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Carrier heating effects on Relative Intensity Noise (RIN)

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Outline

- Physical originations
- Simulations
- Experiment

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Originations

- Spontaneous emission
- Carrier generation-recombination process
- Carrier heating

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Simulations (I)

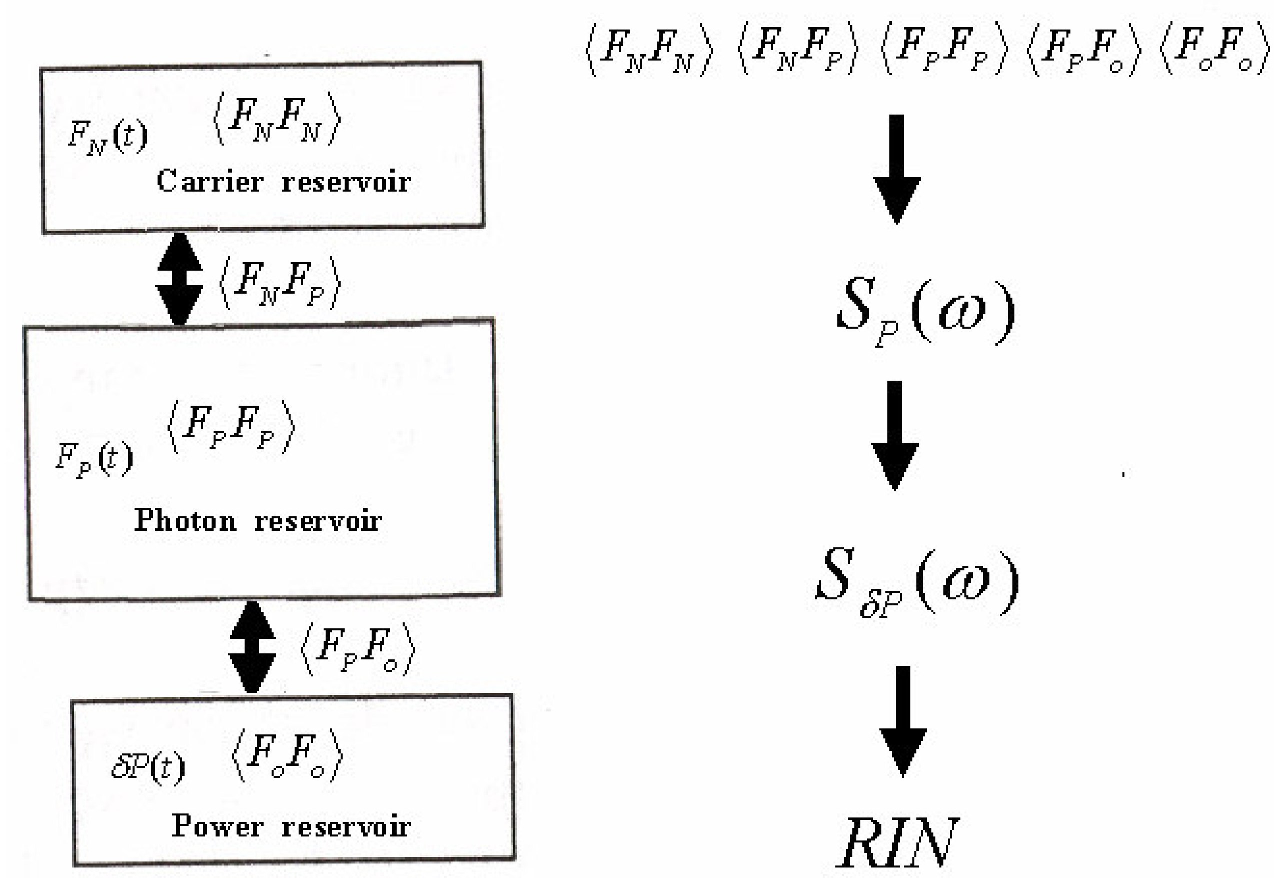
Total RIN

$$RIN = \frac{\langle \delta P(t)^2 \rangle}{P_0^2} = \frac{S_{\delta P}(\omega_0) * 2f}{P_0^2}$$

Laser RIN

$$RIN_L = \frac{RIN}{f} = \frac{2S_{\delta P}(\omega_0)}{P_0^2}$$

Simulations (II)



