First light from new LWA at Bleien observatory, Switzerland on 12 June 2014

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ETH Zurich conducted low frequency solar radio burst observations for many years based on a biconical antenna (BICONE) on the roof of the radio observatory in Bleien. During recent heavy rain activity the matching transformer got water and sensitivity went completely down, making impossible to detect any solar radio bursts. Beginning June 2014 a Long Wavelength Array (LWA) antenna was installed together with a Callisto system to observe solar radio burst activity (figure 1) at the site. On the first observation day we already observed our 1st light, some type III solar radio bursts. Two examples are presented in figures 2 to 3 and associated tables 1 to 2. Data are automatically transferred to the e-Callisto data archive at Fachhochschule Nordwestschweiz (FHNW) in Brugg/Windisch. Data quality is very good due to the fact, that the antenna is more than 20 m away from the observatory which is a source of a lot of rfi (PC, network, monitors, switched power supplies etc.). Some bushes north of the LWA also act as kind of shield for local rfi from nearby town. The antenna sensitivity is much better than originally expected from experience with BICONE- and T2FD-antennas.

Figure 1 ~ An LWA antenna installed at the observatory site in Bleien, Switzerland. Chicken wire mesh on the ground is meant as ground reflector. The blue plastic tube contains two coaxial cables (one per linear polarization) going to the observatory.

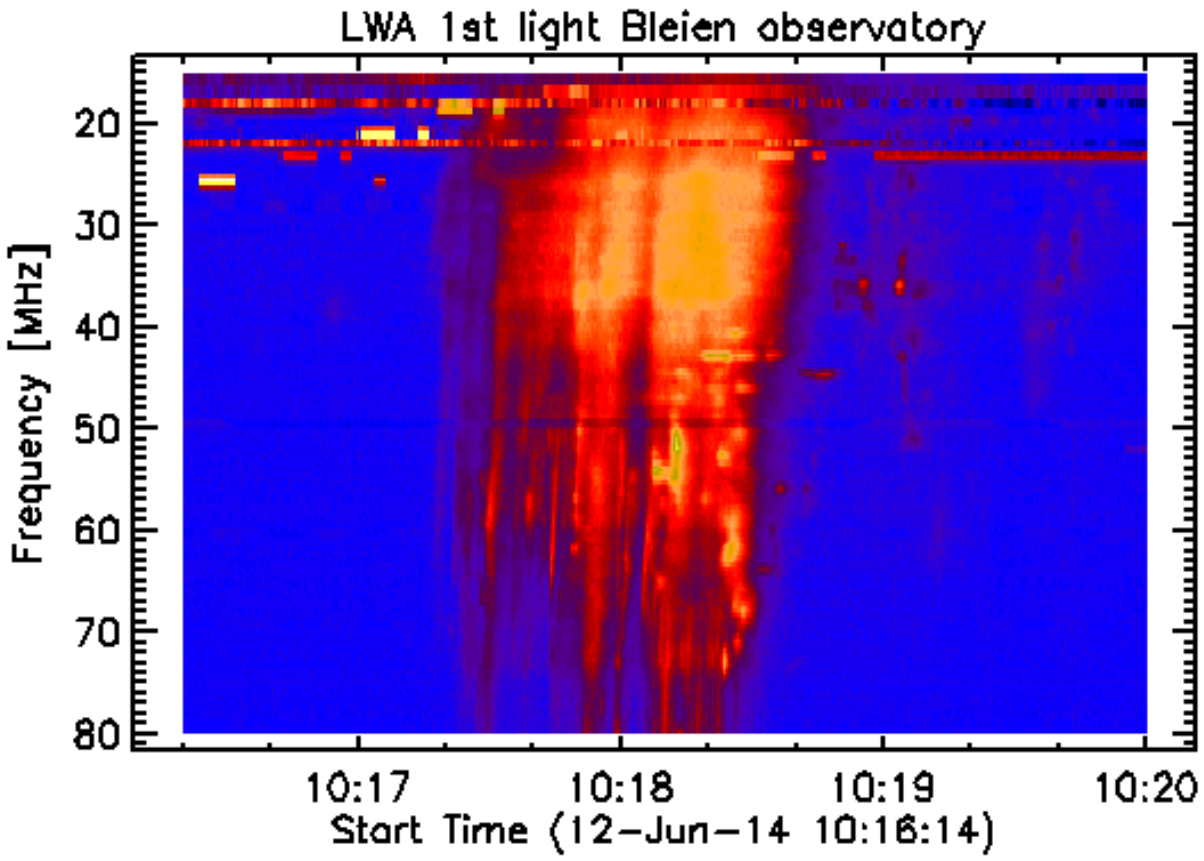

Figure 2 ~ 1st light in Bleien, a type III solar radio burst starting at 10:17 UT until about 12:19. Horizontal structures are local interference from short wave transmitters. Blue stands for low signal while yellow denotes to high signal level. An average spectrum was subtracted to get better contrast in this plot. After switching off TV in band I (47 MHz - 68 MHz) the spectrum went quite clean.

