

$L_n, L_x$  curves

ALQ Pos. 1

$T_n, T_x$  curves



Cutheat – TL curves



IRSLT

IRSL/BOSL = 0.88%



IRSL curve (10 s)



help("Analyse\_SAR\_OSLdata")

unkown measurement





**Fig. 4 – Bos & Wallinga (2012)**





`help("CW2pLM")`



**Fig. 4 – Bos & Wallinga (2012)**







**Fig. 4 – Bos & Wallinga (2012)**



TL (UVVIS)



OSL (UVVIS)

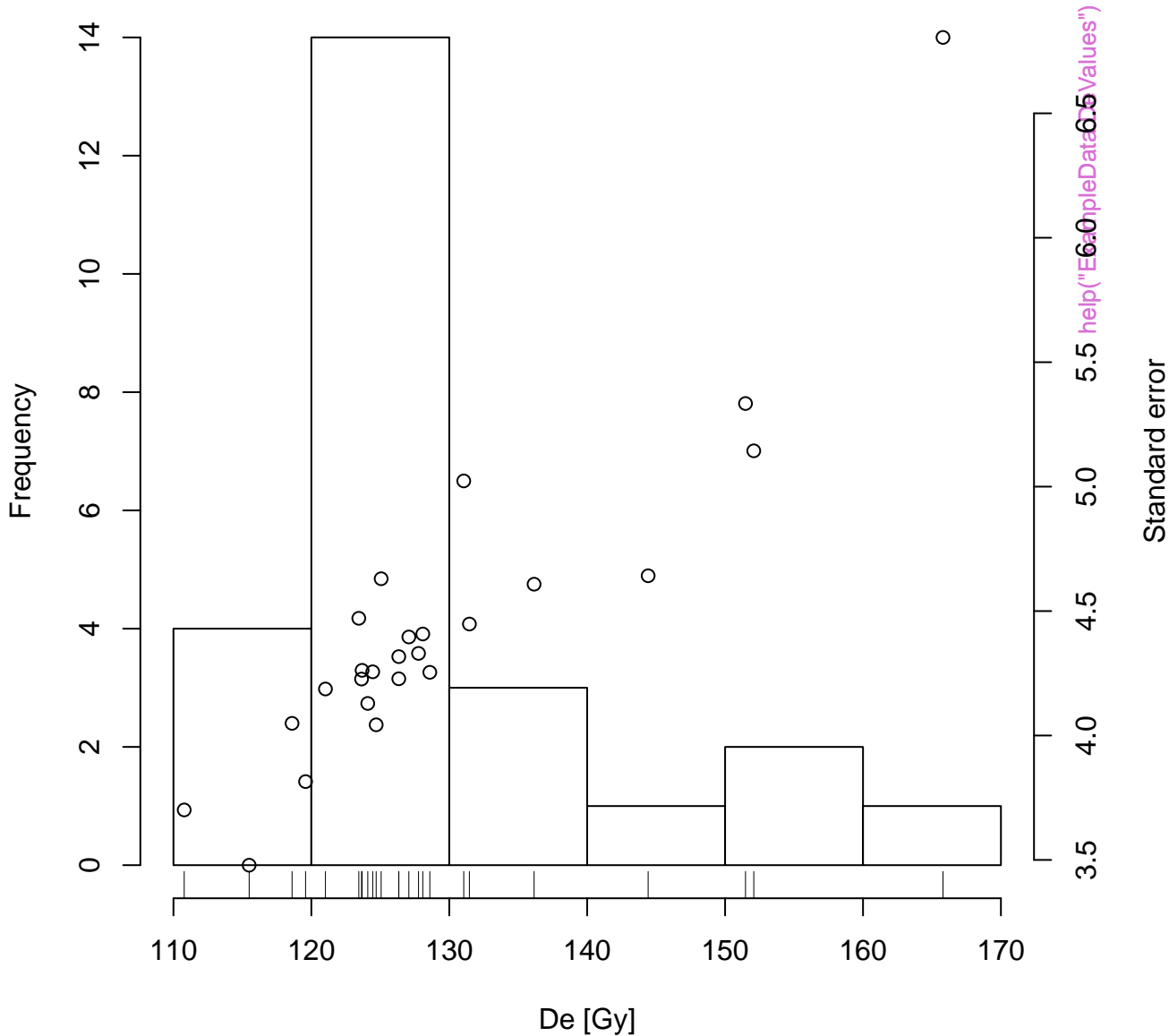




# Histogram



# Histogram



No L<sub>x</sub> curves detected

No T<sub>x</sub> curves detected

help("ExampleData.Fading")

Signal Fading



Density: g-values (%/decade)



# Growth curve

$D_e = 977.38 \pm 105.65$  | fit: EXP

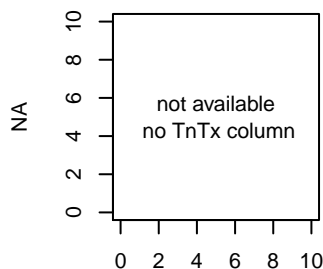


## $D_e$ from MC simulation

$D_{eMC} = 984.66 \pm 105.65$  | quality = 99.3 %



## Test dose response



Dose [s]

NA

n = 100, valid fits = 100



`help("ExampleData.FittingLM")`





`help("ExampleData.LxTxData")`



help("ExampleData.LxTxOSLData")



`help("ExampleData.LxTxOSLData")`

**RF**

**#1**



**RF**

**#2**



[help\("ExampleData.RLum.Analysis"\)](#)

# RLum.Data.Image





help("ExampleData.SurfaceExposure")



help("ExampleData.SurfaceExposure")







help("ExampleData.SurfaceExposure")

# OSL (UVVIS)



help("ExampleData.XSYG")

RLum.Data.Spectrum



help("ExampleData.XSYG")

USER

Record: 1



IRSL

Record: 1



help("ExampleData.portableOSL")

Record: 1



Record: 1



USER

Record: 2



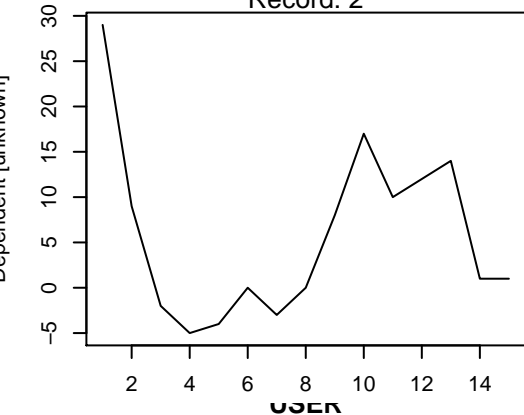
IRSL

Record: 2

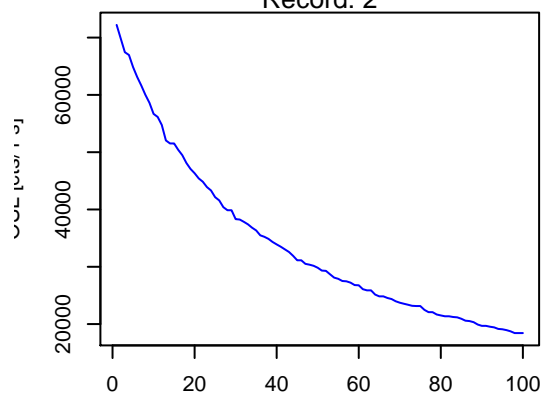


help("ExampleData.portableOSL")

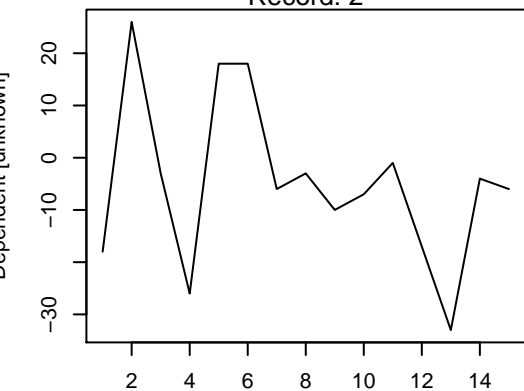
Record: 2



Record: 2



Record: 2





help("ExampleData.portableOSL")

USER

Record: 4



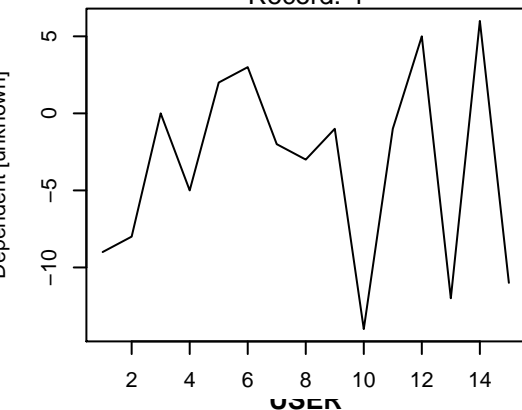
IRSL

Record: 4



help("ExampleData.portableOSL")

Record: 4



Record: 4







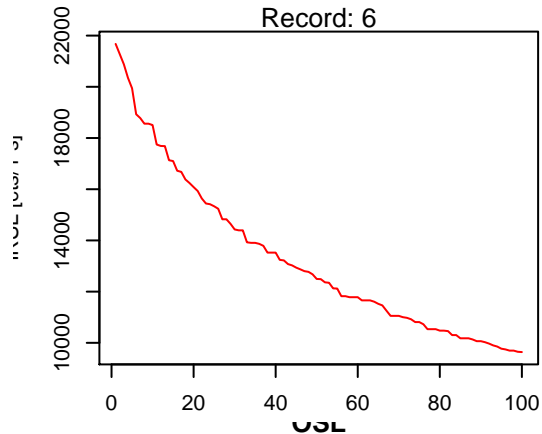
USER

Record: 6



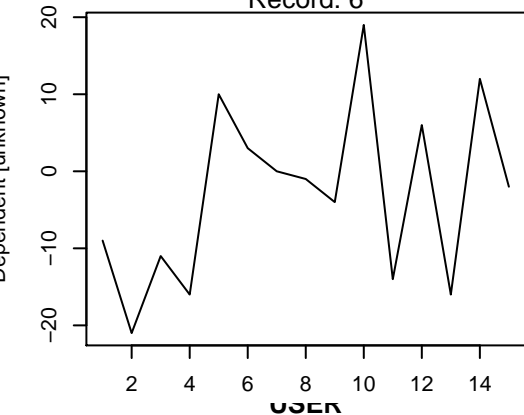
IRSL

Record: 6



help("ExampleData.portableOSL")

Record: 6



Record: 6



USER

Record: 7



IRSL

Record: 7

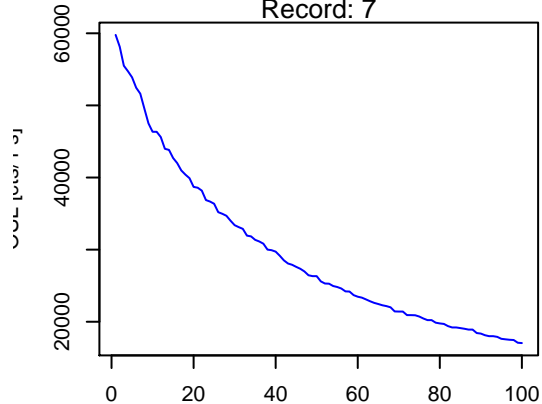


help("ExampleData.portableOSL")

Record: 7

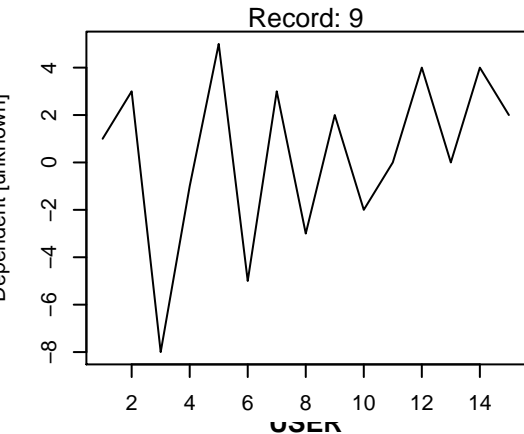


Record: 7

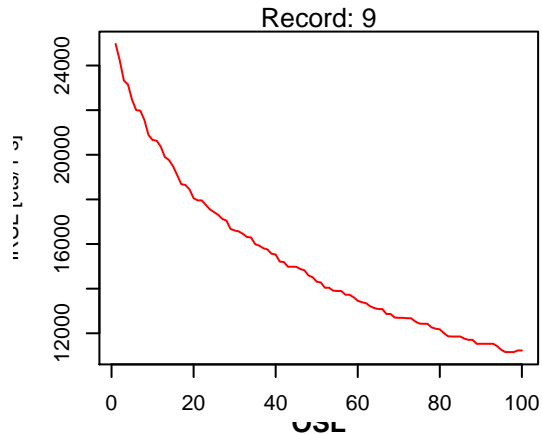




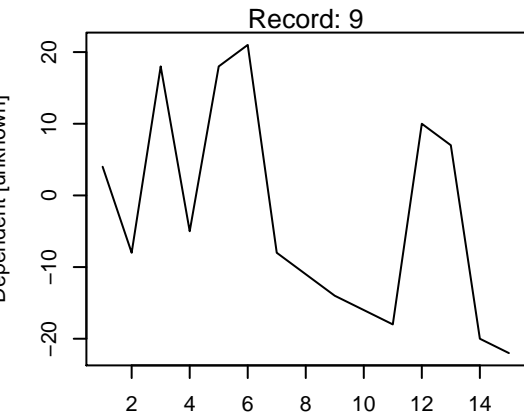
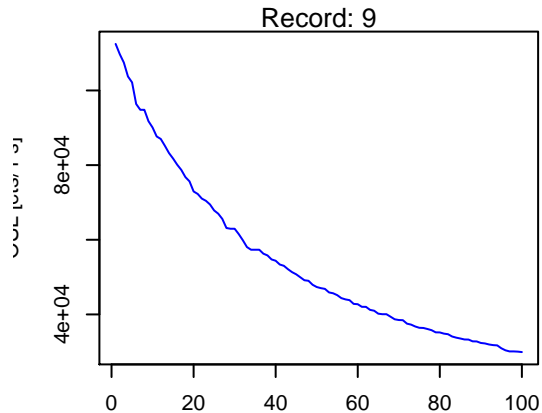
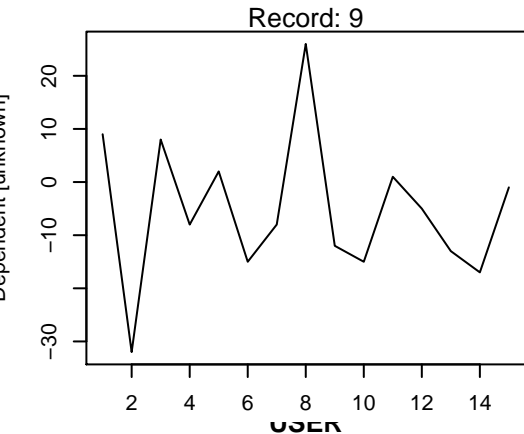
USER



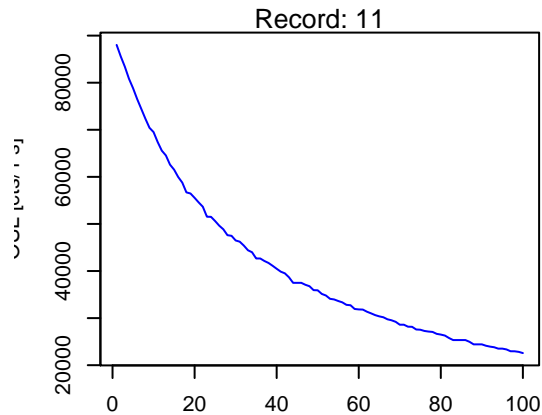
IRSL



help("ExampleData.portableOSL")







USER

Record: 12



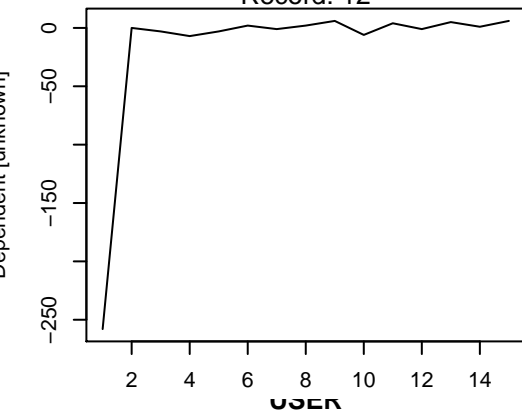
IRSL

Record: 12



help("ExampleData.portableOSL")

Record: 12



Record: 12



USER

Record: 13



Record: 13



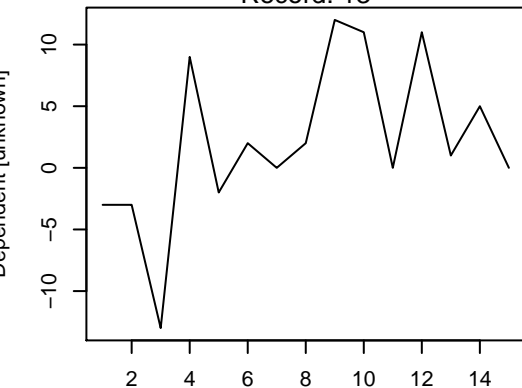
Record: 13



Record: 13



Record: 13



help("ExampleData.portableOSL")



USER

Record: 14



IRSL

Record: 14



help("ExampleData.portableOSL")

Record: 14



Record: 14



USER

Record: 1



IRSL

Record: 1



help("PSL2Riseo.BinfileData")

Record: 1



Record: 1



USER

Record: 2



IRSL

Record: 2



help("PSL2Riseo.BinfileData")

Record: 2



Record: 2





USER

Record: 4



Record: 4

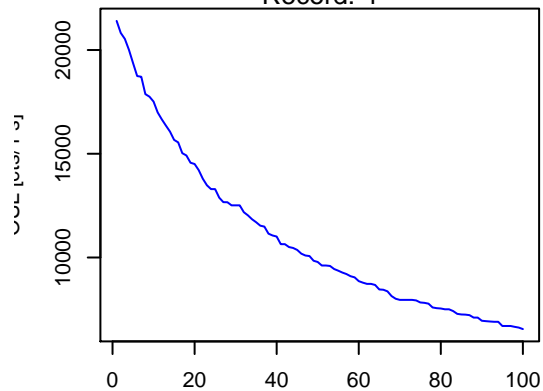


help("PSL2Risee.BINfileData")

Record: 4



Record: 4







USER

Record: 7



IRSL

Record: 7



help("PSL2Riseo.BinfileData")

Record: 7



Record: 7











USER

Record: 11



IRSL

Record: 11

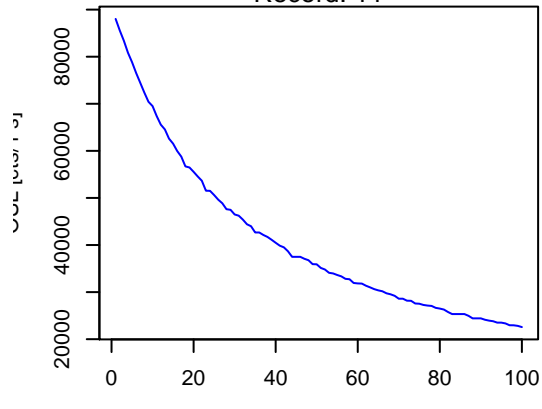


help("PSL2Riseo.BinfileData")

Record: 11



Record: 11



USER

Record: 12



IRSL

Record: 12



Record: 12

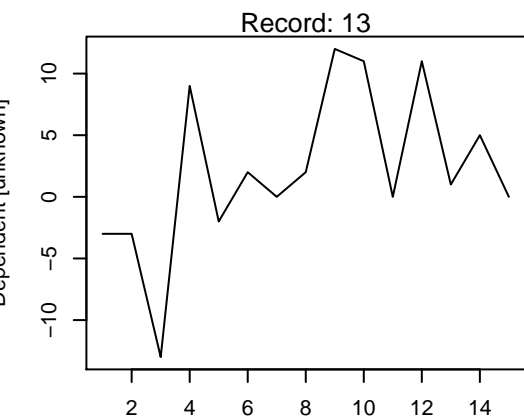


Record: 12



Record: 12

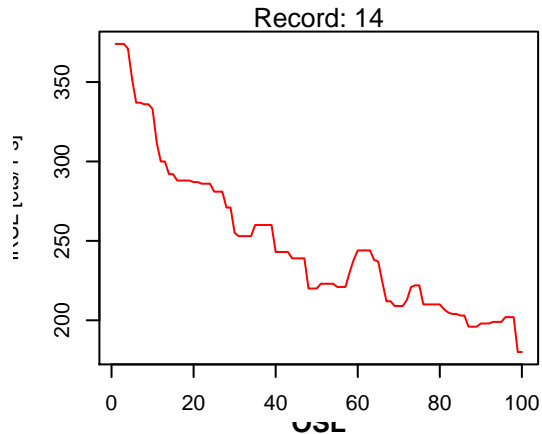




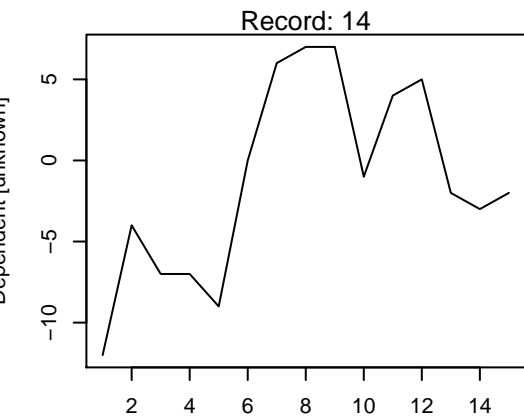
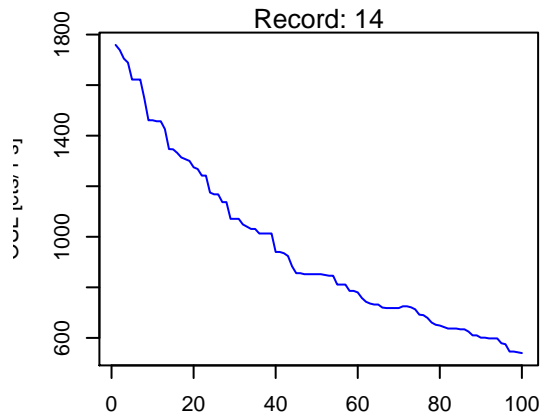
USER



