

GENESIS

SEARCH FOR ORIGINS

<http://genesismission.jpl.nasa.gov/>



National Aeronautics and
Space Administration
Jet Propulsion Laboratory
Pasadena, California

Genesis - Launch



Genesis

Search for Origins

NASA Sample Return Mission

NASA's first sample return mission since Apollo
First Sample Return from beyond the Moon

5th "Discovery Class" mission

1. Mars Pathfinder
2. Near Earth Asteriod Rendezvous
3. Lunar Prospector
4. Stardust
5. Genesis

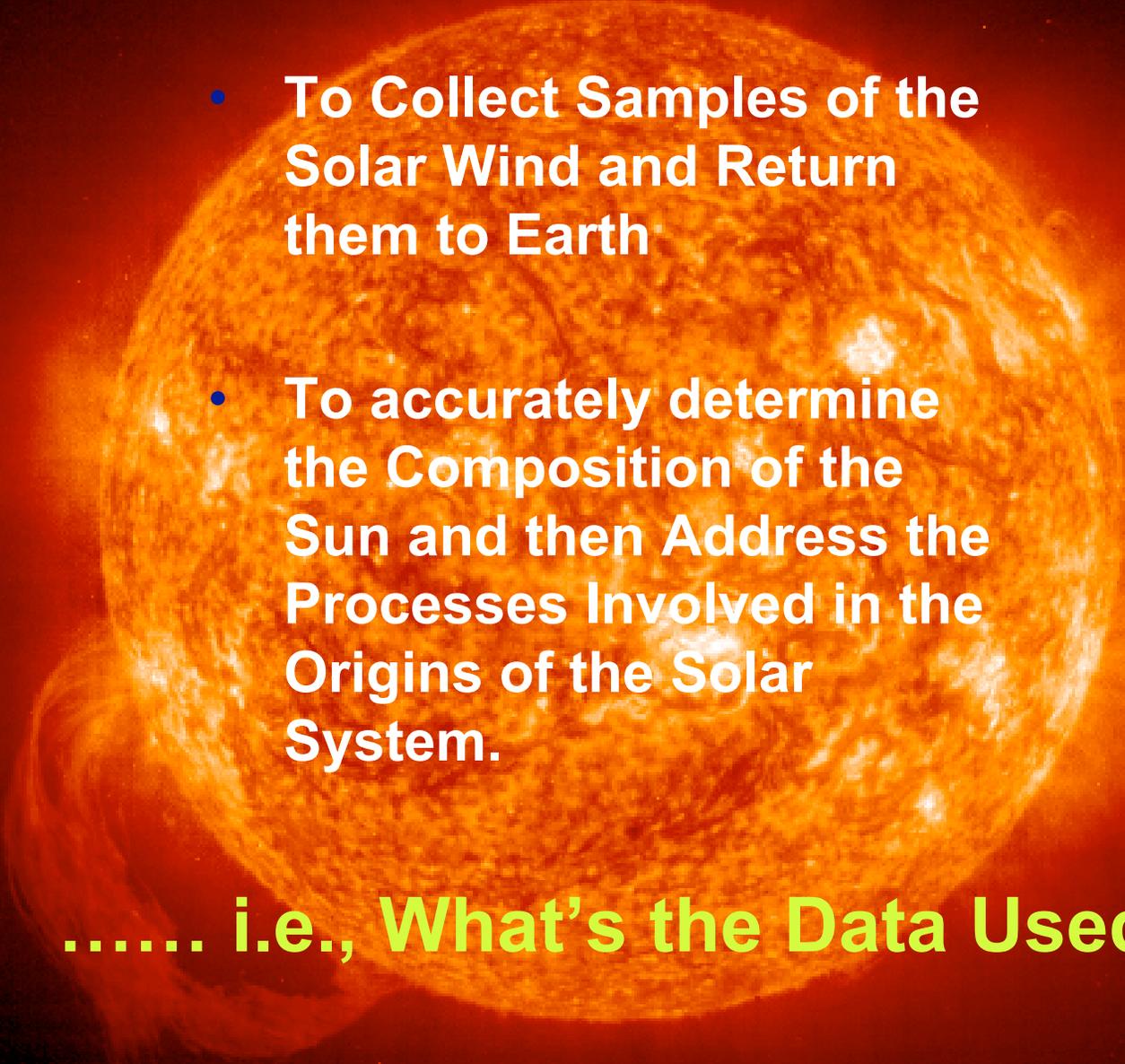
Characterized by Focused Science Objectives, Low Cost, Short Development Time

Conceived in early eighties; Selected in 1997 after a competition with 35 other mission proposals

