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„CALLISTO and The e-Callisto network“

- Solar Radio Burst Observation
- Education and Training
- Radio Monitoring

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Topics of this presentation

- Callisto as Swiss contribution to IHY2007 and ISWI
- What is the radio spectrometer Callisto 'good' for?
- Key specifications of Callisto
- Coverage
- Interference situation worldwide
- Presentation of 8 out of currently 66 instrument sites
- Network structure
- Current user statistics
- 3 examples of resent solar radio events
- Status publications
- Possible students projects
- Problems, issues
- Conclusions

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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

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What is the radio spectrometer Callisto 'good' for?

- Real-time observation of dynamic, electromagnetic solar radio bursts.
- Long term radio-monitoring, environmental studies, site evaluation for future radio-telescopes.
- Education & outreach
- Electronics training for physics apprentices and students

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Key specifications of Callisto

Parameter	Specification
Frequency range	45.0 MHz … 870.0 MHz (34 cm < λ < 6.7 m) any other range, using heterodyne converters
Frequency step size	62.5 KHz
Radiometric bandwidth	300 KHz
Integration time	1 ms
Time resolution	1.25 ms per spectral pixel
Dynamic range	> 50 dB
Noise figure	< 10 dB
Measuring rate	800 pixels/s maximum
Sweep length	4…400, nominal 200 frequencies per sweep
Power consumption	12 V / ~225 mA (2.7 Watt)
Dimensions/weight	110 mm x 80 mm x 205 mm, ~ 1 kg
Cost	Hardware US490$
Inputs	4 files (configuration, frequency, scheduler, calibration)
Outputs	4 files (FITS-files, logfile, light curve file, spectral overview)

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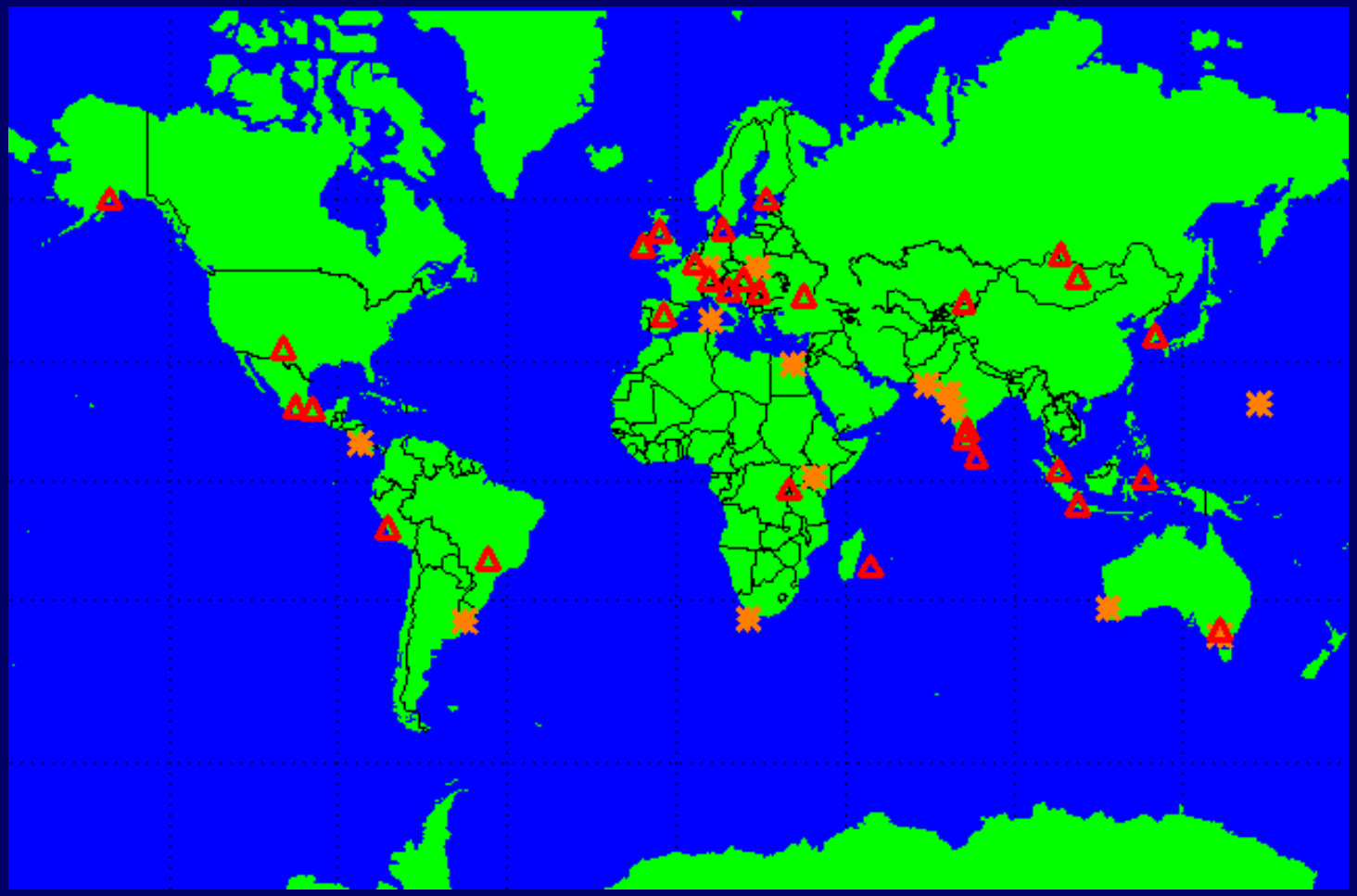
Coverage



Status February 2016: 116 instruments at 66 different locations worldwide.
Reached 100 % coverage all over the seasons in March 2013

