

Improving the Performance of the Space-Based Visible Sensor

J. Sharma, A. Wiseman, and G. Zollinger
MIT Lincoln Laboratory

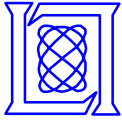
Space Control Conference
April 3-5, 2001



SBV Team

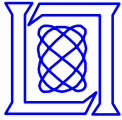


Gerry Banner
Curt von Braun
Bill Burnham
Bob Clouser
Jeff Cooper
Elizabeth Evans
Greg Hogan
Pablo Hopman
Marilyn Lewis
Fred Morton
Ramaswamy Sridharan



Outline

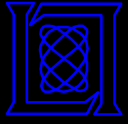
- ➔ • **Introduction**
- **Dual Signal Processor Operations**
- **Pinch Point Operations**



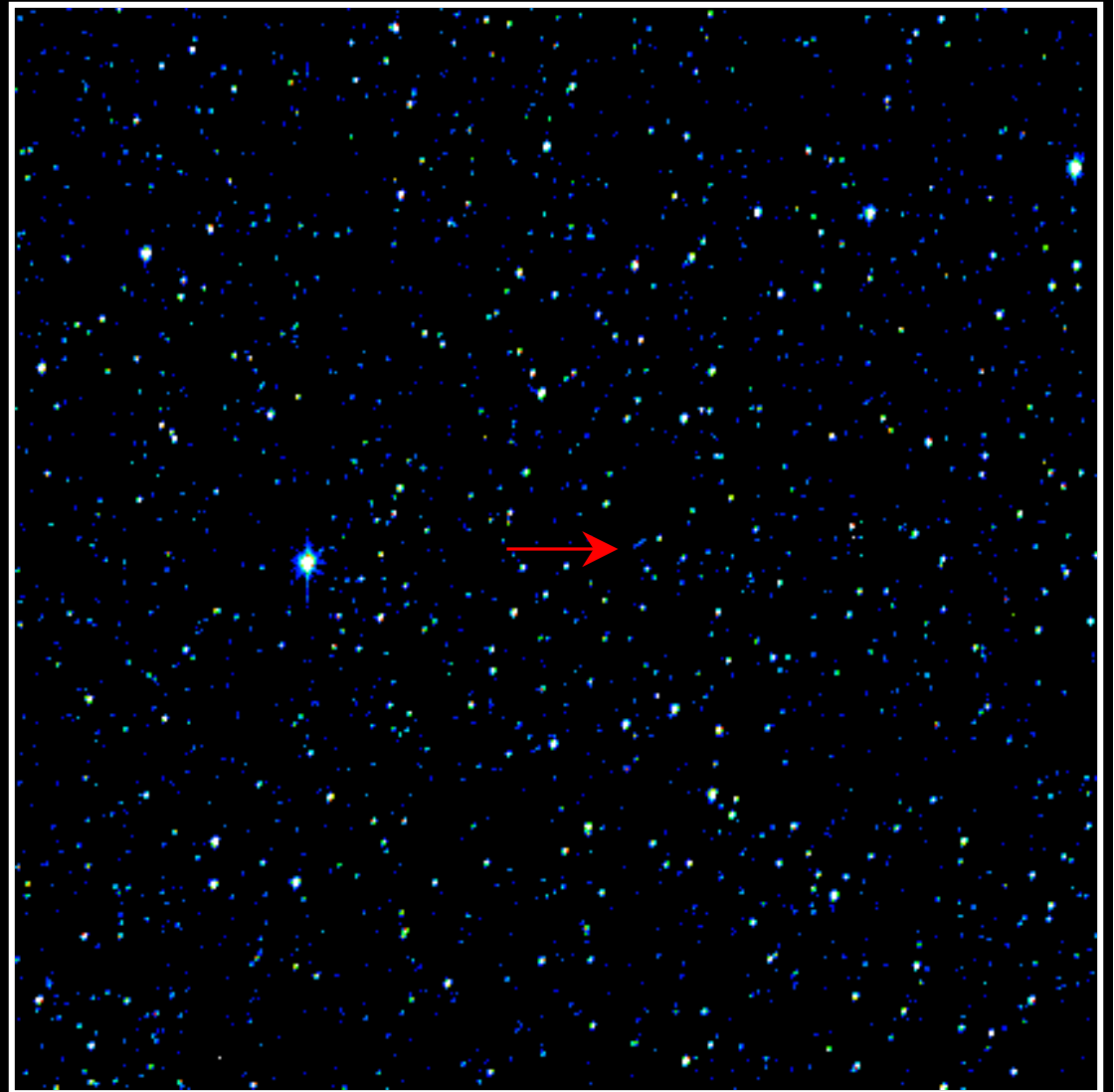
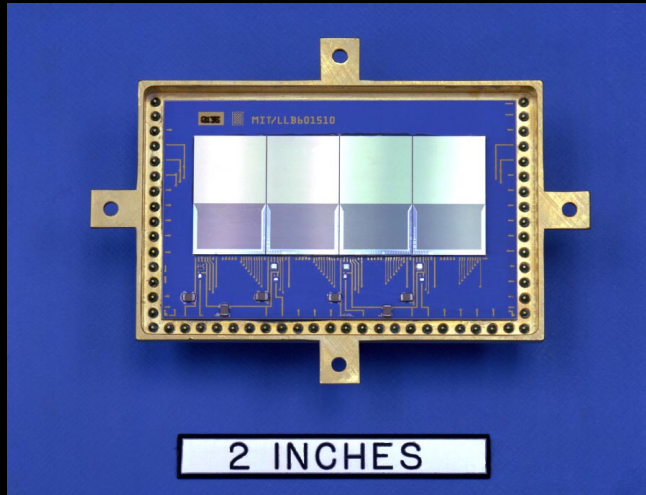
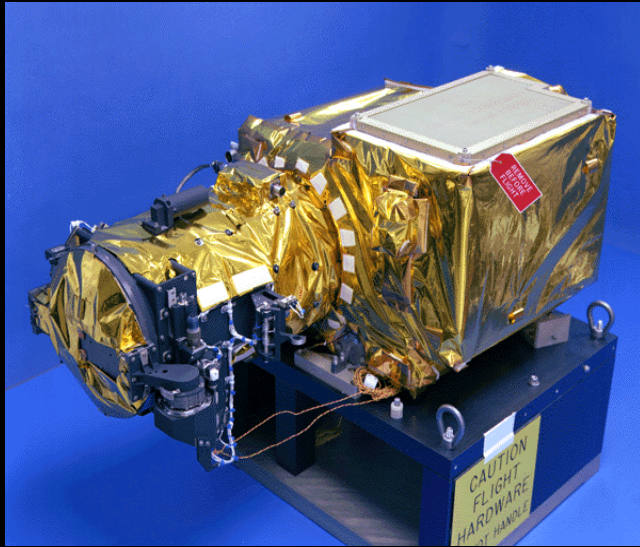
SBV Space Surveillance Program History

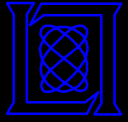


- **Apr 1996: Midcourse Space Experiment (MSX) spacecraft launched**
- **Oct 1997: Advanced Concept Technology Demonstration (ACTD) program initiated**
- **Apr 1998: Contributing sensor operations**
- **Oct 2000: Operational sensor under Space Command sponsorship**

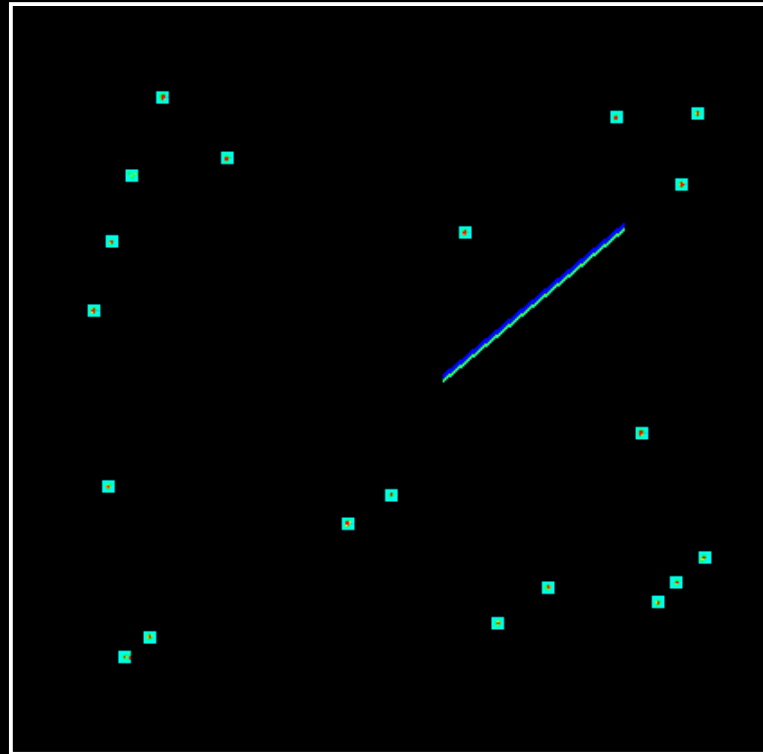
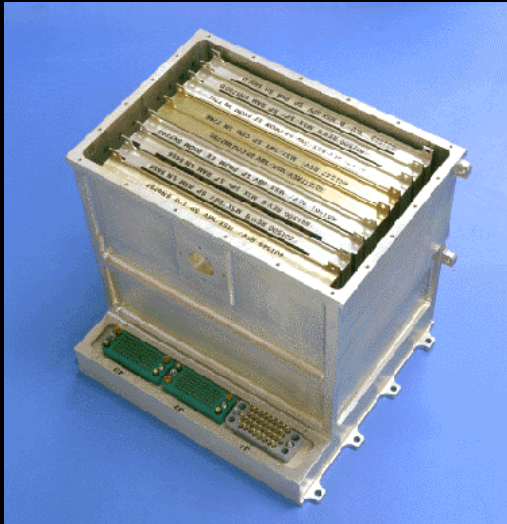


