

Simulation on Transistor Laser Module

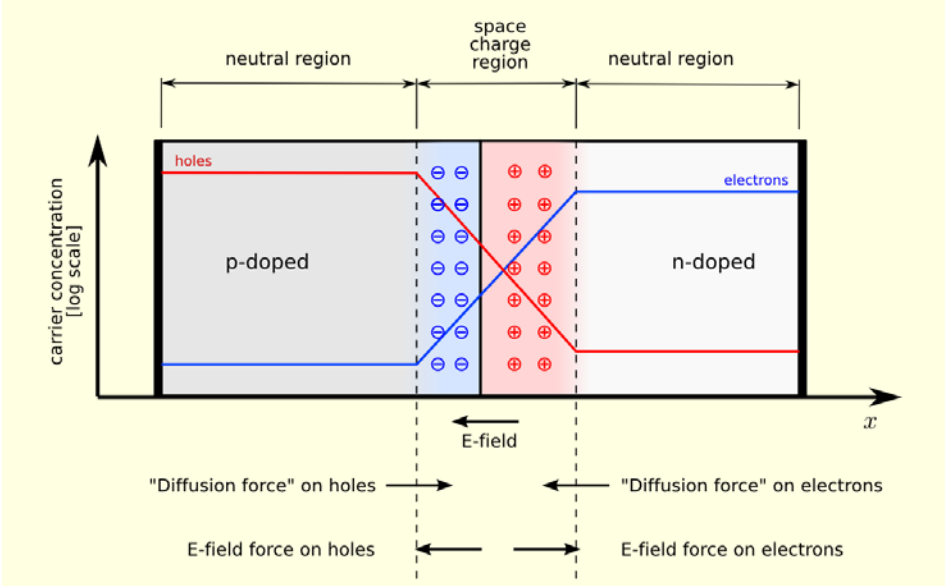
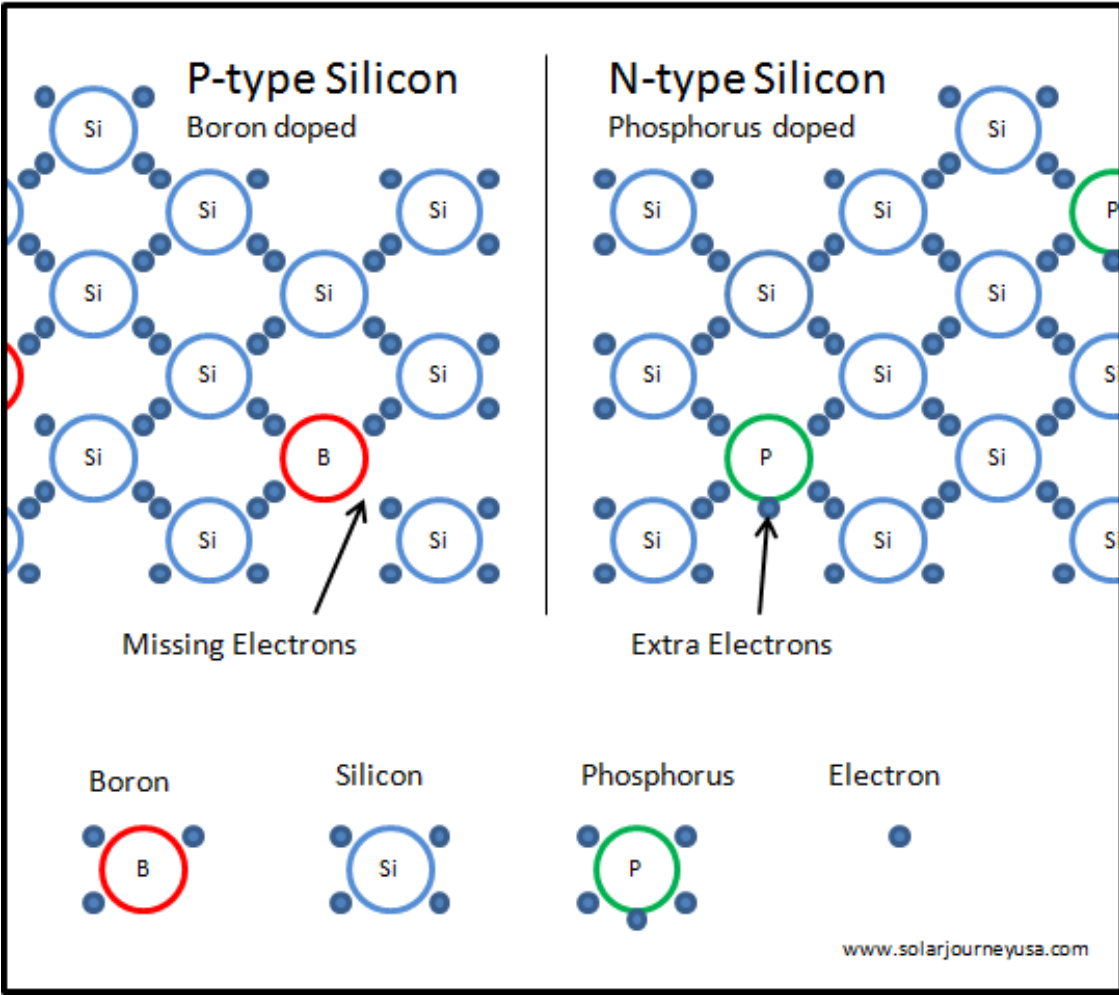
Minchul Kim (15R55017)

