



Practical Training Radioastronomy



Hardware Overview

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Image credits: ALMA (ESO/NAOJ/NRAO), C. Malin & J. Guarda

V2.6 13.5.2024

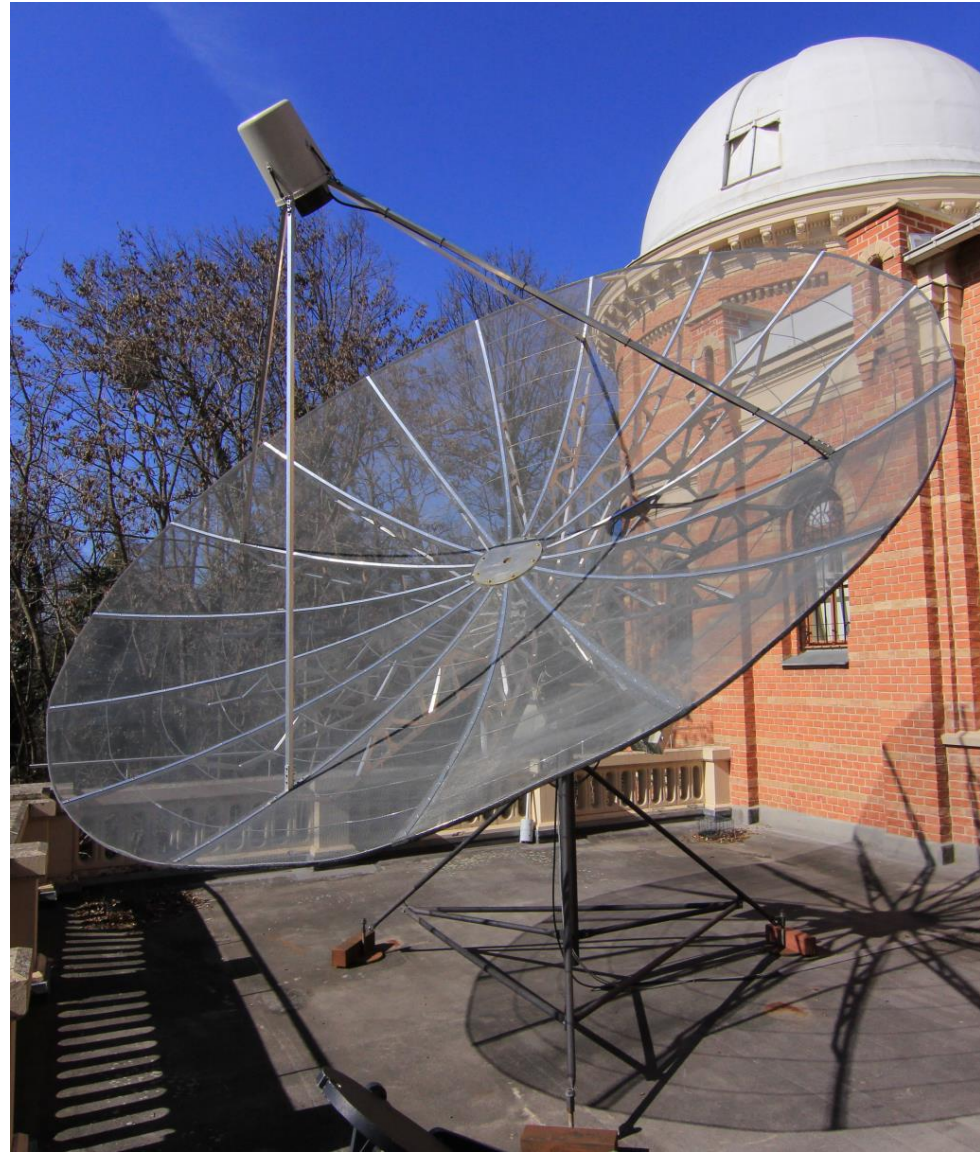
New Radio Telescope Fact Sheet

Diameter: 4,5 m

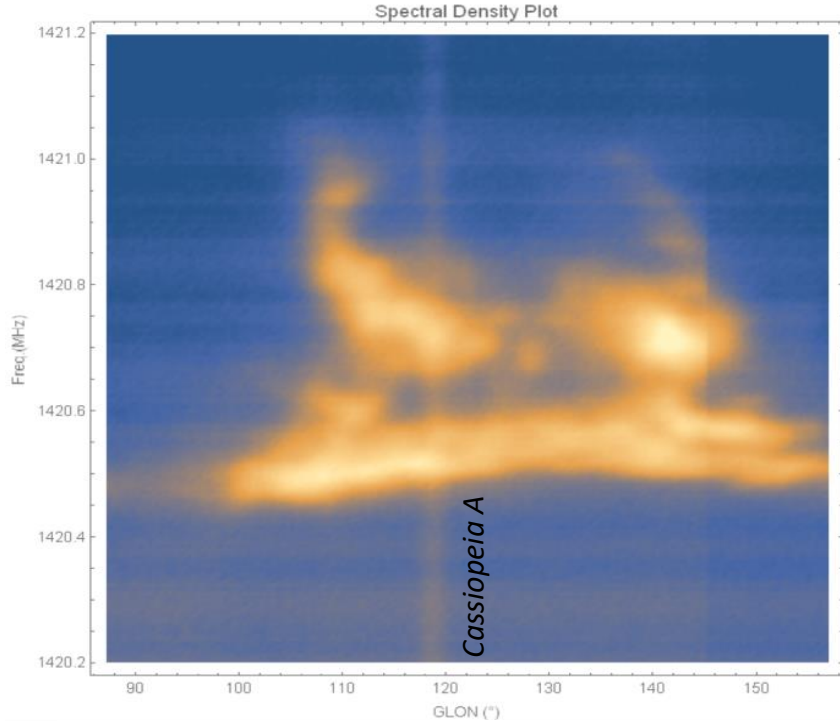
Beam width: $3,2^\circ$ @1420 MHz
 $2,9^\circ$ @1612 MHz

