

# Detectors response studies

## **ANR-SP meeting**

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# Contents

- ▣ Motivation
- ▣ Introduction to the experiment
- ▣ Experimental Set up
- ▣ Results
- ▣ Comments

# Motivation

- ▣ The **Smith-Purcell Radiation (SPR)** at **SOLEIL** is expected to be around 2 orders of magnitude lower than the one at **FACET**
- ▣ We are also planning to use an **SPR** monitor at **ESTB** where according to preliminary simulations we expect also 2 orders of magnitude lower intensity of this radiation than the one at **FACET**

 **Therefore a study to improve the system to collect and amplify the signal from this radiation is needed**

This study provides a **preliminary comparison of the response** of some **pyroelectric detectors and thermopiles**. Also the amplification of the signal with an amplifier has been studied

# Introduction to the experiment:

## Pyroelectric and thermopile detectors

### ▣ Pyroelectric detectors

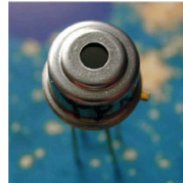
**Voltage response** induced by temperature variation providing detection of **changes in infrared energy** rather than absolute levels

### ▣ Thermopile detectors

**Current response** induced by temperature increase or decrease. Can sense **continuous infrared radiation**

# Introduction to the experiment: Detectors studied

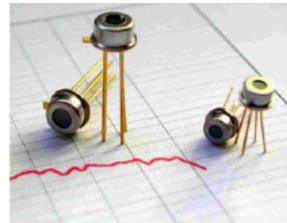
- **HTS-B31** (Thermopile)



- **TPD-2T-0625** (Thermopile )



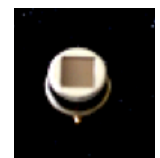
- **HMS-J21** (Thermopile)



- **Eltec-400** (Pyroelectric)



- **HPS-A03E** (Pyroelectric with internal amplification)