SBV Sensor





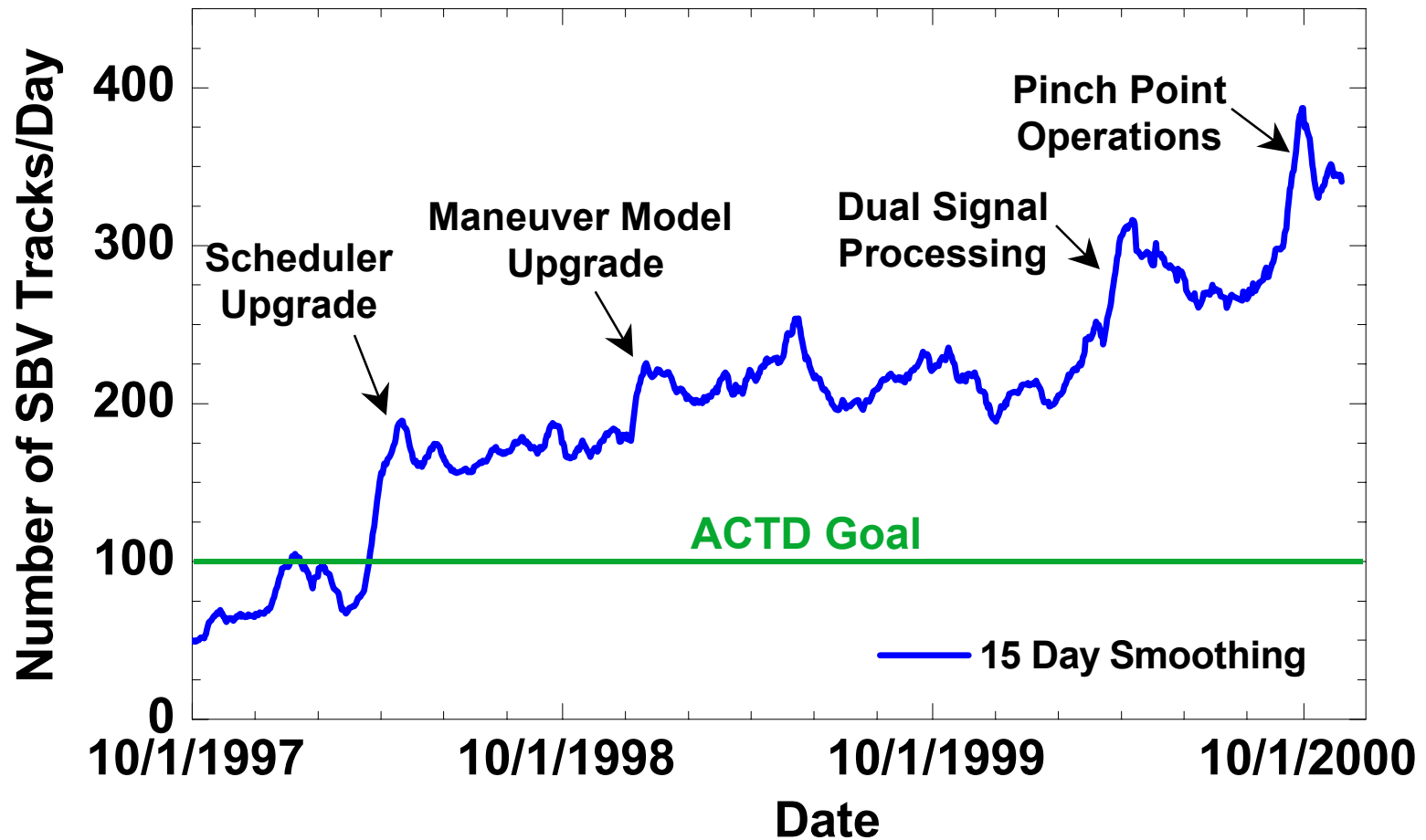
SBV Signal Processor



- Target and star detection
- Clutter rejection
- Data compression

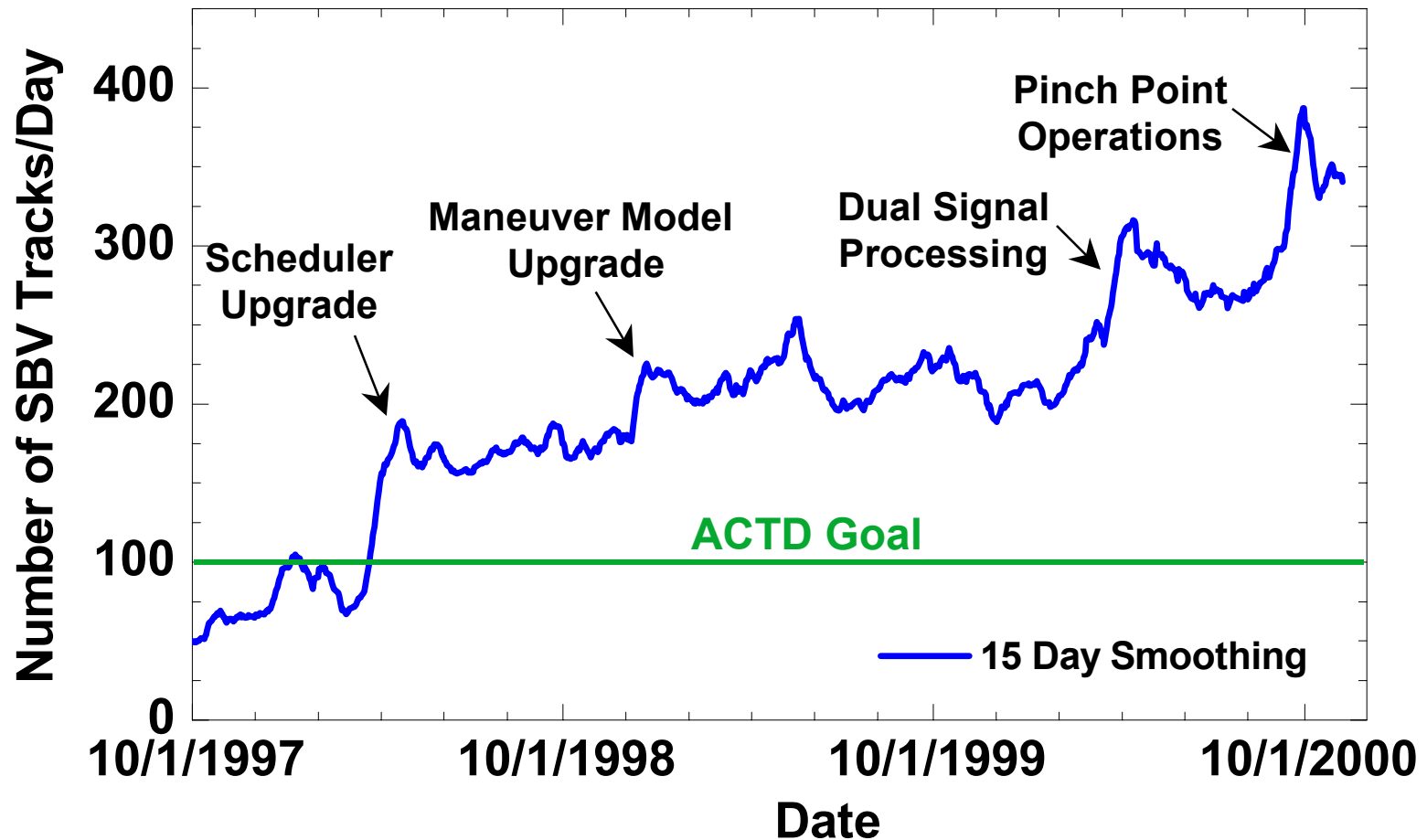


SBV Productivity





SBV Productivity

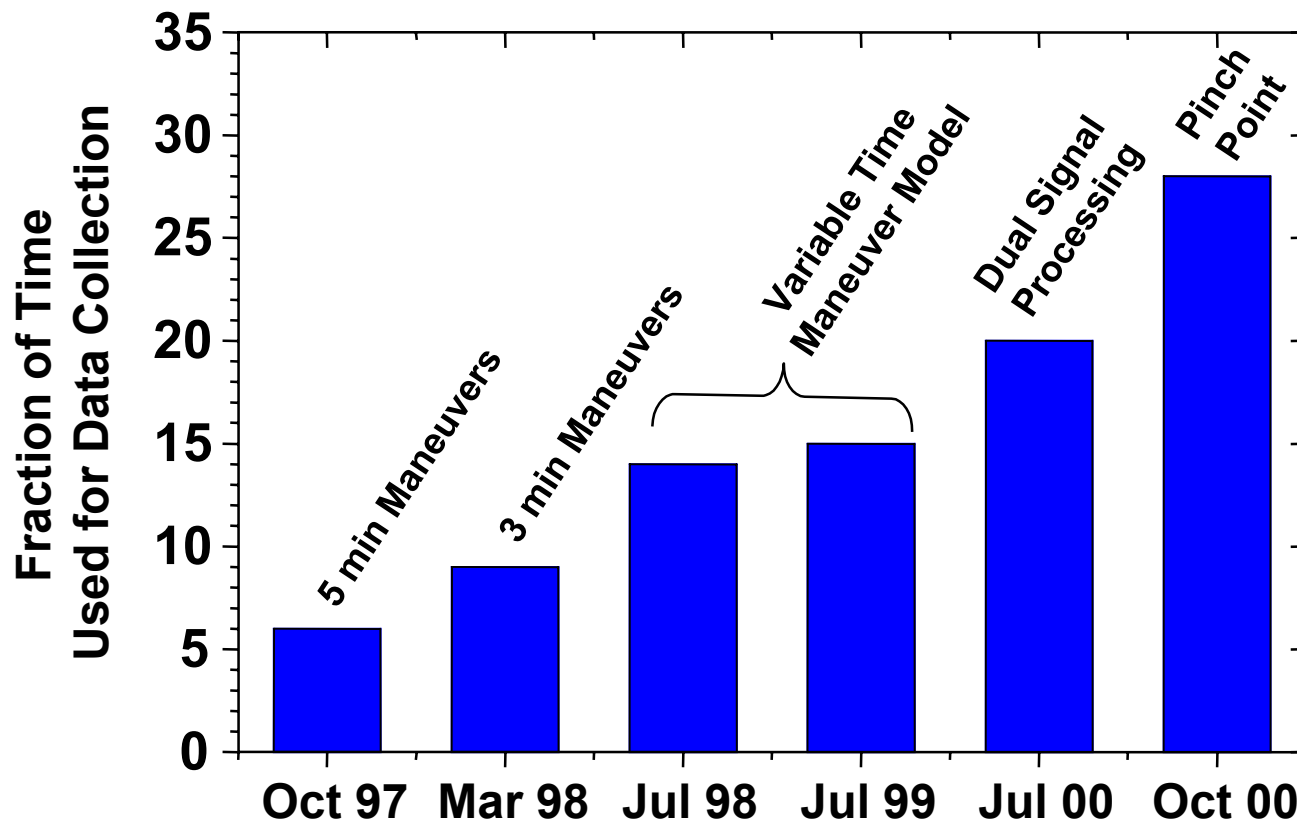


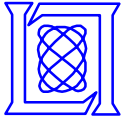
SBV productivity has increased from 50 to 350 tracks/day



Improvement of Spacecraft/Sensor Operations

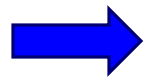
- Increase time available for data collection
- Reduce spacecraft maneuver time
- Reduce onboard signal processing time



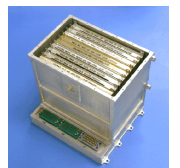
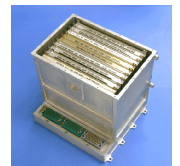


