Space Radiation Services

What New Space wants from radiation test facilities

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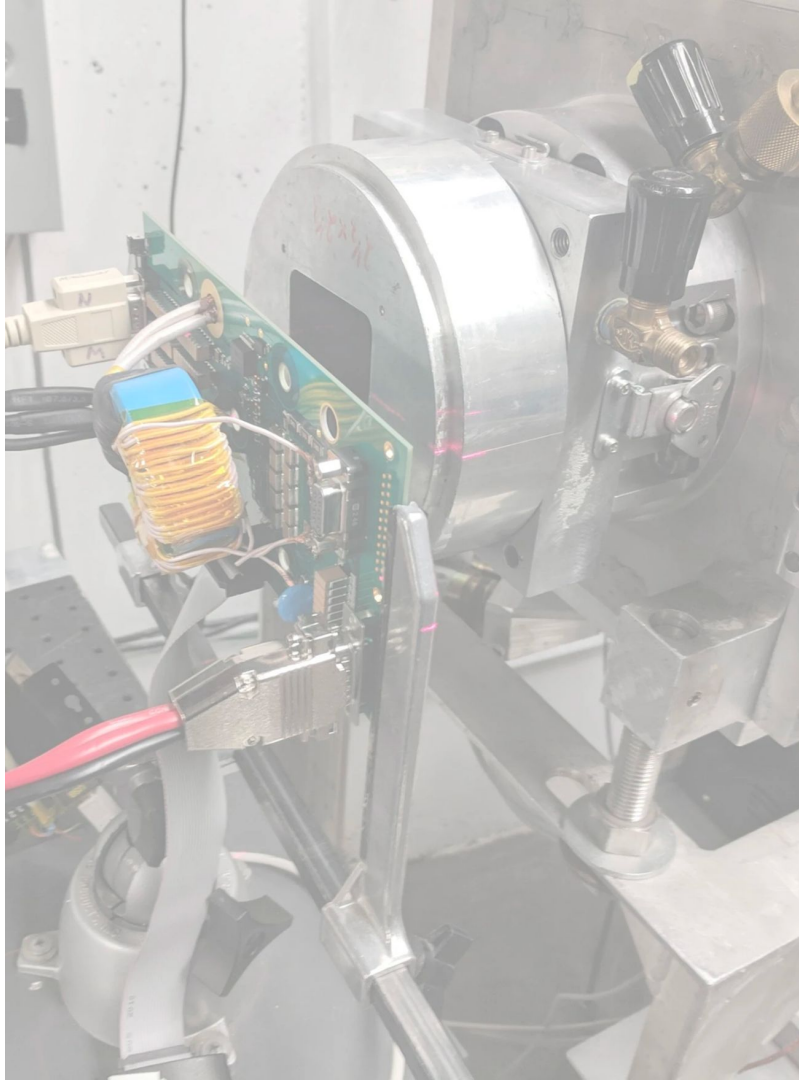
Content

“All happy companies are alike; each unhappy company is unhappy in its own way”
Adapted from Leo Tolstoy, Anna Karenina

- “Why should I listen to you?”
- Background on new space radiation needs
- What New Space looks for in testing facilities
- What News Space wants for the future
  (the list of small miracles)



