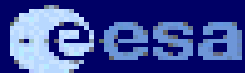
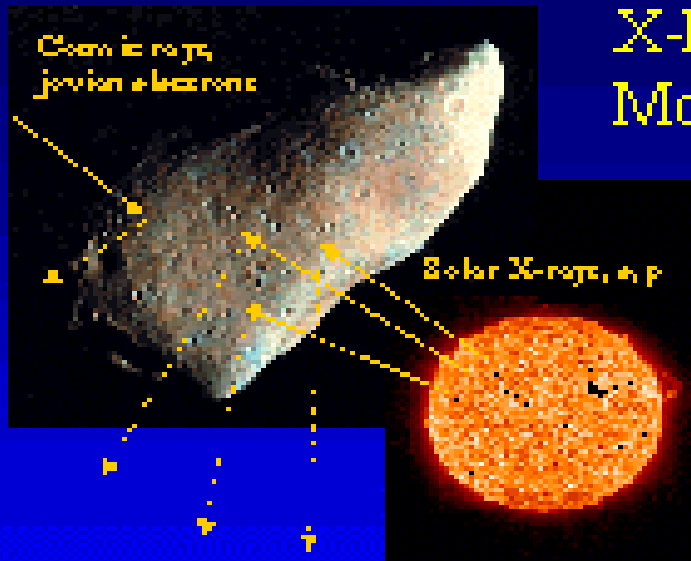


# BEPICOLOMBO MERCURY MISSION



ESA Space Environment &  
Efficient Analysis Section



## X-Ray Surveys of Asteroids and Moons

Induced X-ray line emission:  
indicator of target composition  
(~ 100  $\mu\text{m}$  surface layer)

← Count  
↓  
C, N, O line emissions included

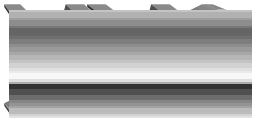
# The main questions about Mercury

- Why Mercury is so dense?
- What is the geological history of Mercury?
- What is the structure of Mercury's core?
- What is the nature of Mercury's magnetic field?
- What are the unusual materials at Mercury's poles?
- What is on the unseen hemisphere of Mercury?
- What new constraints can we set on general relativity and gravitational theories?

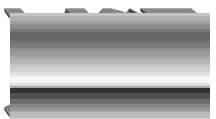
# The spacecraft



Multi-spectral imaging, IR,UV,X-ray spectrometer,  
Neutron spectrometer, K-ray transponder,  
Accelerometer, Altimeter



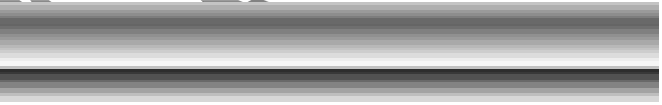
Magnetometer, Ion spectrometer  
Electron electrostatic analyzer  
Cold and energetic plasma detectors  
Plasma wave analyzer




*In situ* chemical and mineralogical observations on  
the surface of Mercury



## The physics



It arises from the solar X-ray flux, sufficient, for the inner planets, to fluorescence significant fluxes to an orbiter



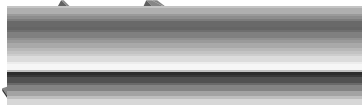
Significant only during particle events, during which it can exceed XRF

## The goal

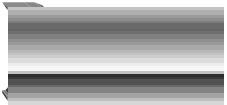
Developing surface maps of absolute concentrations for the various major elements



- Feasibility study for the experiment
- Optimization of the detector by a forecast of the experimental results