Table 1 ~ Space Weather Prediction Center Event Data for solar event on 12 June 2014
(http://www.swpc.noaa.gov/ftpdir/indices/events/20140612events.txt)

#Event	Begin	Max	End	Obs	Q	Type	Loc/Frq	Particulars	Reg#
3260 +	1017	////	1019	SVI	C	RSP	025-180	III/2	2087

For a description of the information shown above, see: http://www.swpc.noaa.gov/ftpdir/indices/events/README

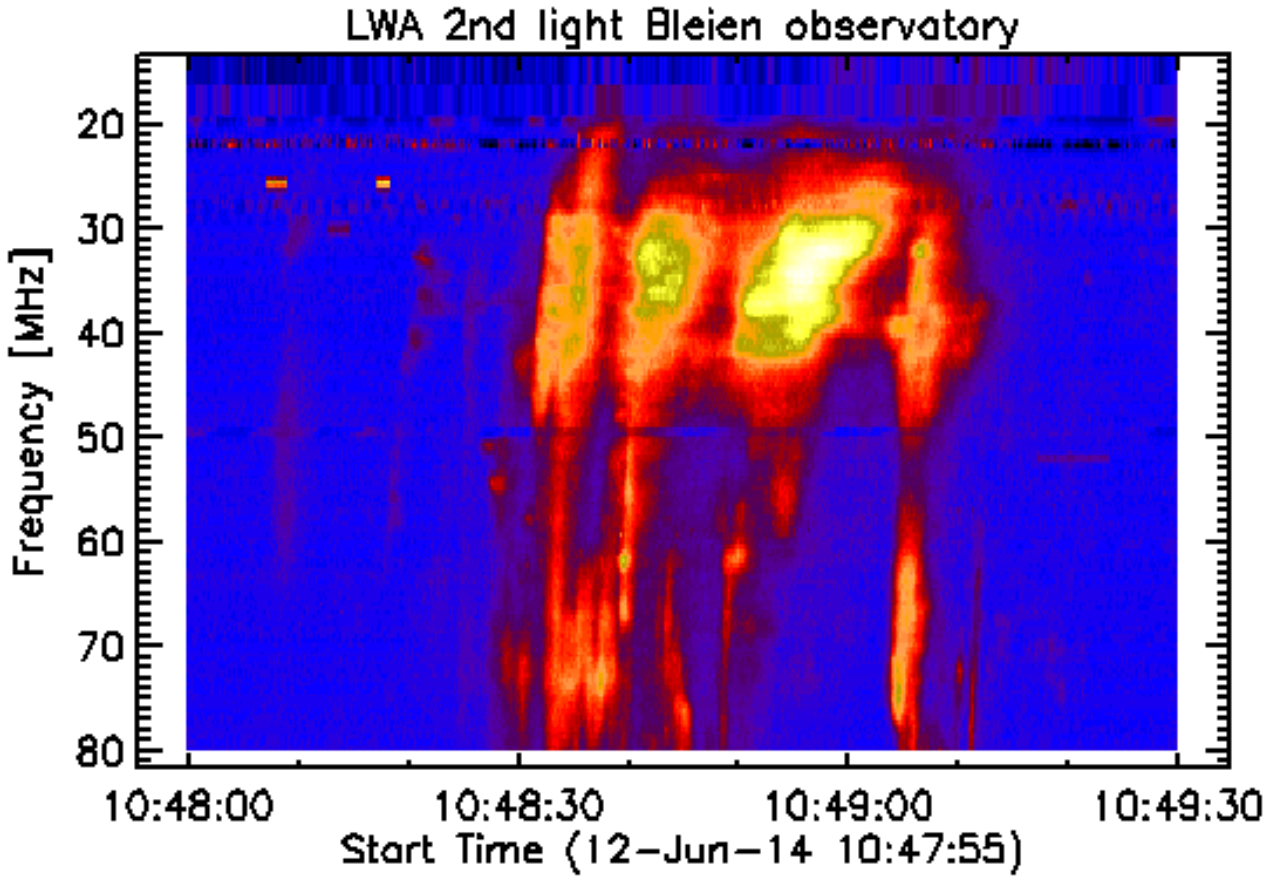

Figure 3 ~ 2nd light at Bleien, a small group of type III solar radio bursts around 10:48 UT. Horizontal structures are local interference from short wave transmitters. Blue stands for low signal while yellow denotes to high signal level.

