Radio spectrometer Callisto

1. Introduction

ETH Zurich operates broadband spectrometers since many years. A new low cost spectrometer named Callisto is presented. Callisto is made of two receivers. Every receiver contains a TV-Tuner as main receiving modul. Callisto is used to operate as a frequency agile spectrometer in the frequency range from 45-870MHz. The main process is controlled by a Atmel RISC processor which is programmed in C.

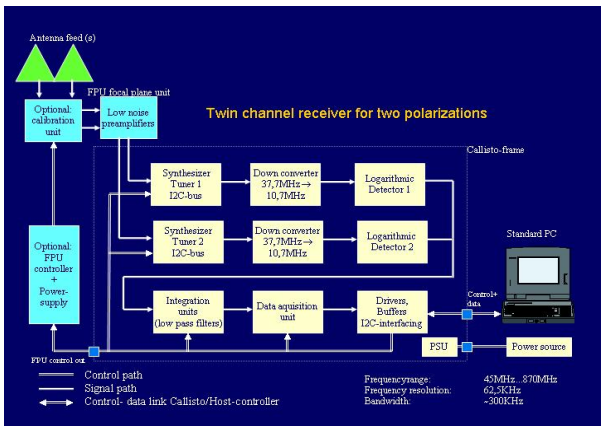
2. Callisto: compact and cheap

Compound
Astronomical
Low frequency
Low cost
Instrument for
Spectroscopy and
Transportable
Observatory

Callisto is a frequency-agile, double mode instrument. It can be copied from commercial available hardware in about two weeks. The material costs are in the order of 1000 SFr. and it takes less than one week to manufacture a complete receiver.
Weblink: www.astro.phys.ethz.ch/instrument/callisto/callisto_nf.html

3. Basic schematic diagram

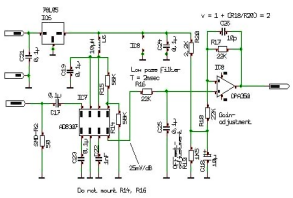
The radiometric bandwidth is 300kHz while the channel spacing is 62.5kHz. The number of channels is limited to 500. Callisto is able to measure 1000 channels/sec in two polarizations.



Overall System Specifications

Frequency range = 45-870MHz
Frequency measurement = 1000 channels/sec
Dynamic range = >50dB
Noise Figure = 7-8dB
Overall Bandwidth = 300kHz @ -3dB
System gain = 100mV/dB
Weight = 1,8kg
Power consumption = 12V, 0.5A
Dimension = half 19'' rack

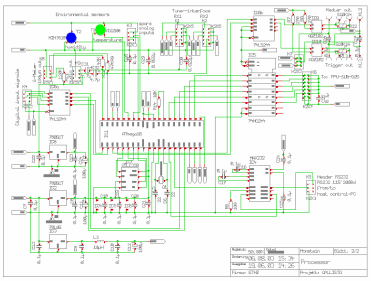
4. Double heterodyne receiver

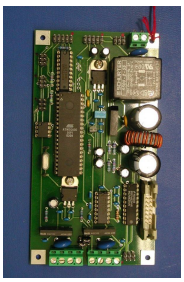


Logarithmic detector and integration circuit

receiver board, showing the TV-tuner

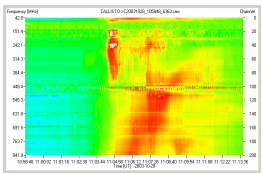
5. Mainboard



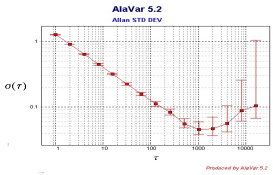


The tuners are fed by I2C bus. Frequency channels are read from the external EERPOM which is linked to the RISC processor Atmega16 via SPI bus.

6. First results



Callisto was not quite finished when it observed the radio emission caused by a X4.4 flare. Showing the shock wave which starts at high frequencies and drifts to lower.



Allan Variance
Error bars = ± 3sigma (0.997)
Tau = 0.2sec
55'000 data points = 24.0h of observation

7. Project Team

Responsible budget & requirements	Prof. Arnold Benz
Mechanical design & manufacturing	Frieder Aebersold
Software RISC processor (C)	Hansueli Meyer
Software preprocessing (C++)	Christian Monstein
Software postprocessing (Pearl/IDL)	Christina Pöpper
Manufacturing focal plane unit FPU	Pascal Behm
Manufacturing receiver RX	Pascal Behm
Manufacturing receiver control unit RCU	Ivo Zamora
Conceptual & hardware design	Christian Monstein

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich
Institute of Astronomy