

$L_n, L_x$  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\("ExampleData.XSYG"\)](#)

# IR-RF

$D_e = 623.25$  [600.63 ; 635.8]



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)

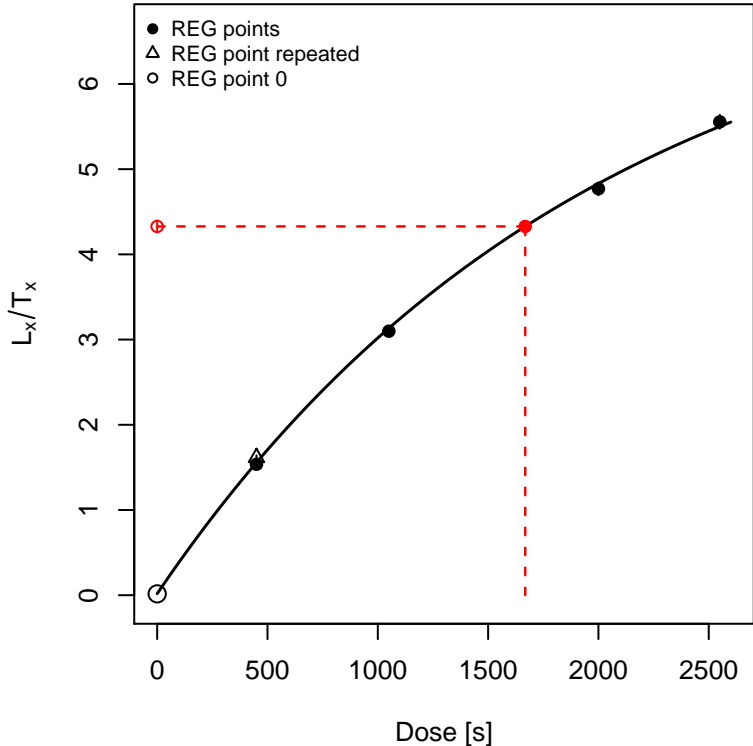
●  
R4  
(2550)

●  
R5  
(450)

●  
R0  
(0)

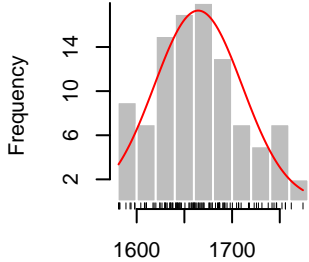
# Growth curve

$D_e = 1668.25 \pm 46.11$  | fit: EXP

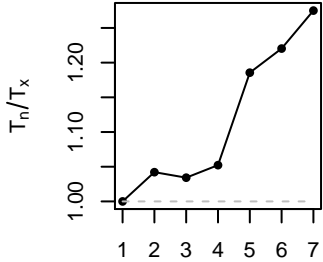


## $D_e$ from MC simulation

$D_{eMC} = 1664.49 \pm 46.11$  | quality = 99.8 %



## Test dose response



## Rejection criteria

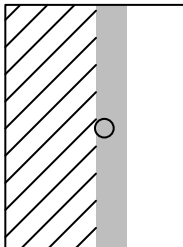
Recycling ratio



Recuperation rate



Palaeodose error



- 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

# Growth curve

$D_e = 406.28 \pm 42.81$  | fit: LIN

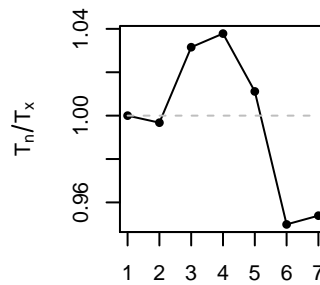


## $D_e$ from MC simulation

$D_{eMC} = 402.95 \pm 42.81$  | quality = 99.2 %



## Test dose response



Dose [s]

n = 100, valid fits = 100

SAR cycle

## Pseudo pIRIR data set based on quartz OSL

TL  
pseudolRSL1  
pseudolRSL2

help("analyse\_pIRIRSequence")

# Pseudo pIRIR data set based on quartz OSL

TL previous  $L_n, L_x$  curves



help("analyse\_pIRIRSequence")

# Pseudo pIRIR data set based on quartz OSL



# Pseudo pIRIR data set based on quartz OSL

TL previous  $T_n, T_x$  curves



help("analyse\_pIRIRSequence")

# Pseudo pIRIR data set based on quartz OSL



# Pseudo pIRIR data set based on quartz OSL

$D_e = 1668.25 \pm 46.11$  | fit: EXP





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

D<sub>MC</sub> = 1664.49 ± 46.11 | quality = 99.8 %



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

$D_e = 1668.25 \pm 48.13$  | fit: EXP



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

D<sub>e,MC</sub> = 1663.13 ± 48.13 | quality = 99.7 %



Dose [s]

n = 100 , valid fits = 100

help("analyse\_pIRSequence")

# Test dose response





## Summarised growth curves



# Sensitivity change



## Rejection criteria



# Monte Carlo Simulation

$n = 10000 \mid \hat{\mu} = 42 \mid \hat{\sigma} = 20 \mid \frac{\hat{\sigma}}{\sqrt{n}} = 0 \mid v = 0.89$



Profile log likelihood for  $\sigma_{OD}$



# Finite Mixture Model

$\sigma_b = 0.2 \mid n = 62$

## Normal distributions



## Proportion of components



## Statistical criteria



help("calc\_FiniteMixture")

used values = 22















# 3-parameter Minimum Age Model

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

n = 62

mean = 69.93

weighted mean = 47.95

median = 71.07

Standardised estimate



Relative standard error (%)

n

20

10

6.7

0

15

0

5

Precision

10

15

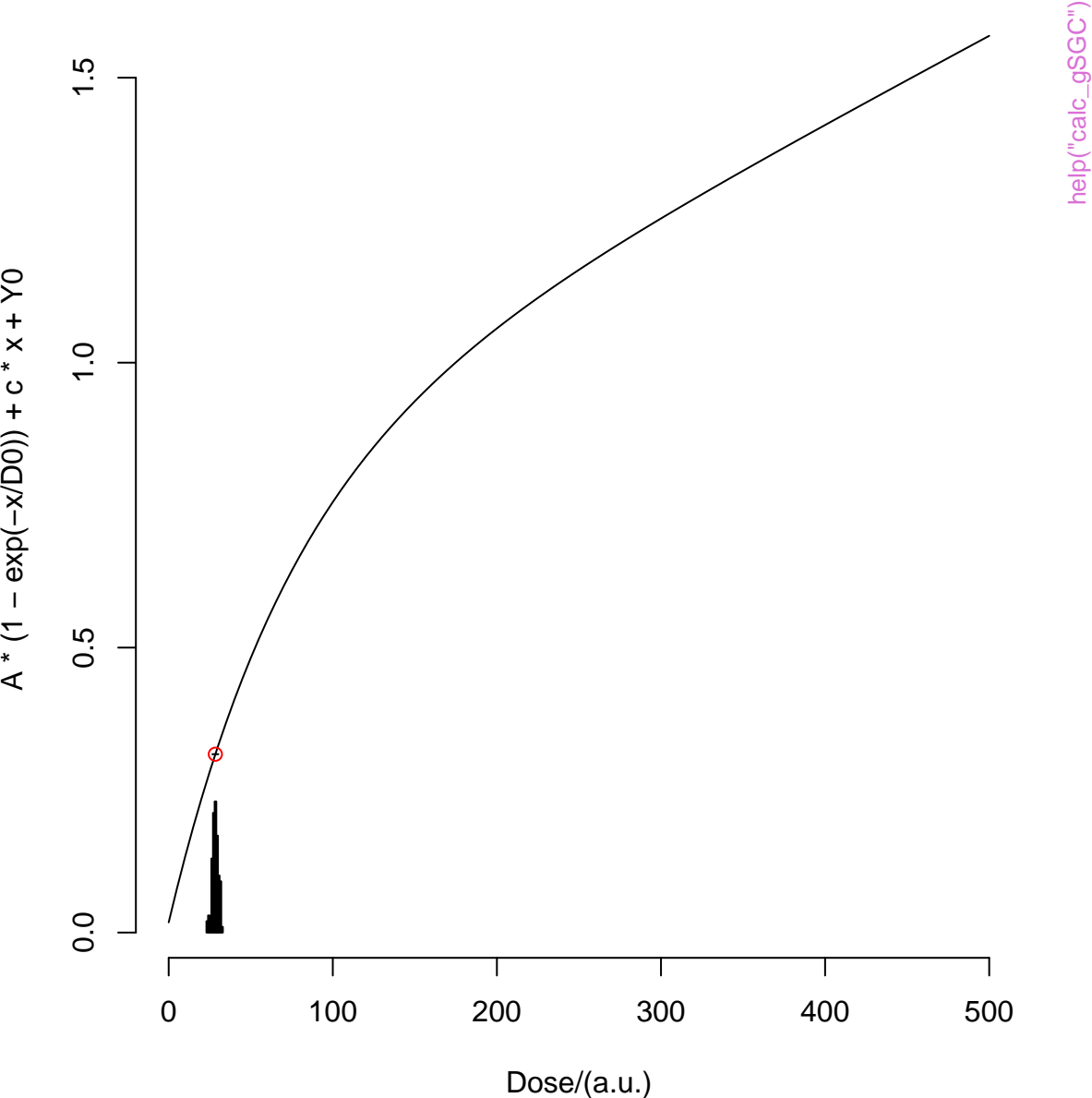
Density (bw 0.1)

0.106

# D<sub>e</sub> distribution

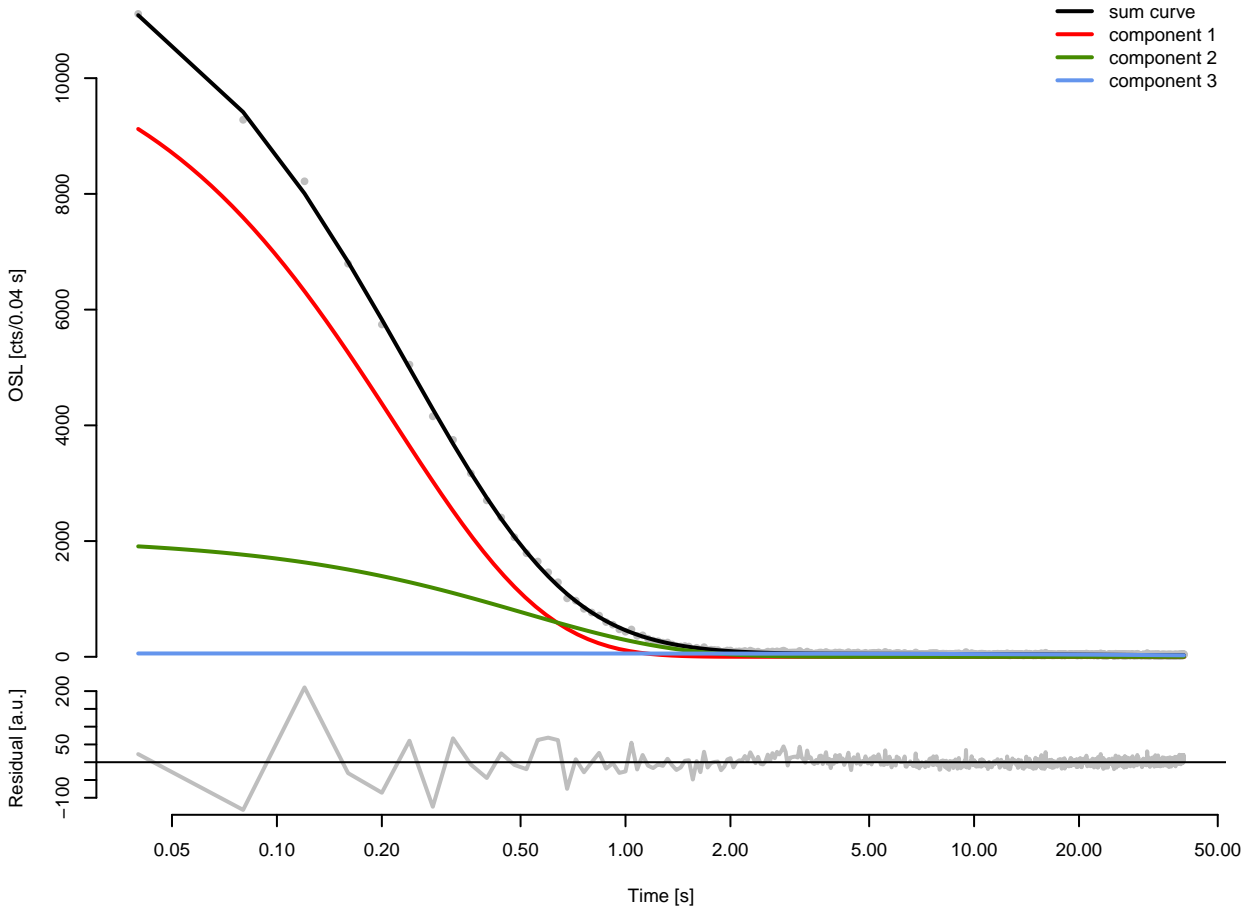


gSGC and resulting De

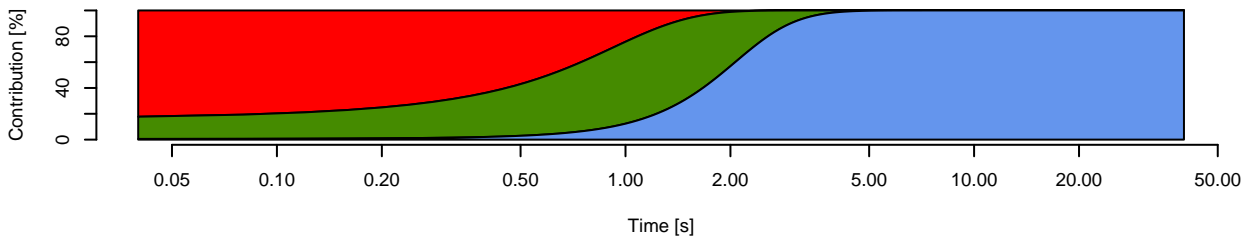


# CW Curve Fit

Default



## Component contribution to sum curve

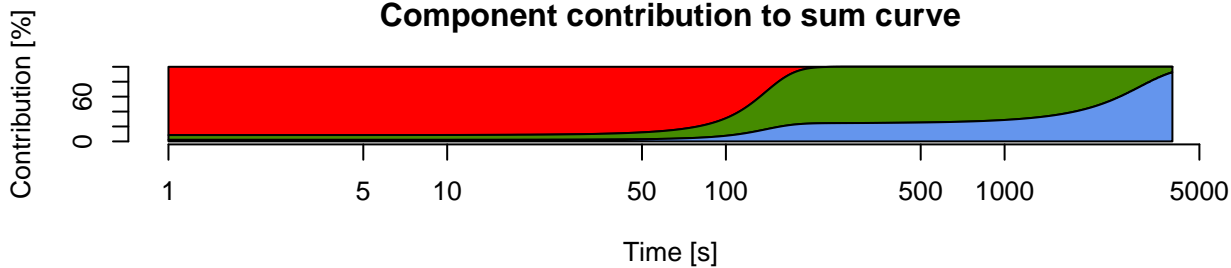




## Default



## Component contribution to sum curve



# Background



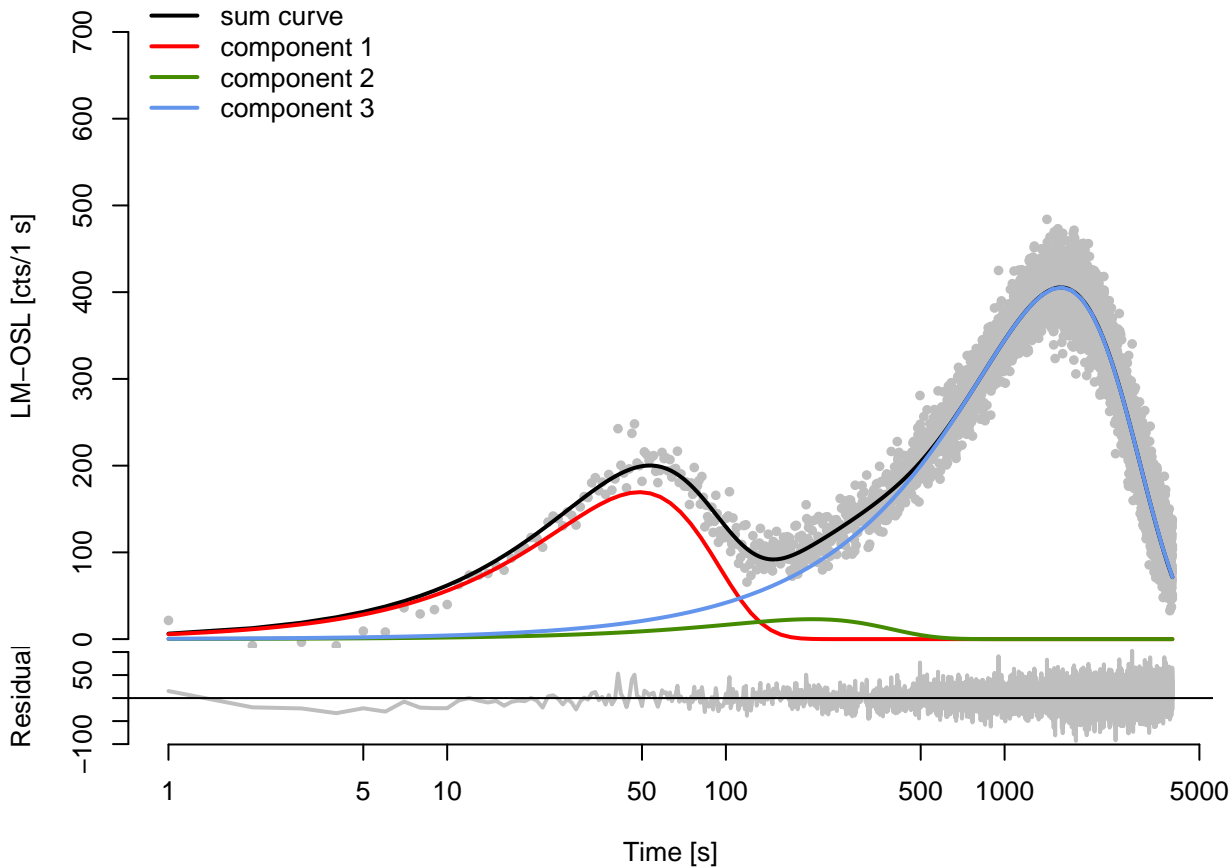
## Default



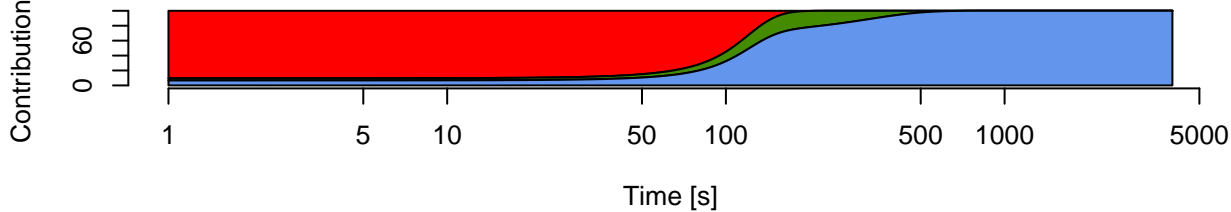
## Component contribution to sum curve



## Default



## Component contribution to sum curve

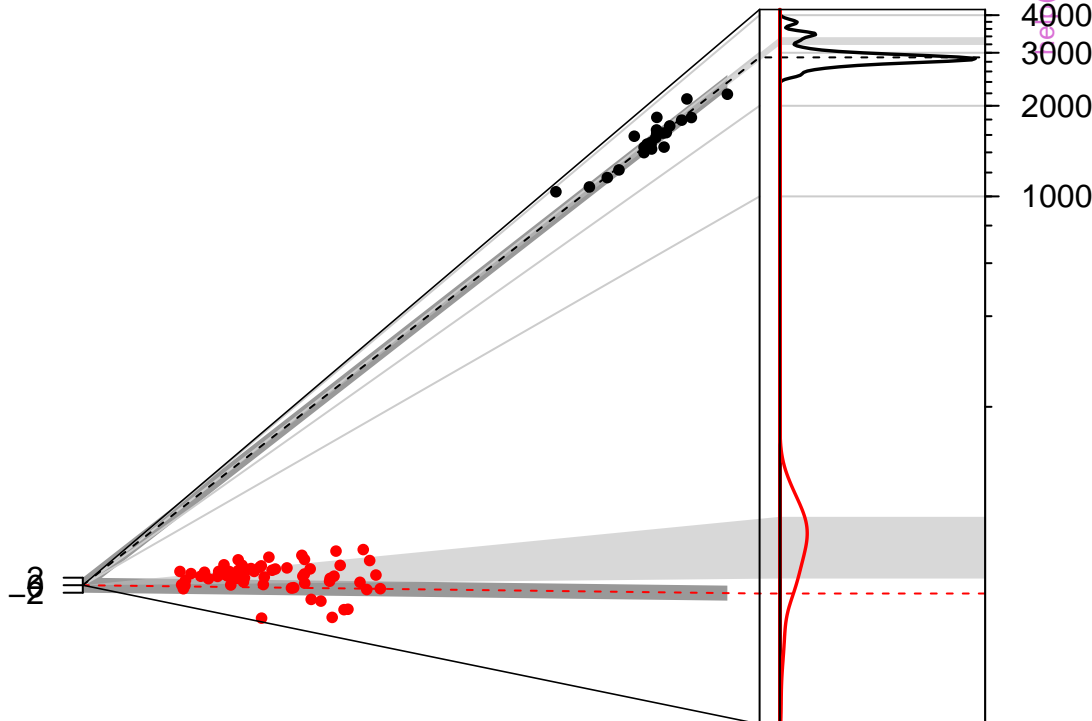


# D<sub>e</sub> distribution

n = 25

n = 62

Standardised estimate



D<sub>e</sub> (Gy)

help("get\_Layout")

help("get\_Layout")

Relative standard error (%)

10

5

3.3

0

10

20

30

0

0.015

Precision

Density (bw 0.085)

# D<sub>e</sub> distribution

n = 25

n = 62



help("get\_Layout")

