ULTRAFAST BEAMS AND APPLICATIONS-2019

Ultrafast beam effects on some E.coli strains

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Modeling of certain problems of space biology in Earth conditions

Khachatryan G.E., Simonyan N.V., Mkrtchyan N.I., Arakelyan V.B., Tatikyan S.Sh., Tsakanov V.M., Antonyan P.M., Karamyan S.K., Harutyunyan V.V. *Biol. J. Armenia, 68 (2), pp.21-29,* ***2016*** (in English).

MAIN INCLUDES TOPICS ARE RADIOBIOLOGY AND CRYOBYOLOGY

TODAY: PRESENTATION OF SOME RESULTS IN RADIOBILOGY

CONTENT OF INVESTIGATIONS

- **STUDY OF SOME *E.coli* STRAINS BEHAVIOR UNDER AREAL BEAMS IRRADIATION (SURVIVAL CURVES)**
- **COMPARISON OF SURVIVAL CURVES FOR *E.coli* STRAINS RECEIVED ON ULTRAFAST AREAL BEAMS WITH THE CURVES RECEIVED BY US EARLIER ON MICROTRON 7.5 MeV (YERPHI)**
- **INVESTIGATION OF THE DEPENDENCE OF STRAINS SURVIVAL ON BEAM FREQUENCY**
- **SURVIVAL CURVES FOR THE SAME STRAINS IRRADIATED IN DEEP FREEZE CONDITIONS**
- **INVESTIGATIONS WITH OTHER CULTURES**
- **THE USE OF CARRIERS FOR IMMOBILIZATION AND STUDY THE SURVIVING OF MICROBS IN THE SAME CONDITITIONS**

Current objects are:

Wild type E. coli K-12 AB-1157

Radiosensitive AB-2463

Radioresistant BL-1114 (*Gam^{r}-444*)

Pseudomonas putida

Pseudomonas sp. A-27

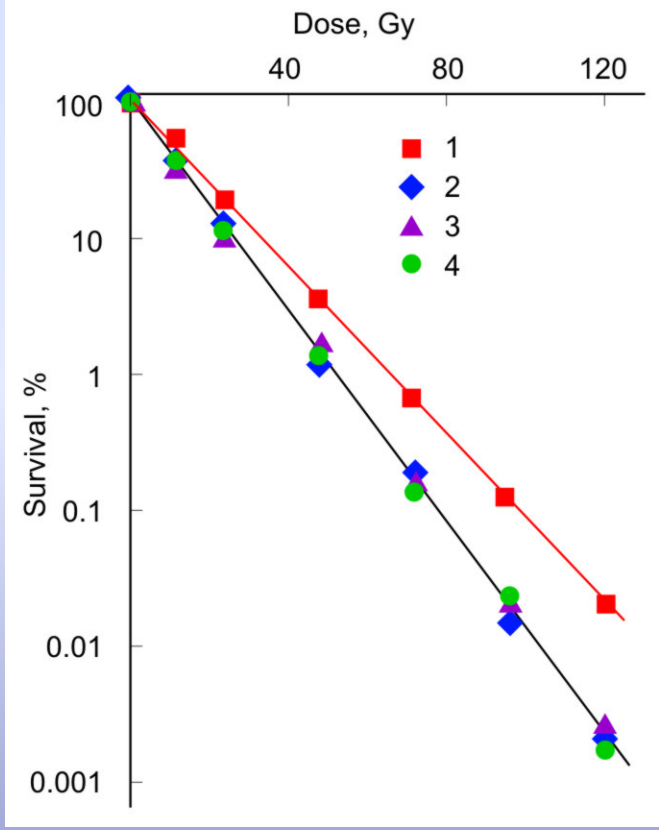
from

SPINPh (prof.Verbenko V., National Research Center «Kurchatov Institute»)

