Amplifier signal analysis

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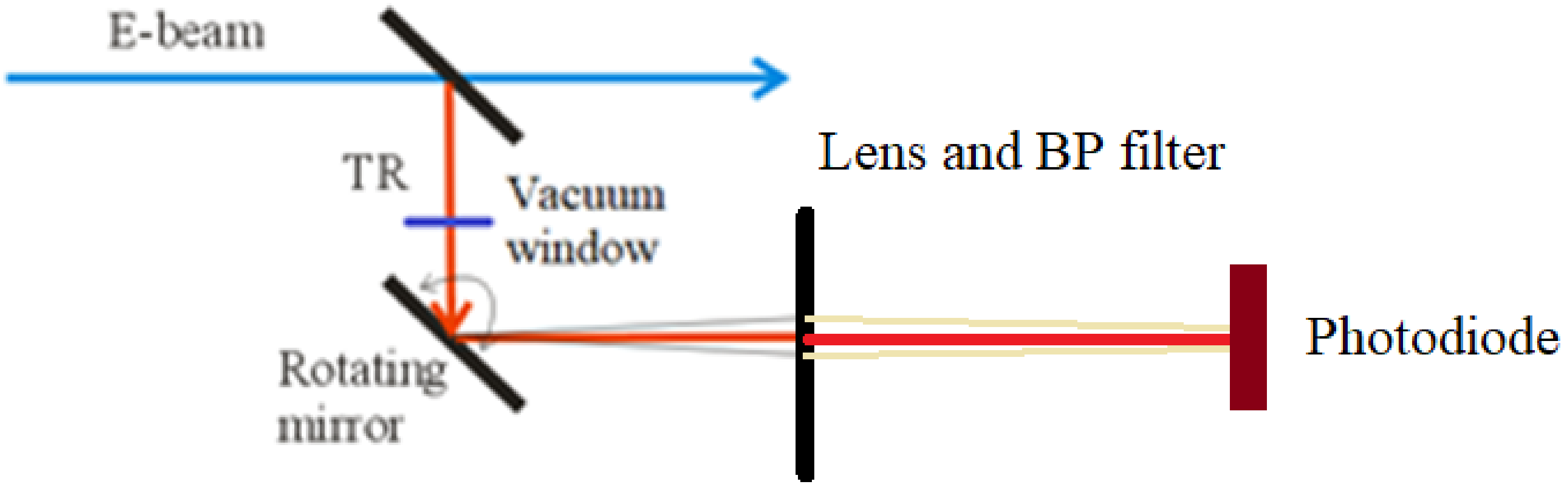
May 19, 2022

