

DNA damage after mixed fields of ionizing radiation

Alice Sollazzo

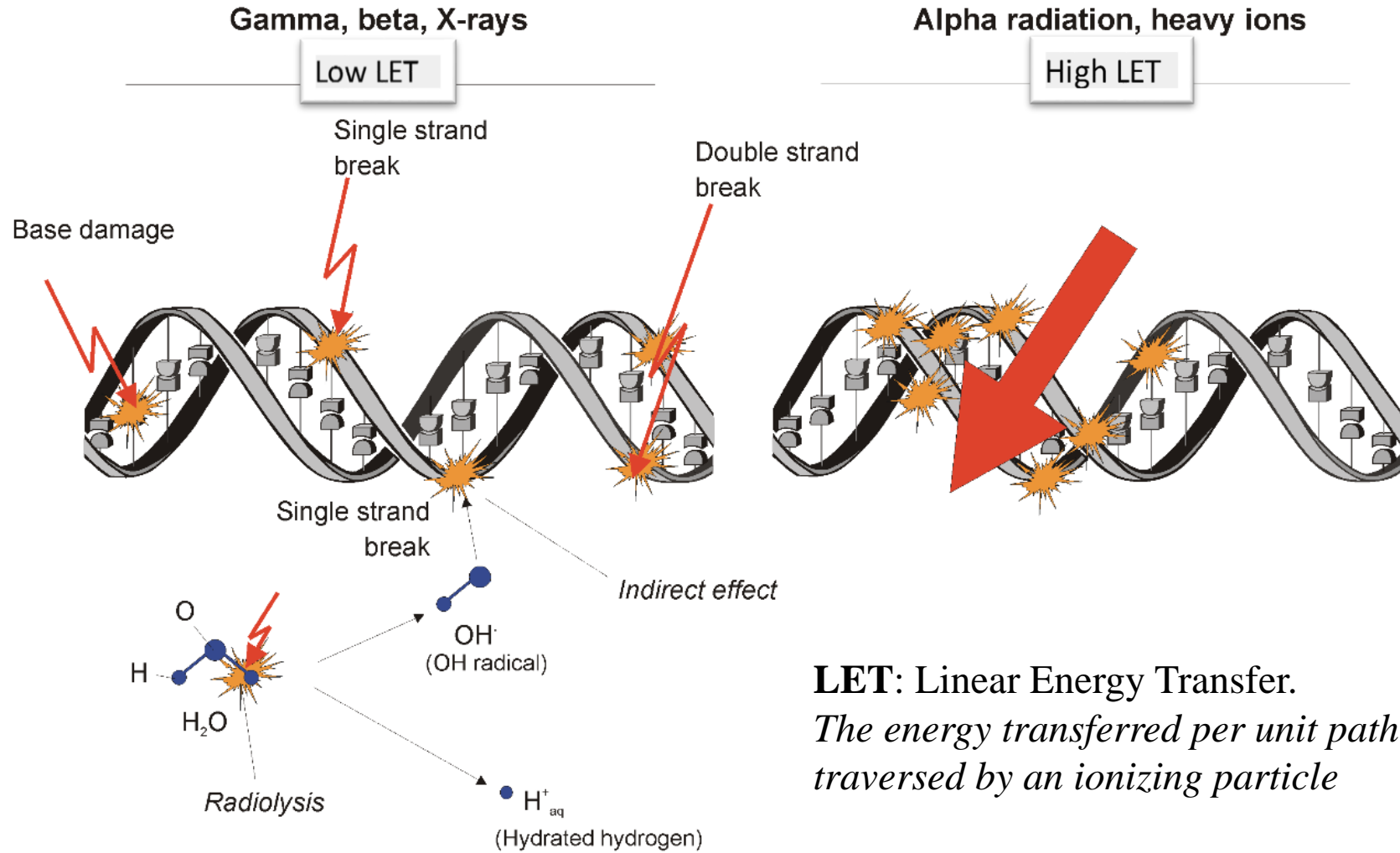
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Co-supervisor: Siamak Haghdoost