Table 2 ~ Space Weather Prediction Center Event Data for solar event on 6 June 2014 (http://www.swpc.noaa.gov/ftpdir/indices/events/20140612events.txt)

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#Event    Begin    Max       End  Obs  Q  Type  Loc/Frq   Particulars       Reg#
#-------------------------------------------------------------------------------
3270       1048   ////      1056  SAG  C   RSP  025-180   III/2
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For a description of the information shown above, see: http://www.swpc.noaa.gov/ftpdir/indices/events/README

Converter

The original frequency range of the LWA goes from 10 MHz up to 88 MHz, but it can be used at least up to about 120 MHz with some loss of sensitivity. Unfortunately Callisto can only observe from 45 MHz up to 870 MHz, therefore a heterodyne up-converter (figure 4) had to be switched in between the LWA and Callisto which converts 5 MHz - 95 MHz into a Callisto compatible range from 205 MHz to 295 MHz. The up-converter is composed of a low pass filter at the input, a low noise amplifier, a mixer circuit and a local oscillator at 200 MHz with 6 dBm of rf-power. Most components from Mini Circuits were procured on eBay for less than 300$ all together.

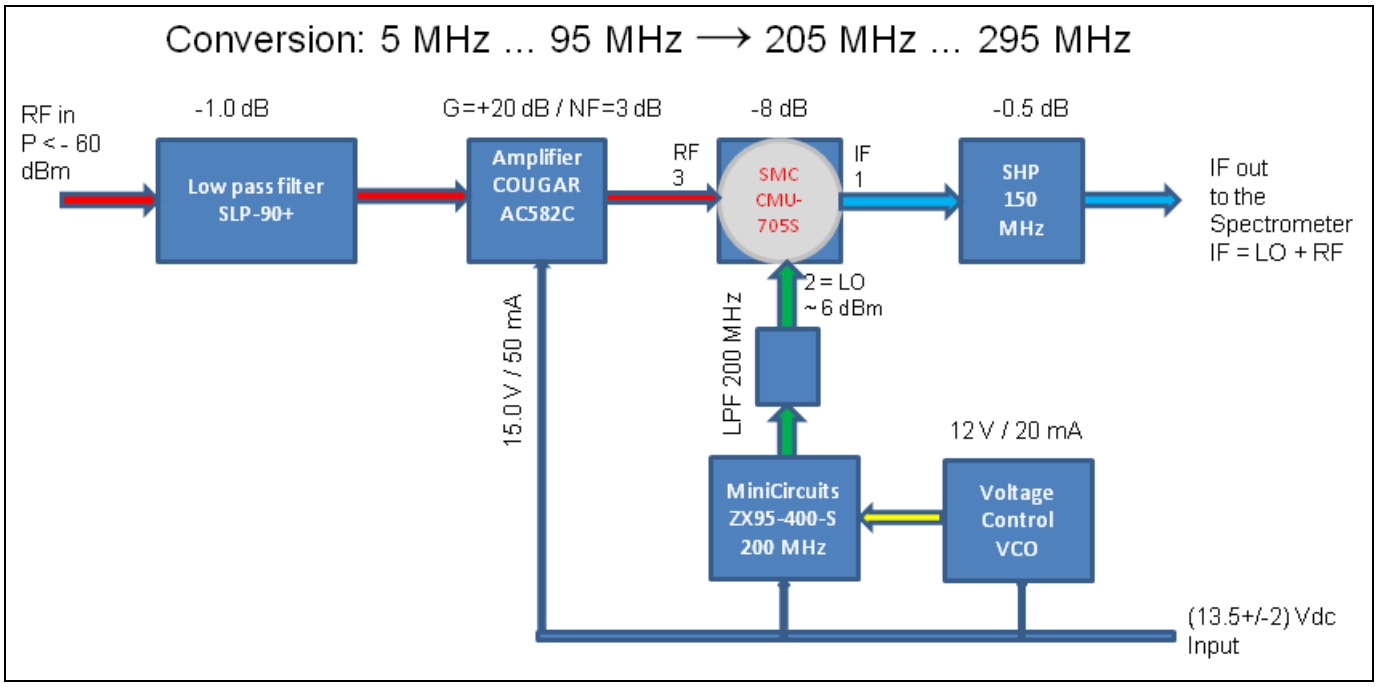

Figure 4 ~ Schematics of the heterodyne up-converter used to shift the frequency range of the LWA into the native frequency range of Callisto spectrometer.

