

$L_n, L_x$  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)**





# Histogram



# Histogram





`help("ExampleData.FittingLM")`



help("ExampleData.LxTxData")



help("ExampleData.LxTxOSLData")



`help("ExampleData.LxTxOSLData")`



**RF**

**#1**



**RF**

**#2**



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

# RLum.Data.Image



# 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





help("ExampleData.portableOSL")

USER

Record: 4



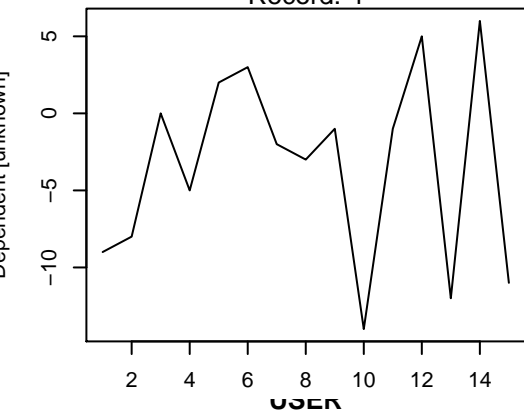
IRSL

Record: 4

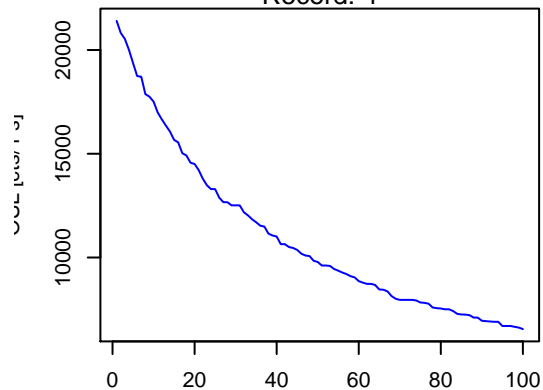


help("ExampleData.portableOSL")

Record: 4



Record: 4







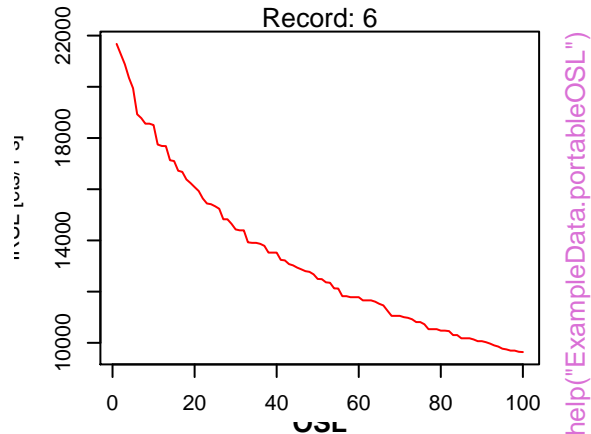
USER

Record: 6



IRSL

Record: 6

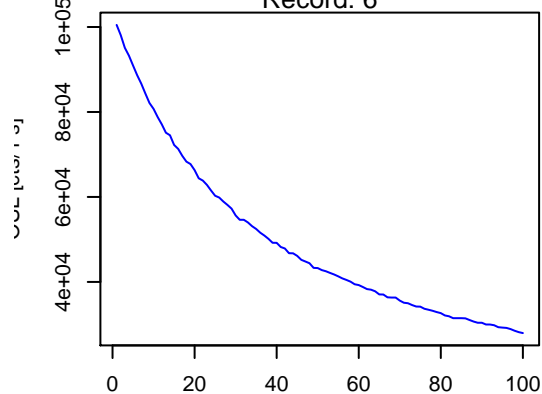


help("ExampleData.portableOSL")

Record: 6



Record: 6



Record: 6



USER

Record: 7



IRSL

Record: 7



help("ExampleData.portableOSL")

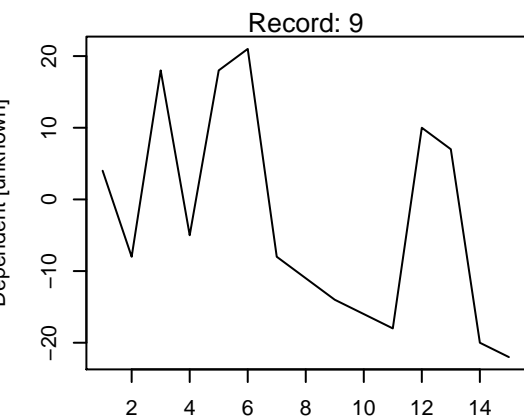
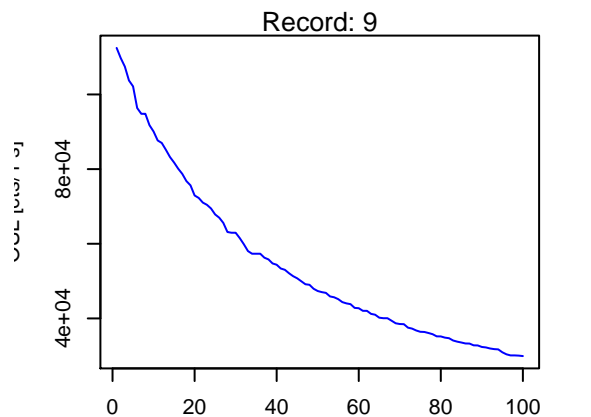
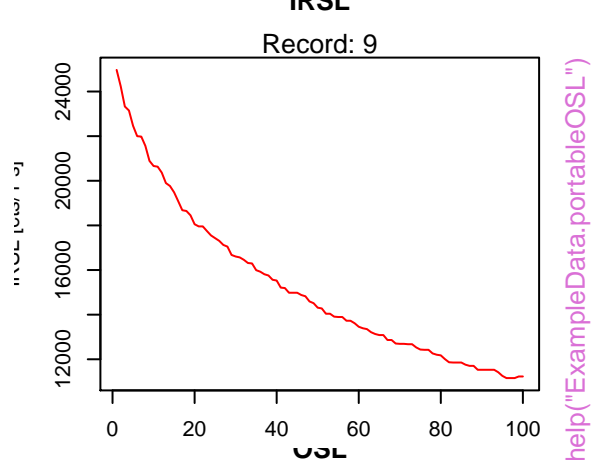
Record: 7



Record: 7







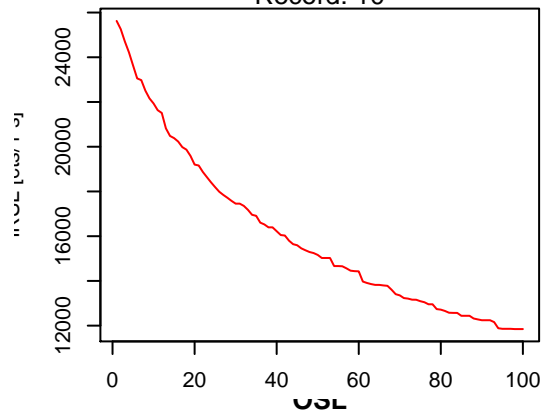
USER

Record: 10



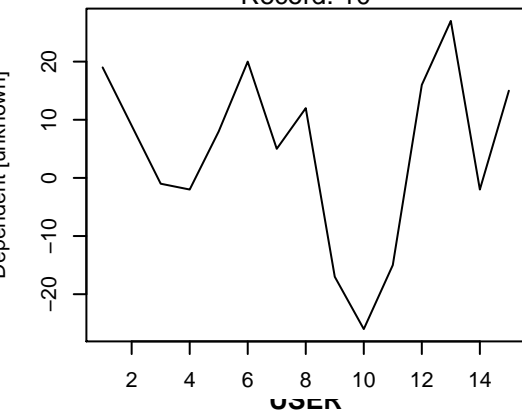
IRSL

Record: 10

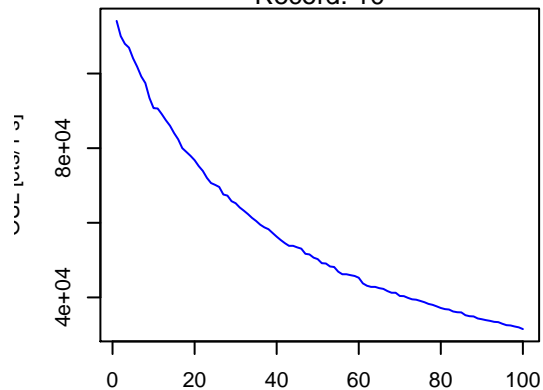


help("ExampleData.portableOSL")

Record: 10



Record: 10





USER

Record: 12



IRSL

Record: 12



help("ExampleData.portableOSL")

Record: 12



Record: 12





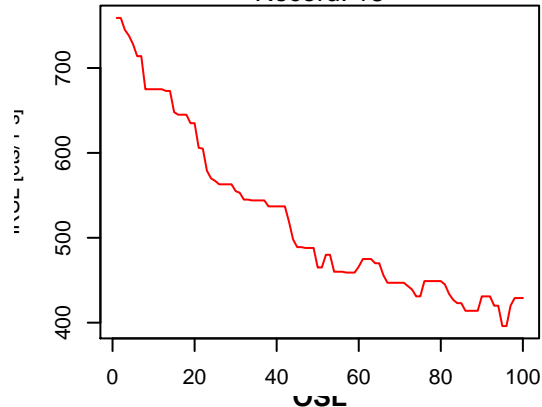
USER

Record: 13



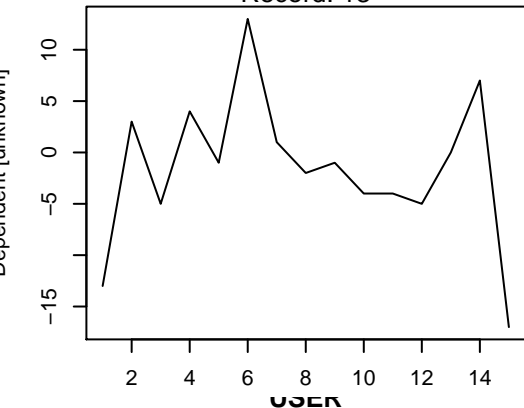
IRSL

Record: 13

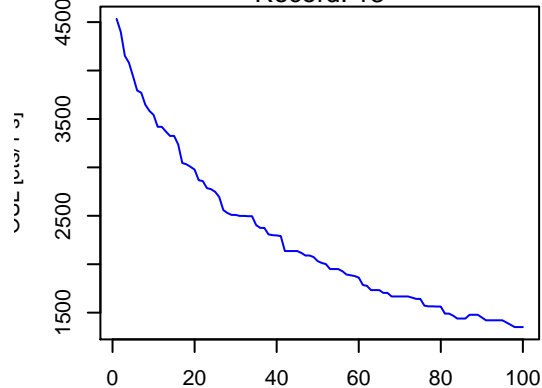


help("ExampleData.portableOSL")

Record: 13



Record: 13



USER

Record: 14



IRSL

Record: 14



help("ExampleData.portableOSL")

Record: 14



Record: 14



USER

Record: 1



IRSL

Record: 1

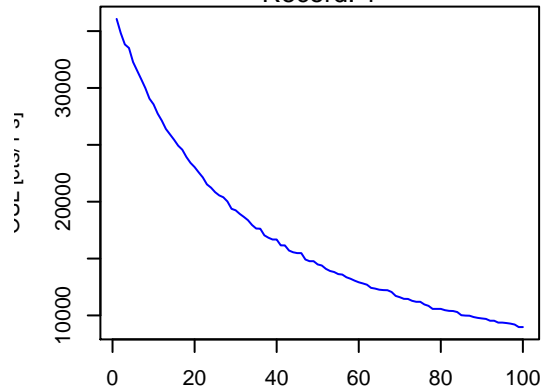


help("PSL2Riseo.BinfileData")

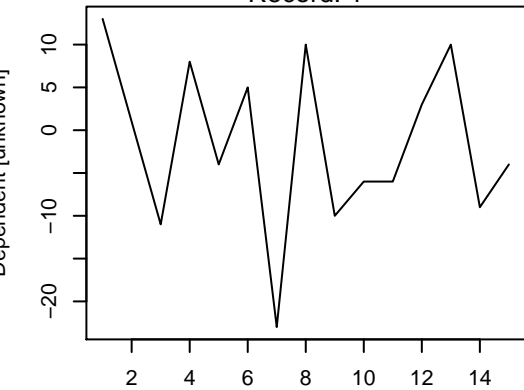
Record: 1



Record: 1



Record: 1



USER

Record: 2



IRSL

Record: 2



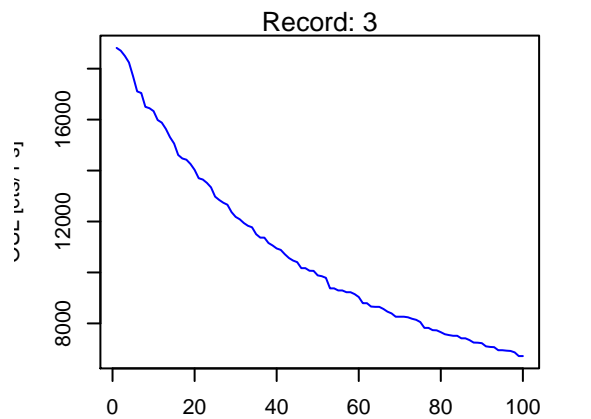
help("PSL2Riseo.BinfileData")

Record: 2



Record: 2



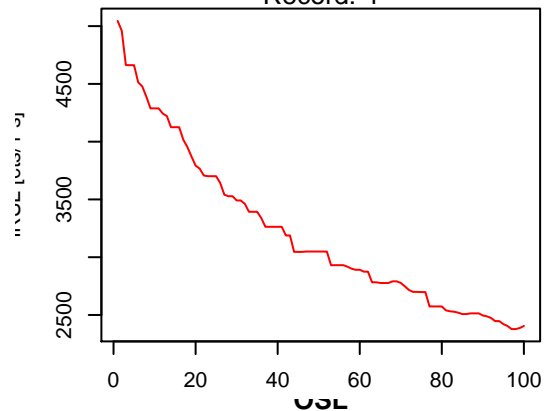


USER

Record: 4

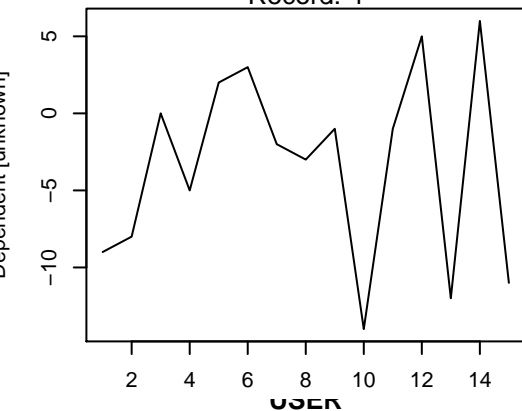


Record: 4

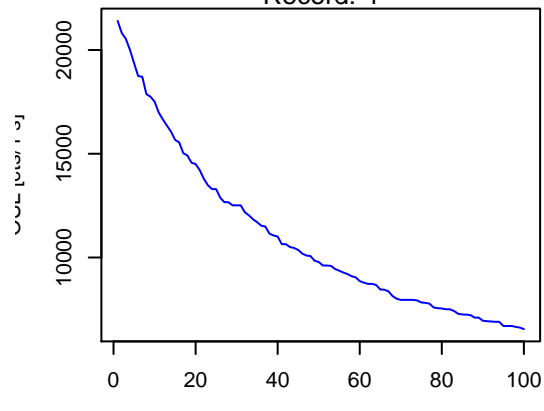


help("PSL2Risee.BINfileData")

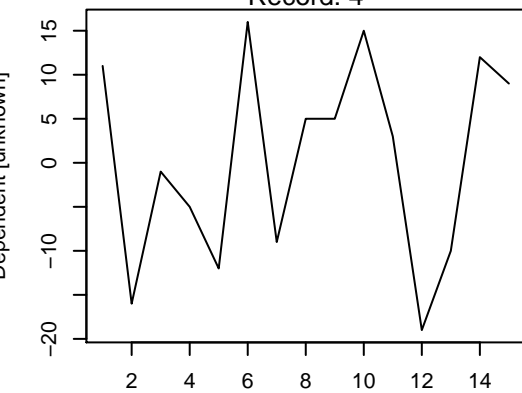
Record: 4



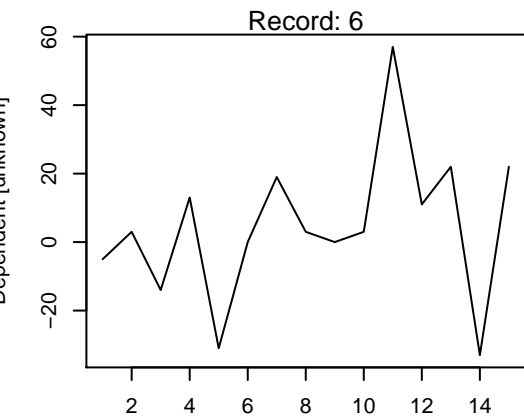
Record: 4



Record: 4









USER

Record: 7



IRSL

Record: 7

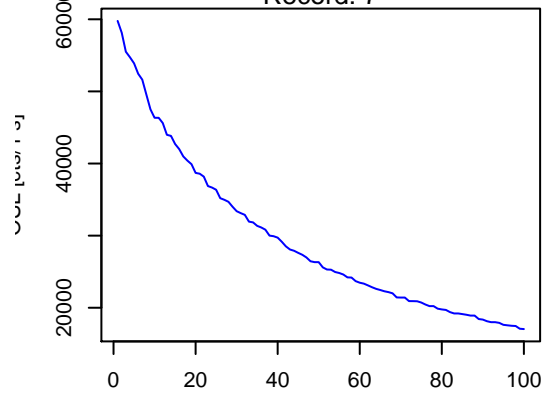


help("PSL2Riseo.BinfileData")

Record: 7



Record: 7









USER

Record: 11



IRSL

Record: 11

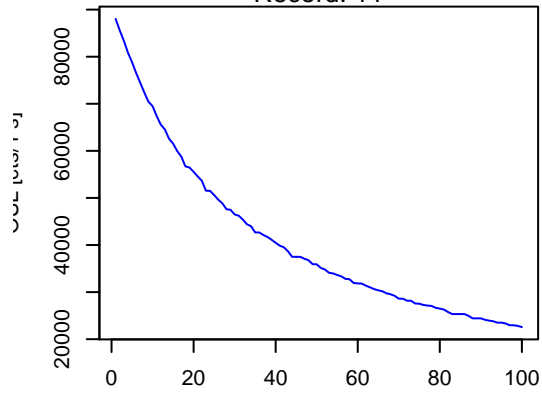


help("PSL2Riseo.BinfileData")

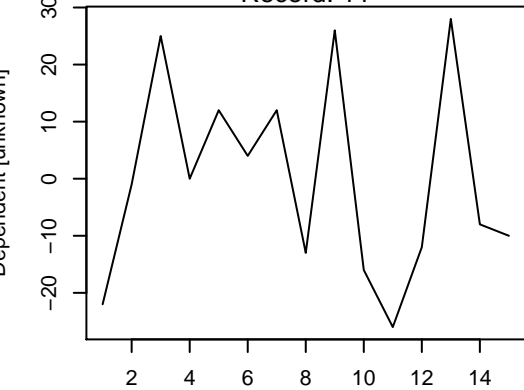
Record: 11



Record: 11



Record: 11



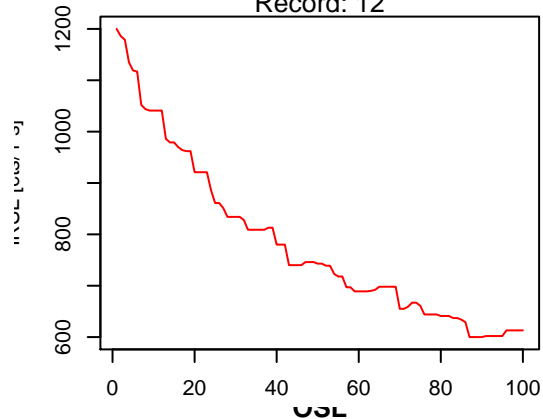
USER

Record: 12



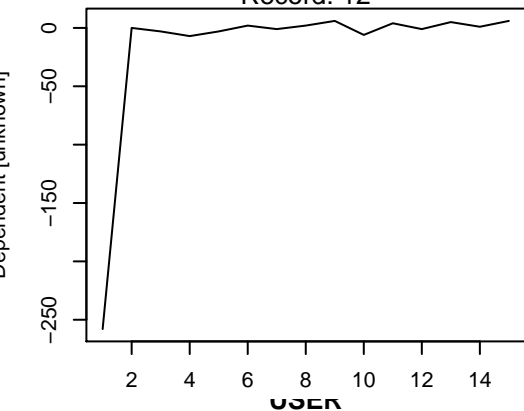
IRSL

Record: 12

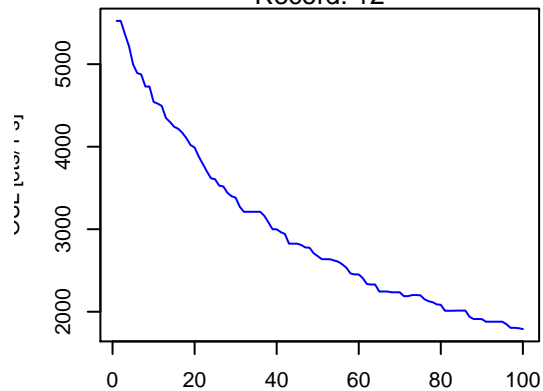


help("PSL2Riseo.BINfileData")

Record: 12



Record: 12



USER

Record: 13

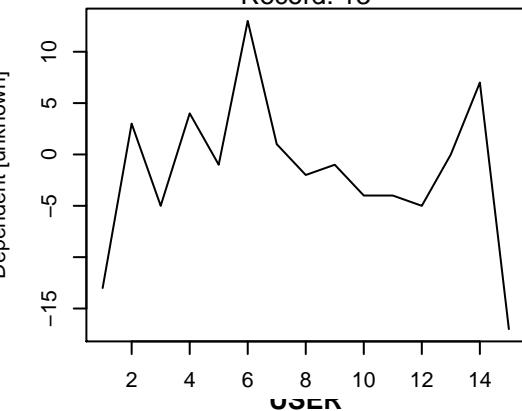


Record: 13

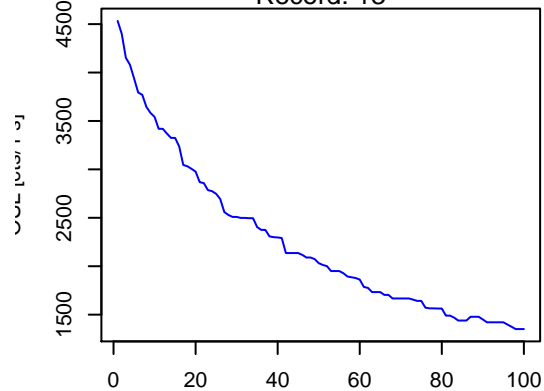


help("PSL2Riseo.BinfileData")