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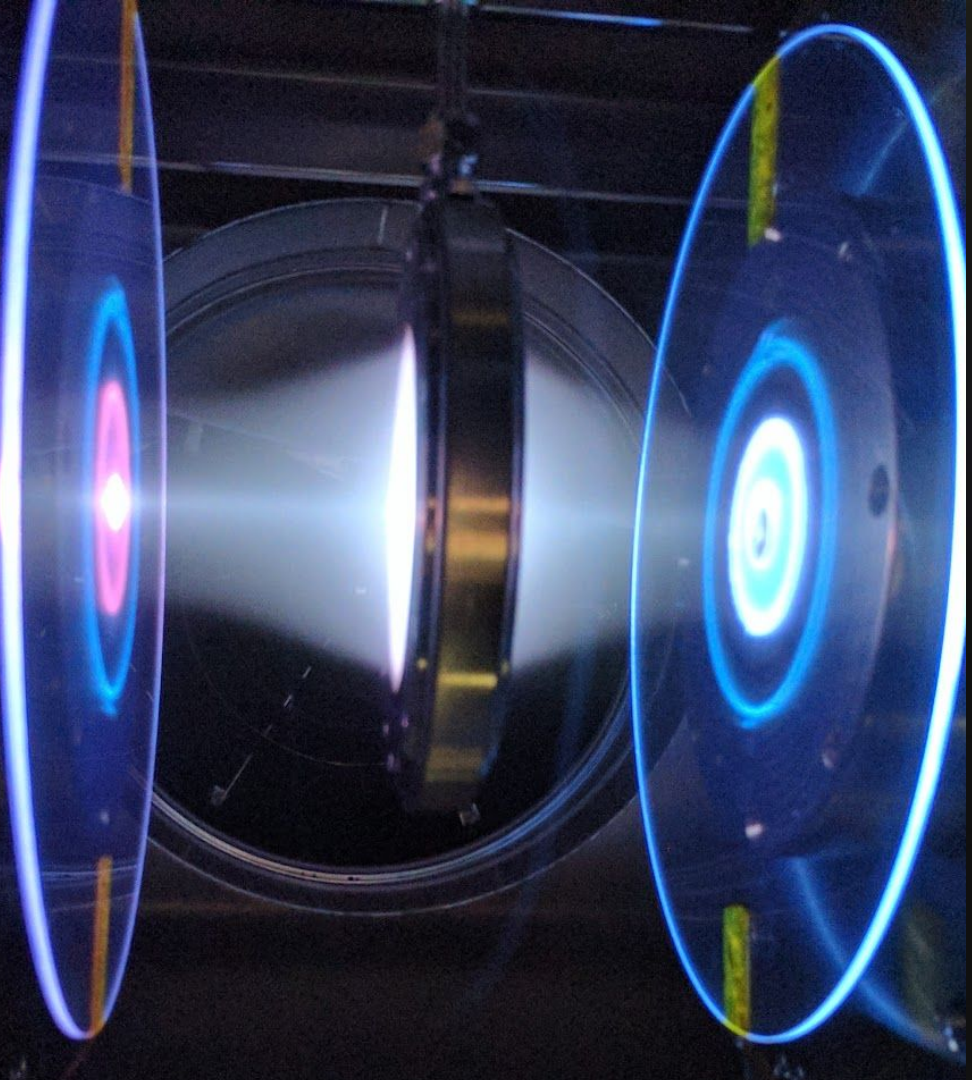
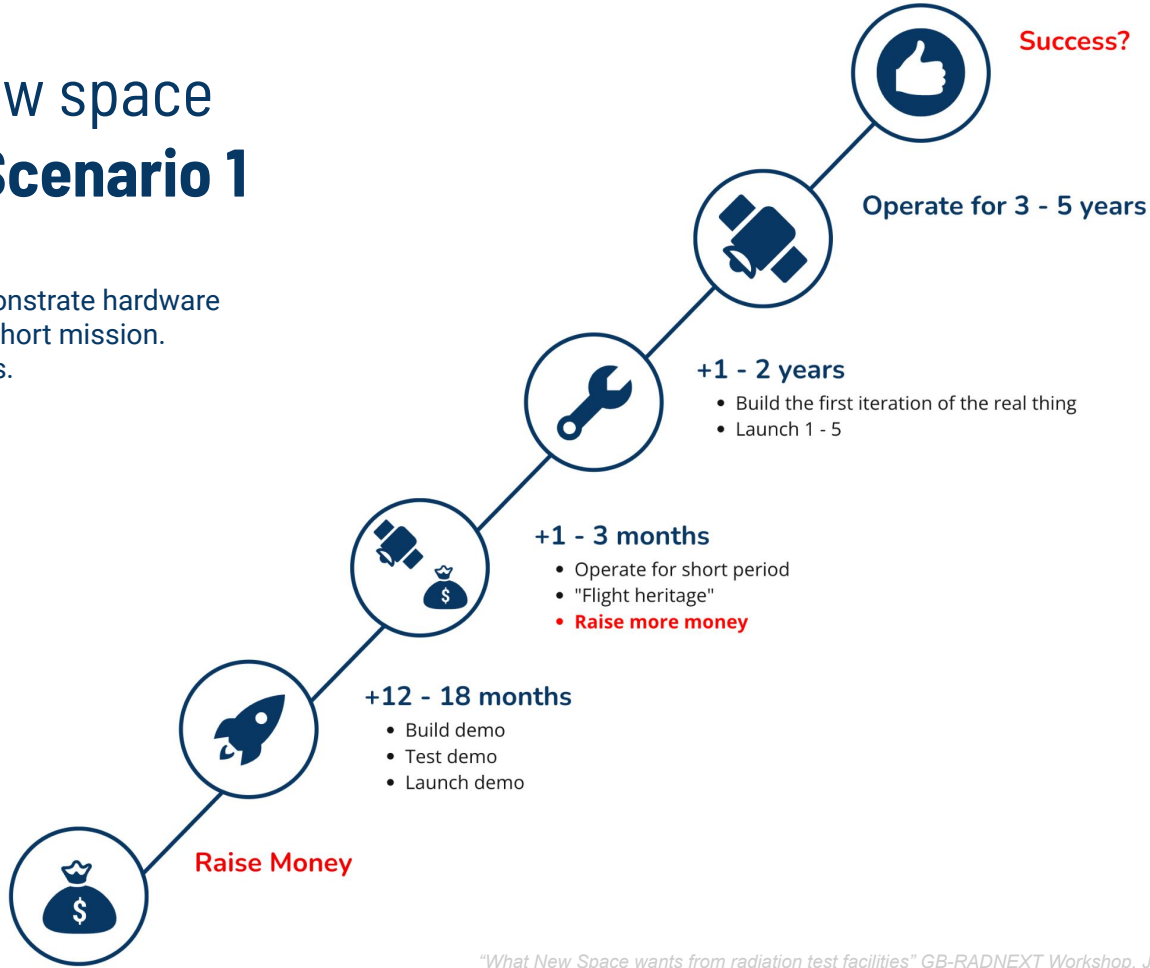


