



FER STUDENT SATELLITE PROJECT

PAYLOAD 4: OZONE LAYER THICKNESS

DETECTION OF UV RADIATION

Filip Bogdanović, Filip Tomašić

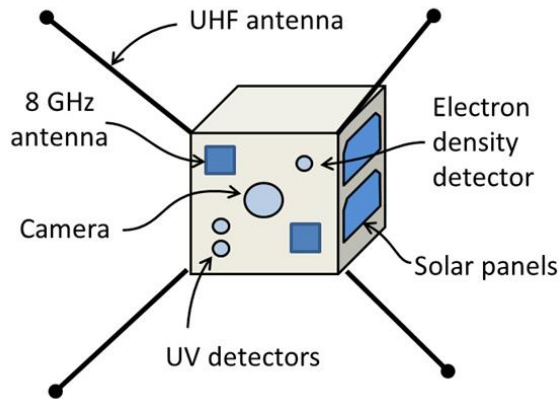


FERSAT



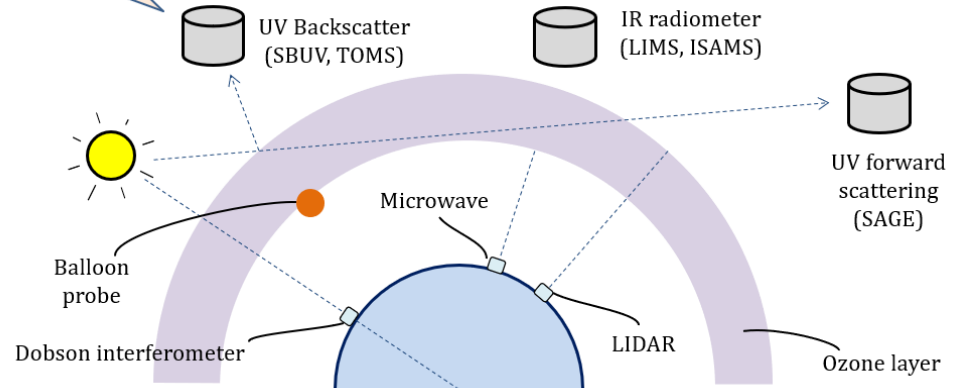
Introduction

- Measuring ozone layer thickness using UV radiation detectors mounted on FERSAT



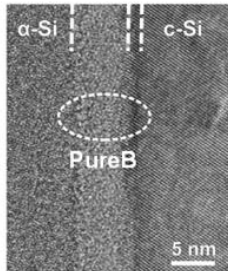
FERSAT
nanosatellite

FERSAT will make UV
backscatter measurements

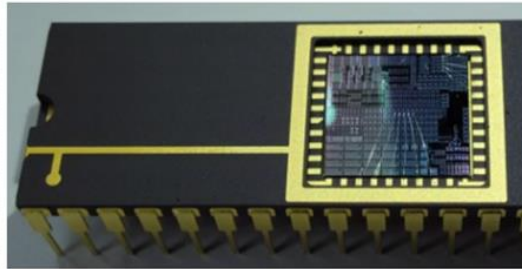


Objectives

- Develop a simple optical technique, suited for a nanosatellite, to measure total thickness of ozone layer
- Develop simple UV detectors putting more emphasis on sensitivity
- Demonstrate operation of Pure-B detectors in space
- Provide world-wide scan of ozone thickness using a nanosatellite



TEM image of
PureB/Si interface

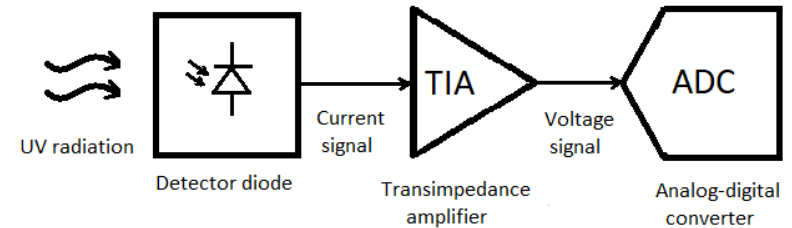


PureB detectors packaged for
characterization

PureB detectors (elemental boron deposited on silicon) are being used for electron detection in scanning electron microscopes, but are also **excellent UV detectors.**