Record: 13



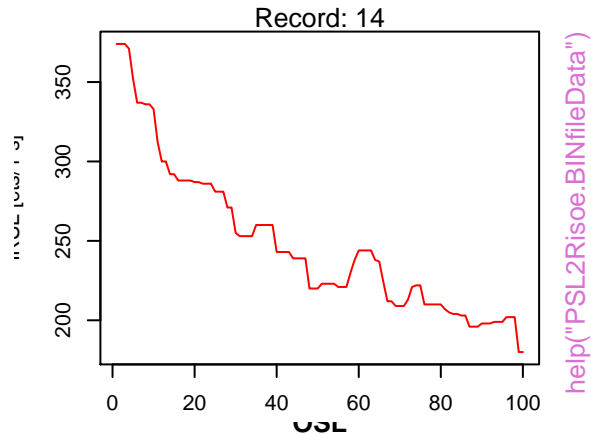
Record: 13



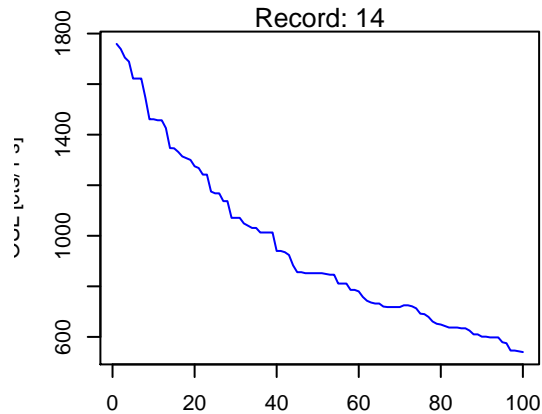
USER



IRSL



help("PSL2Riseo.BINfileData")





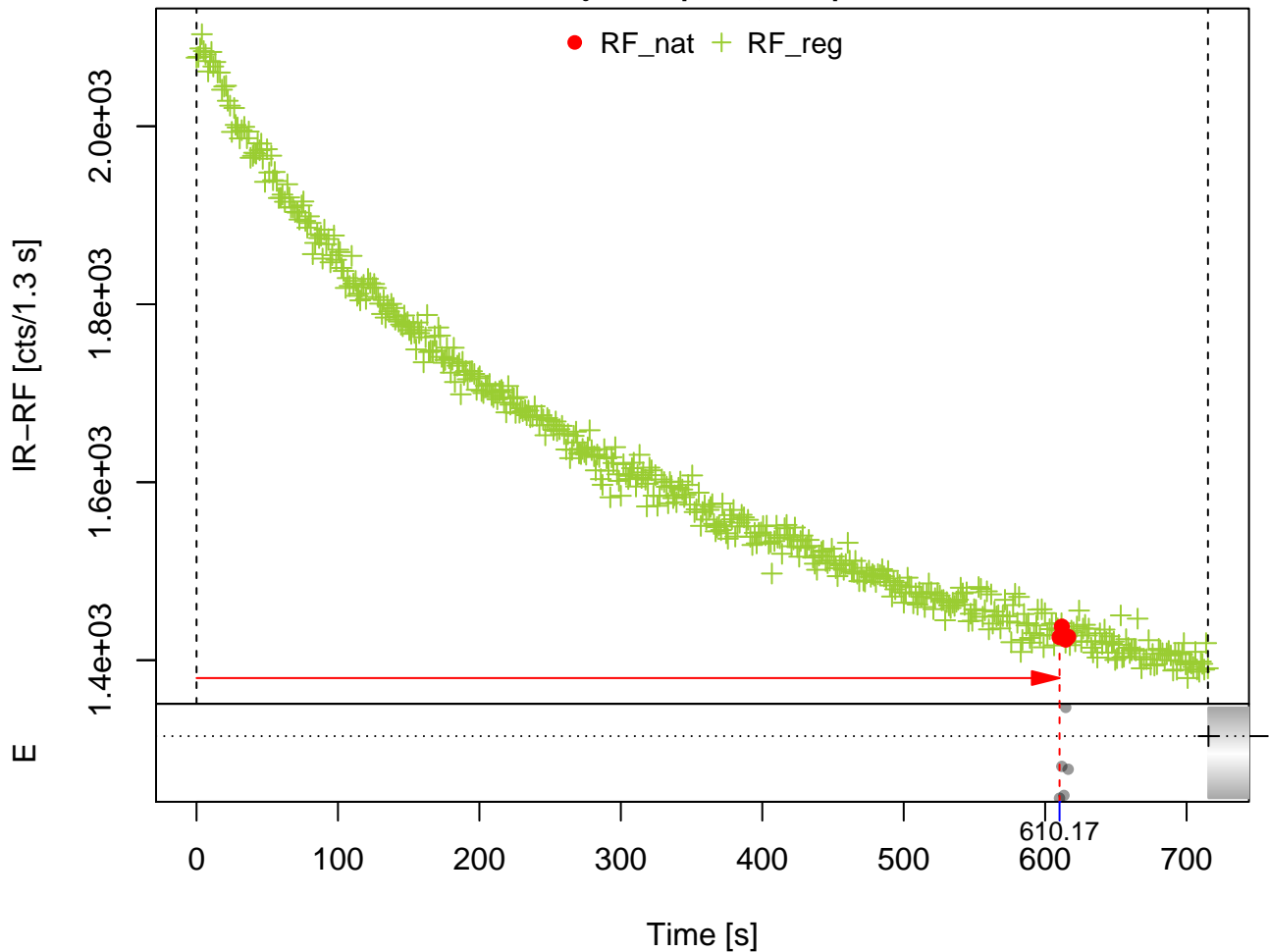
# IR-RF

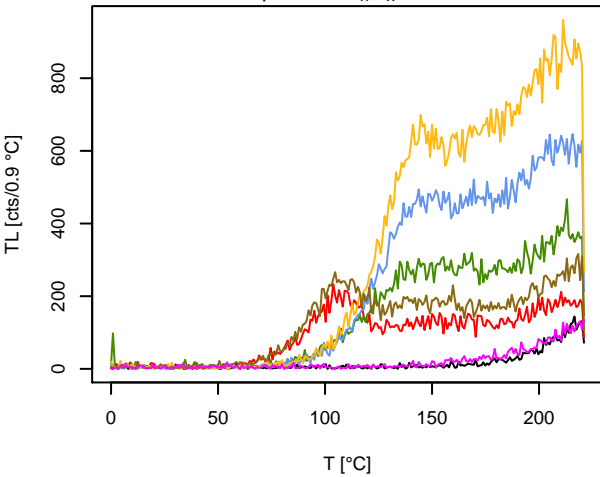
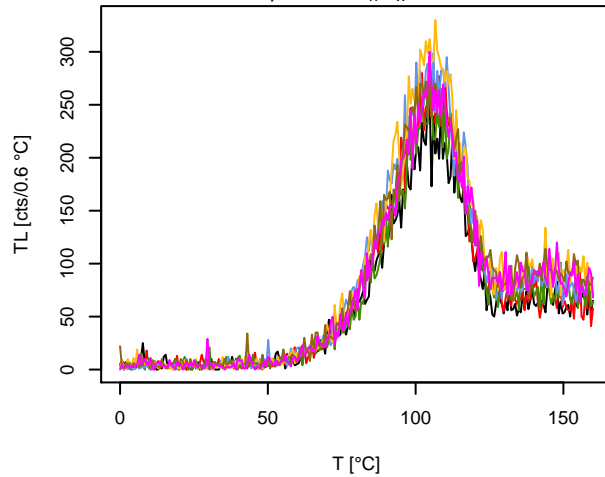
$D_e = 623.25$  [600.63 ; 635.8]



# IR-RF

$D_e = 610.17$  [567.19 ; 653.15]



TL previous  $L_n, L_x$  curvesTL 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)

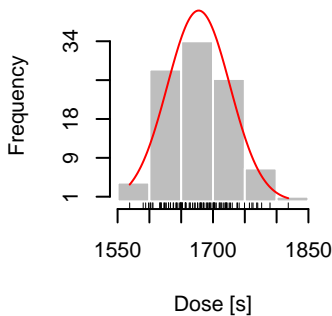
# Growth curve

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

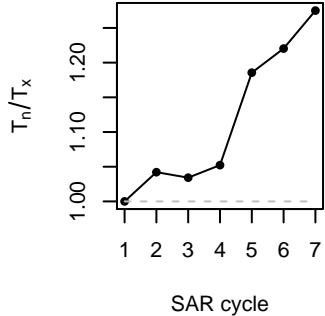


## $D_e$ from MC simulation

$D_{eMC} = 1677.48 \pm 49.22$  | 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)

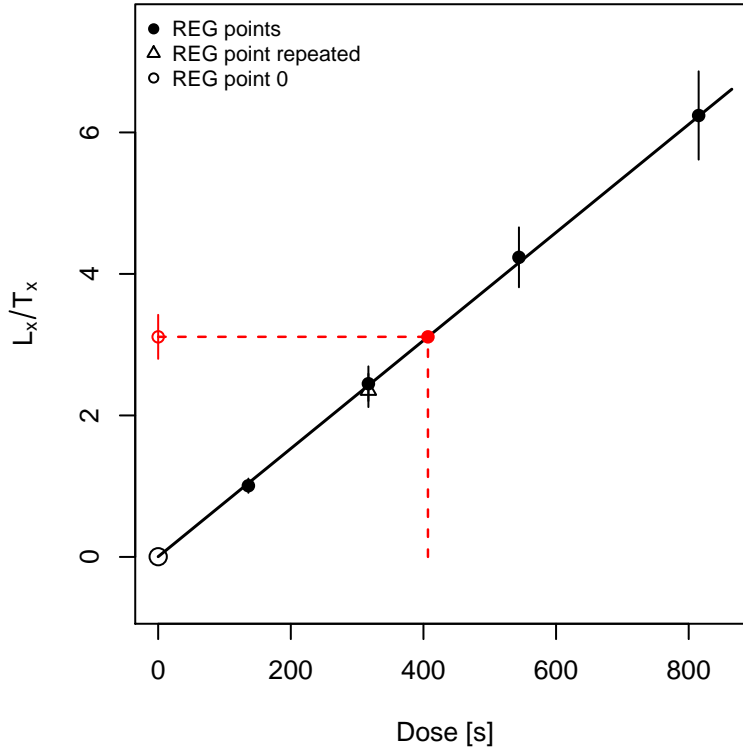
Natural  
(815)

Natural  
(0)

Natural  
(317)

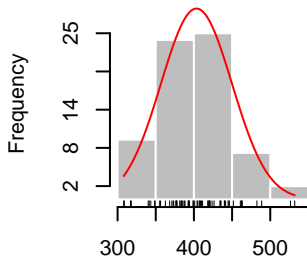
# Growth curve

$D_e = 406.8 \pm 46.54$  | fit: EXP



## $D_e$ from MC simulation

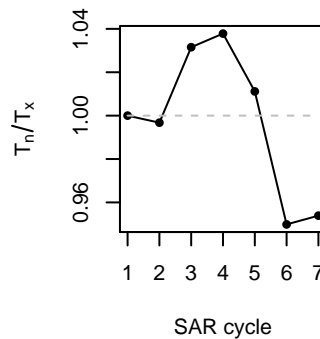
$D_{eMC} = 403.34 \pm 46.54$  | quality = 99.1 %



Dose [s]

n = 100, valid fits = 67

## Test dose response



## 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

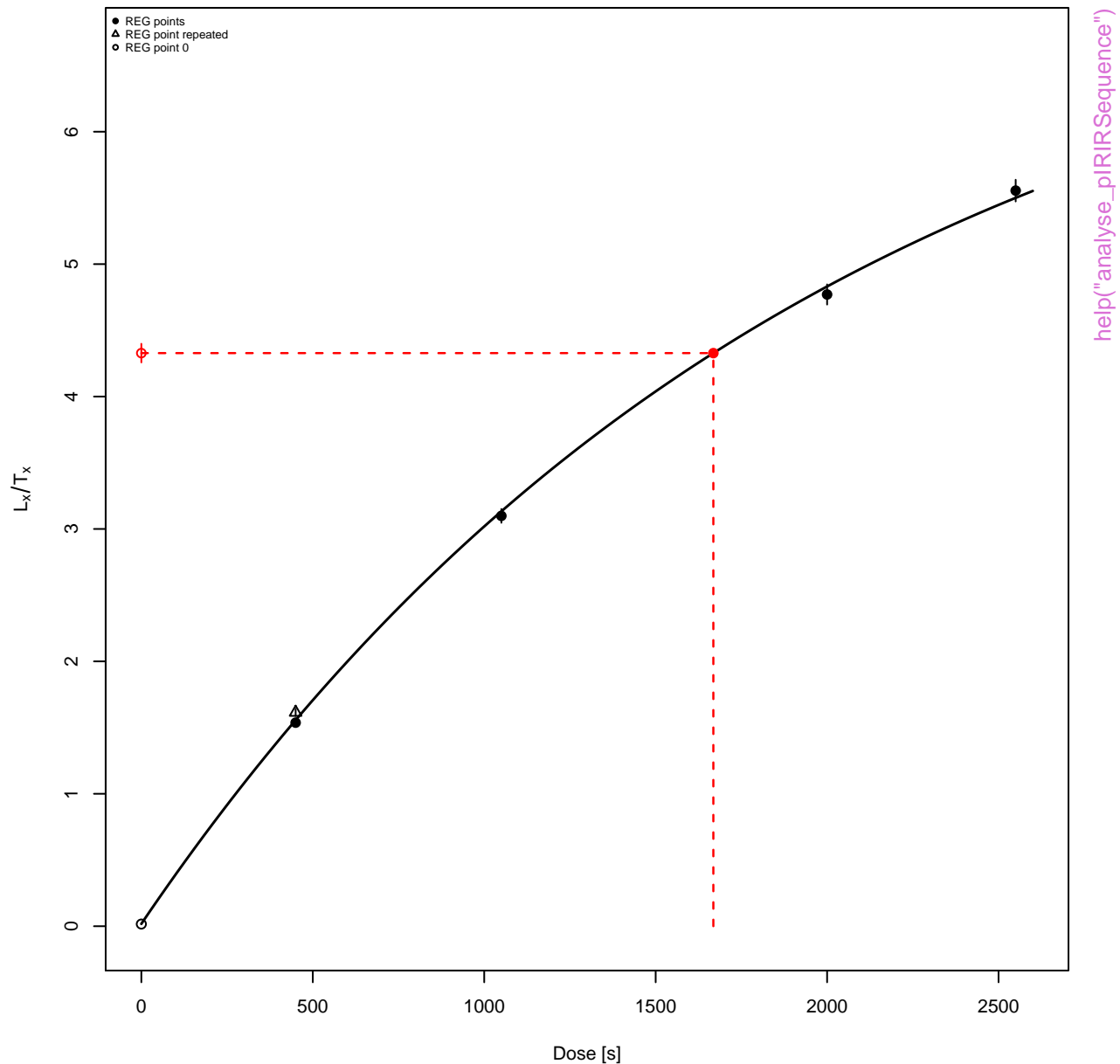


# Pseudo pIRIR data set based on quartz OSL



# 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



help("analyse\_pIRIRSequence")

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

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



Dose [s]

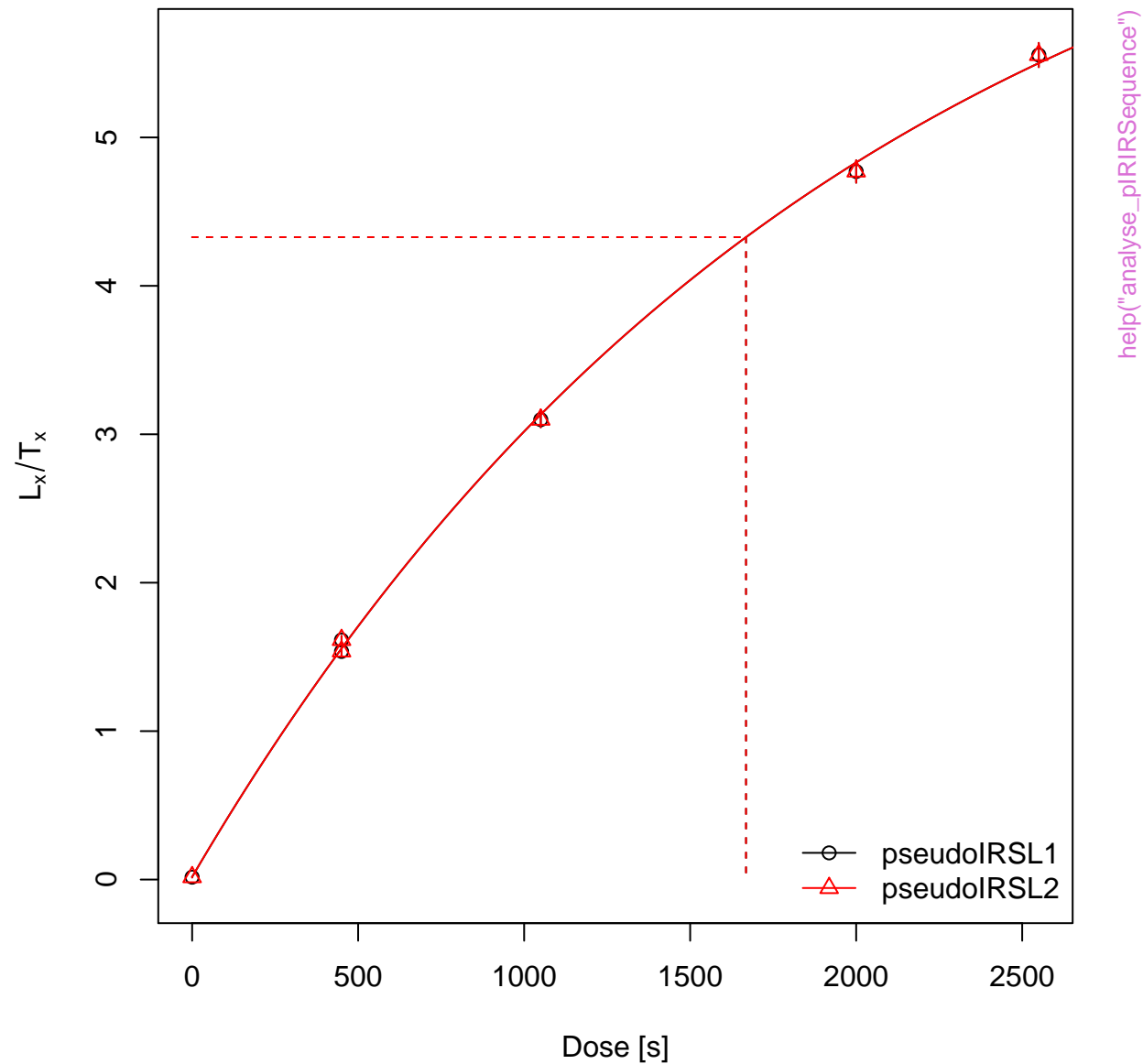
n = 100 , valid fits = 100

help("analyse\_pIRSequence")

# Test dose response



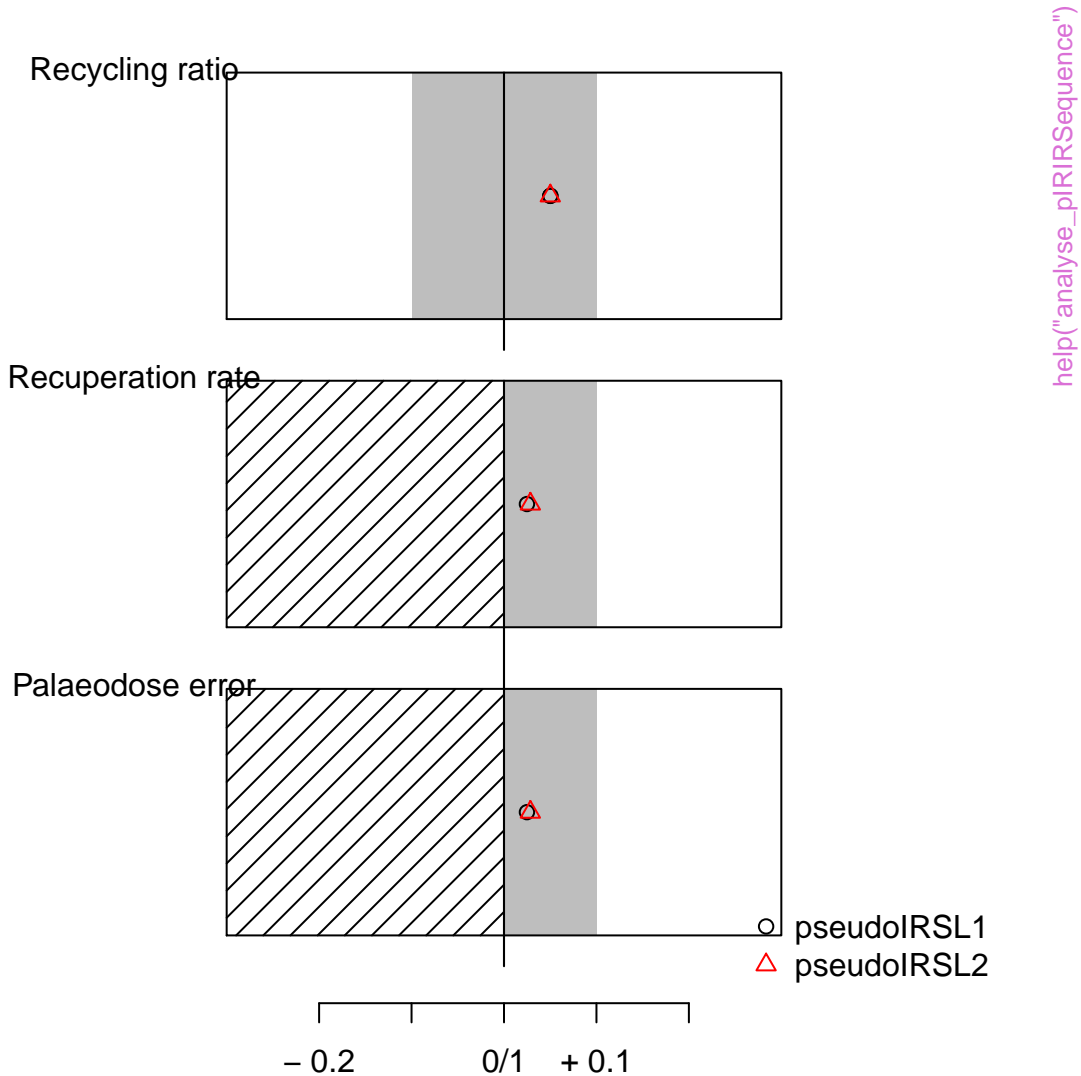
# Summarised Dose Response Curves



# Sensitivity change



## Rejection criteria





## USER combined



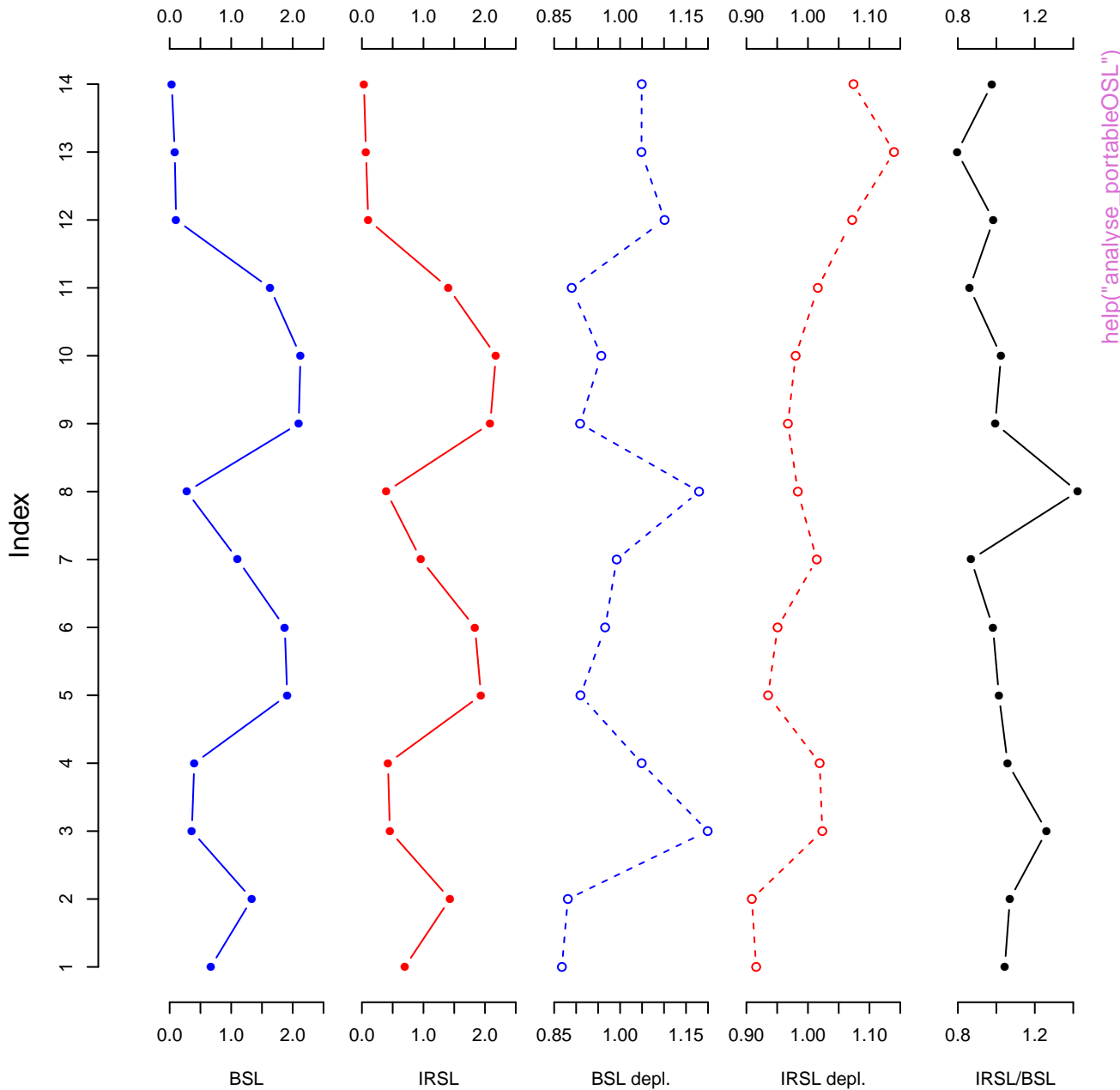
## IRSL combined



help("analyse\_portableOSL")