Korea Advanced Institute of Science and Technology

Prof. Nobuhiko Nishiyama

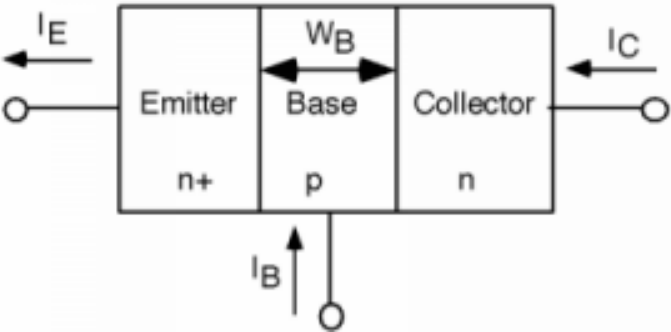
Electrical Engineering, Tokyo Institute of Technology

Doped Semiconductor and PN junction

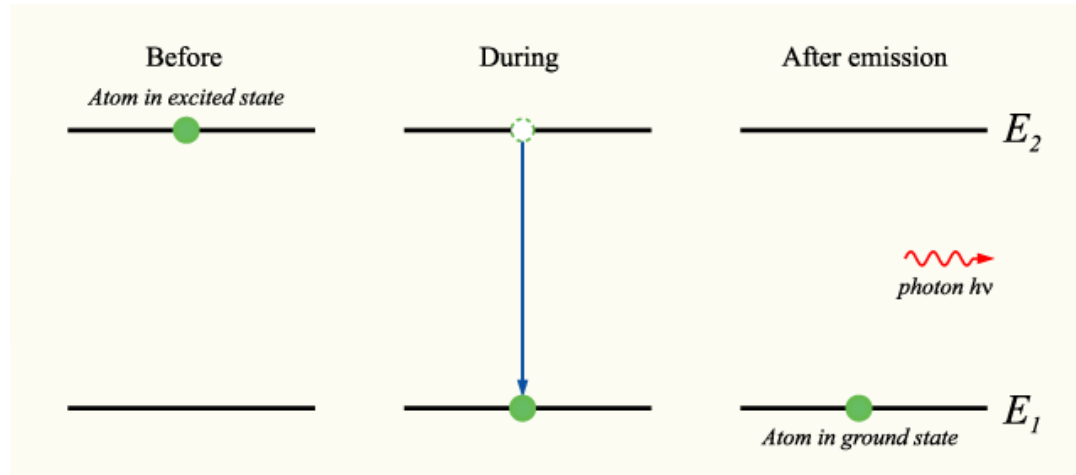


PN Junction Diode

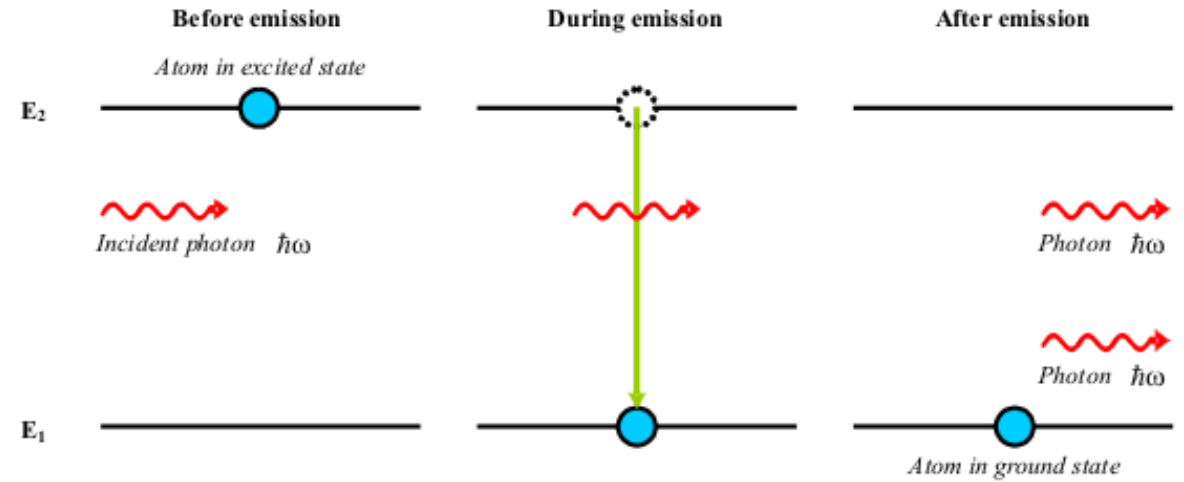
Bipolar Junction Transistor



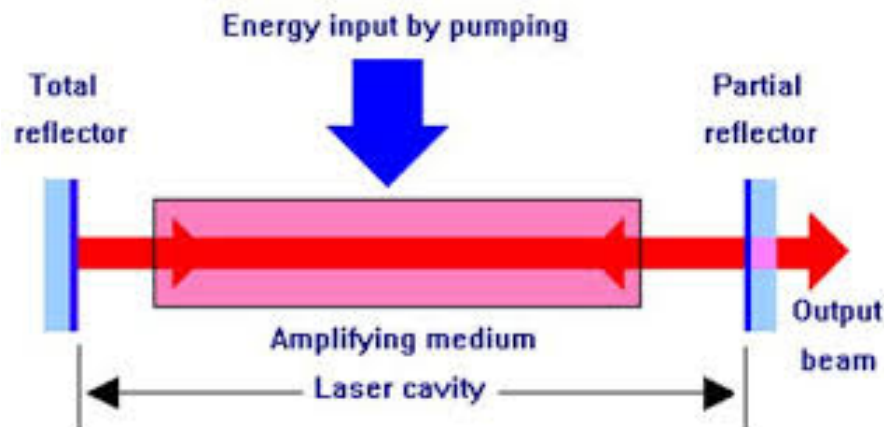
2 mechanisms of light emission in semiconductors



