

THE NEW GAMMA-SCANNING AND TOMOGRAPHY SYSTEM IN THE  
HOT CELL LABORATORY OF THE FORSCHUNGSZENTRUM JÜLICH

by

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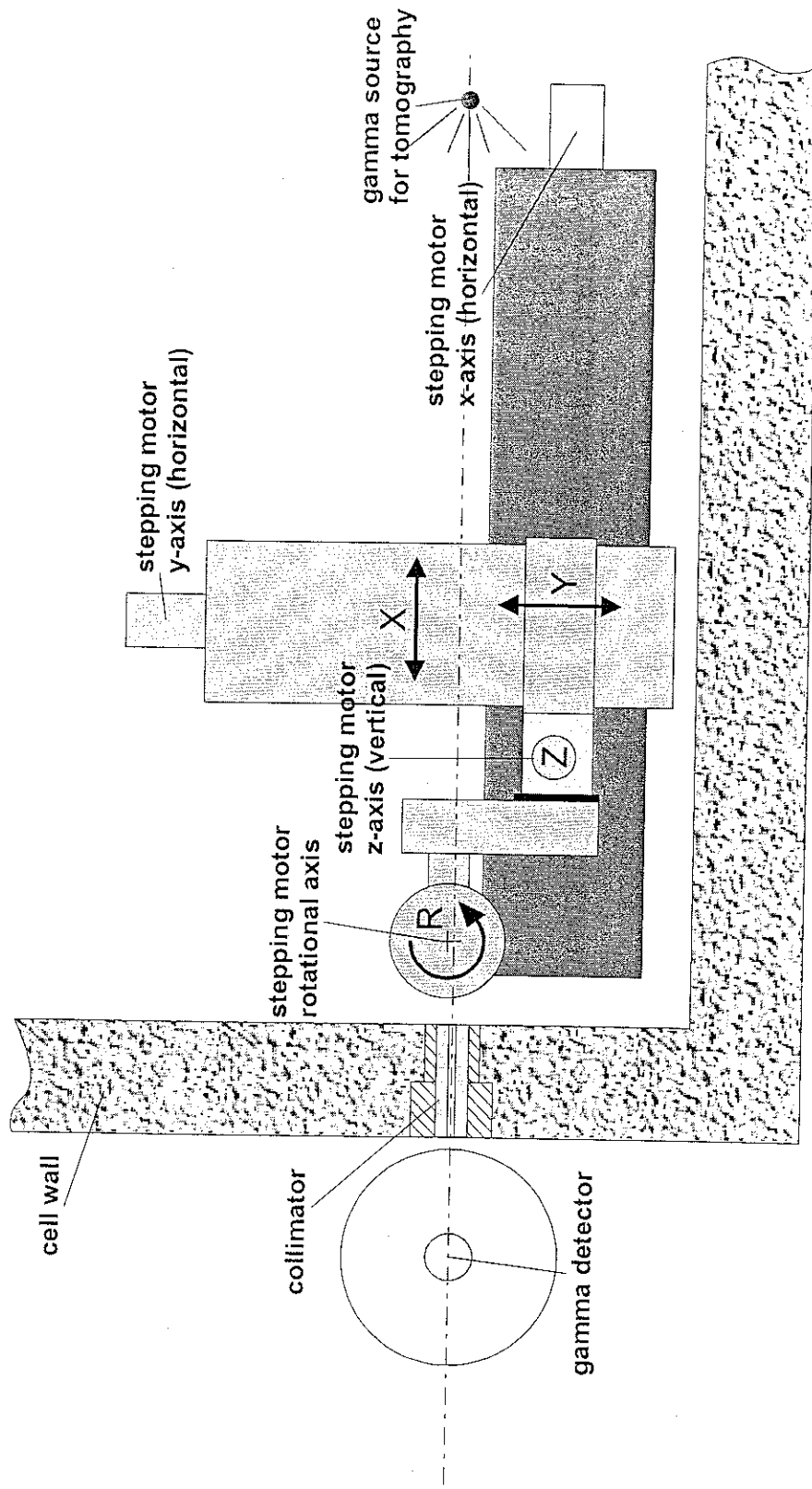
## OVERVIEW

1. Introduction
2. The new gamma-scanning system (hardware)
3. The automatic controlling system (software)
4. Some results
5. Conclusions

## INTRODUCTION

- Non-destructive radioactive measurement techniques:
  - gamma-scanning for activity distribution of the sample,
  - tomography for density and activity distribution inside of the sample
- Old gamma-scanning system:
  - 3-axis (2 linear and 1 rotation) with fixed distance between sample and gamma-detector,
  - stepping motors too weak to handle heavy samples,
  - frequent repairs caused by non-capsulated, oxidized end-switches,
  - computer controlling system supports only 1 linear and rotational axis as necessary for tomography (the system was mainly used for this purpose)

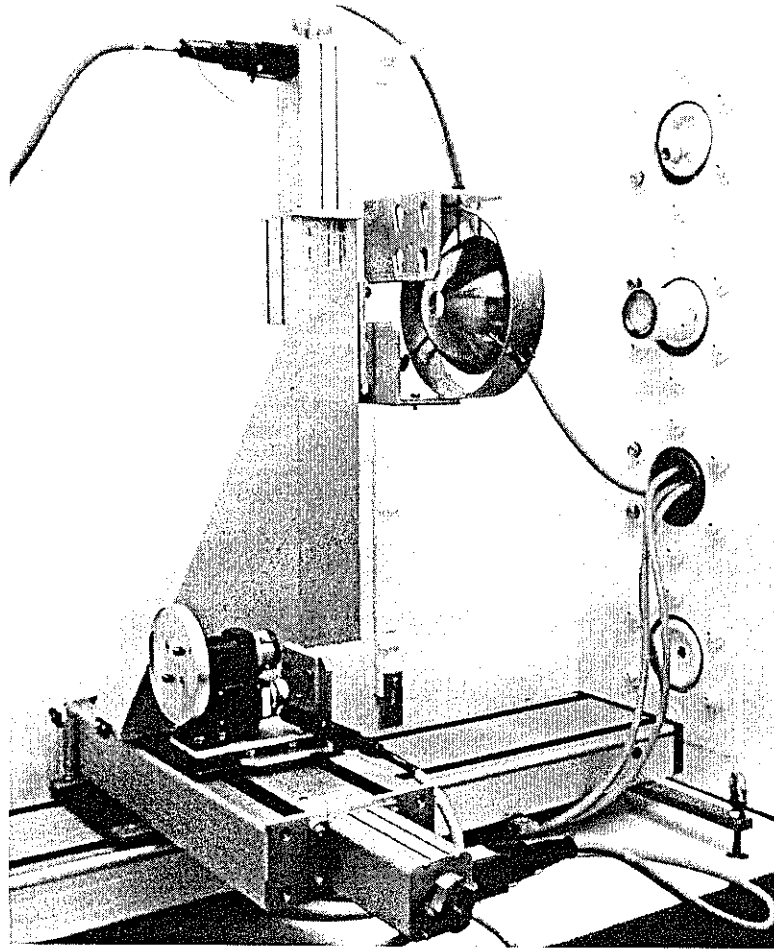
# THE NEW GAMMA-SCANNING DEVICE (SCHEMATIC)



