Development and first tests of the Homodyne detection board for squeezed light

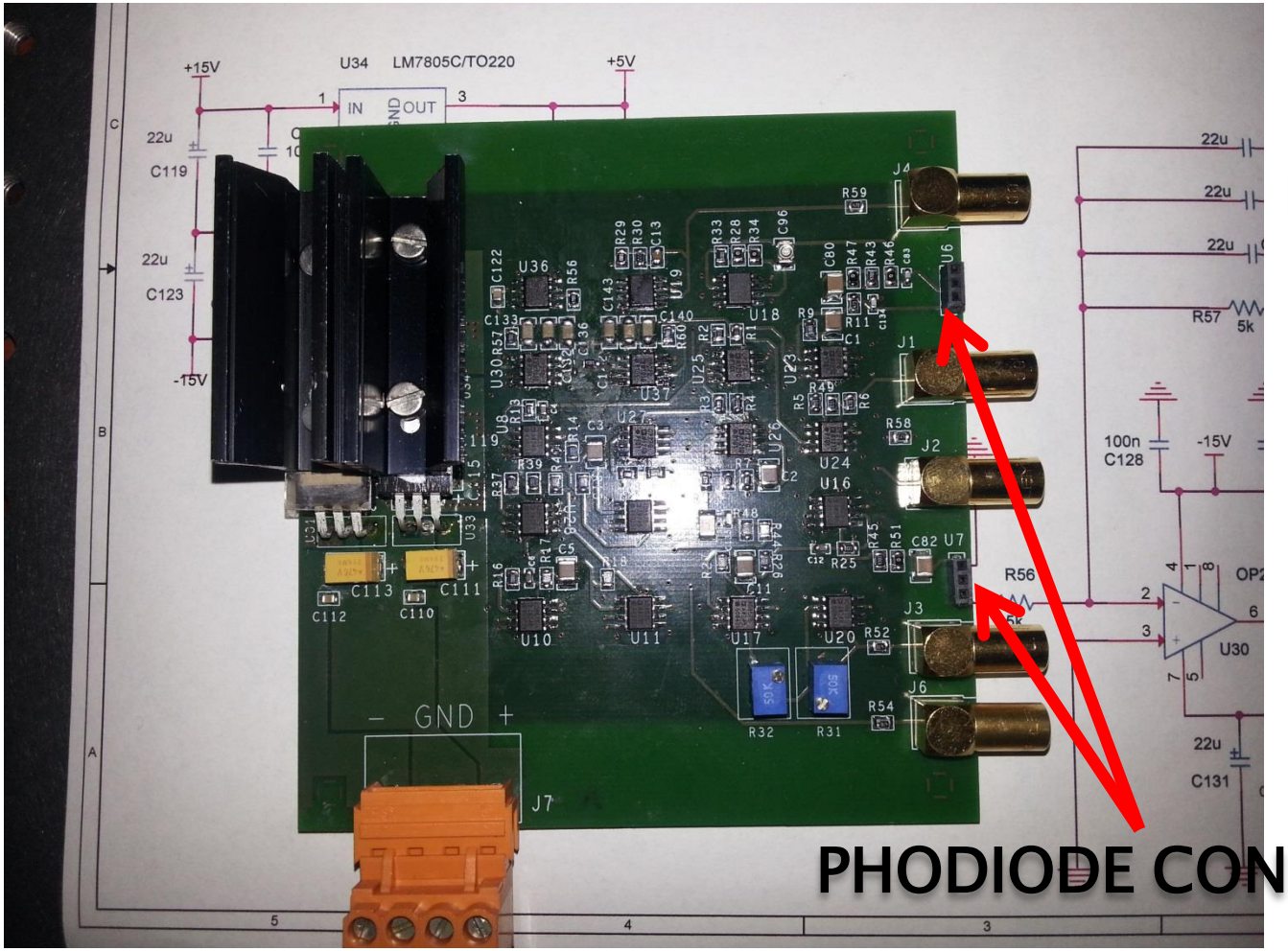
L. Naticchioni

Sapienza Univ. of Rome & INFN Roma

SAPIENZA