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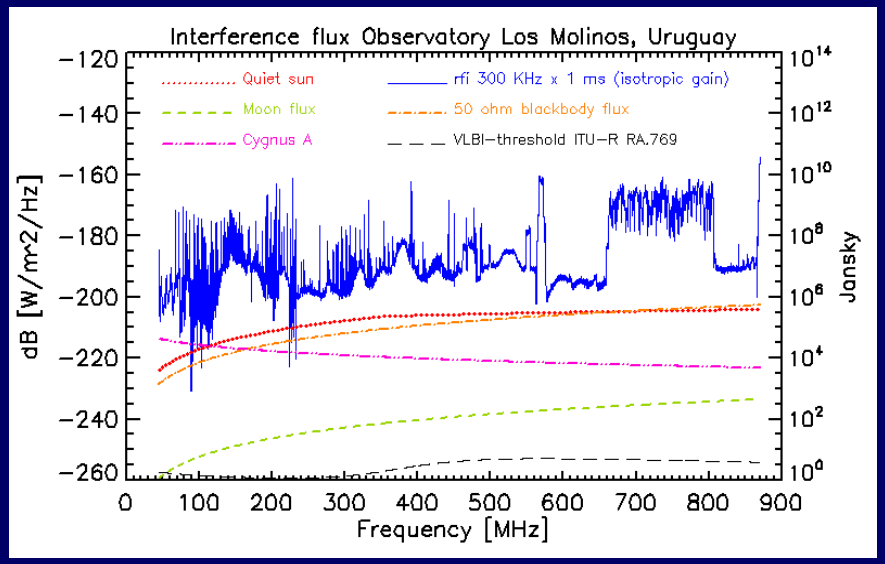
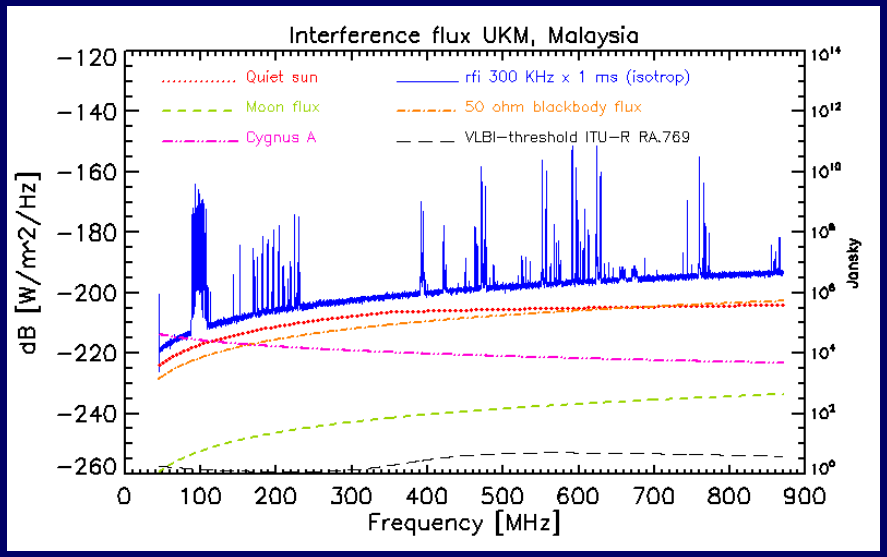
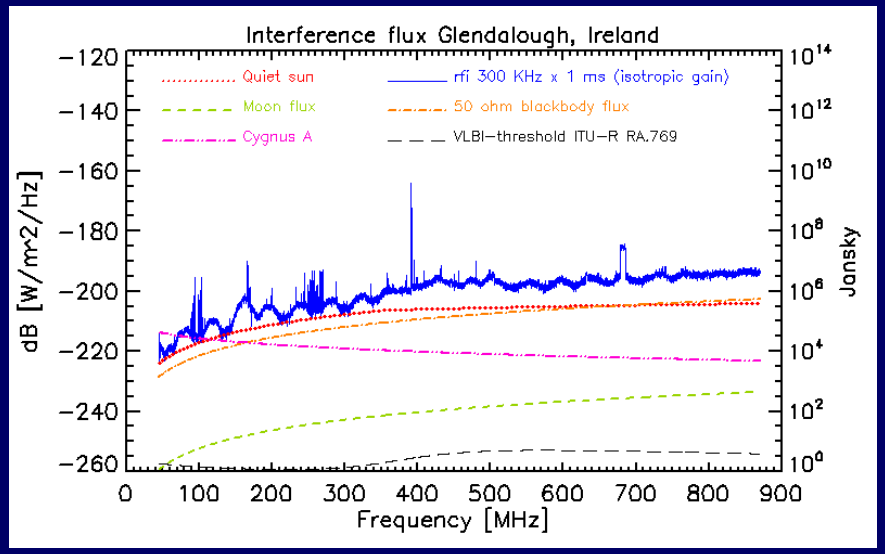
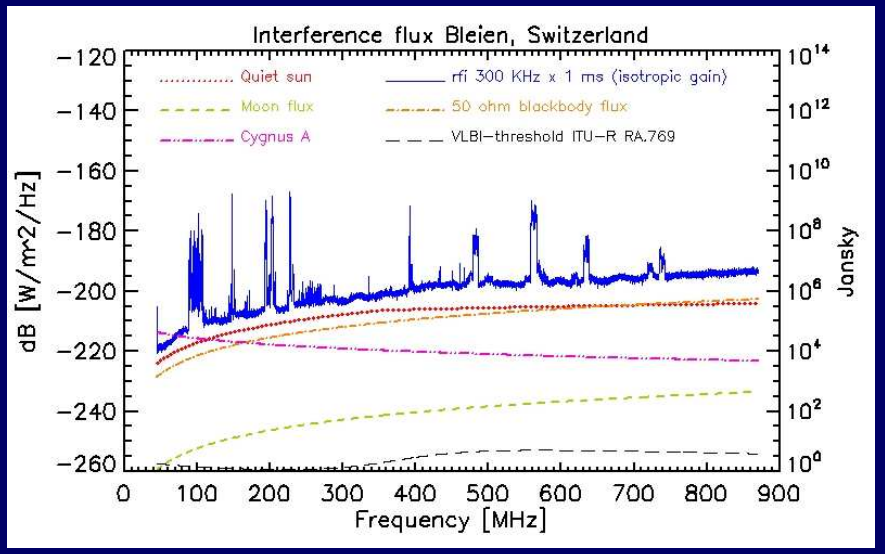
Interference situation worldwide









