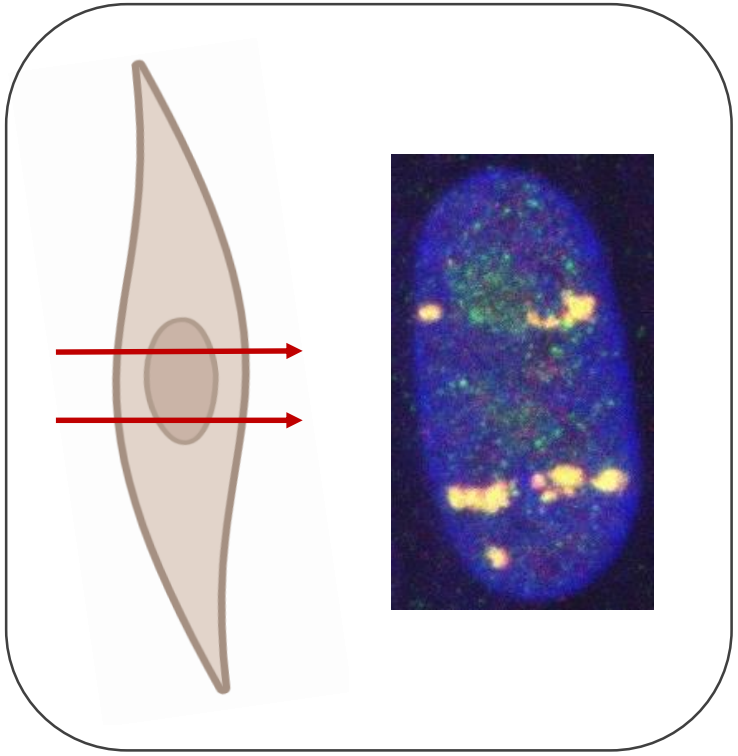
Laboratory of Radiation Biology
Joint Institute for Nuclear Research

Clustered DNA double-strand breaks formation under the influence of ionizing radiation with different physical characteristics

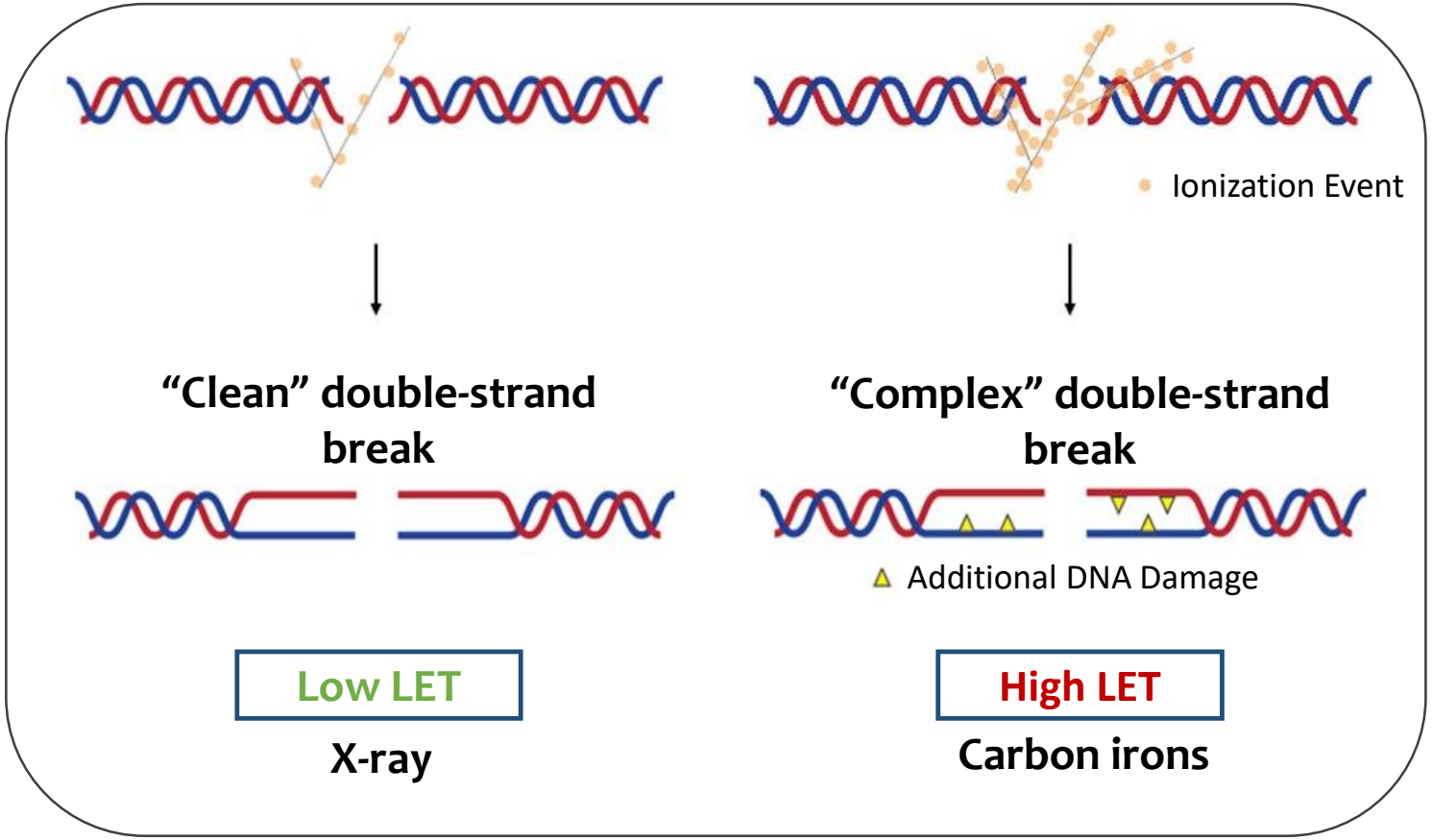
Shamina Daria, *Hramco T., Krupnova M.*

Scientific supervisor: *Doctor of Science*
A. V. Boreyko

Introduction



Fibroblast after exposure to Carbon ions



Geunil Yi, 2023

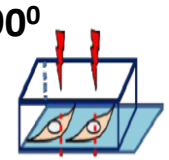
Research goal

Visualization and analysis of clustered DNA double-strand breaks (DSB) structure in human fibroblasts after exposure to low- and intermediate-energy accelerated ions

