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DEGLI STUDI
DI PADOVA



ANNUAL PERFORMANCE REVIEW: YEAR 1 OF PHD RESEARCH

MUHAMMAD WAQAS

40th Cycle, 2024/2025

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- Thesis Title
- Aim of the Project
- Research Activities Carried out
- Characterizations of QDs
- Response of PbS QDs-based Detectors Under X-Rays and Proton Beam
- Courses, Exams, and Training Activities
- Other Research Activities
- Overall Planning of 3 Years

OVERVIEW



THESIS TITLE



**Advanced Detection Systems for Medical Devices in Radiotherapy
and Hadron Therapy**



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AIM OF THE PROJECT



The project focuses on the development of advanced 2D detection systems for radiotherapy and hadron therapy based on quantum dots (QDs) deposited on Polyethylene Naphthalate (PEN) substrates. By combining the high sensitivity and tunable optical properties of QDs with the flexibility and radiation hardness of PEN, the research aims to create lightweight, cost-effective, and precise detectors for the accurate monitoring of X-rays and proton beams in medical applications.

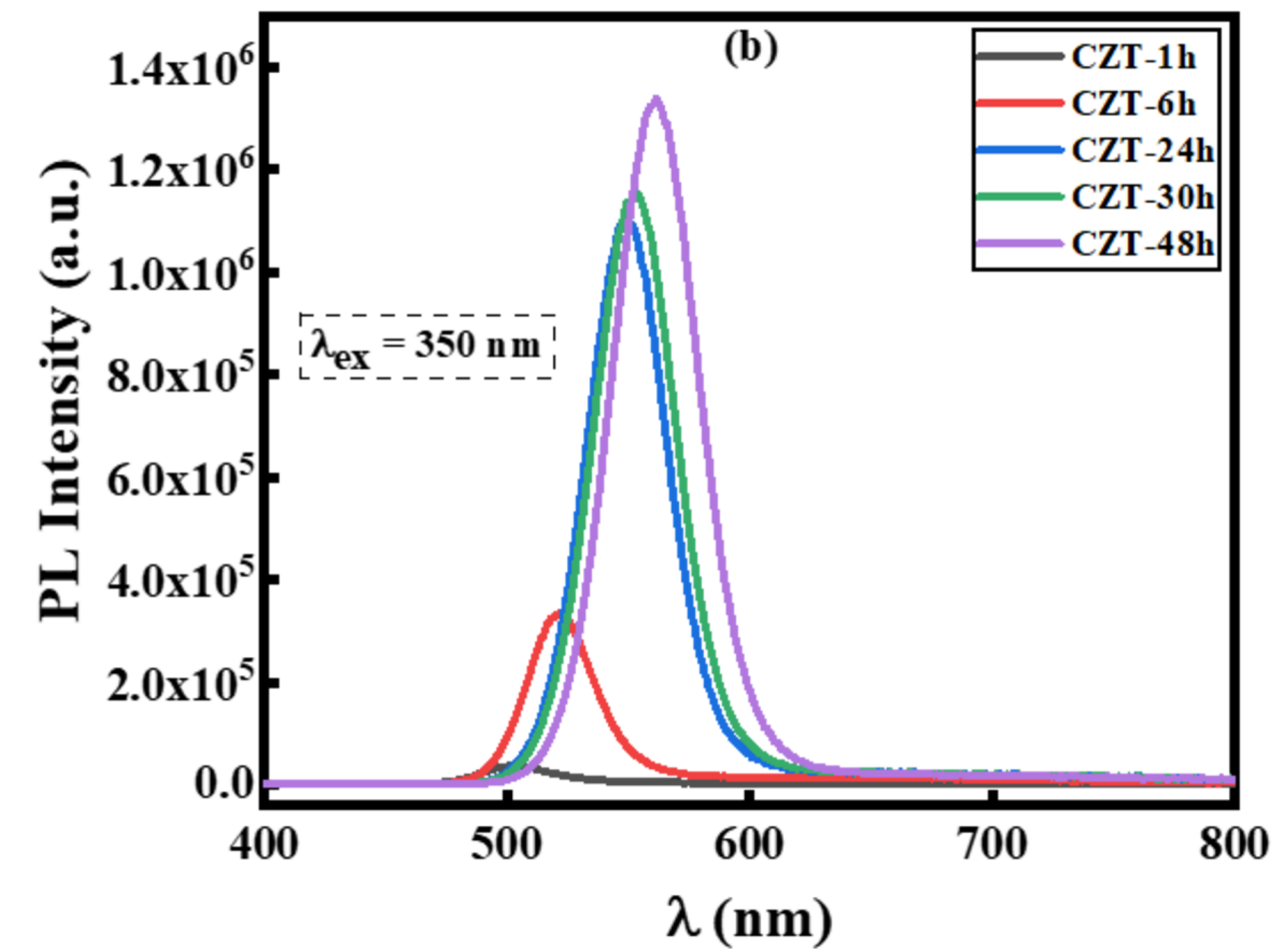
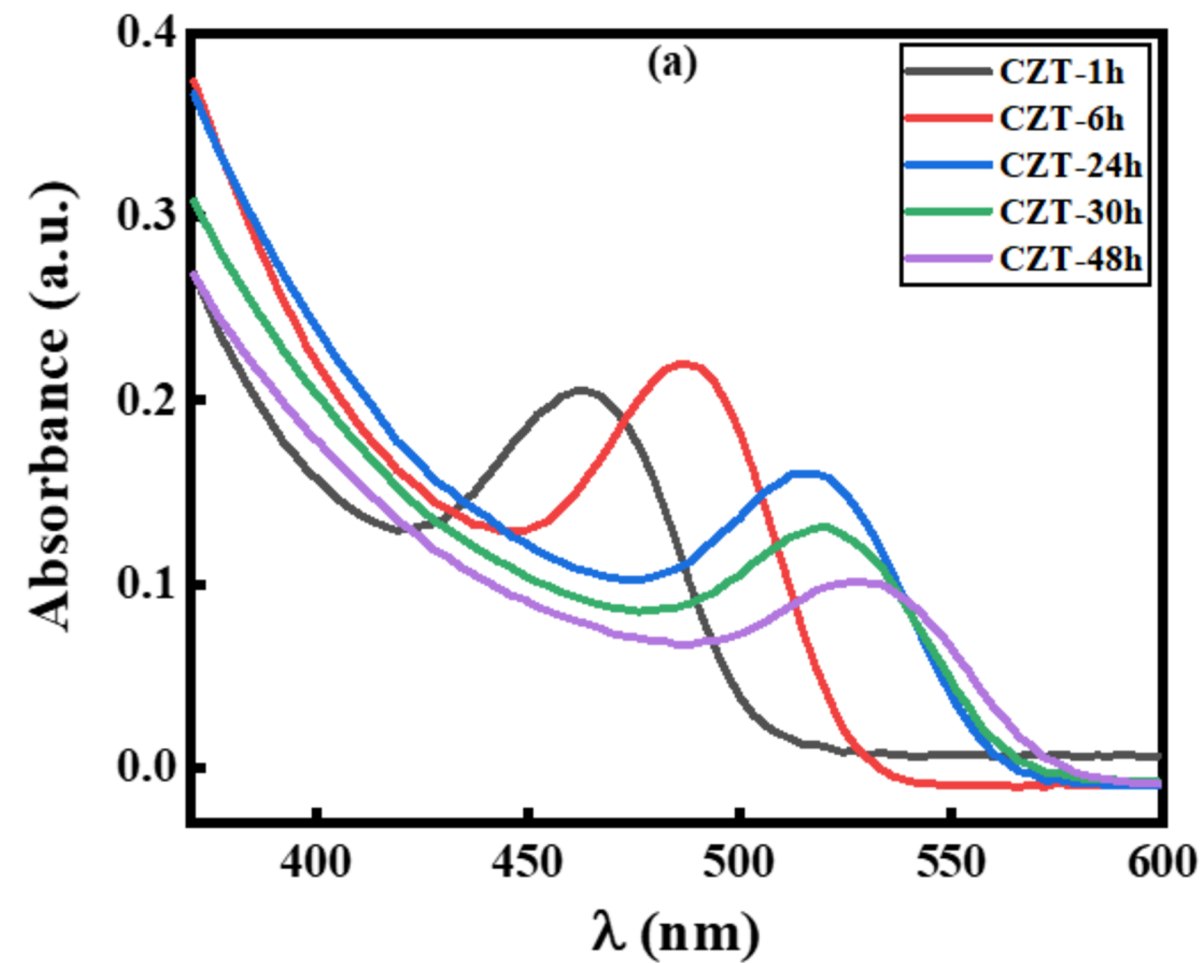
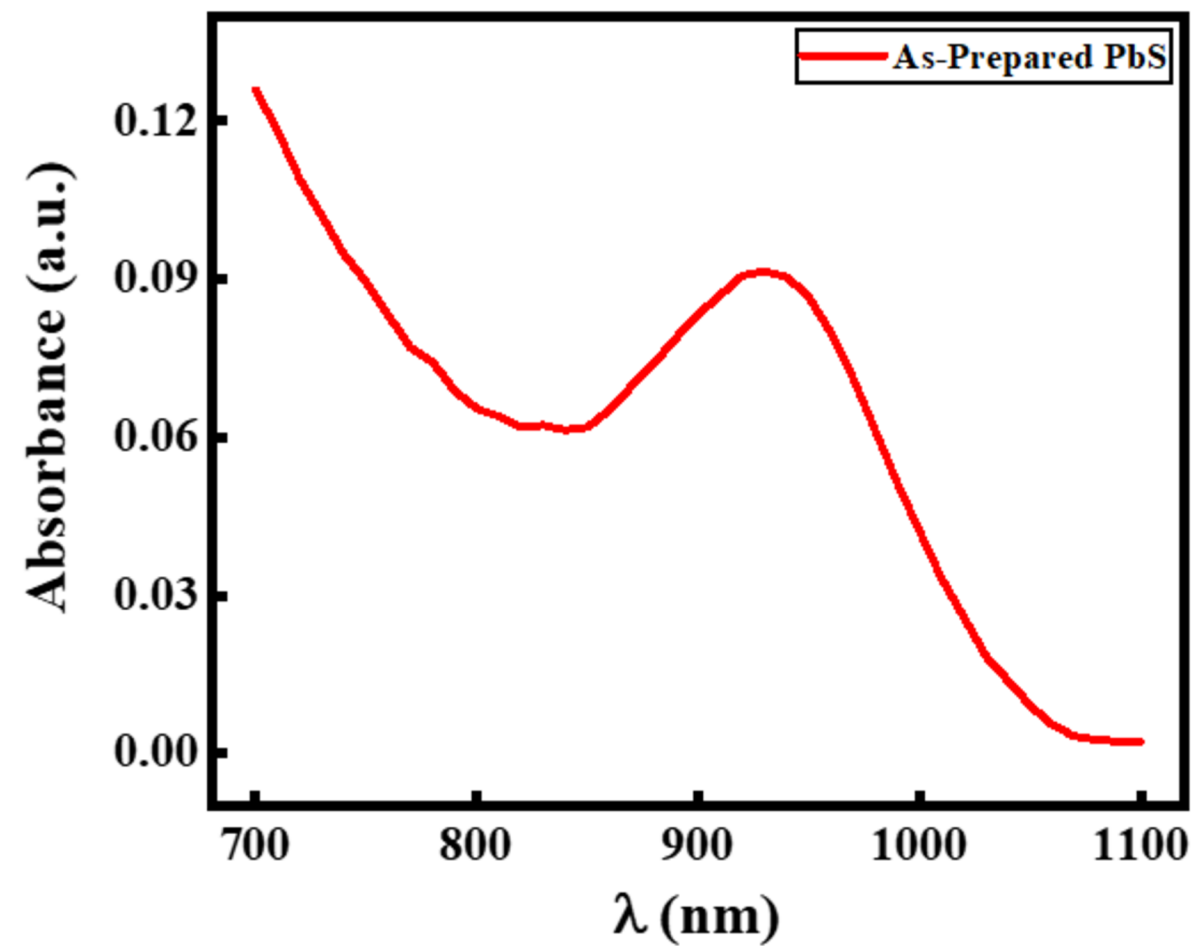
RESEARCH ACTIVITIES