Antenna gain: 33 dBi

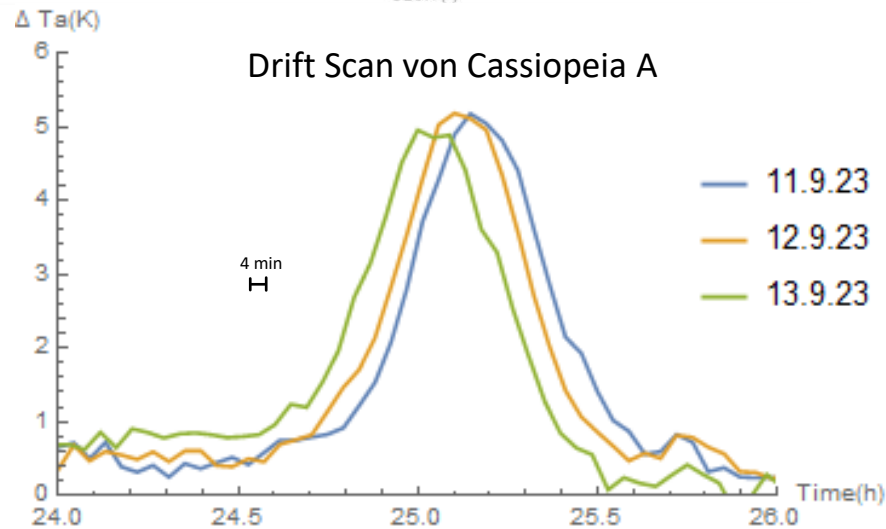
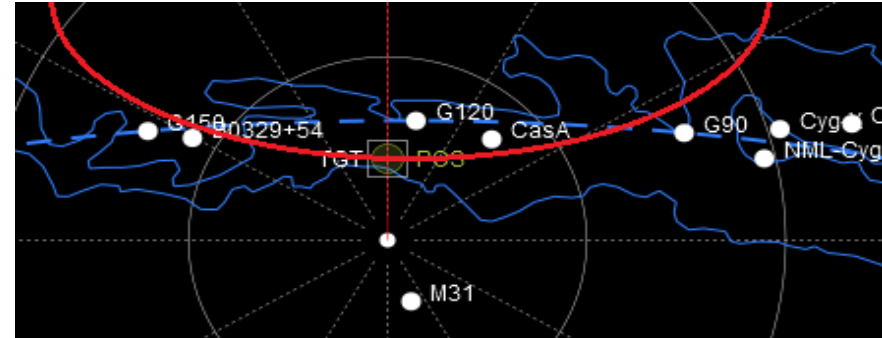
Frequency: 1415...1425 MHz
1607...1617 MHz



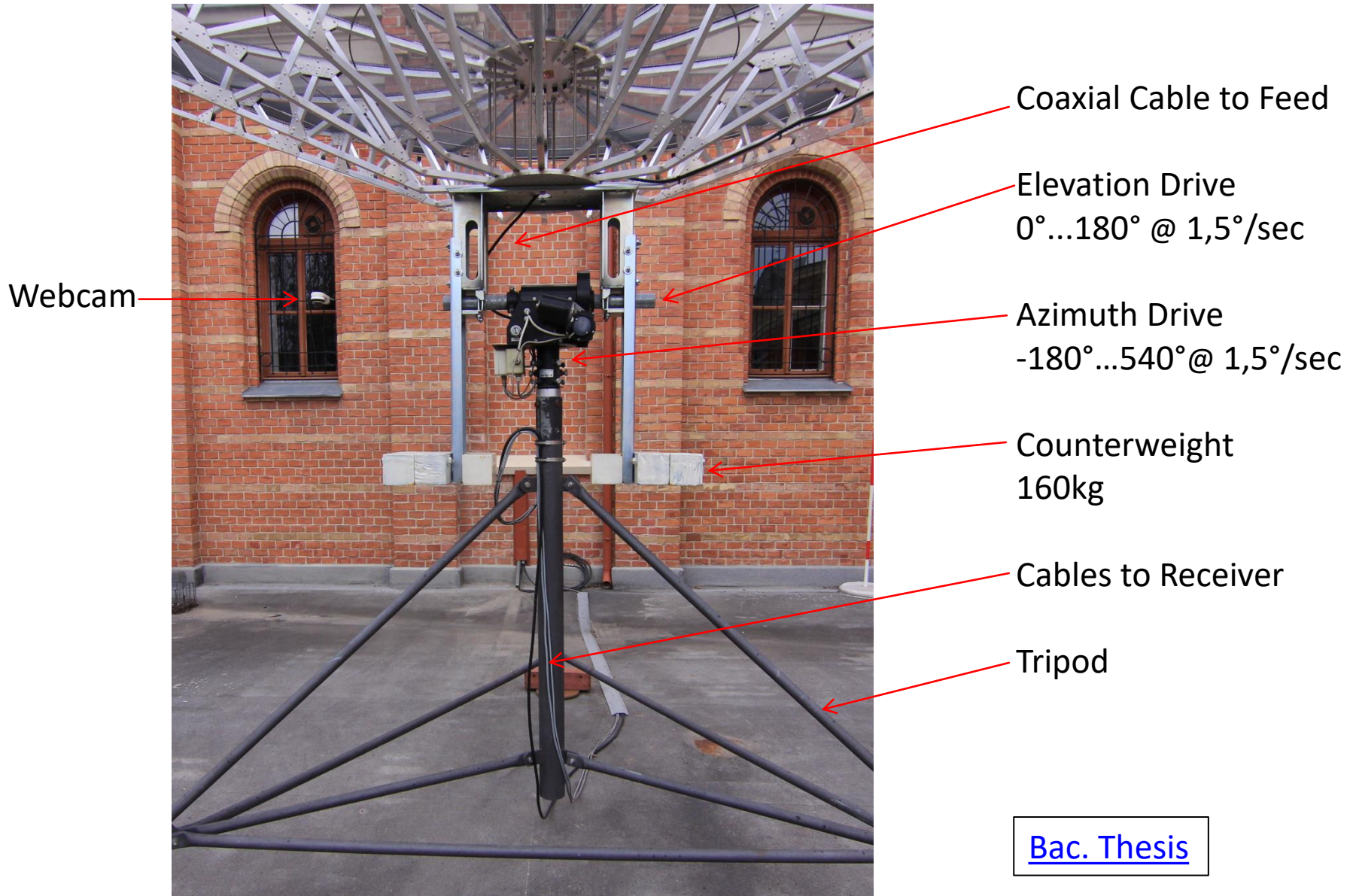
NRT First Light 5.9.2023



Transitpath through the galactic plane

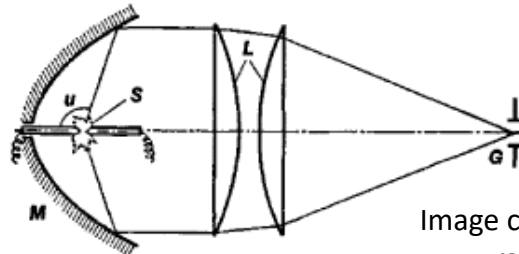
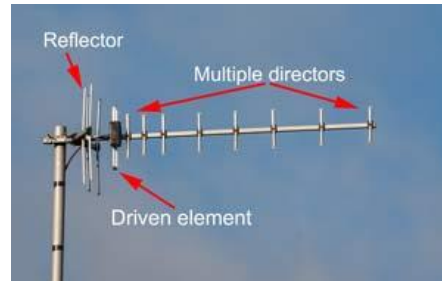
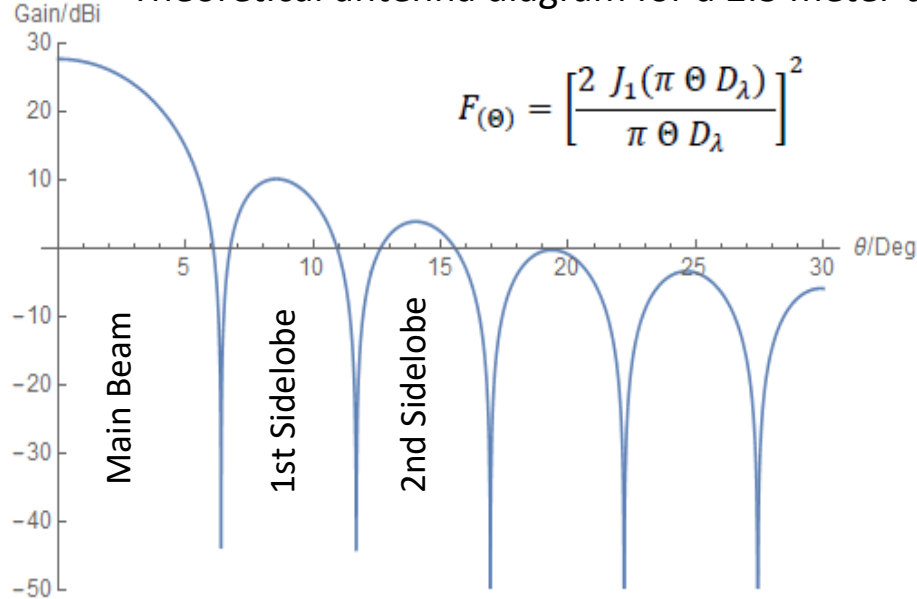