Outline

- Introduction

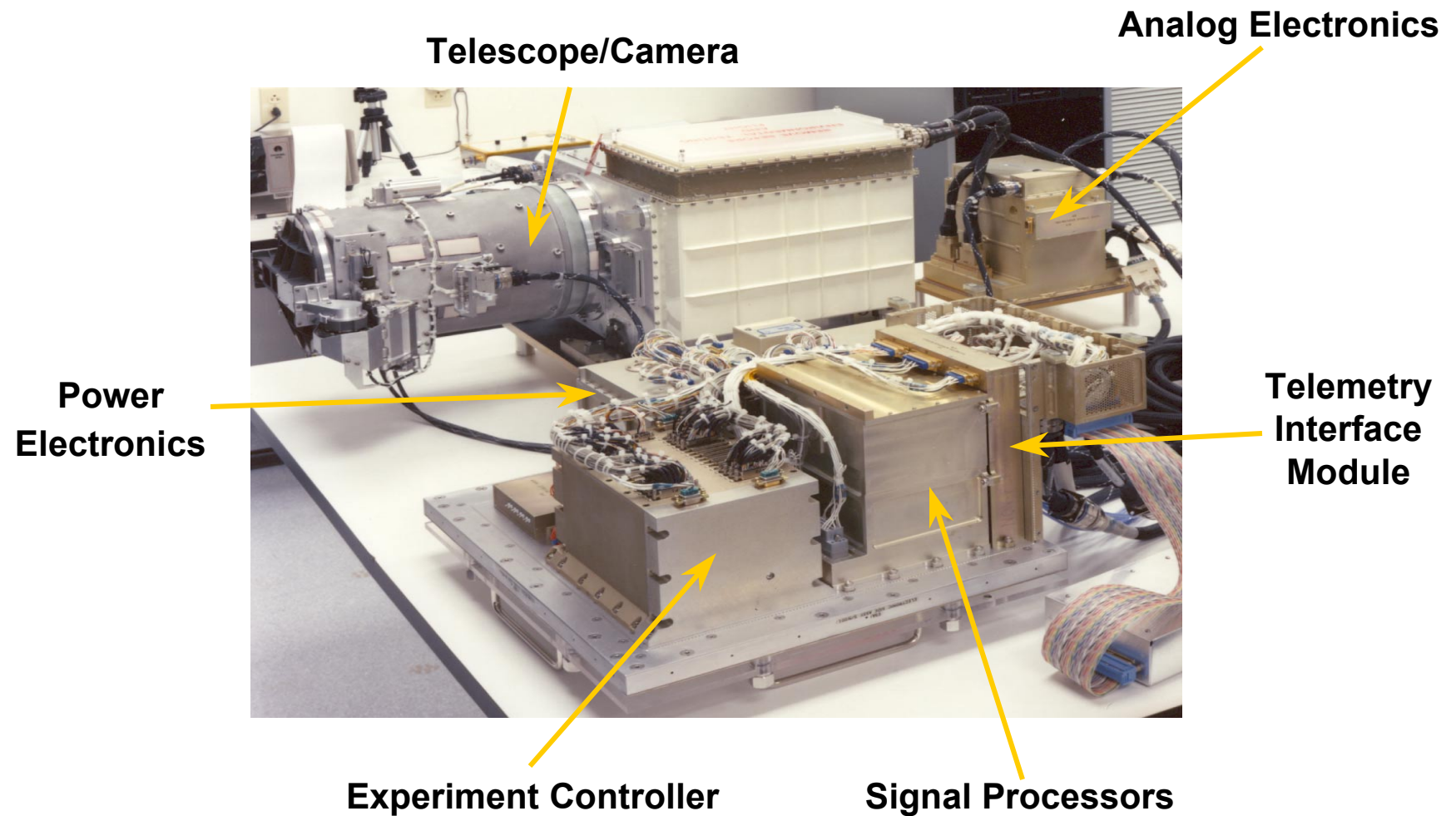


- **Dual Signal Processor Operations**
- Pinch Point Operations



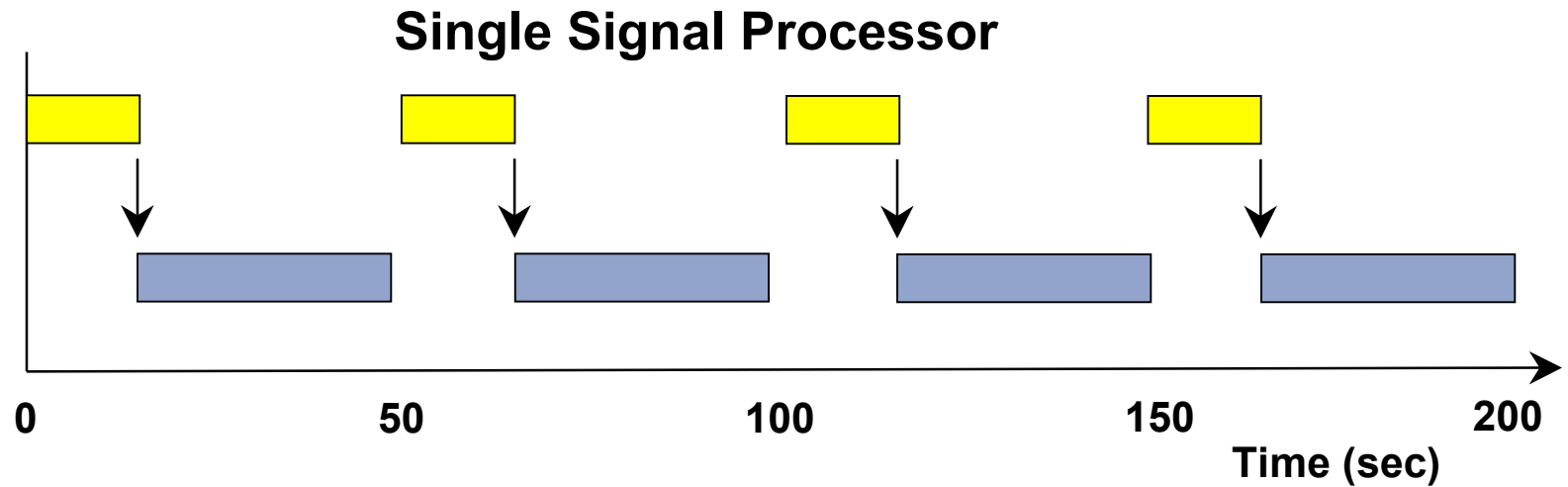
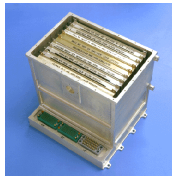


SBV Hardware





Data Collection Processing Timeline

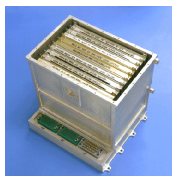
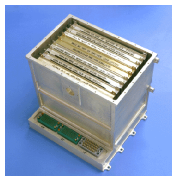
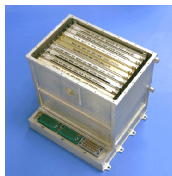


 Integration Time (16 sec)

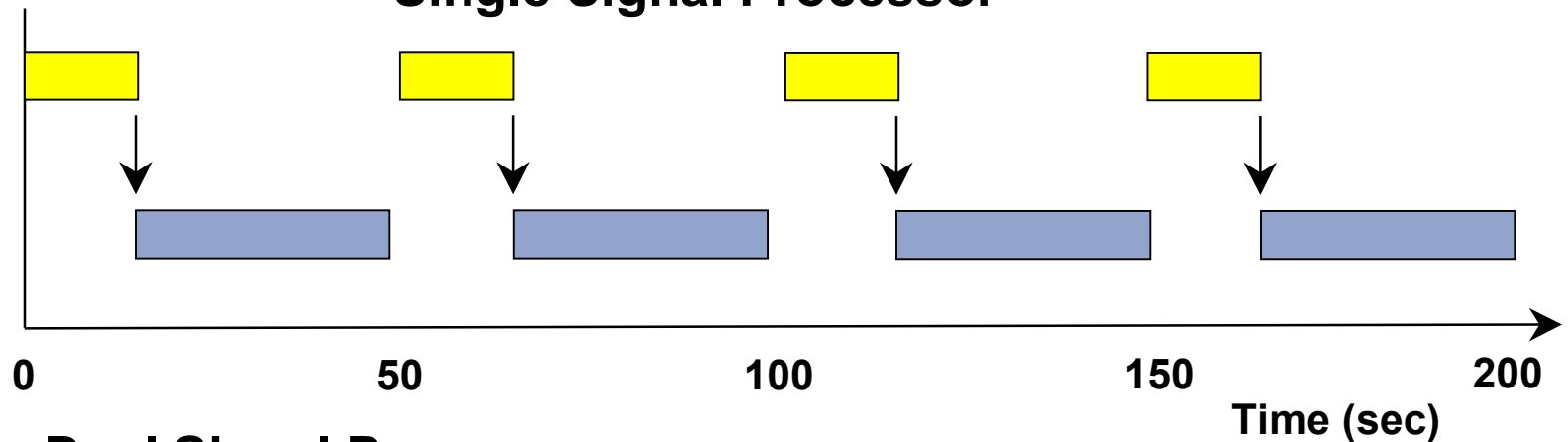
 Signal Processing Time (33 sec)