Technology

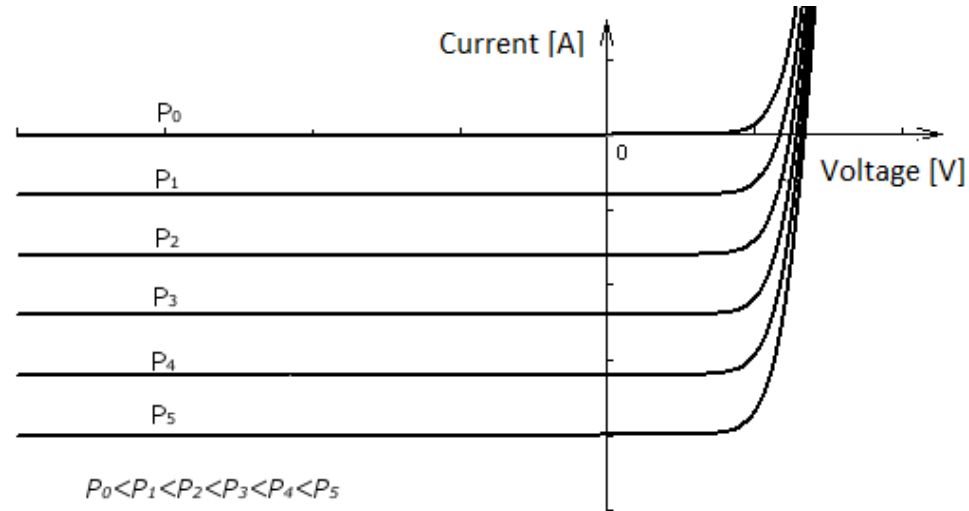
- Detector
 - Photodiode
 - PureB, SiC, GaN
 - generated current from less than 0.1 nA to 1 μ A
 - UV light wavelengths 10 nm to 400 nm
 - Transimpedance amplifier
 - low power
 - high sensitivity
 - low offset currents and voltages
 - Analog-digital converter



Block scheme of UV light detection circuit

Photodiode

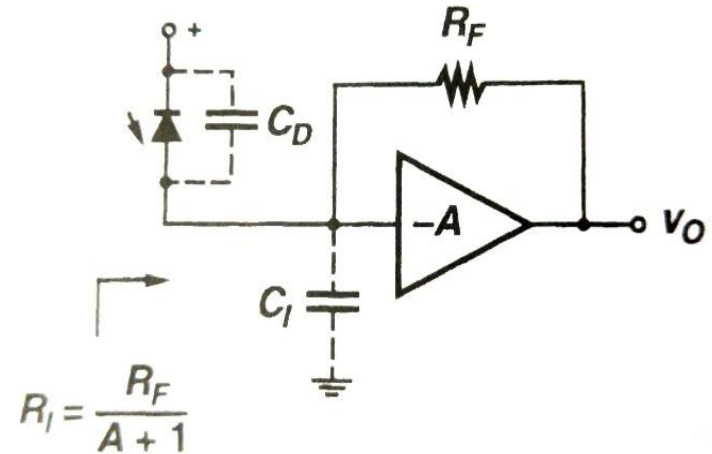
- Reverse bias
- Photon \rightarrow Electron + Hole
- Dark current I_d
- Sensitivity: $R = \frac{I}{P}$ [A/W]
- PIN and avalanche photodiodes
- PureB
- photodiodes available on market:
 - SG01S-18 (sglux) SiC
 - T46G-400-1 (Ecrie Int.) GaN



