



SVENSK FÖRENING FÖR RADIOFYSIK
Swedish Society of Radiation Physics
(Member of IUPESM)

Image quality

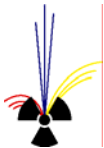
Technical/physical aspects

Nationella kvalitetsdokument för digital radiologi
AG1

Michael Sandborg och Jalil Bahar
Radiofysikavdelningen Linköping

Requirements on QA-tests

- Objective
- High precision
- Quick and simple
- Available
- (Universal and automatic)

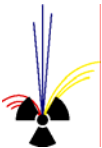


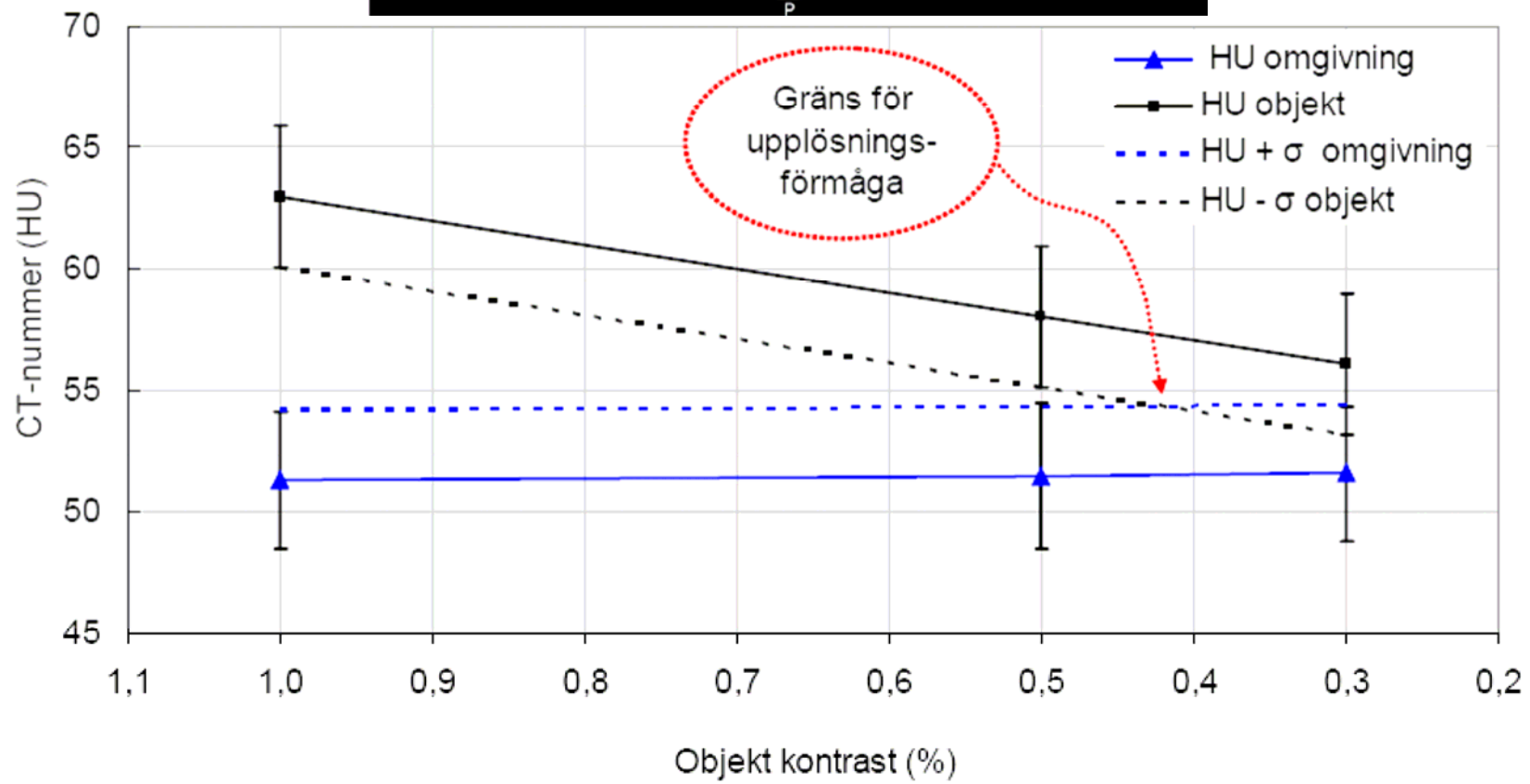
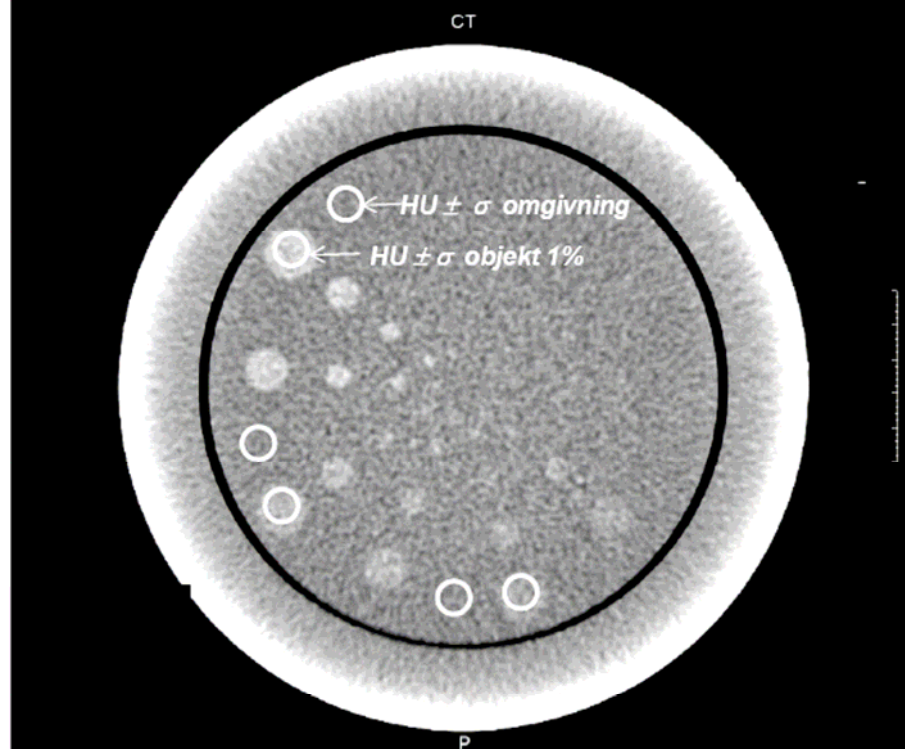
Inspiration from

Statens strålskyddsinstitut
Projekt P1069.98

Utvärdering av datortomografers doseffektivitet

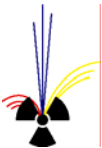
Peter Hägglund, Rolf Johansson och Göran Wickman
Institutionen för strålningsvetenskaper Umeå Universitet





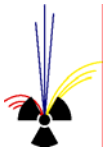
Method

- Objective measures to characterise imaging systems (or detector) performance exists
 - i.e. MTF, NPS, NEQ and DQE
 - Difficult to adapt and time-consuming
- but simple visual evaluation of test phantoms are often used in practice ...
 - # of visible low- and high-contrast details
 - Simple but rather imprecise (subjective)



Suggestion

- **LDI: Low-contrast Detection Index**
is
 - Objective
 - Precise
 - Reproducible
 - Semi-quick?