## ESA Proposal



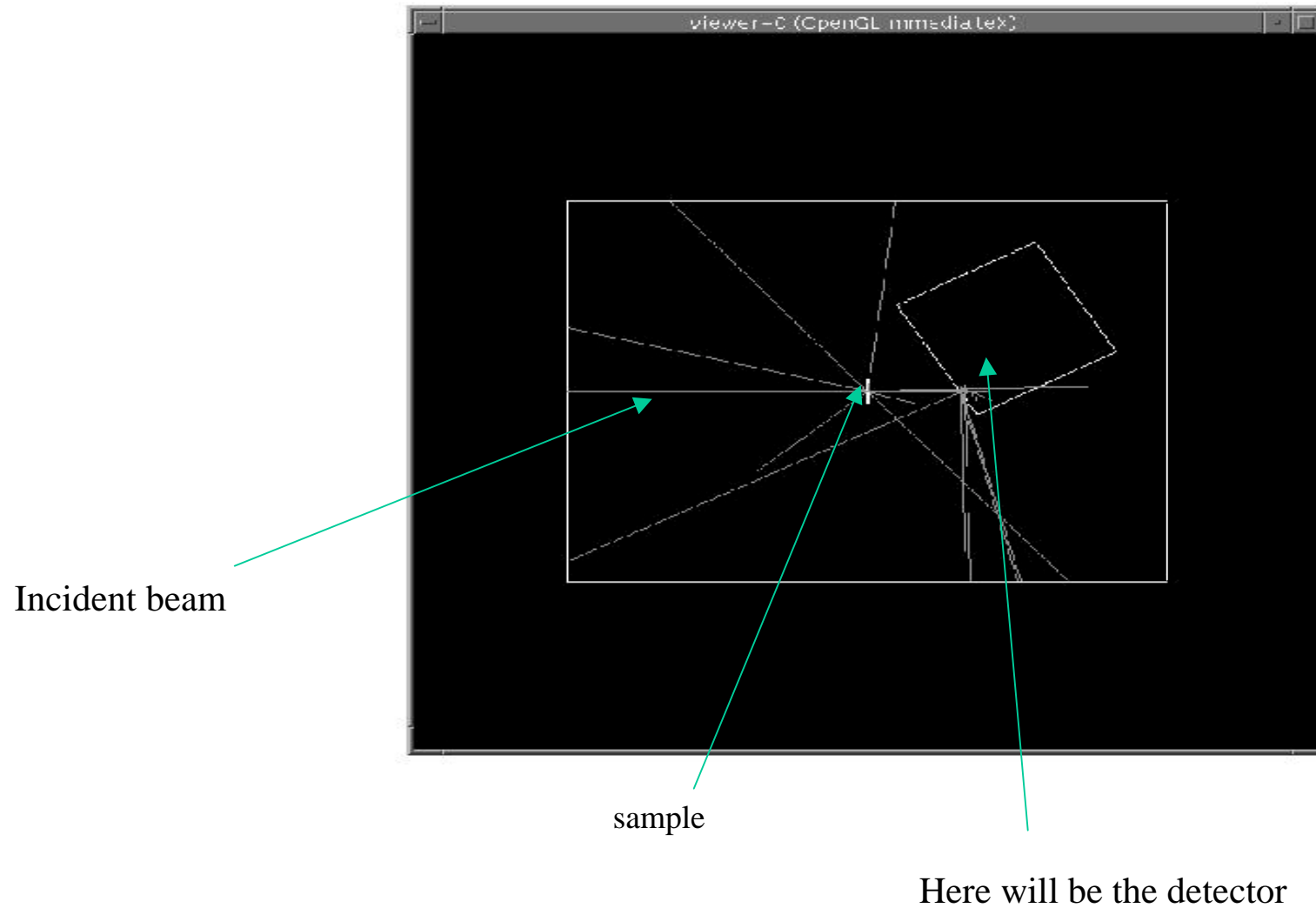
- The work will be concluded within the end of December 2001
- The proposal is being released in spring 2002