Photodiode characteristic

Transimpedance amplifier

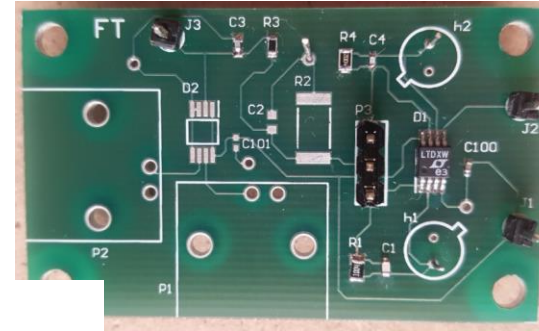
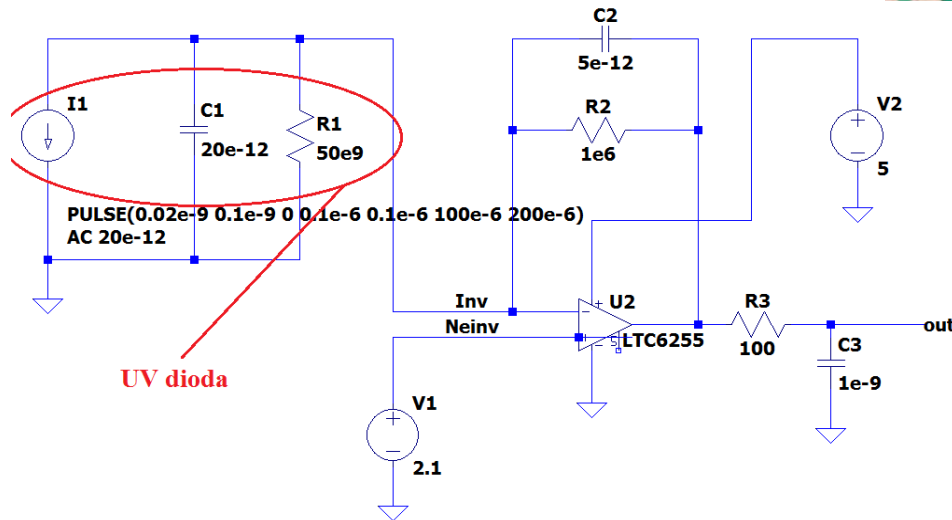
- Current \rightarrow Voltage
- Transimpedance
 - $Z_T = \frac{\Delta v_O}{\Delta i_I} = \frac{A}{A+1} * R_f$ [Ω] or [dB Ω]
- Operational amplifier
 - low current and voltage offset
 - LMC6001A, AD8629, LTC6255
- Large valued feedback resistor R_f
- For stability capacitance is needed C_f (feedback capacitor)



