ARDENT
Advanced Radiation Dosimetry European Network Training

AUSTRIAN INSTITUTE OF TECHNOLOGY

MEDICAL UNIVERSITY OF VIENNA

UNIVERSITY OF WOLLONGONG

SEVENTH FRAMEWORK PROGRAMME

MARIE CURIE ACTIONS

ARDENT MEETING

Andrej Sipaj

October 1st, 2014

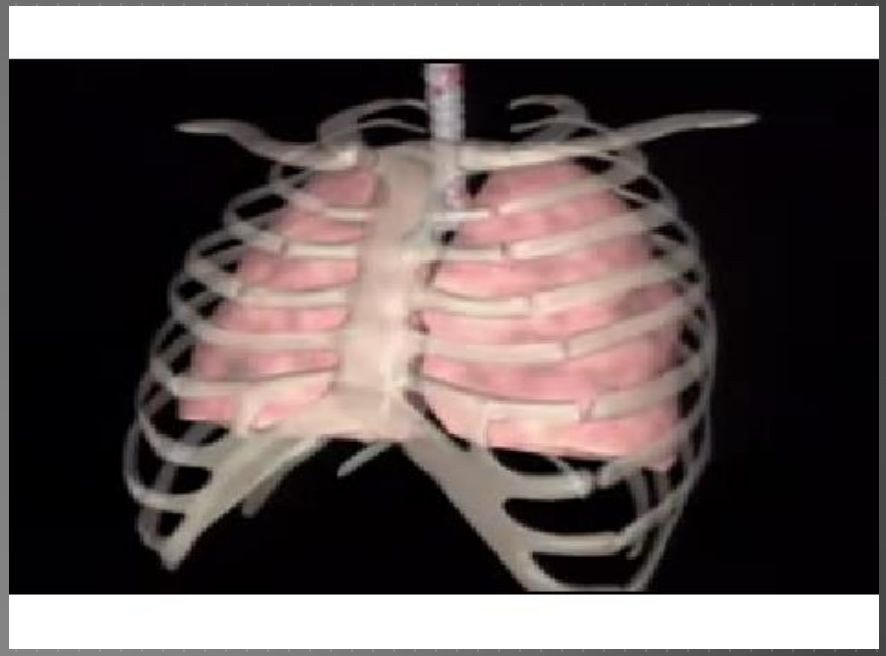
ABOUT ME

- Born and raised in Slovakia
- Studied: BEng in Mechanical Engineering at UOIT, Canada
  MASc in Nuclear Engineering (Radiation science) at UOIT
- Work at AIT, Health & Environment department, Biomedical Systems
- Enrolled at the Medical University of Vienna, PhD in Medical Physics

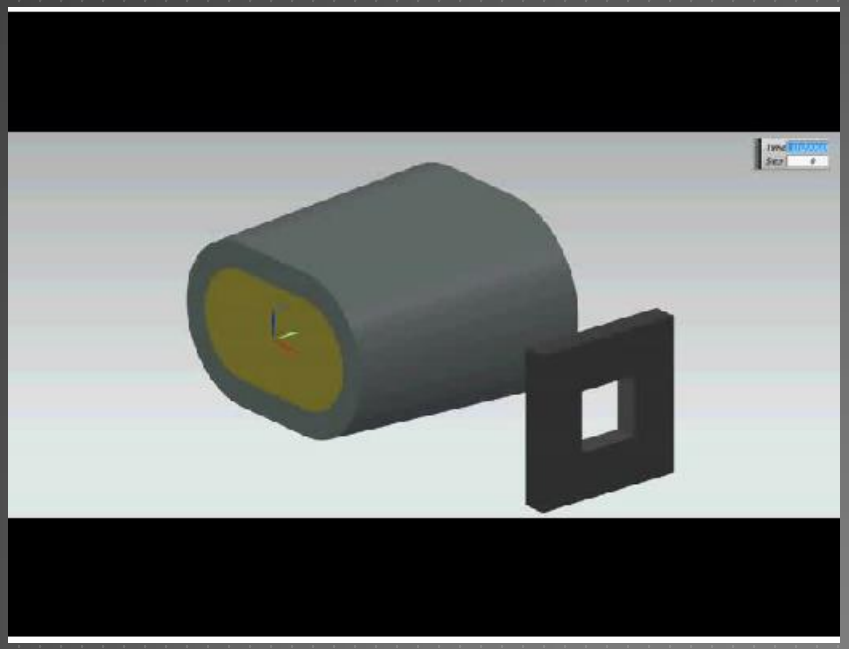
Dosimetric end-to-end test for high precision lung irradiation using a novel heterogeneous thorax breathing phantom