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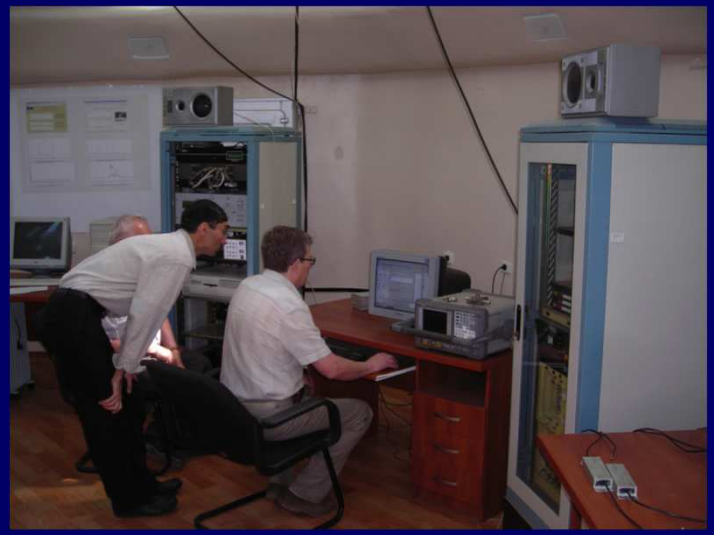
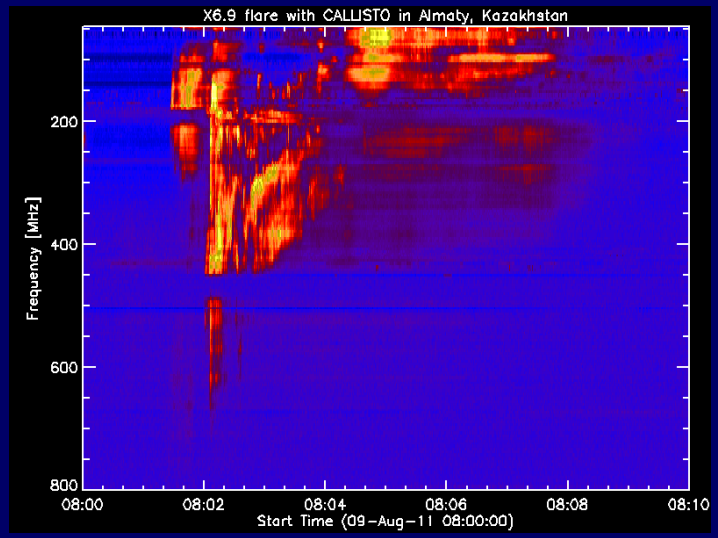
Callisto at Institute of Ionosphere Almaty, Kazakhstan





12 m parabolic dish
Tian Shan mountains,
2735 m asl

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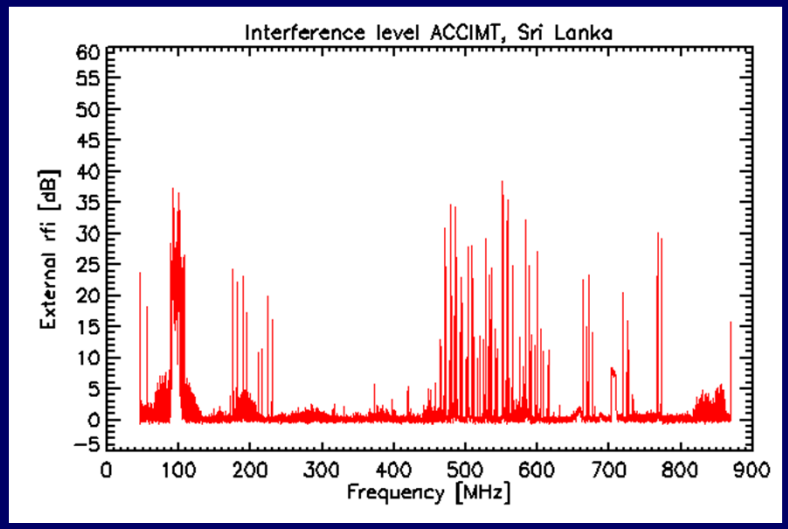
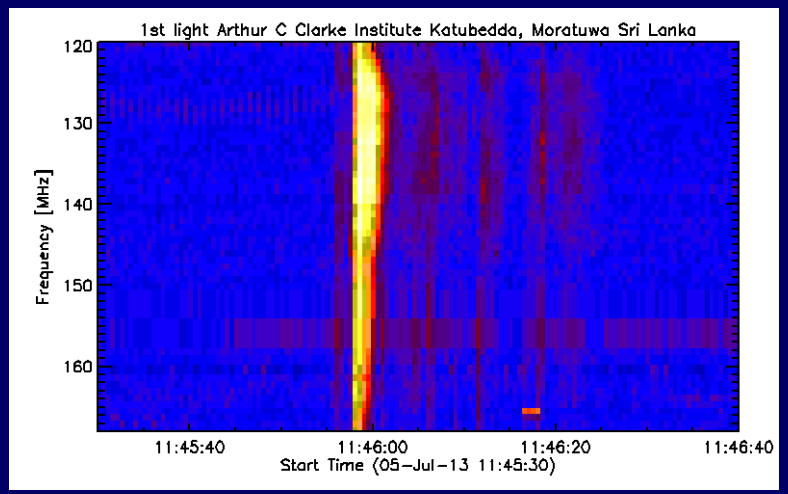
Callisto at Arthur Clarke Institute, Sri Lanka





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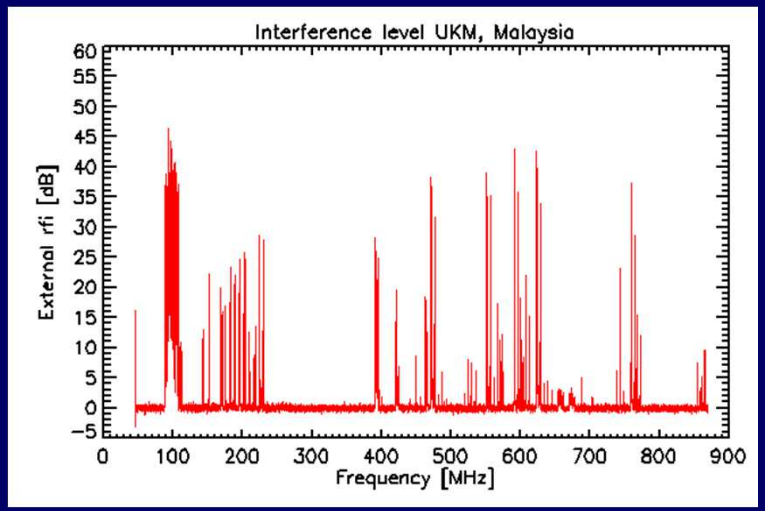
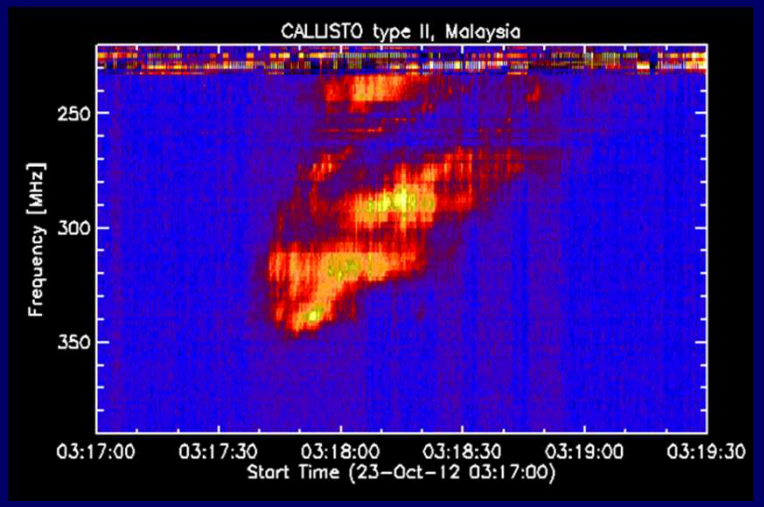
Callisto at National Space Centre in Kuala Lumpur, Malaysia