Proposed setup at x121

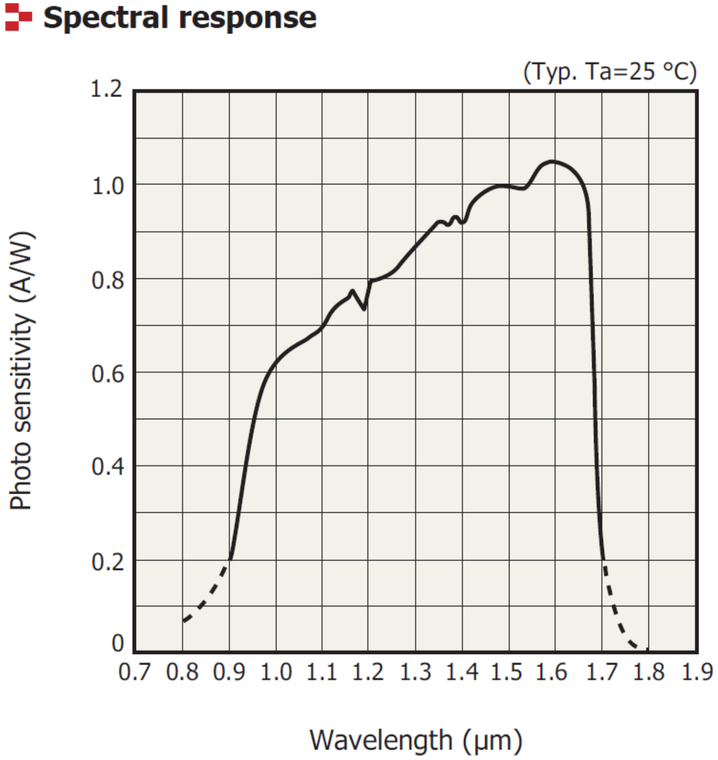


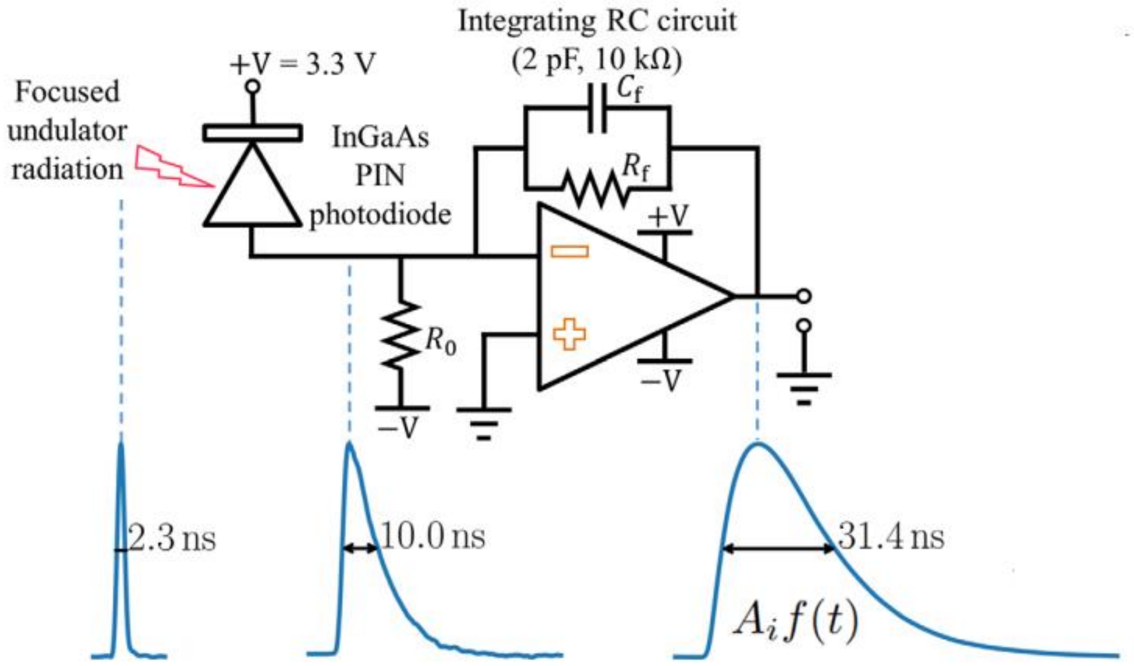
- Proposed optical band: 0.5 - ~2 um (measure in ~100 nm steps)

Amplifier schematic (Ihar's project in the IOTA ring)