Spontaneous Emission

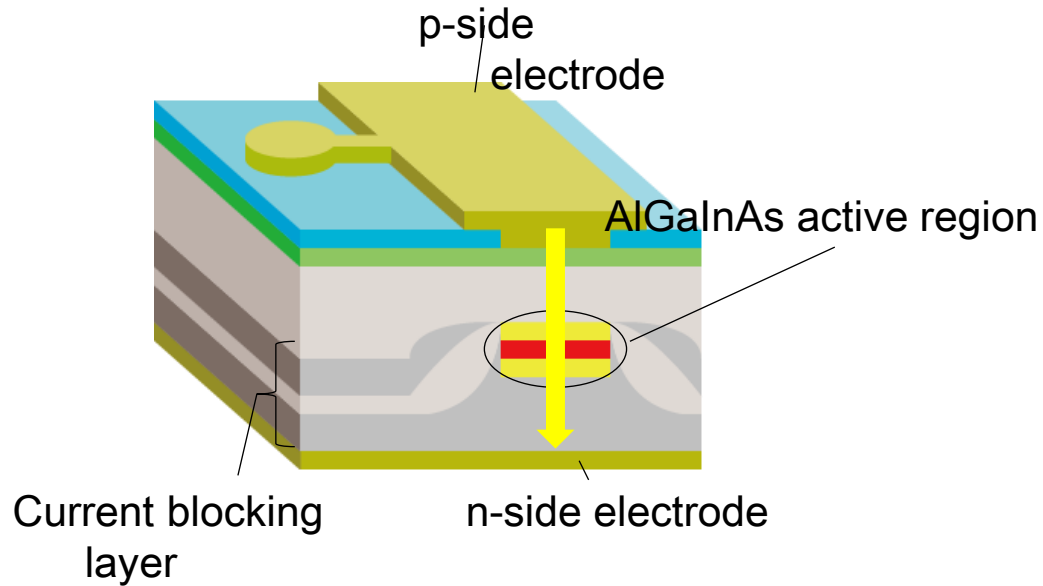


Stimulated Emission



When placed between 2 mirrors, only light on parallel direction will be amplified