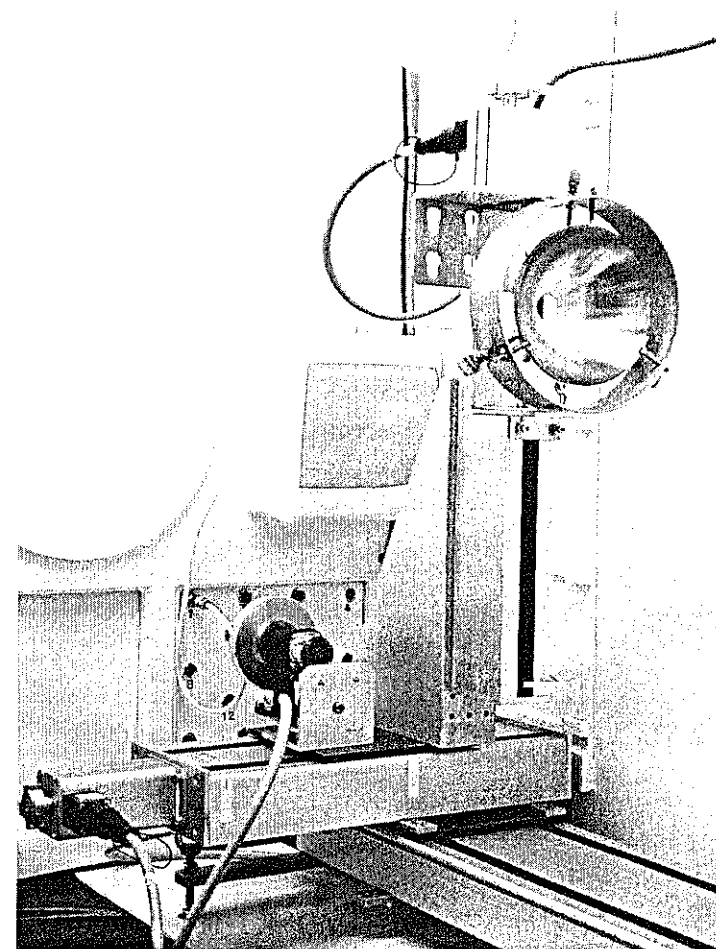
## CAPABILITIES OF THE GAMMA-SCANNING DEVICE

- Linear scans 200 mm in horizontal and 300 mm in vertical direction
- Rotational scans 360 degree
- 2D-scans 200 mm x 300 mm
- Cylindrical scans
- Transmission and emission tomography for measurement of density and activity distribution inside of samples
- Third linear axis for variation of the distance between sample and gamma-detector

# THE GAMMA-SCANNING DEVICE WITH DUMMY SAMPLE



View from backside into the cell

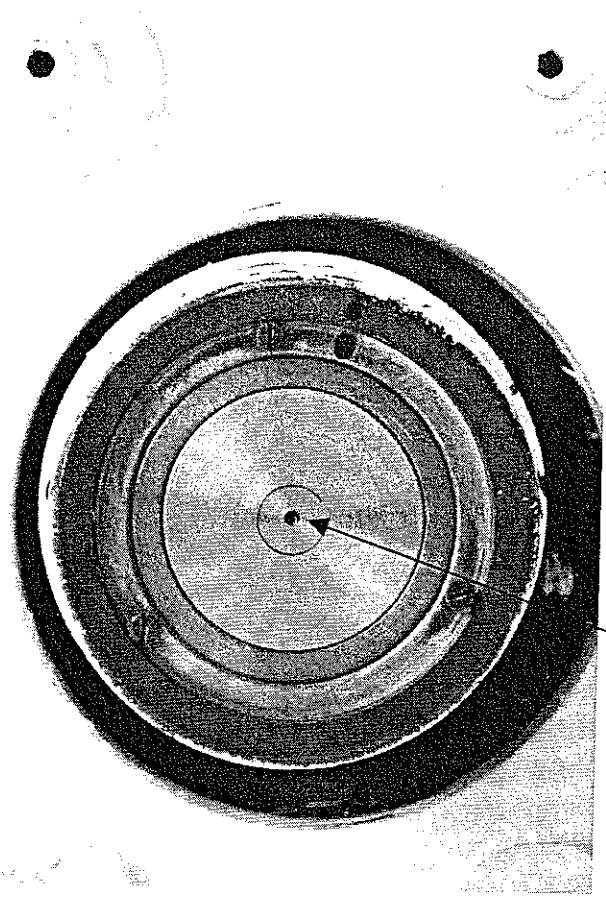
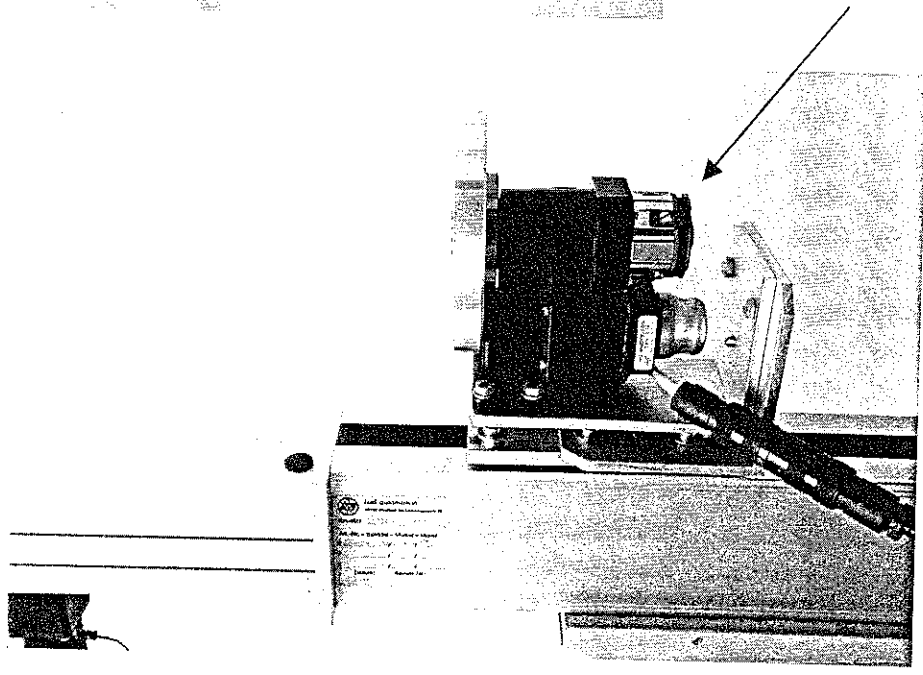