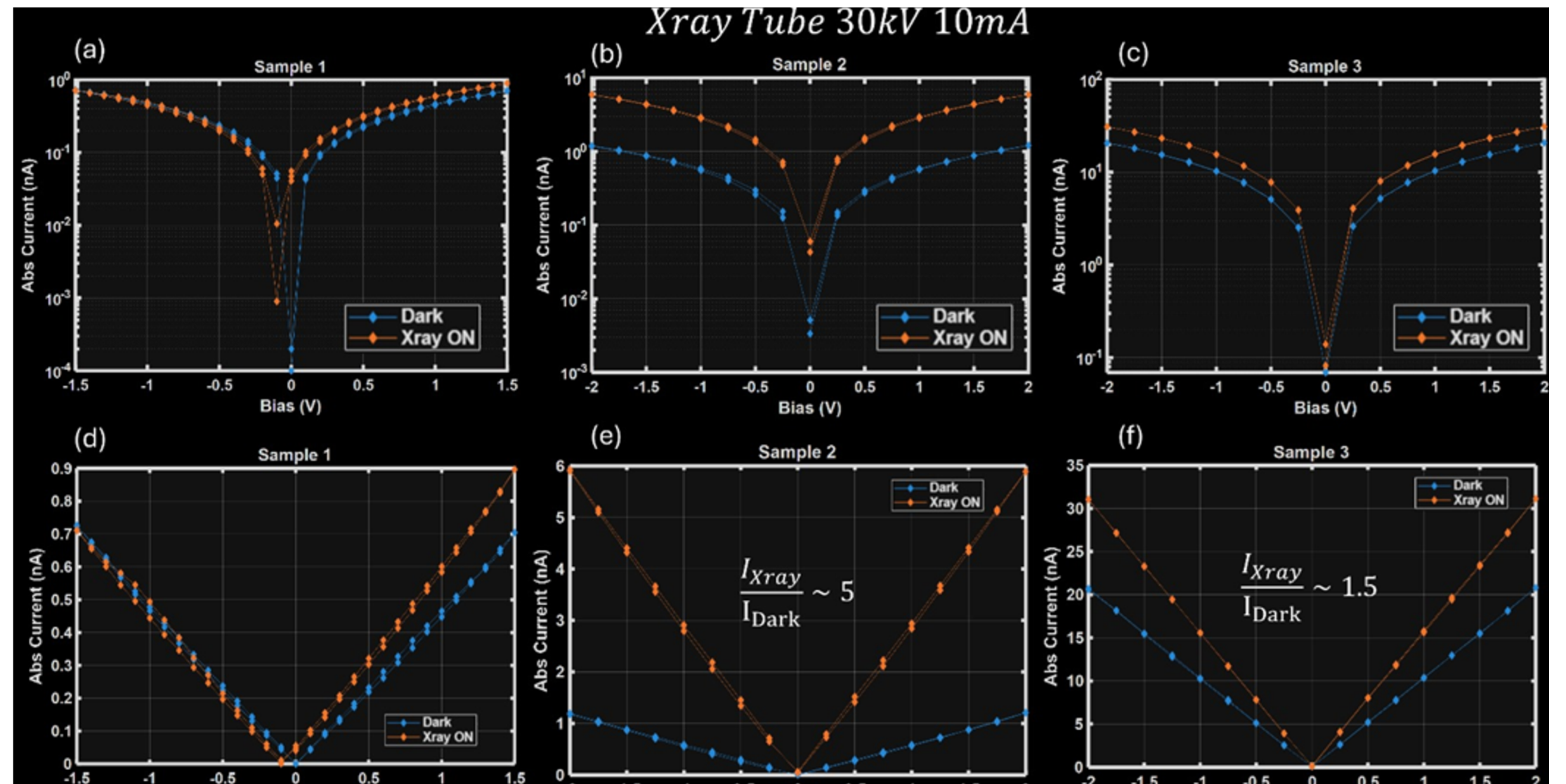
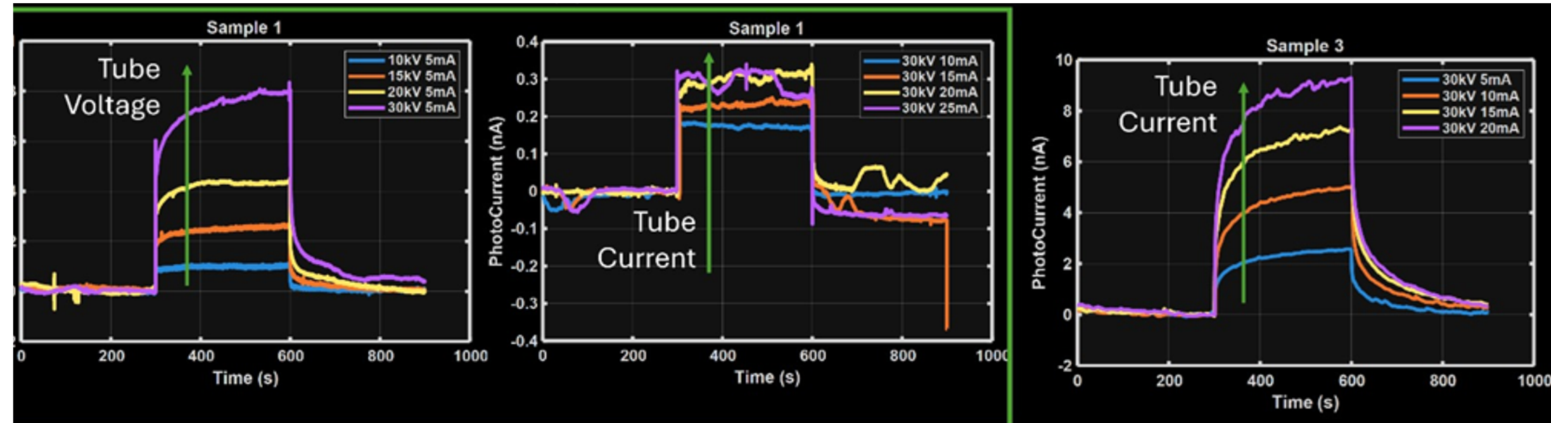
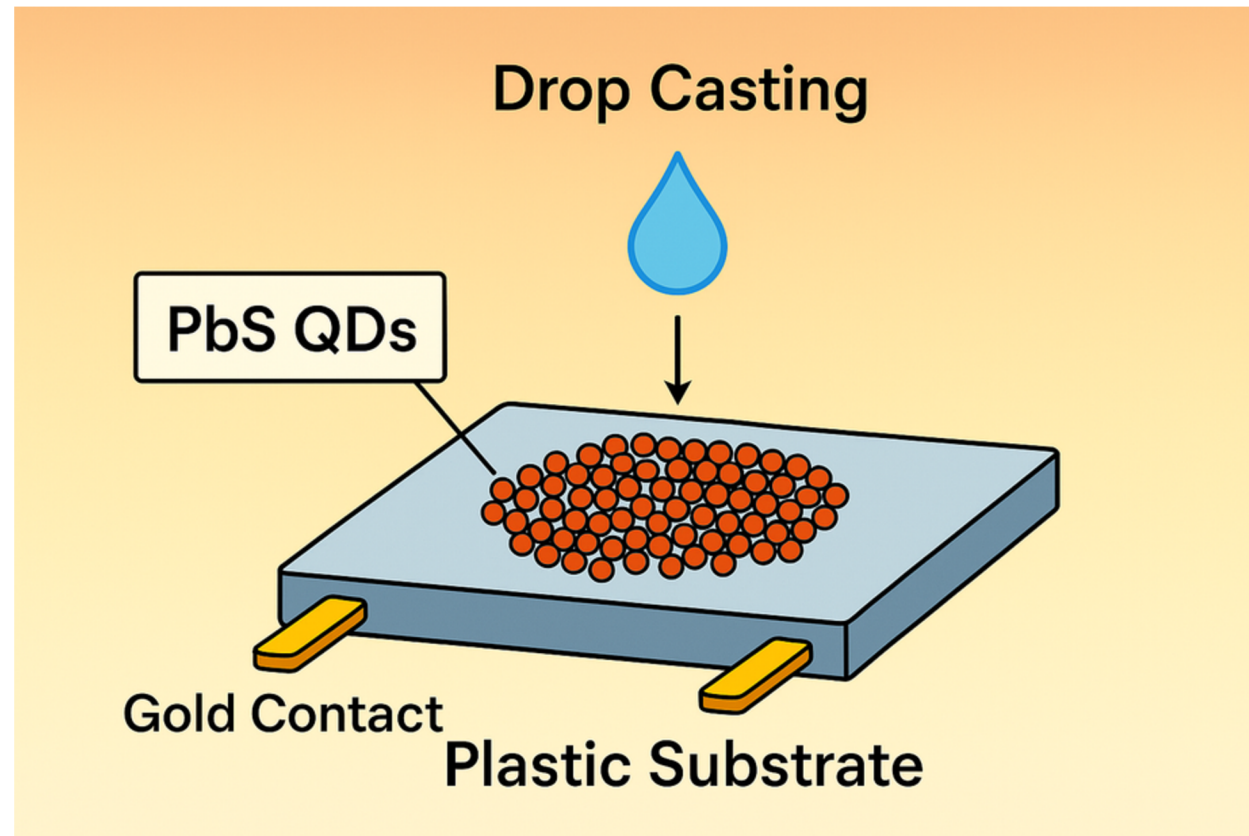
- 1 Synthesized PbS and CdZnTe QDs by Hot Injection Method
- 2 Characterized the QDs using Spectroscopic Techniques: UV-Vis, PL, and DLS
- 3 PbS QD-based photoconductors were fabricated on PEN substrates using both Drop-Casting and Spin-Coating techniques, and different architectures.
- 4 The morphology of the active film was investigated and compared to reference samples by Stylus Profilometry.
- 5 PbS QD-based detectors were evaluated under X-ray and proton beam irradiation.