UNIVERSITÀ DI ROMA

Homodyne detection board

First designed prototype



RADIO –

AUDIO –

AUDIO +

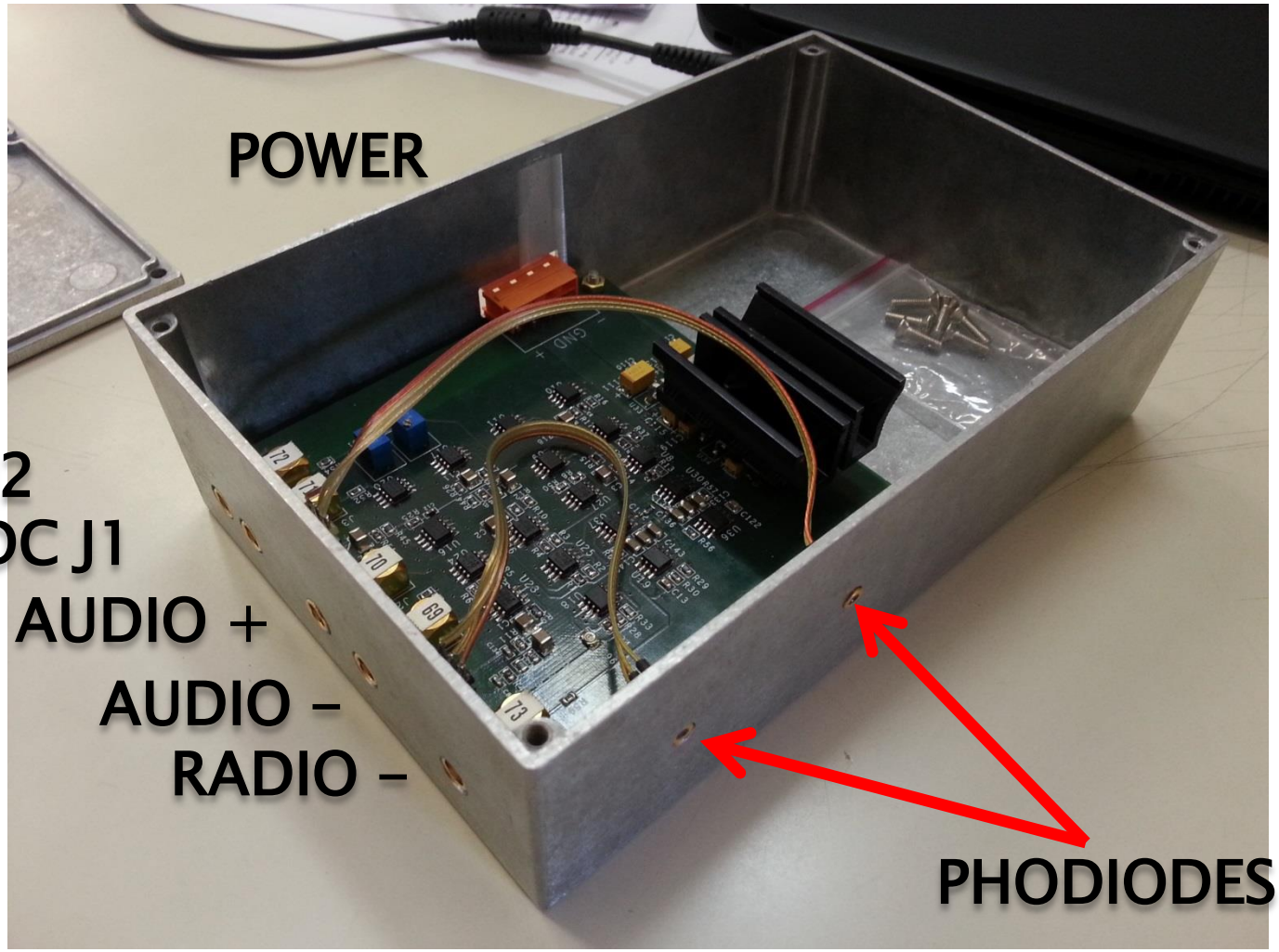
DC J1
DC J2

PHODIODE CONNECTORS

POWER (+/-19V 0.8A)

