

# International Atomic Energy Agency

# World Cancer Day

## The Latest Advances in Nuclear and Radiation Medicine

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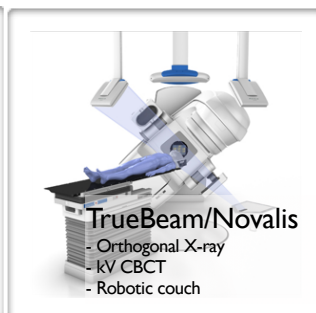
**HELEN DILLER FAMILY COMPREHENSIVE  
CANCER CENTER (HDFCC)**



## SRS



## SBRT



## SBRT



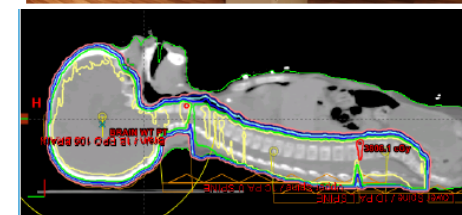
## HDR



## IORT



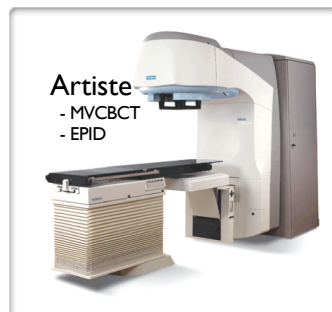
## PROTONS (charged particles)



## IMRT/IGRT



## IMRT/IGRT



## HT



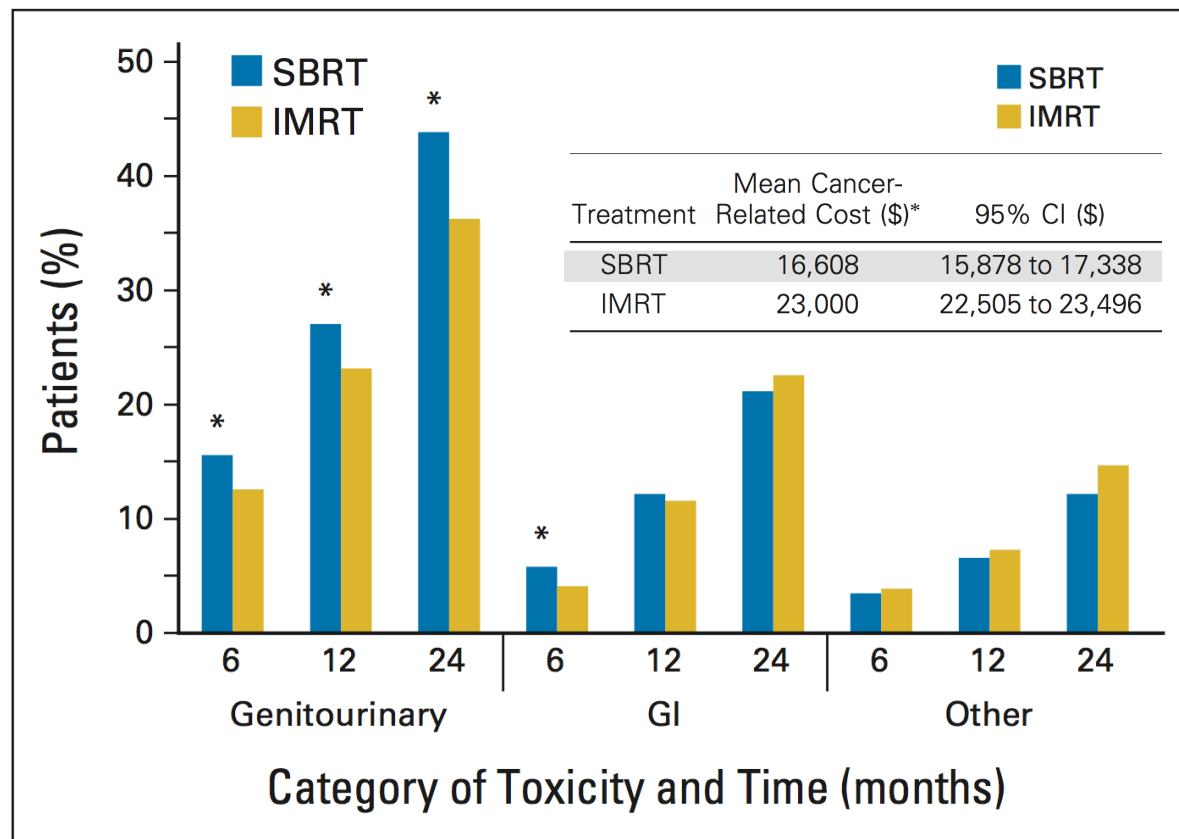
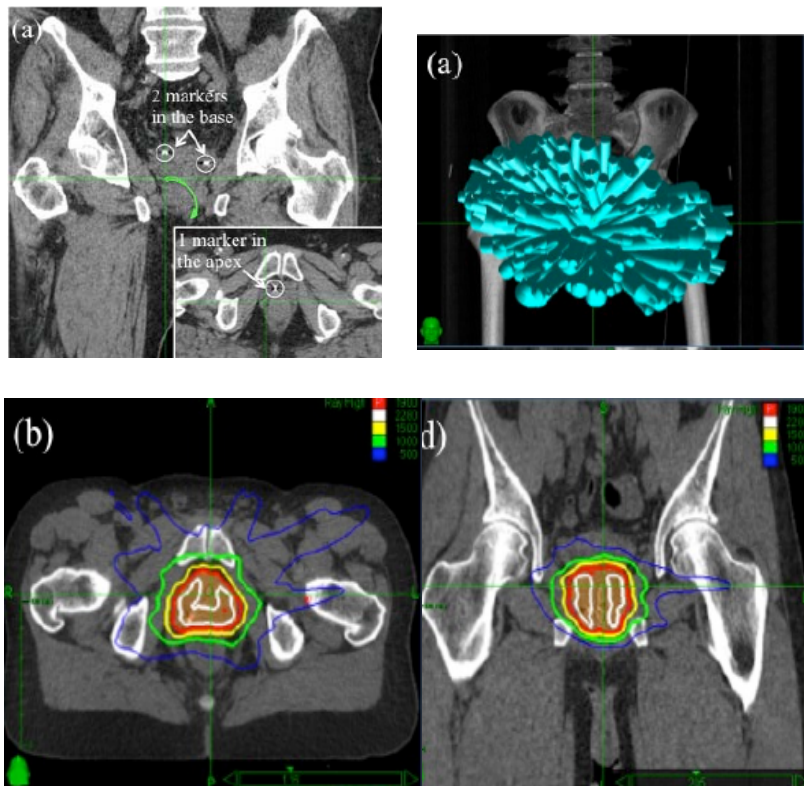
## IMRT/IGRT