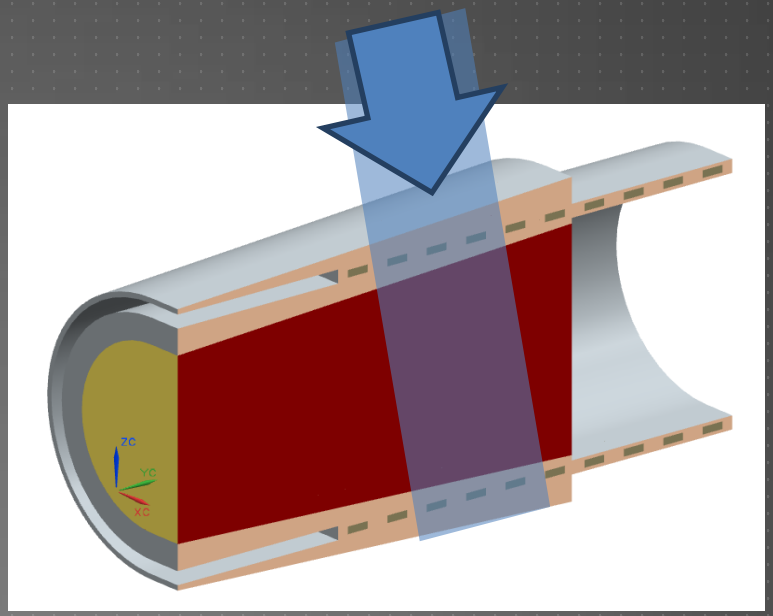
PROJECT BACKGROUND

- Objective: Measure dose to moving lung tumor (online and offline) in order to validate treatment planning system
  - The tumor is not moving alone in human body



