Examining the biological effects of UV-C radiation on *Drosophila melanogaster* in relation to exoplanet habitability around flaring stars

Presented by: Veronika Napsugár Csillag (ELTE, Department of Earth Science/ HUN-REN CSFK)

Supervisors: Anna Medvegy (HUN-REN CSFK)

Bálint Seli (HUN-REN CSFK)

Laboratory Advisor: Tamás Csizmadia (ELTE Department of Anatomy, Cell and Developmental Biology)

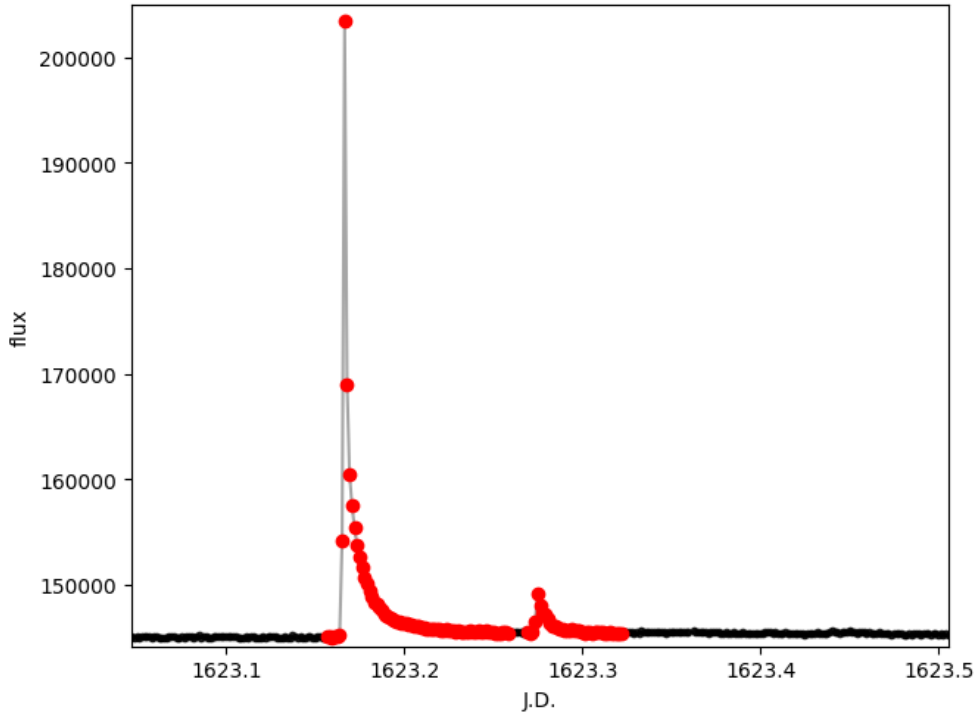
Objectives



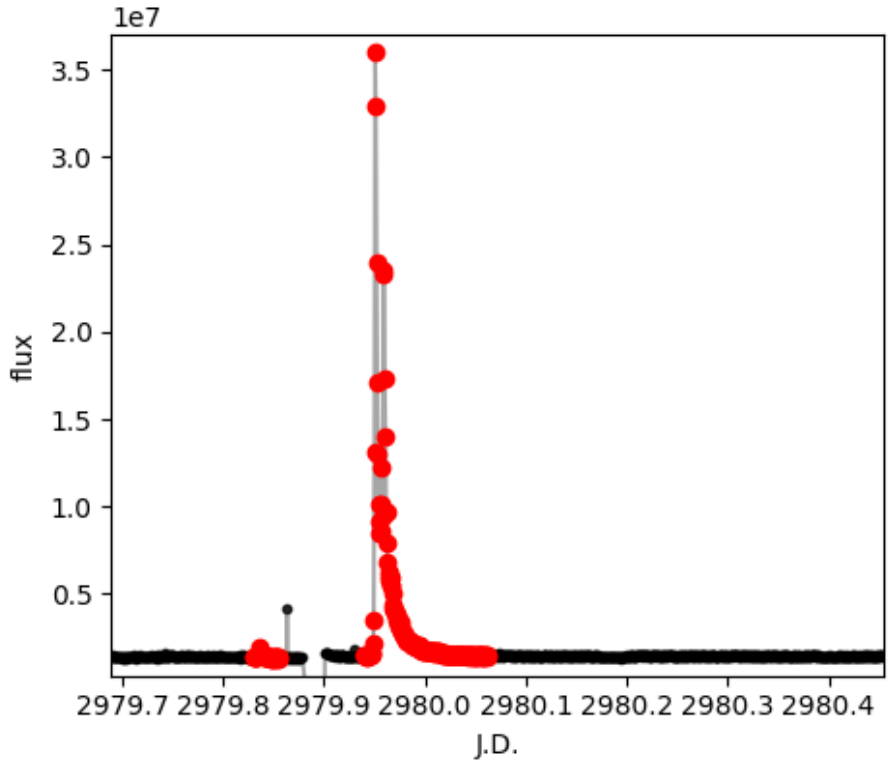
- Studying **flare activity** using stellar light curves.
- **Laboratory experiment:** Irradiating fruit flies with UV-C radiation doses based on flare energies.
- Extending the definition of the **habitable zone**.
- Acquiring more information on the effects of stellar irradiation on multicellular organisms in connection with **space missions**.