# Profile log likelihood for $\sigma_{OD}$



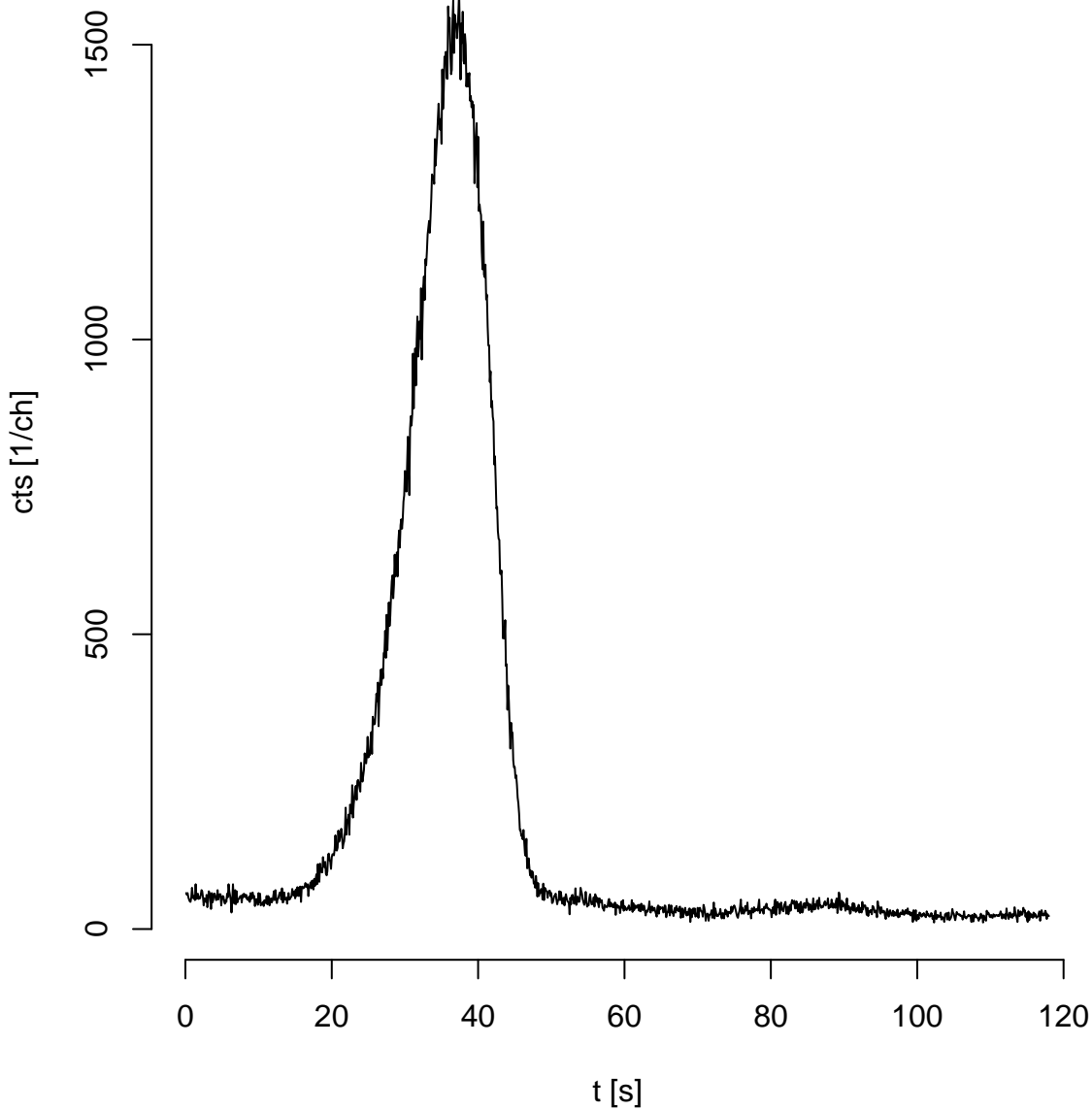
# TL (UVVIS)



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



# TL (UVVIS)



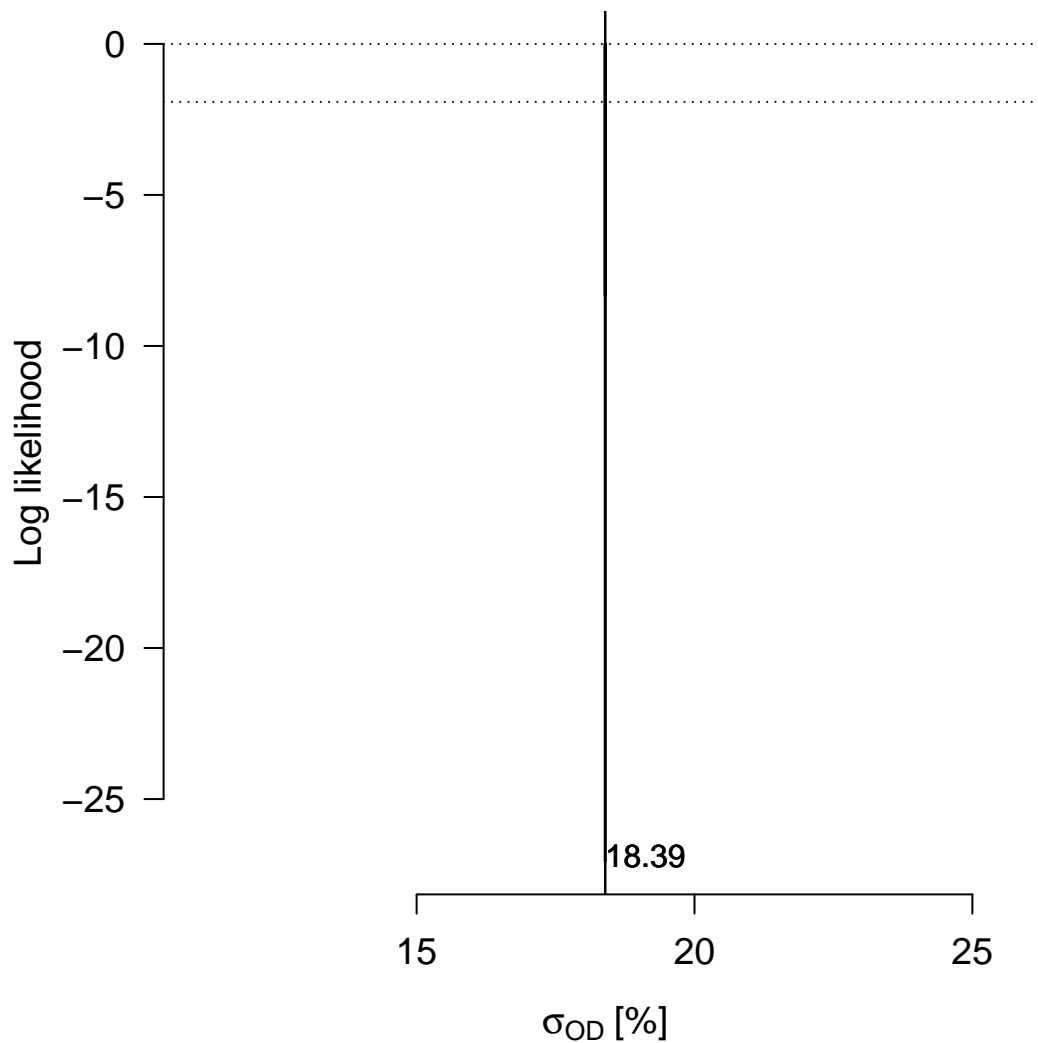
help("merge\_RLum.Data.Curve")

# TL (UVVIS)



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

# Profile log likelihood for $\sigma_{OD}$

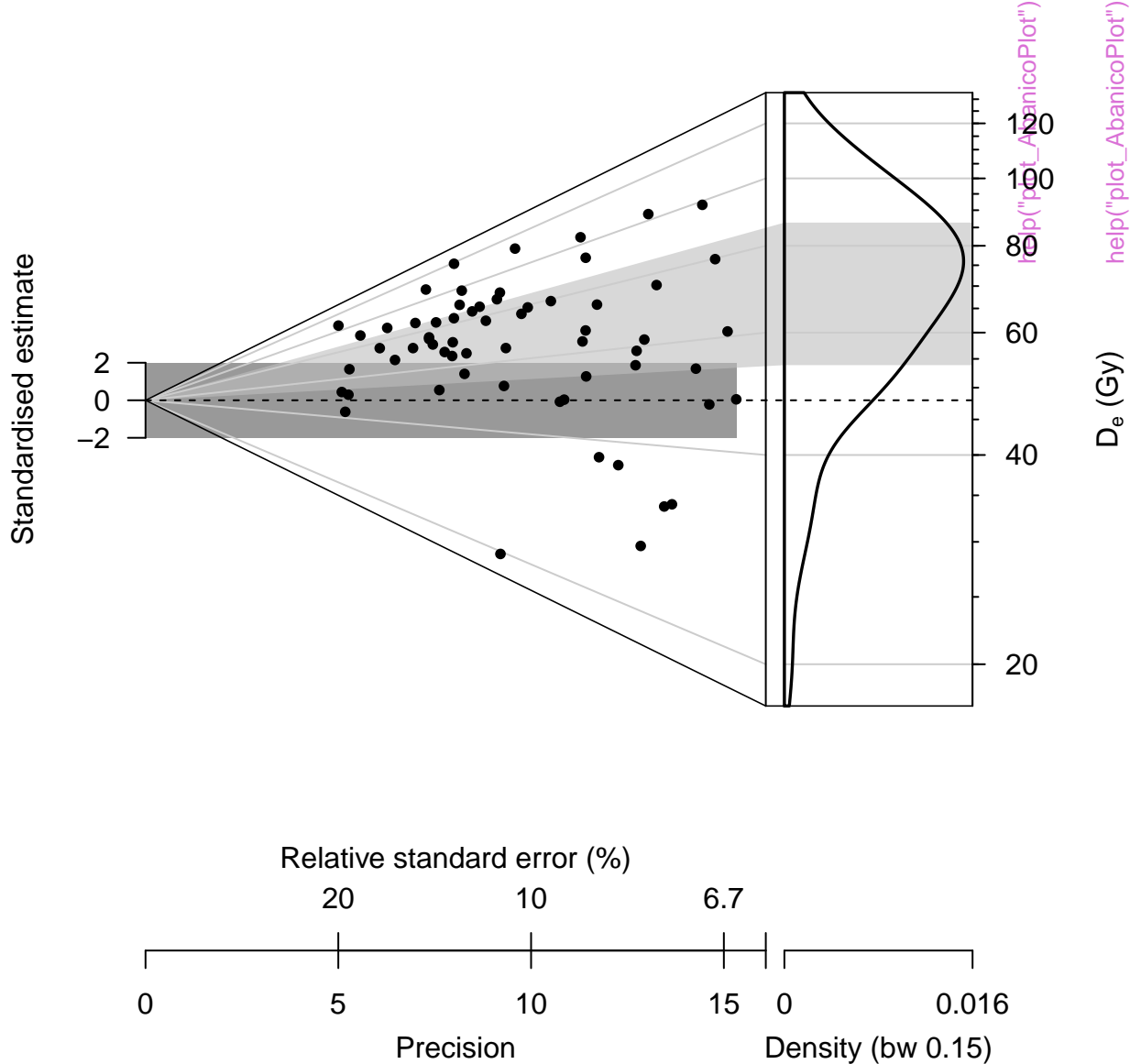


# Profile log likelihood for $\sigma_{OD}$



# D<sub>e</sub> distribution

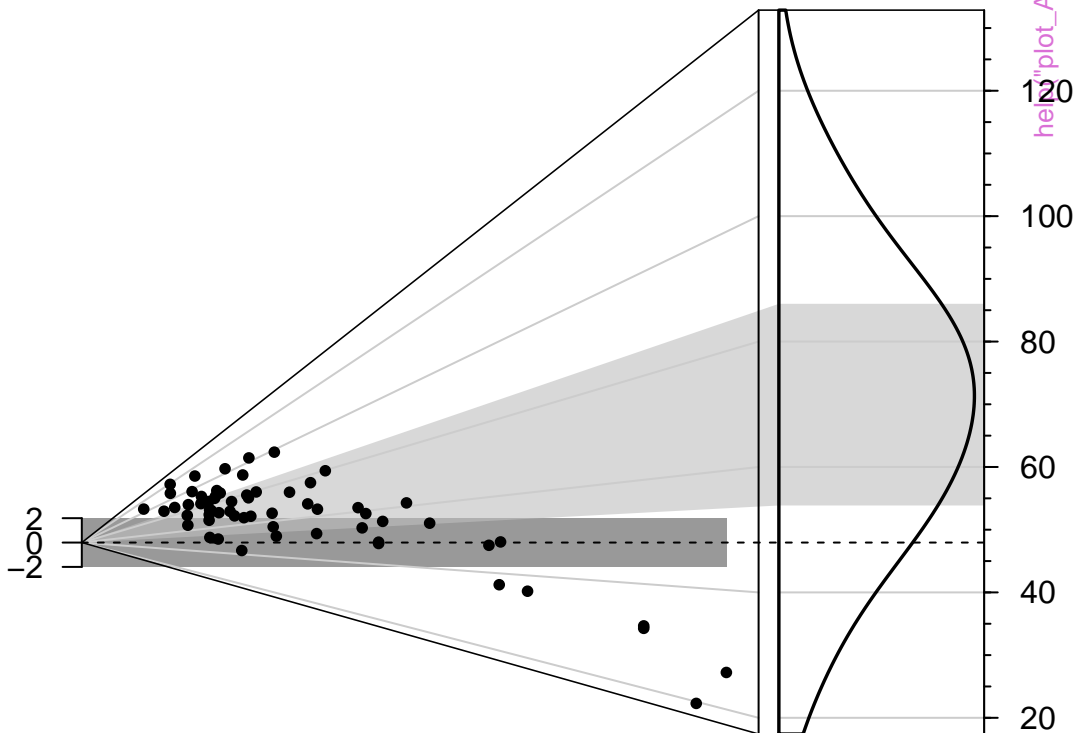
n = 62



# $D_e$ distribution

n = 62

Standardised estimate



help("plot\_AbanicoPlot")

help("plot\_AbanicoPlot")

$D_e$  (Gy)

Standard error

10

5

3.3

2.5

2

0.0

0.1

0.2

0.3

0.4

0.5

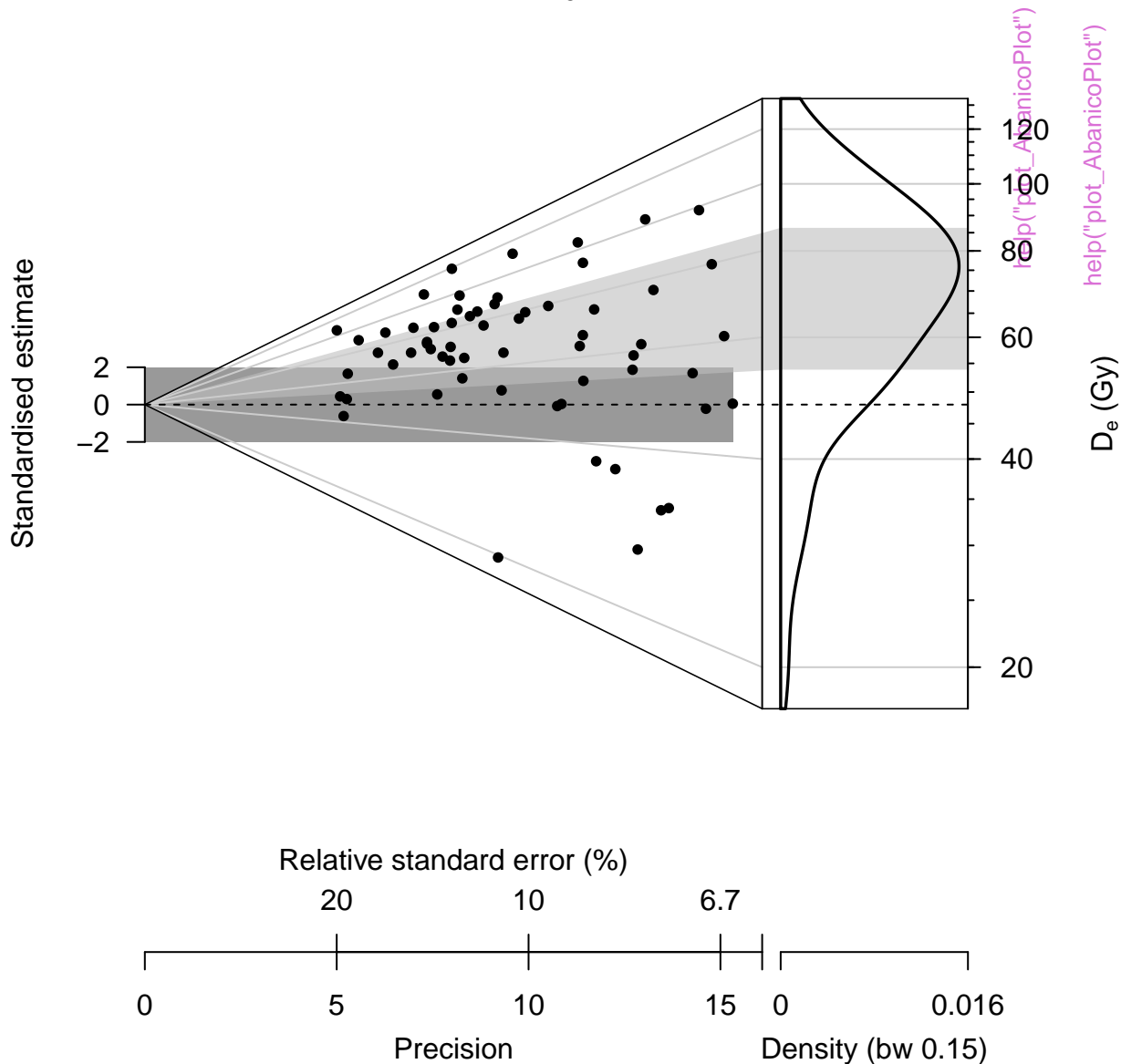
0.016

Precision

Density (bw 11.795)

# D<sub>e</sub> distribution

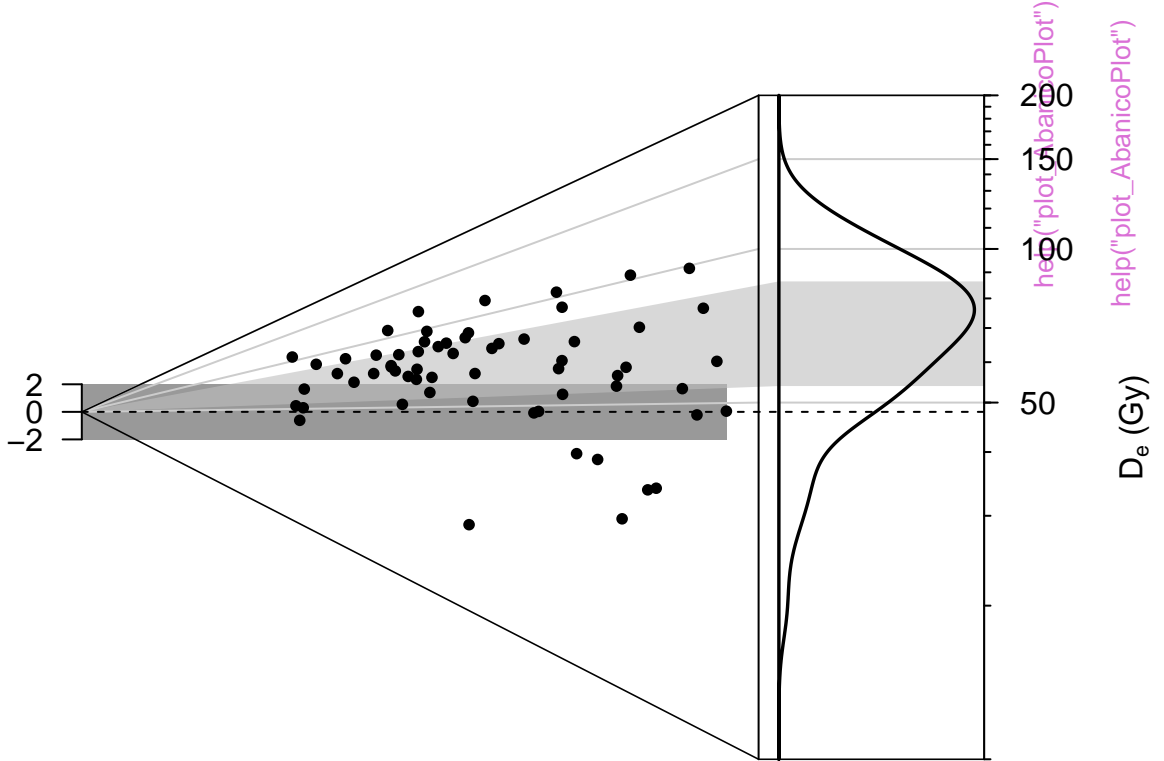
n = 62



# D<sub>e</sub> distribution

n = 62

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

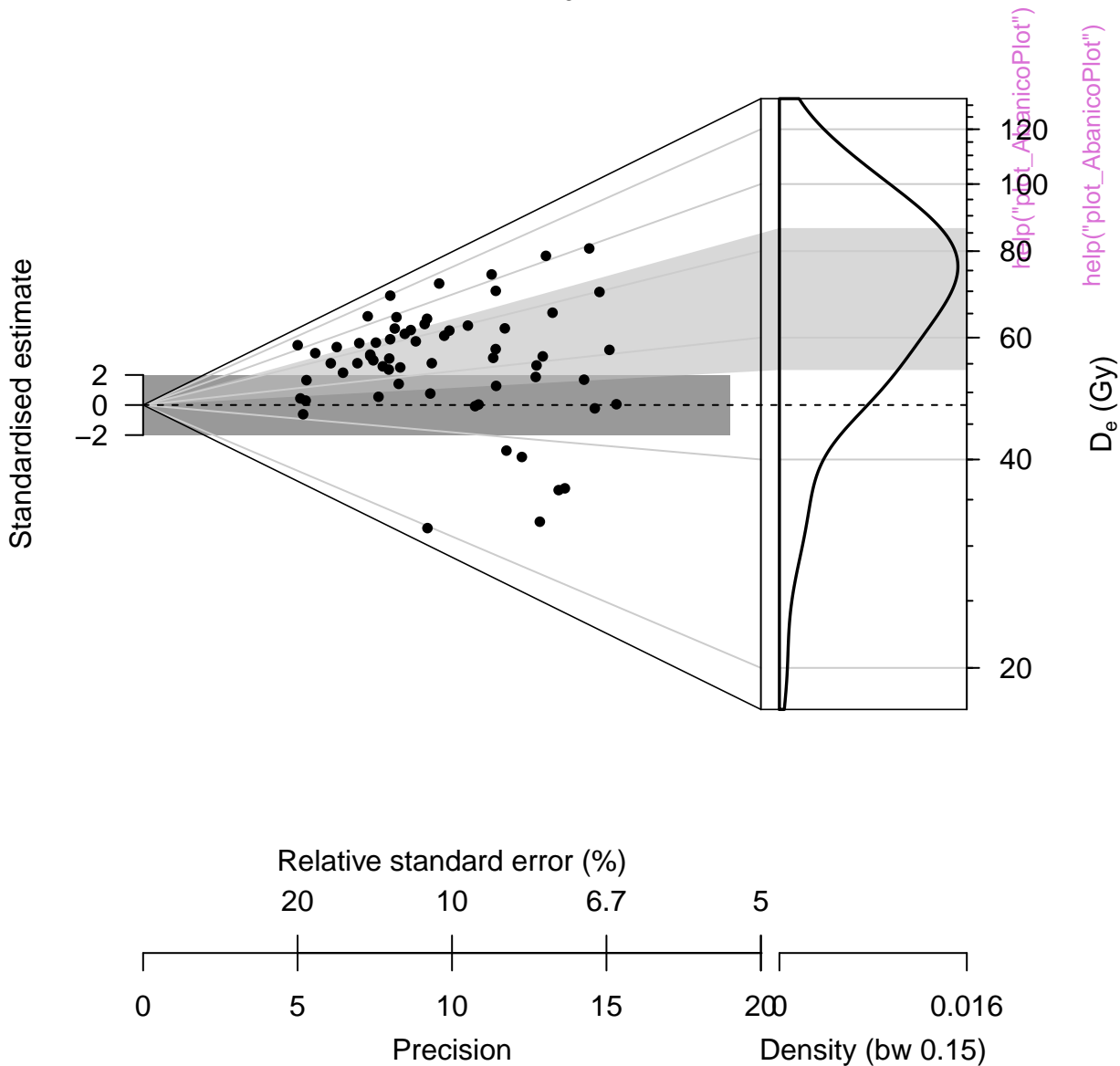
Precision

Density (bw 0.15)



