Scientists have suspected for decades that the production of UH cosmic rays, particularly those with $Z > 50$, may be produced in binary neutron star and neutron star black hole mergers (Frolov, 1999).

- The August 30 binary neutron star merger (NSM) observed by LIGO, VIRGO, FERMI, and other experiments provided spectroscopic evidence of ultra-heavy elements are produced in binary neutron star mergers.
- Unlike photos, it is impossible to directly measure the flux of particles from a NSM as indirect measurements are needed.

Ultra-heavy cosmic ray measurements by HNX would provide critical insights into the nucleosynthesis of ultra-heavy elements by binary neutron NSMs by providing a direct sampling of galactic material and measurement of ultra-heavy elements abundances.

**HNX Mission Concept**

- **HNX uses two complimentary instruments ECCO and CosmicTIGER to span a huge range in atomic number ($6 < Z < 96$). The detectors are sensitive to particles with $Z > 96$ but the flux of these particles is unknown.
- **HNX uses the SpaceX DragonLab launched on a SpaceX Falcon 9 Launch vehicle**:
  - DragonLab is a flying “laboratory” based on the Dragon ISS supply and DragonRider commercial crew spacecraft.
  - DragonLab consists of a pressurized and temperature controlled capsule and unpressurized trunk.
  - HNX would fly inside the capsule and a second instrument could be accommodated in the trunk. This ride-sharing arrangement helps reduce cost.
  - HNX is extremely compatible with a wide variety of co-manifested instruments. Most instruments wish to fly in the trunk to have an unobstructed view of space.
  - Capsule is recoverable, trunk is not. This is important as ECCO requires recovery for mass measurement and slow nuclei to measure.
  - DragonLab supplies all services including power, telemetry and thermal control.
  - DragonLab will be certified for 2 year flights with safe recovery (this may be increased to 3 years with further maturation).

**Ultra-Heavy Particle Production in Binary Neutron Star Mergers**

- **HNX will measure $>1800$ nuclei $38 \leq Z \leq 83$ to probe UHGCR processes**

**ECCO**

- **ECCO is based on TERE experiment on NIKHEF**
- **ECCO BP-1 detector modules cover capsule walls, part of top, and beneath readout system.
- **ECCO silicon strip detectors (6 $\leftrightarrow 2$ x $44$)** measure charge and energy using $dE/dx$ vs. Cherenkov and scint fiber hodo.

**CosmicTIGER**

- **CosmicTIGER consists of three detector subsystems** which provide charge and energy using $dE/dx$ vs. Cherenkov and scint fiber hodo.
- **CosmicTIGER measures relative abundances strongly depend on the age of the GCR**

**HNX: ECCO**

- **ECCO will be certified for 2 year flights with safe recovery (this may be increased to 3-4 years with further maturation)**

**Current State of UHGCR Measurements**

**ECCO**

- **ECCO is simple on-orbit**
- **ECCO silicon strip detectors (6 $\leftrightarrow 2$ x $44$)** measure charge and energy using $dE/dx$ vs. Cherenkov and scint fiber hodo.

**CosmicTIGER**

- **CosmicTIGER is based on TERE experiment on NIKHEF**
- **CosmicTIGER consists of three detector subsystems which provide charge and energy using $dE/dx$ vs. Cherenkov and scint fiber hodo.
- **CosmicTIGER will be certified for 2 year flights with safe recovery (this may be increased to 3-4 years with further maturation)**