InGaAs PIN photodiode

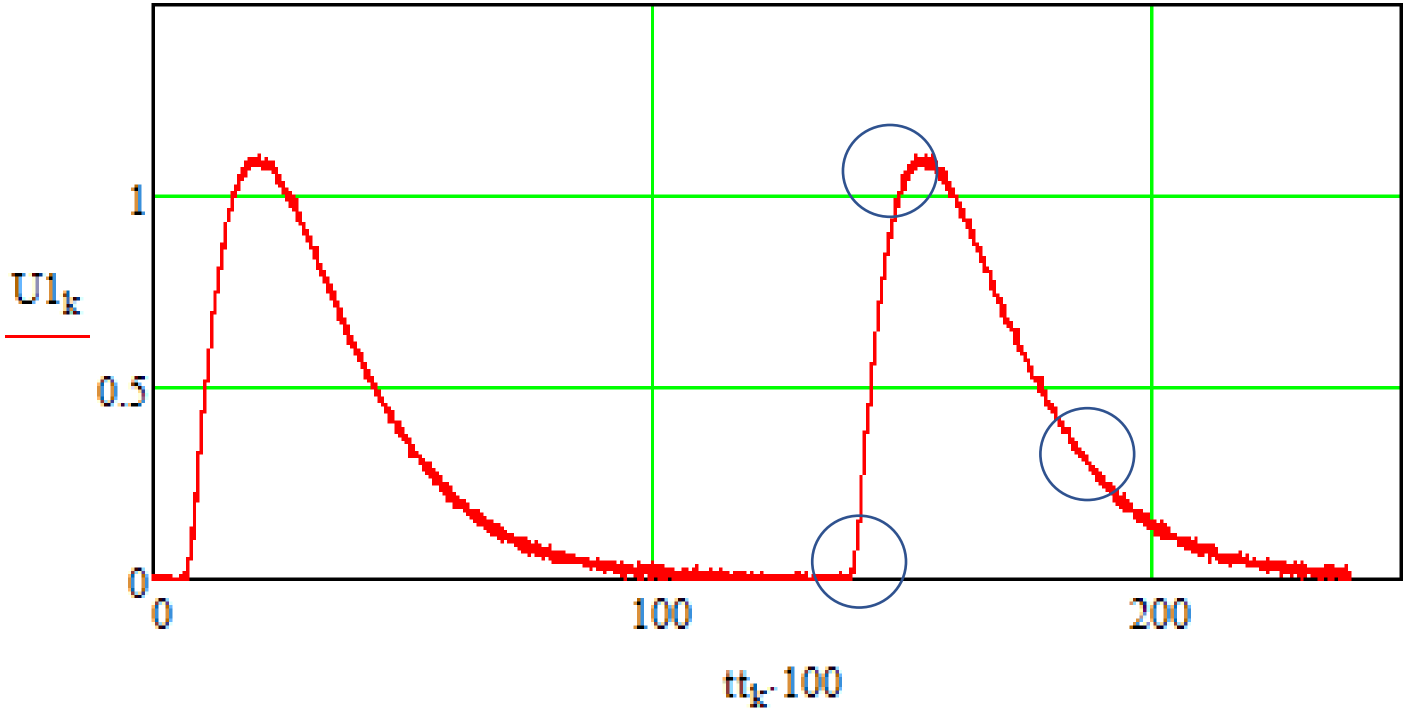
Sensitive area: Ø1mm
Quantum efficiency at 1.16 µm: 80%





