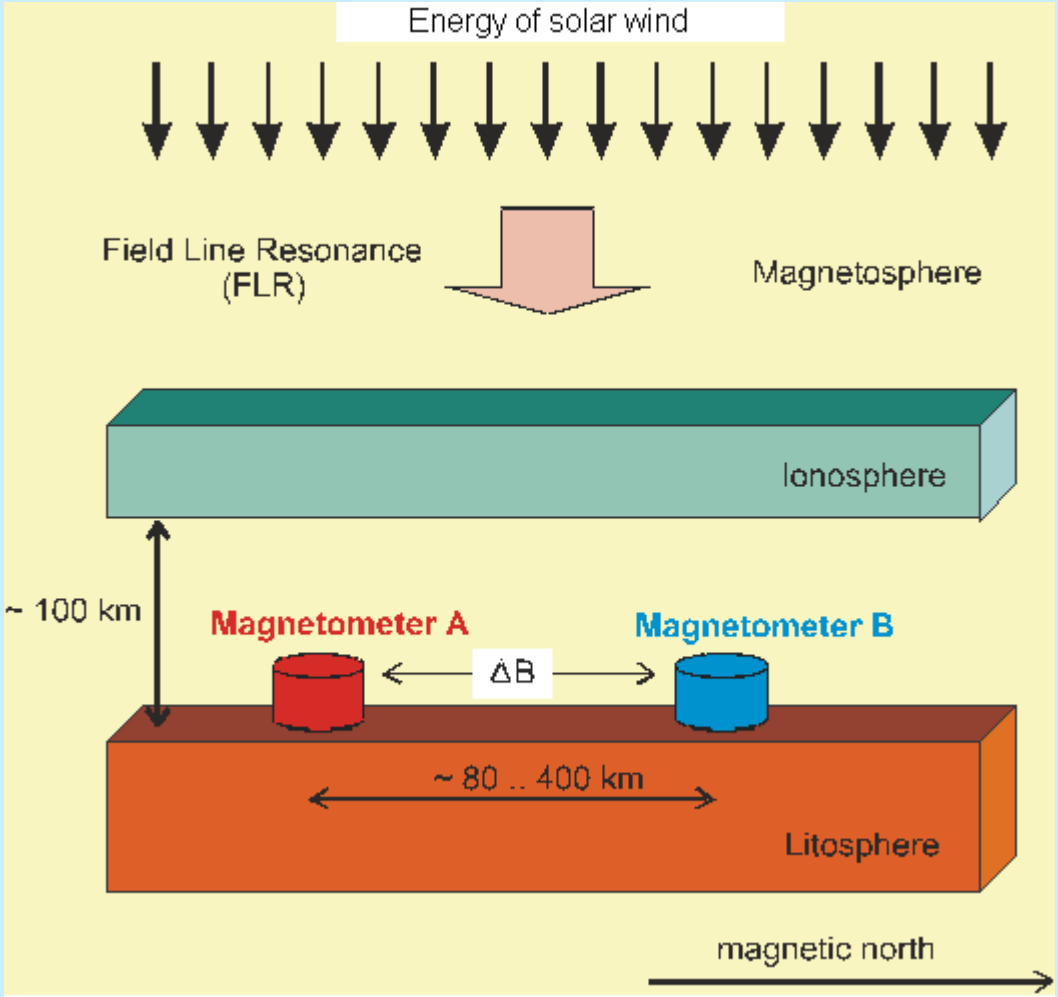
l - length of the field line

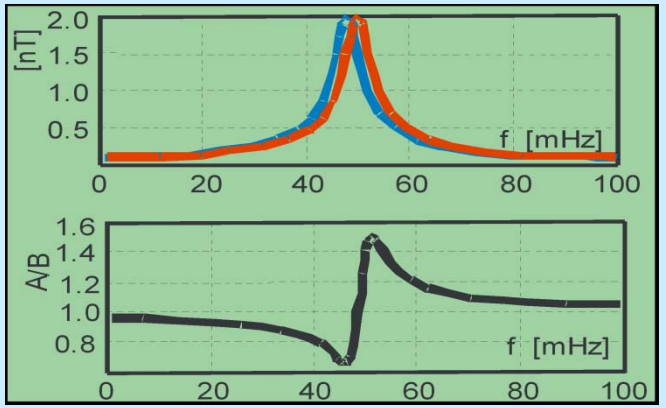
B - magnetic field

μ - permeability of the plasma

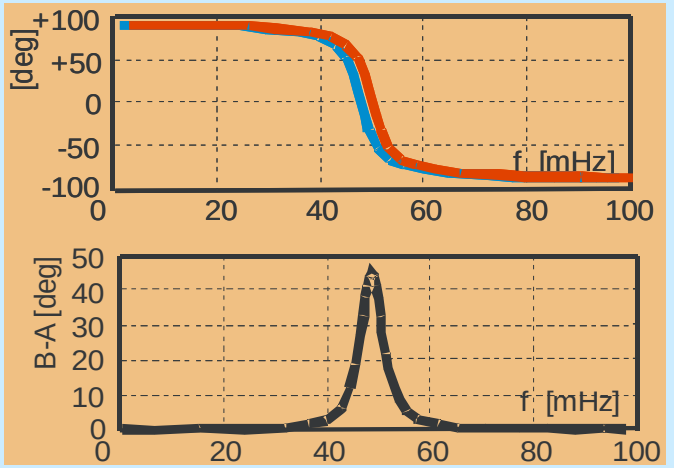
ρ - density of the plasma

Methods of FLR detection

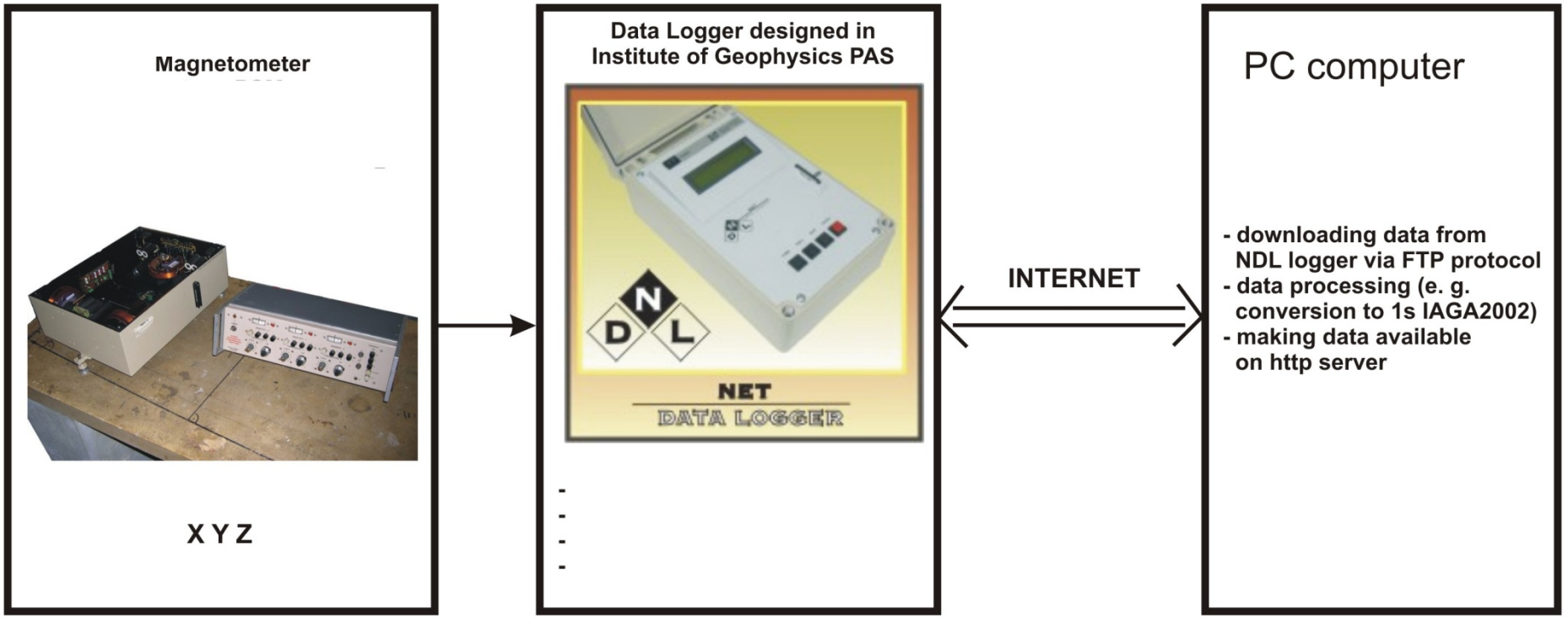




Amplitude Ratio Method



Phase Difference Method