Video in courtesy of Werner Friedland

- **Introduction:** Radiation-induced DNA damage
- **Aims:** Estimate the risk associated to mixed beams exposure
- **Methods:** Irradiation setup
- **Results:** DNA Double Strand Breaks marker (53BP1 foci)
- **Conclusion:** Future studies

Radiation-induced DNA damage

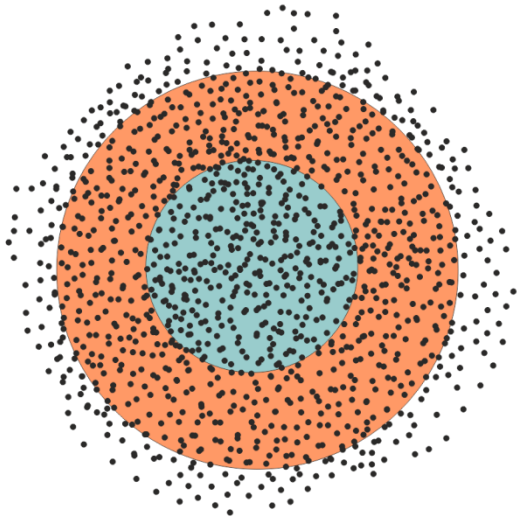


LET: Linear Energy Transfer.
The energy transferred per unit path length traversed by an ionizing particle

Radiation hits are distributed differently in Low LET and high LET radiation

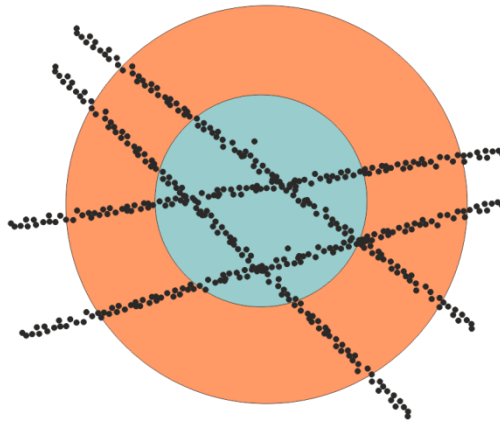
Low LET
X-rays

1 Gy ~ 1000 hits/cell
~ 100 000 ionisations/cell



High LET
alpha particles

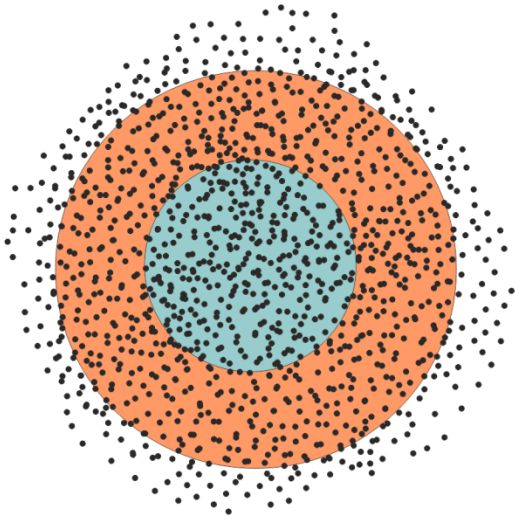
1 Gy ~ 4 hits/cell
~ 100 000 ionisations/cell



