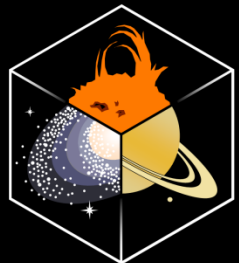


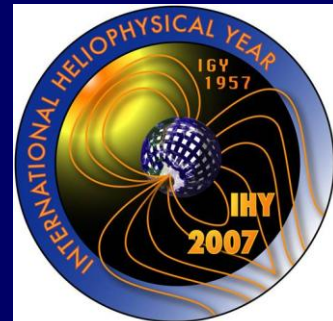


# Solar radio spectrometer network e-Callisto

## Solar Radio Burst Observation and Radio Monitoring

ETH Zurich  
Institute of  
AstronomyChristian Monstein  
ETH Zurich  
Switzerland

2015-03-02





# Topics

- General information about project and instrument
- Coverage aspects
- Presentation of a few observation sites
- Network structure
- Science aspects
- Conclusions



# Callisto as Swiss - contribution to IHY2007 and ISWI

**C** ompound  
**A** stronomical  
**L** ow cost  
**L** ow frequency  
**I** nstrument for  
**S** pectroscopy and  
**T** ransportable  
**O** bservatory

13<sup>th</sup> anniversary of Callisto since 1<sup>st</sup> light of the prototype receiver in 2002



# What is Callisto good for?

- Real-time observation of dynamic, electromagnetic solar radio bursts of different types
- Radio-monitoring, environmental studies, site evaluation for other radio-telescopes.
- Education & outreach in developing countries
- Electronics training for our Physics Apprentices