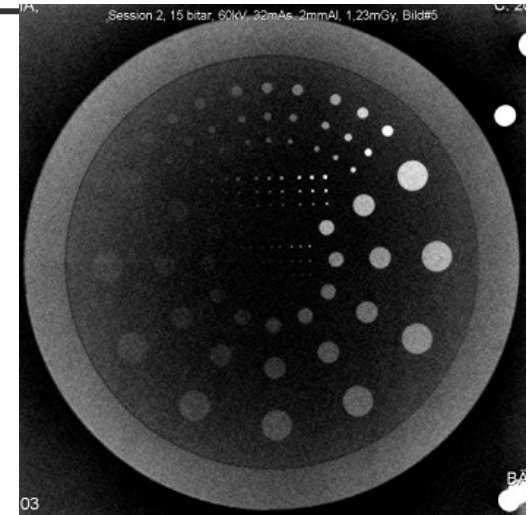


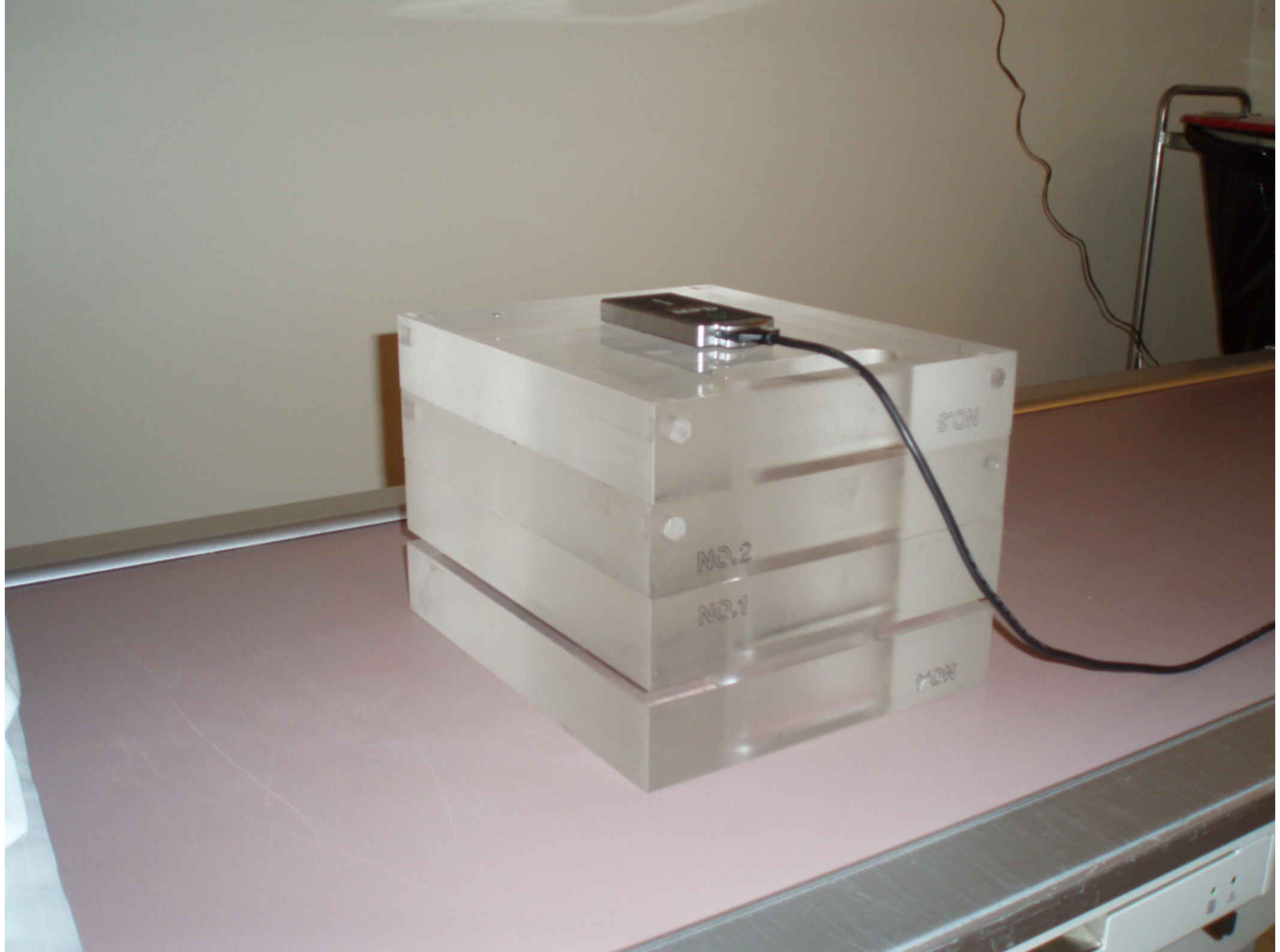
Material

- Leeds To10 phantom (SN174)
- Philips Digital Diagnost (2001)
- 4 x 5 cm PMMA blocks
- Barracuda MPD kerma-meter
- Same image processing (Unique) 'Bäcken'
- FDA=100 cm
- 25 x 25 cm field size
- No table top cushion
- Manuel exposure

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POLONIUS, OFELIA,
450406-9248

C: 19343.5, W: 2447.0
S= 800.0

↔ 13.75mm

2007-03-12, 15:48:03
US Linköping, lab16

BÄCKEN FRONTAL



Zoom to pixel-to-pixel

POLONIUS, OFELIA,
450406-9248

C: 19343.5, W: 2447.0
S= 800.0

Medel: 21506, Std avv: 328



2007-03-12, 15:48:03
US Linköping, lab16

BÄCKEN FRONTAL



26

A circular ROI is applied. Average p.v. and s.d. is measured

POLONIUS, OFELIA,
450406-9248

C: 20063.5, W: 2447.0
S= 400.0

Medel: 19791, Std. avv.: 263

Medel: 20875, Std. avv.: 282

Medel: 19707, Std. avv.: 261

Medel: 19444, Std. avv.: 262

BÄCKEN FRONTAL

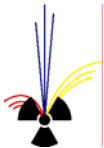
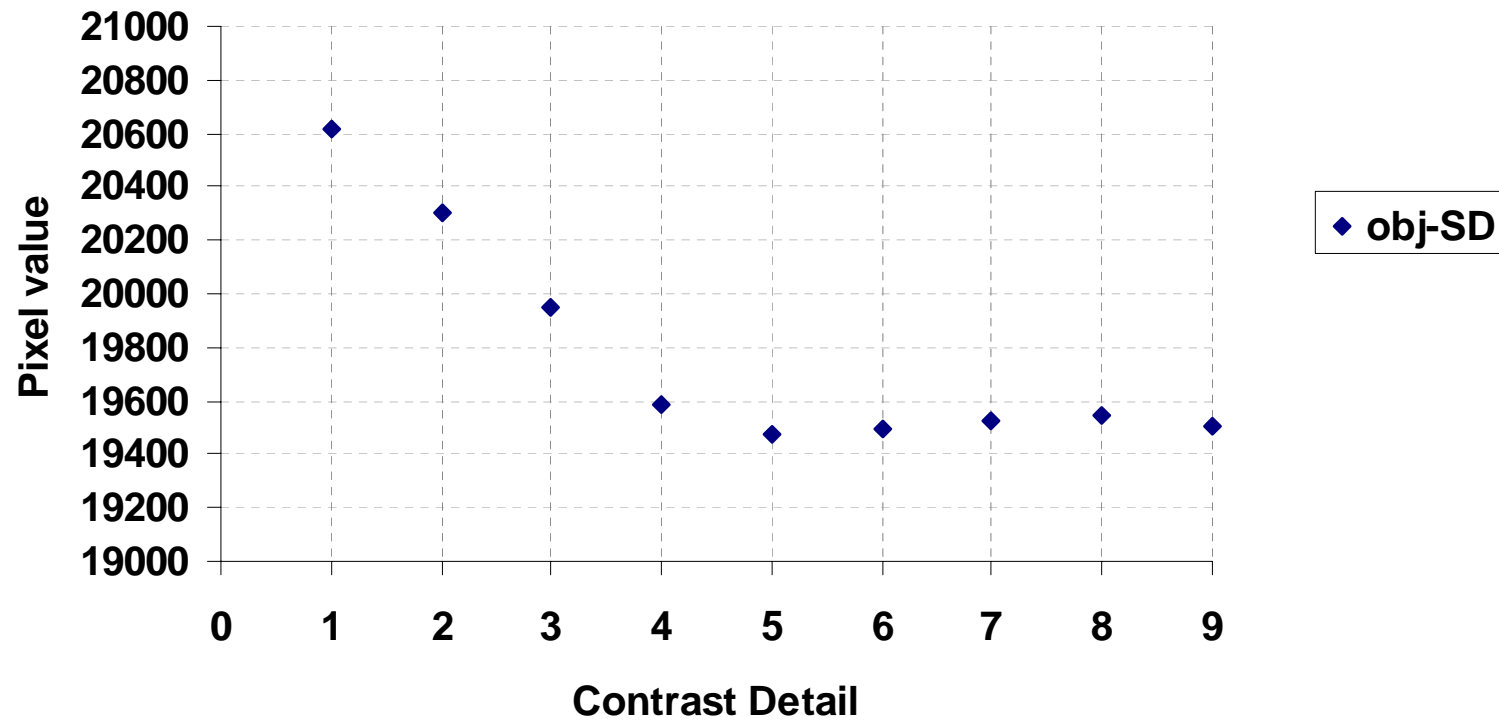
2007-03-12, 14:30:14
US Linköping, lab16



