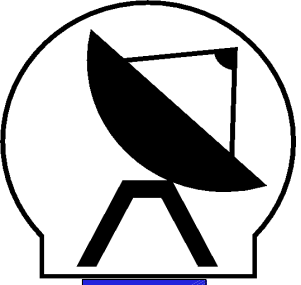

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Works in Process

Currently, our team in Metsähovi is involved in two big international projects.

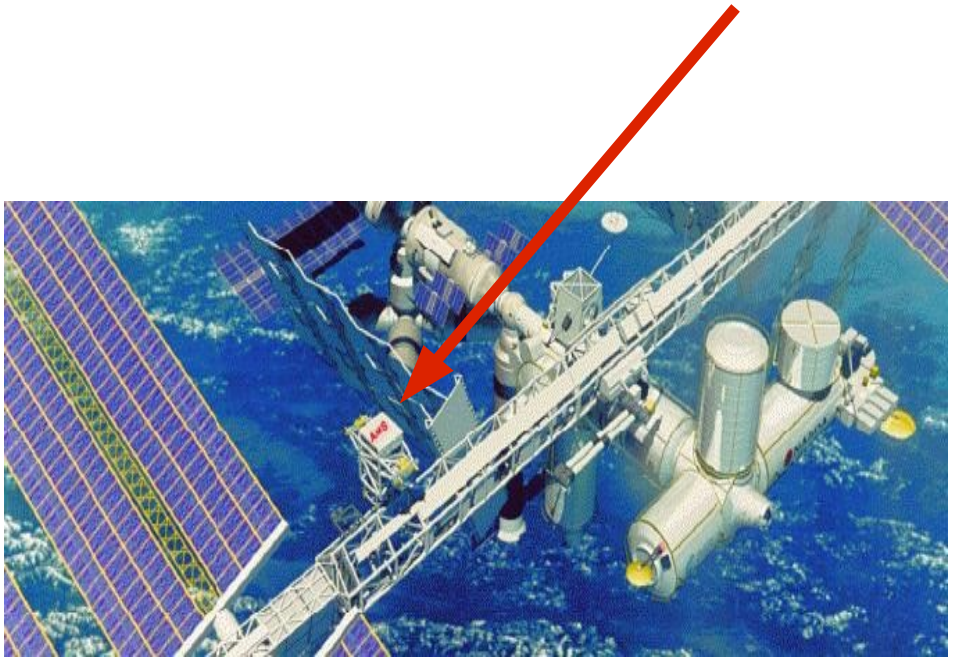
1. AMS-02
2. eVLBI

EUROPEAN
NETWORK

Alpha Magnetic Spectrometer

- AMS-02 is an experiment to search in space for dark matter, missing matter & antimatter on board of the International Space Station.
- Basic objective of AMS is to catch the cosmic rays and analyze their properties when they travel trough the system.
- AMS will observe the behavior of the electrons, positrons, protons, anti-protons and nucleis.