## Emerging evidence on SBRT





# **The Latest Advances in Nuclear and Radiation Medicine**

## **Examples of Categories for “Advances”:**

### **1. (Practical) Advances in Clinical Care (Practical, “done”)**

- a. Treatment of pelvic nodes in post Op patients (“Occult disease”?)**
- b. Treatment of the primary in pts with metastatic disease (“Primary”?)**
- c. SABR Treatment of Mets in addition to drugs (“Gross metastatic Disease”)**

### **2. Future Directions (Potential Advances in Physics and Radiobiology)**







# NRG/RTOG 0534


- Negative conventional imaging
- pT2/T3 +/- R+ N0M0
- Entry PSA level: 0.1- 2.0 ng/ml

R  
A  
N  
D  
O  
M  
I  
Z  
E

5yr FFP   5 yr FFDM

Arm 1      PBRT (64.8 -70.2 Gy)   **71%**   **91.7%**

Arm 2      PBRT + STAD(4-6 months)   **81%**   **94.4%**

Arm 3      PLNRT (45 Gy) + PBRT(to 64.8 - 70.2Gy) + STAD (4-6 months)   **87%**   **95.2%**

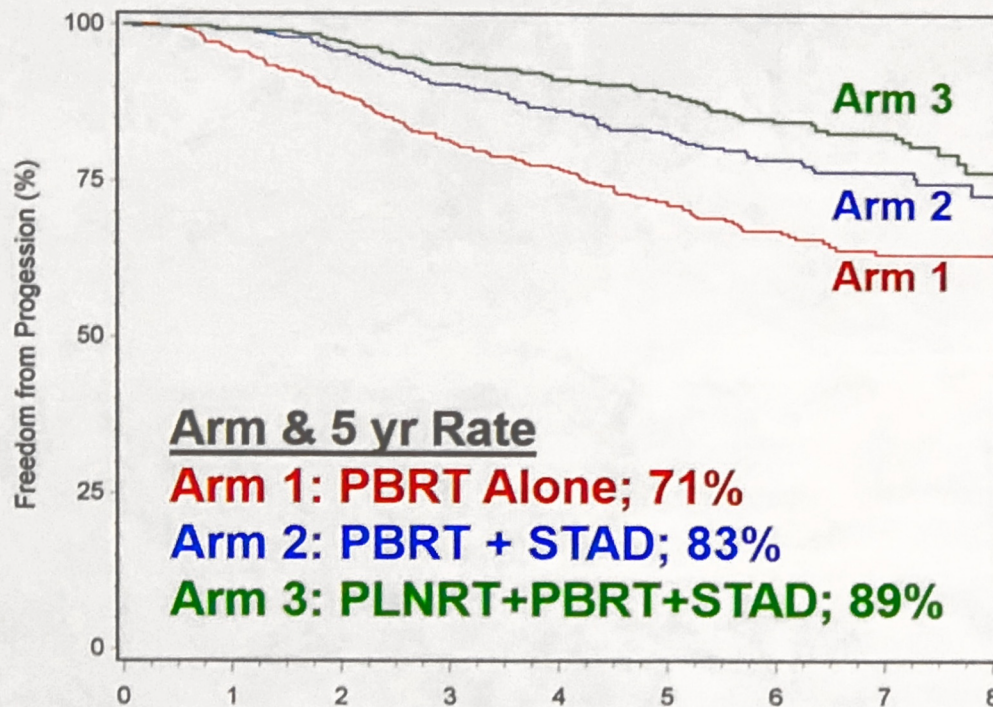
**All SS.**   **3 vs. 1 SS.**





## FFP for First 1191 Eligible Patients - Interim Analysis Population

**Minimum  
potential FU 5 yr;  
Median FU 6.4 yr**



### 5 yr Rate Comparison

Arm 3 vs Arm 1:  $p < 0.0001$

Arm 2 vs Arm 1:  $p = 0.0001$

Arm 3 vs Arm 2:  $p = 0.0063$

### DMC Recommendation

**Report findings for all  
three arms**

No. at Risk	Years from Randomization								
	0	1	2	3	4	5	6	7	8
PBRT Alone	399	363	324	286	259	223	150	84	34
PBRT+NC-STAD	398	381	360	329	299	265	170	91	37
PLNRT+PBRT+NC-STAD	394	385	371	352	334	311	208	125	51





## Radiotherapy to the primary tumour for newly diagnosed, metastatic prostate cancer (STAMPEDE): a randomized controlled phase 3 trial. Parker et al. Lancet Onc. Dec., 2018

The metastatic burden assessed at randomization by Bone scan and CT or MRI. High Metastatic burden was defined as four or more bone mets with  $\geq 1$  outside the vertebral bodies or pelvis or visceral metastatic or both; all others considered “low” metastatic burden.