View through the cell window

## COMPONENTS OF THE GAMMA-SCANNING SYSTEM

- 3 linear axis driven by powerful stepping motors with magnetic brakes for the vertical and the rotational axis connected to controlling units with intelligent interface cards
- Different collimators with varying geometries (slit or cylindrical holes of different diameters) made from brass or densimet a tungsten alloy
- Different sample holders easy to mount and to dismount
- A laser pointer for positioning of the sample from outside through the collimator hole
- A gamma-detector outside the cell connected to the nuclear electronic equipment
- A PC-based control and data acquisition system

# COMPONENTS OF THE GAMMA-SCANNING SYSTEM (CONTINUED)

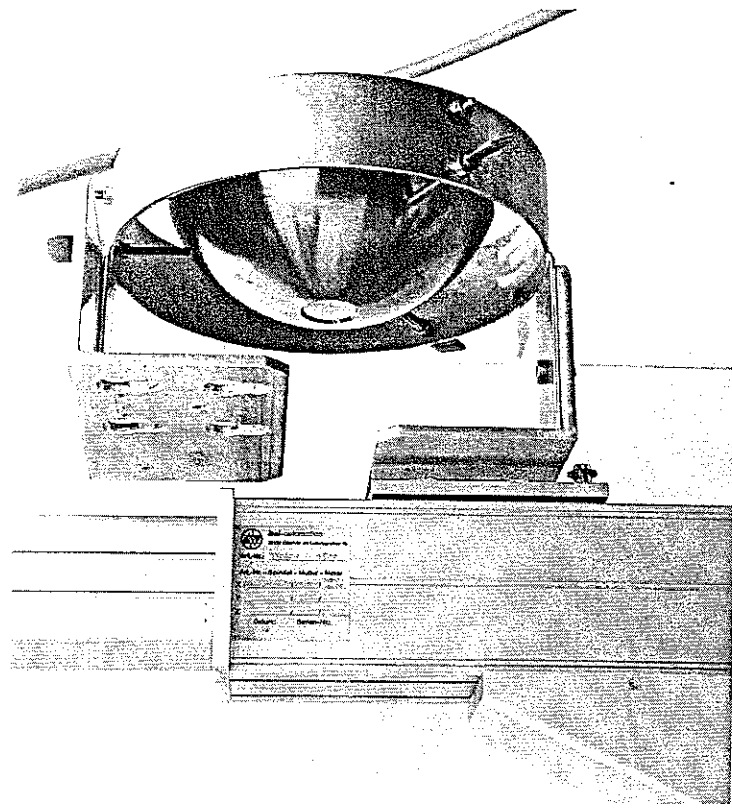
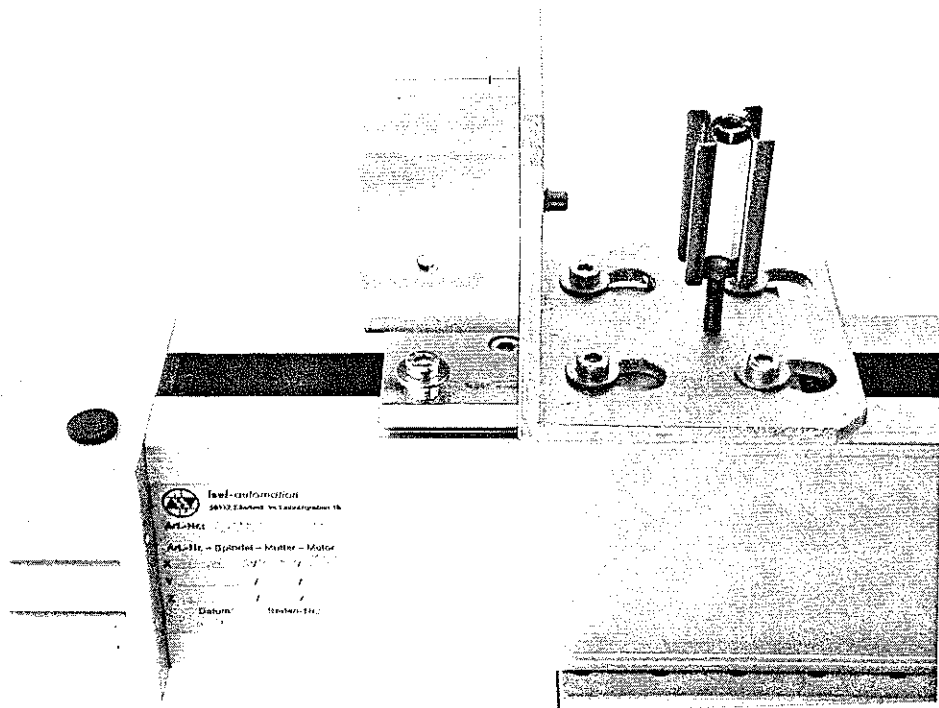