Altazimuth Mount Drive



Antenna Basics

Theoretical antenna diagram for a 2.3 meter dish @ 1420 MHz

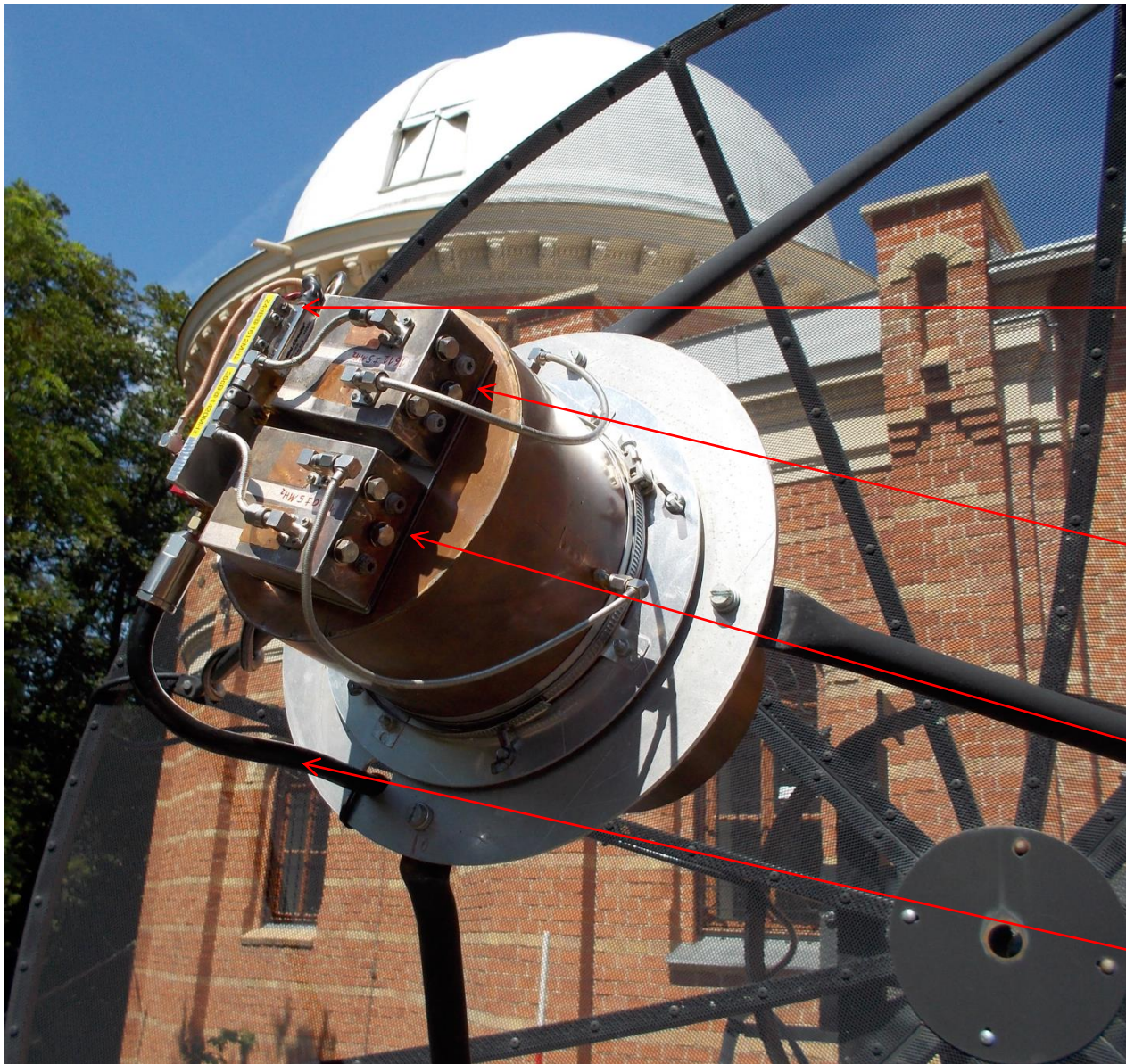


Austria's highest antenna, 265m
destroyed 02/2010

Image credit: www.eso.org/public/teles-instr/alma/antennas/

Image credit:
www.radio-electronics.com/info/antennas/yagi
encyclopedia2.thefreedictionary.com/Condenser