Measure p.v. and s.d. on top and beside the detail

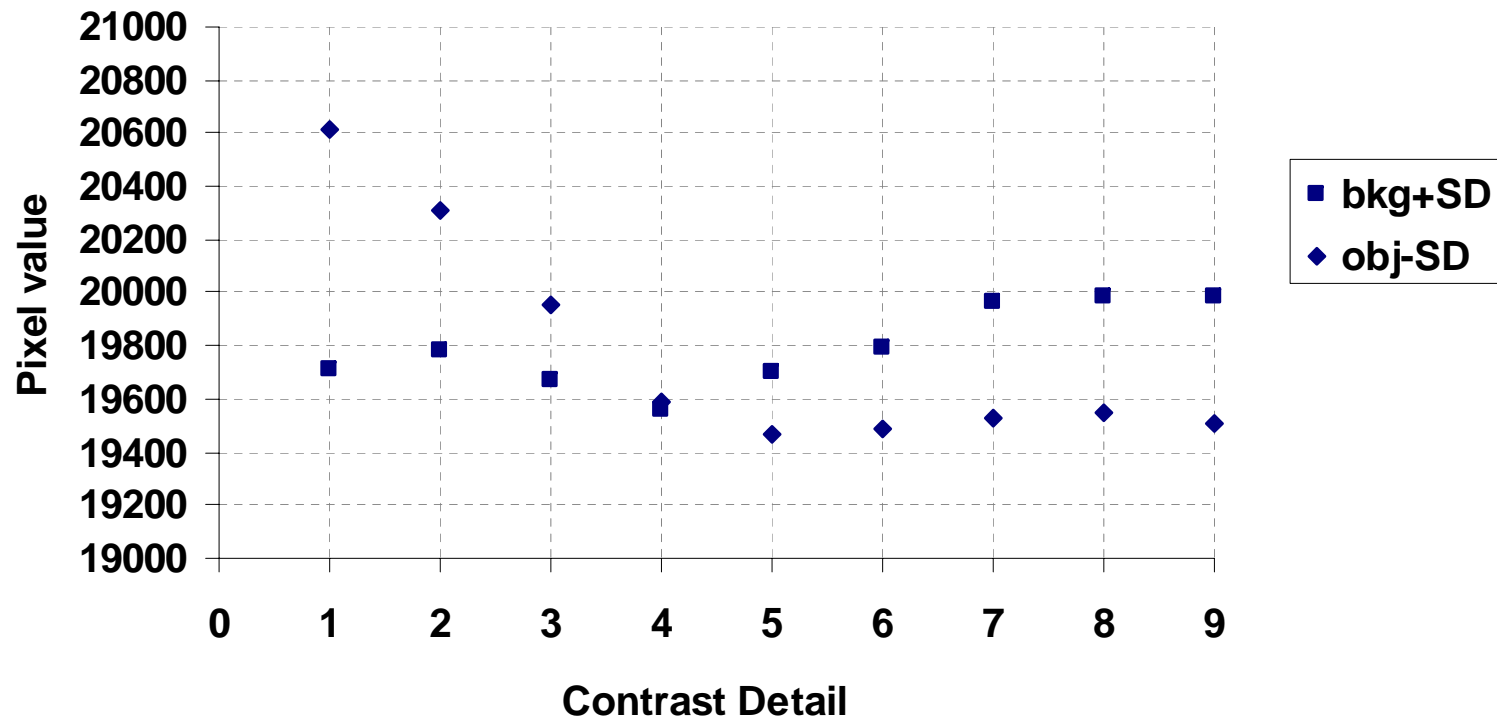
Method

Uncorrected



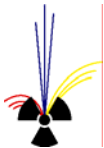
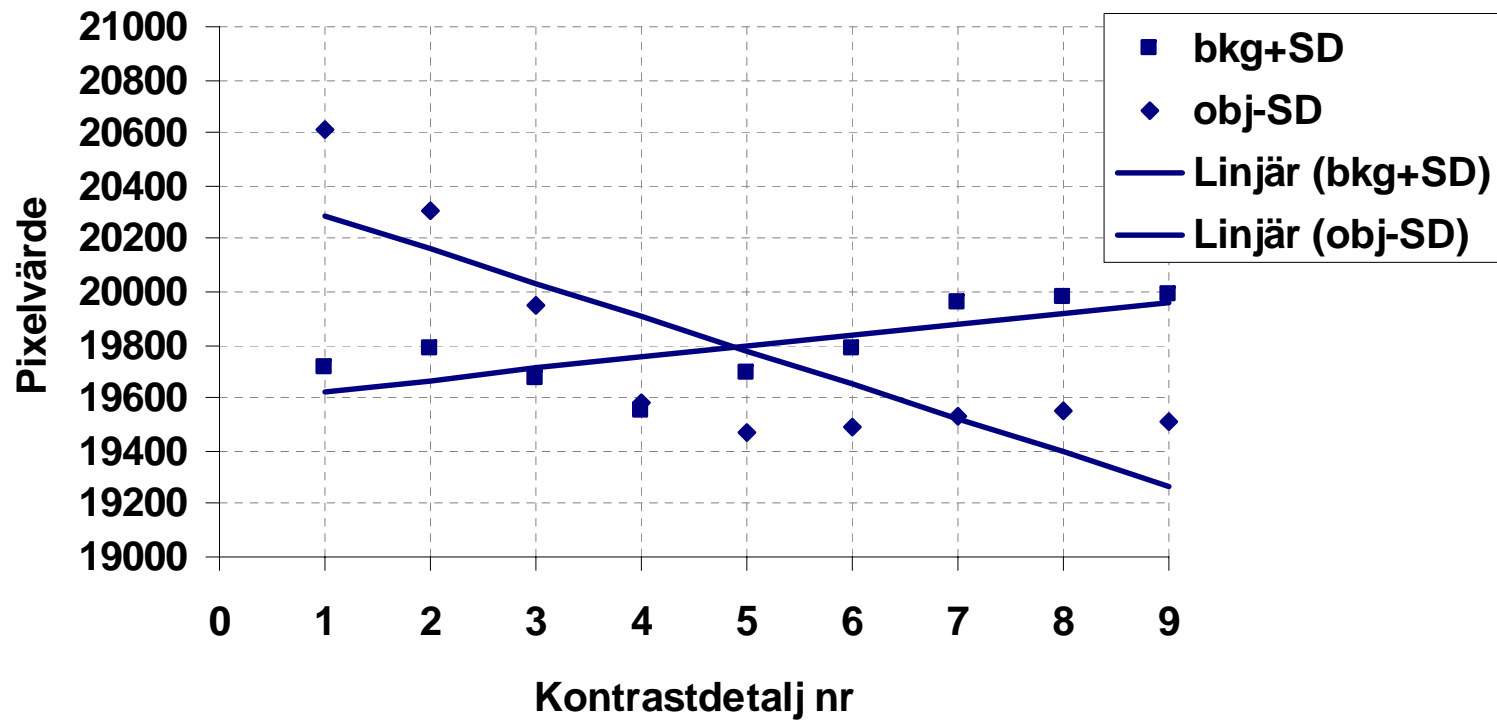
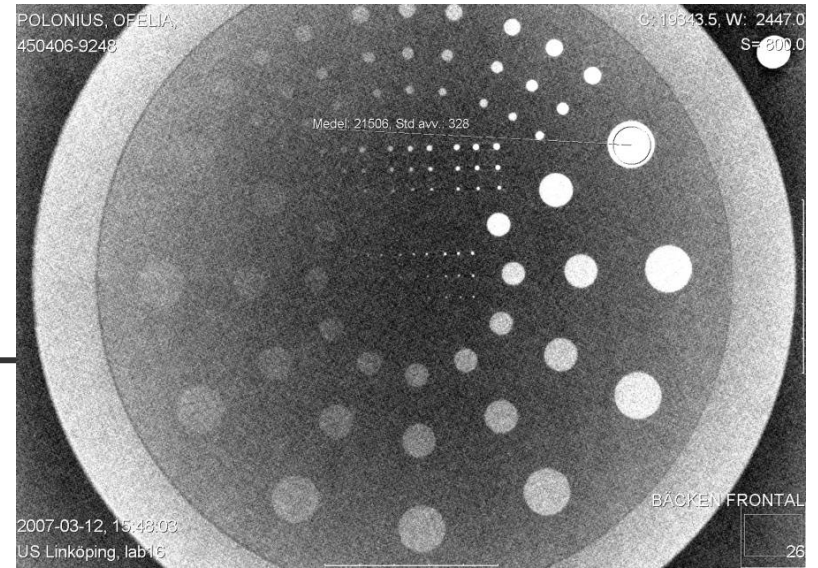
Method

