



Ionizing radiation detection with mobile phones

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Reasons to study ionizing radiation detection with mobile phones

- Multiple Apps available for Android and iOS
- Public queries have been made to STUK about reliability of these meters

Possible benefits

- Cost efficient radiation detection
- Wide availability



Radioactivity Count
Rolf-Dieter Klein



GammaPix - Gamma
Image Insight, Inc.



RadSensor (Geiger)
Zhang Hong



Radioactivity-Meter
SpitConsult



Radiation Detector
The Moj Tools



Dosimeter simulator, Geiger
counter prank

Elitfun Studio Simulation

PEGI 7

Game that simulates radiation dosimeter or geiger counter.
You can increase or decrease showed radiation value by tilting your device.
In this way you can prank on your friends by showing them fake radiation hazard in any place.
Different themes available: modern digital dosimeters and old analog geiger counters.

Methods of detection with mobile phones

External detector probes

- Pulse counter via audio jack
- Wireless communication to external probe



Mobile phone only

- Using camera
- Retrospective dosimetry on electrical components

Dose reconstruction using mobile phones

K. Beerten, F. Reekmans, W. Schroevers, L. Lievens, F. Vanhavere

Radiation Protection Dosimetry, Volume 144, Issue 1-4, March 2011, Pages 580–583, 9.11.2010



Tested applications

- Tested mobile phone applications:

- Smart Geiger Pro (external semiconductor probe, Fig. 1)
- Smart Geiger (external semiconductor probe, Fig. 1)
- GammaPix (camera, Fig. 1 and Fig. 2)
- Radioactivity Counter (camera, Fig. 1)



