

# Cosmic-ray Irradiation Study of a Space Medicine for Future On-Orbit Manufacturing

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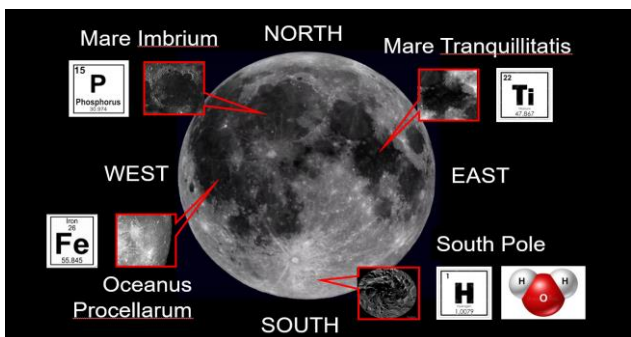
## Problems with Space Medicine

Medicines are commonly used between all crew member during a space mission

### Medicines used by Astronauts

- Instability with cosmic ray
- Short shelf-life
- Reduce effect on disease

## Formulation



100 mg tablet

**Shape:** Oval, Convex  
**Outer Diameter:** 6 mm  
**Thickness:** 1.5 mm

## Our Solution

Space medicine which can self-stabilized under radiation via:

- Drug-exciptent interaction
- High atomic number elements in the coating
- High atomic number elements in the matrix

## Manufacturing

### Implementing step-wise mixing:

- Ibuprofen deviation is reduced from 20% to 5%.

### Compressing with improved evenness:

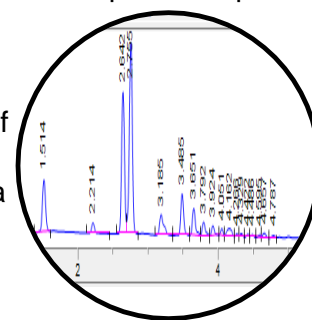
- Tablet thickness deviation is controlled at 10%.

## Earth-stimulated Radiation Study

\*Radiation levels are similar to the real space conditions

- Mild UV-C and low LET-beta source isn't creating a detectable damage population under current condition.
- Alpha radiation decomposed ibuprofen

UHPLC results of pure Ibuprofen after 5hr of Alpha irradiation



- Ibuprofen: best characterised drug for irradiation impact on Earth (UV).
- Raw materials for all excipients can be found on the moon in abundant volumes.
- Moon abundance materials, e.g., Iron and Titanium is used for coating.



### Particle radiation:

- Alpha
- Beta
- Proton

- X-ray irradiated samples show up to 20% reduction of Ibuprofen after 0.6-60 Gy radiation.

Sample	X-ray Dose (rad)	Reduction (%)
Base case	0.6	4
	60	10
Low Iron content	0.6	17
	60	14
High Iron content	0.6	9
	60	12
Low titania	0.6	9
	60	21
High Titania	0.6	6
	60	3

### Energy radiation:

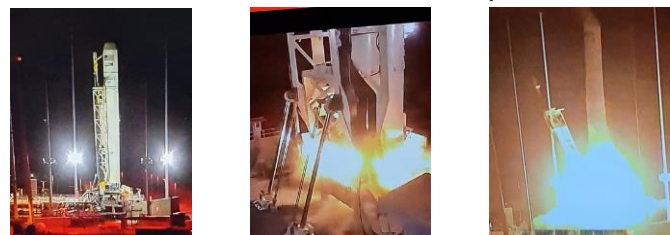
- UV-C
- X-ray
- Gamma



## Real Space Investigations

### NG-14 Mission

**ISS National Lab Provider:** Space Tango  
**Launch Provider:** Northrup Grumman  
**Launch Date:** October 3, 2020, Wallops Island



### NG-15 Mission

**ISS National Lab Provider:** Alpha Space  
**Launch Provider:** Northrup Grumman  
**Launch Date:** 20 February, 2021, Wallops Island

