



Department of medical physics
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Study of the effect of laser pulse duration in the ultraviolet spectral range on fibroblasts

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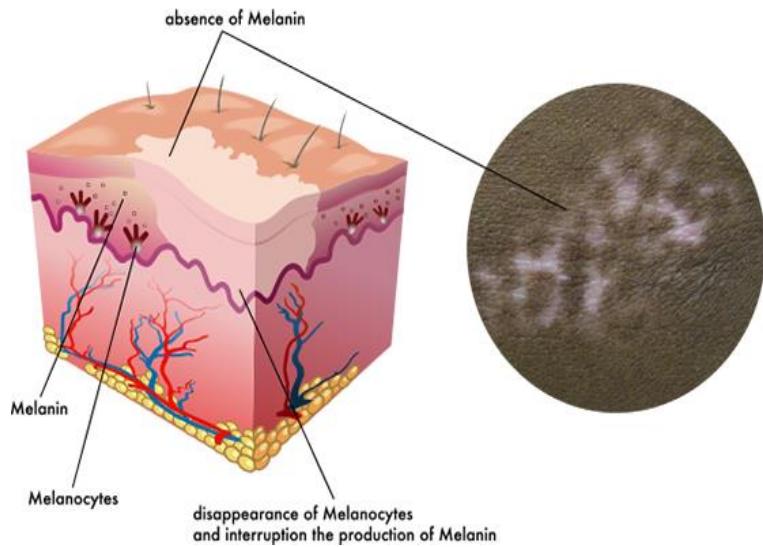
Dissertation Supervisor
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Kazan, Russia