Calculations

- **Isolating flares**

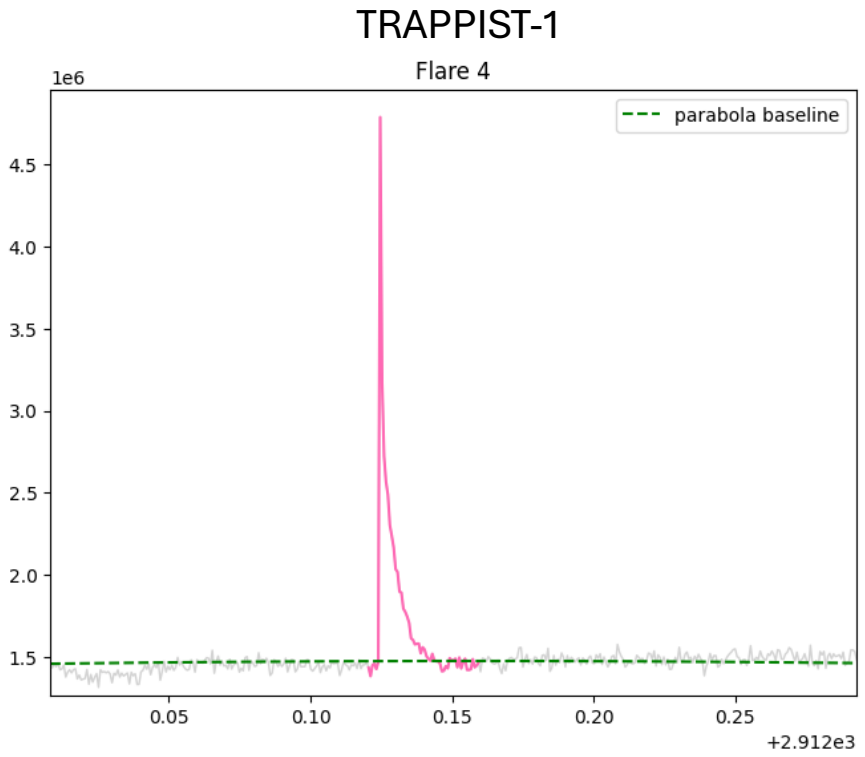


Proxima Centauri



TRAPPIST-1

- **Baseline:** Quadratic polynomial



- **Equivalent duration (ED):**

$$ED = \int \frac{F_{\text{flare}} - F_{\text{baseline}}}{F_{\text{baseline}}} dt$$

- **Converting into absolute energy using a stellar model spectrum:**

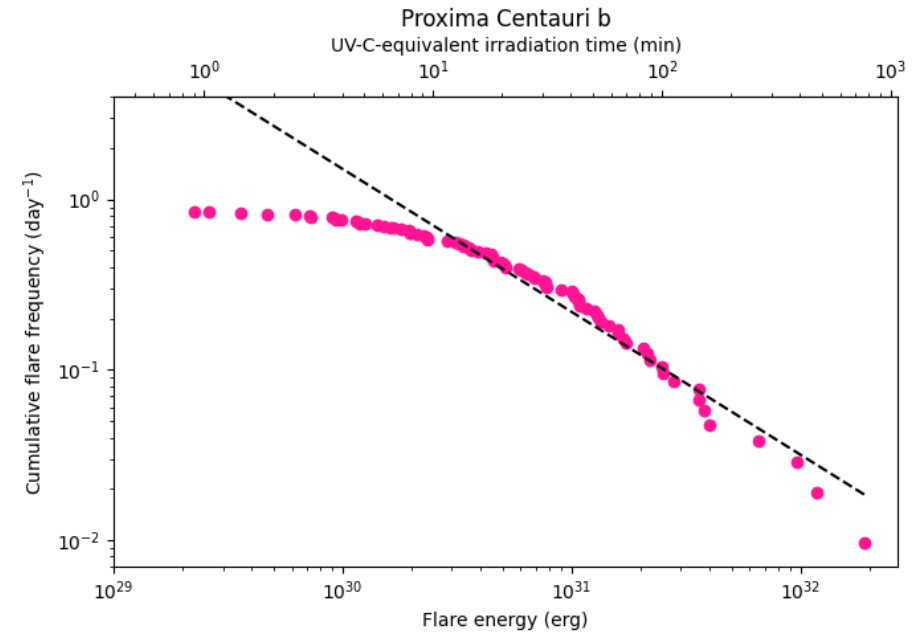
$$E_{flare} = ED \cdot L_{filter}$$

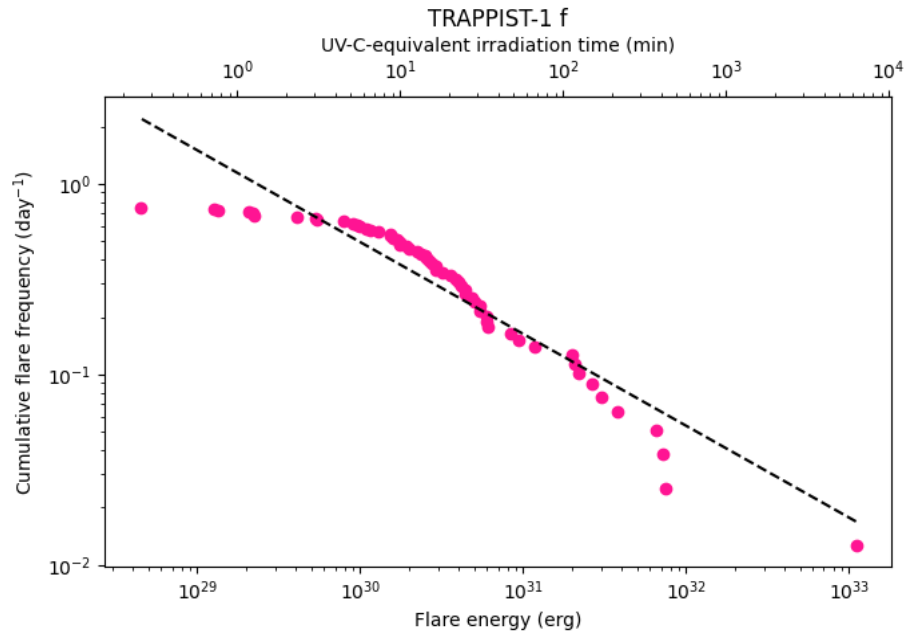
- **Flare frequency distribution**
- **Energy emitted in the UV-C range**
- **Fluence at the exoplanet's orbital distance:**