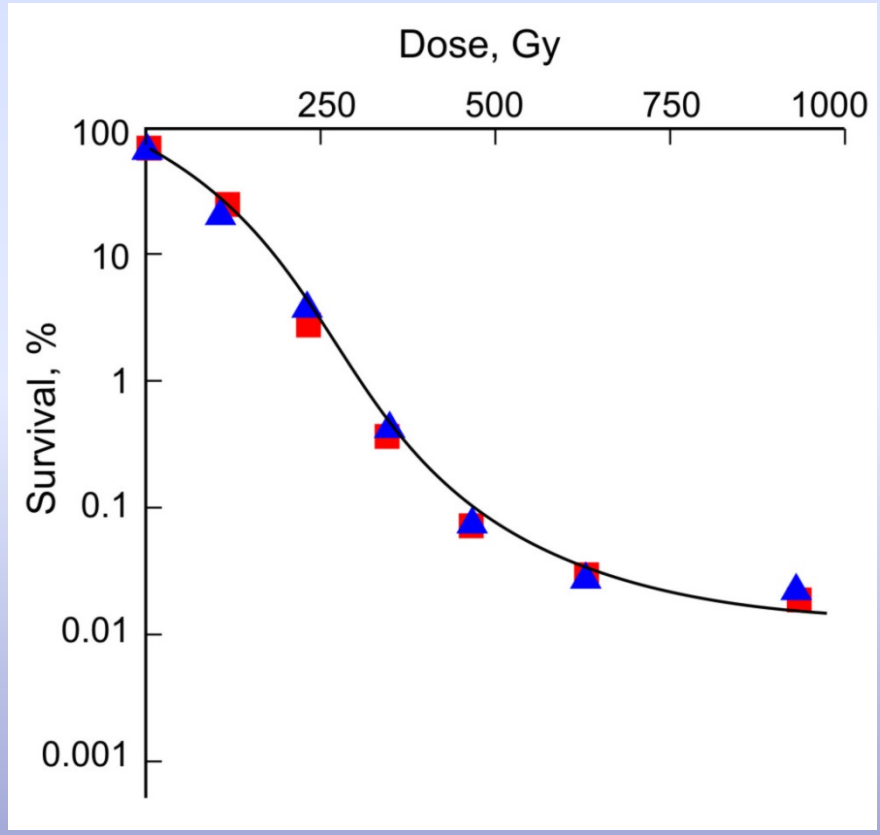
preliminary agreement for collaboration

The samples of dose-effect curves for different kinds of bacteria

Irradiation was performed earlier by our group on RUM-17 (x-ray, continuous beam)