CHARACTERIZATIONS

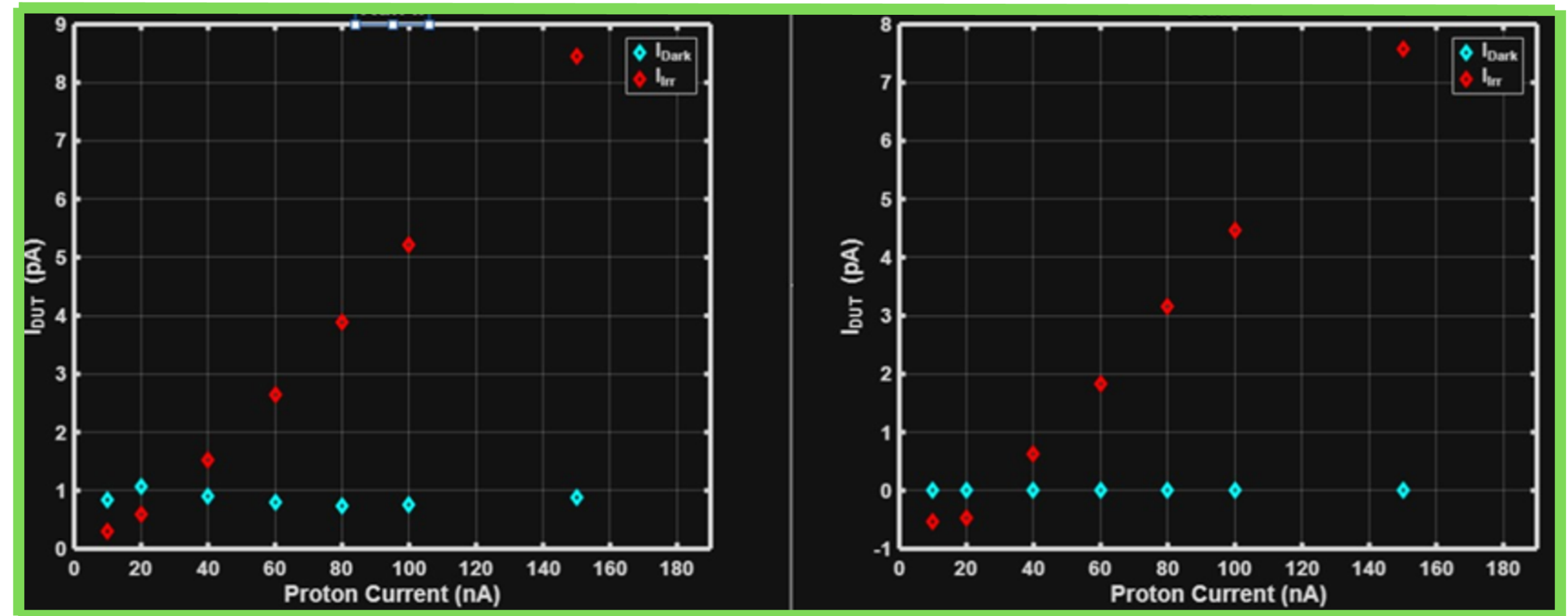
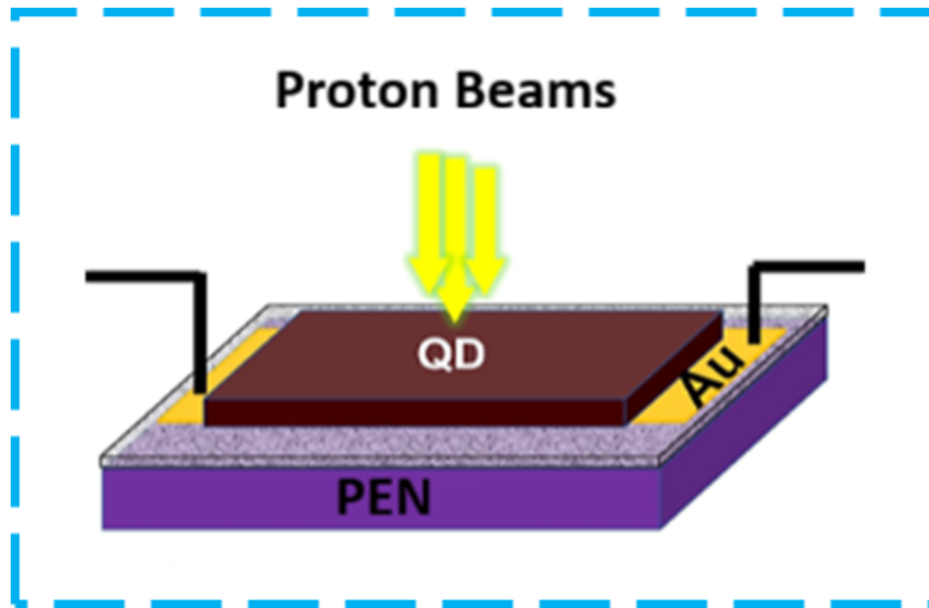
1: UV-VIS And PL SPECTROSCOPIES