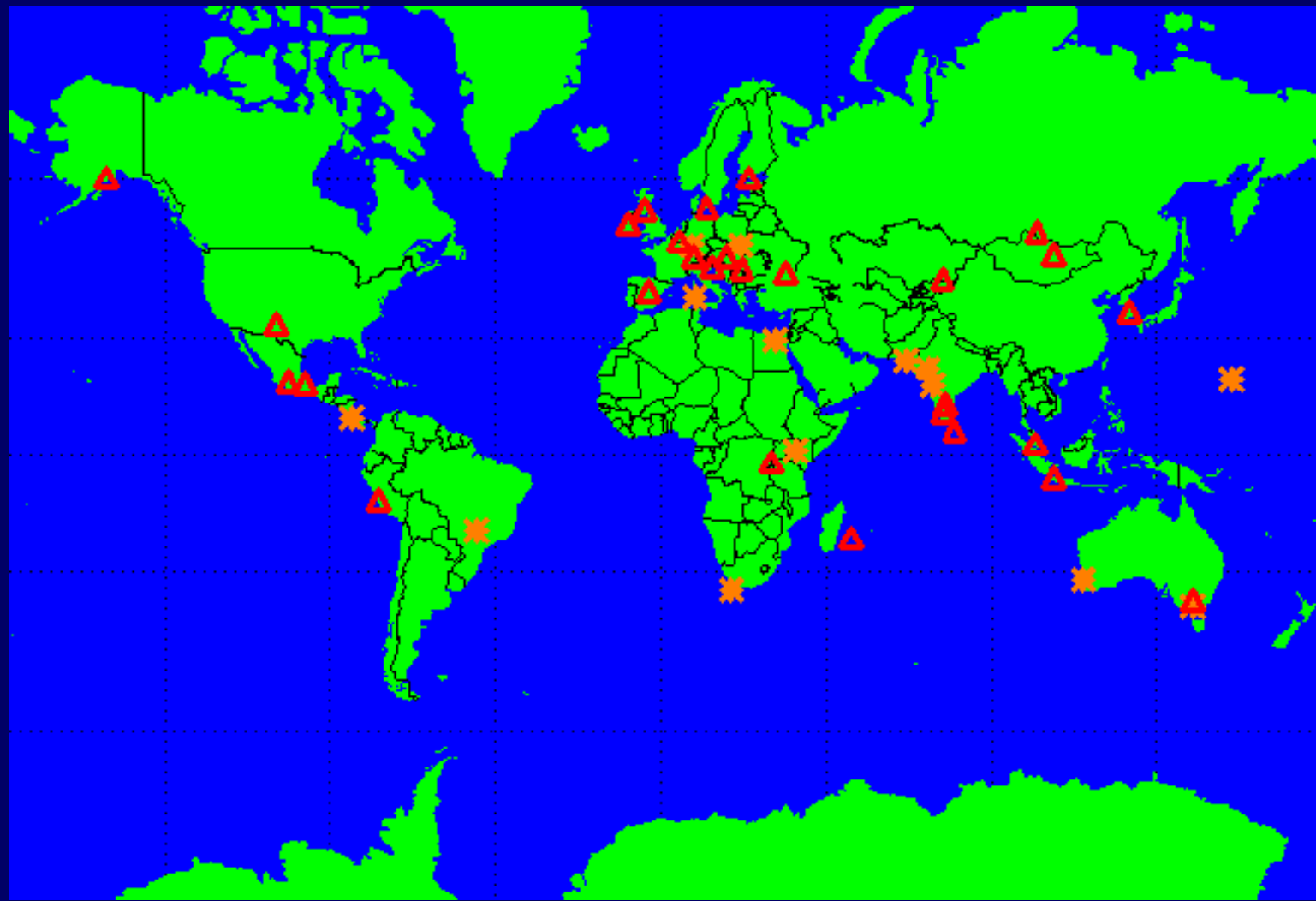
# Specification Callisto

## Parameter

## Specification

Frequency range	45.0 MHz ... 870.0 MHz ( $34 \text{ cm} < \lambda < 6.7 \text{ m}$ ) any other range, using heterodyne/homodyne converters
Frequency resolution	62.5 KHz (13'200 channels)
Radiometric bandwidth	300 KHz @ -3dB
Integration time	1 msec
Dynamic range	> 50 dB
Detector sensitivity	25 mV/dB +/- 1mV/dB
Noise figure	< 10 dB
Measuring rate	800 pixels/sec maximum
Sweep length	1...400, nominal 200 frequencies per sweep
Power consumption	12 V +/- 2 V / ~225 mA (2.7 Watt)
Weight	~ 1 kg
Dimensions	110 mm x 80 mm x 205 mm
Cost	Hardware < 500\$, labour 1 week (soldering, testing etc.)
Inputs	4 files (configuration, frequency, scheduler, calibration)
Outputs	4 files (FITS-files, logfile, light curve file, spectral overview)

# Coverage



Status March 2015: 70 instruments at 38 different locations worldwide

# Callisto at Institute of Ionosphere Almaty, Kazakhstan



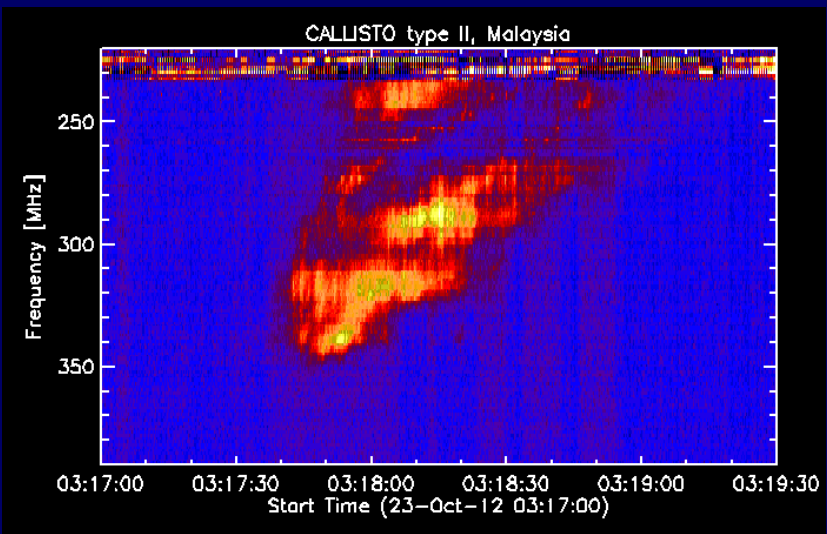
Log-per antenna mounted at the lower rim of the 12 m dish of a Russian satellite tracking Antenna in Tian Shan mountains 3000 m asl.



Standard Windows PC controlling Callisto and the FTP client.  
Oleg Gontarev †, Institute of Ionosphere  
Kamenskoie Plato, Almaty, Kazakhstan



# Callisto at National Space Agency Kuala Lumpur, Malaysia





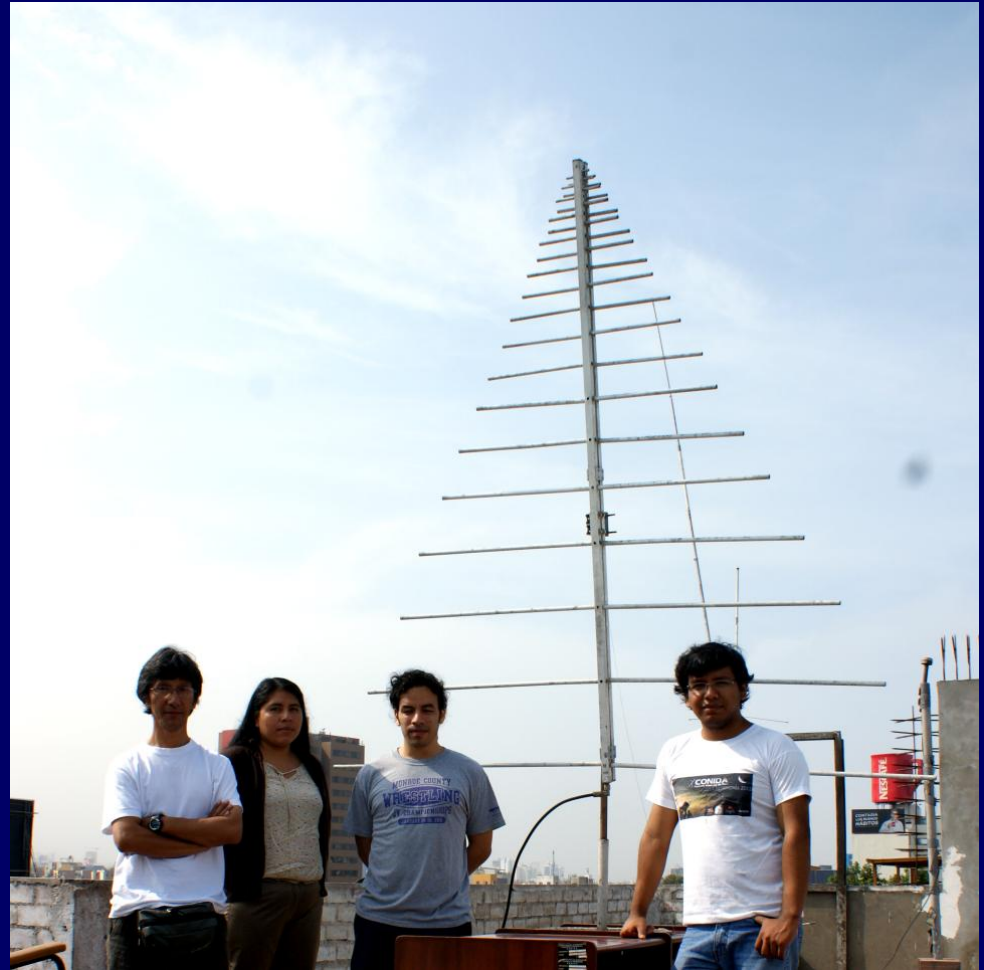
# Callisto at National Space Agency Kuala Lumpur, Malaysia



