SMALL ORBITAL STEREO TRACKING CAMERA TECHNOLOGY DEVELOPMENT

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Background

Current estimated Density of debris at various orbital attitudes with notation of recent collisions and resulting spikes.

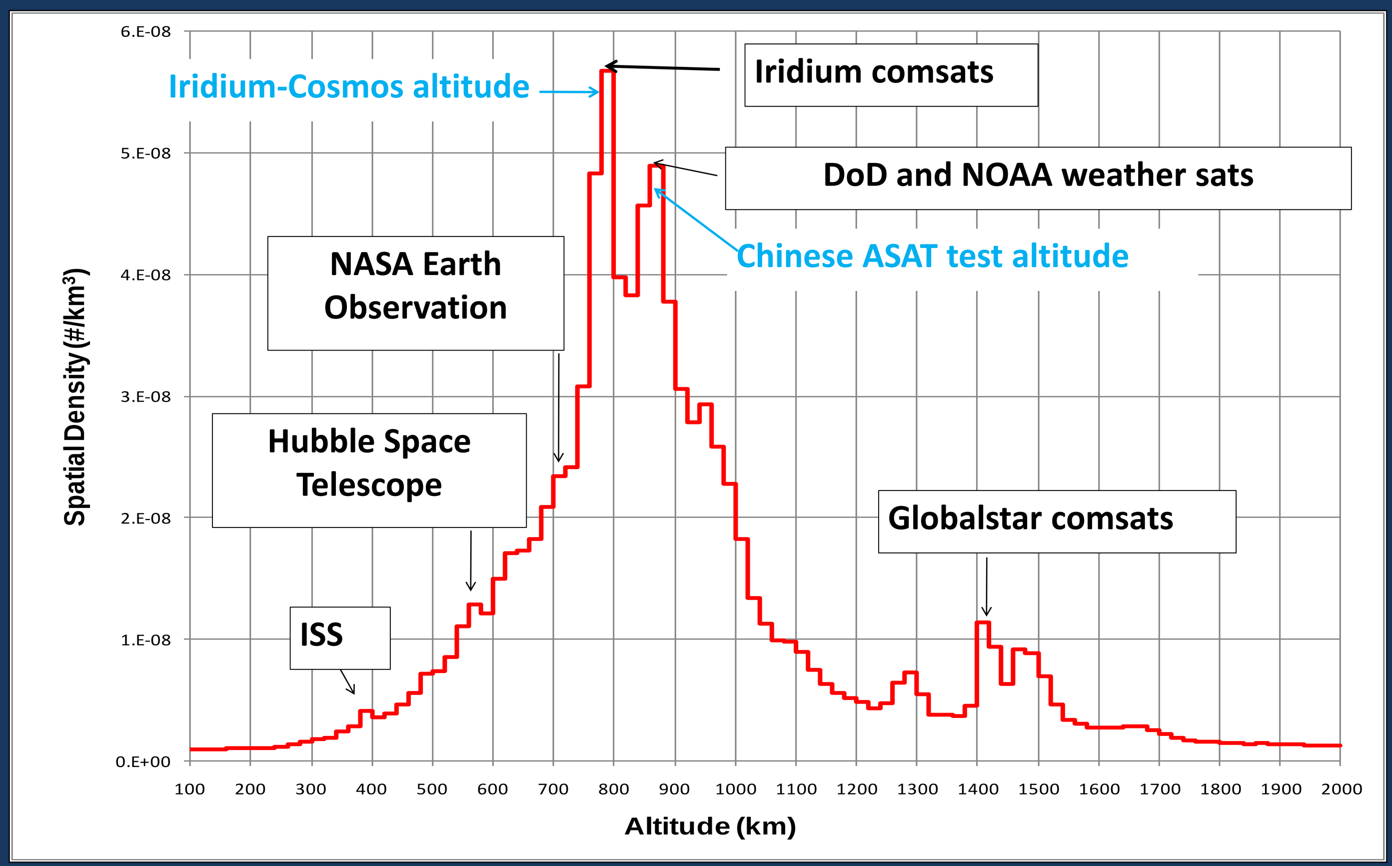


Figure courtesy of Orbital Debris Program Office

Any exploration vehicle assembled or Spacecraft placed in LEO or GTO must pass through this debris cloud and survive