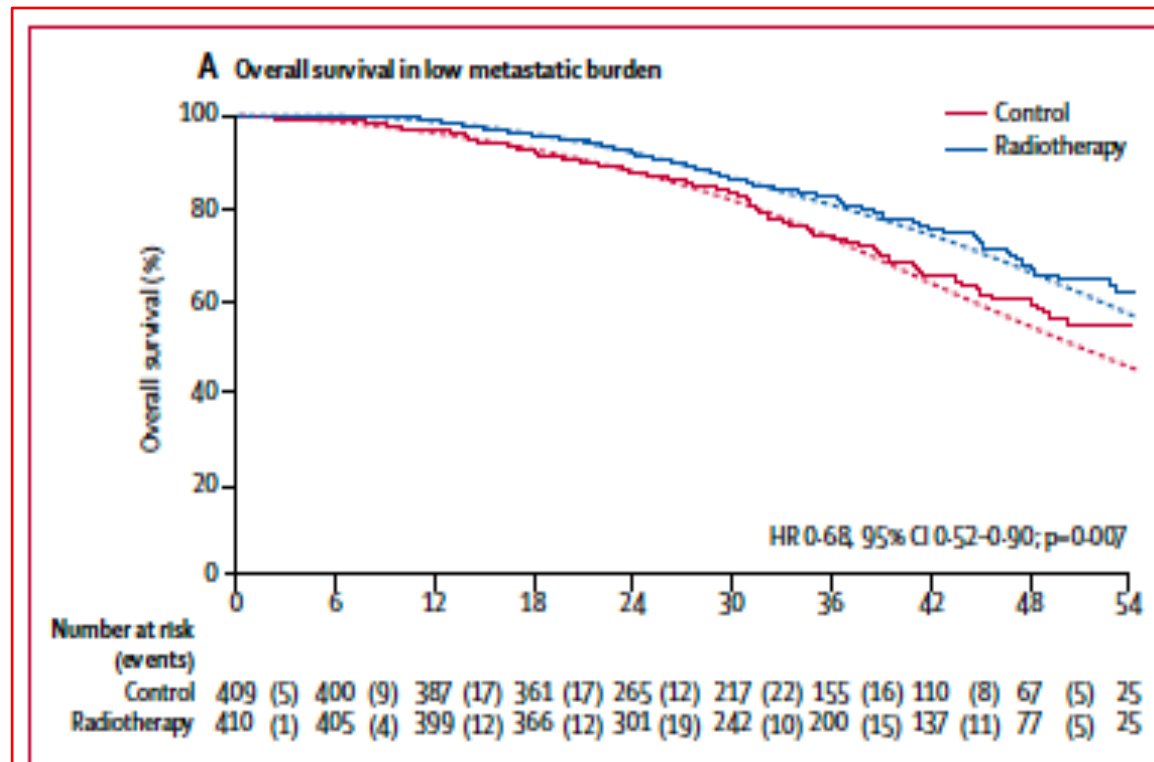
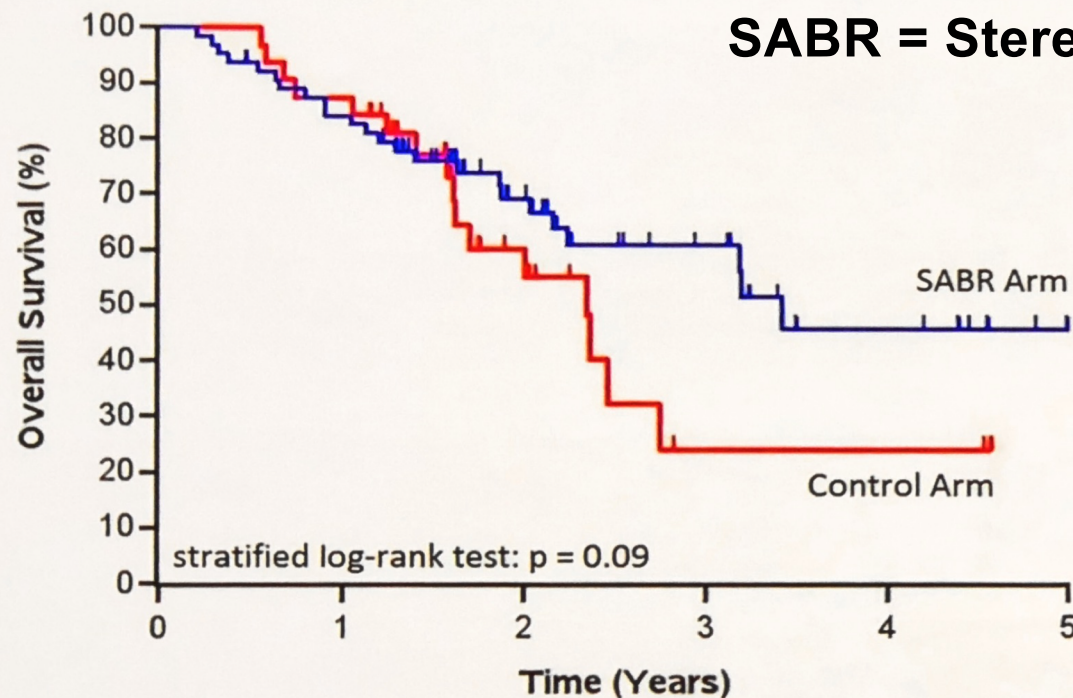