Irradiation parameters

Type of irradiation	LET, keV/μm	Energy, MeV/n	Dose, Gy	Radiation source
^{15}N ions	183	13	2.20	U-400M, FLNR JINR
	85	33	1	
^{11}B ions	138	8	1	
	91	13		
	44	32		
^{20}Ne ions	132	47	1	
^{12}C ions	10	500	0.30	Nuclotron, VBLHEP JINR
protons	2	30	1	U-120M, NUCLEAR PHYSICS INSTITUTE CAS
γ-rays ^{60}Co	0.3		0.8	Rocus – M, DLNP JINR

Materials and methods

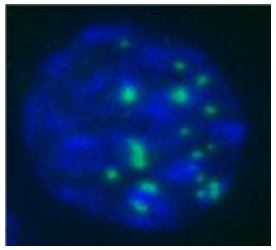


U400-M

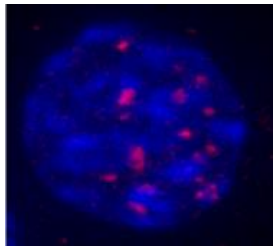
Rocus-M

Fibroblasts

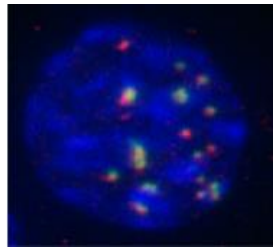
γH2AX



53BP1



γH2AX/53BP1



Radiation-induced foci - the site of **DSB** formation

Irradiation of cells with accelerated ions, y-rays and protons

↓

Fixation of cells at different times post-irradiation

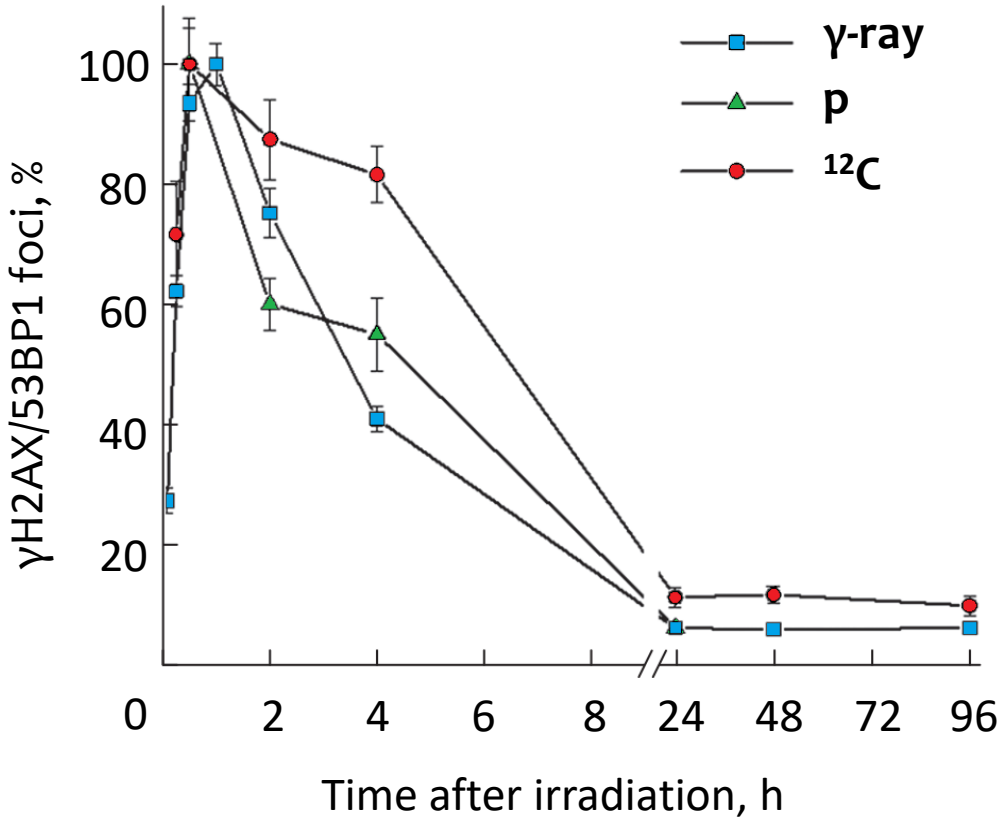
↓

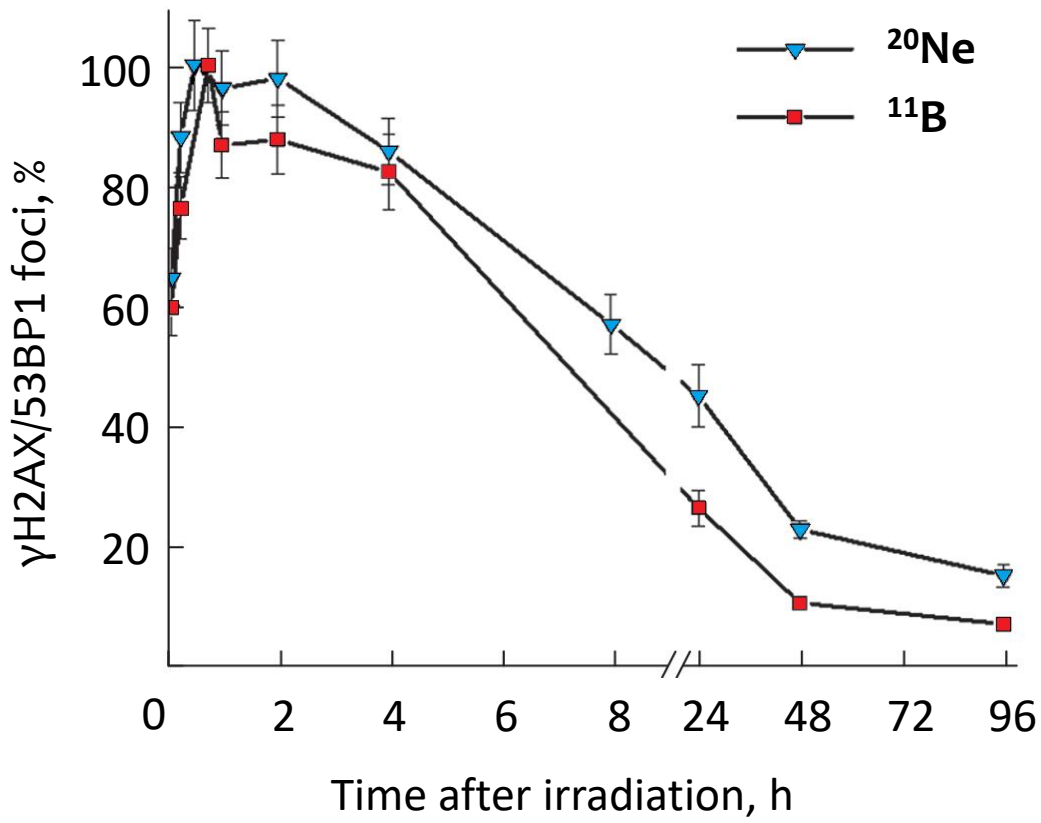
Visualization of induced DSBs:
- immunostaining procedure
- obtaining images of stained samples using microscope

↓

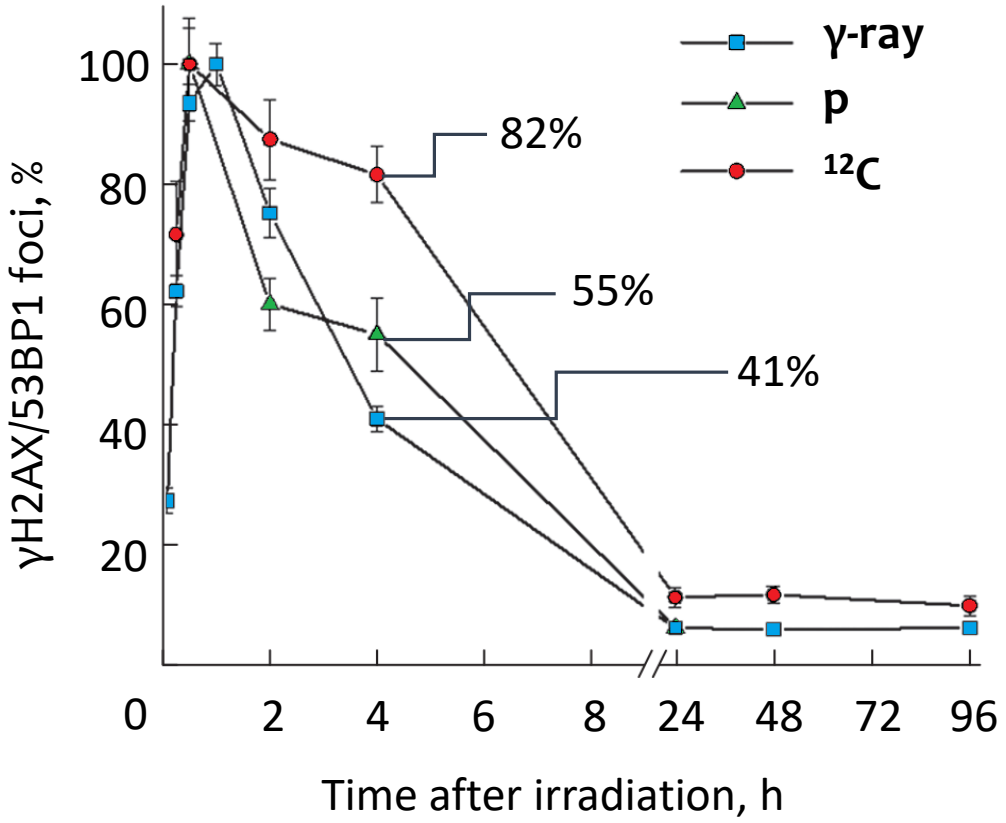
Analysis of the γH2AX/53BP1 foci in obtained 3D images

