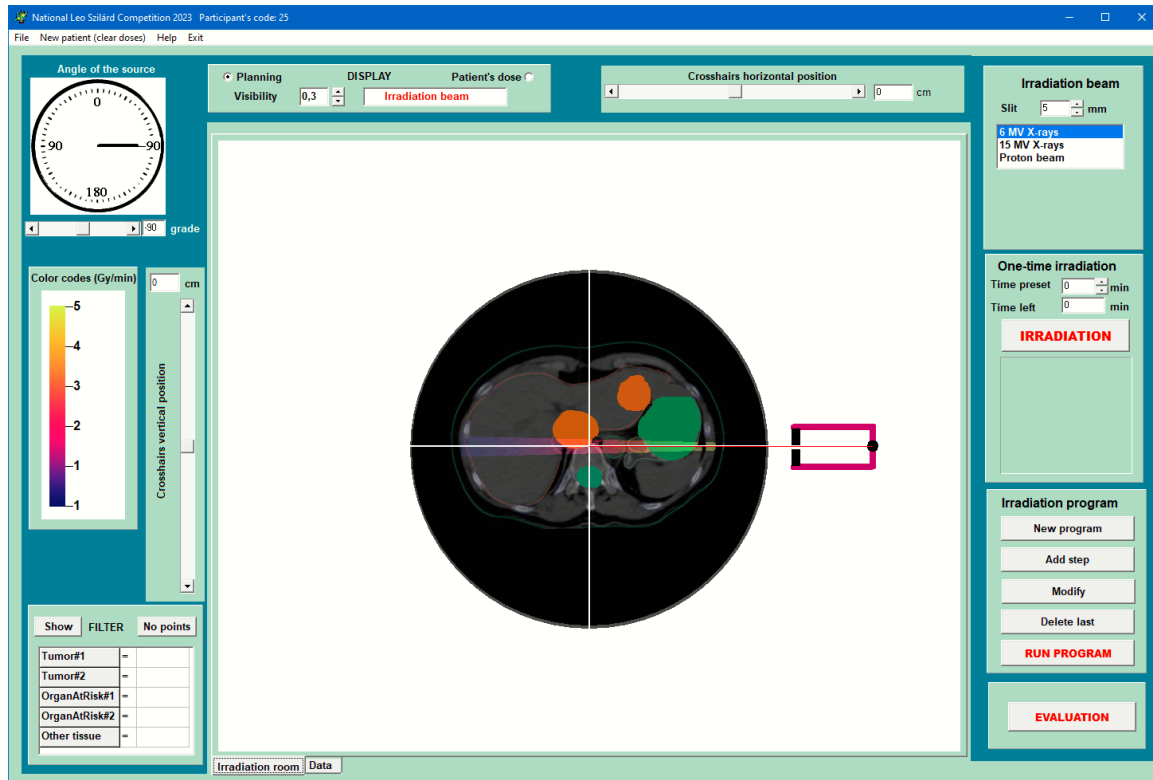




Simulation of Radiation Therapy

After starting the program (and logging in with your name), one sees the image of the "Irradiation room" in the middle of the screen with a "patient" and the radiation source (purple rectangle). The central part with a white background is surrounded by green panels containing controls.



The „patient”

In the middle of the screen an X-ray image of the patient can be seen, on which the "doctor" has marked four areas. The two orange areas indicate tumors in the patient's liver, the smaller green area is the patient's spinal canal (with the spinal cord to be protected), and the larger green area is the patient's stomach, which must also be protected. These two latter are referred to as „**Organs at Risk**” (OAR) in the following.

The controls of the radiation source

- **Crosshairs** Its position can be changed with a horizontal and a vertical scrollbar. The center of the crosshairs is the "**isocenter**", around which the radiation source can be rotated. When displaying the patient's dose, the program shows both the horizontal and vertical sections of the patient's dose-distribution along the lines of the crosshairs.
- **The angle of the radiation source** In the upper left corner there is an image similar to a clock face, which shows the direction and the angle of the radiation source. The radiation source can be rotated around the isocenter - the center of the crosshairs.
- **Radiation beam** In the upper right corner, one can use the "**Slit**" to select the exit angle of the beam from the source. In the field below, three types of beam can be selected. If a proton beam is chosen, its energy can also be controlled.

Visualization

Above the irradiation room the "**Visibility**" parameter can be set in the [0.0, 1.0] interval. By its setting one can gradually project the dose field and the X-ray image of the patient onto each other. The dose-intensity of the radiation field (Gy/min) is indicated by a color code. The meaning of the colors can be seen on the left side of the screen. When setting up the radiation field, the "**Planning**" option should be selected, but if one wants to see what dose the individual organs of the patient received during the irradiation, then one should use the "**Patient's dose**" option. In this case, the color codes show the dose (Gy). When selecting the patient's dose, two graphs are also displayed showing the doses taken along the lines of the crosshairs (horizontal and vertical).

One-time irradiation

In the right-hand panel, one can specify how long the irradiation should take place ("**Time preset**"). In the simulation, we "speed up" time: what would take a minute in reality, happens here in a second. The field "**time left**" shows how much time is left from the irradiation time.

Irradiation program

In general, adequate dose distribution can be achieved only by irradiation from several directions and for different durations. Therefore, to complete the task, an irradiation program has to be set up. This, of course, consists of several individual steps. The direction (angle), the irradiation time, the type and energy of the beam should be set for every step. If the setting is done, pressing the "**Add step**" button will add the given step to the program.