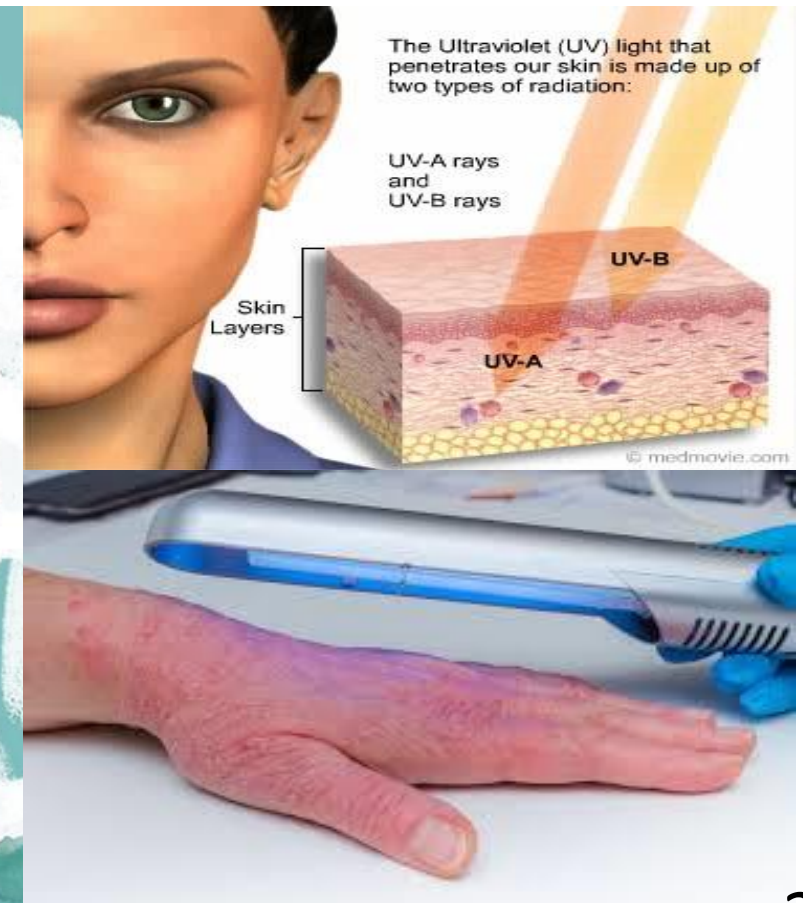
Background