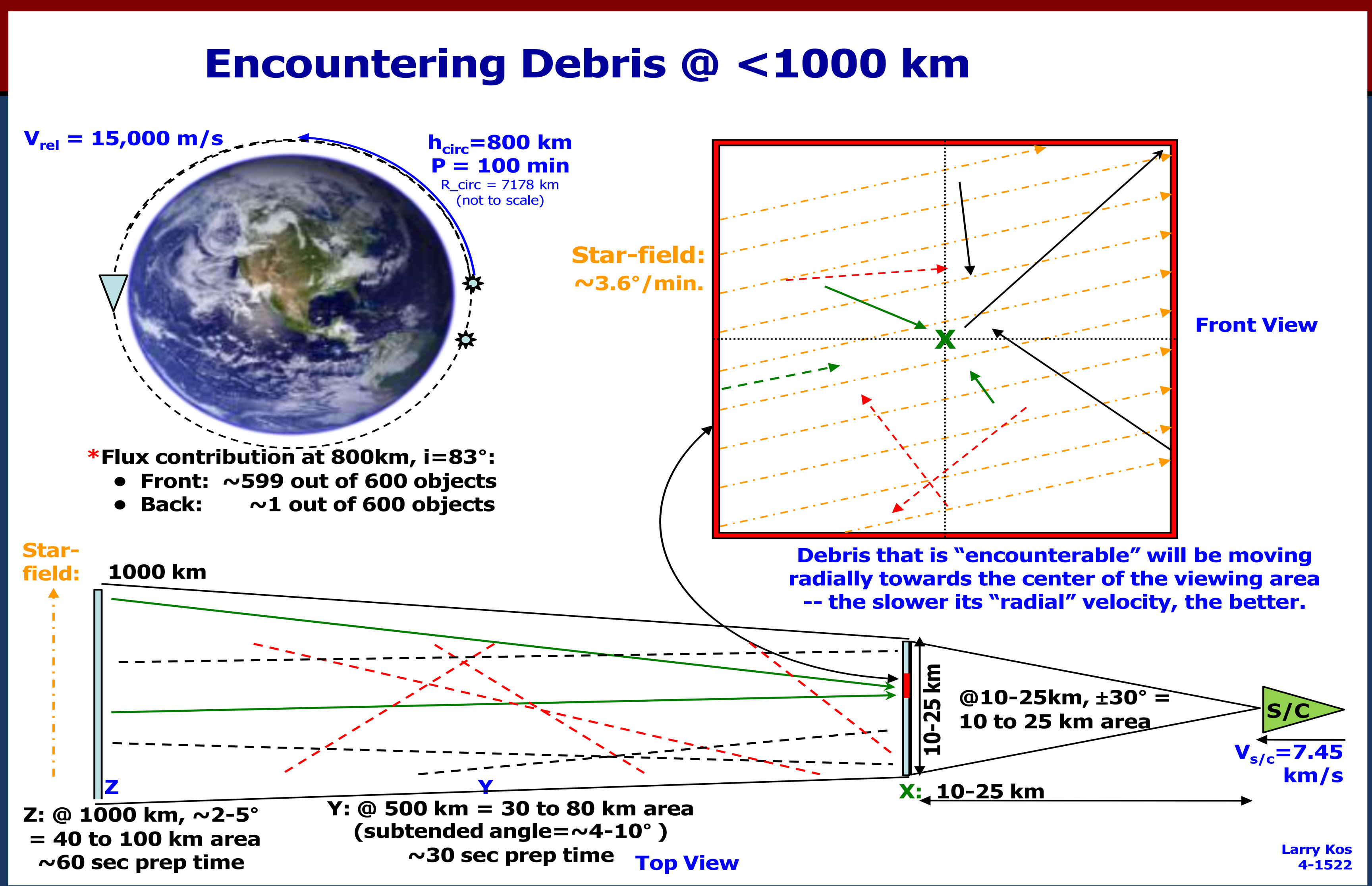
Large cross section, low thrust vehicles will spend more time spiraling out through the cloud and will suffer more impacts.

Better knowledge of small debris will improve survival odds.

Orbital Debris Tracking and Characterization has now been added to NASA Office of Chief Technologist's Technology Development Roadmap in Technology Area 5 (TA5.7)[Orbital Debris Tracking and Characterization] and is a technical gap in the current National Space Situational Awareness necessary to safeguard orbital assets and crews due to the risk of Orbital Debris damage to ISS & Exploration vehicles.

The Problem: Traditional orbital trackers looking for small, dim orbital derelicts and debris typically will stare at the stars and let any reflected light off the debris integrate in the imager for seconds, thus creating a streak across the image.