Figure 4: Overall survival by treatment and metastatic burden; HR=hazard ration



## Overall Survival



### Median OS

Control Arm: 28 months  
(95% CI: 19-33 months)

SABR Arm: 41 months  
(95% CI: 26 months to 'not reached')

#### Number at risk:

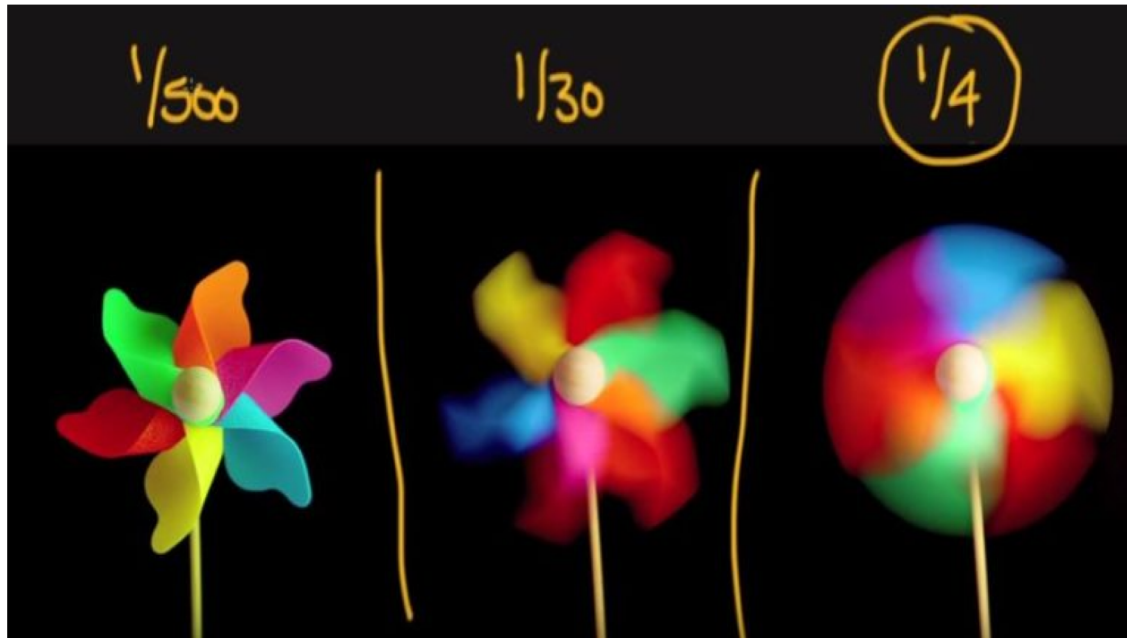
Control	33	28	12	2	2	
SABR	66	53	29	15	7	1