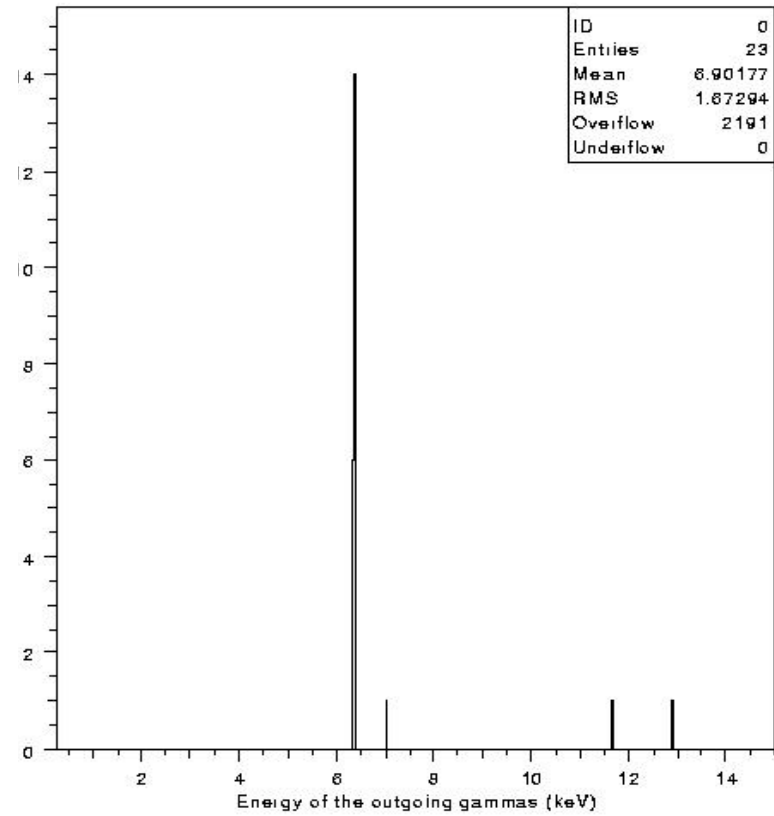
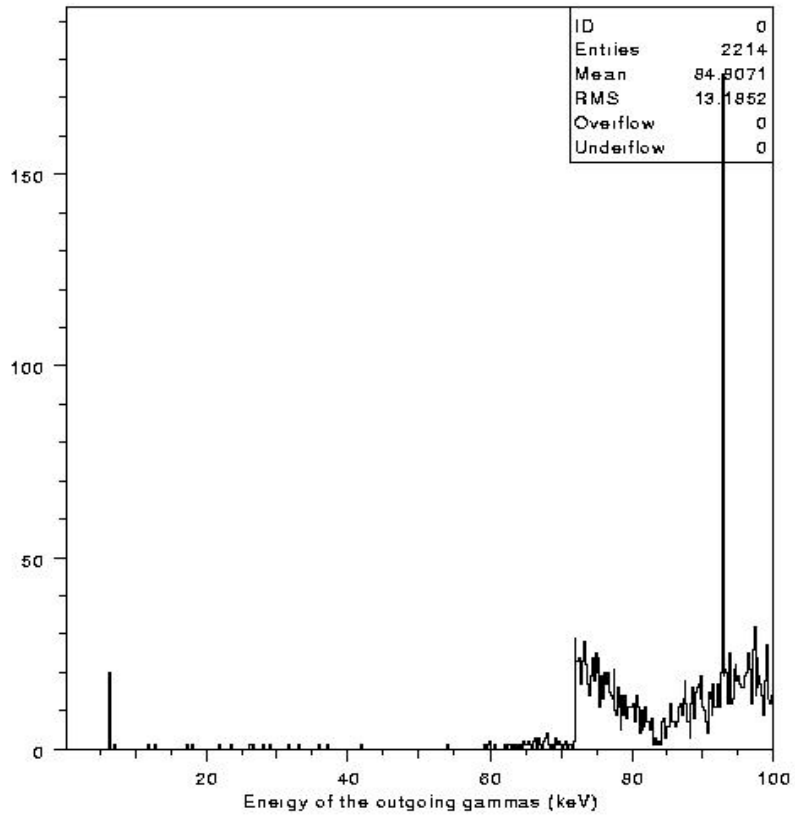
The project plane of the experiment is cyclic in the way of developing:

- a first approximate instance of the experimental set-up will be constructed, with a simple cube as a target of a monochromatic beam
- a test beam with an similar set-up will take place, and the experimental results will be compared with those coming from the simulation in order to test its code
- the virtual set-up will be modified and made closer to the final one
- another test beam will take place and the results will be compared again
- After a number of tests the definitive simulation will be written, with the planet Mercury as the target of a beam whose composition will be provided by ESA Space Environment Section

A beam of photons of 100 keV is shot on a sample...