## OSL combined





# OSL



help("bin\_RLum.Data")

# OSL



help("bin\_RLum.Data")

# OSL



help("bin\_RLum.Data")

# Monte Carlo Simulation

$$n = 100 \mid \hat{\mu} = 43 \mid \hat{\sigma} = 20 \mid \frac{\hat{\sigma}}{\sqrt{n}} = 2 \mid v = 0.73$$



Profile log likelihood for  $\sigma_{OD}$



# Fast Ratio



help("calc\_FastRatio")



# Finite Mixture Model

$\sigma_b = 0.2 \mid n = 62$

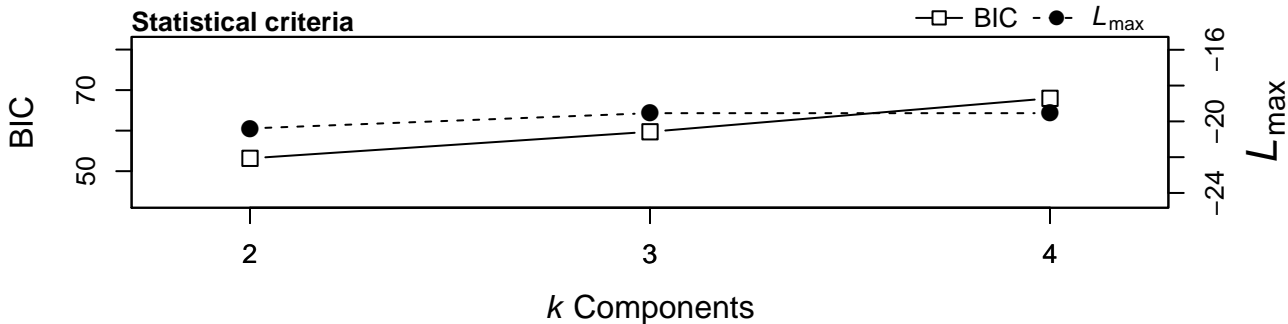
## Normal distributions



## Proportion of components



## Statistical criteria



# Fuchs & Lang (2001)







help("calc\_I EU")

**Likelihood profile: gamma**



**Likelihood profile: sigma**



help("calc\_MaxDose")

**Likelihood profile: p0**



**Likelihood profile: gamma**



**Likelihood profile: sigma**



help("calc\_MinDose")

**Likelihood profile: p0**



**Likelihood profile: gamma**



**Likelihood profile: sigma**



help("calc\_MinDose")

**Likelihood profile: p0**



# 3-parameter Minimum Age Model

Parameters:  $\sigma_b = 0.1$  ,  $\gamma = 3.5$  ,  $\sigma = 0.7$  ,  $\rho = 0.01$

n = 62

mean = 65.99

median = 69.64

Standardised estimate





# 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



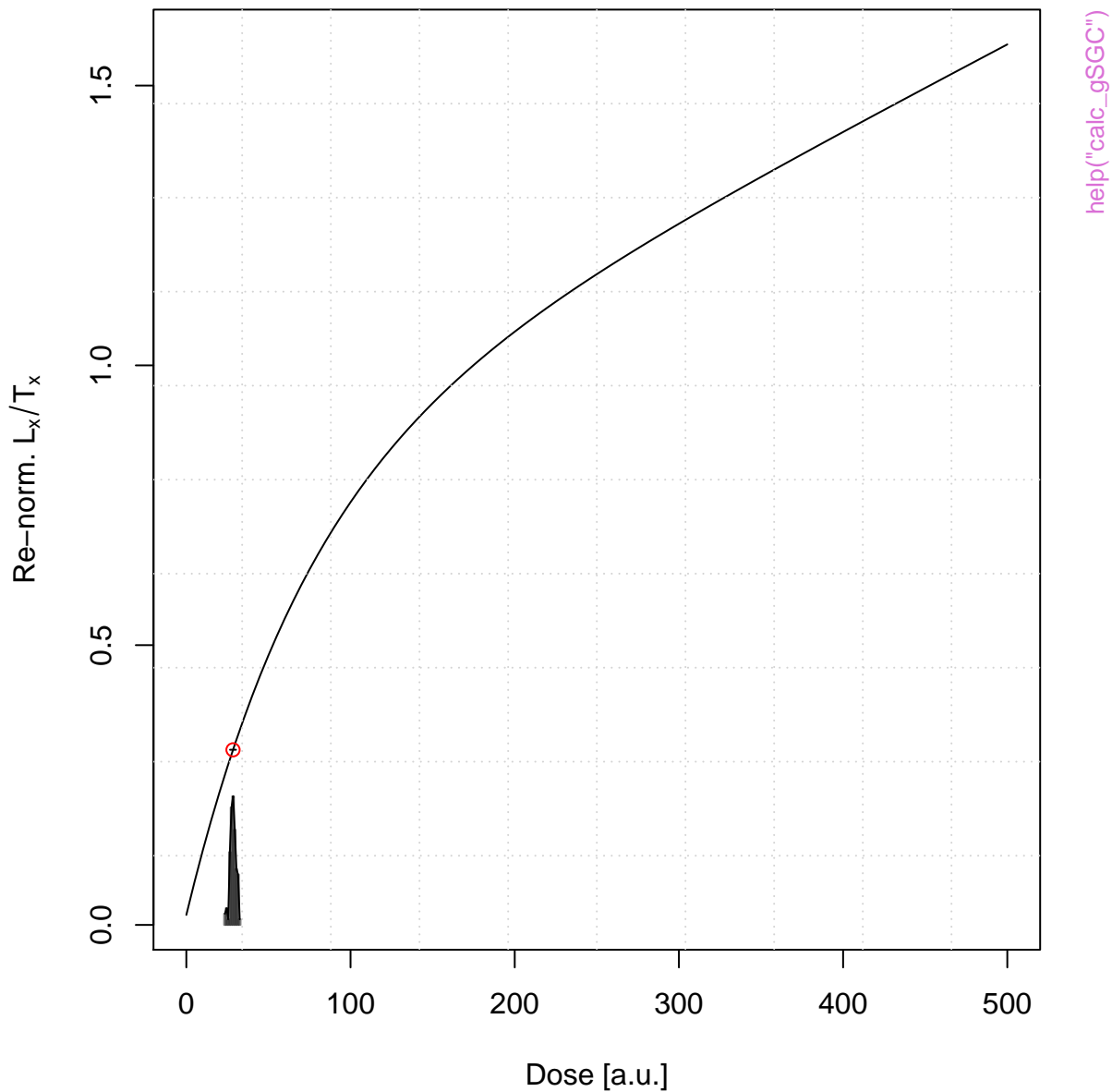
`help("calc_ThermalLifetime")`

# D<sub>e</sub> estimation 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

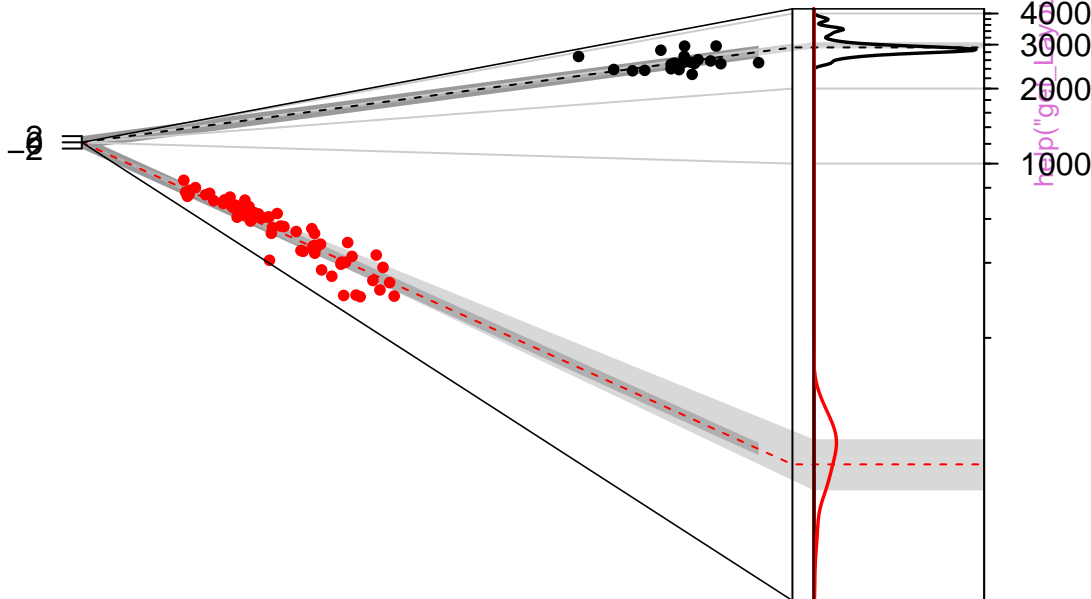


# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



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

help("get\_Layout")

Relative standard error (%)

10

5

3.3

0

10

20

30

0 0.015

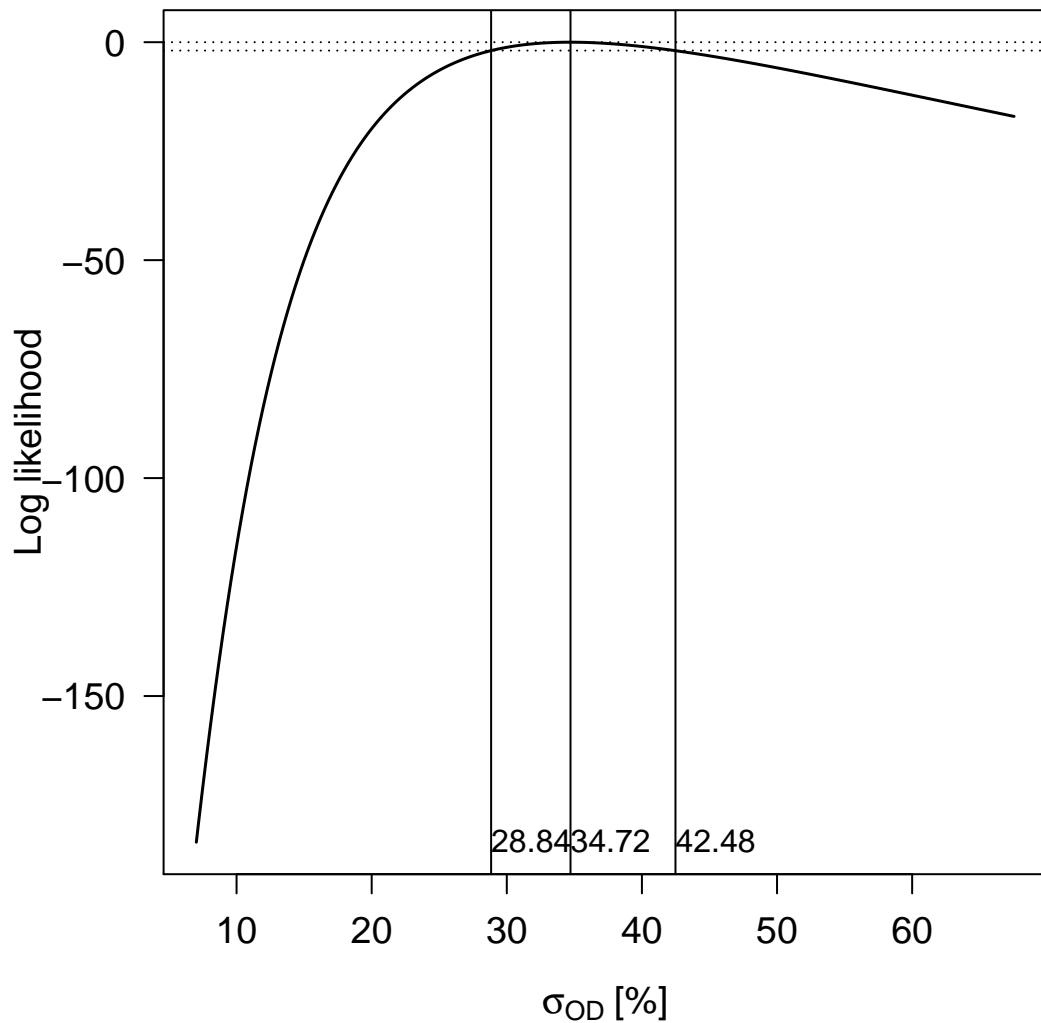
Precision

Density (bw 0.085)



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  $\sigma_{OD}$



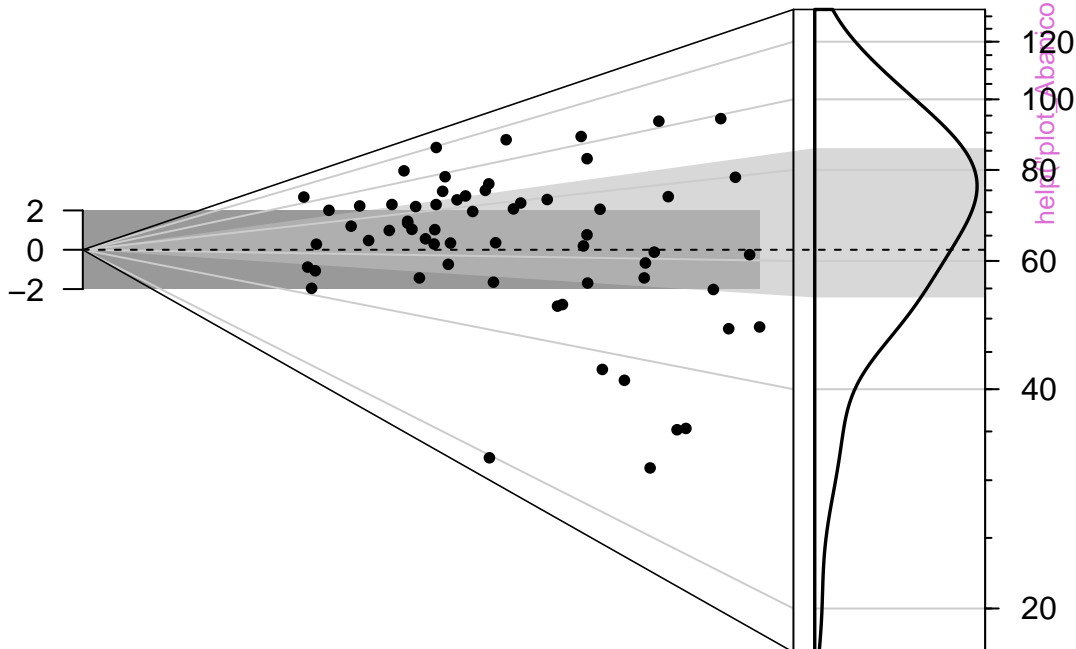
Profile log likelihood for  $\sigma_{OD}$



# 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

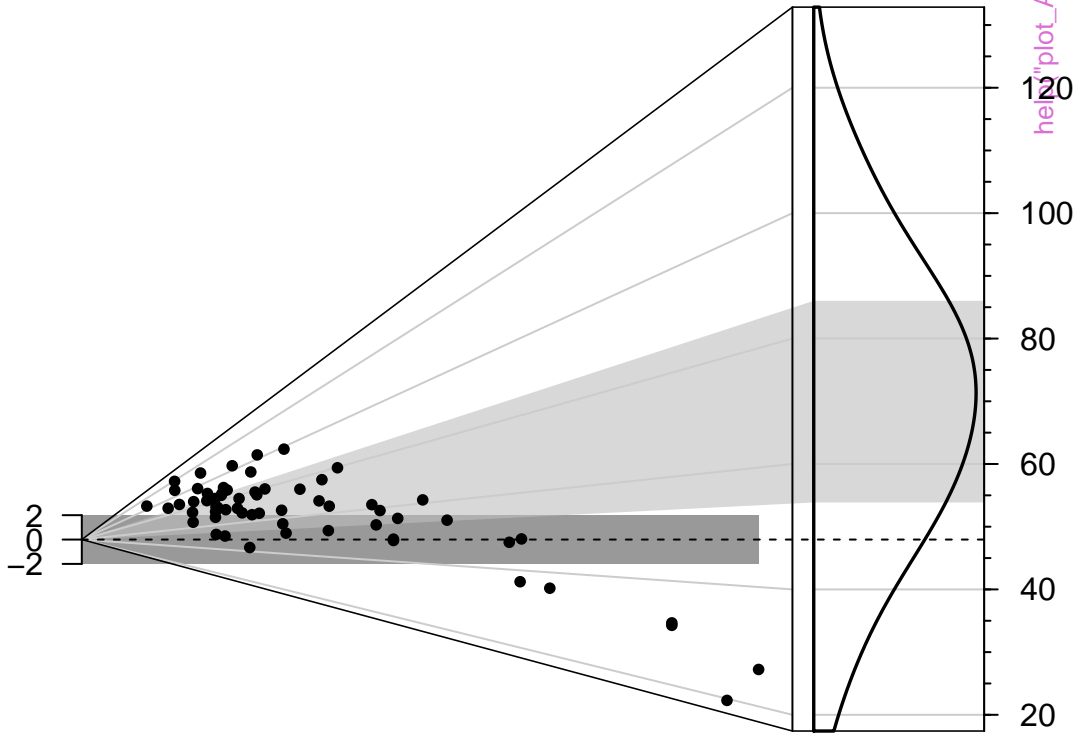
Precision

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

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



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

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



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

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 %

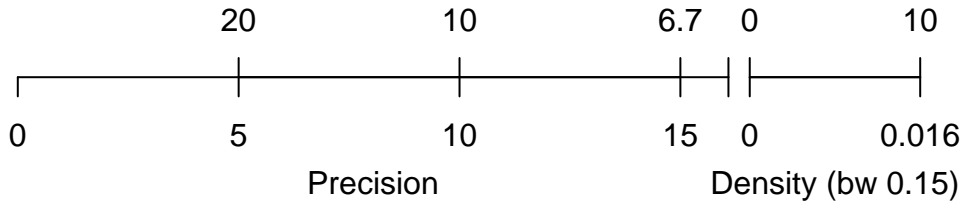
Standardised estimate



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

Relative standard error (%)

n



# 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

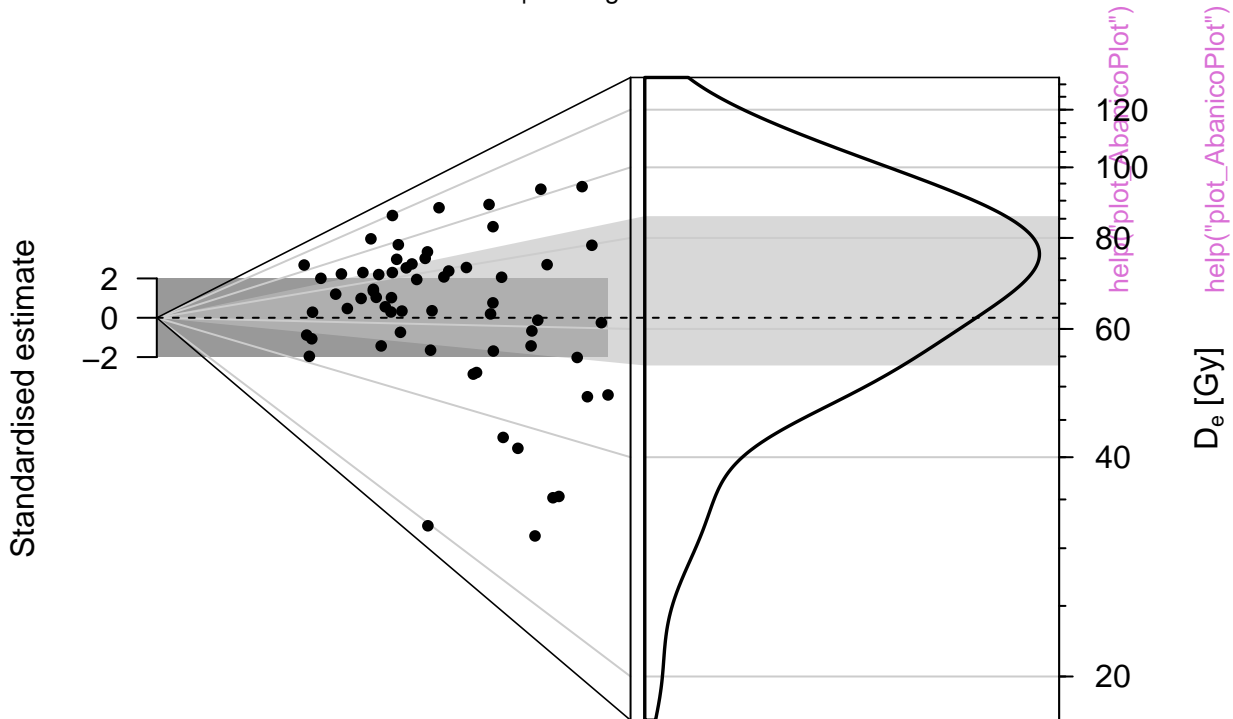
0.016

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

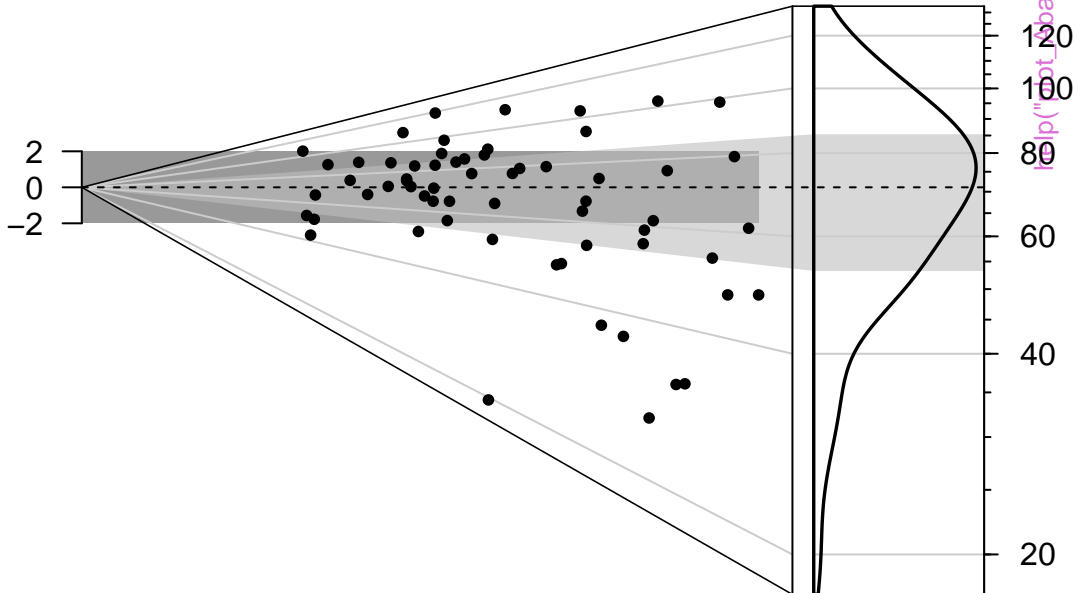
Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 54.8 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