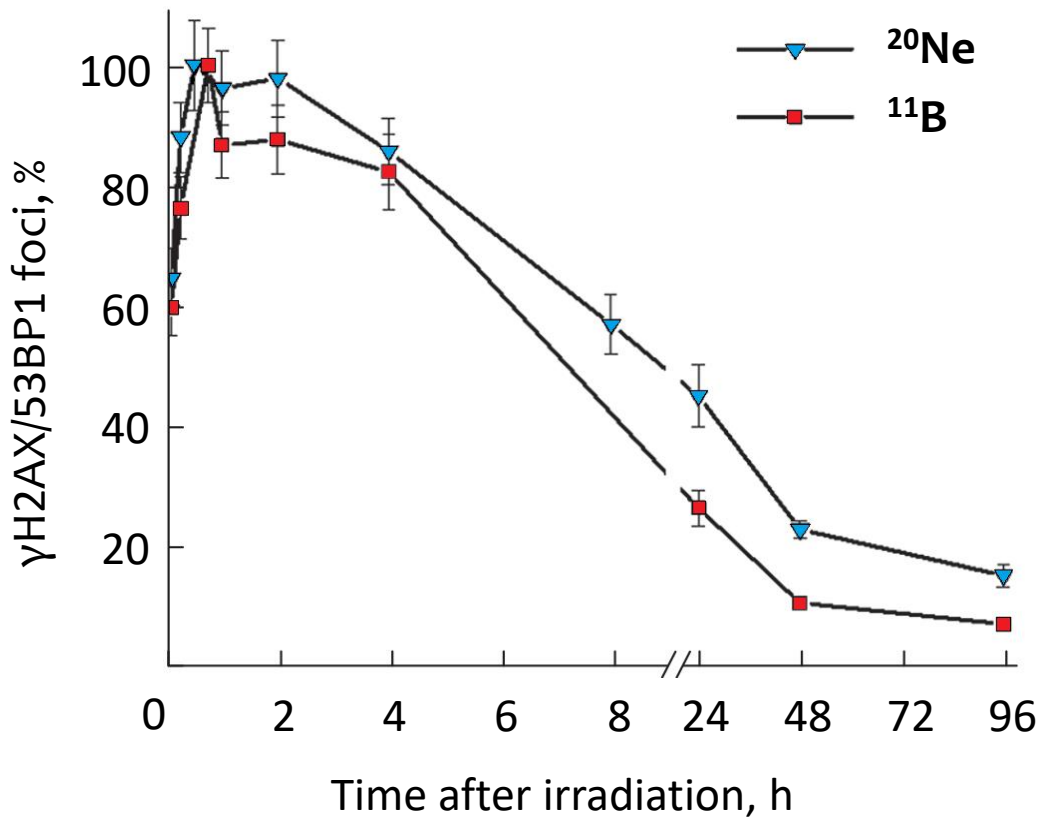
γH2AX/53BP1 foci formation and loss (DSB repair dynamics) in fibroblasts nuclei