A partnership of Academic, Industrial and NASA space:

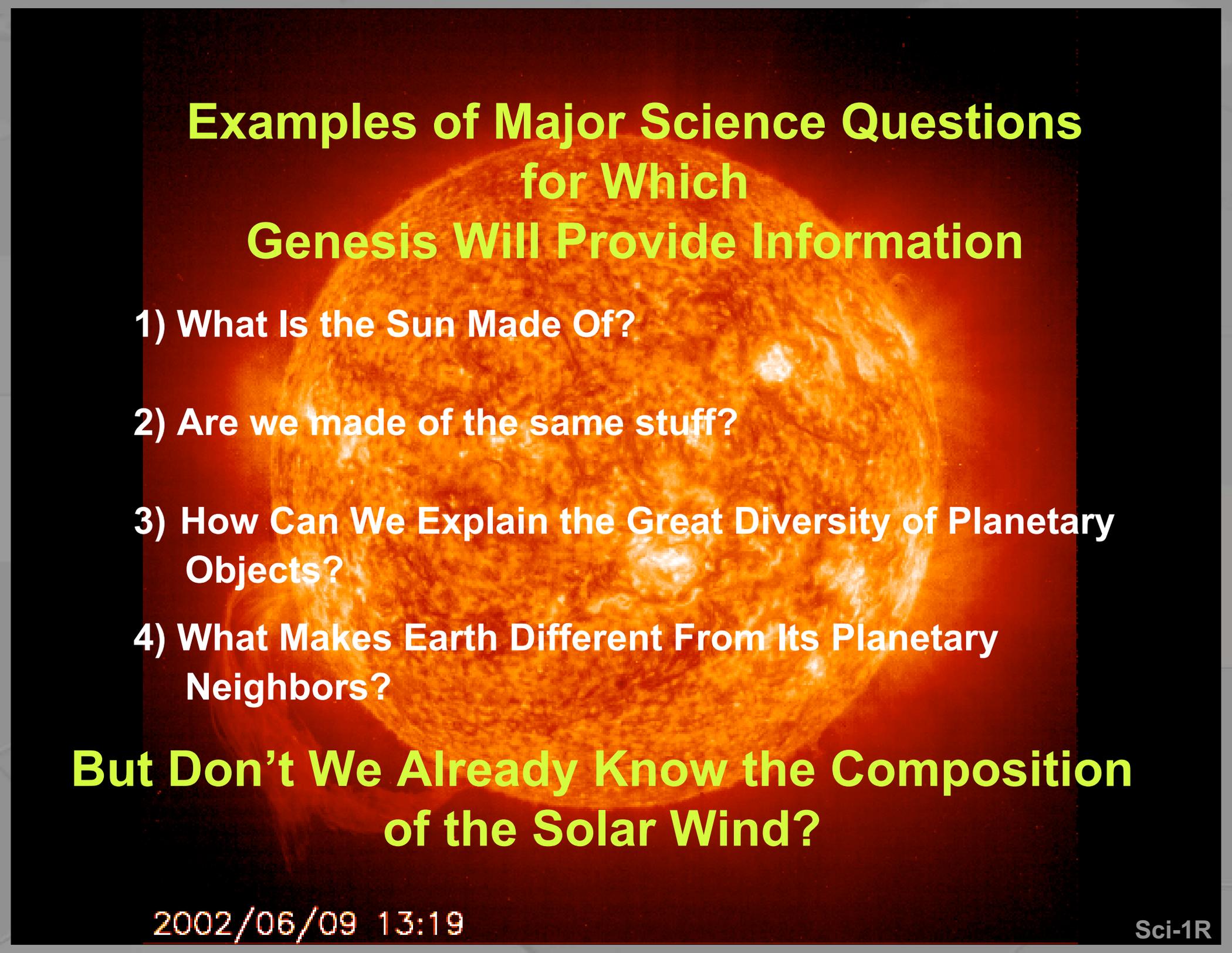
- Principal Investigator: Dr. Don Burnett / Caltech
- Project Management: Jet Propulsion Laboratory (JPL)
- Payload: Los Alamos National Laboratory (LANL) and JPL
- Spacecraft: Lockheed Martin Space Systems, Denver, CO
- Mission Ops: JPL, LMA, LANL
- Sample Curation: Johnson Center Space (JSC)
- Outreach: JPL & McREL

Science Objectives



- To Collect Samples of the Solar Wind and Return them to Earth
- To accurately determine the Composition of the Sun and then Address the Processes Involved in the Origins of the Solar System.