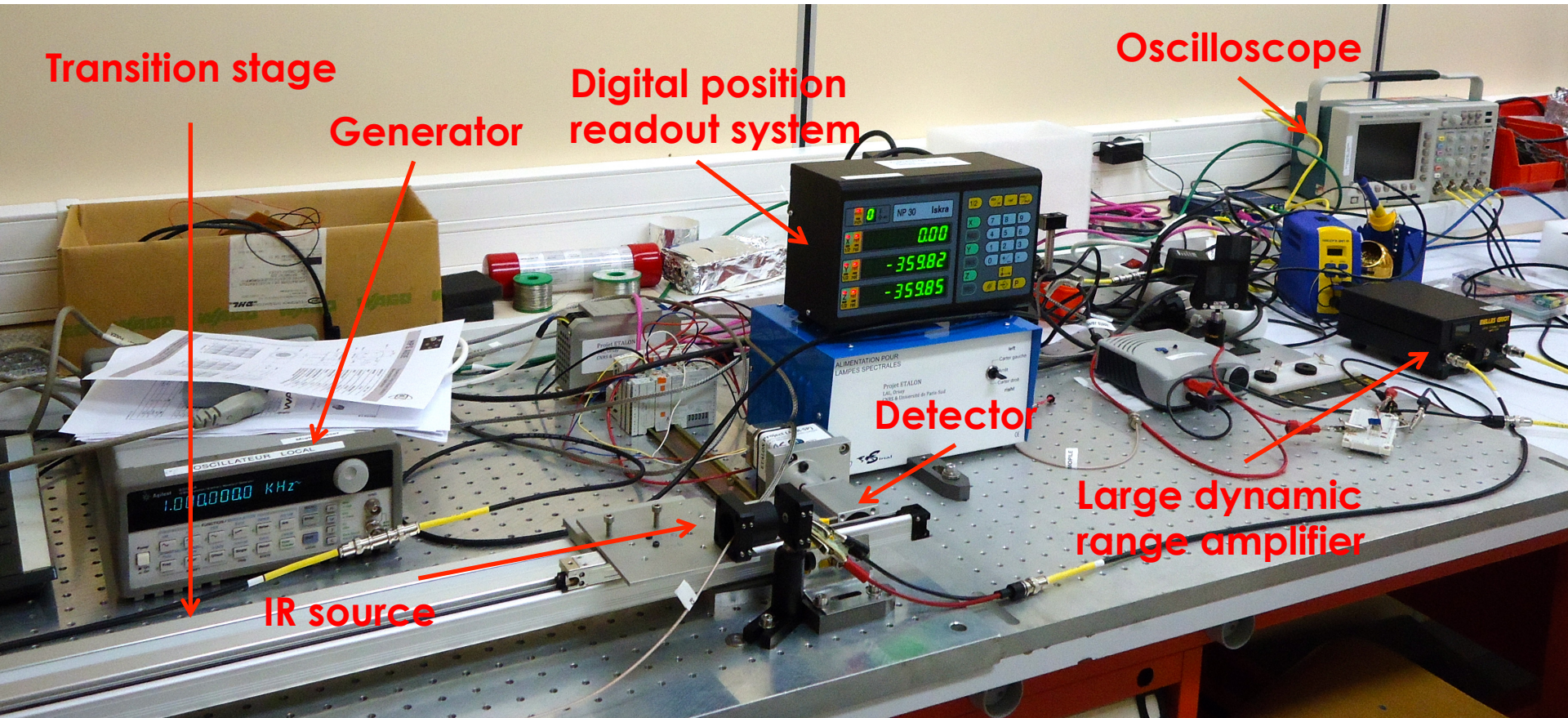


# Introduction to the experiment:

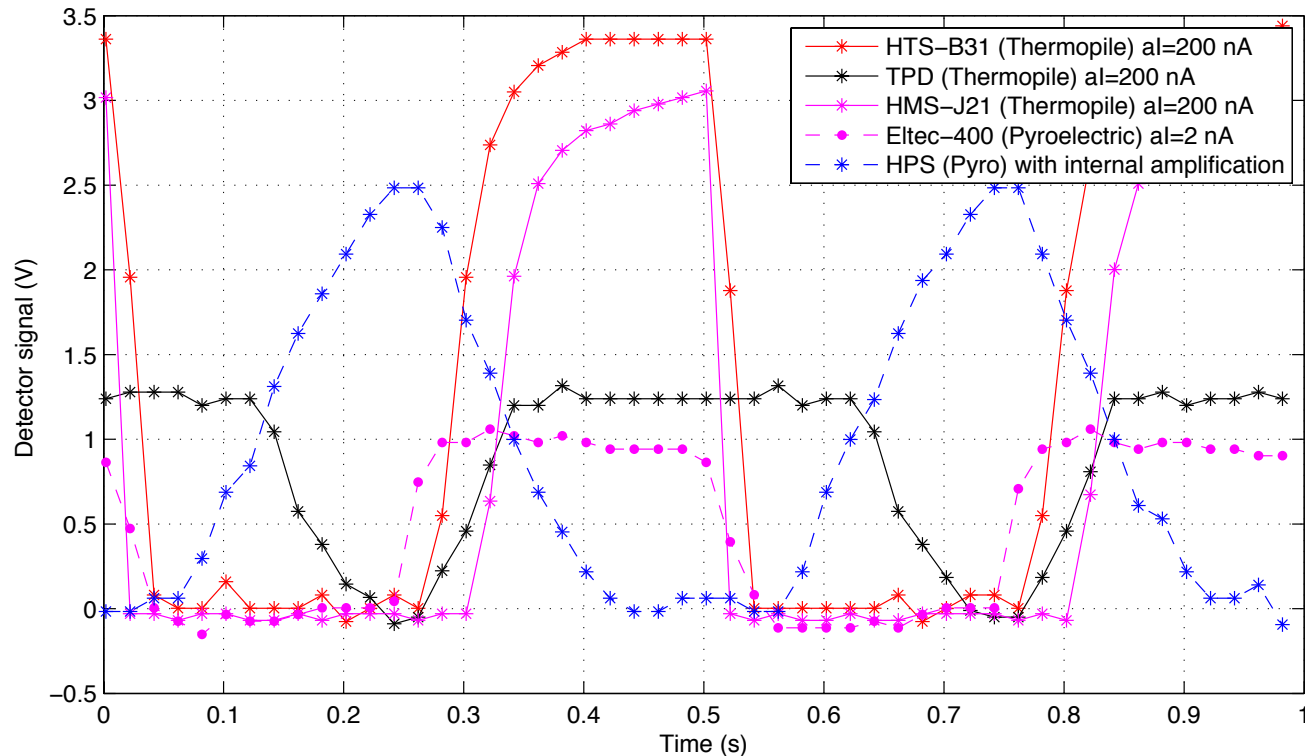
## Properties studied

- ▣ Responsitivity with different amplitude generator signal
- ▣ Responsitivity with frequency
- ▣ Responsitivity with distance between source-detector