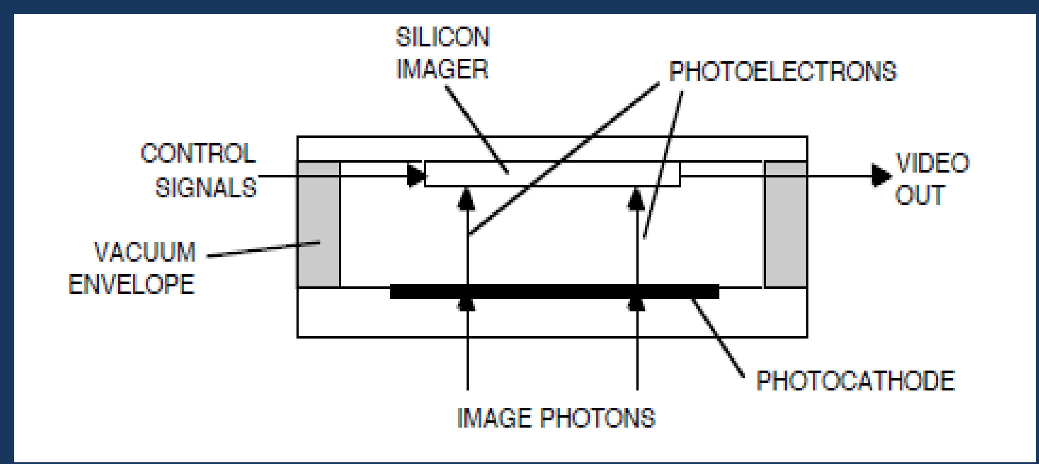
Technology Development



Conceptual images from the Small Tracker using Amplified Real-time Imaging (STARING) when fixed on ISS looking toward the orbital velocity vector.

The Solution: The Small Tracker will see Stars and other celestial objects "rise" through its Field of View (FOV) at the rotational rate of its orbit, but the glint off of orbital objects will move through the FOV at different rates and directions. Debris on a head-on collision course (or close) will stay in the FOV at ~14 Km per sec.

The Small Tracker can track at 60 frames/sec allowing up to 30 fixes before a near-miss pass.
A Stereo pair of Small Trackers can provide range data within 5-7 Km for better orbit measurements

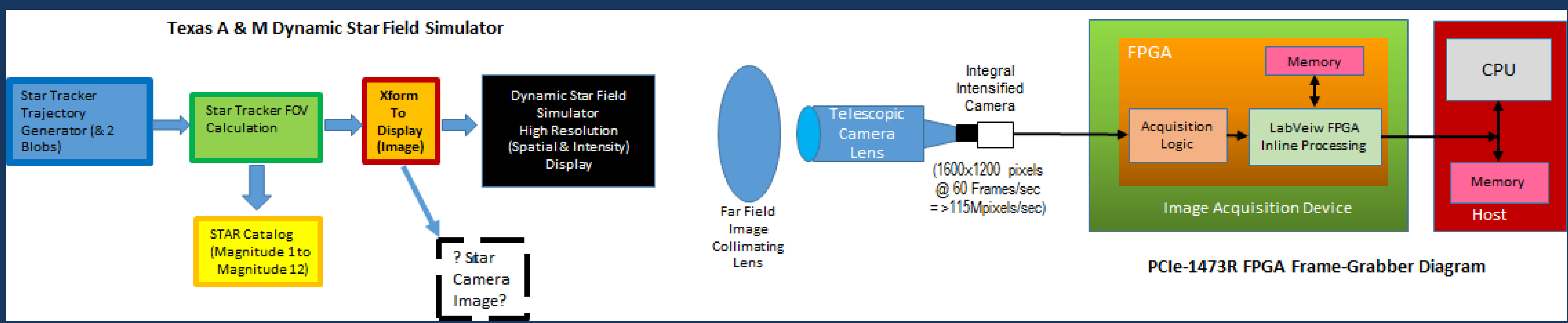


An EBAPS (Electron Bombarded Active Pixel Sensor) sensor will amplify their light with an intensified video imager (as found in the Apache helicopter). For our purposes, we will focus our image to a narrow field of view with a telephoto camera lens that has been ruggedized for launch and outer-space use.

Data Processing: The Small Tracker uses a FPGA (Field-programmable gate array) to convert all lit pixels to spots and identifies the spots NOT moving with the Stars and sends those and star tracker data down for ground processing

Small Tracker using Amplified Real-time Imaging (STARING) Sensor Proof of Concept

Tests will use the Dynamic Star Field Simulator (developed at MSFC with Texas A&M) which generates a high resolution image of the background stars in motion and one to three small orbital objects to verify the control and performance of the amplified imager, pixel-to-spot FPGA processing, and the orbital object discrimination algorithms.



Orbital Debris STEREO Camera Test-bed Plan

Other tests may mount the Small Tracker to MSFC's Lunar Impact Telescope Observatory to verify real-time star-field processing while tracking ISS from ground then tracking orbital objects from ISS.