# D<sub>e</sub> distribution

n = 62



# D<sub>e</sub> distribution

n = 62

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

Precision

10

15

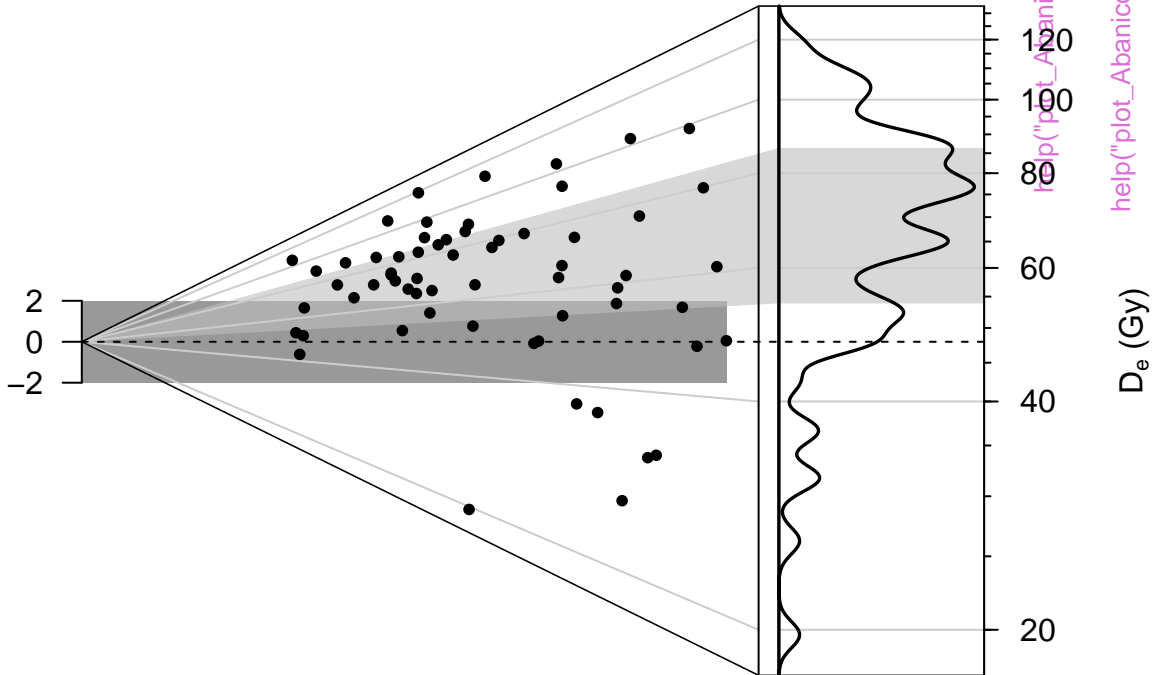
Density (bw 0.15)

0.016

# D<sub>e</sub> distribution

n = 62

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

Precision

10

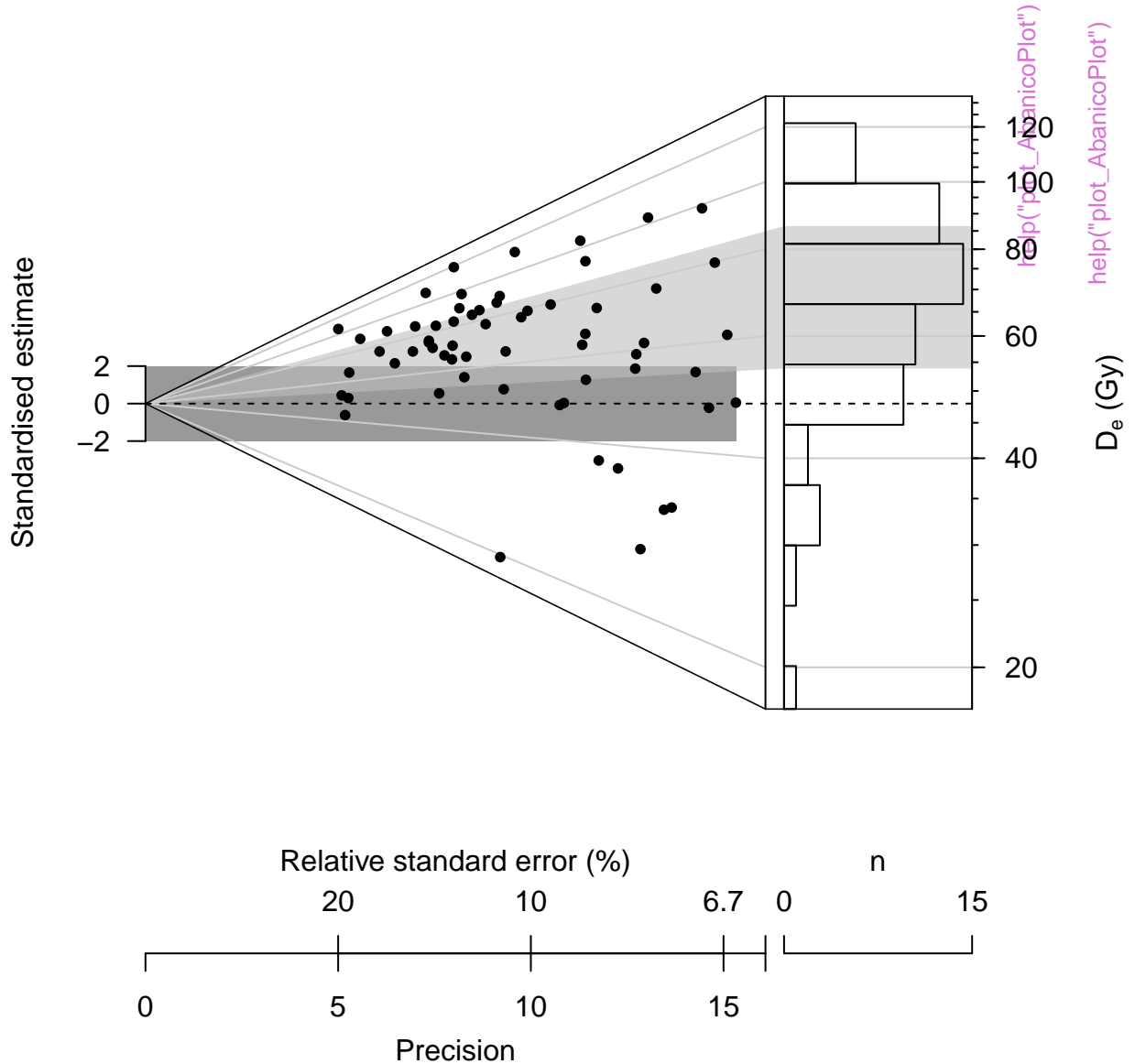
15

Density (bw 0.04)

0.264

# D<sub>e</sub> distribution

n = 62



# D<sub>e</sub> distribution

n = 62

Standardised estimate



Relative standard error (%)

n

20

10

6.7

0

10

0

5

Precision

10

15

Density (bw 0.15)

0.016

# D<sub>e</sub> distribution

n = 62

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

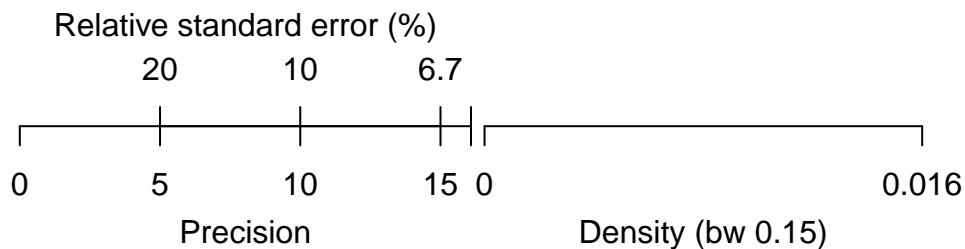
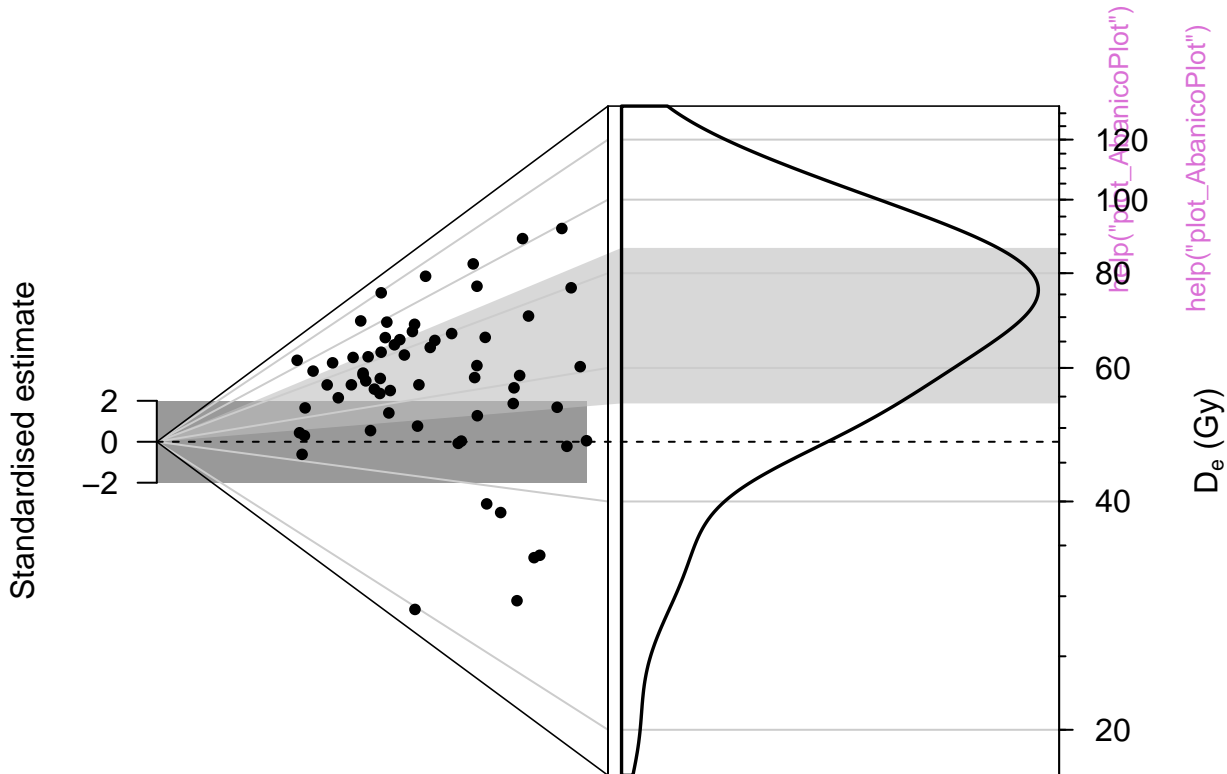
0.016

Precision

Density (bw 0.15)

# $D_e$ distribution

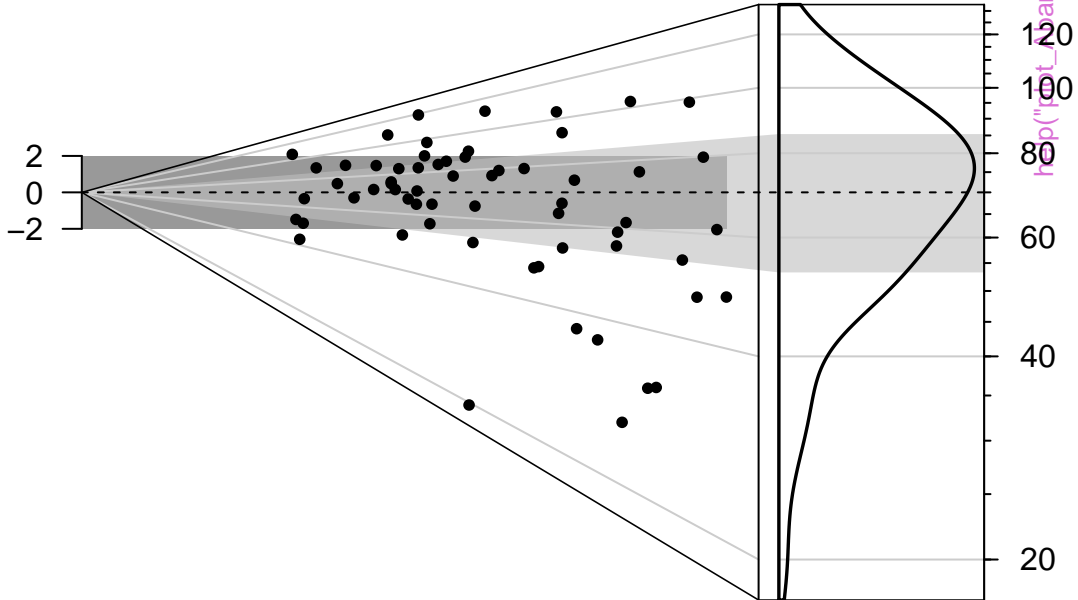
n = 62



# $D_e$ distribution

n = 62

Standardised estimate



help("plot\_AbanicoPlot")

$D_e$  (Gy)

Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

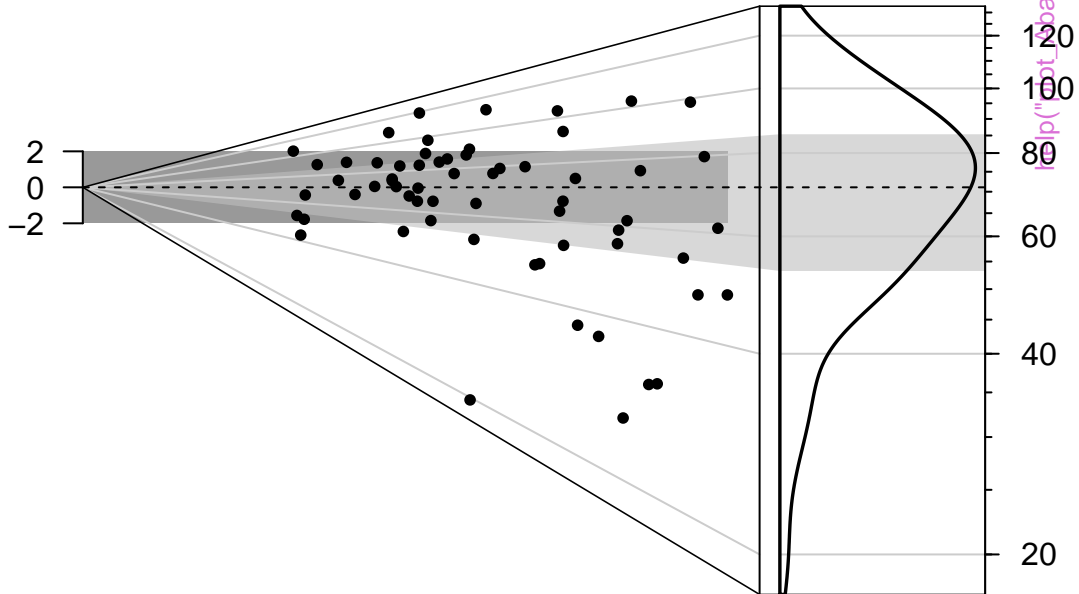
Density (bw 0.15)



# $D_e$ distribution

n = 62

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

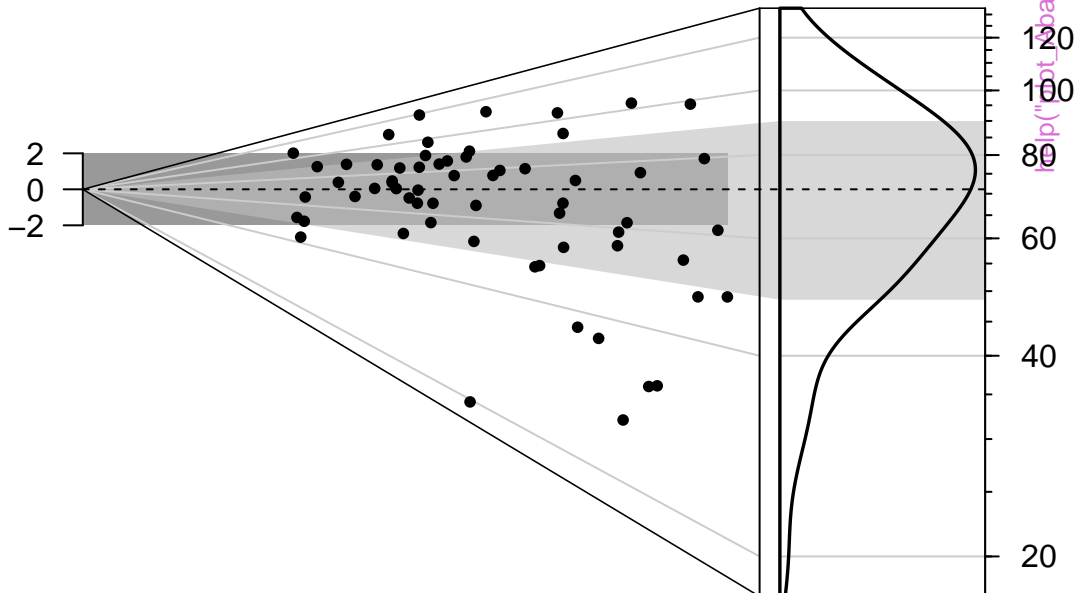
Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62

Standardised estimate



help("plot\_AbanicoPlot")

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

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

Precision

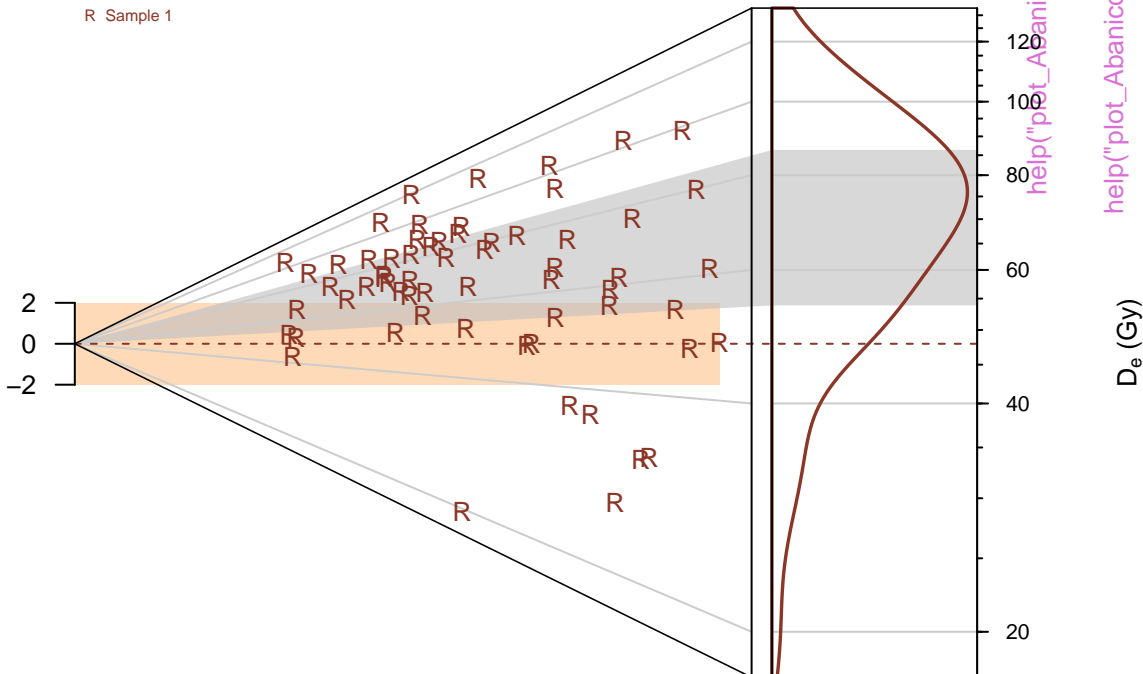
Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62

R Sample 1

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0

0.016

Precision

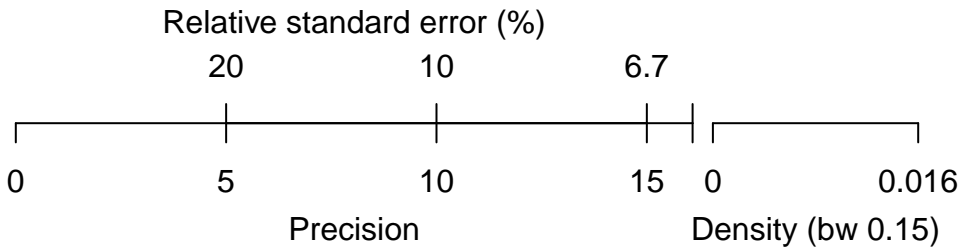
Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62

Standardised estimate

0



help("plot\_AbanicoPlot")

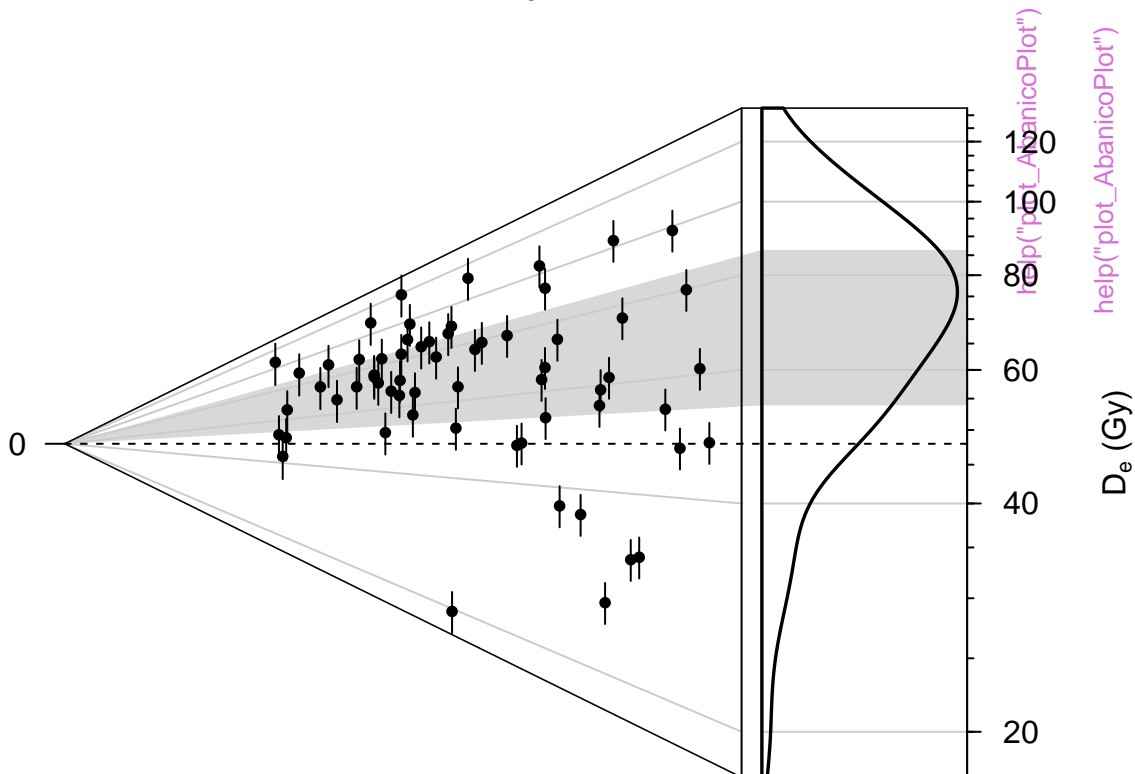
help("plot\_AbanicoPlot")