## The Latest Advances in Nuclear and Radiation Medicine

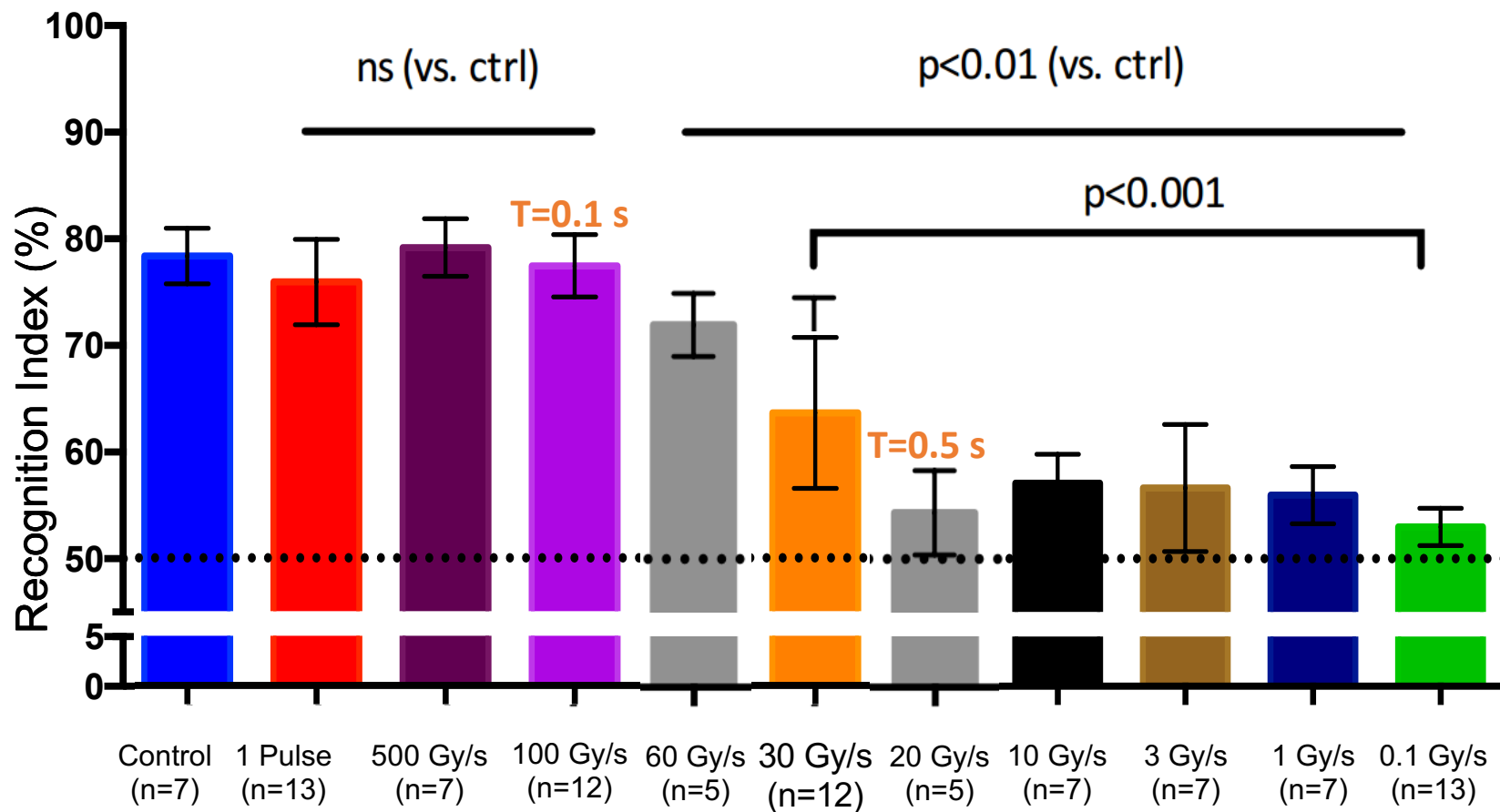
**“Conventional” dose rate radiation  $\sim 4 \text{ Gy/min}$  (60 sec)  
vs “Flash” Radiation @  $40 \text{ Gy/sec} = 2400 \text{ Gy/min}$ . (“600 x faster”)**



1. More accurate delivery of dose
2. Faster treatment times
3. Different biology
  - a. Effective against tumor
  - b. Sparing normal tissues?



Normal tissue toxicity - Whole Brain Irradiation in mice; Novel Object Recognition test: 2 Months post RT