Collimator of 2 mm diameter

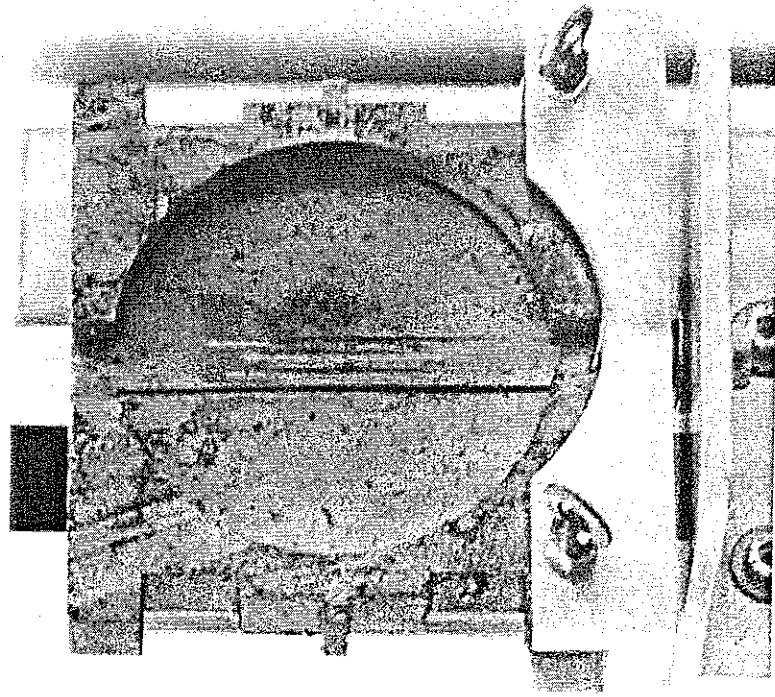
The rotational axis with stepping motor



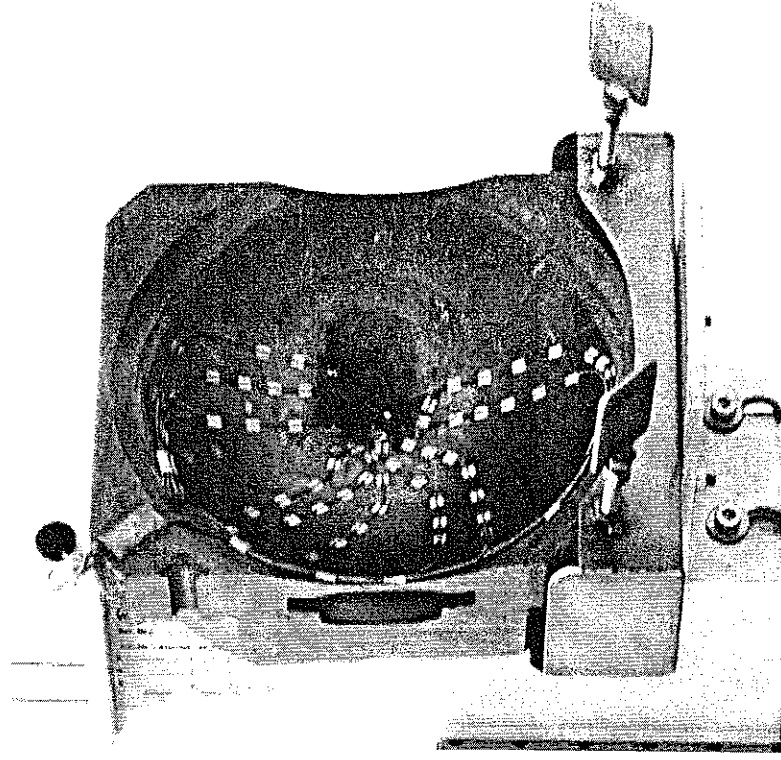
# EXAMPLES OF SAMPLE HOLDERS



# EXAMPLES OF SAMPLE HOLDERS (CONTINUED)

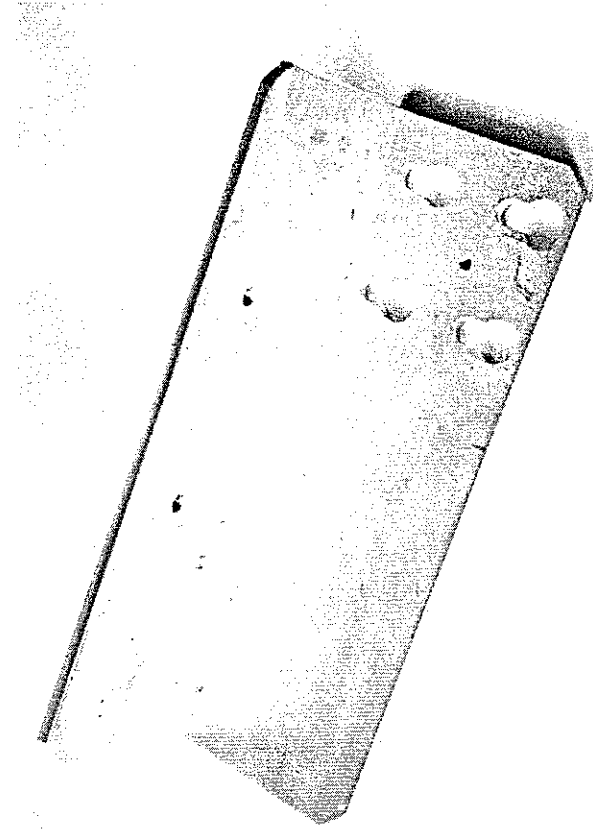
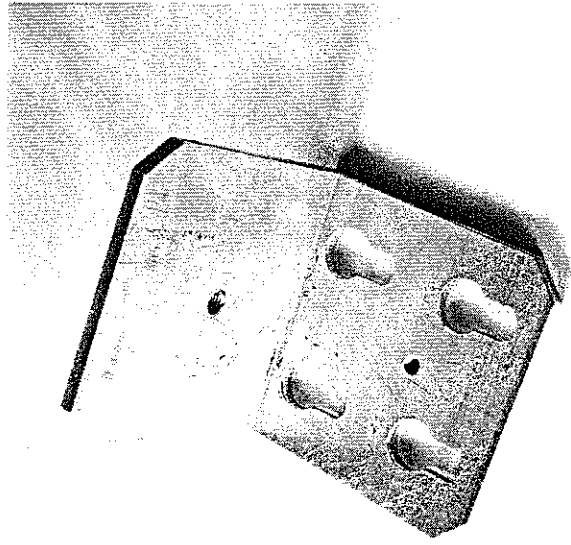