# Callisto in San Isidro, Peru



Site evaluation in Punta Lobos, Peru



Current observation place in San Isidro, Peru



# Callisto in Mexico



UNAM - Instituto de Geofísica unidad Michoacan  
Servicio de Clima Espacial (SCiESMEX), Mexico

# Callisto in Karachi, Pakistan





# Callisto in Karachi, Pakistan



# Callisto in Karachi, Pakistan



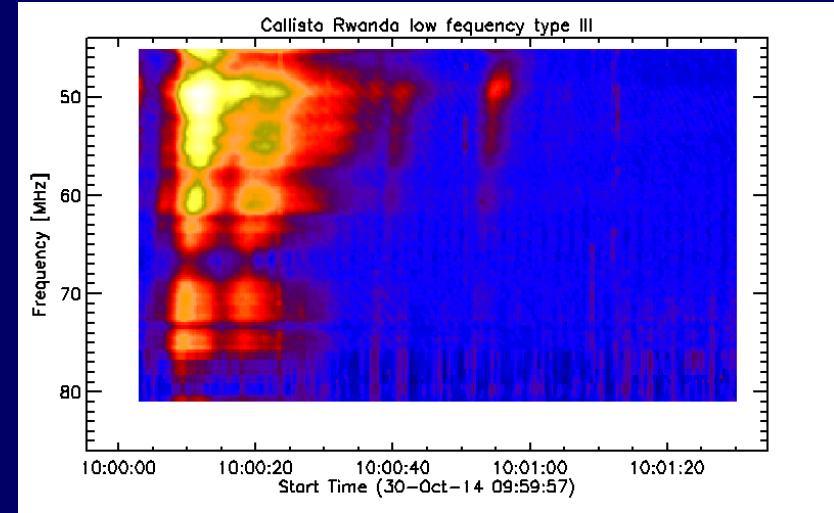
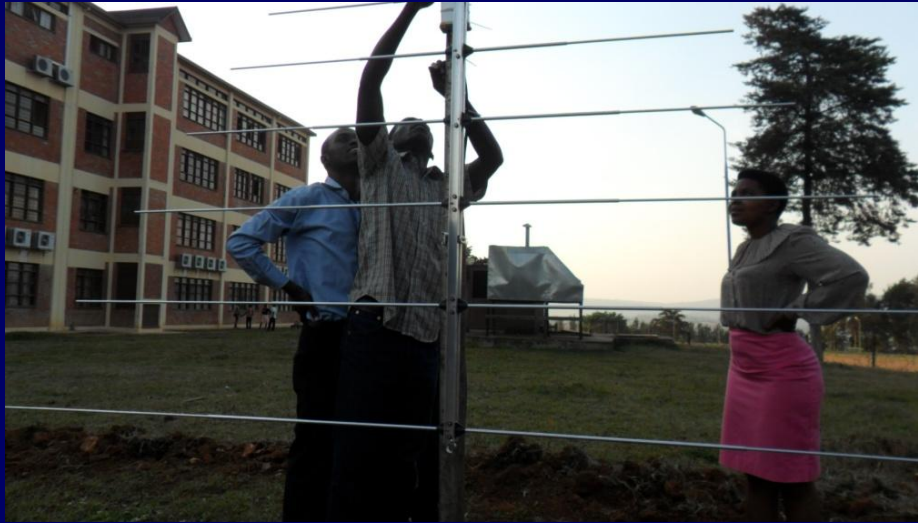