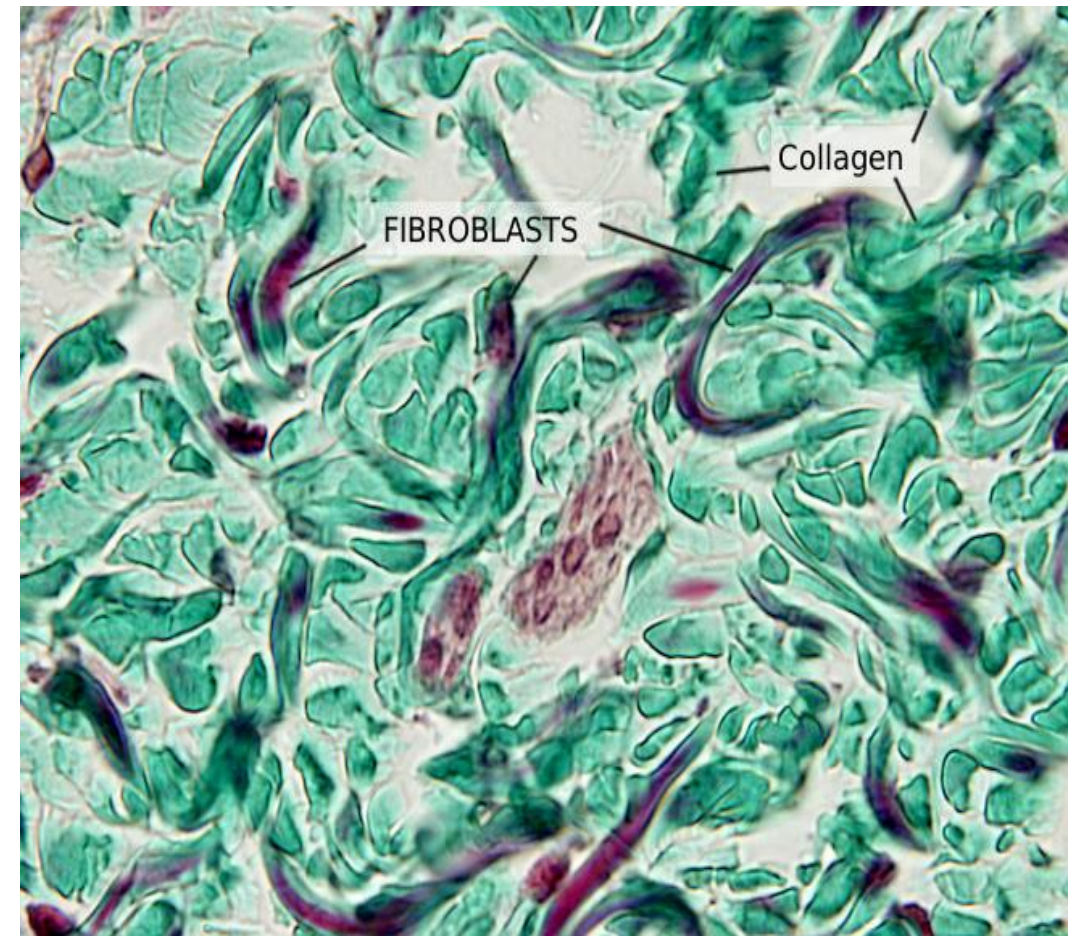
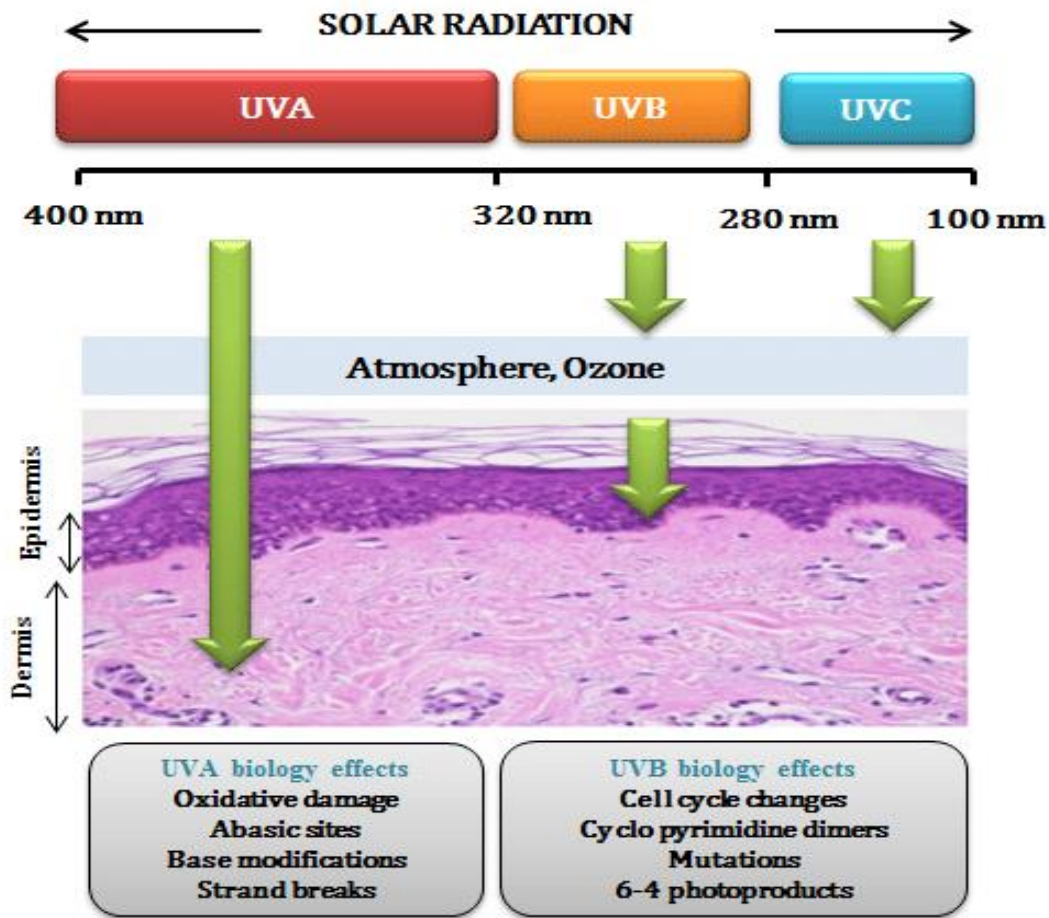
VITILIGO