D<sub>e</sub> (Gy)

120  
100  
80  
60  
40  
20

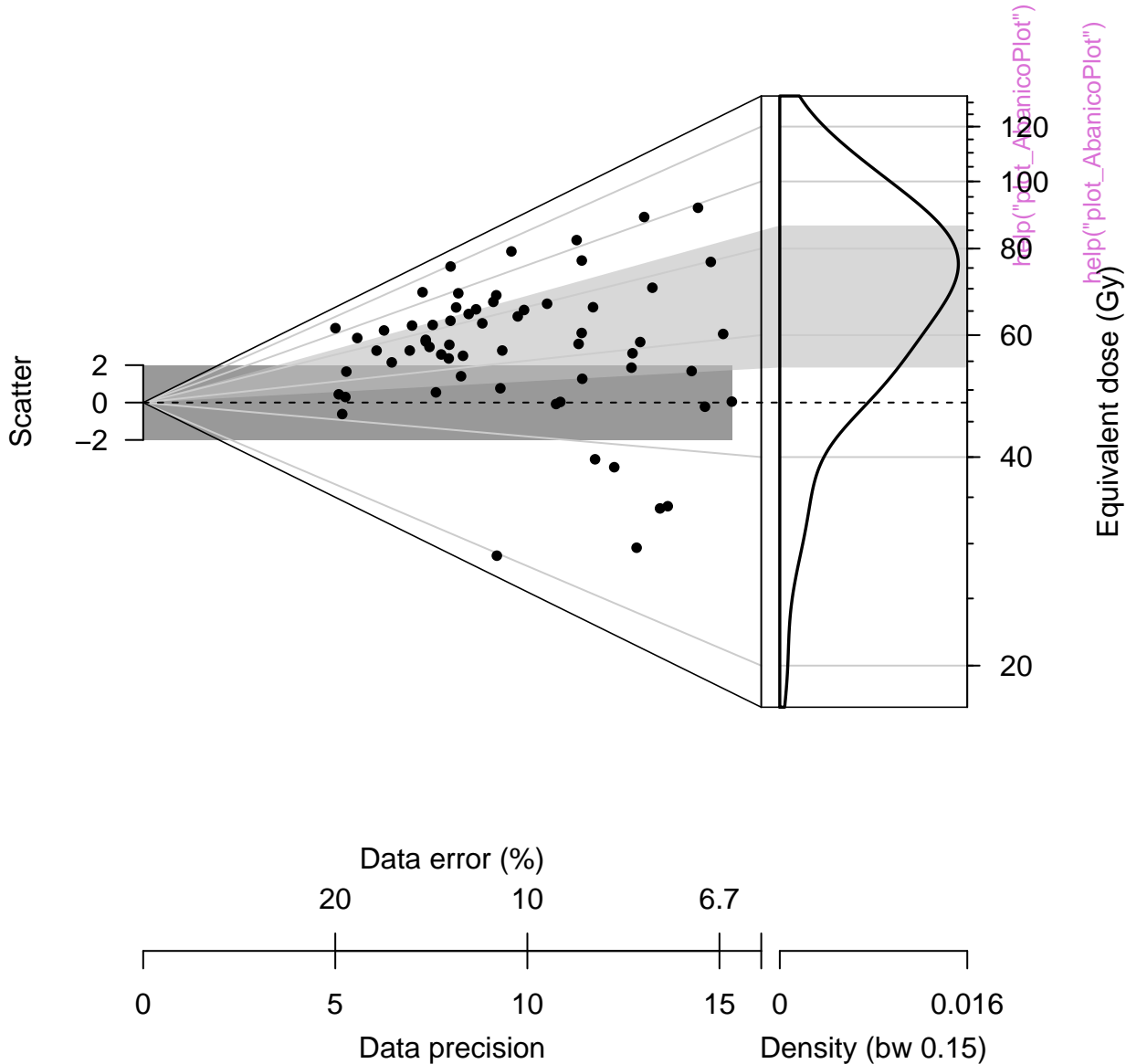
# D<sub>e</sub> distribution

n = 62



# D<sub>e</sub> distribution

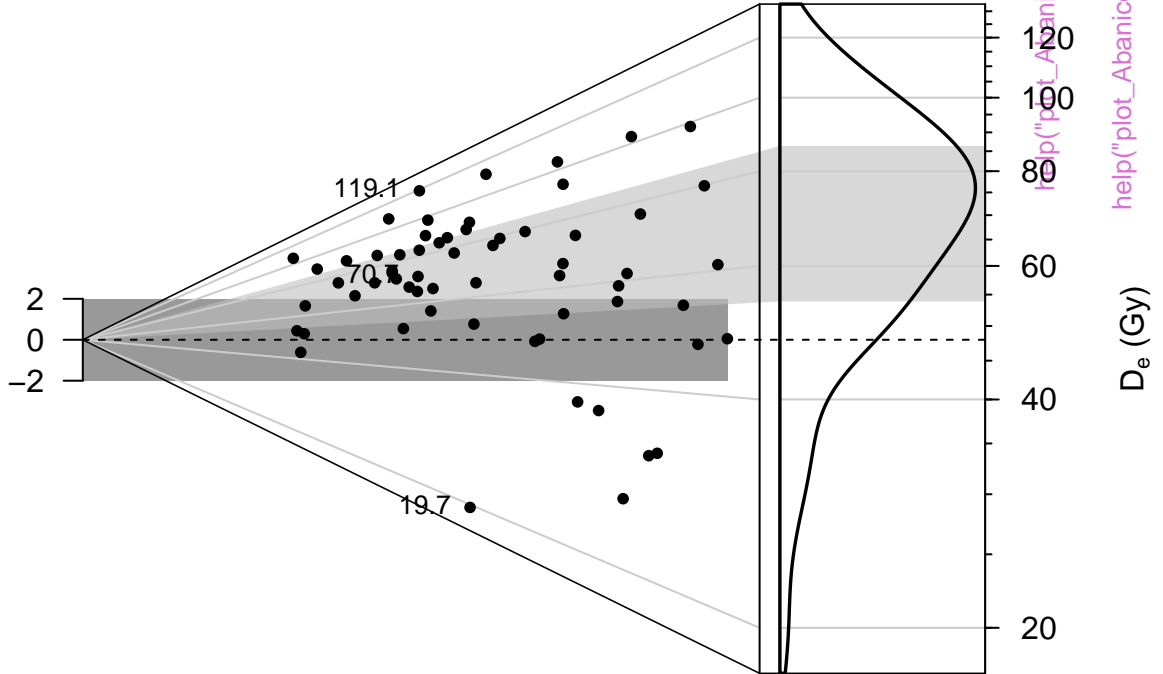
n = 62



# D<sub>e</sub> distribution

n = 62

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0.016

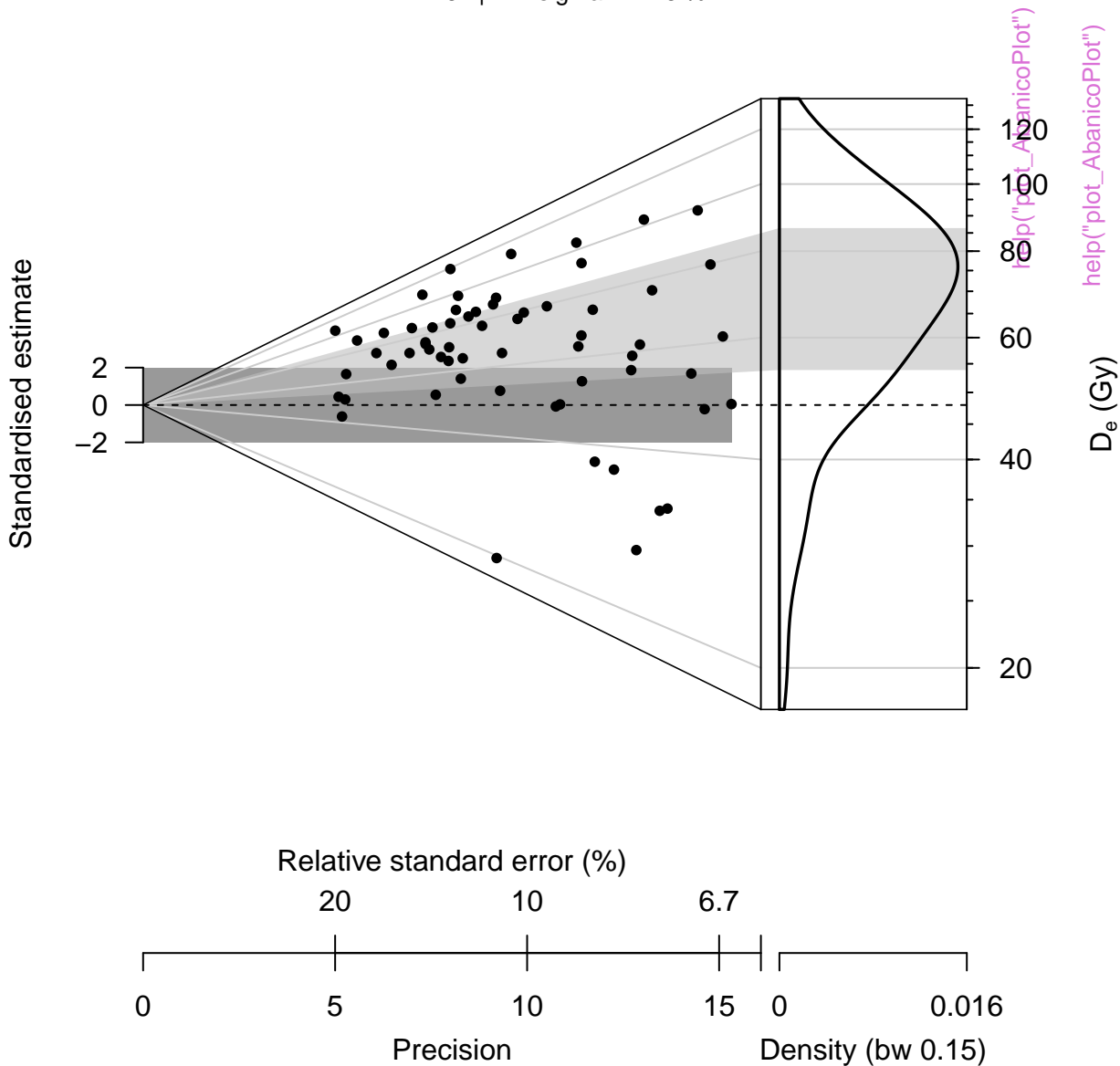
Precision

Density (bw 0.15)



# D<sub>e</sub> distribution

n = 62 | in 2 sigma = 22.6 %

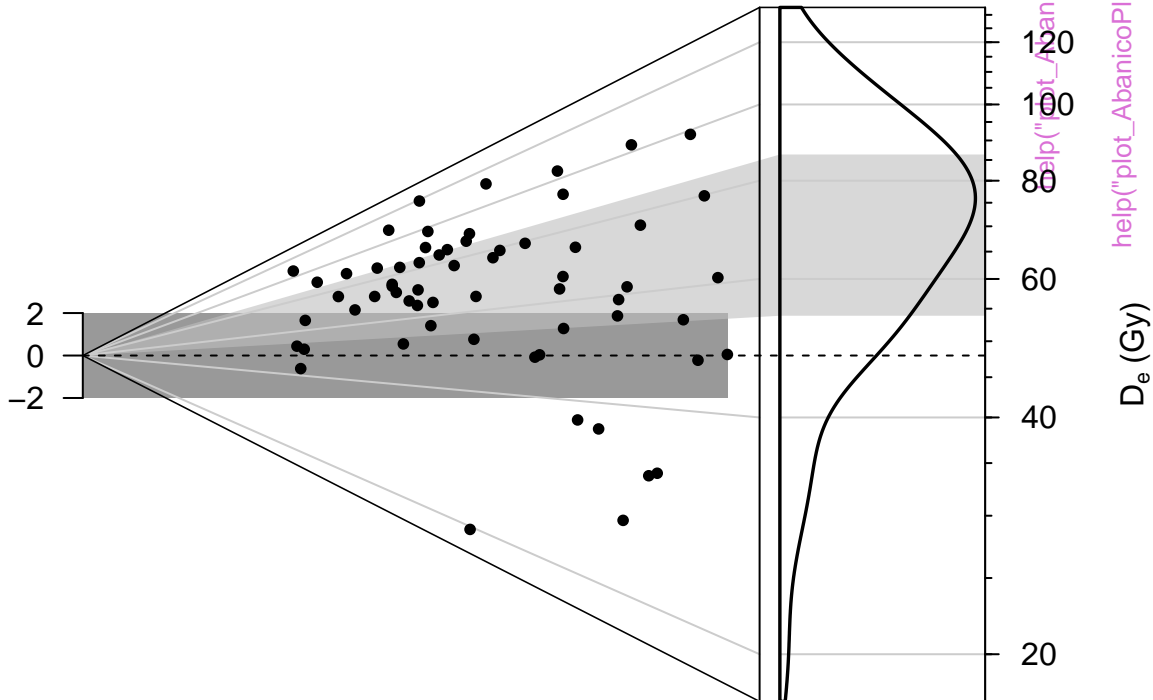


# $D_e$ distribution

weighted mean = 47.95

median = 71.07

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

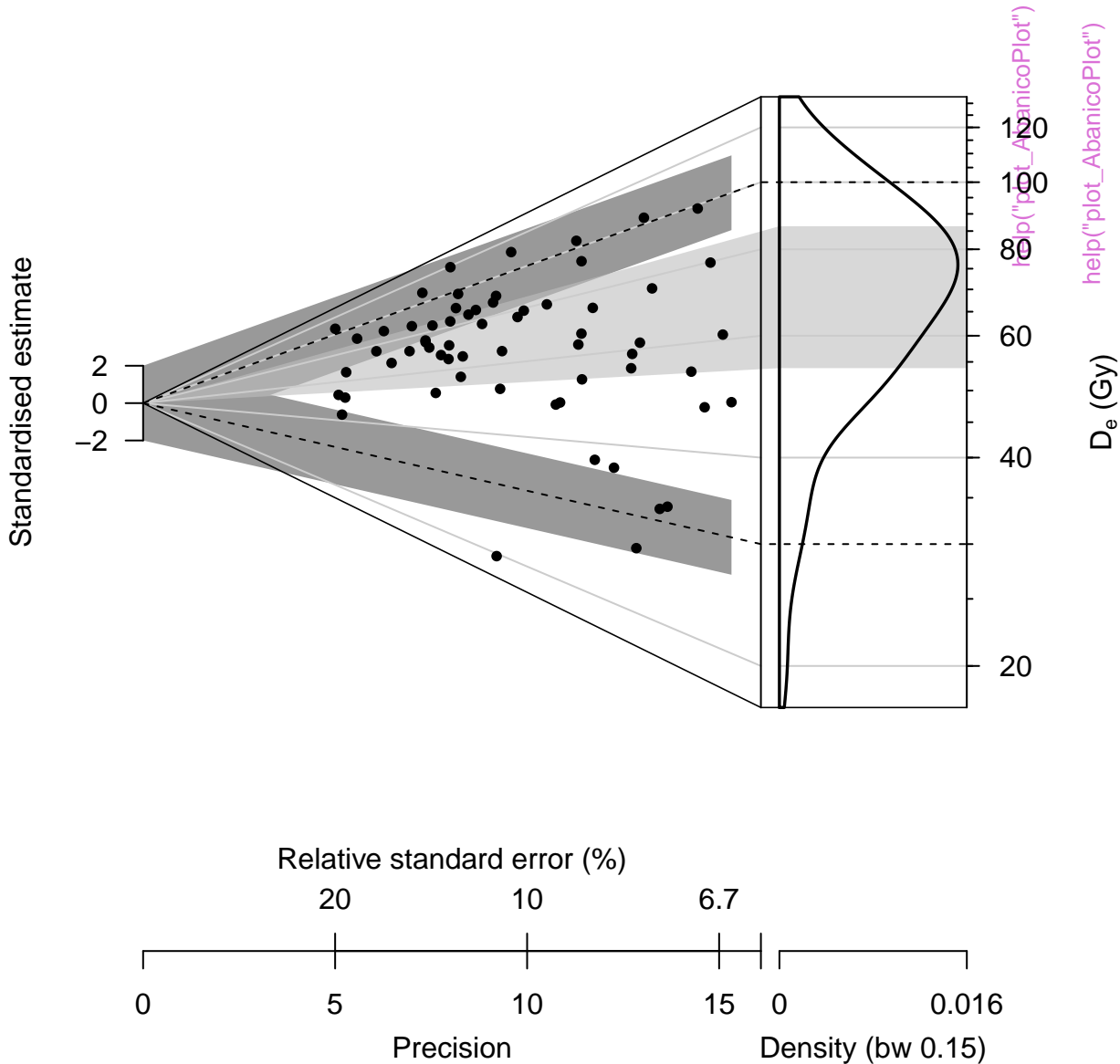
0.016

Precision

Density (bw 0.15)

# D<sub>e</sub> distribution

n = 62

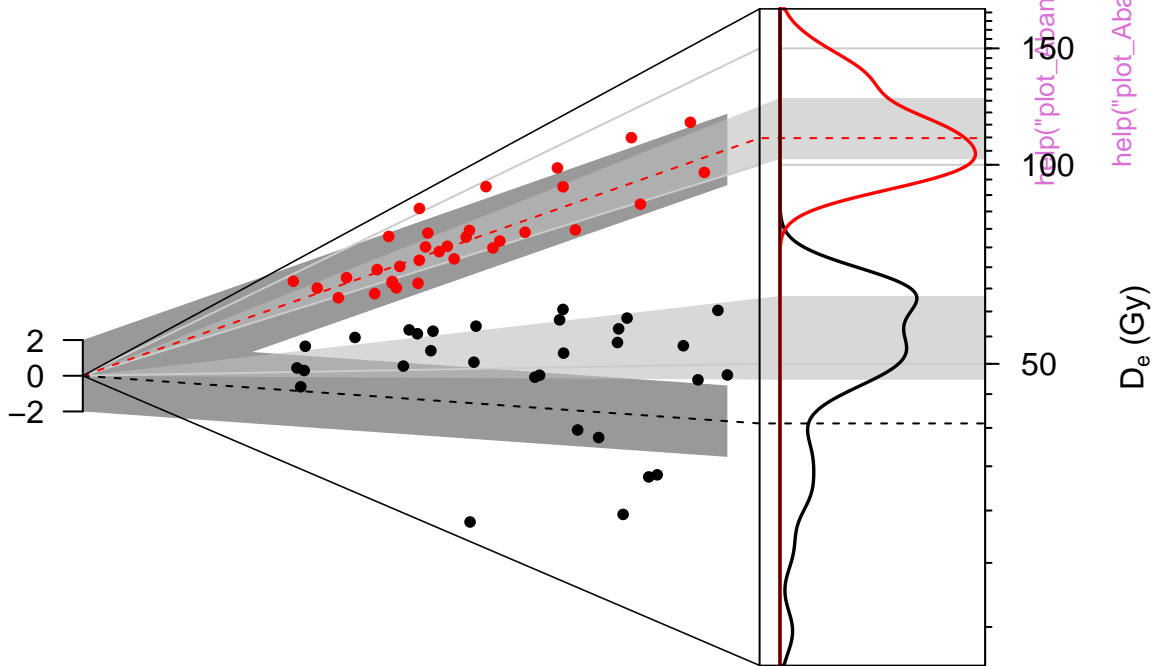


# D<sub>e</sub> distribution

n = 30

n = 32

Standardised estimate



Relative standard error (%)

20

10

6.7

0

5

10

15

0.032

Precision

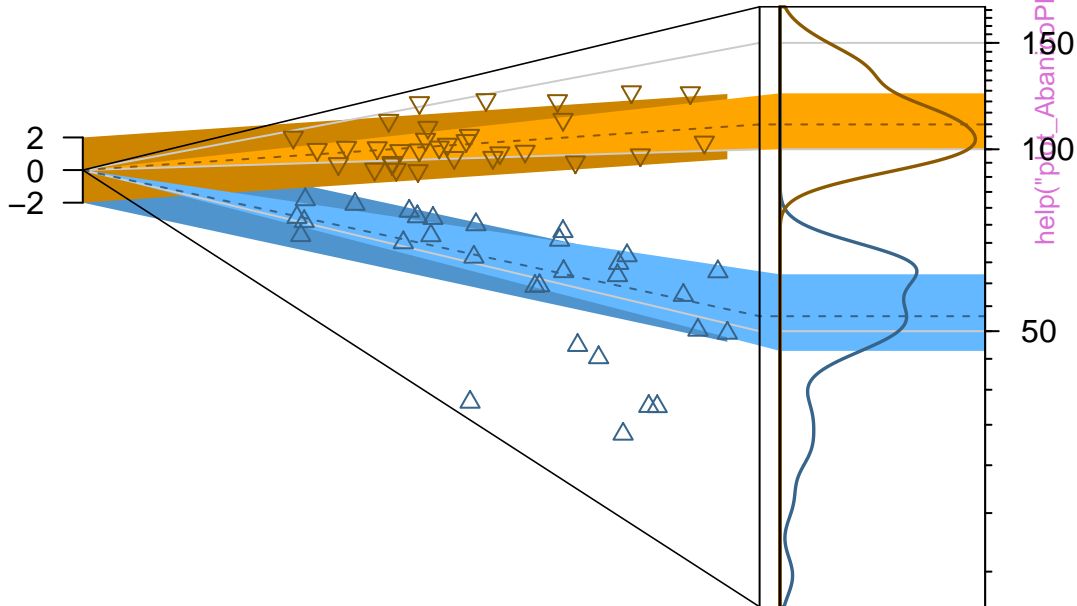
Density (bw 0.074)

# D<sub>e</sub> distribution

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

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

Standardised estimate



help("plot\_AbanicoPlot")

help("plot\_AbanicoPlot")

D<sub>e</sub> (Gy)

Relative standard error (%)

20

10

6.7

0

5

10

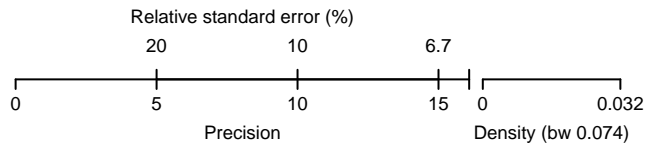
15

0.032

Precision

Density (bw 0.074)