SRT Primary Focus Assembly



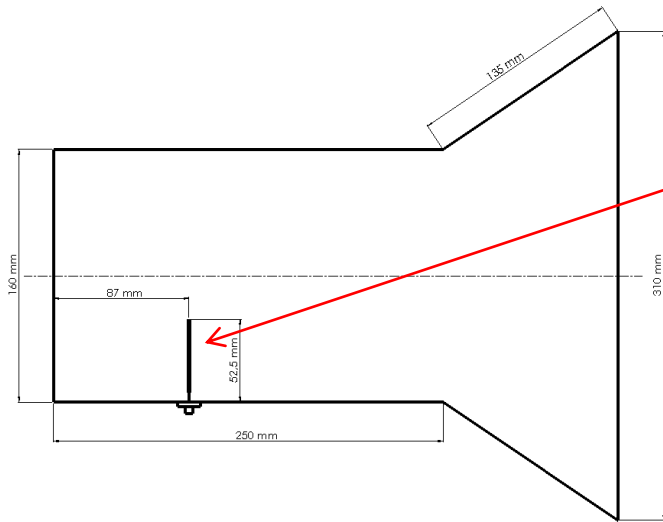
2x Amplifier
26dB@1420MHz
24dB@1612MHz

Band Filter
1612MHz

Band Filter
1420MHz

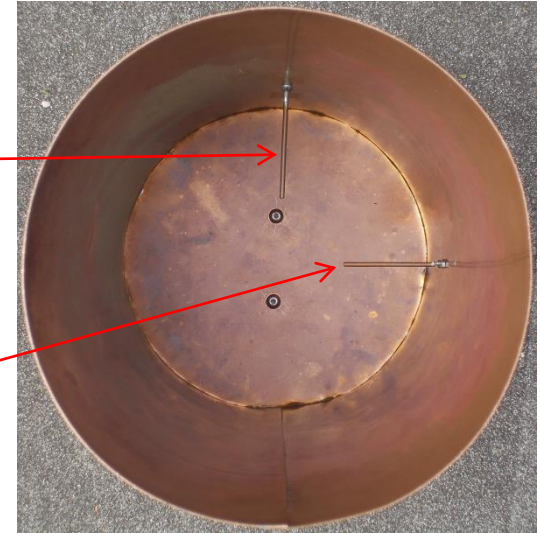
Coaxial Cable
to Receiver

Can Antenna used as Feed