IRSL



help("PSL2Riseo.BINfileData")



# Sample Carousel Crosstalk





# Irradiation Time Correction



help("analyse\_Al2O3C\_ITC")

## ALQ POS: 1 | OSL



## ALQ POS: 1 | T#1



## ALQ POS: 2 | OSL



## ALQ POS: 2 | T#2



help("analyse\_Al2O3C\_Measurement")

No L<sub>x</sub> curves detected

No T<sub>x</sub> curves detected

help("analyse\_FadingMeasurement")

Signal Fading



Density: g-values (%/decade)



# IR-RF

$D_e = 623.25$  [600.63 ; 635.8]



# IR-RF

$D_e = 610.17$  [567.19 ; 653.15]



TL previous  $L_n, L_x$  curves



TL previous  $T_n, T_x$  curves



$L_n, L_x$  curves



$T_n, T_x$  curves



●  
Natural  
(0)

●  
R1  
(450)

●  
R2  
(1050)

●  
R3  
(2000)

●  
R4  
(2550)

●  
R5  
(450)

●  
R0  
(0)

## Growth curve

$D_e = 1668.25 \pm 49.22$  | fit: EXP



## $D_e$ from MC simulation

$D_{eMC} = 1677.48 \pm 49.22$  | quality = 99.4 %



## Test dose response





## Rejection criteria



- 0.2      + 0.2

## IRSL



[help\("analyse\\_SAR.CWOSL"\)](#)

$L_n, L_x$  curves $T_n, T_x$  curvesPlateau test  $L_n, L_x$  curvesplateau Test  $T_n, T_x$  curves

Natural  
(0)

Natural  
(136)

Natural  
(317)

Natural  
(544)

Natural  
(815)

Natural  
(0)

Natural  
(317)



## Pseudo pIRIR data set based on quartz OSL

TL  
pseudolRSL1  
pseudolRSL2

help("analyse\_pIRIRSequence")

# Pseudo pIRIR data set based on quartz OSL



# Pseudo pIRIR data set based on quartz OSL



# Pseudo pIRIR data set based on quartz OSL



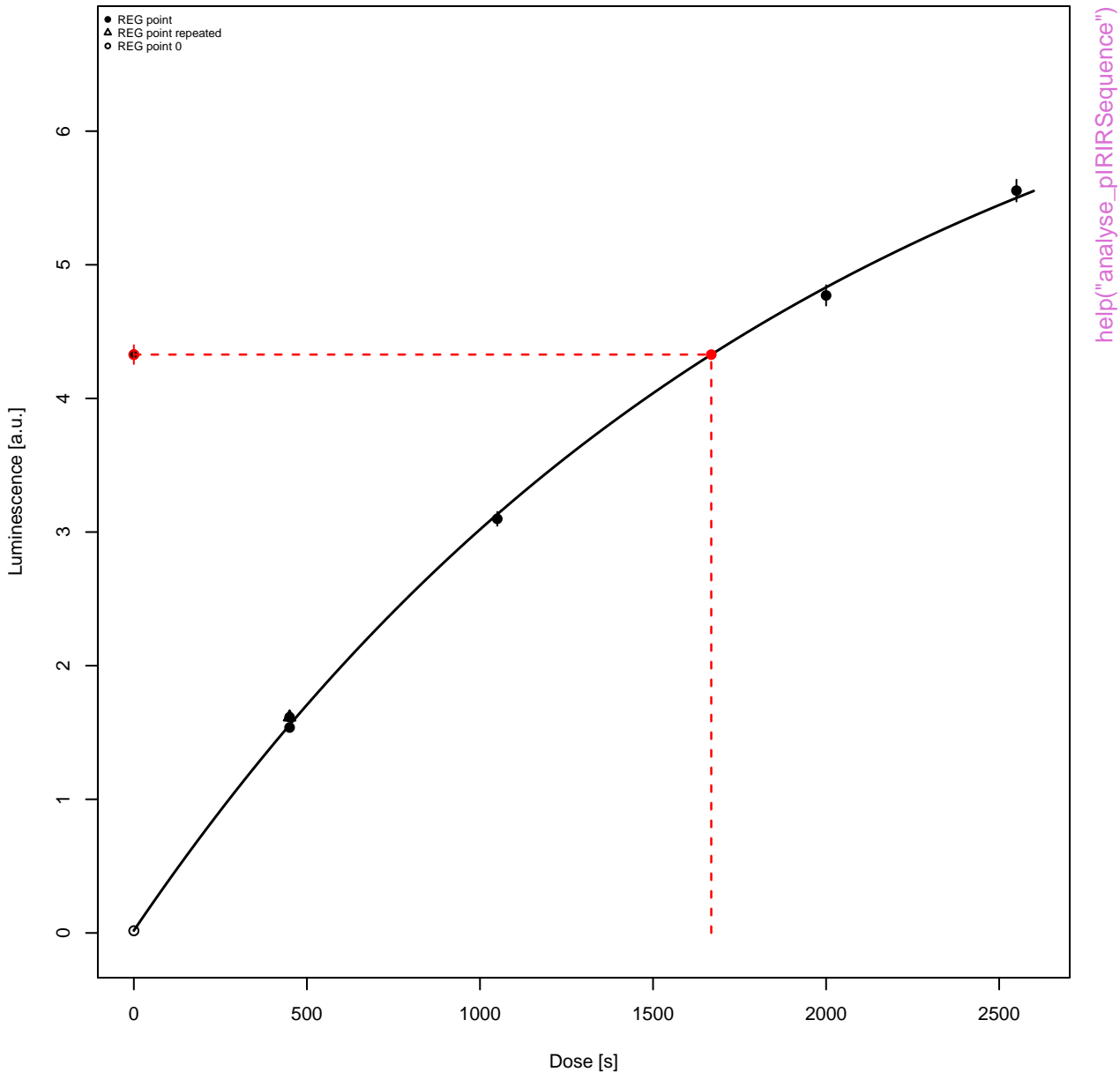
# Pseudo pIRIR data set based on quartz OSL





# Pseudo pIRIR data set based on quartz OSL

$D_e = 1668.25 \pm 41.38$  | fit: EXP



# D<sub>e</sub> from MC simulation

D<sub>eMC</sub> = 1666.57 ± 41.38 | quality = 99.9 %



help("analyse\_pIRIRSequence")

Test dose response



# Pseudo pIRIR data set based on quartz OSL



# Pseudo pIRIR data set based on quartz OSL





Pseudo pIRIR data set based on quartz OSL

$D_e = 1668.25 \pm 47.59$  | fit: EXP



# D<sub>e</sub> from MC simulation

D<sub>e,MC</sub> = 1669.37 ± 47.59 | quality = 99.9 %



Dose [s]

n = 100 , valid fits = 100

help("analyse\_pIRSequence")



# Test dose response



# Summarised Dose Response Curves



# Sensitivity change



## Rejection criteria



## USER combined



## IRSL combined



help("analyse\_portableOSL")

## OSL combined





# OSL



`help("bin_RLum.Data")`

# OSL



help("bin\_RLum.Data")



# OSL



`help("bin_RLum.Data")`

# Monte Carlo Simulation

$$n = \left| \hat{\mu} = 43 \mid \hat{\sigma} = 20 \mid \frac{\hat{\sigma}}{\sqrt{n}} = 2 \mid v = 0.73 \right|$$



**Observed: Equivalent dose**

n = 56



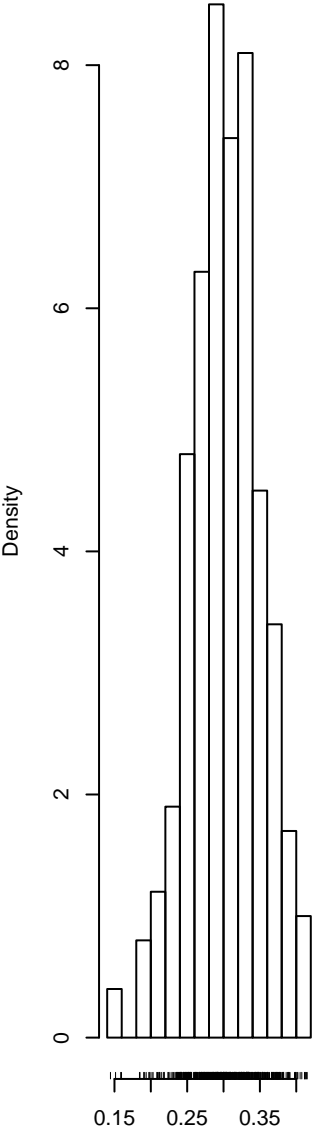
**Bootstrapping: Average Dose**

n = 500



**Bootstrapping: Sigma\_d**

n = 500



help("calc\_AverageDose")

# D<sub>e</sub> distribution

n = 56 | in 2 sigma = 53.6 %



Profile log likelihood for  $\sigma_{OD}$



# Fast Ratio

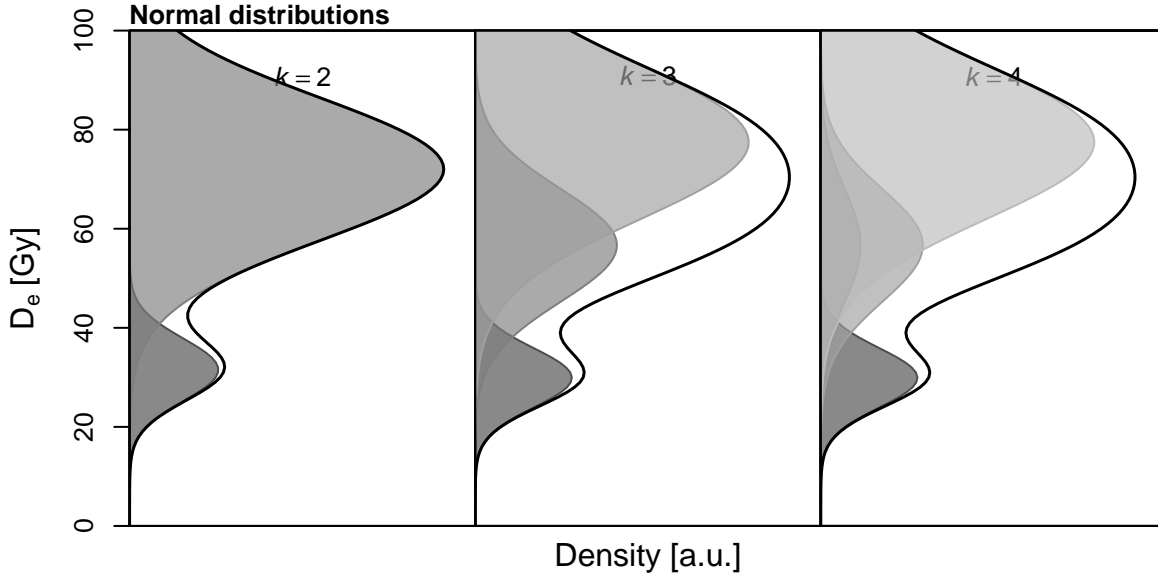


help("calc\_FastRatio")

# Finite Mixture Model

$\sigma_b = 0.2 \mid n = 62$

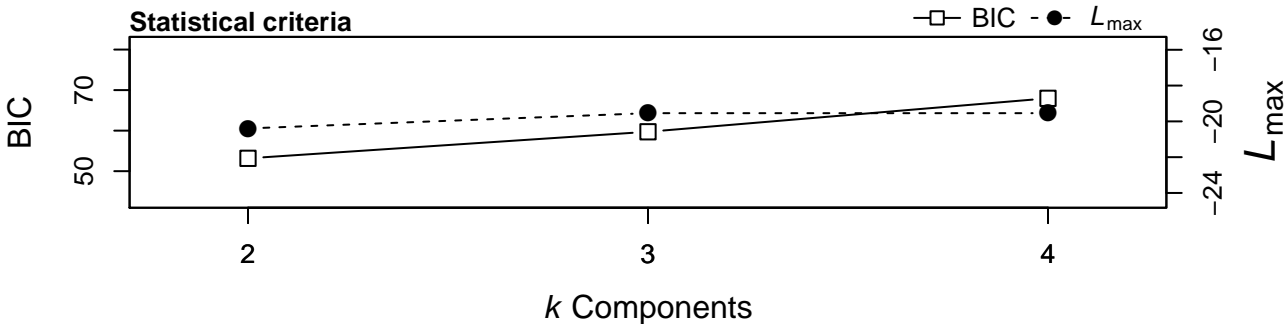
## Normal distributions



## Proportion of components



## Statistical criteria



help("calc\_FiniteMixture")

# Fuchs & Lang (2001)





No  $L_x$  curves detected

No  $T_x$  curves detected

help("calc\_Huntley2006")

Signal Fading



Density: g-values (%/decade)



# Measured dose response curve

$D_e = 130.97 \pm 17.12$  | fit: EXP



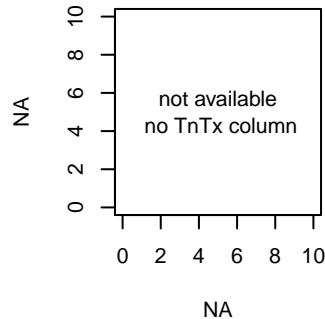
## $D_e$ from MC simulation

$D_{eMC} = 132.17 \pm 17.12$  | quality = 99.1 %



Dose (Gy)  
n = 100, valid fits = 100

## Test dose response



# Simulated dose response curve

$D_e = 282.67 \pm 38.63$  | fit: EXP



## $D_e$ from MC simulation

$D_{eMC} = 289.46 \pm 38.63$  | quality = 97.6 %



## Test dose response



Dose response curves







help("calc\_I EU")

No L<sub>x</sub> curves detected

No T<sub>x</sub> curves detected

help("calc\_Kars2008")

Signal Fading

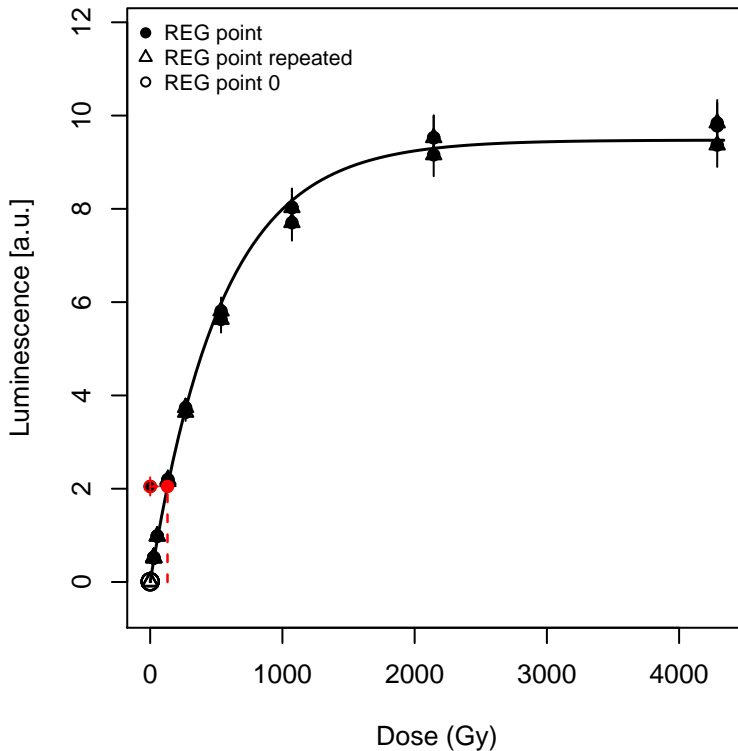


Density: g-values (%/decade)



# Measured dose response curve

$D_e = 130.97 \pm 17.12$  | fit: EXP

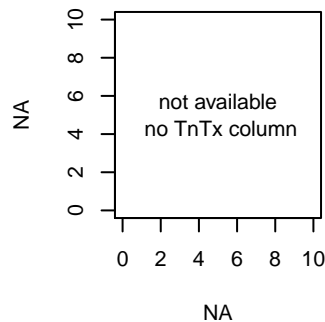


## $D_e$ from MC simulation

$D_{eMC} = 132.17 \pm 17.12$  | quality = 99.1 %



## Test dose response





# Simulated dose response curve

$D_e = 282.67 \pm 38.63$  | fit: EXP



## $D_e$ from MC simulation

$D_{eMC} = 289.46 \pm 38.63$  | quality = 97.6 %



## Test dose response

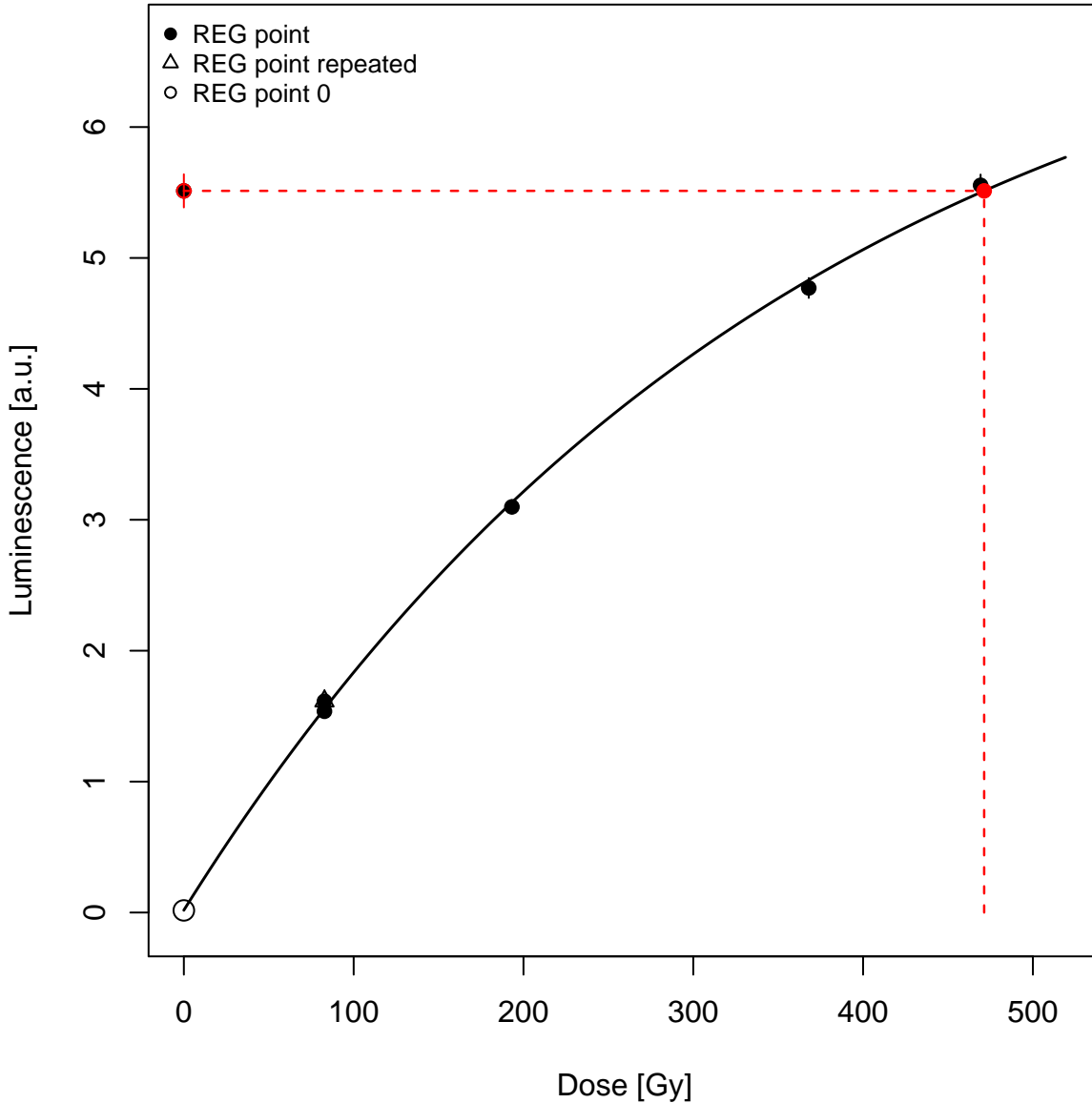


Dose response curves



# Corrected Dose Response Curve

$D_e = 471.3 \pm 21.74$  | fit: EXP



help("calc\_Lamothe2003")

**Likelihood profile: gamma**



**Likelihood profile: sigma**



help("calc\_MaxDose")

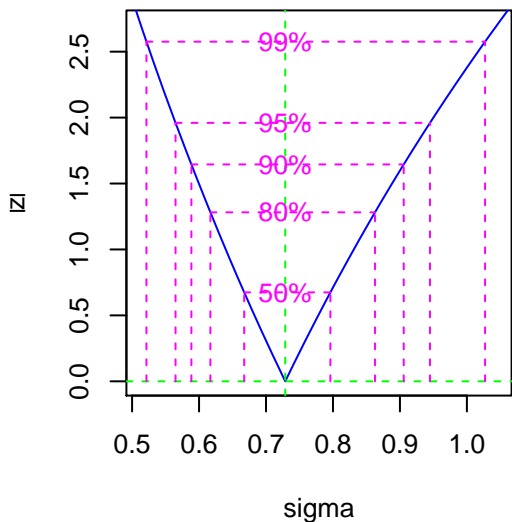
**Likelihood profile: p0**



**Likelihood profile: gamma**

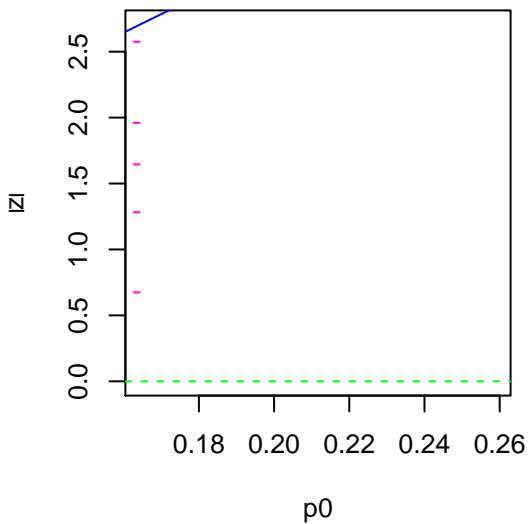


**Likelihood profile: sigma**



help("calc\_MinDose")

