

# Study of Proton Irradiation on InGaAs Photodiodes and Laserdiodes

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# Introduction

- Proton irradiation: affects device performances through displacement damage
- What parameters are affected?
- Understand the process causing these effects



# Electrical Parameters

- Photodiodes

- I-V characteristic
- Dark current
- Photocurrent

- Laser diodes

- Power versus the injected current
- Threshold current

Note: Measurements @ 20 °C



# Predictions

- Photodiodes

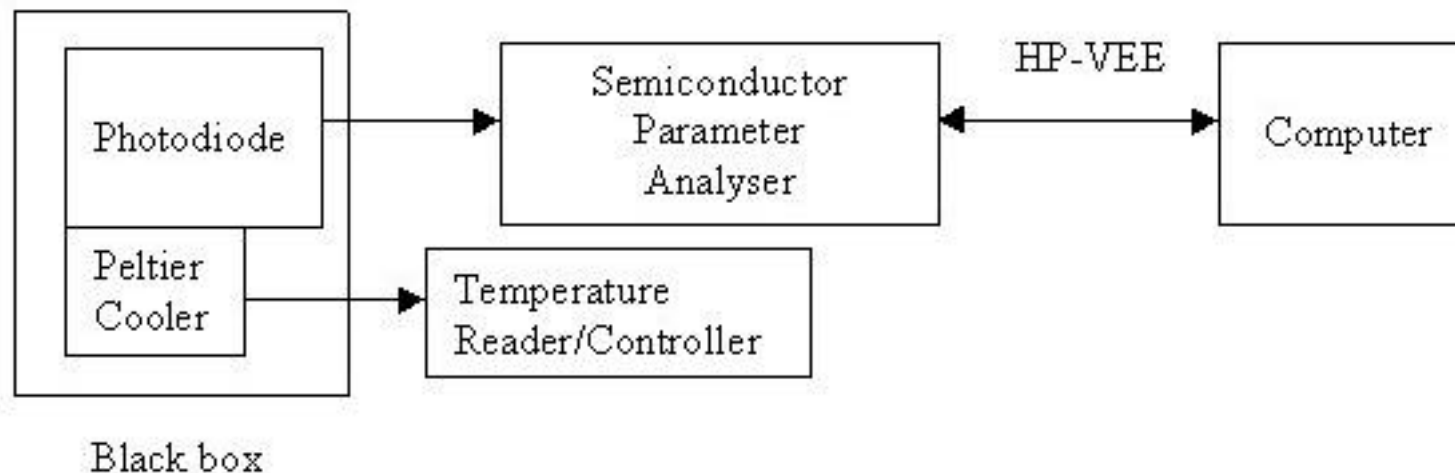
- Dark current  $\uparrow$
- Photocurrent  $\downarrow$
- I-V curve modified

- Laser diodes

- Threshold current  $\uparrow$
- Optical Power  $\downarrow$

# Bench Set-up

## I-V Characteristic (PD)



# HP-VEE Program

## (Visual Engineering Environment)

- Instrument control
- Measurement processing
- Test reporting



# Example:

Graphical interface  
of I-V program

Main

PROGRAM TO GET THE I-V CHARACTERISTIC OF THE PHOTODIODE

Time

Parameters

Start Value (V) -0.706

Stop value (V) 0.729

Compliance (A) 1.7m

Graph parameters

Max for I (A) 2m

Max for V (V) 0.6

Min for I (A) 1m

Min for V (V) 1.2

Temperature

Save Data

Data Name 1st Meas. C:\Laserdiode\SN38

OK

2nd meas. ?