Laser Diode and Transistor Laser



Laser Diode:
can give signal only through
current modulation

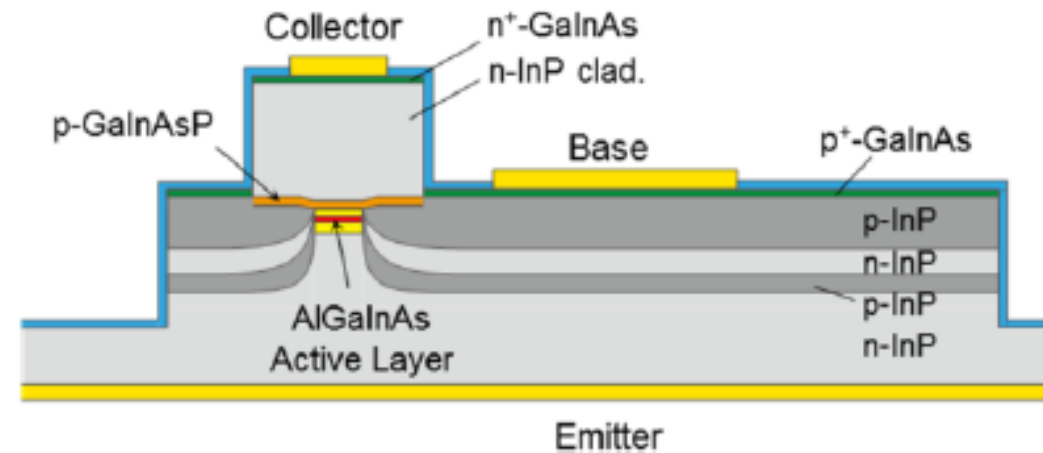
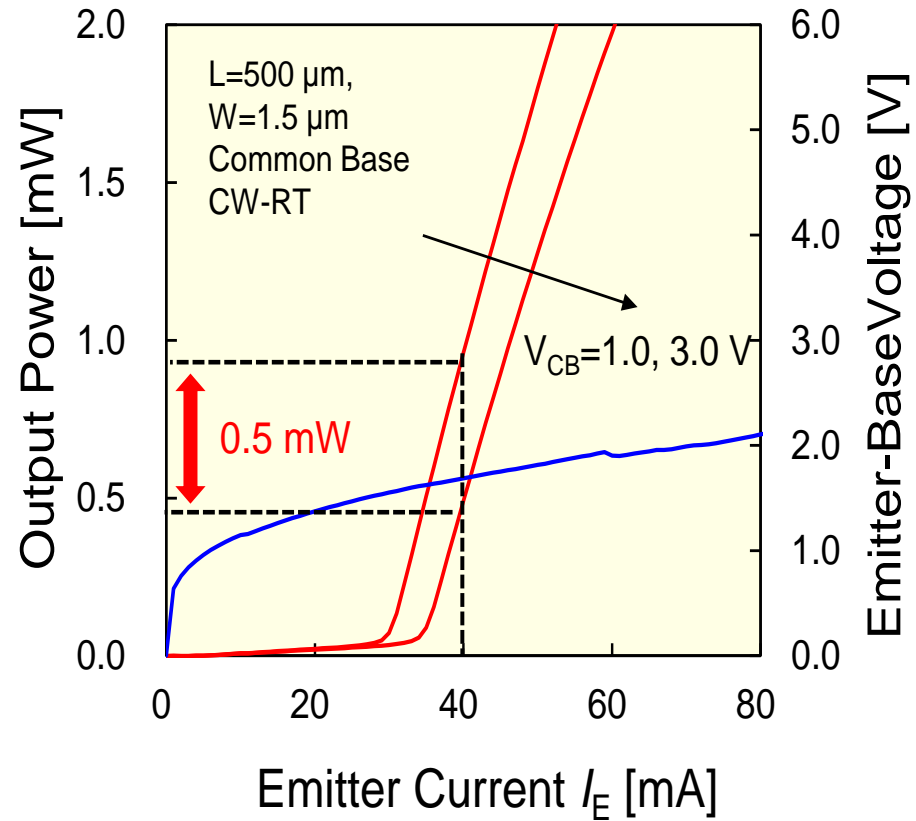


