**EV085 / #208**

**E-POSTER VIEWING - MECHANISMS**
**PHYSICO-CHEMISTRY: FLASH CHEMISTRY, OXYGEN CONTRIBUTION, ROS**
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# INVESTIGATION OF RADICAL FORMATION AND OXYGEN DEPLETION IN FLASH AND CONVENTIONAL RADIOTHERAPY USING EPR SPIN TRAPPING

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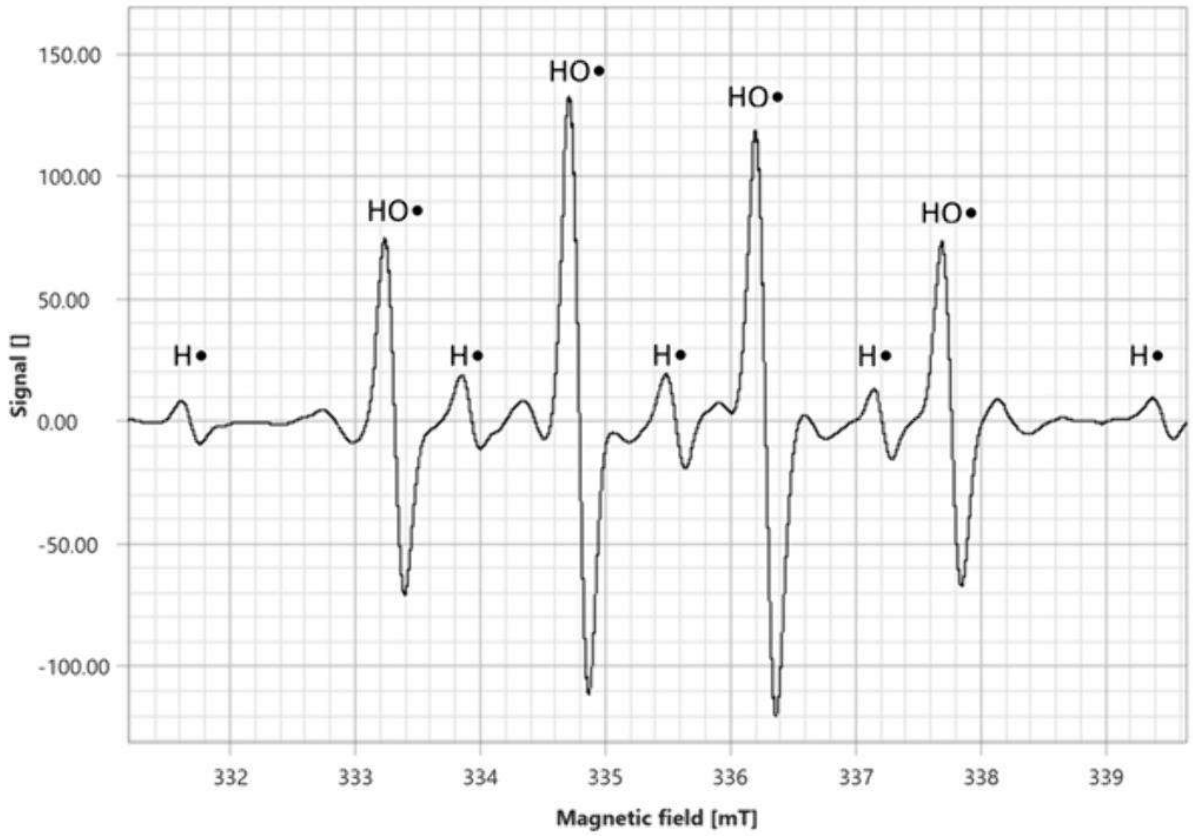
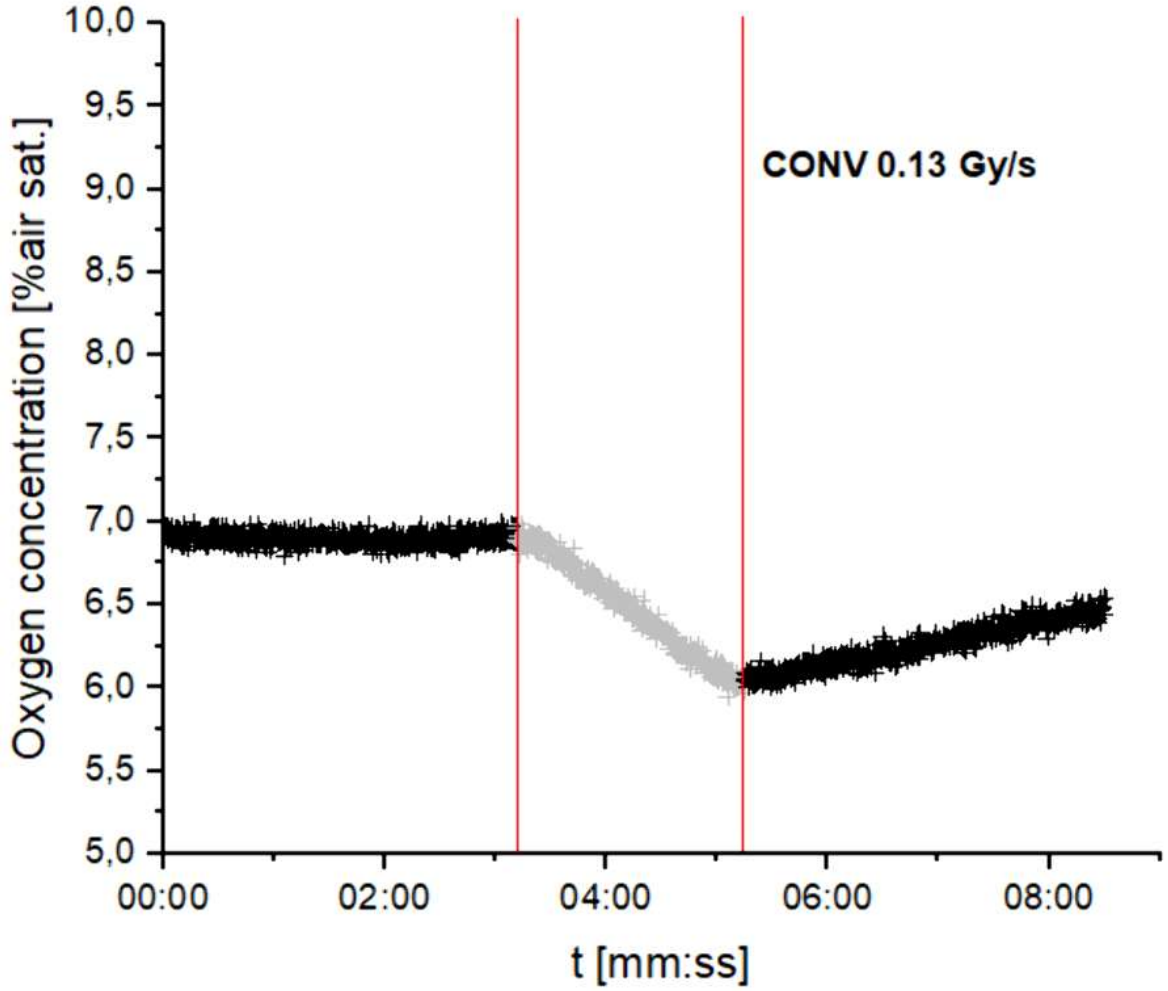
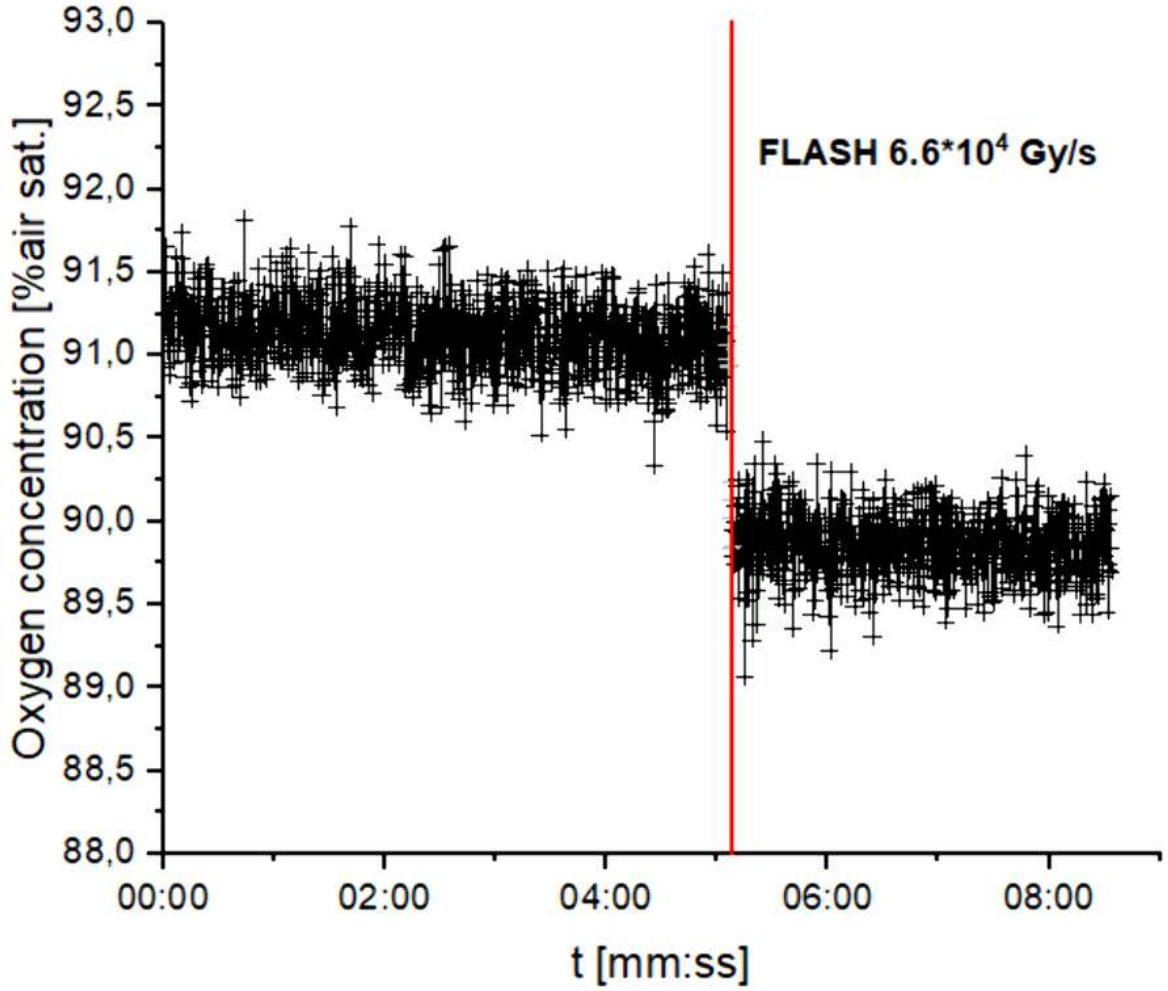
**Background and Aims:** The underlying mechanism of the FLASH effect remains a topic of significant debate. One prominent hypothesis is the radical-radical recombination hypothesis. This hypothesis suggests that ultra-high dose rate (UHDR) water radiolysis leads to the formation of concentrated radicals, promoting recombination and diminishing reactions with oxygen. Our study aims to investigate this hypothesis by examining factors influencing radical formation and oxygen depletion during irradiations with varying pulse dose rates. We employ EPR spin trapping to measure radical concentrations and an online fiber-based oxygen sensor to monitor oxygen concentration.