# Callisto in Copenhagen, Denmark



National Space Institute, Elektrovej, DK - 2800 Kgs. Lyngby, Denmark

# Callisto in Kigali, Rwanda

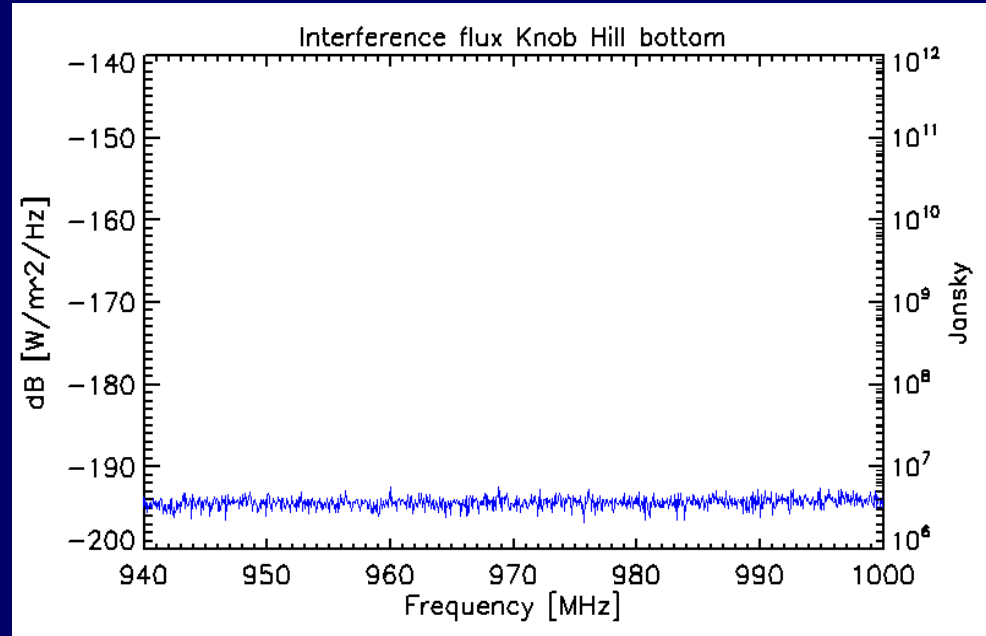


Jean Uwamahoro  
University of Rwanda  
College of Education  
Maths & Physics Department  
P.O.BOX 5039 Kigali



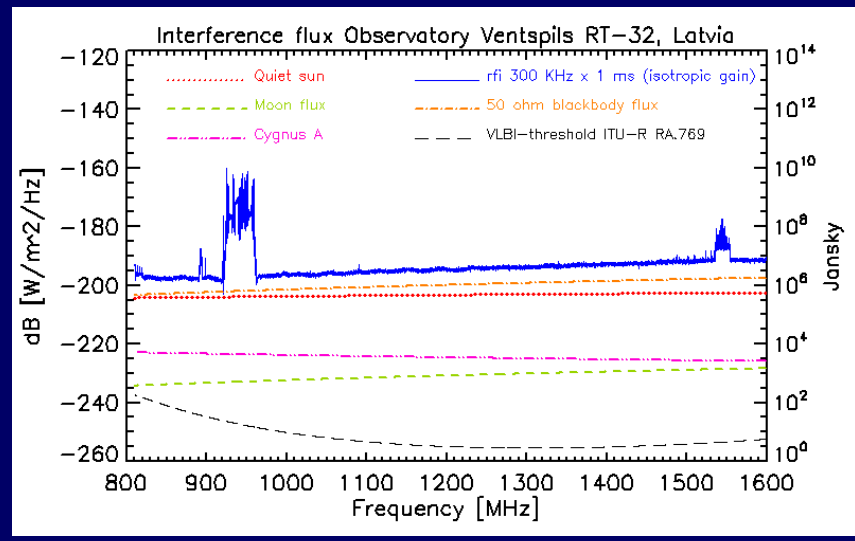
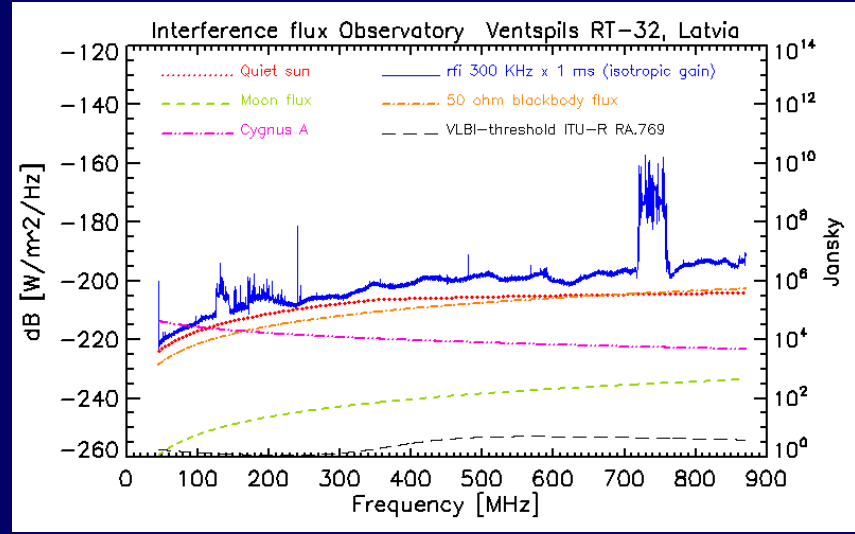