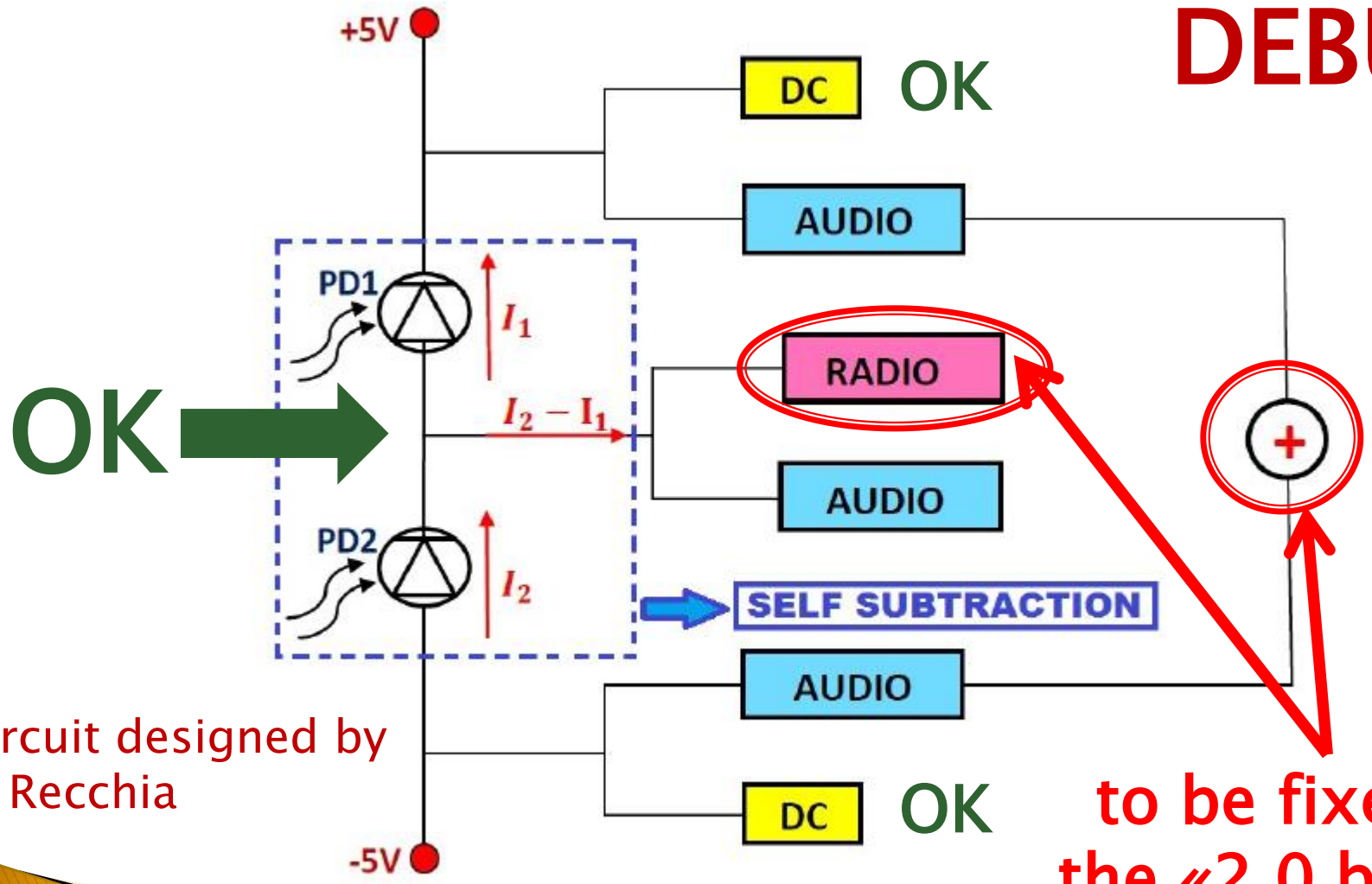
Homodyne detection board

First designed prototype



Homodyne detection board

First designed prototype



Circuit designed by
S. Recchia

Audio: 10Hz – 10kHz
Radio: 1MHz – 100MHz

Homodyne detection board

- **Detection Board Prototype check**:
  - Fixed minor mistakes in the realization (wrong R, C..)
  - Emiting IR led used to test the two **EPITAXX ETX500T** photodiodes:
    - DC & AC test: OK
    - fotodiodes electronics balancing: OK
    - background noise measurement: OK, *compliant with the theoretical predictions*)
  - Found a main «bug» in the electronics design: «+» and «–» circuits (audio band) do the same thing: $I_1 + (-I_2) = I_1 - I_2$! *We will overcome this problem re-designing a **new detection board 2.0** (modified op-amp connections);*
  - Radio-difference circuit must be fixed and will be tested soon using the laser source (Mephisto laser, 200 *mW*).

SINCE THE SUBTRACTION CIRCUIT BETWEEN I_1 AND I_2 WORKS, THE PROTOTYPE DETECTION BOARD CAN BE USED IN THE OPTICAL TEST BENCH !

