Radiation Signaling Group

Biological and molecular effects of radiation

Chronic Radiation Effects

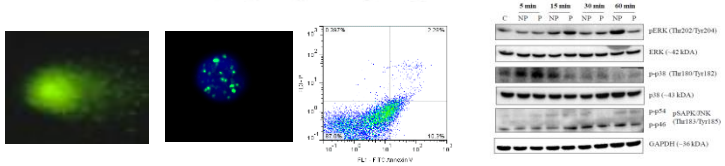
Healthy adults from High Level Natural Radiation Areas of Kerala

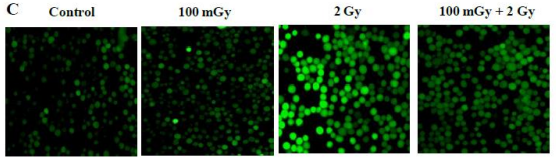
High Level Natural Radiation Area
≤ 1.0 mGy to >45 mGy/y

Normal Level Natural Radiation Area
≤ 1.5 mGy/y

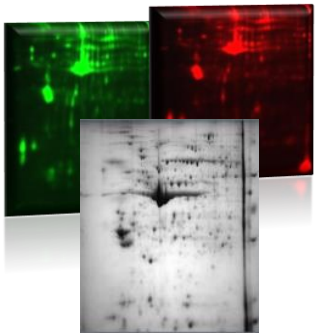
Acute Radiation Effects

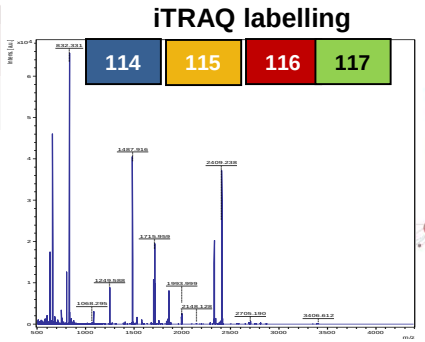
Random healthy adults from Mumbai

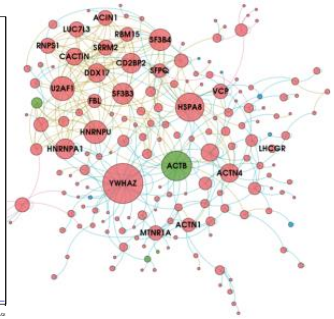




Comparative Proteomic Analysis: 2D PAGE/DIGE & LC-MS/MS







HLNRA individuals show

- **Evidence of radio-adaptive response.**
- **Higher expression of DNA repair & pro-survival proteins**

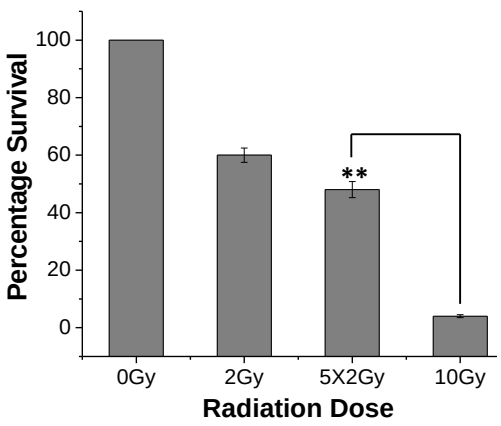
Mechanism of Radio-adaptive response

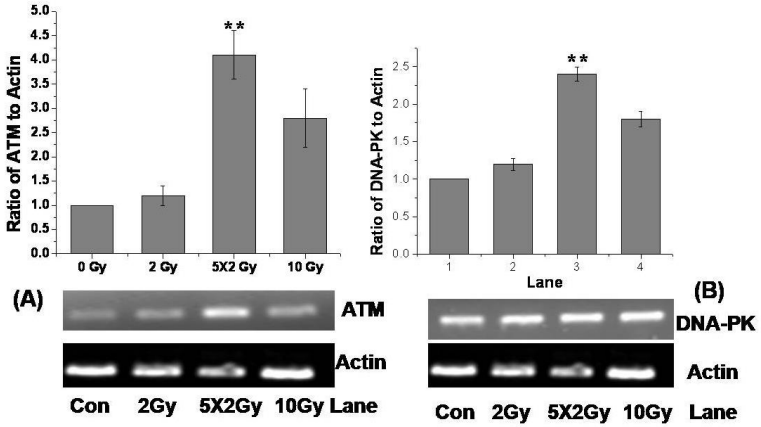
Primed cells show:

- **Lower DNA damage & better repair**
- **Lower levels of ROS**
- **Higher activity and gene expression of antioxidant enzymes**
- **Increased binding of transcription factors Nrf2 and NFκB**
- **Enrichment of proteins involved in transcriptional, ubiquitination, signaling and chromatin remodelling.**

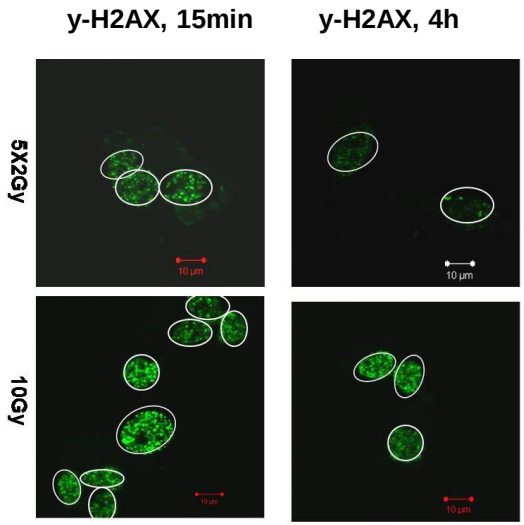
Radiation Signaling Group

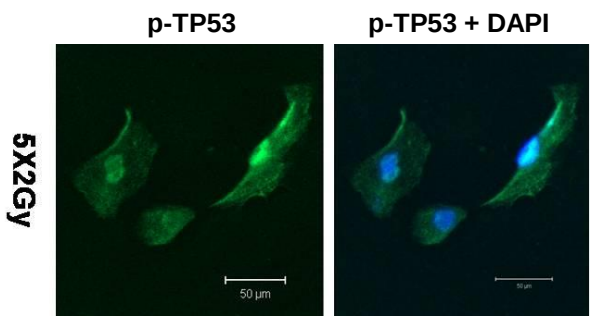
Understanding mechanisms of radio-resistance in cancer cells

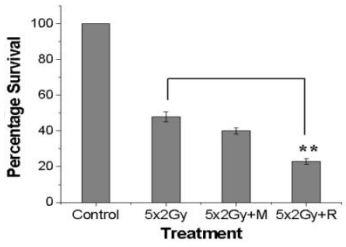


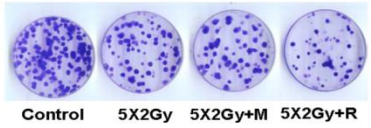


- **A549 (Human lung carcinoma) cells were found to be relatively more radio-resistant with 10Gy dose delivered as a fractionated regimen.**









Radio-resistant cells show:

- **Efficient DNA repair**
- **Upregulation of DNA repair pathway-associated genes (DNA-PK, ATM, Rad52, MLH1 and BRCA1).**
- **Translocation of phospho-p53 into the nucleus of A549 cells.**

Silencing of DNA repair gene Rad 52 makes A549 cells radio-sensitivet

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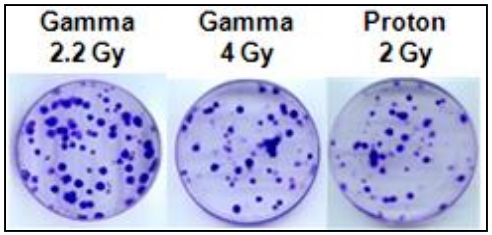
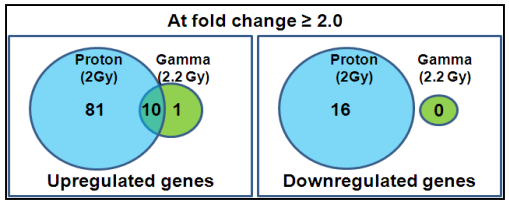
Biological effectiveness of Low and High LET radiation