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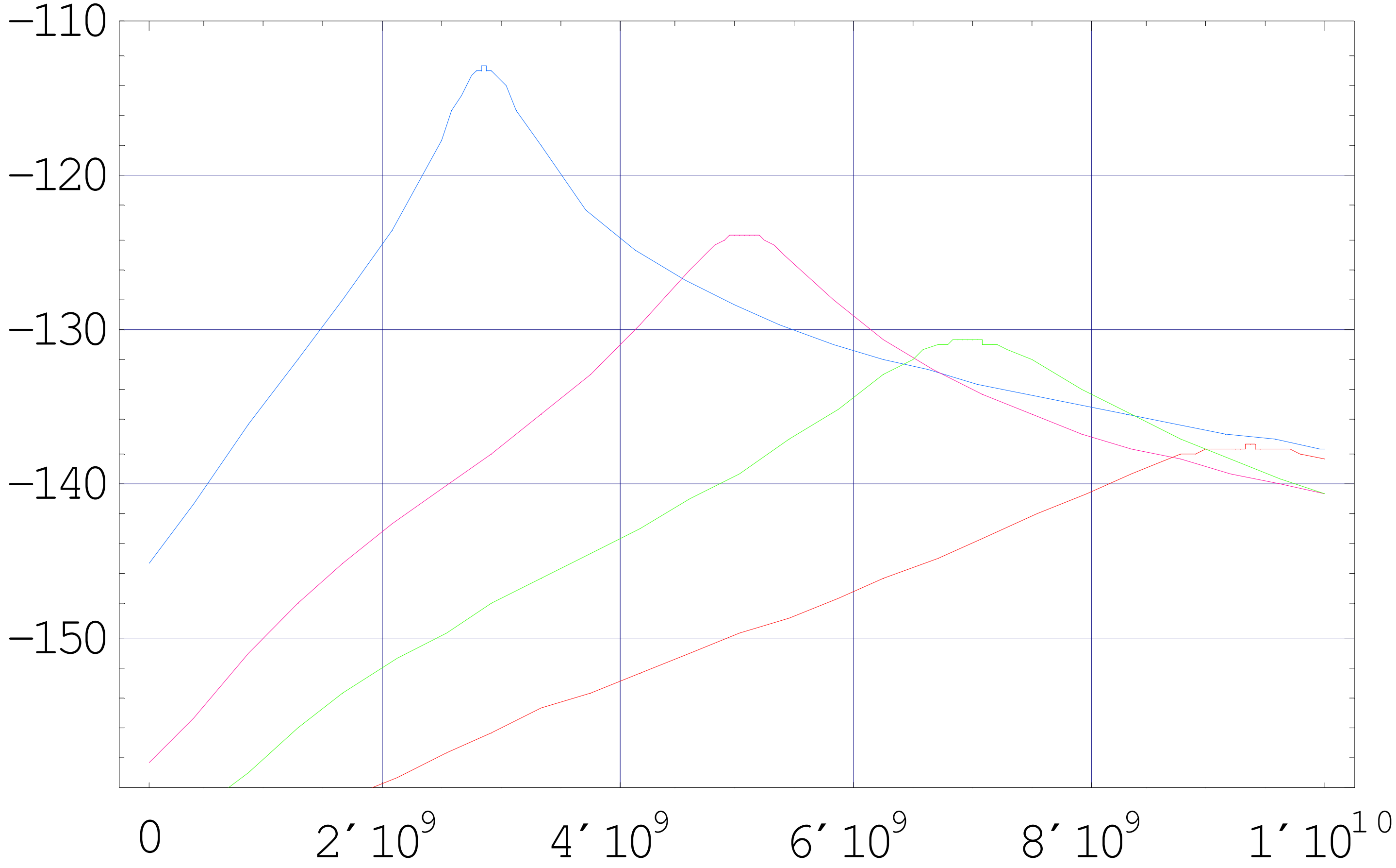
Simulation (III)