VITILIGO



UV THERAPY







Project aim

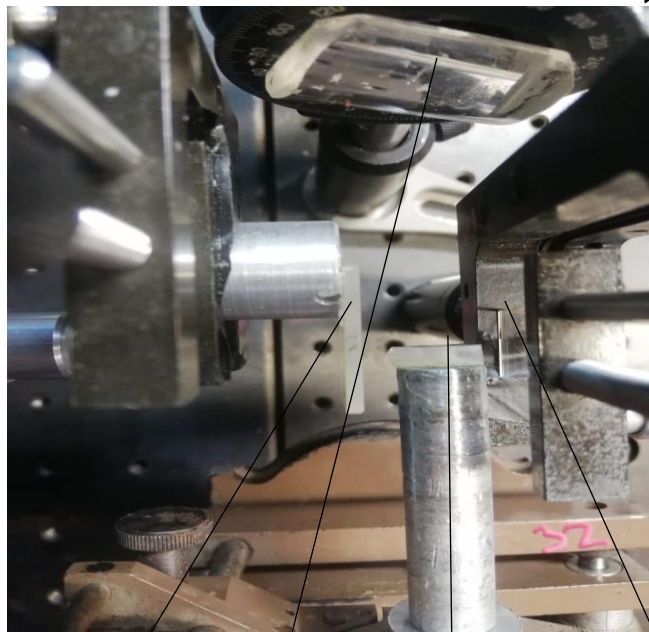
Study the effect of pulse duration and wavelength of laser light in the ultraviolet range of the spectrum on fibroblast cells.

Tasks:

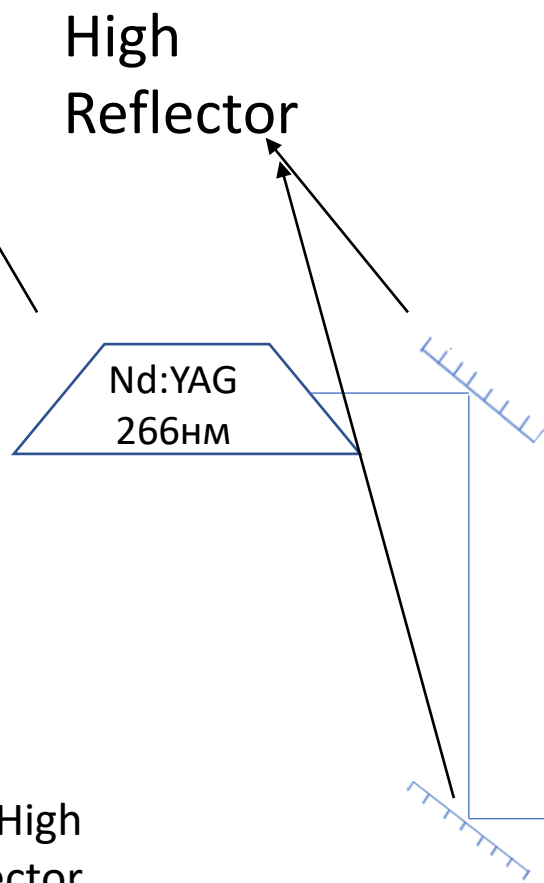
1. To achieve a laser on the active medium $\text{LiLu}_{0.7}\text{Y}_{0.3}\text{F}_4:\text{Ce}^{3+}, \text{Yb}^{3+}$ with the possibility of changing the pulse duration.
2. To study the survival of fibroblast cells when irradiated with laser light in the ultraviolet range of the spectrum with different duration and wavelength.