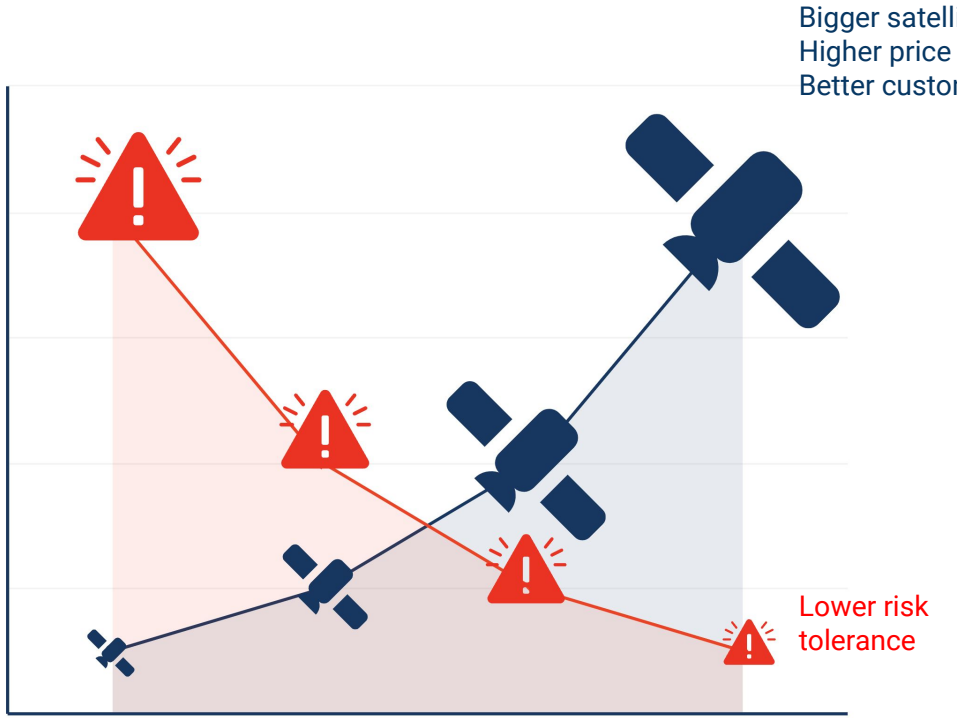
Background on new space radiation needs: **Scenario 1**