# Iron: all the photons leaving the sample

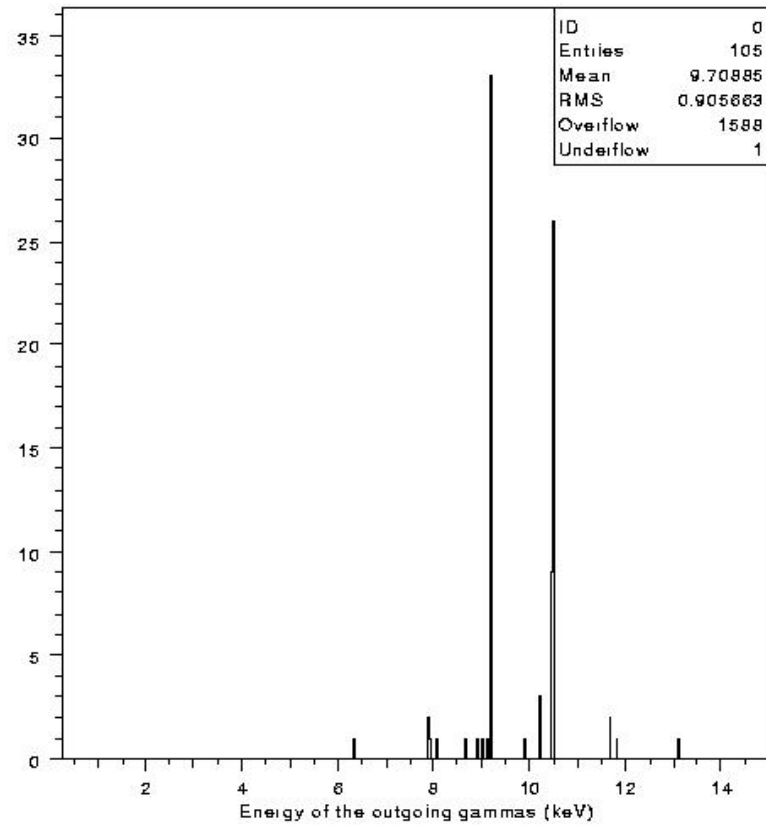
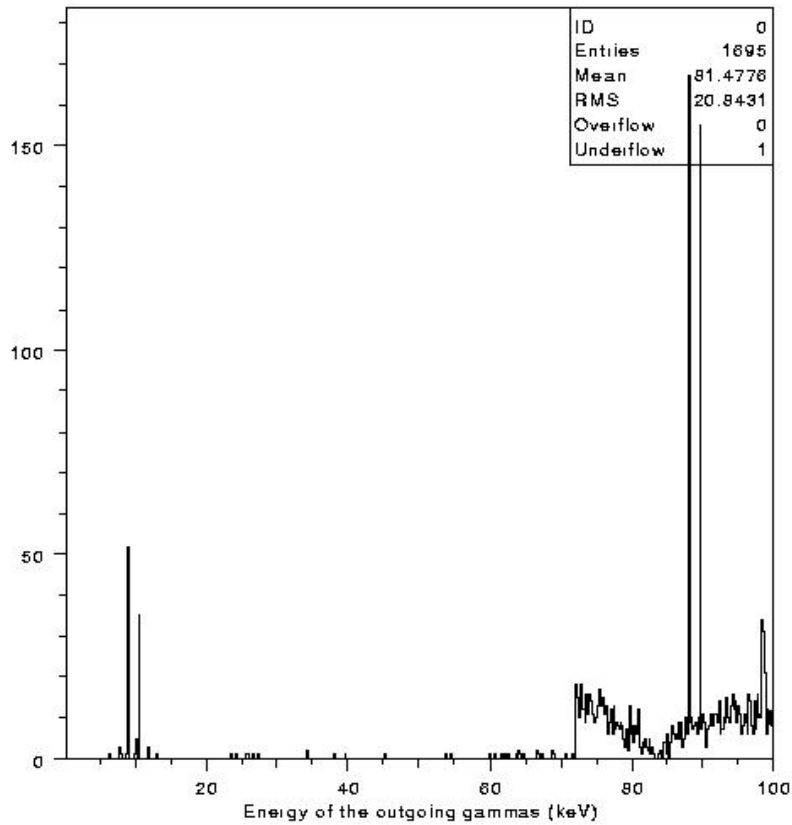




## Radiative Transitions of Fe

Subshell	Transition probability	Emitted Photon(eV)
K L2	1.01391 -1	6349.85
K L3	1.98621 -1	6362.71
K M2	1.22111 -2	7015.36
K M3	2.40042 -2	7016.95
L2 M1	4.03768 -3	632.540
L2 M4	1.40199 -3	720.640
L3 M1	3.75953 -3	619.680
L3 M5	1.28521 -3	707.950

