



# MATROSHKA- Overview 2004 - 2006

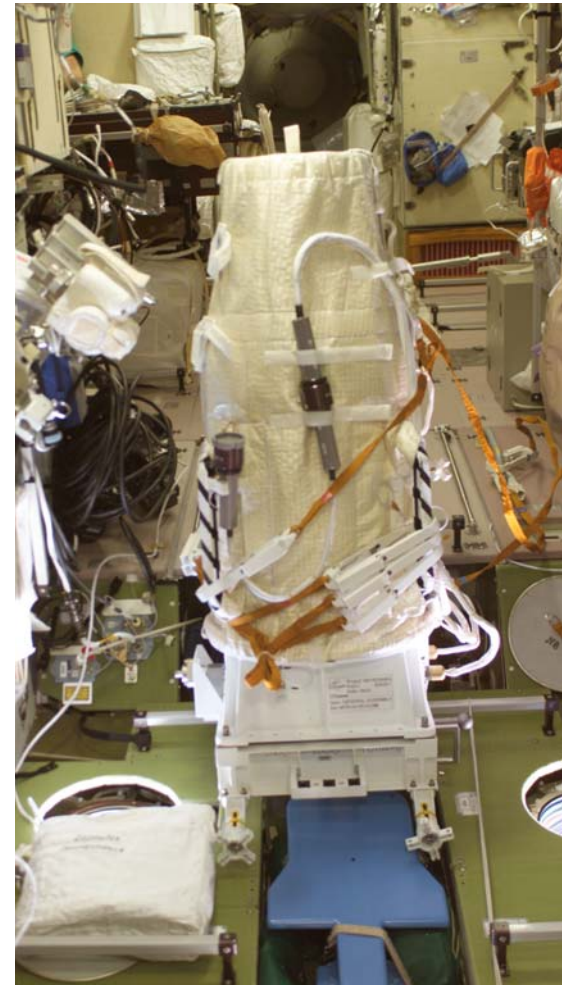
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Institute of Aerospace Medicine, 51147 Cologne,  
Germany*



## Objective and Benefits (1/2)

- Exposures in long-term missions approach or even exceed radiation protection limits
- More accurate risk assessments are required
- Risks are based on organ doses
- Organ doses are determined by the use of anthropomorphical phantoms
- **MATROSHKA** is designed to determine the required exposure of an astronaut/ cosmonaut using a human phantom torso equipped with active and passive radiation sensors
  - during an extravehicluar activity
  - MATROSHKA 1 and MATROSHKA „Phase C**
  - inside the ISS Modules
  - MATROSHKA 2 A/B**