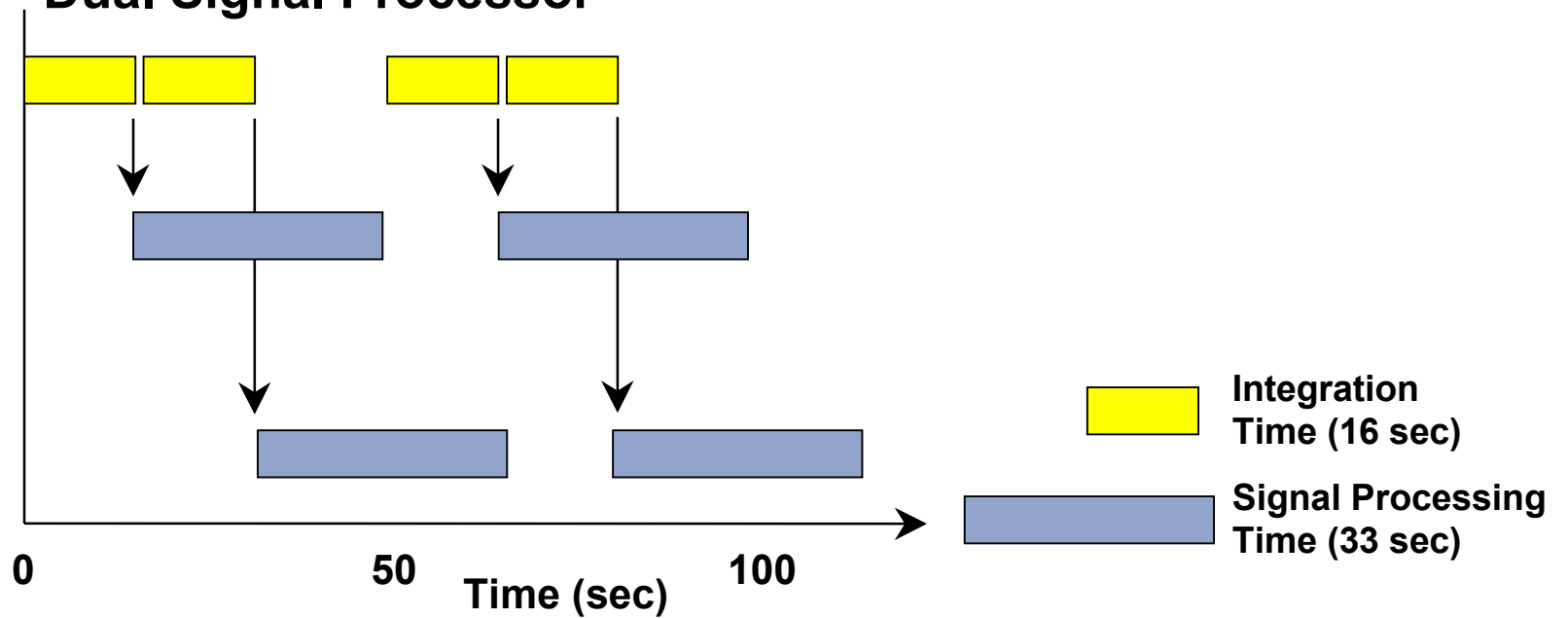
Data Collection Processing Timeline



Single Signal Processor

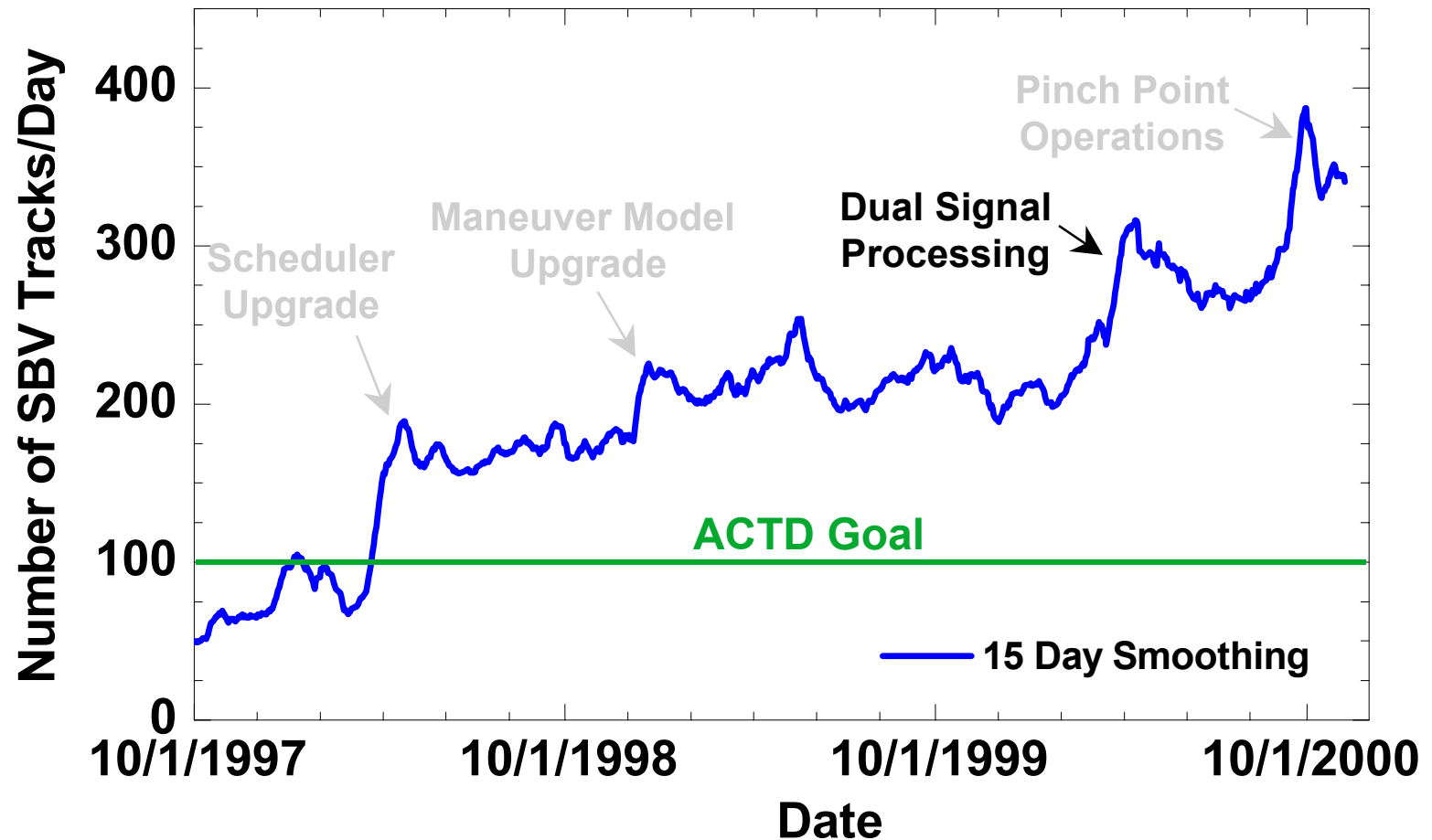


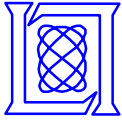
Dual Signal Processor





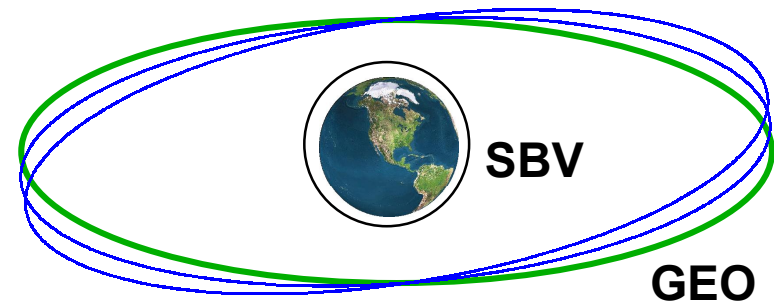
SBV Productivity





Outline

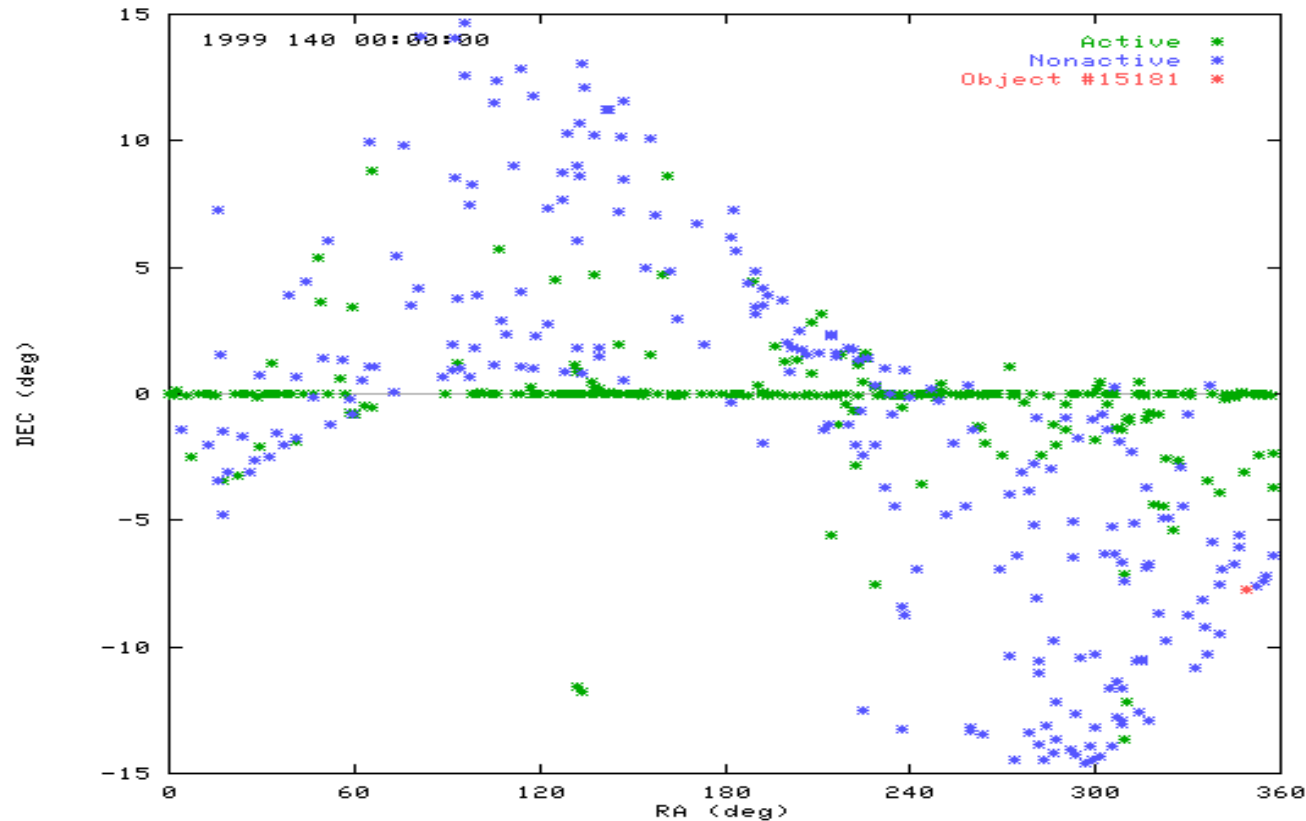
- Introduction
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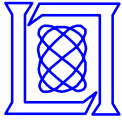




Geosynchronous Population

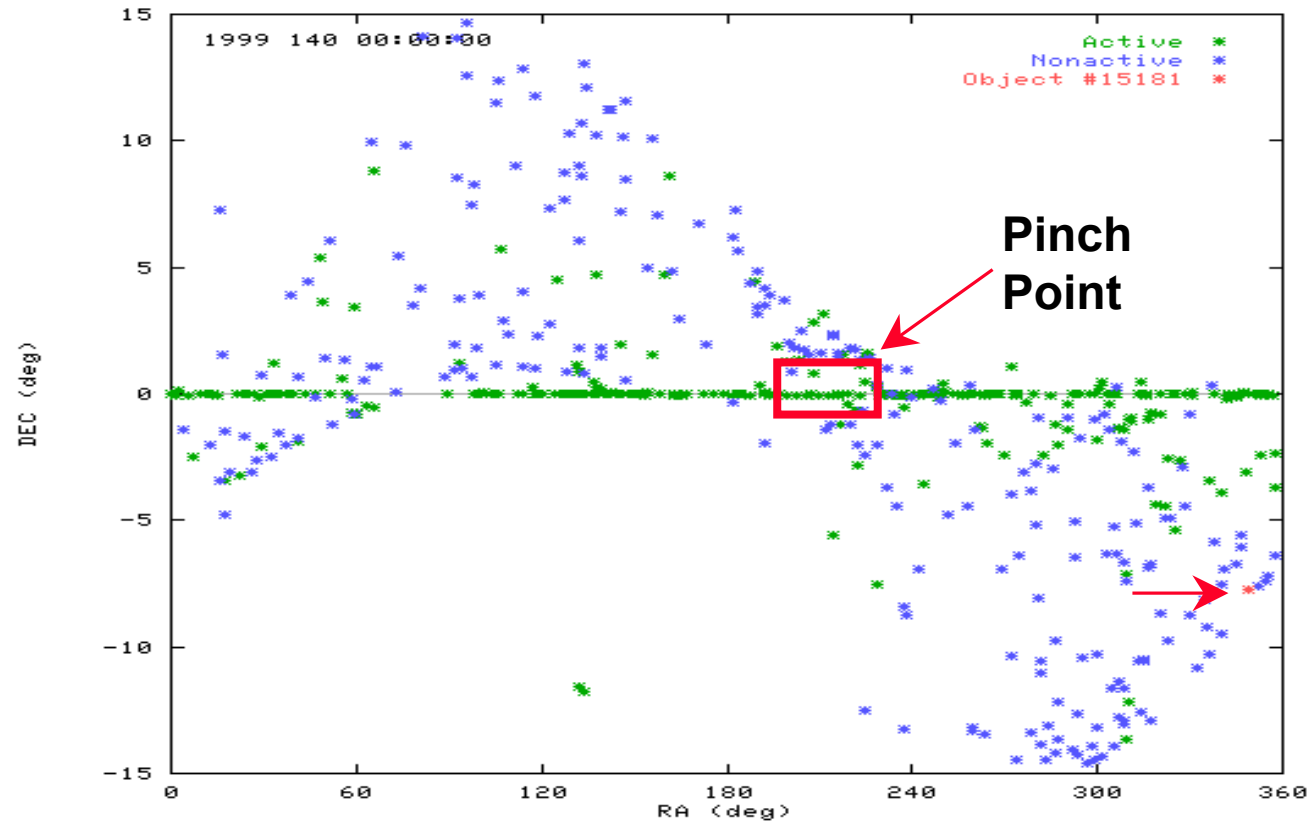
- Geosynchronous population pattern
 - Result of station-keeping technique and natural orbit perturbations
- Improve SBV productivity
 - Simultaneously observe low and high inclination GEO objects

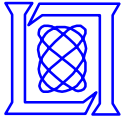




Geosynchronous Population

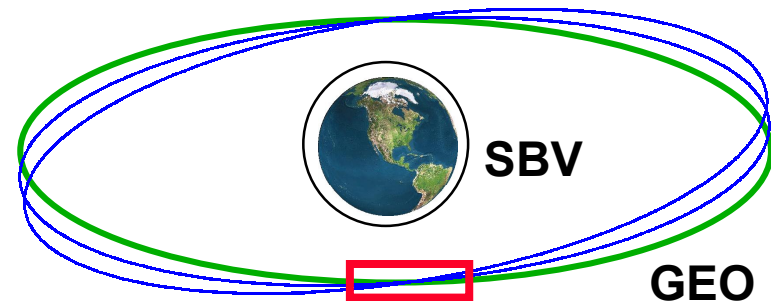
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Pinch Point Search Strategy