Fig. 1. GammaPix and SmartGeiger, Sr-90 inspection source demo

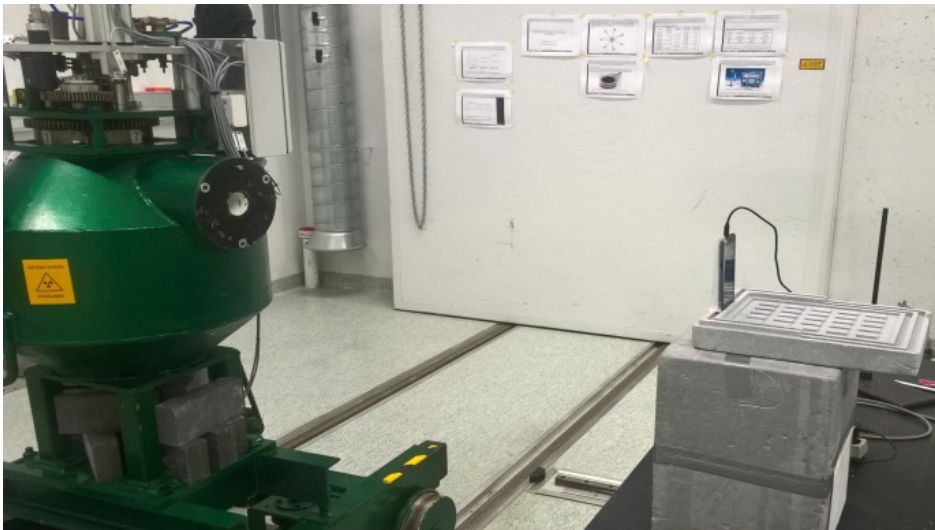


Fig. 2. GammaPix, Co-60 calibration

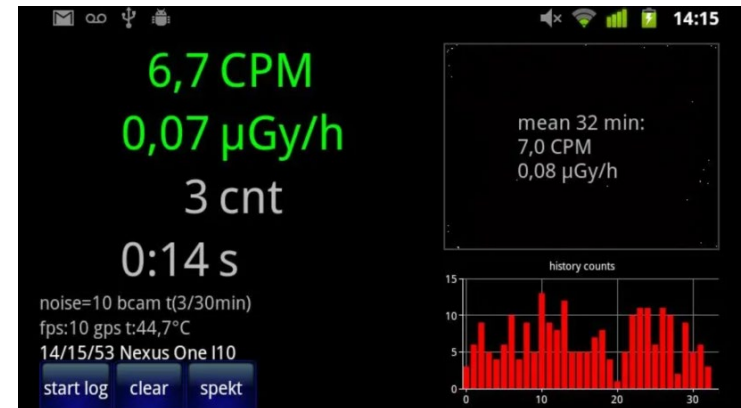


Fig. 3. Radioactivity Counter

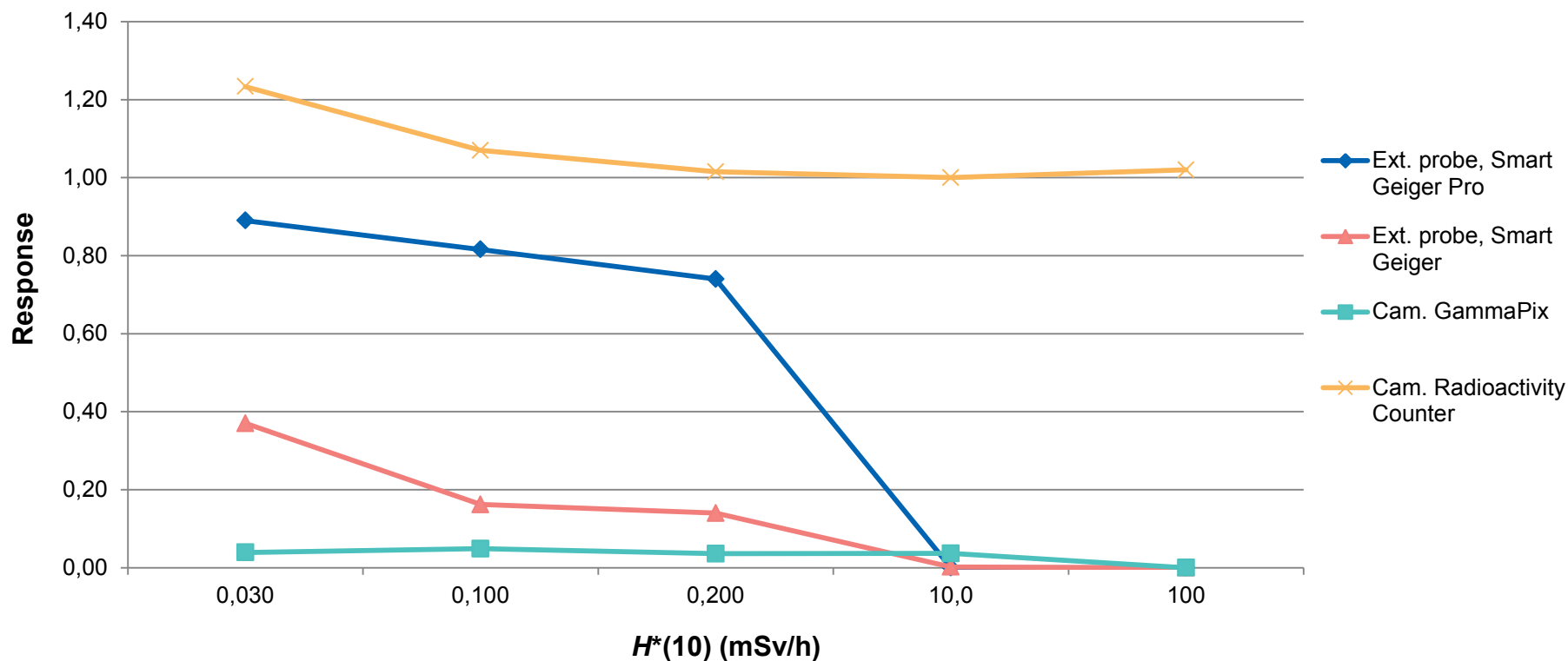
Test methods

- The tests were performed in the Finnish National Metrology Laboratory in STUK.
- Applications are designed to measure low dose rates of X-ray and gamma radiation.
- Applications were tested with three different mobile phone models:
 - Prestigio PAP5500DUO
 - Samsung Galaxy A3 (SM-A310F)
 - LG Optima L7
- Used radiation quantity were ambient dose equivalent rate $\dot{H}^*(10)$.
- Response is reading / reference dose rate.
- The tests included the calibration for dose rate response, energy response, repeatability, angle dependence and overload.