RESPONSE OF PbS QDs-BASED DETECTORS UNDER X-RAYS

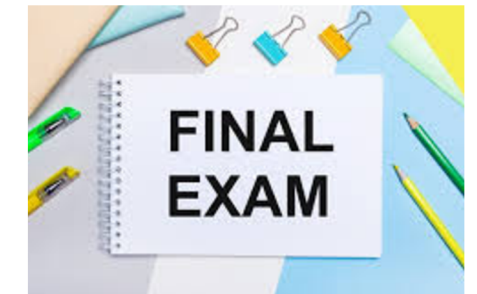


RESPONSE OF PbS QDs-BASED DETECTORS UNDER PROTON BEAMS



COURSES, EXAMS, AND OTHER ACTIVITIES

- | | |
|--|-------------------------------|
| 1. Design of Readout Integrated Circuits For Particle Detectors: | Attended, and Passed the Exam |
| 2. Advanced Electronic Sensing Devices: | Attended, and Passed the Exam |
| 3. Cabling and Shielding for Low Noise Applications: | Attended, and Passed the Exam |
| 4. Electronics Systems in High Energy Physics: | Attended, and Passed the Exam |
| 5. Programmable System on Chip (SoC): | Attended, and Passed the Exam |
| 6. Microelectronics of Radiation Detector II: | Attended, and Passed the Exam |
| 7. Photodetection Scintillators and Silicon Photomultipliers: | Attended |
| 8. Italian language course - intensive and communicative: | Ongoing |
| 9. Cyber Security – Basic: | Attended, and Passed the Exam |
| 10. Chemical Safety Course: | Attended, and Passed the Exam |