Uncorrected



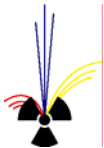
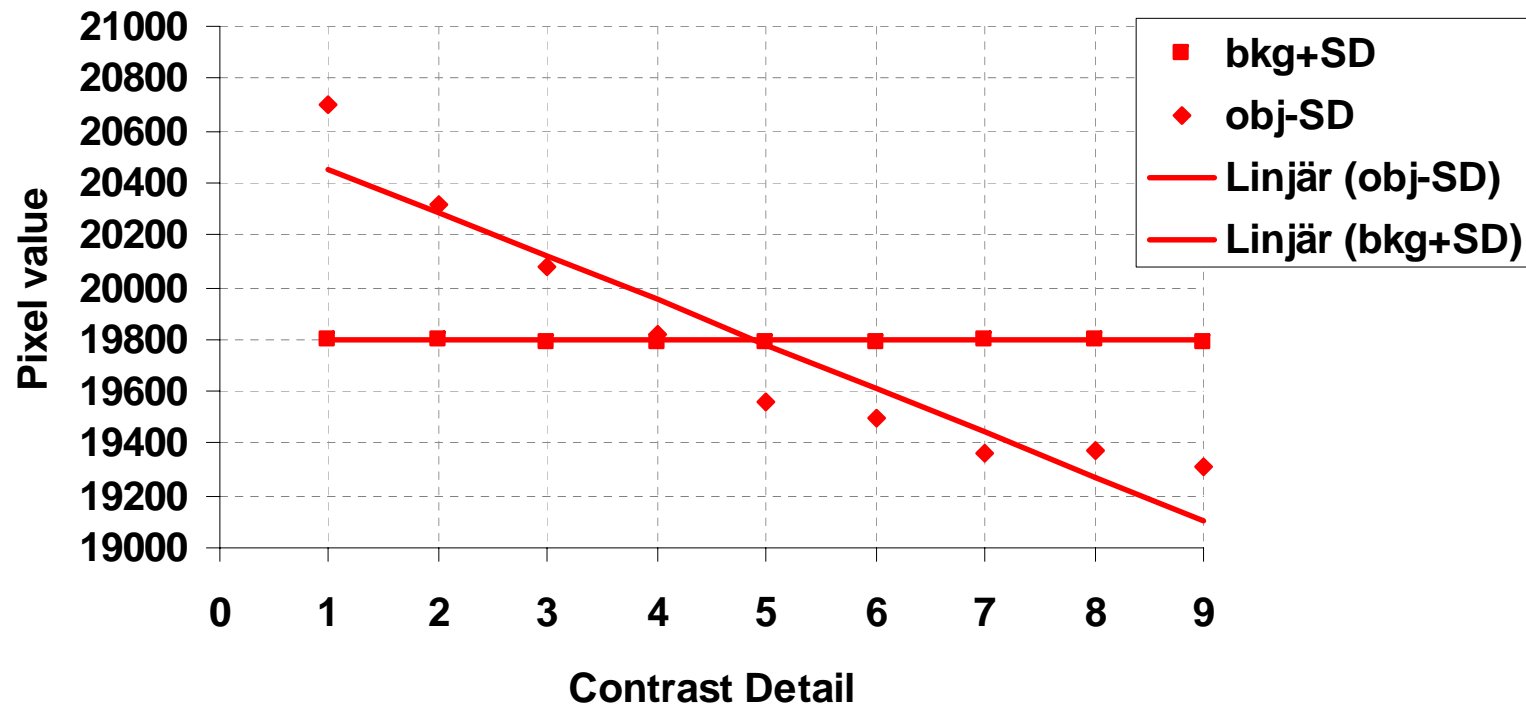
Method

Uncorrected linear reg, LDI



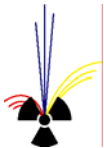
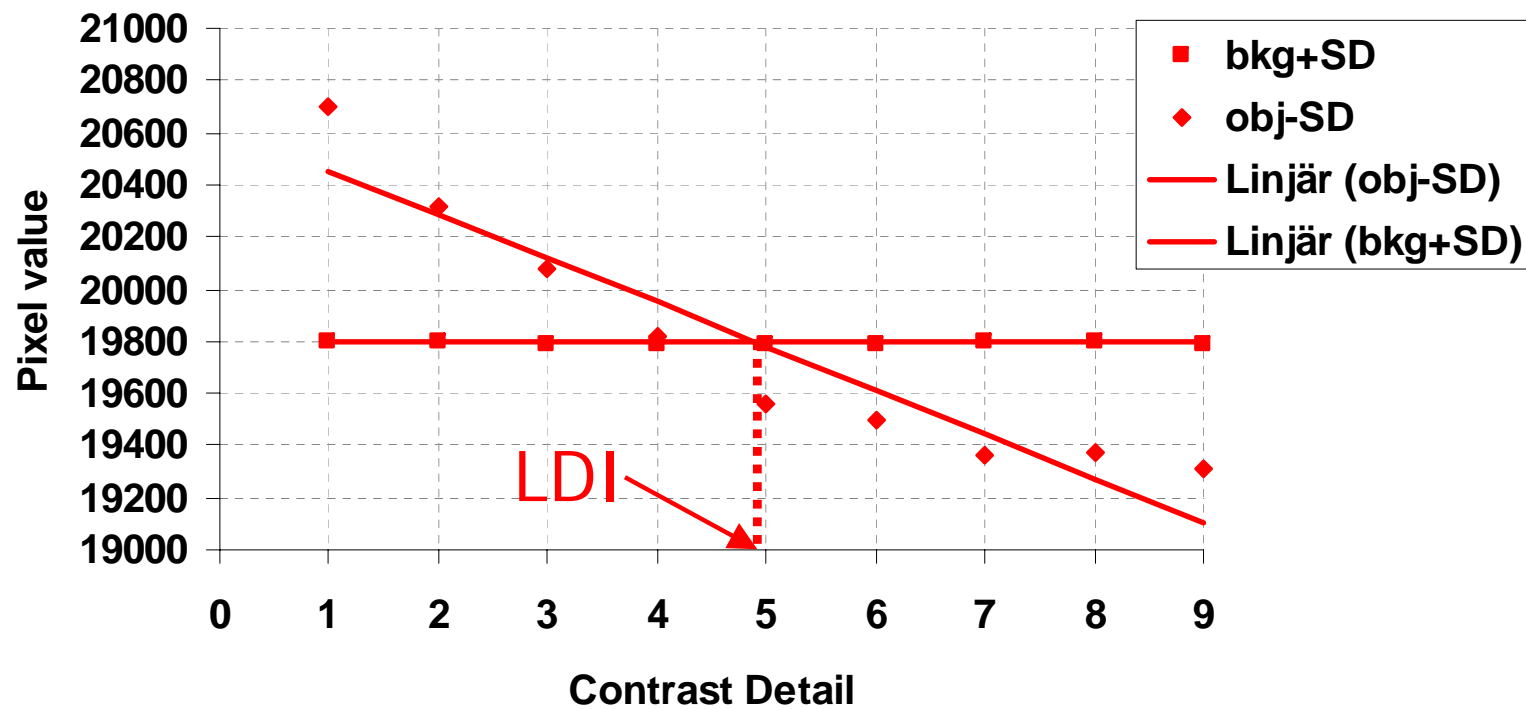
Method