`help("plot_AbanicoPlot")`

# 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



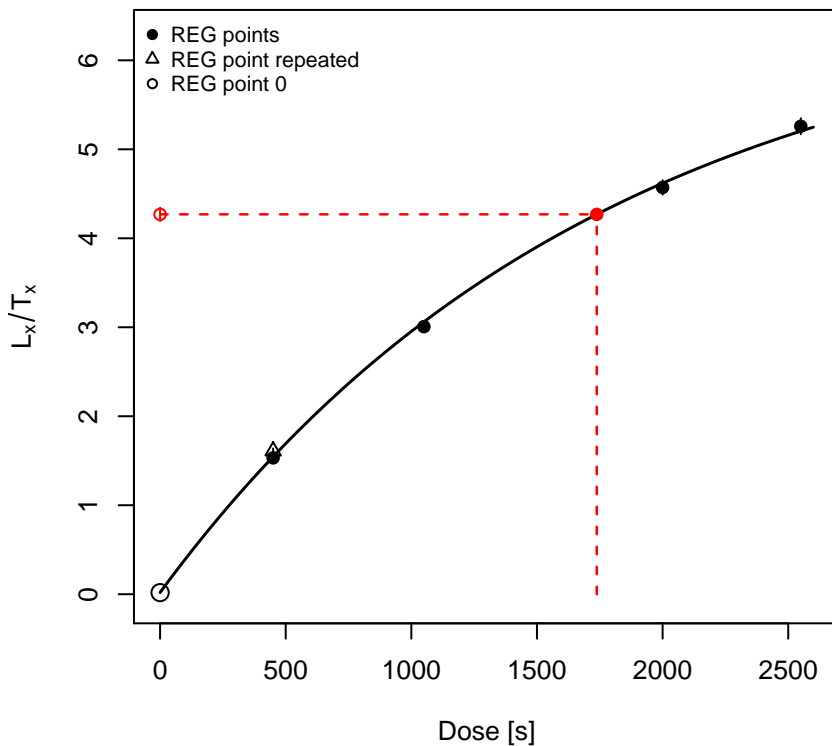


# Dose recovery test

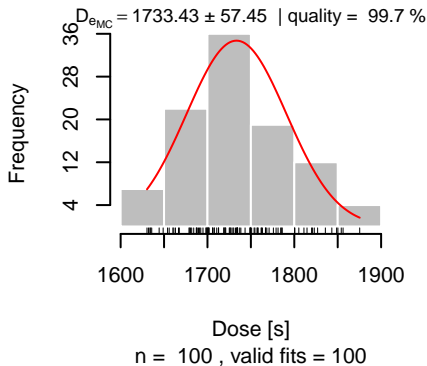


# Growth curve

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



## $D_e$ from MC simulation



## Test dose response



# Growth curve

$D_e = 1737.88 \pm 59.97$  | fit: EXP



## $D_e$ from MC simulation

$D_{eMC} = 1732.18 \pm 59.97$  | quality = 99.7 %



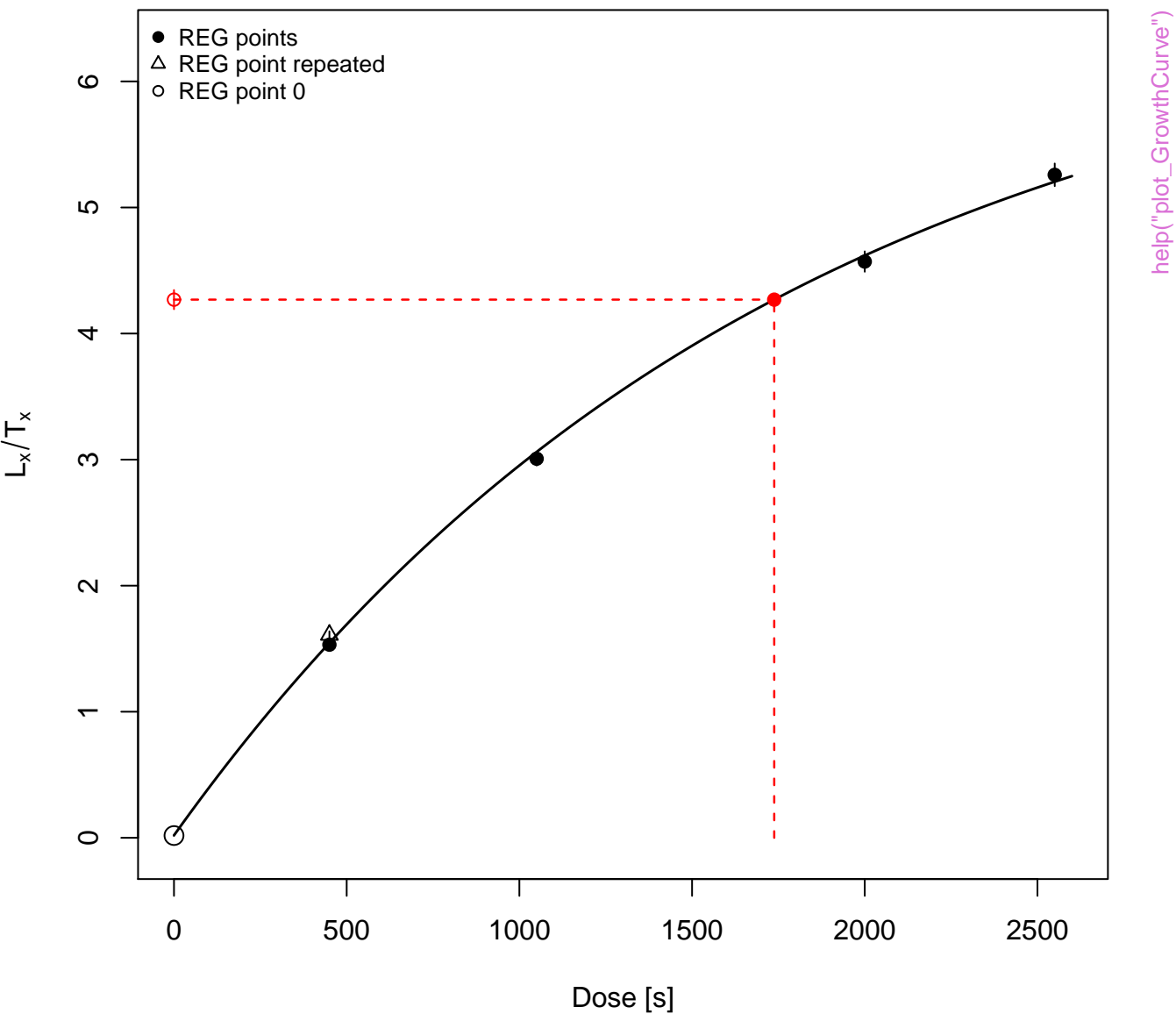
Dose [s]  
n = 100 , valid fits = 100

## Test dose response



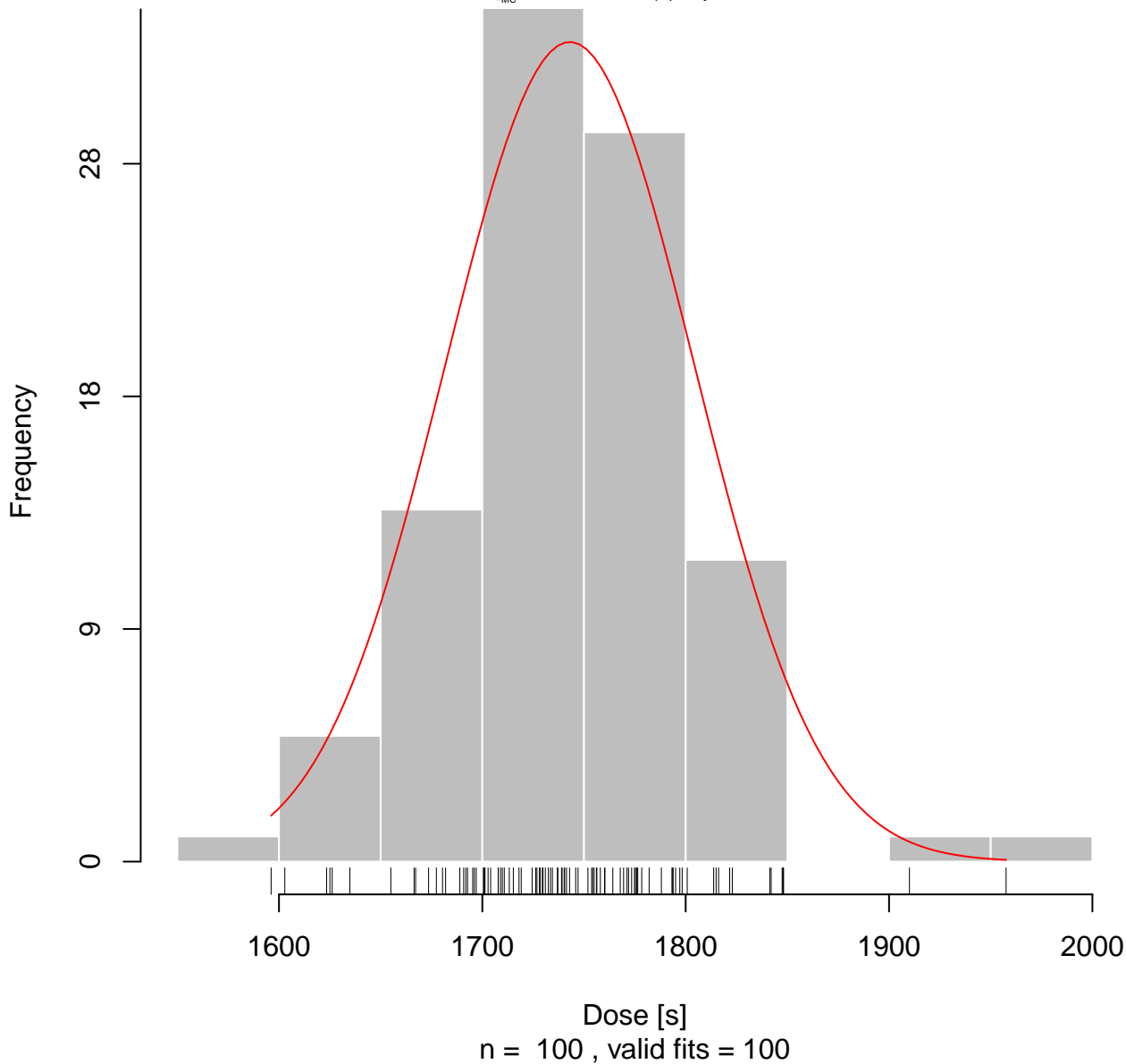
# Growth curve

$D_e = 1737.88 \pm 61.2$  | fit: EXP



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

D<sub>MC</sub> = 1743.04 ± 61.2 | quality = 99.7 %



# Test dose response



# Histogram



# Histogram of De-values

Example data set





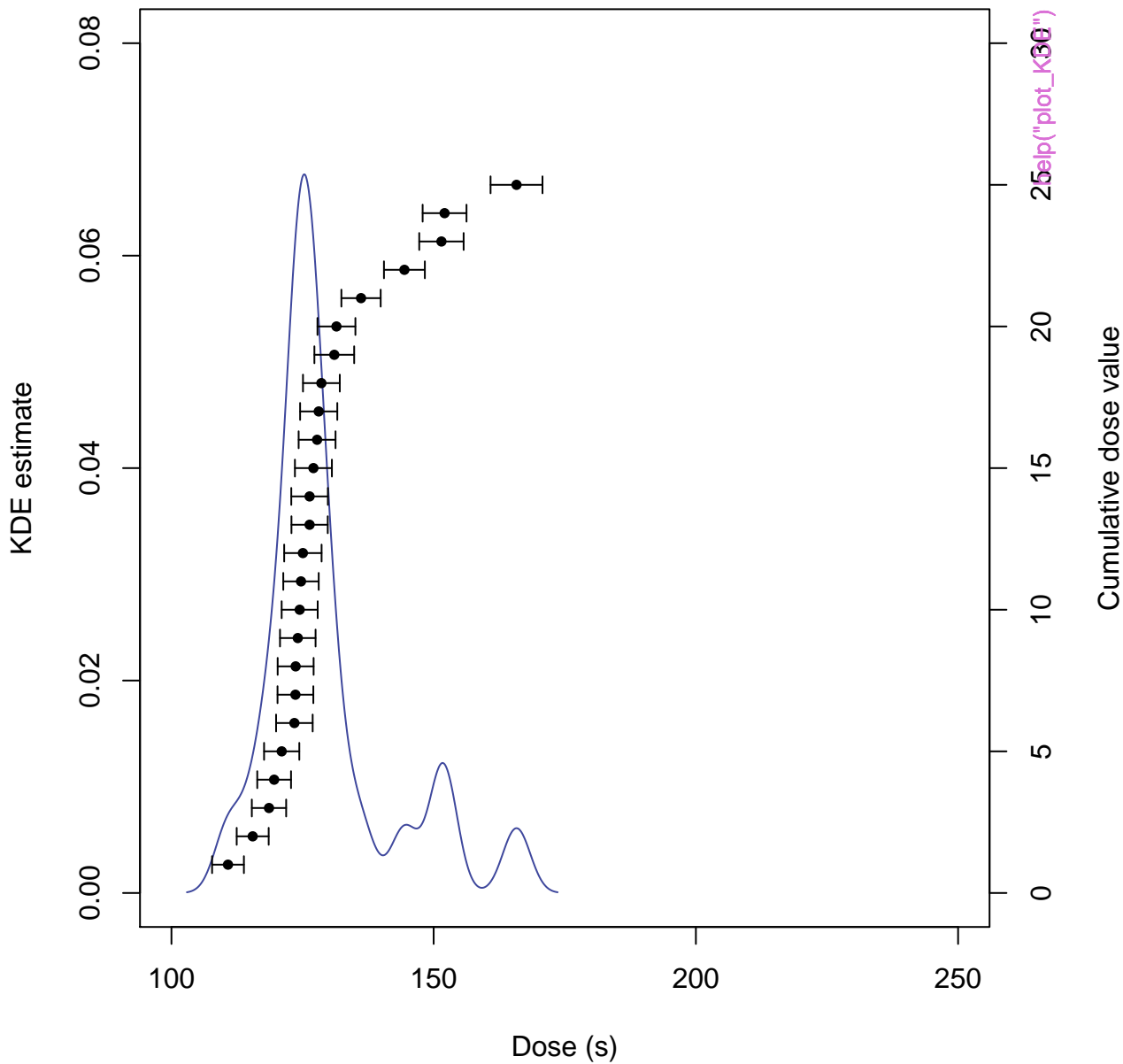
# D<sub>e</sub> distribution



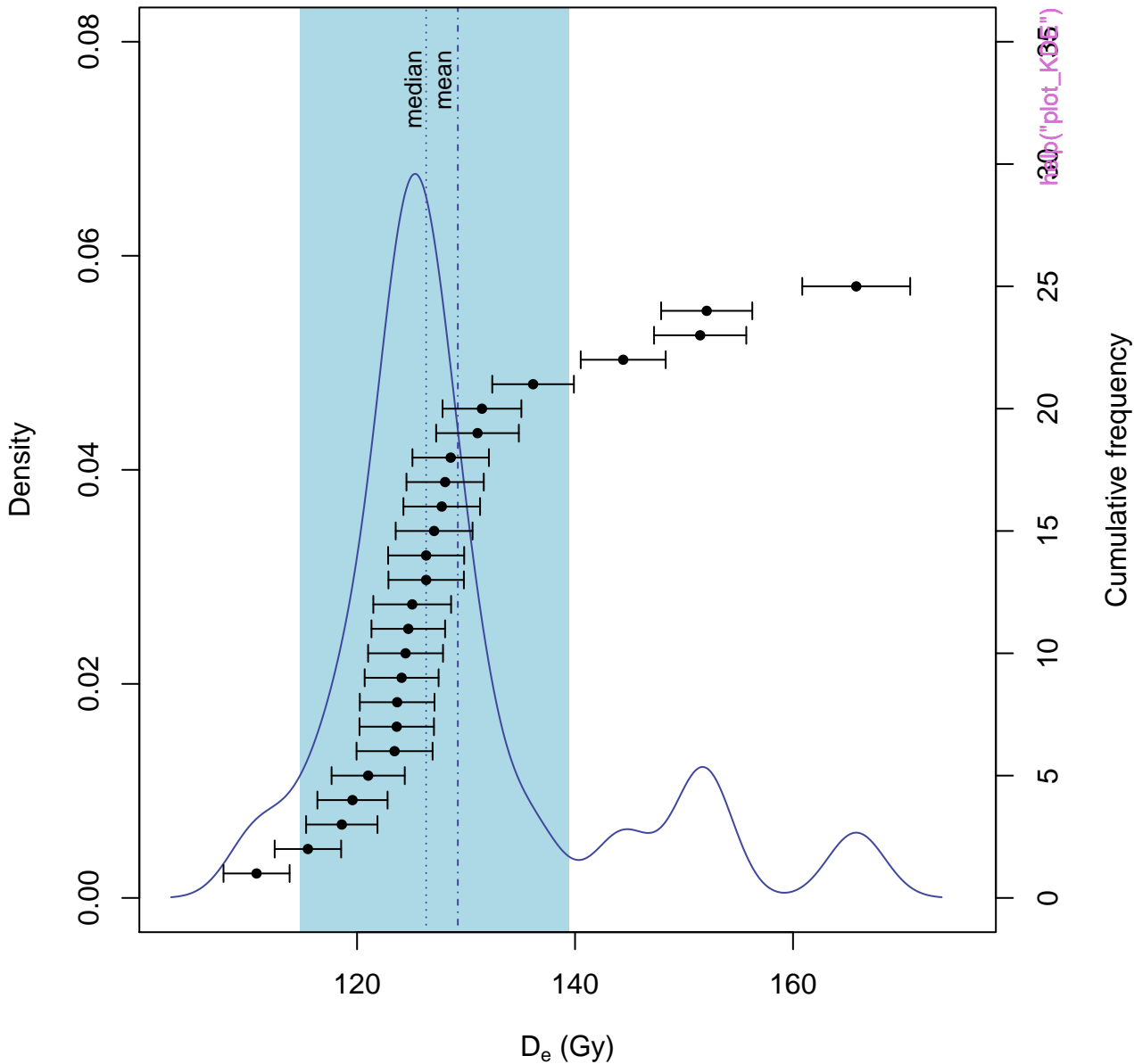
**D<sub>e</sub> distribution**



# Dose distribution



**D<sub>e</sub> distribution**

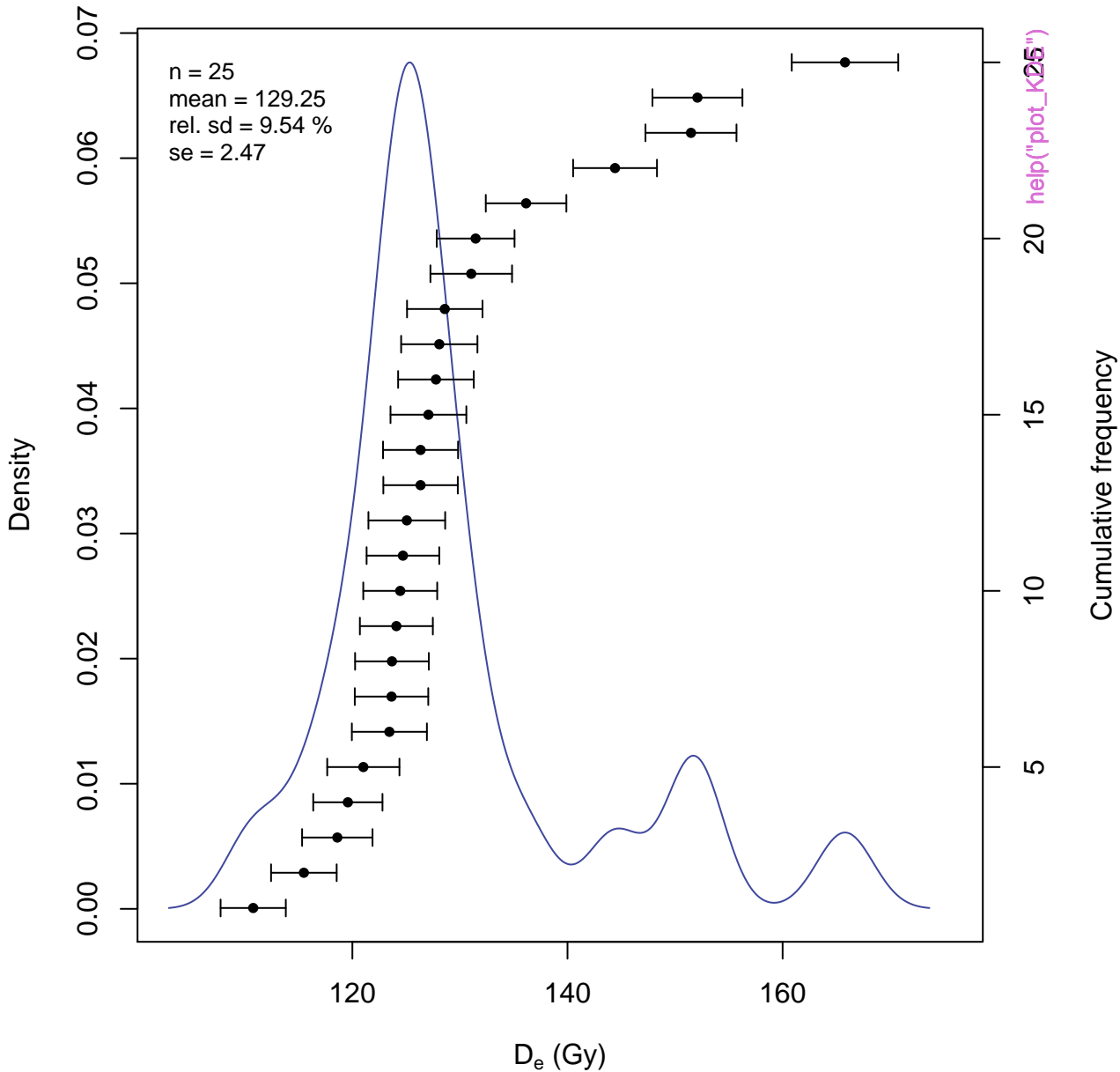


# D<sub>e</sub> distribution

n = 25 | median = 126.34 | skewness = 1.34



# D<sub>e</sub> distribution



**D<sub>e</sub> distribution**



# D<sub>e</sub> distribution





# D<sub>e</sub> distribution



NR(t) Plot

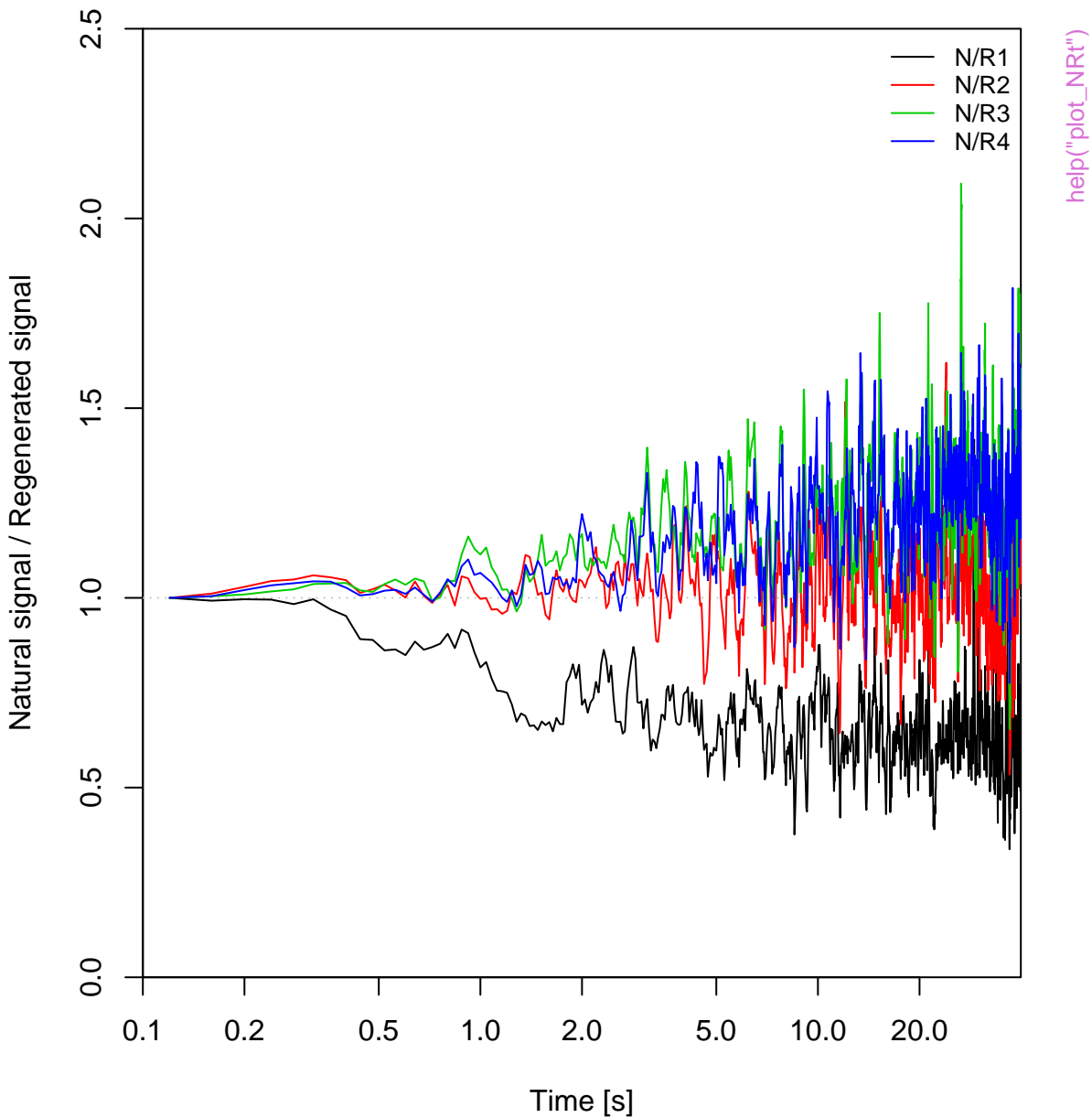


NR(t) Plot



help("plot\_NRt")