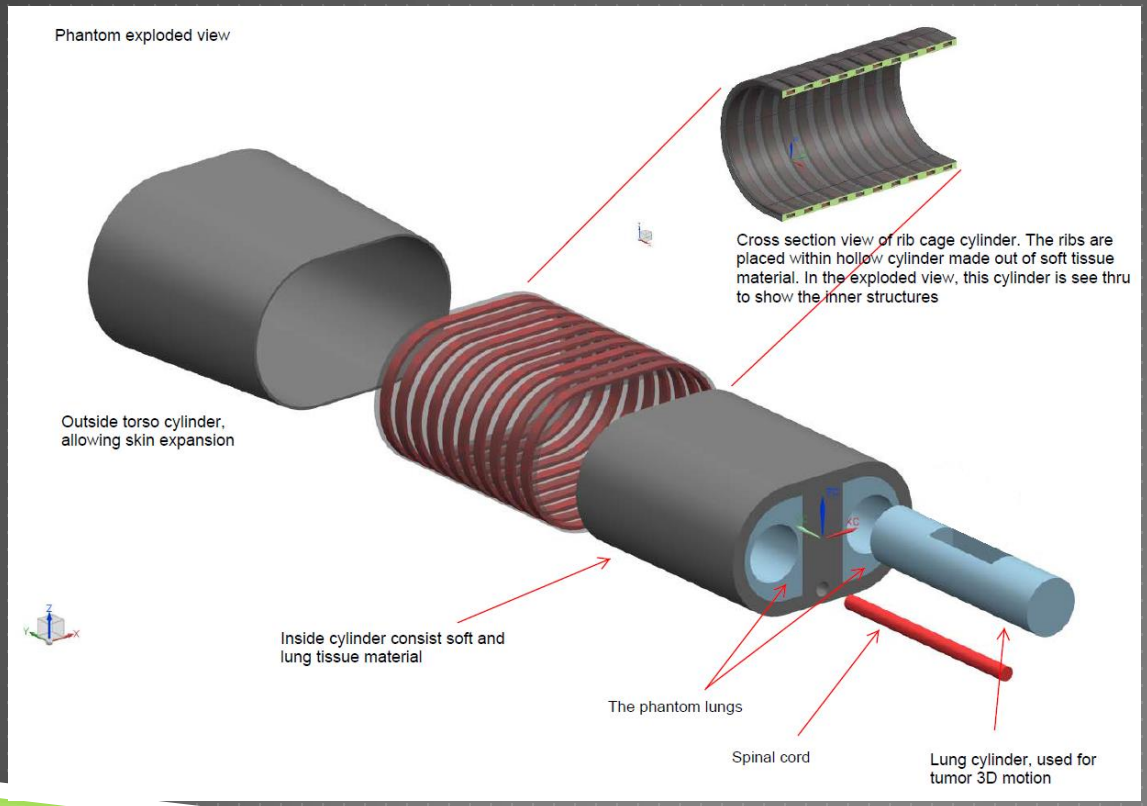
PROJECT BACKGROUND





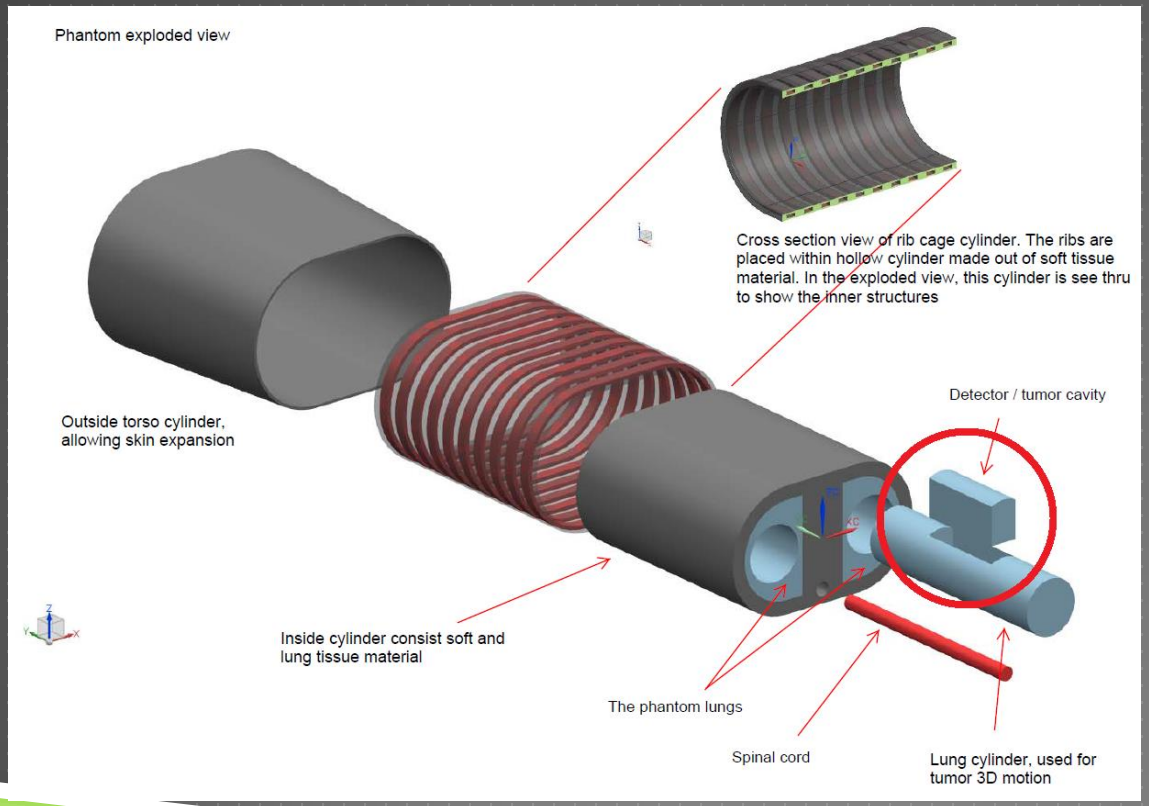
- 4 programmable independent motions
  - Tumor (rotational, translational) up to 360 degrees, 10 cm
  - Lung expansion up to 4 cm
  - Rib motion up 10 cm