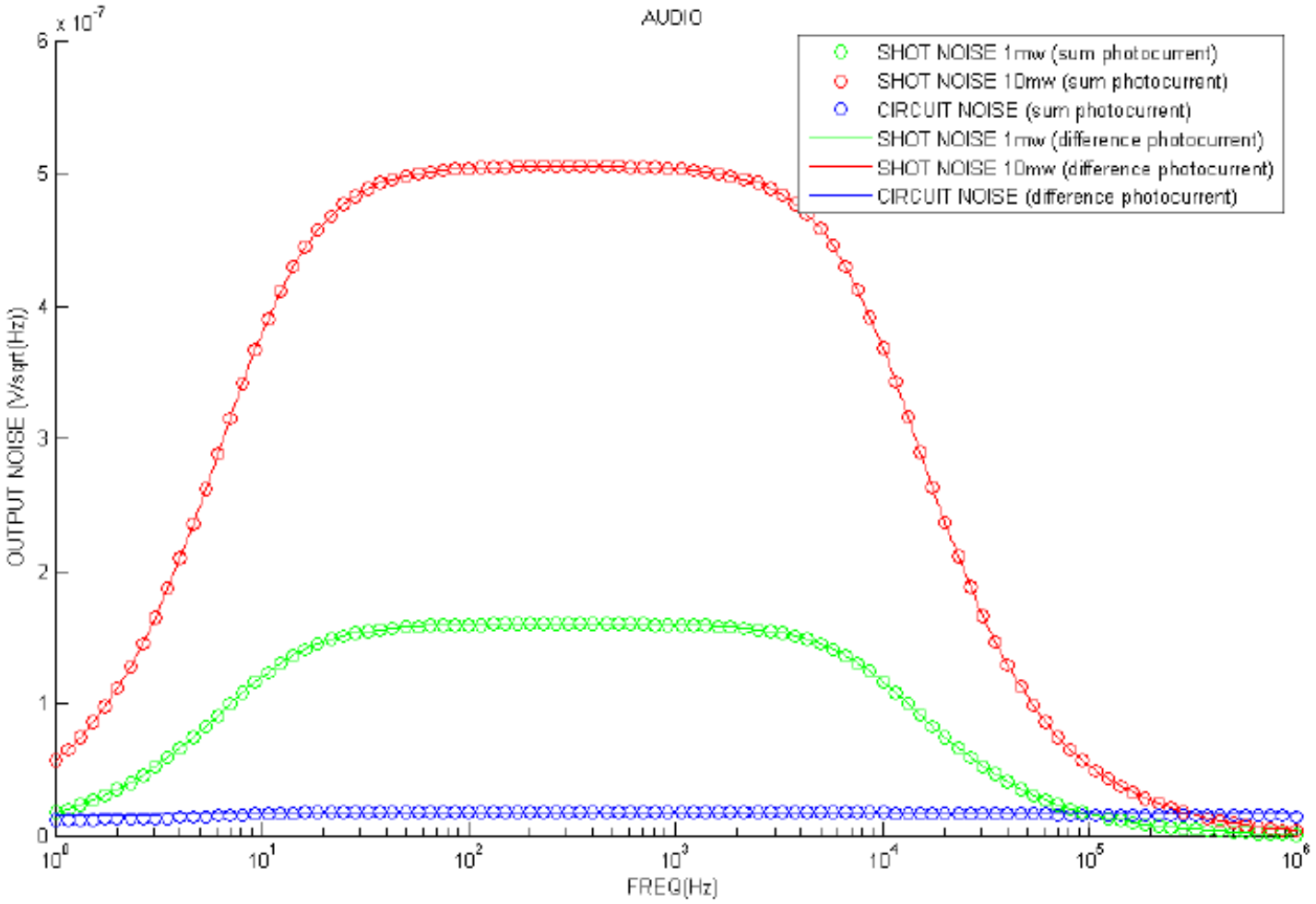
Homodyne detection board

Background noise from electronics

8*10-7

1*10-7

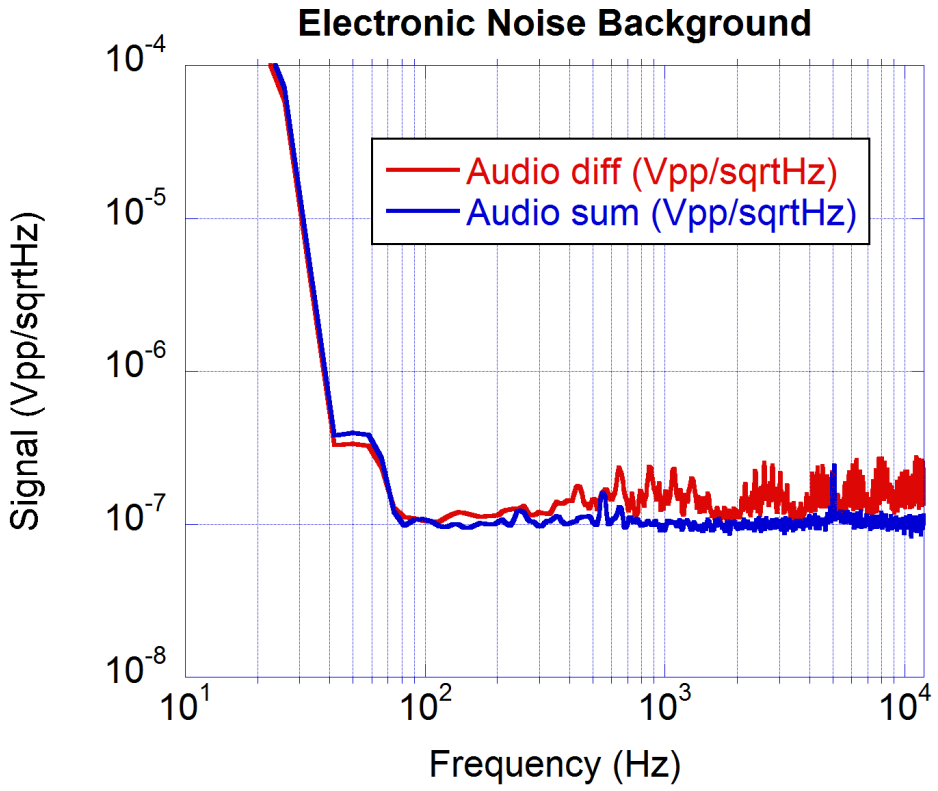