Experimental Setup:

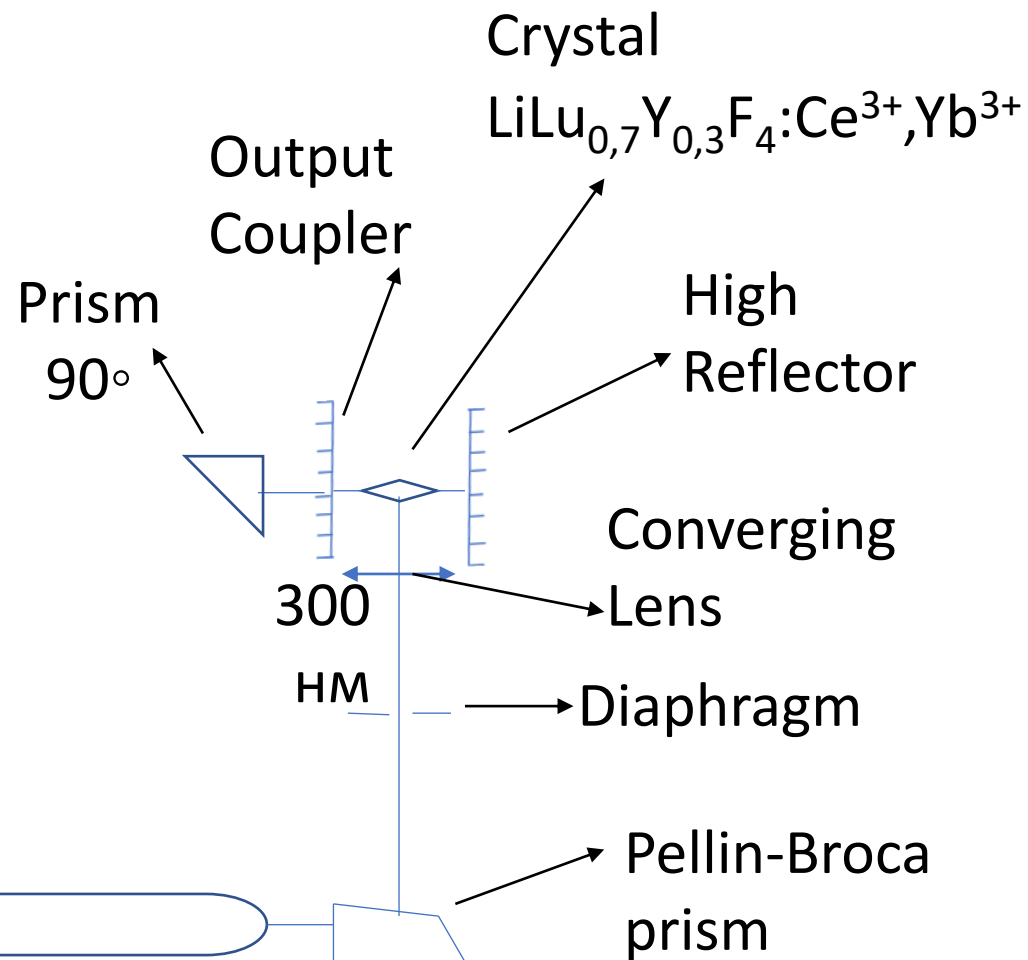
Nd:YAG laser with a wavelength of 266 nm



