



**IAEA**

International Atomic Energy Agency

# **Nuclear Science and Instrumentation Laboratory**

**IAEA Department of Nuclear Sciences & Applications  
Division Physical & Chemical Sciences, Physics Section**



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# Nuclear Science and Instrumentation Laboratory

# Organizational Structure

## Nuclear Science and Instrumentation Laboratory



IAEA, International Atomic Energy Agency



NAPC, Department of Nuclear Sciences and Applications



Physic Section

# NSIL Activities



Trainings



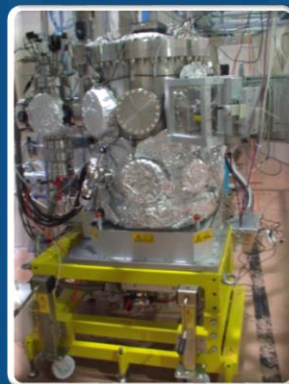
Missions



Expertise



Development



Capacity Building

## Nuclear Science and Instrumentation Laboratory

helps Member States to develop, operate and maintain various nuclear instrumentation and spectrometry techniques in support of a wide range of applications such as health care, food, agriculture, environment, forensics, cultural heritage, and materials science.



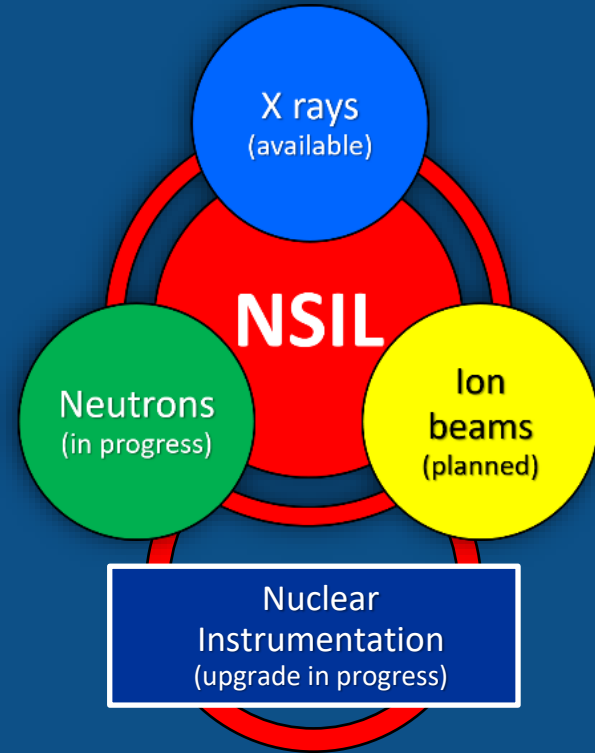
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# NSIL Labs