9*10-8

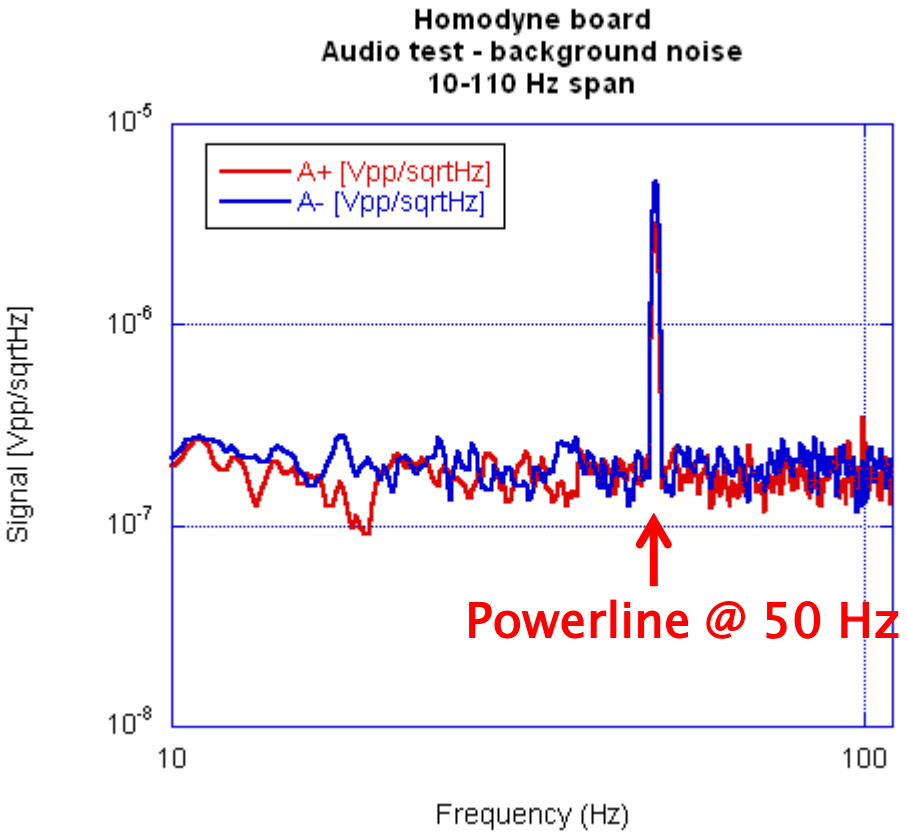


Theoretical noise estimation considering the A+/A- circuits (only Johnson noise from resistences)