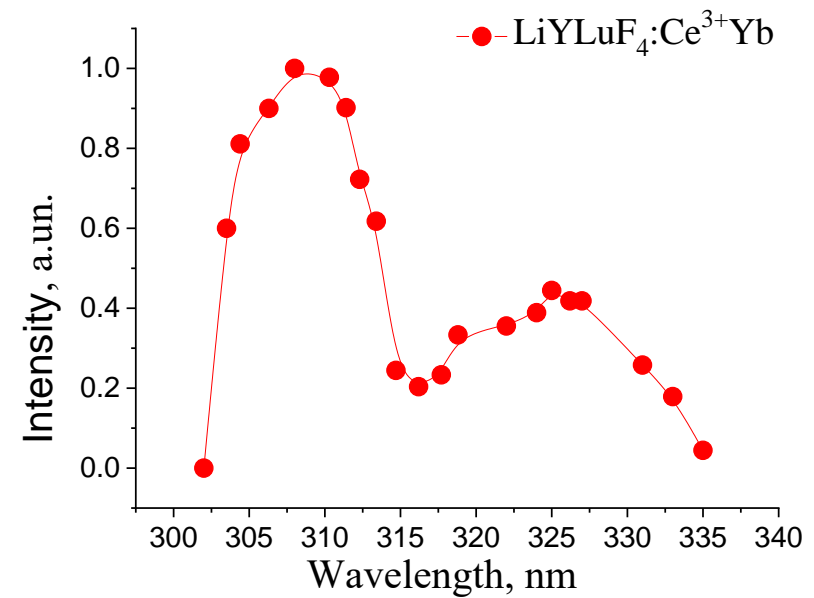
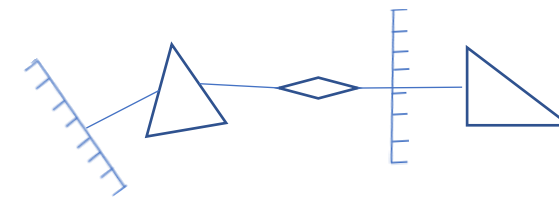
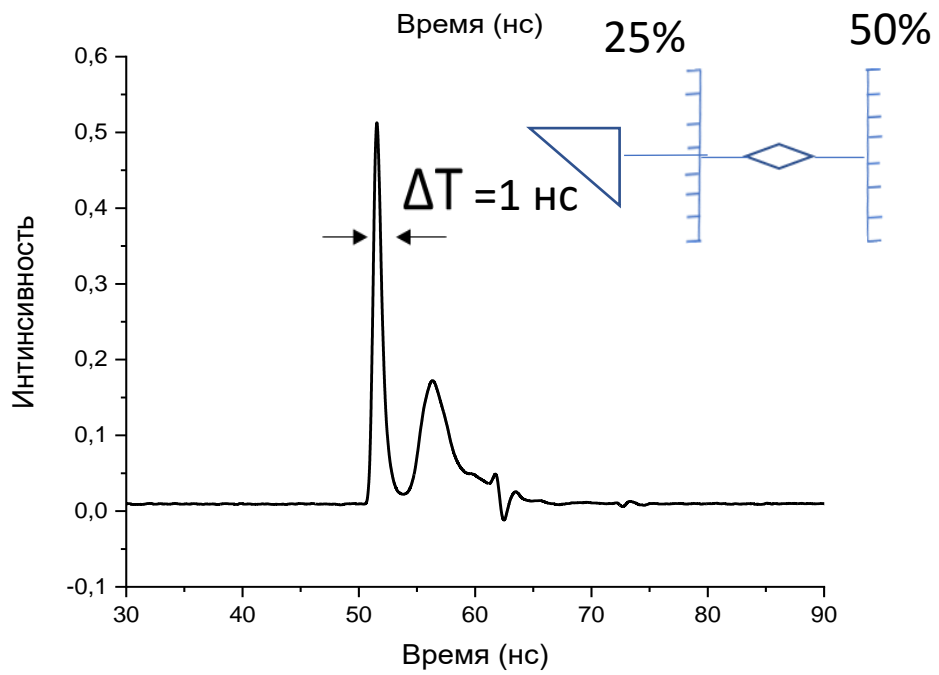
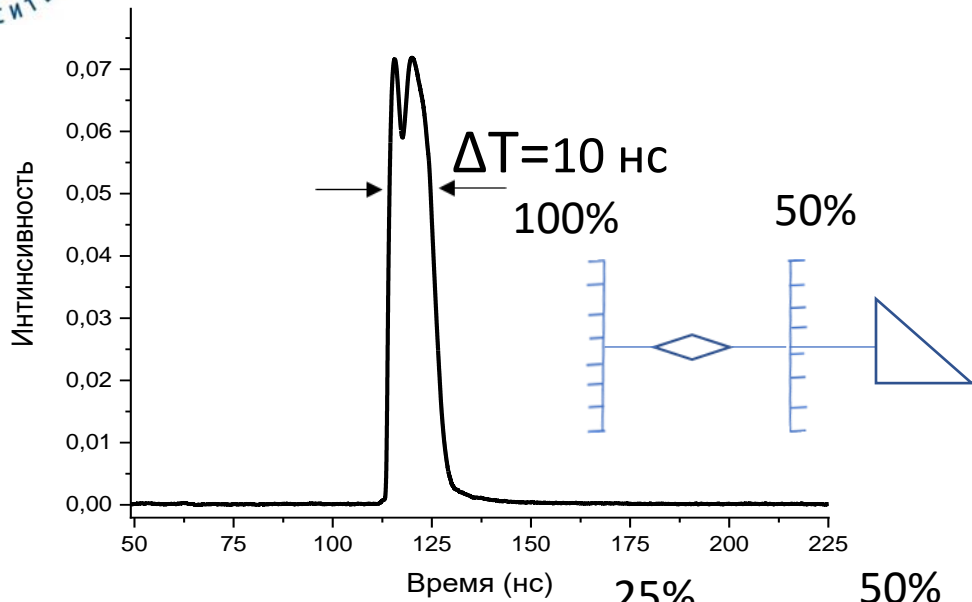
Converging Lens
Output Coupler
Crystal $\text{LiLu}_{0,7}\text{Y}_{0,3}\text{F}_4:\text{Ce}^{3+},\text{Yb}^{3+}$
High Reflector



