MATROSHKA

An ESA-Facility for Radiation Measurements under EVA-Conditions

6th Workshop on Radiation Monitoring for the International Space Station

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presented by

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MATROSHKA

An ESA-Facility for Radiation Measurements under EVA-Conditions

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Scientific Objective

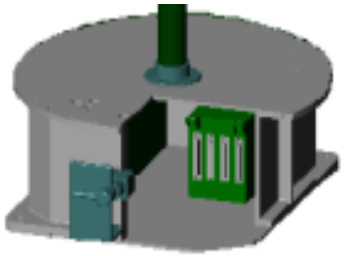
Studies of the depth dose distribution of the different components of the orbital radiation field at different sides of the organs, occurring in men being exposed during an Extravehicular Activity (EVA).

The MATROSHKA Facility shall provide:

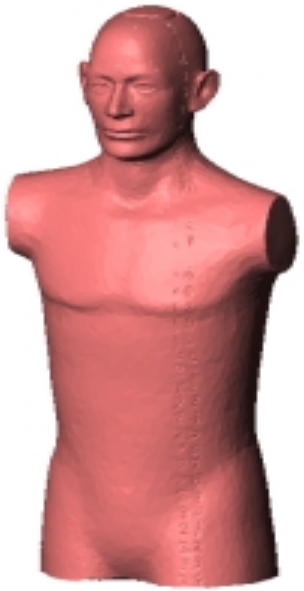
- simulating the human body with respect to size, shape, position, mass density
- housing of user provided passive and active experiment packages inside and outside the Phantom body including suited fixation of the elements and harnessing
- experiment data acquisition, storage and transfer to onboard data management system
- house-keeping data acquisition, storage and transfer to onboard data management system
- disassembly/assembly operations to exchange the passive experiments inside the Service Module

MATROSHKA simulates an astronaut during an Extra Vehicular Activity. A human phantom is exposed in a pressurized container which meets the meanmean shielding thickness of a space suit (0.5 – 1 g/cm^2).

Base structure



Phantom



Container

MATROSHKA

PHANTOM (RANDO)

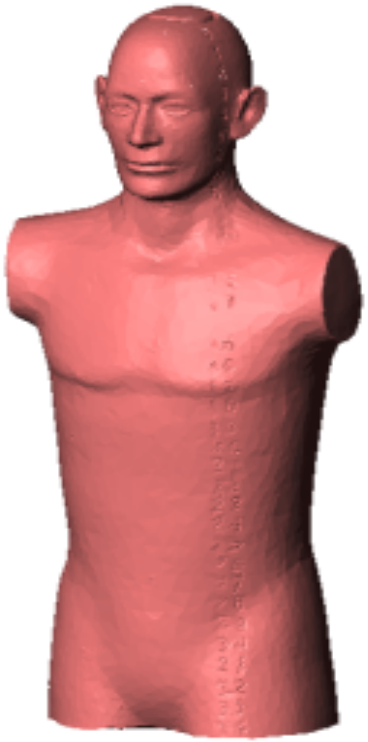
The Phantom simulates the human body with respect to

- Size
- Shape
- Mass density
- Nuclear interaction

The Phantom consists of

- Tissue equivalent material (Poly-Urethane (PU))
- Natural bone and
- PU of lower density to simulate lungs

The phantom is build up of slices of 25 mmm thickness stabled over a middle rod. Each slice provides an alignment pin to define the orientation of the slice to each other.



Computer Tomography

Detector Systems for MATROSHKA

Detector Type	Number of Sensors
Active Devices	
Dosimetry Telescope (DOSTEL) University Kiel, Germany	1
Tissue Equivalent Proportional Counter (TEPC) NASA JSC, Houston	1
Silicon/Scintillator Device (SSD) University Kiel/ DLR, Cologne, Germany	5
HiLET Device (HiLRS) NASA, GSC, Washington, USA	1
Passive Devices	
Nuclear Track Detector Packages (NTDP) University GH Siegen, Germany/KFKI Budapest Hungary, University San Francisco, USA	6
Thermoluminescence Dosimeters (TLDs) DLR, Cologne, Germany, KFKI Budapest, Hungary/ INP Krakow, Poland	numerous
Neutron Dosimeter (CR39, PC, converter foils, TLDs) PTB Braunschweig, Germany/KFKI Budapest Hungary	3

