IARPA SINTRA Proposer's Day

BlueHalo Corporate Capabilities

10 August 2022

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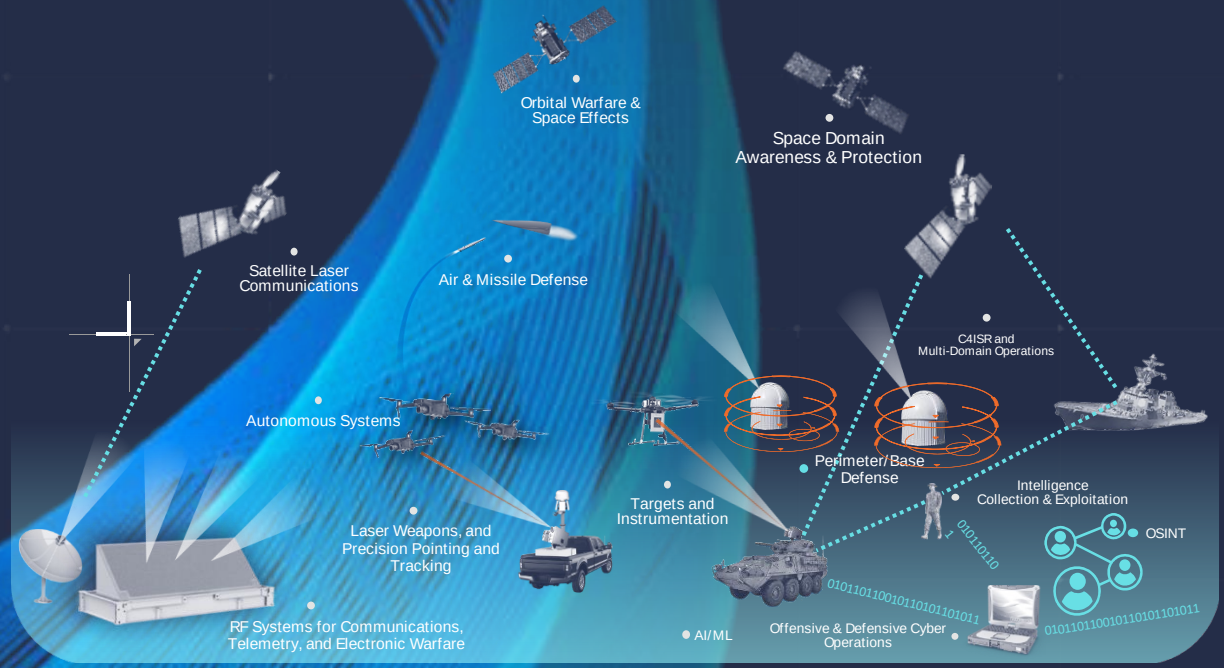
Summary of BlueHalo Areas of Expertise

BLUEHALO MISSION AREAS

PROVIDER OF MISSION ENABLING CAPABILITIES



- **A significant number of BlueHalo capabilities are relevant to SINTRA**
- **These include the Space Superiority Mission Area and a number of capabilities that include Satellite Laser Communications, Orbital Warfare and Space Effects and Space Domain Awareness & Protection**
- **Ground based technology areas in RF Systems, Intelligence Collection illustrate data handling capability Relevant to SINTRA**