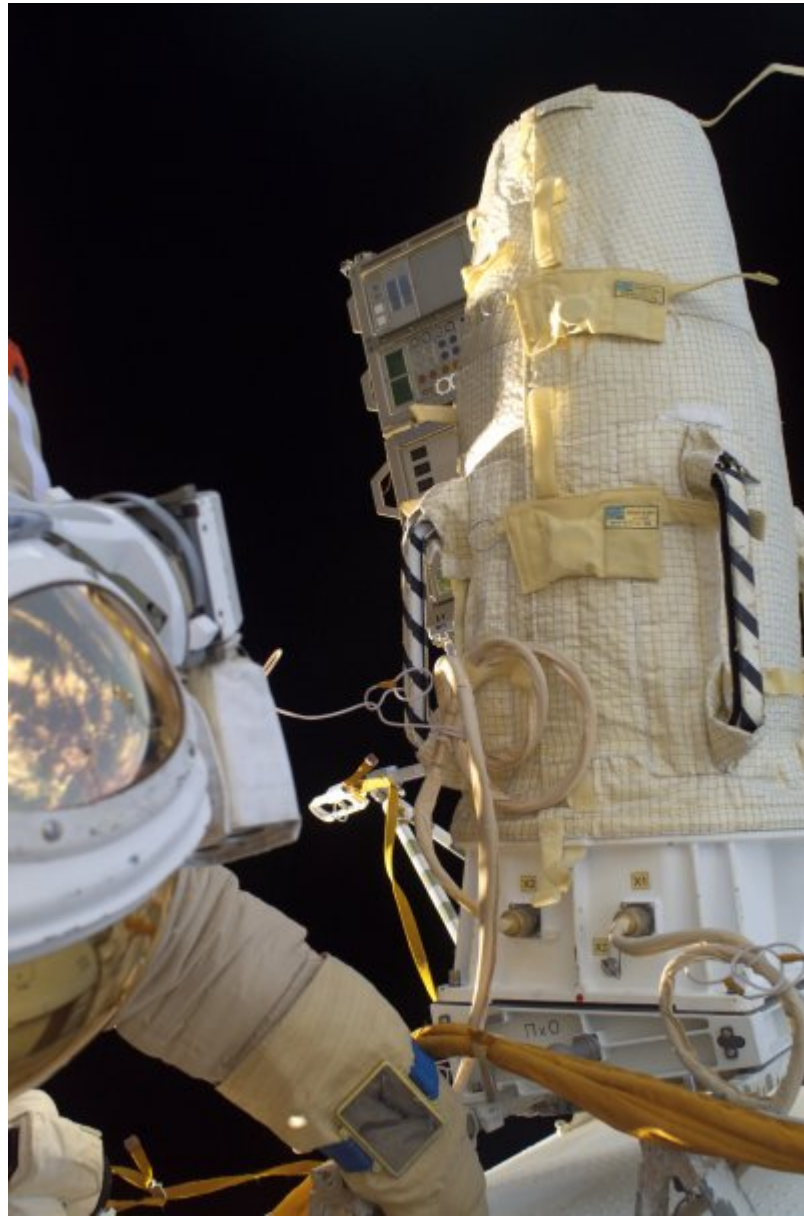
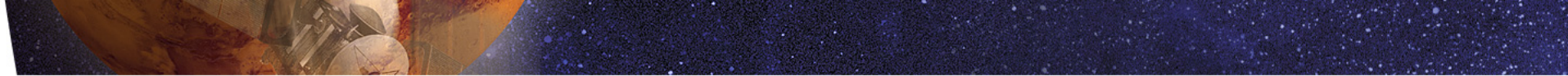
MATROSHKA inside ISS  
January 2004

## Objective and Benefits (2/2)

- **MATROSHKA** provides for
- Skin dose measurements
- Measurement of depth dose distributions inside the phantom
- Measurements at the positions of selected organs
- Assessment of organ doses
- Benchmarking for model calculations
- Improved radiation risk estimates for long duration spaceflights