HETEROGENEOUS THORAX BREATHING PHANTOM



Microcontroller system with 3x linear and 1x rotary actuators providing positional resolution of 0.1mm/0.05rad and system cycle frequency of 1/6 Hz. PC connectivity and programmability with single point USB interface.

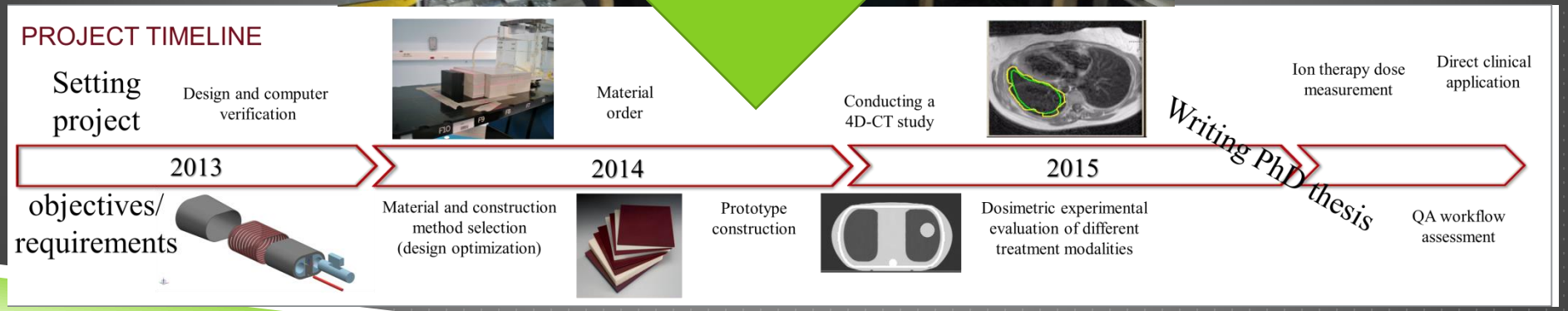
HETEROGENEOUS THORAX BREATHING PHANTOM



Detectors used up to now and being considered:

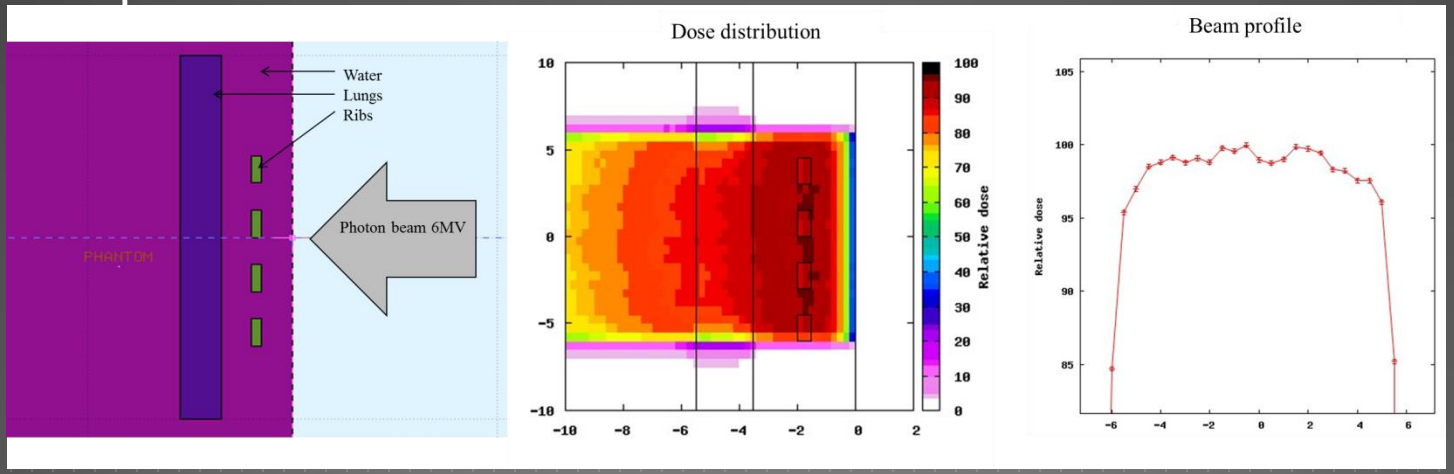
- *EBT 3 FILM*
- *Micro Diamond detector*
- *Silicon detector*
- *Ion chamber*