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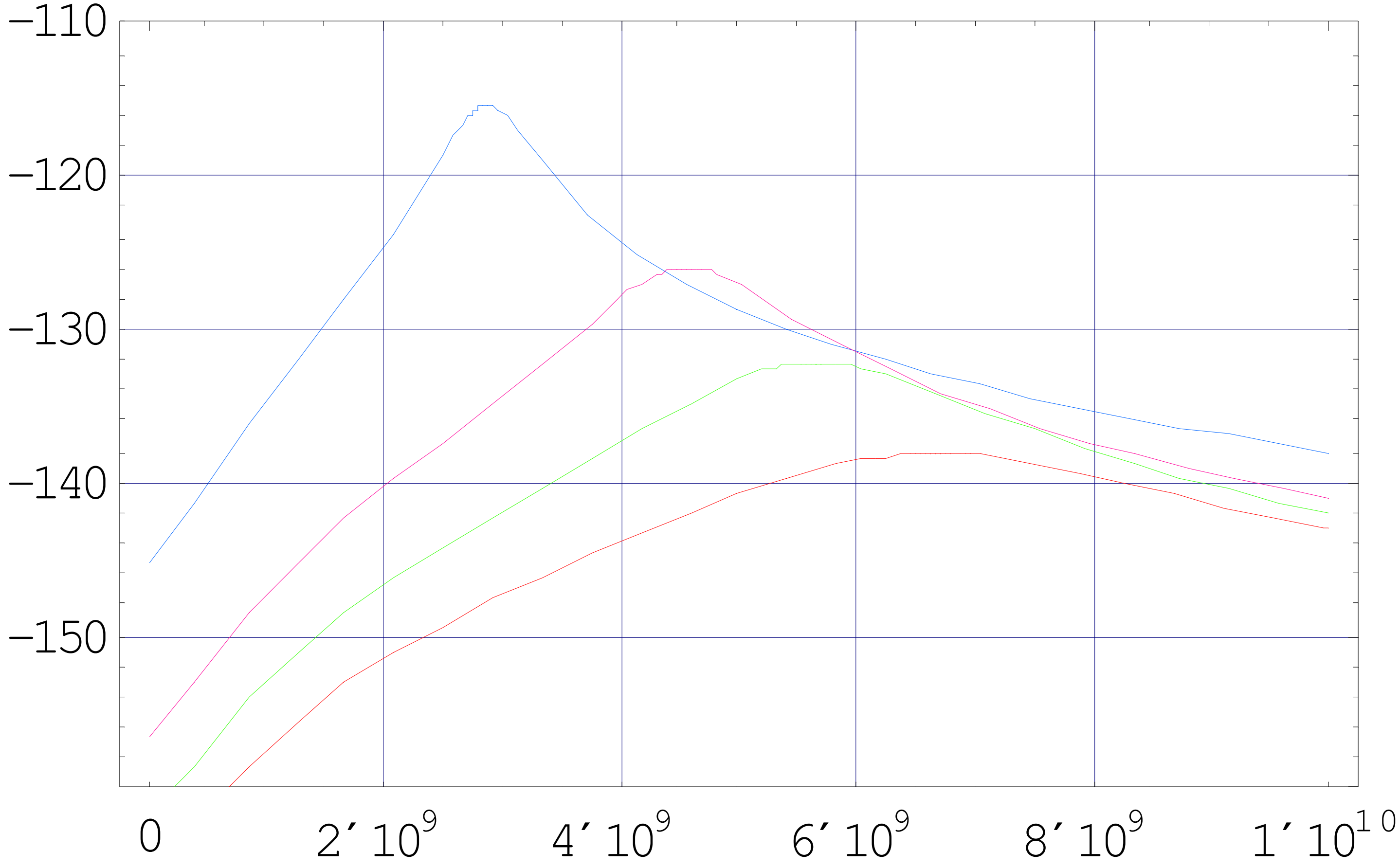
Simulation (IV)



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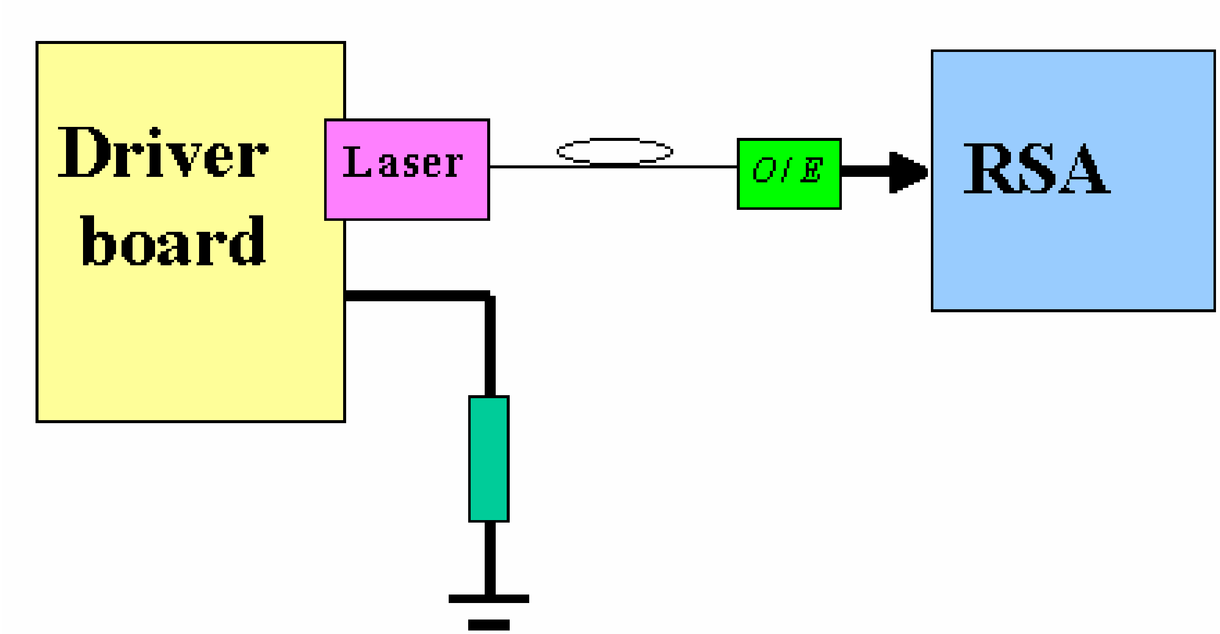
Experiment (I)