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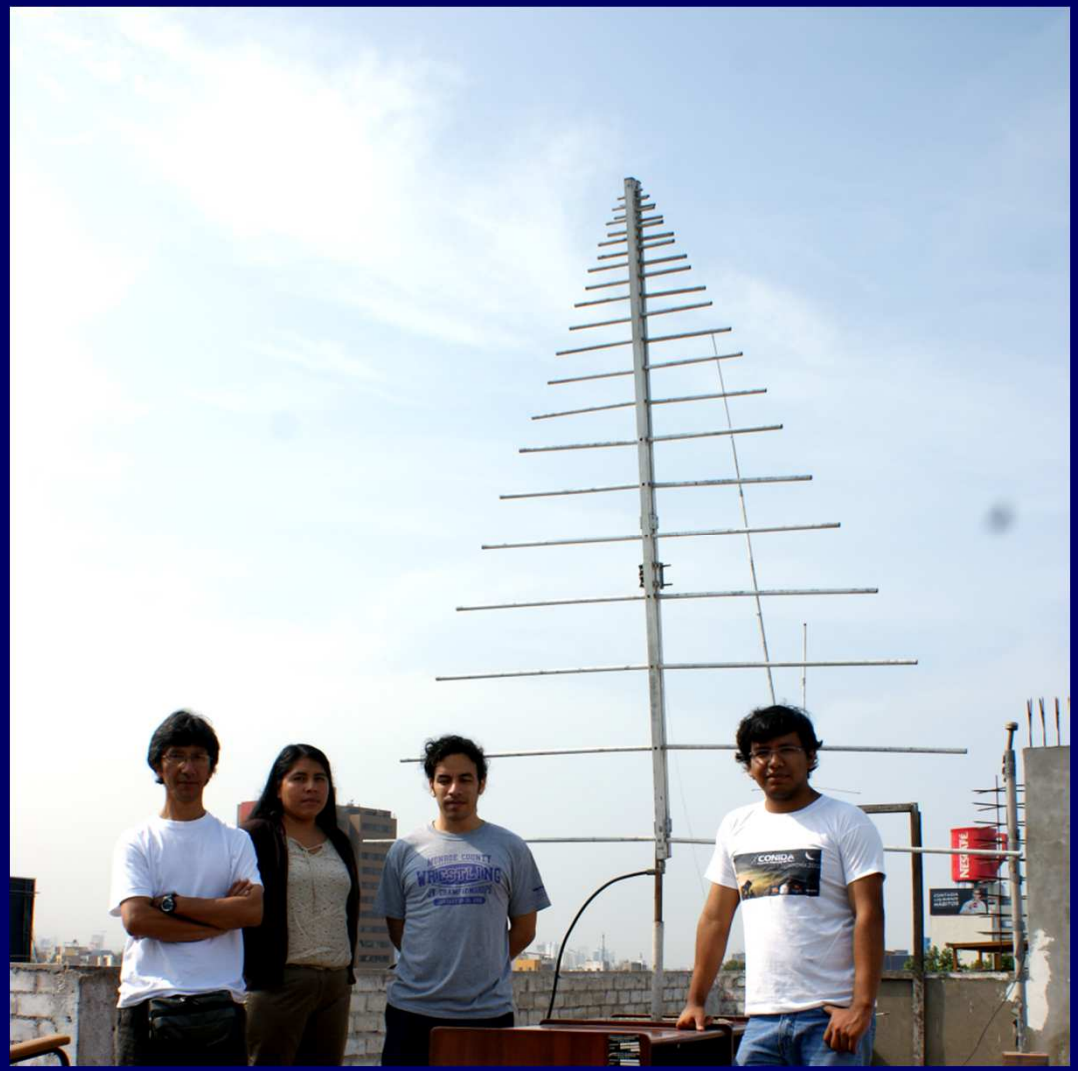
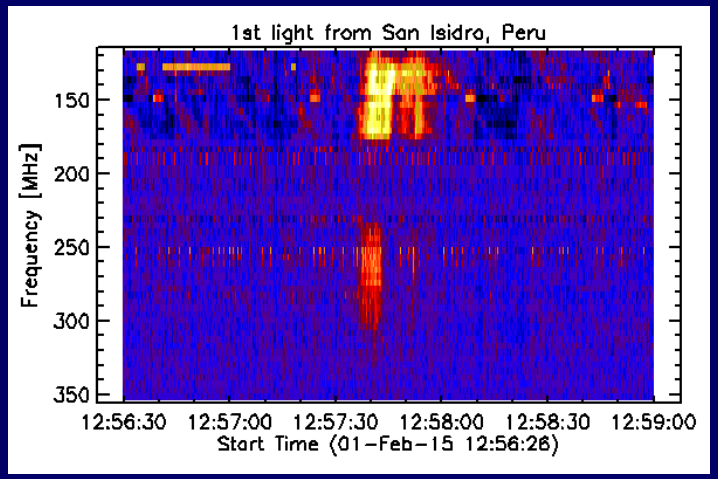
Callisto in San Isidro, Peru