PROJECT TIMELINE

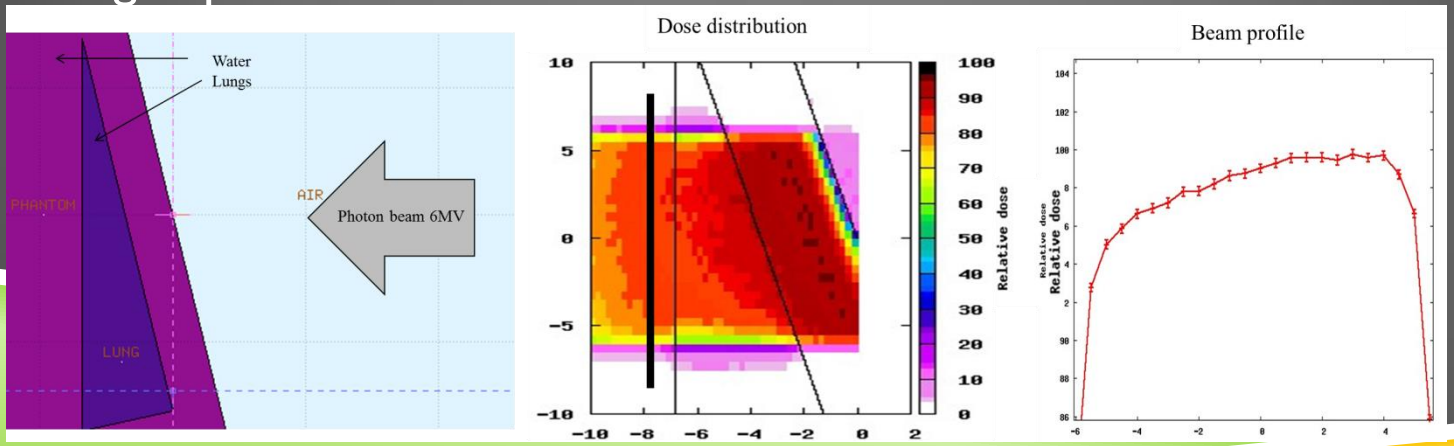


DOSE STUDIES

- Rib placement in beam direction:

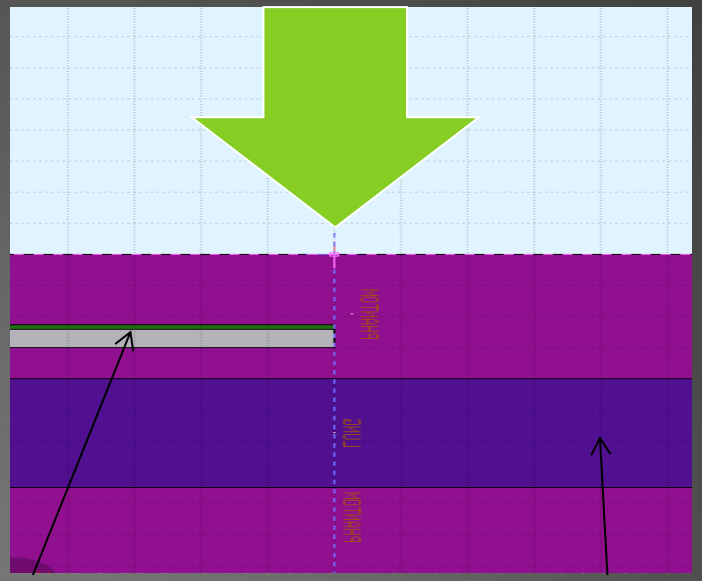


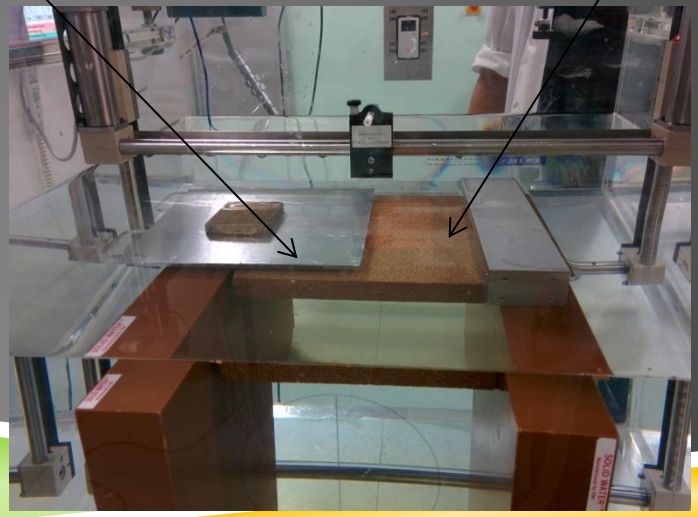
- Lung expansion in beam direction:



DOSE STUDIES

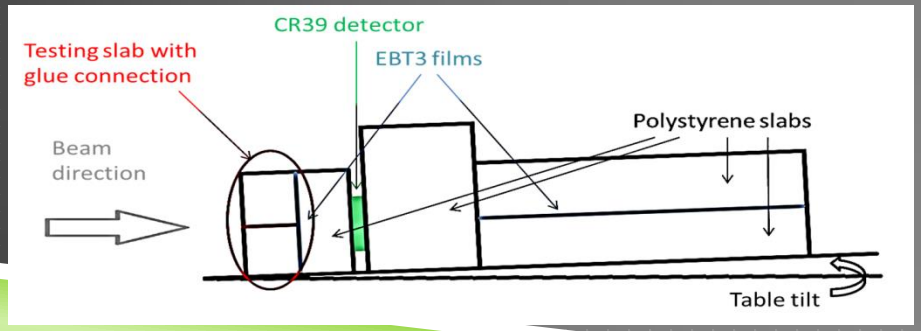
- Dose distribution measurement with "rib" placement in the direction of photon beam.
- Phantom:
  - Water
  - Cork
  - PMMA, aluminum and glue
- Detectors:
  - Micro Diamond detector (PTW 60019)
    Sensitive volume: 0.004 mm3
  - Silicon detector (PTW 60016)
    Sensitive volume: 0.03 mm3
  - Ion chamber (PTW Semiflex 31010)
    Sensitive volume: 0.125 mm3