AMS in the ISS



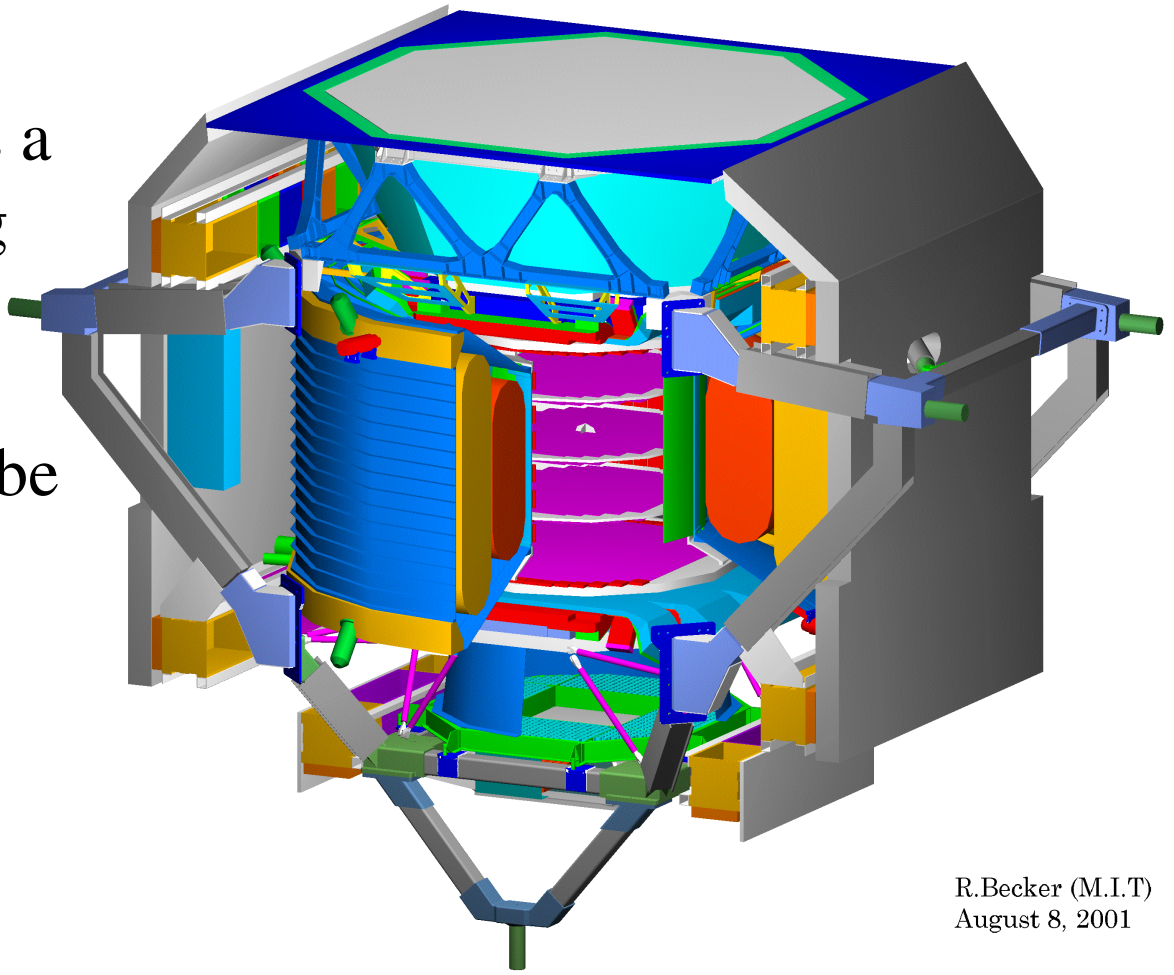
AMS-02 will be located in one of the arms of the ISS, but it will be almost working independently from the rest.

It is expected to be launched in early 2008, but probably it will be delayed to the ends of the year. There is not schedule for the launch.

