

Chewing gum for retrospective determinations of radiation doses, by means of EPR analysis

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Terror attack

Adapted from www.travelid.se

- ✓ Evacuate people
- ✓ Estimate radiation doses to individuals
- ✓ Treat injured
- ✓ Decontaminate environment

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DNA Damage

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Damage effects

<h3>Stochastic effects</h3> <ul style="list-style-type: none"> ✓ Induces cancer ✓ The cells are reproduced 	<h3>Deterministic effects</h3> <ul style="list-style-type: none"> ✓ Occur above a certain radiation dose ✓ The cells are can not be reproduced and die ✓ Organs are damaged
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Effects of radiation on humans

SOCIALSTYRELSEN: SOS-rapport 1998:13, 1998

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Methods of Retrospective dosimetry

Biological methods

- ✓ Chromosome aberration analysis
- ✓ FISH

Physical methods

- ✓ TLD
- ✓ OSL
- ✓ Electron Spin Resonance (ESR)

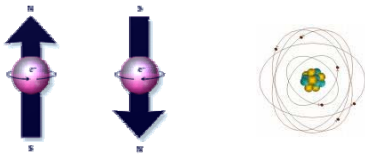
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Aim

- ✓ To find a material carried by people that is possible to use for ESR dose reconstructions
- ✓ To investigate the accuracy of the dose reconstruction

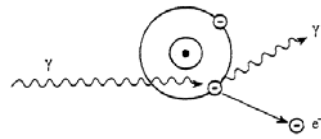
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Electron Spin Resonance

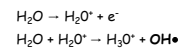


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Unpaired electrons

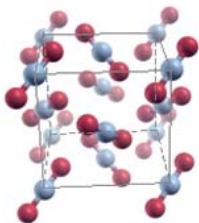


In water:



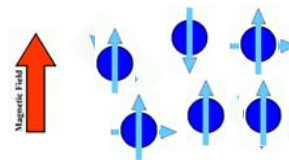
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The crystal



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Unpaired electrons in a magnetic field

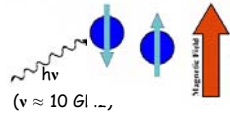


$$\Delta E = g\mu_B B$$

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Electrons in a magnetic field

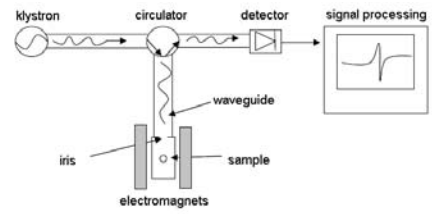
$$\text{If } h\nu = g\mu_B B$$



($\nu \approx 10 \text{ G} \dots$)

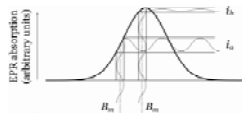
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ESR Spectrometer



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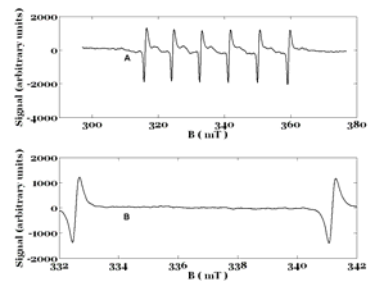
The modulation



GUSTAFSSON H: Development of sensitive EPR dosimetry methods. Linköping University Medical Dissertation No. 1044, 2008

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The Manganese reference



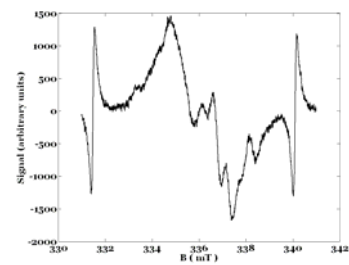
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Irradiation of samples



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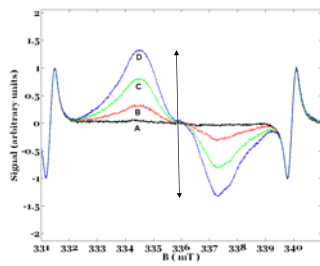
ESR spectrum sugar