# InGaAs devices

- MIPAS ODS project

- 4 photodiodes
- 2 laser diodes of 1.3  $\mu\text{m}$  wavelength

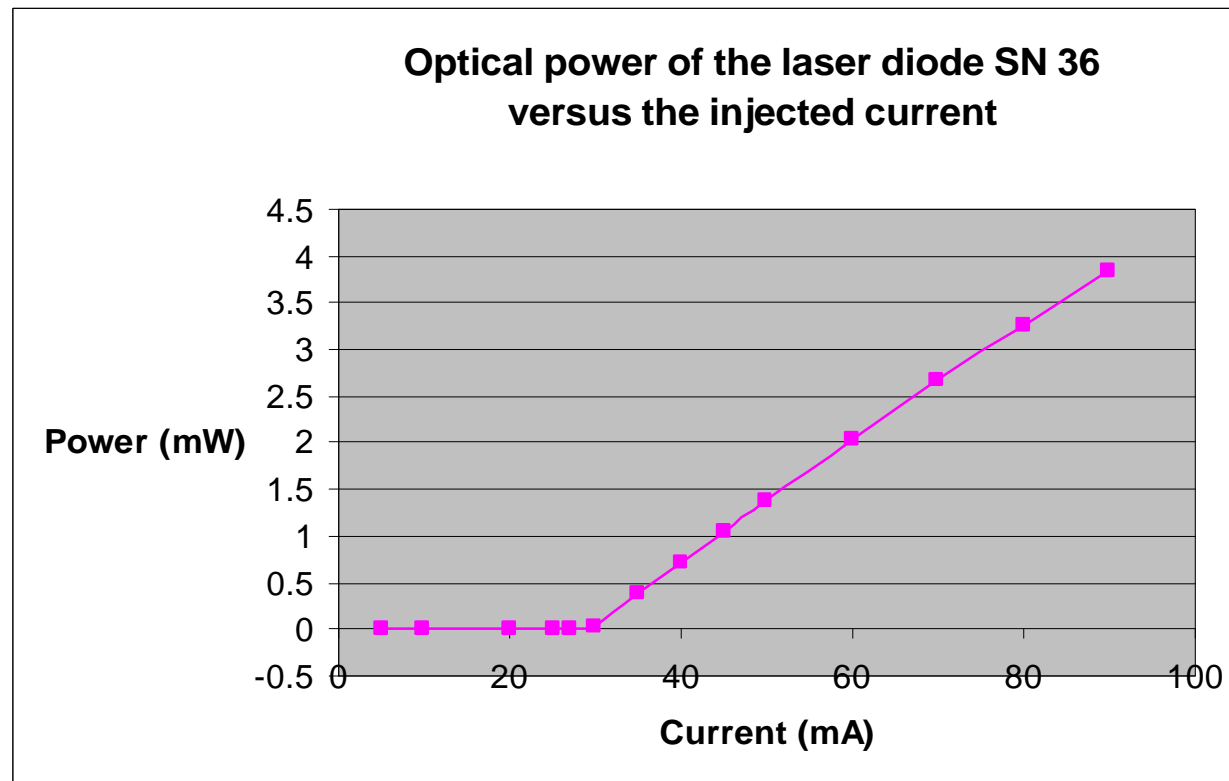
- THOMSON-CSF

- 14 devices with active layer thickness of 3  $\mu\text{m}$  and 6  $\mu\text{m}$
- 2 MSG SEVIRI devices