Test results, all applications

- Dose rate response test, Cs-137, 0,030 – 100 mSv/h, $H^*(10)$ with Samsung Galaxy A3.

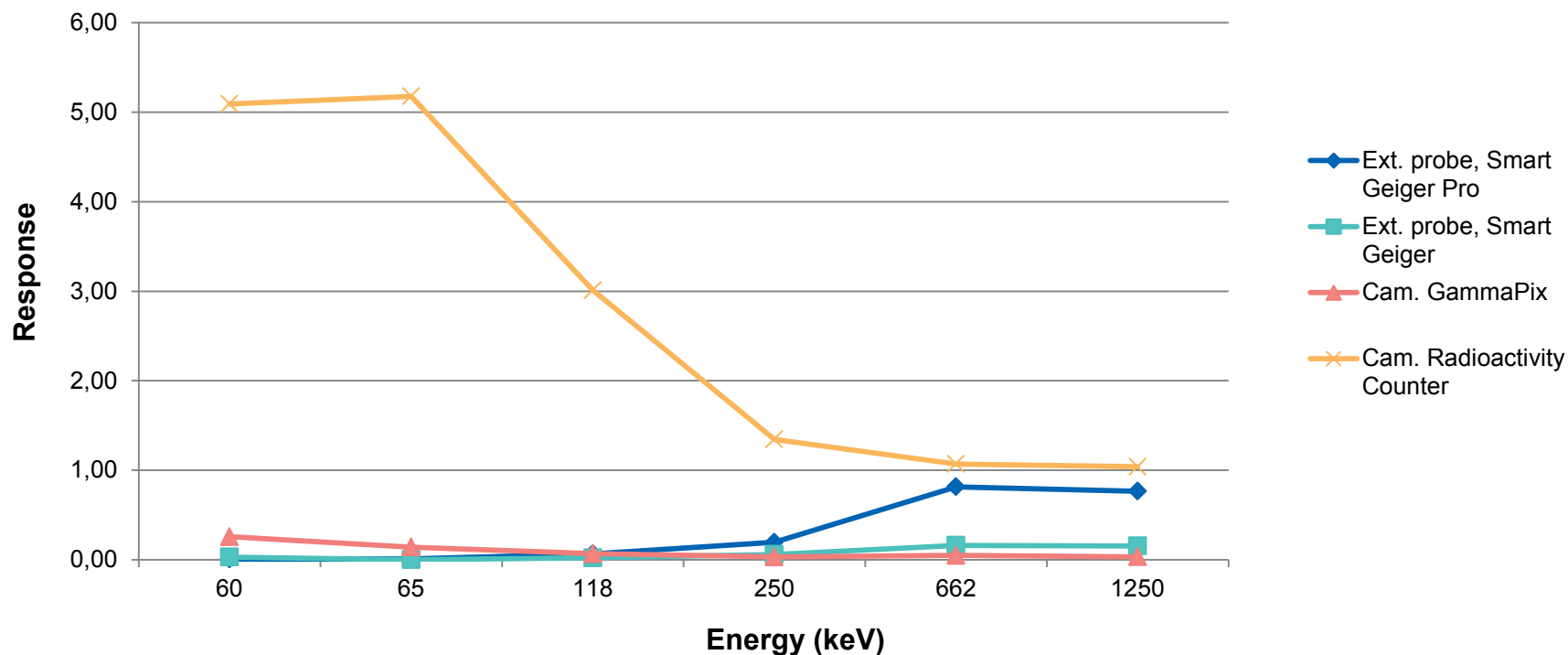
Dose rate response



Test results, all applications

- Energy response test (60 – 1250 keV), $H^*(10)$ dose rate 72 – 195 $\mu\text{Sv/h}$ with Samsung Galaxy A3.