Current observation place in San Isidro, Peru

Site evaluation in Punta Lobos, Peru



1st light type III burst in Punta Lobos, Peru

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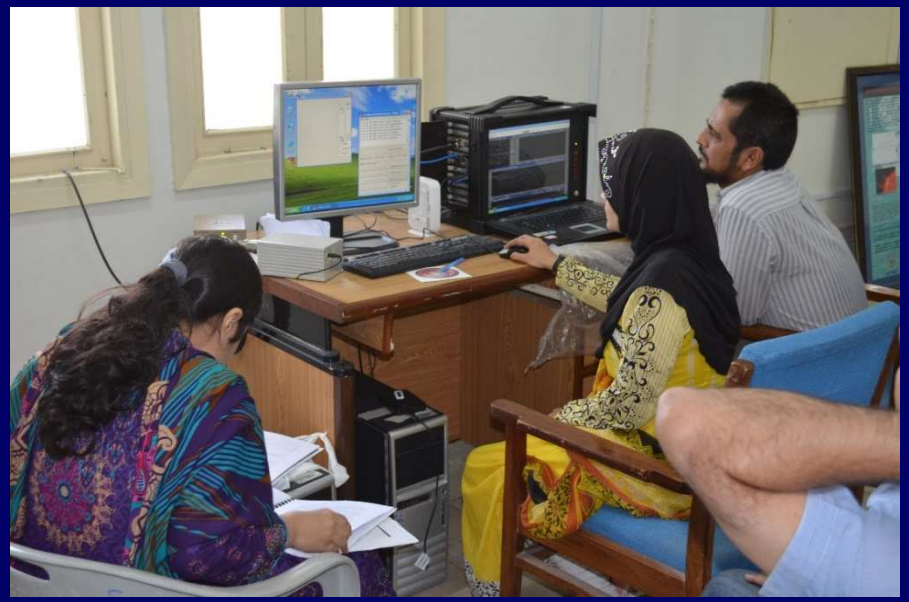
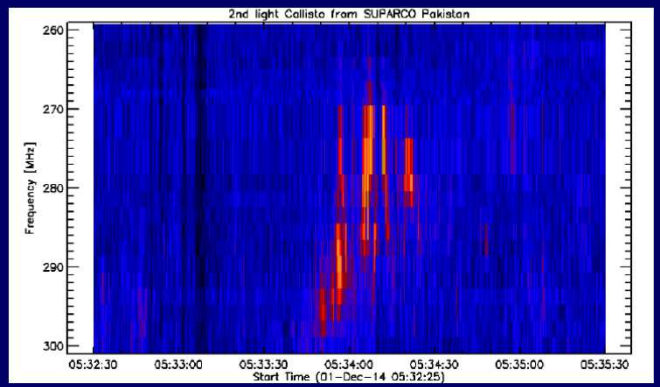
Callisto installation in Karachi, Pakistan





1st light:
a type I burst
=
noise storm

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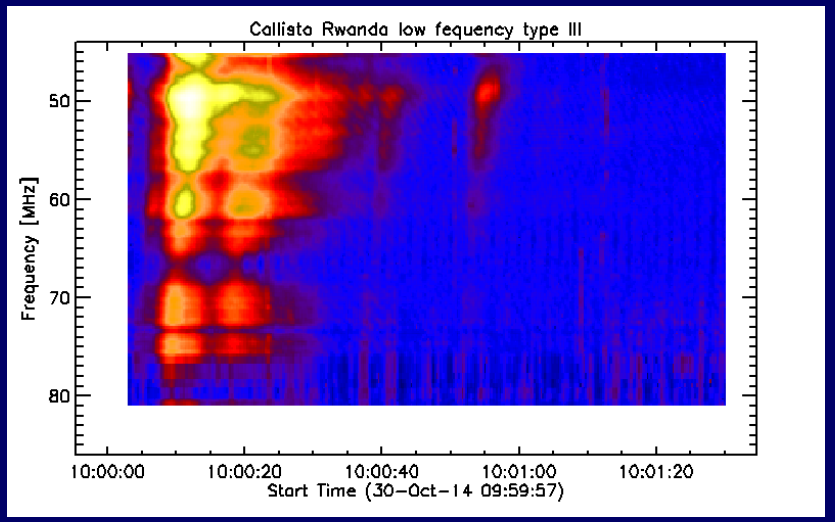
Callisto in Kigali, Rwanda



Hosted by:
Jean Uwamahoro
University of Rwanda
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Maths & Physics Department
5039 Kigali

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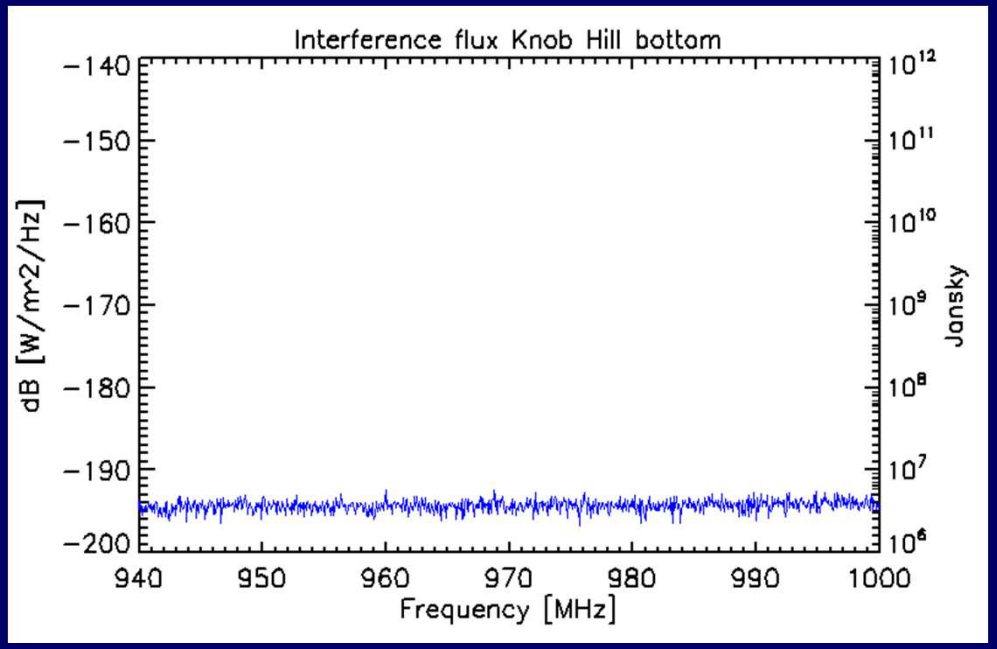
Radio monitoring at Gold Mine Knob Hill Minas de Corrales, Uruguay