$\Rightarrow 3 \text{ PDs} / \text{device} = 48 \text{ PDs}$



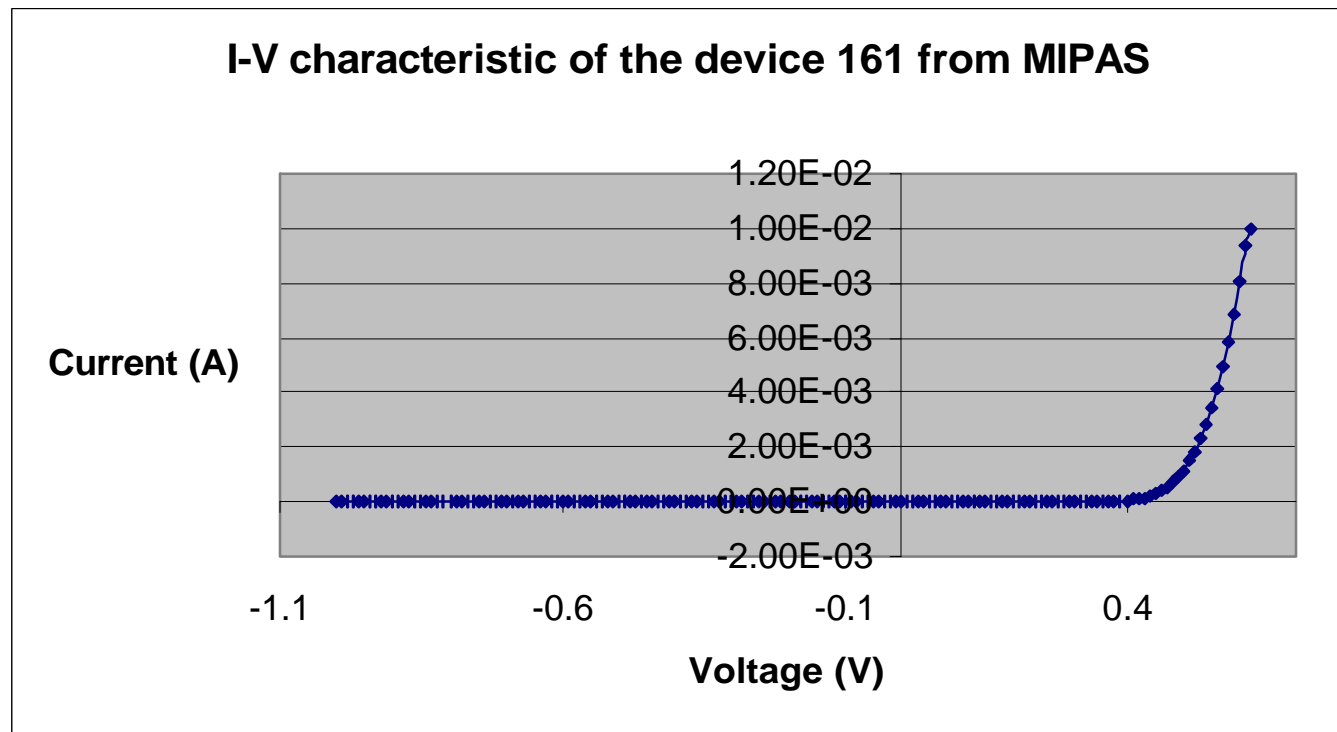
# Typical Characteristic of MIPAS laser diode



# Typical Values for the Threshold Current (MIPAS Laserdiodes)

Device Names	SN 27	SN 36
I threshold	28.27 mA	28.66 mA

# Typical I-V Characteristic



# Typical Value of Photocurrent MIPAS / THOMSON devices

Photocurrent (A) at $V_R = 5V$					
MIPAS and THOMSON devices					
Wavelength	3 $\mu m$ epitaxy layer	6 $\mu m$ epitaxy layer	MSG SEVIRI	Sn243	Sn249
700 nm	-1.91 e-7	-1.66 e-7	-1.46 e-7	-5.8 e-8	-6.7 e-8
900 nm	-1.77 e-7	-1.65 e-7	-1.58 e-7	-8.68 e-8	-9.5 e-8
1100nm	-3.12 e-7	-2.69 e-7	-3.11 e-7	-1.6 e-7	-1.66 e-7
1300 nm	-4.37 e-7	-4 e-7	-4.26 e-7	-2.04 e-7	-2.08 e-7

# Typical Values of Dark Current MIPAS / THOMSON devices

Dark Current (nA) at $V_R = 5V$ MIPAS and THOMSON devices			
3 $\mu m$ epitaxy layer	6 $\mu m$ epitaxy layer	MSG SEVIRI	Sn243
-0.072	-0.095	-10.54	-0.124

# Irradiation Test Plan

## MIPAS / THOMSON

	MIPAS		THOMSON
	Photodiodes	Laserdiodes	Photodiodes
	Fluence (p/cm <sup>2</sup> )		
30 MeV	1 10 <sup>8</sup>	1 10 <sup>9</sup>	1 10 <sup>9</sup>
	1 10 <sup>10</sup>		1 10 <sup>11</sup>
2 MeV	1 10 <sup>11</sup>	1 10 <sup>11</sup>	1 10 <sup>8</sup>
			1 10 <sup>10</sup>
			1 10 <sup>12</sup>



# Conclusion

- Next steps:
  - Irradiation of devices
  - Electrical characterisations
  - Pre and post data analysis
  - Second run of irradiation