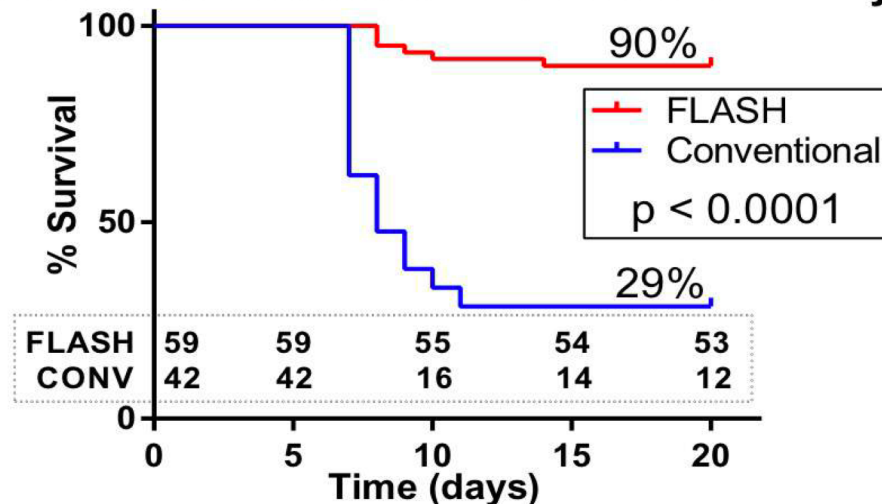


# Why FLASH?

## Unprecedented preclinical demonstration of *increased therapeutic index*

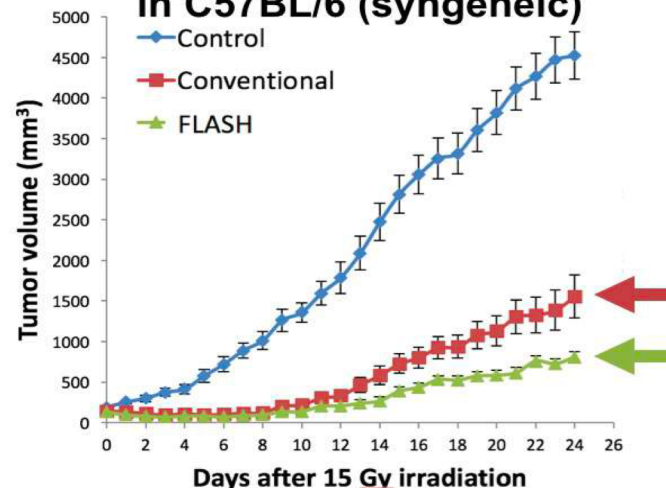


Mouse total abdomen irradiation 13-19 Gy



Loo Am Rad Soc 2017

Subcutaneous Lewis lung carcinoma in C57BL/6 (syngeneic)



Chou, Lartey Unpublished 2017

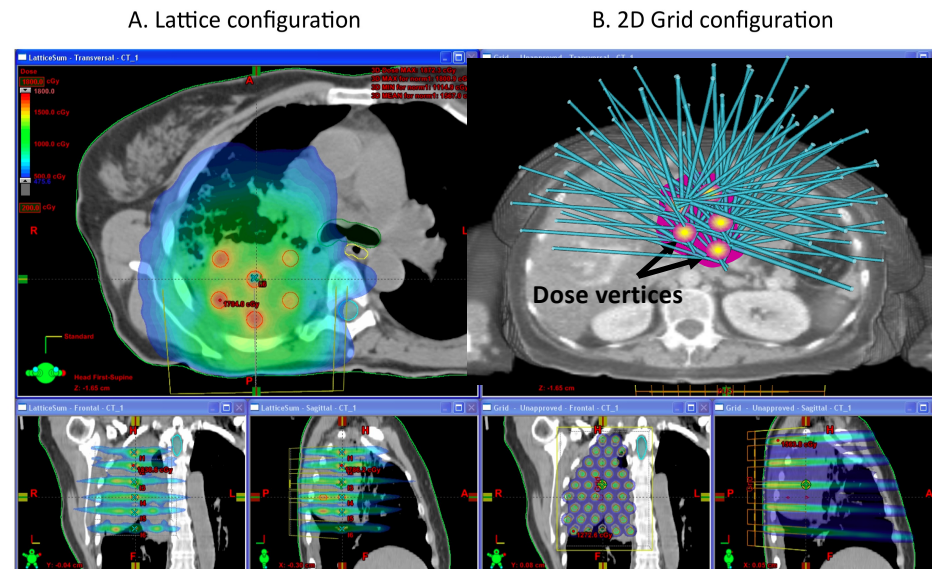




# The Latest Advances in Nuclear and Radiation Medicine

## FIMPS (Flash, Ion, MicroBeam, Particle, Spatially) Radiation?:

- **Flash:** Improved biology + motion control, faster treatment!
- **Ion:** Less exit dose!
- **Microbeam:** Normal tissue sparing
- **Particles:** possibility of a higher RBE
- **Spatially Fractionated (GRID, Lattice ...)**





**"Not everything that counts can be counted,  
and not everything that can be counted counts."**

***Albert Einstein***

***(Sign in his office at Princeton)***

**"Count what you can count and hope that it counts!"**

***Mack Roach III***