Dosimeter Locations

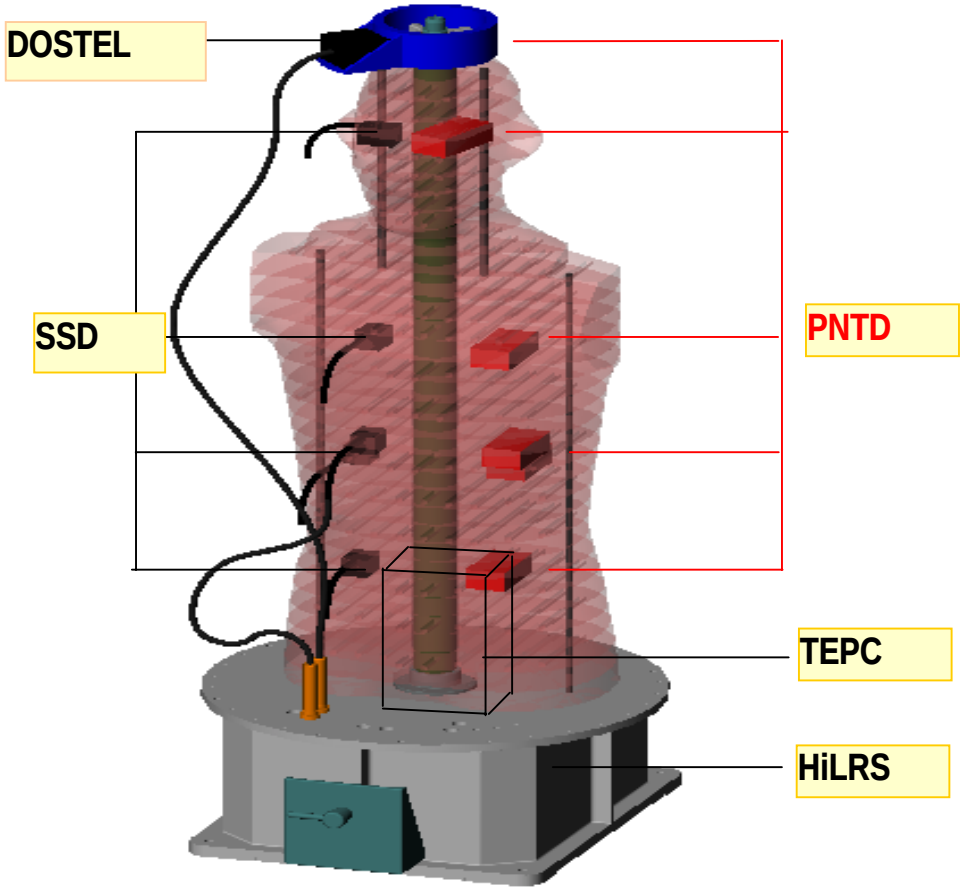
The dosimeter types SSD and PNTD are located at the sites of important organs inside he phantom.

- Bone marrow
- Colon
- Eye
- Lung
- Stomac

The TEPC is mounted in front of the phantom.

DOSTEL and one PNTD are accommodated at top of the head.