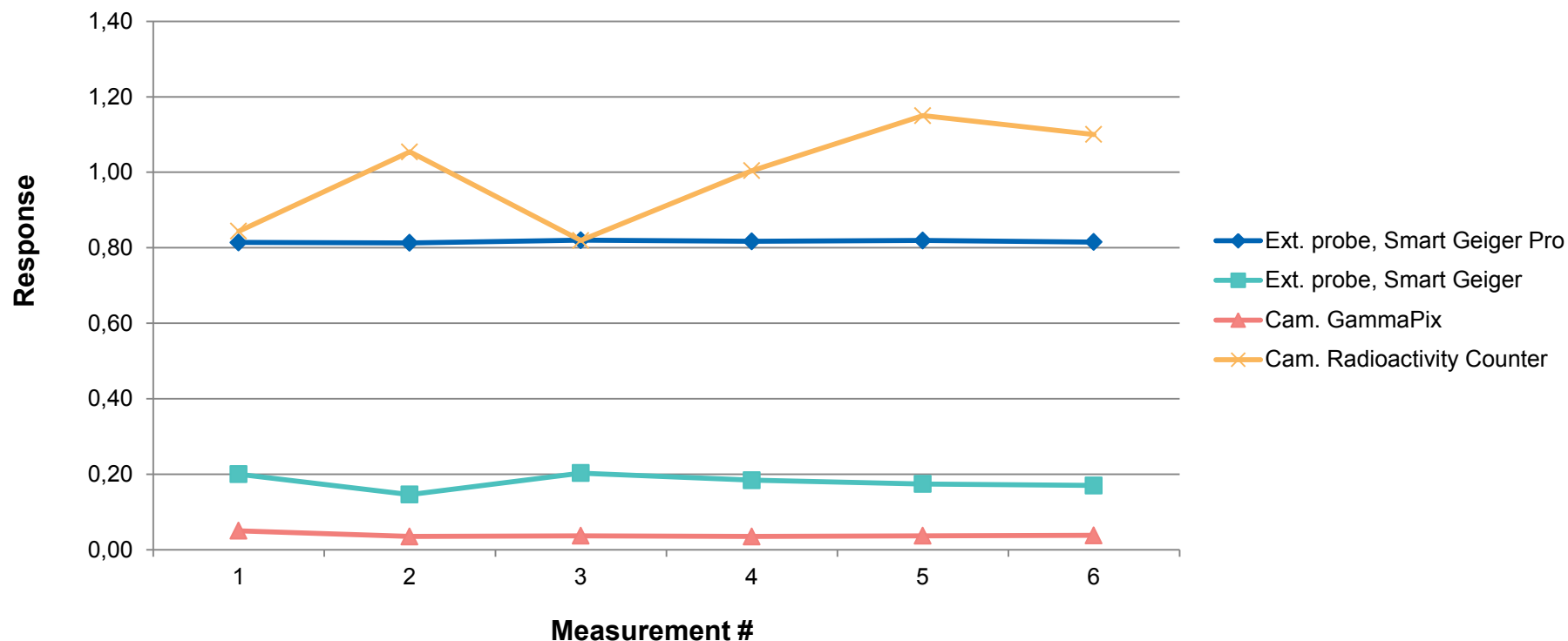
Energy response



Test results, all applications

- Repeatability test: Cs-137, $H^*(10)$, dose rate 100 $\mu\text{Sv/h}$ with Samsung Galaxy A3.