Corrected linear reg, LDI



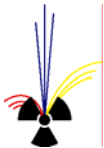
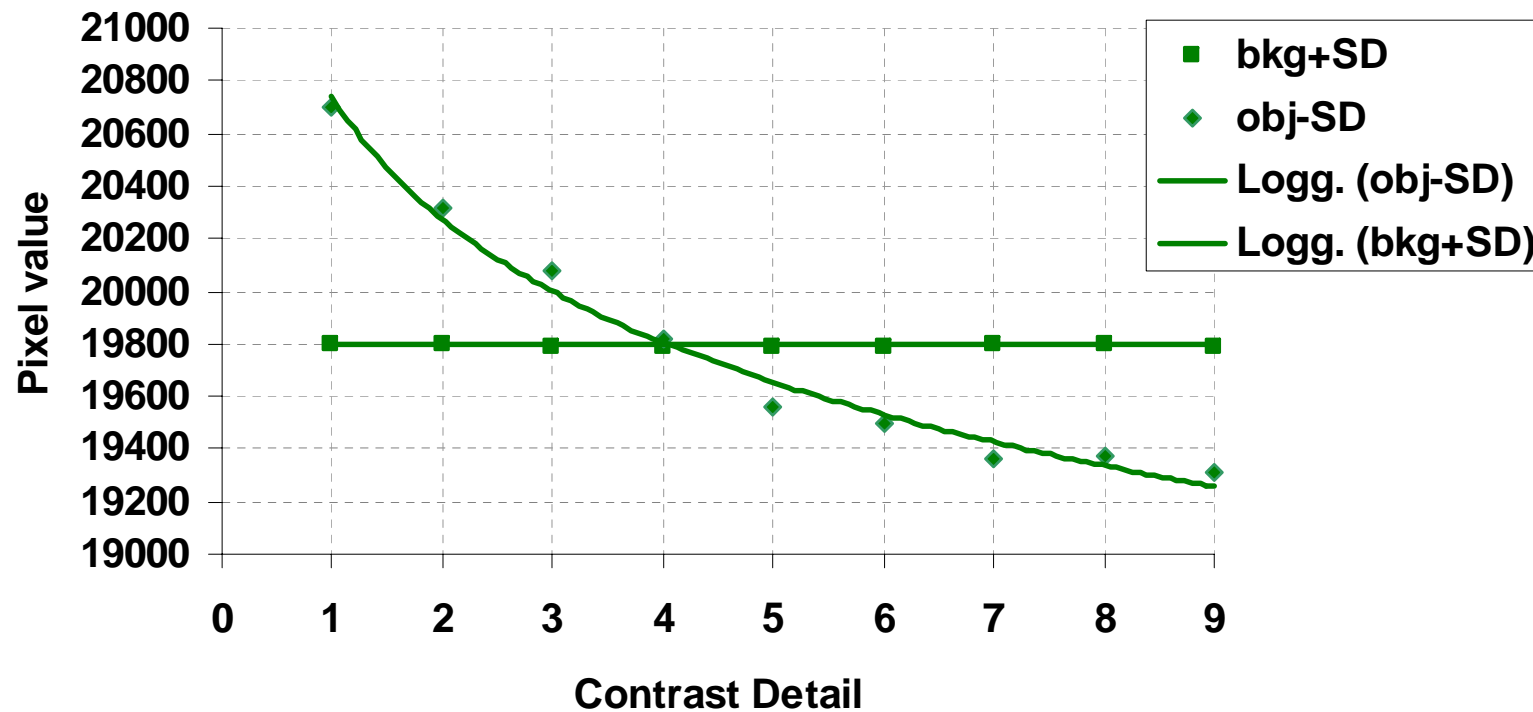
Method

Corrected linear reg, LDI



Method

Corrected log reg, LDI



Repeat 3-5 times

POLONIUS, OFELIA,
450406-9248

Session 2, 15 bitar, 60kV, 32mAs, 2mmAl, 1,23mGy, Bild#1
C: 20723.5, W: 6847.0
S= 800.0

POLONIUS, OFELIA,
450406-9248

Session 2, 15 bitar, 60kV, 32mAs, 2mmAl, 1,23mGy, Bild#2
C: 20523.5, W: 4847.0
S= 800.0

POLONIUS, OFELIA,
450406-9248

Session 2, 15 bitar, 60kV, 32mAs, 2mmAl, 1,23mGy, Bild#3
C: 20723.5, W: 5407.0
S= 800.0

POLONIUS, OFELIA,
450406-9248

Session 2, 15 bitar, 60kV, 32mAs, 2mmAl, 1,23mGy, Bild#4
C: 20923.5, W: 5247.0
S= 800.0

POLONIUS, OFELIA,
450406-9248

Session 2, 15 bitar, 60kV, 32mAs, 2mmAl, 1,23mGy, Bild#5
C: 20323.5, W: 3407.0
S= 800.0

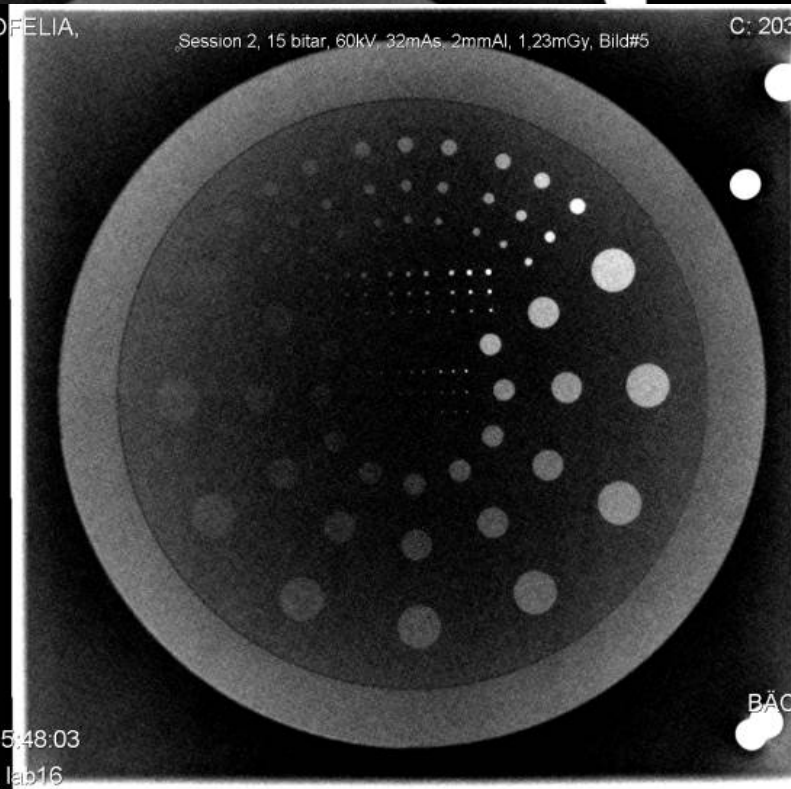
2007-03-12, 15
US Linköping, I

2007-03-12, 15
US Linköping, I

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US Linköping, I

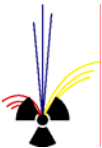
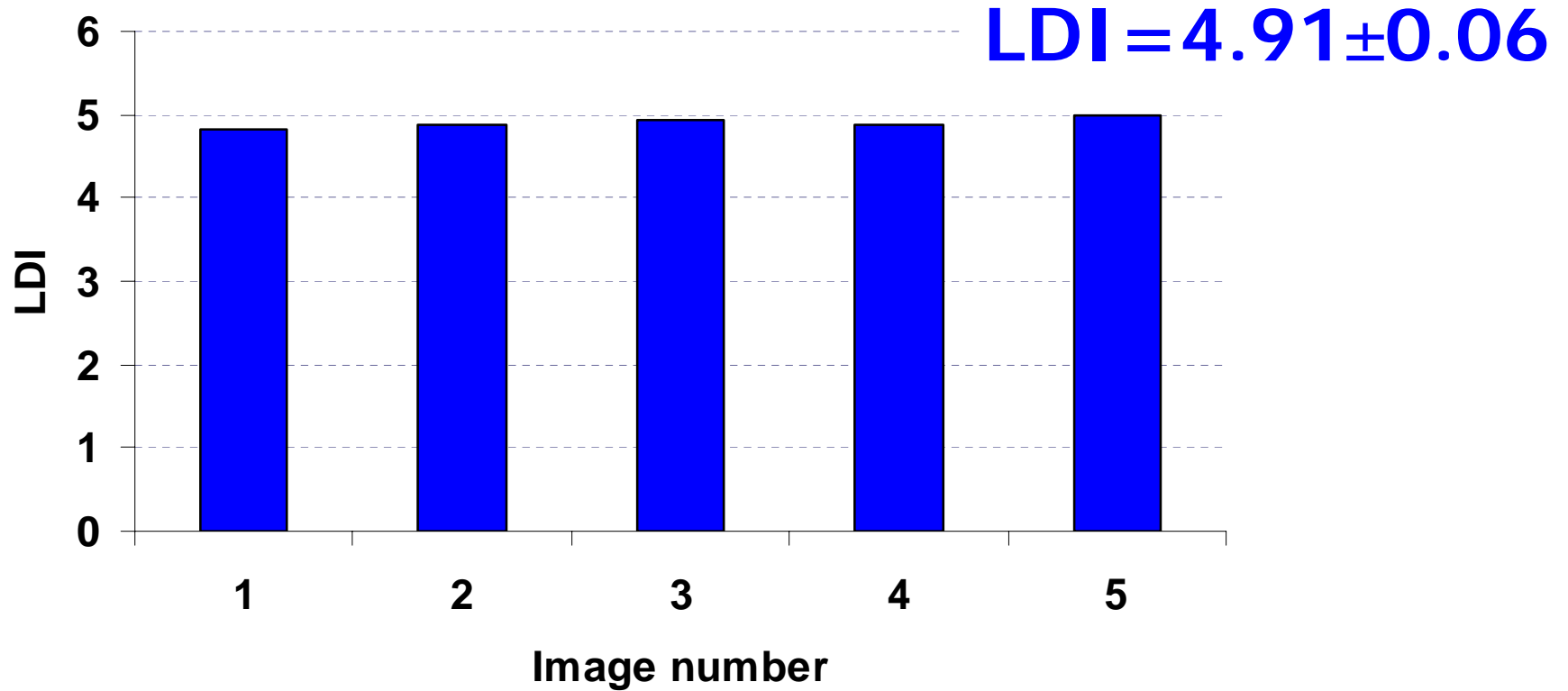
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US Linköping, lab16