Dose = 20 Gy.
Modulation amplitude = 0,2 mT

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ESR spectrum sugar

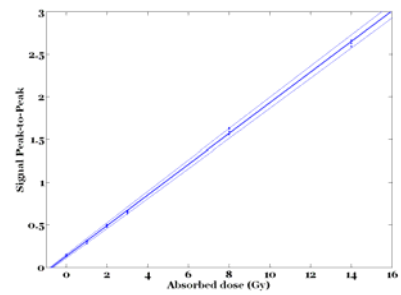


A = 0 Gy
B = 3 Gy
C = 8 Gy
D = 14 Gy

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Dose response sucrose



Minimum detectable dose 0.12 Gy. (2SD)

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Chewing gum



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Irradiation of V6



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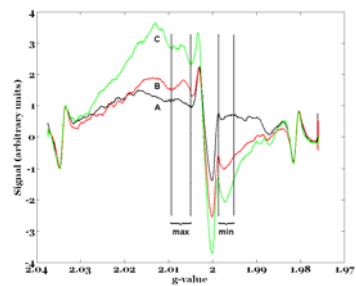
Tablet press



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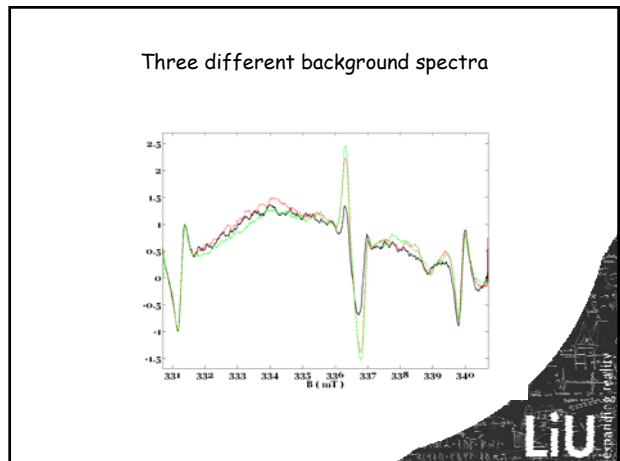
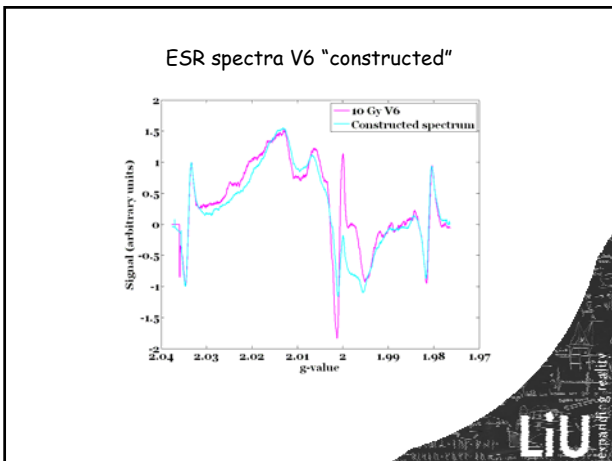
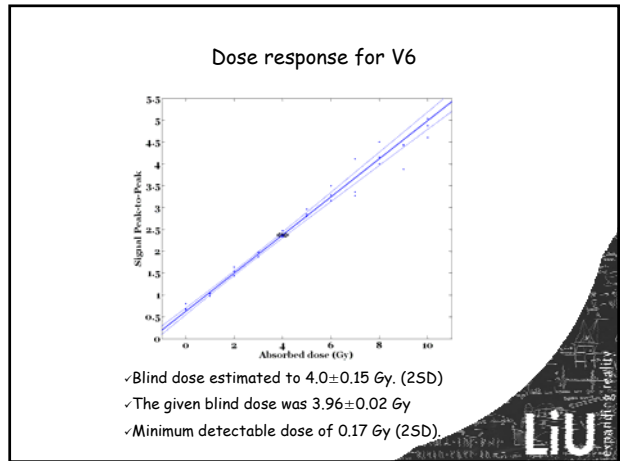
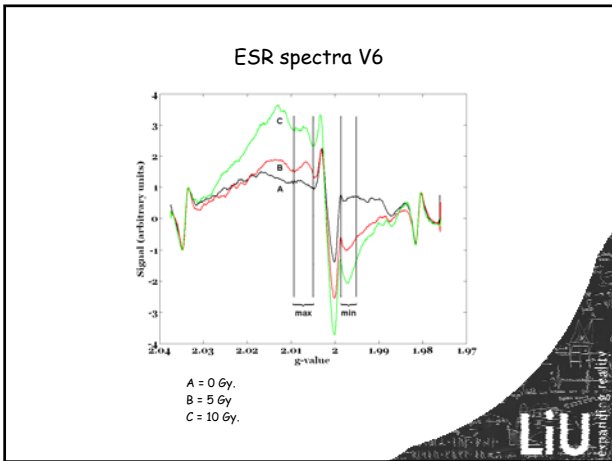
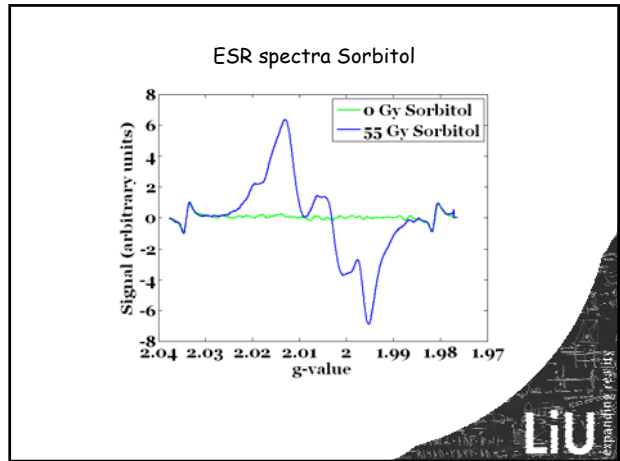
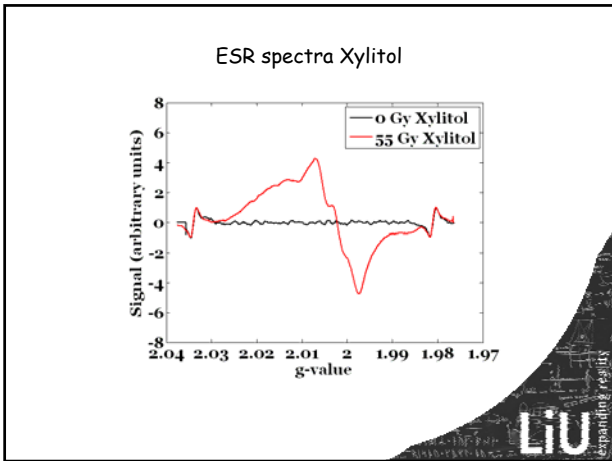
ESR spectra V6



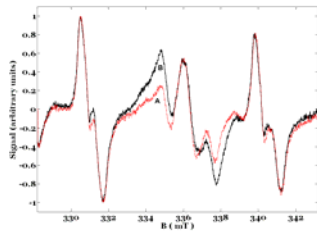
A = 0 Gy.
B = 5 Gy.
C = 10 Gy.

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Stimorol



A = 0 Gy,
B = 20 Gy.

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Conclusion

- ✓ Chewing gums are useful for retrospective dose determinations
- ✓ Minimum Detectable Dose = 0.17 Gy (2SD)

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Future work

- ✓ Separate the chewing gum outer layer from the inside content
- ✓ Determine dose response of Xylitol and Sorbitol
- ✓ Investigate signal evolution with time
- ✓ Dose response measurements of Stimorol and Juicy Fruit
- ✓ Increase the sensitivity with a new spectrometer

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Any questions?

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Thank you for listening!

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