Raman Shifter



Experimental Setup:



Methodology



Dual channel power meter Ophir Pulsar-2

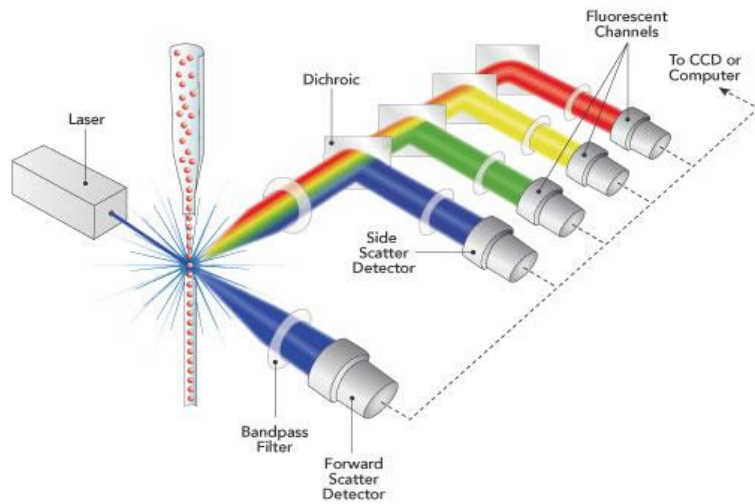


Four channel oscilloscope

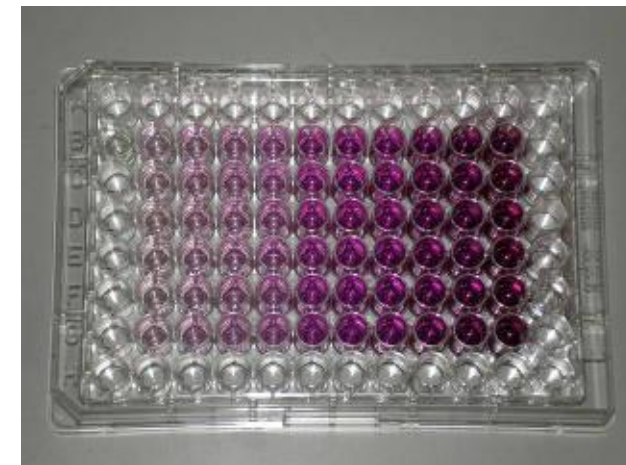


Spectrometer Solar laser systems S100

Rohde & Schwarz



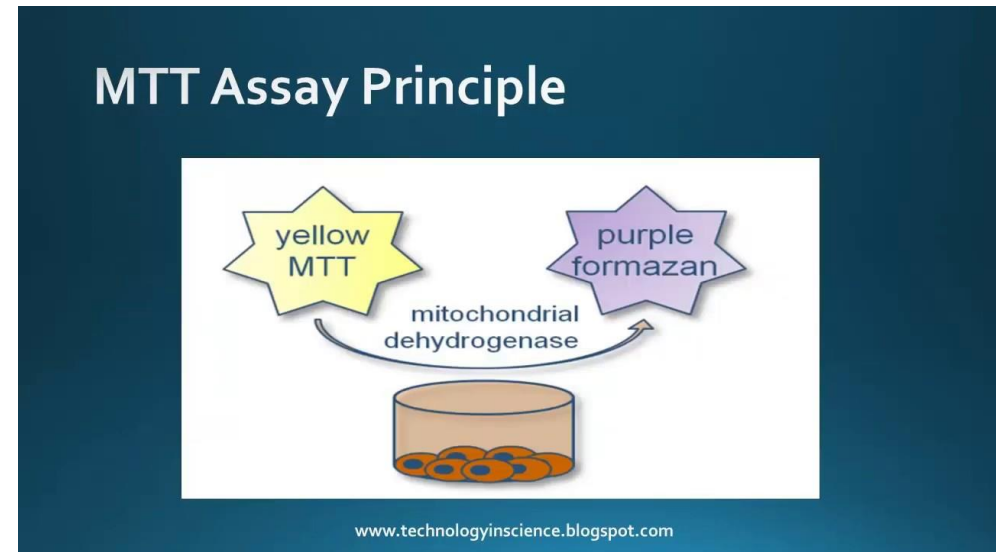
Cytometry



MTT assay

MTT assay

The MTT test is based on the reduction reaction of the yellow tetrazolium salt MTT by mitochondrial dehydrogenases of living cells to purple formazan crystals, which are insoluble in the aquatic environment of the cells. The amount of formazan formed is proportional to the number of viable cells in the well.

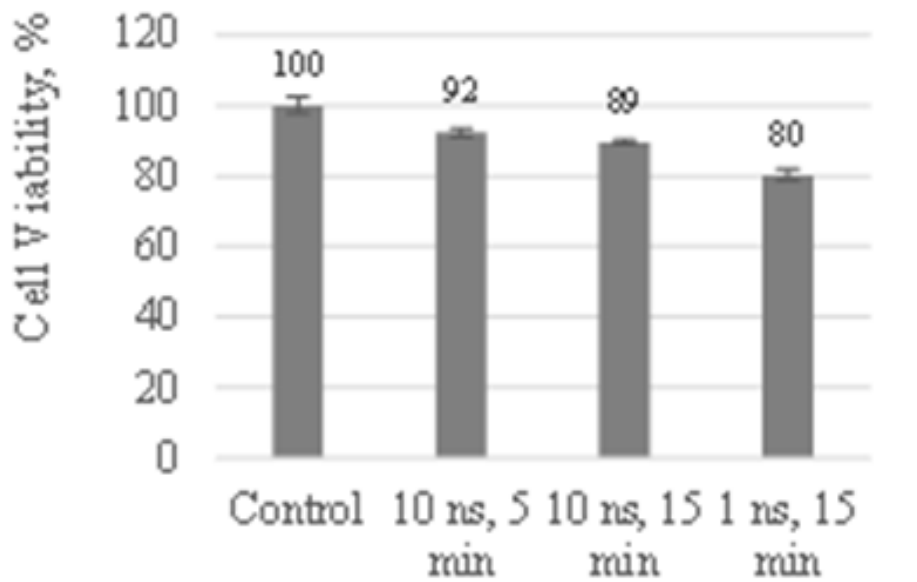


MTT results

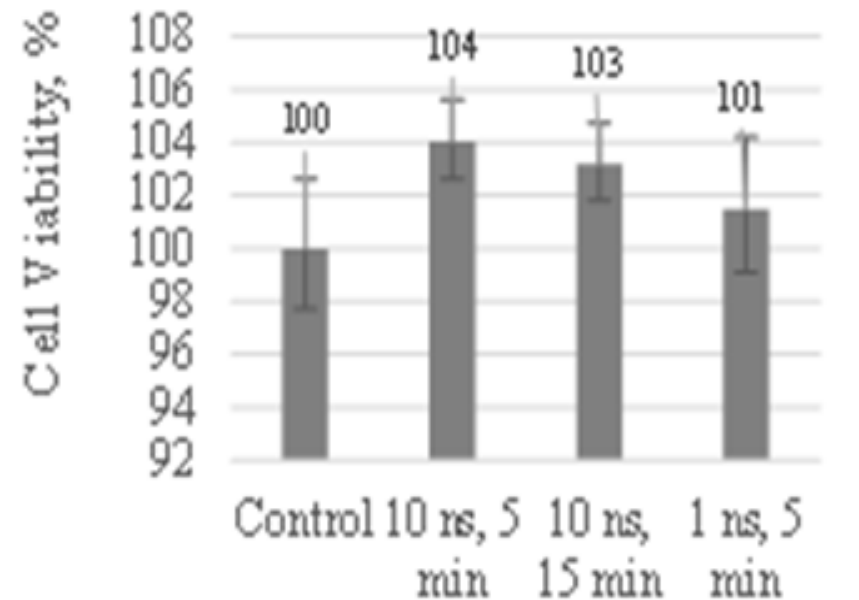
Evaluation of changes in the viability of human skin fibroblasts under the effect of laser irradiation using the MTT test. HSF cells.