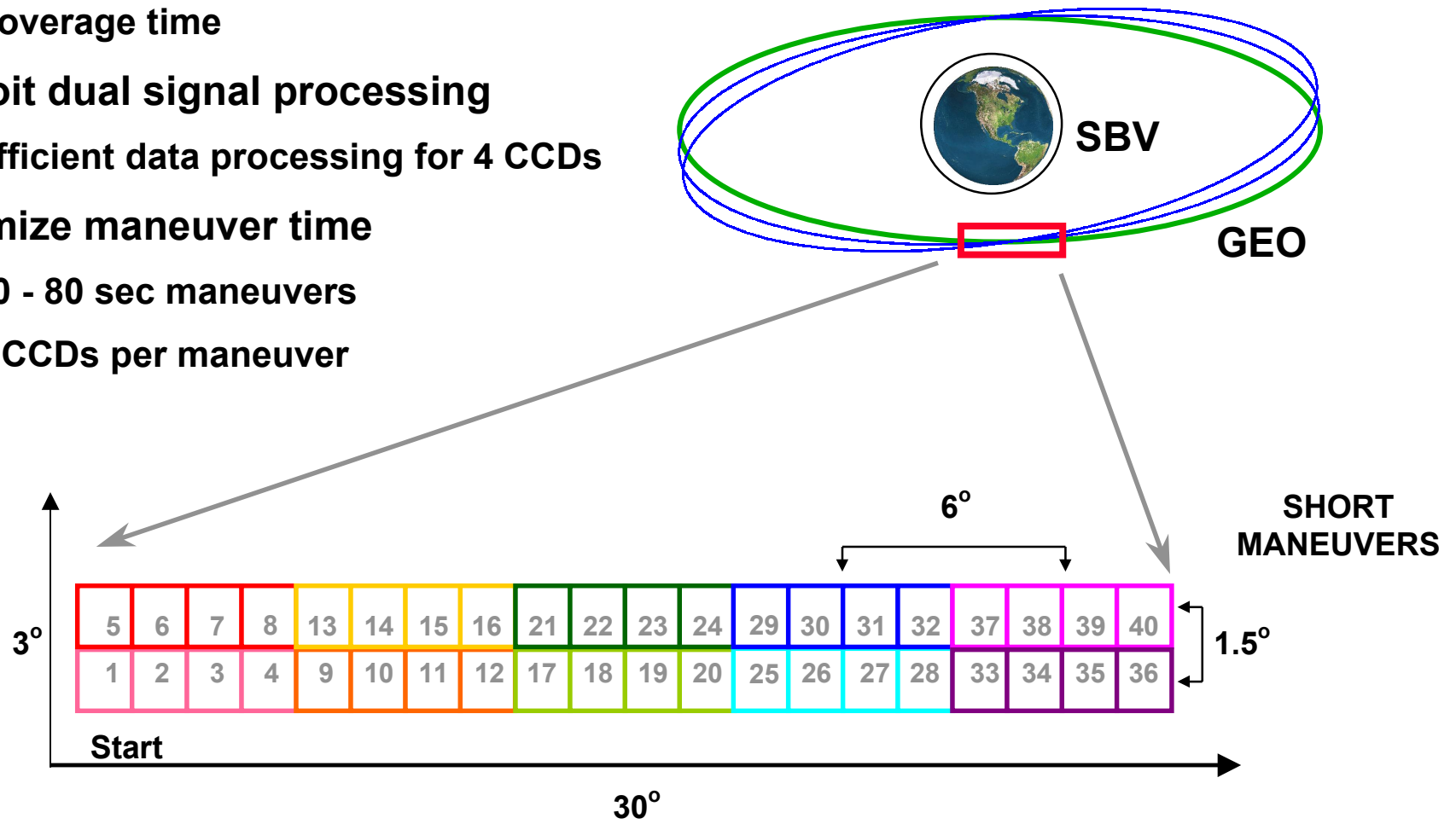
- **Maximize pinch point search region**
 - Visibility from SBV
 - Coverage time
- **Exploit dual signal processing**
 - Efficient data processing for 4 CCDs
- **Minimize maneuver time**
 - 60 - 80 sec maneuvers
 - 4 CCDs per maneuver





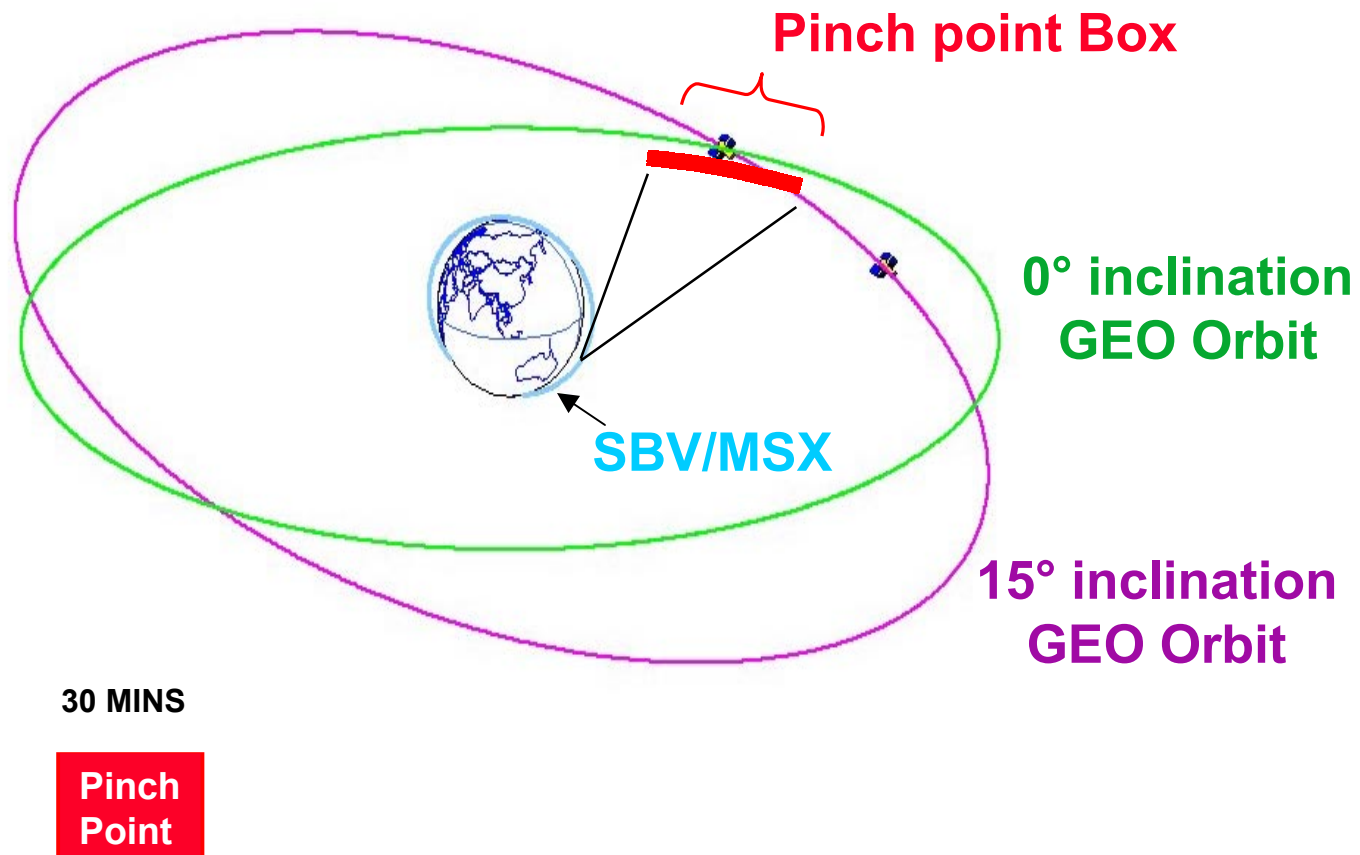
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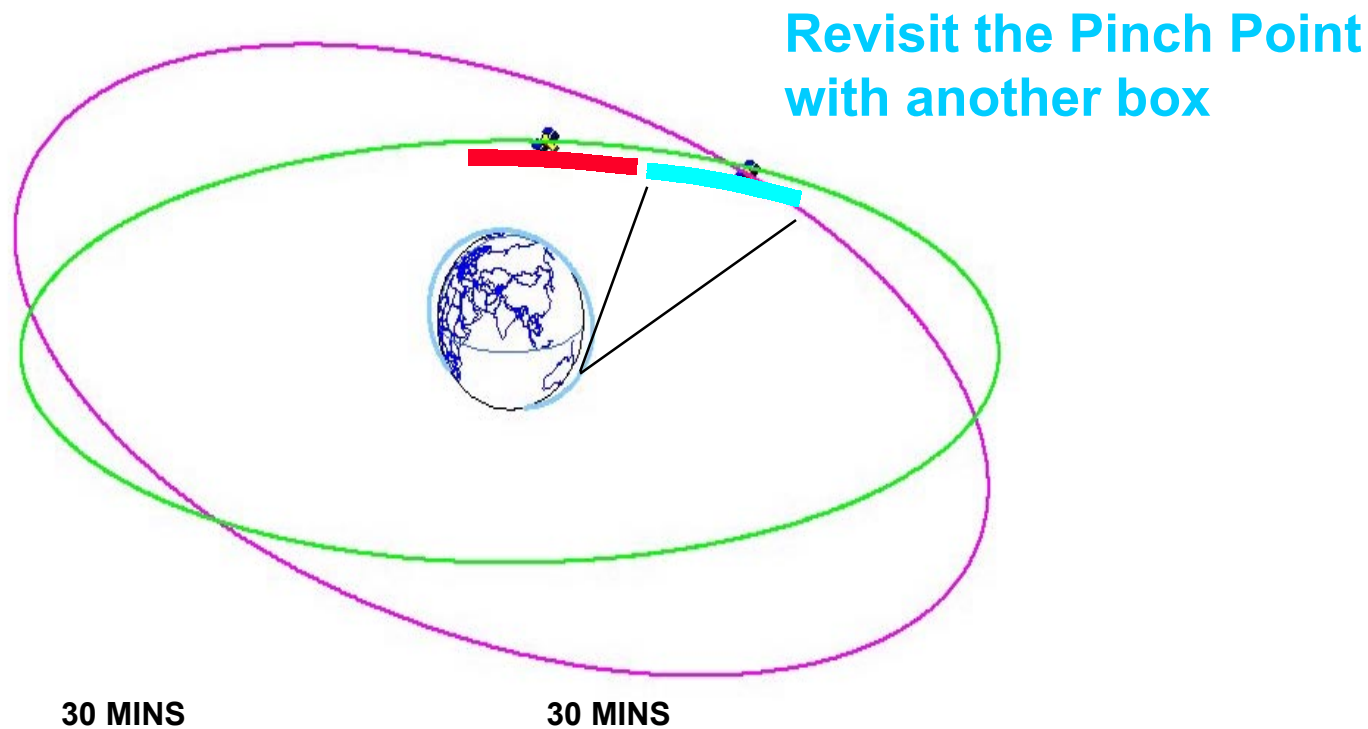
Pinch Point Operations