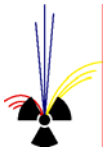
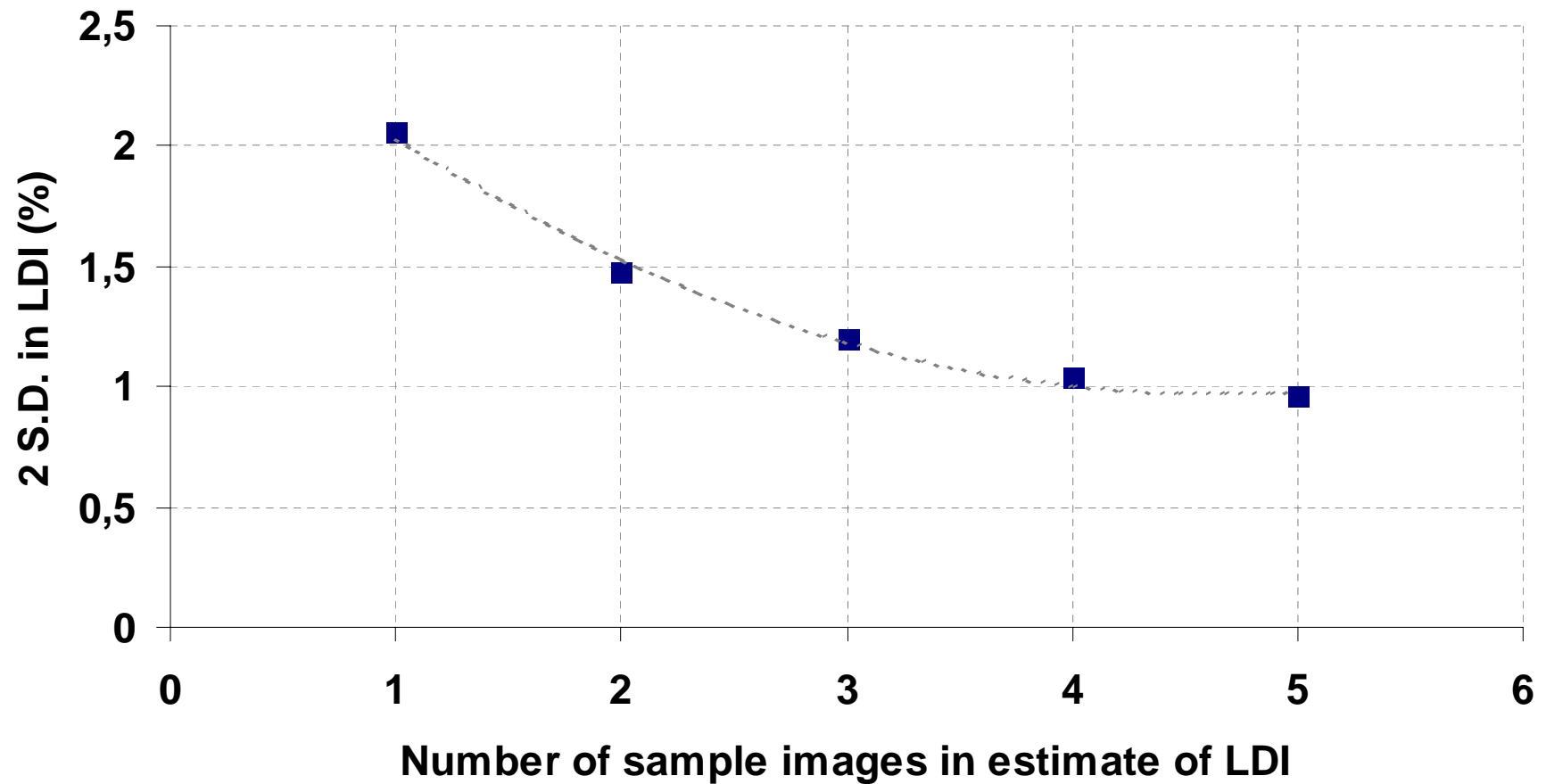
BÄCKEN FRONTAL

Method

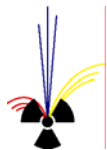
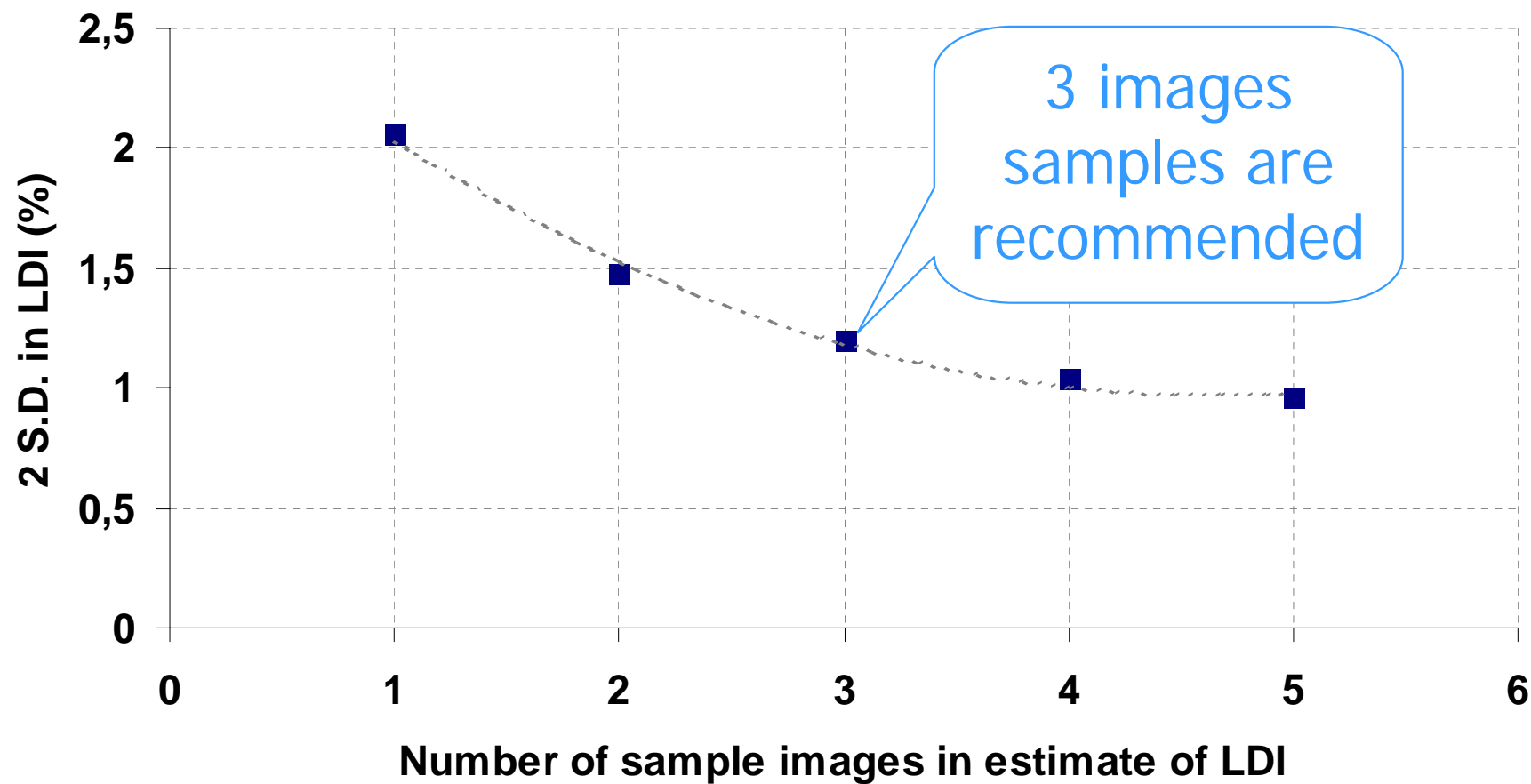
5 image samples



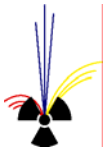
Results: Uncertainty



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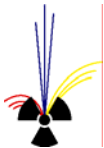


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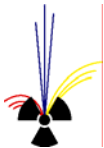
Uncertainty

- Uncertainty is stable with
 - Bit-depth
 - Detector dose



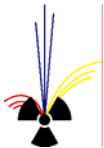
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- **BUT very important** to set up and align the phantom and x-ray unit in a consistent way!