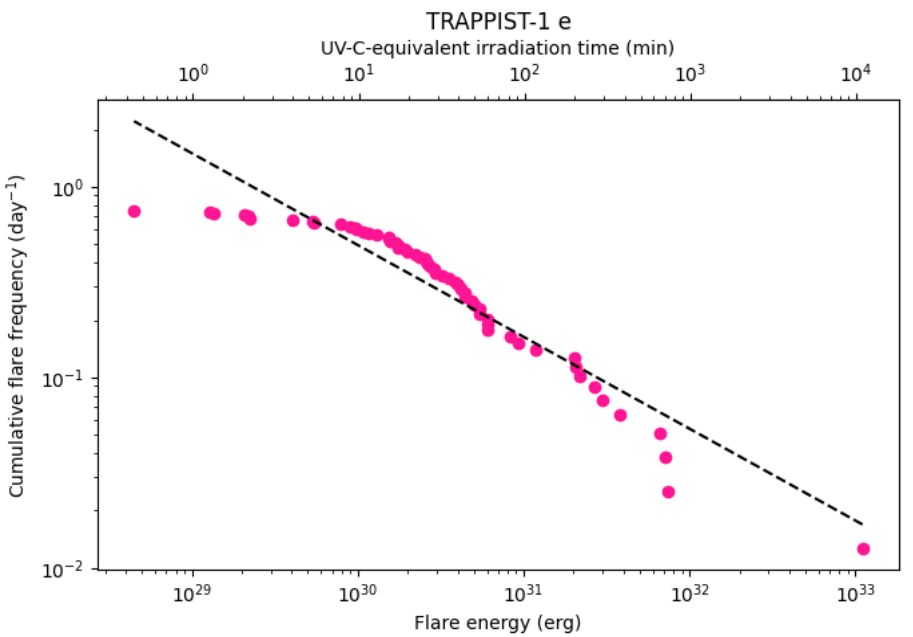
$$\mathcal{F} = \frac{E}{4\pi r^2}$$

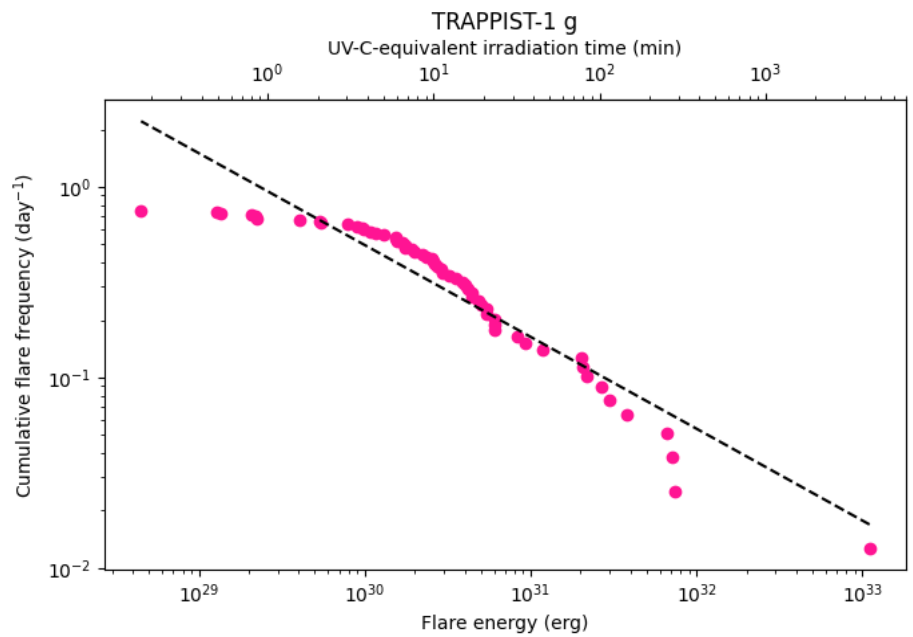
- **Converting to lamp irradiation time:**

$$t_{\text{lamp}} = \frac{\mathcal{F}_{\text{flare}}}{P_{\text{lamp}}}$$


Proxima Centauri b
UV-C-equivalent irradiation time (min)
Cumulative flare frequency (day^{-1})
Flare energy (erg)

