Compute module redundancy management for space applications using **FPGAs**

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CritiX

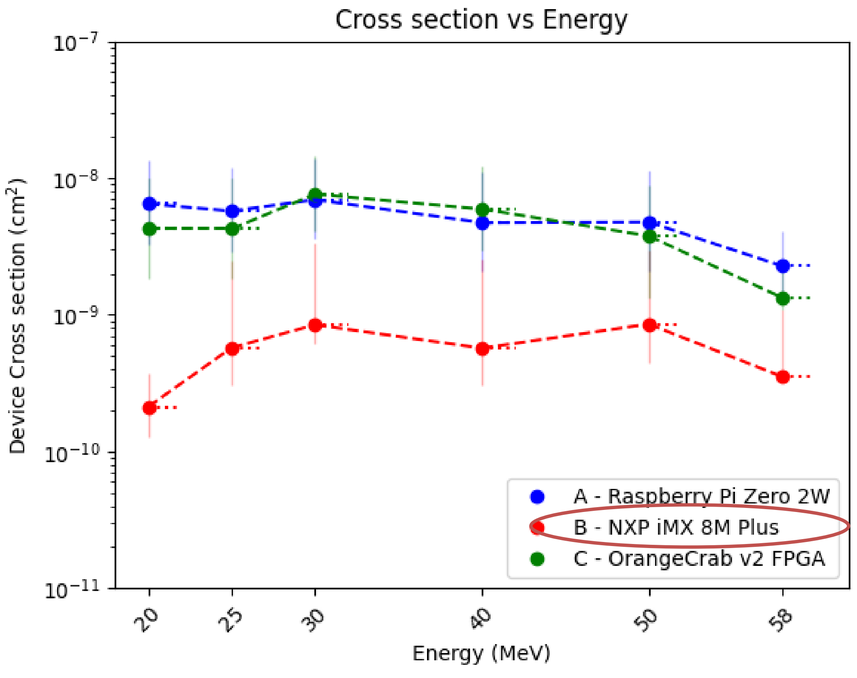
FPGA Control of Computer Modules

Redundant execution on Commercial-off-the-shelf (COTS) modules offers increased radiation resilience and adjustable performance for space applications, provided redundancy is properly managed. This work introduces our radiation test prototype for managing four **Toradex VERDIN iMX8MP** Compute Modules (CM) and their CAN communication links through a **LATTICE Crosslink-NX Board** Field Programmable Gate Array (FPGA).

Proactive Rejuvenation for Space

COTS hardware requires active power cycling and system reboot to withstand radiation without expensive shielding. Adjusting rejuvenation to environment grants performance during low phases and resilience during high radiation phases, while securing critical operations through replication and voting. This includes triggering rejuvenation itself.

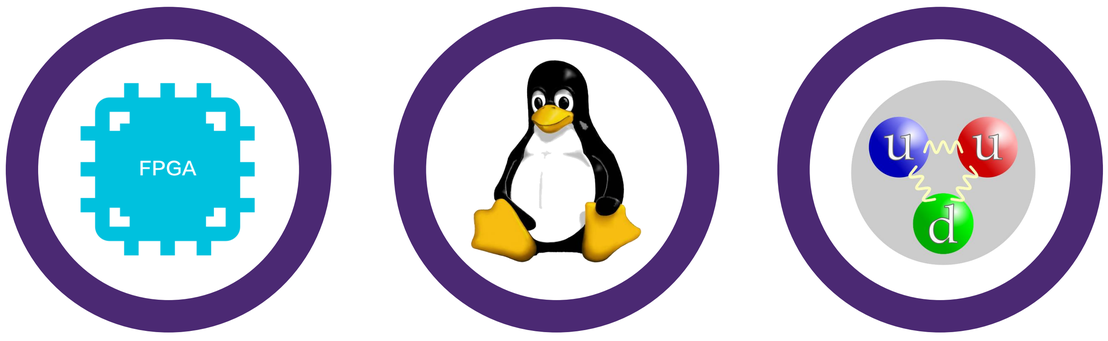
Promising Cross-Section



Additionally boosted through hypervisor-triggered FPGA-enforced consensual rejuvenation

Hypervisor Enforced Radiation Tolerance

- **Unprecedented performance** through hypervisor-enforced adaptive radiation tolerance for COTS processing modules.
- **Low-level fault mitigation** policies enforced in the **kernel layer to** prevent radiation-induced faults from cascading to higher level layers and specifically the user payload.
- Protection of user applications by hosting secure and safety monitored **containers** (safety islands).



Low-power COTS performance gap.

Software consolidation under Linux is well in reach

Proton Beam Radiation Tested

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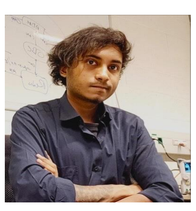
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