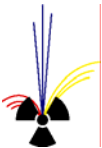
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- **Keep detailed notations** and document x-ray unit set up (photograph)



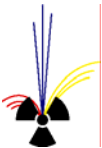
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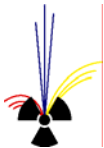
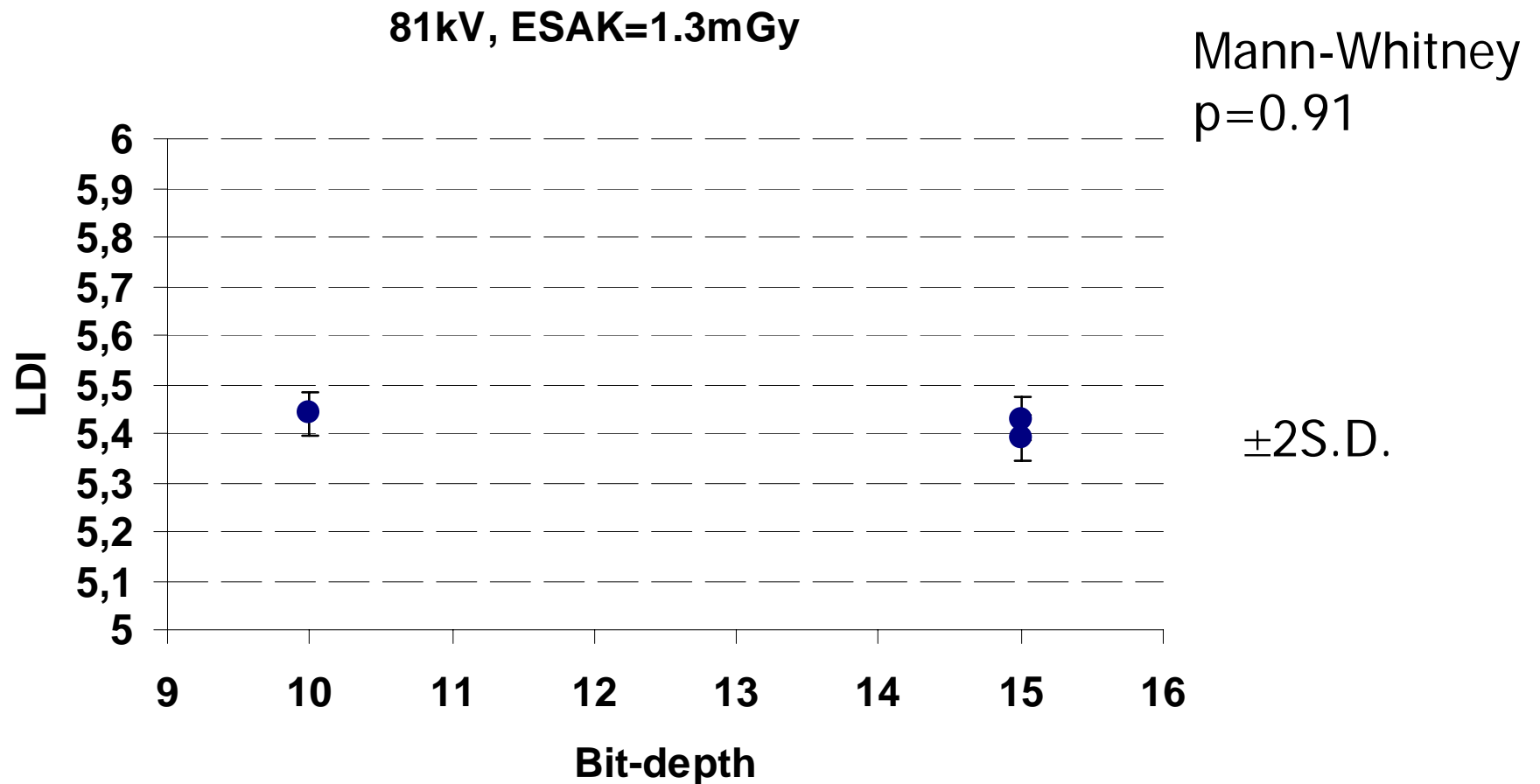


Applications / tests of method

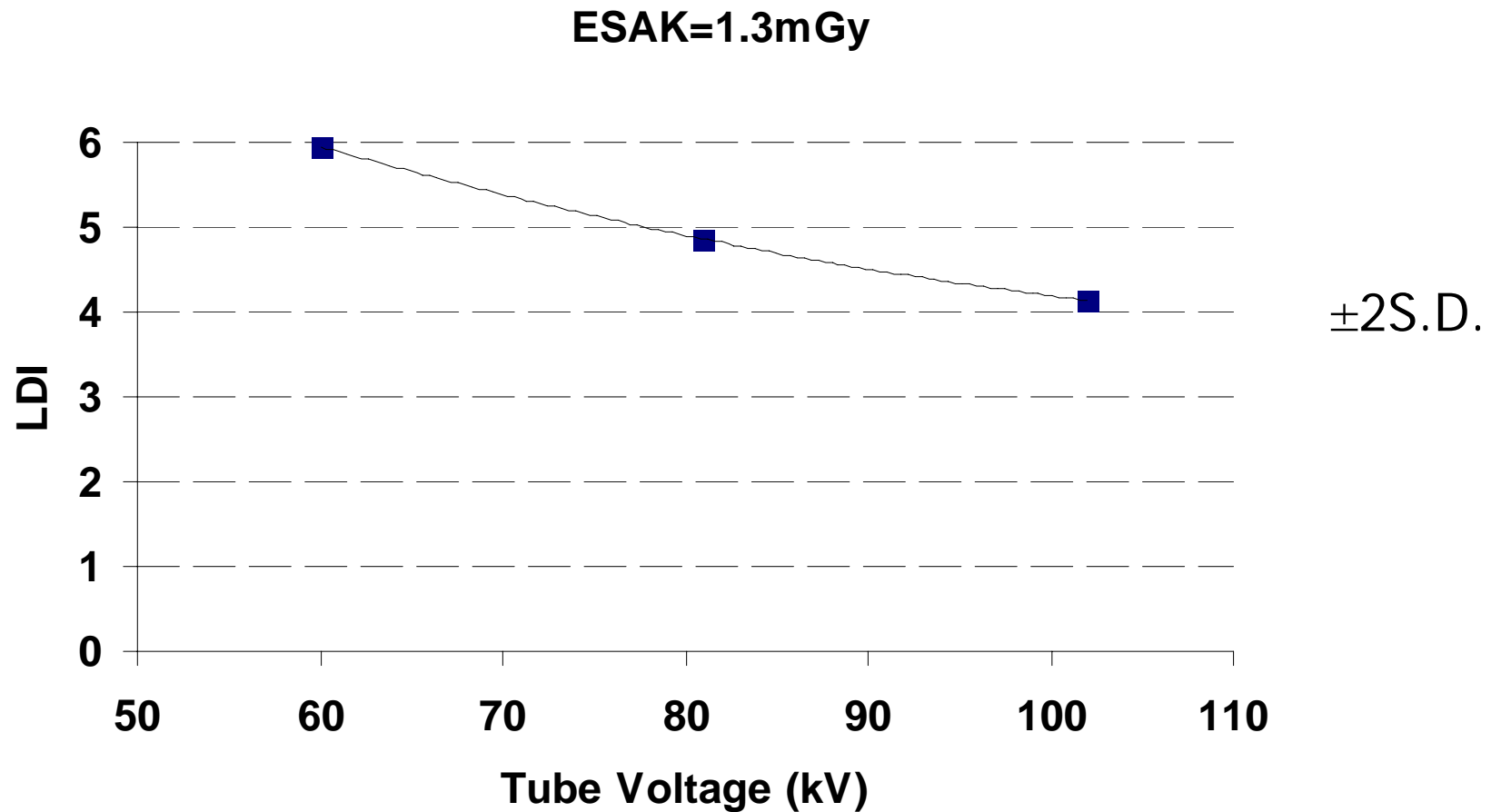
- LDIs dependence on
 - bit-depth
 - kV
 - ESAK