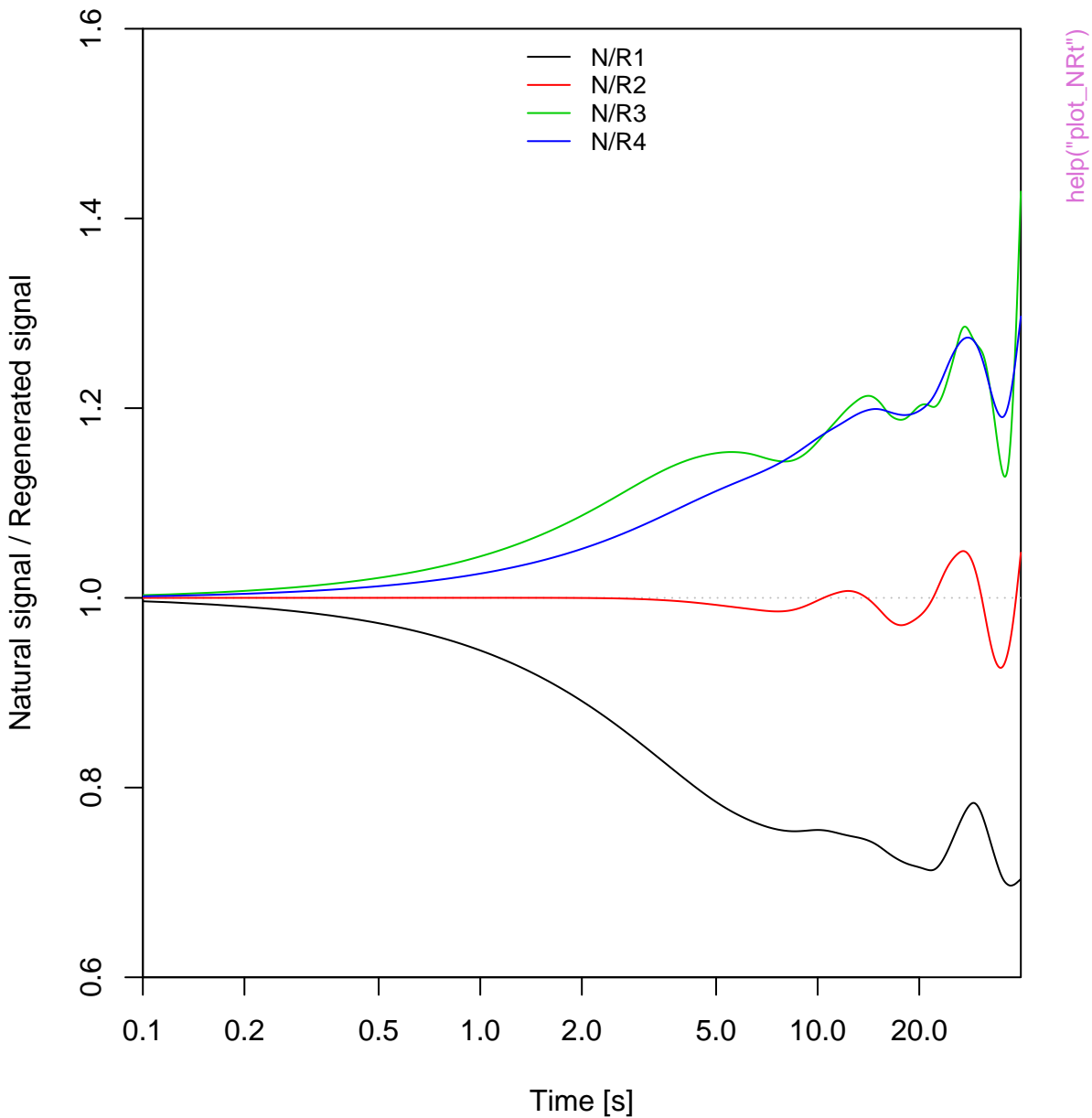
NR(t) Plot



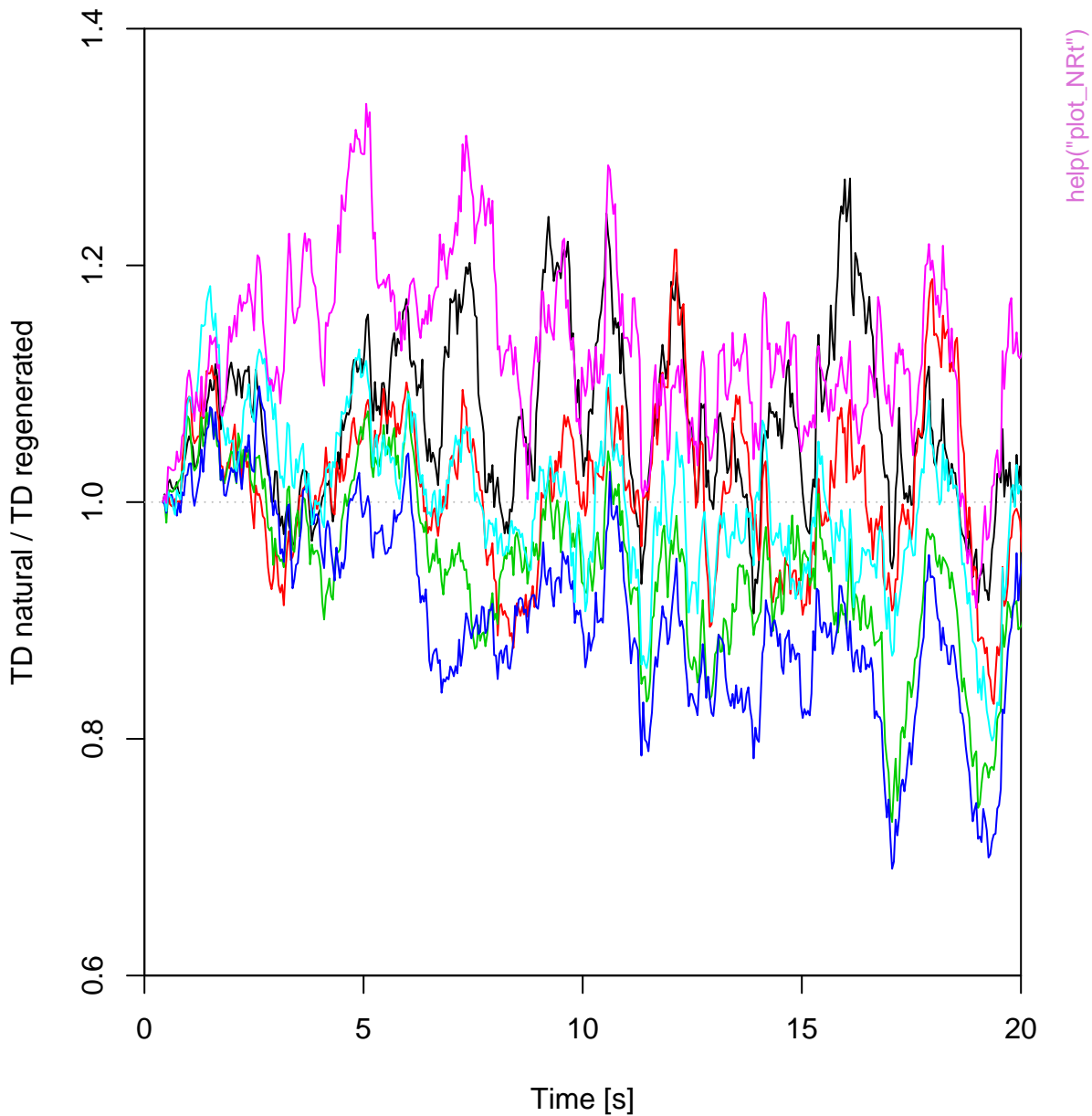
NR(t) Plot

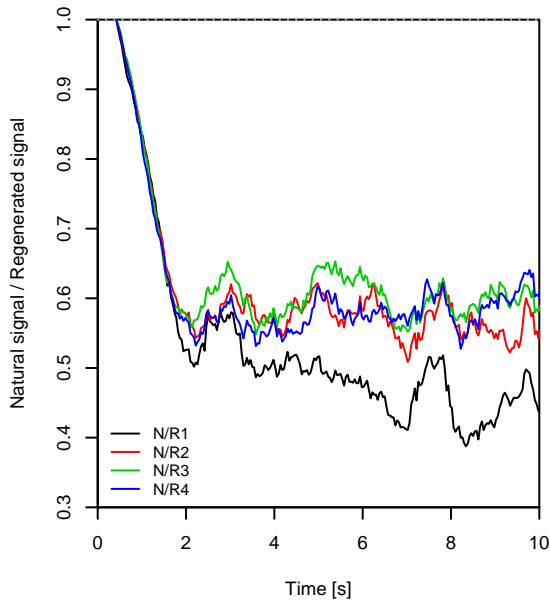
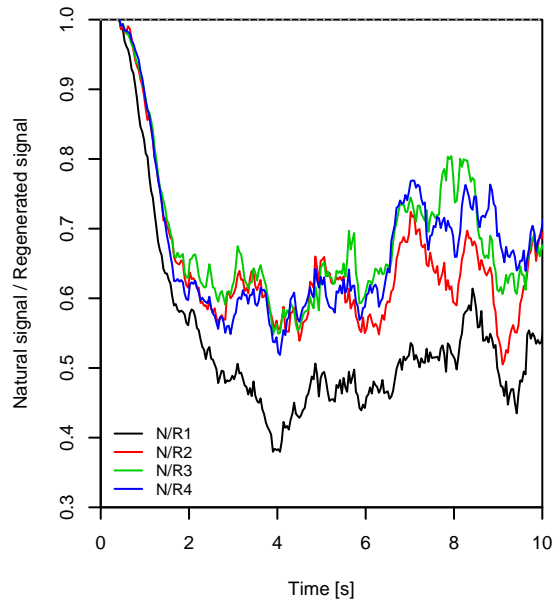


# NR(t) Plot

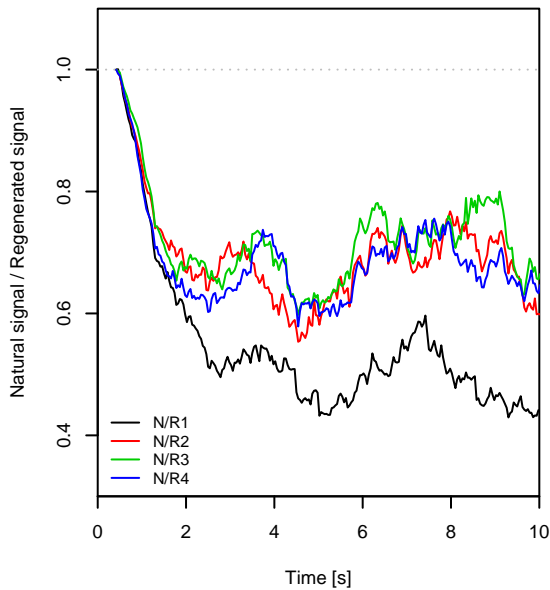
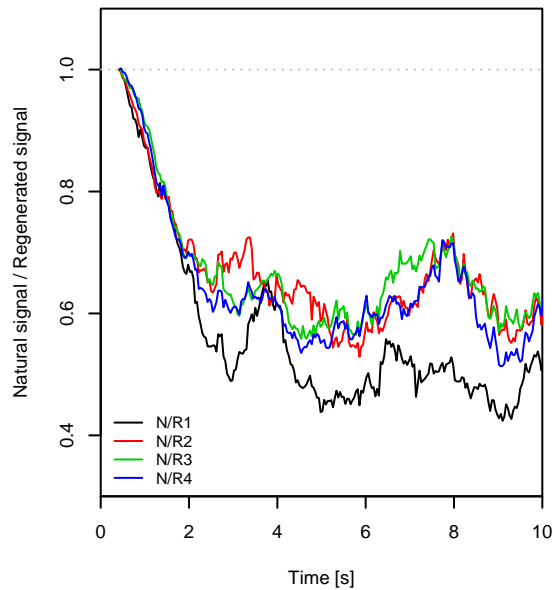


TnTx(t) Plot

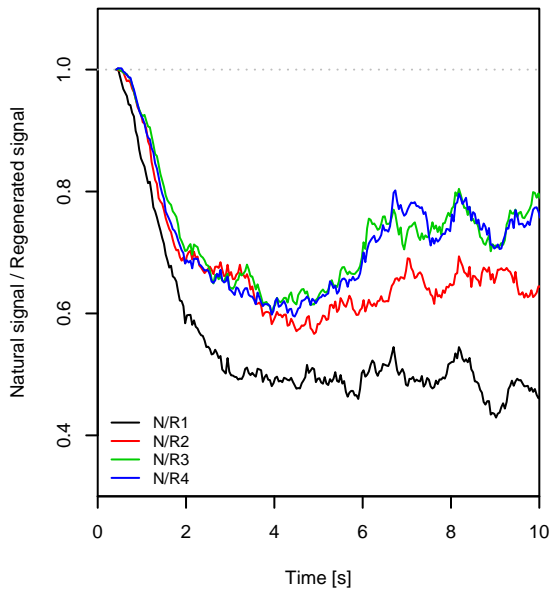
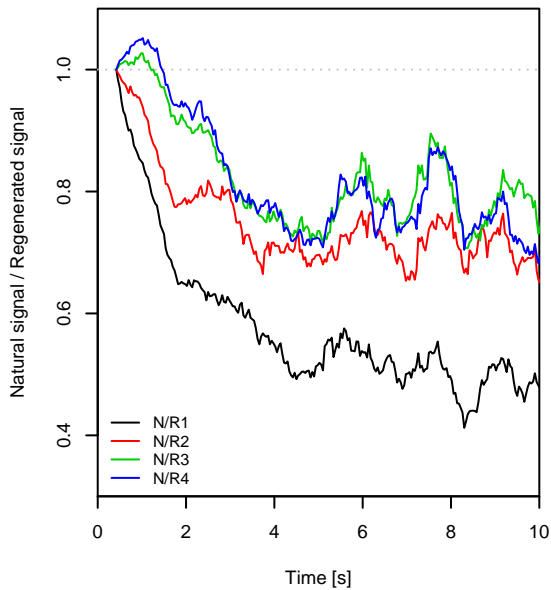
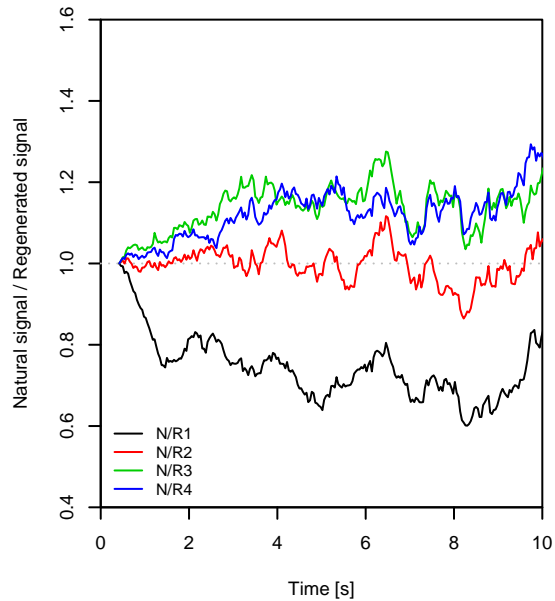


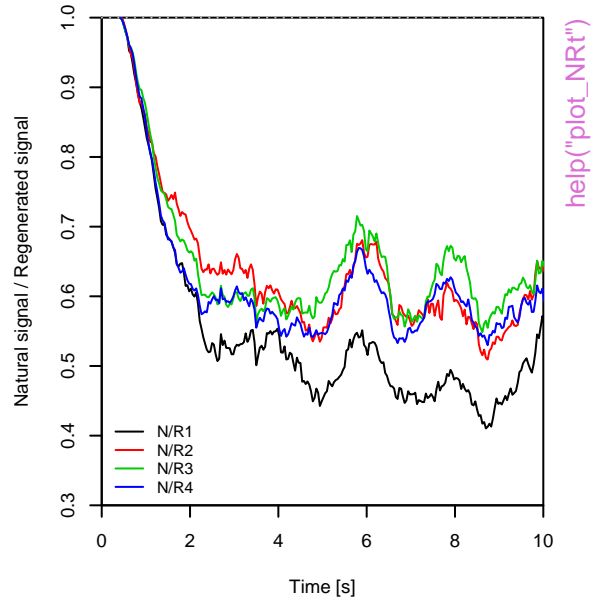
**Aliquot #1****Aliquot #2**

help("plot\_NRt")

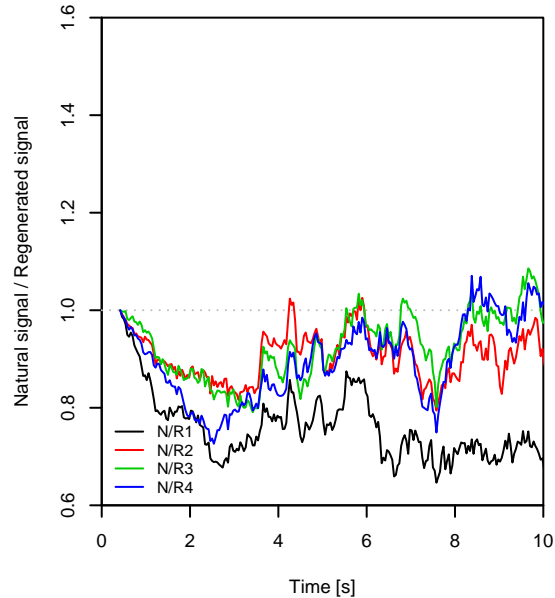
**Aliquot #3****Aliquot #4**

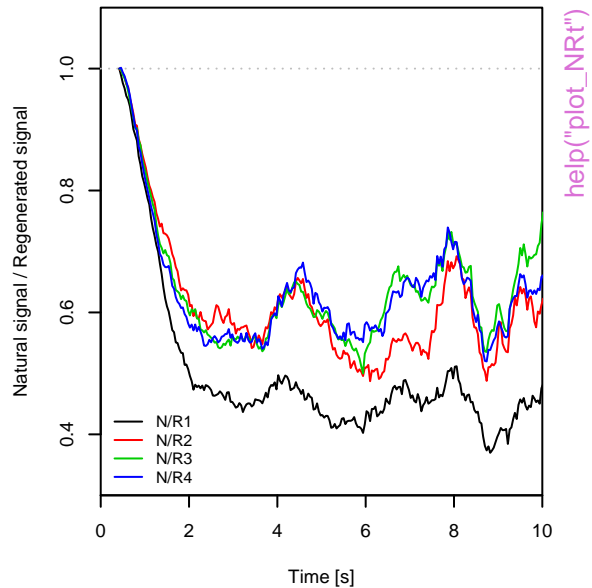
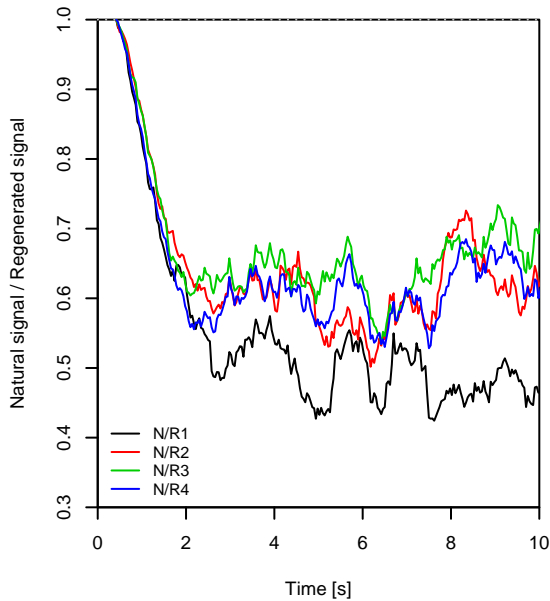
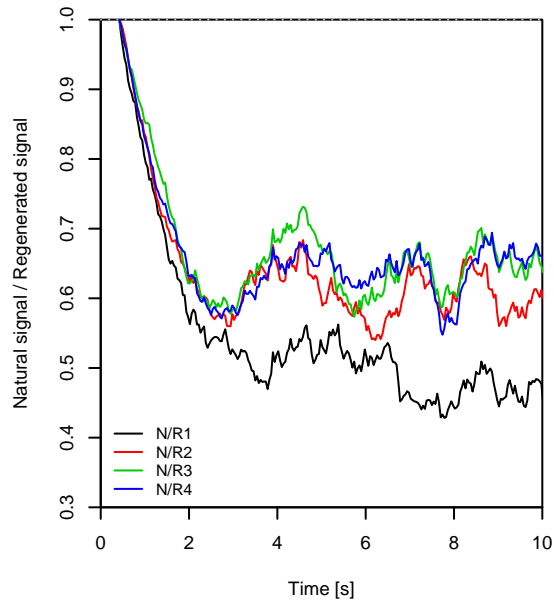