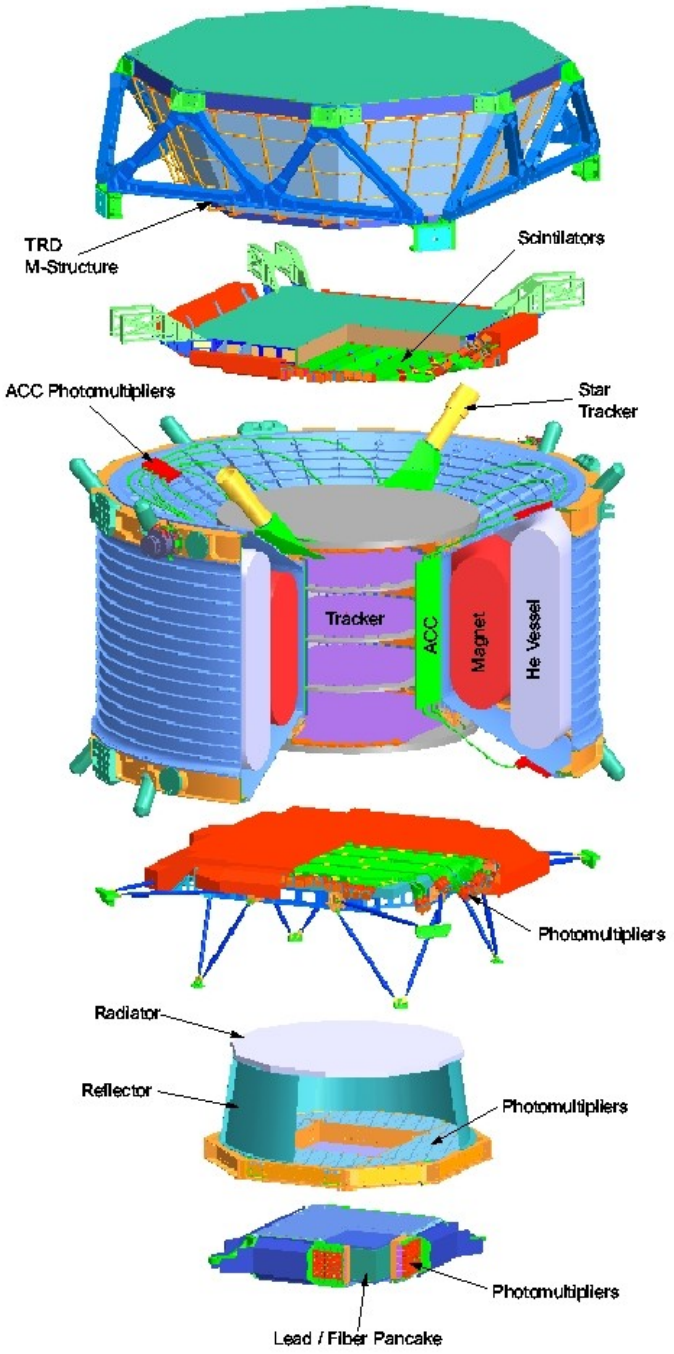
The minimum operational time is 3 years, but its hope to continue working as long as possible.

Basic scheme of AMS-02

The core of AMS it is a huge superconducting magnet and six different ultraprecize detectors, which will be measuring all the parameters and characteristics of the cosmic rays.