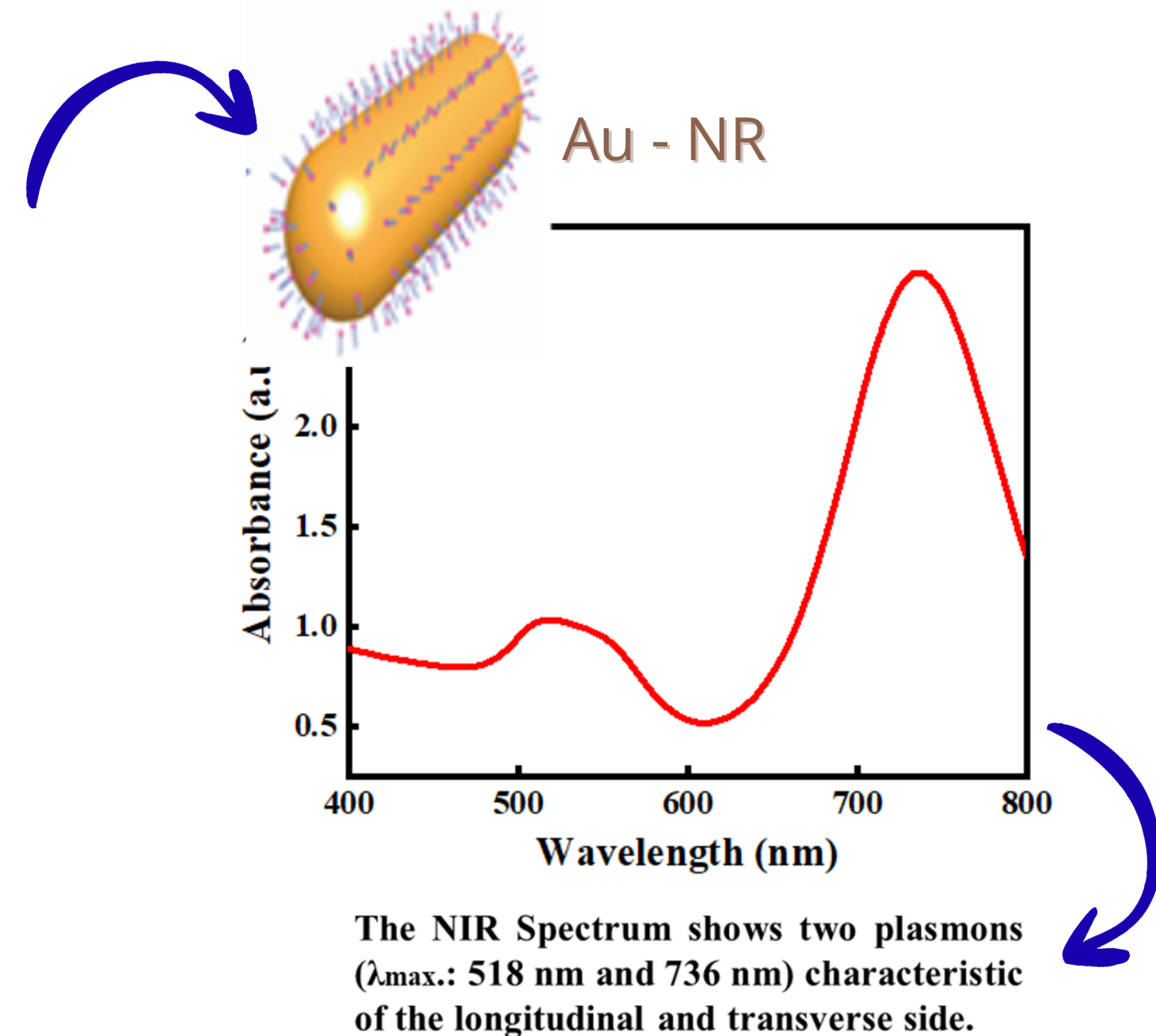
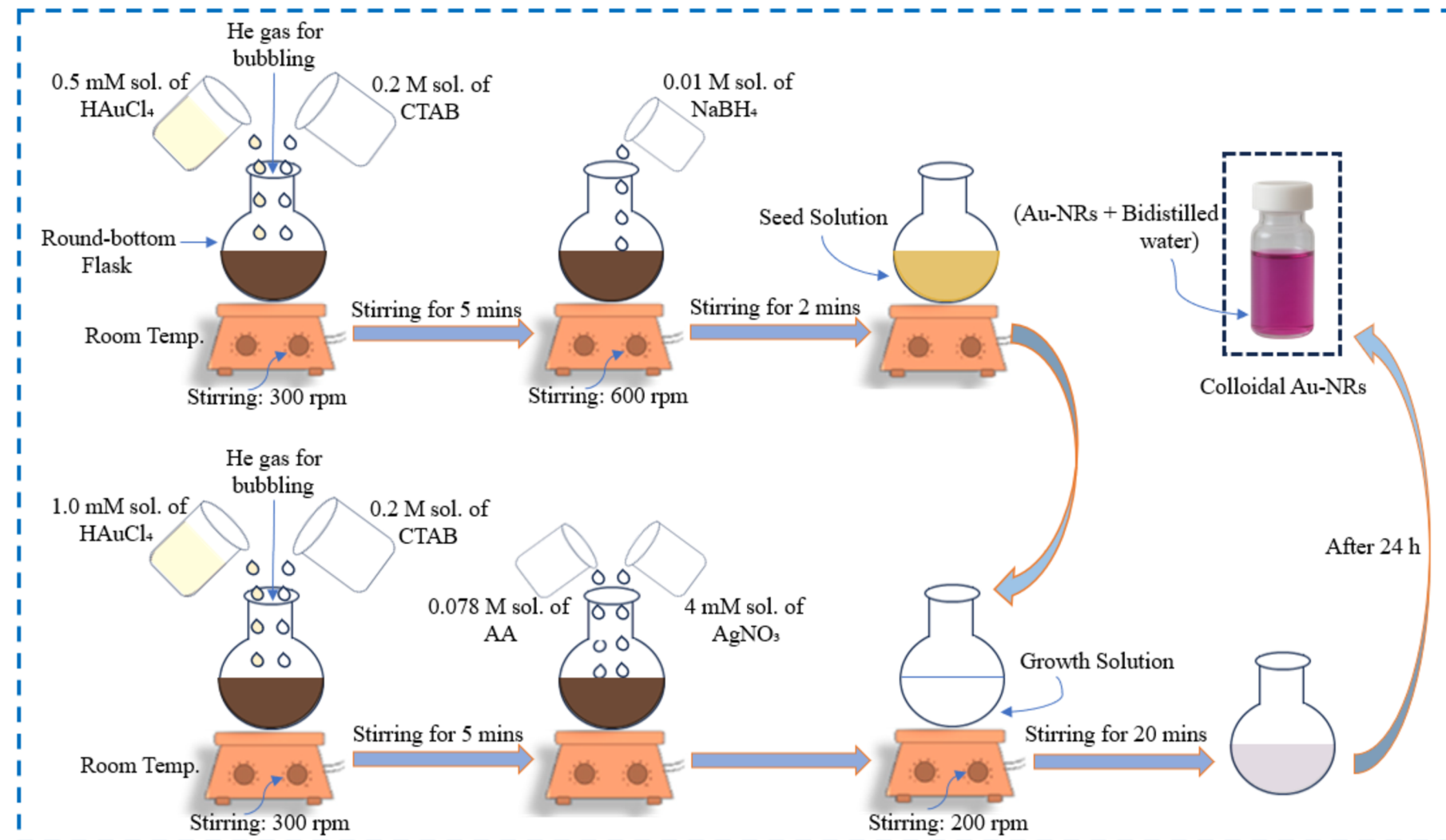