**Likelihood profile: p0**



# Source Dose Rate Prediction

source type: Sr-90 | half-life: 28.9 a



help("calc\_SourceDoseRate")

# D<sub>e</sub> distribution



# Thermal Lifetime Contour Plot

(values quoted in Ma)



help("calc\_ThermalLifetime")



# Thermal Lifetime Density Plot



help("calc\_ThermalLifetime")

# $D_e$ applying Woda and Fuchs (2008)



help("calc\_WodaFuchs2008")

# gSGC and resulting De



# CW Curve Fit

Default



## Component contribution to sum curve



## Default



## Component contribution to sum curve



# Background



## Default



## Component contribution to sum curve



## Default



## Component contribution to sum curve







help("fit\_SurfaceExposure")



help("fit\_SurfaceExposure")

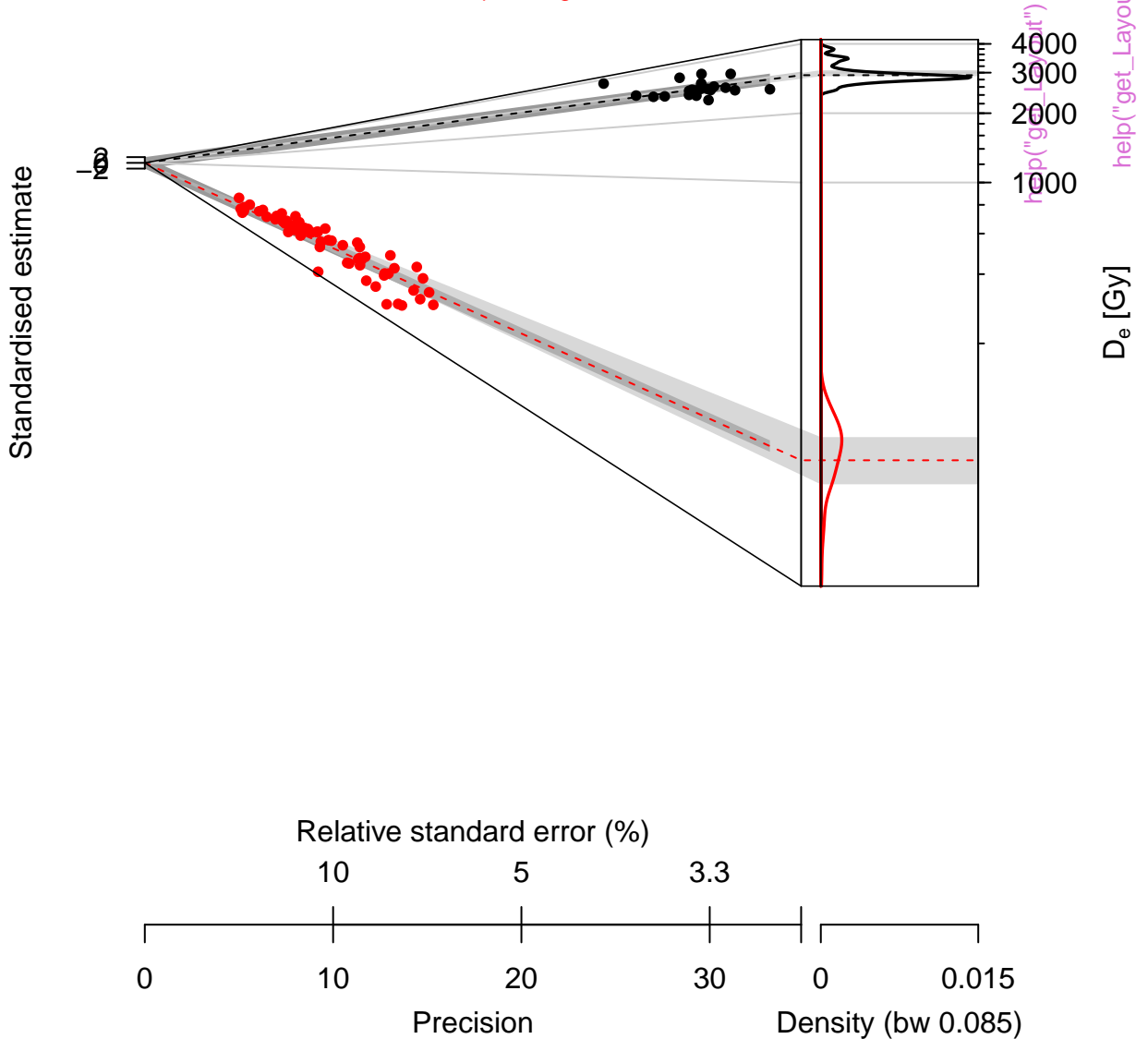


help("fit\_SurfaceExposure")



help("fit\_SurfaceExposure")

n = 25 | in 2 sigma = 68 %  
n = 62 | in 2 sigma = 41.9 %





help("get\_Layout")

Profile log likelihood for  $\sigma_{OD}$



# TL (UVVIS)



help("merge\_RLum.Data.Curve")



# TL (UVVIS)



help("merge\_RLum.Data.Curve")

# TL (UVVIS)



help("merge\_RLum.Data.Curve")

Profile log likelihood for  $\sigma_{OD}$



Profile log likelihood for  $\sigma_{OD}$



# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

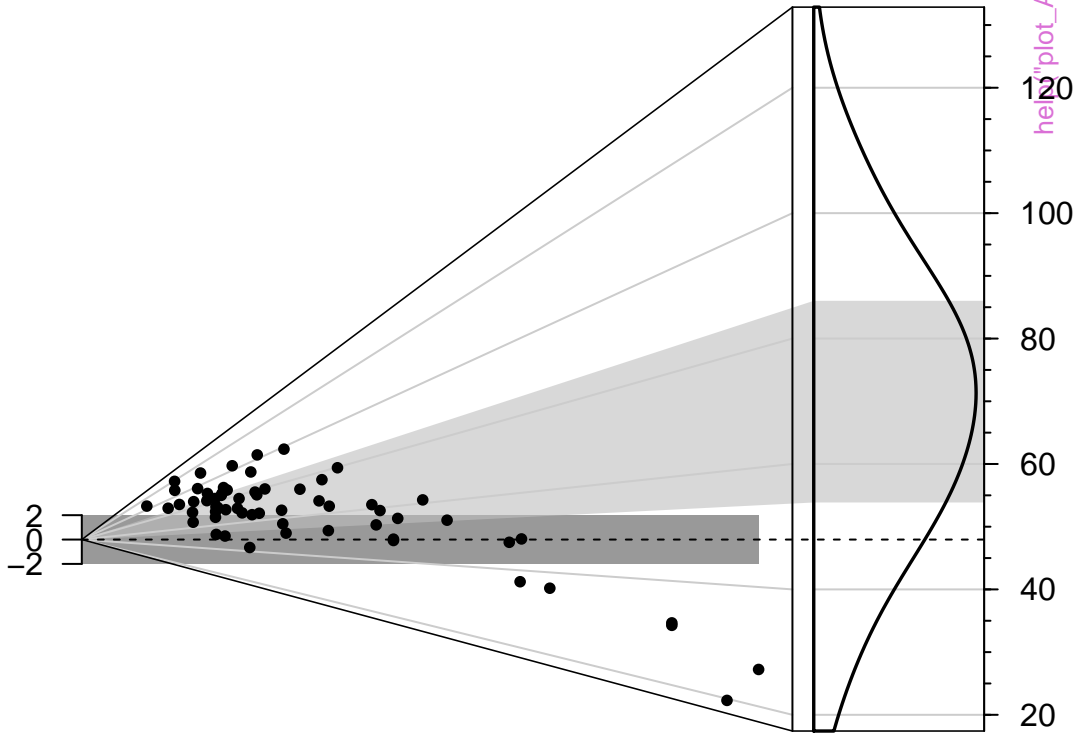
Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 24.2 %

Standardised estimate



help("plot\_AbanicoPlot")

help("plot\_AbanicoPlot")

Standard error

10

5

3.3

2.5

2

0.0

0.1

0.2

0.3

0.4

0.5

0.016

Precision

Density (bw 11.795)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



D<sub>e</sub> [Gy]

Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

Density (bw 0.15)



# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



Relative standard error (%)

20

10

6.7

5

0

5

10

15

200

0.016

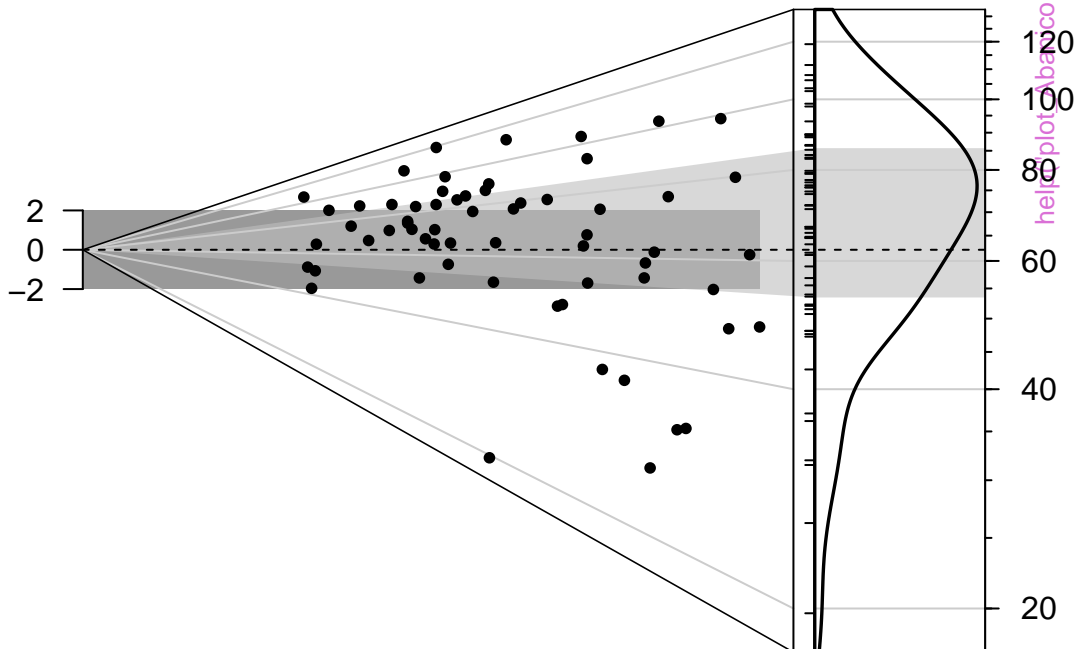
Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



D<sub>e</sub> [Gy]

Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



D<sub>e</sub> [Gy]

Relative standard error (%)

20

10

6.7

0

5

10

15

0

0.264

Precision

Density (bw 0.04)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

n

15

0

5

10

15

Precision

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



Relative standard error (%)

n

20

10

6.7

0

10

0

5

10

15

0

0.016

Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

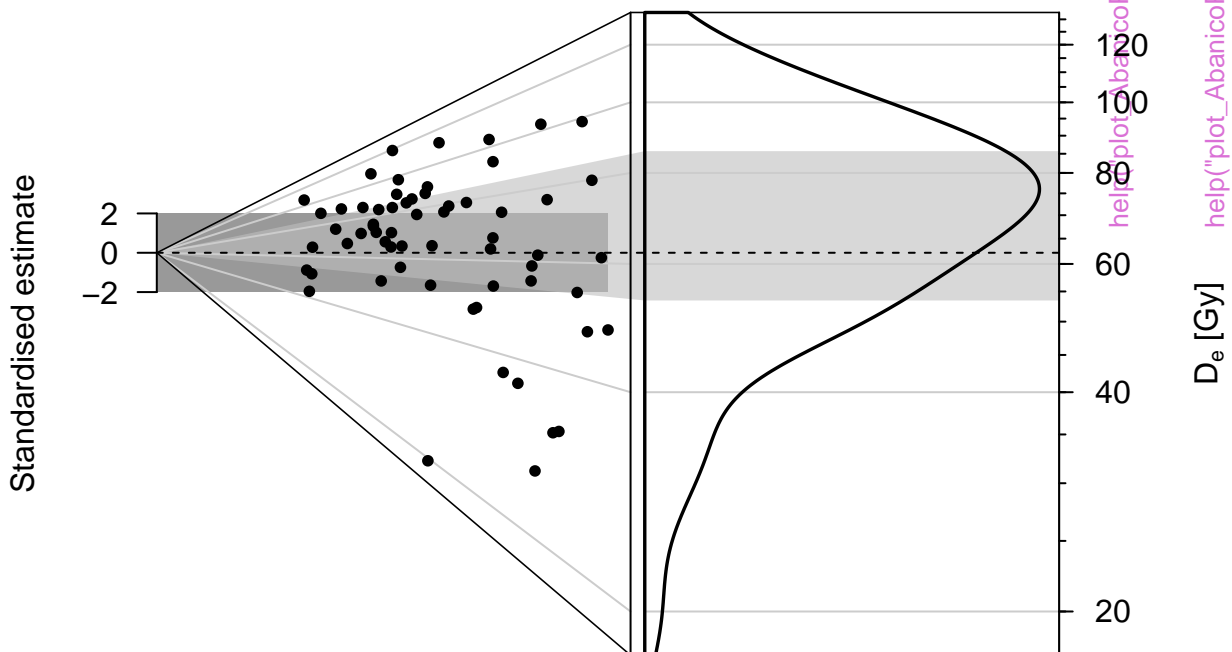
0.016

Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %



Relative standard error (%)

20

10

6.7

0

5

10

15

0

0.016

Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 53.2 %

Standardised estimate



help("plot\_AbanicoPlot")

help("plot\_AbanicoPlot")

Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

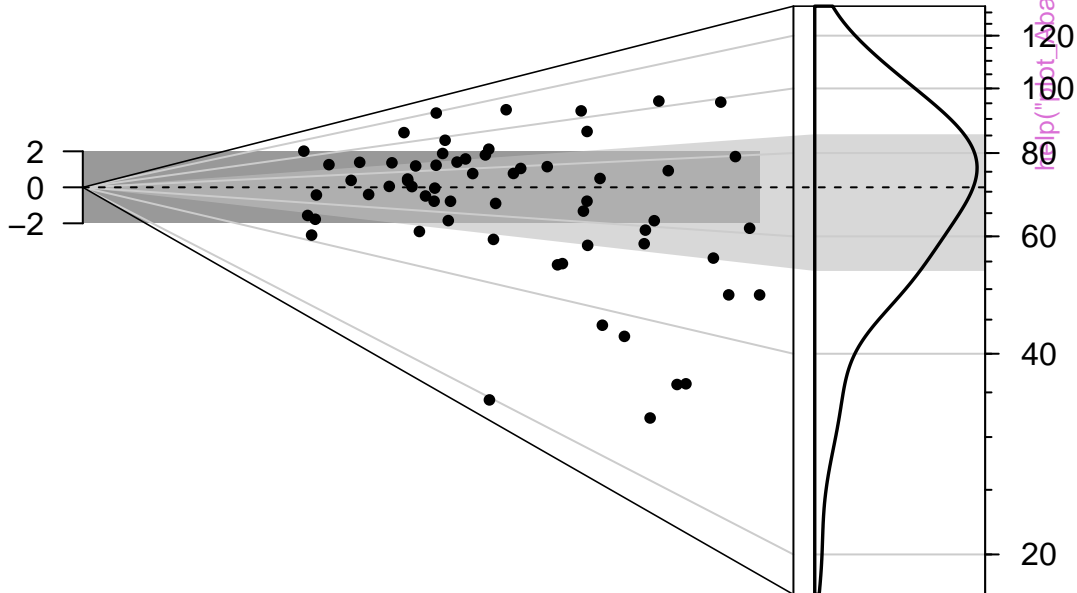
Density (bw 0.15)



# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 54.8 %

Standardised estimate



D<sub>e</sub> [Gy]

Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 54.8 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0

0.016

Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %



# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

R Sample 1

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate

0

120

100

80

60

40

20

D<sub>e</sub> [Gy]

Relative standard error (%)

20

10

6.7

0

5

10

15

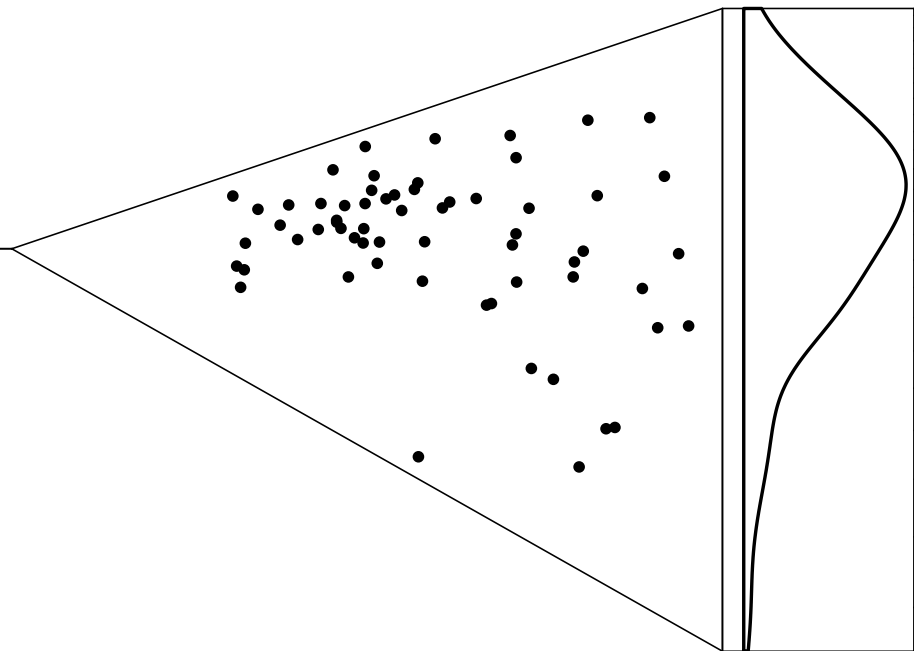
0.016

Precision

Density (bw 0.15)

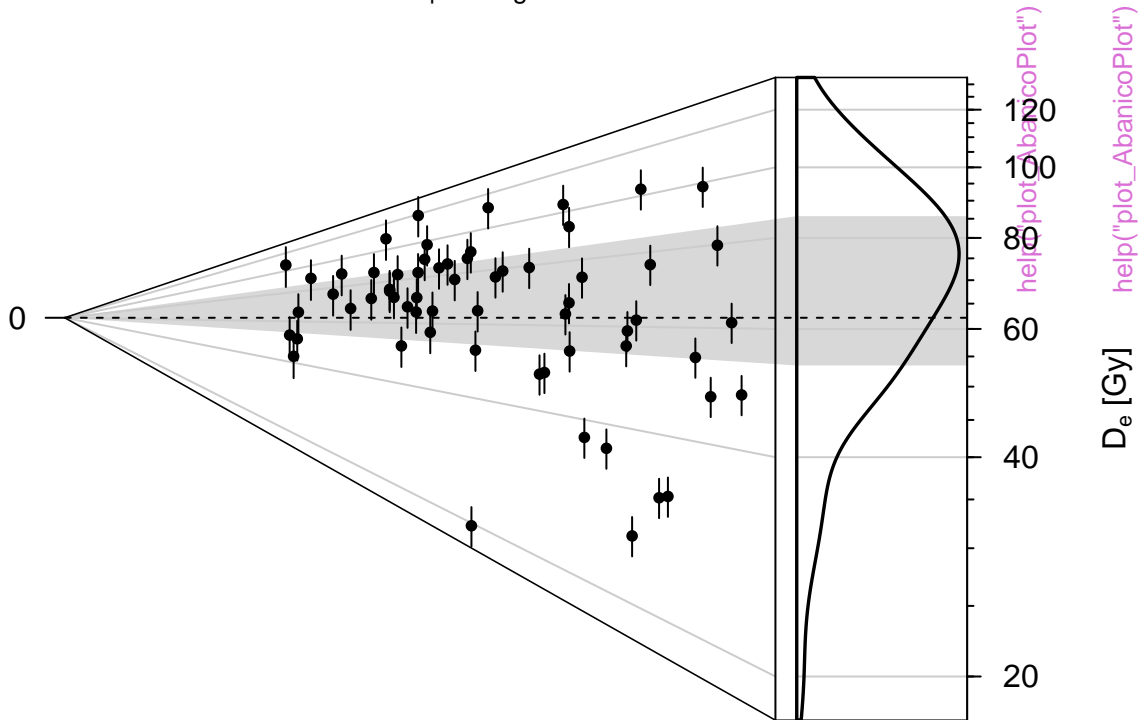
help("plot\_AbanicoPlot")

help("plot\_AbanicoPlot")



# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %



Relative standard error (%)