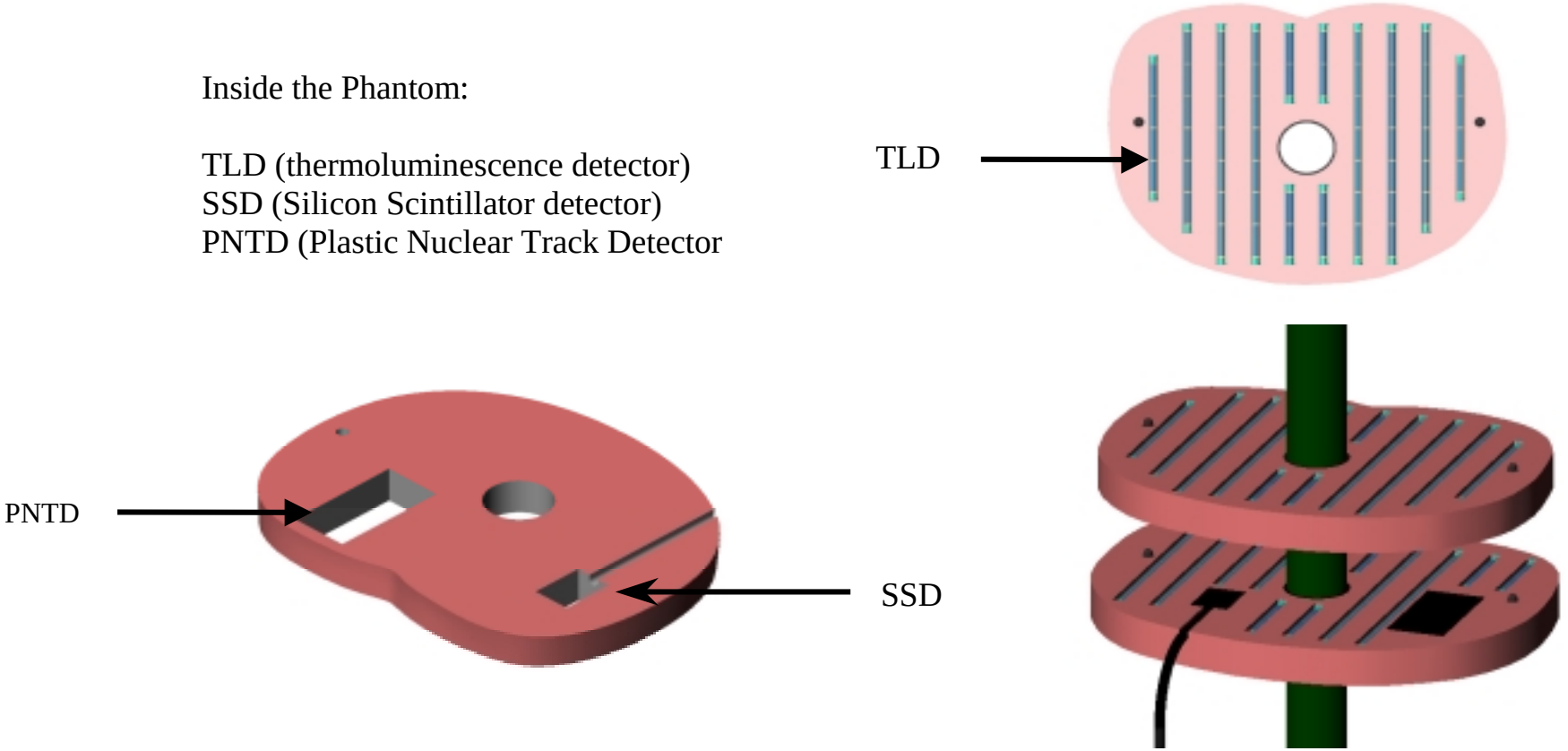
TLD crystals are distributed inside the phantom within a raster of 2.5 cm.



Integration of Dosemeters

Inside the Phantom:

TLD (thermoluminescence detector)
SSD (Silicon Scintillator detector)
PNTD (Plastic Nuclear Track Detector