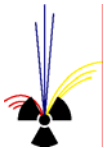
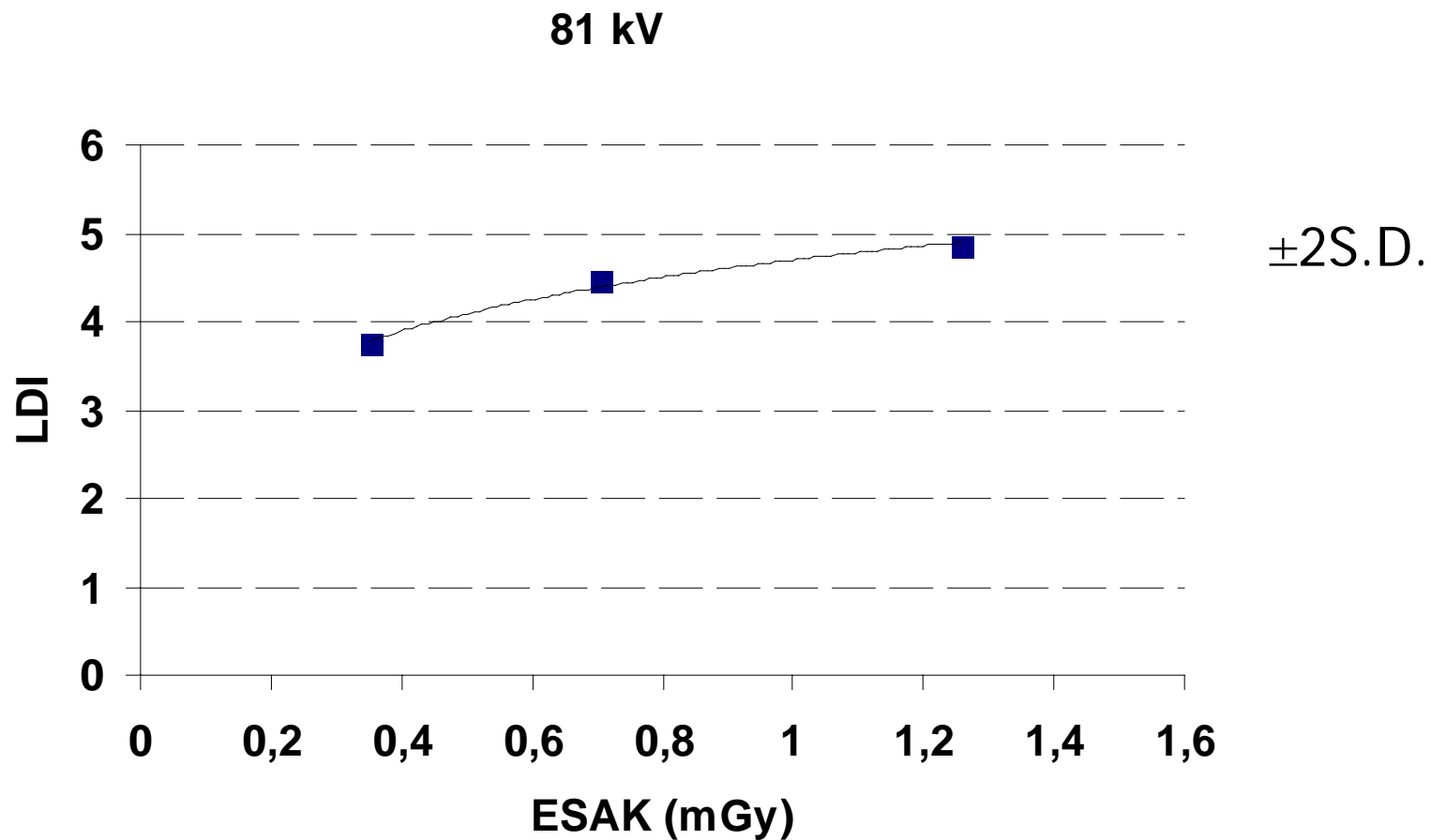
Results: Different Bit depth



Results: Different kV

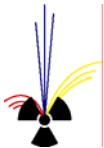
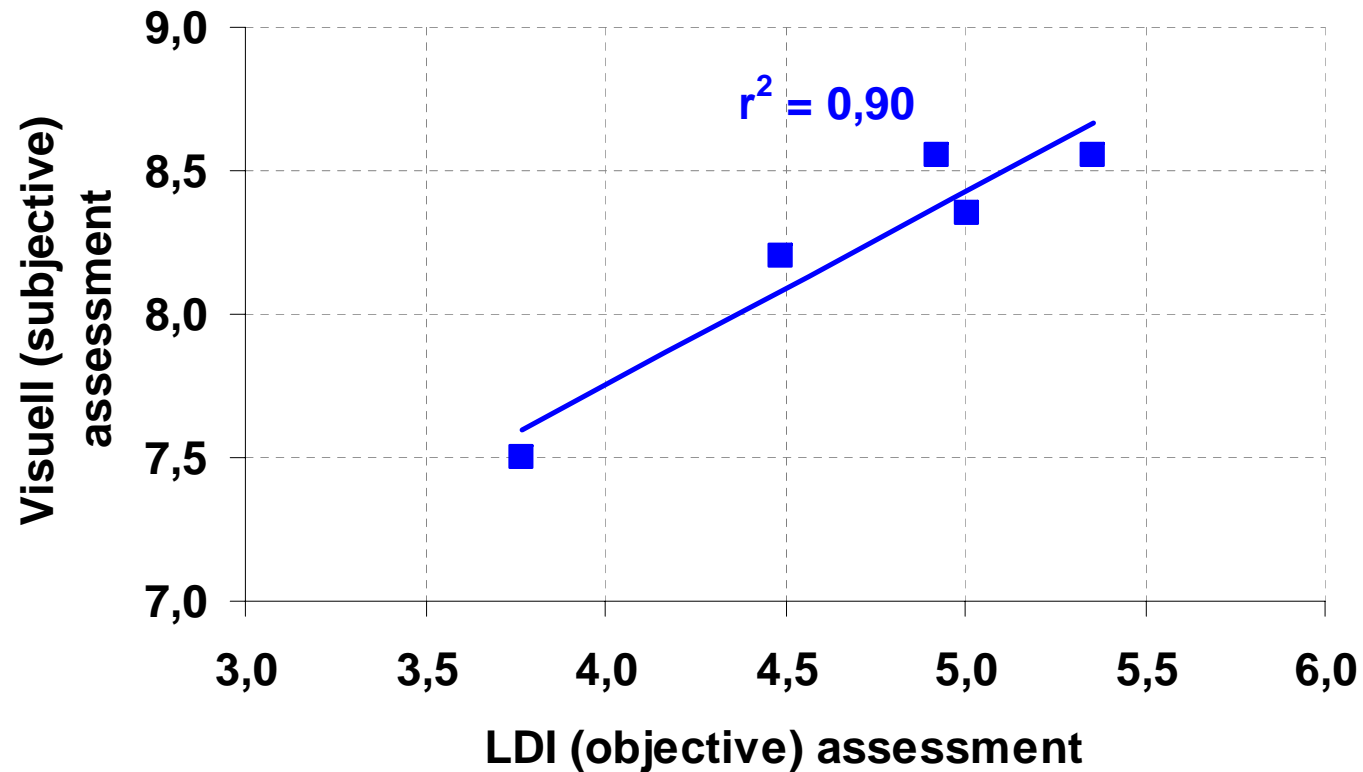


Results: Different ESAK



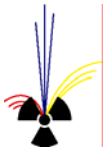
Results: Correlations

Subjective v.s. Objective assessment



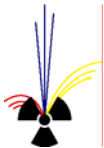
Conclusions and further work

- LDI method seem ´appropriate´ for QA-test
- Further tests and validations of sensitivity to different
 - image processing schemes
 - dynamic range of image data
 - X-ray units
 - sizes of contrast detail
 - test phantoms
- Automatic image assessment with software

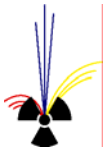


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Comments ? !



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- Please send comments and suggestions for improvement to
 - Jalil.Bahar@lio.se or
 - Michael.Sandborg@lio.se