20

10

6.7



# D<sub>e</sub> distribution

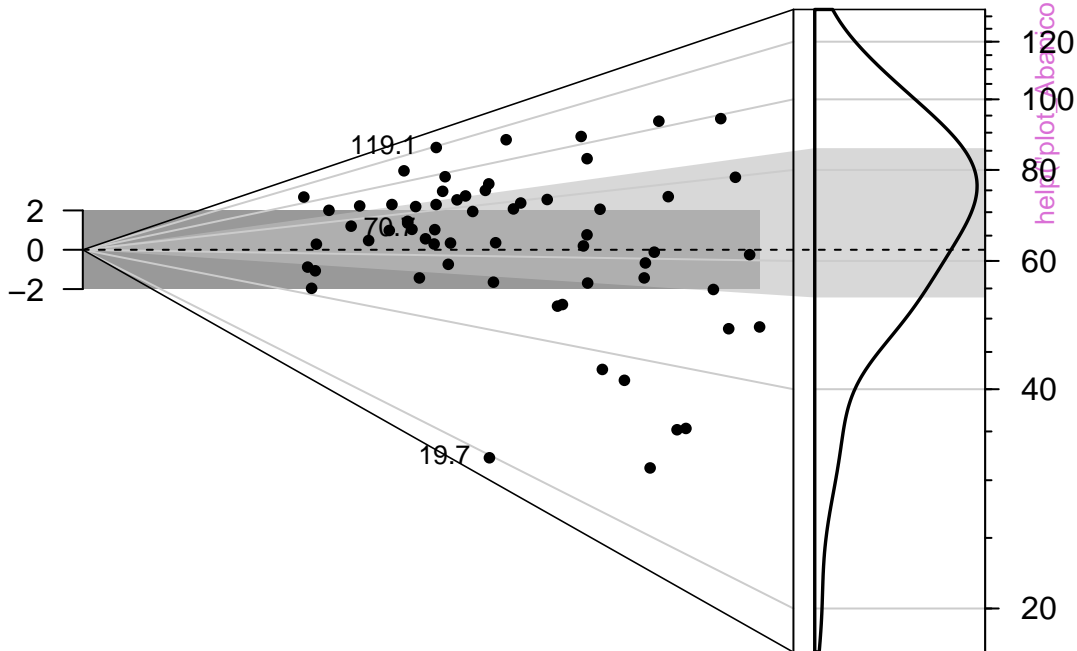
n = 62 | in 2 sigma = 41.9 %



# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



D<sub>e</sub> [Gy]

Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

Density (bw 0.15)



# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

median = 71.07

Standardised estimate



D<sub>e</sub> [Gy]

Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

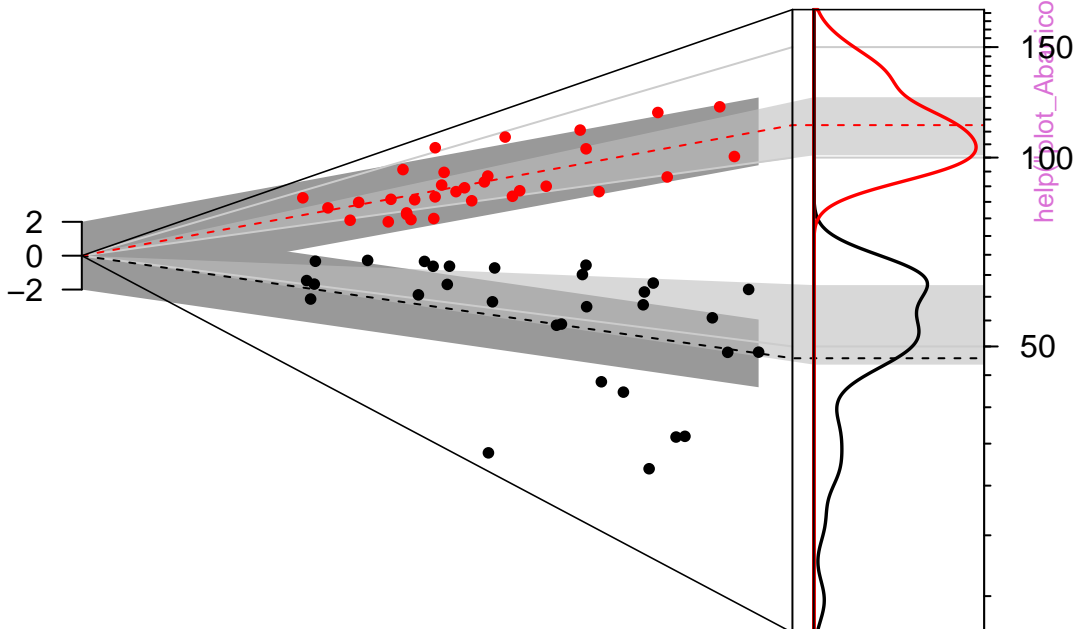
Density (bw 0.15)

# D<sub>e</sub> distribution

n = 30 | in 2 sigma = 46.7 %

n = 32 | in 2 sigma = 87.5 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0.032

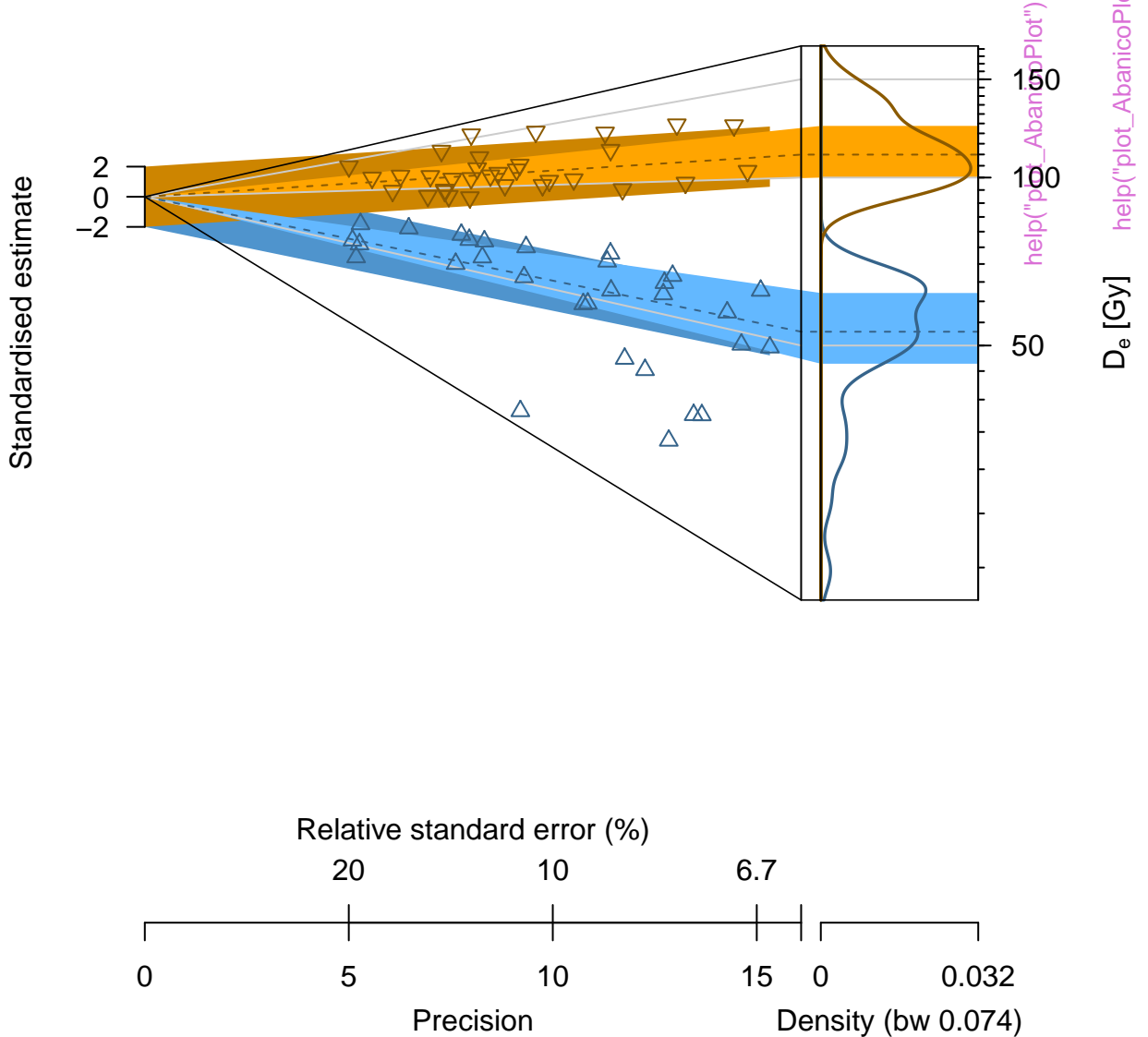
Precision

Density (bw 0.074)

# D<sub>e</sub> distribution

n = 30 | in 2 sigma = 70 % | median = 52.94

n = 32 | in 2 sigma = 84.4 % | median = 109.93





help("plot\_AbanicoPlot")



help("plot\_AbanicoPlot")

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

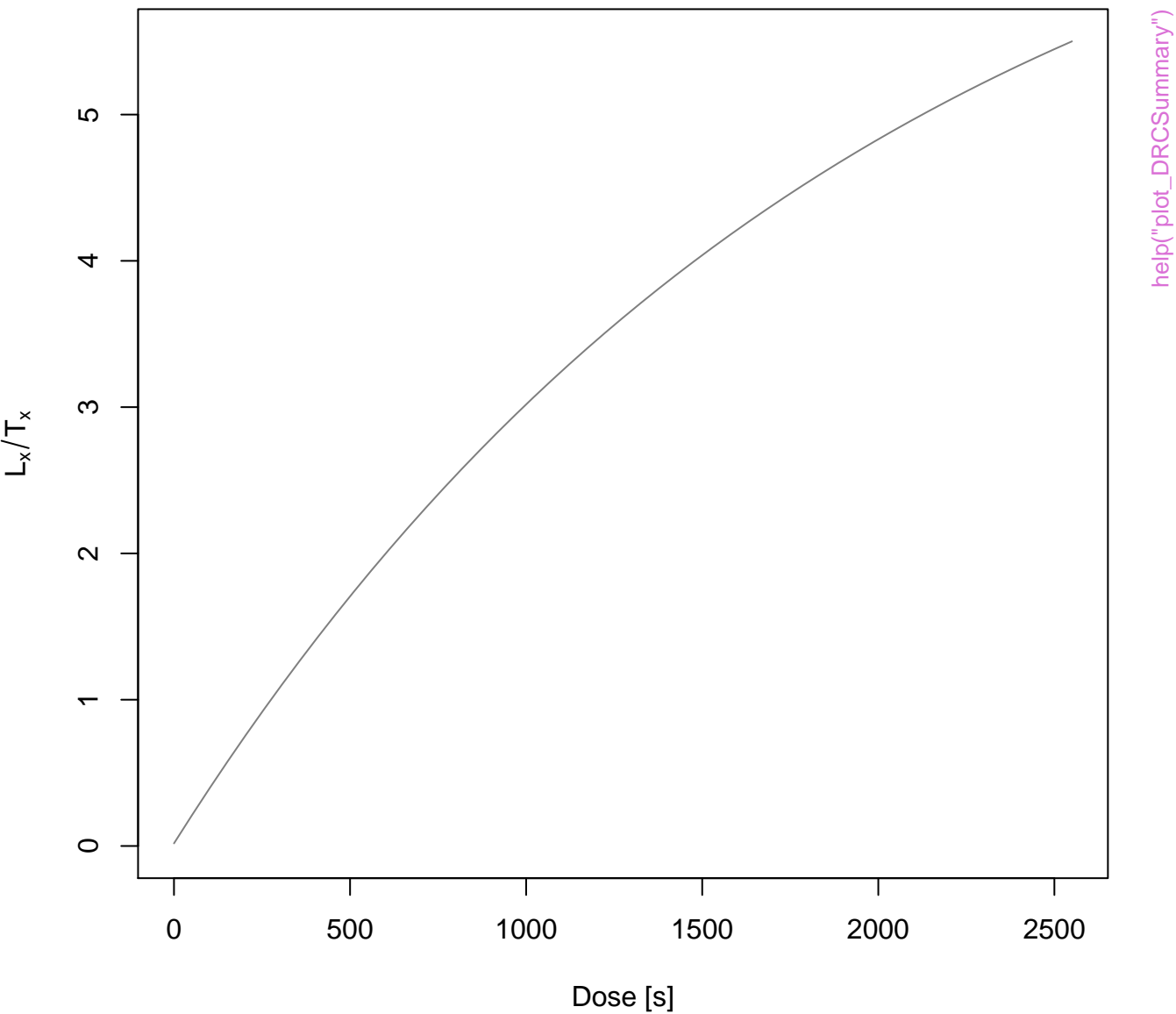
0.016

Precision

Density (bw 0.15)