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1. TECH-FPA PhD Retreat 2025, L'aquila
 2. Authentic Impact Workshop by B.V. Bakel on Team Development

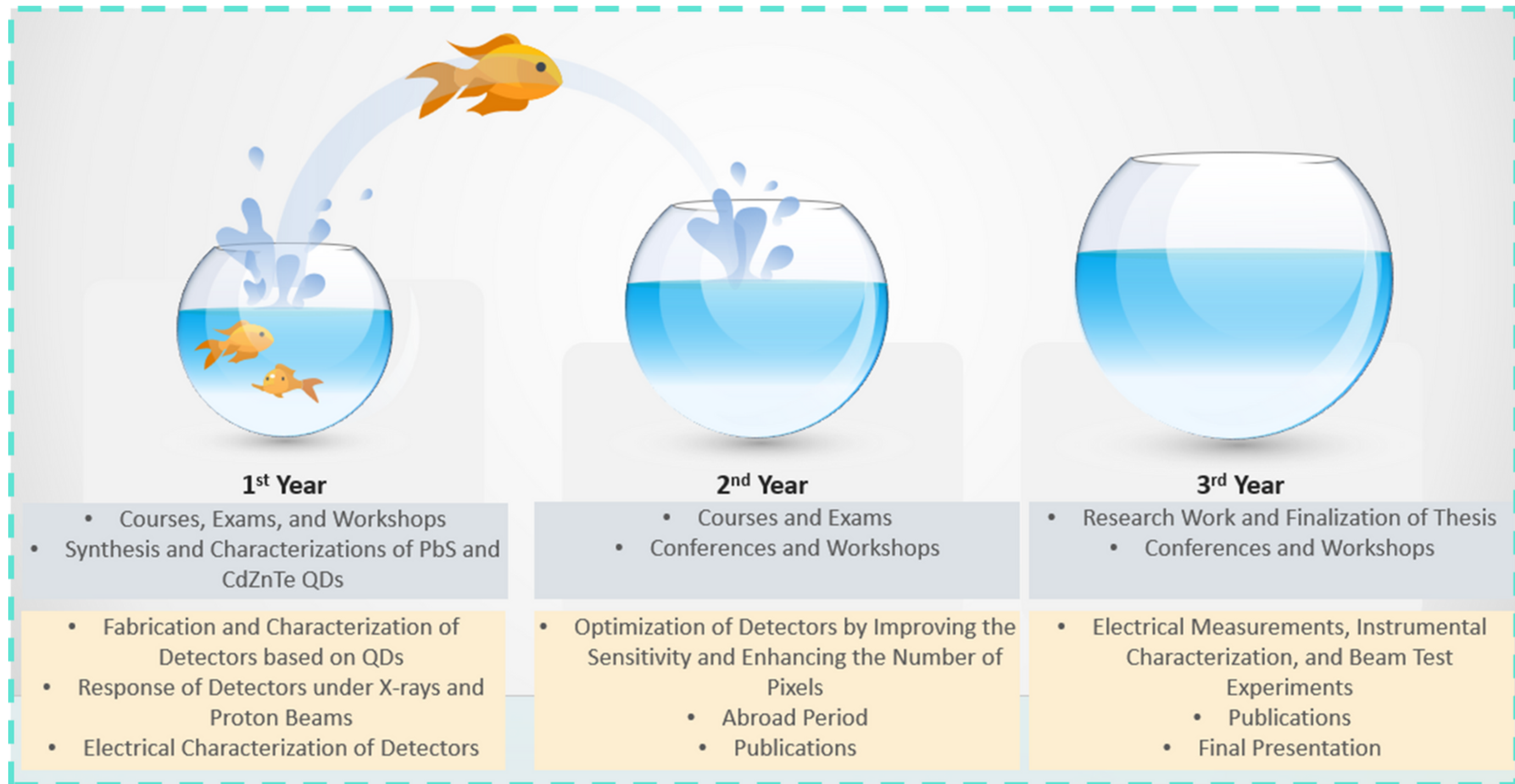


OTHER RESEARCH ACTIVITIES

Gold nanorods (NRs) were successfully synthesized using a two-step method and subsequently characterized for their potential application in advanced drug delivery systems for cancer therapy.



OVERALL PLANNING OF 3 YEARS





THANK YOU



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