	<b>IBL 637 Cesium-137<math>\gamma</math>-ray machine 2018</b>	SOP nr.: DCB-C-D006
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## 1. Equipment identification

IBL 637 Cesium-137 $\gamma$ -ray machine  
UMCG building 3215 room 3215.0549A

## 2. Goal

The Cesium-137 $\gamma$ -ray machine is to be used by authorized researchers to irradiate cells, Drosophila larvae, mice and rats and other samples.

## 3. Scope of this SOP

To provide a rule for the use of the Cesium-137 $\gamma$ -ray machine, including online reservation, access to the irradiation room and irradiation of samples.

## 4. Definitions & abbreviations

$^{137}\text{Cs}$ : Cesium 137 isotope

$\gamma$ -ray: gamma radiation, high-frequency electromagnetic radiation

RPO (Radiation Protection Officer): Rob Coppes (3616124)

RPE (Radiation Protection Expert): Rick Havinga (06-10756273)

Radiation worker (level 5): name will follow soon

FSD (Focus Subject Distance)

PFGE (Pulsed Field Gel Electrophoresis)

## 5. Principle

$\gamma$ -ray is extremely high-frequency electromagnetic radiation and consists of high-energy photons. Gamma rays are ionizing radiation, and are thus biologically hazardous.

### A. Materials

- IBL 637 Cesium-137 $\gamma$ -ray machine
- authorized entrance pass
- cells or other sample

## 6. Safety & precaution

It is always safe to use the  $\gamma$ -ray machine. The radiation is shielded by lead and can never expose the person that is using the machine significantly. To secure, annual leak tests and dose rate controls are performed.

Samples are placed in the machine and are exposed when the shutter within the machine is opened, this can only happen when the door is closed properly.

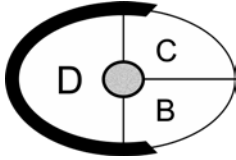
## 7. Method

### A. Beforehand

New users must register with the RPO (Rob Coppes) for instruction and access to the irradiation area.

The RPO instructs the secretary (Greetje Noppert) to authorize for access and use of the source. Access is granted by the service Security and Access control (Beveiliging en Toegangsbeheer).

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Usually access is granted during working hours from 7 o'clock in the morning until 7 o'clock in the evening. If access is required for 24-hour, the alarm has to be switched off. For this a code is will be provided.

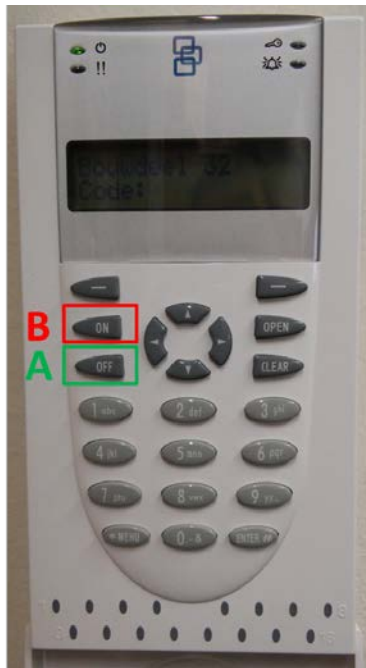
When access is approved, the code will be sent to you by email.

### B. Access Cs source

Access to the area is only possible through an authorized staff pass.

Outside office hours (Mondays – Fridays 19:00 - 7 AM and weekend (Friday evening 19.00 till Monday 7.00 AM) the alarm is activated. When entering the room, the alarm has to be switched of within 30 seconds, by pressing the access code (\*\*\*\*) and press OFF (*Fig.1 A*). When leaving the room, the alarm has to be turned on. This by pressing the access code again and press ON (*Fig.1 B*).

In case of a failure and/or alarm, contact immediately the incident room of the Security **050-3612678**



**Figure 1: Alarm inside Cs room. (A) = OFF, (B) = ON**

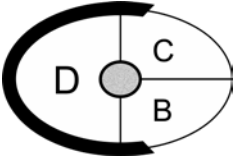
Access to the room for unauthorized persons is not permitted. The door must always be closed. So leaving the door open, for example with a wedge is not allowed.

As an authorized person it is not allowed to give your entrance pass to an unauthorized person to provide him or her access to the room.

### C. Instructions Cs-source

Make a reservation online: [www.internetagenda.nl](http://www.internetagenda.nl) (accountname: f102526 / password: cesium137).