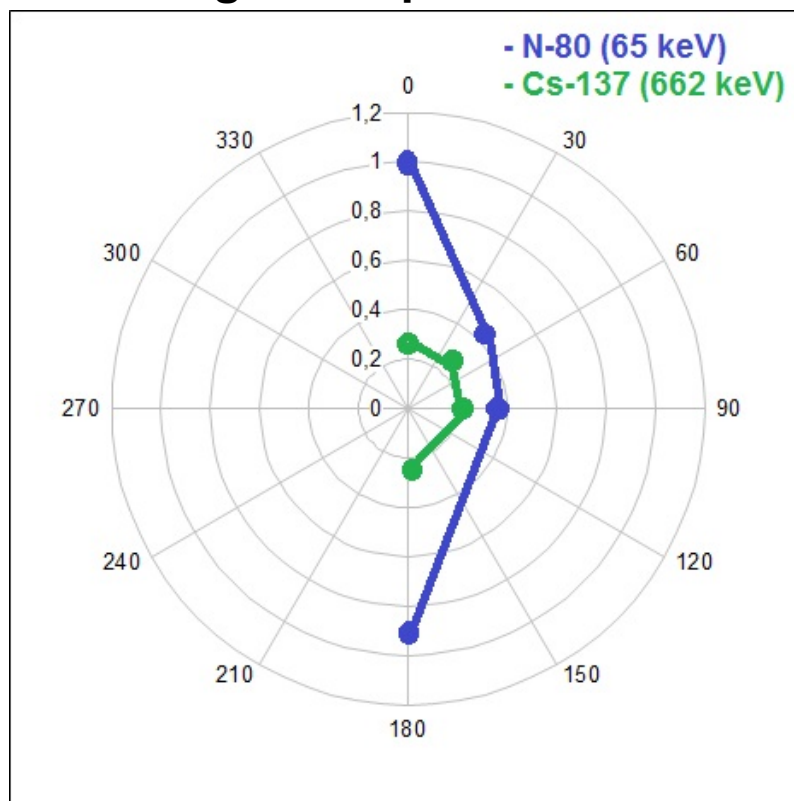
Repeatability



Test results, GammaPix

- Angular dependence test, GammaPix + LG Optima L7: $H^*(10)$, Cs-137, 100 $\mu\text{Sv/h}$ and X-ray (N-80, 65 keV) 130 $\mu\text{Sv/h}$, angles 0°-180°.