Homodyne detection board

Background noise from electronics

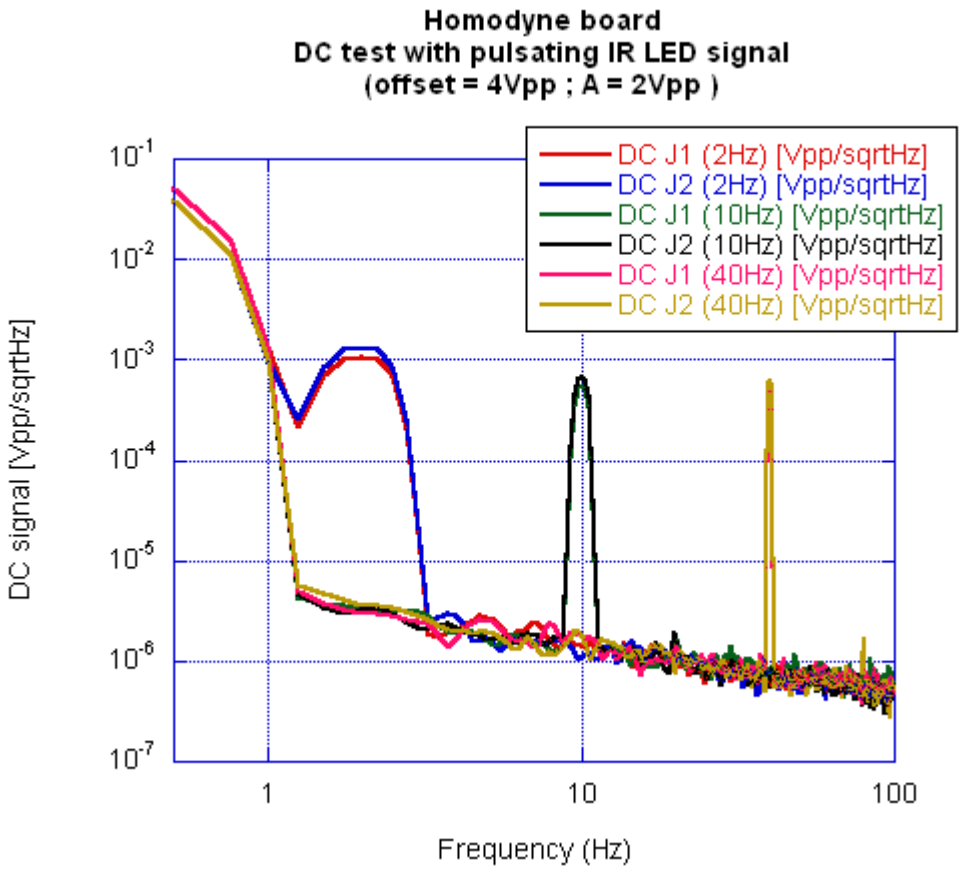


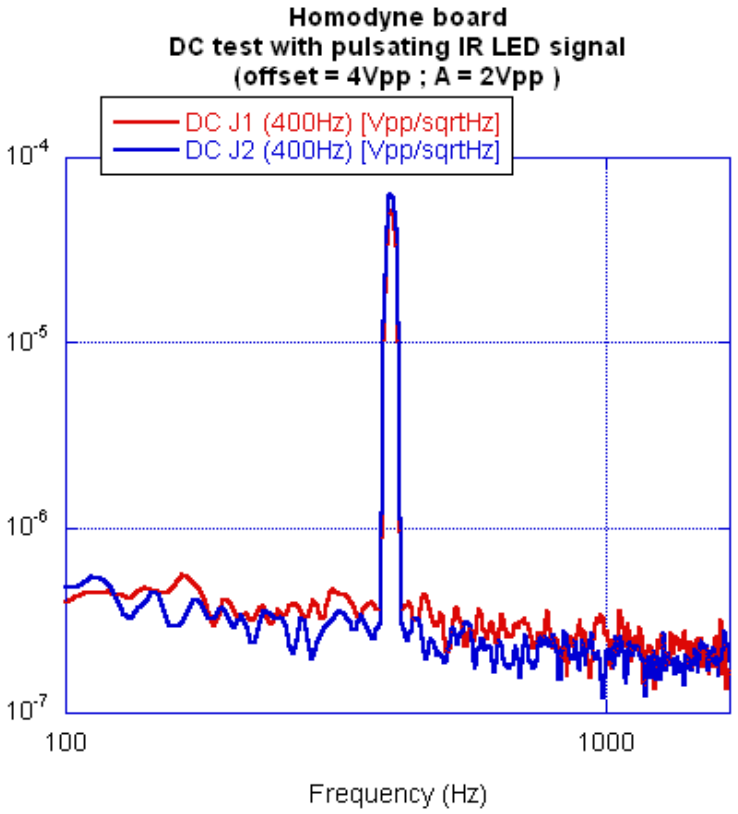


N.B. : measures are in Vpp/sqrt(Hz), therefore compare with its half value; $R_{audio-} = 48\ \Omega$