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When the time comes, place the object to be irradiated at the desired height in the radiation chamber (level 25, 35, 45, 55). This FSD (Focus Subject Distance) depends on the dose rate and the dose that has to be given to a certain object.

For example:

The dose rate at level 45 is **0,009019 Gy/sec.** (\*)

The dose rate at level 25 is **0,026322 Gy/sec.** (\*)

Irradiation time (seconds) = (Dose (Gy) / Dose rate (Gy/sec) + 9 (\*\*))

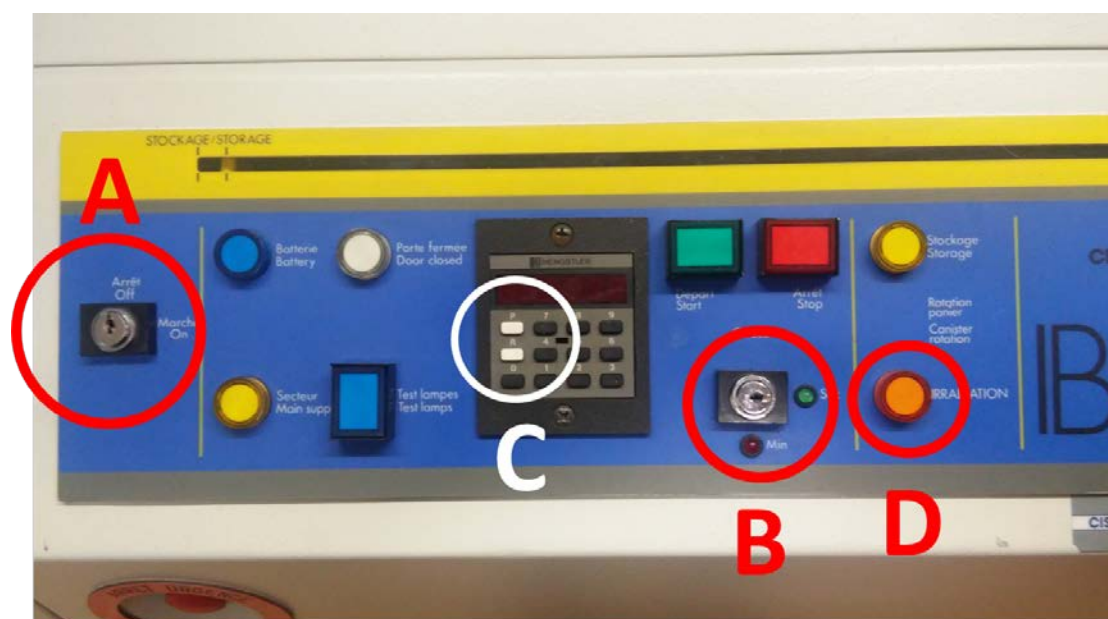
Irradiation time for 20 Gy (level 45):  $(20/0,009019) + 9 = 2227$  seconds

Irradiation time for 20 Gy (level 25):  $(20/0,026322) + 9 = 769$  seconds

(\*) until june 2019

This number indicates a significance that does not exist: due to ra-decay the numbers should be adapted by approx. 2% annually. Two (or maybe three) significant digits suffice – keep track of the exact number on a specified date in order to adequate rounding. Remark also applies to irradiation time and attachments 4, 5, 6 and 7.

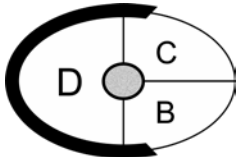
(\*\*) actual radiation time is 9 seconds longer because of the position of the radioactive source



**Figure 2: Display Cs source, A: on/off B: time seconds/minutes C: irradiation indicator.**

Turn on the machine with the key (**Fig.2 A**). The key can be found in the closet next to the source.

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Make sure that the timer is on seconds (**Fig.2 B**). If not, there is another key in the closet to turn it from minutes on seconds.

Press (P) and set the time, followed by pressing (R) and (P) simultaneously to set the time (**Fig.2 C**).

Start the irradiation by pressing the green “START CYCLE” button. The “IRRADIATION” light (**Fig.2 D**). turns on when the shutter is opened. If the irradiation time passed, the shutter will close and the Cesium is covered again.

Shut down the machine by turning the key, take it out and put it back in the closet.

Fill in the logbook, which lies on the machine.