ISIS target window 1



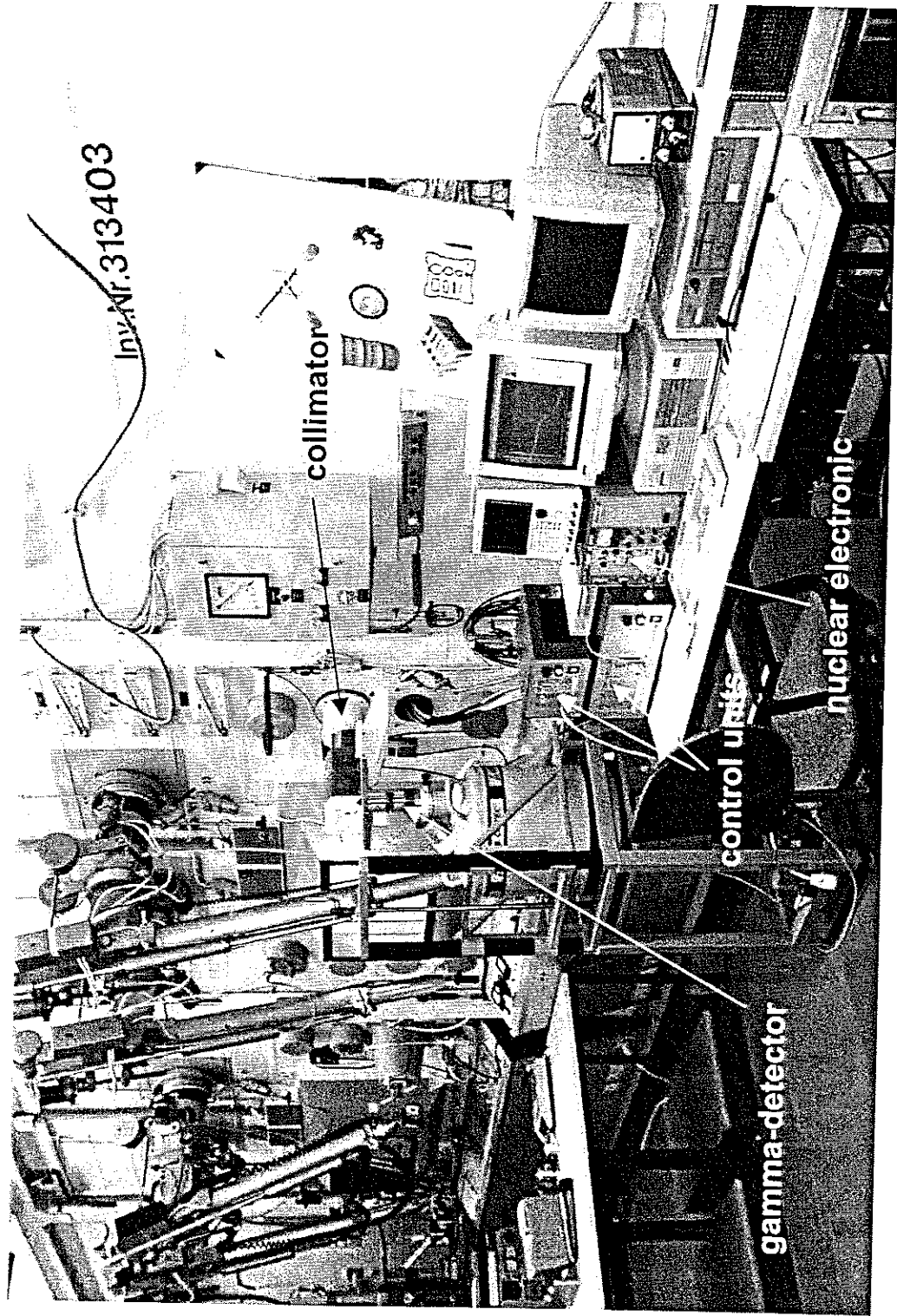
PSI window 2

# EXAMPLES OF SAMPLE HOLDERS (CONTINUED)



angular mounting parts

VIEW OF THE GAMMA-SCANNING SYSTEM FROM THE OPERATIONAL AREA



# THE PC-BASED CONTROL AND DATA ACQUISITION SOFTWARE

Consist of

- Gamma-counting software from EG&G ORTEC which can control measuring cycles by reading of command files
- Software to control the different axis of the scan device interactively and to position the sample correctly for measurement
- Software to store other necessary input data for the automatic run of the gamma-scan
- Software to control and run the actual measurement and store the acquired and evaluated data in files of the hard disk