R.Becker (M.I.T)
August 8, 2001



TRD:
Transition
Radiation
Detector

TOF: (s1,s2)
Time of Flight
Detector

MG:
Magnet

TR:
Silicon Tracker

ACC:
Anticoincidence
Counter

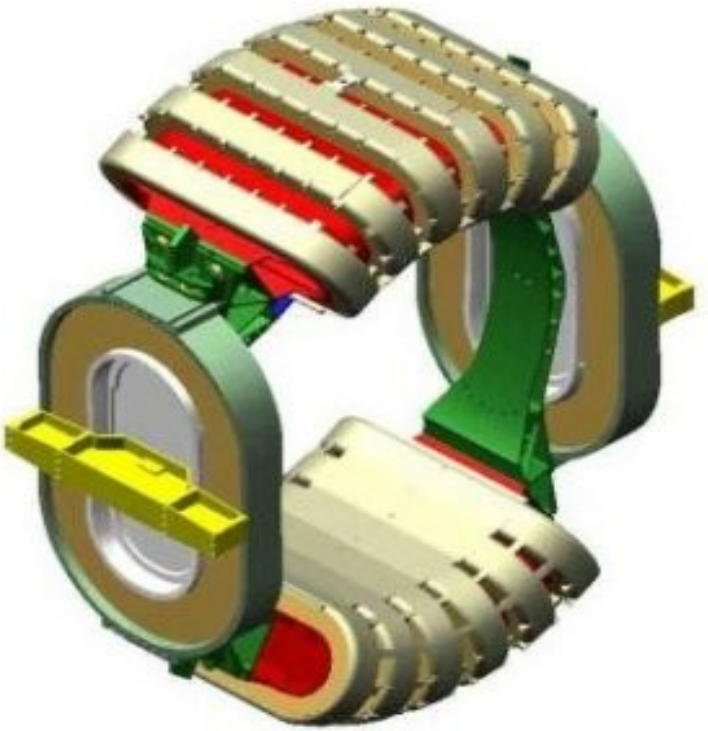
AST:
Amiga Star
Tracker

TOF: (s3,s4)
Time of Flight
Detector

RICH:
Ring Image
Cherenkov Counter

EMC;
Electromagnetic
Calorimeter

AMS Alpha Magnetic Spectrometer



- He vessel will contain more than 360 kg of helium to keep the magnet cool for the 3 next years at the temperature of 1,8 K. Not tests available on Earth's environment.

Detectors I

- **Transition Radiation Detector (TRD):** is installed on the top of AMS-02, it will be the first layer which cosmic rays will cross. Its specific goal is to identify those particles (protons, electrons, pions or muons) that others detectors can't differentiate in high-energies.
- **Time Of Flight (TOF):** through two layers it measures the velocity and direction of the particles. The procedure is simple, it counts when the particle enters to the magnet barrel and when leaves from the other side. After that it calculates the elapsed time with an accurate timing system.

Detectors II

- **Silicon Tracker (ST):** The AMS center consists of eight large, thin sheets of silicon. It measures the particle trajectories through the strong magnetic field. This trajectory will draw some kind of arc, depending its own *momentum*. And its the only detector that can tell helium and anti-helium apart.

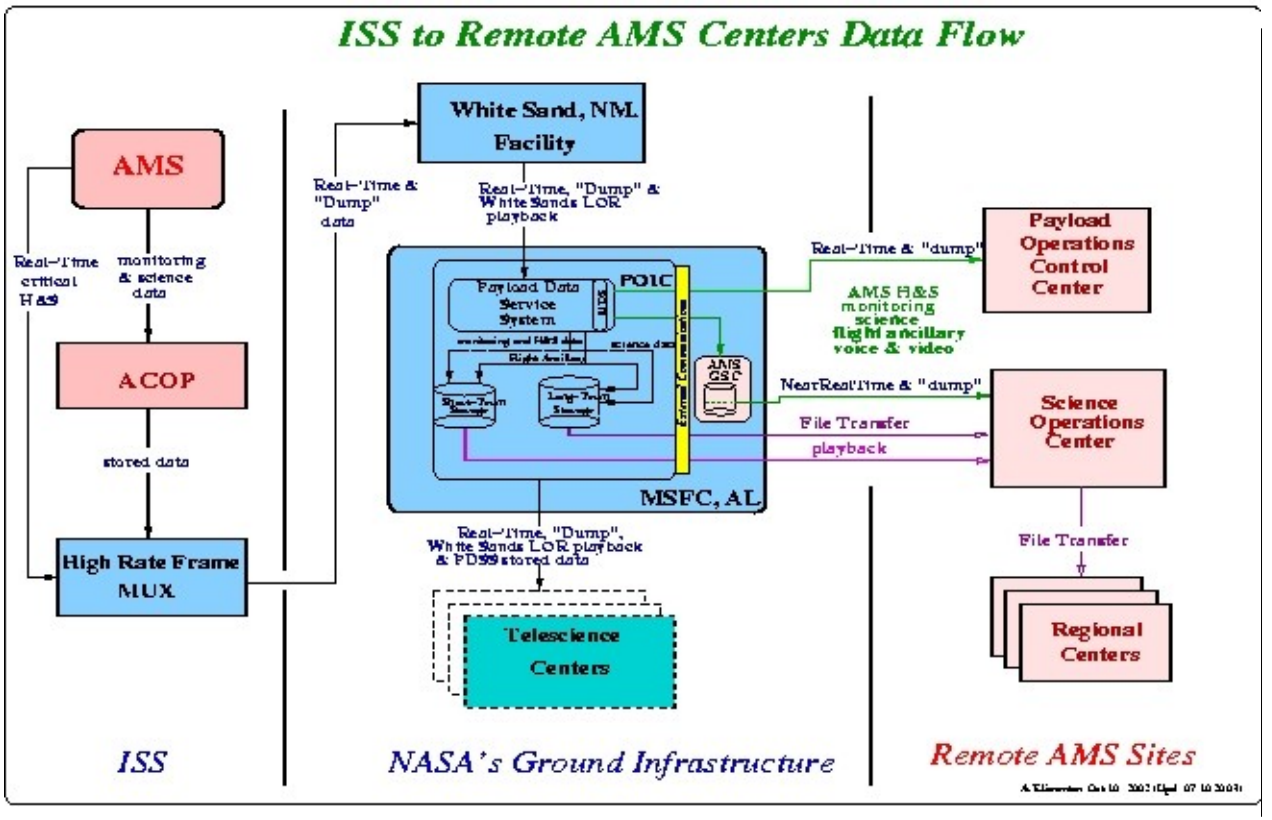
- **Ring Image Cerenkov Counter (RICH):** It pretends to measure particle's velocity close to the speed of light, when it really needs accurate results. When the high-speed particle cross a glass surface emits a conical spray of light (Cerenkov radiation). Working with the opening angle we get the speed.

