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Response of Primary Human Fibroblasts Exposed to Solar Particle Event Protons

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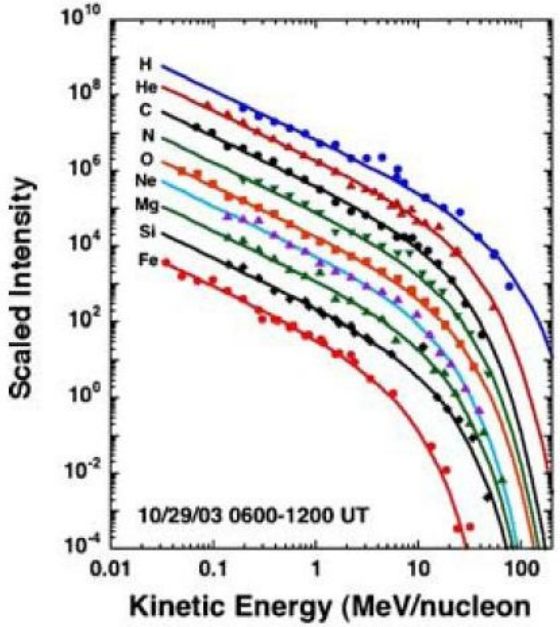
NASA Space Radiation Laboratory

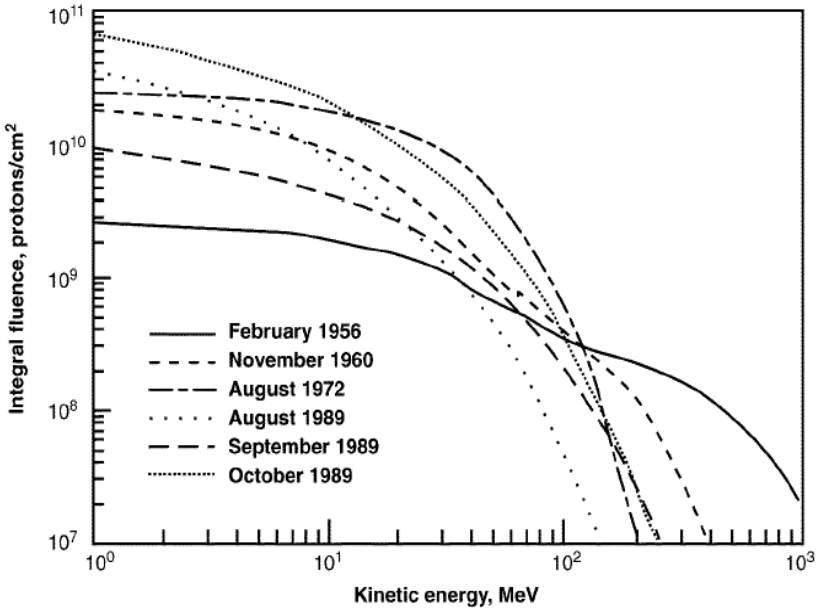
Ion Species [1]	Energy [2] (MeV/nucleon)	Maximum Intensity [3](ions per spill)	LET [4](keV/m)
H-1	50 - 2500	6.4×10^{11}	1.26 - 0.21
He-4	300	0.88×10^{10}	1.413
C-12	135 - 1000	1.2×10^{10}	21.21 - 8.01
O-16	100 - 1000	0.4×10^{10}	47 - 14
Ne-20	300	0.10×10^{10}	35.34
Si-28	94 - 1000	0.3×10^{10}	151 - 44
Cl-35	500 - 1000	0.2×10^{10}	80 - 64
Ti-48	150 - 1000	0.08×10^{10}	265 - 108
Fe-56	100 - 1000	0.2×10^{10}	494 - 150
SequentialField (Fe/H)	1000	Various	150/0.2
Solar Particle Event	50 - 1000	Various	1.26 - 0.21

Solar Particle Events (SPEs)

•Během předpokládané mise na Mars budou astronauti vystaveni ionizujícímu záření. Zdrojem jsou GCR a SPEs.
•Velké SPEs mohou dokonce způsobit akutní efekty– simulace jedné z největších známých SPE
•~10% pravděpodobnost, že taková SPE nastane během dvouleté mise na Mars
•Schopnost předpovídat SPEs je stále omezená



Mewaldt : Space Science Rev (2006)