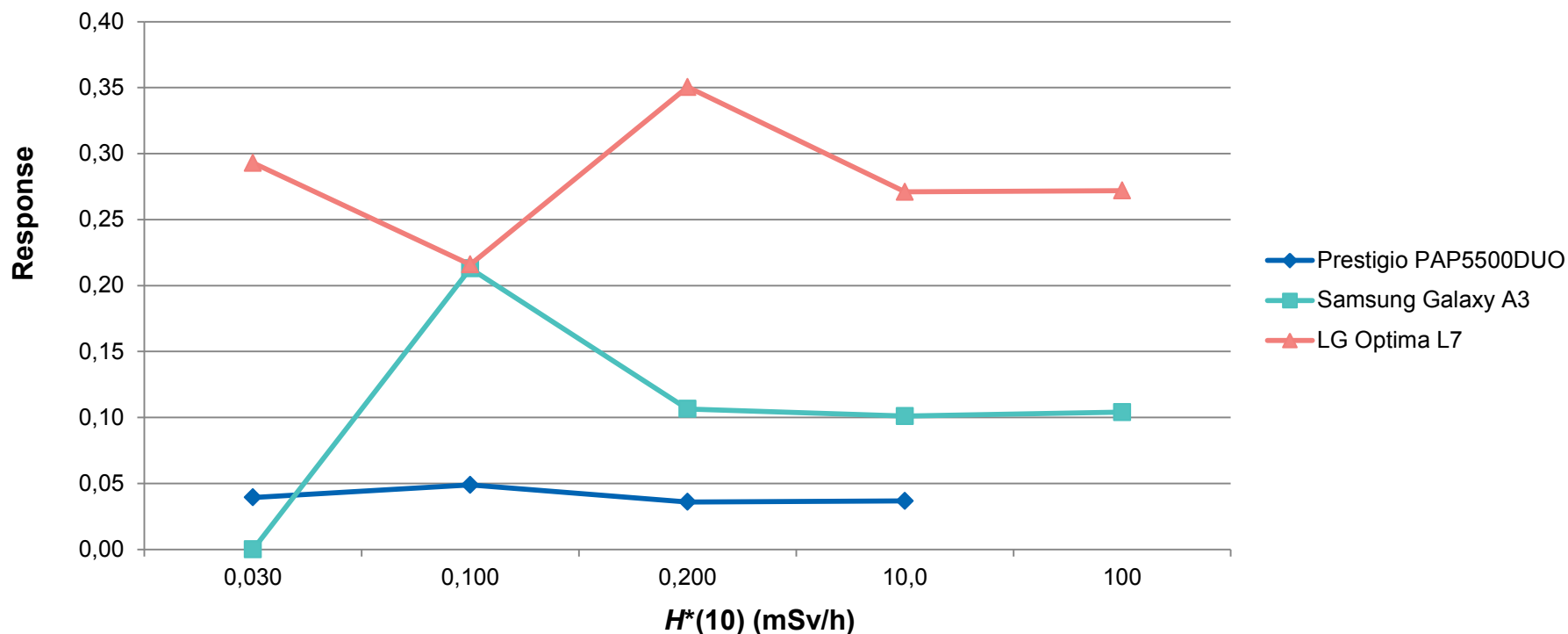
Angular dependence



Test results, GammaPix

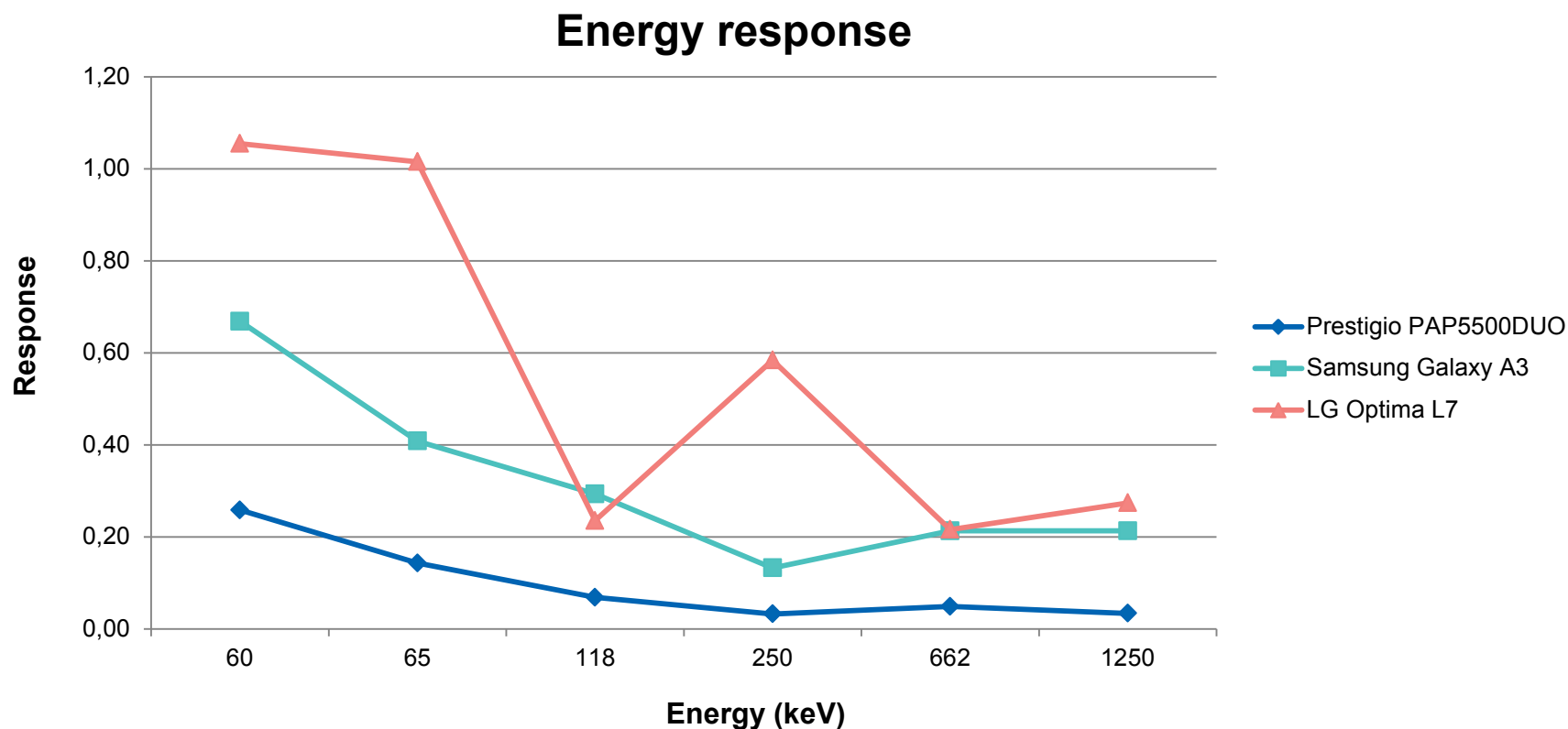
- Dose rate test for GammaPix with three different mobile phone models, Cs-137, 0,030 – 100 mSv/h, $H^*(10)$.