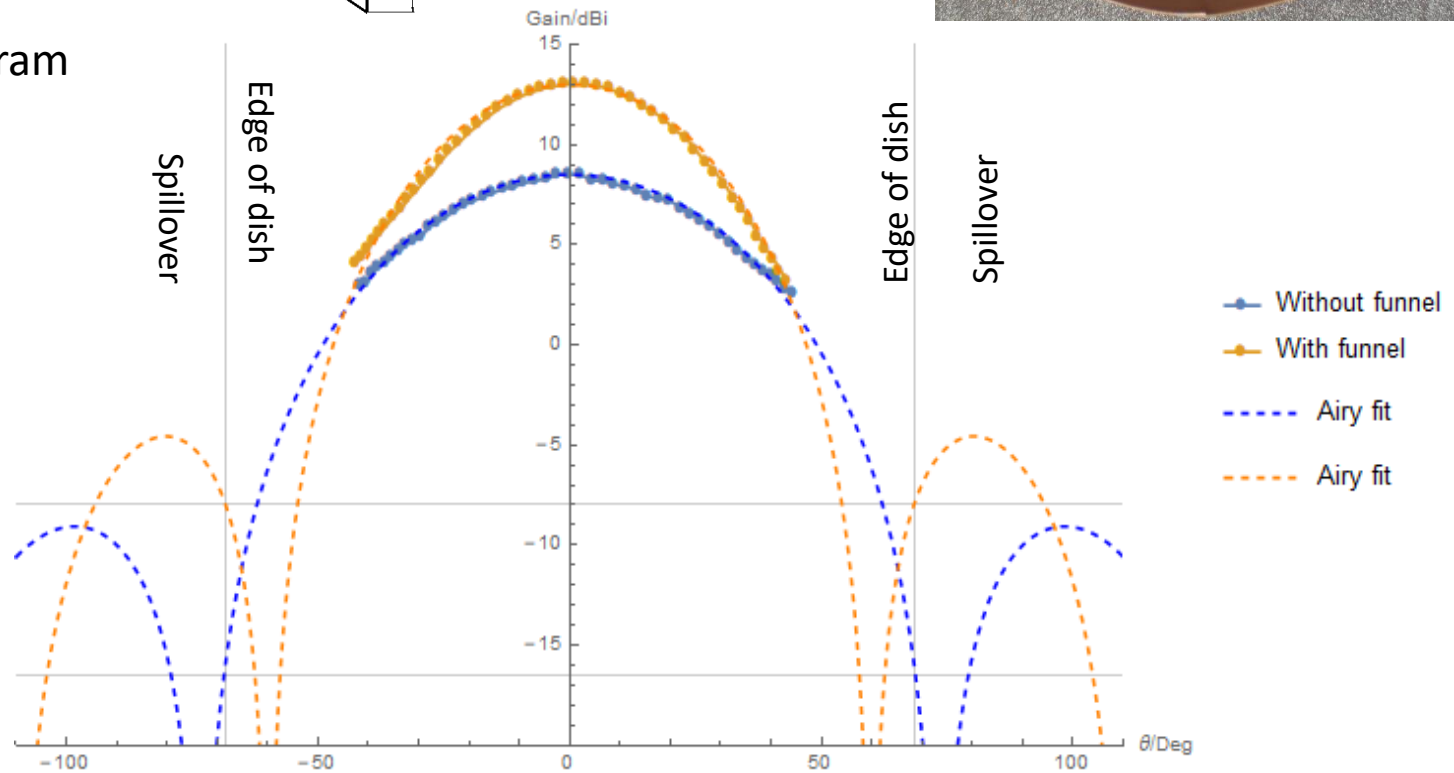


$\lambda/4$ Antenna
@1420MHz

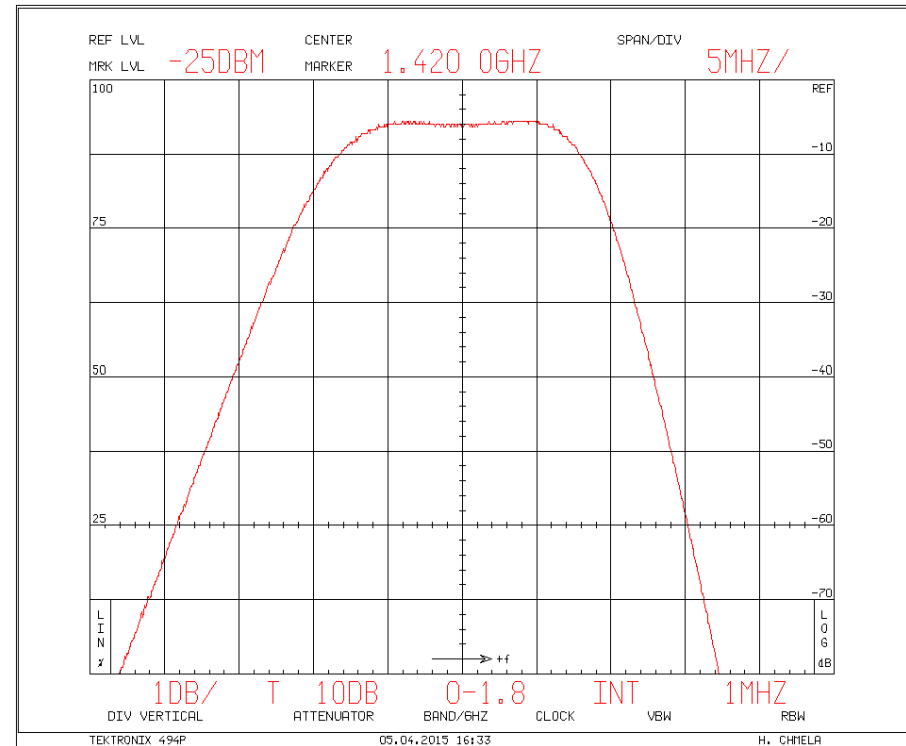
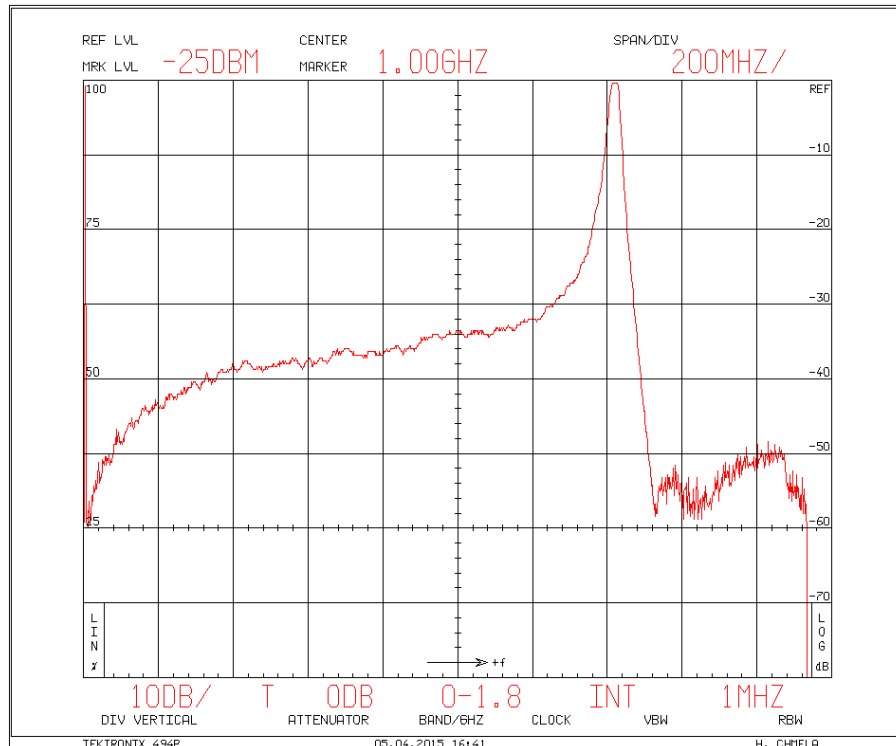
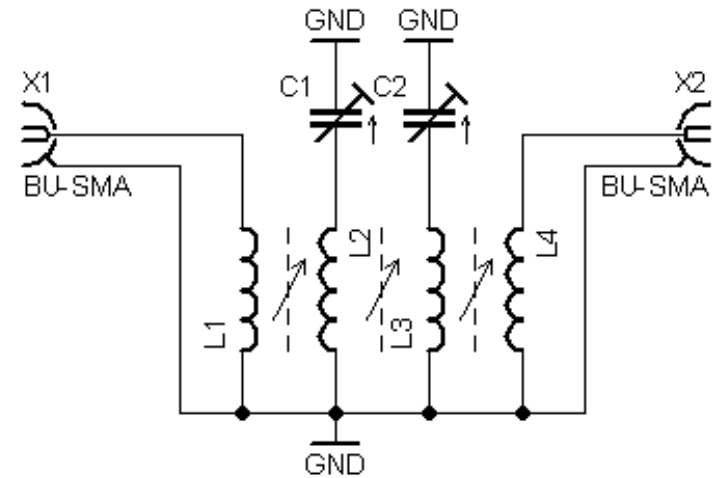
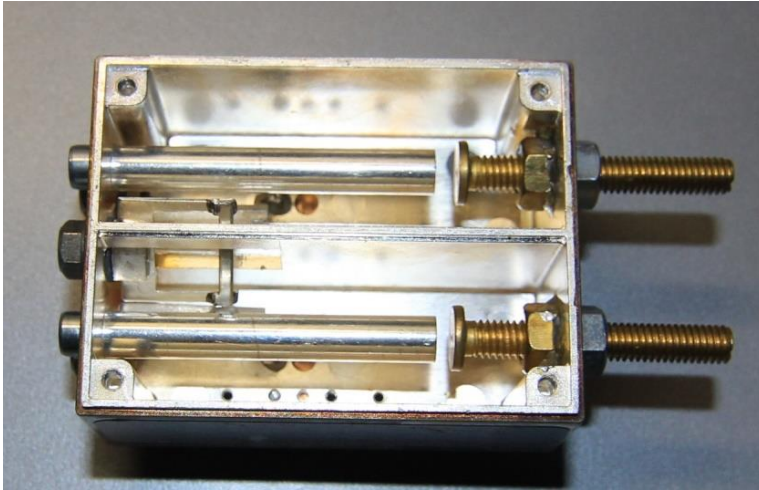
$\lambda/4$ Antenna
@1612MHz



