

Design and Setup of a New HPGe Detector Based Body Counter Capable of Detecting Also Low Energy Photon Emitters

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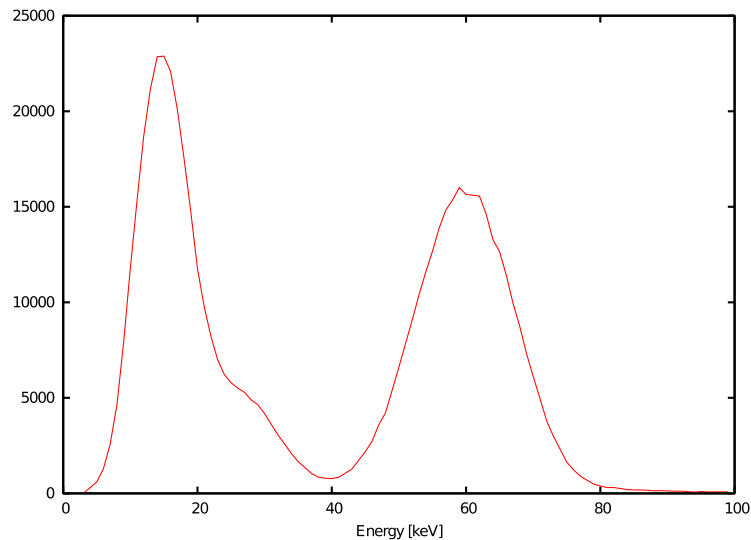


Why This PhD?

A body counter was already there!

We couldn't see

- what we wanted
- how we wanted

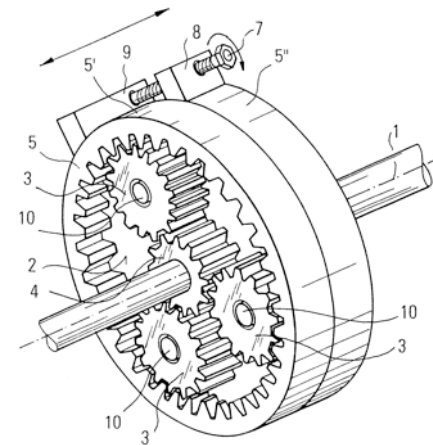


Solution

- Sharper “glasses”

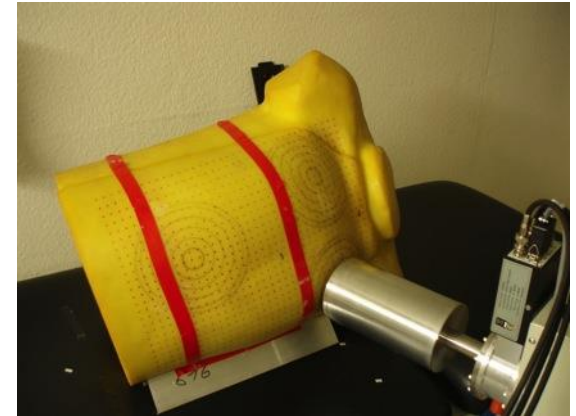


- New mechanics



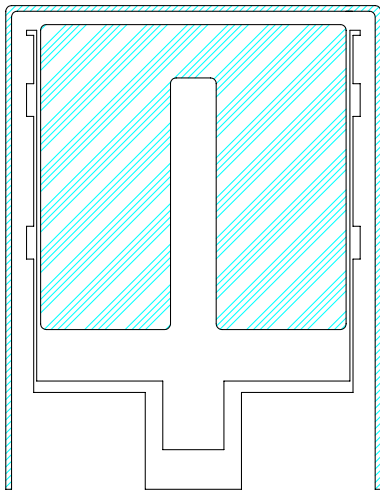
Why Scientific Project?

- Try and fail? too slow!
- Systematic approach: Monte Carlo simulations
- Physical system based on the calculations