## DRC Summary



# Dose recovery test

Example data



# Dose recovery test



# Dose recovery test



# Dose recovery test



# Dose recovery test



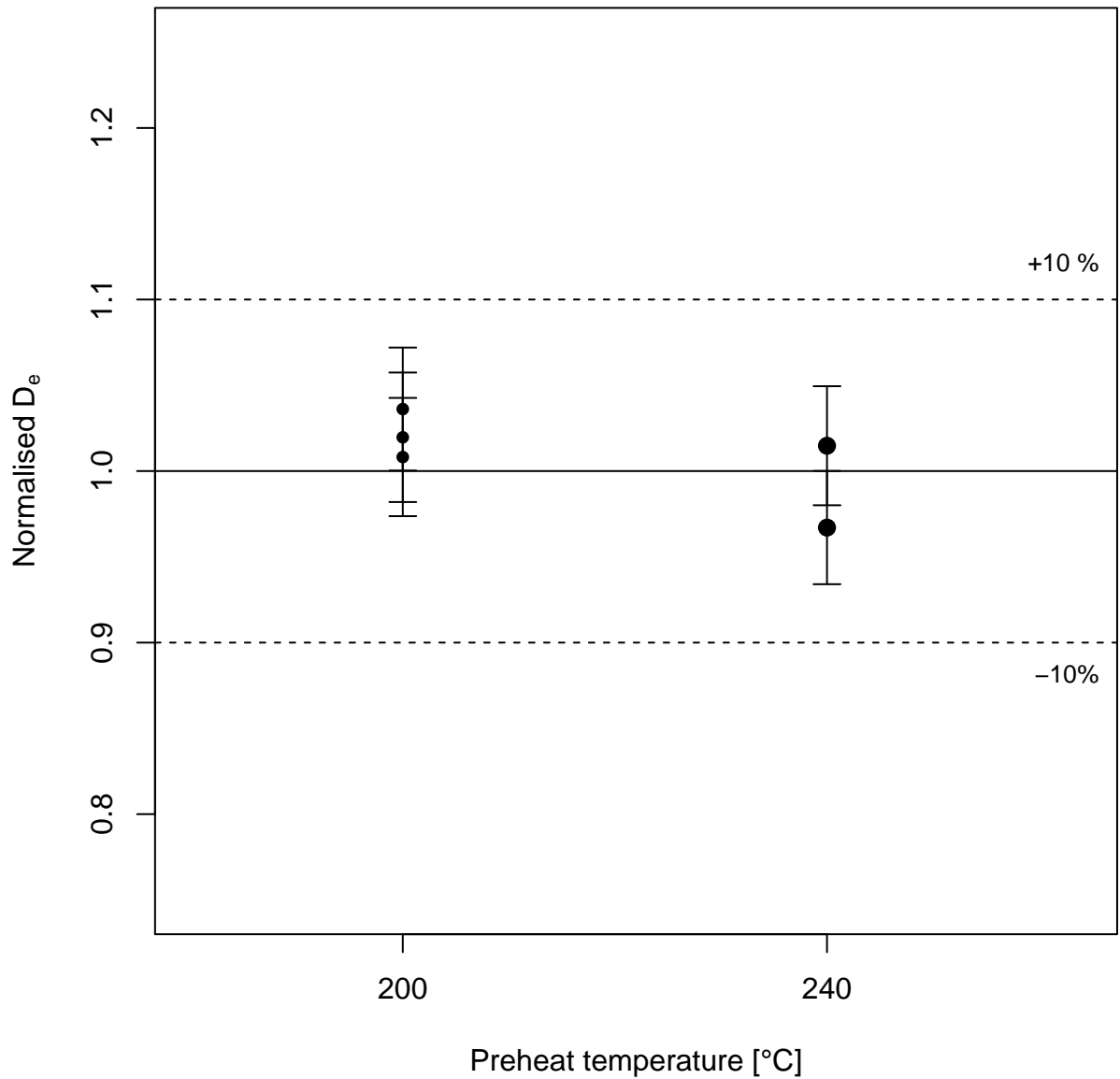
# Dose recovery test

n = 5

n = 5



# Dose recovery test



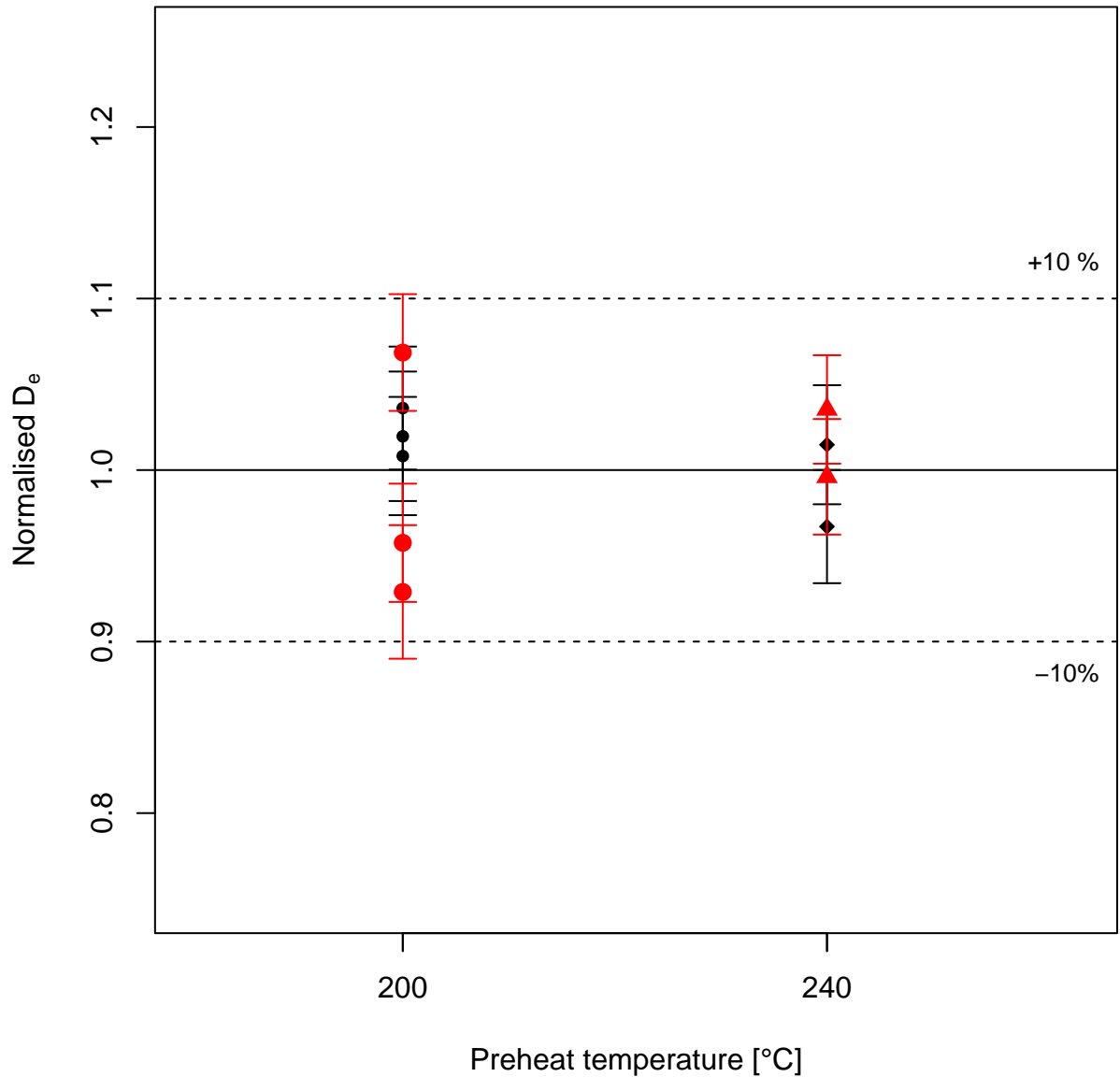


# Dose recovery test

Example data



# Dose recovery test



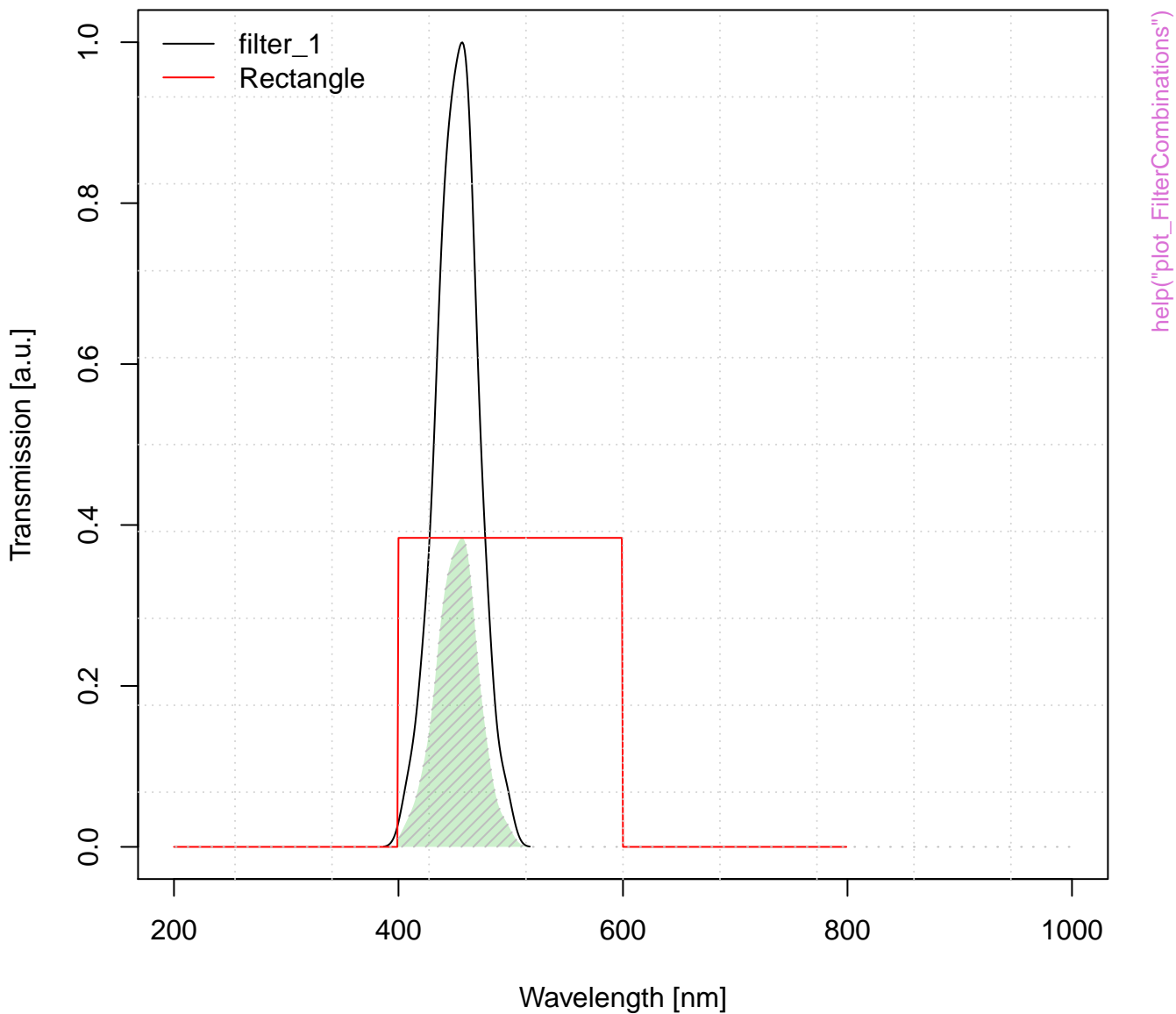
# Dose recovery test



## Filter Combination



# Filter Combination

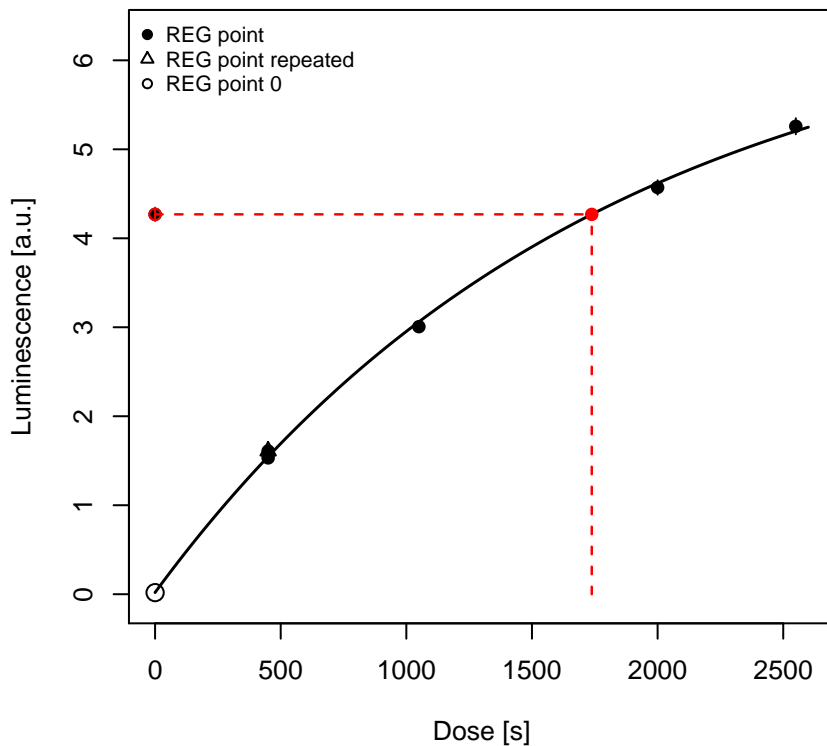




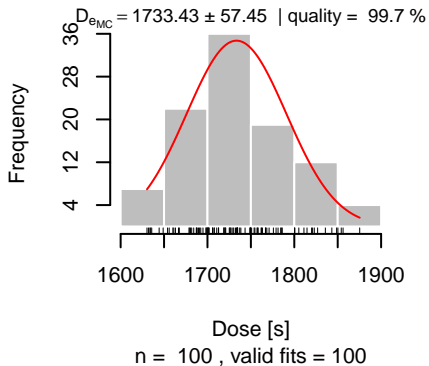
`help("plot_FilterCombinations")`

# Growth curve

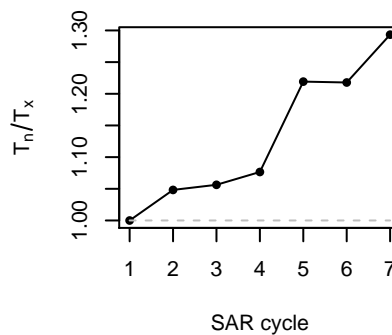
$D_e = 1737.88 \pm 57.45$  | fit: EXP



## $D_e$ from MC simulation

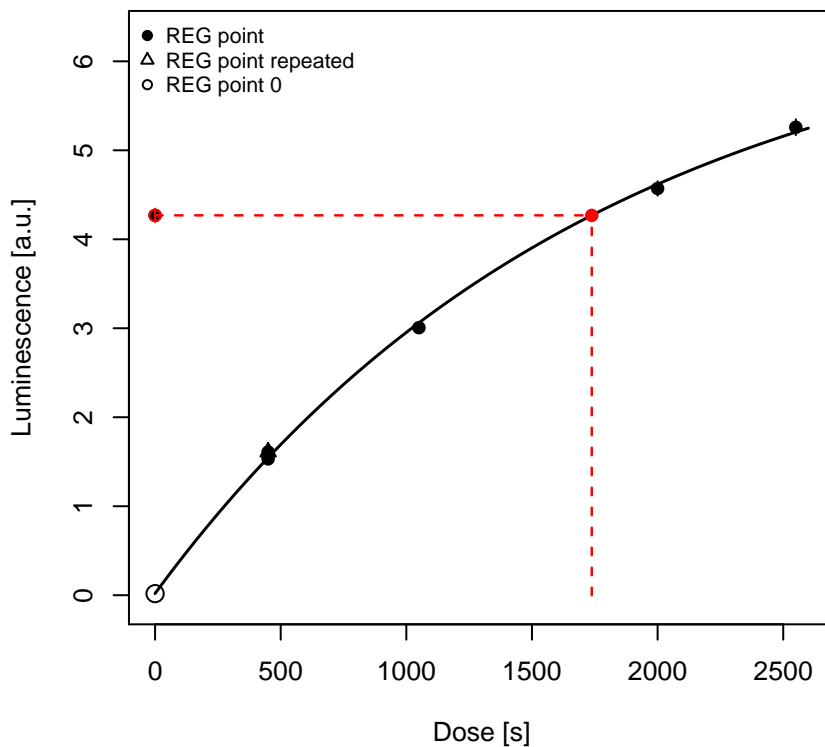


## Test dose response



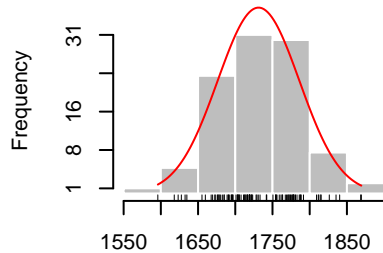
# Growth curve

$D_e = 1737.88 \pm 54.9$  | fit: EXP



## $D_e$ from MC simulation

$D_{eMC} = 1731.23 \pm 54.9$  | quality = 99.6 %



Dose [s]  
n = 100 , valid fits = 100

## Test dose response





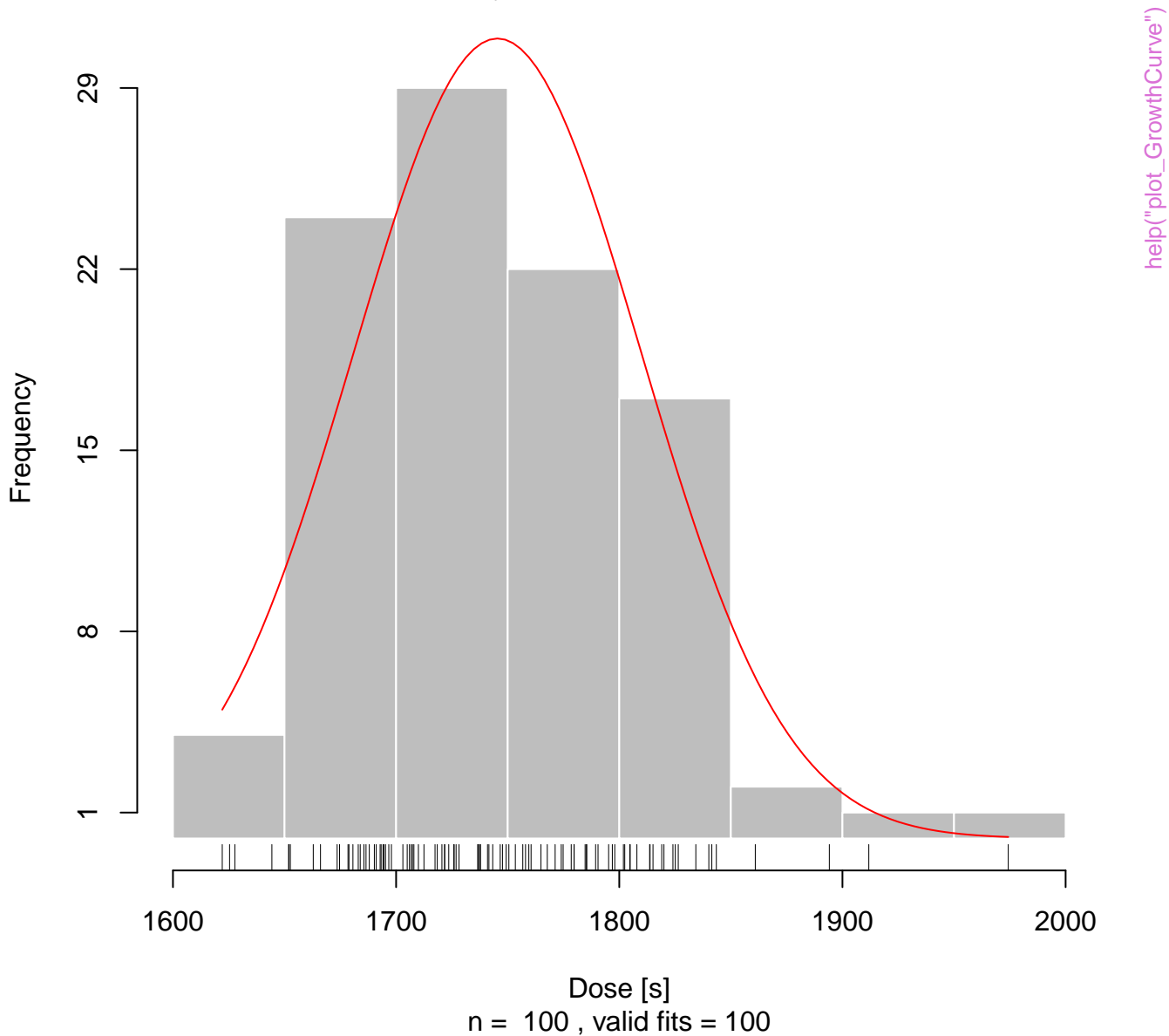
# Growth curve

$D_e = 1737.88 \pm 64.53$  | fit: EXP



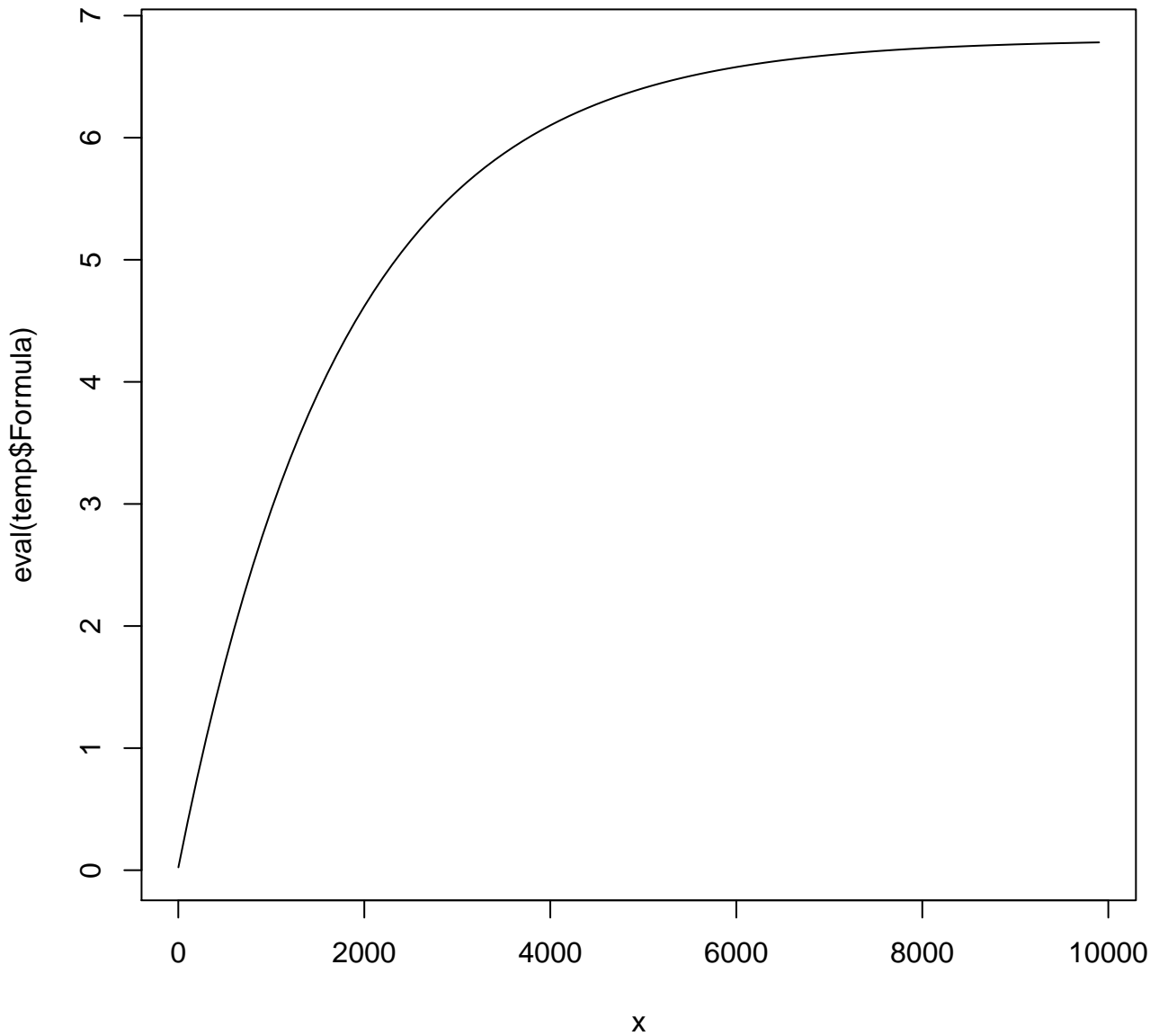
# D<sub>e</sub> from MC simulation

D<sub>eMC</sub> = 1745.42 ± 64.53 | quality = 99.6 %



# Test dose response





help("plot\_GrowthCurve")

