What can I do with CALLISTO data?

Callisto can be used for a large variety of experiments and studies of radio signals in the range 45 MHz to 870 MHz. Other frequencies can be observed by switching in a heterodyne/homodyne down-converter or an up-converter between antenna and Callisto.

- Connect a 50 Ω resistor to the input of the preamplifier and measure spectra for at least 4 hours. Extract one or more light curves out the FIT-files and process them with ALAVAR, a tool to derive the Allan-time out of a time series. Result -> instrument Allan-time (stability). Do the same with the antenna connected to the preamplifier and pointing to the sky. Compare the results.

- Determine shock wave speed of type II bursts for data stored in the archive and compare with other instruments. Produce a list containing date, time, CME-velocity and Newkirk model selected.

- Identify solar bursts and produce a list about date, time and burst type (I, II, III, IV, V, U, DCIM etc.) like this one here: http://soleil.i4ds.ch/solarradio/data/BurstLists/2010-yyyy_Monstein/2023/e-CALLISTO_2023_03.txt
- Make statistics about local radio interference as function of time & date and location, identify strong transmitters and produce optimized frequency programs (Occupancy plots). If you find out that those frequencies which are reserved for radio astronomy are interfered, according to the list of reserved frequencies, get into contact with OFCOM (office of communication).

- Correlate burst-time with x-ray data from GOES

- Correlate burst-time and structure with data from WIND- WAVE and STEREO-satellites.

- Make statistics about geostationary military down-links signals in the VHF-range (240 MHz – 300 MHz) to find out if they can be used as a check for stability of the receiving system. As an option one may find a way to use these transponders for calibration. By analyzing standard deviation divided by mean you might find out the coherence bandwidth in VHF. Compare the results with and without solar radio bursts.

- Find out if rfi at different stations are correlated or not. In case they are correlated what might be the origin of the rfi?

- Try to observe space radar echoes at 143.050 MHz from moon, satellites or meteors. E.g GRAVES in France.

- Invent a statistical process to qualify different radio spectrometers with respect to local interference.

- Invent a statistical process to qualify different radio spectrometers with respect to sensitivity to solar burst in mV/SFU or dB/SFU or digit/SFU or any other measure.

- Create an easy tool to visualize, print and plot FIT-files and which can run on as many operating systems as possible and which is portable to new OS.

- Do a measurement campaign with Callisto and an omni-directional antenna and measure rfi as function of geography (longitude, latitude) to generate an rfi map of your town or country. This can be used to identify radio-quiet areas.

- Build a total power interferometer with two antennas separated by about 10…50 wavelengths to observe the solar corona and try to derive the angular size of the corona as function of solar activity (sun spot number).

- Measure for 24h while pointing the antenna to a fixed elevation in sky, e.g. pointing to Cas A or Cyg A or Tau A, galactic center or any other strong sidereal radio source. Post-integrate the observed data in time- and in frequency domain to improve sensitivity. Sensitivity improves with the square root of integrated channels times integration time (radiometer equation dT = Tsys/sqrt(B*Tau).

- Write a program in LabView to communicate with Callisto such that it can be used as a spectrometer producing FIT-files.

- Write a program in Python to communicate with Callisto such that it can be used as a spectrometer producing FIT-files.

- Identify a strong type III burst as time reference. Analyze all available stations regarding this burst and try to find out which station provides appropriate time-stamp and which station needs to adjust clock on their Windows computer. Perfect timing is essential to compare or correlate data from different stations. Think about a Python tool to repeat this task automatically e.g. once a month or so.

- Invent a script to cross-correlate observations from different locations.
  Advantages:
  -Rfi is not correlated, therefore interference should decrease
  -Instrumental noise is not correlated, therefore SNR should improve.
  -Lightning stokes are not correlated, therefore they should disappear
  -Solar bursts are correlated; therefore, SNR should improve.
  Try to take care about more than just two stations, ideally as many as possible. Of course, only station which see the Sun at the same time. Example: Australia with Alaska and Greenland or Austria with Switzerland and Spain etc.

- Invent a Python script, based on AI which is able to identify CTM events in FIT-files. Manual detection of CTM is not only very boring but, also very time consuming.

- Invent a Python script for cross-calibration. Callisto burst observations are not calibrated in flux units. Therefore, if calibration is required on should have a process for calibration, based on calibrated observation such as Learmonth-data or data from Nançay,

- Invent a Python script which allows to merge different Callisto-observations (FIT-files) in frequency- and in time-space, assuming they have different starting times due to non-synchronized observation-time. Merging also means cut out overlapping frequencies.