# Experimental Set up



# Results: Response of the detectors studied

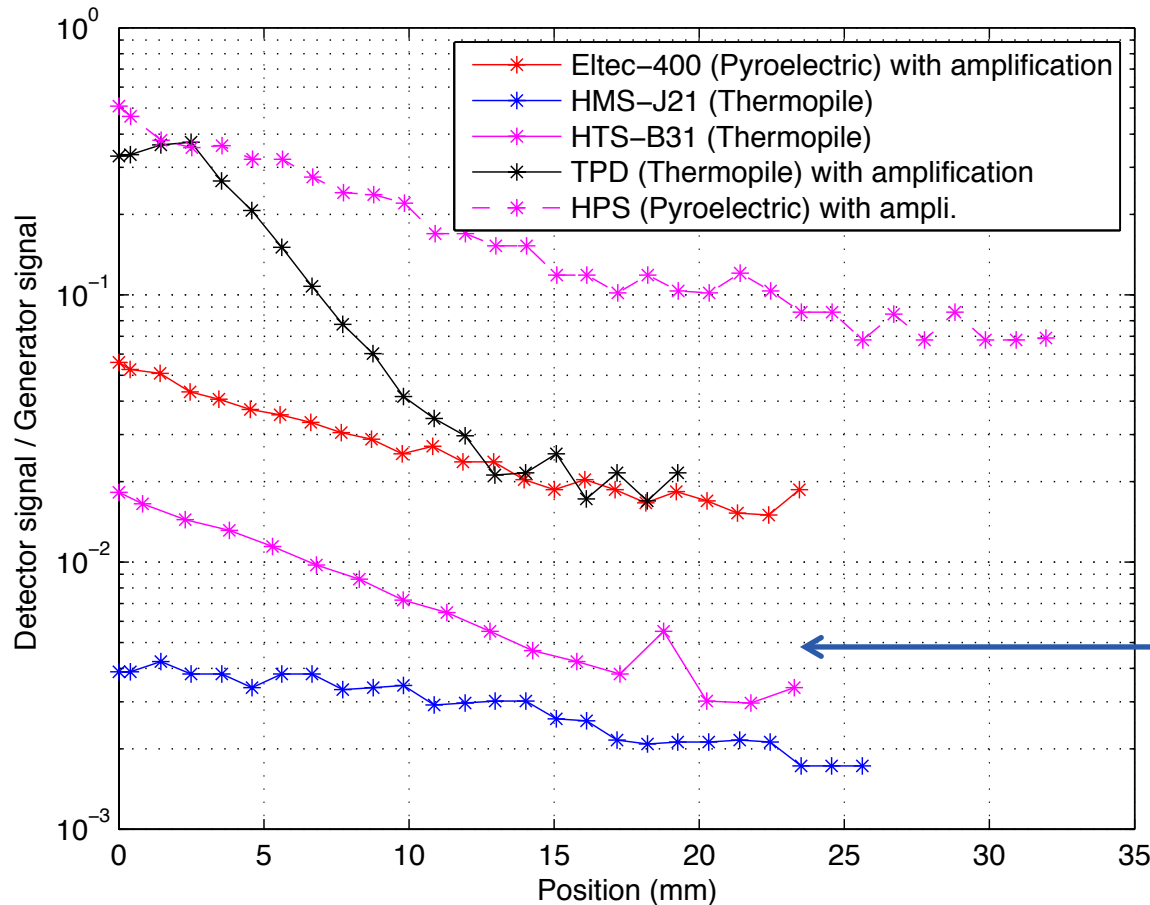


This figure illustrates the response for thermopiles and pyroelectric detectors

**Input signal:  $f = 2 \text{ Hz}$ .  $V_{pp} = 4 \text{ V}$  and  $d_{s-d} = 1 \text{ mm}$**



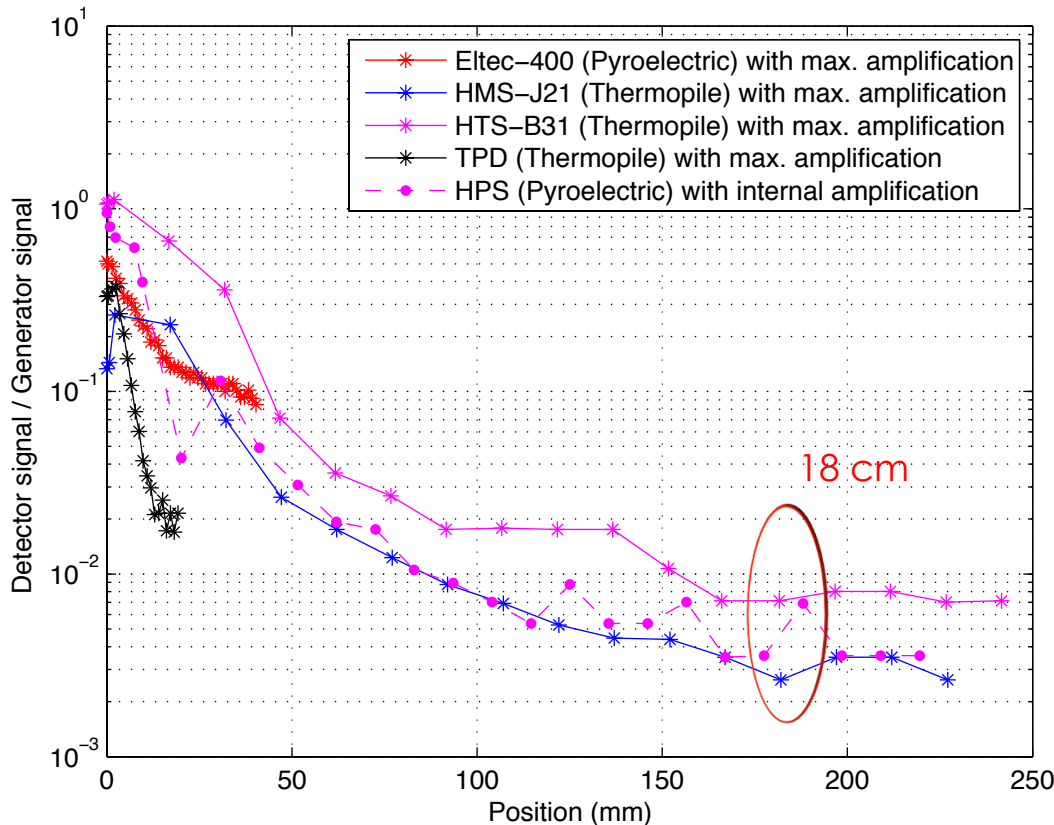
# Results: Responsivity with detector-source distance