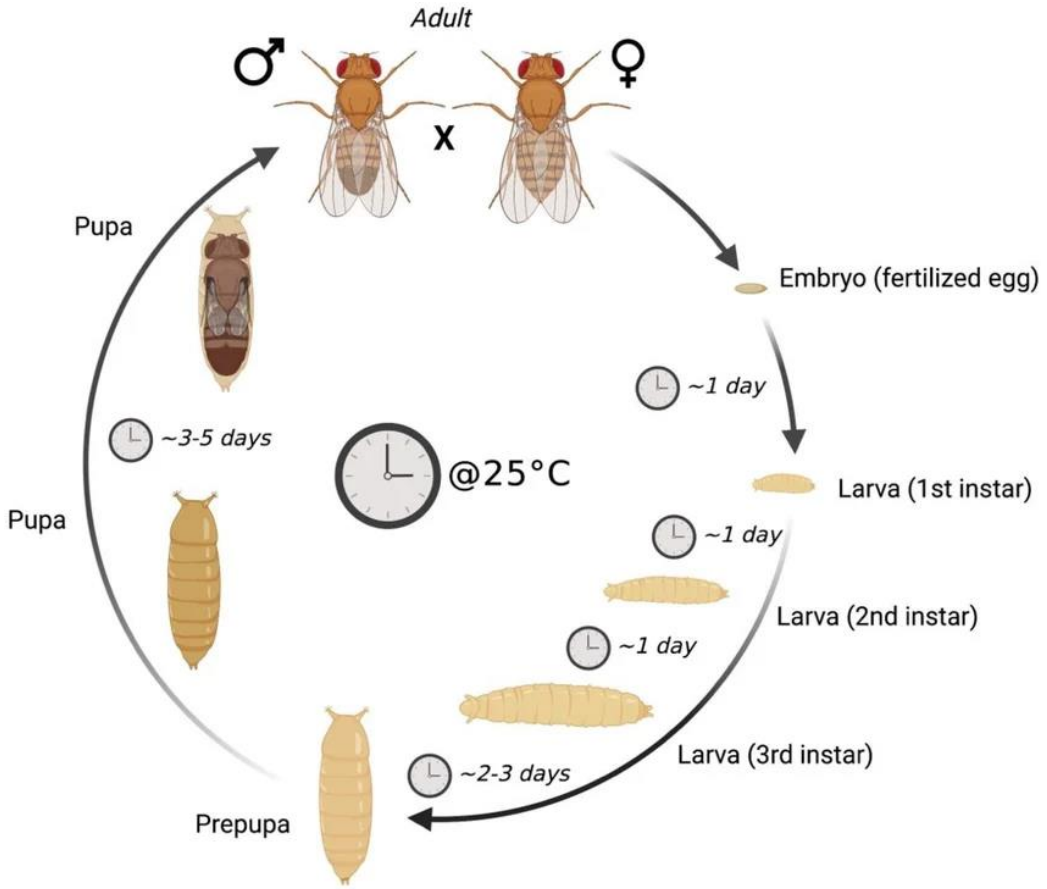

TRAPPIST-1 f
UV-C-equivalent irradiation time (min)
Cumulative flare frequency (day^{-1})
Flare energy (erg)


TRAPPIST-1 e
UV-C-equivalent irradiation time (min)
Cumulative flare frequency (day^{-1})
Flare energy (erg)


TRAPPIST-1 g
UV-C-equivalent irradiation time (min)
Cumulative flare frequency (day^{-1})
Flare energy (erg)

Laboratory work

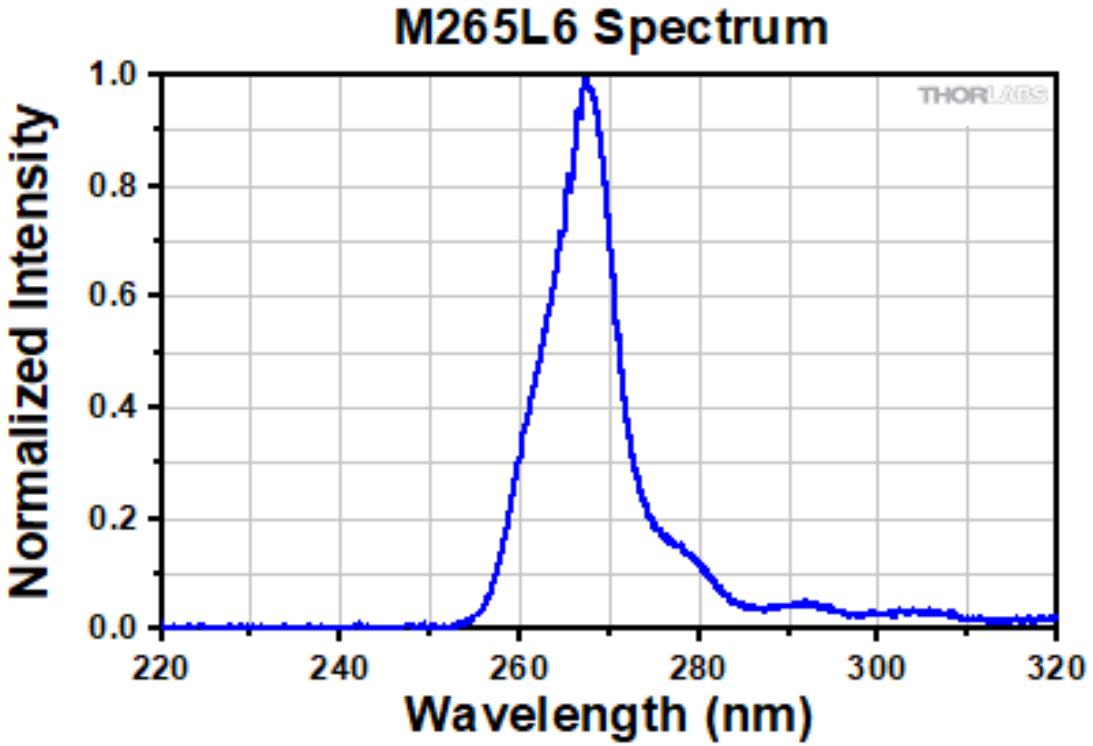
- ***Drosophila melanogaster*** (fruit fly): class: *Insecta*, order: *Diptera* (true flies), family: *Drosophilidae*
- **Key attributes:** fast life cycle, easy maintenance, genetic similarity to humans



Drosophila life cycle



- THORLABS's UV-C lamp: Highest intensity at a wavelength of 265 nm, Irradiance: 0.5 μW/mm^2