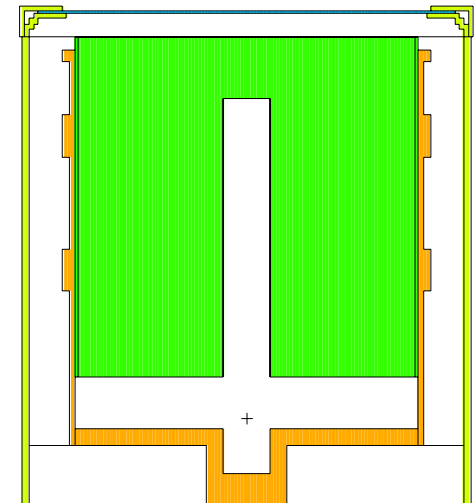
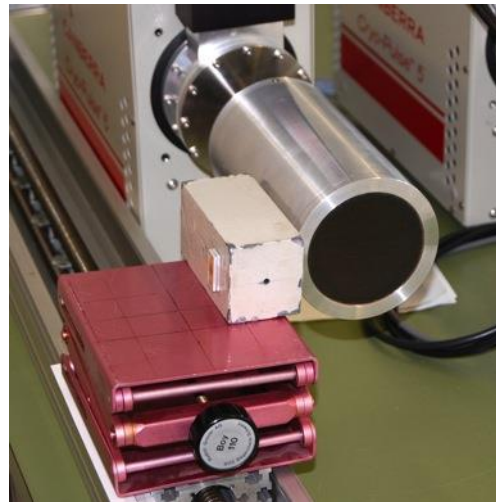


The Beginning: a Custom Monte Carlo Model

- Accurate results only with accurate models
- Monte Carlo models built from
 - Datasheet
 - Measurements
 - Manual correction
- Final model accuracy: 5%



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Partial- and Whole Body Counter

- Goal: lowest detection limit
 - Low background counts
 - High detection efficiency

- Systematic approach
 - No try and fail
 - Monte Carlo simulations as tool

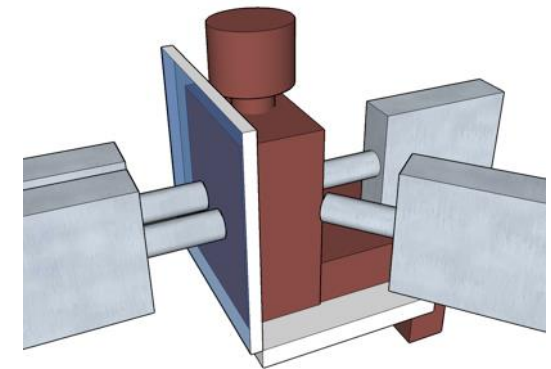
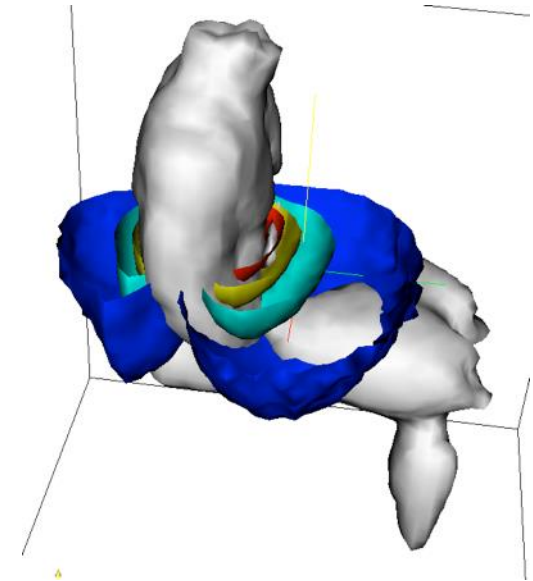
- Same method for different systems
 - PBC: simplified, just photon fluxes
 - WBC: standard deviation too

Partial-Body: Mostly Surfaces

- Lower complexity than WBC case
- Test bed for the new method

- Simulations to define
 - highest-flux regions
 - Compton background

- Detectors placed accordingly



WBC: More than Fluxes

- Goal: uniform (high!) detection efficiency
- Different sets: organ / nuclide / phantom
- Photon fluxes tracked in space:

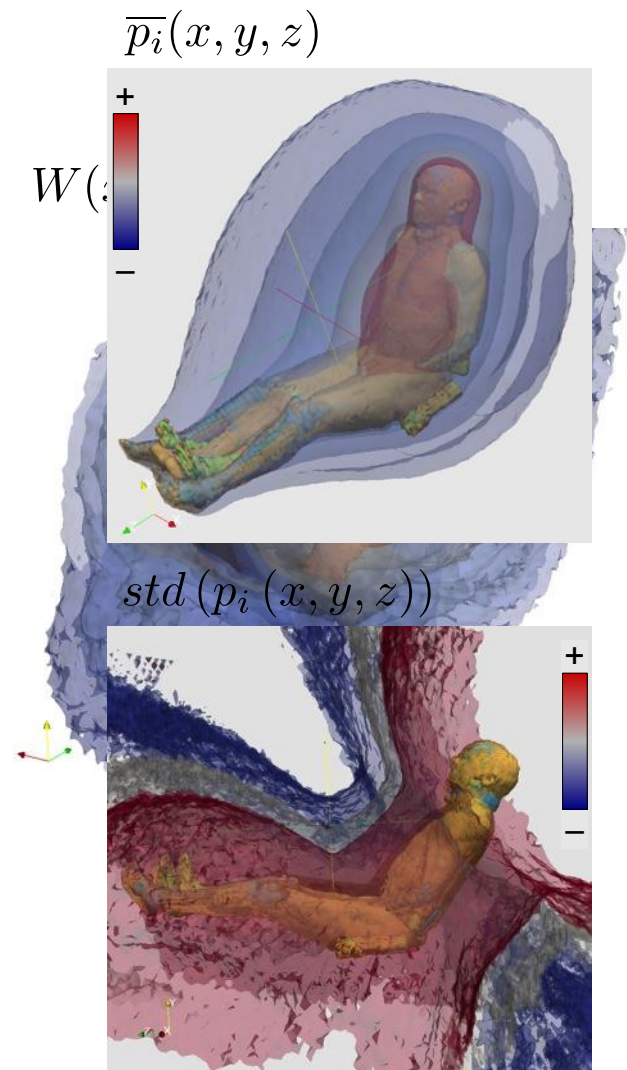
$$p_i(x, y, z)$$

- Results grouped appropriately
- Average and std. deviation calculated:

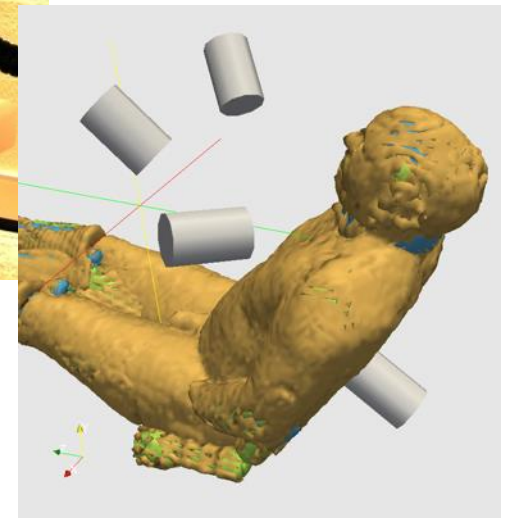
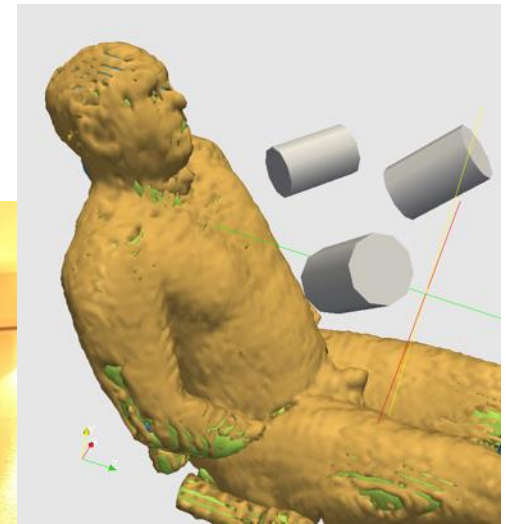
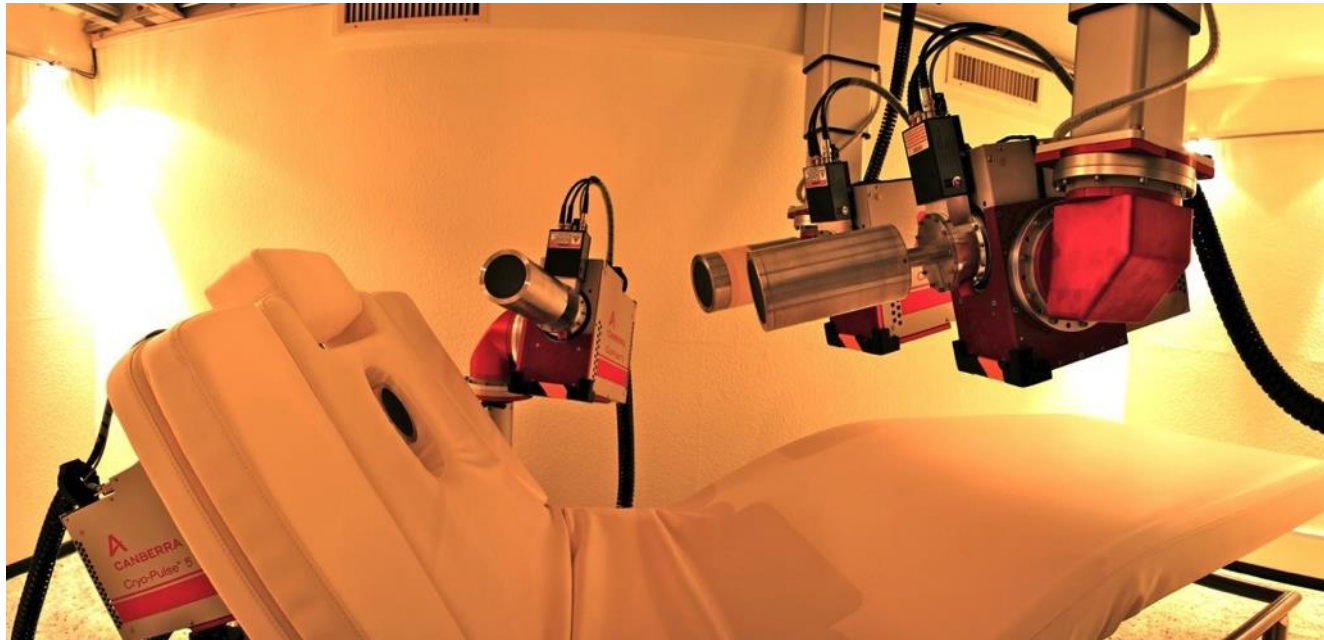
$$\overline{p_i}(x, y, z) \quad std(p_i(x, y, z))$$