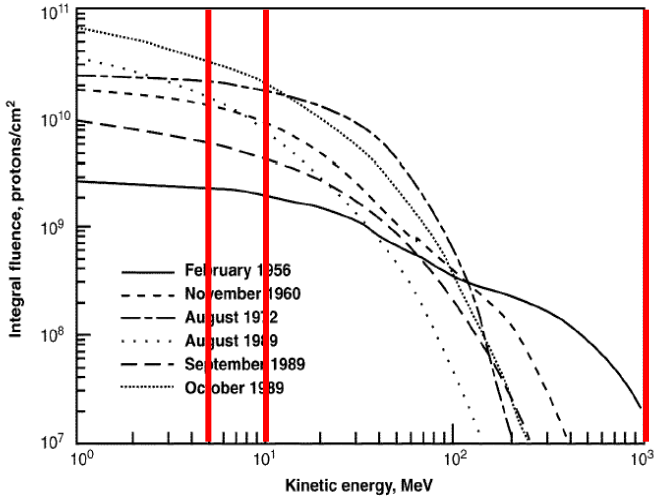


Wilson et al.: NASA Tech. Paper 3668 (1997)

Materiály a metody

Ozařování

Radiation	Energy (MeV)	LET (keV·µm^{-1})
protons	50	1.25
	100	0.72
	1000	0.22
X-rays	100 kV, 8mA	2

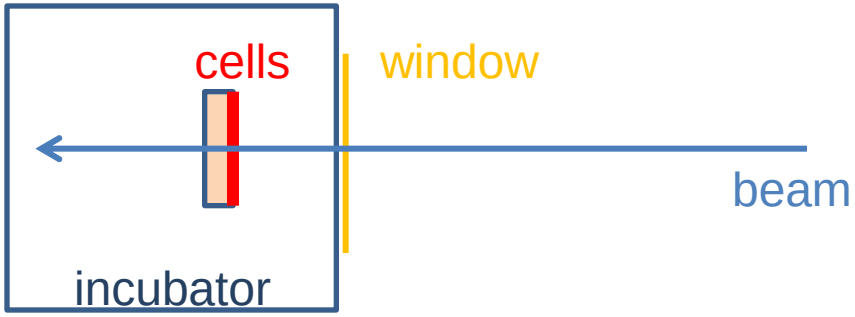


Dávkový příkon 33.3 cGy min^{-1} (20 Gy h^{-1})
1.65 cGy min^{-1} (1 Gy h^{-1})

Materiály a metody

Ozařování

Geometrie experimentu



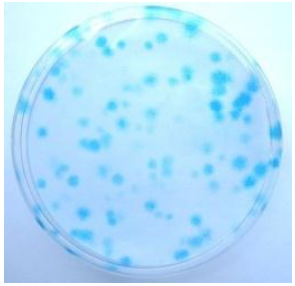
Materiály a metody

Buňky

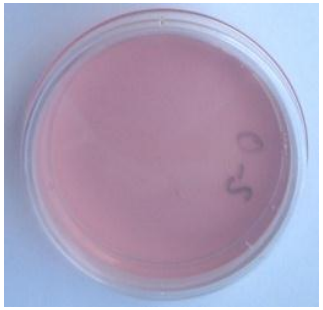
Primární lidské fibroblasty

Low passage number
Exponentially growing
No antibiotics
5% CO2, humidified atmosphere, 37C
Handled in presence of yellow light / dark