# NSIL - Laboratory Facilities & Instrumentation

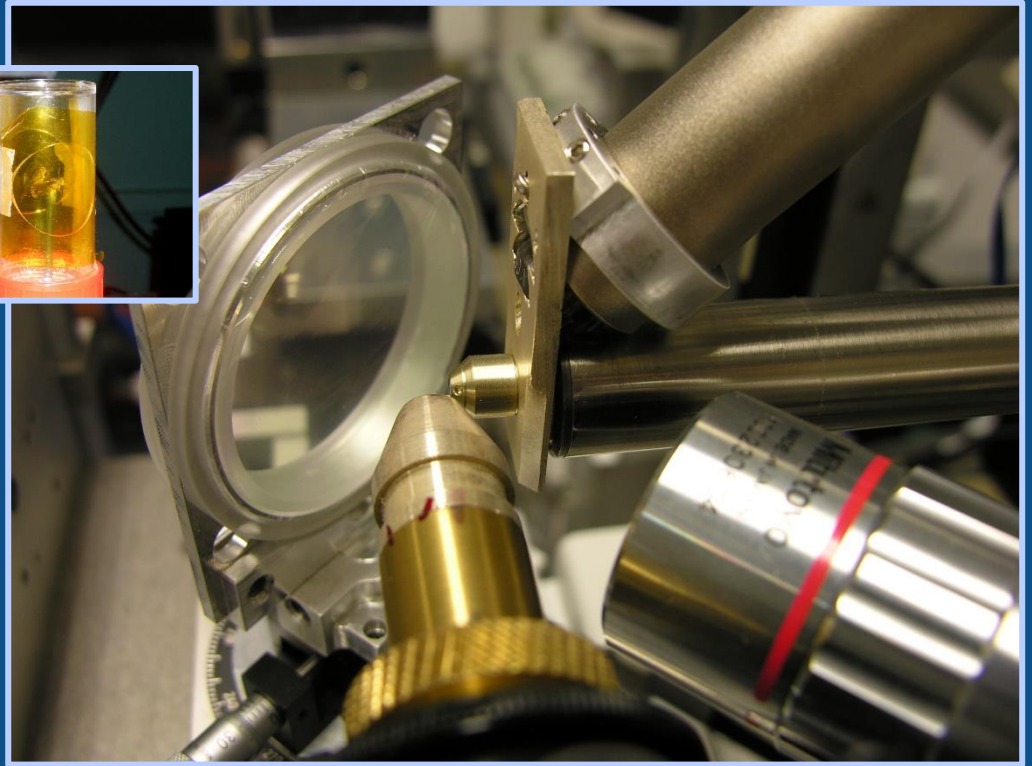
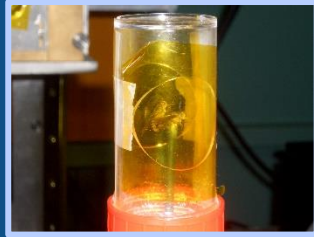
- **X-Ray**  
Instrumental and expertise capacity for complete X-Ray non-destructive analyses, Laboratory and in-situ techniques.
- **Neutrons**  
Neutron Science Facility with D-D and D-T neutron (to be completed in 2022)
- **Ion-Beam**  
Planned establishment of an ion-beam accelerator facility.
- **Nuclear Instrumentation**  
Instrumental and expertise capacity for laboratory and in-situ measurement.



# New Nuclear Instrumentation Laboratory



# XRF Laboratory

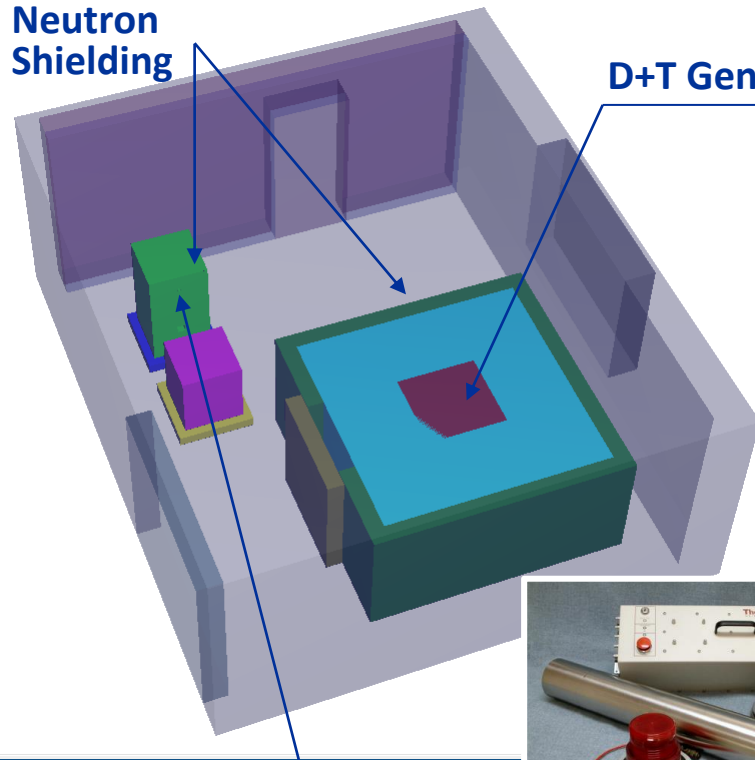




# Neutron Science Facility

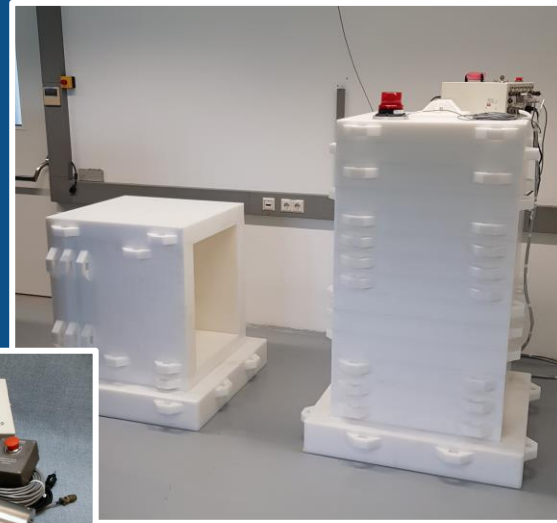
Neutron  
Shielding

D+T Generator



D+D Generator

D+D reaction  $\rightarrow$  2.45 MeV neutron source, comparable to fission neutrons  
D+T reaction  $\rightarrow$  14 MeV neutron source, comparable to fusion neutrons