**Methods:** Water samples containing phosphate buffer (pH 7.4), DTPA as a transition metal chelator, and DMPO spin trap were prepared with different oxygen levels. Irradiation was conducted at the research accelerator ELBE with 30 MeV electrons at both conventional dose rates (0.13 Gy/s) and FLASH dose rates ($6.6*10^4$ Gy/s). EPR signals were obtained using a Bruker Magnettech ESR5000 approximately 4 minutes post-irradiation. Oxygen concentration was continuously monitored throughout irradiation using a PyroScience oxygen sensor, recording data every 0.3 seconds.

**Results:** Preliminary results using EPR spin trapping demonstrate the feasibility of detecting hydroxyl radicals (HO•) and hydrogen radicals (H•) using DMPO. Oxygen depletion in samples under both normoxic and hypoxic conditions was successfully measured during FLASH and conventional
irradiation.


150.00
100.00
50.00
0.00
-50.00
-100.00
Signal []
HO•
HO•
HO•
HO•
H•
H•
H•
H•
H•
332
333
334
335
336
337
338
339
Magnetic field [mT]


CONV 0.13 Gy/s
Oxygen concentration [%air sat.]
10,0
9,5
9,0
8,5
8,0
7,5
7,0
6,5
6,0
5,5
5,0
00:00
02:00
04:00
06:00
08:00
t [mm:ss]




We are conducting a comprehensive measurement series with varying oxygen concentrations and pulse dose rates, focusing on measuring both oxygen depletion and radical concentrations. Further tests with potentially more stable and kinetically favorable spin traps are planned.

**Conclusions:** Our study demonstrates a method for measuring radicals formed during both FLASH and conventional dose rate irradiation, offering insights into reaction kinetics and potential differential effects. The systematic investigation of pulse structure, oxygen content of samples, and resulting radical and oxygen measurements are ongoing, paving the way for future research involving more complex biological systems.