Antenna Diagram
@1420MHz



Two Cavity Bandpass Filter



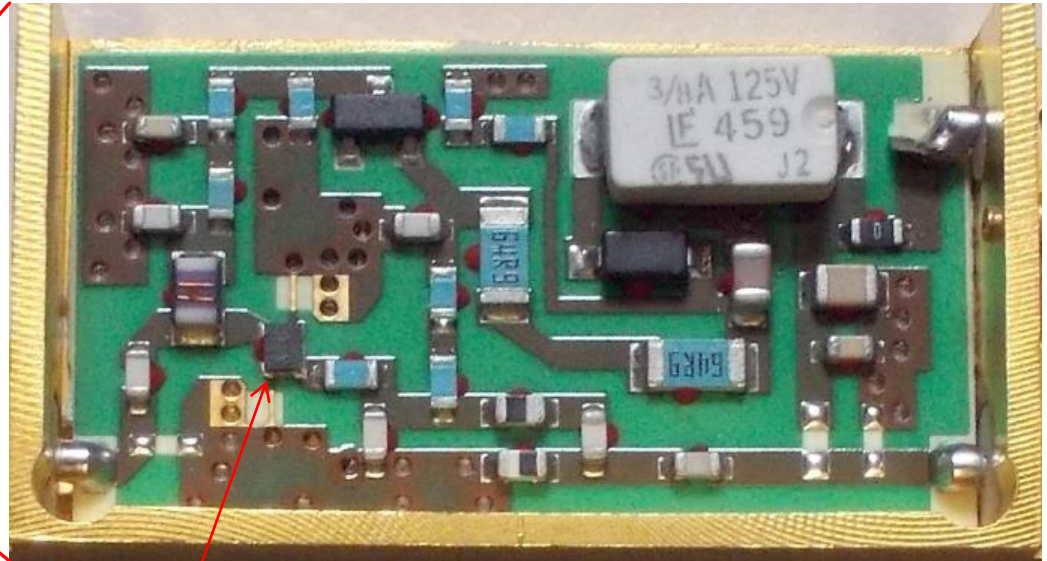
Front End Amplifier



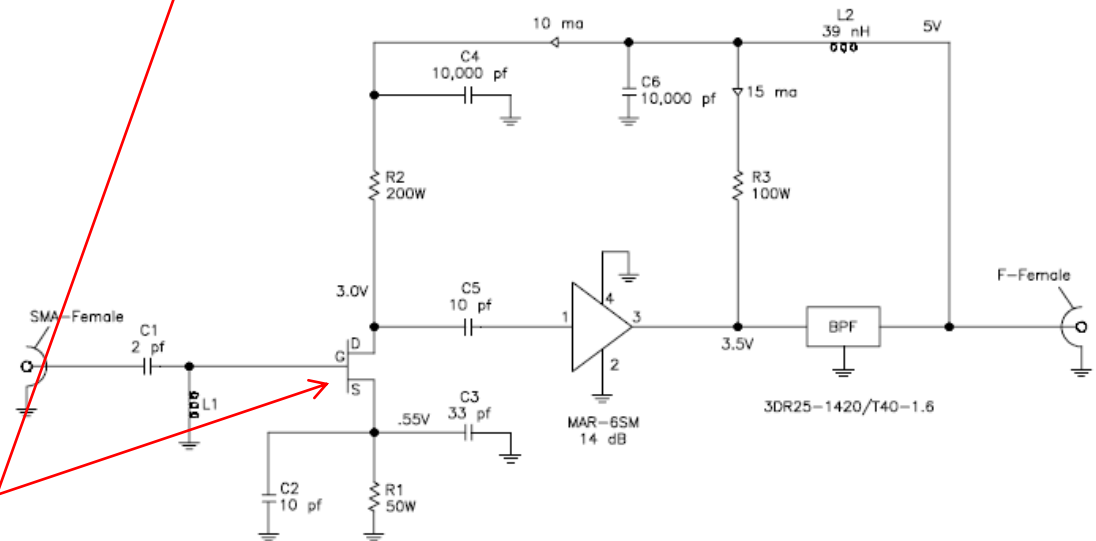
To Receiver

Bias Tee

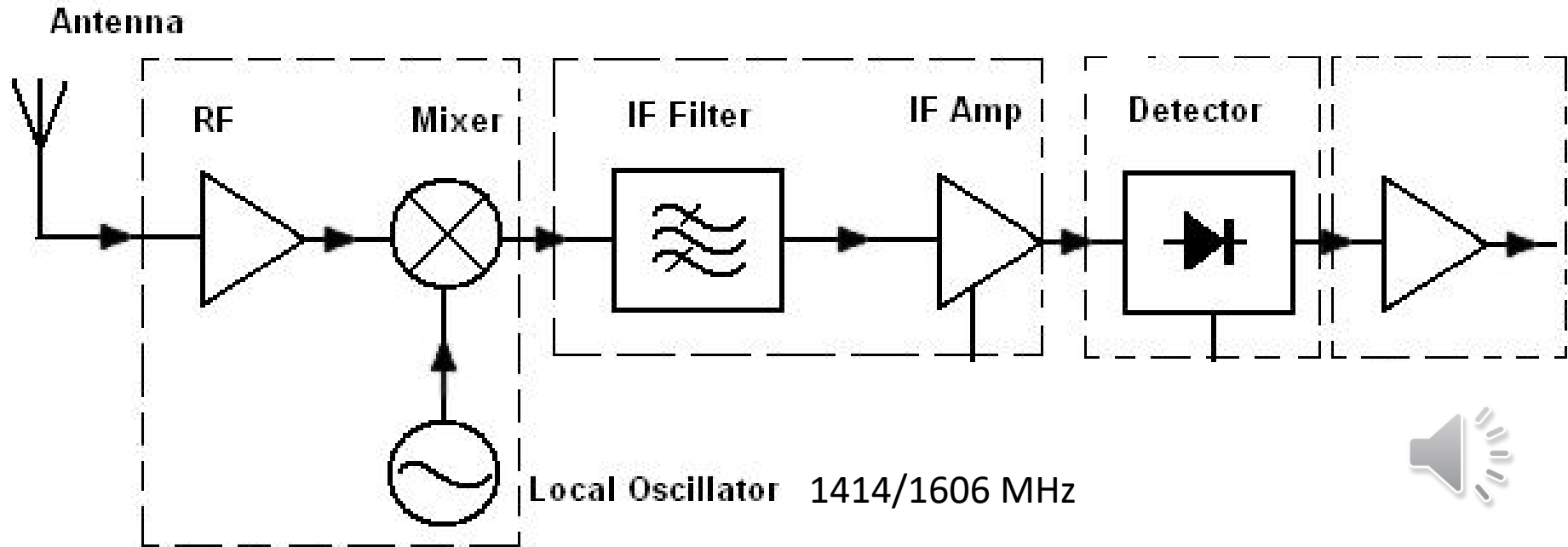
The one and only pixel of the telescope



Type: [ZX60-1614 LN-S](#)



Superhetrodyne Receiver



RF:
1420/1612 MHz
Amplification
Tuning
Down conversion

IF:
6 MHz
11MHz Bandwidth

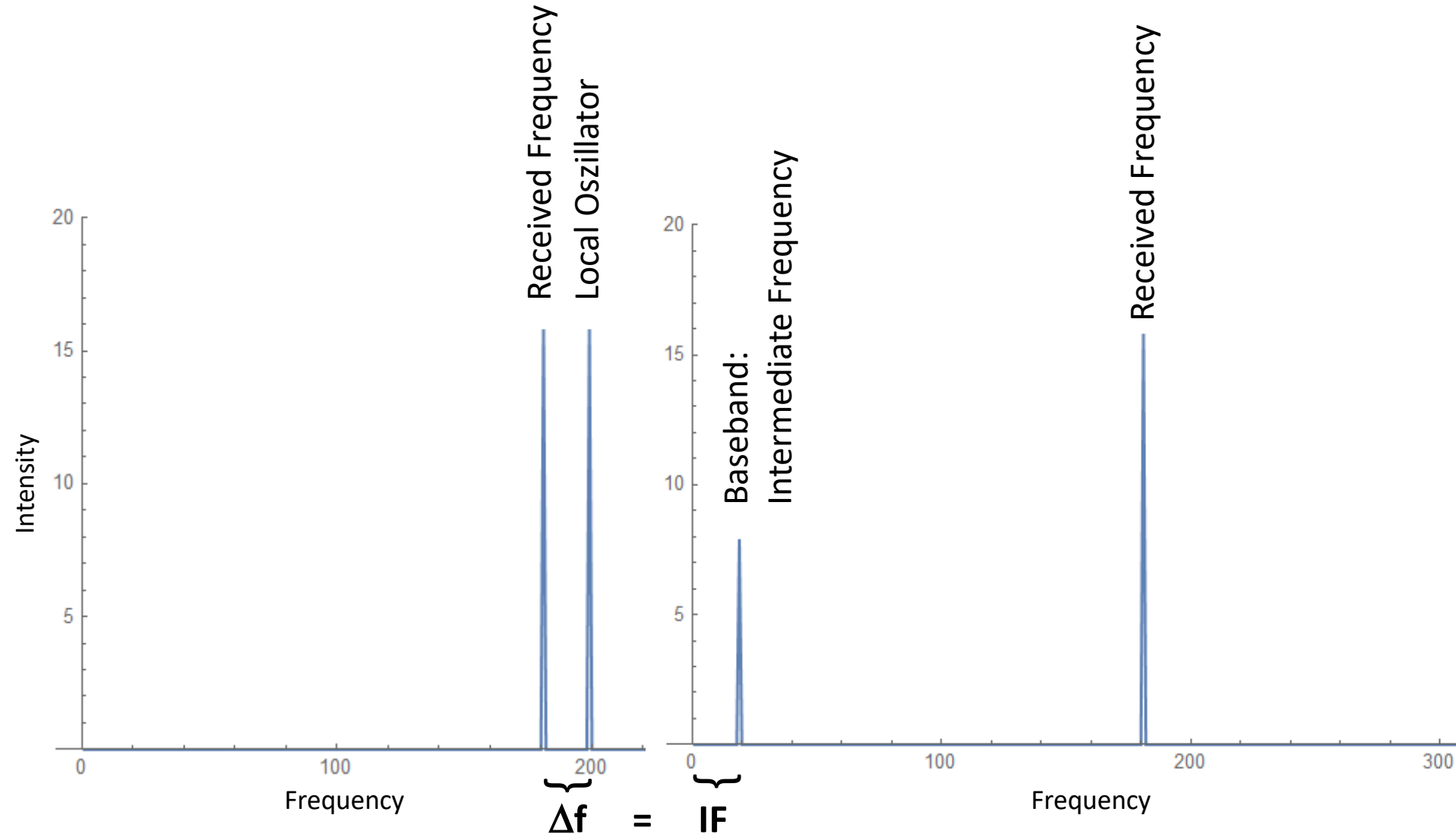
IF Detection
Samplingrate 66,67MHz
FFT Bandwidth 190kHz