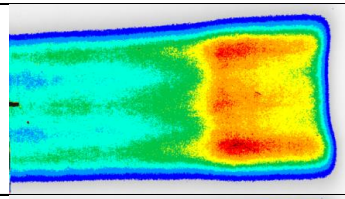
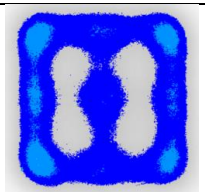
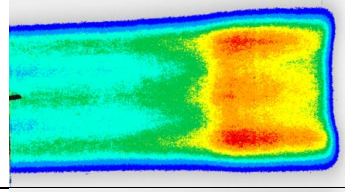
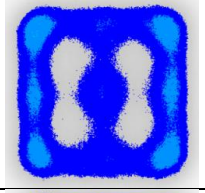
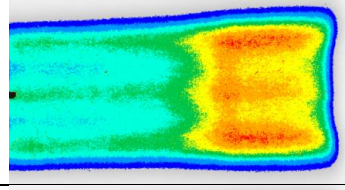
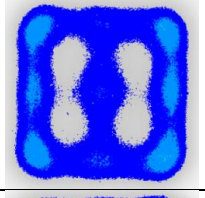
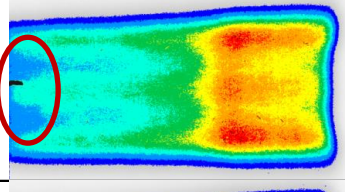
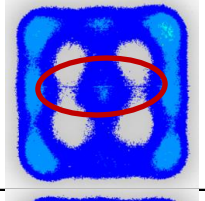
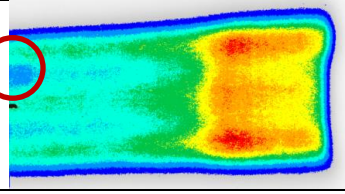
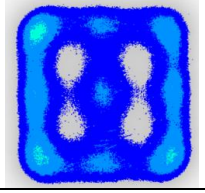




MATERIAL INHOMOGENEITY TEST

- CNAO Experimental evaluation of different connection materials and techniques for phantom construction by the use of proton beam (169.7 -185.6 MeV) and GAFCHROMIC EBT 3 films



Test Material	Parallel beam cross section dose distribution after tested material at SOBP	Perpendicular beam cross section dose distribution after tested material
Solid block / No connection material		
Pattex multi-purpose adhesive		
Tesa spray glue (flat cut)		
WELD ON polystyrene glue (flat cut)		
WELD ON polystyrene glue (45 degree Cut)		

PHD COURSES

- Basic Seminars
  - Physical Fundamentals of Radio Oncology
  - Lasers in Medicine
  - Magnetic Resonance Tomography
- Doctoral Seminars
  - Radiation Physics Applications in Radiation
- Propedeutics
  - Scientific Software and Databases
  - Project Management and Intellectual Property Rights
  - Ethics in Medicine and Good Scientific Practice
  - Clinical Studies
- Journal club
  - Advanced Radiotherapy Techniques I & II
  - Medical Radiation Physics

OTHER TRAINING ACTIVITIES

- FLUKA courses
  - 14th Fluka Course, Dresden, Germany
- Radiation protection training
- LINAC daily and monthly QA
- Eye melanoma dose measurements
- ARDENT B&A training course

CONFERENCES / WORKSHOPS

- European Congress of Radiology
  - Vienna, Austria, March/2014
- European Society for Therapeutic Radiology and Oncology
  - Vienna, Austria, April/2014
- AIT 6th Imaging in Life Science Workshop
  - Vienna, Austria, April/2014
- AIT Business Poster and IPR Workshop
  - Vienna, Austria, May/2014

OUTREACH

- University of Ontario Institute of Technology
  - November 2013
  - PhD seminar presentation
  - ARDENT activities and detectors
  - Showed interest in JABLOTRON medipix
- Austrian Institute of Technology
  - July 2014
  - Junior scientist poster award
  - Presented to AIT management and representatives from ACCENT and TECNET (startup incubators)

NEXT STEPS…

- B&A secondment
  - UOIT, 20th October – 14th November
  - Office of Research Services deals with the management of all research grants, research ethics and safety, technology transfer, economic development and international cooperation
- Picking up and testing the heterogeneous thorax breathing phantom
  - Universal Machinery Developments, Canada, 17th – 21st November
- Phantom microcontroller programming / USB interface
- 4D-CT acquisition
- Writing and publishing phantom scientific manuscript

THANK YOU FOR

YOUR ATTENTION