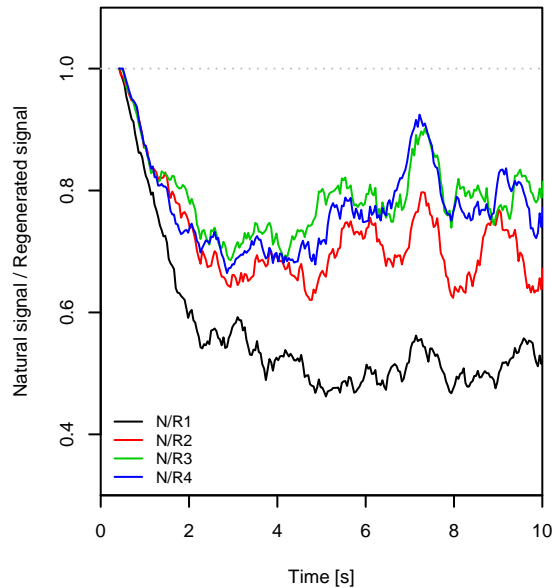
**Aliquot #5****Aliquot #6****Aliquot #7****Aliquot #8**

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

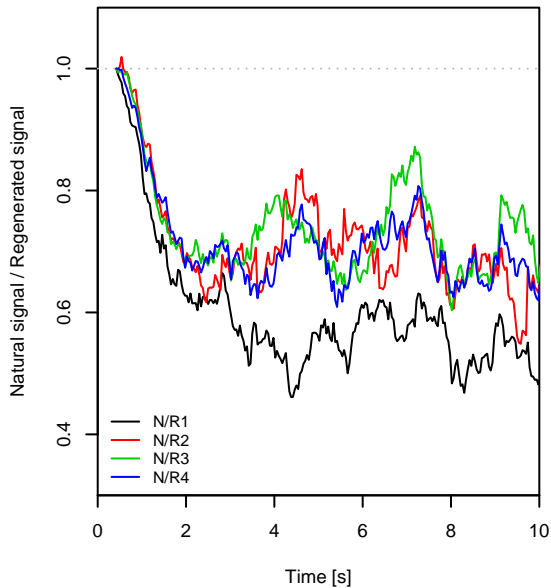
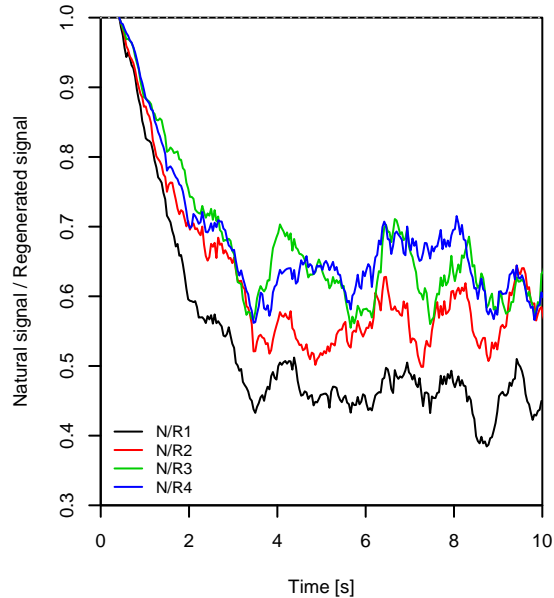
help("plot\_NRt")

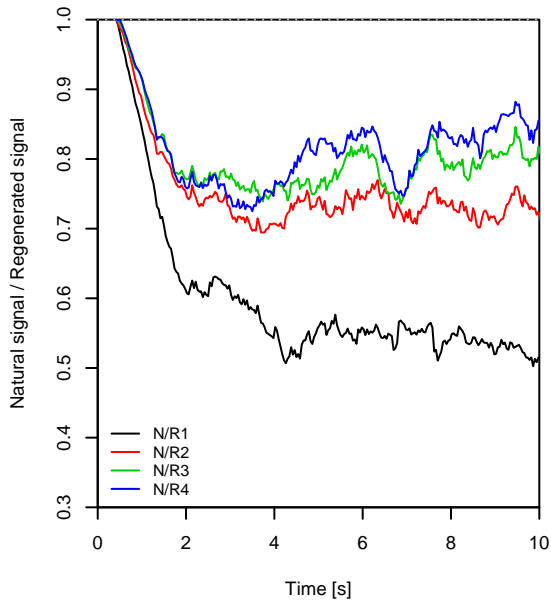
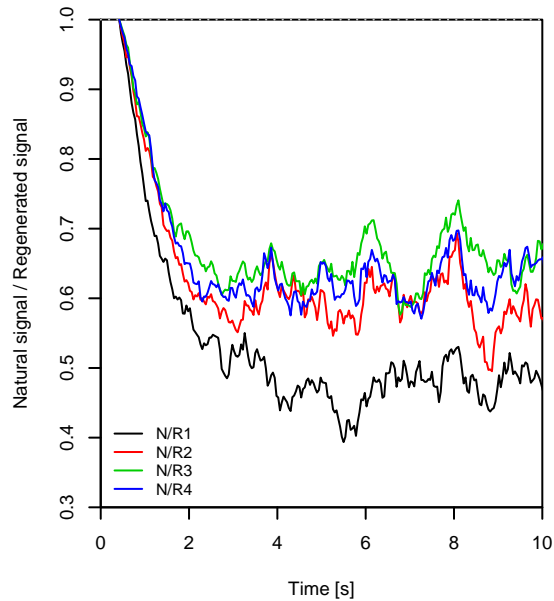
**Aliquot #11****Aliquot #12**

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

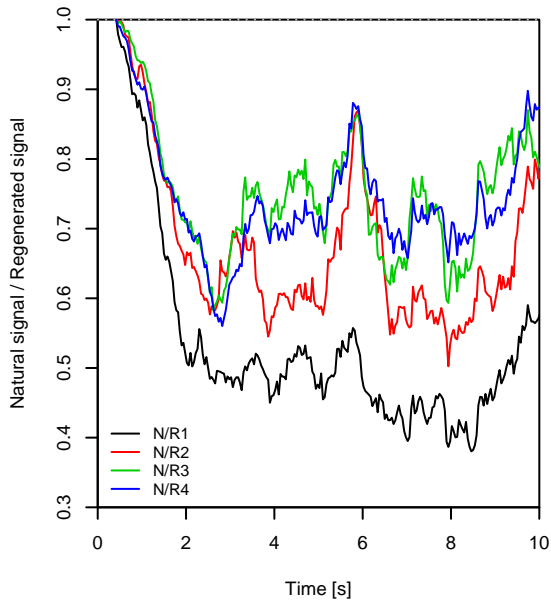
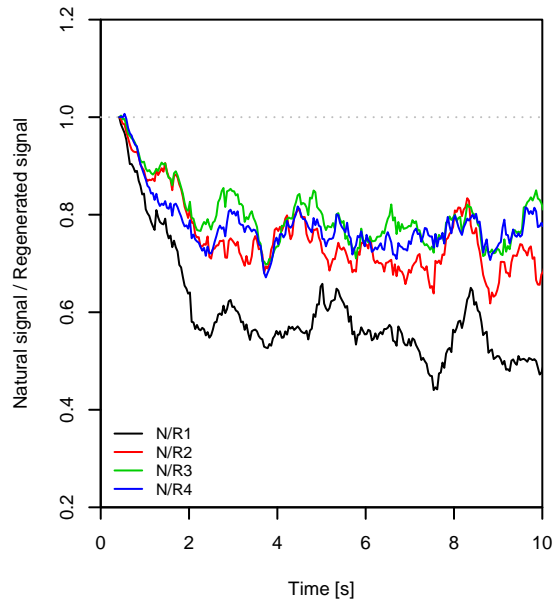
**Aliquot #17****Aliquot #18**

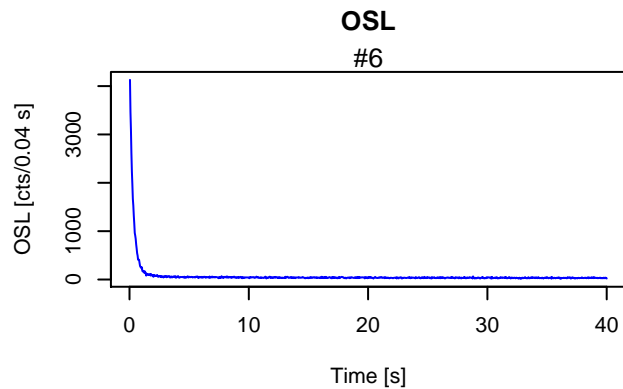
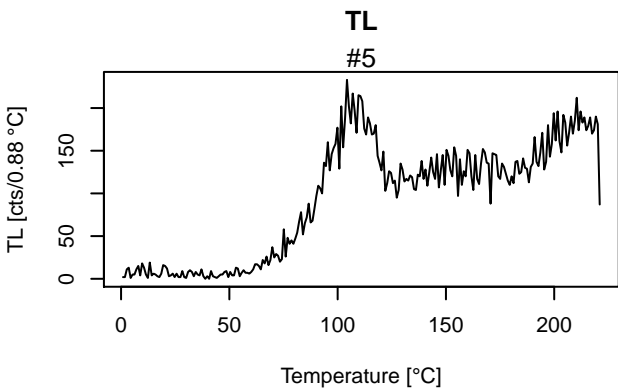
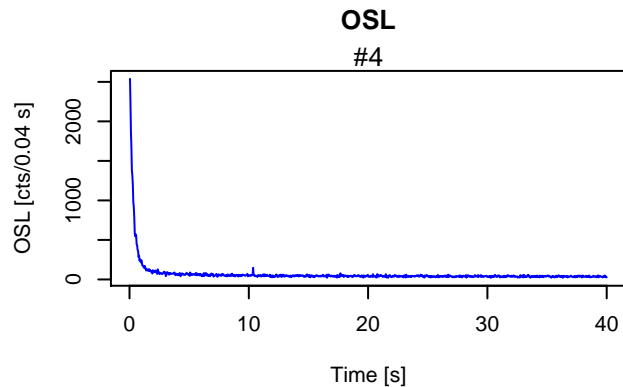
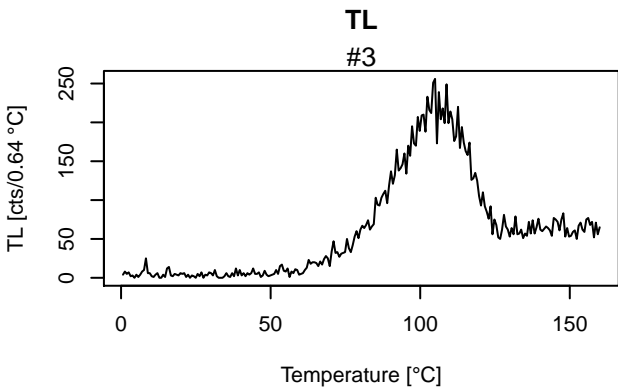
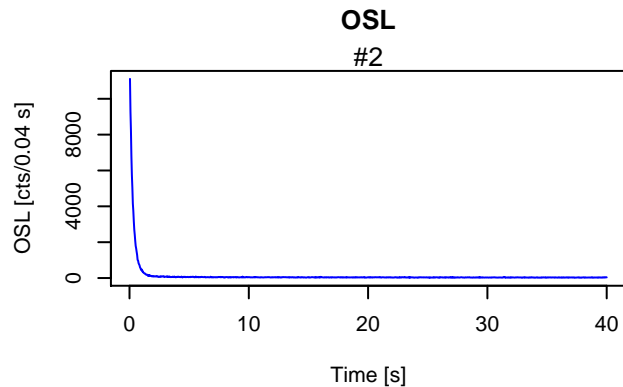
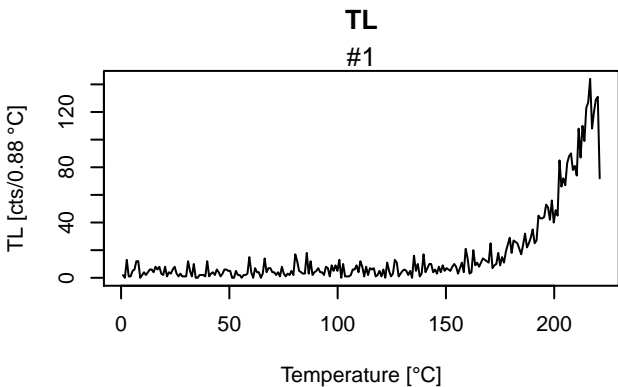
help("plot\_NRt")

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

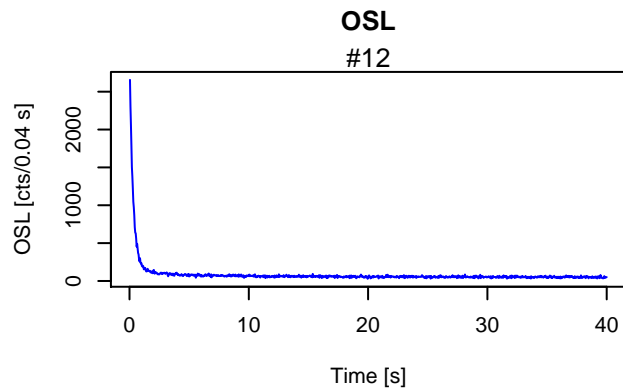
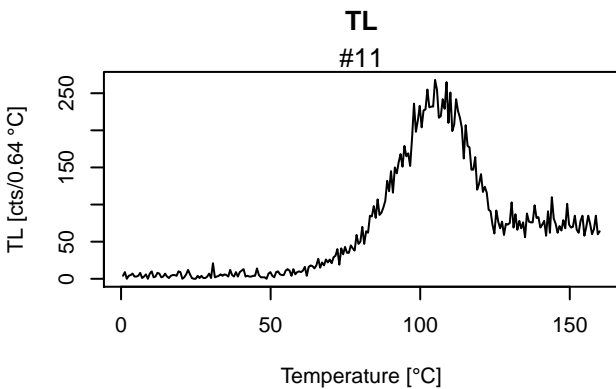
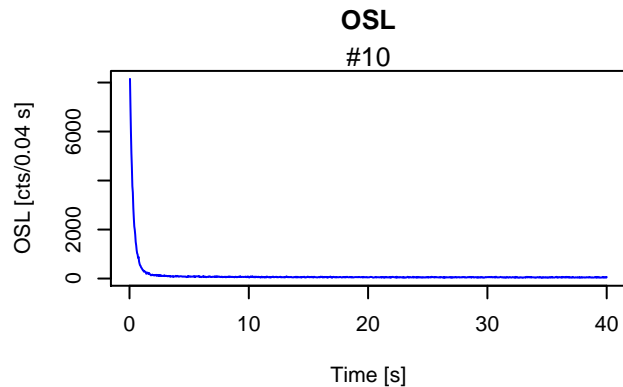
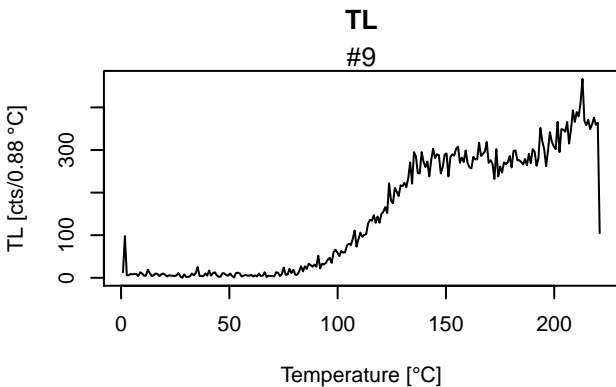
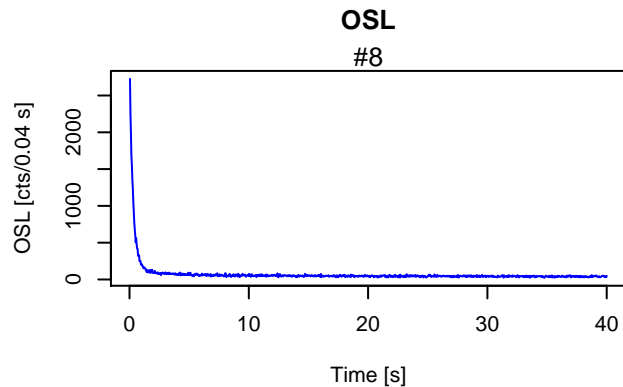
**Aliquot #21****Aliquot #22**

help("plot\_NRt")

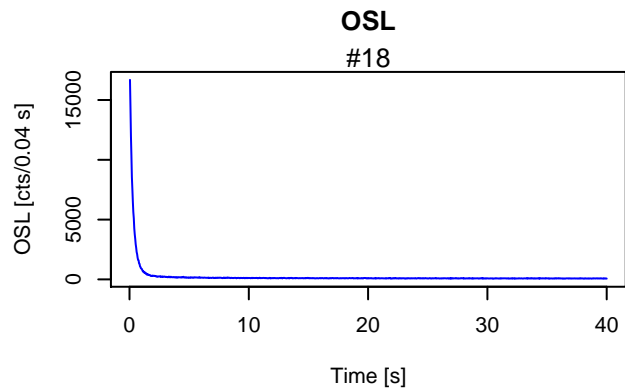
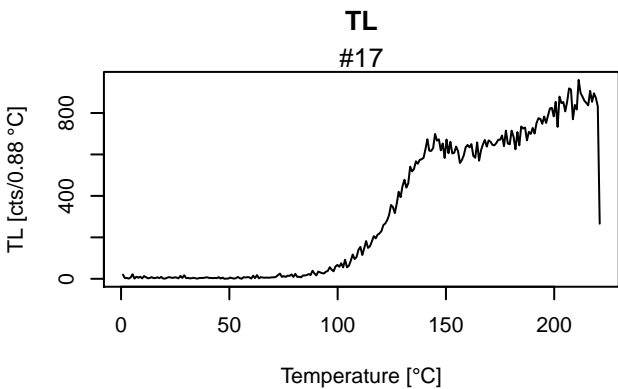
**Aliquot #23****Aliquot #24**



help("plot\_RLumAnalysis")



help("plot\_RLumAnalysis")







help("plot\_RLum\_Analysis")



help("plot\_RLumAnalysis")

# TL combined



## unkown curve type



# RLum.Data.Image



RLum.Data.Spectrum



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

# RLum.Data.Spectrum



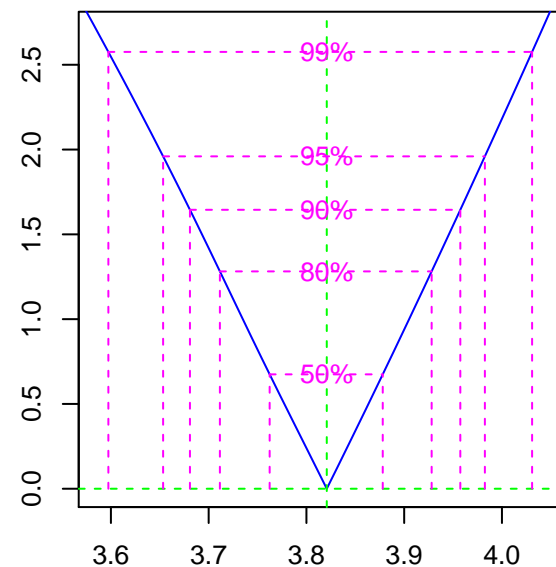
[help\("plot\\_RLum.Data.Spectrum"\)](#)

## unkown curve type

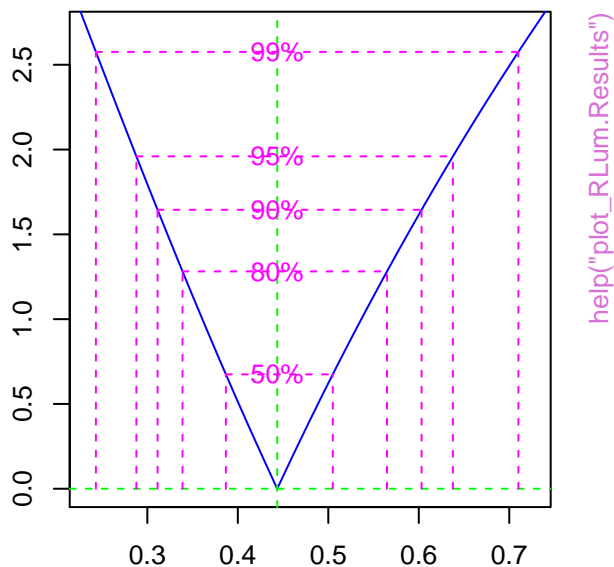




**Likelihood profile: gamma**



**Likelihood profile: sigma**



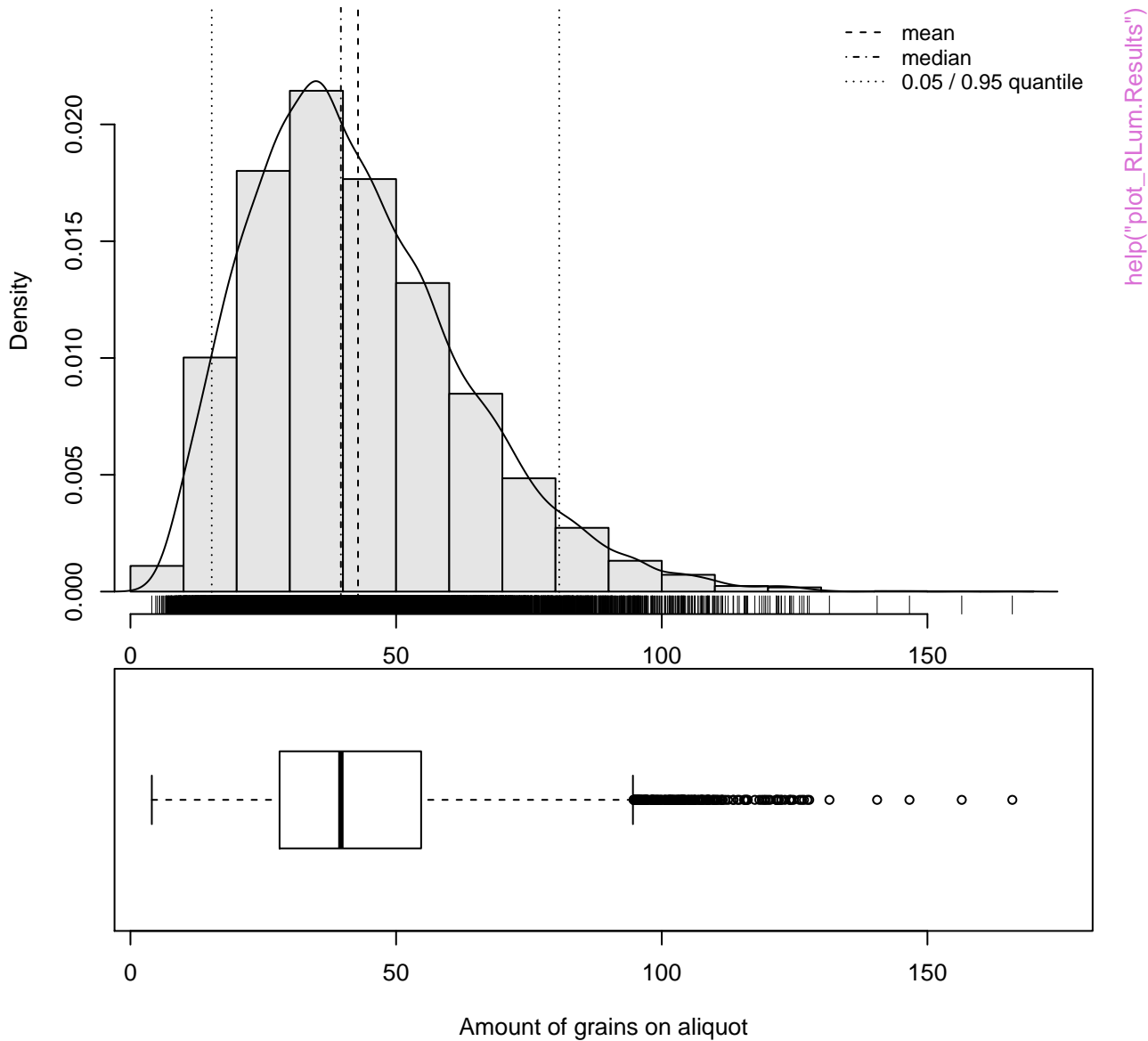
help("plot\_RLum.Results")