Metody



Clonogenic survival

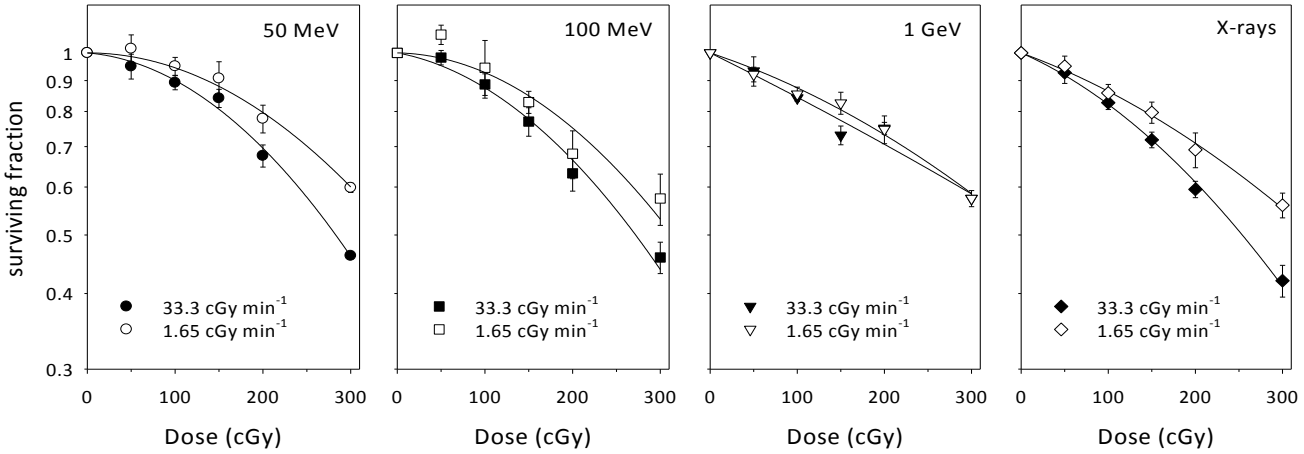


Induction of neoplastic transformation

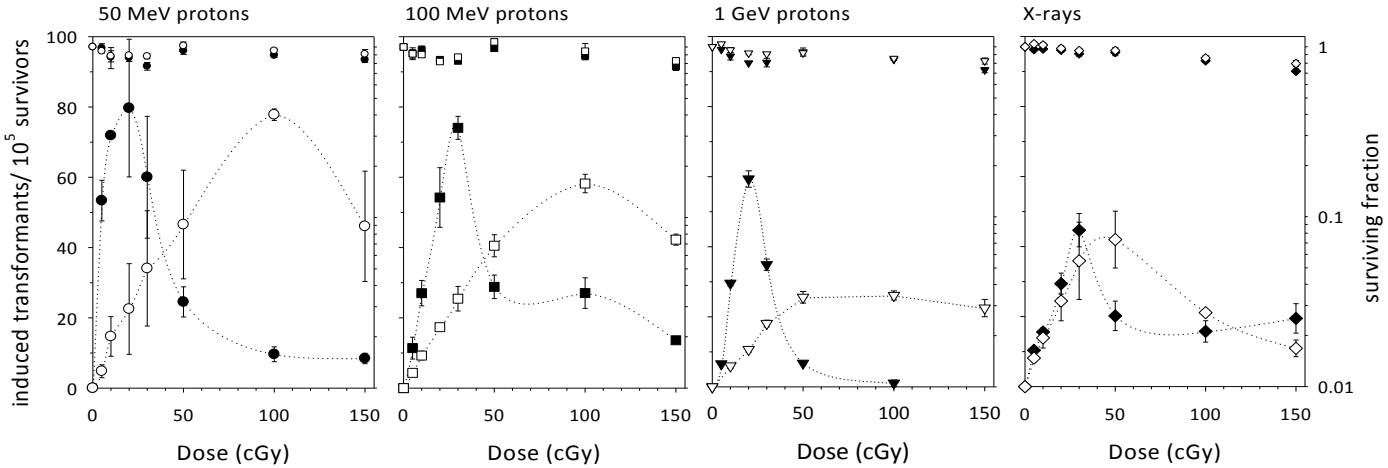
Výsledky

Vliv dávkového příkonu

Křivky přežití



Transformace



Výsledky

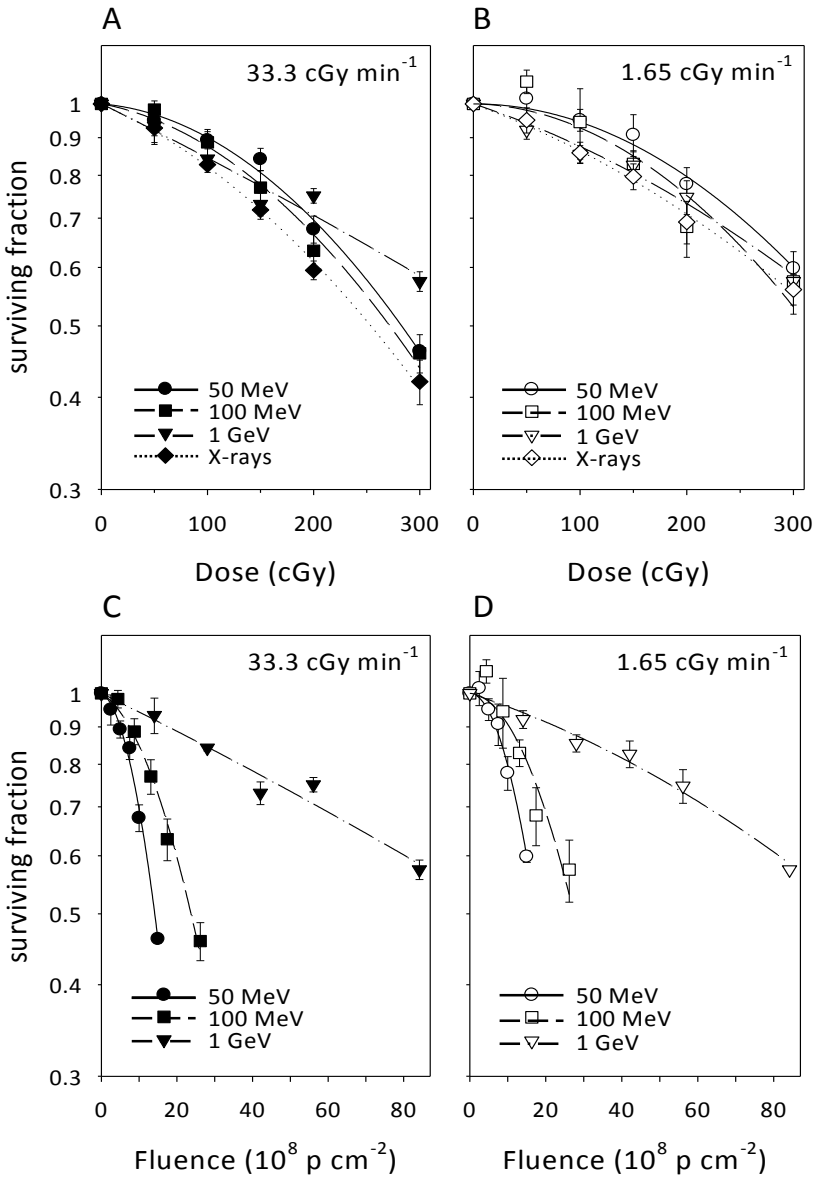
Vliv LET

Křivky přežití

Particle fluence = $6.242\ 10^{6} \times D \times LET^{-1}$

Dose (cGy)	particle fluence 10^{8}		
	50 MeV	100 MeV	1 GeV
5	0.2	0.4	1.4
10	0.5	0.9	2.8
20	1.0	1.7	5.6
30	1.5	2.6	8.4
50	2.5	4.4	14.0
100	5.0	8.7	28.1
150	7.5	13.1	42.1
200	10.0	17.5	56.1
300	15.0	26.2	84.2

10 cGy to a cell nucleus
50 MeV p+.....14 hits
100 MeV p+.....24 hits
1 GeV p+.....80 hits