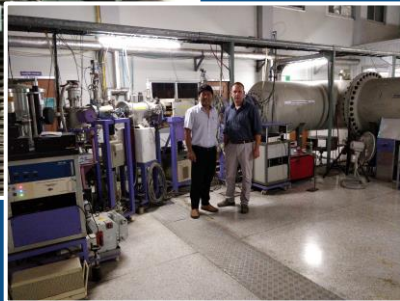


# NSIL International Missions – Commissioning, Maintenance and Training



Assisting MS in upgrade and commissioning of the cyclotron - Jordan

Assisting MS maintenance and upgrade of electrostatic accelerator - Philippines



# NSIL International Assistance Mission

On 06 August 2020, the IAEA's Incident and Emergency Centre (IEC) received a request for assistance from the Lebanese Atomic Energy Commission, (LAEC-CNRS) with regard to an explosion that took place at Beirut port.

The Lebanese Republic has requested assistance from the IAEA in the areas of Radiation Survey, Sampling and Analysis and Environmental Sampling, Security Assessment in Hospitals.



# San Rafael Mining Complex, Argentina

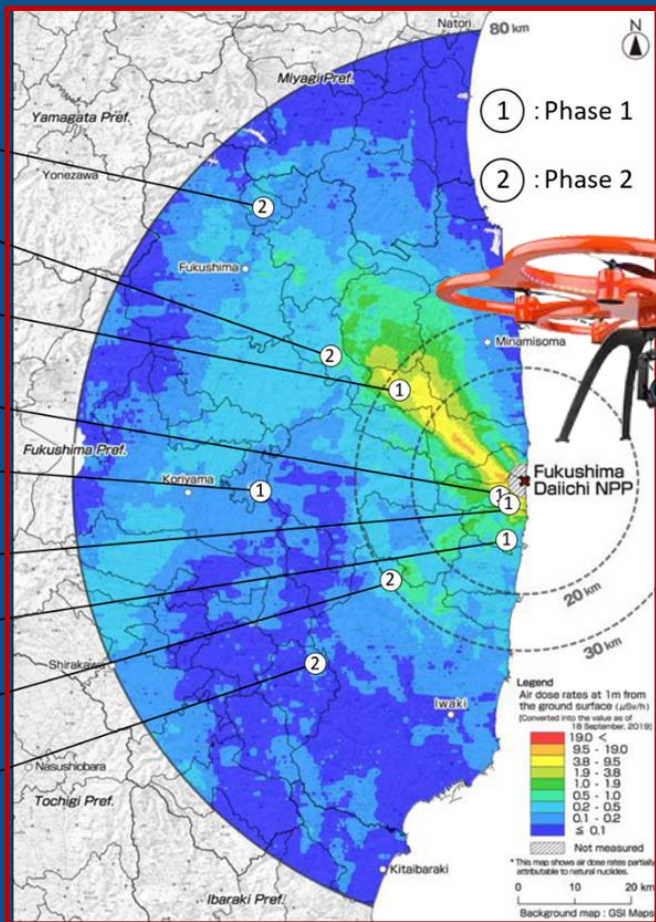
**Measurement Mission** - La Terraza area of San Rafael Uranium mine, Argentina.  
Flight path over Southern Faces highlighted (2016)

- Capture of Geotagged imagery using the Aibot X6 Hexacopter
- Capture of radiometric data with on-board detector where required
- Surveying of any required Ground Control Points (GCPs)