# Radio monitoring at Gold Mine Knob Kill Minas de Corrales, Uruguay



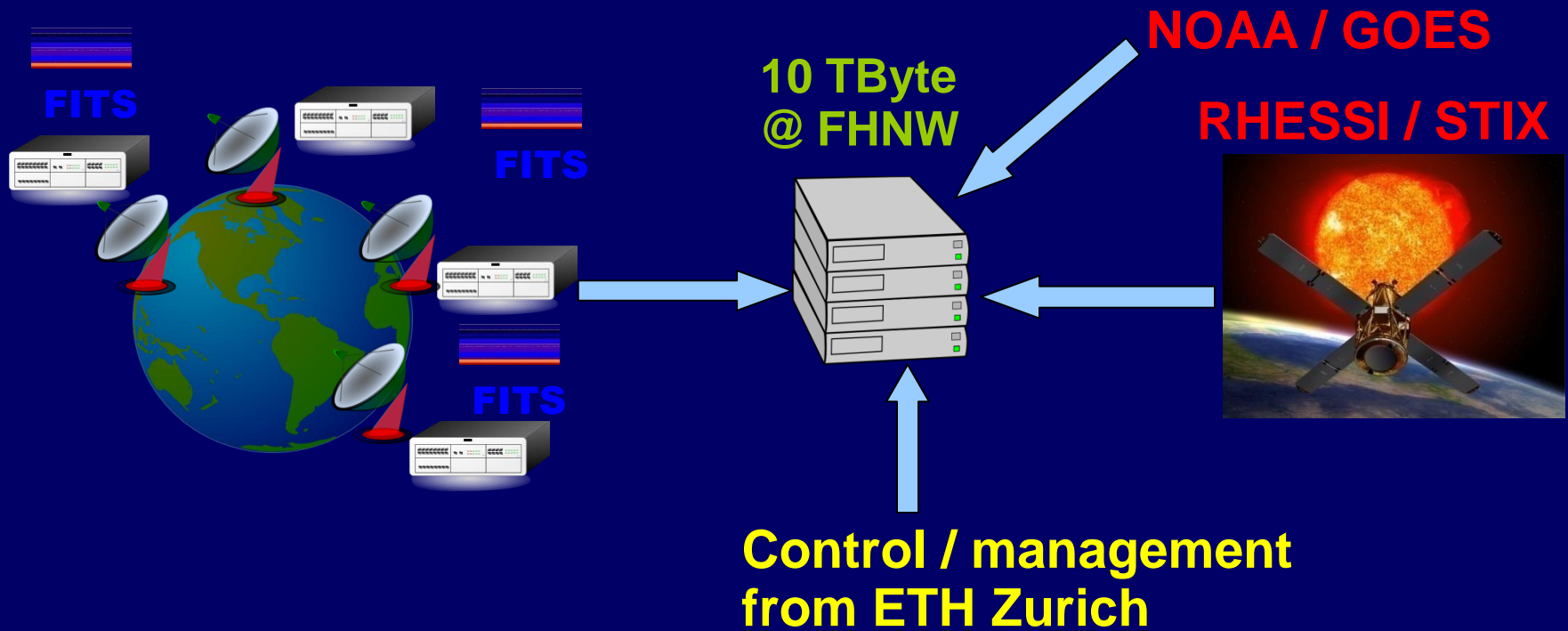
Site survey in quarries and gold mines to find a place with low rfi for a new radio telescope in the southern hemisphere.

# Radio monitoring at RT-32 in Latvia



# e-Callisto network

<http://soleil.i4ds.ch/solarradio/>



# Current User Statistics



~ 660 worldwide visits per month from 112 countries

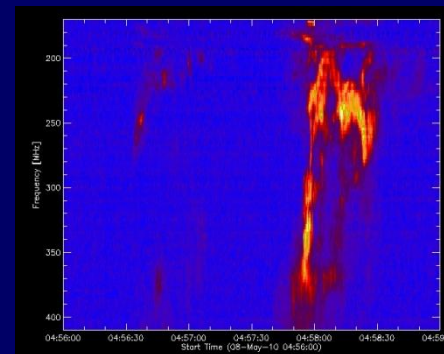
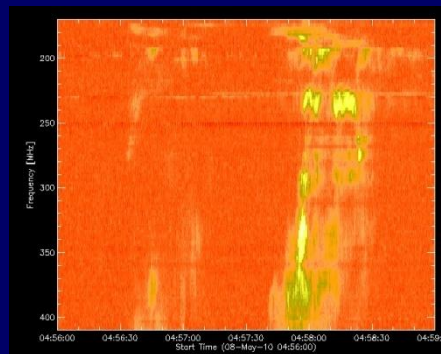
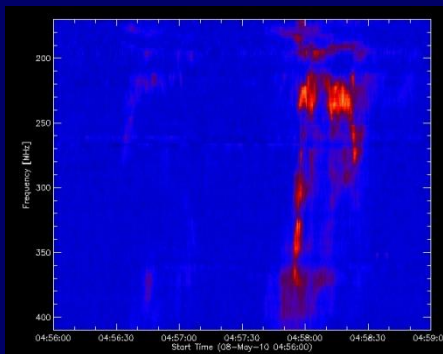
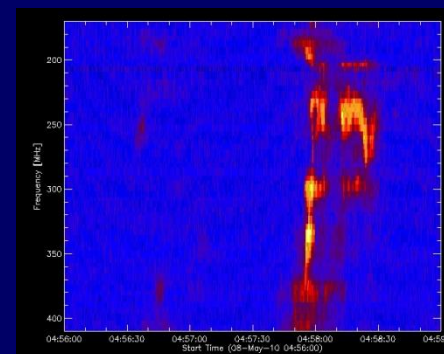
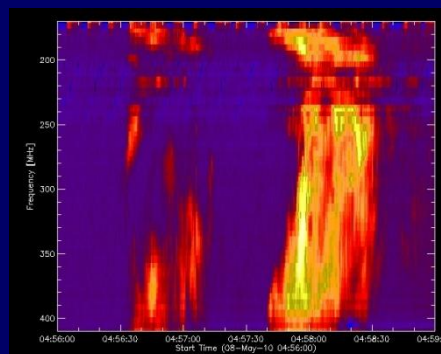
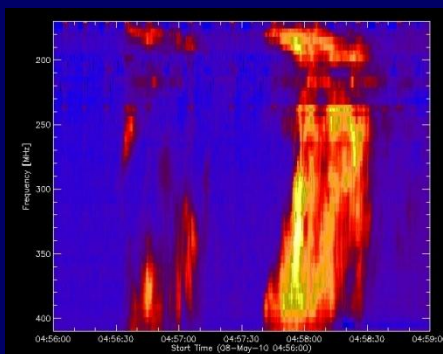
~ 60 GByte solar radio data per year (gzipped FITS-files)