Homodyne detection board

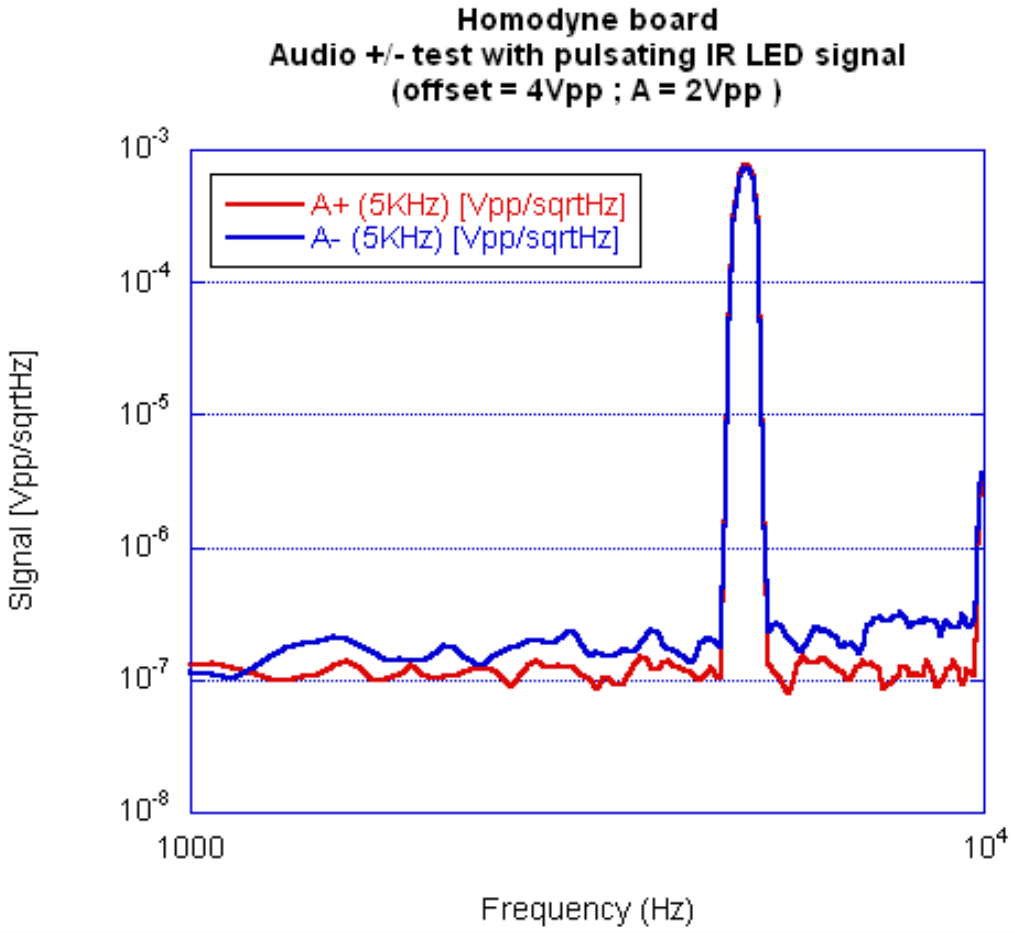
Pulse test with IR emitting led





Homodyne detection board

Pulse test with IR emitting led



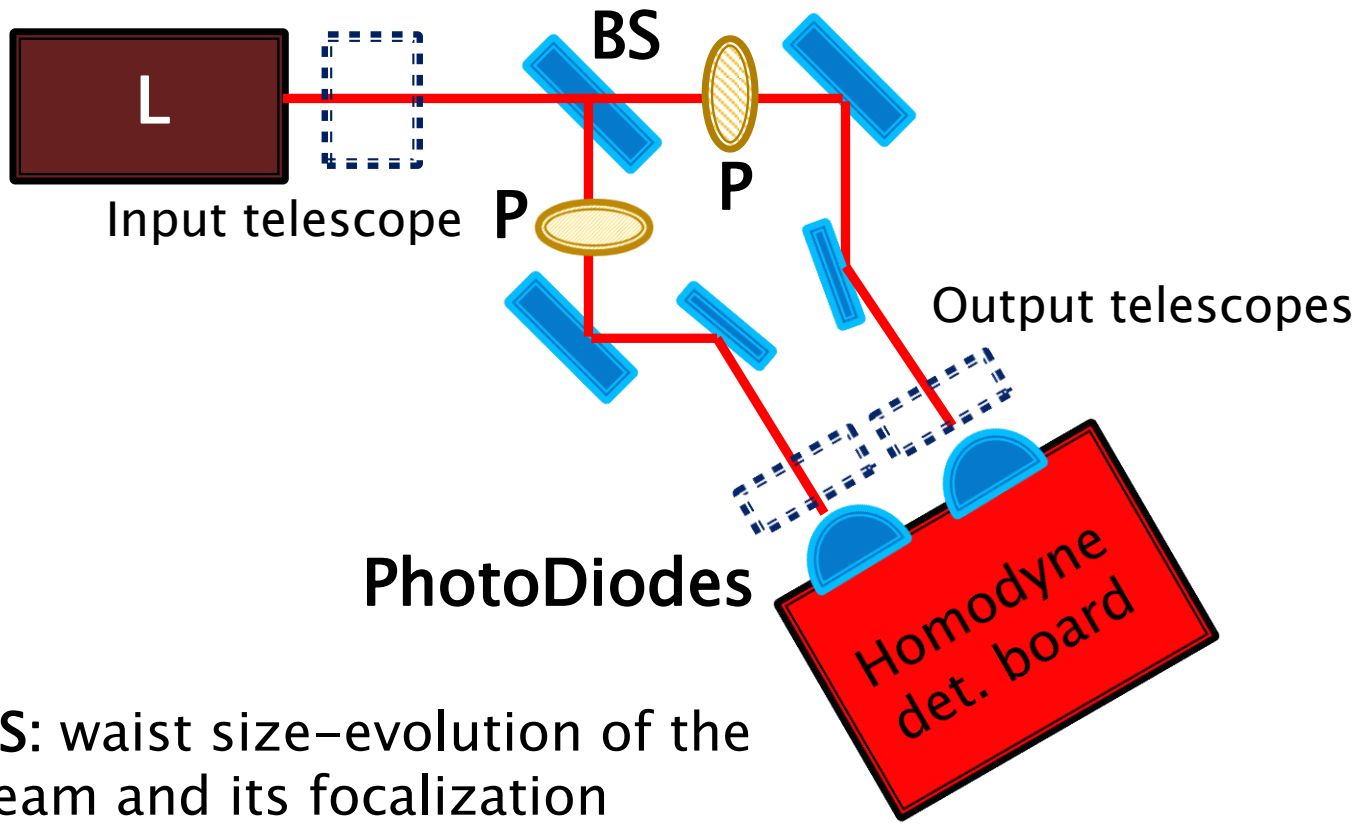
N.B. : Audio+ and Audio- show the same output (mistake in the A+ block); the peak is produced by the amplified unbalancing between the two different IR emitting leds used in the test (misalignment, distance)