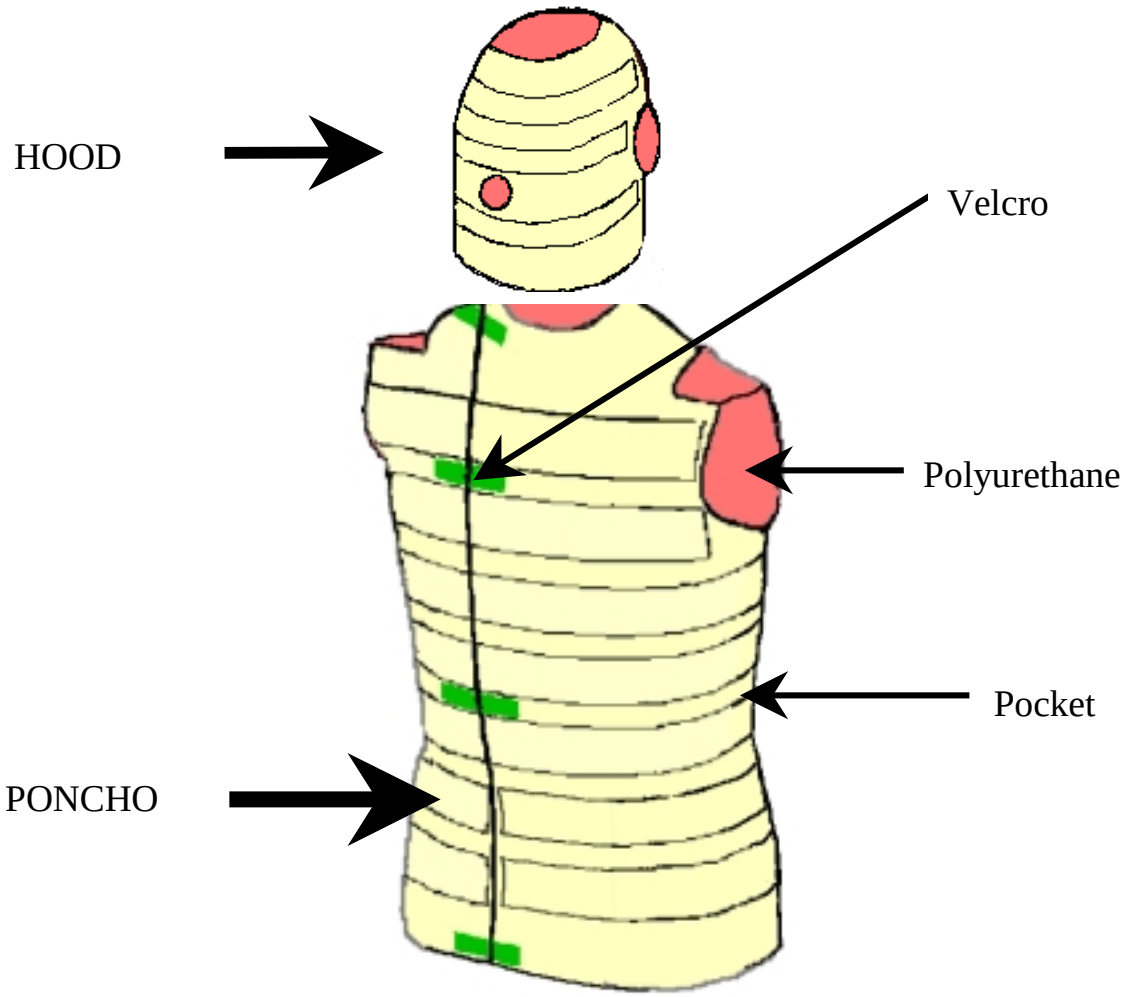


Integration of Dosemeters

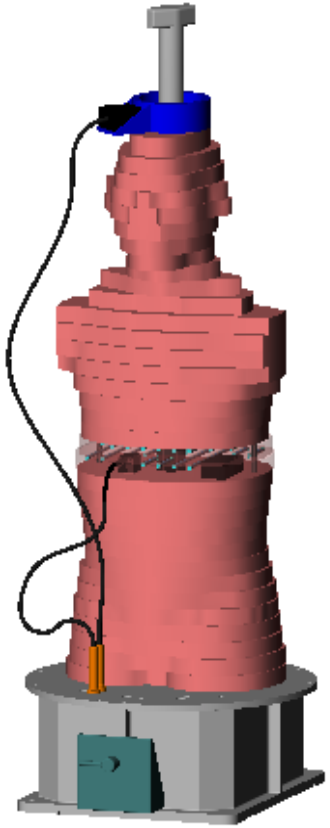
On the phantom surface:

The Phantom is dressed with a Poncho and a Hood made of Nomex.

The Poncho has pockets allowing integration of stripes equipped with TLD crystals.

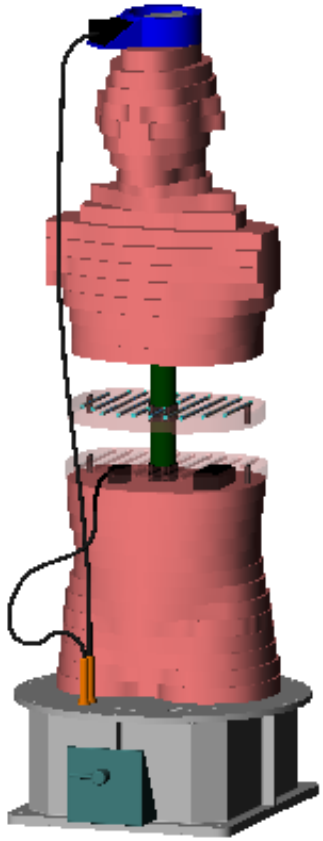


Removal of Passive Dosimeters



For disassembly the middle rod is extended by an additional rod piece. This allows to shift the single slices of the phantom by 15 cm. The inserted dosimeters can than be removed easily.

The harness is long enough that during assembly the active experiment needs not to be disconnected.



Facility Milestones (status Jan 25, 02)

Preliminary Design Review Close-Out	Oct 2001
Critical Design Review	Aug 2002
Delivery of MATROSHKA Training Model	Jul 2002
Delivery of MATROSHKA Technical Model	Feb 2003
Delivery of MATROSHKA Flight Model	Aug 2003
Launch date	end 2003

Experiment Milestones

Delivery of Experiments for the MAT Technical Model **Nov 2002**

Delivery of experiment engineering models including preliminary software. The models have to provide all external interfaces and to allow all experiment operations. Perfect is an experiment prototype, but it is not mandatory.

Delivery of experiments for the MAT Training Model **Jun 2002**

Training models need just to provide mechanical interfaces.

Delivery of experiments for the MAT flight Model **Apr 2003**

Delivery of experiment flight models.