Mixer Simulation 1

[Mixer simulation 1 in Mathematica](#)

Linear Superposition

Nonlinear Superposition



Mixer Simulation 2

[Mixer simulation 2 in Mathematica](#)

Nonlinear distortion in time domain

leads to unwanted mixing in frequency domain

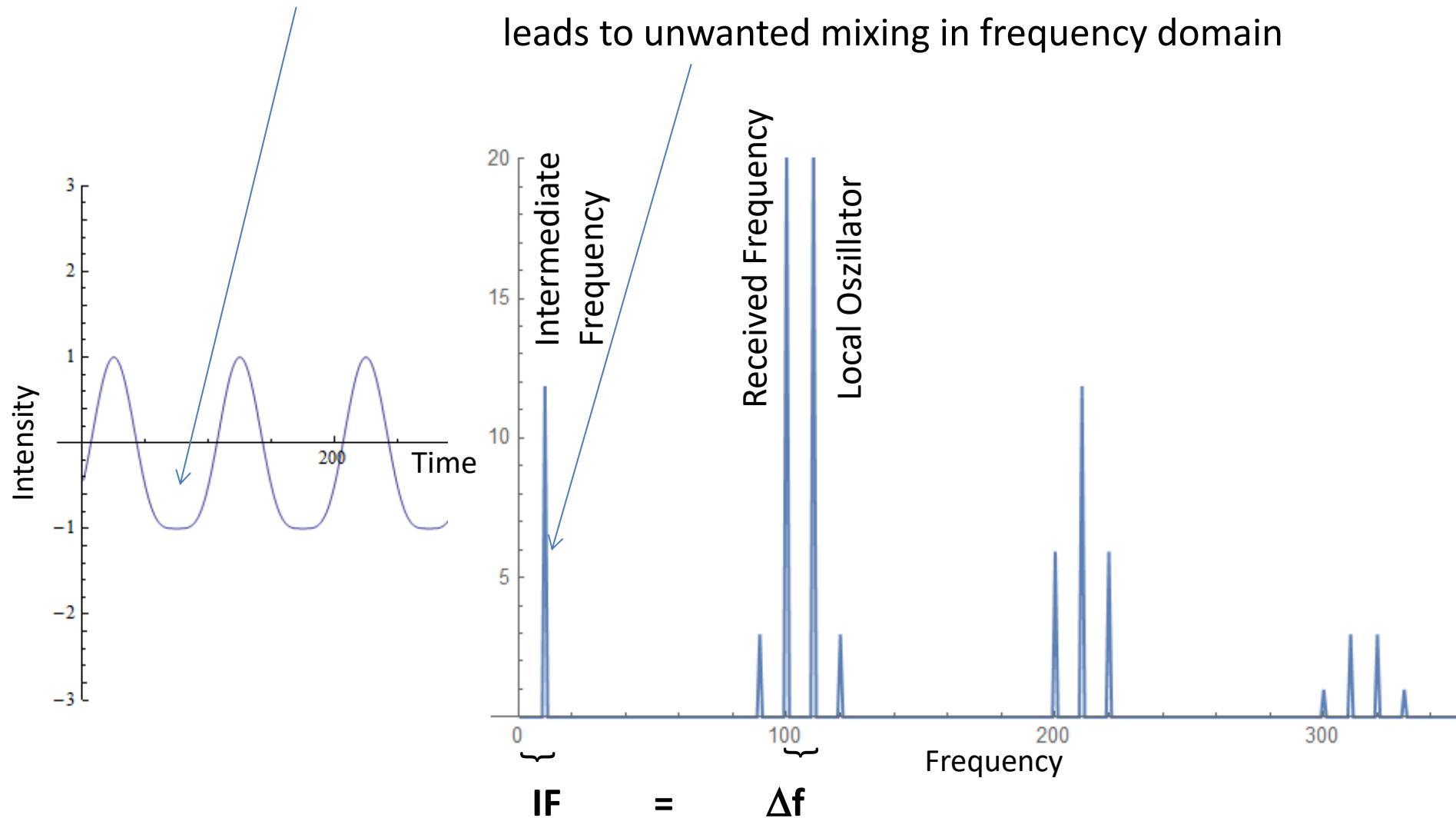


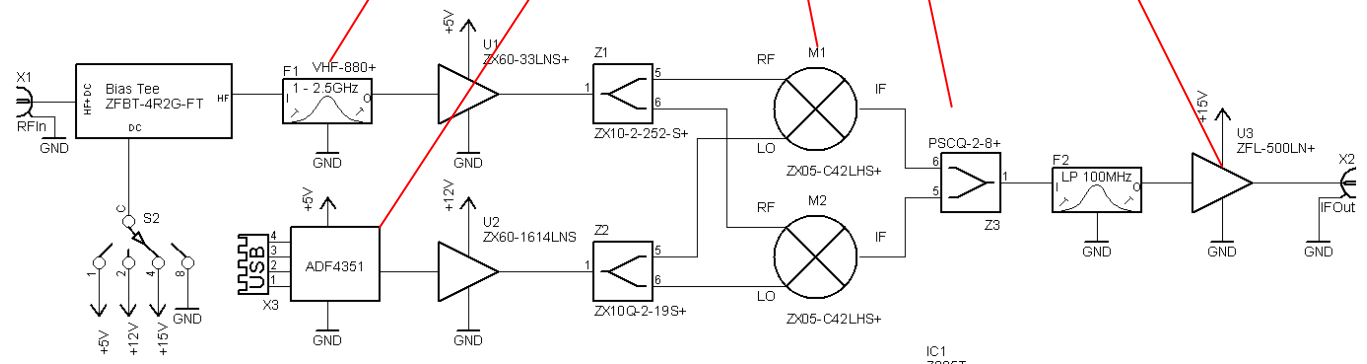
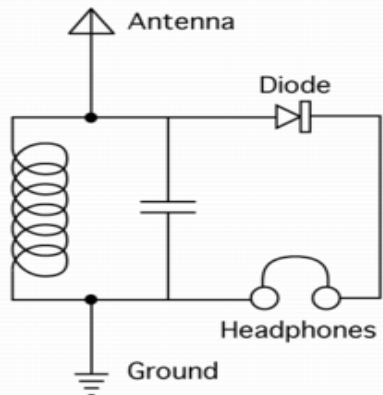
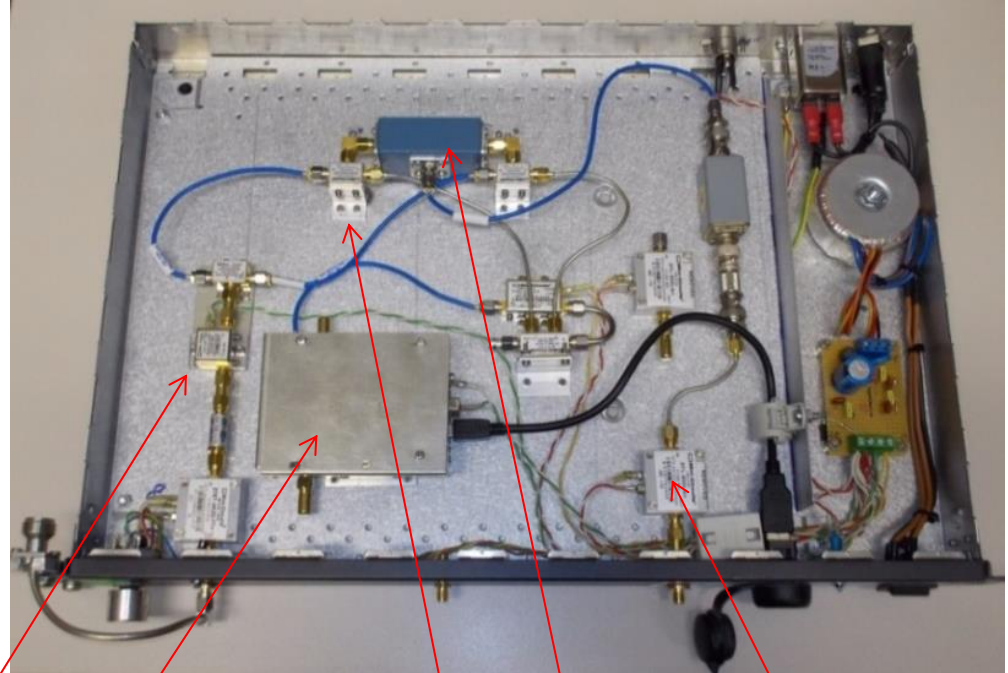
Image Rejection Receiver

Detector Radio Receiver 1924



Image credit:
www.radiomuseum.ch/13804_detektorempfaenger_c1_c_1.html

NRT Receiver 2024