## 8. Quality control

Because of the decay of the cesium, irradiation times are updated every year.

The device is inspected annually by:

RPS Services Limited  
Unit 1A, The Cottage  
100 Royston Road  
Byfleet  
Surrey  
KT14 7NY

## 9. Attachments

**Attachment 1:** Level 25 Irradiation of 1 ml cell suspension in 10 ml tubes (1 cm depth)

**Attachment 2:** Level 45 Irradiation of 1 ml cell suspension in 10 ml tubes (1 cm depth)

**Attachment 3:** Level 55 Total body Irradiation rats

**Attachment 4:** Radiation dose of Cell suspensions - Level 25 Dose 20 Gy and higher

**Attachment 5:** Radiation dose of Cell suspensions - Level 45 Dose 20 Gy and lower

**Attachment 6:** Level 55 Total body Irradiation rats

**Attachment 7:** Level 45 Total body Irradiation mice

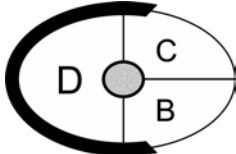
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<b>Name author:</b> R.P. Coppes
<b>Signature author:</b> 

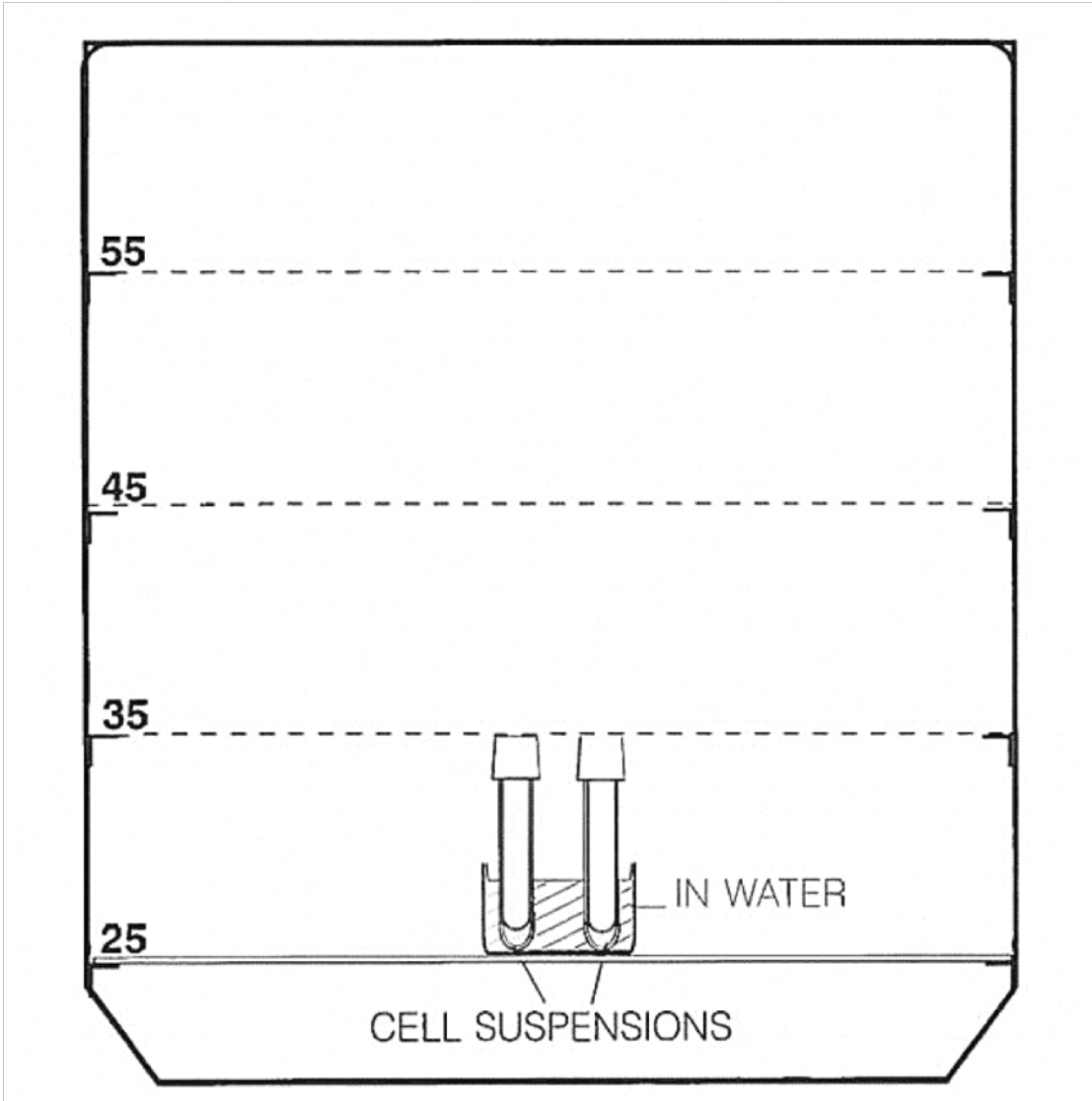
<b>Name of the person authorising:</b>
<b>Signature of the person authorising:</b>