10 Tera Byte data archive available at University of Applied Sciences, Institute for 4D technologies (FHNW).



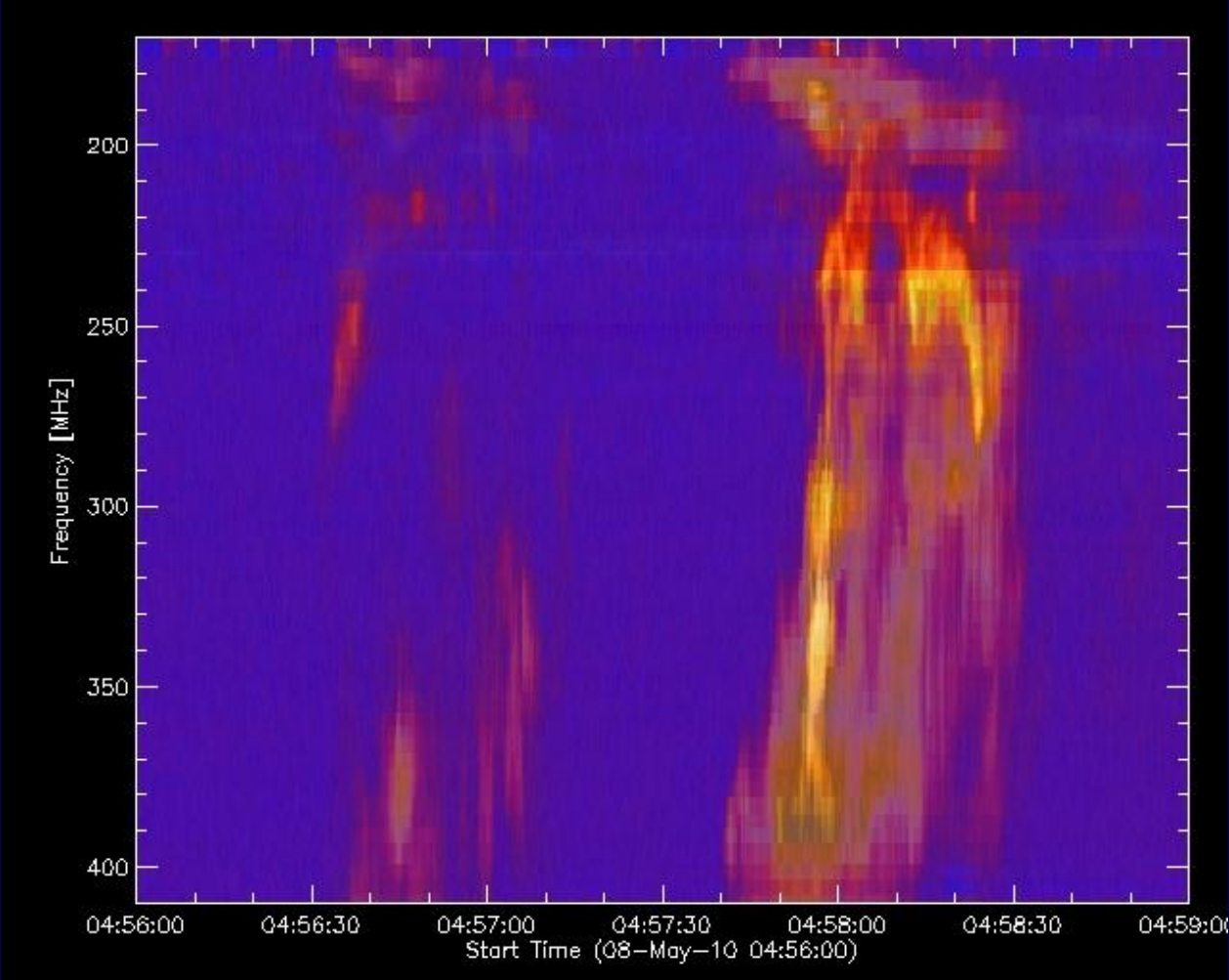


# Geographical Redundancy



2 x Switzerland (LHCP, RHCP) + Mauritius + Ooty + Gauribidanur + Siberia  
Event of May 8th 2010 at 04:56 - 04:59 UT