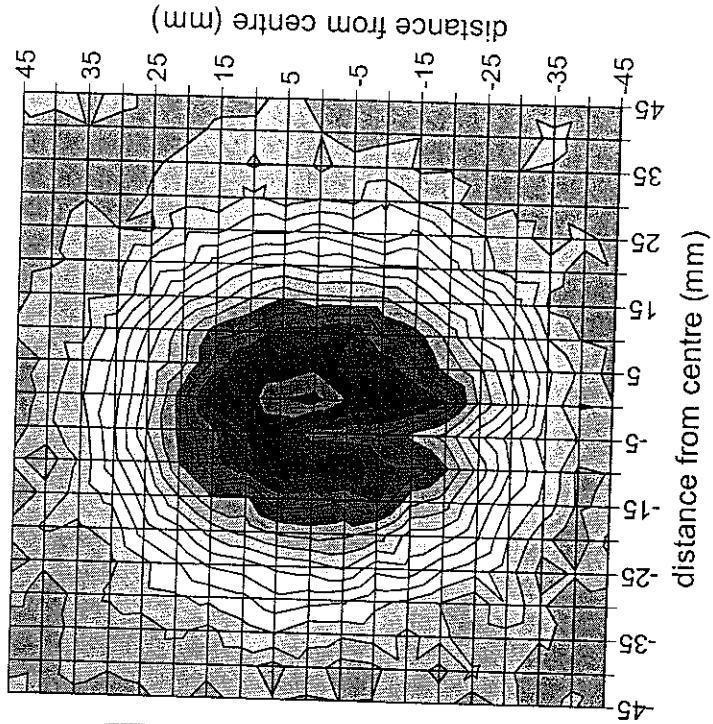
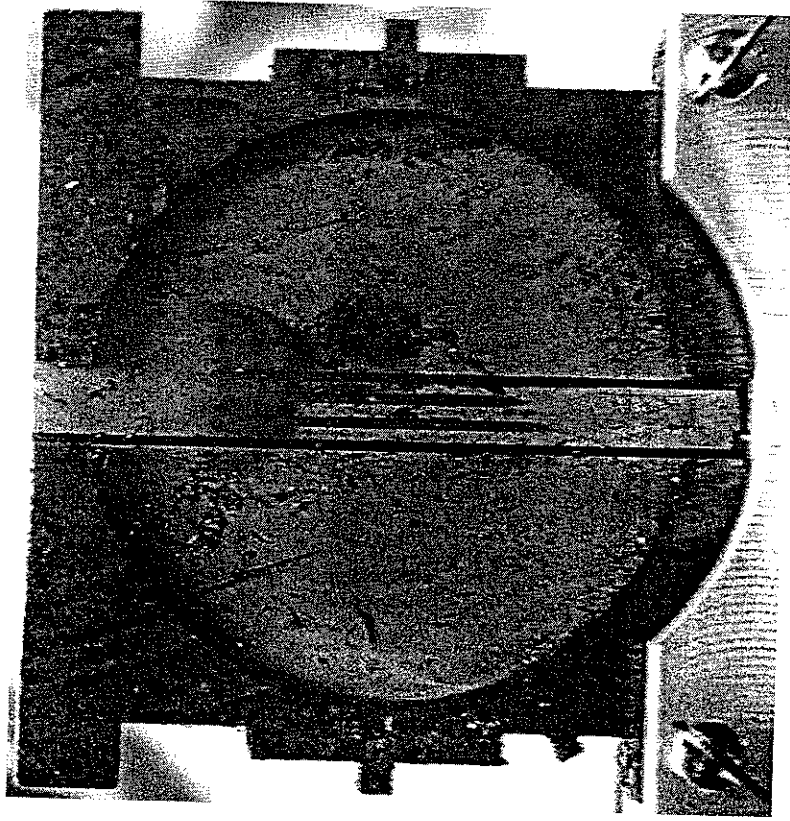


## MAIN IMPROVEMENTS OF THE NEW SOFTWARE SYSTEM

- Extension to control more than 2 linear axis (2D-scans and cylindrical scans)
- More reliability by transferring the data of the sample position back to the controlling program of the PC for comparison
- Status of the scan is shown by a bar graph
- Restart option in case of an interrupt (helpful due to the fact that the scan mostly takes several days)
- Export of the scan data in a format compatible with popular spreadsheet (i.e. EXCEL)



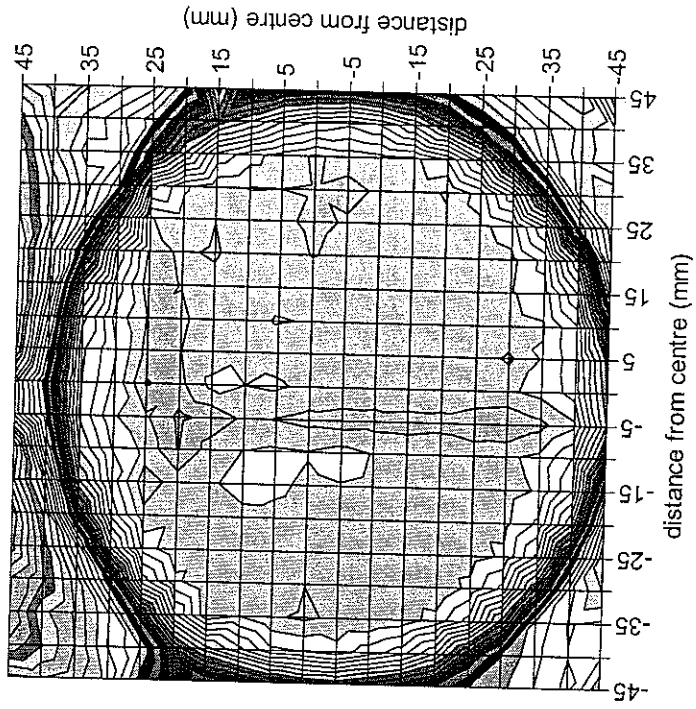
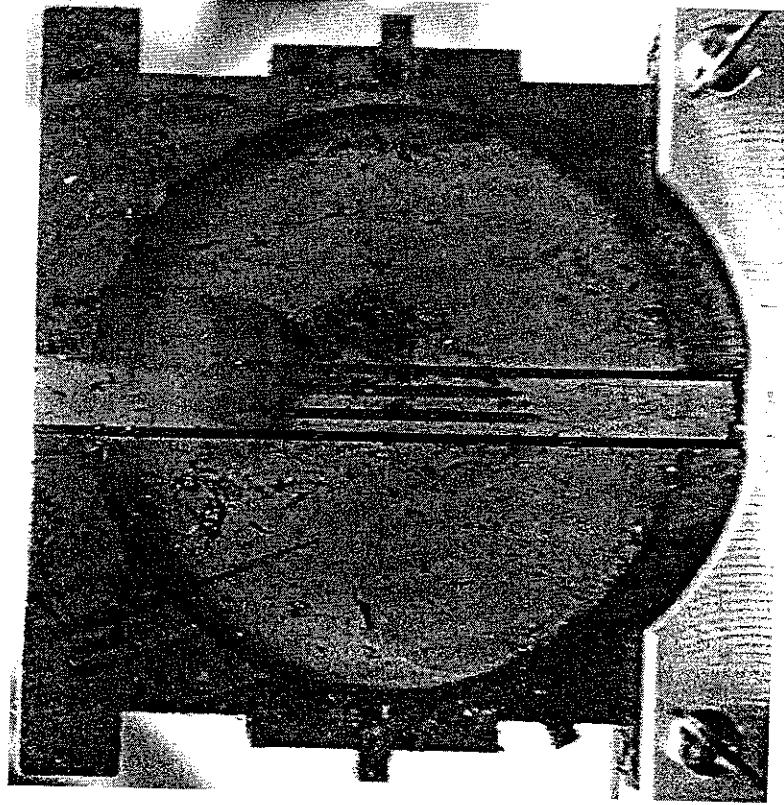
# GAMMA-SCANNING RESULTS