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Experiment (II)

$$RIN = RIN_M - \frac{N_{th}}{R_L (rP_{AVG(opt)})^2} - \frac{N_q}{R_L (rP_{AVG(opt)})^2}$$

$N_q(f)$	Thermal noise power per Hz
N_{th}	Photonic shot noise power per Hz
r	Responsivity of photo-detector
R_L	Load resistor of the spectrum analyzer input
$P_{AVG(opt)}$	Average power of the photocurrent.

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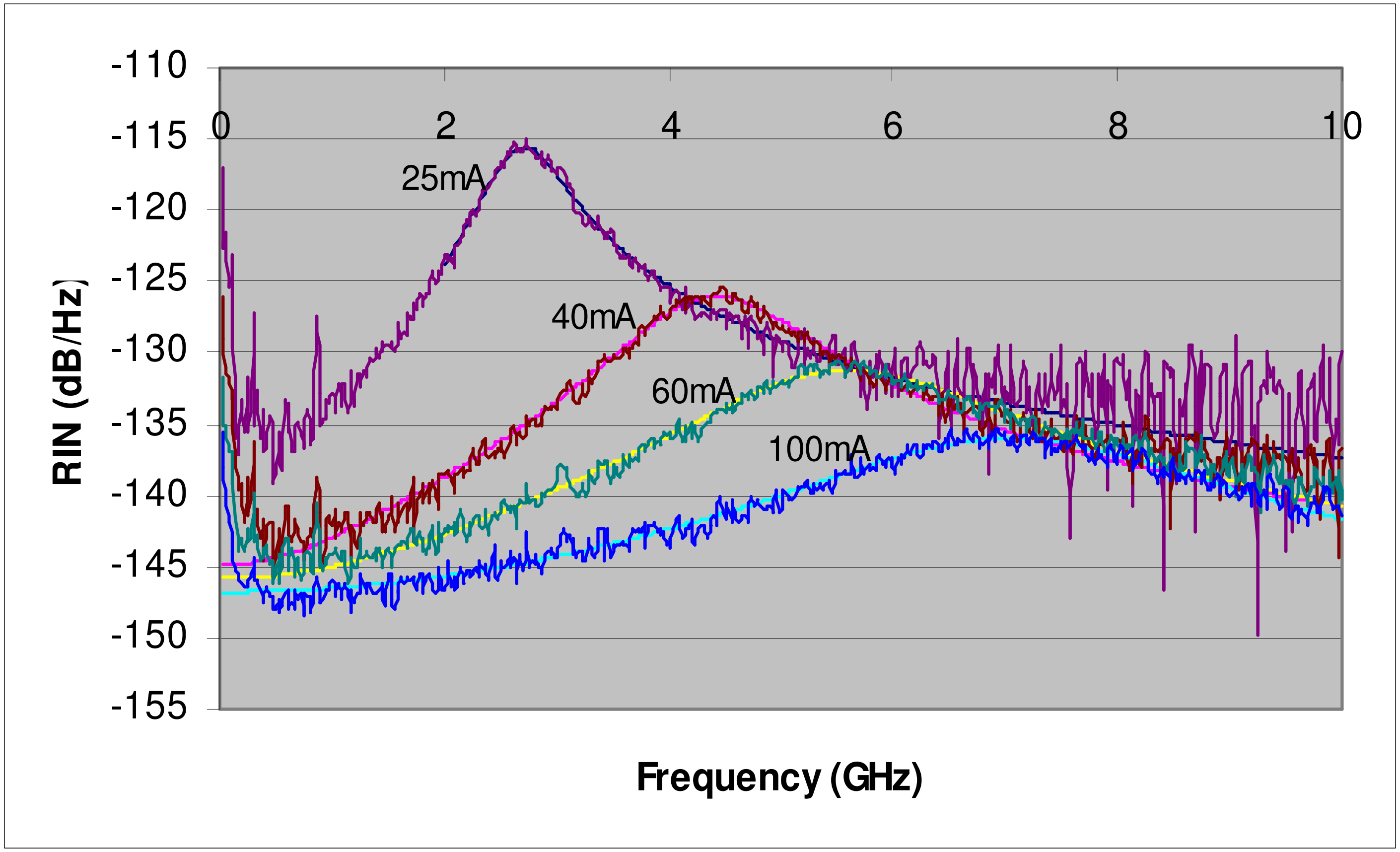
Experiment (III)



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Conclusion

- Carrier heating reduces the peak position of the RIN spectrum especially at high injection levels.
- Carrier heating may contribute to the RIN in low frequency ranges