# Growth curve

$D_e = 109.74 \pm 2$  | fit: EXP



## $D_e$ from MC simulation

$D_{eMC} = 109.94 \pm 2$  | quality = 300.2 %



n = 100 , valid fits = 100

## Test dose response



## Growth curve



## D<sub>e</sub> from Monte Carlo simulation



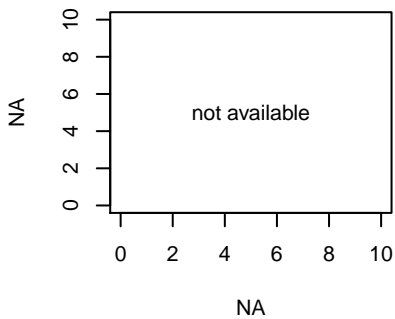
## Test dose response



## Growth curve



$D_e$  from Monte Carlo simulation



Test dose response



# Histogram





# Histogram of De-values

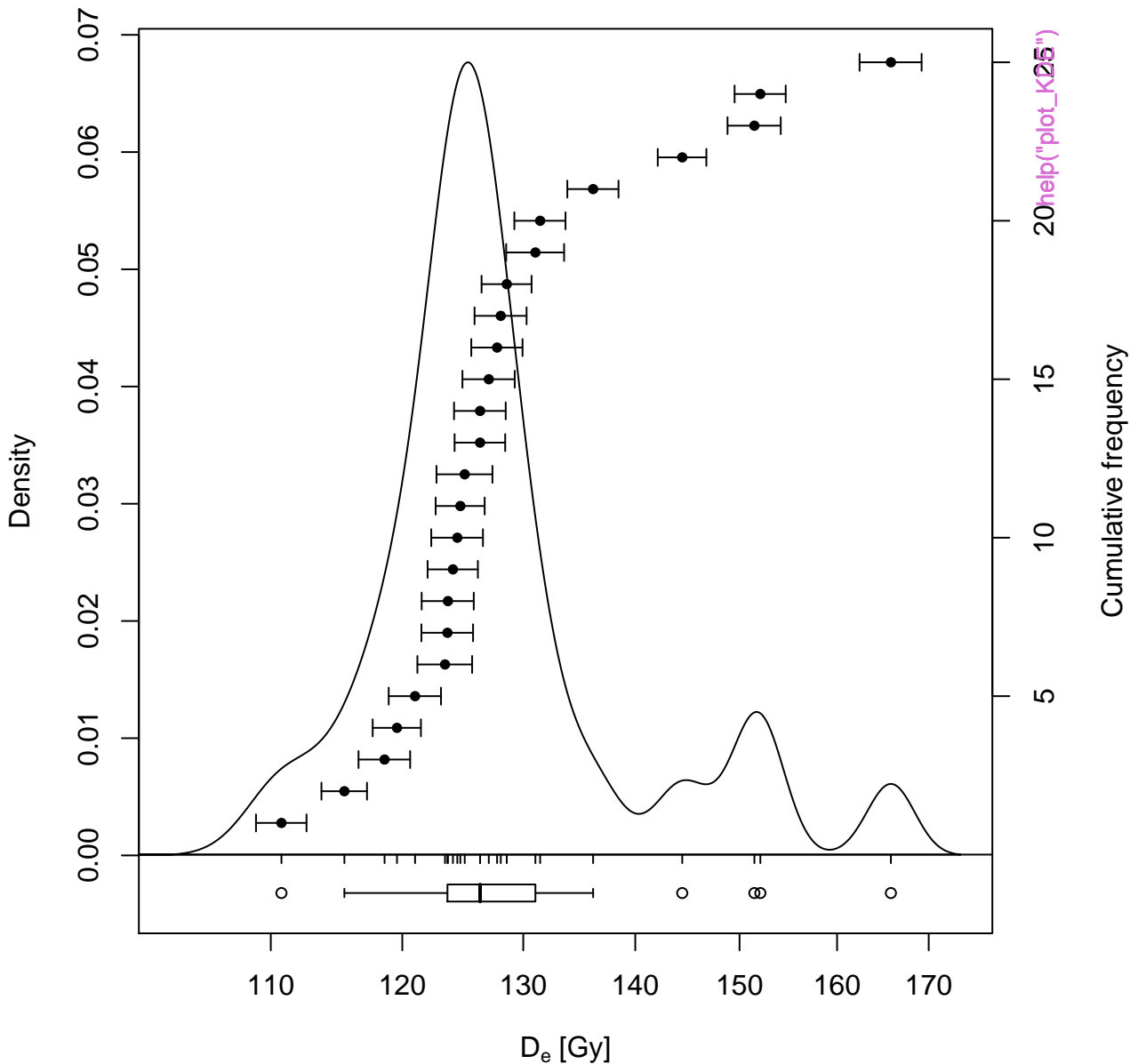
Example data set



# D<sub>e</sub> distribution



# D<sub>e</sub> distribution



# Dose distribution

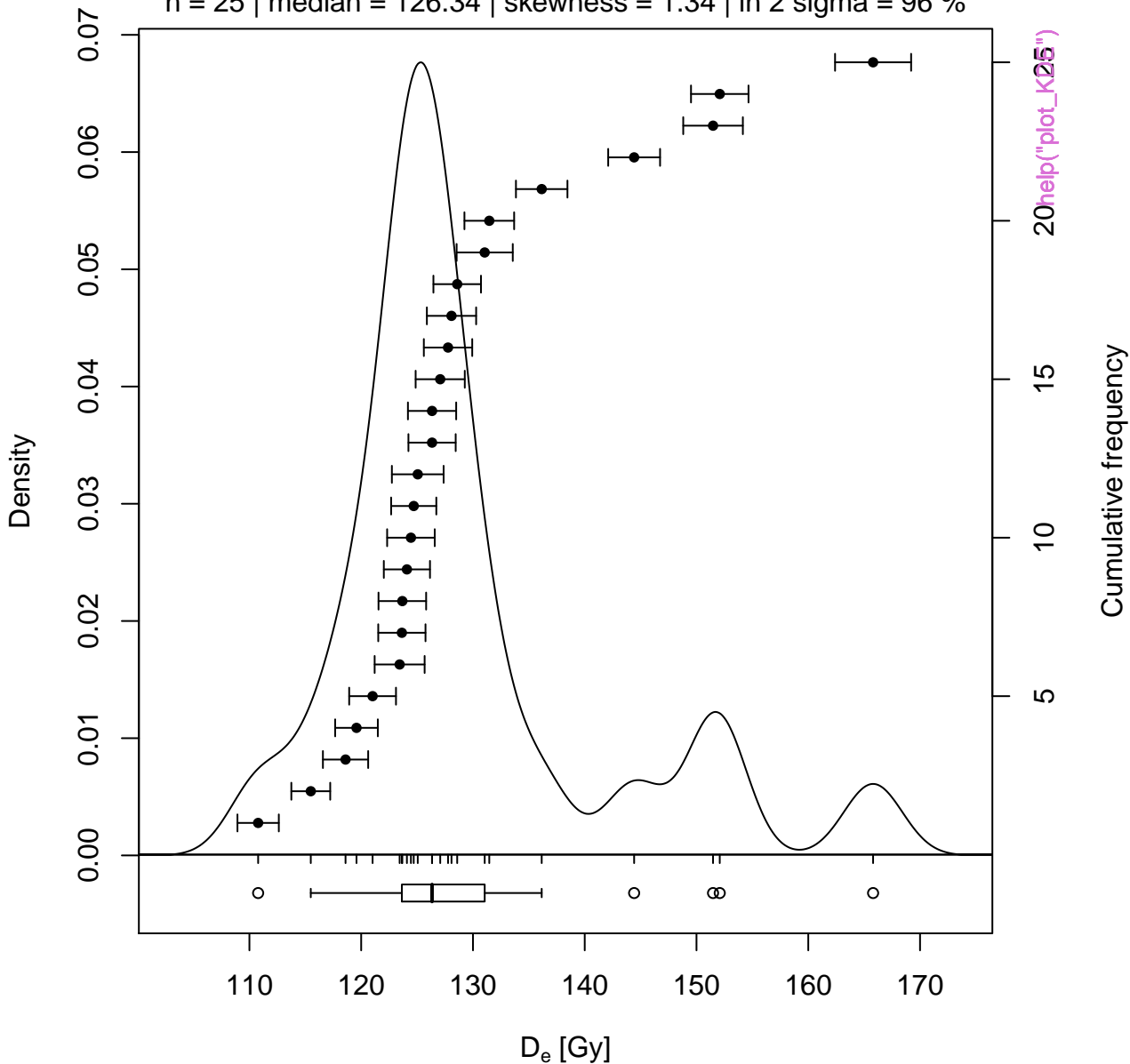


# D<sub>e</sub> distribution

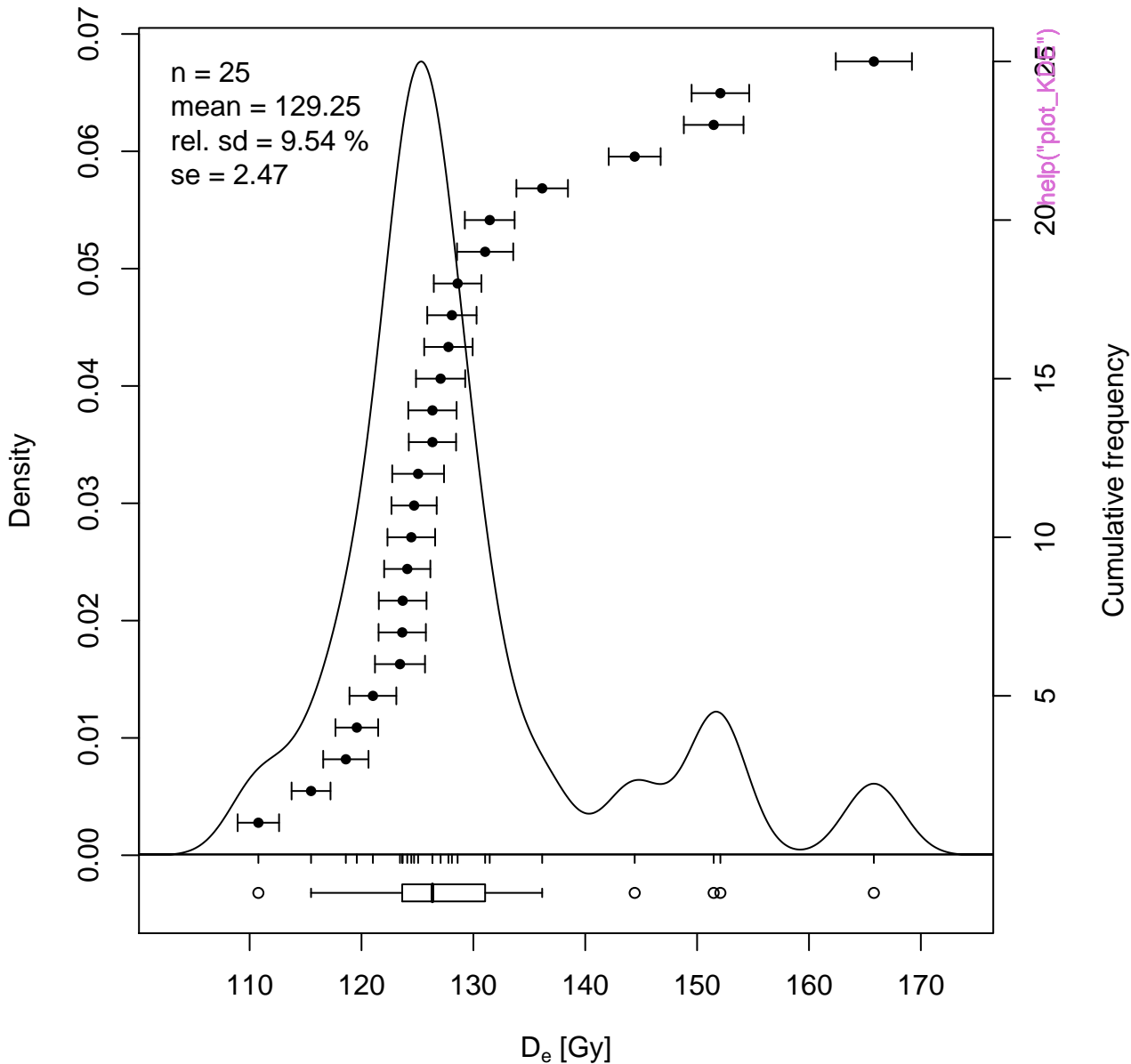


# D<sub>e</sub> distribution

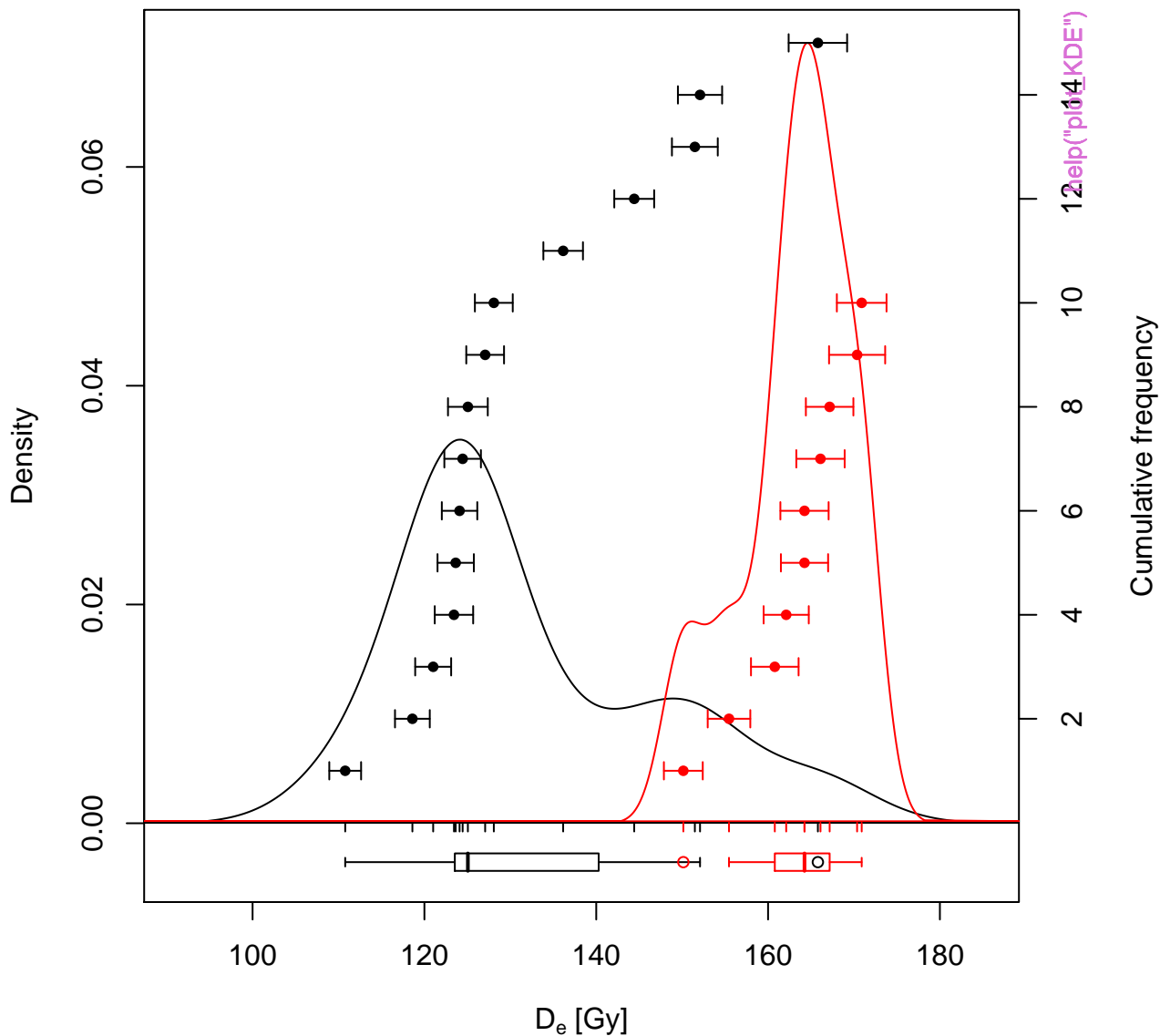
n = 25 | median = 126.34 | skewness = 1.34 | in 2 sigma = 96 %



# D<sub>e</sub> distribution

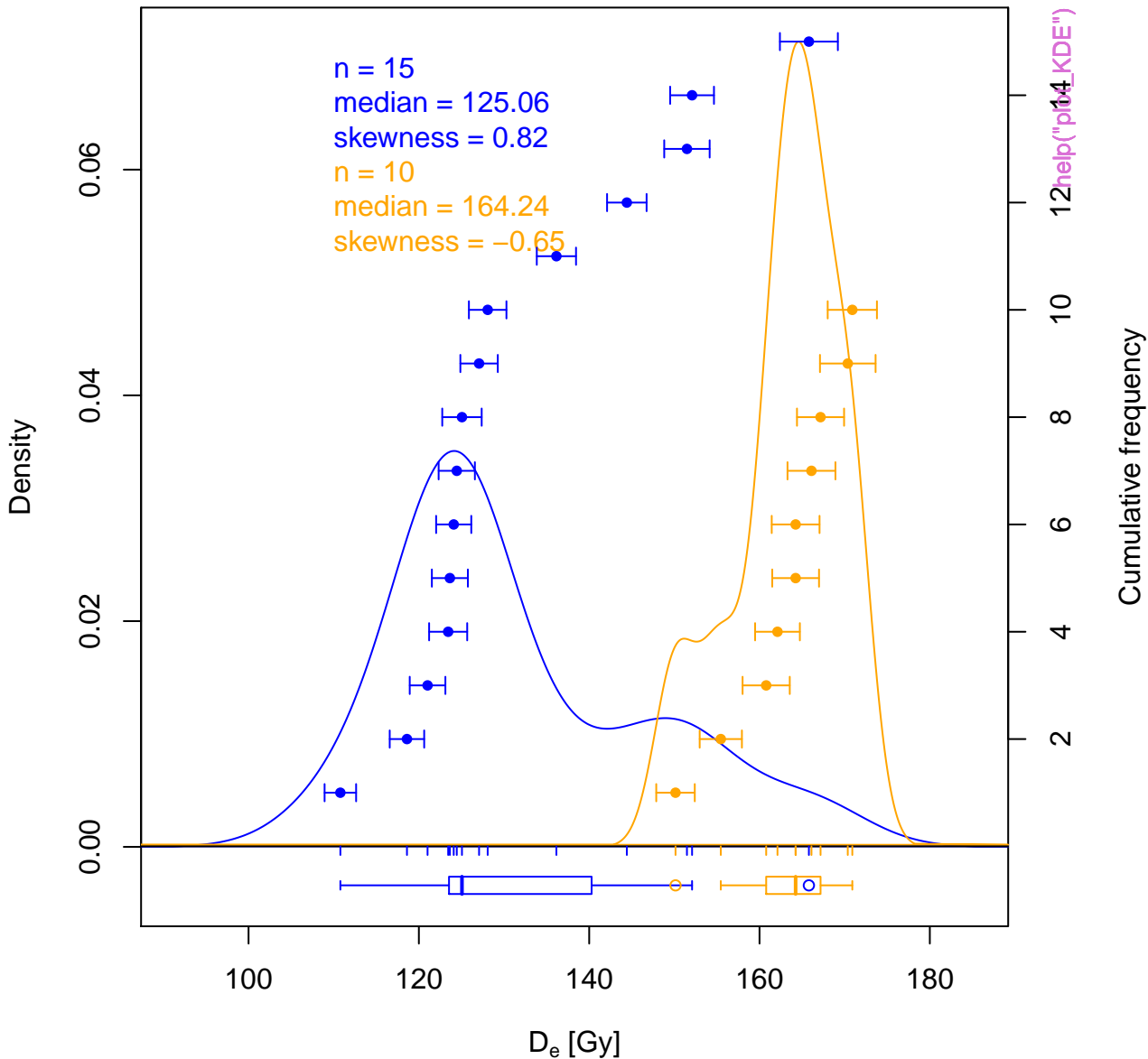


# D<sub>e</sub> distribution





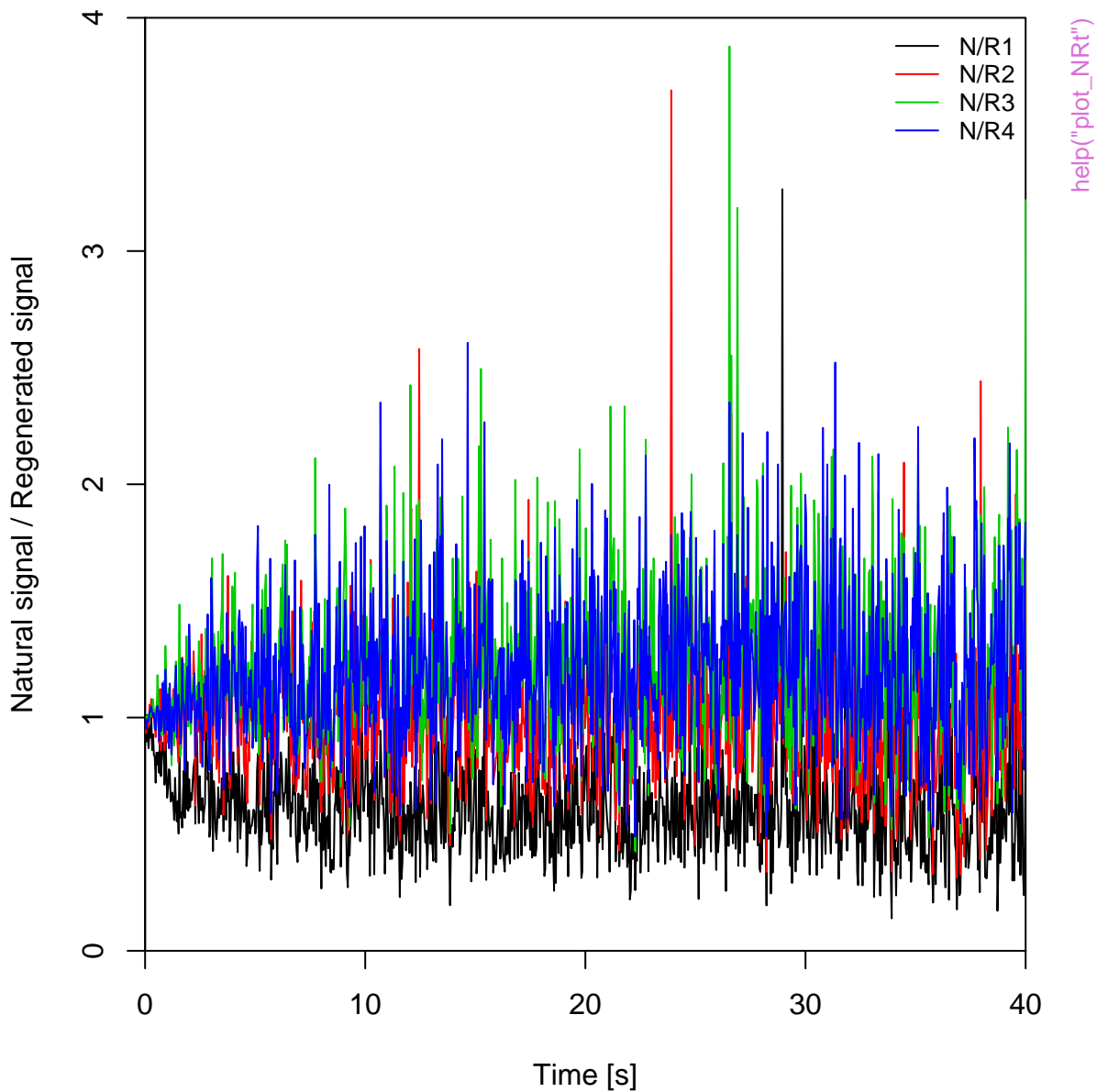
# D<sub>e</sub> distribution



# D<sub>e</sub> distribution



NR(t) Plot



NR(t) Plot



help("plot\_NRt")

NR(t) Plot



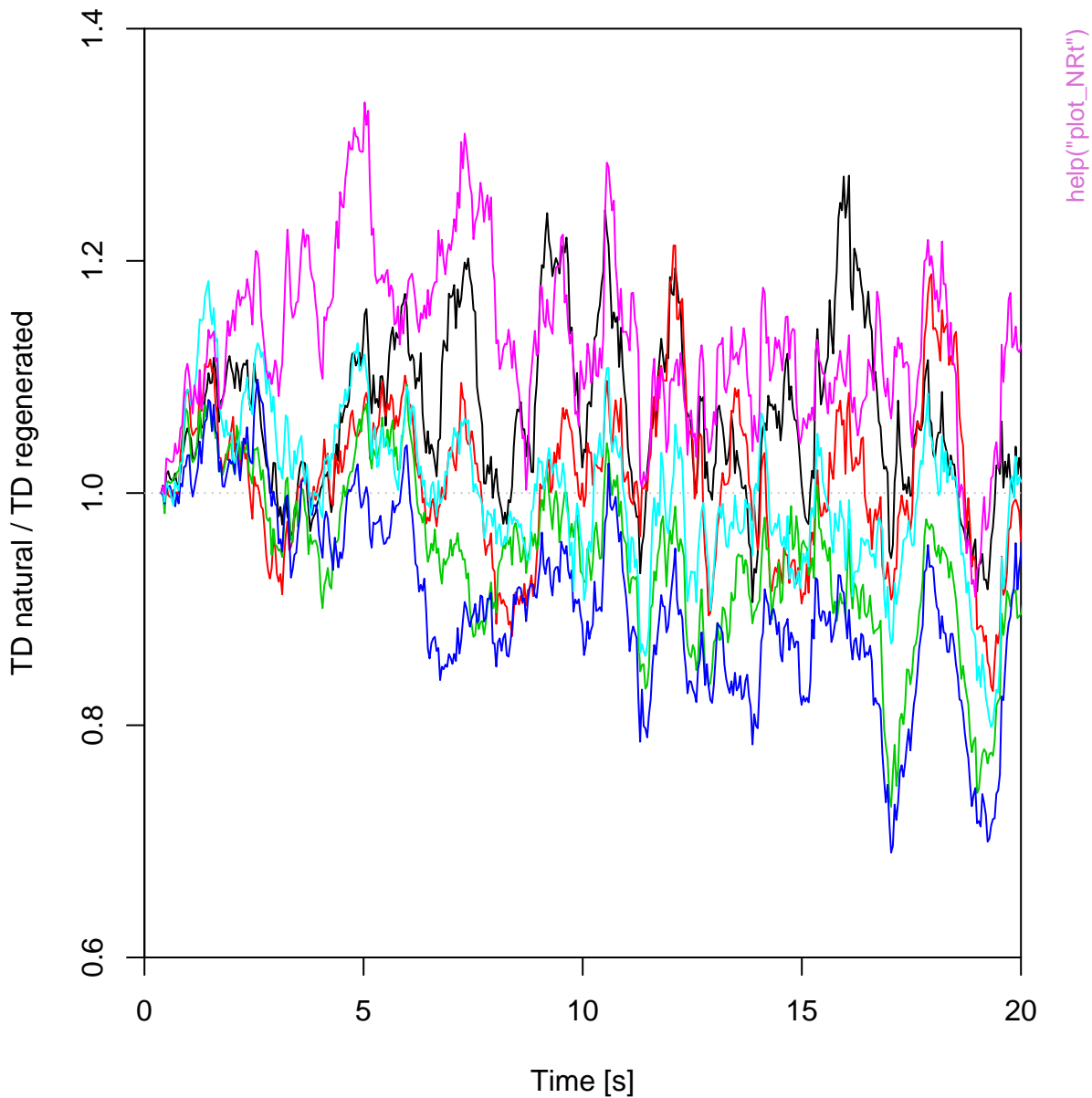
NR(t) Plot



# NR(t) Plot



**TnTx(t) Plot**



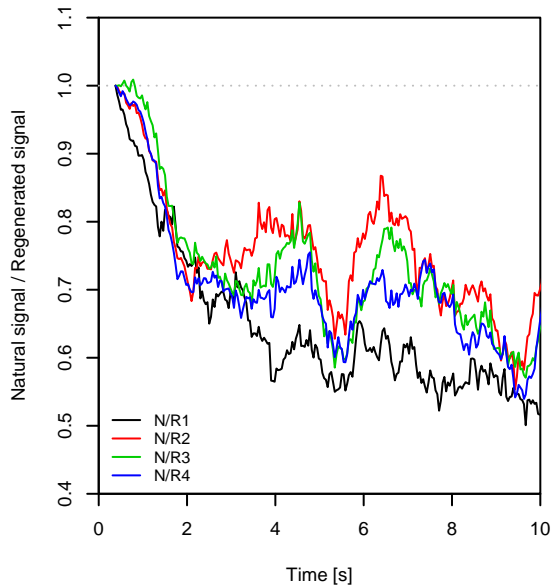


**Aliquot #1****Aliquot #2**

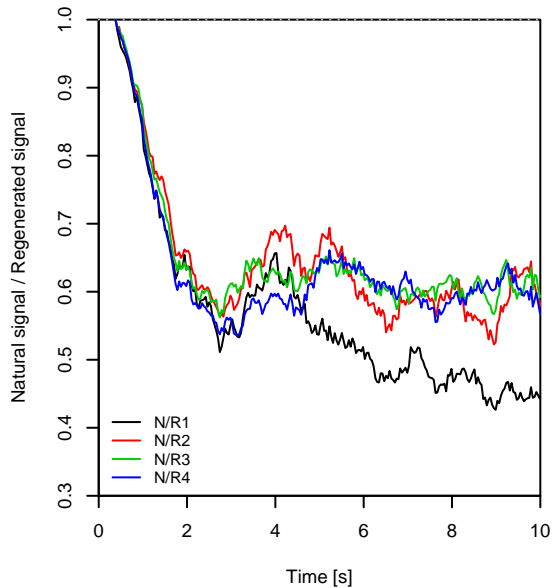
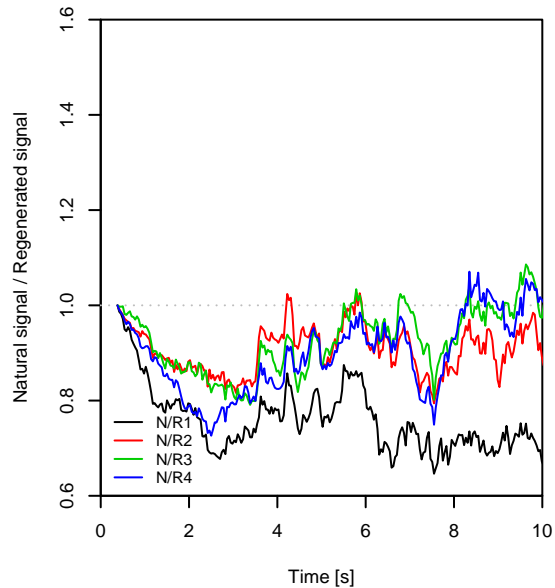
help("plot\_NRt")