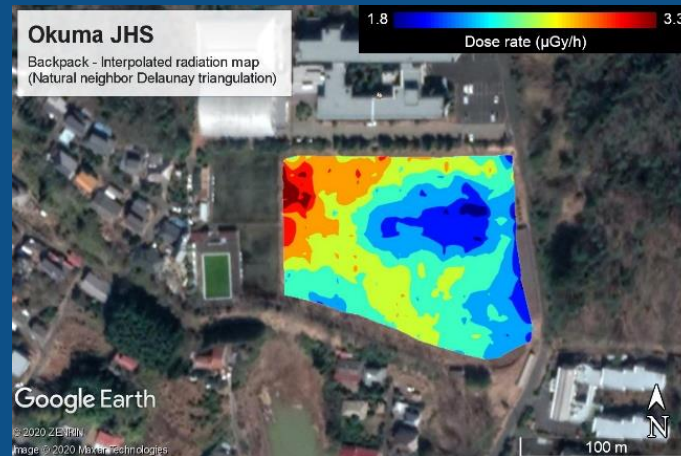


# Project with Fukushima Prefecture

No.9:	Koori TSS
No.5:	Kawamata TSS
No.1:	Namie HS / Tsushima branch
No.4:	Okuma JHS
No.2:	Miharu Takizakura PL
No.3:	Kumamachi ES
No.7:	Tomioka HS
No.6:	Iwaki TSS
No.8:	Furudono TSS



## Rapid Environmental Mapping with Unmanned Aerial Vehicle (UAV) 2012-2020





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# NSIL Trainings

# NSIL Training Capacity Building & Development



Laboratory Techniques

In-Situ Techniques

Mobile Techniques

# NSIL Trainings (GFT Nuclear Electronics, XRF, Radiotracers, In-Situ Techniques, Nuclear Security Instrumentation, Radiological Mapping, ... )



**Backpack Radiation Devices**



**Radiation Portal Monitors**



**UAV Technology**



**Laboratory Techniques**



# Trainings on In-Situ Nuclear Instrumentation



**RSS-131**  
High Pressure  
Ionization Chamber



**μ-DETECTIVE**  
HPGe In-Situ Gamma  
Spectroscopy System



**AEGIS**  
HPGe In-Situ Gamma  
Spectroscopy System



**PGIS (Upgrade)**  
Backpack Gamma  
Spectrometer

# Nuclear Instrumentation Laboratory

HPGe Gamma Spectroscopy System (Electrically Cooled)



Scintillation Gamma Spectroscopy  
PMT or SiPM Detectors

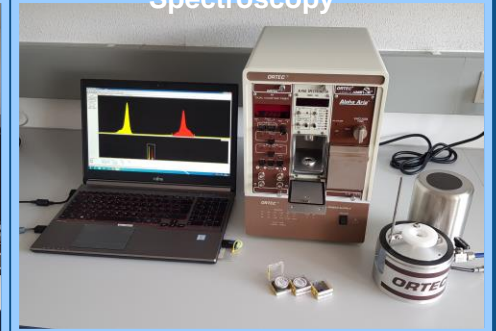


Alpha/Beta Counting



HPGe Gamma Spectroscopy (LN2)

PIPS Alpha/Beta Spectroscopy



LSC Liquid Scintillation

# New Catalogue of Training in Nuclear Instrumentation

## NUCLEAR INSTRUMENTATION



### EXPERIMENTS OVERVIEW 2021

NUCLEAR SCIENCE INSTRUMENTATION LABORATORY  
DIVISION OF PHYSICAL & CHEMICAL SCIENCES  
DEPARTMENT OF NUCLEAR SCIENCES & APPLICATIONS