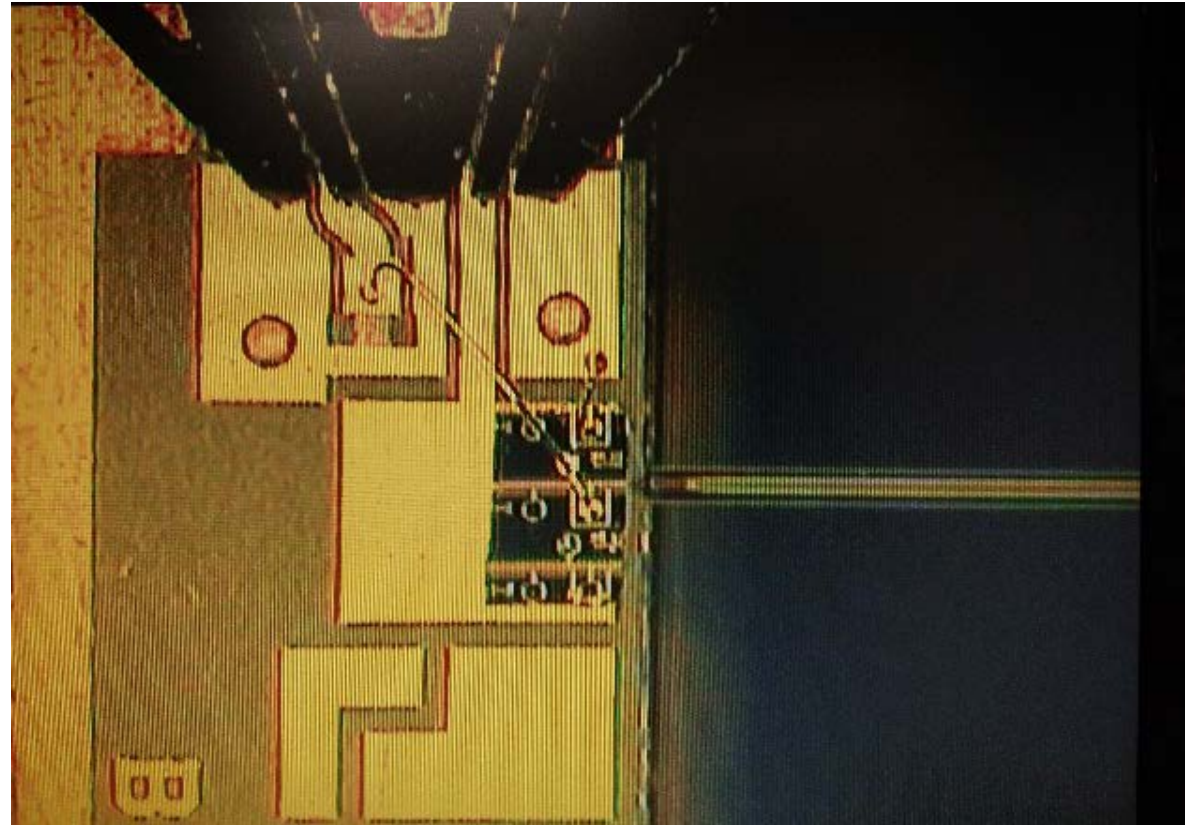
Fig.1. The structure of a fabricated npn-AlGaInAs/InP TL.