# GaAs: all the photons leaving the sample



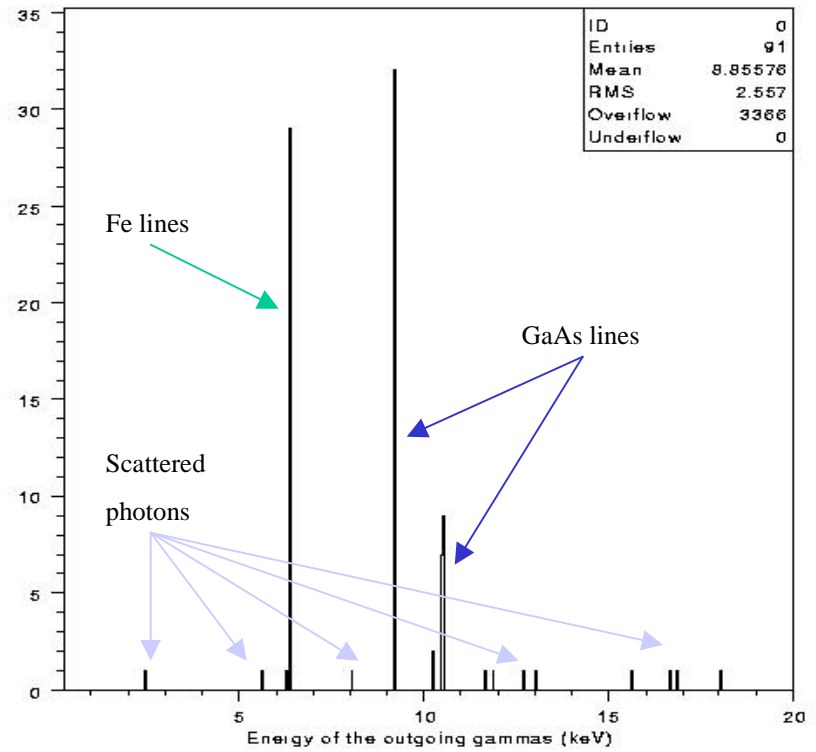
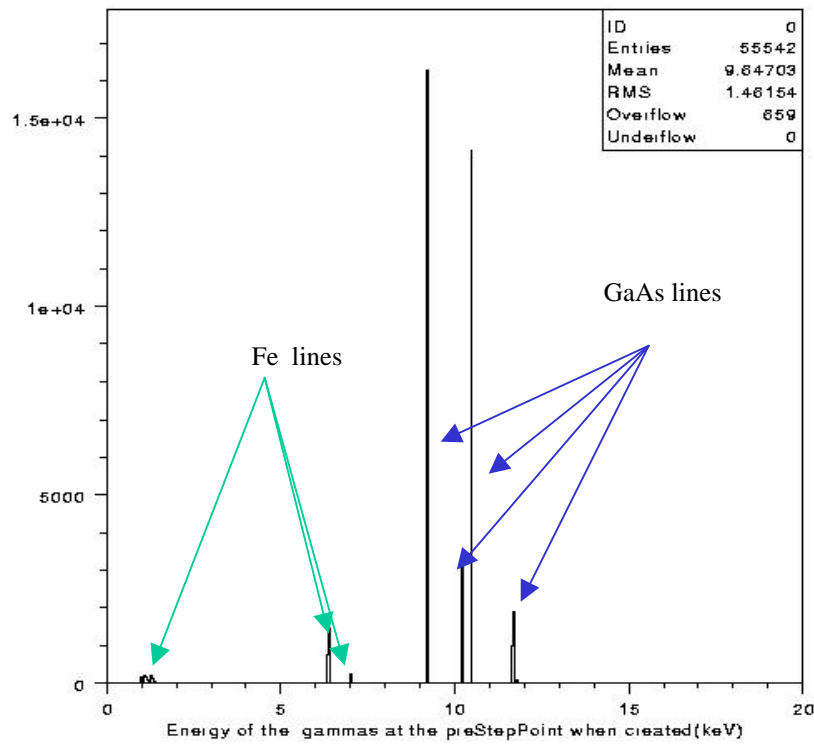
## Radiative transitions of Ga

Subshells	Transition Probability	Emitted Photon(eV)
K L2	1.49780 -1	9180.60
K L3	2.91200 -1	9209.00
K M2	1.89300 -2	10220.0
K M3	3.69890 -2	10223.7
L1 M3	1.28631 -3	1183.42
L2 M1	4.43283 -3	992.650
L2 M4	7.53404 -3	1123.03
L3 M1	4.30092 -3	964.250
L3 M5	6.71294 -3	1095.13

