KW45 biochem experiments

Brief report

Anna Grebinyk

17. Nov 2022

Cancelled

1 osimetry with tubes

with varying films number at highest dose

ose:

The highest dose that can be achieved - 50, 75 or 100 Gy

Dose rate:

10^6 Gy/s

	1	2	3	4	5	6	7	8	9
1	with one film before without the tube			with one film only after without the tube			with two films before and after without the tube		
	50 or 75 or 100 Gy, 10^6 Gy/s								
2 20 µL	with one film before with 20 µL in 0.5 mL tube			with one film only after with 20 µL in 0.5 mL tube			with two films before and after with 20 µL in 0.5 mL tube		
	50 or 75 or 100 Gy, 10^6 Gy/s								
3 50 µL	with one film before with 50 µL in 0.5 mL tube			with one film only after with 50 µL in 0.5 mL tube			with two films before and after with 50 µL in 0.5 mL tube		
	50 or 75 or 100 Gy, 10^6 Gy/s								
4 0.5 mL	with one film before with 0.5 mL in 2 mL tube			with one film only after with 0.5 mL in 2 mL tube			with two films before and after with 0.5 mL in 2 mL tube		
	50 or 75 or 100 Gy, 10^6 Gy/s								

Adapted

2 Chemical effects of PITZ beam

H_2 production measurements during water radiolysis

Dose:

0, 10, 25, 50, 75, 100 Gy

Dose rate:

for conventional 5 x 10^{-2} Gy/s

for UHDR: 10^6 Gy/s

50 µL in
0.5 mL tube

h: 7 mm

- **irradiation in duplicate**
- **calibration for every samples set**

PITZ time:

36 irradiated samples, repeated three times – 8 h at daytime (app. 6:00 am – 6:00 pm)

	1	2	3	4	5	6	7	8	9
1	0 Gy	10 Gy		75 Gy			50 Gy		
		5 x 10^{-2} Gy/s							
2	0 Gy	10 Gy		25 Gy			100 Gy		
		5 x 10^{-2} Gy/s							
3	0 Gy	10 Gy		75 Gy			50 Gy		
		10^6 Gy/s							
4	0 Gy	10 Gy		25 Gy			100 Gy		
		10^6 Gy/s							

Adapted

3 ochemical effects of PITZ beam

plasmid conformation

se:

0, 5, 10, 25, 50 Gy

Dose rate:

for conventional 5 x 10^{-2} Gy/s

for UHDR: 10^6 Gy/s

20 µL in
0.5 mL tube

h: 4.3 mm

- **irradiation in duplicate**
- **in 50 µL**

PITZ time:

24 irradiated samples, repeated three times – 8 h at any time (stored at +4^{0}C)

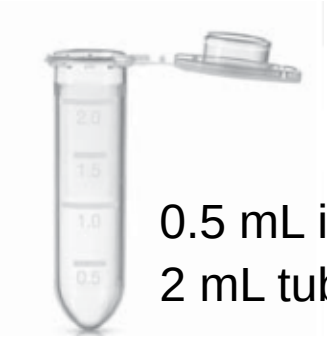
	1	2	3	4	5	6	7	8	9
1	0 Gy	5 Gy			10 Gy				
		5 x 10^{-2} Gy/s							
2	0 Gy	25 Gy			50 Gy				
		5 x 10^{-2} Gy/s							
3	0 Gy	5 Gy			10 Gy				
		10^6 Gy/s							
4	0 Gy	25 Gy			50 Gy				
		10^6 Gy/s							

Cancelled

4 Biological effects of PITZ beam

survival after irradiation

- 4 cell lines: HeLa, **A549**; HEK293, HEL299



0.5 mL in
2 mL tube

h: 11 mm
w: 10.5 mm

Dose:
0, 2, 5, 10, 15 Gy

Dose rate:
for conventional 5 x 10^{-2} Gy/s
for UHDR: 10^6 Gy/s

** Sample volume can be tested in 0.2-0.3 (0.1) mL (in 0.5 or 2 mL tube), if bigger beam could not be set*

PITZ time:
With triplicates 24 irradiated samples per cell line – 8 h per cell line
Repeated minimum three times – 8 h per cell line at daytime (app. 6:00 am – 6:00 pm)