**Aliquot #3****Aliquot #4**

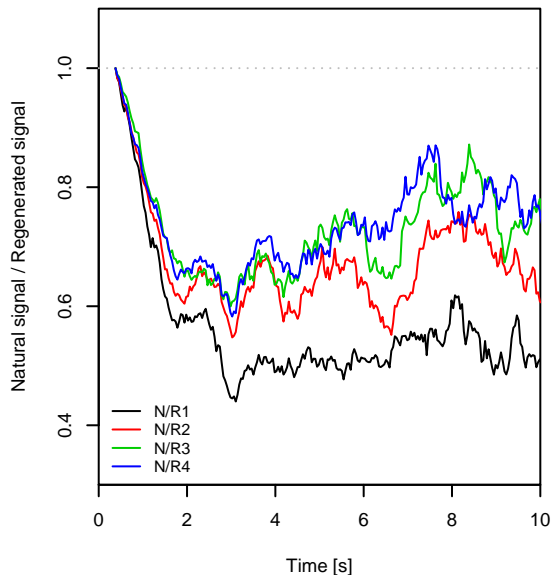
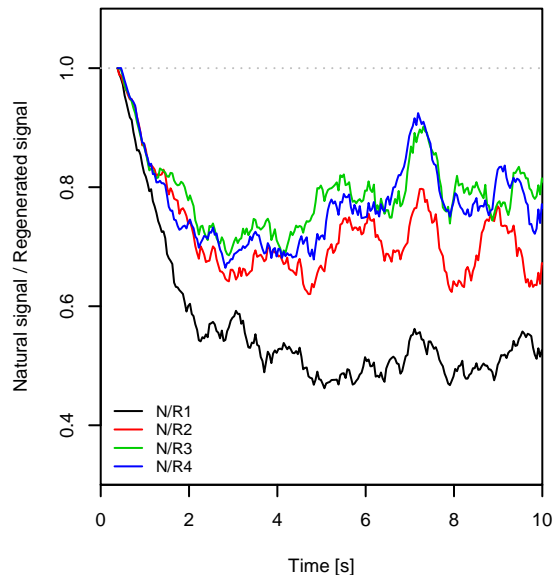
**Aliquot #5****Aliquot #6****Aliquot #7****Aliquot #8**

**Aliquot #9****Aliquot #10**

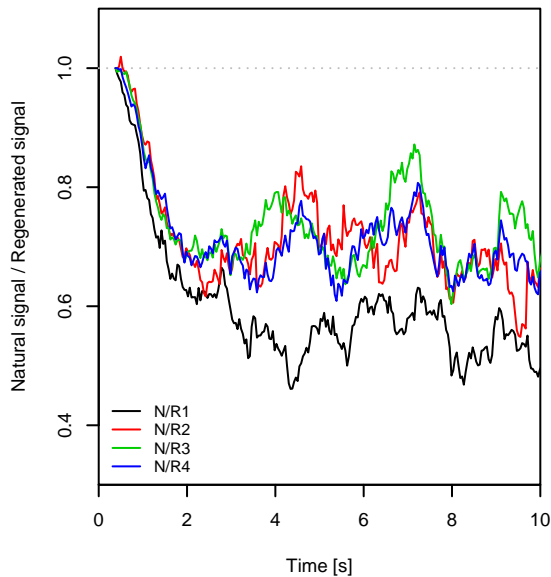
help("plot\_NRt")

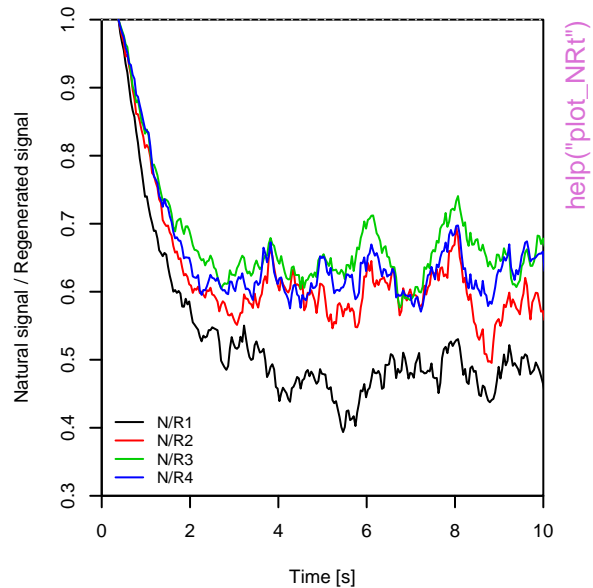
**Aliquot #11****Aliquot #12**

**Aliquot #13****Aliquot #14****Aliquot #15****Aliquot #16**

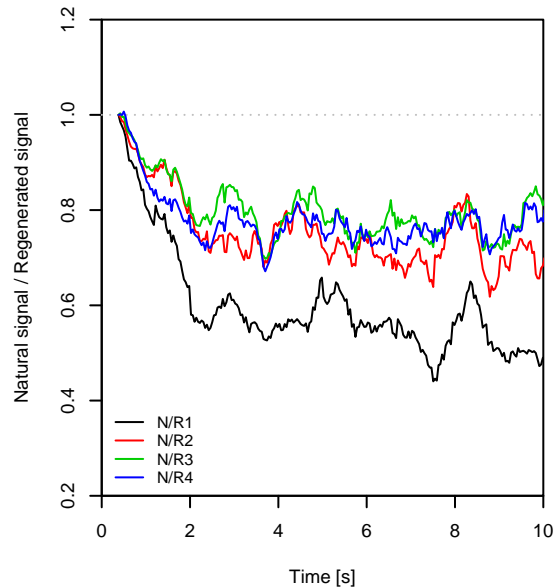
**Aliquot #17****Aliquot #18**

help("plot\_NRt")

**Aliquot #19****Aliquot #20**

**Aliquot #21****Aliquot #22**

help("plot\_NRt")

**Aliquot #23****Aliquot #24**

# TL combined



# TL combined





## unkown curve type



# RLum.Data.Image



# RLum.Data.Spectrum



[help\("plot\\_RLum.Data.Spectrum"\)](#)

# RLum.Data.Spectrum



`help("plot_RLum.Data.Spectrum")`

# RLum.Data.Spectrum



## unkown curve type



**Likelihood profile: gamma**



**Likelihood profile: sigma**



**Likelihood profile: p0**



# Monte Carlo Simulation

$$n = \left| \hat{\mu} = 45 \mid \hat{\sigma} = 21 \mid \frac{\hat{\sigma}}{\sqrt{n}} = 2 \mid v = 0.84 \right|$$





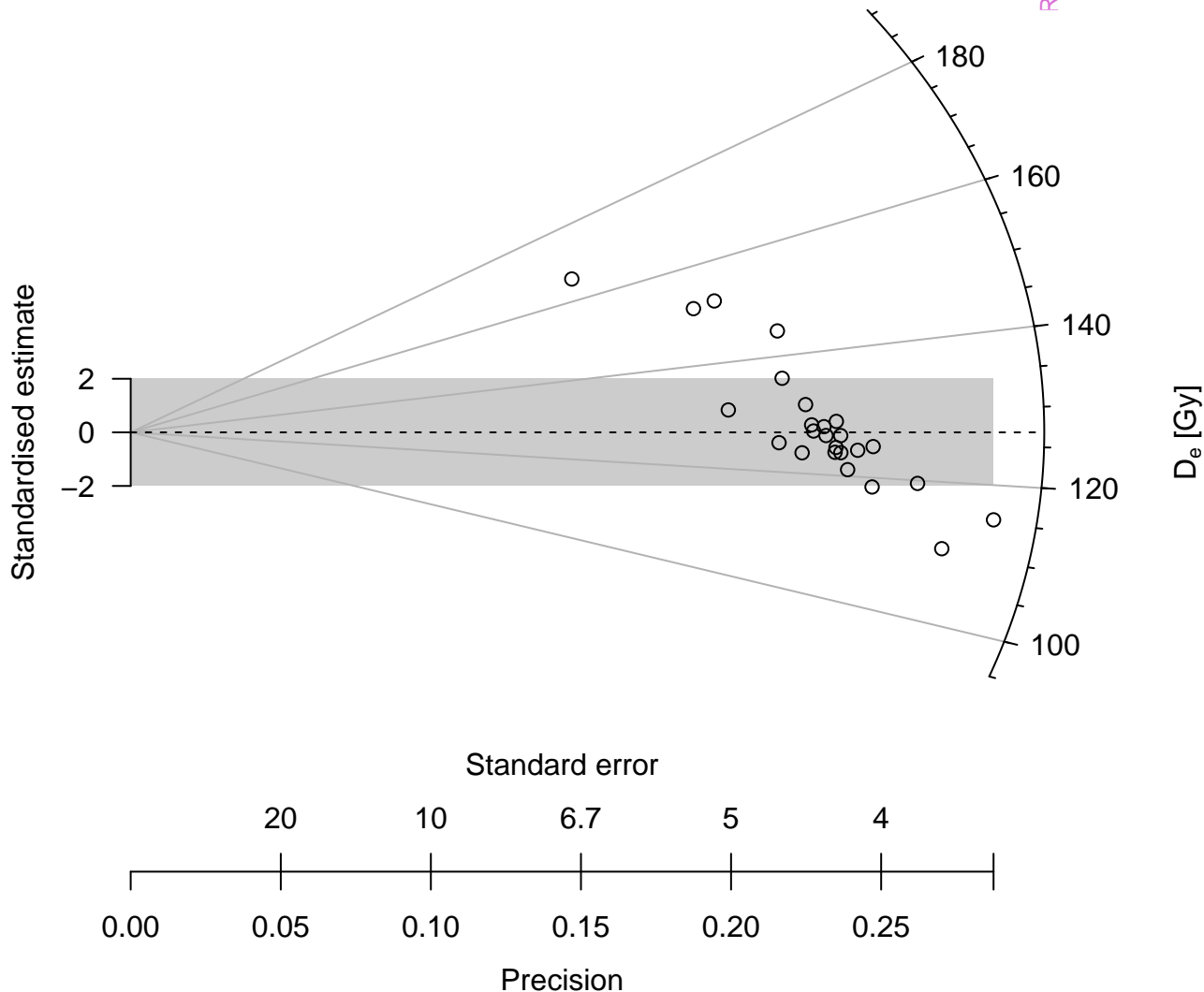
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



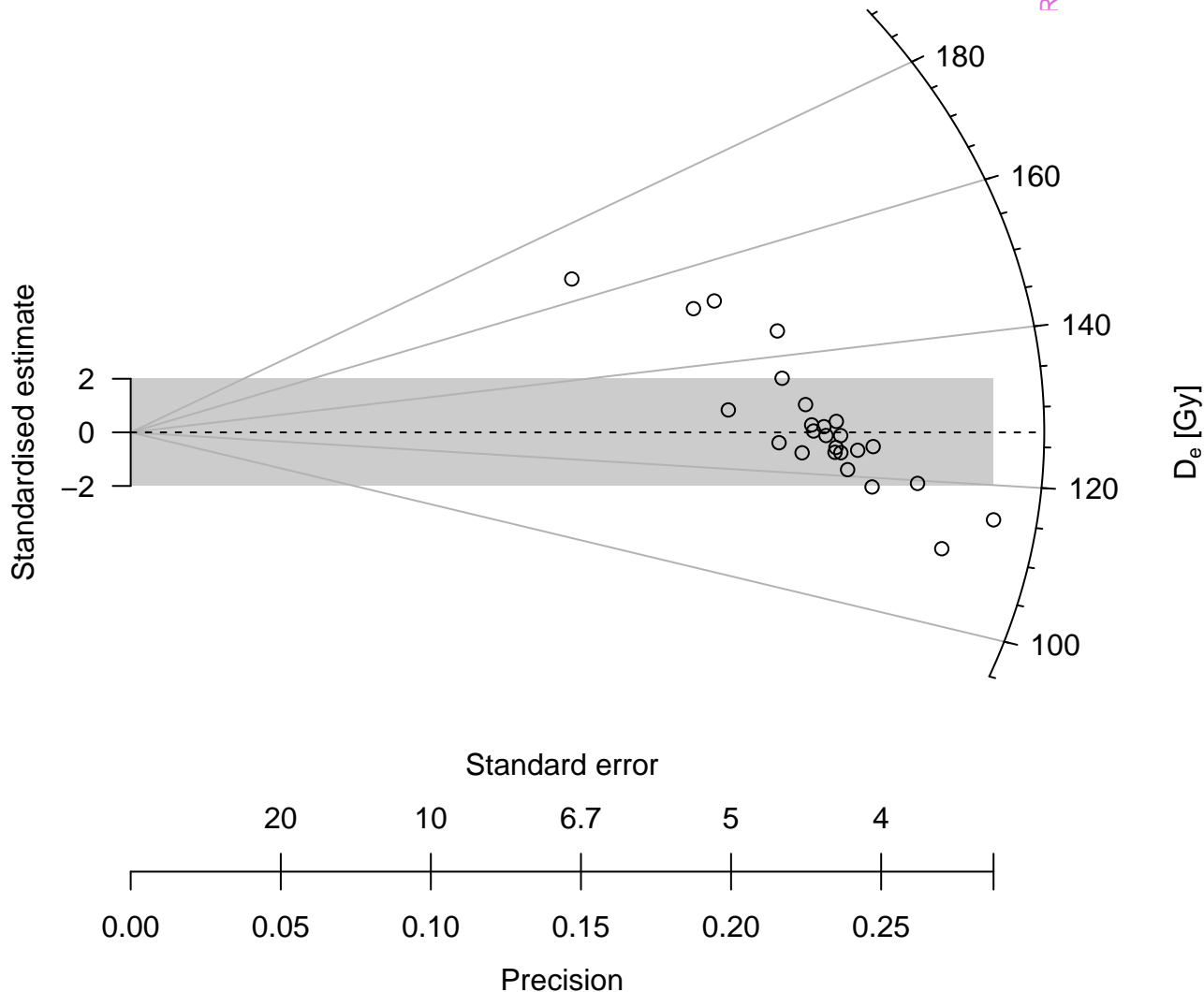
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



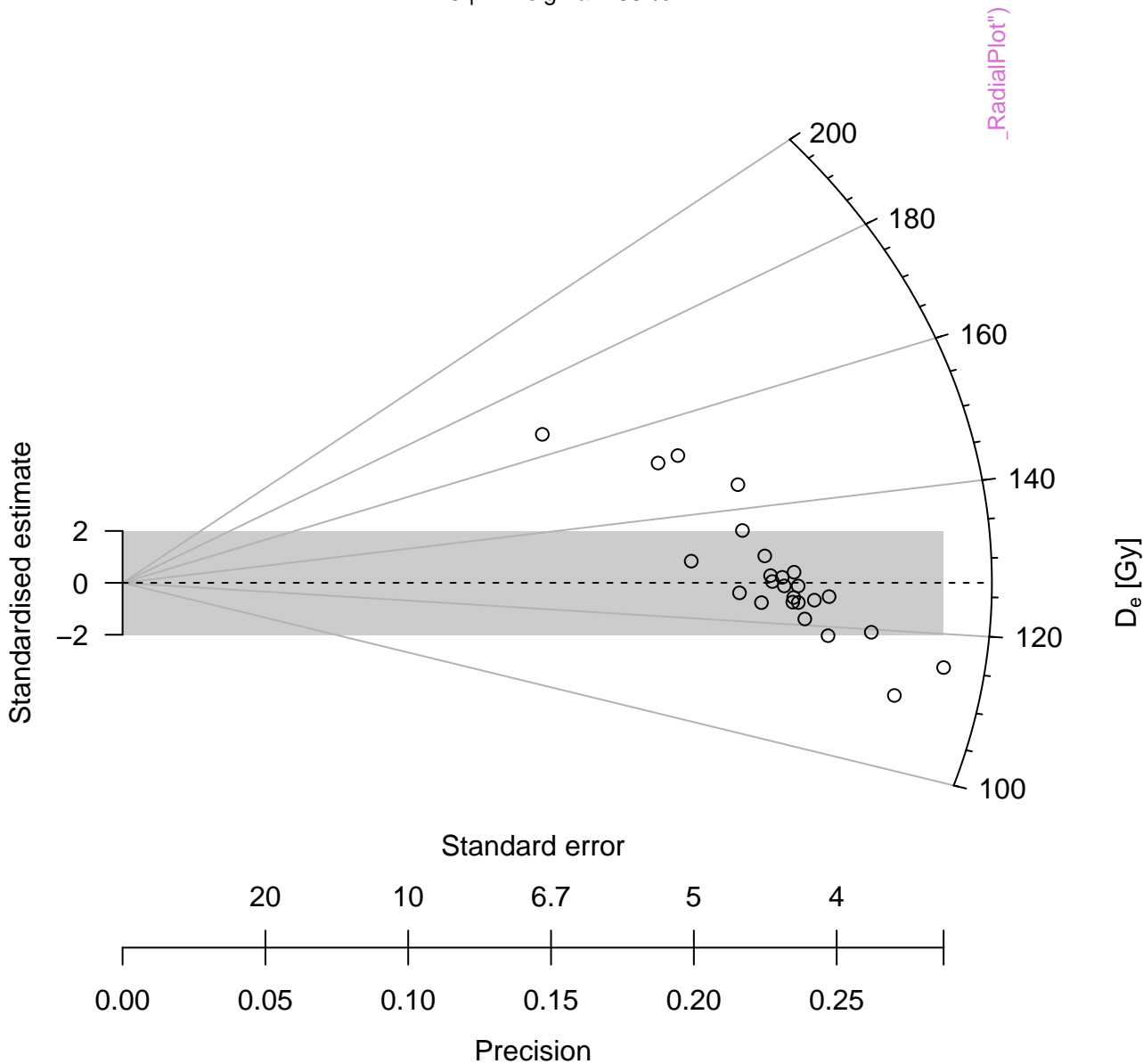
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