Early stage company. Needs to demonstrate hardware on-orbit quickly - needs to survive a short mission. Heavily dictated by VC funding cycles.



Background on new space radiation needs: **Scenario 2**

Growing company. The general trend is bigger satellites, higher price tags, better customers. All resulting in lower risk tolerance.



Timeline of a growing new space company

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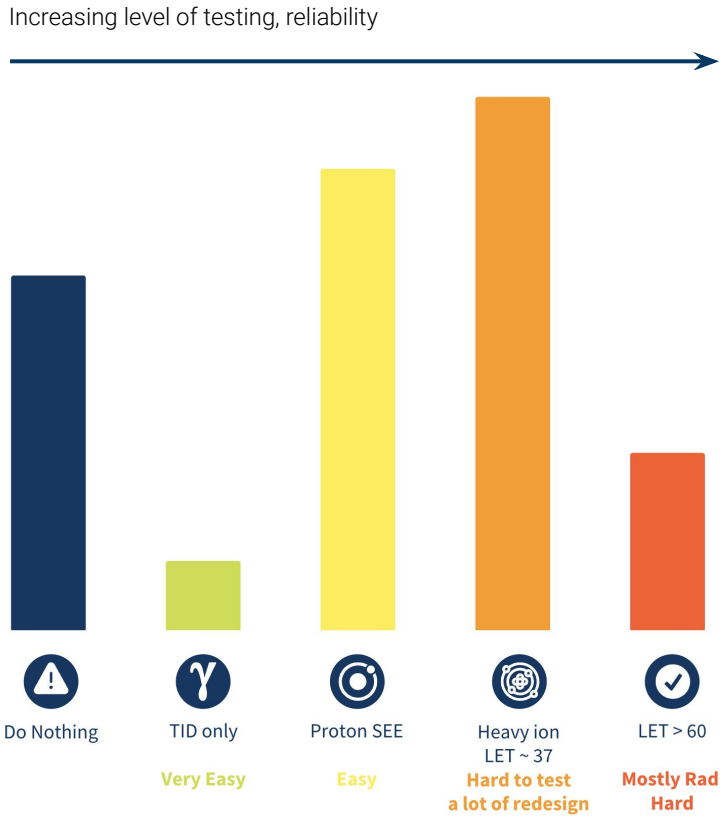
New Space companies are doing more than you would expect

Left to right increasing level of testing, reliability, difficulty, and market size. Step change in difficulty moving to heavy ion SEE testing means that a lot of companies stop short.

There is widespread frustration on the lack of guidance on what you should do if budget and schedule dictates that you can do heavy ion testing!! So people tend to follow the crowd.

Other trends:

- DIY radiation testing
- Flying dosimeters



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New space want test facilities to be: big, powerful, fast, cheap and near

1. **Companies new to radiation testing want the most “Bang for your buck:”** It’s ideal if one facility can cover TID, DD, and some SEEs - testing at multiple facilities is a HUGE time sink.
2. **Fast access**: Booking in less than 3 months is preferred. A simple scheduling process.
3. **Location:** Within driving distance is preferred - shipping hardware internationally SUCKS.
4. **Ability to irradiate a lot at once:** Ideally over 10 cm in diameter for board level testing.
5. **Highly penetrating:** To cover both sides of a board as well as no need to decap

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What News Space wants for the future (the list of small miracles)

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1) Easy access to heavy ion testing without the need to de-cap parts, and beams large enough for board level testing

NASA Space Radiation Laboratory

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2) Guidance on what to do for short-term missions, or when “rad hard” isn’t an option from a cost/schedule perspective

Companies tend to follow the crowd rather than look for the best solution. Most gravitate towards “Careful COTS” - This is a reasonable approach, but is following a >10 year old , non-peer reviewed conference paper the best solution we have?