Detectors III

- **Electromagnetic Calorimeter (ECAL):** is a detector which does accurate particle identification and energy measurement. It works by stopping the particles in a big lead brick and calculate how much light is emitted by them.
- **Anti-Coincidence Veto Counter (ACC):** helps to tell AMS which particles are important for the experiment. It is predicted that more than 10000 particles/second will pass through the several detectors and ACC has to process which are worth of analyze or which not.

Metsähovi in AMS-02 project

HRDL (High Rate Data Link) is data transmission from AMS-02 to the Marshall NASA center. This channel will send all the information processed by the detectors to be studied on the ground.



Metsähovi in AMS-02 project

Data has to be acquired in the Ground System Equipment (GSE) in MSFC, to be stored in hard disks and send it to operational center.

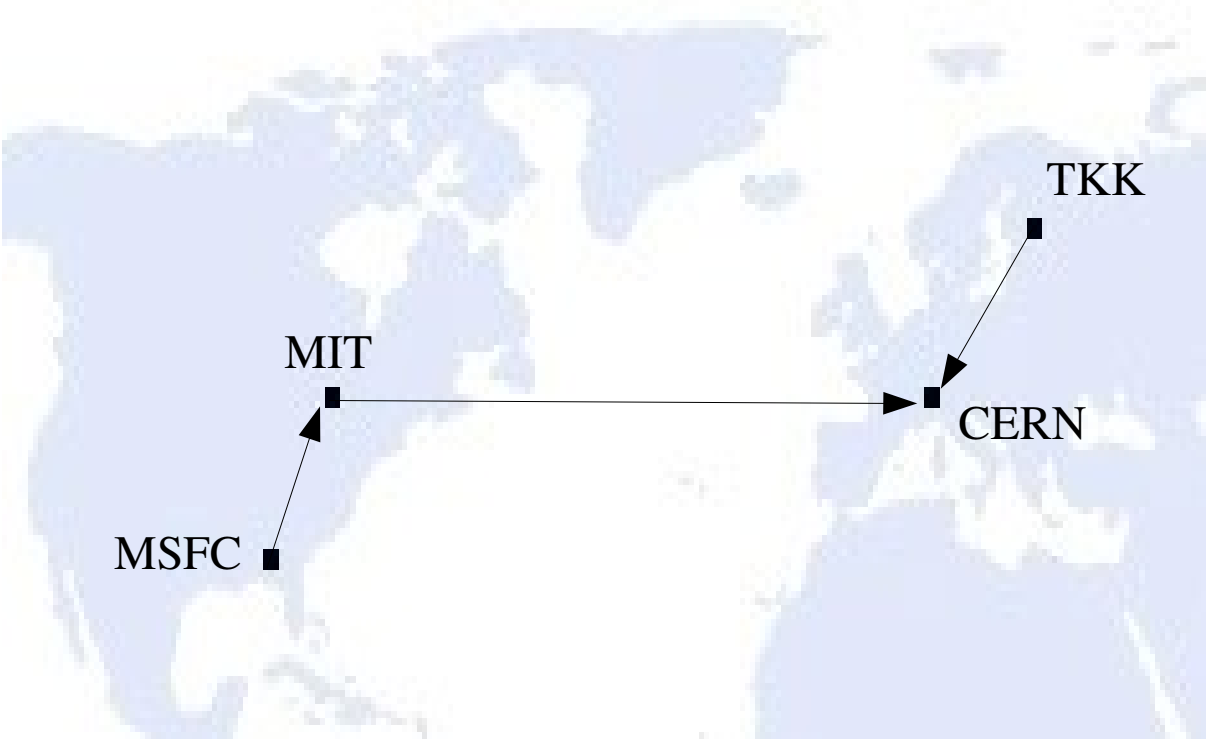
The download channel works in Ku band at 50 Mbps from the ISS to MSFC. We have successfully tested in our laboratory up to 10 times higher rate with the Metsähovi VLBI data acquisition system.