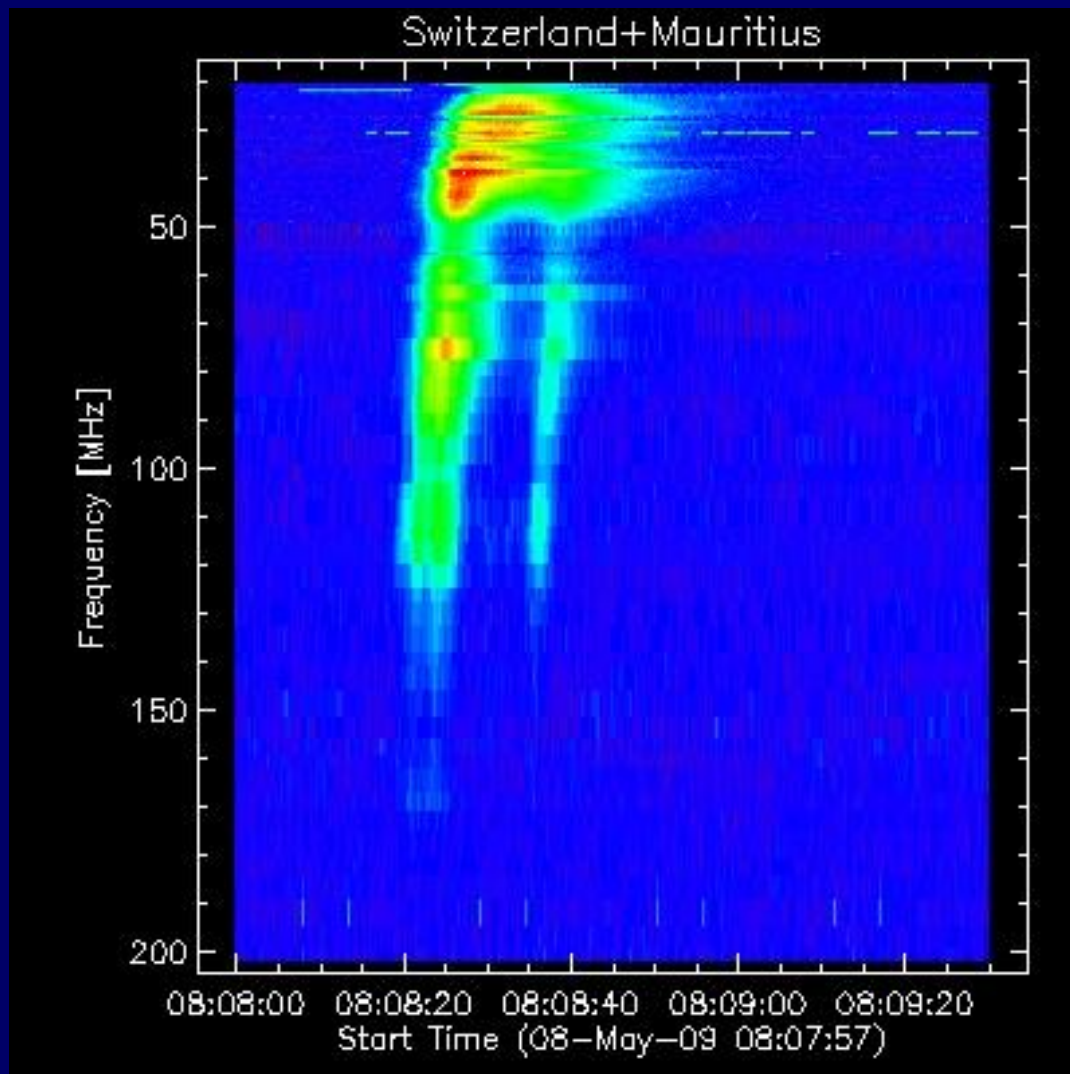
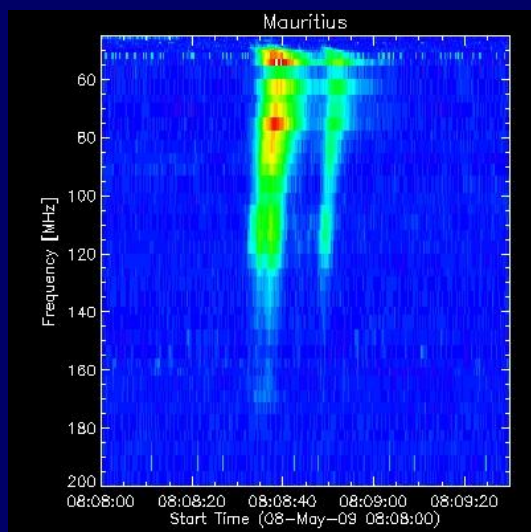
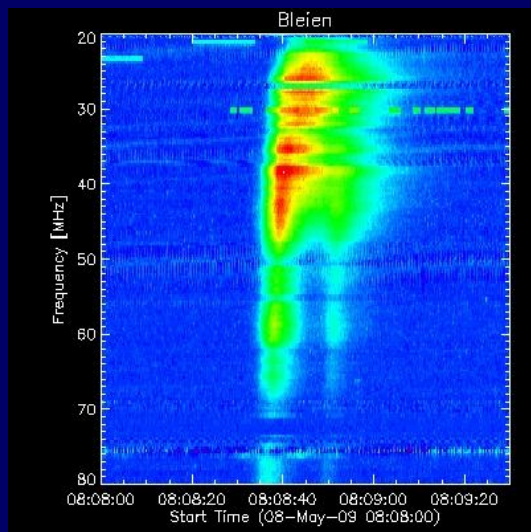
# 6 integrated locations