ISIS target window 1 - 2D-plot of activity distribution of annihilation peak (511 keV)



# GAMMA-SCANNING RESULTS (CONTINUED)

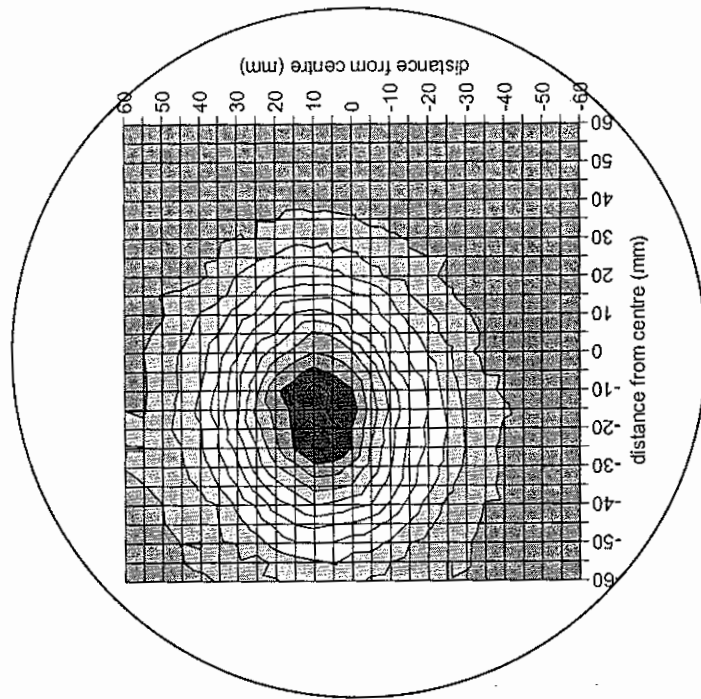
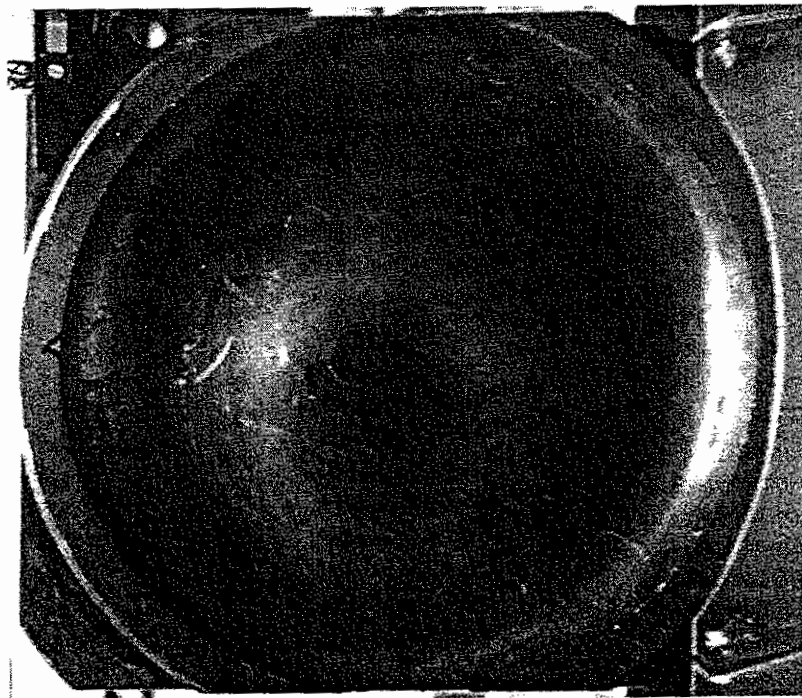


ISIS target window 1 - 2D-plot of activity distribution of Co-60





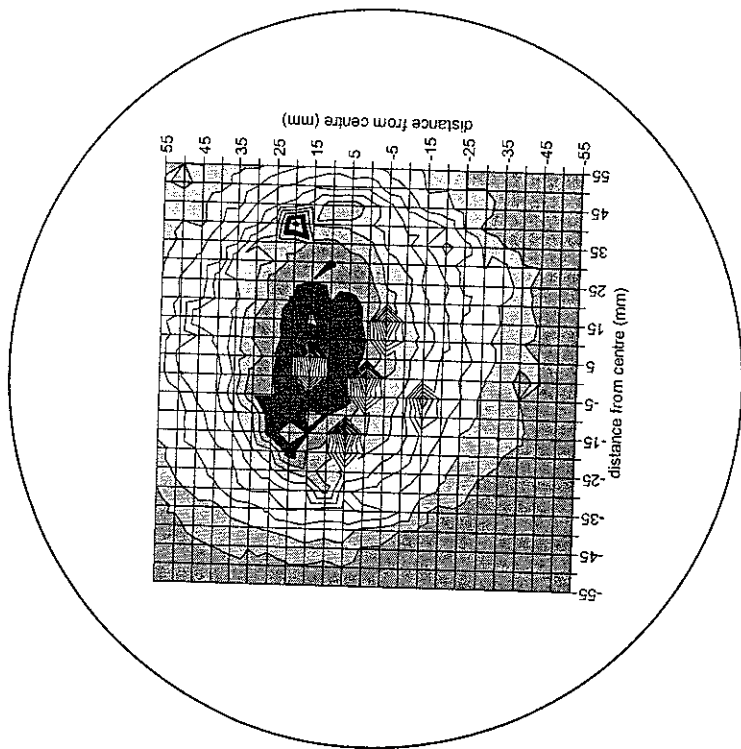
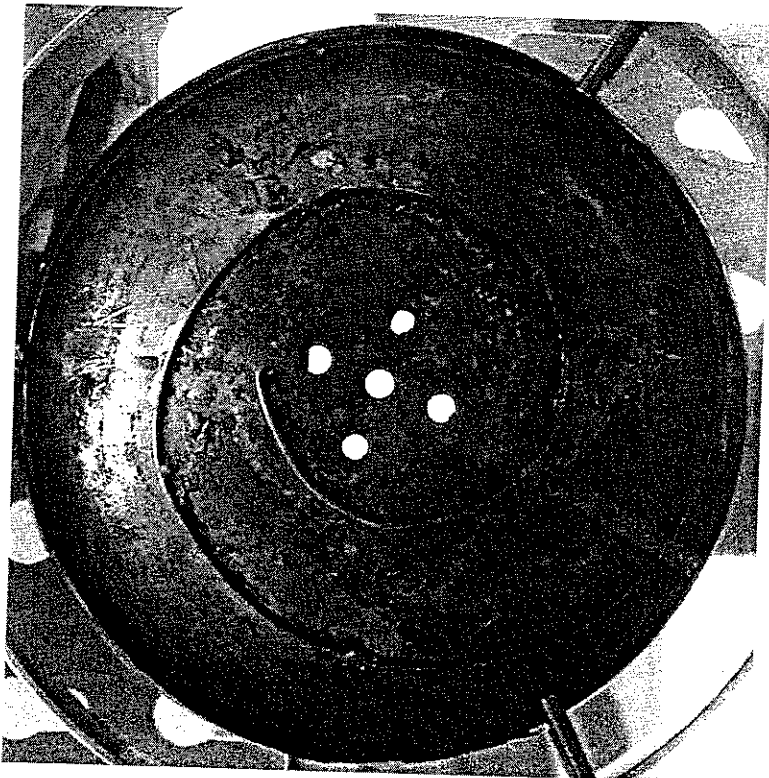
# GAMMA-SCANNING RESULTS (CONTINUED)