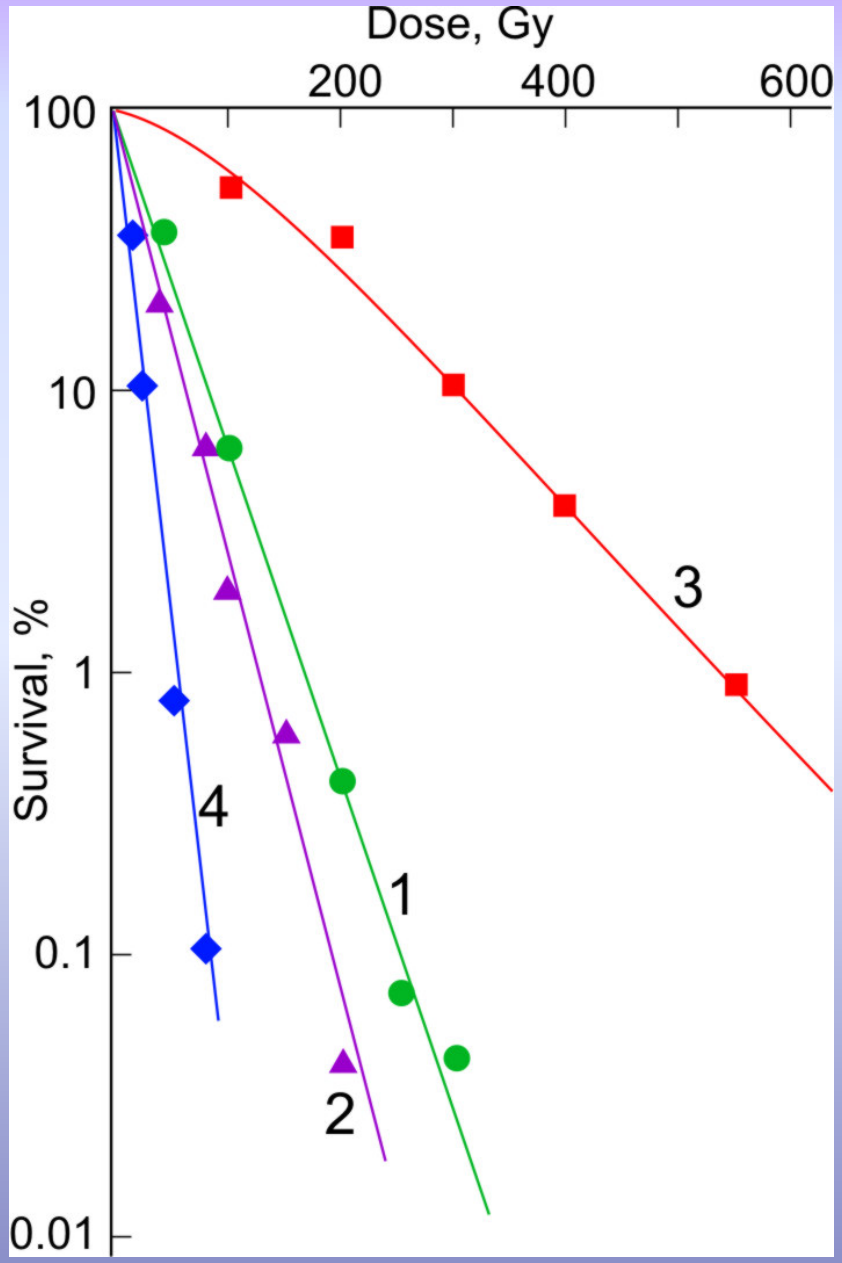


Radiosensitive cells of bacteria *P. fluorescens*



Radioresistant cells of bacteria *Bacillus subtilis*

Sporulating bacterium



Microtron (YerPhI):