Pinch Point Operations

73 minutes later



30 MINS

30 MINS

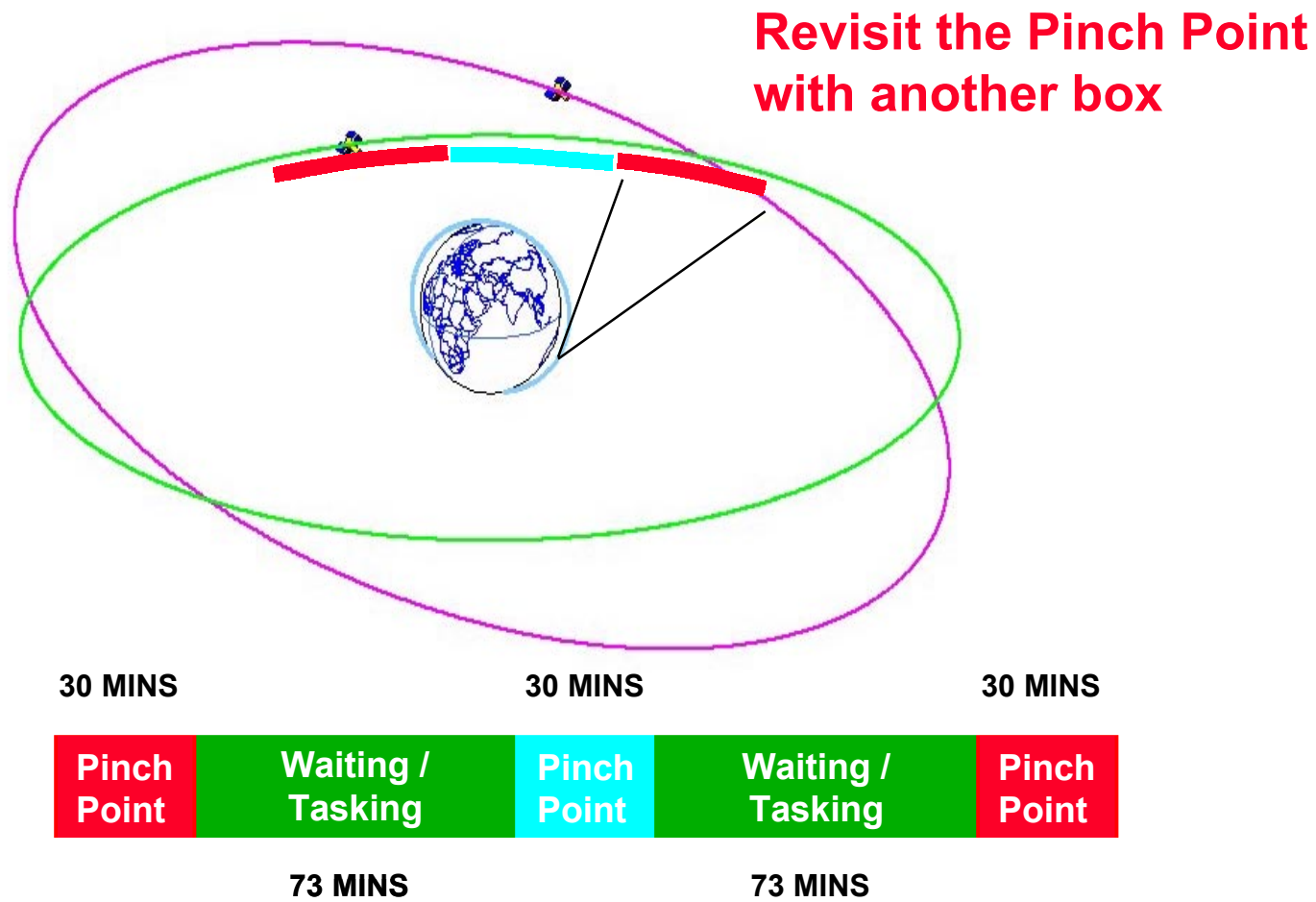


73 MINS



Pinch Point Operations

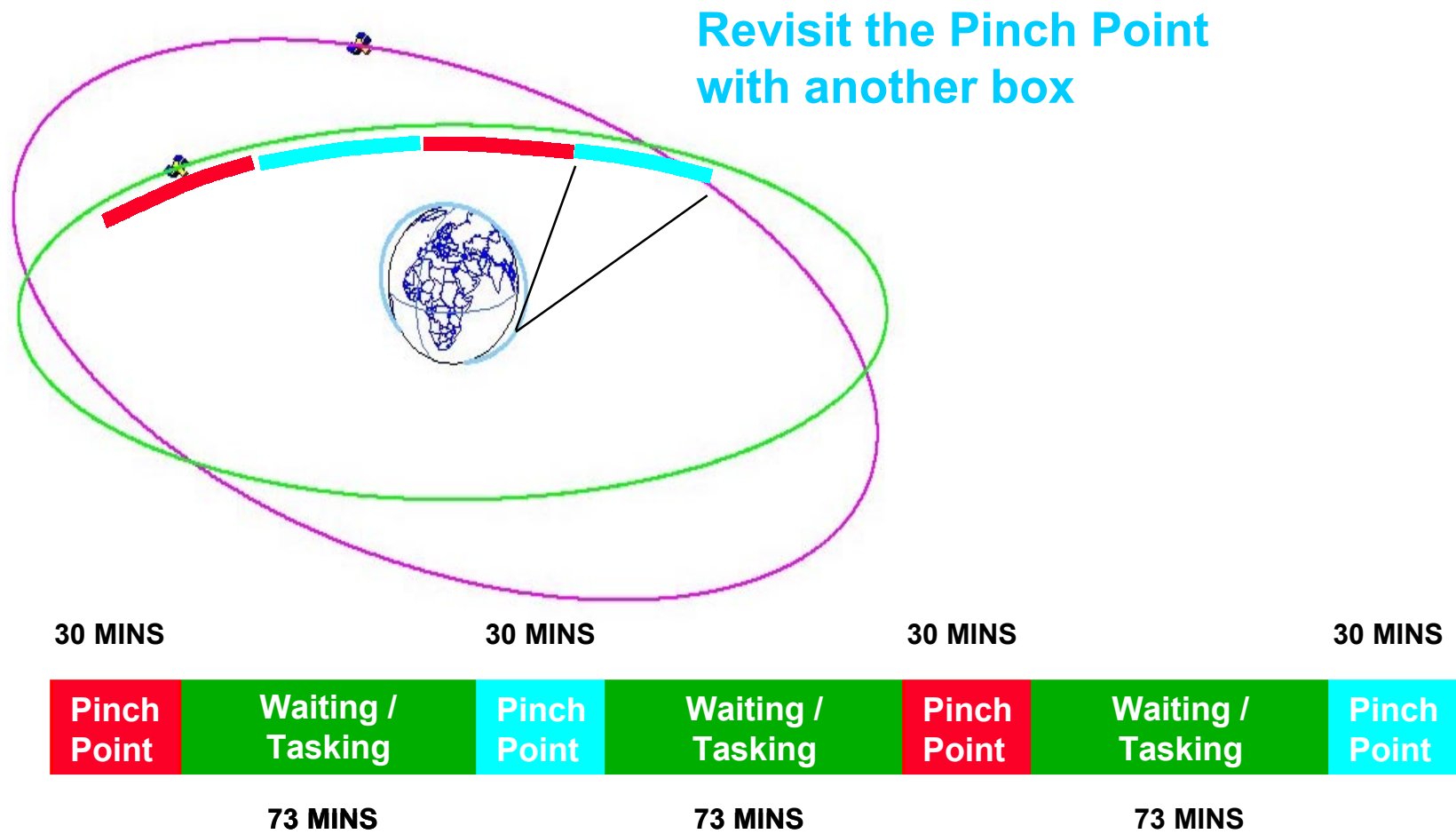
73 minutes later

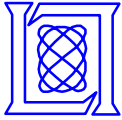




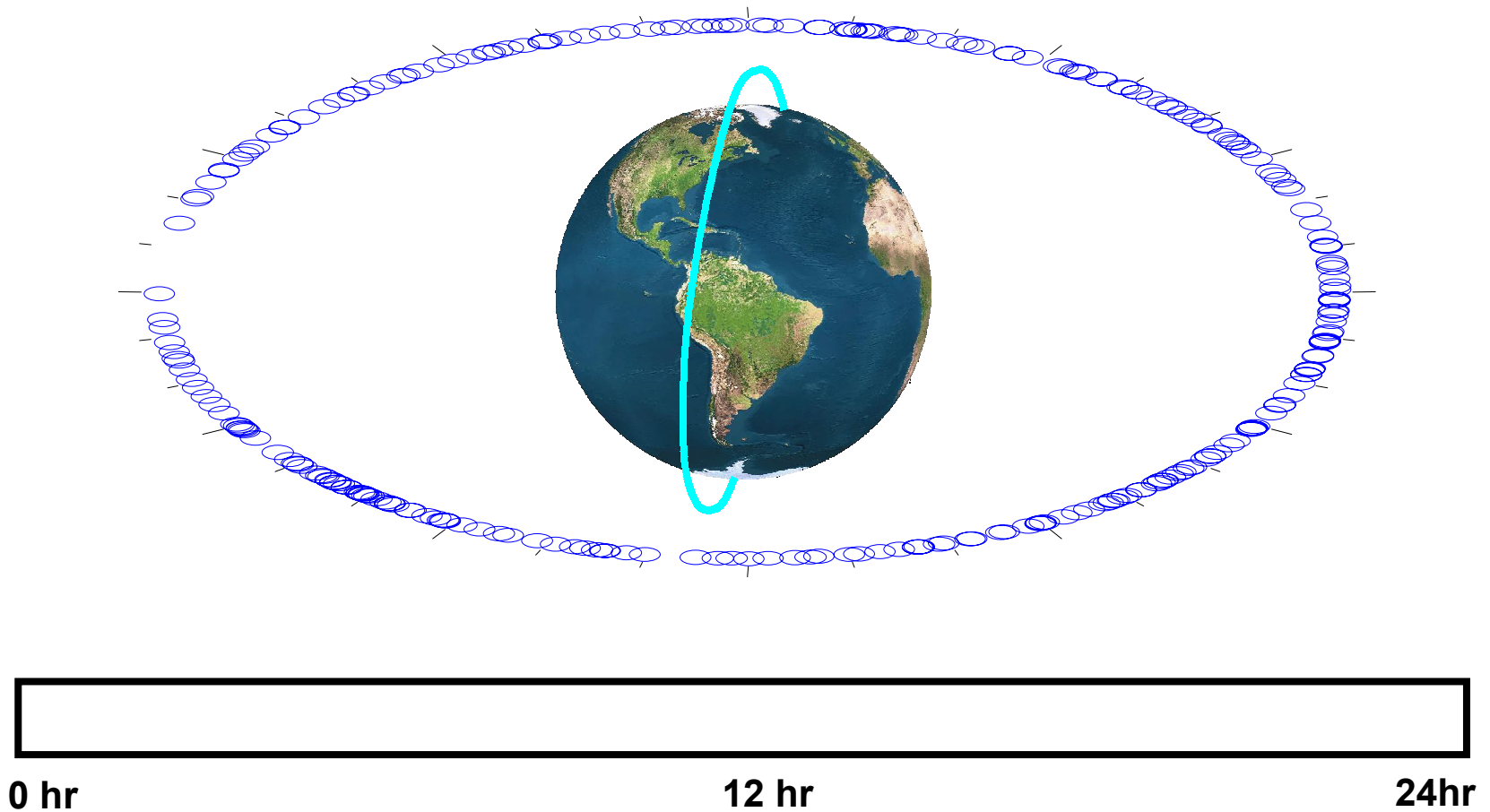
Pinch Point Operations

73 minutes later



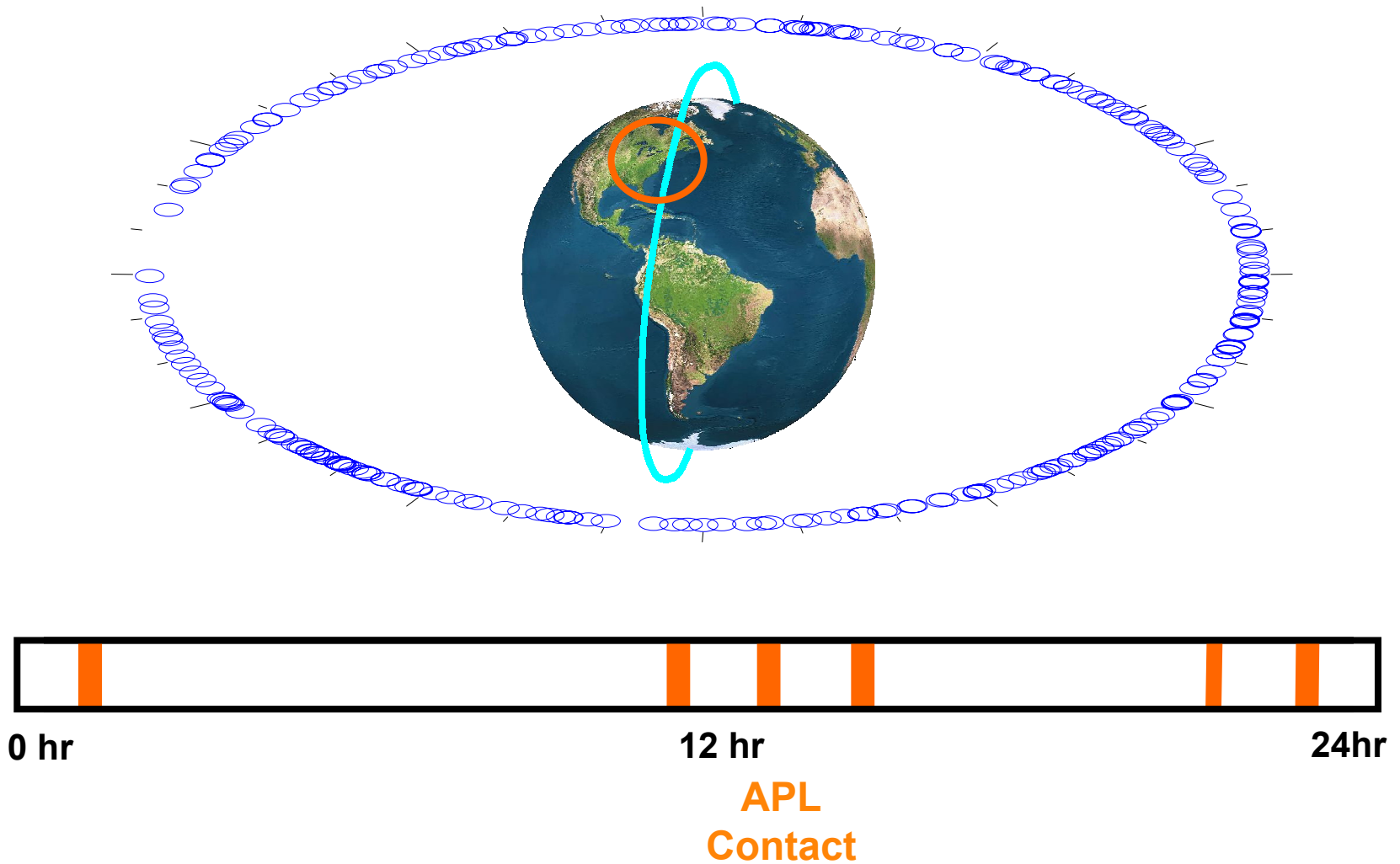


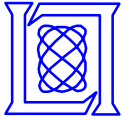
Pinch Point Scheduling



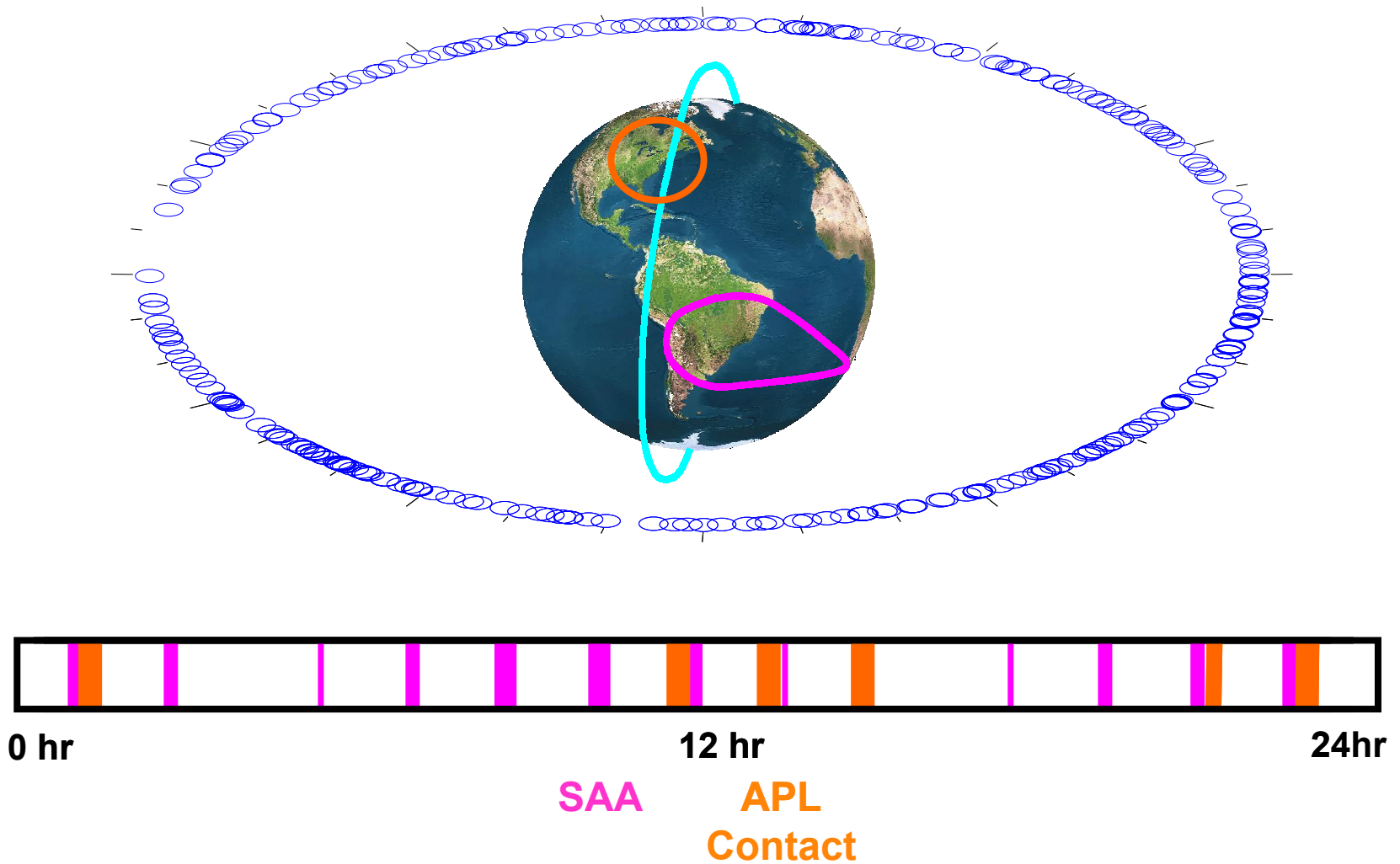


Pinch Point Scheduling



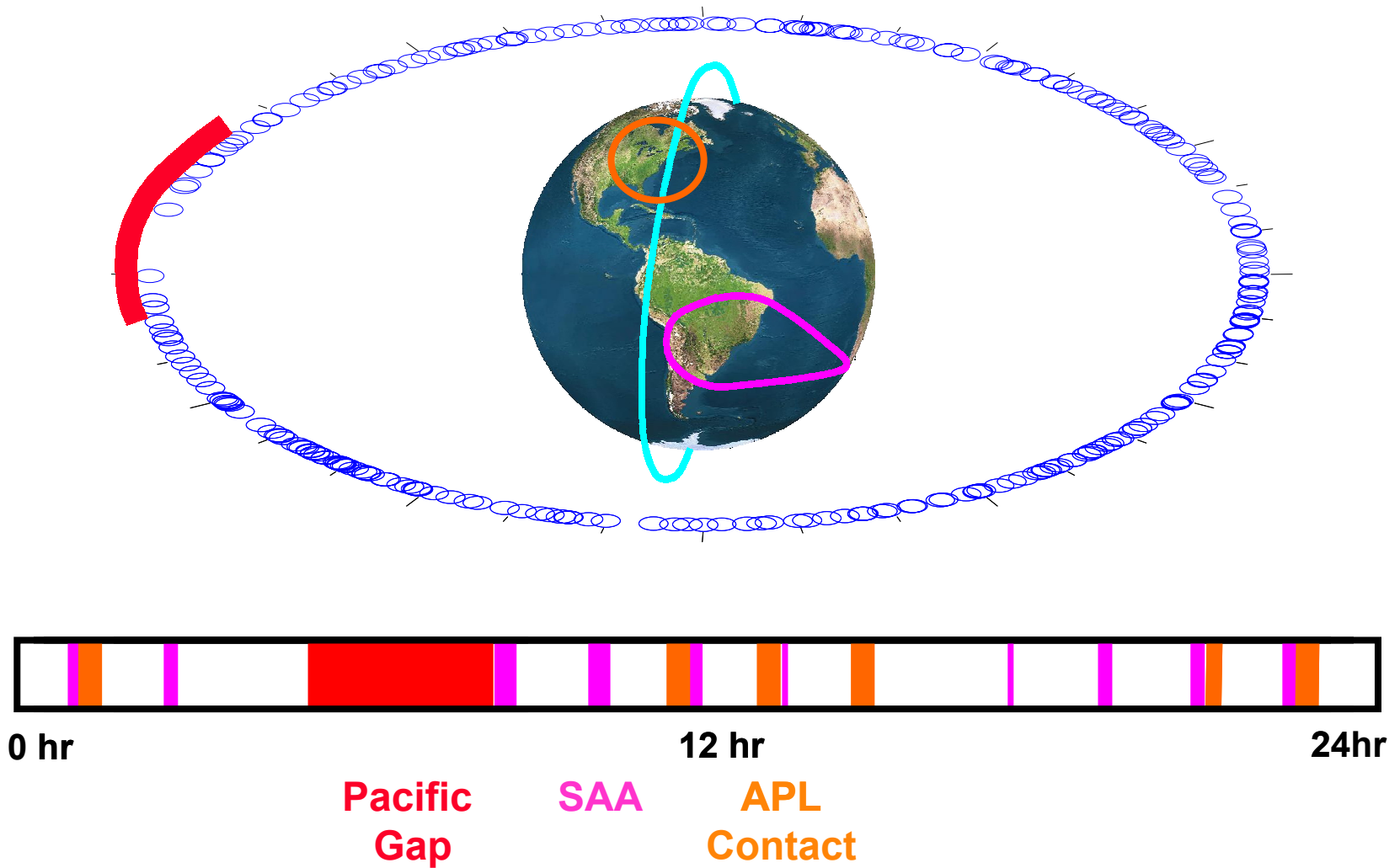


Pinch Point Scheduling



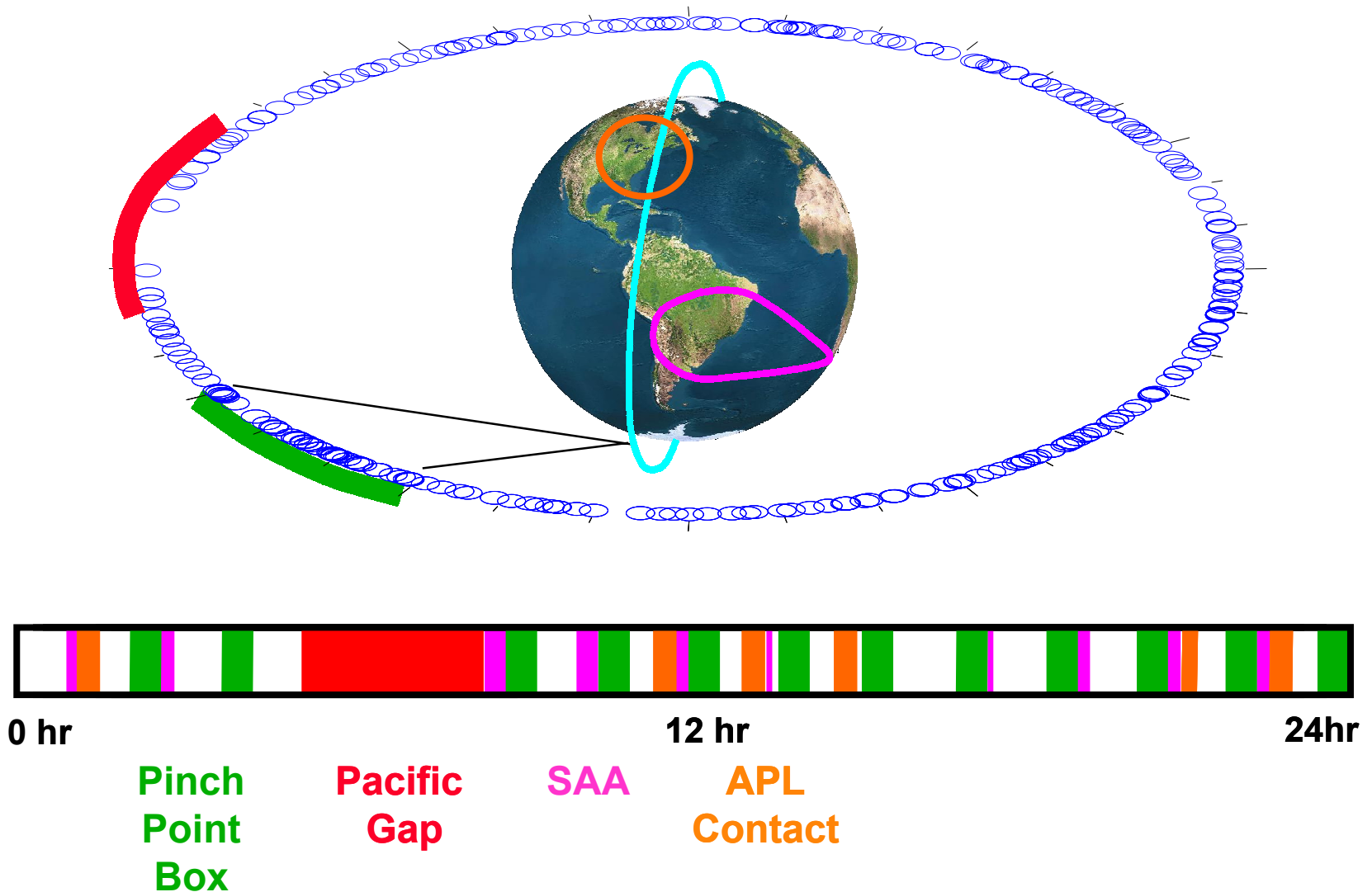


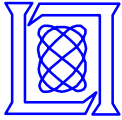
Pinch Point Scheduling





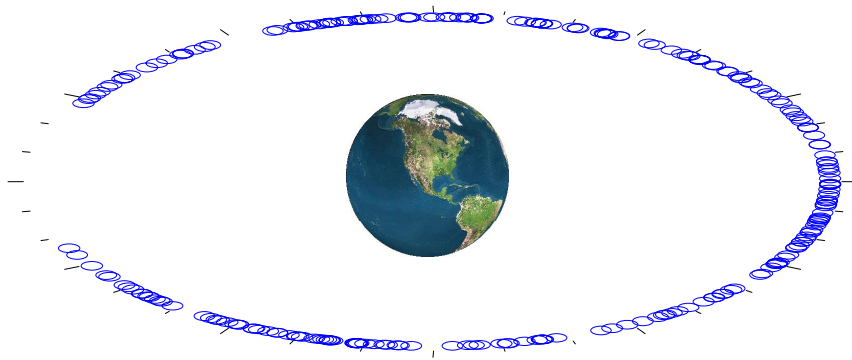
Pinch Point Scheduling





24 hr Pinch Point Detections

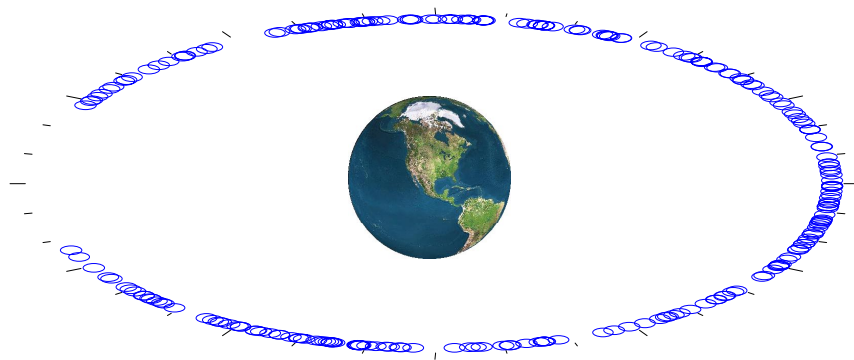
GEO Detections



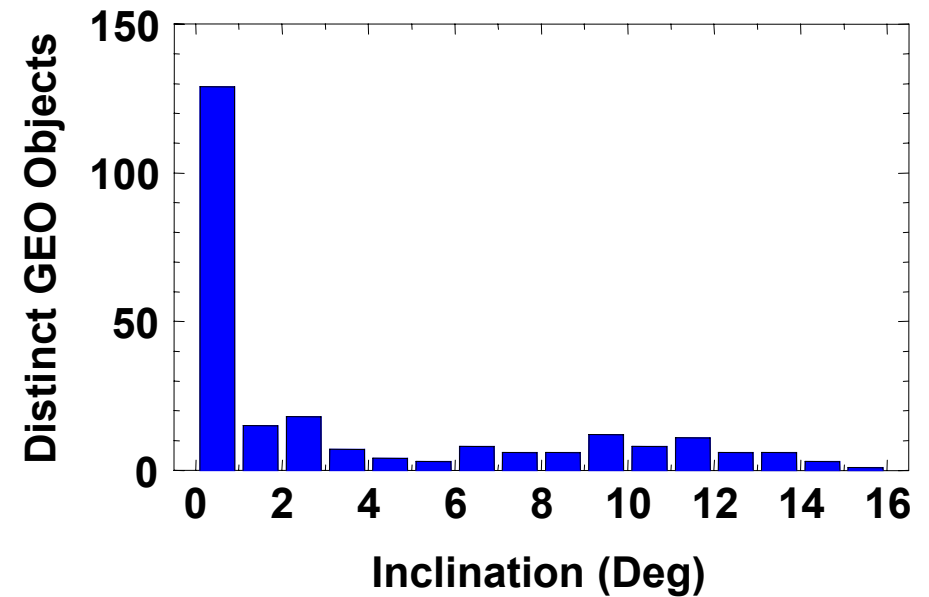


24 hr Pinch Point Detections

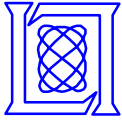
GEO Detections