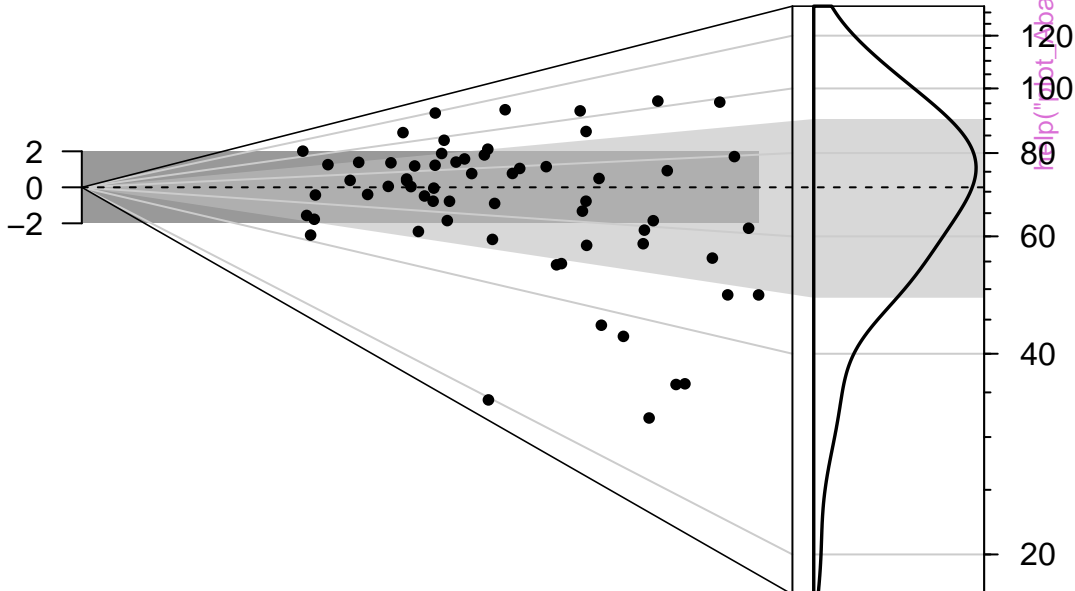
Density (bw 0.15)



# 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

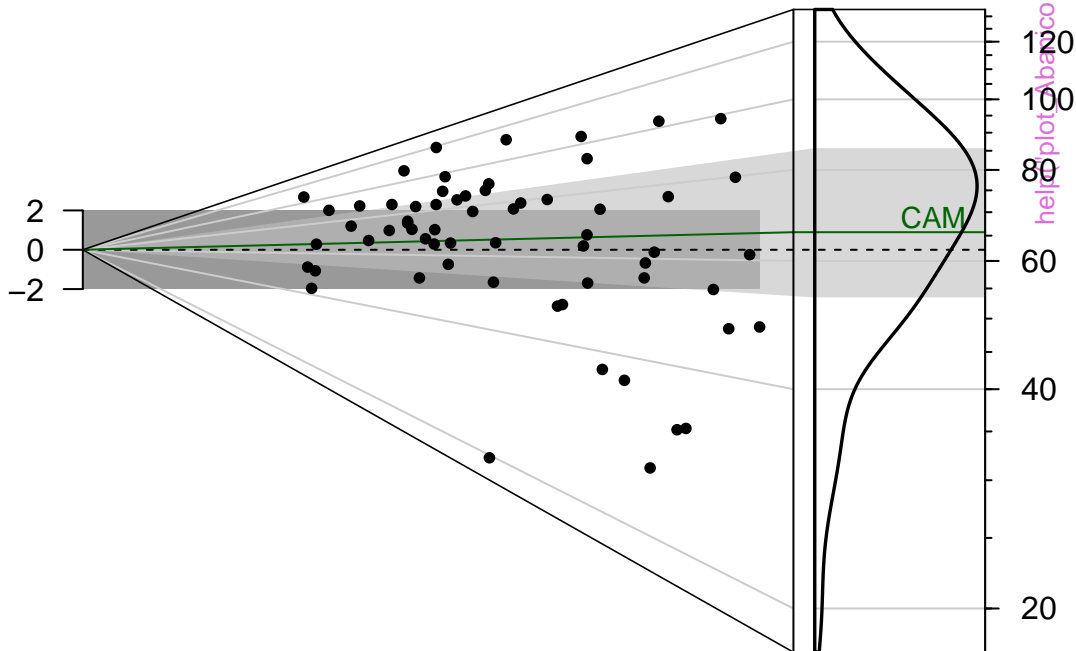
Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 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 %

R Sample 1

Standardised estimate



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

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 = 41.9 %

Standardised estimate

0

120  
100  
80  
60  
40  
20

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

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 = 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 = 41.9 %



# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

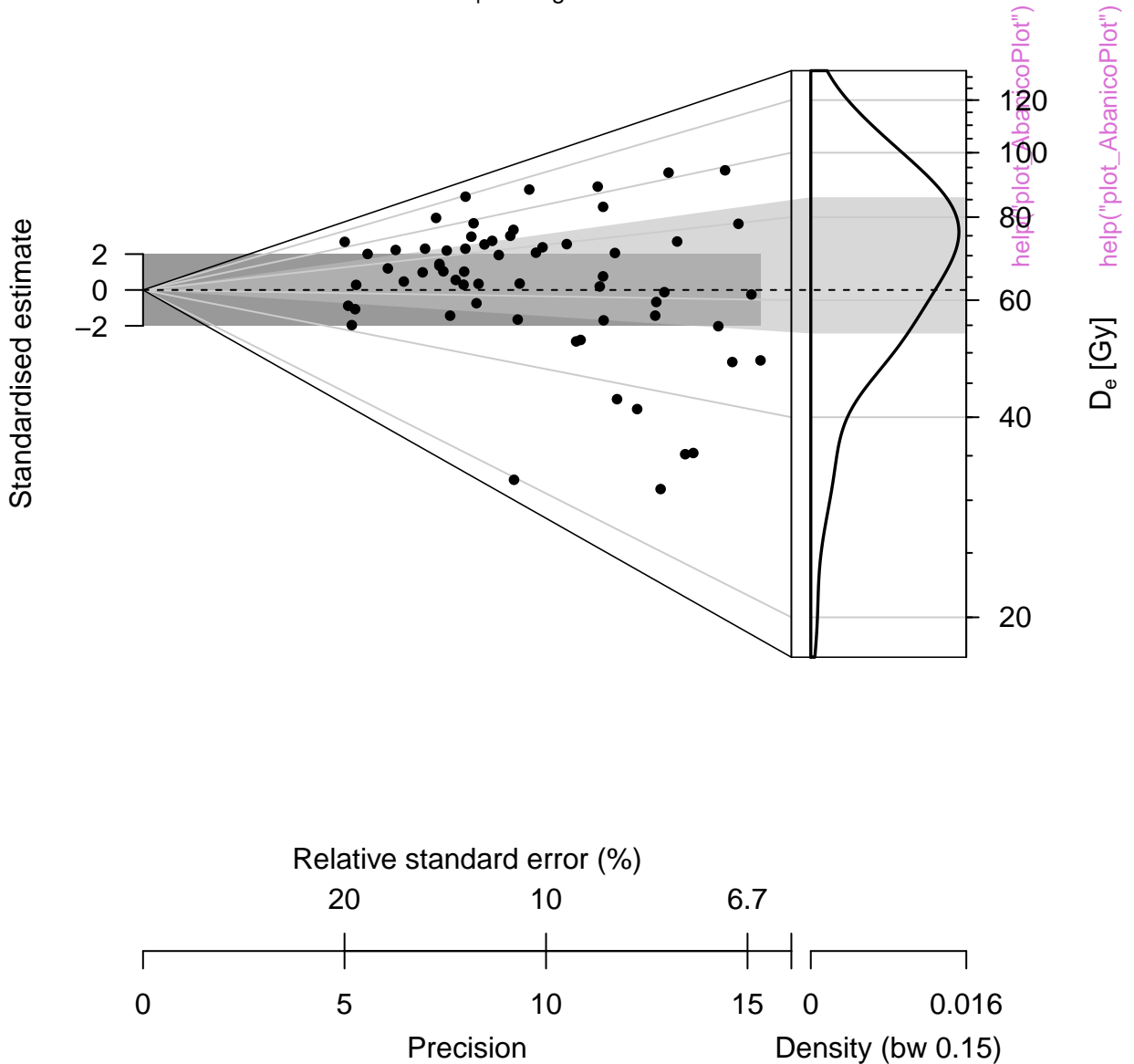
15

0.016

Precision

Density (bw 0.15)

n = 62 | in 2 sigma = 41.9 %





# D<sub>e</sub> distribution

median = 69.75

Standardised estimate



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

Relative standard error (%)

20

10

6.7

0

5

10

15

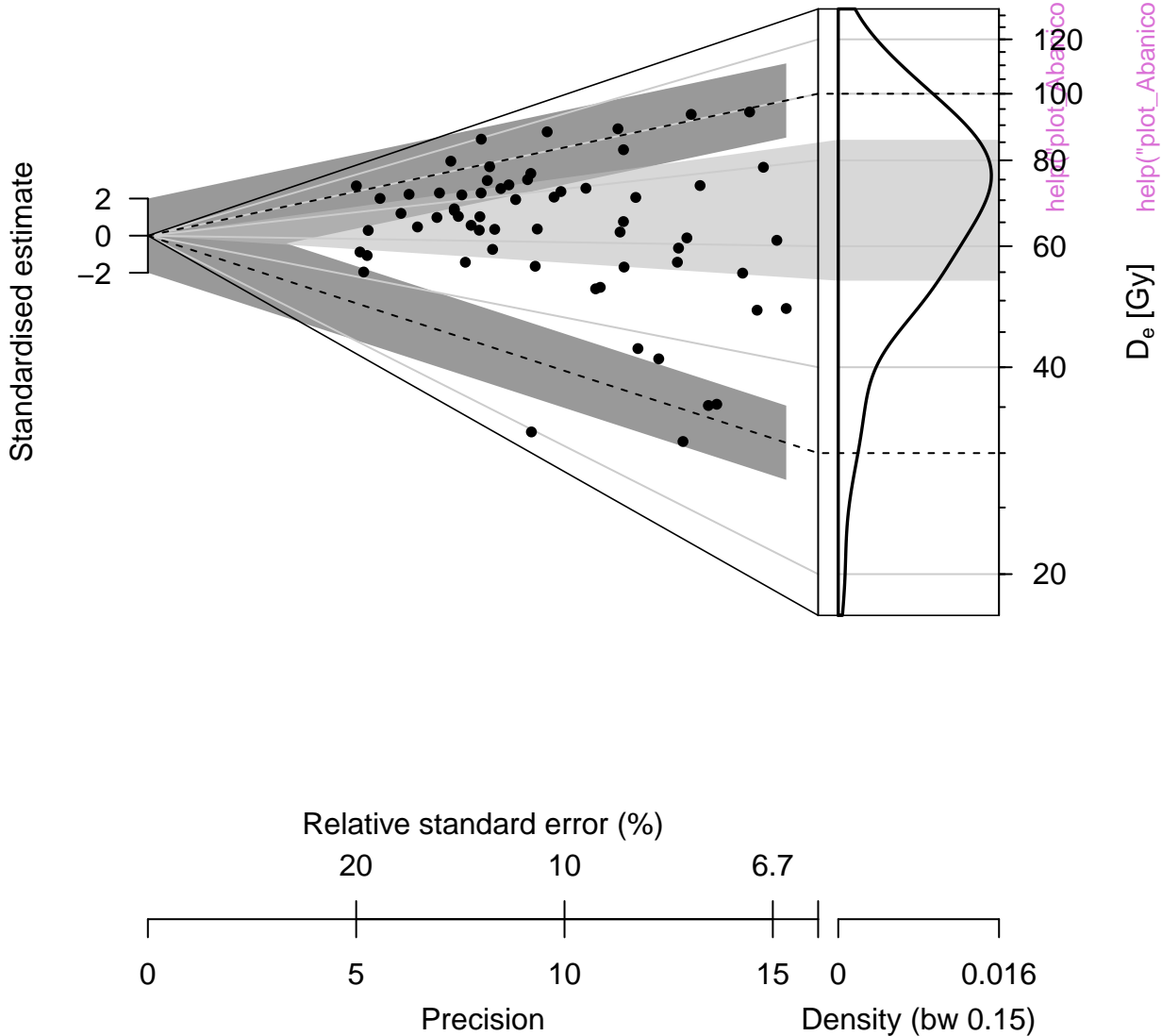
0.016

Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 41.9 %



# D<sub>e</sub> distribution

n = 30 | in 2 sigma = 46.7 %

n = 32 | in 2 sigma = 87.5 %

Standardised estimate



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

help(plot\_AbanicoPlot")

help("plot\_AbanicoPlot")

Relative standard error (%)

20

10

6.7

0

5

10

15

0.032

Precision

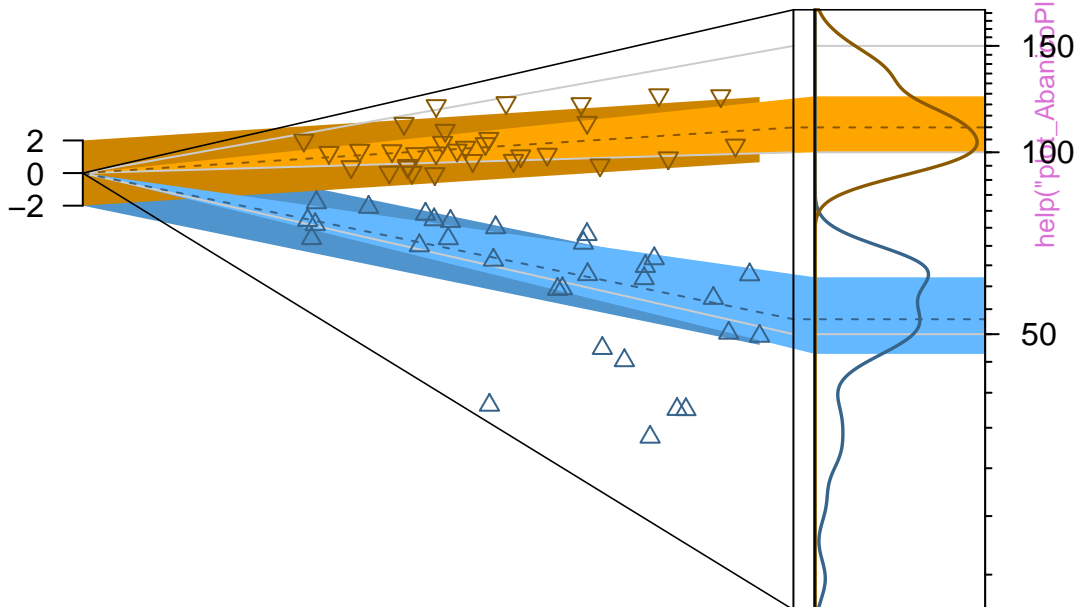
Density (bw 0.074)

# D<sub>e</sub> distribution

n = 30 | in 2 sigma = 70 % | median = 53.39

n = 32 | in 2 sigma = 84.4 % | median = 110.51

Standardised estimate



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

Relative standard error (%)

20

10

6.7

0

5

10

15

0.032

Precision

Density (bw 0.074)



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)