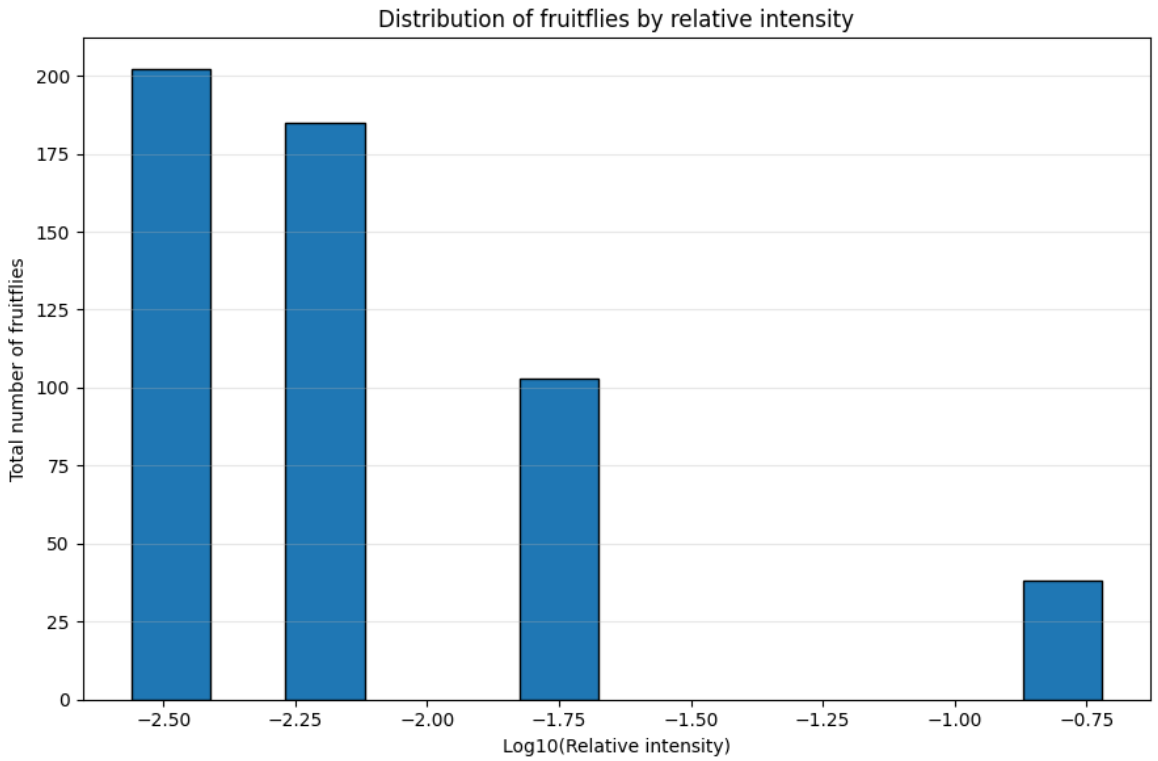




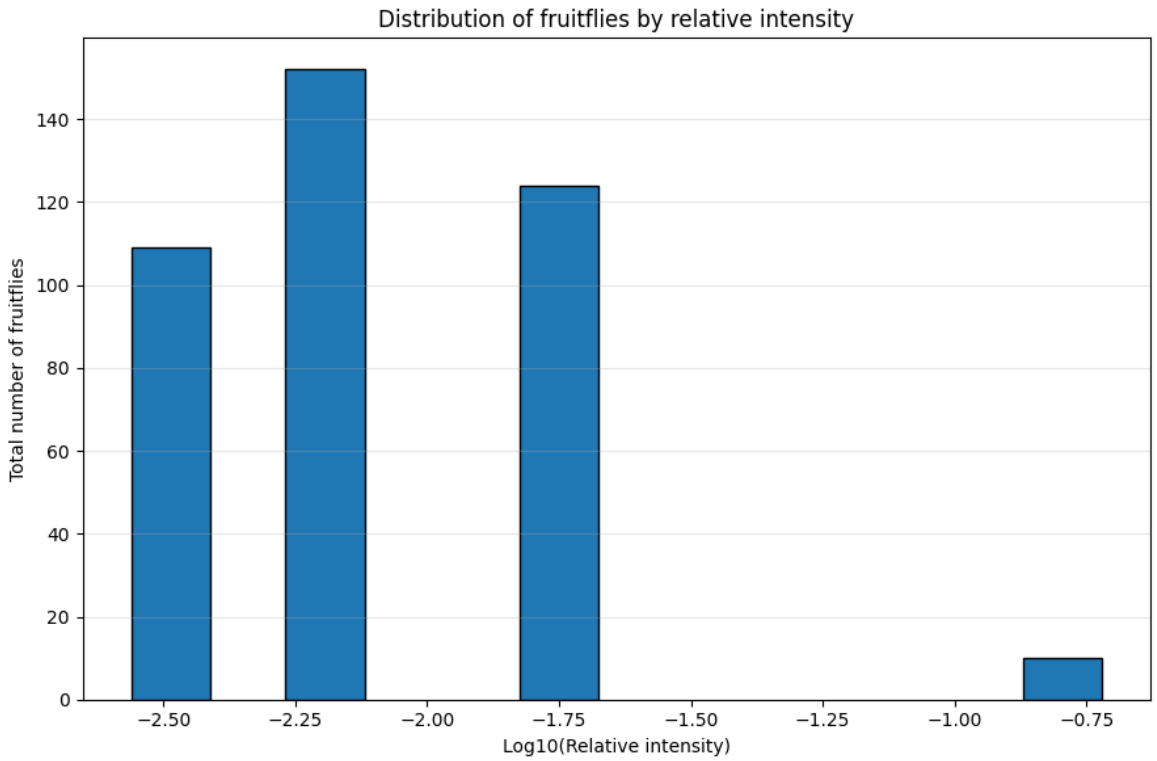


Error calculation and fly distribution

Irradiated for 1 hour:



Irradiated for 2 hours:



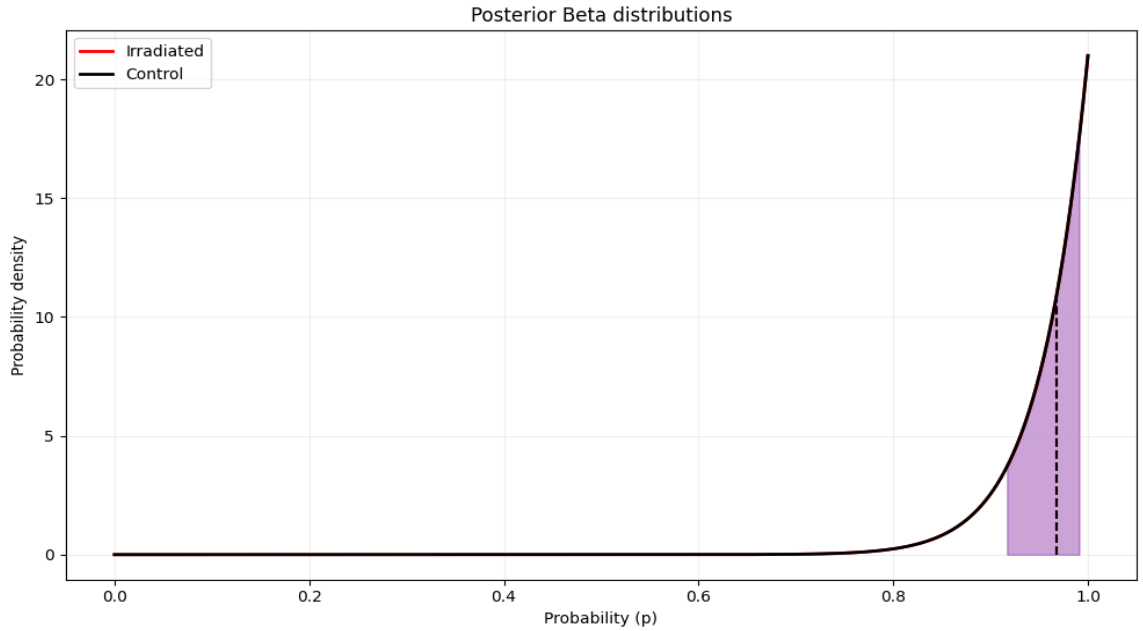
The experiment and Results

- We irradiated 3 batches of fruitflies for 1 hour and 2 hours.
- At a distance of 20 cm the fluence is $1800\ \mu J/mm^2$ and $3600\ \mu J/mm^2$.
- At a distance of 5 cm the fluence is $28800\ \mu J/mm^2$ and $57600\ \mu J/mm^2$.

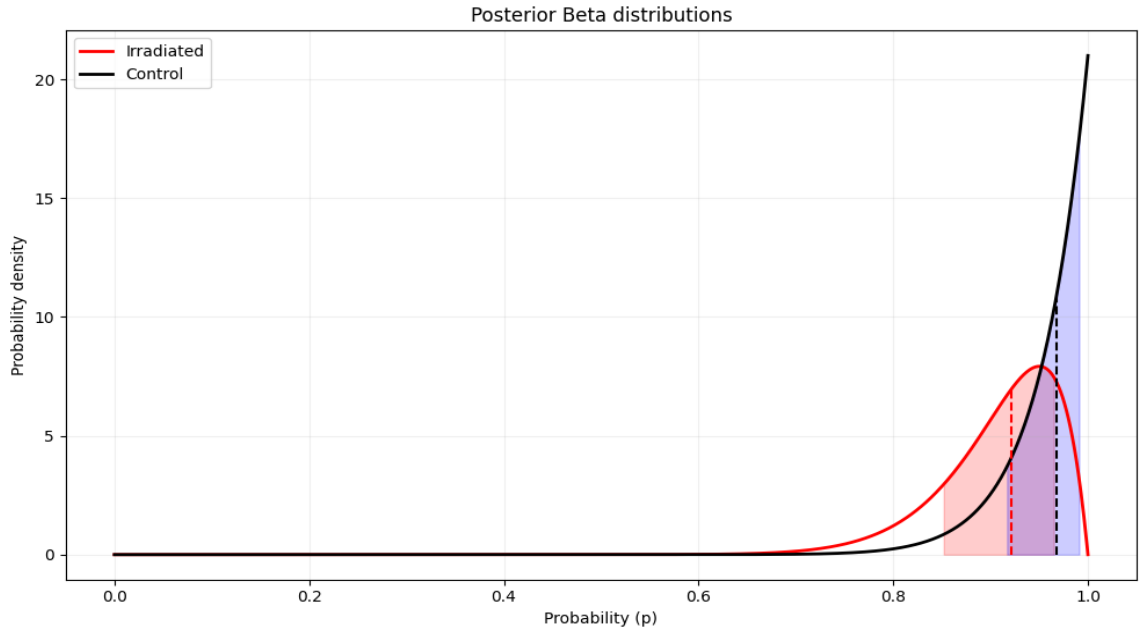
- We observed results in about a week.
- Survival remained relatively stable until a sudden increase in mortality was observed.
- The control batches had little change.