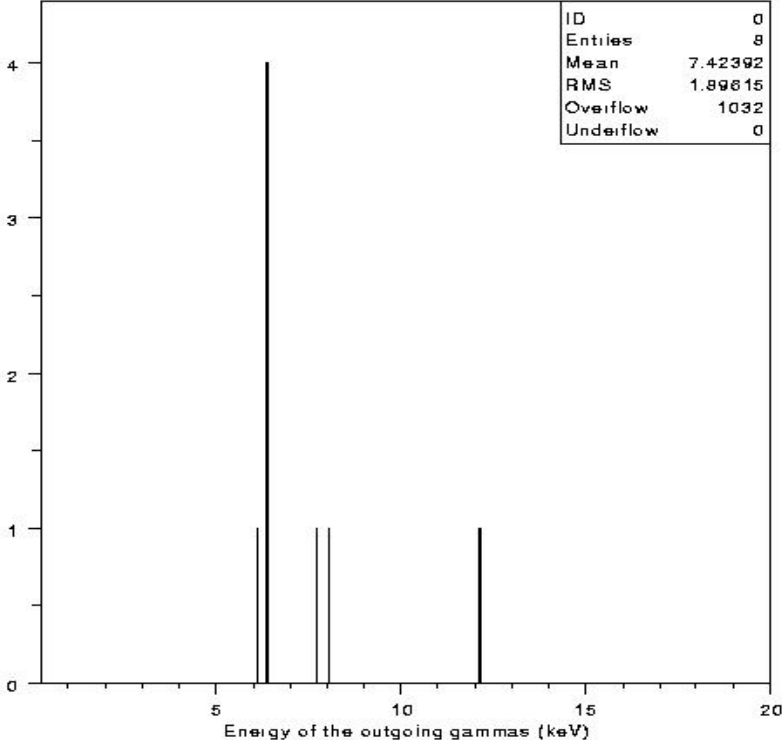
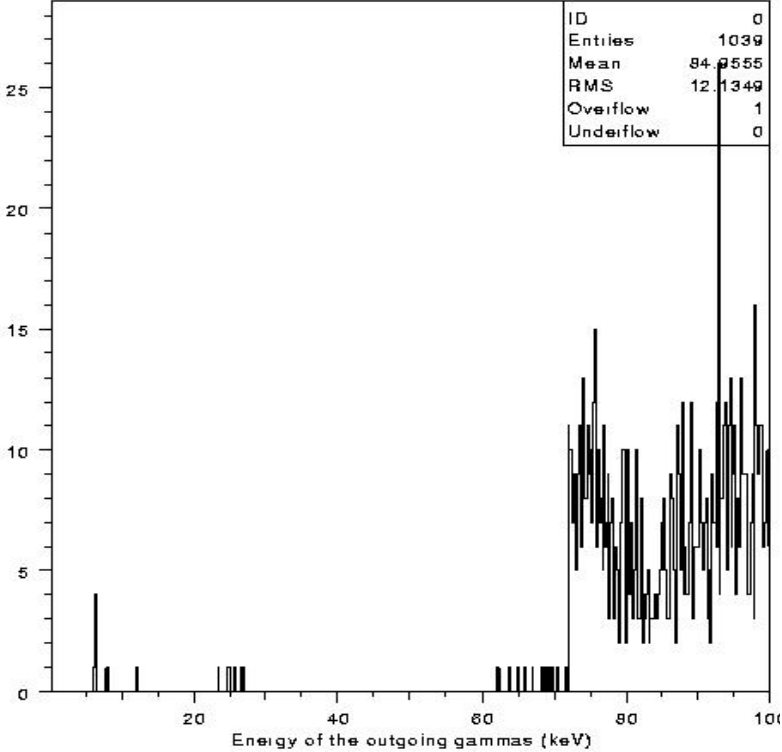
## Radiative transitions of As

Subshell	Transition Probability	Emitted Photon (eV)
K L2	1.66890 -1	10463.3
K L3	3.23251 -1	10500.7
K M2	2.20590 -2	11680.0
K M3	4.30891 -2	11685.2
K N3	1.29230 -3	11821.2
L1 M3	1.55206 -3	1375.42
L2 M1	3.97241 -3	1163.68
L2 M4	1.12390 -2	1314.38
L3 M1	4.16398 -3	1126.28
L3M5	1.00090 -2	1277.75

# GaAs + Fe: all the photons generated (1) and leaving the sample (2)



# Basalt: all the photons leaving the sample



# Now:

- Tested x-ray emissions from different materials
- Reproduction of the experimental set up of the test beam
- Comparison of the data from the test beam with those from the simulation

# Next Steps:

- Reproduction of the surface of Mercury (from a model provided by the Astrophysic Division of ESTEC)
- Reproduction of the incident solar beam (from a model provided by Petteri Nieminen's group)
- Insertion of the detector (from the work of Simeone Dussoni)
- Effects of the losses of photons due to the bodies interposed between the detector and the planetary surface