# Dose recovery test

Example data





# Dose recovery test



# Dose recovery test



# Dose recovery test



# Dose recovery test



# Dose recovery test

| n = 5 | weighted mean = 1.01 |

| n = 5 | weighted mean = 1 |



# Dose recovery test



# Dose recovery test

Example data



# Dose recovery test





# Dose recovery test



# Filter Combination



# Filter Combination

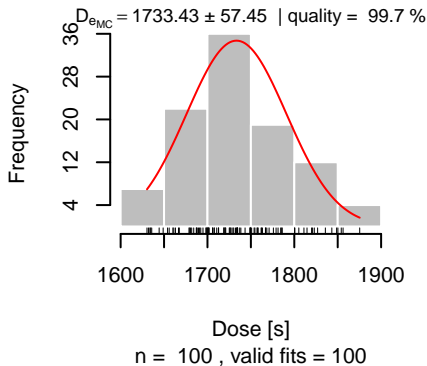


# Growth curve

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



## $D_e$ from MC simulation

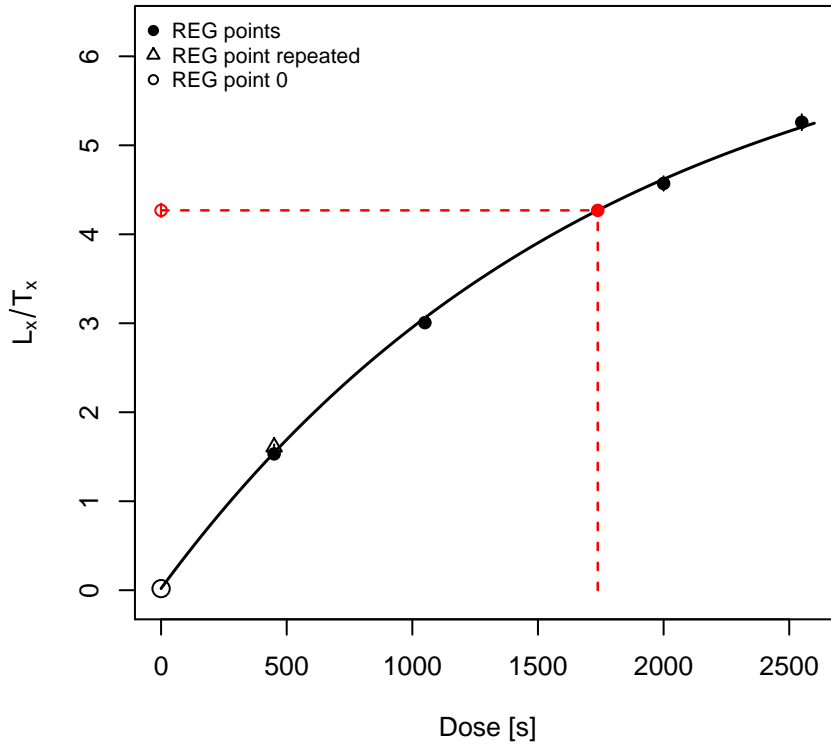


## Test dose response



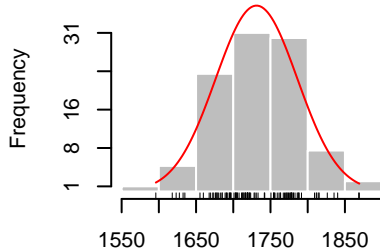
# Growth curve

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



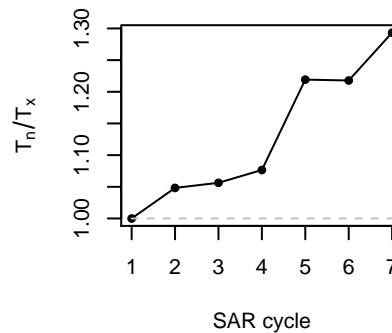
## $D_e$ from MC simulation

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



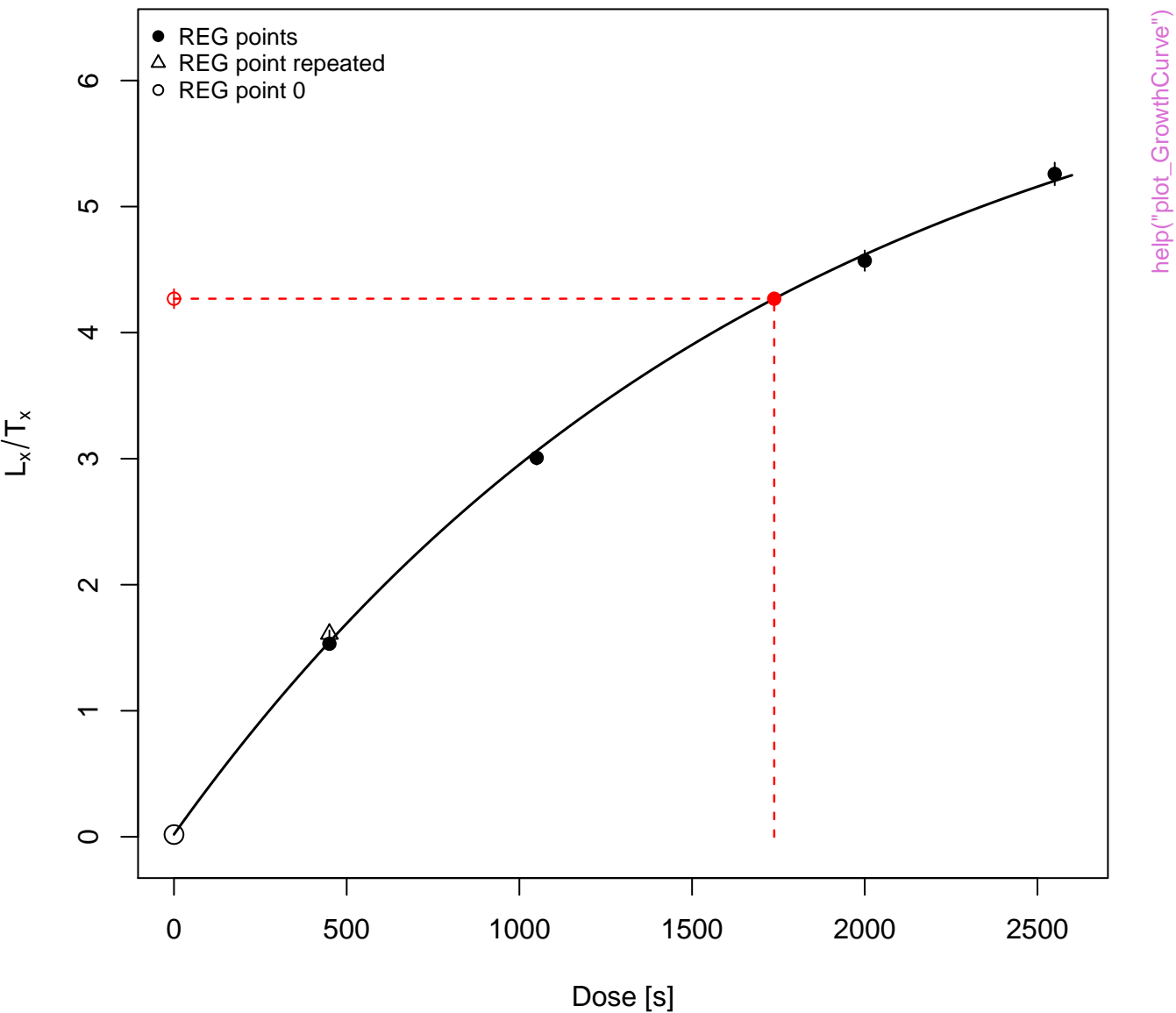
Dose [s]  
n = 100 , valid fits = 100

## 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")

# Histogram



# Histogram of De-values

Example data set



# D<sub>e</sub> distribution



# D<sub>e</sub> distribution



# Dose distribution

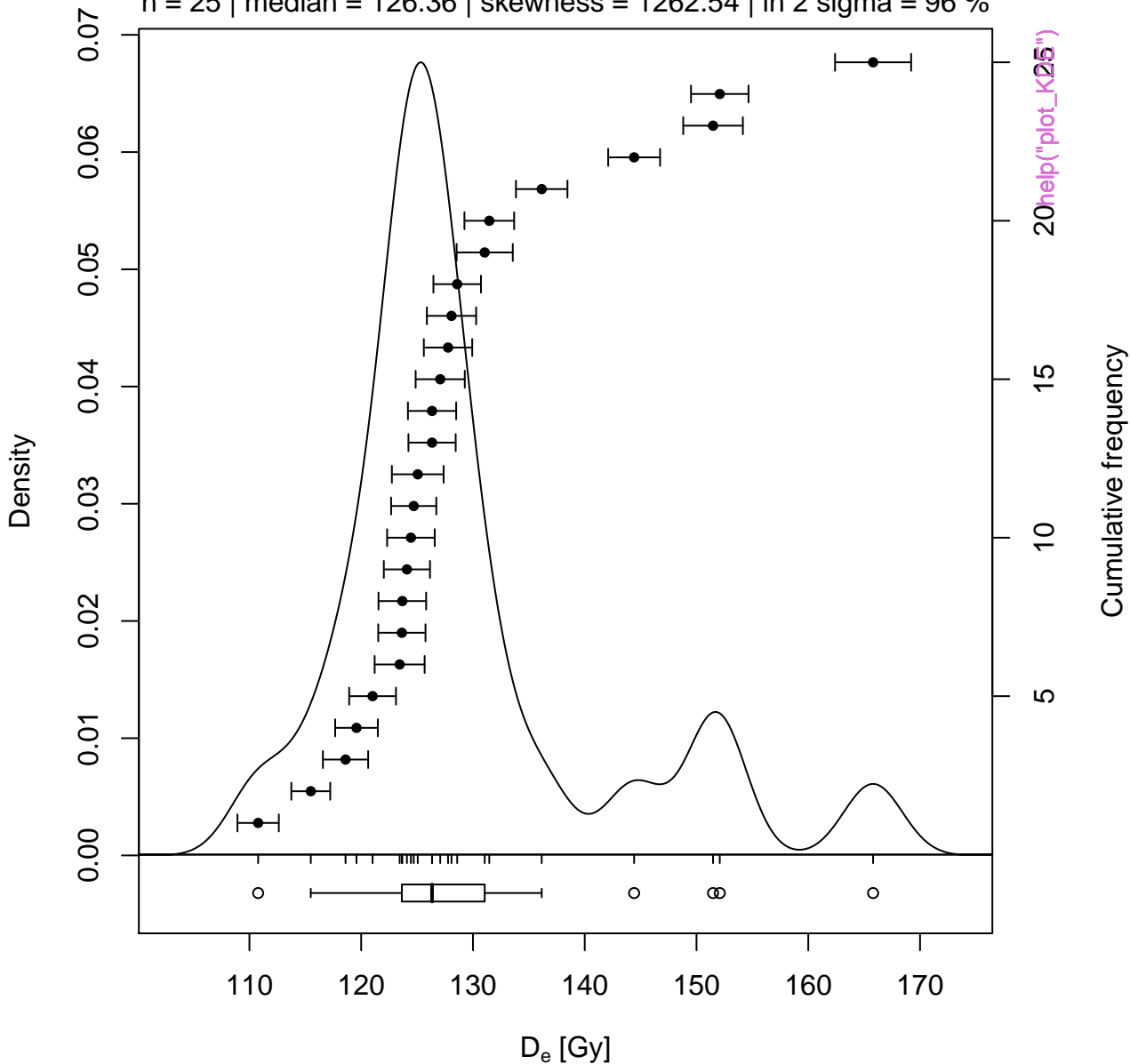


# D<sub>e</sub> distribution



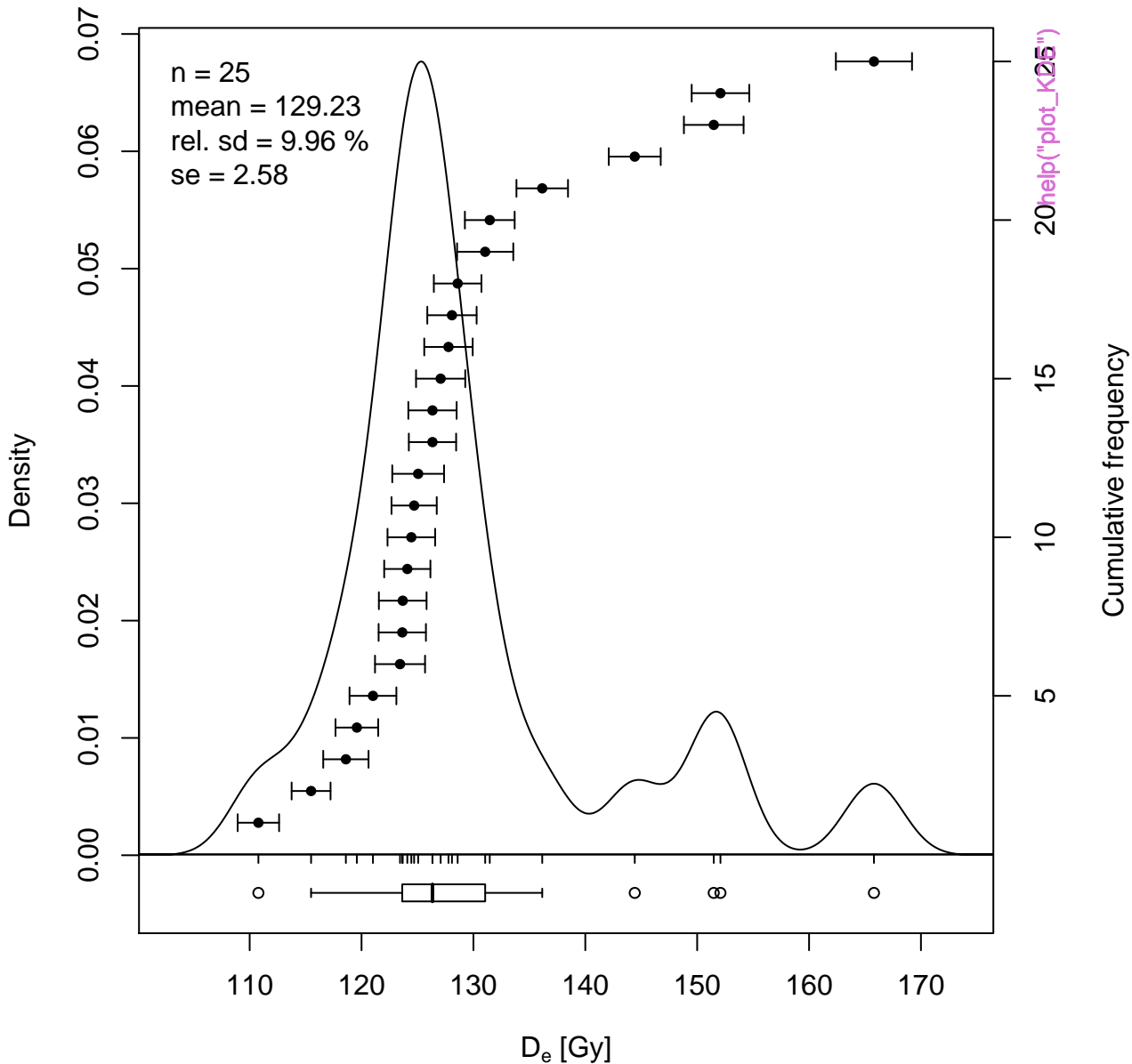
# D<sub>e</sub> distribution

n = 25 | median = 126.36 | skewness = 1262.54 | in 2 sigma = 96 %

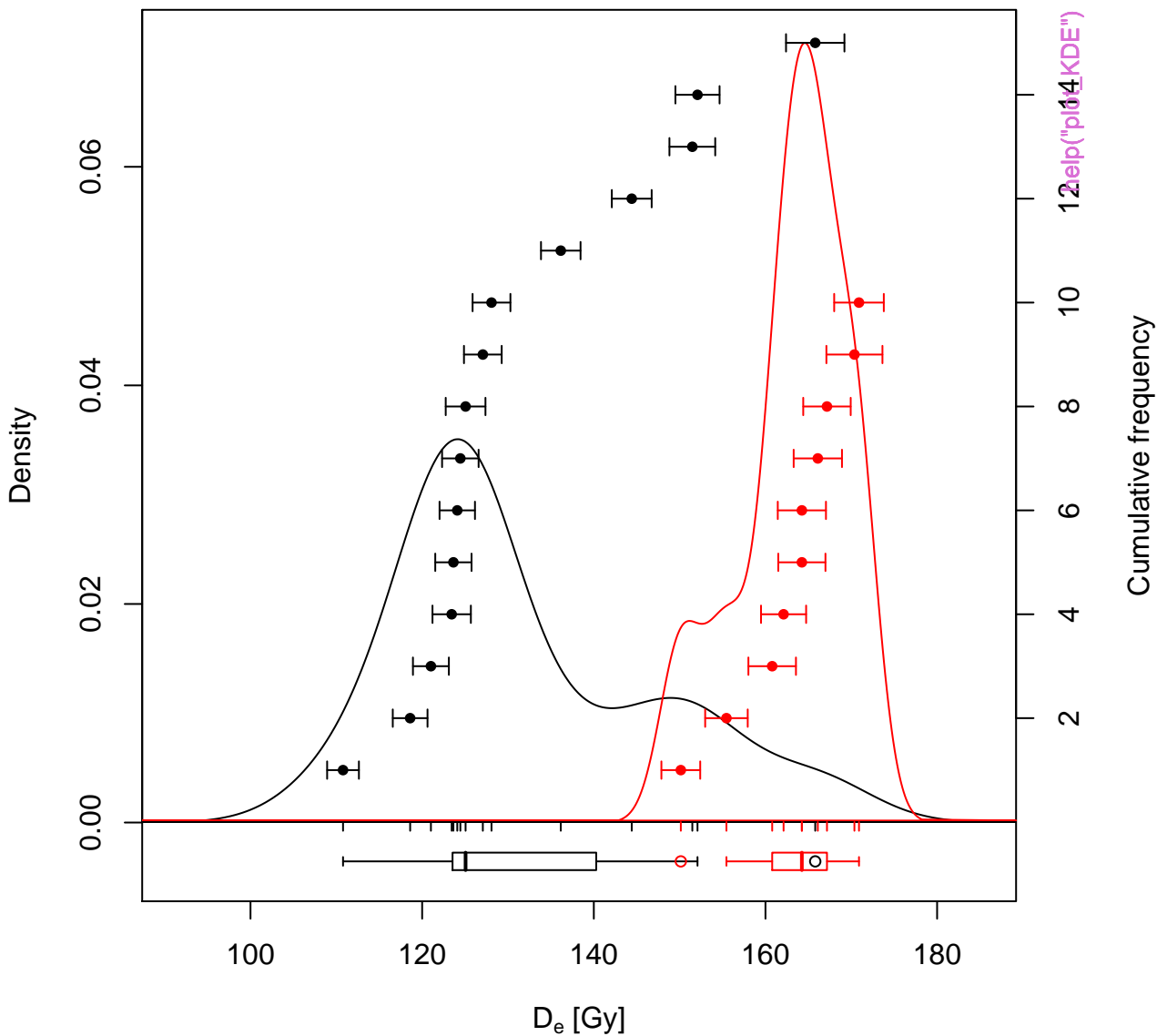




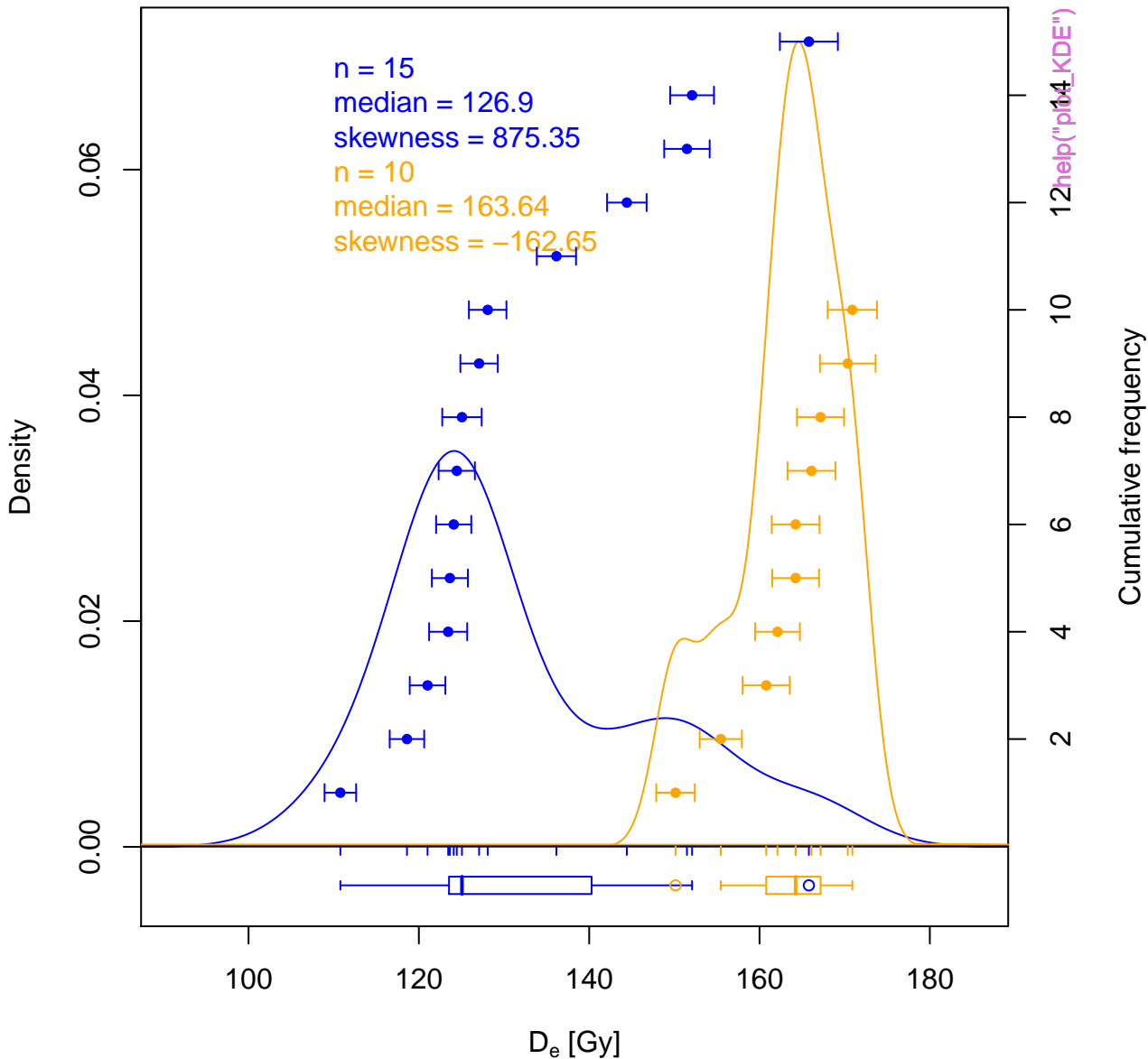
# D<sub>e</sub> distribution



# 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



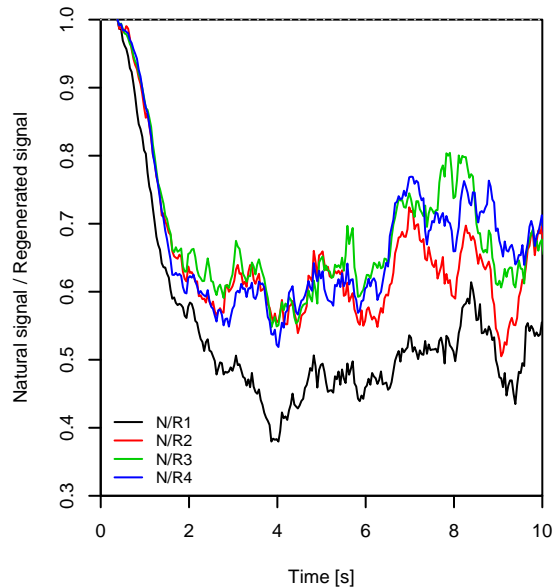


# NR(t) Plot

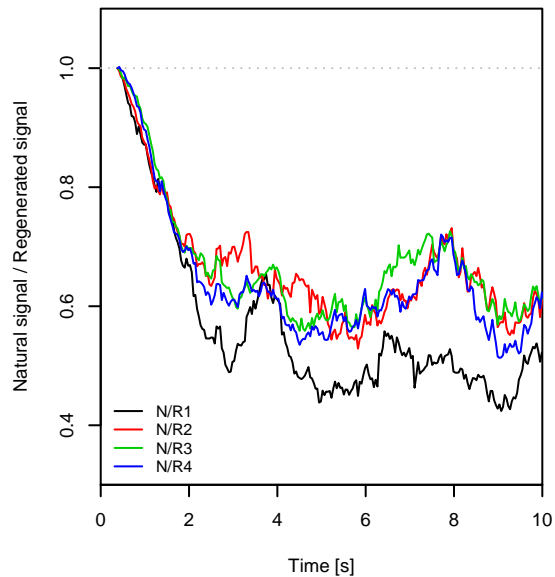


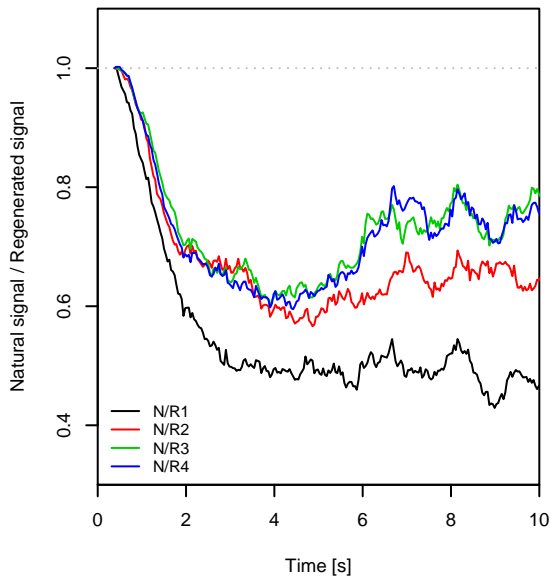
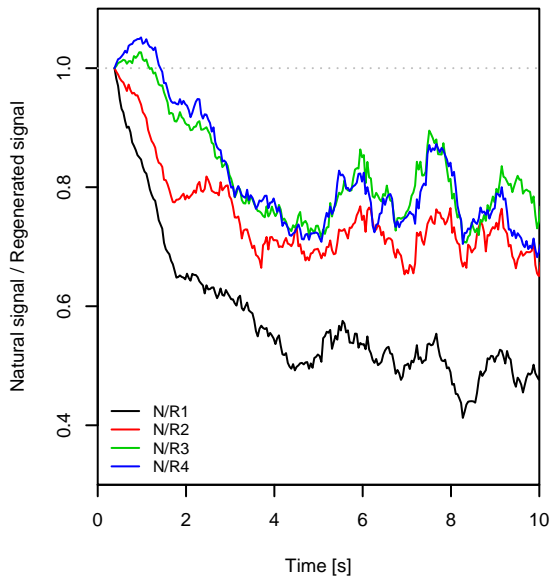
**TnTx(t) Plot**

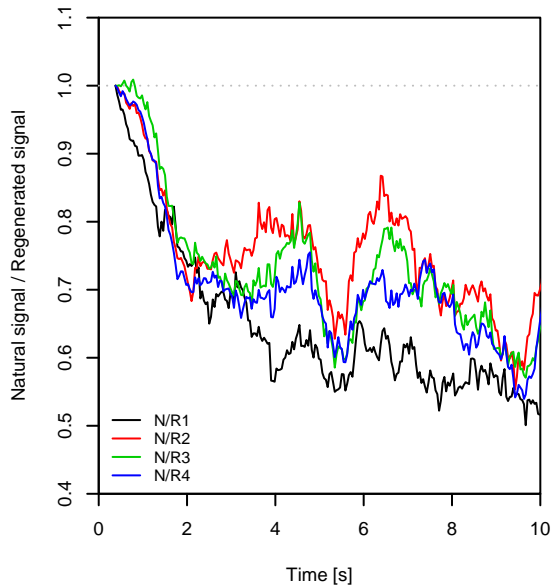
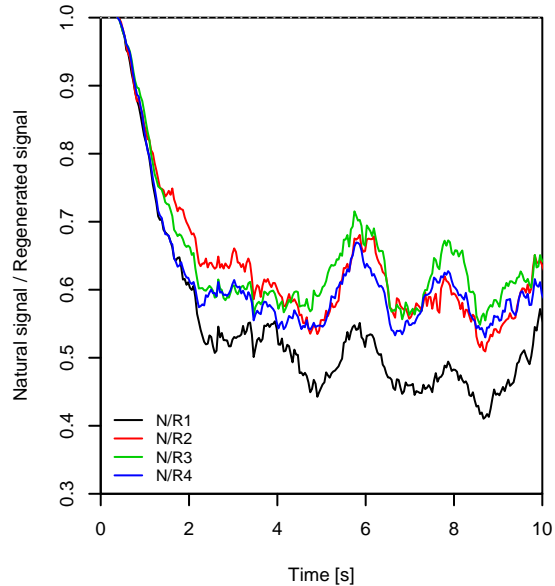


**Aliquot #1****Aliquot #2**

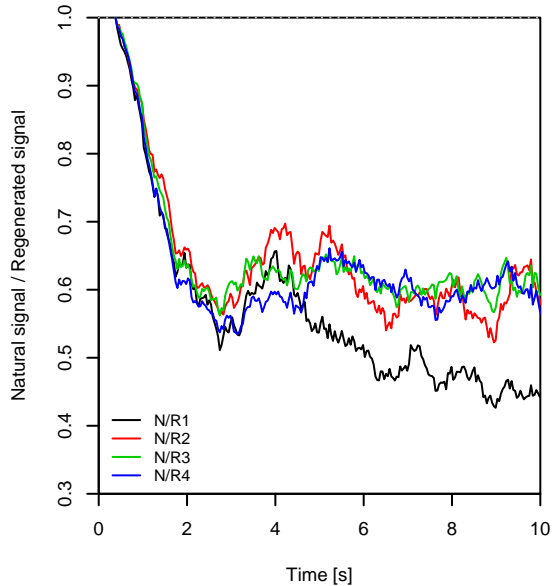
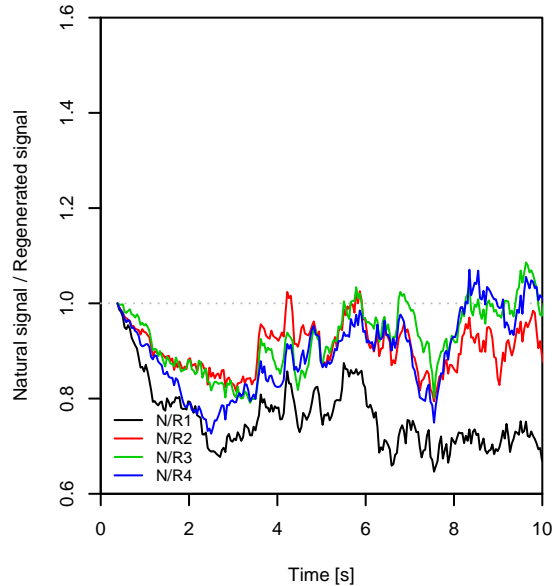
help("plot\_NRt")