# LIST OF EXPERIMENTS - LABORATORY



8 COUNTING STATISTICS AND RESULTS INTERPRETATION

9 CHARACTERISTIC CURVE OF GEIGER-MULLER COUNTER

10 STUDY OF BETA ATTENUATION IN ALUMINIUM

11 SCINTILLATION GAMMA SPECTROMETRY

12 ABSORPTION OF GAMMA RADIATION IN DIFFERENT MATERIALS

13 ANGULAR RESPONSE OF SCINTILLATION DETECTOR

14 DOSE AND DOSE RATE CALCULATION

15 ACTIVITY AND MDA CALCULATION

16 HALF-LIFE MEASUREMENT

17 HIGH RESOLUTION GAMMA SPECTROMETRY

18 PERFORMANCE OF CZT DETECTORS

PULSE ANALYSIS AND BASIC DISCRIMINATION METHODS 19

ALPHA SPECTROMETRY AND COUNTING 20

BETA SPECTROMETRY AND COUNTING 21

LIQUID SCINTILLATION COUNTING 22

DETERMINATION OF BETA EMITTERS BY CHERENKOV COUNTING 23

CHARACTERISTICS OF DIFFERENT TYPES OF SCINTILLATORS 24

COMPTON SCATTERING 25

NEUTRON SPECTROMETRY BY USING BONNER SPHERES 26

GAMMA-GAMMA COINCIDENCE MEASUREMENT 27

MEASUREMENT WITH PARTICLE DETECTOR 28

MEASUREMENT OF SINGLE PHOTONS BY SILICON PHOTOMULTIPLIER 29



# LIST OF EXPERIMENTS -

# IN-SITU

- 30 RADIATION MAPPING
- 31 DETERMINATION OF RADIUM CONCENTRATION IN SOIL BY USING LSC
- 32 RADON DETERMINATION IN WATER BY USING LSC
- 33 MONITORING OF RADIOACTIVITY IN ENVIRONMENT - SOIL, VEGETATION AND FOOD
- 34 MONITORING OF RADIOACTIVITY IN ENVIRONMENT - AIR SAMPLING
- 35 STUDY OF ENVIRONMENTAL SAMPLES USING NEUTRON ACTIVATION ANALYSIS AND HIGH-RESOLUTION GAMMA SPECTROMETRY
- 36 IN-SITU MEASUREMENT OF OBJECTS BY USING HPGE DETECTORS
- 37 IN-SITU MEASUREMENT OF SOILS BY USING HPGE DETECTORS
- 38 RADIATION MONITORING



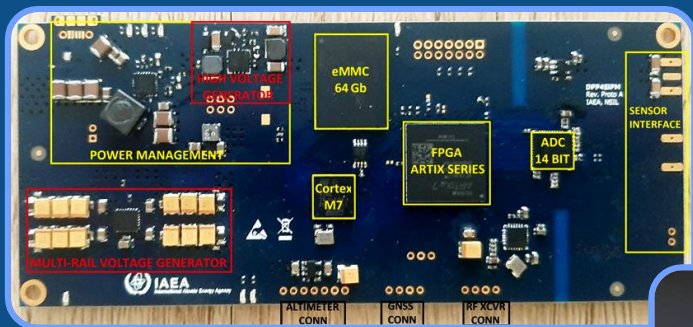
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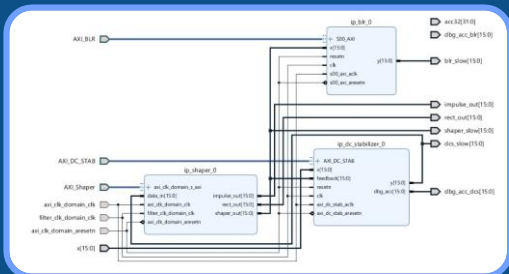
# NSIL Development

# Nuclear Instrumentation - Development

## Digital Pulse Processor for UAV (MCA)



## Application of DPP Module on UAV



GNSS Antenna, Laser Altimeter,  
RF Communication,

New Firmware for DPP

New Type of  
SiPM Detectors

Data Format  
SW for Base Station



# UAV Based Radiation Mapping System



UAV DJI Matrice 210 V2  
Commercial GS Module  
1x1" SiPM NaI(Tl)



UAV DJI Matrice 210 V2  
Experimental GS Module  
2x2" NaI(Tl) & 1.5x1.5" SiPM CeBr3