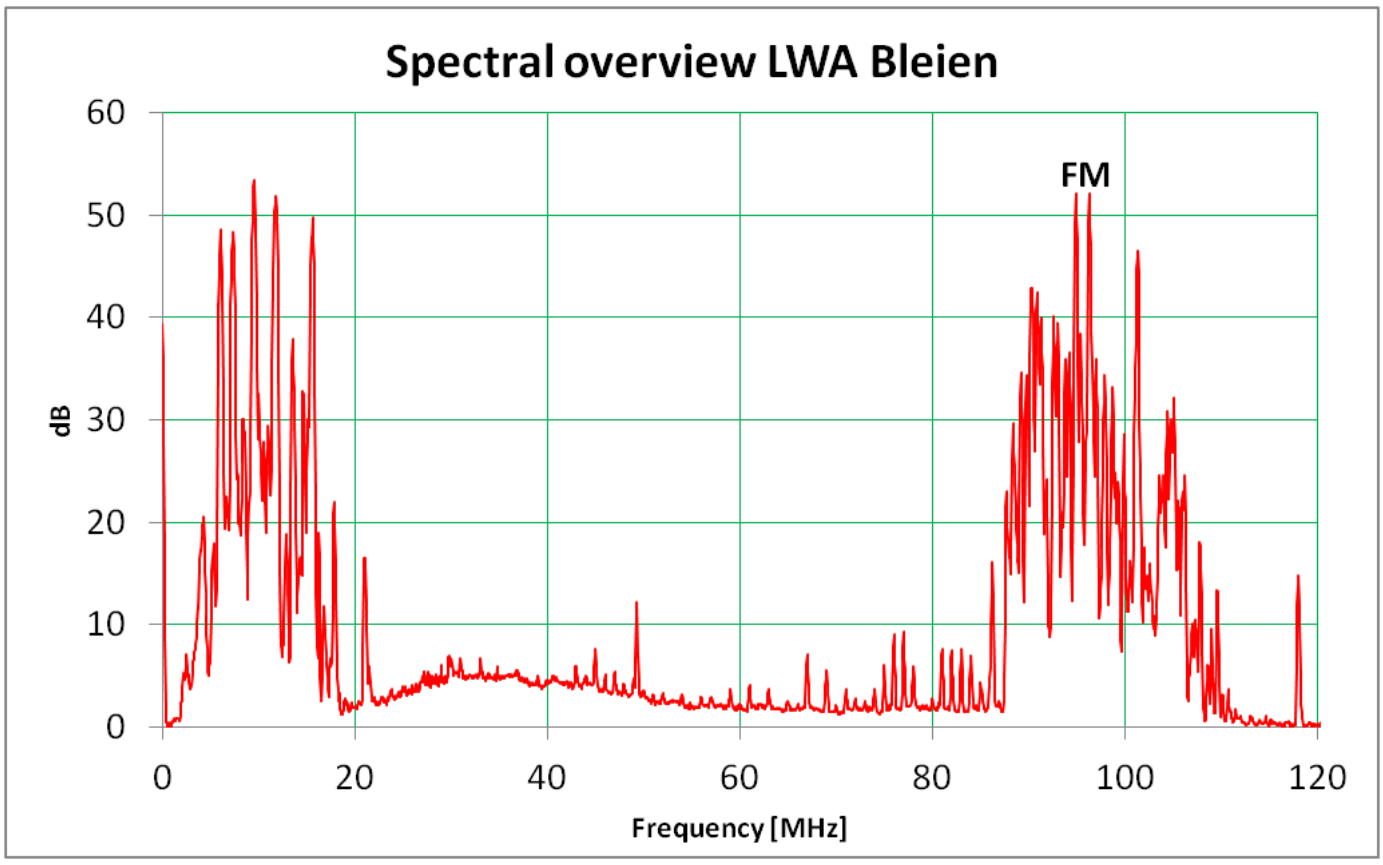

Figure 5 ~ Spectral overview taken at night with 62.5 KHz resolution, 300 KHz radiometric bandwidth and 1 ms integration time. 0 dB is referring to minimum signal of the spectrum. The spectrum between 19 MHz and 87 MHz is quite clean with only minor rfi. Below 20 MHz we can see a lot of short wave transmitters while from 88 MHz up to 108 MHz there are strong FM radio transmitters.

Further information and reading:

More information about the instrument Callisto and the network e-Callisto can be found here:
http://e-callisto.org/

More information about the LWA can be found here:
http://www.reeve.com/RadioScience/Antennas/ActiveCrossed-Dipole/ActiveBalunOrderInfo.htm

The First Station of the Long Wavelength Array:
http://www.ece.vt.edu/swe/lwa/memo/lwa0171.pdf

The Long Wavelength Array (LWA): A Large HF/VHF Array for Solar Physics, Ionospheric Science, and Solar Radar
http://www.ece.vt.edu/swe/lwa/memo/lwa0173.pdf