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

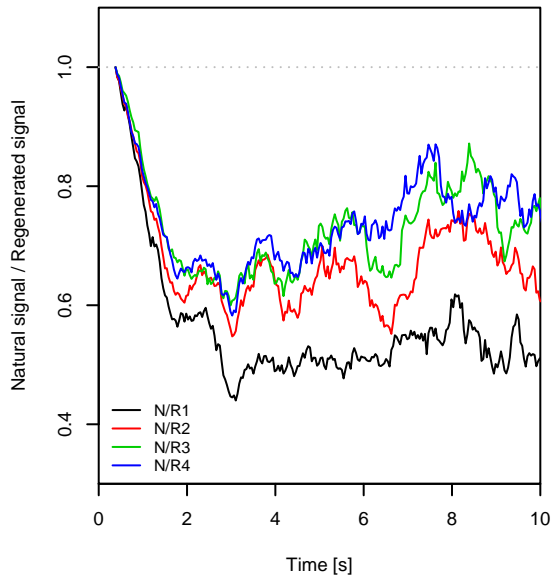
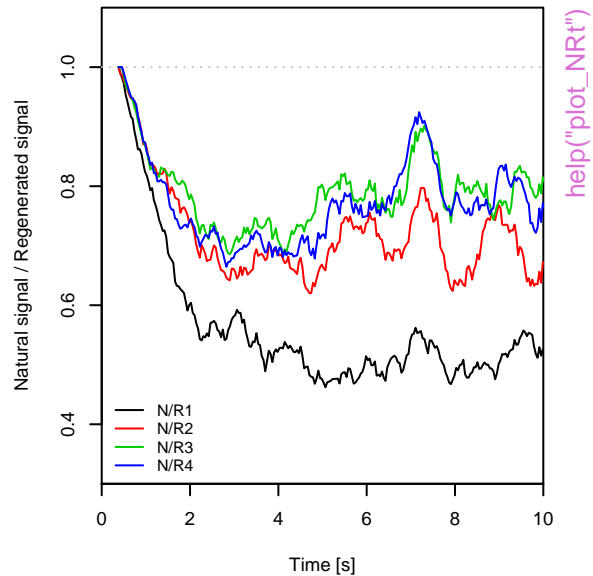
**Aliquot #5****Aliquot #6****Aliquot #7****Aliquot #8**

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

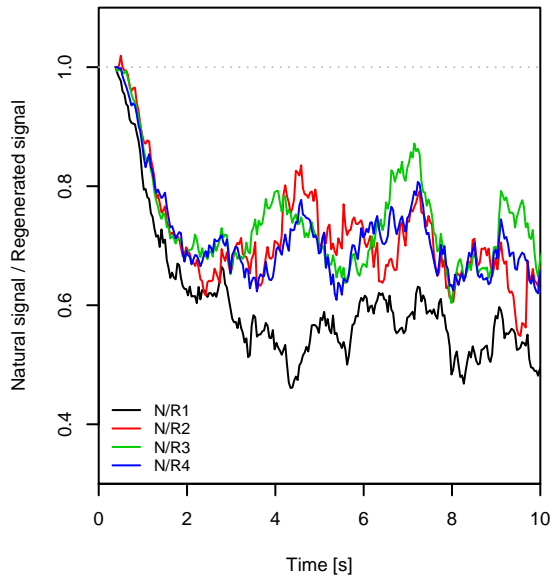
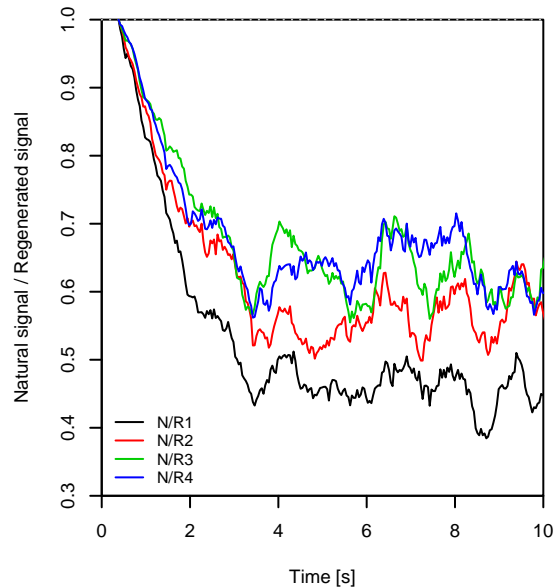
help("plot\_NRt")

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

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

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

help("plot\_NRt")

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

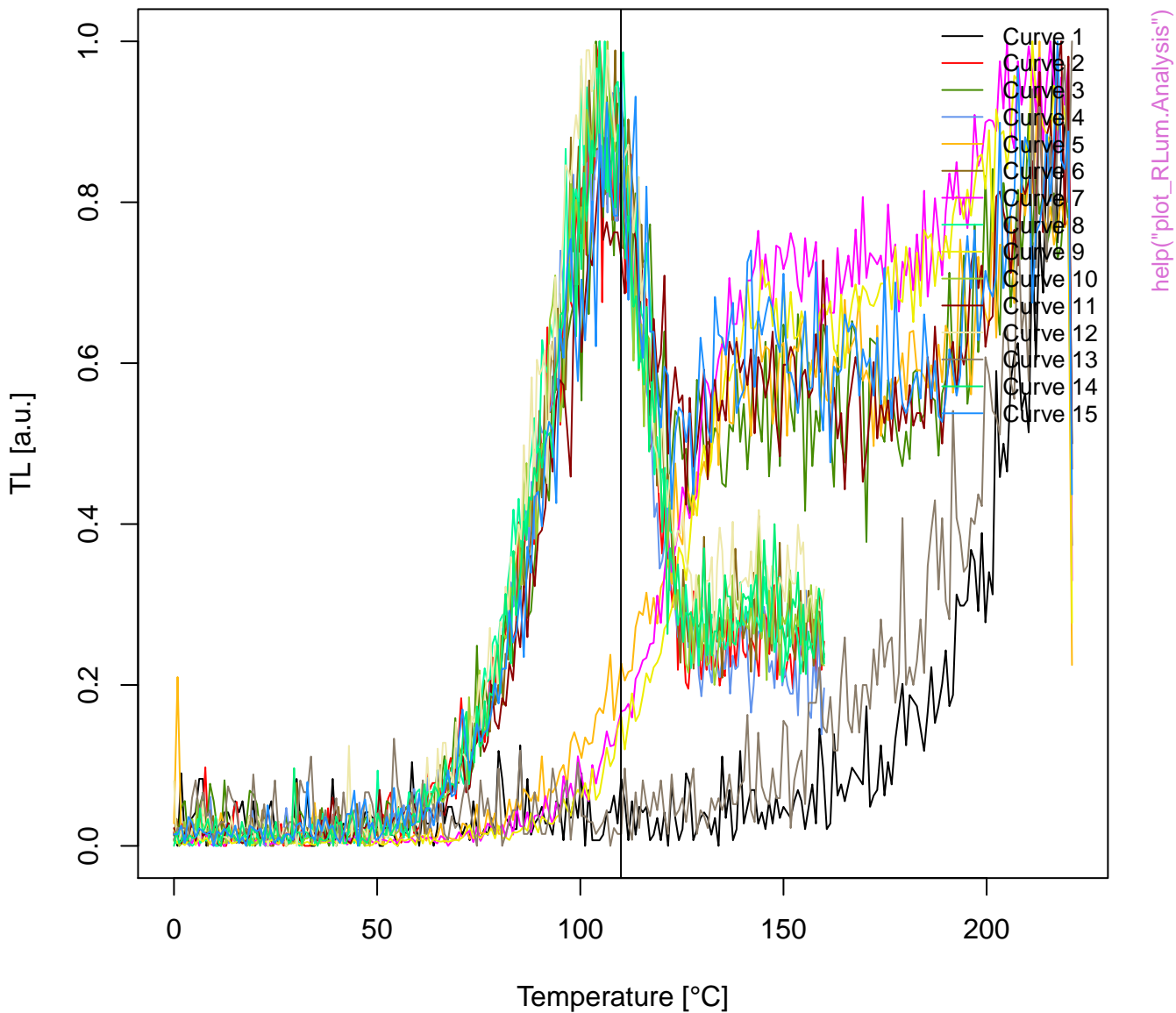
**Aliquot #21****Aliquot #22**

help("plot\_NRt")

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



# TL combined



## unkown curve type



# RLum.Data.Image



RLum.Data.Spectrum



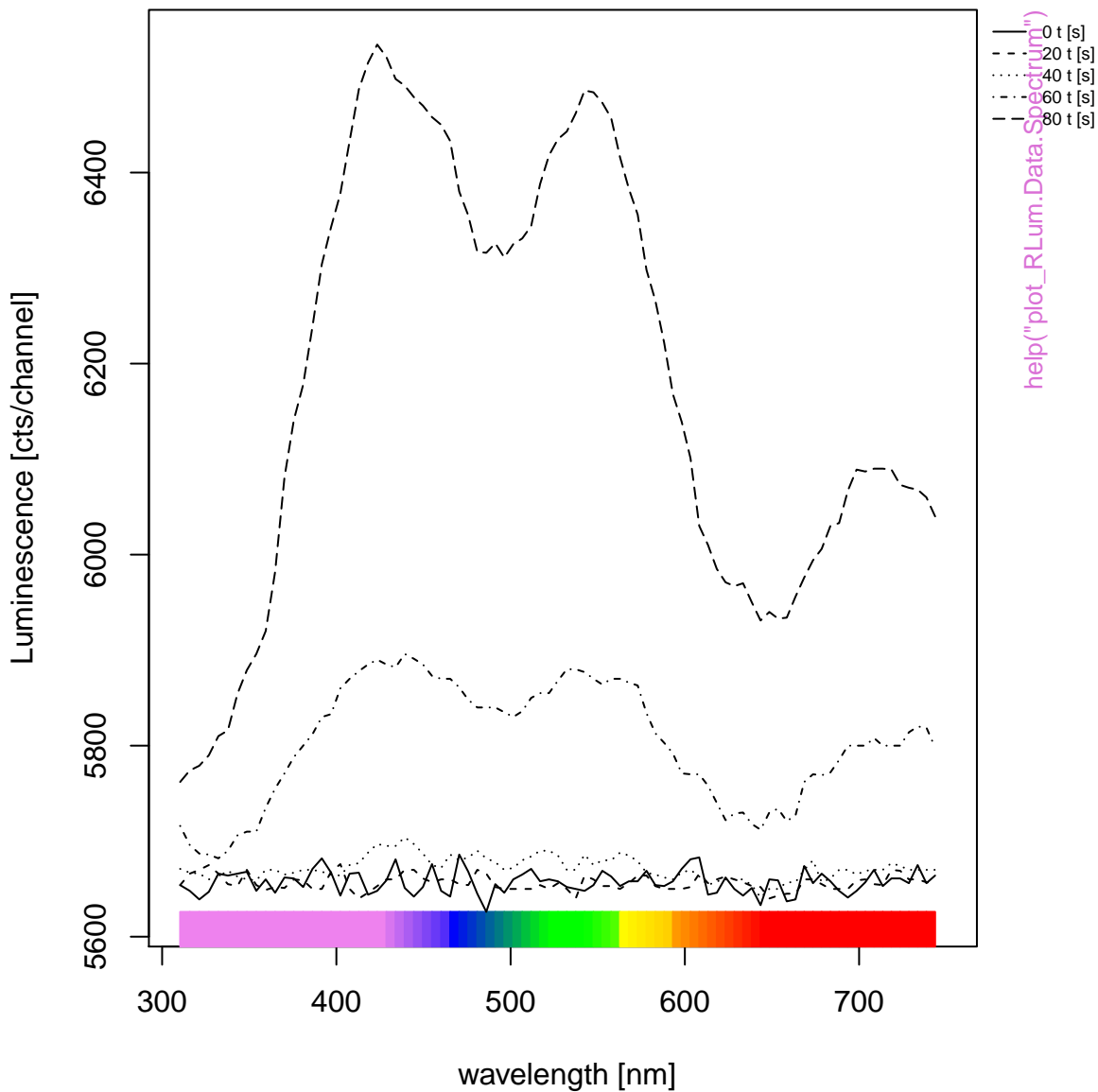
[help\("plot\\_RLum.Data.Spectrum"\)](#)

# RLum.Data.Spectrum



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

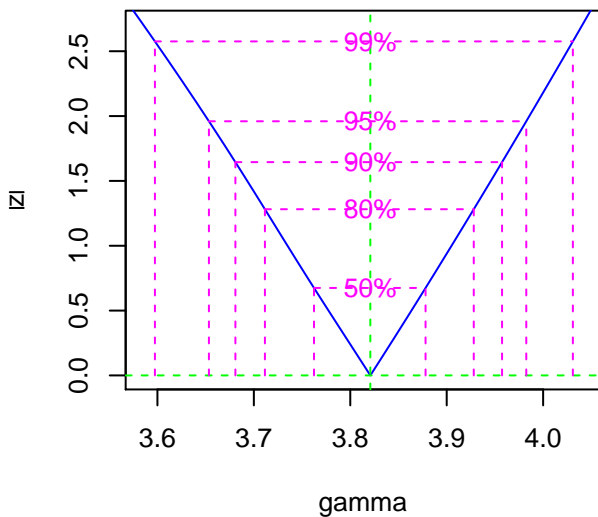
# RLum.Data.Spectrum



# unkown curve type



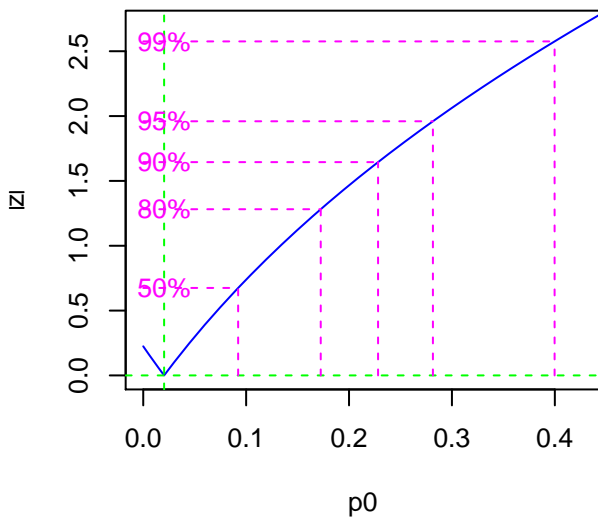
**Likelihood profile: gamma**



**Likelihood profile: sigma**



**Likelihood profile: p0**



help("plot\_RLum.Results")



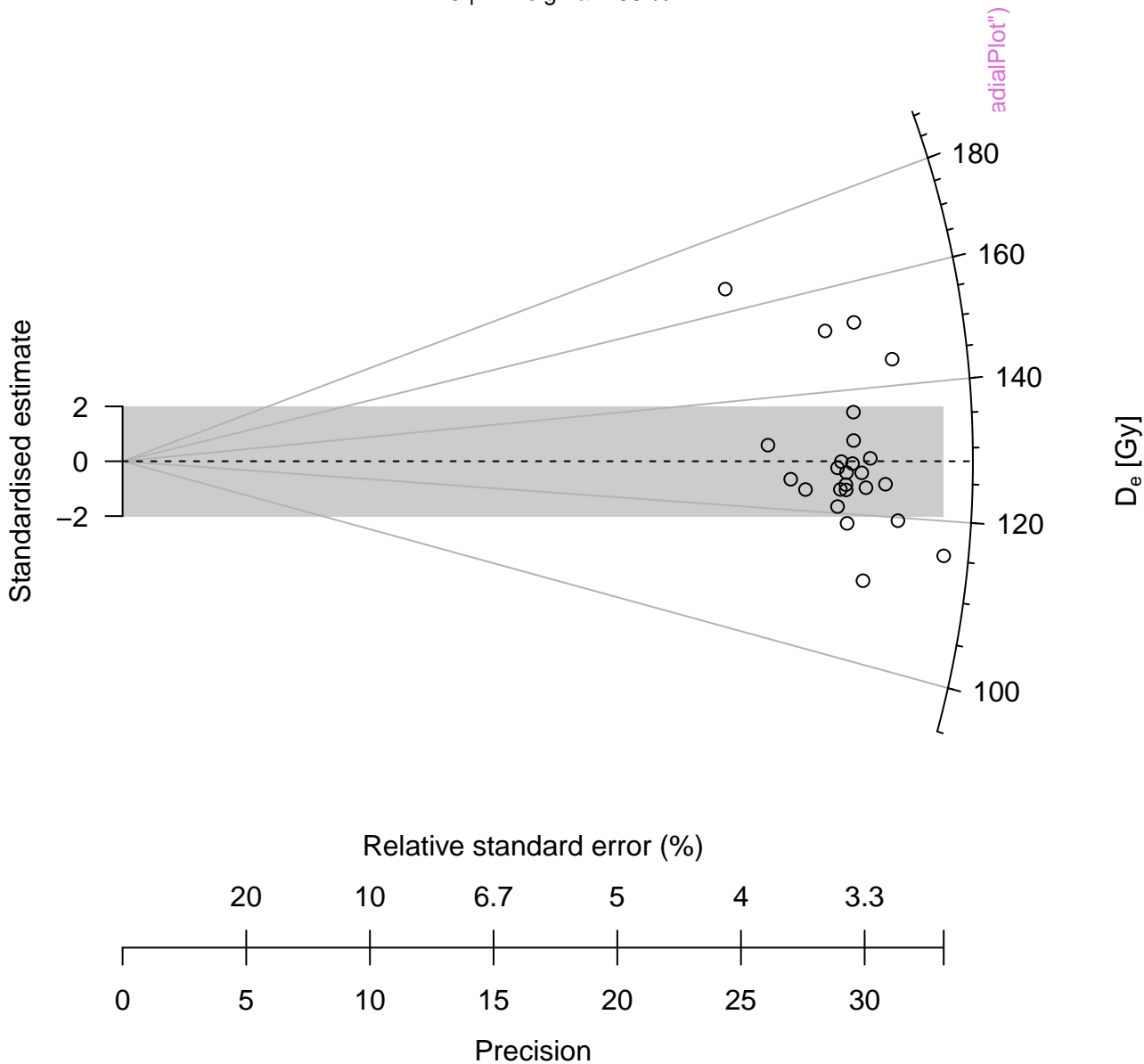
# Monte Carlo Simulation

$$n = 100 \mid \hat{\mu} = 45 \mid \hat{\sigma} = 21 \mid \frac{\hat{\sigma}}{\sqrt{n}} = 2 \mid v = 0.84$$



# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



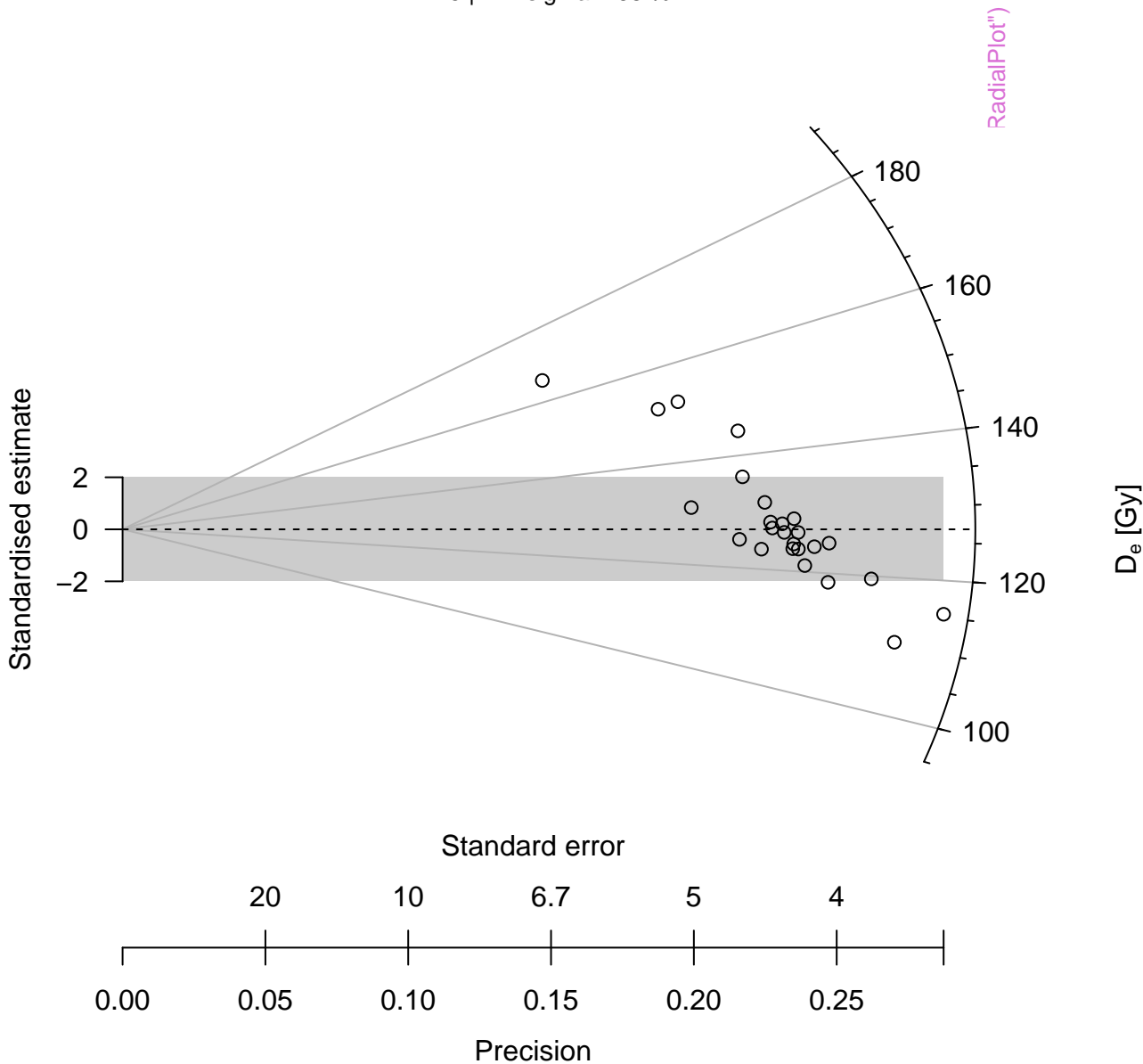
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