- The **most sensitive** detector is the **HPS (Pyro)** with **internal amplification**
- The **TPD (Thermo)** response drops faster with increasing distance
- The **most sensitive detector without amplification** is **HTS-B31 (Thermo)**

Input signal:  $V_{pp}=4V$  and  $f=2$  Hz

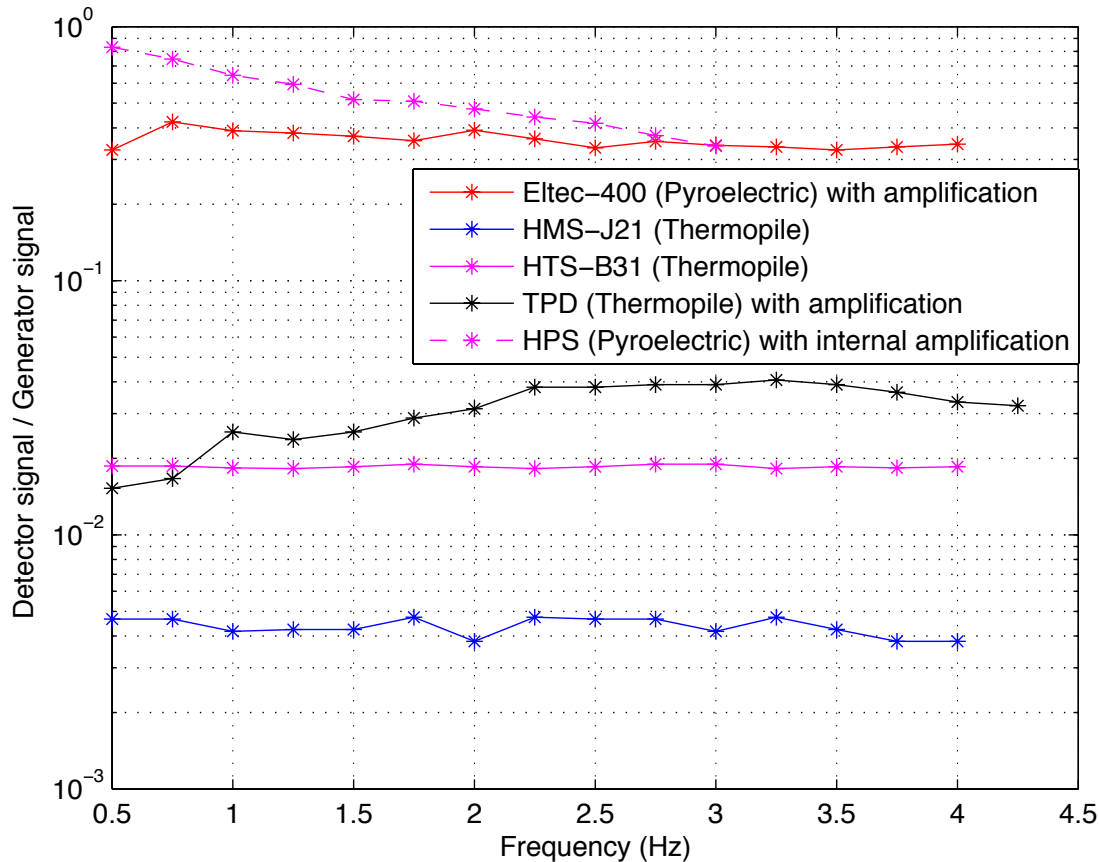
# Results: Responsivity with detector-source distance



- How far we measure signal for the different detectors
- The **most sensitive** detectors with amplification with the distance are the **HMS**, **HTS (Thermopiles)** and **HPS (Pyro)**. For these three detectors we stopped seeing signal around **18 cm**