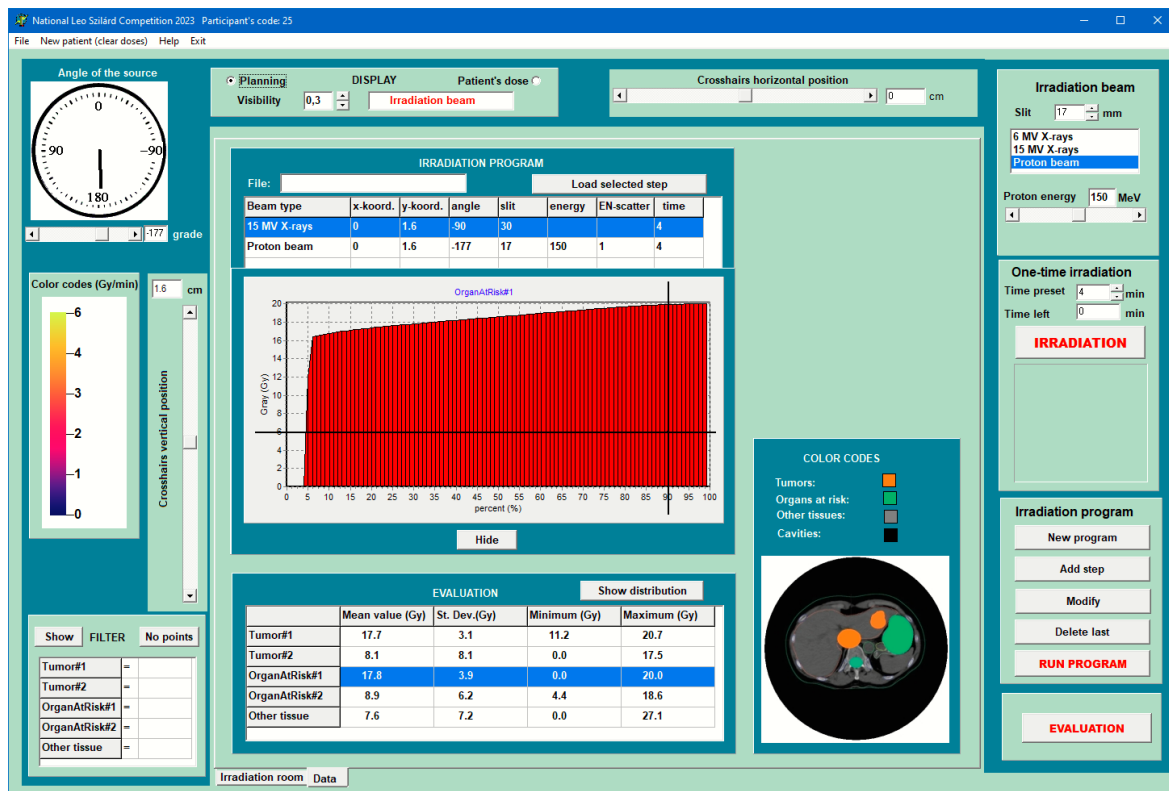
The other buttons in the panel are used to manage the program:

- **New program** Every previously defined steps of the program will be deleted.
- **Modify** The selected step will be overwritten with the newly defined parameters.
- **Delete** The selected step of the program will be deleted.
- **RUN PROGRAM** The irradiation program is carried out step by step. Be careful, because if the patient has already received doses, this step does not delete them! The patient's previous doses can be deleted using the "**New patient**" menu item in the top menu bar. It is advisable to do this before starting the irradiation program, otherwise the doses of the current program will be added to the previous dose values.

EVALUATION

When this button is pressed, the program evaluates the dose map for the patient and automatically switches to the "**Data**" page (by the way, we can do this at any time). The "**Irradiation room**" part of the screen changes, and instead we see tables and graphs (see the picture on the next page).

- **Evaluation** The table at the bottom of the screen shows the **mean** value, the standard deviation (**St. Dev.**), as well as the smallest and largest dose values received by the unit volume (one pixel) of the respective organ.
- **Graphs** The interpretation of the graphs on the page is special! The percentage on the horizontal axis represents the percentage of the organ's material. For example, if at 90% the value of the function is 20 Gy, it means that 90% of the organ received a maximum dose of 20 Gy (or less)! This - of course - also means that the remaining 10% received a dose greater than 20 Gy. The graph also shows a black "crosshair" that divides the graph into four sections. According to the interpretation, a dose distribution is good if the values of the graph for tumors are entirely in the upper left part, and for the organs to be protected (organs at risk, OAR) the upper left part must be completely empty. (The diagram below does NOT correspond to this!)



The dose distributions can be selected by clicking on the corresponding row of the lower table. If necessary, the graph can be hidden with the "Hide" button.

- **Irradiation program** This table contains the data for the individual irradiation steps. This program can be saved with the "Save irradiation program" option when opening the "File" item of the top menu bar, and can be loaded later with the "Load irradiation program" option. In the table, one can select the current program step and load it with the "Load selected step" button. The significance of selecting the current step is that the "Modify" button always overwrites the parameters of the selected, current step.

FILTER

In the lower left part of the screen there is another panel that can help you plan the irradiation. With the help of this, one can "paint white" certain pixels on the dose map that has already been irradiated. A dose condition can be defined for each of the five tissues to be monitored: in the first column, one of the equal signs (=), greater (>) or less than (<) can be written. In the column next to it, one can enter what the dose values of the pixels should be compared with. A valid non-negative number must be written here (use a decimal point if needed). If this field is deleted (left empty), no comparison will be made for the given organ/tissue.

Items in the main menu

- **File / Load irradiation program** Previously saved irradiation program can be loaded.
- **File / Save irradiation program** The steps of the irradiation program will be saved.
- **File / Save evaluation** This saves all evaluated data in picture format.
- **New patient** Deletes the previously received doses of the patient.
- **Help** Shows some information about the program (About), the theoretical introduction and the description of the tasks, and contains this User's manual too.
- **Exit** Terminates the program.