Dose rate response



Test results, GammaPix

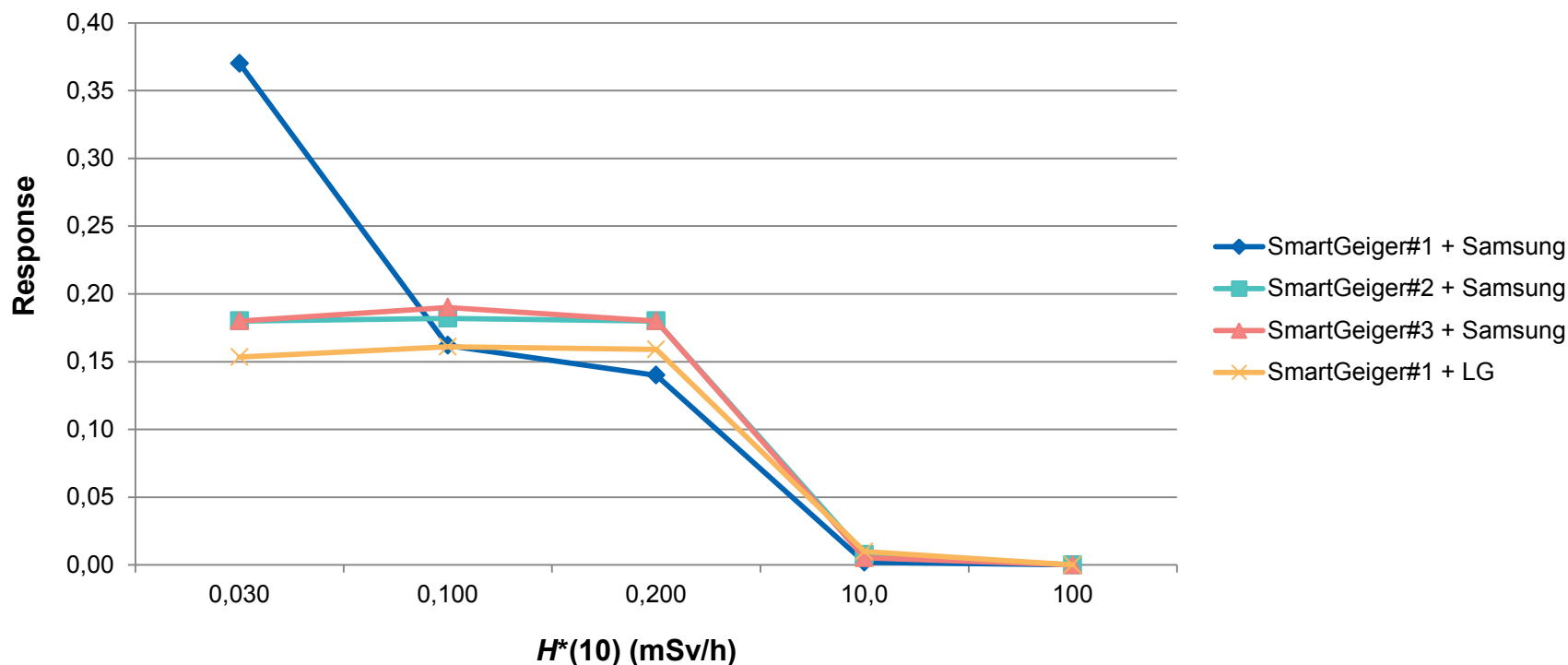
- Energy response test for GammaPix with three different mobile phones (60 – 1250 keV), $H^*(10)$ dose rate 72 – 195 $\mu\text{Sv/h}$.