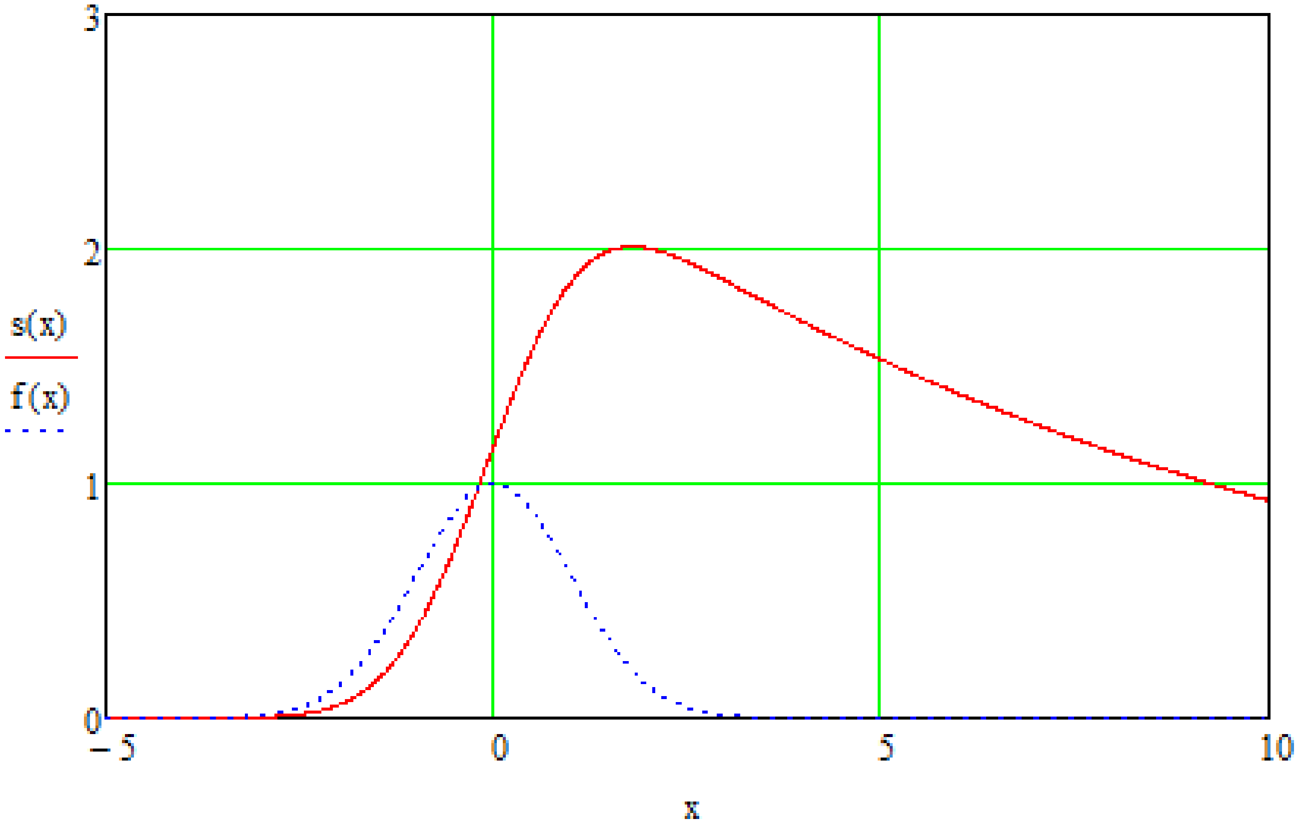
- In the IOTA the experiments were performed with a 1-ns rms bunch.
  - Data were taken with about ~1 pJ per radiation pulse
- Question: how does this amp respond to a 5-ps radiation pulse (~1 pJ)

Signals from the IOTA experiment



- Revolution period in IOTA is 133 ns
- There are 3 distinct time constants: σ, τ_0, τ_1