Where We Create and Innovate

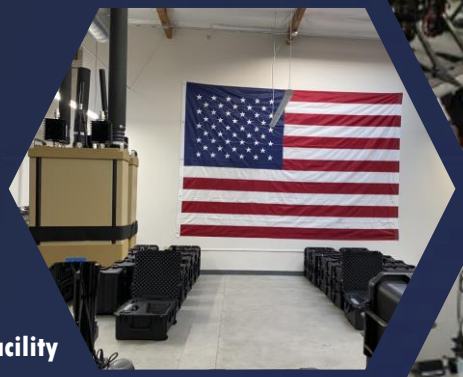
BlueHalo Development Labs

Product Innovation High Bay Facility

Autonomous Systems Manufacturing Facility

Space Threat Characterization Lab

Albuquerque, NM Facilities



cUAS Facility

Space Qualified Electronics Development Cleanroom

Space Systems High Bay with Cleanroom

Huntsville, AL Facilities

Advanced Laser Lab

Sensor Production Facility

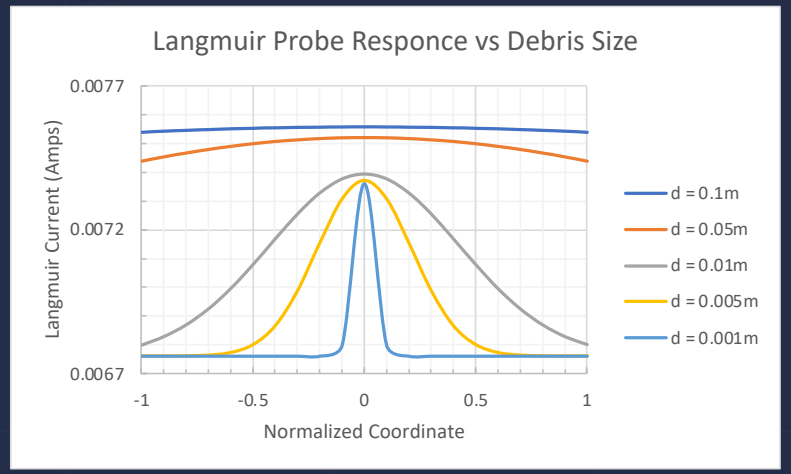
Space Telescope

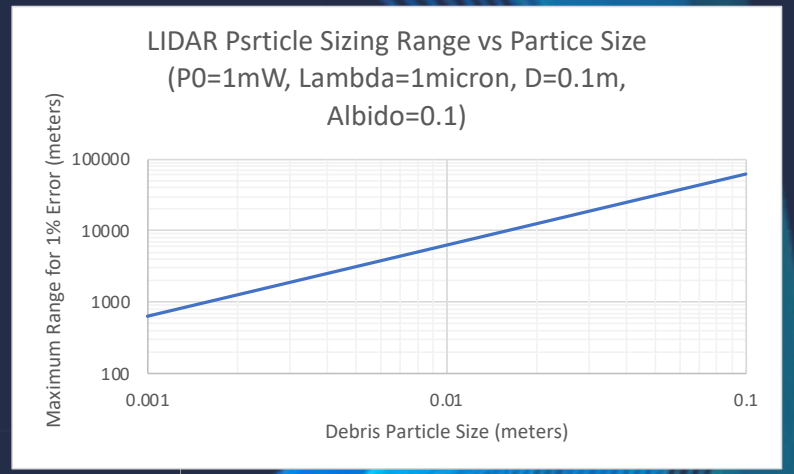
BLUEHALO

Opportunities for Interaction

Technology Area	Relevant Blue Halo Experience	Opportunity for Collaboration
Plasma Soliton Characteristics	Theoretical Background in Plasma Physics and Mathematics	Strong Theoretical and Experimental Experience
CubeSat Constellation Orbit Design	SmallSat Activities: ANGLES, EAGLE, SHARC and DSX	Development of Optimal Satellite Array and Orbit
CubeSat Design	SmallSat Activities: ANGLES, EAGLE, SHARC and DSX	Transition to Optimal SWAP
Soliton Detection	Noise Theory for Langmuir Probe Detection and Sizing	Strong Theoretical and Hardware Experience
LIDAR Crossvalidation	Noise Theory for LIDAR Detection and Crossvalidation	LIDAR Hardware and Processing
Data Analysis & Post Processing	Ground based Intelligence Experience and AI/ML	Develop Data Based Training Algorithms Optimal Post Processing Capability

BlueHalo Orbital Debris Assessment Concepts



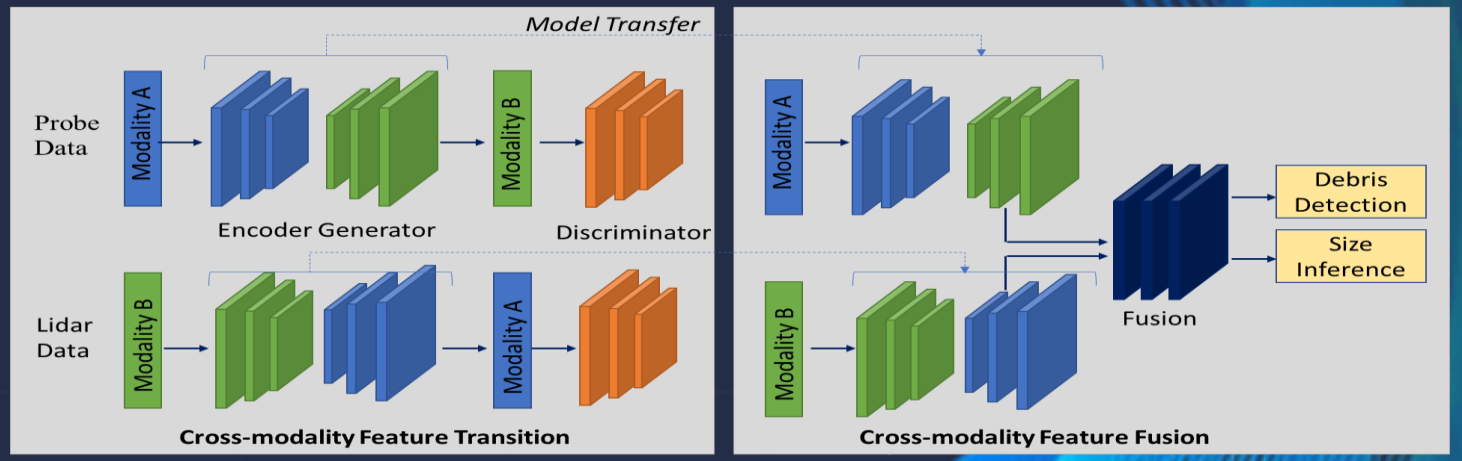


- **The basic approach is to utilize space based measurements to combine three technologies to detect the size and density of debris particles at various altitudes**
  - **Debris particle induced soliton detection**
  - **LIDAR debris particle detection**
  - **Artificial Intelligence and Machine Learning (AI/ML) using Physics based cross modality feature transition and fusion**
- **To facilitate this process it is recognized that the particle size distribution problem can be expressed as the solution of an integral equation of the form**

$$m(i) = \int da\, p(a) G(i,a)$$

- **This integral equation is typically unstable and noise theory is required to assess the practicality of inversion**
- **The figure on the left illustrates that the soliton Langmuir pulse shape produces 7 milliamp signals and sizing capability**
- **The figure on the right illustrates that for 1% size error mm class particle population can be assessed as almost 1km range**

BlueHalo Artificial Intelligence and Machine Learning



- Investigate Deep Learning Models for fusion of Langmuir Probe and LIDAR data products
- Leverage recent efforts on cross-modality feature learning and fusion
- Two learning processes:
  - Cross-modality feature transition - learn to transform features from one modality to another, using a generative adversarial network, thereby learning a rich feature representation that captures relationship between both modalities
  - Cross-modality feature fusion – learns to combine features from the two modalities to perform inference tasks.