Test results, SmartGeiger

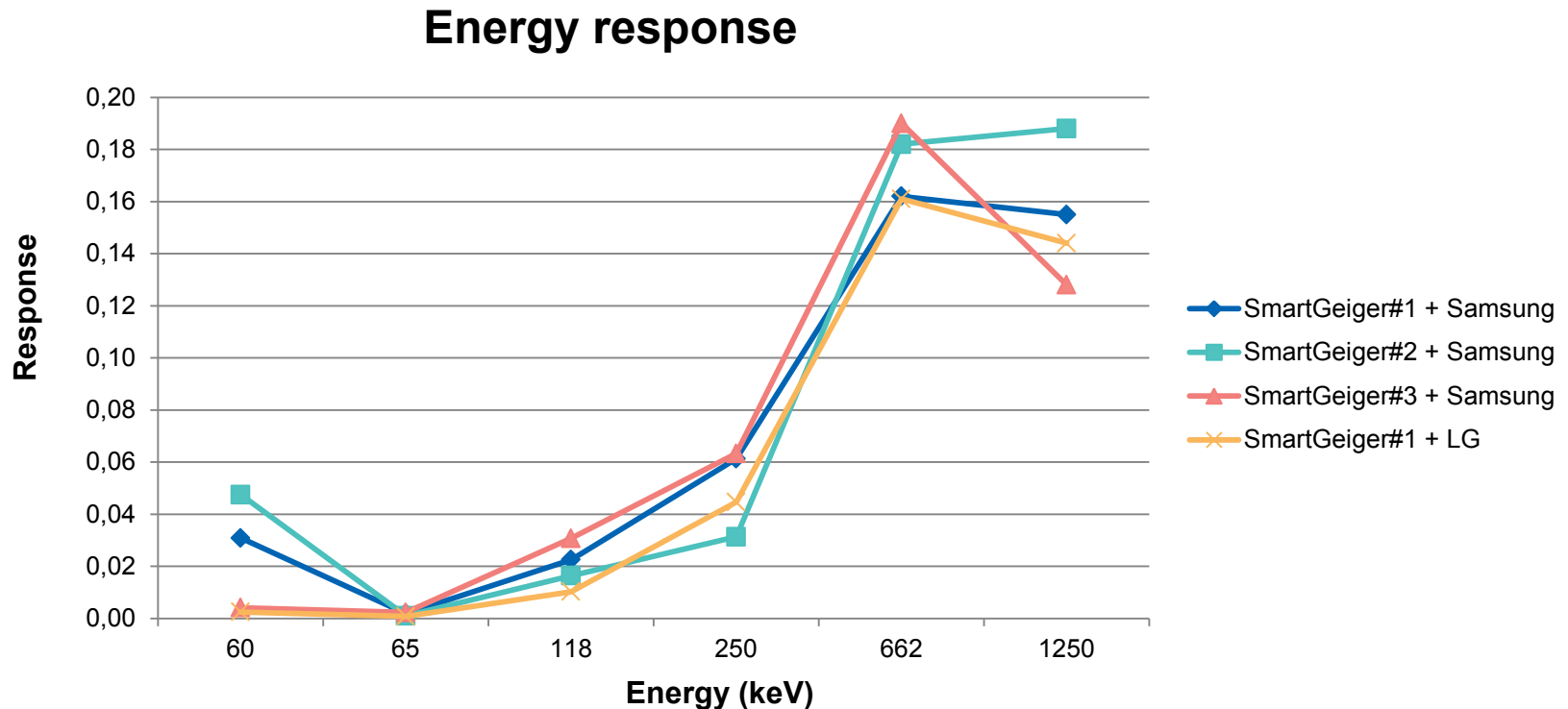
- Dose rate response test for SmartGeiger with three different probes and two mobile phone models, Cs-137, 0,030 – 100 mSv/h, $H^*(10)$.

Dose rate response



Test results, SmartGeiger

- Energy response test for SmartGeiger with three different probes and two mobile phone models (60 – 1250 keV), $H^*(10)$ dose rate 72 – 195 $\mu\text{Sv/h}$.



Conclusions

- To summarize the test results, tested mobile phone radiation meter applications can detect ionizing radiation, but the measurement results are not very reliable.
- Tested applications measured radiation quite repeatable, but the calibration is needed. Response time also varied a lot.
- Tested applications mostly failed to fulfill their own specifications.
- Overload feature failed for other applications except Radioactivity Counter. Dangerous feature!
- Measurement results depend a lot on the model of the mobile phone.
- Some of the tested applications were sensitive to external interference such as Wi-Fi and static electricity.

Thank you!