Input signal:  $V_{pp}=4V$  and  $f=2$  Hz

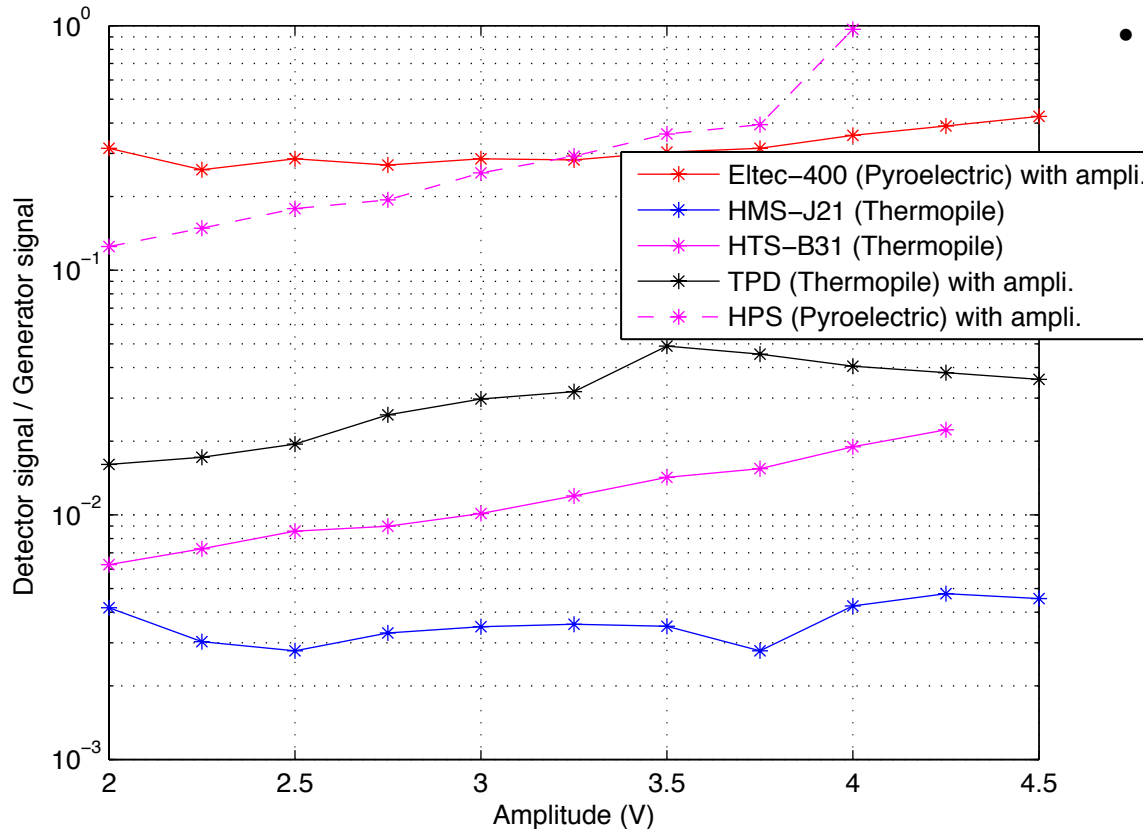
# Results: Responsivity with frequency



- The **response** for the detectors tested is **almost constant** with frequency variation in the range studied **except** for the **HPS (Pyro)** with internal amplification