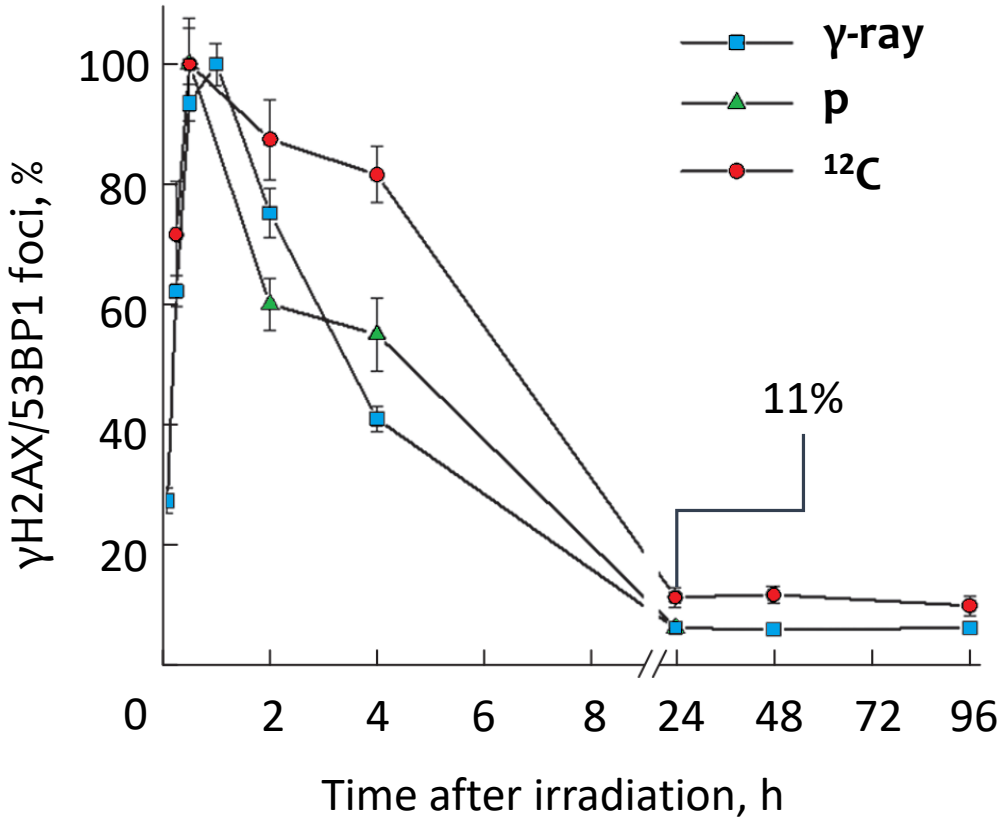


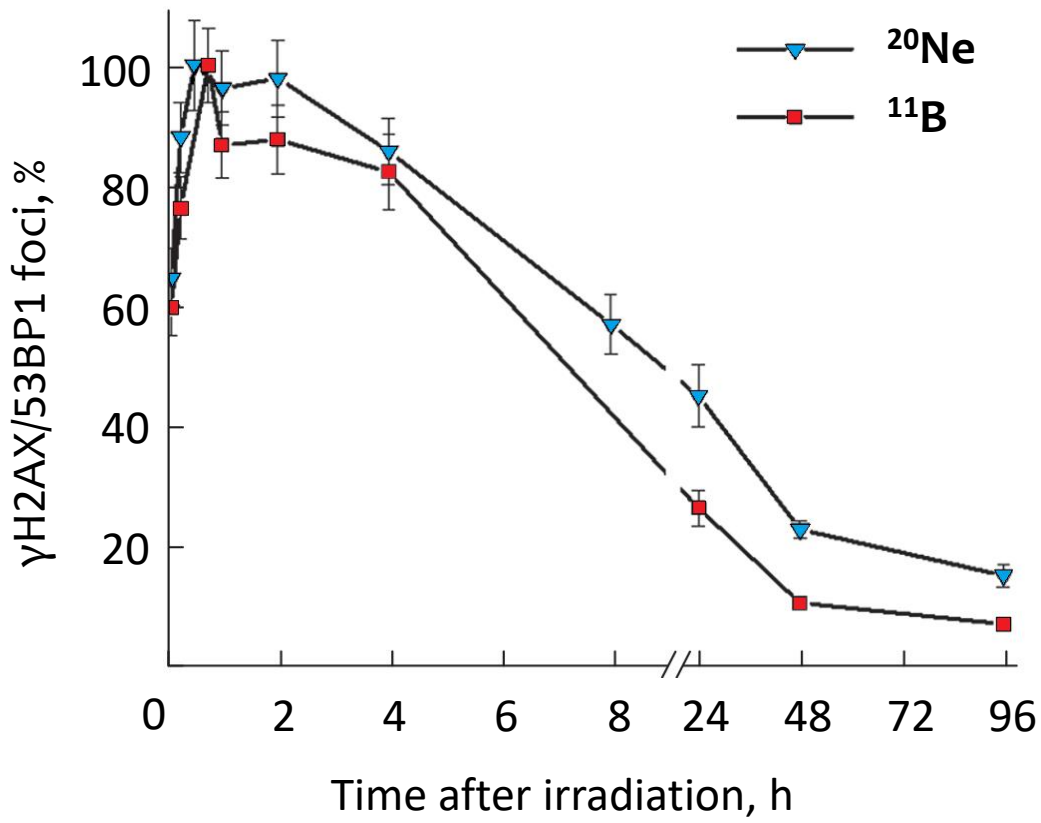
γH2AX/53BP1 foci formation and loss (DSB repair dynamics) in fibroblasts nuclei