PSI window 2 - 2D-plot of activity distribution of annihilation peak (511 keV)



# GAMMA-SCANNING RESULTS (CONTINUED)

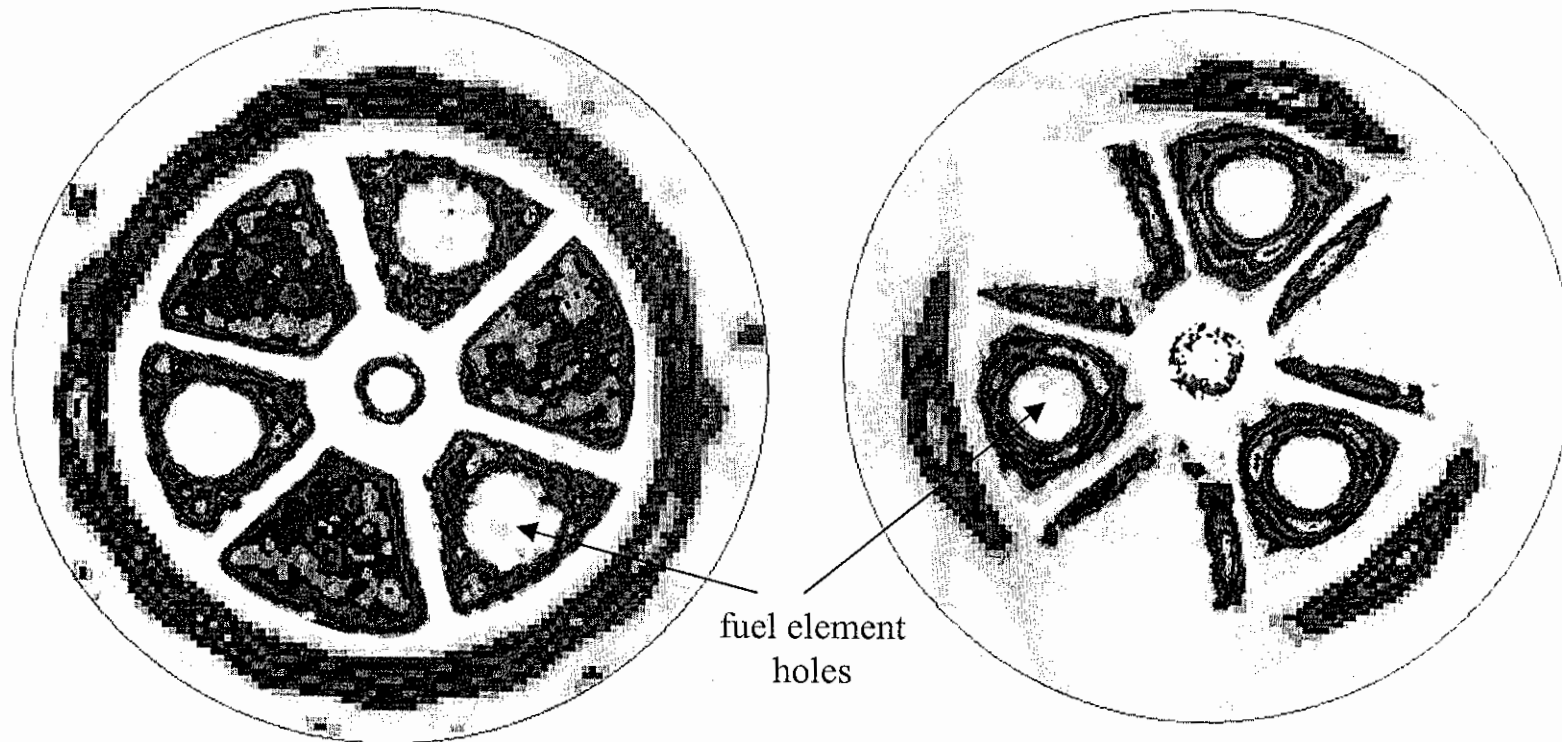


LANL water degrader part B - 2D-plot of activity distribution of Mn-54



# RESULTS – TOMOGRAPHY OF IRRADIATED GRAPHITE BODY

(measured with the old device)



Transmission tomography  
density distribution

Emission tomography  
Cs-137 activity distribution



## CONCLUSIONS

The new gamma-scanning device has:

- More flexibility with more features of sample holders and measuring modes
- More reliability with powerful motors, capsulated end-switches and magnetic brakes
- A better handling and mounting of the samples by using a third linear axis
- A better data controlling and processing system
- Proven itself on measuring results shown before