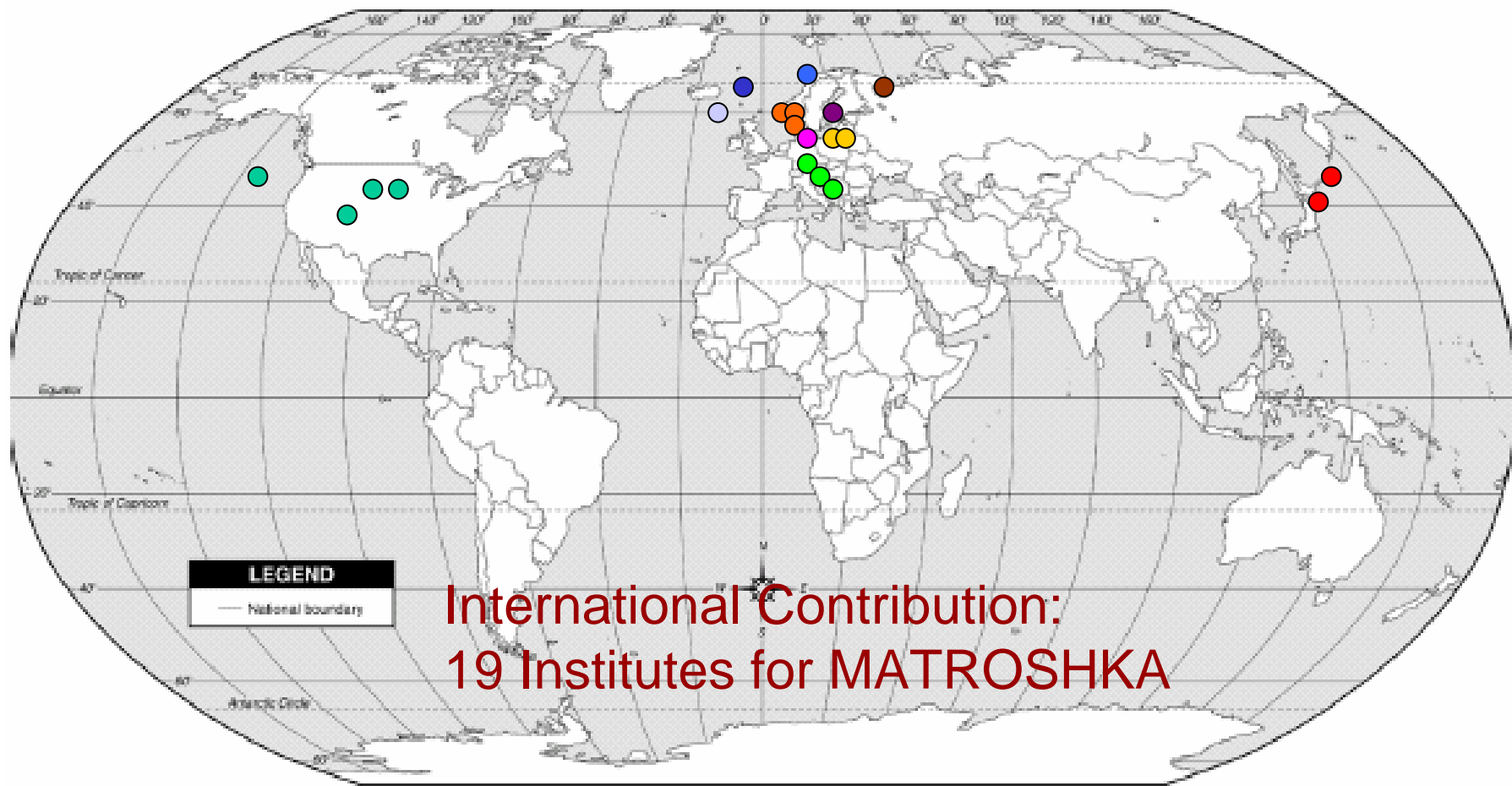


MATROSHKA-1 EVA February 2004



**ESA Multi-User  
Facility**

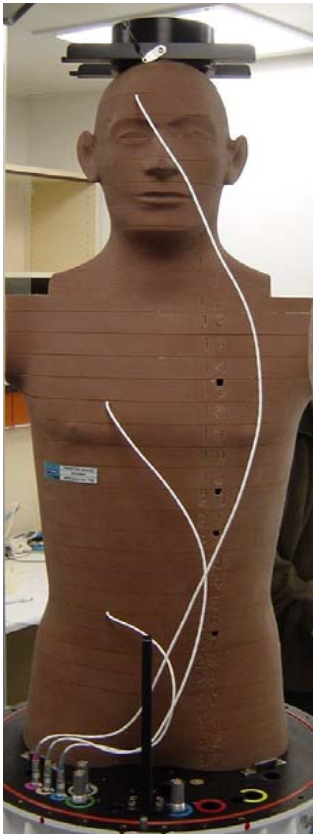
**Science and Project Lead: G. Reitz, DLR  
Russian Co-PI: V. Petrov, IMBP**



**International Contribution:  
19 Institutes for MATROSHKA**

# MATROSHKA Facility

Phantom Torso



+ Poncho



+ Container



+ MLI (MTR-1)