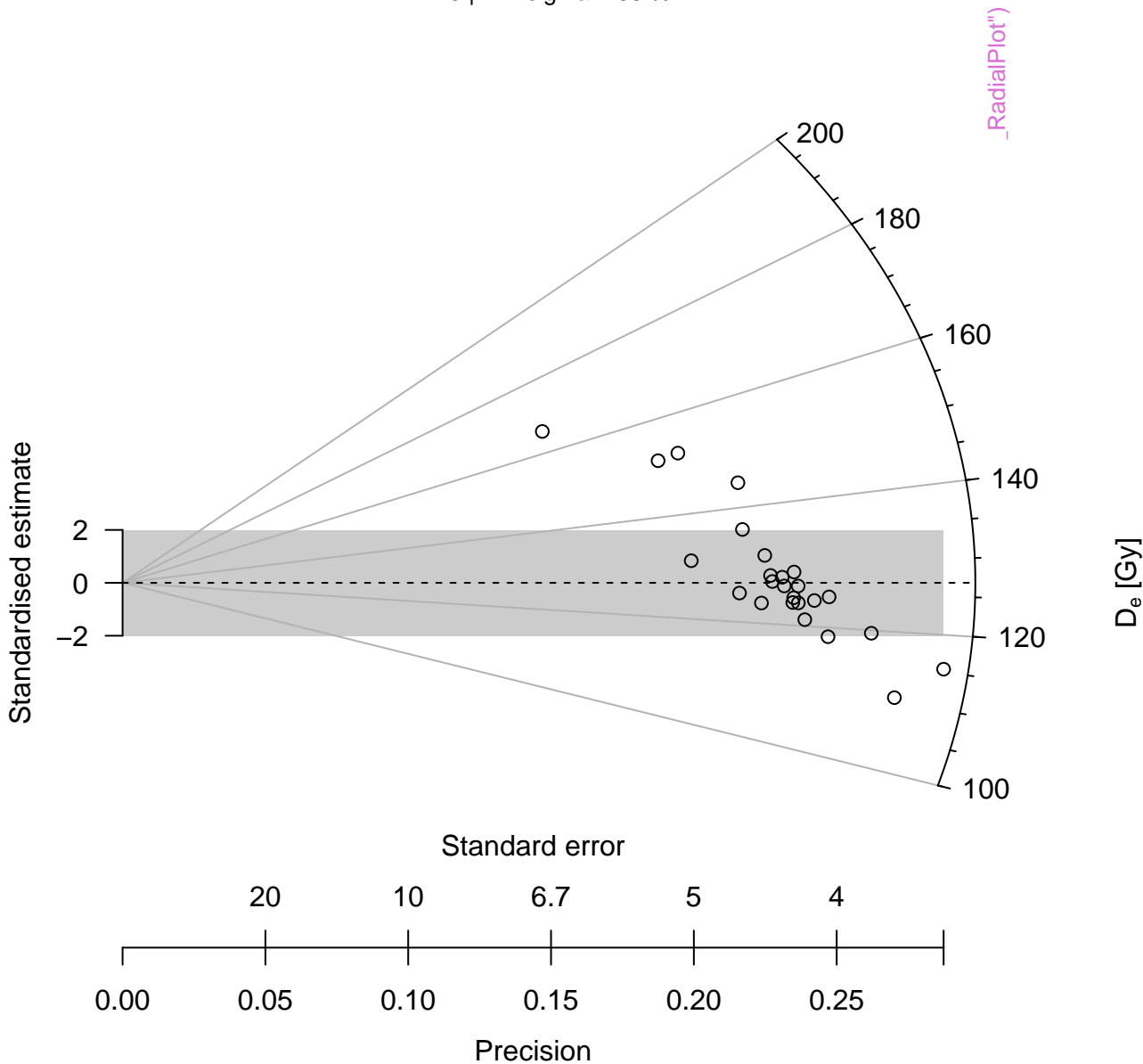
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



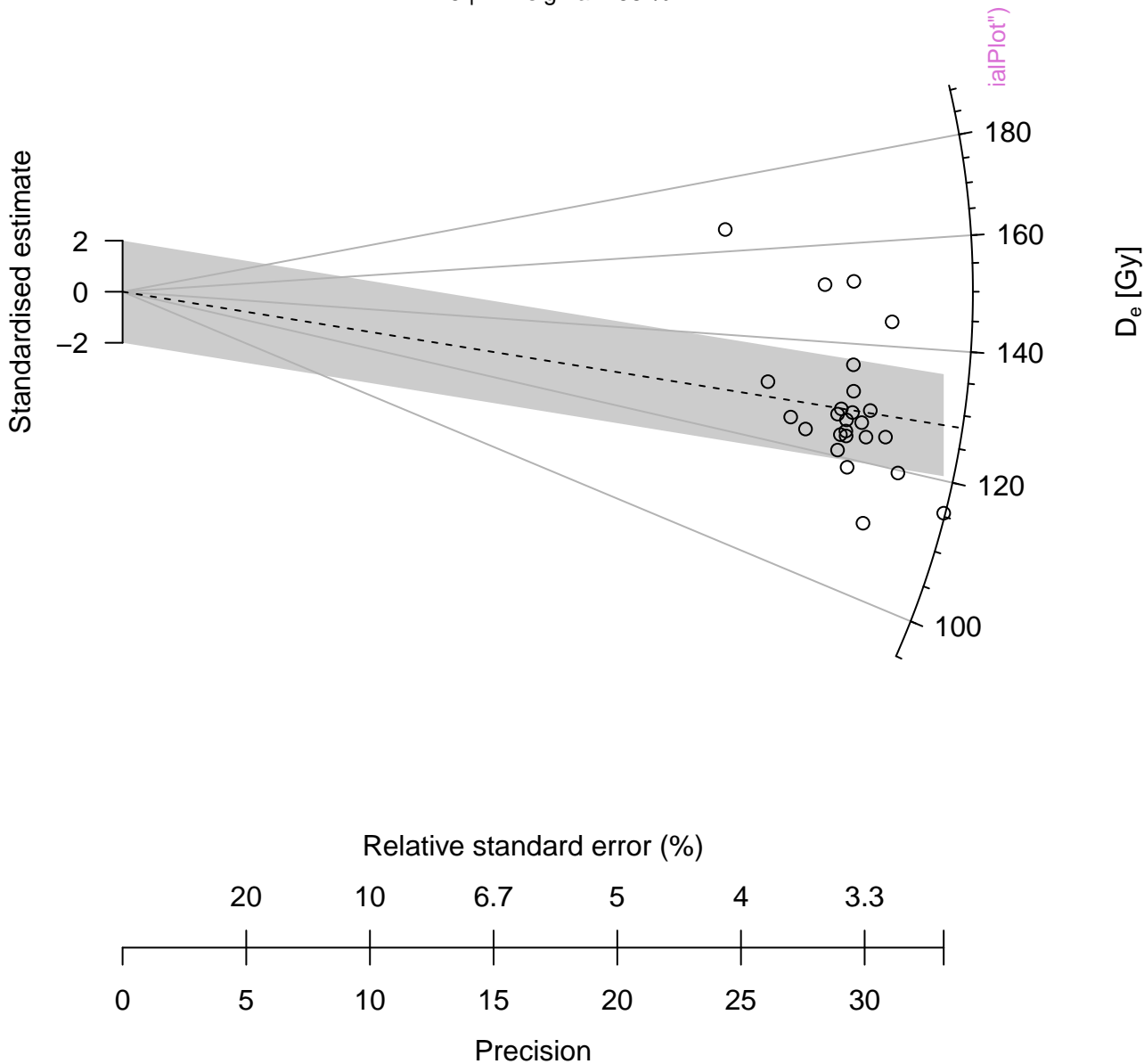
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



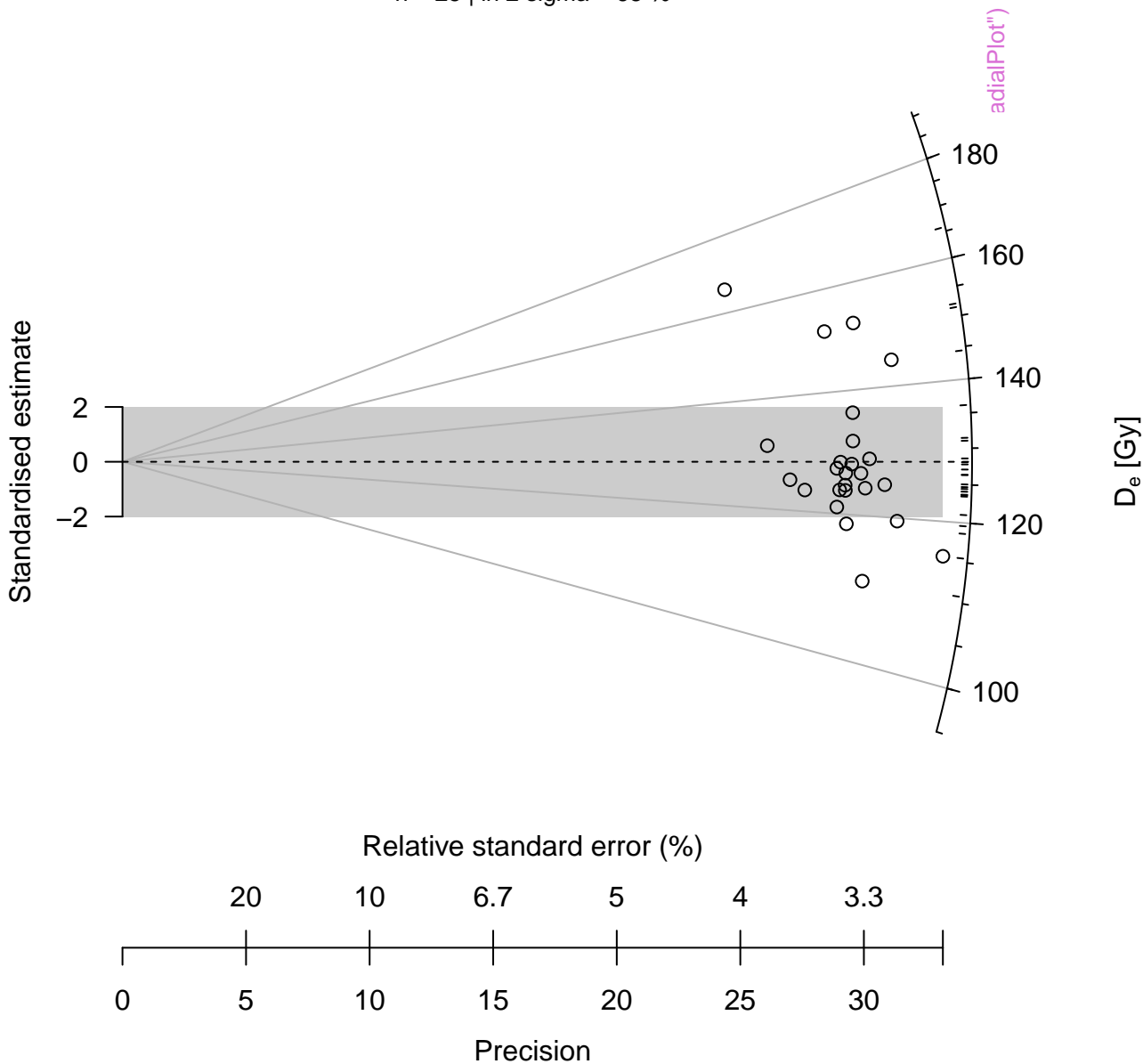
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



# D<sub>e</sub> distribution

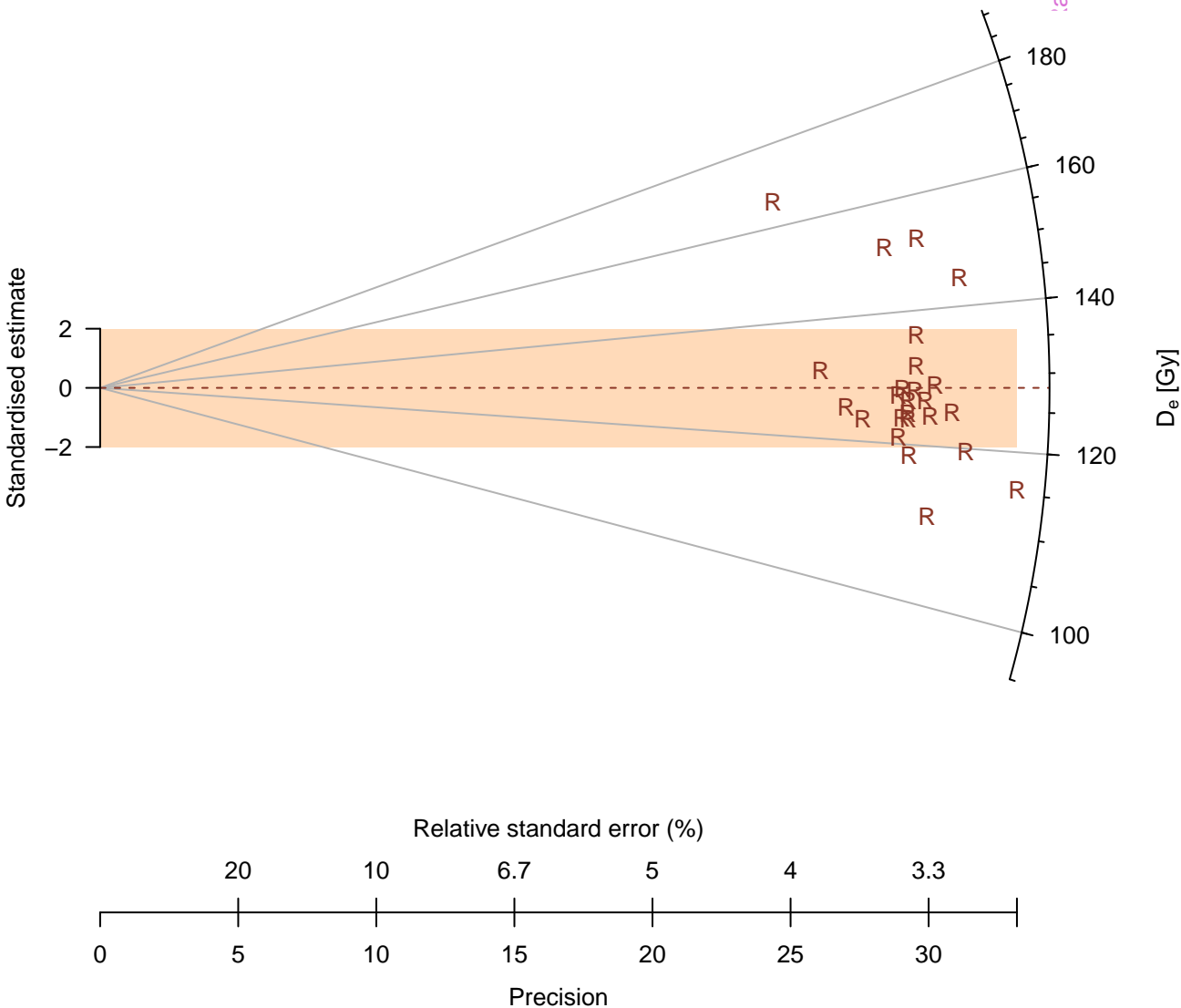
n = 25 | in 2 sigma = 68 %



# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %

radialPlot()





# 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

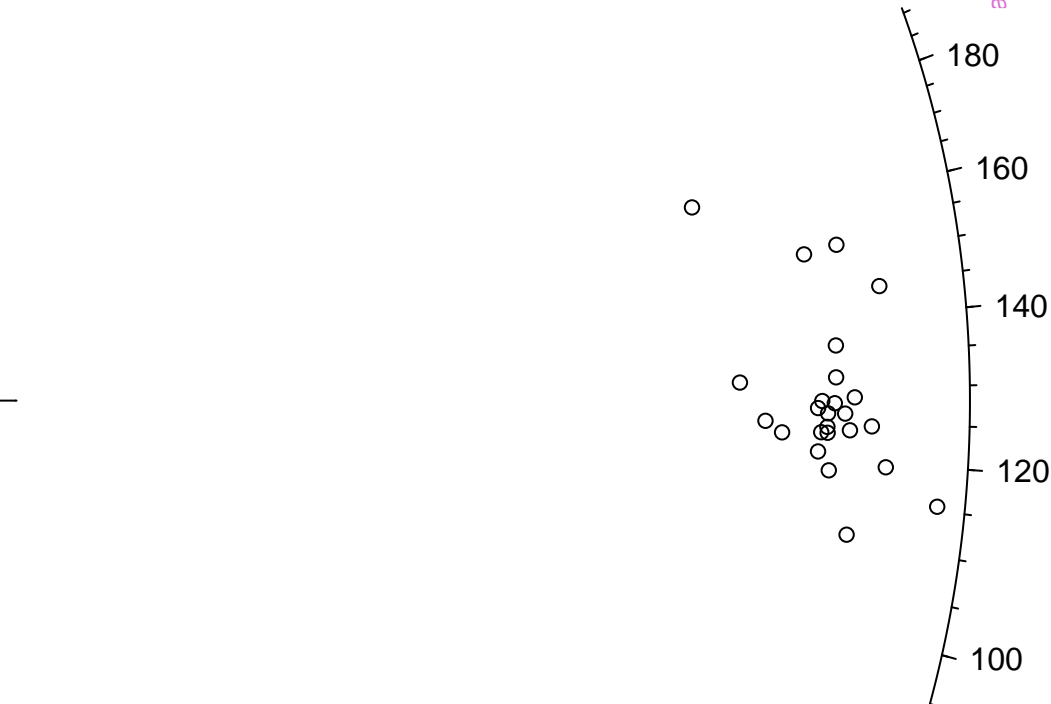
160

140

120

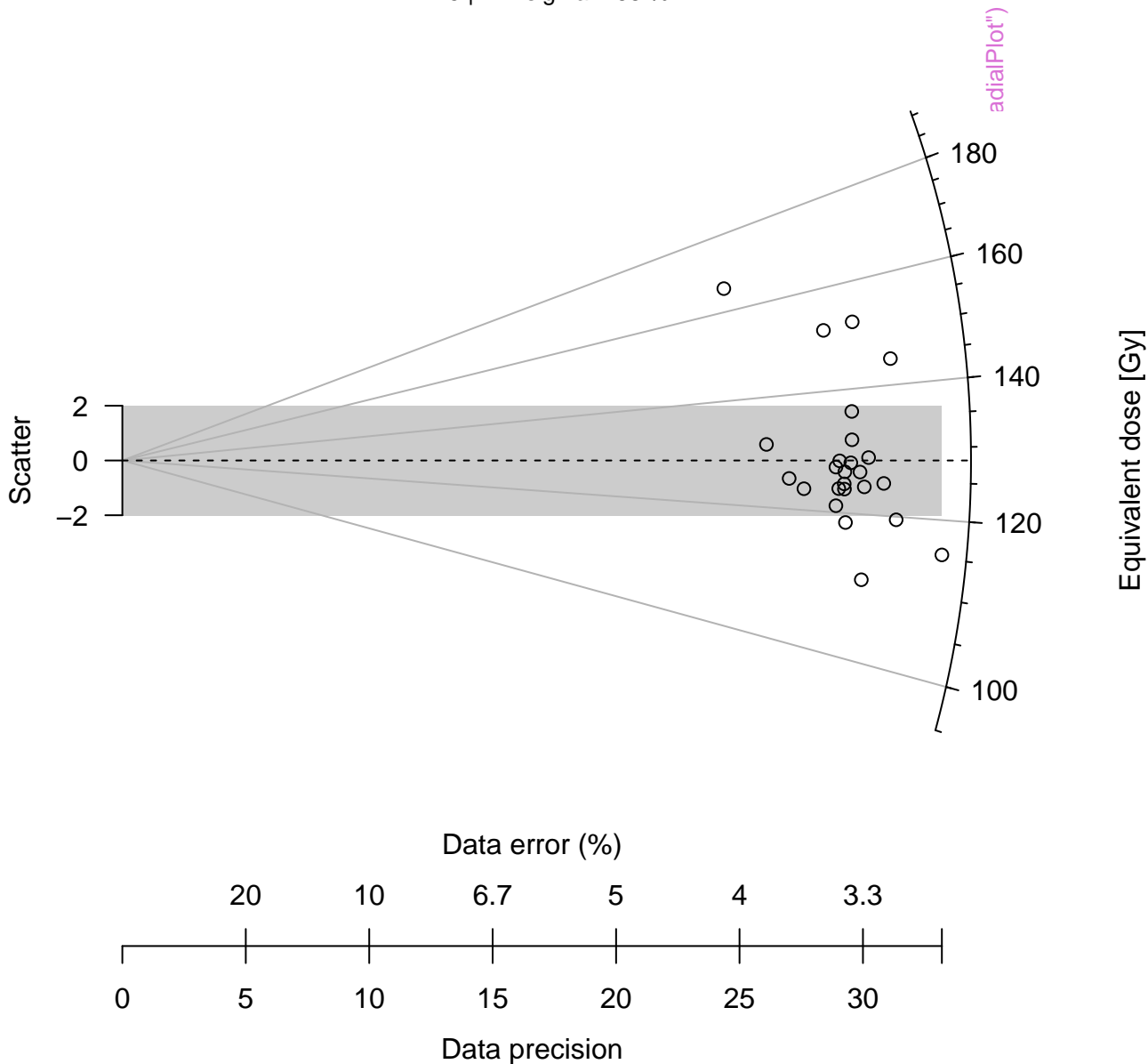
100

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



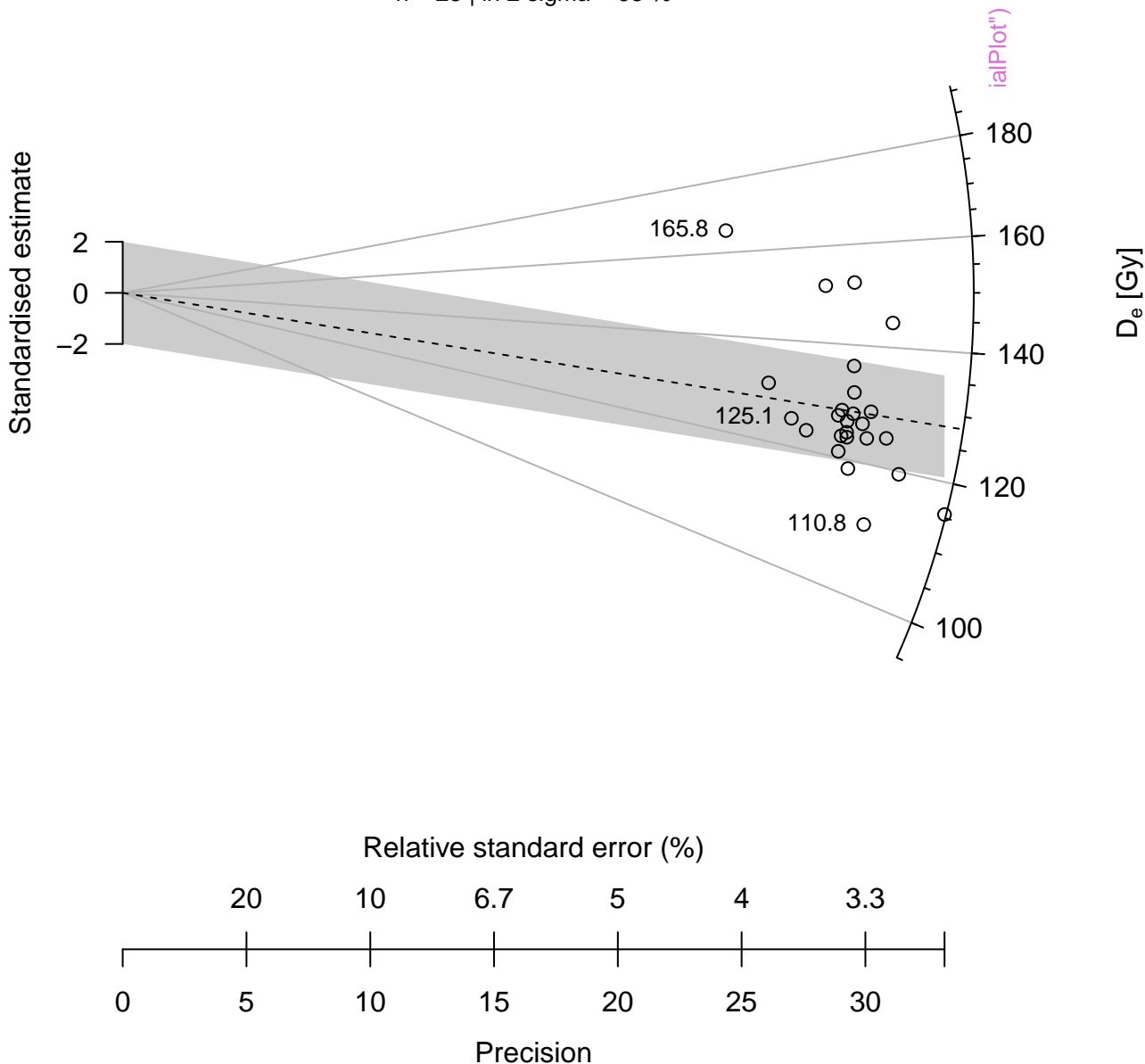
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