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

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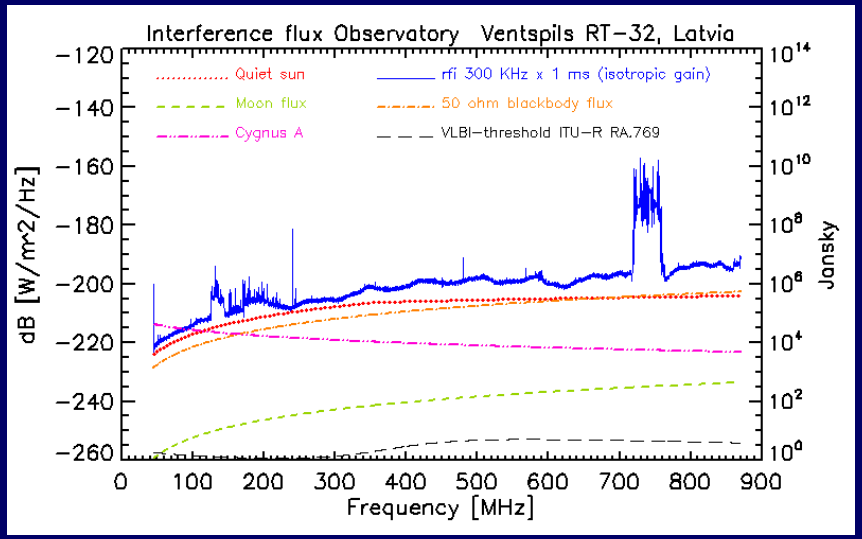
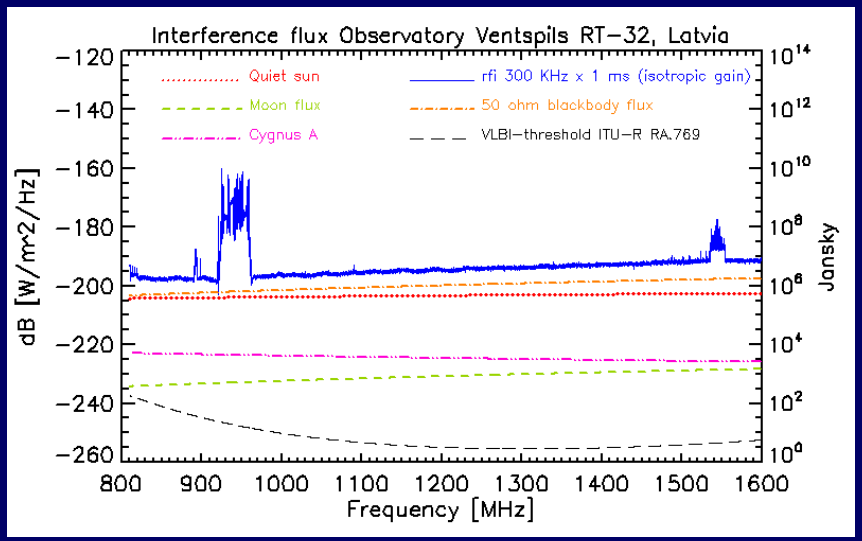
Radio monitoring at RT-32 in Latvia





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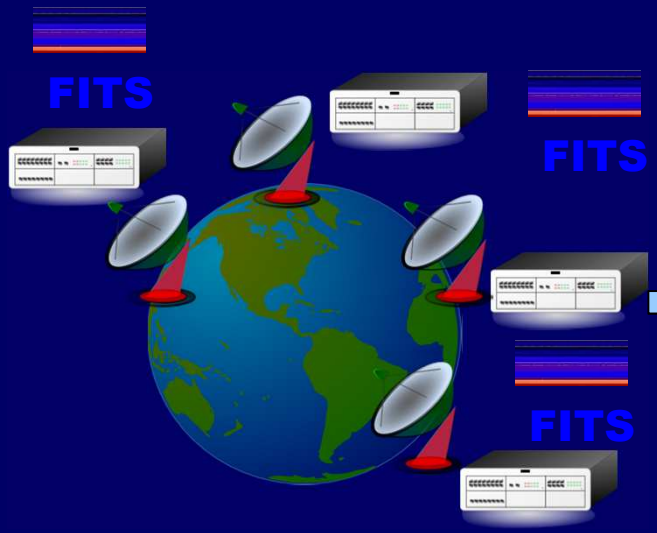
e-Callisto network



FTP

University of Applied Sciences in Brugg

NOAA / GOES

RHESSI

> 2017 → STIX

Control / management from ETH Zurich

Majority of hosts sends data actively via FTP to our data server. For very few we get data from their servers.

We provide:
→ FIT-files and
→ QuickViews

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Current User Statistics

~ 700 worldwide visits per month from 124 countries

~ 60 GByte solar radio data per year (gzipped FIT-files) freely accessible for everyone

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

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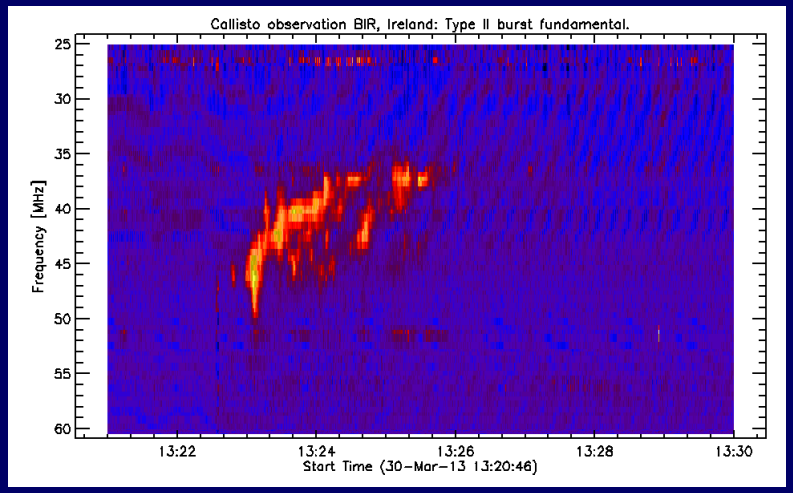
Advantage of distributed instruments



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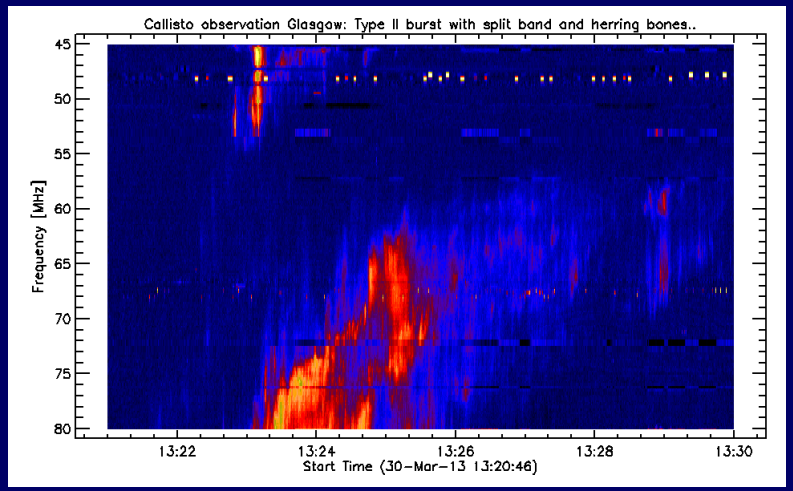