# MATROSHKA Facility – Active radiation detectors

**DOSTEL**  
(Dosimetric Telescope)

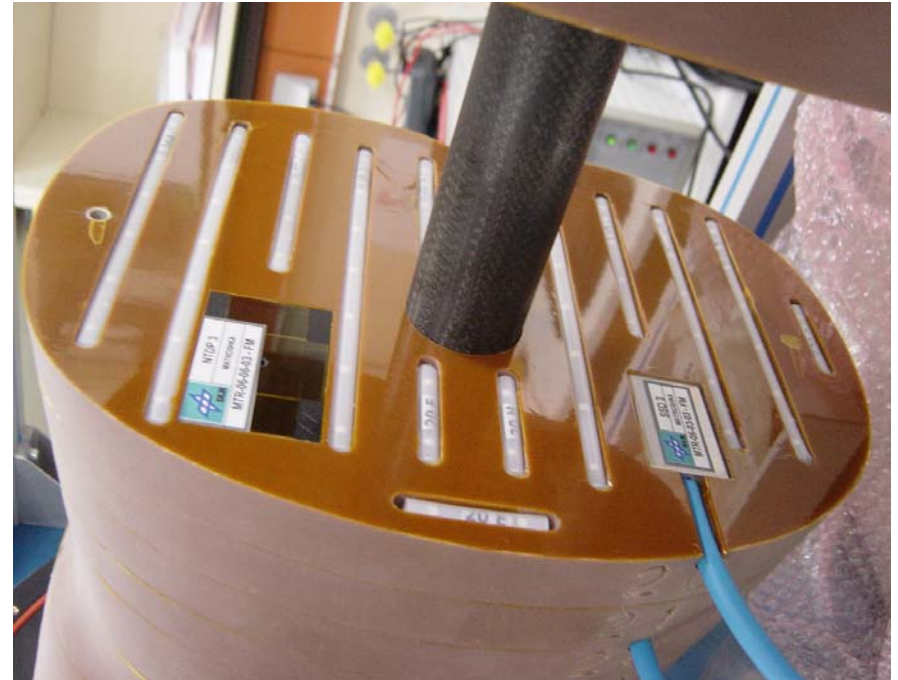


**SSD**  
(Silicon Scintillator Device)

- Eye
- Lung
- Stomach
- Kidney
- Intestine

**TEPC**  
(Tissue equivalent proportional counter)

## MATROSHKA Facility – Passive radiation detectors



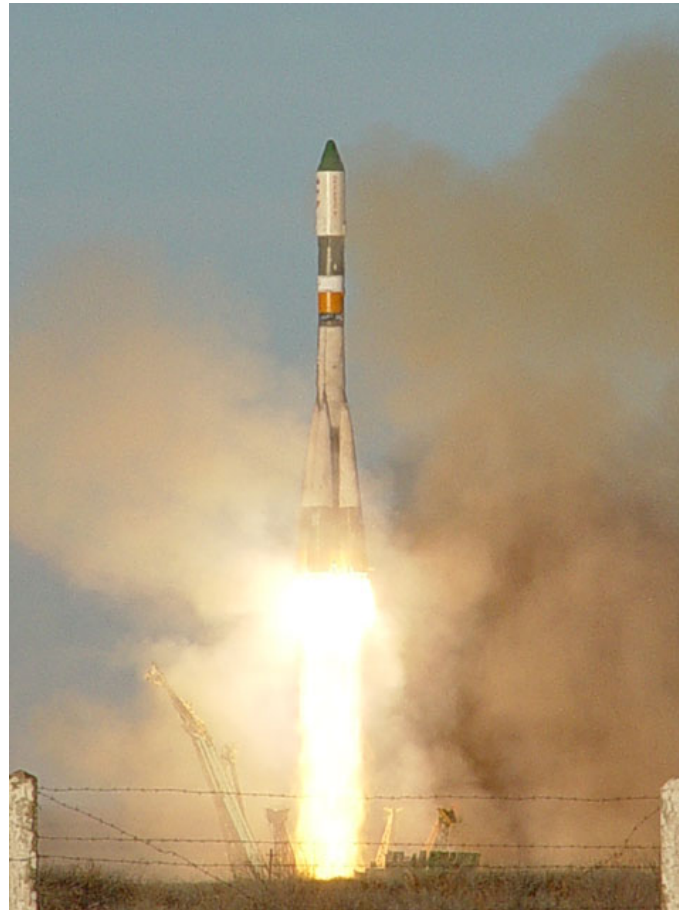
Thermoluminescence detectors (TLDs) and Nuclear Track Etch detectors  
Total Number : ~ 6000