Day 1

Irradiated for 1 hour

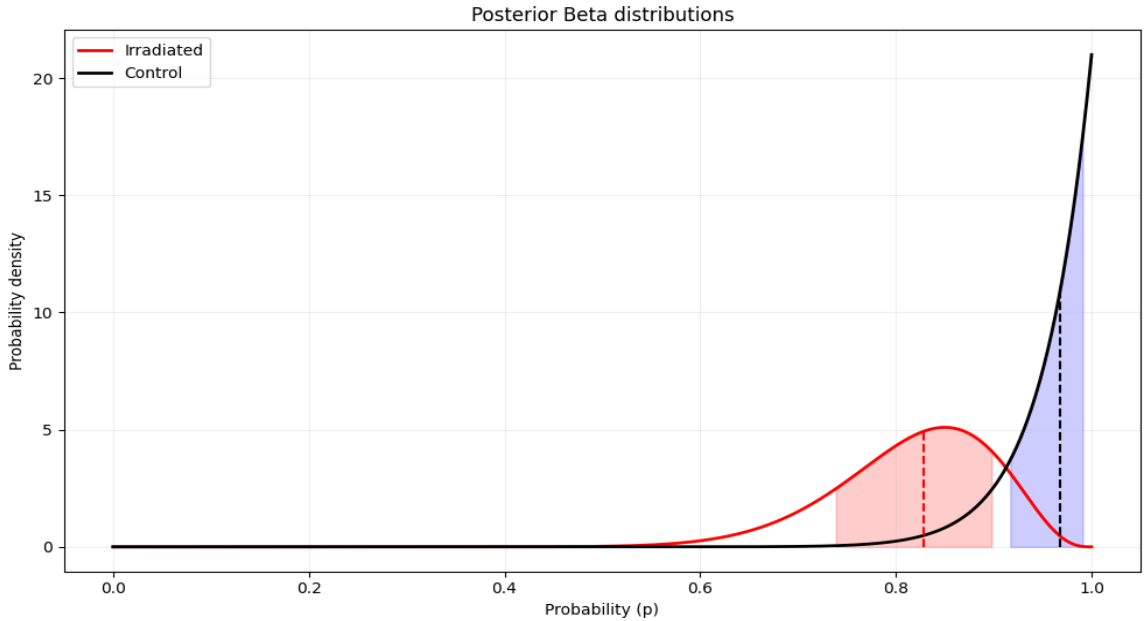


Irradiated for 2 hours

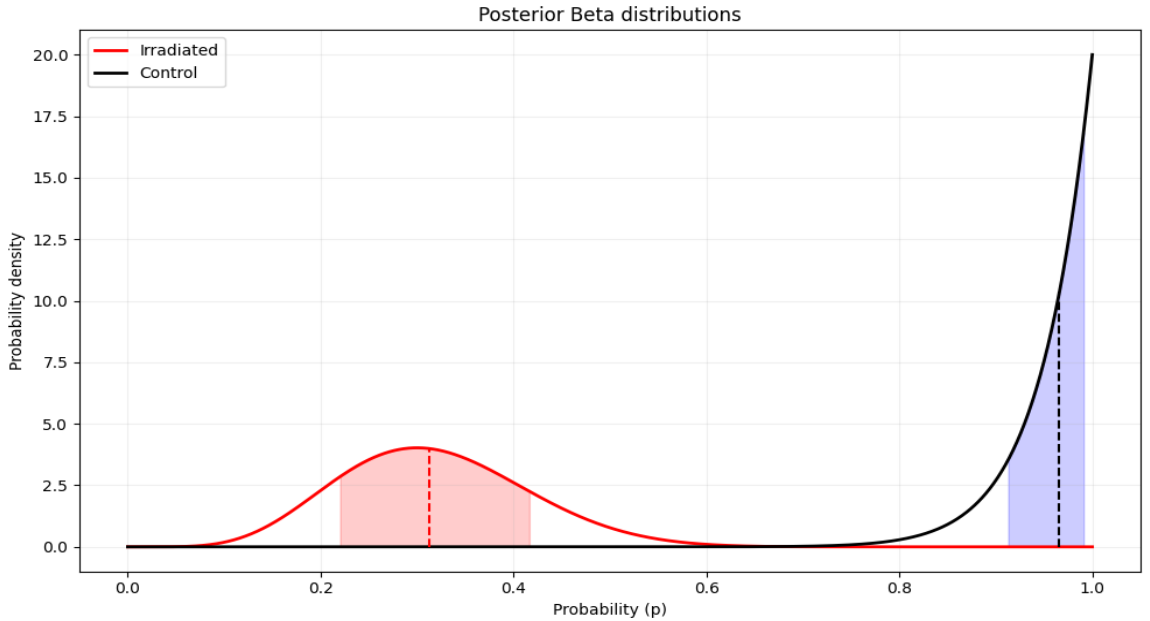


Day 13

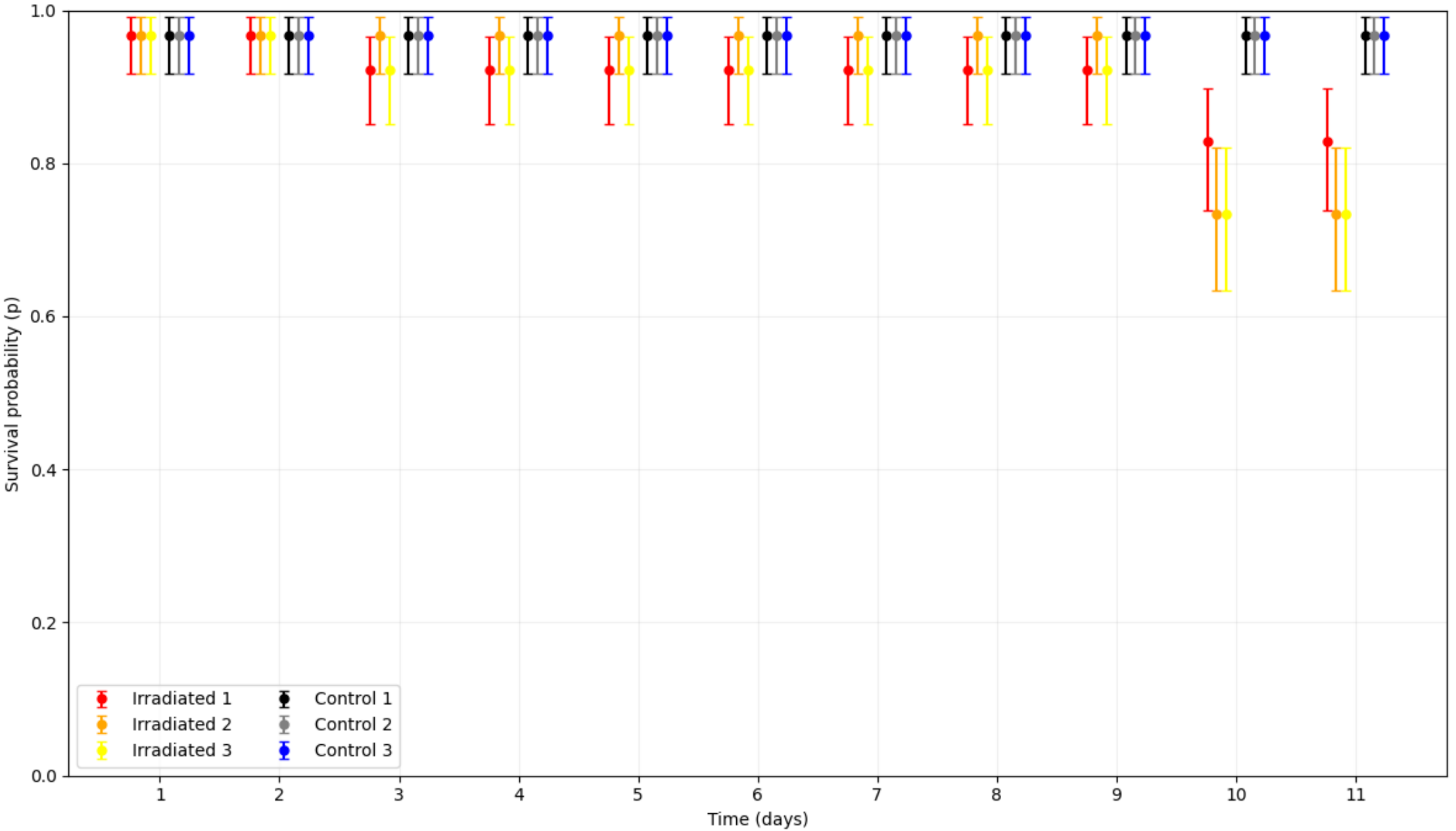
Irradiated for 1 hour



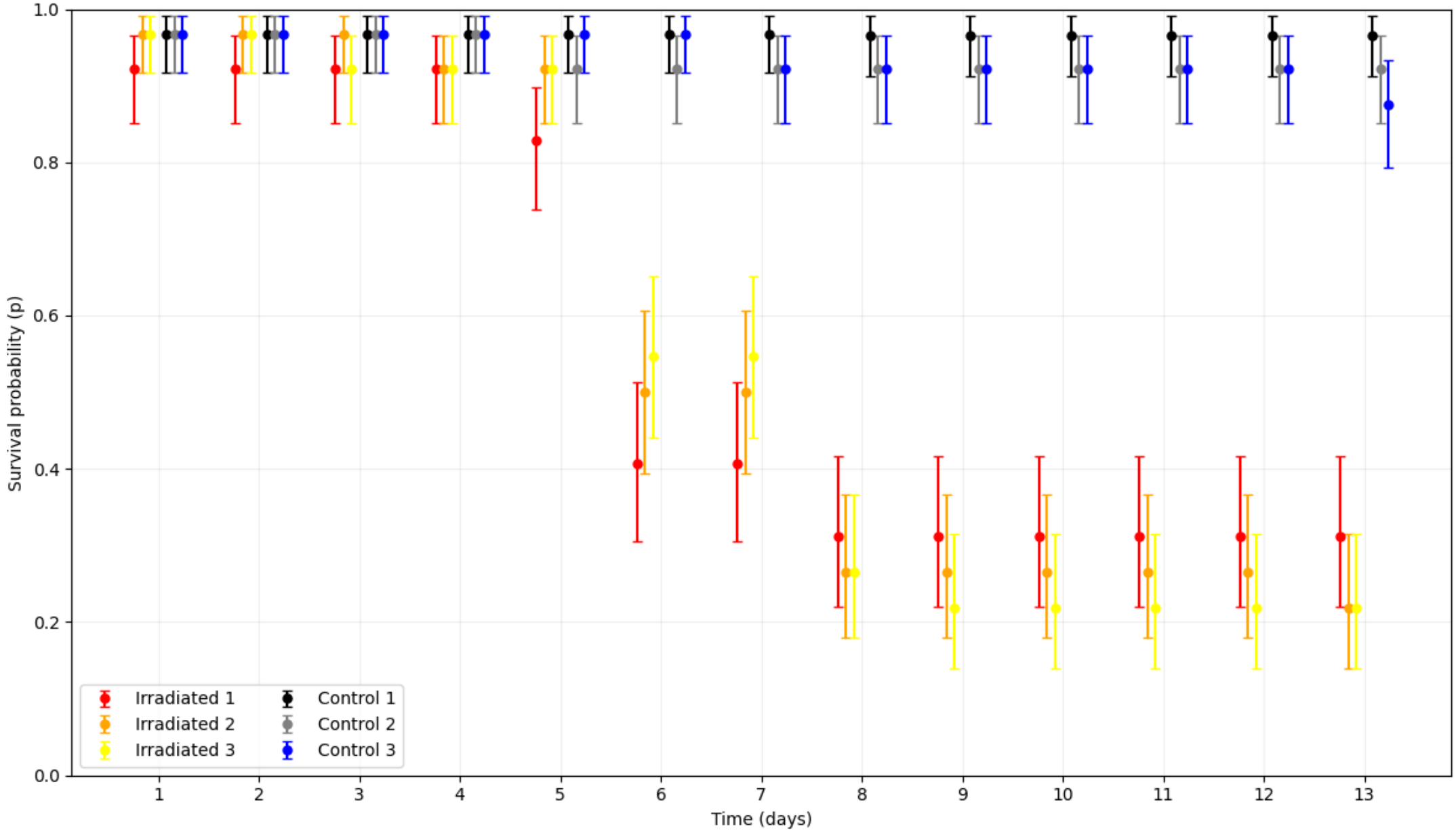
Irradiated for 2 hours



Irradiated for 1 hour



Irradiated for 2 hours



Future plans

- **More experiments** with different parameters
- Scientific Students’ Association Conference (TDK)

Thank you for your attention!

You can contact me at: csillagnapsi@gmail.com