Transistor Laser:
can also give signal through
voltage modulation

Result from Measurement



When voltage between collector and base is changed, the output power also changes by 0.5mW



Transistor lasers are placed on board like this

Measurement and Calculation on Data

Data collected from measurement was calculated by excel for verification

The image shows an Excel spreadsheet with several data tables and a graph. The graph plots the value of α_i [cm⁻¹] on the y-axis (ranging from 0 to 60) against the input current [mA] on the x-axis (ranging from 20 to 80). The data points show a non-linear relationship that levels off at higher currents. The graph is labeled 'RT-CW A9-2'.

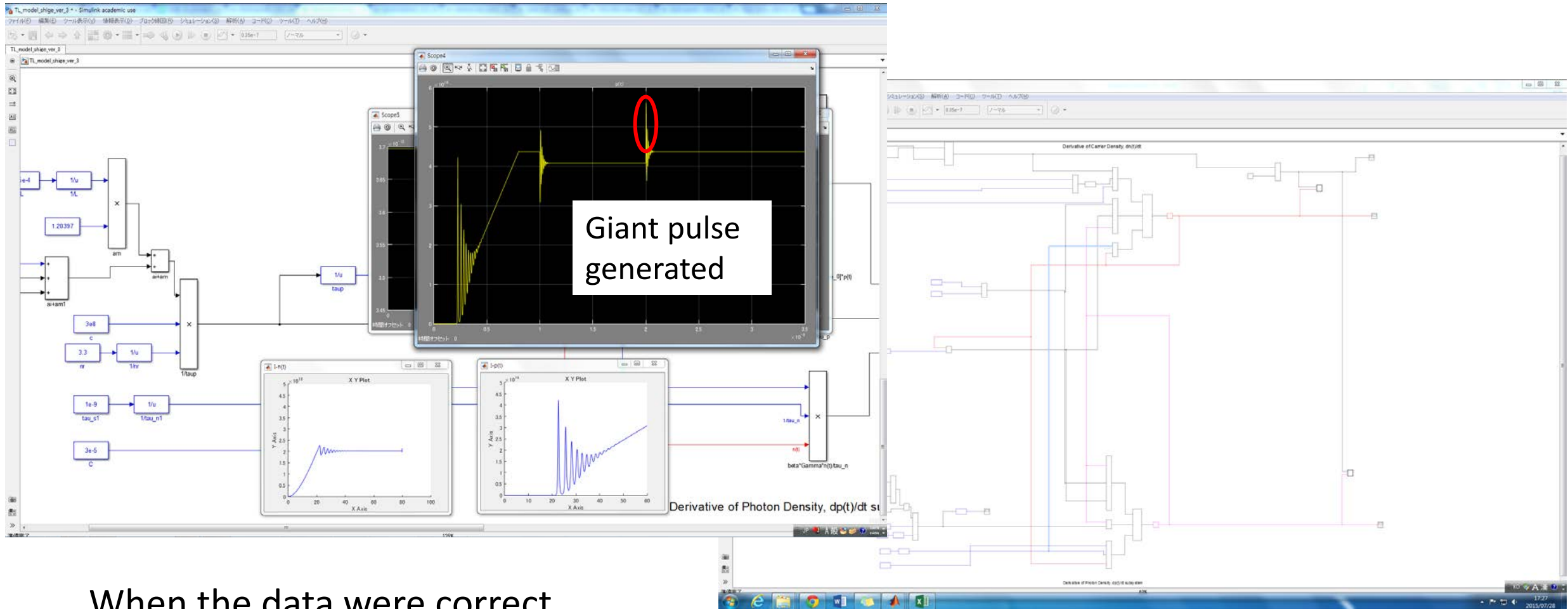
The spreadsheet contains multiple tables for different devices and conditions. The tables are organized into sections for different devices (e.g., NQH062-A9-2, NQH062-A1-10, NQH062-A5-10) and conditions (CW, pulse, Po). The tables include columns for input current (I), input power (Po), and calculated values for α_i .