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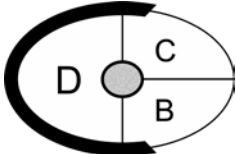
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**Attachment 1: Level 25 Irradiation of 1 ml cell suspension in 10 ml tubes (1 cm depth)**

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 9713 AV Groningen

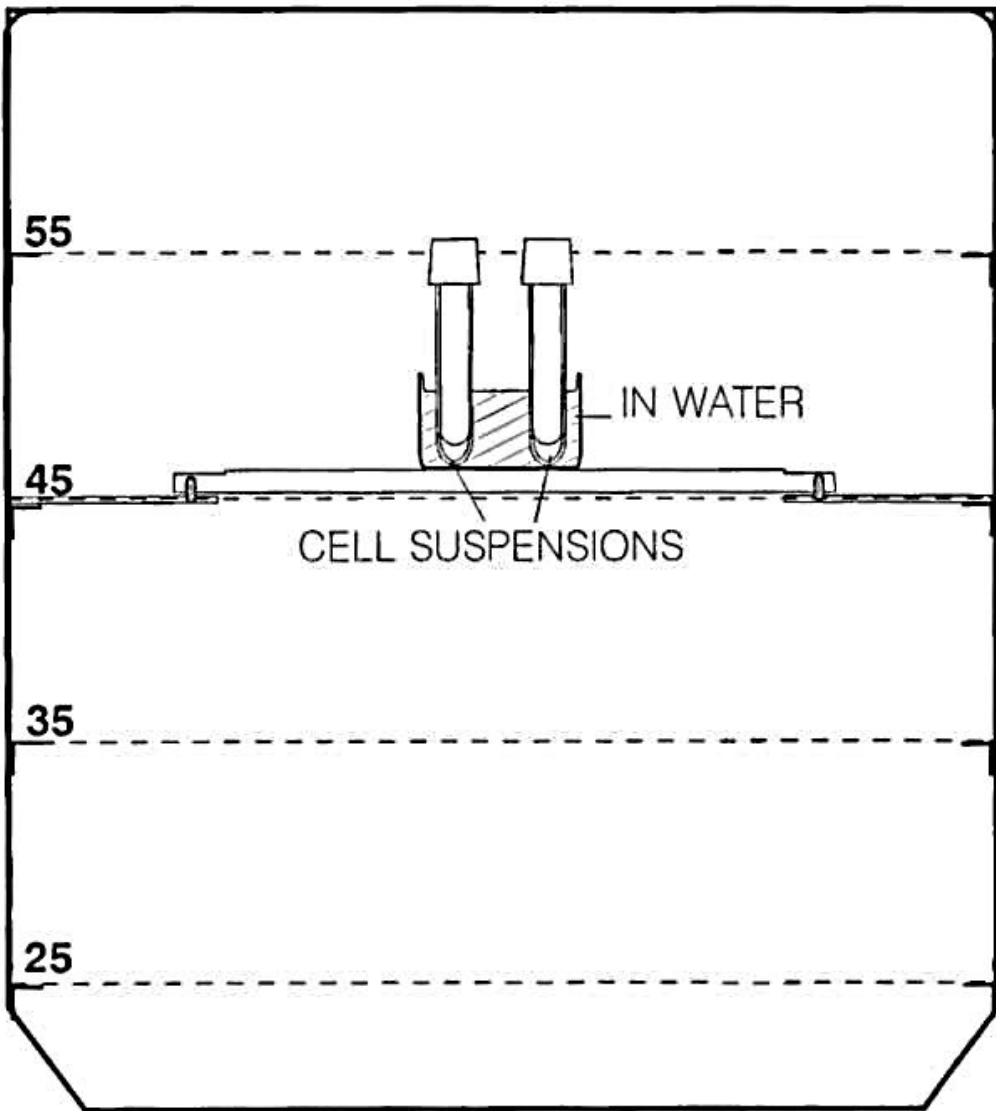


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**Attachment 2: Level 45 Irradiation of 1 ml cell suspension in 10 ml tubes (1 cm depth)**