Basic transimpedance amplifier circuit

2-channel amplifier → 2 different impedance in feedback

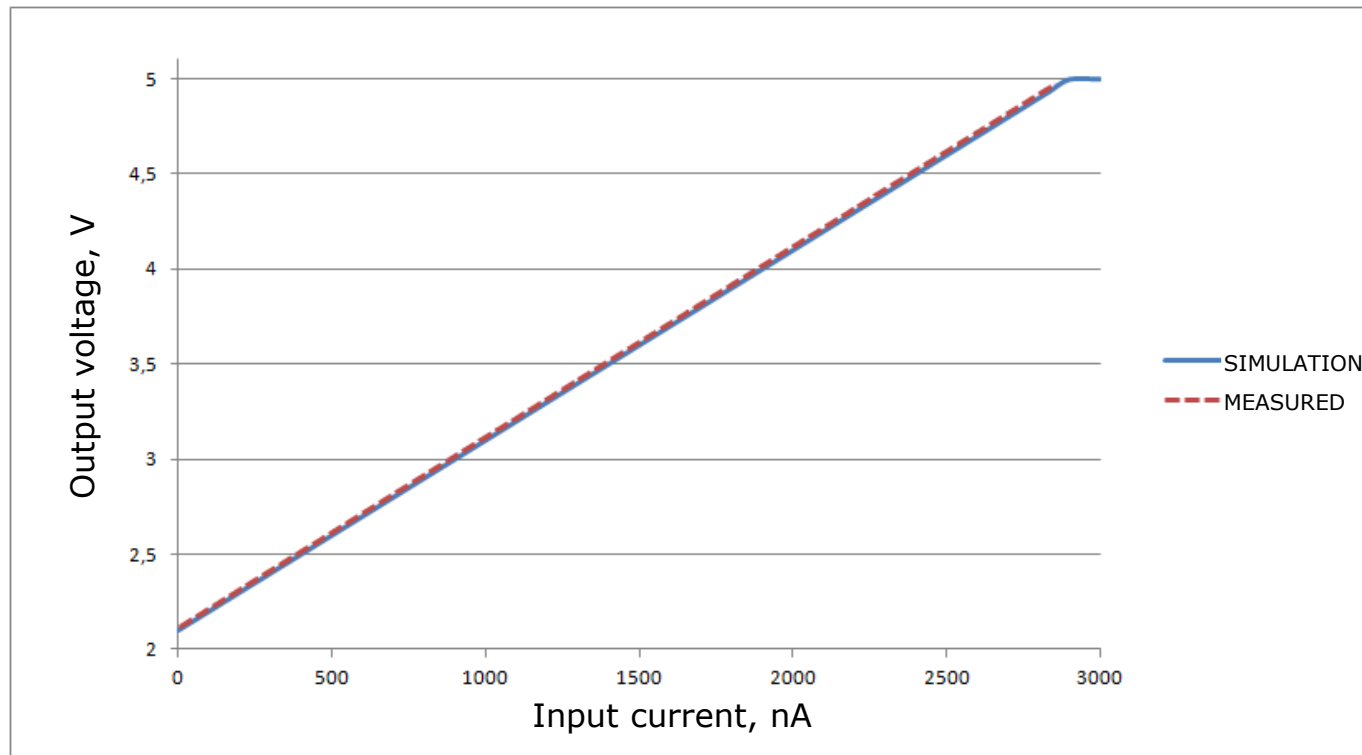
CIRCUIT FOR READING SIGNAL OF UV DIODE



V(inv) :	2.1
V(n001) :	2.10099
V(neinv) :	2.1
V(n002) :	5
V(out) :	2.10099
V(nc_01) :	5
I(C3) :	2.10099e-021
I(C2) :	4.92923e-027
I(C1) :	4.2e-023
I(I1) :	2e-011
I(R3) :	0
I(R2) :	9.85846e-010
I(R1) :	4.2e-011
I(V2) :	-6.53963e-005
I(V1) :	-9.197e-010
Ix(u2:1) :	9.197e-010
Ix(u2:2) :	9.23846e-010
Ix(u2:3) :	6.53963e-005
Ix(u2:4) :	-6.5397e-005
Ix(u2:5) :	-9.85048e-010
Ix(u2:6) :	0

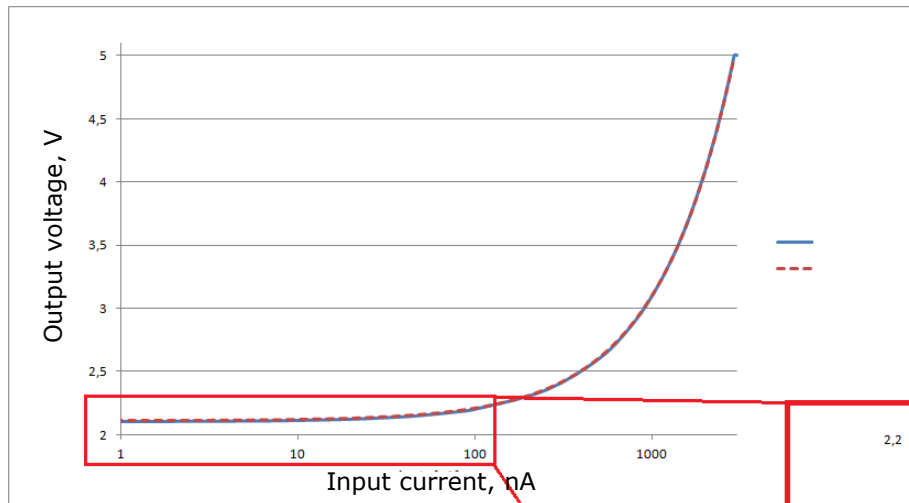
electrostatic

Measured vs simulated TIA characteristics

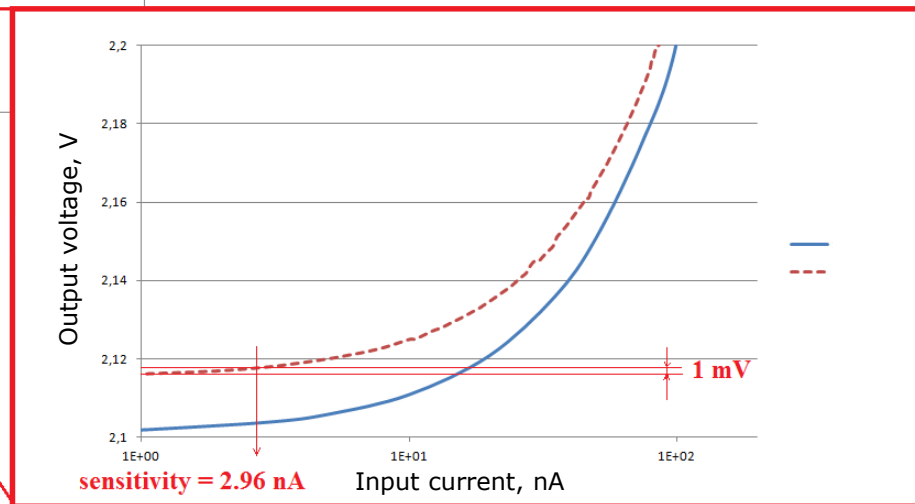


lin-lin plot





lin-log plot



Further steps

- Develop and test prototypes with different OP amplifiers and detector diodes
- Select most suitable combination for set method of measurement
- Develop a model(method) to test method of measurement in lab



HRZZ
Croatian Science
Foundation