# MATROSHKA-1 Timetable

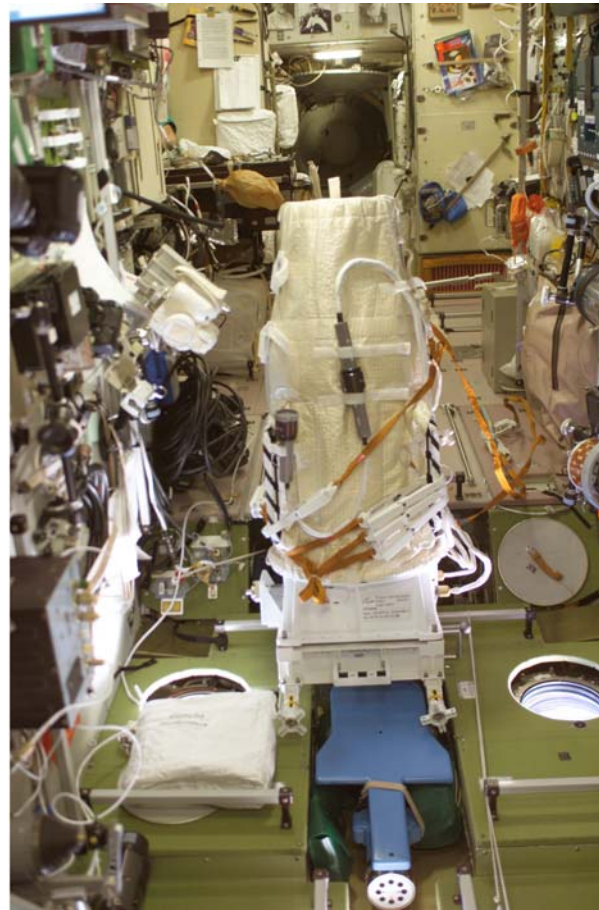
Increment	8	Launch of MATROSHKA	29. January 2004 with PROGRESS
		Docking with ISS	31. January 2004
		EVA	26. February 2004 performed by expedition 8 crew Alexander Kaleri Michael Foale
		Activation of the active instruments	April 2004
	8 - 11	Outside Exposure	26. February 2004 – 18. August 2005
	11	EVA	18. August 2005 performed by expedition 11 crew Sergei Krikalev and John Phillips
		Dismounting of the passive detectors	14. September 2005 performed by expedition 11 crew Sergei Krikalev and John Phillips
		Detector download	With Soyuz landing 11. October 2005