Beam energy: 7.5 MeV

Pulse Duration: > 50ps

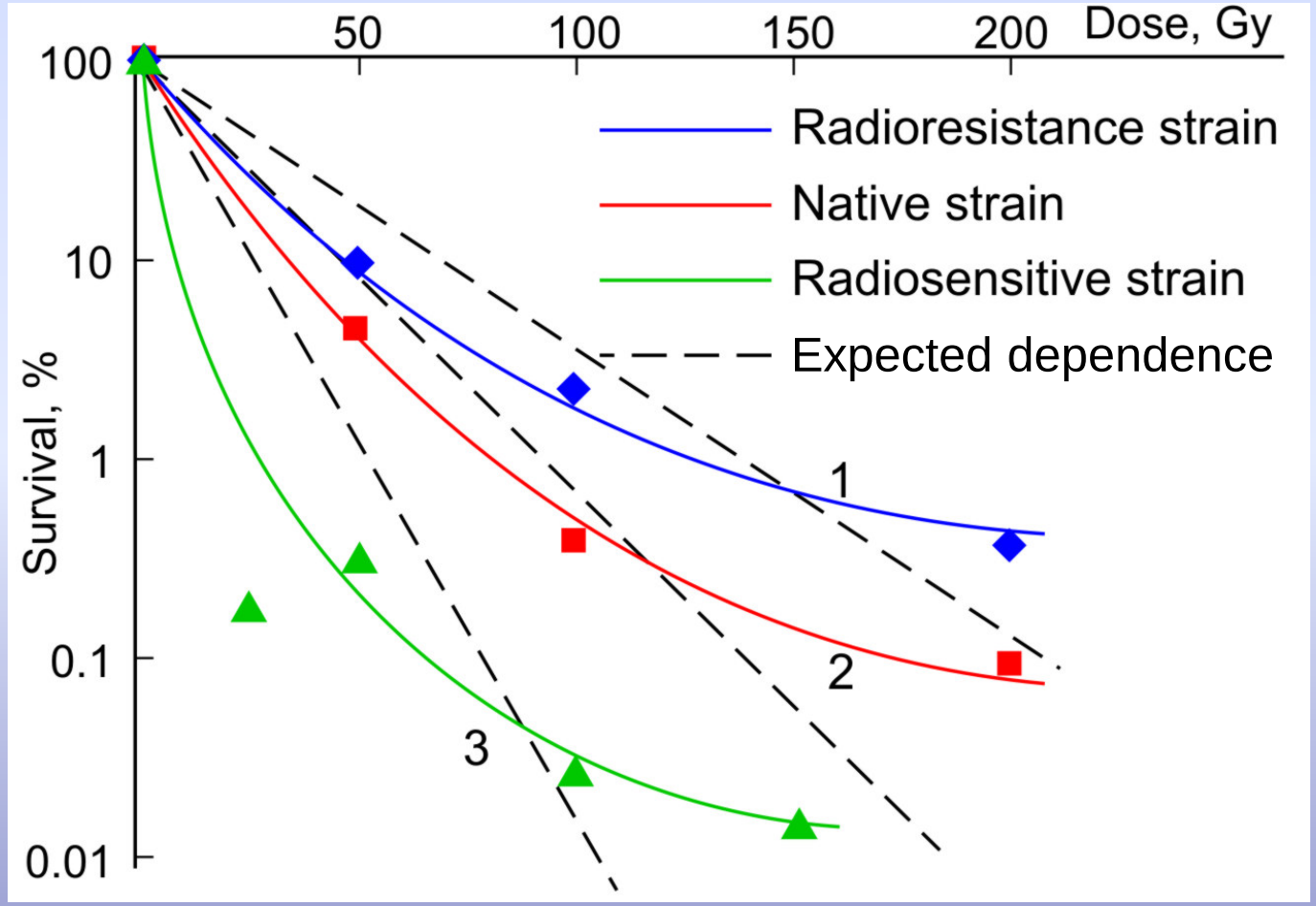
Survival curves of *E. coli K-12* different strains irradiated with electrons of 7.5 MeV:

1. Strain *AB-1157* in usual conditions,
2. Strain *AB-1157* - 2 hours preliminary exposed in physiological saline,
3. Radioresistant strain *BL-1114*,
4. Radiosensitive strain *AB-2463*.