**Likelihood profile: p0**



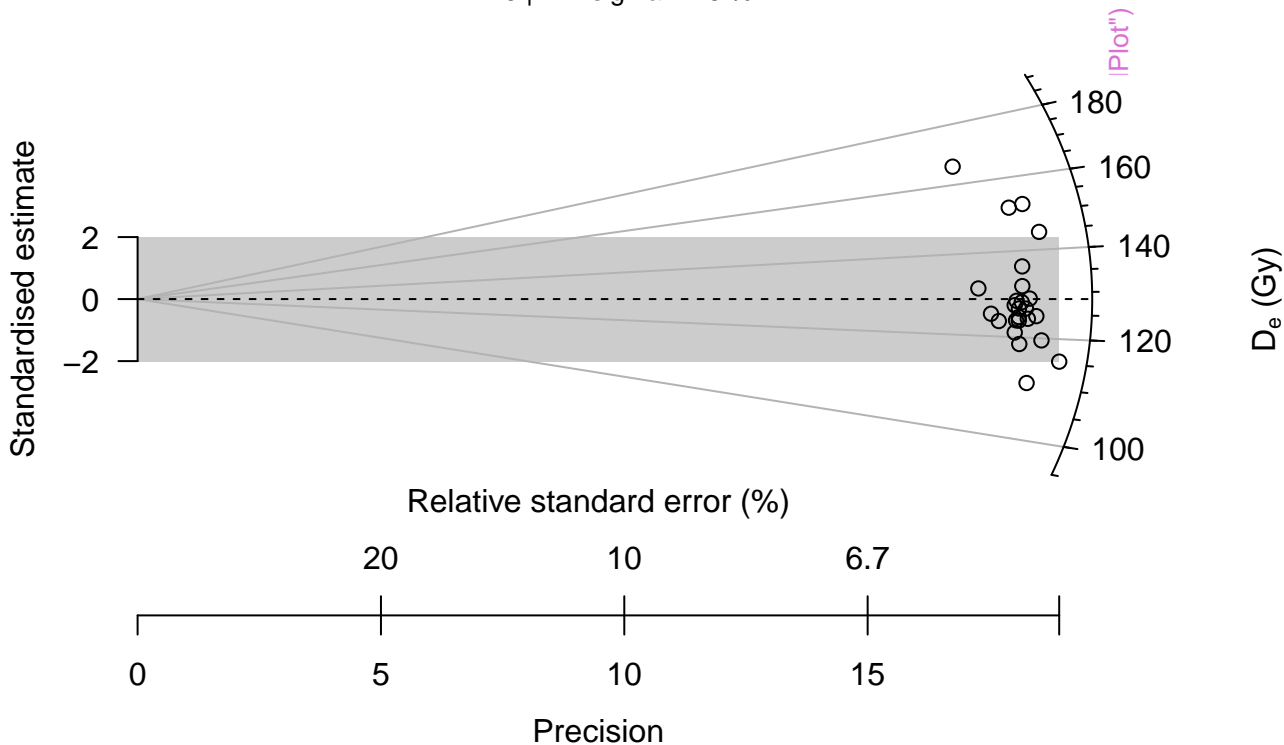
# Monte Carlo Simulation

$n = 10000 \mid \hat{\mu} = 43 \mid \hat{\sigma} = 20 \mid \frac{\hat{\sigma}}{\sqrt{n}} = 0 \mid v = 0.85$



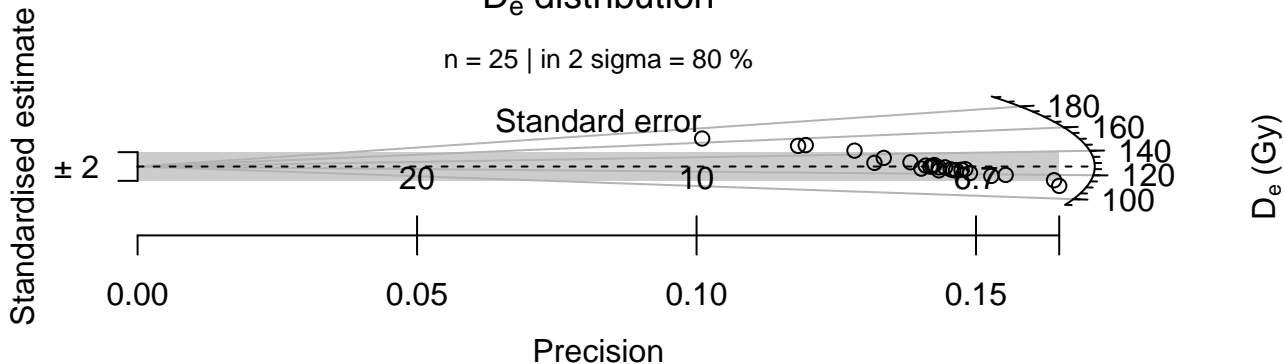
## D<sub>e</sub> distribution

n = 25 | in 2 sigma = 76 %



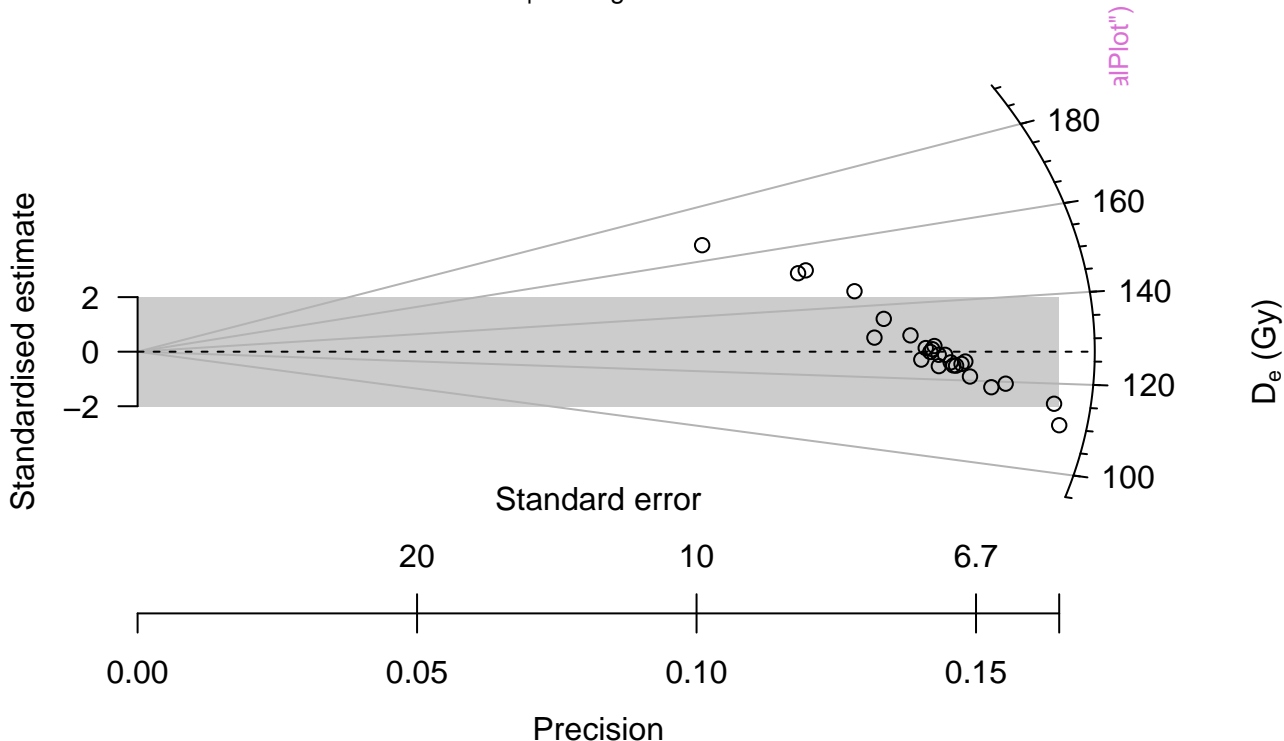
## D<sub>e</sub> distribution

n = 25 | in 2 sigma = 80 %



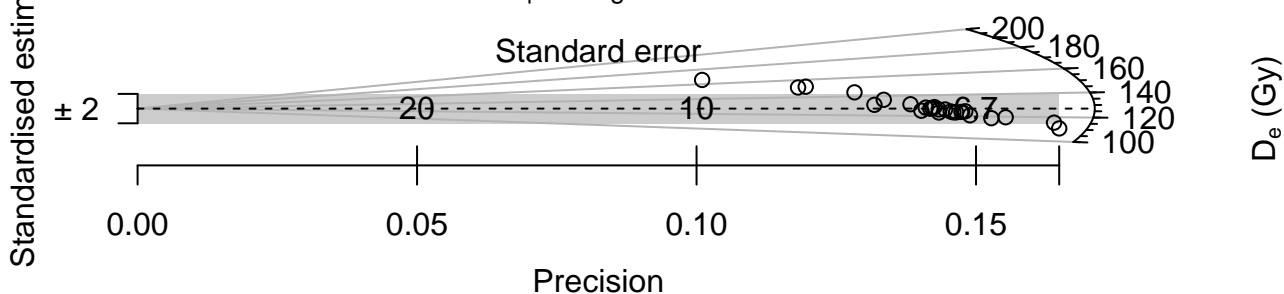
## D<sub>e</sub> distribution

n = 25 | in 2 sigma = 80 %



## D<sub>e</sub> distribution

n = 25 | in 2 sigma = 80 %



## D<sub>e</sub> distribution

n = 25 | in 2 sigma = 76 %

Standardised estimate



Relative standard error (%)

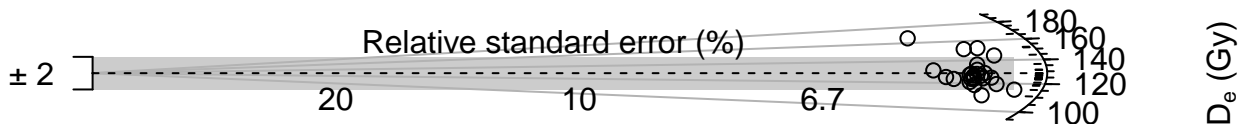


Precision

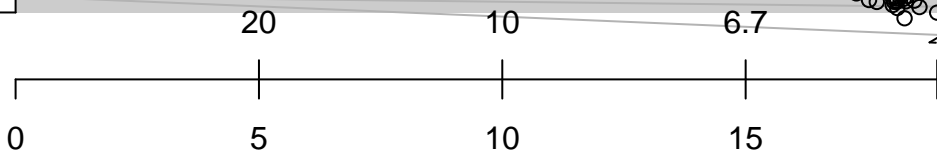
## D<sub>e</sub> distribution

n = 25 | in 2 sigma = 76 %

Standardised estimate



Relative standard error (%)

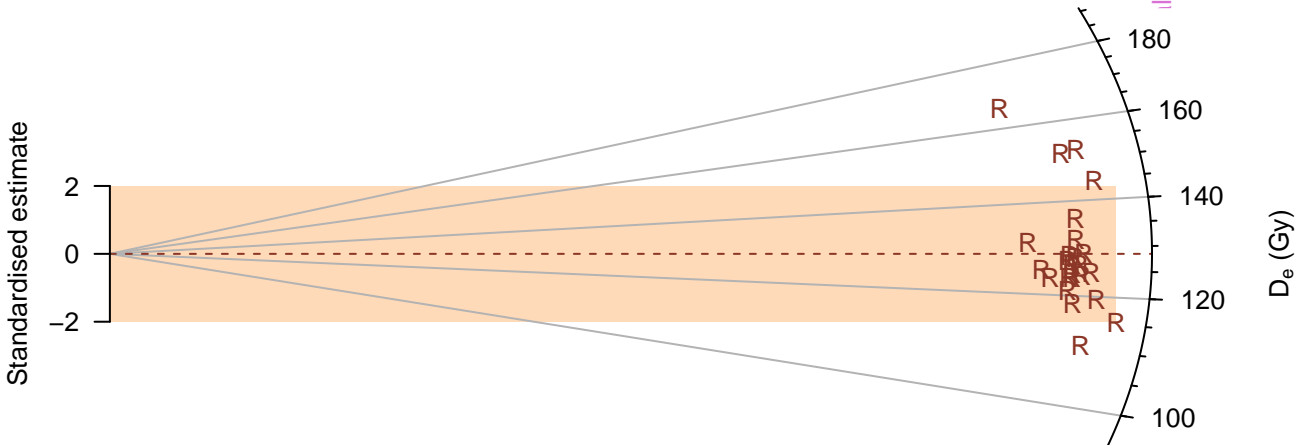


Precision

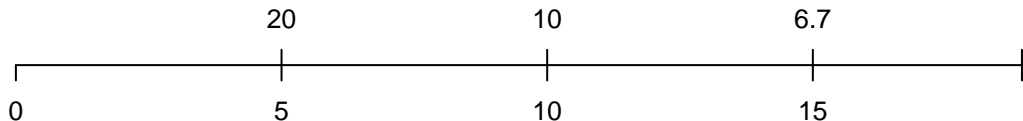
# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 76 %

Plot



Relative standard error (%)

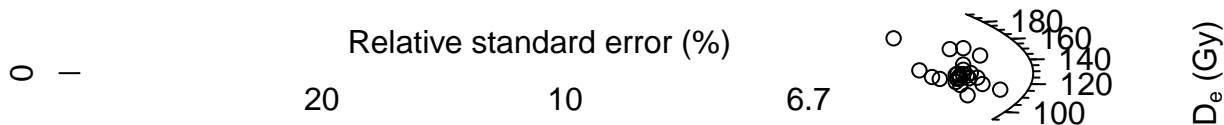


Precision

# D<sub>e</sub> distribution

n = 25 | in 2 sigma = 76 %

Relative standard error (%)



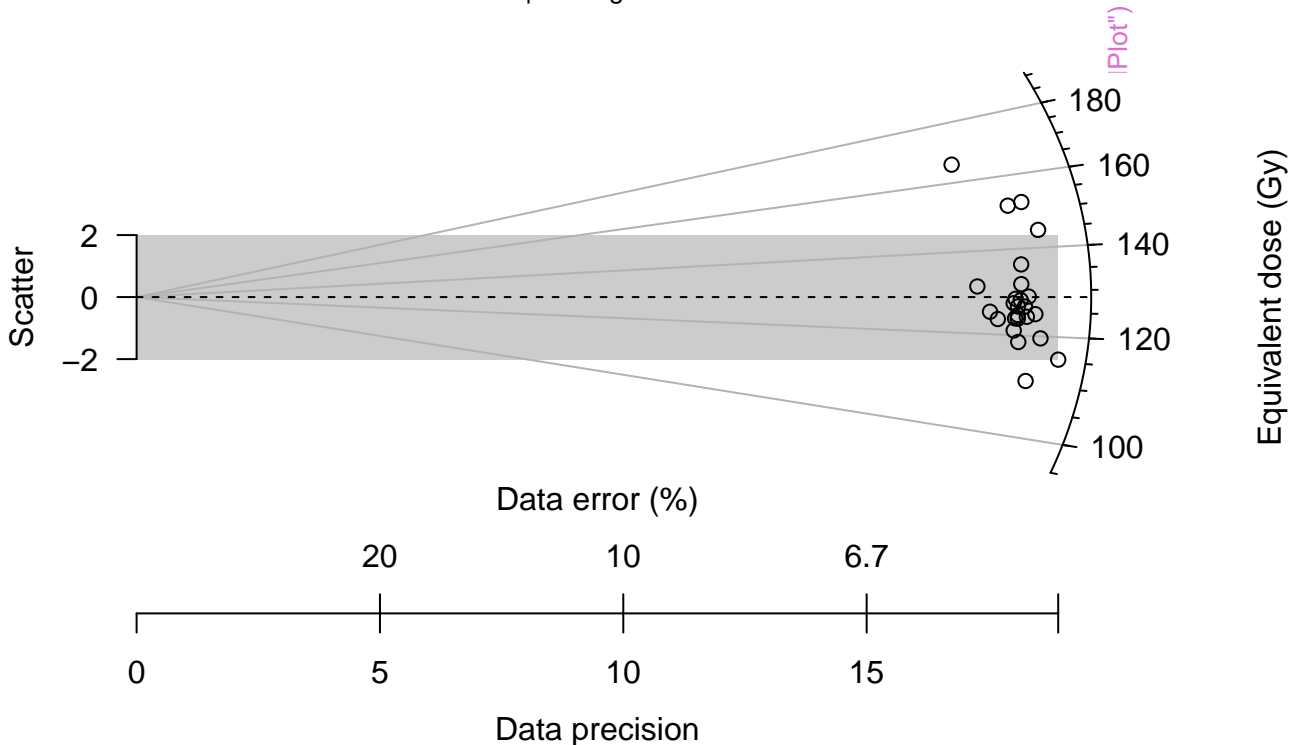
Standardised estimate

D<sub>e</sub> (Gy)

Precision

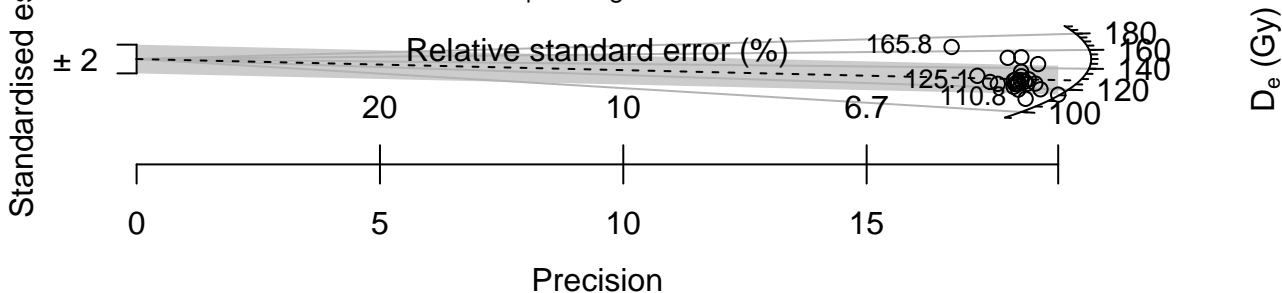
## D<sub>e</sub> distribution

n = 25 | in 2 sigma = 76 %



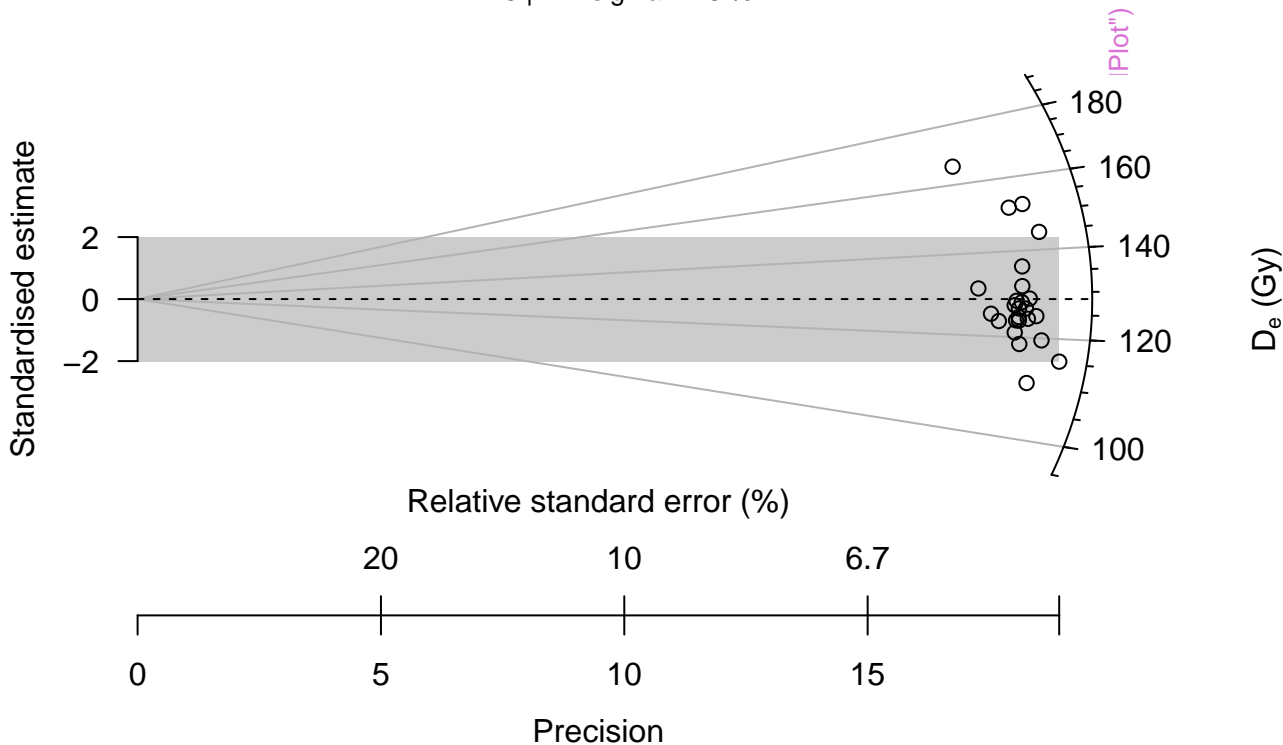
## D<sub>e</sub> distribution

n = 25 | in 2 sigma = 76 %



## D<sub>e</sub> distribution

n = 25 | in 2 sigma = 76 %



## D<sub>e</sub> distribution

weighted mean = 127.13 | median = 126.34





## D<sub>e</sub> distribution

n = 15 | in 2 sigma = 73.3 %

n = 10 | in 2 sigma = 100 %



## D<sub>e</sub> distribution

n = 15 | in 2 sigma = 73.3 %

n = 10 | in 2 sigma = 100 %