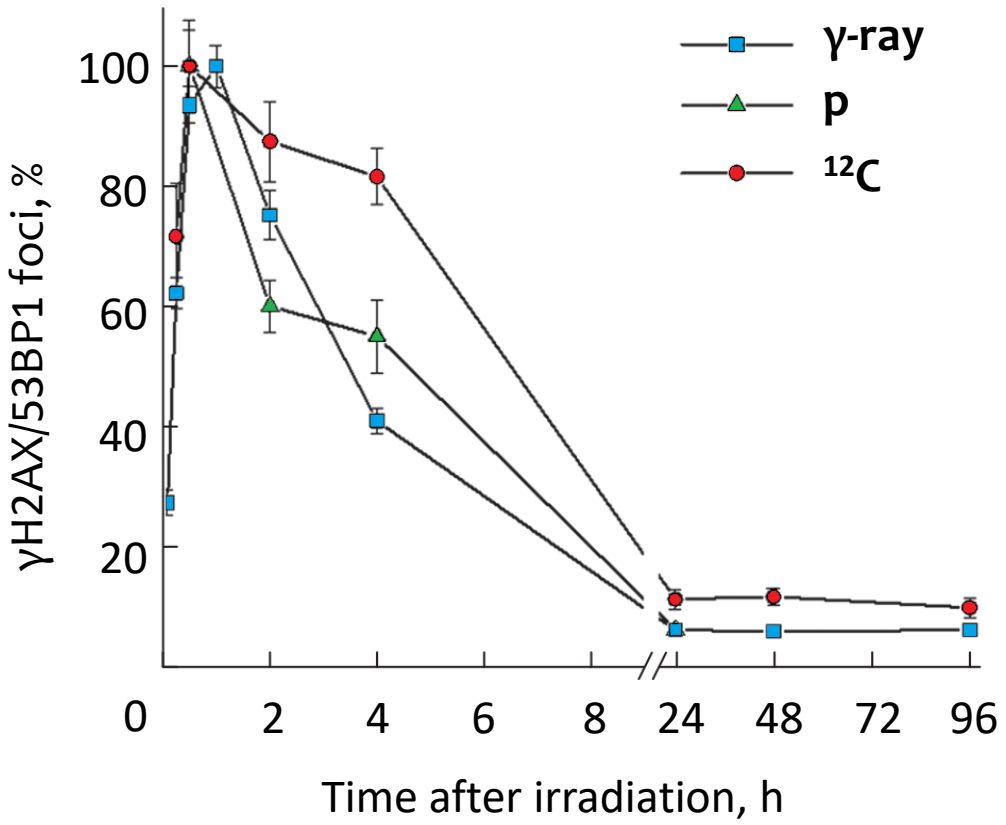


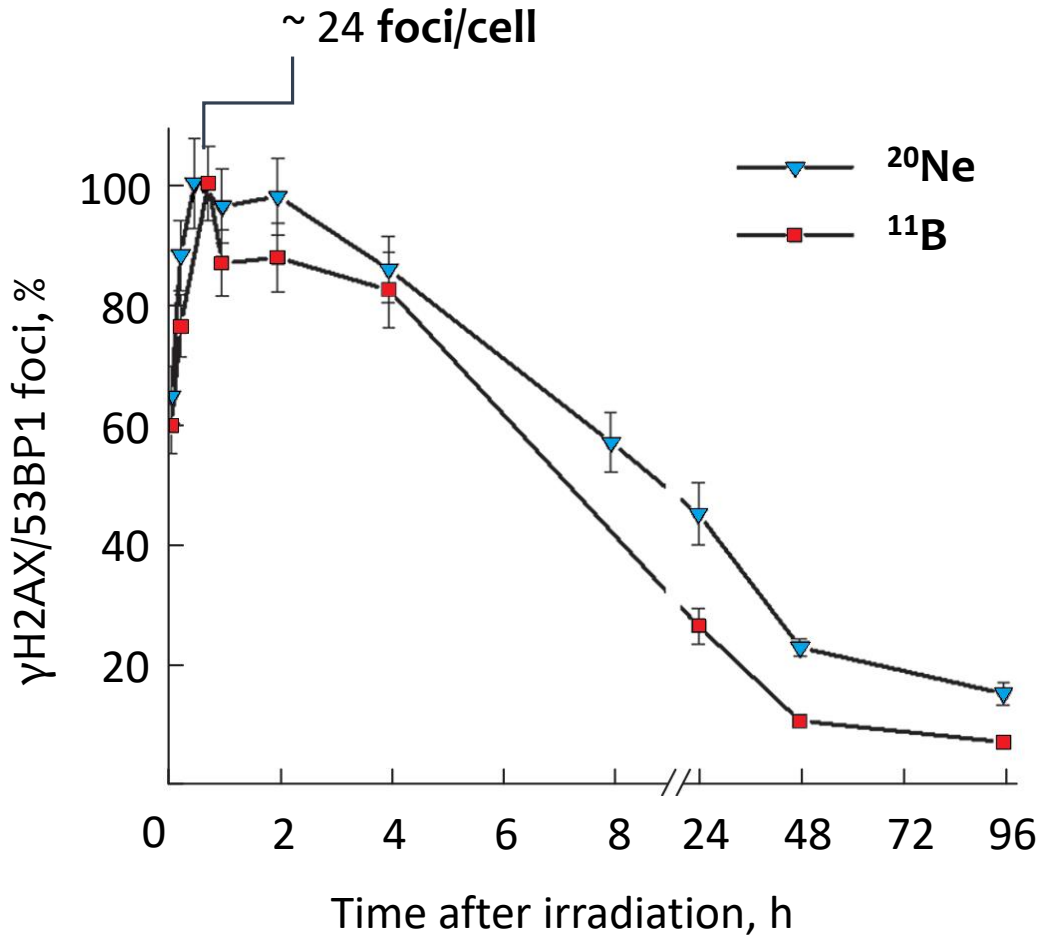
γH2AX/53BP1 foci formation and loss (DSB repair dynamics) in fibroblasts nuclei