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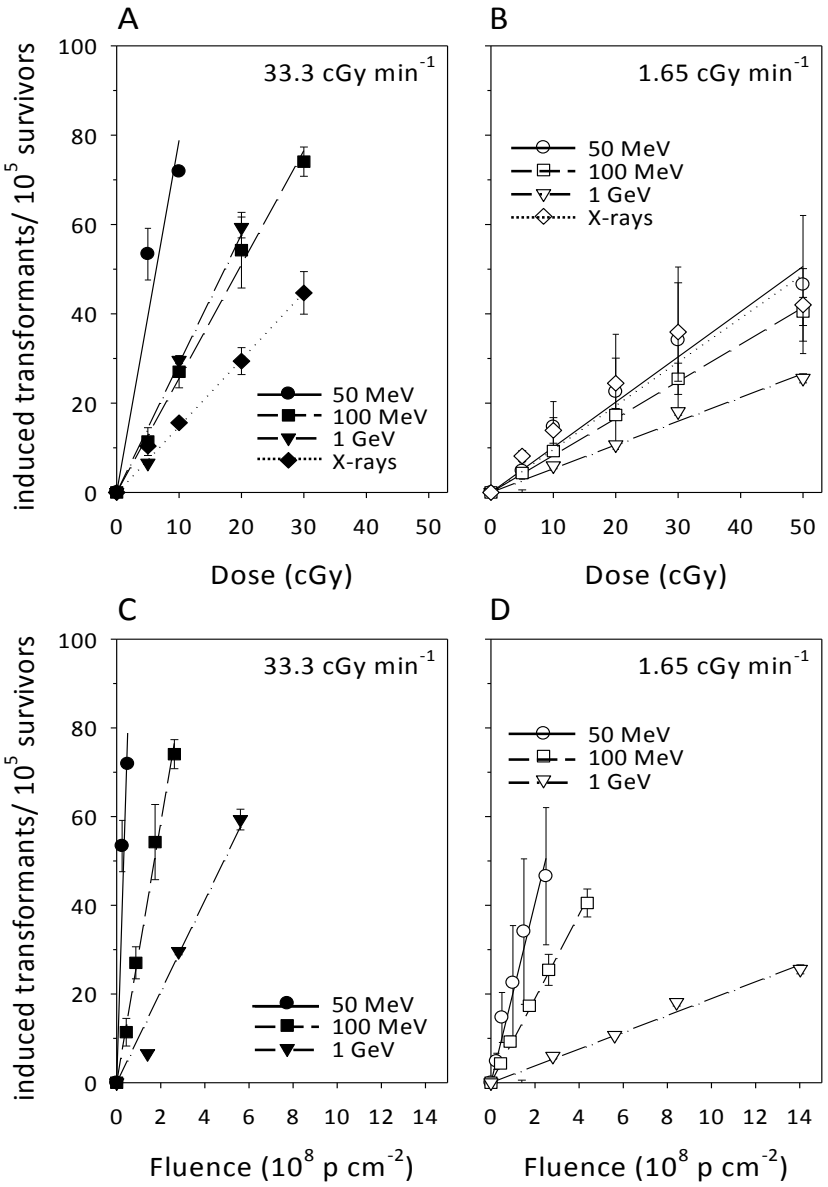
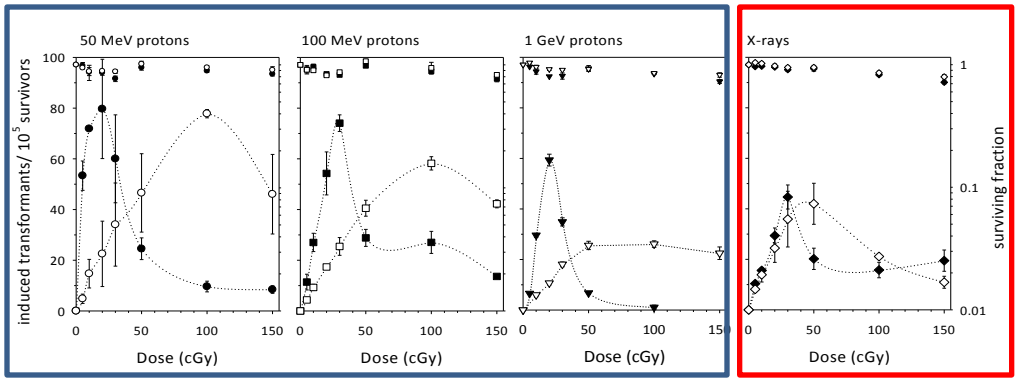


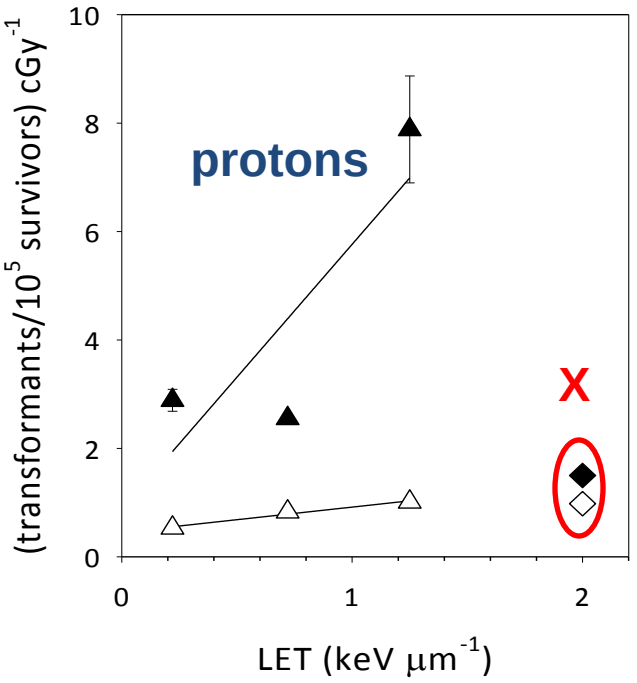
Výsledky

Protony vs. X



At none of the dose rates did the transformation efficiency of X-rays follow a positive trend of increase with the LET of protons.

Also, the transformation efficiency of X-rays was less dependent on dose rate than it was for protons of all energies.



Poděkování

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Kolegům z laboratoře

Acknowledgements

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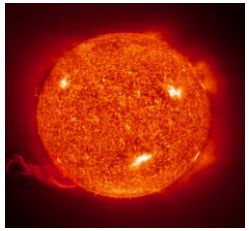
We acknowledge Drs. Deborah Keszenman, Mamta Naidu, Stefan Tafrov, and Mr. James Jardine for supporting our experiments.



Thank you for your attention!