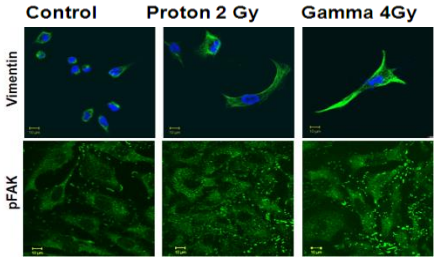
Proton irradiation

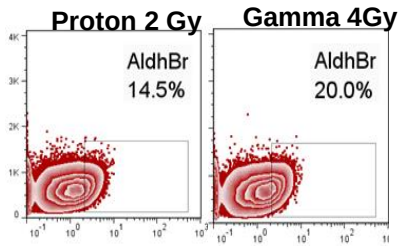


4 Gy of Gamma equitoxic to Proton 2 Gy



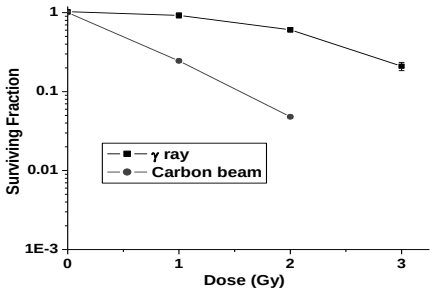
Transcriptional response of proton and gamma irradiated cells

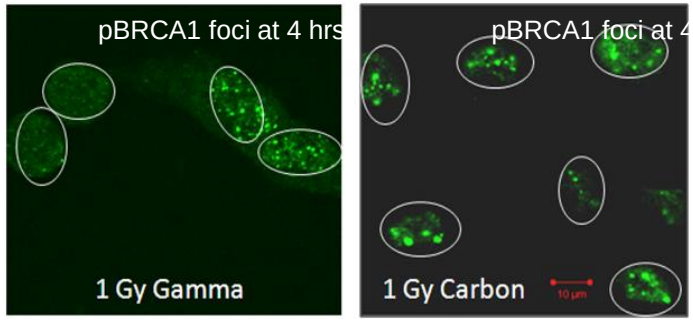




Equitoxic dose of proton suppresses EMT and cancer stem cell like cells phenotype

Carbon - beam irradiation

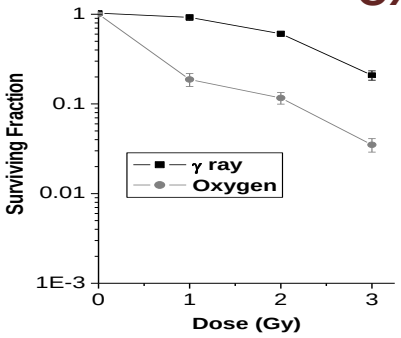


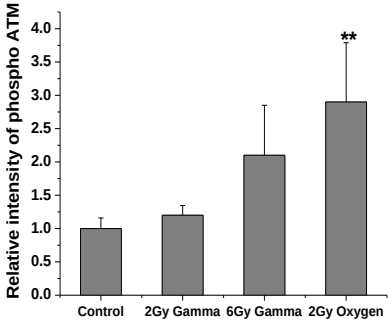


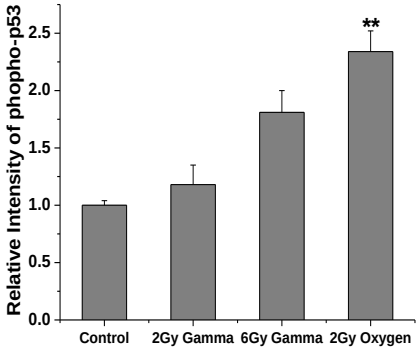
Carbon-beam irradiated cells showed:

- 1.2 times higher γH2Ax foci than gamma.
- Qualitative and quantitative differences in Radiation induced foci (RIF) of ATM, ATR, BRCA1 compared to gamma.
- Early apoptosis

Oxygen - beam irradiation





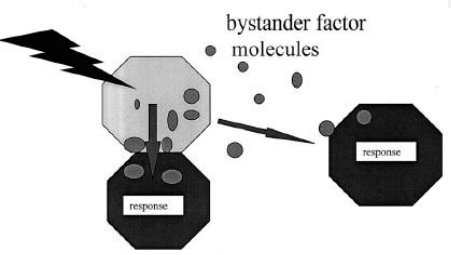


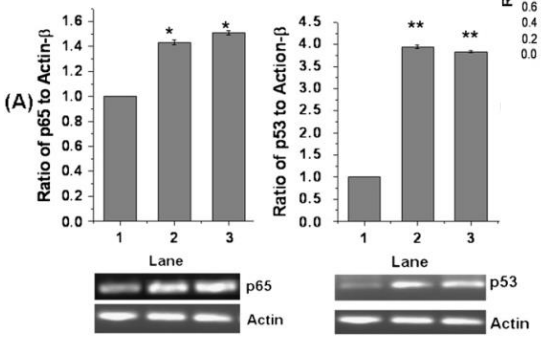
Oxygen-irradiated cells showed:

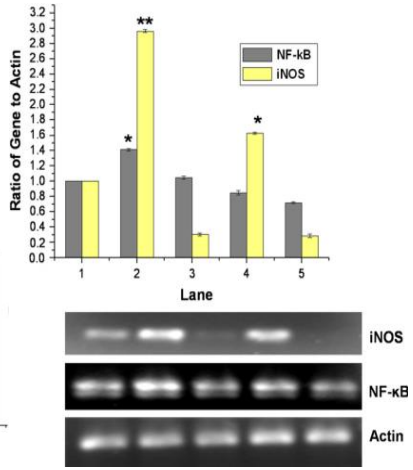
- An RBE of 3 at 20% survival
- Differences in DNA damage response with equitoxic doses of low LET radiation

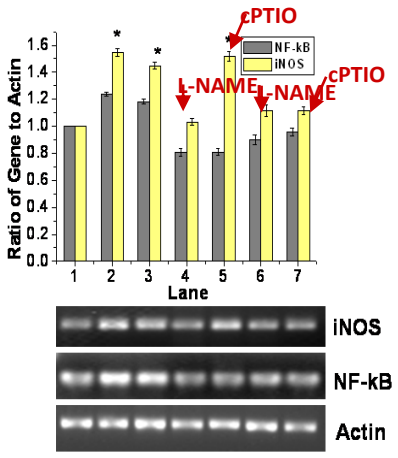
Radiation Signaling Group

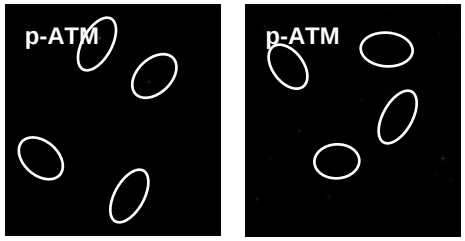
Radiation induced bystander signaling





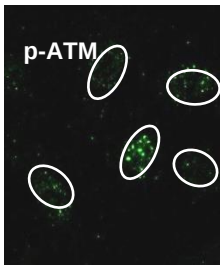




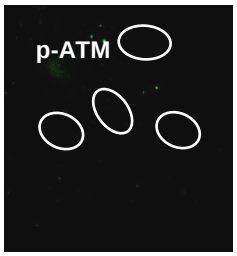


(A) Control

(D) Medium from irradiated U937



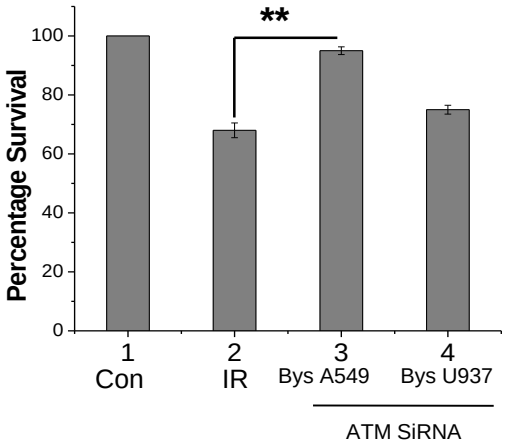
(B) Cross Bystander



(C) Medium from stimulated U937

Bystander cells showed:

- Up-regulated expression of NF-κB, iNOS, p53 and p21 genes
- Increased DNA damage, apoptosis and NO
- Bystander signaling between macrophages and EL-4 cells
- Reduced bystander response after L-NAME treatment
- Partially reduced bystander response after cPTIO treatment



- Existence of bystander signaling between different cell types (U937 and A549 cells)
- Suppression of ATM with siRNA completely inhibits bystander effect in similar cell types

Radiation Signaling Group

Interaction of cold atmospheric pressure plasma with cancer cells

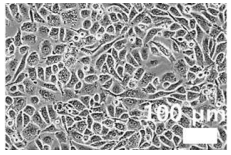
In collaboration with Institute for Plasma Research (IPR), Gandhinagar

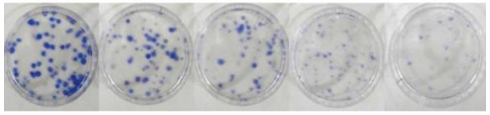
Single Jet System

Multi-jet System

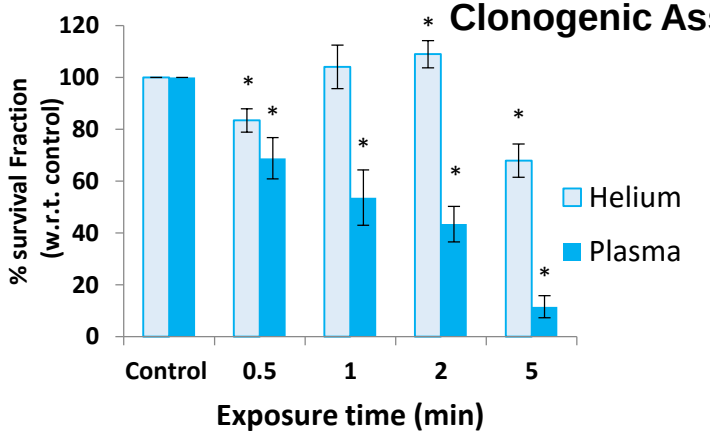
Cell Model

Human lung adenocarcinoma cell line (A549)



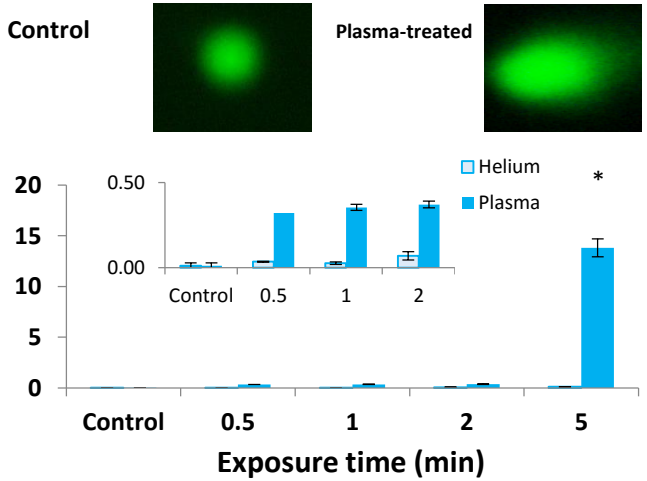


Clonogenic Assay



Plasma exposure reduces A549 cell viability in a dose-dependent manner

DNA damage analysis with alkaline comet assay



Plasma exposure leads to a significant increase in DNA damage in A549 cells