Homodyne detection board

Optical Layout for the test

(almost finished, 3 grad students are currently working on it)

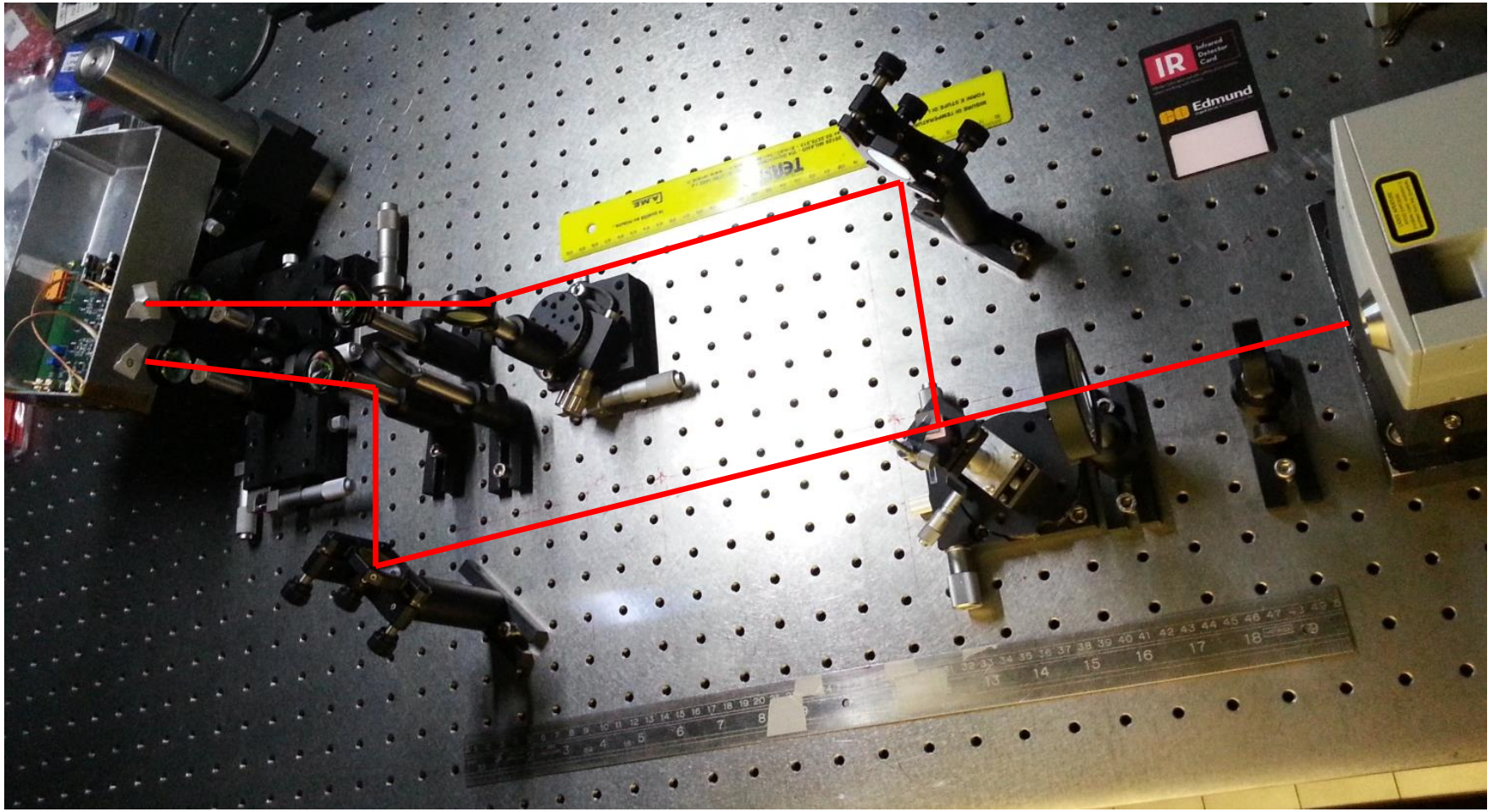
IR Laser Source:
Mephisto (200 mW)
// polarized



--> **SIMULATIONS:** waist size-evolution of the gaussian laser beam and its focalization **(gaussianbeam + zeemax)**

Homodyne detection board

Optical Layout for the test



…work in progress!