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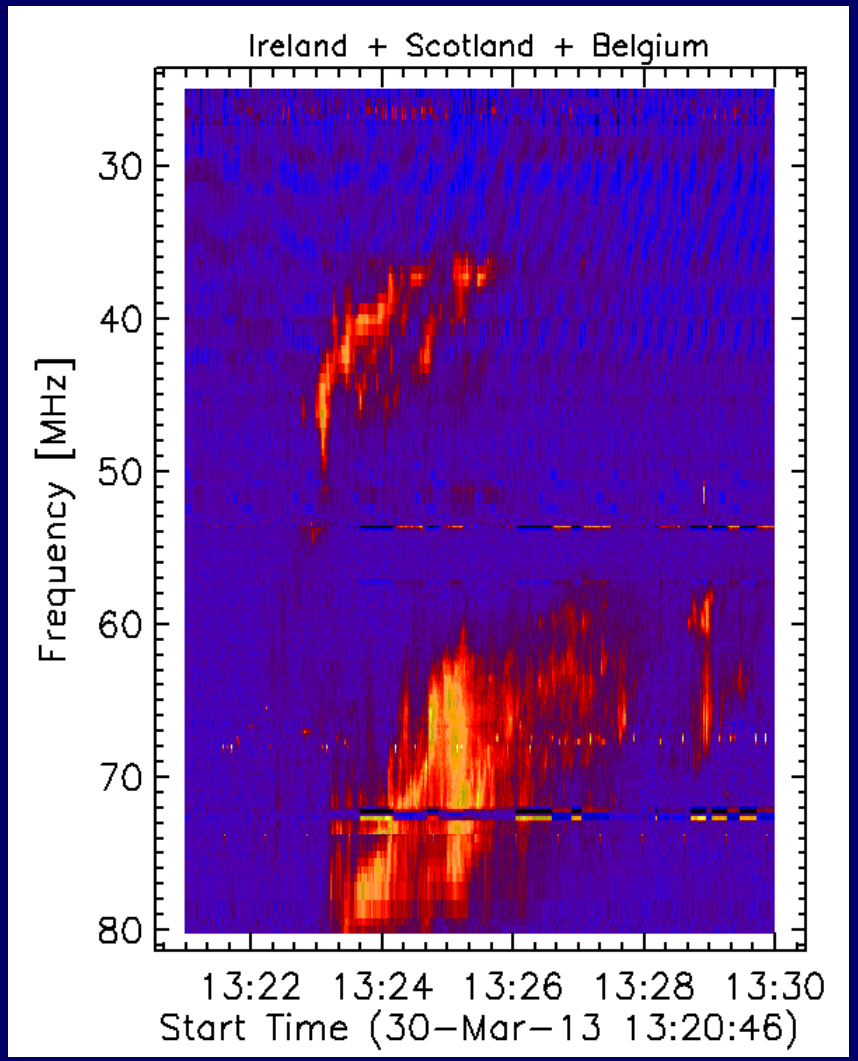

Ireland 25-60 MHz + Glasgow 45-80 MHz + Belgium 45-80 MHz

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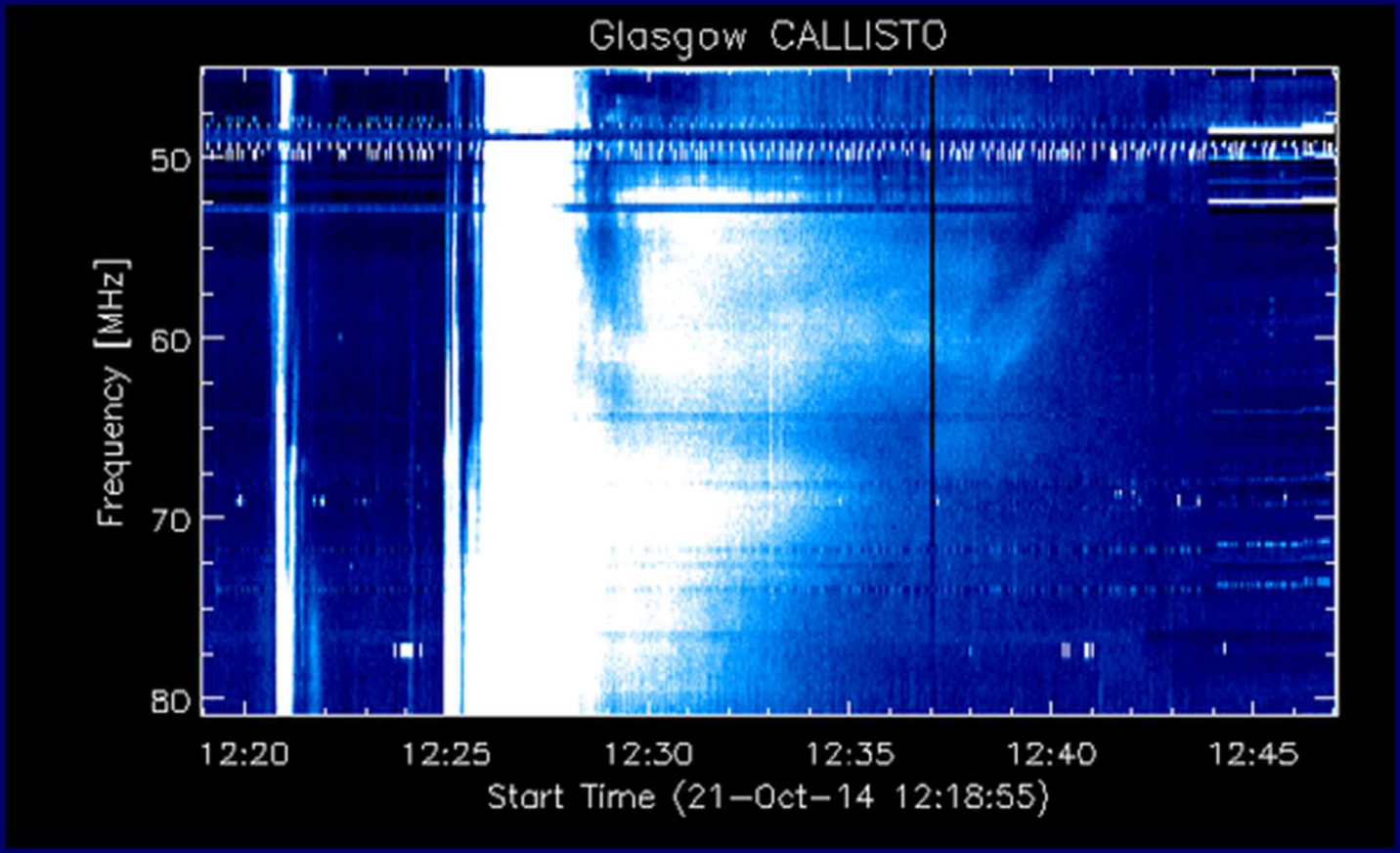
Glasgow Callisto and CME-less type II burst