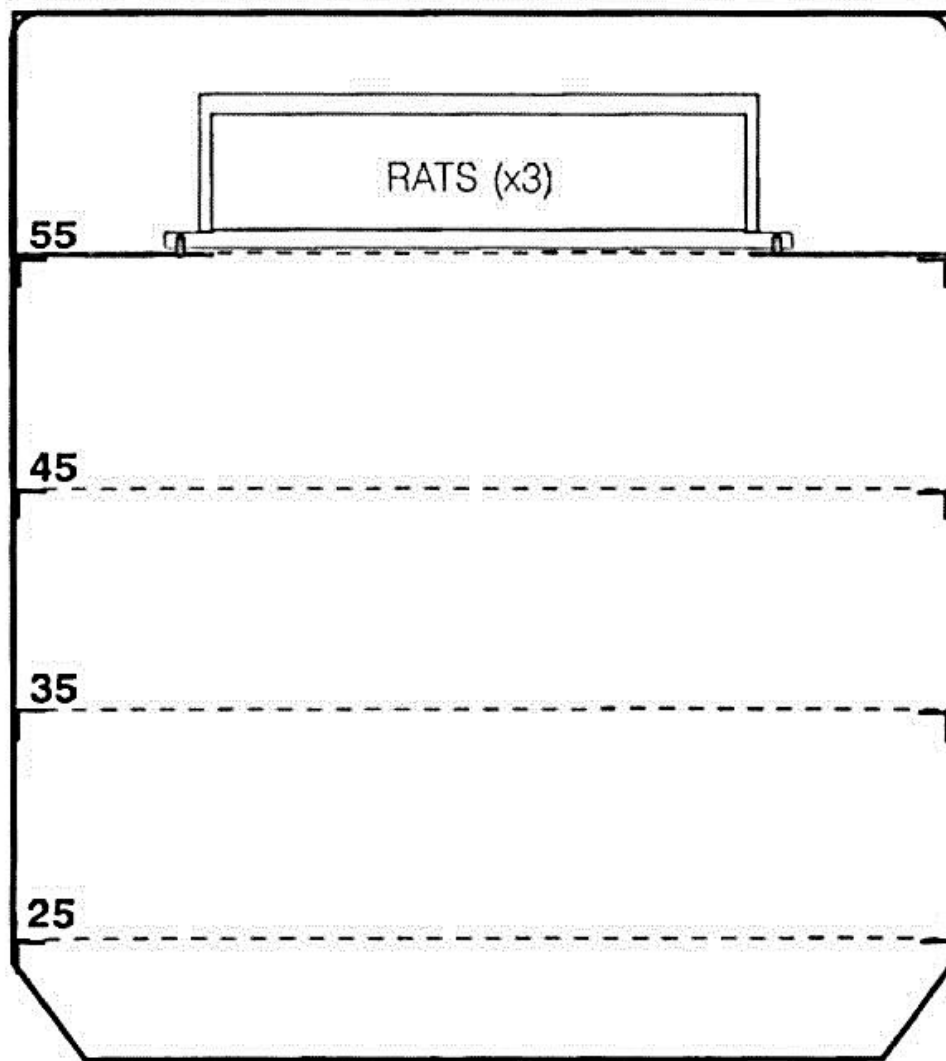
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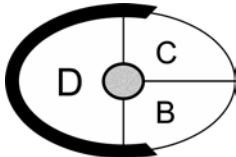
**Attachment 3: Level 55 Total body Irradiation rats**

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## Attachment 4: Radiation dose of Cell suspensions - Level 25 Dose 20 Gy and higher

**Valid for 2018**

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Department of Cell Biology  
A.Deusinglaan 1  
9713 AV Groningen

- Place the cell suspensions (up to 1 ml, and not more than 1 cm.) In 10 ml tubes within the 7 cm diameter circle on the metal plate (level 25: FSD 30 cm).
- The cell suspension must be irradiated in water.
- The timer must be set to seconds.
- Press P and set the time, then press R followed by P so the timer is set.
- Close the door (carefully) and press the green start button.