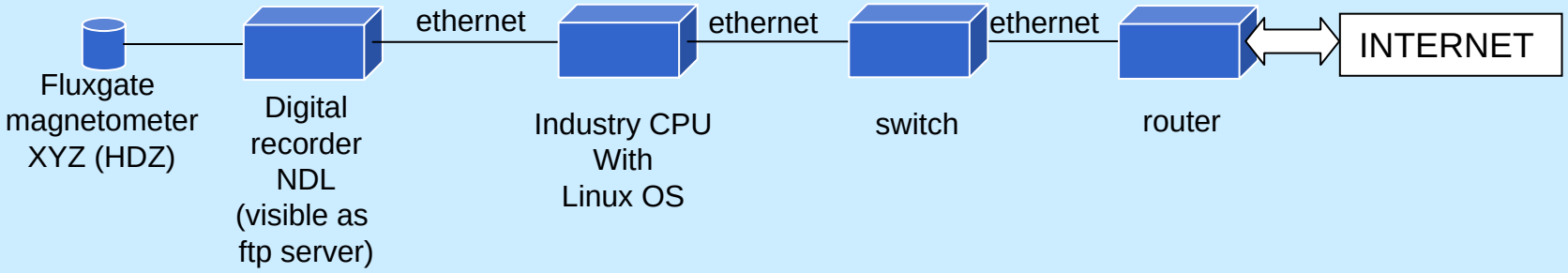
- Noise 10pT
- Stabitlity 2-3 nT/year

- Sigma delta A/D 24 bits
- Sampling 1.25ms – 60s
-Time accuracy 1ms (GPS)
- ftp server

Apparatus used for ULF recording

Block diagram of the field stations

SITUATION 1



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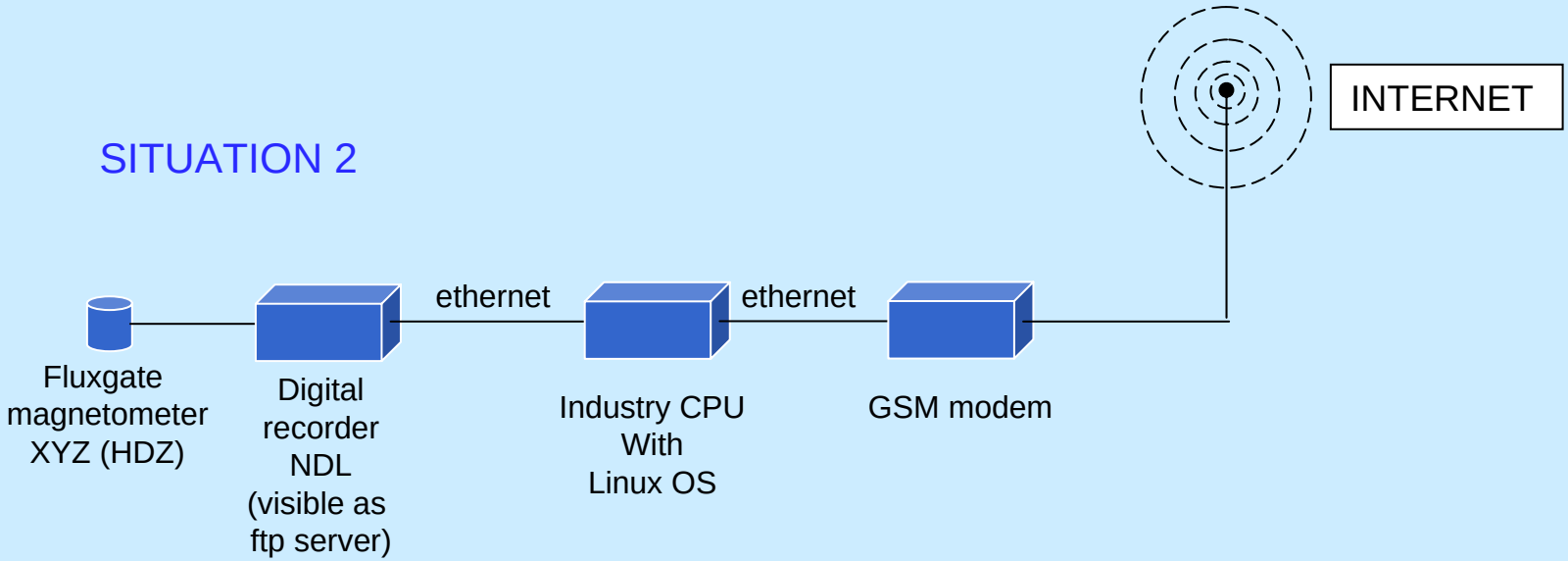

Main tasks of the IGFPAS in the PLASMON

- We will install 3 ULF magnetic stations, 2 in Poland and 1 in Lithuania.
- The 3 new mid-latitude stations and 3 already existing (Belsk, Hel and Suwalki) will be maintained.
- We will participate in cross-calibration of the instruments especially in relation to magnetometers.
- We will participate in modeling of plasmasphere

Thank you ☺