Plenty of work has looked at quantifying the limitations of different testing approaches, or what types of mission can handle no/limited testing


National Aeronautics and Space Administration

NASA

Board Level Proton Testing Book of Knowledge for NASA Electronic Parts and Packaging Program

Radiation Effects and COTS Parts in SmallSats

Download

Doug Sinclair, *Sinclair Interplanetary*
Jonathan Dyer, *Skybox Imaging*

30,132 DOWNLOADS
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Session

Technical Session IV: Down The Middle

Abstract

An emerging class of small satellite missions requires assured operational lifetime and rapid development on a moderate budget. This paper describes a “Careful COTS” approach to component selection and testing to meet these needs. Commercial parts are selected based on best practices, and radiation tested to limits based on the modeled mission environment. High-energy proton testing allows simultaneous exploration of total dose, displacement damage, and some single-event effects. The authors have developed these methodologies over the course of a number of successful low-earth orbit missions. Provided the lifetime dose is under 30 krad, a solution can probably be realized with commercial parts. Various case studies of commercial parts that have failed under this dose are given.

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3) Where can New Space companies reduce their margin, margin, margin, margin, margin, margin, margin, margin, ...

Testing in worst case bias condition and no duty-cycling accounted for

Radiation simulations with 90+% confidence interval

TID testing uses sources that give a worst case fractional yield

TID and DD test results with 3 sigma tolerance limit

TID and DD Radiation Design Margin of 1.2 - 2 x

DSEE additional 70% de-rating on lowest survival bias

The list goes on

I can give lots of examples where additional margin was necessary. But I couldn't tell you where the best places are to cut margin out.

Lot number	TID performance
1	100 krad(Si)
2	30 krad(Si)
3	10 krad(Si)

Table 8-1. LM108 TID performance. Lot Nos. 1 and 3 were processed one month apart at the same wafer fab.

https://www.ti.com/seclit/eb/sgzy002a/sgzy002a.pdf

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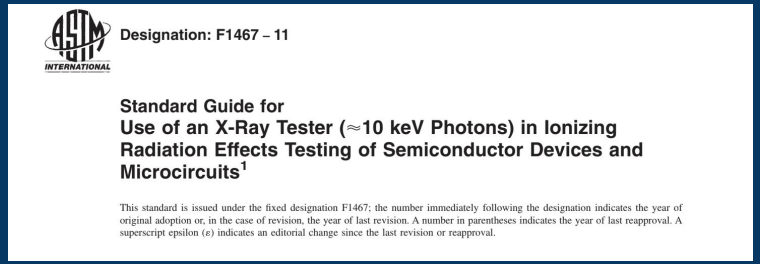
4) Guidance on board level testing and alternative testing methods

Without guidance, people make mistakes. Many don't realize that components tested on a board in one bias condition, might not be suitable for a different board operating in a different bias condition.

There are some great papers out there but there are also some huge gaps.



Designation: F1467 – 11

Standard Guide for
Use of an X-Ray Tester (≈10 keV Photons) in Ionizing Radiation Effects Testing of Semiconductor Devices and Microcircuits[1]

This standard is issued under the fixed designation F1467; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

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Single-Event Effects Testing with a Laser Beam

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Guidelines

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What News Space wants for the future (the list of small miracles)

1. Easy access to heavy ion testing without the need to de-cap parts, and beams large enough for board level testing
2. Guidance on what to do for short-term missions, or when “rad hard” isn’t an option from a cost/schedule perspective
3. Where they can drop the margin
4. Guidance on board level testing and alternative testing methods

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Questions?

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