NQH062-A9-2					500um	0.3	1020
CW	Ith[A]	Po(40mA)[mW]	Po(40mA)[W]	α_i			
0V	0.028	1.17E+00	1.17E-03	43.04217			
1V	0.029	9.60E-01	9.60E-04	51.15587			
3V	0.034	4.91E-01	4.91E-04	56.17579			
pulse							
0V	Ith	Po	Po(40mA)[W]	α_i			
27.80647	0.027806	1.516325	0.001516325	28.72154			
24.51854	1V	0.024519	1.547456	0.001547456	41.61044		
29.5	3V	0.0295	1.033409	0.001033409	42.63531		

NQH062-A1-10					750um	0.45	1370
CW	Ith[A]	Po(20mA)[mW]	Po(20mA)[W]	α_i			
0V	0.017282	4.37E-01	4.37E-04	25.92852			
1V	0.017285	4.25E-01	4.25E-04	27.03032			
3V	0.017697	3.45E-01	3.45E-04	28.98976			
pulse							
0V	Ith	Po	Po(20mA)[W]	α_i			
14.14857	0.014223	1.016925	0.001016925	22.26811			
	1V	0.014319	0.9674419	0.000967442	23.55909		
	3V	0.014792	0.846124	0.000846124	25.46964		

NQH062-A5-10					650um	0.45	1370
CW	Ith[A]	Po(20mA)[mW]	Po(20mA)[W]	α_i			
0V	0.013282	1.22E+00	1.22E-03	119.3516			23.86291
1V	0.013791	1.09E+00	1.09E-03	133.2589			25.27744
3V	0.015019	7.95E-01	7.95E-04	182.1506			29.76847
pulse							
0V	Ith	Po	Po(20mA)[W]	α_i			
14.14857	0.014857	0.9334998	0.0009335	152.7717			23.99206
	1V	0.014546	9.45E-01	0.000944556	152.8664		26.02512
	3V	0.014821	7.56E-01	0.000755544	194.7376		34.30337

Matlab Simulation using Simulink

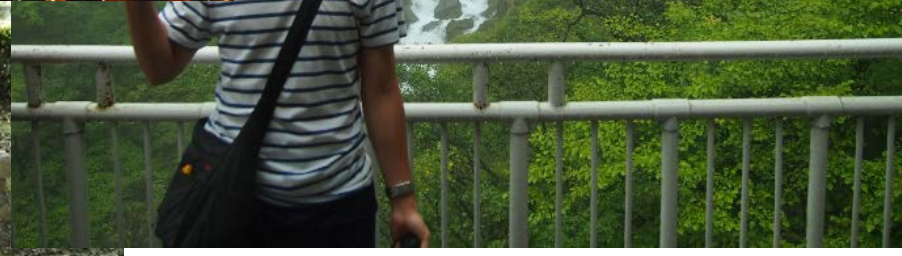


When the data were correct,
values from data were put into Simulation.

Friends in Japan



Places I visited



Special thanks to

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Shigehisa Arai

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