Radiation hits are distributed differently in Low LET and high LET radiation

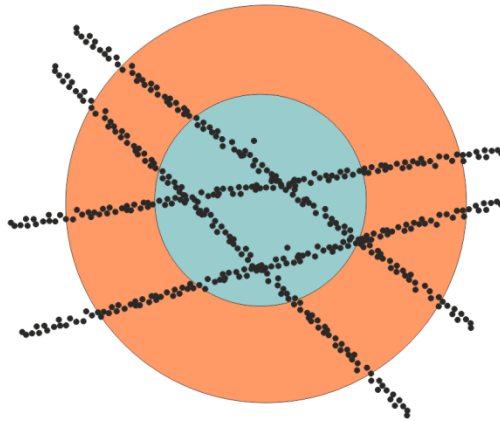
X-rays

1 Gy ~ 1000 hits/cell
~ 100 000 ionisations/cell



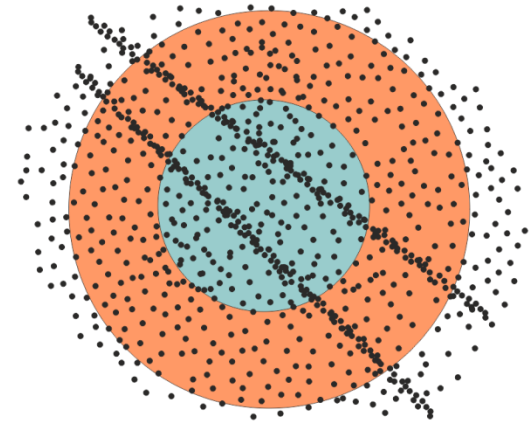
alpha particles

1 Gy ~ 4 hits/cell
~ 100 000 ionisations/cell

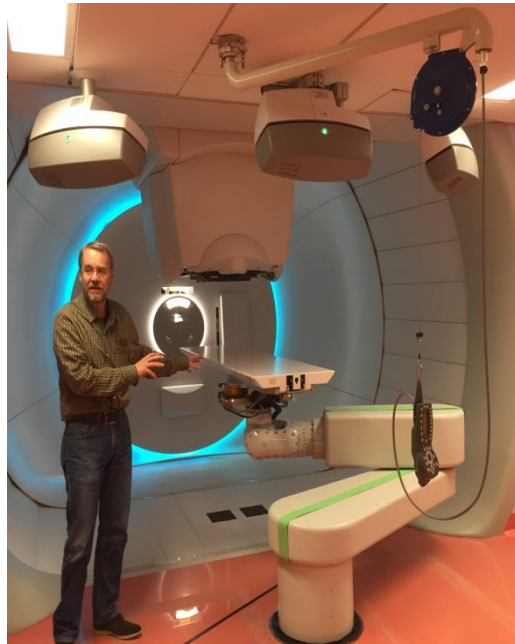


X-rays + alpha particles

1 Gy ~ 500 + 2 hits/cell
~ 100 000 ionisations/cell



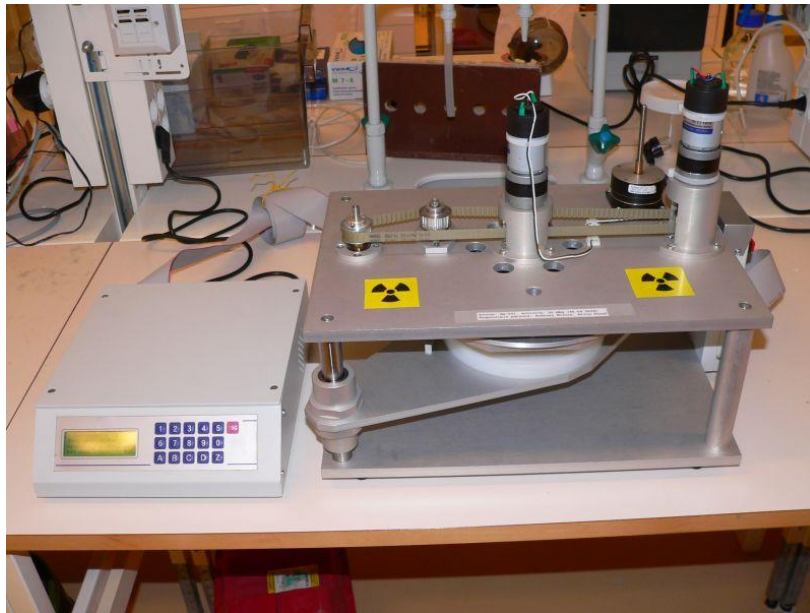
Mixed radiation fields.