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

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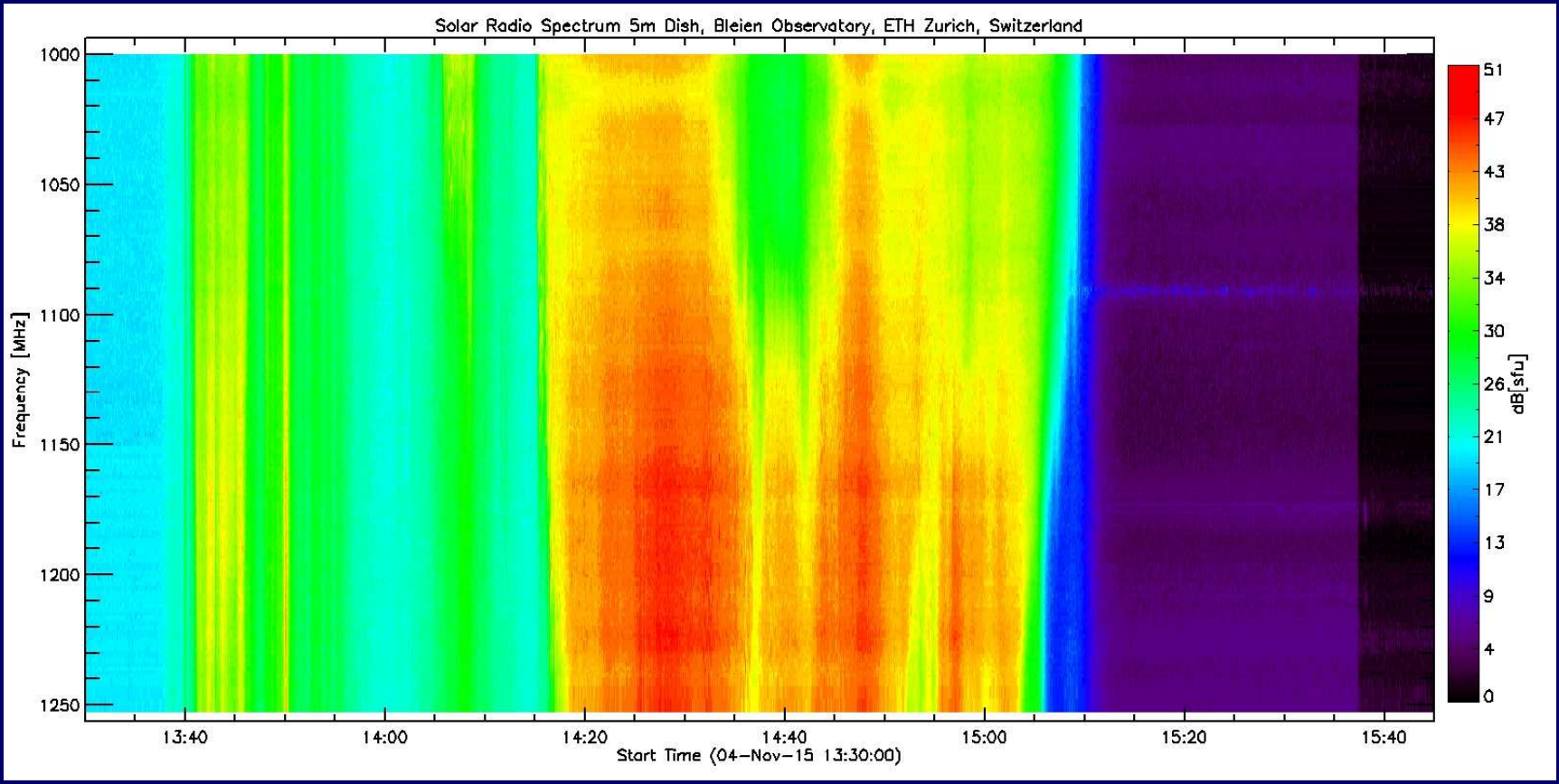
Solar radio burst shut down Swedish airport



STOCKHOLM 04-Nov-2015 — Swedish aviation officials say a solar storm has knocked out their air traffic control systems, prompting them to shut down the country's airspace for more than an hour.

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Publications

Main activity from eastern countries (Malaysia and India),
some others from all over Europe
and very very few from the American continent
(mainly Brazil).

ADS:
~30 reviewed and published papers over a
period of ~13 years

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Possible students projects

- Identification of - and statistics about - solar radio bursts
- Determine velocity of CME from type II bursts
- Occupancy of spectrum over a longer period of time → do we have free channels?
- Monitor local rfi and keep contact to OFCOM in case of illegal transmissions
- Far field calibration with an rf-generator/noise source → calibration process
- Variability of UHF satellite transponders → potential calibration sources
- Invent a method to qualify Callisto observatories sites regarding rfi and regarding burst sensitivity as a measure for data quality
- Measurement campaign per country → find radio quiet zones
- Setup interferometer to determine the diameter of the solar corona
- Build a down- or an up-converter for other frequency ranges

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Problems, issues

Major problems in developing countries:
- Missing know how in: operating & maintaining instruments
- Missing know how in: data analysis and associated tools
- Missing know how in: 'how to write a report or a paper'
- Sustainability of the network

Minor problems of PI:
- Visibility at different levels (institute, university, country)
- Funding situation to install, operate and maintain instruments
- Language issues (e.g. Mongolia, Kazakhstan, …)

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Conclusions

- Network is still growing, currently requests from:
  Greenland in 3 weeks, Italy, Bulgaria. Ethiopia still on the agenda)

- Geographical coverage to be improved, especially American/Pacific region

- Data quality is improving (learning process)

- rfi situation is getting worse worldwide

- More science could be done (educational problem)

- Only very little funding available to further support
  instruments & training in developing countries.

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Additional information:

http://e-callisto.org

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