Output from the photodiode



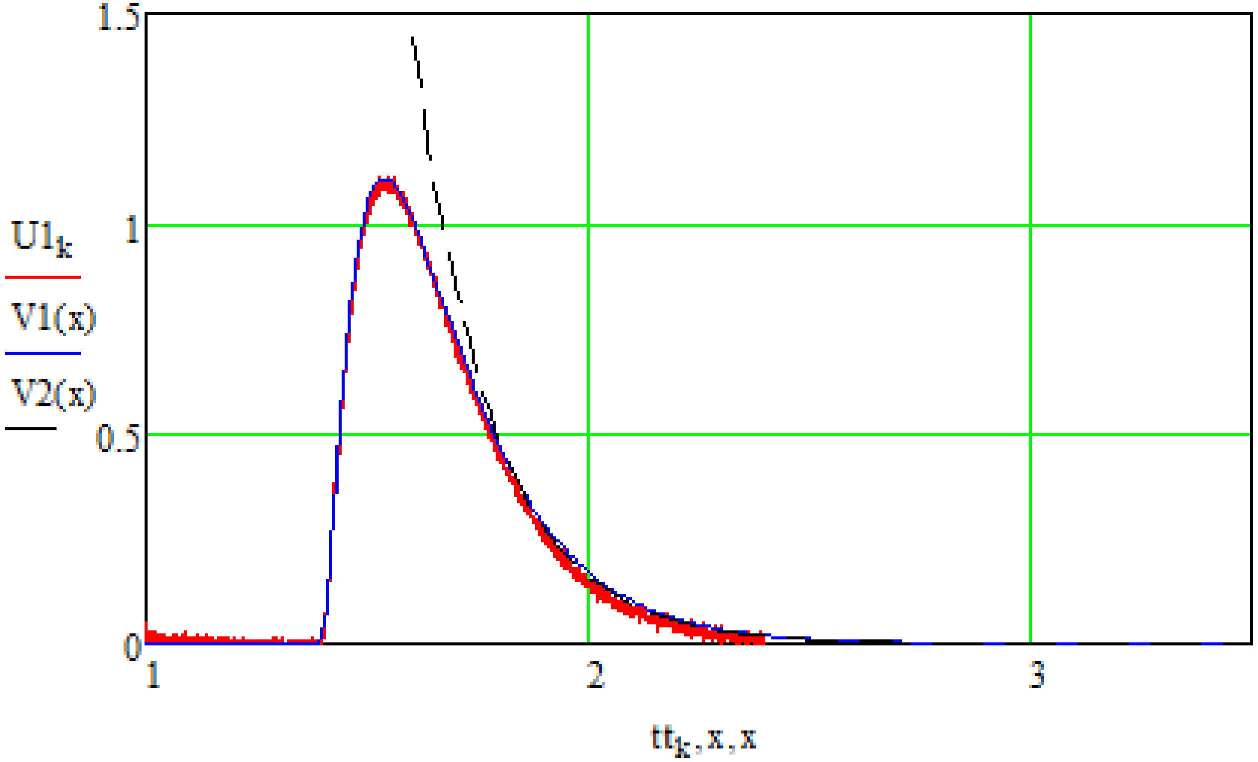
$\sigma := 1 \qquad \tau_0 := 10$

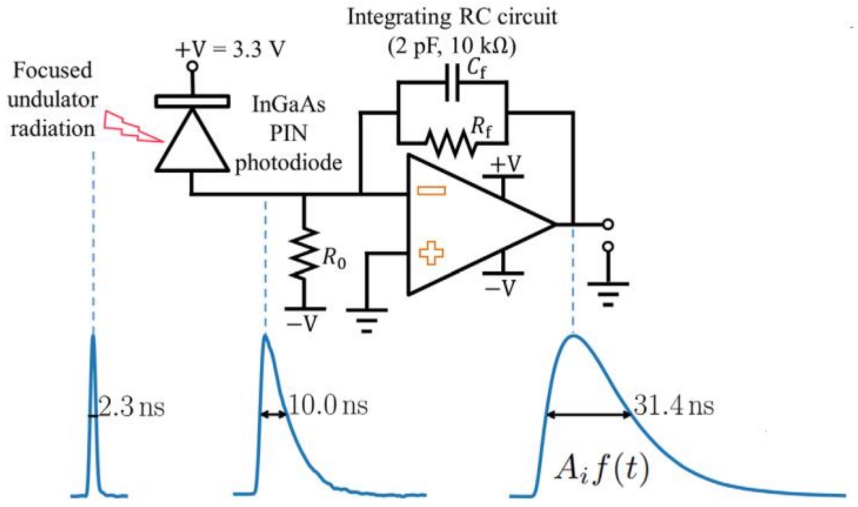
$$s(x) := \int_0^\infty \exp\left[\frac{-(x-y)^2}{2\cdot\sigma^2} - \frac{y}{\tau_0}\right] dy \qquad f(x) := \exp\left(\frac{-x^2}{2\cdot\sigma^2}\right)$$

$$f(x) := \exp\left(\frac{-x+t1}{t0}\right)\cdot\left[1 + \operatorname{erf}\left[\frac{1}{\sqrt{2}}\cdot\left(\frac{x-t1}{\sigma} - \frac{\sigma}{t0}\right)\right]\right]$$

- Photo-electrons “slowly” leave the photodiode.