Mr. Ritakari and Mr. Mujunen have already a high experience by working in AMS-01 HRDL architecture in 1998.

Ground transmission

- The other efforts are focused to work on the transmission of the packets from MSFC to the SOC (Science Operations Center) as MIT, CERN or others associate institutes as Metsähovi.

It needs a fast, reliable and secure Tx protocol.



Tsunami Protocol

Tsunami protocol is based on transmission by UDP packets. Metsähovi has been developing tests, writing software and doing a demonstration with JIVE (Joint Institute VLBI Europe) and the results are :

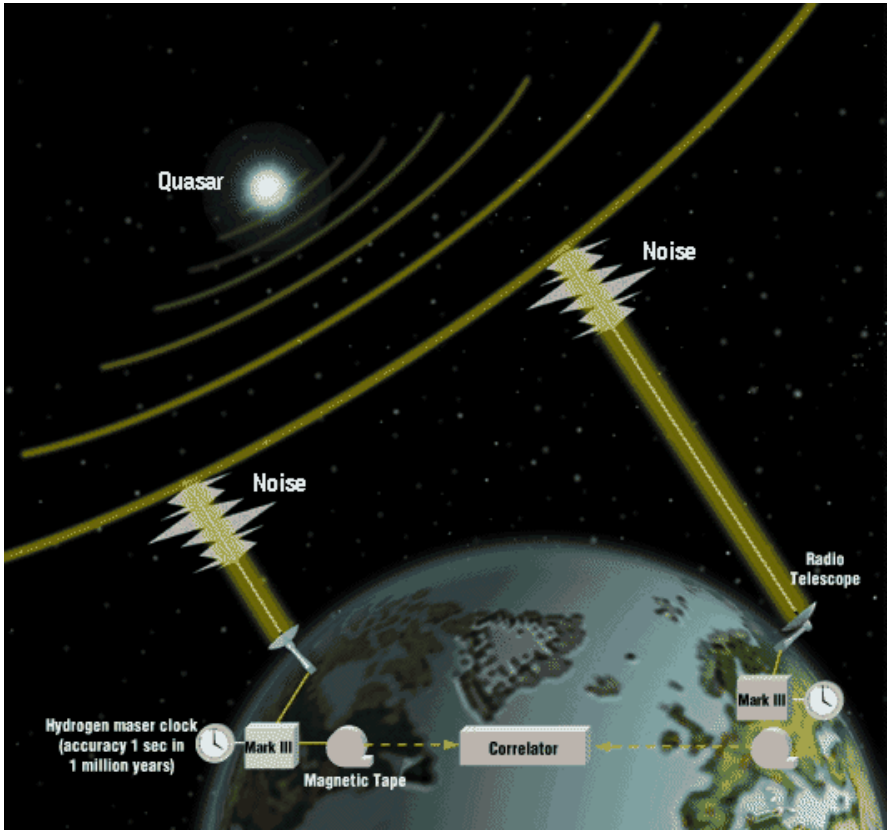
Fast-> Speeds up to 500 Mbps from HUT to JIVE.