	1	2	3	4	5	6	7	8	9
1	0 Gy			2 Gy			5 Gy		
	5 x 10^{-2} Gy/s								
2	0 Gy			10 Gy			15 Gy		
	5 x 10^{-2} Gy/s								
3	0 Gy			2 Gy			5 Gy		
	10^6 Gy/s								
4	0 Gy			10 Gy			15 Gy		
	10^6 Gy/s								

KW 45 time line

to do:	FLASH-RT Run						
Week 45	Mon Nov-07	Tue Nov-08	Wed Nov-09	Thu Nov-10	Fr Nov-	Sat Nov-12	Sun Nov-13
Morn. 7:00 to 15:30	Aftab Riemer	Aftab Grebinyk	Richard Oppelt	Boonpornpras Kongmon	Boonporn s Kongmo	Boonpornpras	orgiev
Late 15:00 to 23:30	Li Lotfi	Hoffmann Riemer	Hoffmann Lotfi	Krasilnikov Lotfi	Krasilnikov Lotfi	Krasilnikov	Boonp
Night 23:00 to 7:30	Vashchenko Amirkhanyan	Vashchenko Amirkhanyan	Li Dm	Li	Hoffmann Riemer	Hoffmann Riemer	Ho R
Resp. Phys	Grebi	Grebinyk	Grebinyk				
Laser	Hoffmann	Hoffmann	Hoffmann	Hoffmann	Gross	Gross	Gross
RF	Jachmann	Jachmann	Jachmann	Jachmann	Jachmann	Jachmann	Jachmann
Vaku.	Philipp	Philipp	Philipp	Philipp	Philipp	Philipp	Philipp
Contr.	Petrosyan	Petrosyan	Petrosyan	Petrosyan	Petrosyan	Petrosyan	Petrosyan
Electr.	Schultze	Schultze	Schultze	Schultze	Schultze	Schultze	Schultze
Infrast.	Schmal	Schmal	Schmal	Schmal	Schmal	Schmal	Schmal
SSB	Vashchenko	Vashchenko	Oppelt	Oppelt	Krasilnikov	Krasilnikov	Gross
Schichtabsich							

Issued on 08-Nov-2022

A gray field means the status has changed since the last version

High adjustment

Samples shielded

1.2-9.2 samples 10^6 Gy/s

19.3-27.3 samples 10^6 Gy/s

28.2-36.2 samples 10^6 Gy/s

1.2-9.2 samples 10^6 Gy/s

28.3-32.3 & 56.2-59.2 samples, 10^6 Gy/s

37.2-45.2 & 1.3-5.3 samples, 10^{11} Gy/s

19.2-27.2 samples 5×10^{-2} Gy/

1.2-18.2 samples 5×10^{-2} Gy/s

10.2-18.2 sam 10^6 Gy/s

33.3-37.3 & 51.2-54.2 samples, 10^{11} Gy/s

20.2-28.2 samples 10^6 Gy/s

19.3-27.3 sample 5×10^{-2} Gy/s

19.2-27.2 samp 10^6 Gy/s

19.2-27.2 samples 10^6 Gy/s

* H_2O

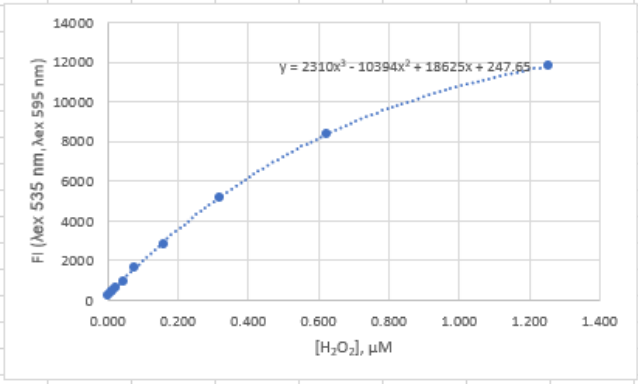
* DNA plasmid

Data Analysis is ongoing

H_2O_2 one sample set:

20	12.11.2022 06:17:47			1.65E+06	One train only			Dose rate (Gy/s)				
21	Start Time:			2.00E+03				Charge (pC)				
22	Eppitube								Front	Back	Position	Time
23		Dose (Gy)	FI 1	FI 2	FI, averege	FI, SD		Dose rate (Gy/s)			11	
24	19.2	75.08	4598	4575	4586.5	76.404625		8.34E+05	264	255	12	3:09
25	20.2	75.08	4543	4426	4484.5			8.34E+05	265	256	13	3:10
26	21.2	50.33	3289	3251	3270	73.943672		8.39E+05	266	257	14	3:11
27	22.2	50.33	3423	3331	3377			8.39E+05	267	258	15	3:11
28	23.2	25.58	2041	1983	2012	34.432301		8.53E+05	268	259	16	3:13
29	24.2	25.58	2065	2028	2046.5			8.53E+05	269	260	17	3:14
30	25.2	9.90	1039	979	1009	29.330019		9.00E+05	270	261	18	3:15
31	26.2	9.90	1043	1024	1033.5			9.00E+05	271	262	19	3:16
32	27.2	0.00	62	59	60.5	2.1213203		0.00E+00	272	263	20	
33												

[H2O2], µM			FI
0.000	206		206
0.005	376	352	364
0.010	457	444	450.5
0.020	634	599	616.5
0.039	934	998	966
0.078	1684	1629	1656.5
0.156	2842	2817	2829.5
0.313	5140	5222	5181
0.625	8403	8354	8378.5
1.250	11802	11797	11799.5
2.500	11207	10808	11007.5
5.000	6177	5756	5966.5
10.000	6554	6461	6507.5



DNA plasmid for selected samples running right now in a lab by Julia

5 samples = 6 h at a lab + 1 h for processing

Main points

- One sample set (9 samples) = 1 shift
- Adjustments to spare time:
  - irradiation in duplicate
  - H_2O_2 calibration for every samples set
  - DNA plasmid in 50 µL
- Beam has significant back scattering → 4 samples sets are not reliable → 3 samples sets were repeated
- Beam has significant dark current → 5 samples sets at 5×10^{-2} Gy/s are probably not reliable
- Crisis management by biologist → at least one set at 10^{11} Gy/s could have been spared
- Data analysis requires dosimetry data

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RF	Jachmann	Jachmann	Jachmann	Jachmann	Jachmann	Jachmann	Jachmann
Vaku.	Philipp	Philipp	Philipp	Philipp	Philipp	Philipp	Philipp
Contr.	Petrosyan	Petrosyan	Petrosyan	Petrosyan	Petrosyan	Petrosyan	Petrosyan
Electr.	Schultze	Schultze	Schultze	Schultze	Schultze	Schultze	Schultze
Infrast.	Schmal	Schmal	Schmal	Schmal	Schmal	Schmal	Schmal
SSB	Vashchenko	Vashchenko	Oppelt	Oppelt	Krasilnikov	Krasilnikov	Gross
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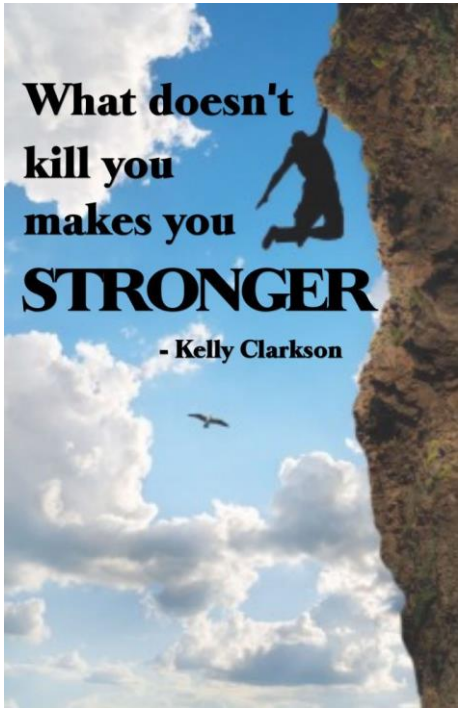
* H_2O

* DNA plasmid

Main conclusion

- Proof-of-concenpt of some biochem experiments at PITZ done
- Beam proof by disometry before any further biochem experiment
- Careful time planning
- Physicist supervision



? FRPT poster

? Master Student at TH Wildau for cellular effects of PITZ beam in March-August 2023

Huge thanks to shift crews for your efforts!

Thank you for your attention!

DESY PITZ moon shot