# MATROSHKA-1



MATROSHKA 1 Launch 29. January 2004

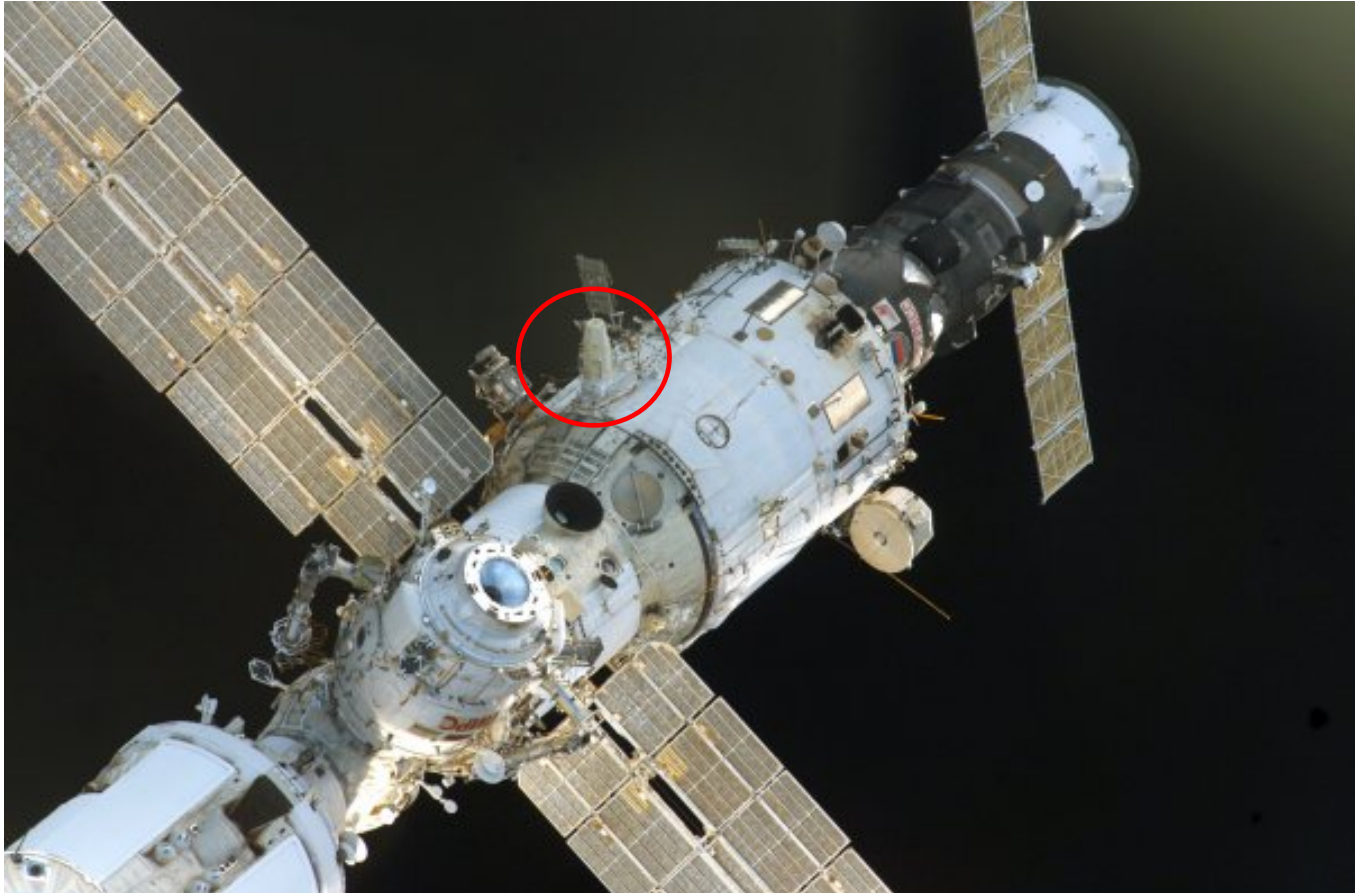
# MATROSHKA-1



MATROSHKA 1 inside the station 31. January - 26. February 2004



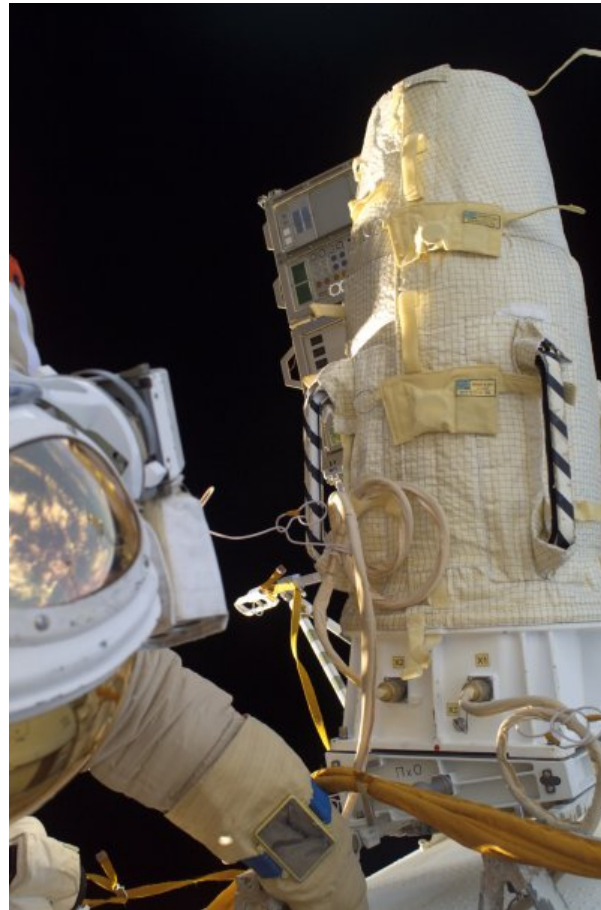
# MATROSHKA-1



MATROSHKA mounted outside the ISS 26. February 2004 – 18. August 2005



# MATROSHKA-1



18. August 2005 – MATROSHKA Retrieval EVA

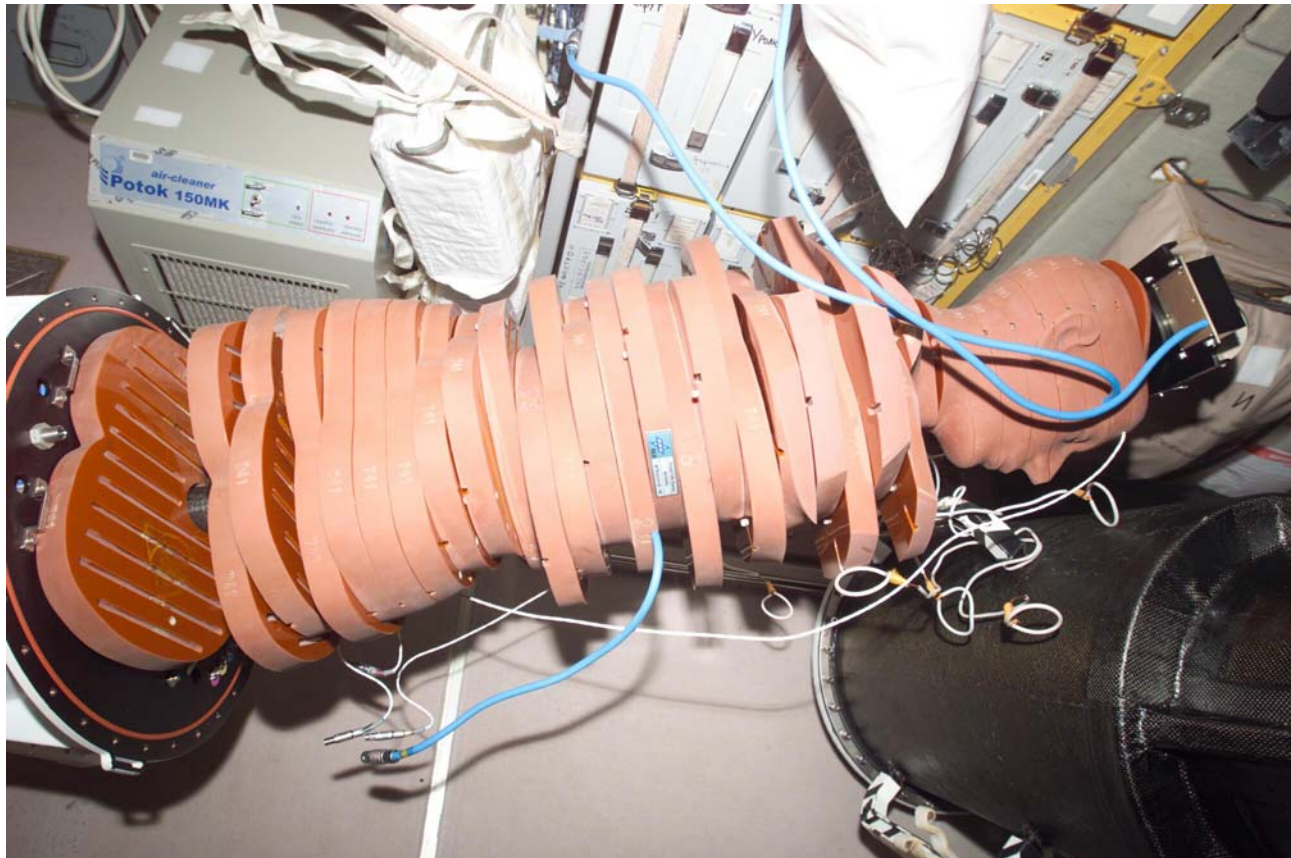


# MATROSHKA-1



14. September 2005 – MATROSHKA 1 Detector dismounting

# MATROSHKA-1



14. September 2005 – MATROSHKA 1 Detector dismounting



## MATROSHKA-1 Exposure Times

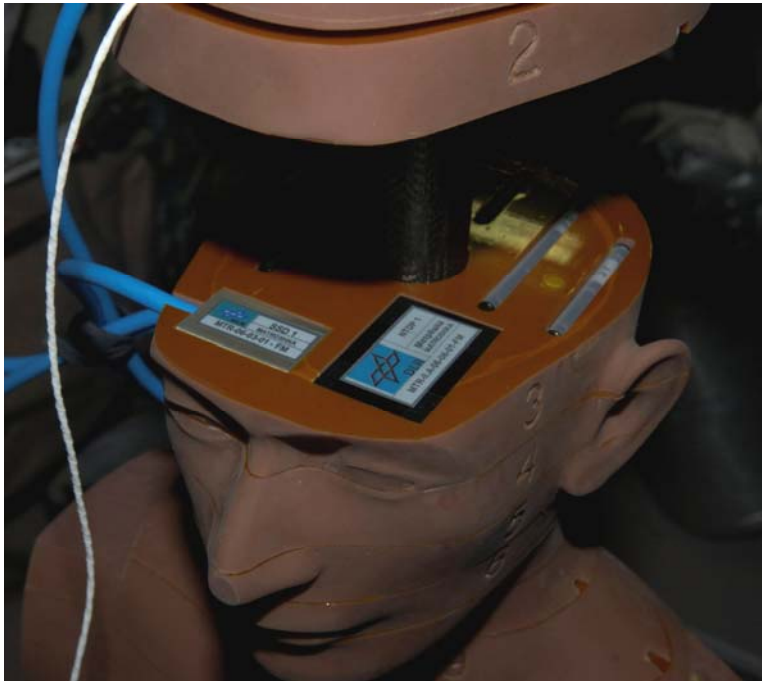
- MTR 1: Space Exposure (total)  
31. January 2004 – 08. October 2005 → **616 days**
  
- MTR 1: Outside Exposure (total)  
26. February 2004 – 18. August 2005 → **539 days**
  
- MTR 1: Inside Exposure (total = 77 days)  
  
31. January 2004 – 26. February 2004 (Detectors inside → 26 days)  
18. August 2005 – 14. September 2005 (Detectors inside → 27 days)  