Reliable-> No packets loss during more than 30 hours of non-stopping transmission.

Secure-> Enough security for fulfill the requirements.

eVLBI

The propose of eVLBI is to connect European observatories with fast optical fibers, in order to get VLBI correlated data on real time in JIVE. Observatories have to acquire the data and transmit instantaneously them through Internet to Netherlands, where is compared with the rest of obtained information.

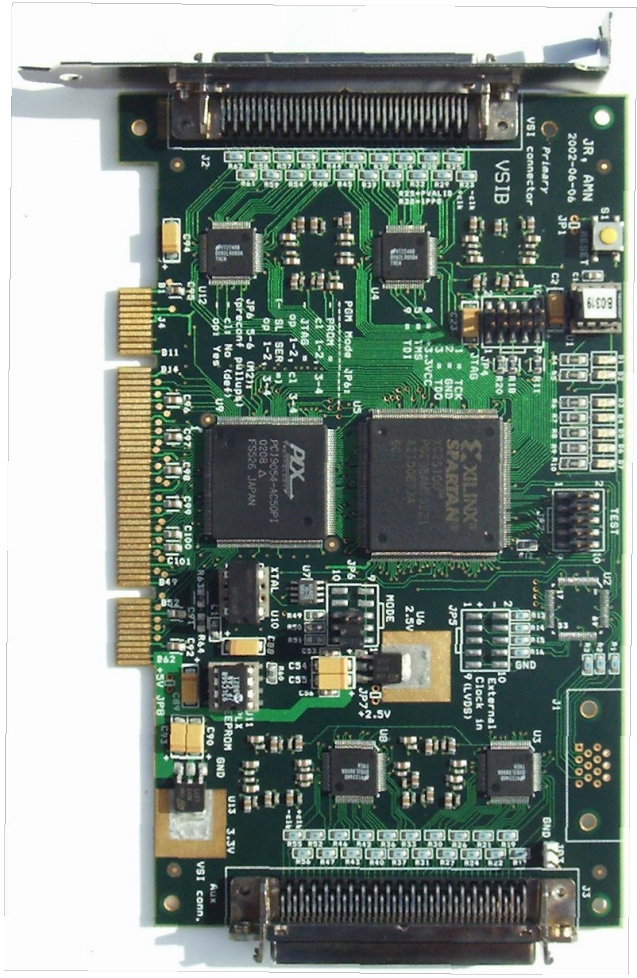


Metsähovi in eVLBI project

VSI-board and the software has been designed at 2002 in Metsähovi by J.Ritakari & A.Mujunen. It is able to acquire VLBI data in a single Pc and up to 512 Mbps.

It has been produced and sold around 100 units and is used in many observatories.

To transmit VLBI data Metsähovi is still doing tests in collaboration with several institutes, in order to implant Tsunami Protocol to get real time data.



Conclusions

- AMS-02 is just in the beginning and hard work is waiting us to develop software and hardware.
- The contribution from Metsähovi to eVLBI project has been already recognized, specially for the VSI-board. But we are going on developing tests and reports, in order to get fast and low-cost full network between all the European observatories.
- In two weeks we will have installed and operating at 10 Gbps optical fiber from TKK to Metsähovi. We can provide real tests acquiring and transmitting scientific data.