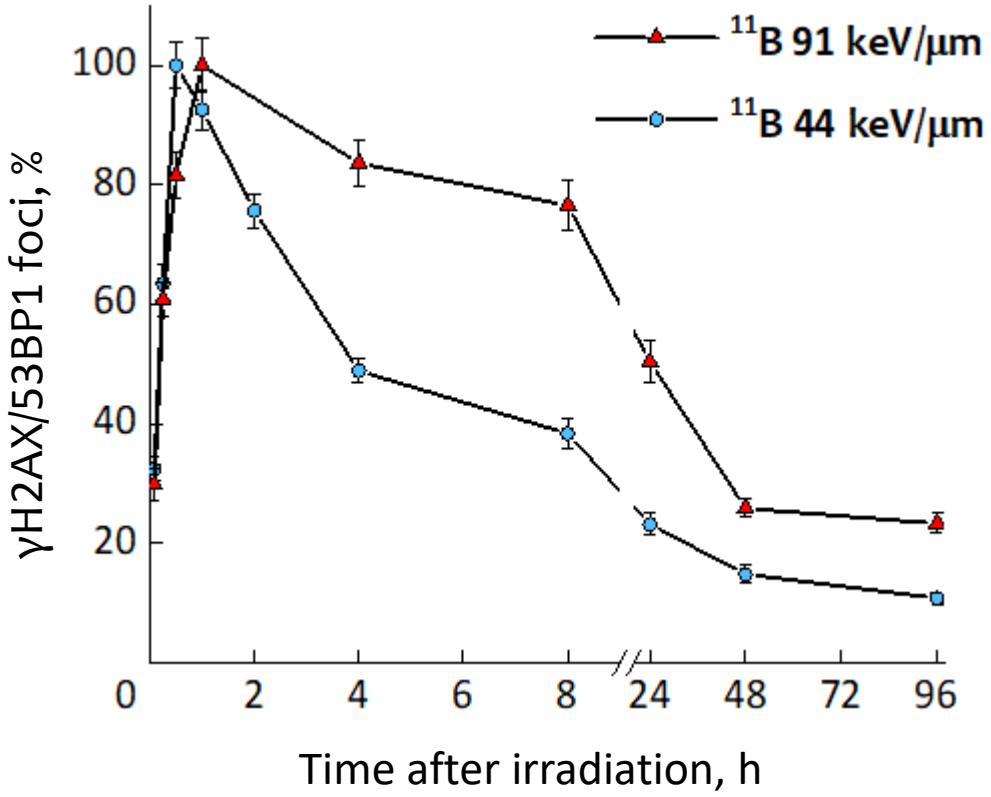


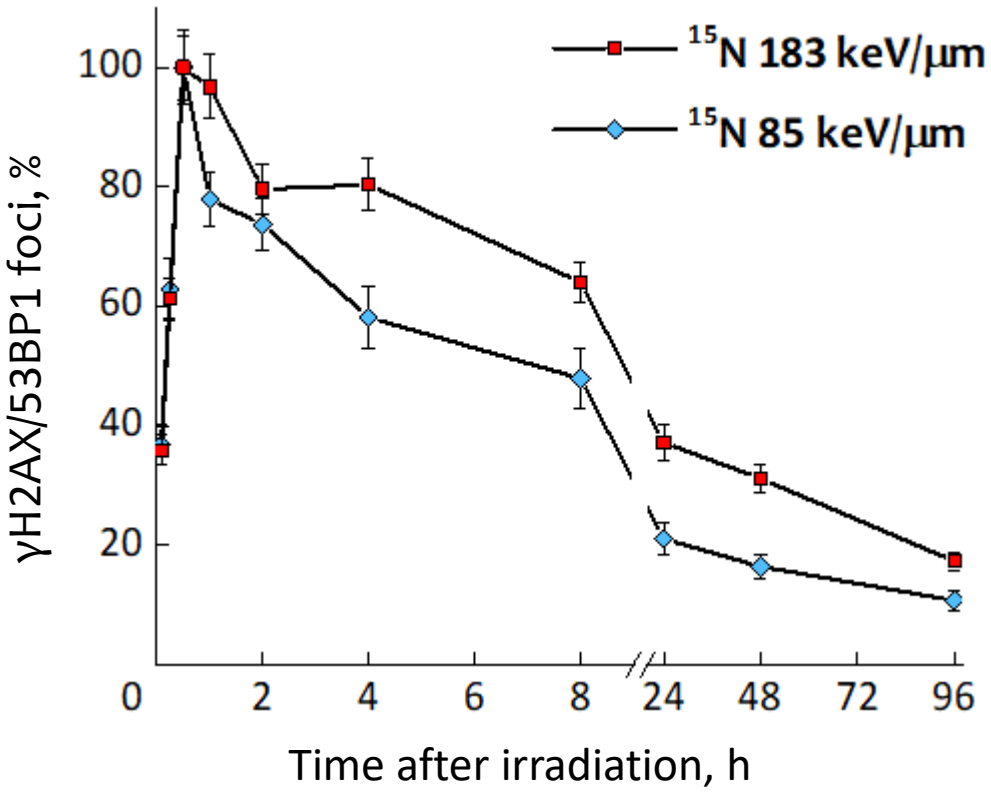
γH2AX/53BP1 foci formation and loss (DSB repair dynamics) in fibroblasts nuclei