the survival of fibroblast cells is less when irradiated with UV light with a shorter pulse duration (1 ns)

increasing in HSF cells viability after 24 of irradiation



(a) impulse/time duration, ns/min



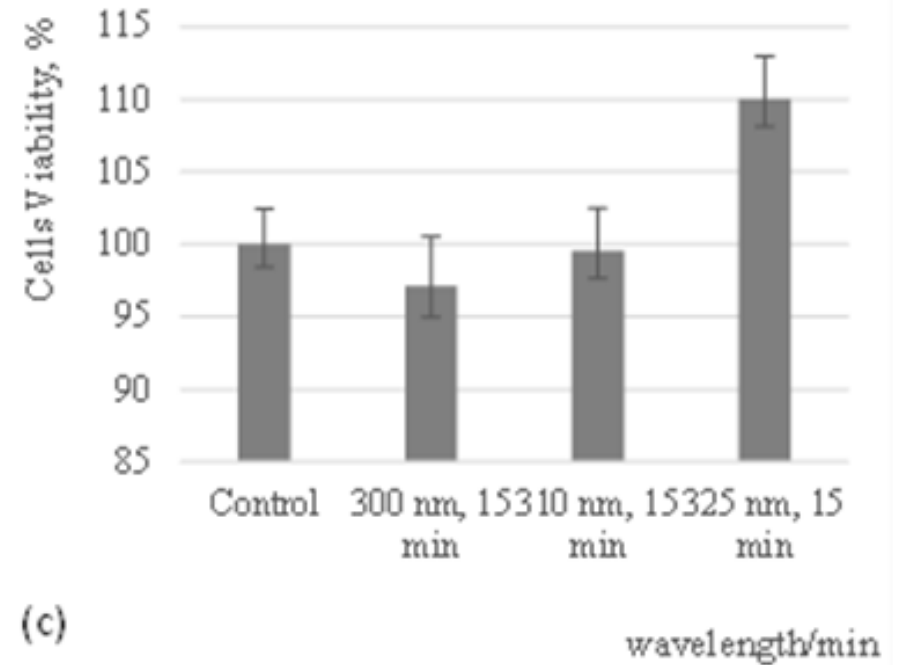
(b) impulse/time duration, ns/min



MTT results

Evaluation of changes in the viability of human skin fibroblasts under the effect of laser irradiation using the MTT test. HSF cells.

The survival decreases with shorter wavelength.





Results of Cytometry

No event	percent of events	Comment
I	0.4%	DiOC6+PI- (alive)
II	12.6%	DiOC6-PI- (with damaged mitochondria)
III	6.2%	DiOC6-PI+ (dead, late apoptosis)
IV	80.8%	DiOC6+PI+ (perforated cytoplasmic membrane)

DiOC6(3) : 3,3'-dihexyloxacarbocyanine iodide.

PI : propidium iodide.



Conclusion

1. Laser generation on the $\text{LiLu}_{0.7}\text{Y}_{0.3}\text{F}_4:\text{Ce}^{3+}, \text{Yb}^{3+}$ active medium in the pulsed mode with wavelength tuning from 305 to 335 nm, as well as with different pulse durations, has been achieved.
2. The viability of human skin cells under the action of laser UV radiation was assessed.
 - It has been shown that the survival of fibroblast cells is less when irradiated with UV light with a shorter pulse duration (1 ns)
 - It has also been shown that survival decreases as the wavelength of UV laser light is shortened.
 - It has been established by flow cytometry that as a result of UV laser irradiation of fibroblasts, the cytoplasmic membrane is damaged in 80% of cases.



Acknowledgments

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Supervisor

Dr. Alexey Nizamutdinov





References

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