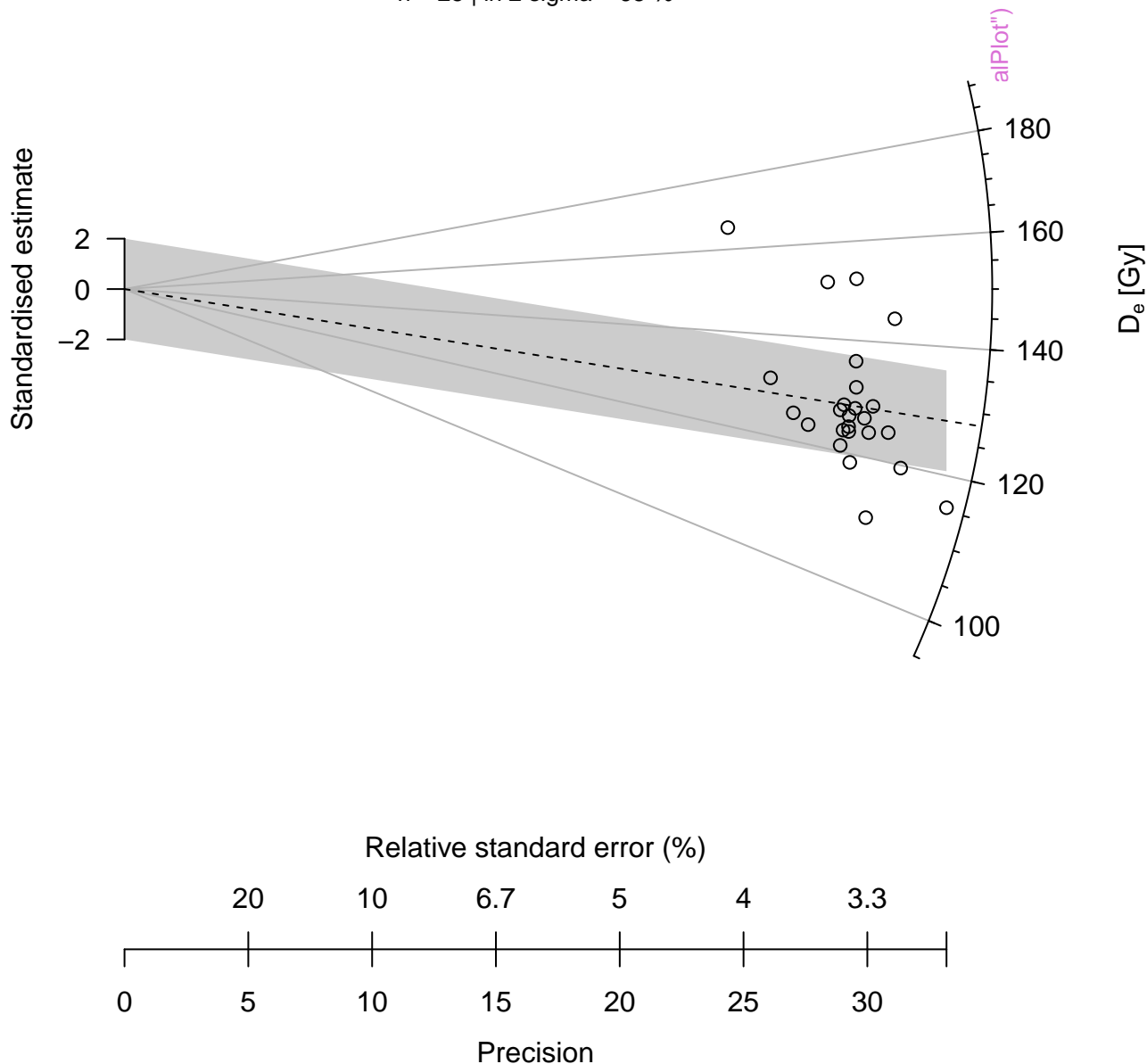
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



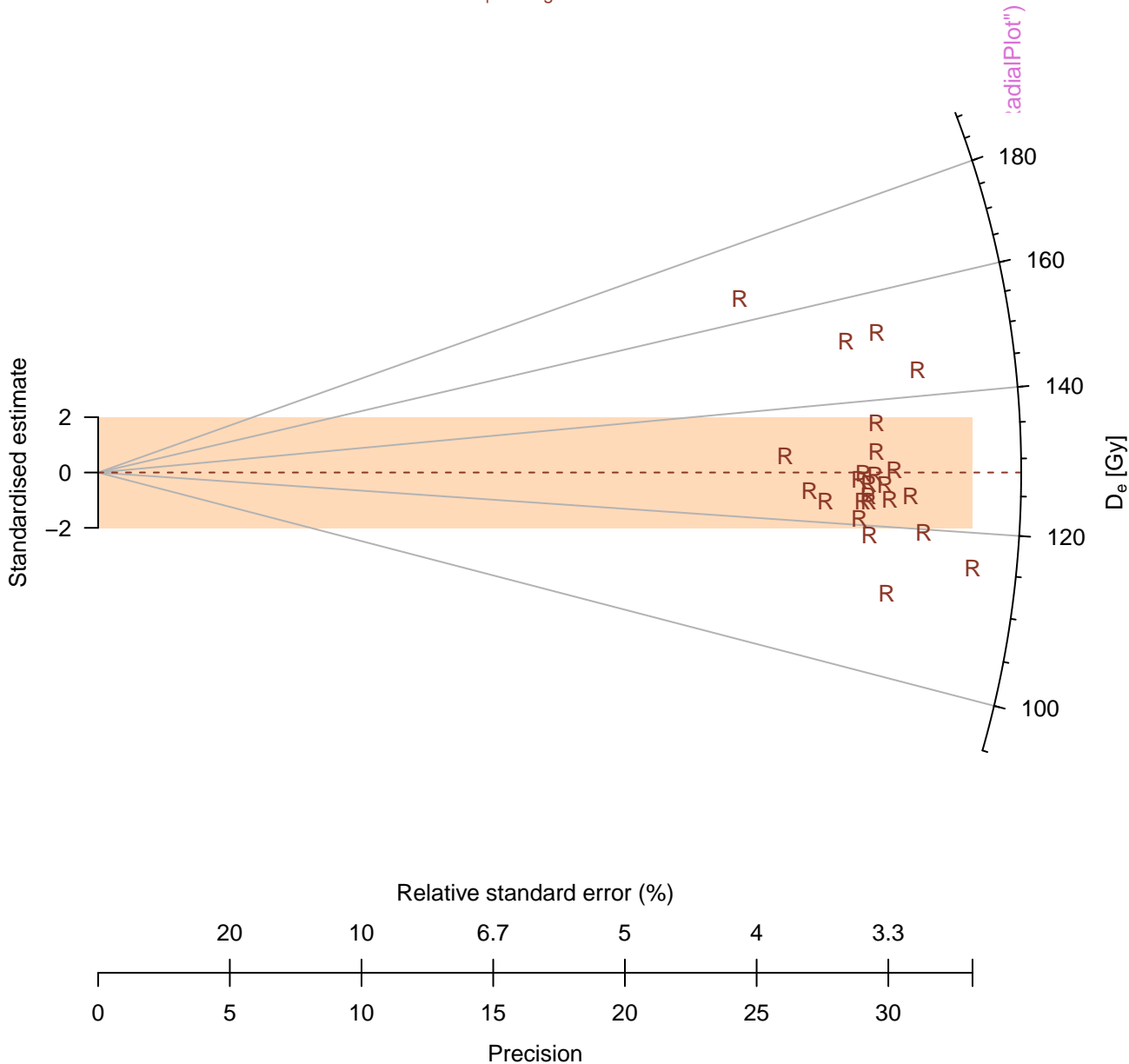
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %

Standardised estimate

0

0

20

5

10

10

6.7

15

5

20

4

25

3.3

30

Precision

Relative standard error (%)

adialPlot")

180

160

140

120

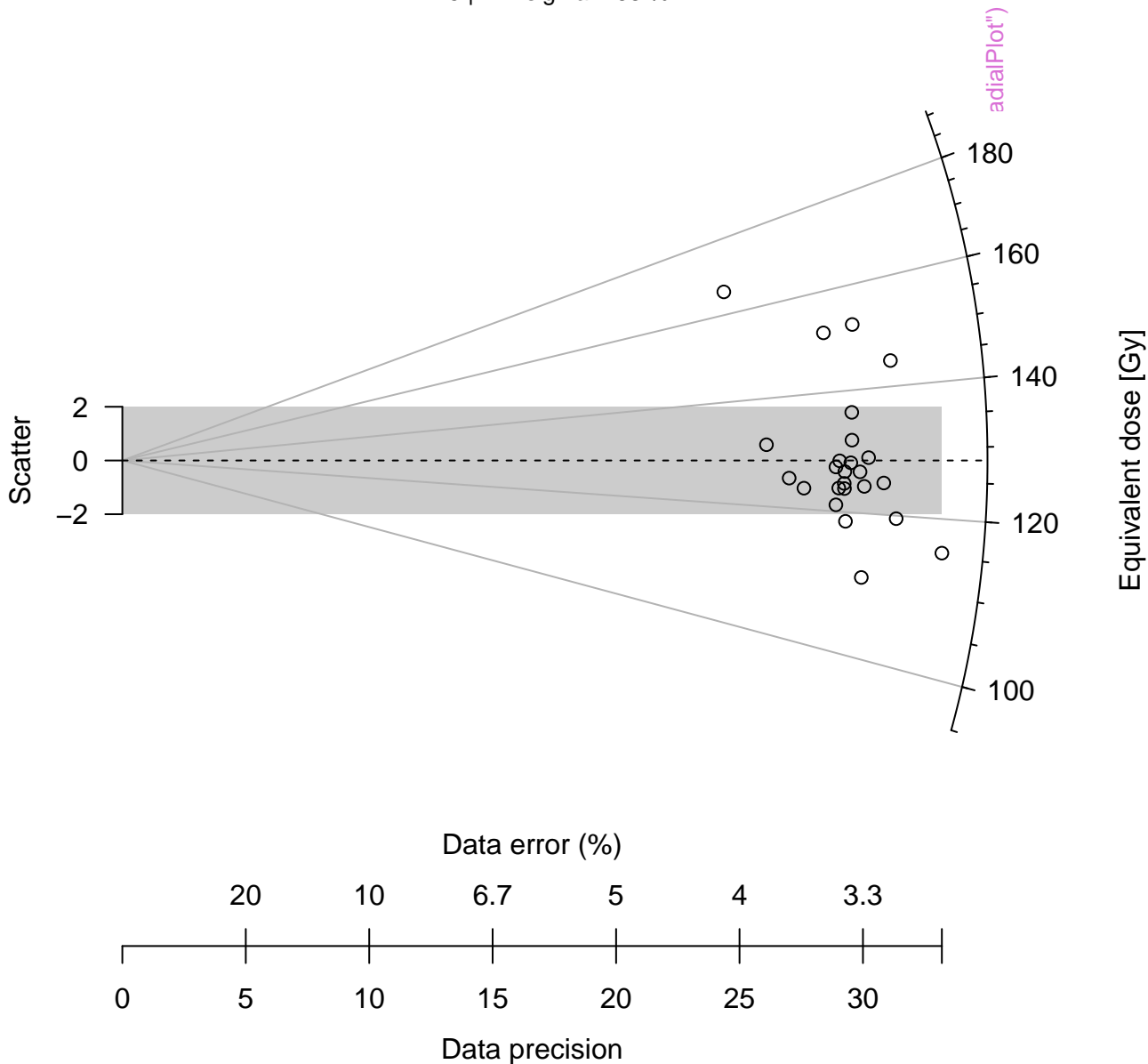
100

D<sub>e</sub> [Gy]



# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



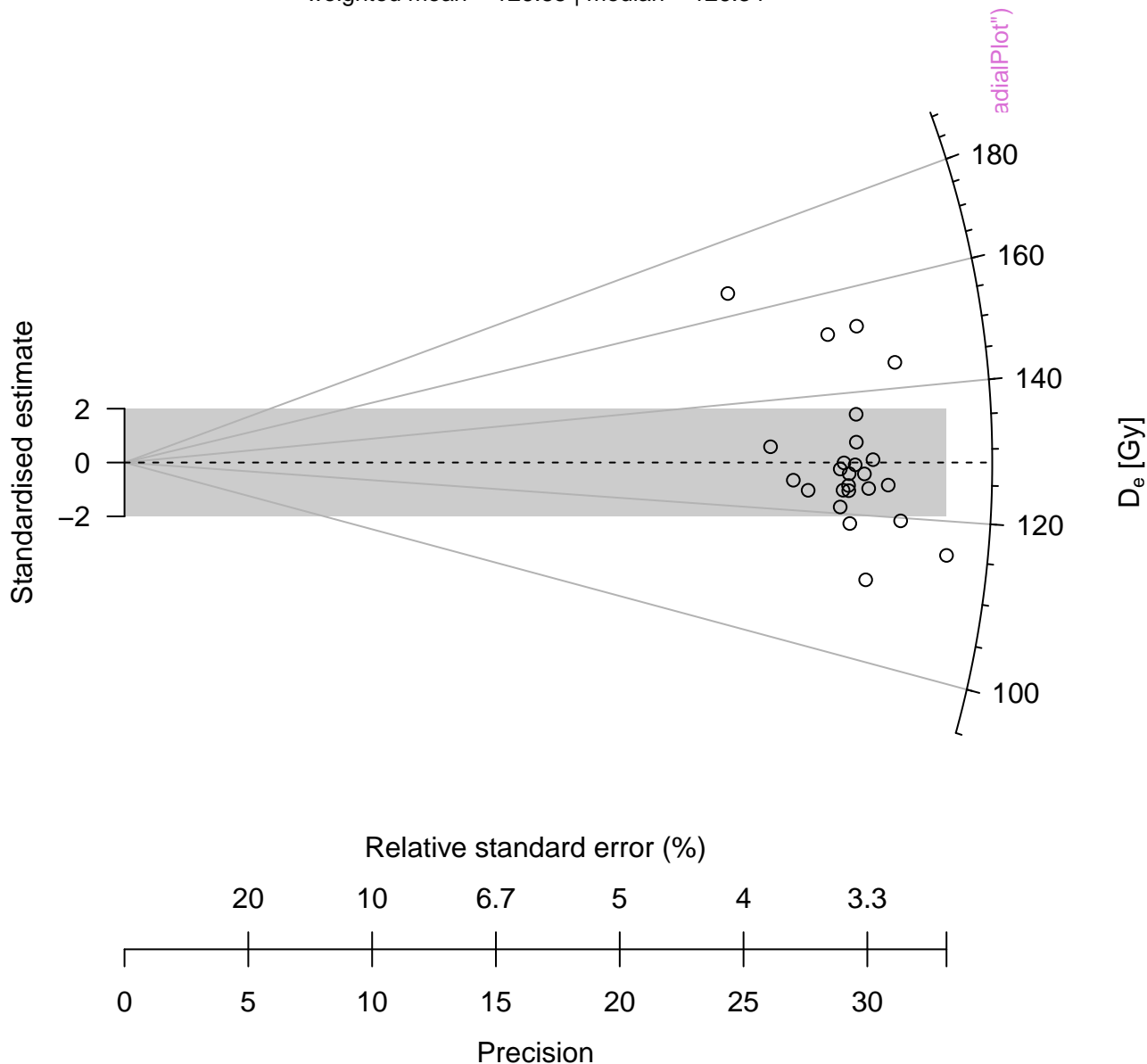
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



# D<sub>e</sub> distribution

weighted mean = 126.85 | median = 126.34



# D<sub>e</sub> distribution

n = 15 | in 2 sigma = 53.3 %

n = 10 | in 2 sigma = 90 %



# D<sub>e</sub> distribution

n = 15 | in 2 sigma = 53.3 %

n = 10 | in 2 sigma = 90 %

△ Sample 1

▽ Sample 2

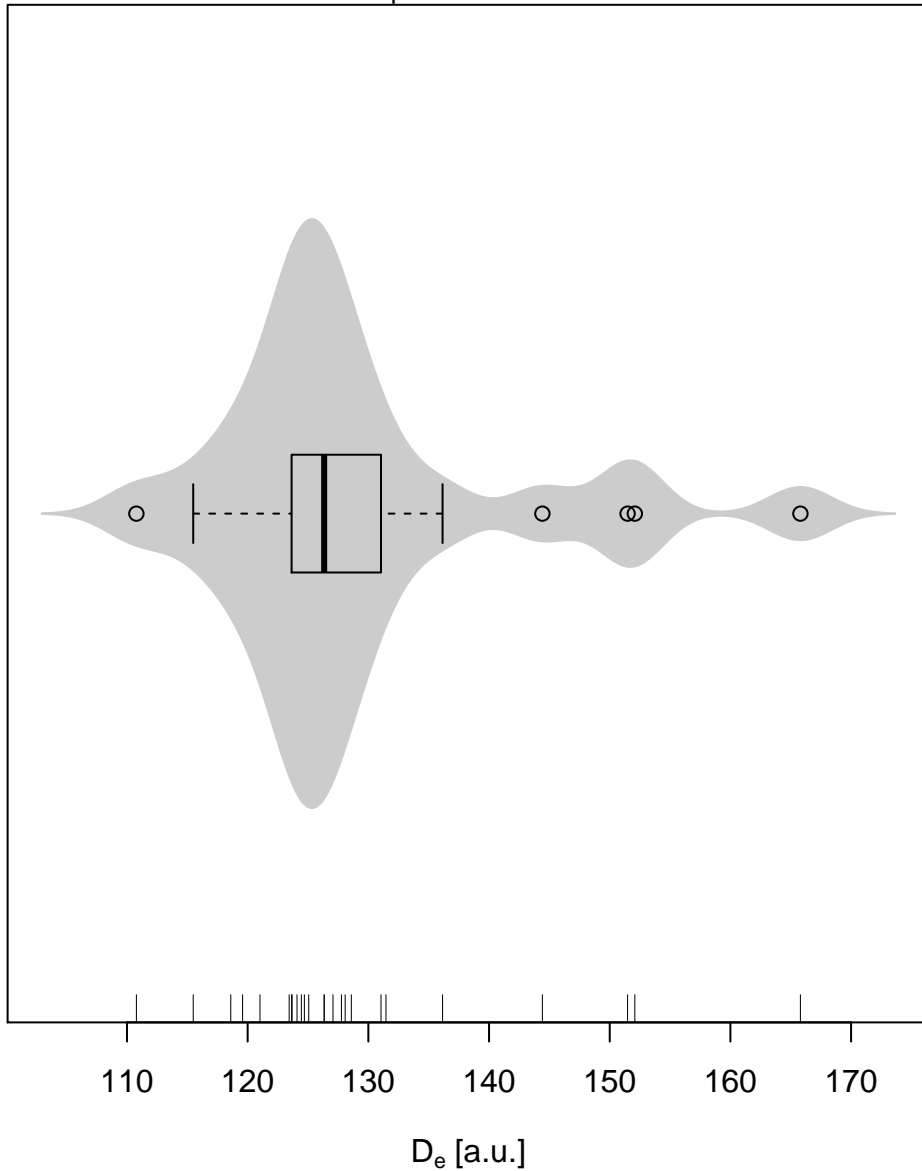


# Violin Plot

n = 25 | median = 126.34

Density

[help\("plot\\_ViolinPlot"\)](#)



**USER combined**



**IRSL combined**



`help("read_PSL2R")`

**OSL combined**





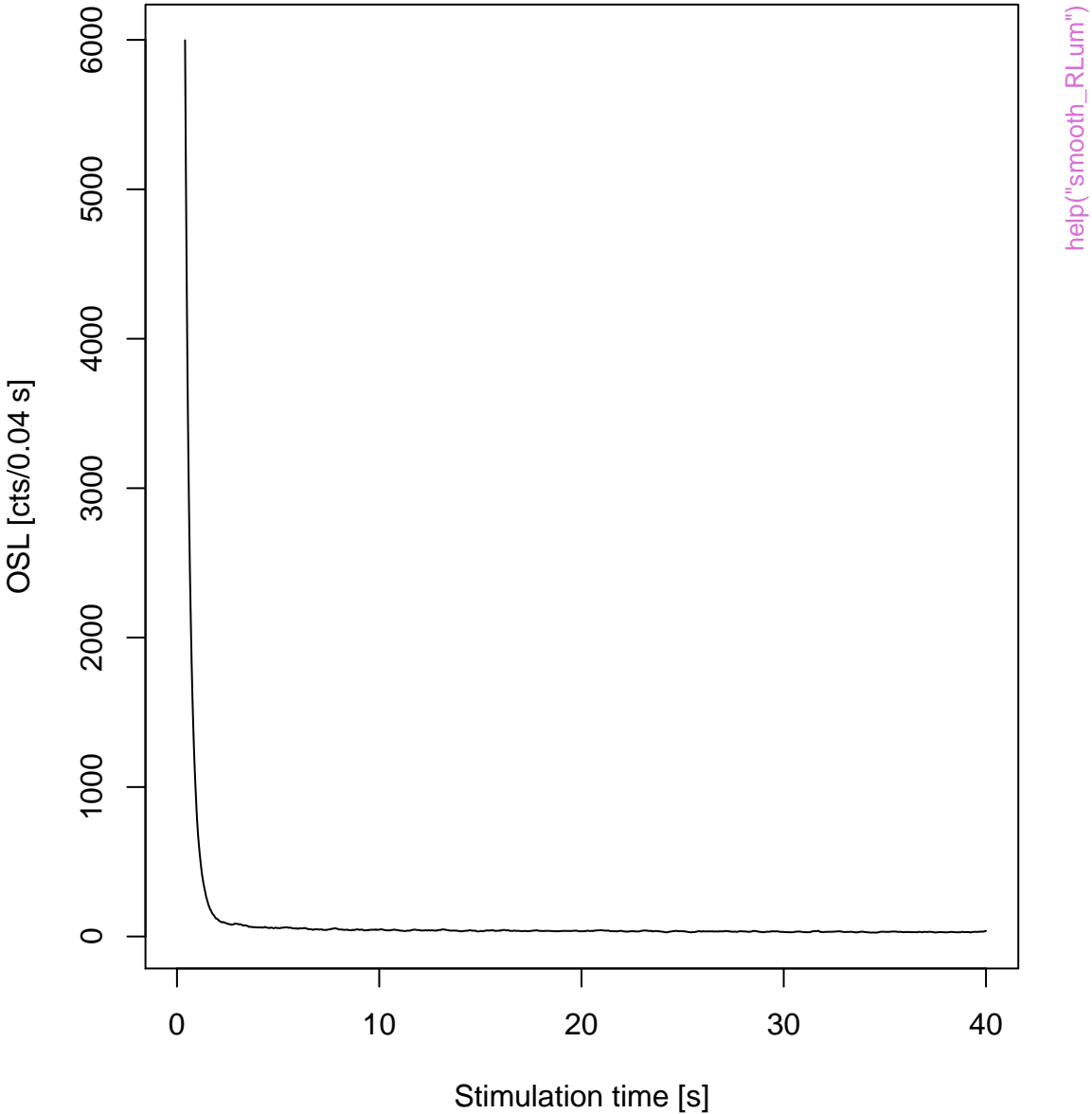
# OSL



# OSL



# OSL



# D<sub>e</sub> distribution

n = 62 | mean = 66.01



# D<sub>e</sub> distribution

n = 62 | mean = 66.01