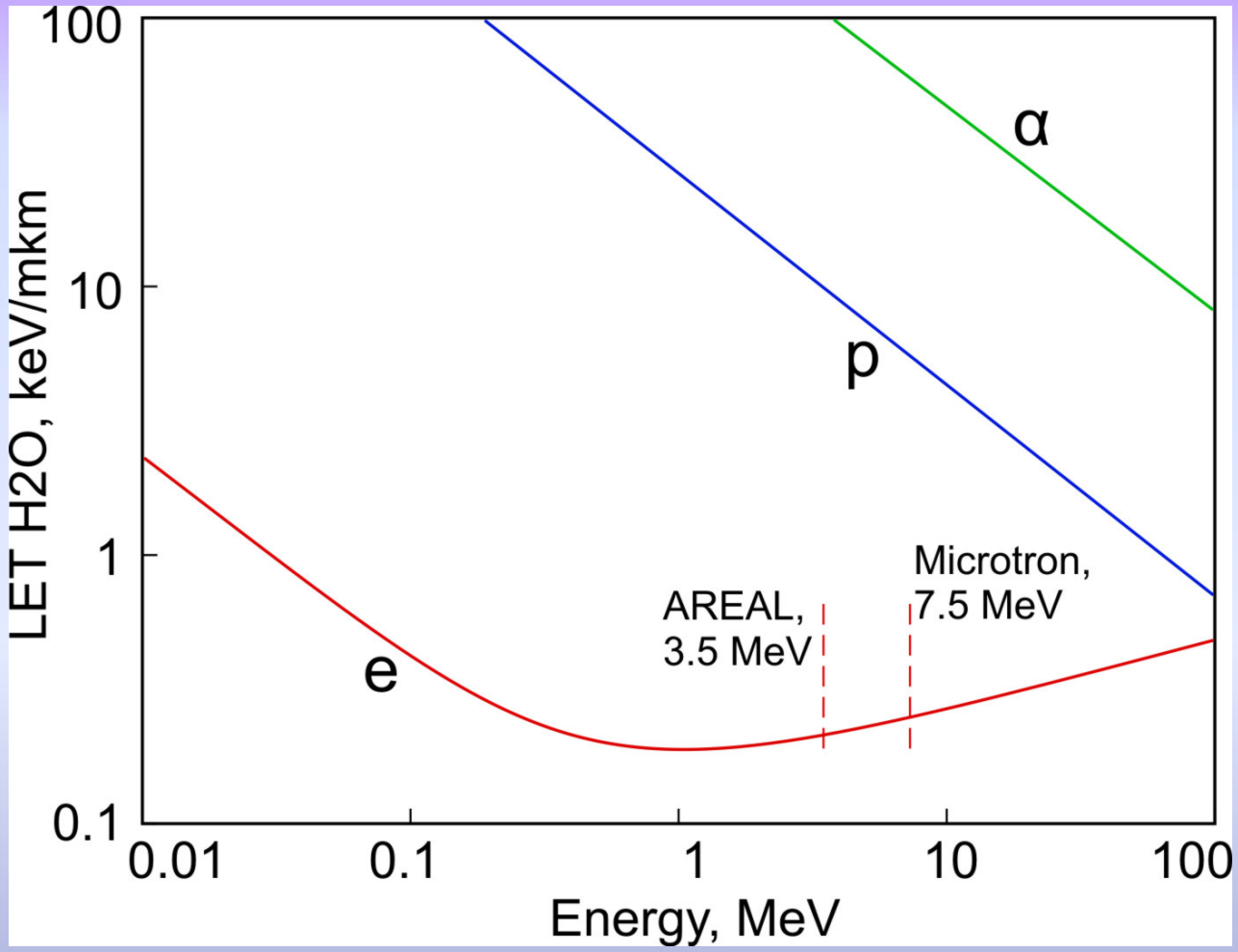
PRELIMINARY DATA RECEIVED ON AREAL

Beam energy: 3.5 MeV

Pulse Duration: 400 fs



Survival curves for *E.coli* strains with different radiosensitivity - concaved curves