Dose rate in cell suspension (**June 2018**):

$$= 0,026322 \text{ Gy/sec}$$

$$\text{Irradiation Time (seconds)} = (\text{Dose (Gy)} / 0,026322) - 9^*$$

(\* ) actual radiation time is 9 seconds more than the preset time as a result of the positioning of the radioactive source

Dose (Gy)	Radiation Time (seconds)
20	751
30	1131
40	1511
50	1891
60	2270
80	3030
100	3790
Only PFGE!	
2	67
5	181
10	371
15	561

In emergencies, problems and / or questions: Rob Coppes, room 557.

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## Attachment 5: Radiation dose of Cell suspensions – Level 45 Dose 20 Gy and lower

**Valid for 2018**

IBL 637 Cesium-137 γ-ray Machine

Department of Cell Biology

A.Deusinglaan 1

9713 AV Groningen

- 
- Place the cell suspensions (up to 1 ml, and not more than 1 cm.) In 10 ml tubes within the 7 cm diameter circle on the metal plate (level 45: FSD 50 cm).
  - The cell suspension must be irradiated in water.
  - The timer must be set to seconds.
  - Press P and set the time, then press R followed by P so the timer is set.
  - Remove any extra steel plates on levels 25 and 35
  - Close the door (carefully) and press the green start button.

Dose rate in cell suspension **(June 2018):**

$$= 0,009019 \text{ Gy/sec}$$

$$\text{Irradiation Time (seconds)} = (\text{Dose (Gy)} / 0,009019) - 9^*$$

(\* actual radiation time is 9 seconds more than the preset time as a result of the positioning of the radioactive source

Dose (Gy)	Irradiation Time (seconds)
0,5	46
1	102
2	213
3	324
4	435
5	545
6	656
7	767
8	878
9	989
10	1100
12	1322
15	1654
20	2209

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In emergencies, problems and / or questions: Rob Coppes, room 565.

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## Attachment 6: Level 55 Total body Irradiation rats

**Valid for 2018**

IBL 637 Cesium-137 γ-ray Machine  
 Department of Cell Biology  
 A.Deusinglaan 1  
 9713 AV Groningen

- 
- Position the perspex chamber on the metal plate (Level 55: FSD 60 cm) (max 3 rats).
  - The timer must be set to seconds.
  - Press P and set the time, then press R followed by P so the timer is set.
  - Close the door (carefully) and press the green start button.

Dose rate in cell suspension (**June 2018**):

$$= 0,005758 \text{ Gy/sec}$$

$$\text{Irradiation Time (seconds)} = (\text{Dose (Gy)} / 0,005758) - 9^*$$

(\* ) actual radiation time is 9 seconds more than the preset time as a result of the positioning of the radioactive source

Dose (Gy)	Irradiation Time (seconds)
1	165
2	338
3	512
4	686
5	859
6	1033
7	1207
8	1380
9	1554
10	1728
11	1901
12	2075

In emergencies, problems and / or questions: Rob Coppes, room 557.

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## Attachment 7: Level 45 Total body Irradiation mice

**Valid for 2018**

IIBL 637 Cesium-137  $\gamma$ -ray Machine  
 Department of Cell Biology  
 A.Deusinglaan 1  
 9713 AV Groningen

- 
- Position the perspex chamber on the metal plate (Level 45: FSD 50 cm) (max 10 mice).
  - The timer must be set to seconds.
  - Press P and set the time, then press R followed by P so the timer is set.
  - Remove any extra steel plates on levels 25 and 35.
  - Close the door (carefully) and press the green start button.

Dose rate in cell suspension (**June 2018**):

$$= 0,008502 \text{ Gy/sec}$$

$$\text{Irradiation Time (seconds)} = (\text{Dosis (Gy)} / 0,008502) - 9^*$$

(\* ) actual radiation time is 9 seconds more than the preset time as a result of the positioning of the radioactive source

Dose (Gy)	Irradiation Time (seconds)
1	109
2	226
3	344
4	461
5	579
6	697
7	814
8	932
9	1050
9,5	1108
10	1167
11	1285
12	1402

In emergencies, problems and / or questions: Rob Coppes, room 565.

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