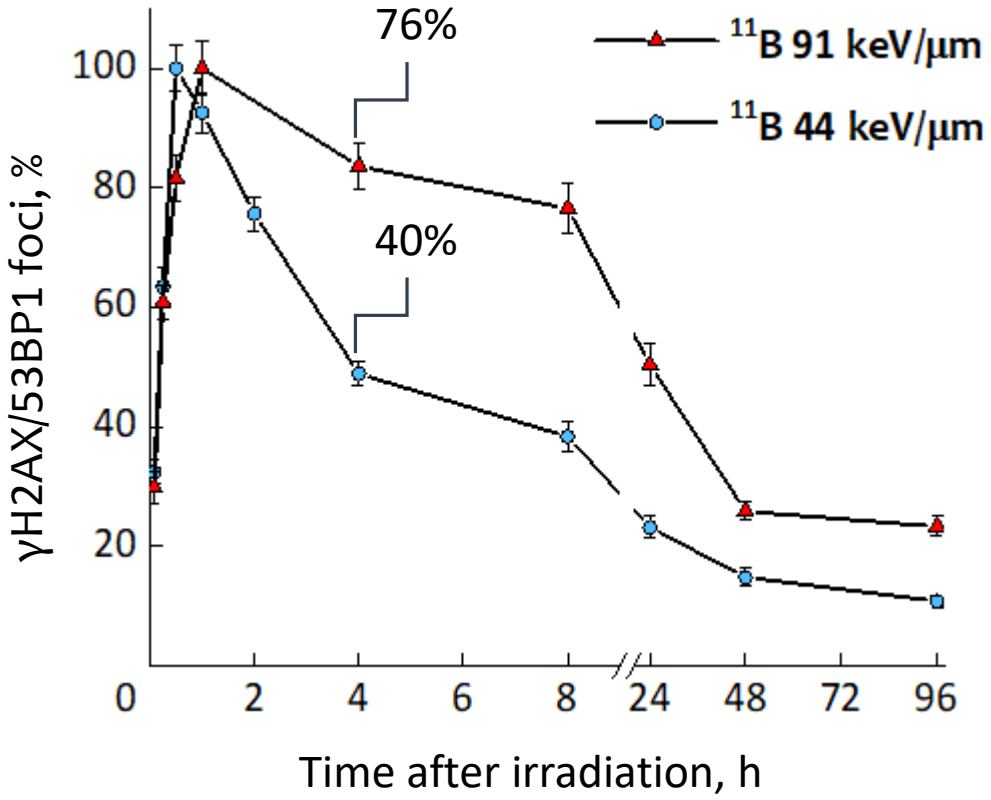


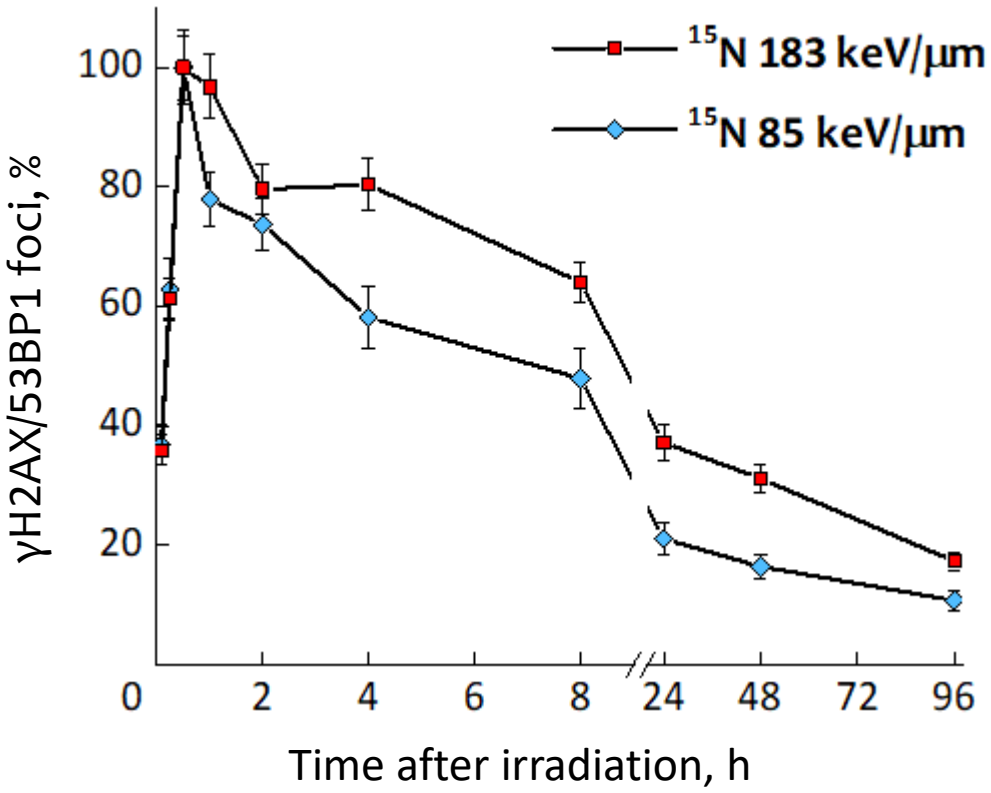
γH2AX/53BP1 foci formation and loss (DSB repair dynamics) in fibroblasts nuclei