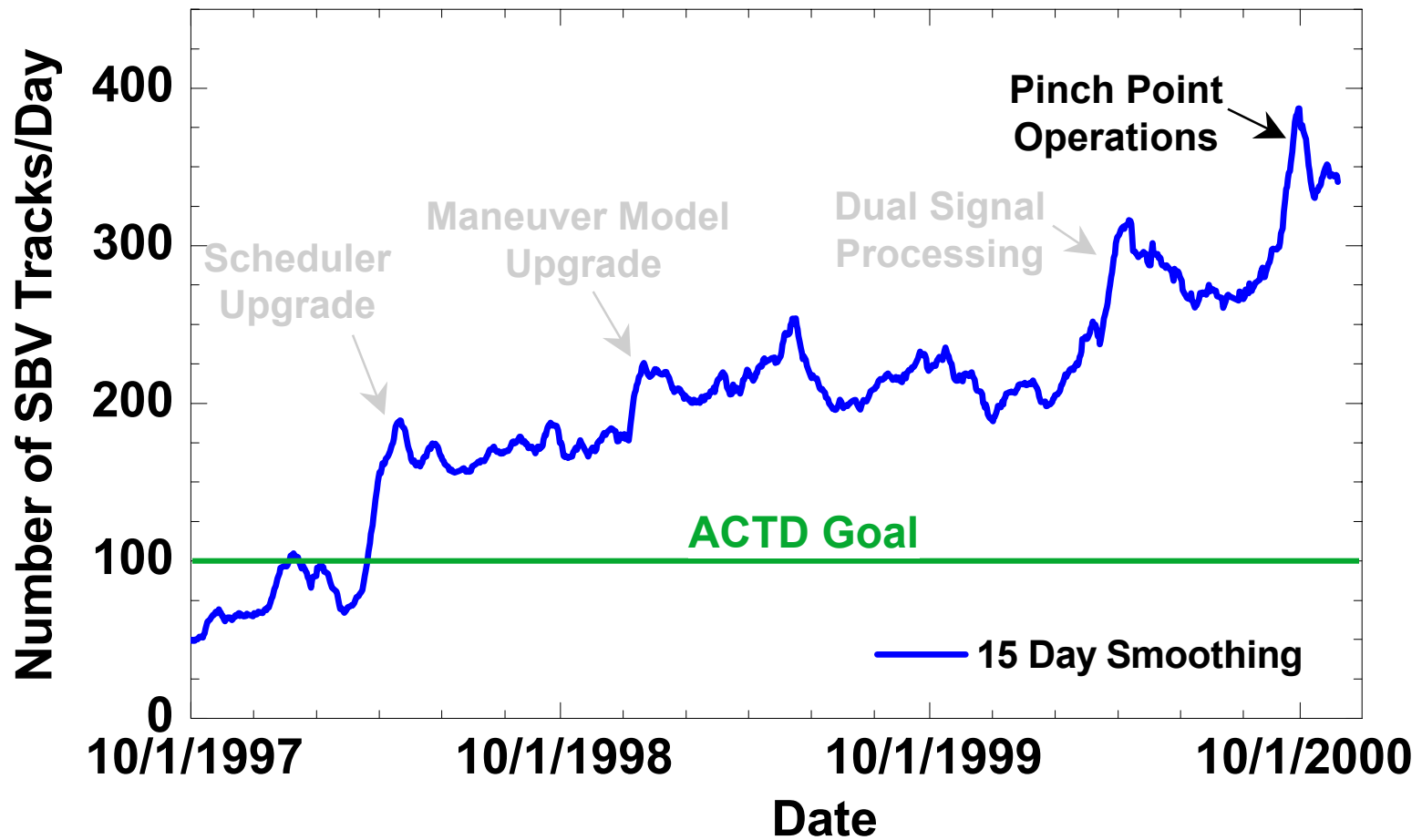
GEO Inclination

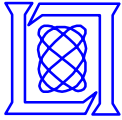


Pinch Point Operations provide global coverage and simultaneous detection of low and high inclination objects



SBV Productivity





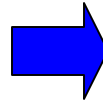
Evolution of SBV Sensor Operations

ACTD Operations

Exploit unique properties of SBV

Global coverage

Wide field of view



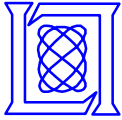
Contributing Sensor Operations

**Exploit unique properties of SBV and
GEO belt objects**

Global coverage

Wide field of view

Pinch point geometry



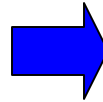
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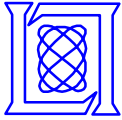
Tasked operations (~6 hours/day)

Efficiently track objects for Space Command

GEO belt search (~2 hours/day)

Scan regions of the GEO belt

Emphasis on 0 - 90 deg E Lon



Evolution of SBV Sensor Operations

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Exploit unique properties of SBV

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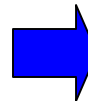
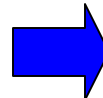
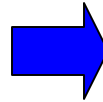
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Emphasis on 0 - 90 deg E Lon



Contributing Sensor Operations

Exploit unique properties of SBV and GEO belt objects

Global coverage

Wide field of view

Pinch point geometry

Tasked Operations (~2 hours/day)

Efficiently track high priority objects for Space Command

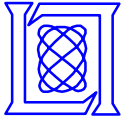
Pinch Point (~6 hours/day)

Scan pinch point once per orbit

Emphasis on entire GEO belt

Efficiently track objects for

Space Command



Summary

- **Successful ACTD program**
- **Transitioned to operational sensor**
- **Improvement of SBV capability through both ground and spacecraft system upgrades**
 - **Dual signal processor operations**
 - **Pinch point operations**