- Two values merged:

$$W(x, y, z) = a \cdot \overline{p_i}(x, y, z) + b \cdot std(p_i(x, y, z))$$

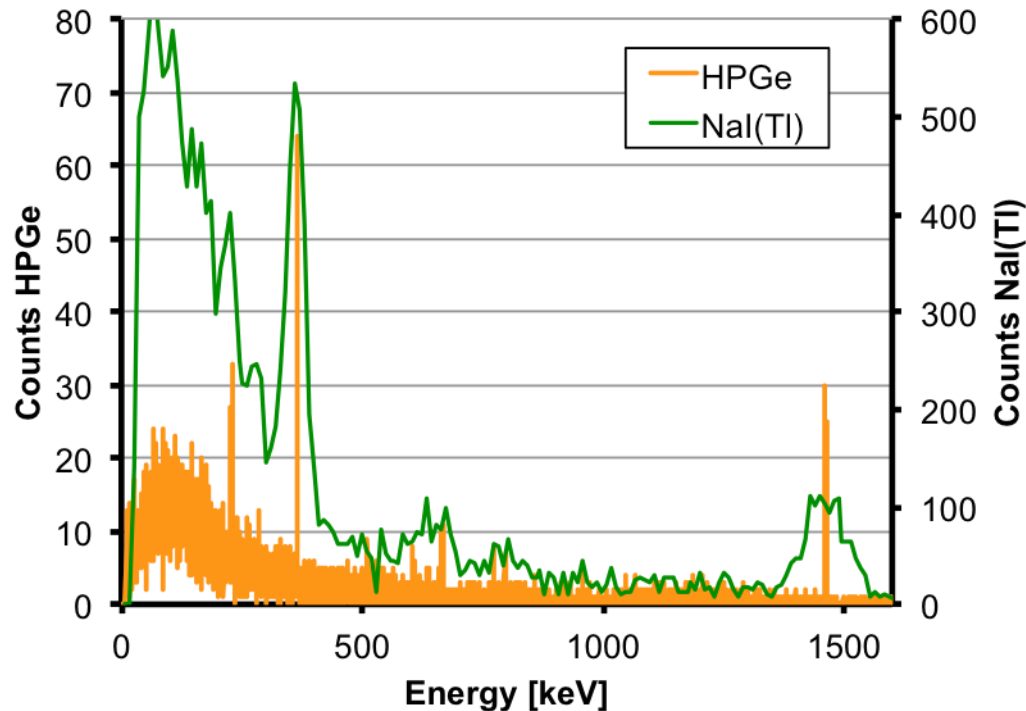


The Final WBC Configuration



A Test Case: the Fukushima Accident

- Different subjects measured with both old and new system
- Only one contamination case detected (0.1 mSv)
- Identification possible only with HPGe system



Summary

- Upgrade/redesign of a PBC/WBC
 - Simulations instead of measurements/tests
 - Significant time savings
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- PBC as test scenario for more complex WBC simulations
 - Theoretical results confirmed by final measurements
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- New system already better performing than old one
 - Further optimizations possible

Thanks for your attention!

and don't forget to book your own measurement!