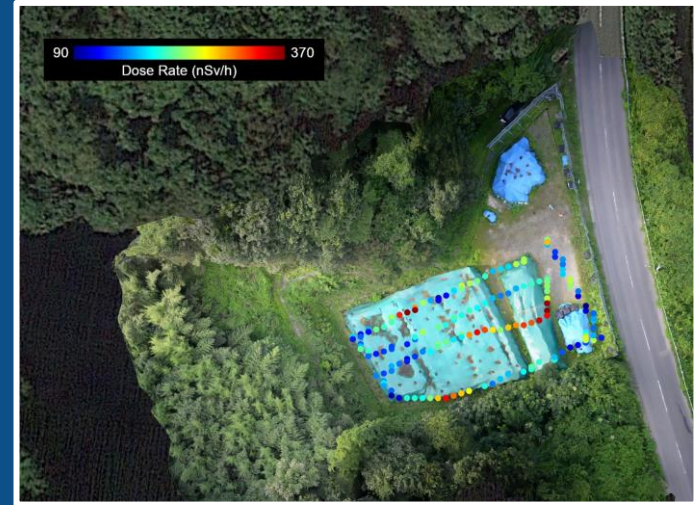


# Photogrammetry & 3D Mapping

## Photogrammetry

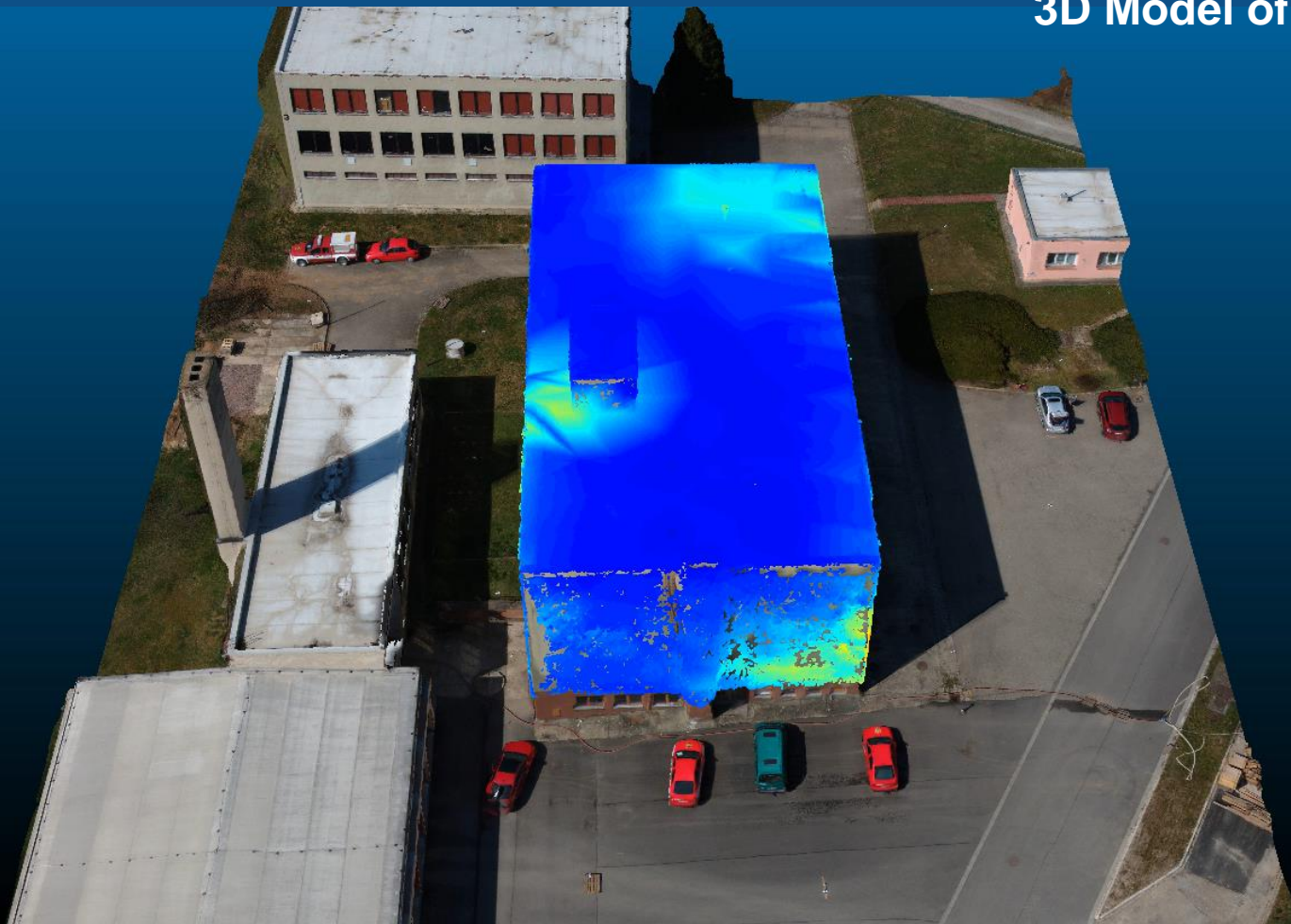


## Radiation Mapping



Implementation of 2D and 3D Photogrammetry into UAV Based Radiation Monitoring Technology

# 3D Model of Radiation Map



Thanks for your  
attention ...