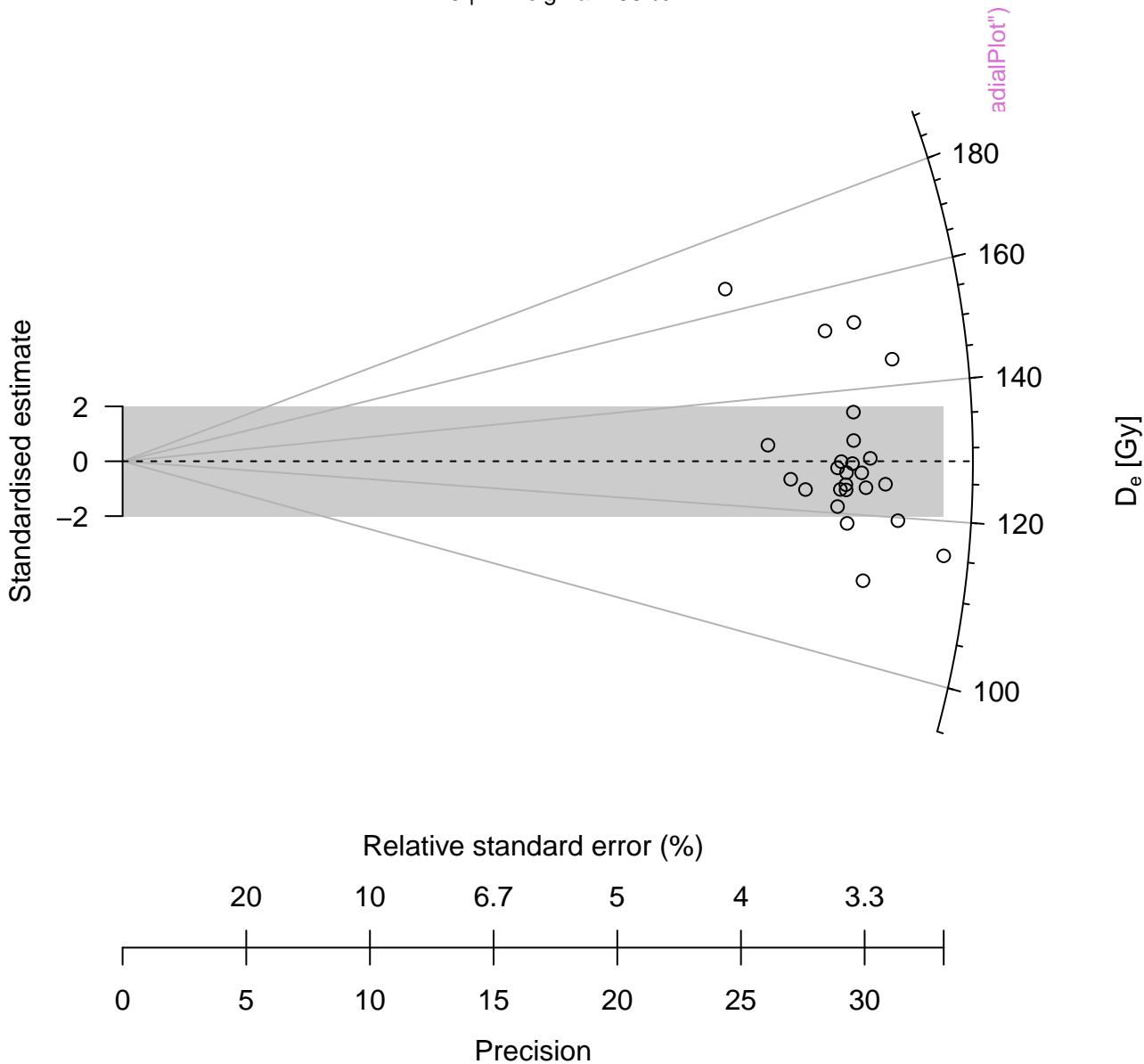
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



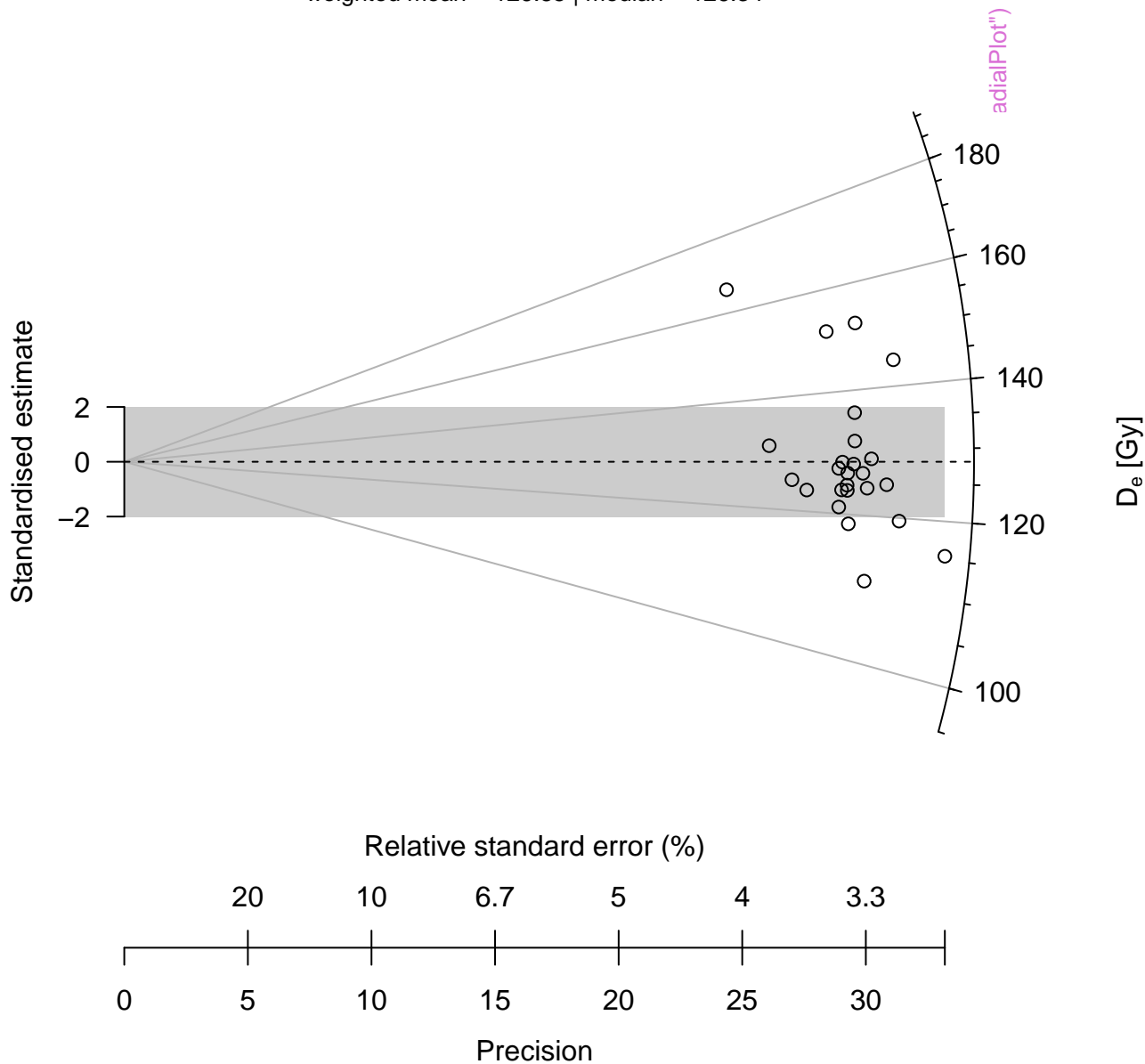
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 68 %



# D<sub>e</sub> distribution

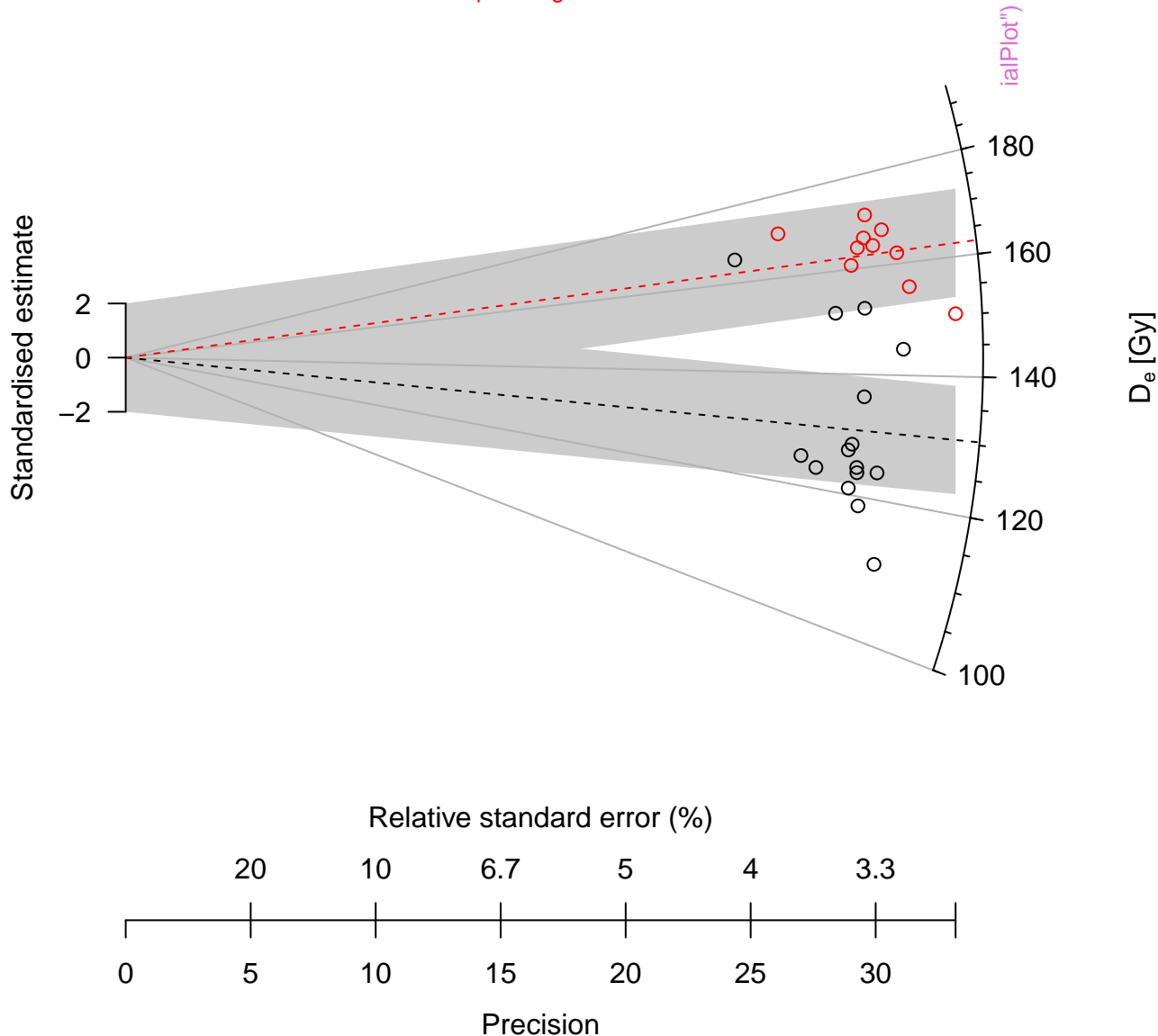
weighted mean = 126.85 | median = 126.34



# D<sub>e</sub> distribution

n = 15 | in 2 sigma = 53.3 %

n = 10 | in 2 sigma = 90 %



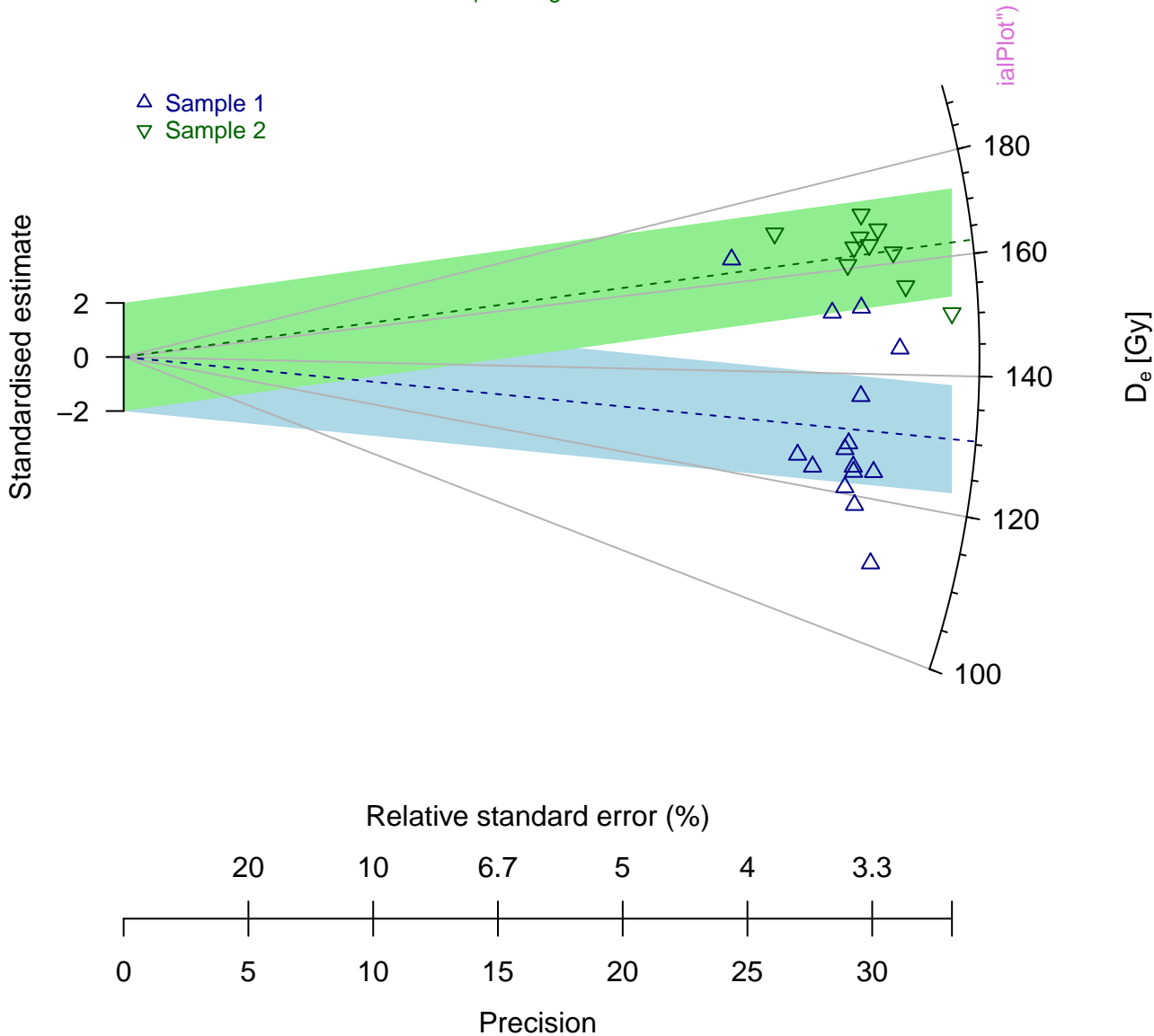
# D<sub>e</sub> distribution

n = 15 | in 2 sigma = 53.3 %

n = 10 | in 2 sigma = 90 %

△ Sample 1

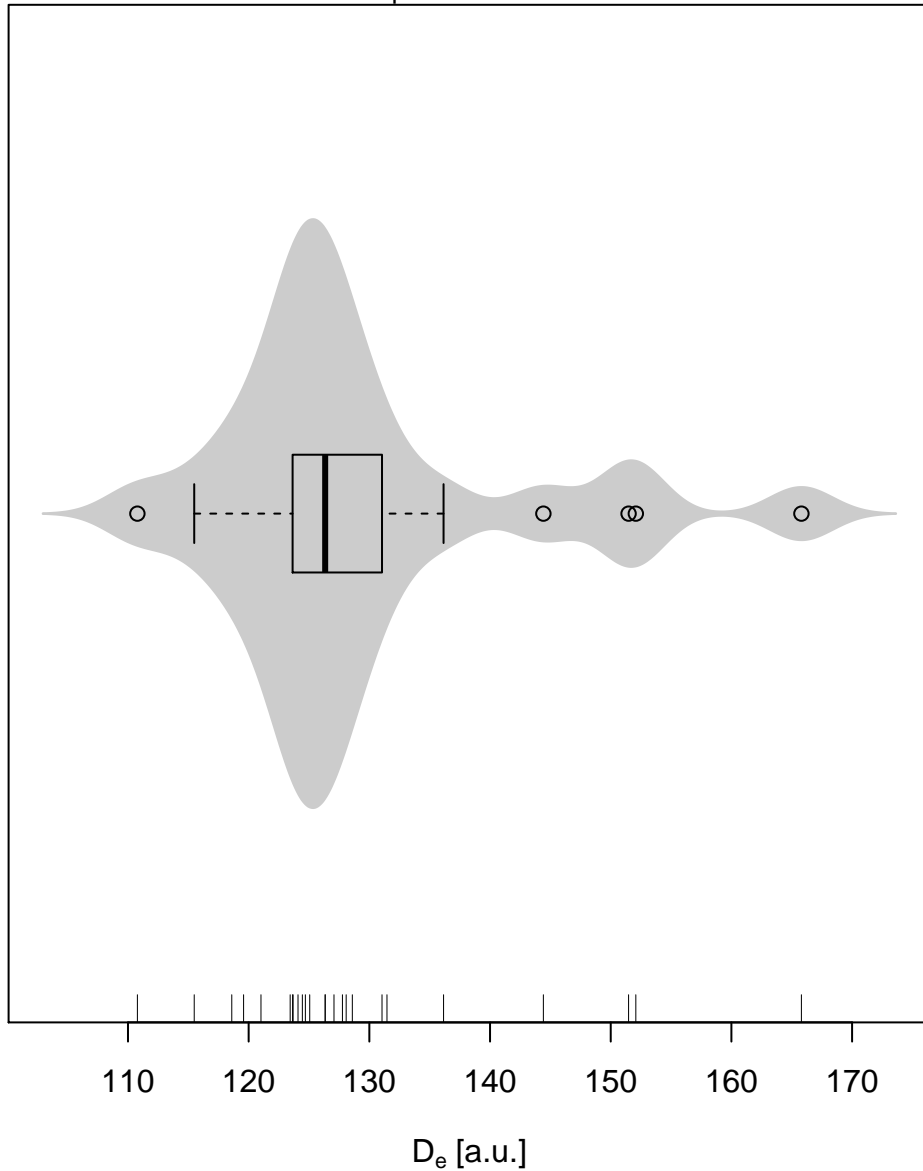
▽ Sample 2



# Violin Plot

n = 25 | median = 126.34

Density



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

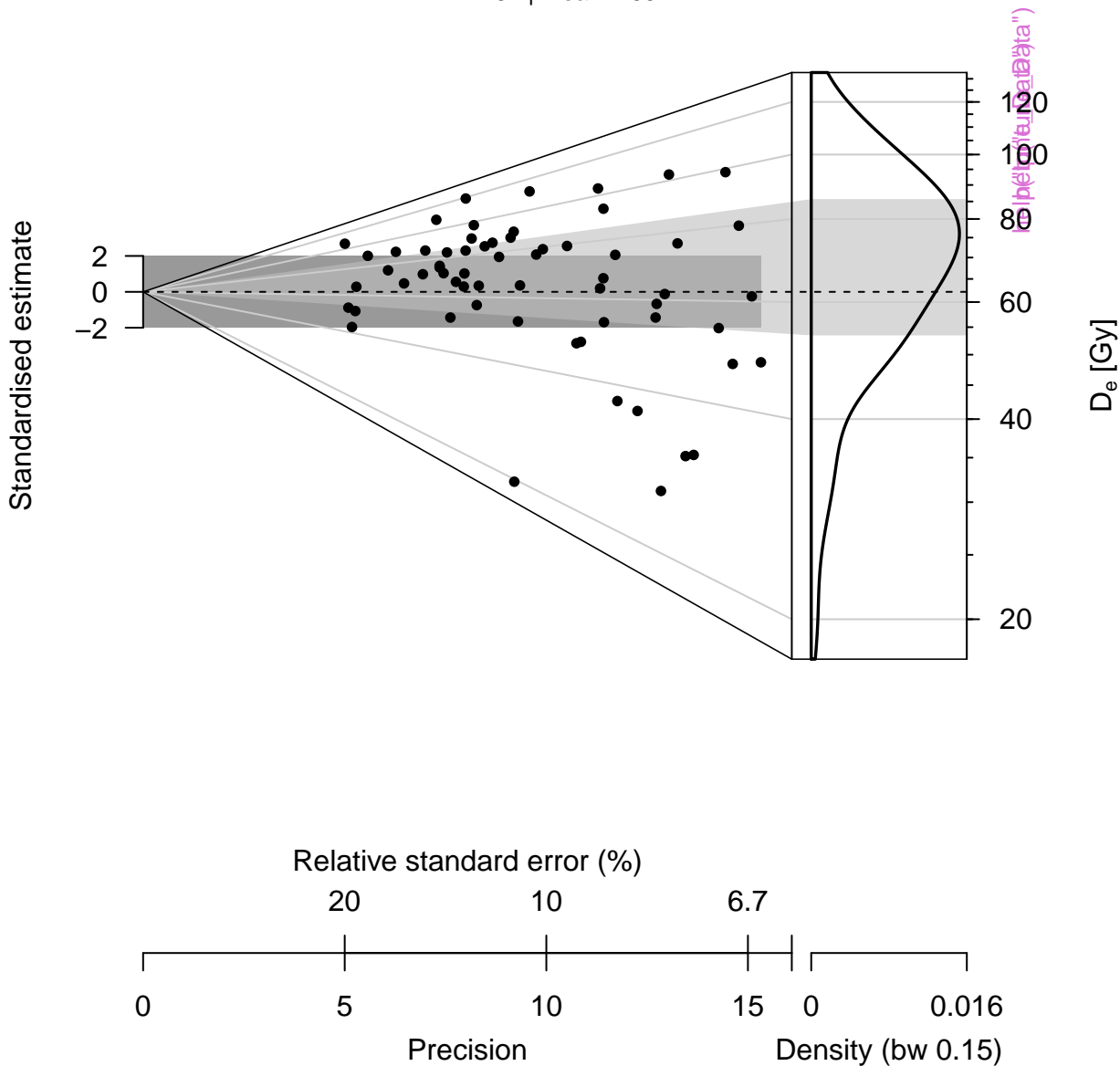


# OSL



# D<sub>e</sub> distribution

n = 62 | mean = 66



# D<sub>e</sub> distribution

n = 62 | mean = 66