Local Oscillator Synthesizer

Image Rejection Mixer

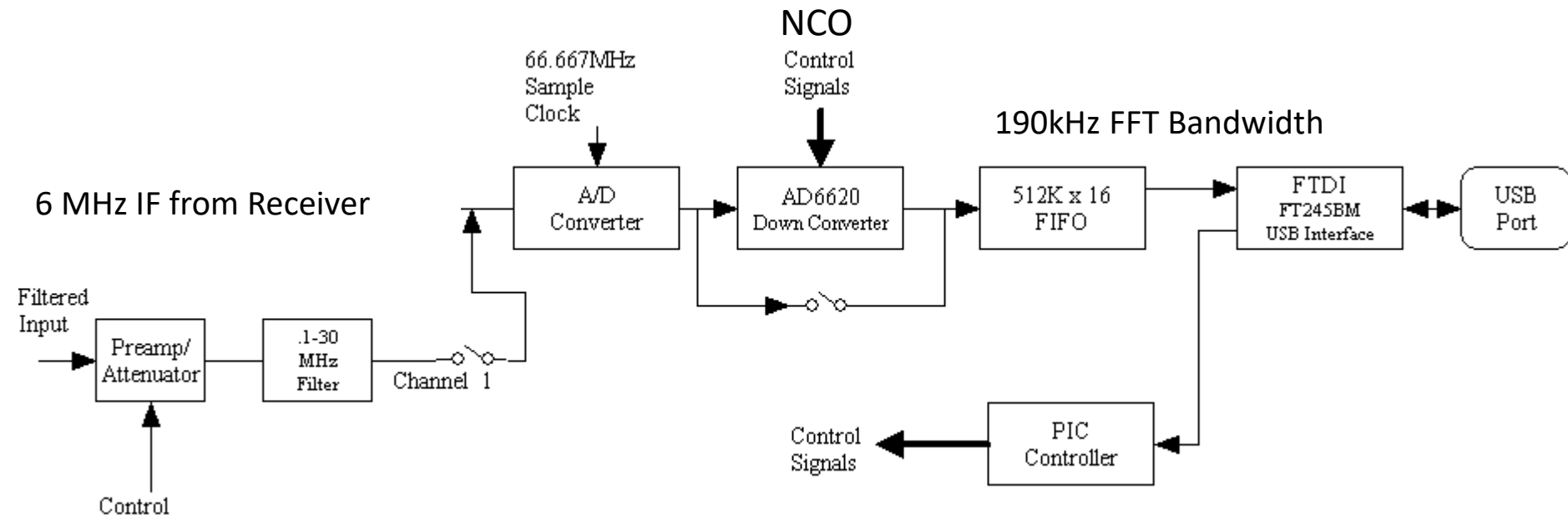
ZF-Output
6 MHz

Detection System / Spectrometer

- SDR14 – Software Defined Radio
- 14 Bit ADC, Digital Downconverter
Signal/Noise Conversion Gain
- Numerical Tuning, NCO
- Complex IQ-Sample Output
- FFT on external Computer



Image Credit: www.universal-radio.com



Block Diagram, Image Credit: www.moetronix.com/sdr14info.htm

ALMA's Band 3 Receiver

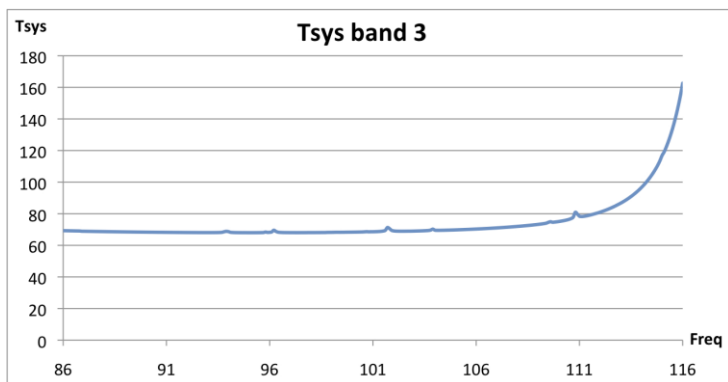


Image credits:
ALMA Cycle 2 Technical Handbook V.1.1
www.almascience.eso.org