Amplifier output



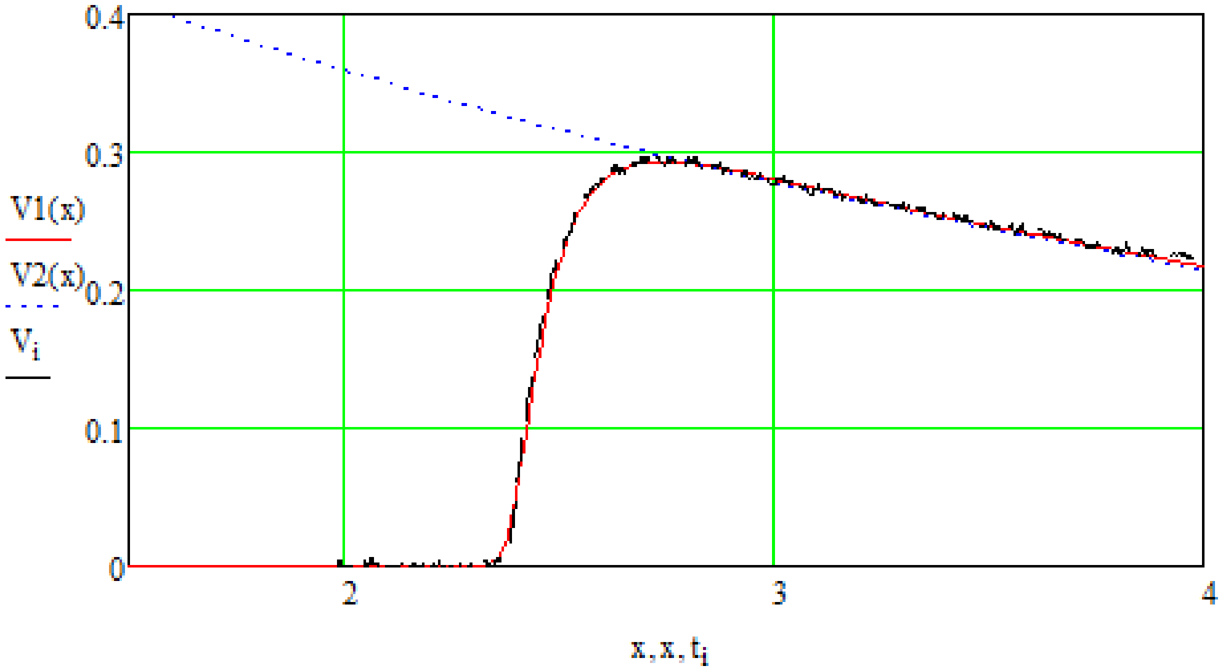


- Best fit: σ = 1 ns, τ_0 = 9 ns, τ_1 = 19 ns

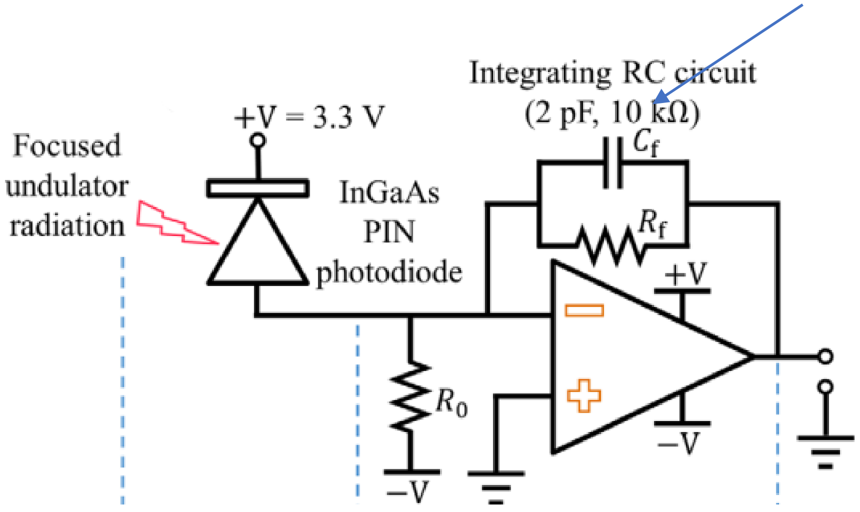
Test with a laser at 1053 nm

- Energy: 1 pJ
- rms pulse length: 5 ps
- Expected signal level: ~0.3 V (peak) into a 50-Ohm load.

Amplifier output



Resistor was replaced with a 100 kOhm



- Best fit: σ = 2.8 ns, τ_0 = 9 ns, τ_1 = 400 ns
- Puzzle: why is σ greater than before? Why is τ_1 = 400 ns and not 200 ns?