14. September 2005 – 08. October 2005 (Detectors outside → 24 days)
  
- Inside Background: **53 days detectors inside MTR**  
**24 days detectors outside MTR**



# MATROSHKA-2 Timetable

Increment	12	New Detector upload – Start of <b>MATROSHKA-2 Phase A</b> (passive)	21. December 2005 with PROGRESS 20P
		Integration of the passive detector set into the MATROSHKA Facility	05. January 2006 performed by expedition 12 crew William McArthur and Valery Tokarev
	12-13	Exposure time for <b>MATROSHKA-2 Phase A</b>	January - December 2006
	13	Dismounting of the passive detectors / Detector Download MATROSHKA-2 Phase A	December 2006
	14	Start of <b>MATROSHKA-2 Phase B</b> (passive and active)	Early 2007
		Exposure and measurement time for <b>MATROSHKA-2 Phase B</b> (including ALTEINO)	~ 6 months

## MATROSHKA-2 / A Detector mounting



MATROSHKA-2 Phase A passive detector mounting January 2006

## MATROSHKA-2 / A Exposure Inside ISS



MATROSHKA-2 Phase A ISS exposure in the docking compartment (DC-1)

## MATROSHKA-2 / B Exposure Inside ISS

- MATROSHKA -2 / B includes besides passive radiation the activation of the active detectors
- MATROSHKA will be relocated in the SM of the ISS
- MATROSHKA will be equipped with 2 PILLE ISS detectors
- **ALTEINO** will provide a characterisation of the radiation environment in the mounting place of MATROSHKA



**ALTEINO** on board the ISS

# MATROSHKA Status Summary

- MATROSHKA was the first Phantom experiment outside the ISS and is the biggest international radiation experiment ever performed in space
- MATROSHKA showed full functionality during the whole mission
- First results are now available and are presented during the 11th WRMIS <http://www.oma.be/WRMIS/>
- The MATROSHKA experiment is continued with two internal exposure periods of 9 and 6 months **MTR 2 Phase A/ B**, followed by a further outside exposure of 12 month **MTR 2 Phase C**