γH2AX/53BP1 foci formation and loss (DSB repair dynamics) in fibroblasts nuclei





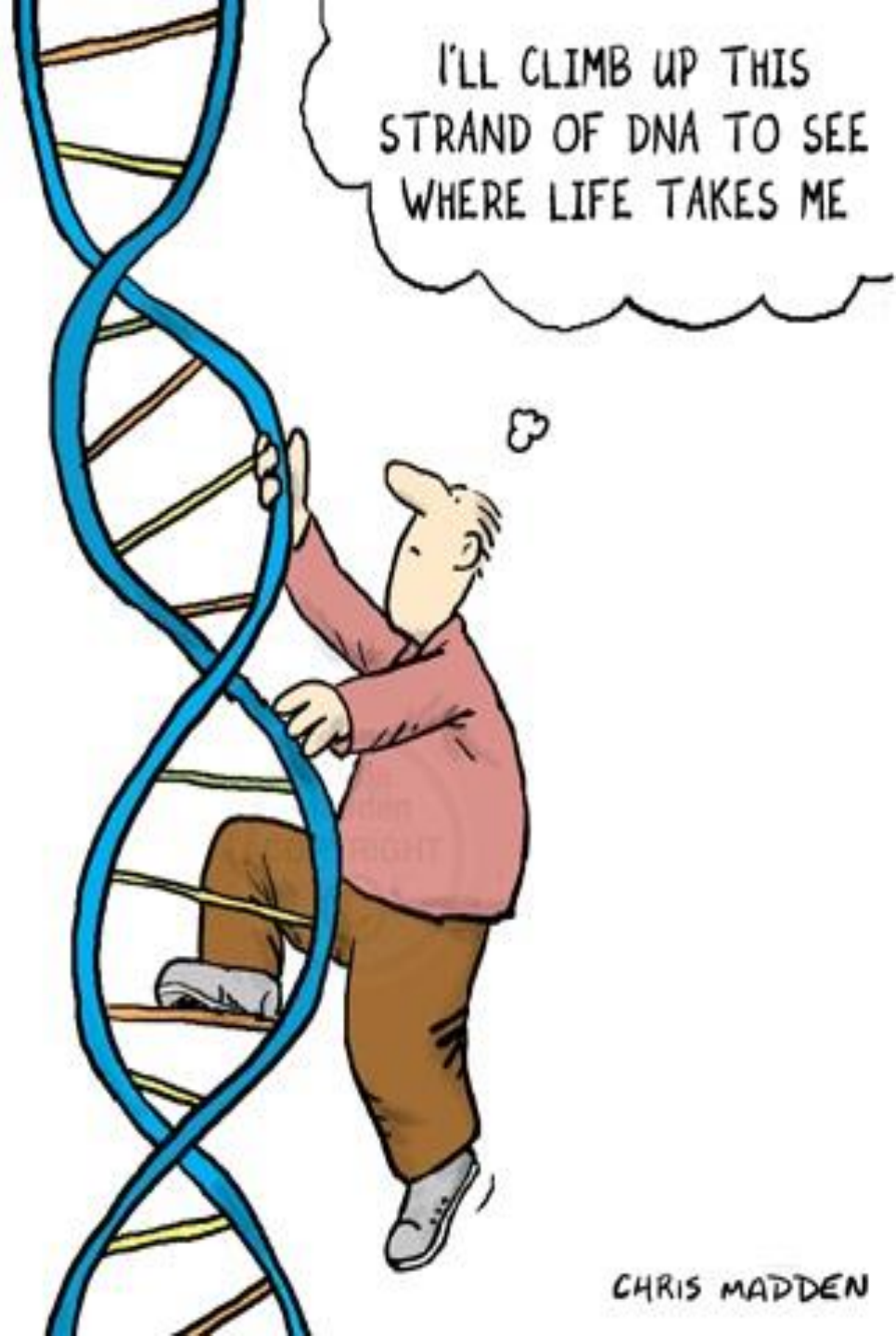
Conclusions

- The kinetics of clustered DNA DSB repair after irradiation with accelerated ^{12}C ions is slower compared to the action of γ-rays and protons. This may indicate a more complex structure of damage induced by heavy charged particles

- Different accelerated ions with the same LET induce DNA damage of different complexity and repair efficiency. Accelerated ^{20}Ne ions induce more repair-resistant DNA damage

- With decreasing particle energy and increasing their LET, the efficiency of clustered DNA DSB repair decreases

Thank you for your attention!



Immunostaining procedure