6 different locations integrated into one plot improves SNR  
Radio frequency interference contribution only 1/6 per location



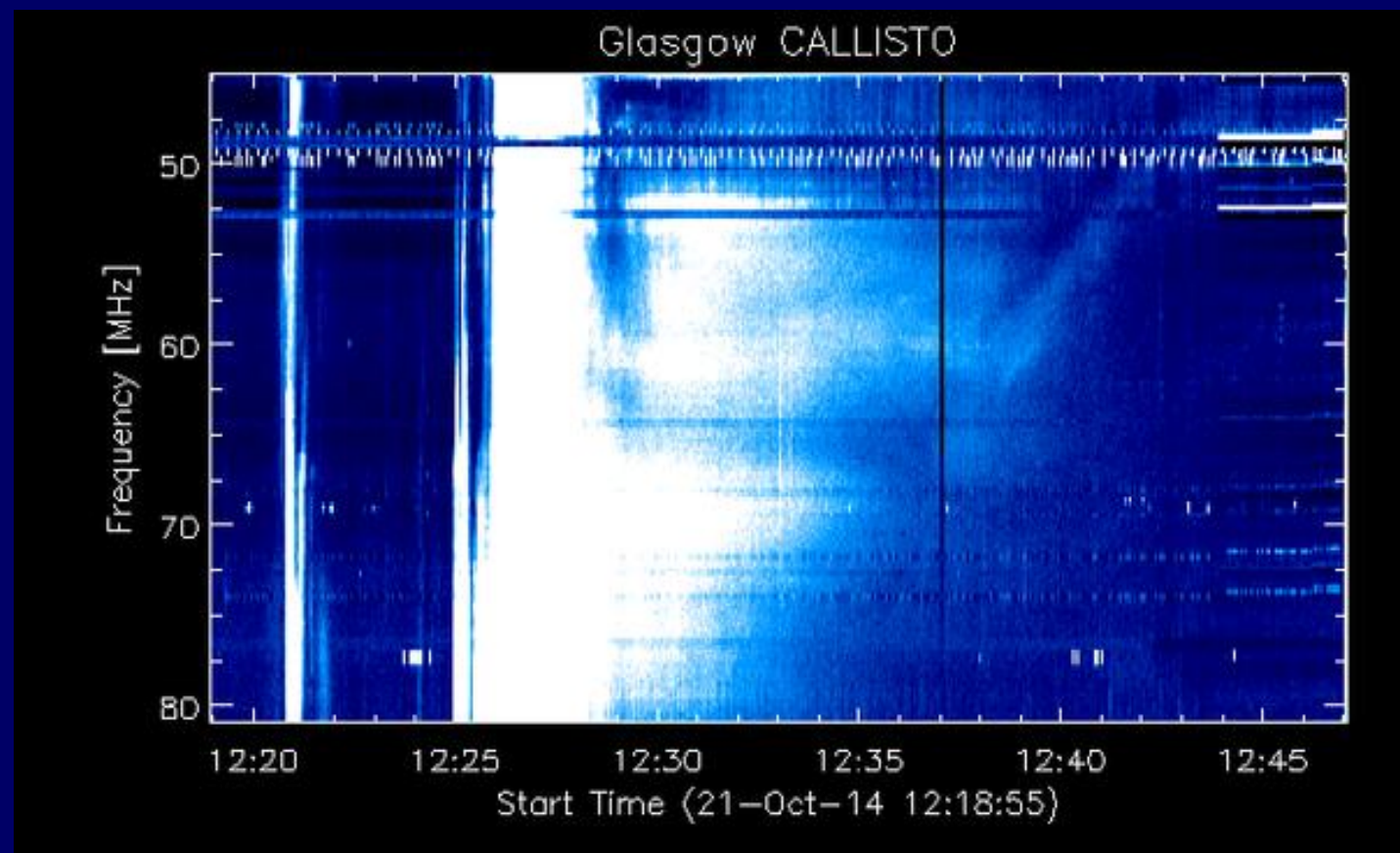
# Append in frequency range



Switzerland 20-60 MHz + Mauritius 63-200 MHz, event of 2009-May-08 08:08 UT



# Glasgow Callisto and CMEless type II bursts



RHESSI-Nugget Number: 246 1st Author: Peter Wakeford  
2nd Author: Hugh Hudson Published: February 16, 2015



# Conclusions

- Network still growing, some new requests (...)
- Geographical coverage to be improved, especially American/Pacific region. What about Japan?
- Data quality improving (learning process)
- Apprentice of D-Phys very much like Callisto production
- More science could be done (Problem: education)
- Only very little funding in Switzerland to further support instruments in developing countries.



Additional information and data access:

<http://e-callisto.org>