- Airplanes
- Space
- Some types of Radiotherapy
- Areas with high background radiation + radon

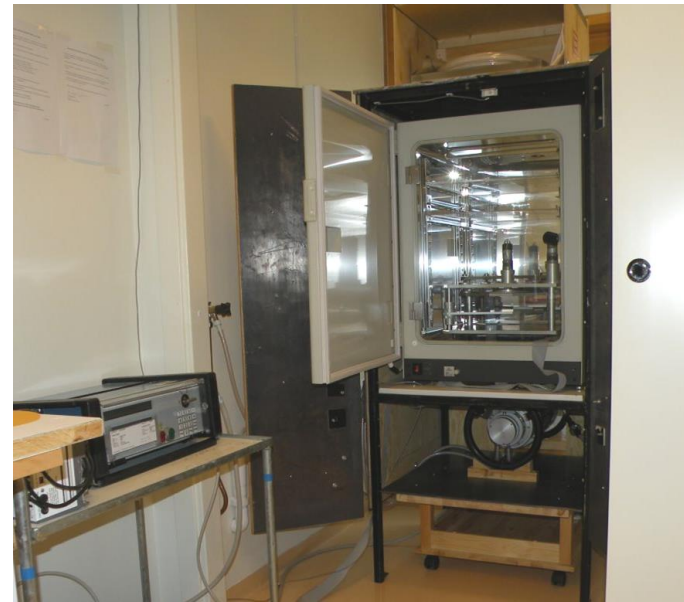
Irradiation facility: ^{241}Am + X-ray tube

- **Alpha source** ^{241}Am (50 MBq)



- Dose rate: 0,27 Gy/min

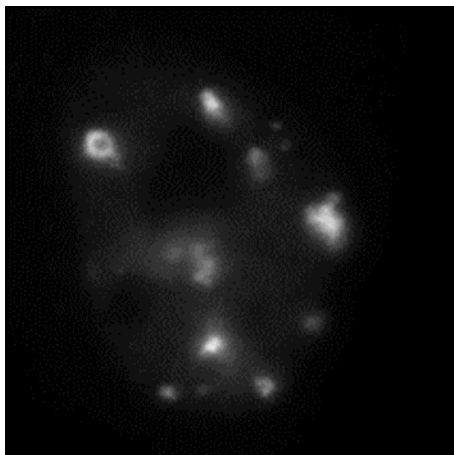
- The mixed beams irradiation incubator with the **X-ray source** (190kV, 4.0 mA)



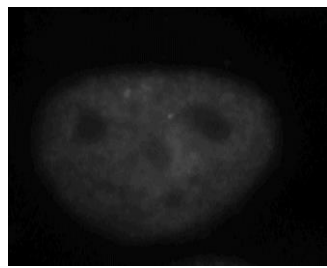
- Dose rate: 0,07 Gy/min

U2OS Cells Osteosarcoma cells

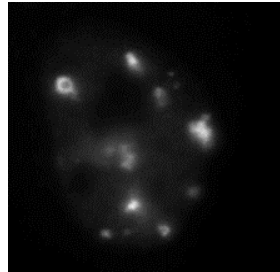
- Stably expressing **53BP1-GFP**- fusion protein
(DNA DSB repair signaling involved in the NHEJ pathway)
 - Dose response, 53BP1 foci
 - Repair kinetics, 53BP1 foci