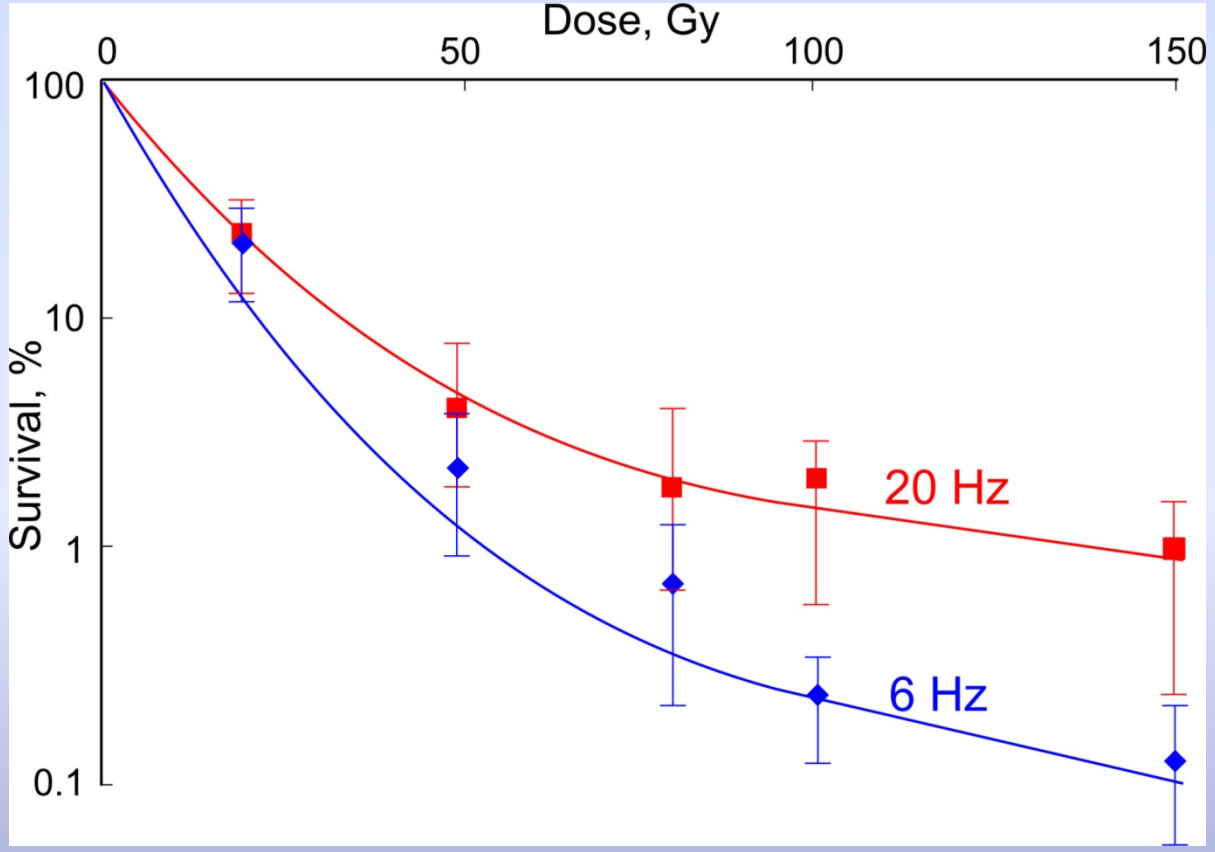


Dependence of Linear Energy Transfer (LET) from Energy for different partcles in water.
The quality factor for both electron beams equals to 1.

AREAL

Beam energy: 3.5 MeV

Pulse Duration: 400 fs



Bunch frequency influence on survival of the *E.coli K-12 AB-1157* strain

In the range of high doses the difference is one order!

WHAT DOES THIS MEAN??

THE ONLY IDEA THAT COMES TO MIND

SOMETHING LIKE PETKAU EFFECT???

WE OFFER TO BE LIMITED WITH THIS DEFINITION

A prolonged dose of chronic radiation may have a stronger effect than the same dose obtained with a short-term radiation exposure of greater dose rate.

PRELIMINARY CONCLUSIONS

- **Essential difference is between survival curves received under long and ultrashort pulses.**
- **Non-linear survival curve is observed for ultrashort beam.**
- **A pronounced effect is observed with ultrashort pulses: a strong dependence of the survival rate of the strains on the beam frequency at the same given doses.**
- **Further study needs to be performed for more high and lowest beam frequencies, and for larger doses of irradiation.**

Perspectives for collaboration

Expected object

- ***Deinococcus radiodurans***

Jointly with SPINPh (prof. Verbenko V., Kurchatov Center)

OUR TEAM

Would like to express gratitude to the leadership of CANDLE for constant attention and benevolent atitude, and to the personnel of AREAL for readiness to help and kind support.

THANKS A LOT!

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СПАСИБО!