Input signal:  $V_{pp}=4V$  and  $d_{s-d} = 1mm$

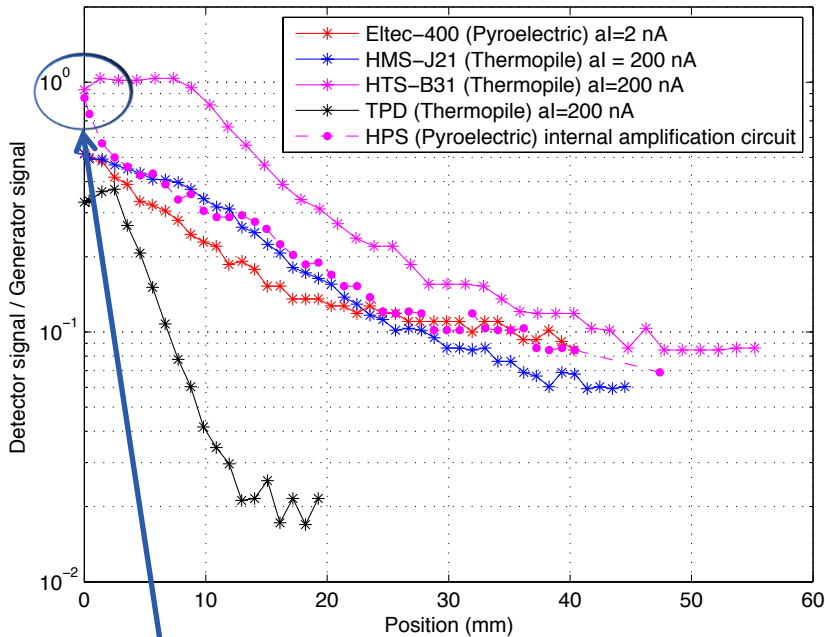
# Results: Responsivity with Amplitude generator



- The **response** for **HPS (Pyro)** and **HTS (Thermo)** is **increasing** with the amplitude of the input signal in the range studied while the tendency of the response for the **other detectors** is **not well defined**

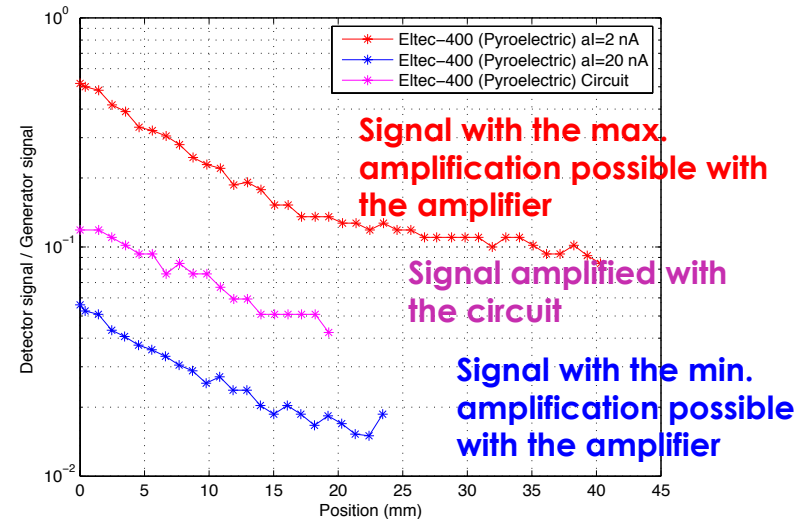
Input signal:  $f=2\text{Hz}$  and  $d_{s-d} = 1\text{mm}$

# Results: Amplification studies



- The **most sensitive** detectors with **amplification** are **HTS-B31 (Thermo)** and **HPS (Pyro)**

- The **amplification** reached with a **simple circuit** (2 resistance and one transistor) is one order of magnitude lower than the maximum amplification with a **large dynamic range amplifier**



Input signal:  $V_{pp}=4V$  and  $f=2$  Hz

# Comments

- ❑ **HTS-B31** and **HMS-J21 (Thermo)** are the only detectors tested that give **signal without amplification**
- ❑ **HTS-B31 (Thermo)** is the **most sensitive** detector tested **without amplification**
- ❑ The **response** for the detectors tested is **almost constant with frequency** variation in the range studied **except** for the the **HPS (Pyro)** with internal amplification
- ❑ The response for **HPS (Pyro)** and **HTS (Thermo)** **increases with the amplitude of the input signal** in the range studied while is not well defined for the other detectors
- ❑ More accurate tests still to come...