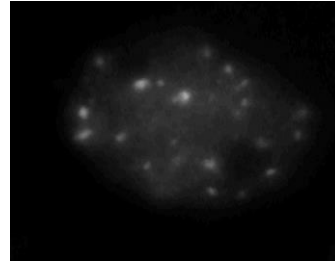
Dose response 53BP1 foci



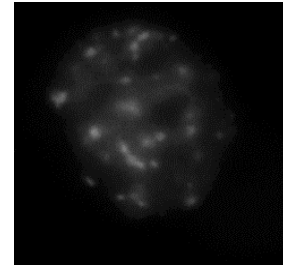
Control



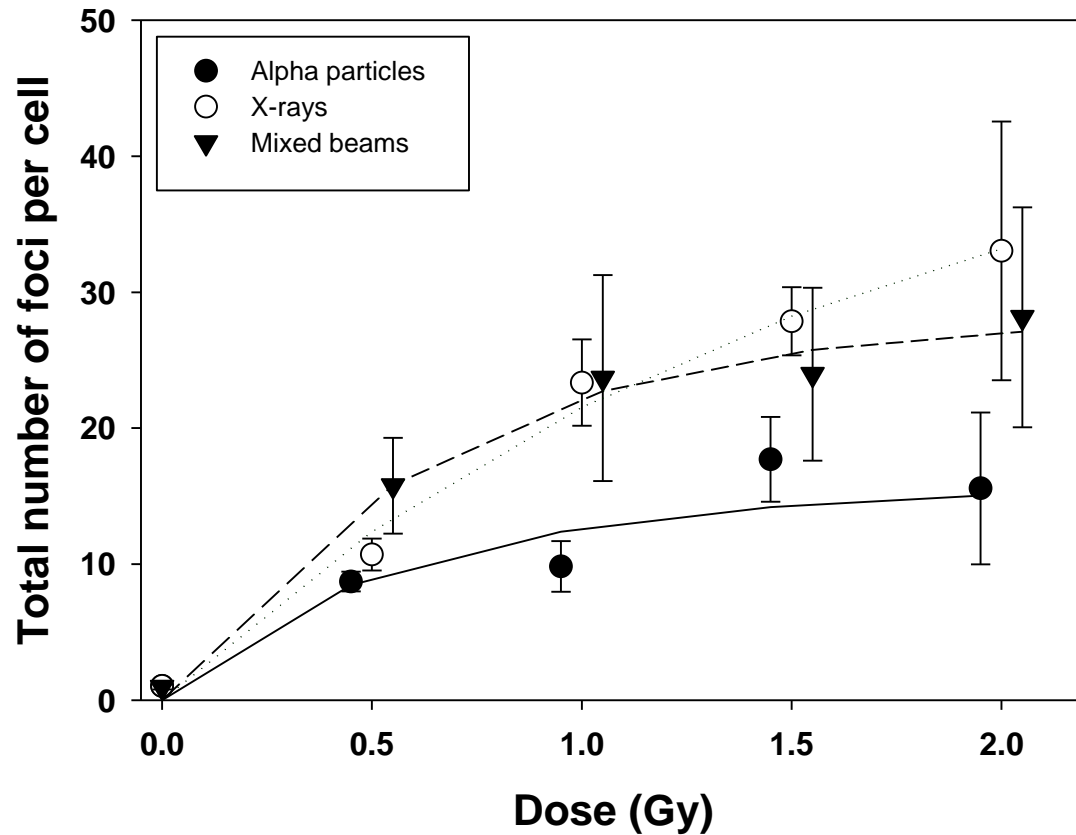
Alpha



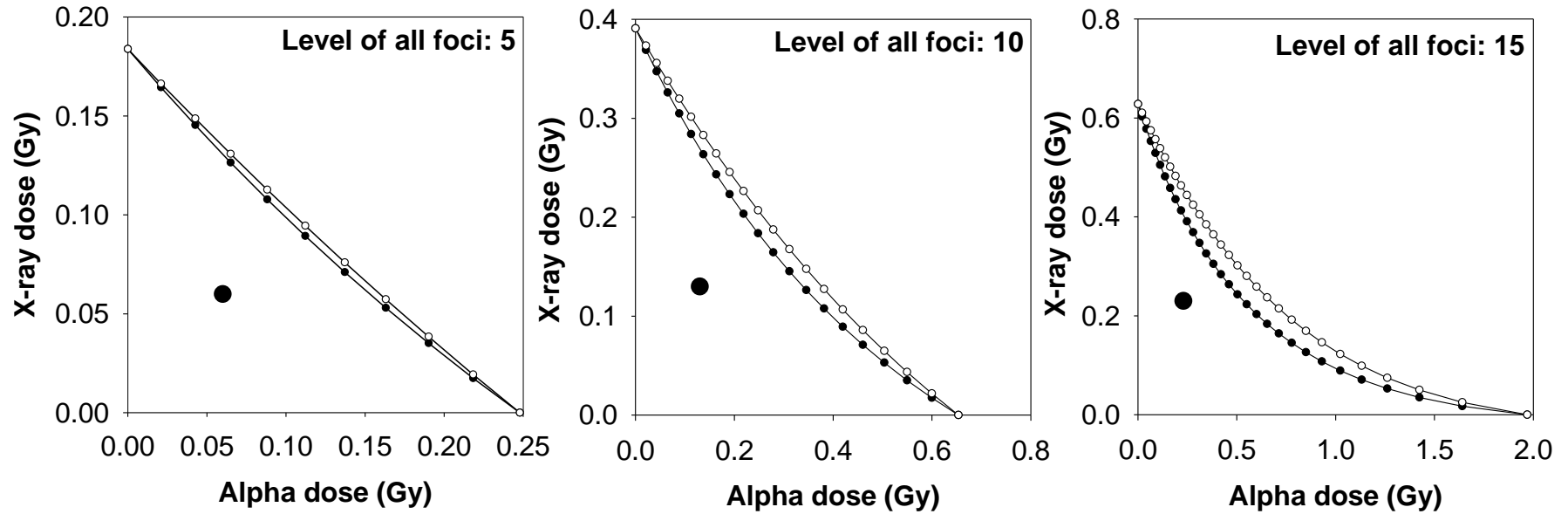
X-rays



50% Alpha + 50% X-rays

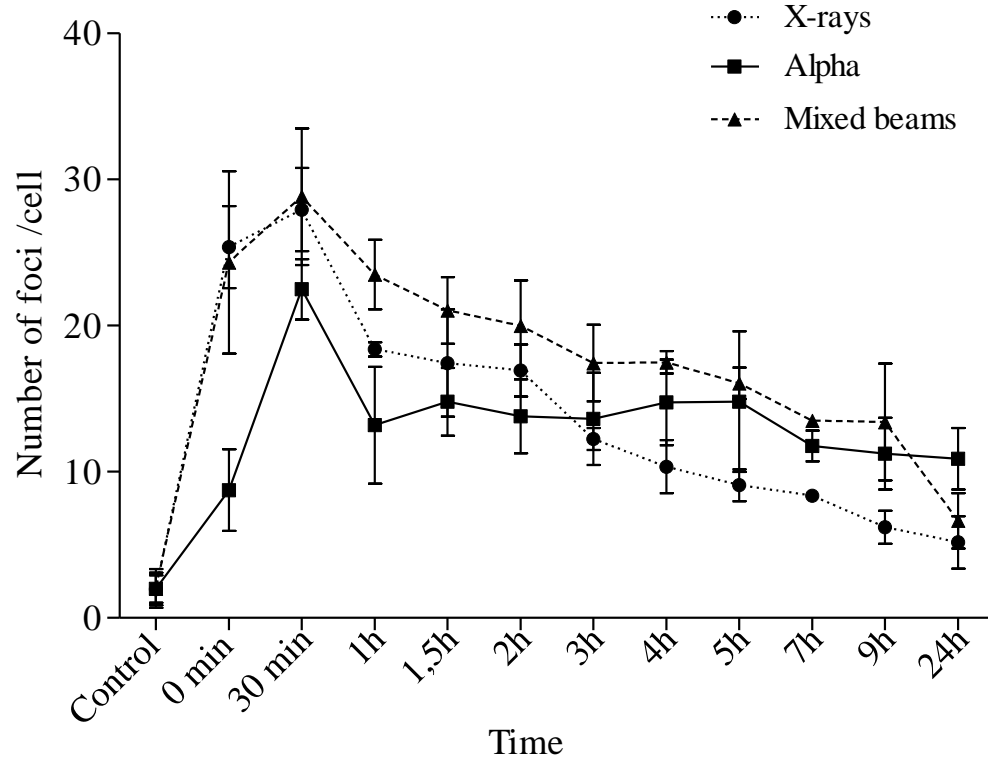


Envelope of additivity for testing synergism

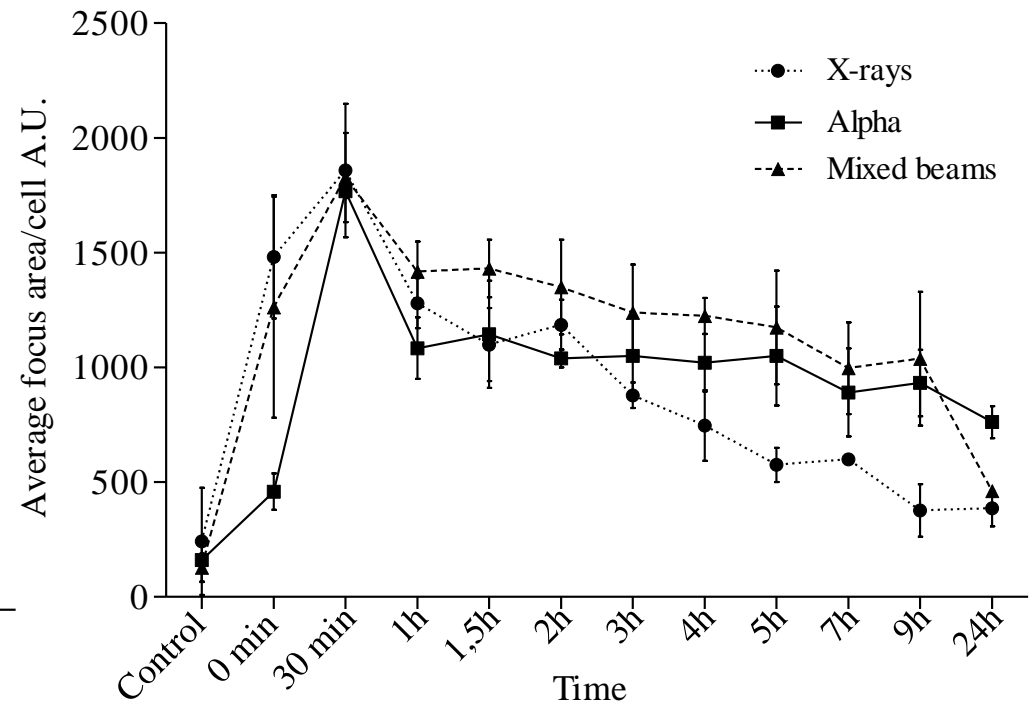


Repair kinetics 53BP1 foci

53BP1 foci after 1Gy



53BP1 foci area after 1Gy



Conclusions

53BP1 foci dose response:

Alpha particle induce lower number of foci than X-rays and mixed beams
Synergism in the induction of 53BP1 foci

Repair kinetics :

53BP1 foci after mixed beams irradiation show different repair kinetics compared to those induced by alpha particles and X-rays.

Possibility:

Interaction between different particles
More complex damage, difficult for the cell to repair
Disruption of higher chromatin structure that make the DNA more vulnerable to the attack of X-rays and free radicals

Thanks to...

- Andrzej Wojcik
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