..... i.e., **What's the Data Used For?**



Examples of Major Science Questions for Which Genesis Will Provide Information

- 1) What Is the Sun Made Of?**
- 2) Are we made of the same stuff?**
- 3) How Can We Explain the Great Diversity of Planetary Objects?**
- 4) What Makes Earth Different From Its Planetary Neighbors?**

**But Don't We Already Know the Composition
of the Solar Wind?**

Essentially Little Is Known About SOLAR ISOTOPIC Composition

- 1) Apollo Foils Provided Precise Solar Wind He and Ne Isotope Ratio With $^{20}\text{Ne}/^{22}\text{Ne}$ Ratio a Surprising 38% Greater Than The Terrestrial Atmosphere
- 2) The Only Practical Source Of Solar Isotopic Abundances is the Solar Wind;
- 3) No Solar-Terrestrial Differences Can Be Seen for C, O, Mg Isotopes, but Uncertainty in the data is 5 - 40%

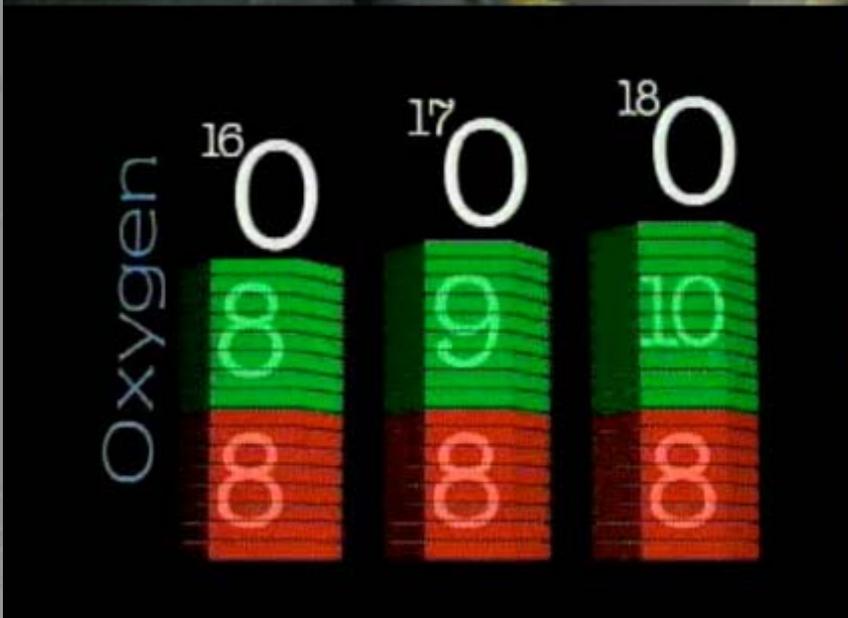
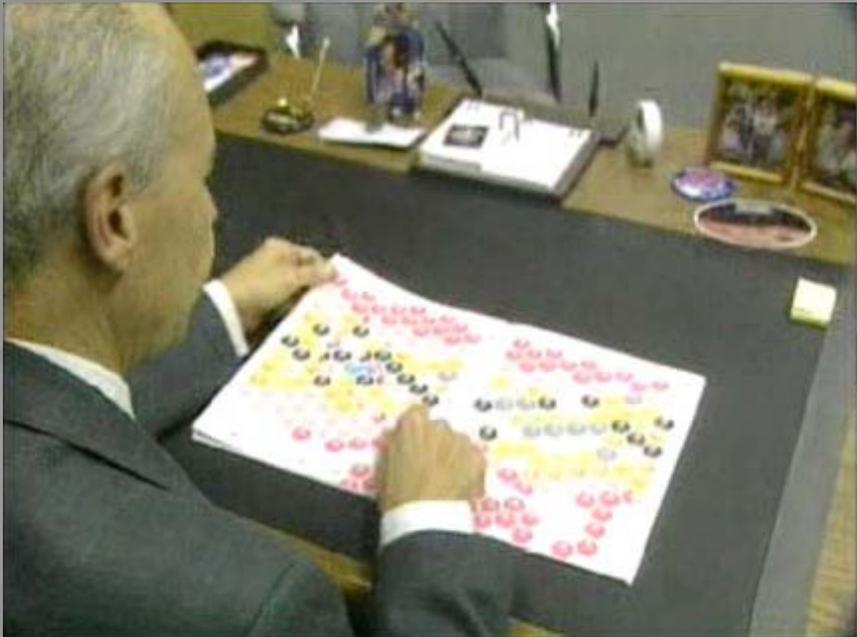
Best Source of Data:

There Is No Data For A Significant Number Of Elements Since They Cannot Be Measured At All

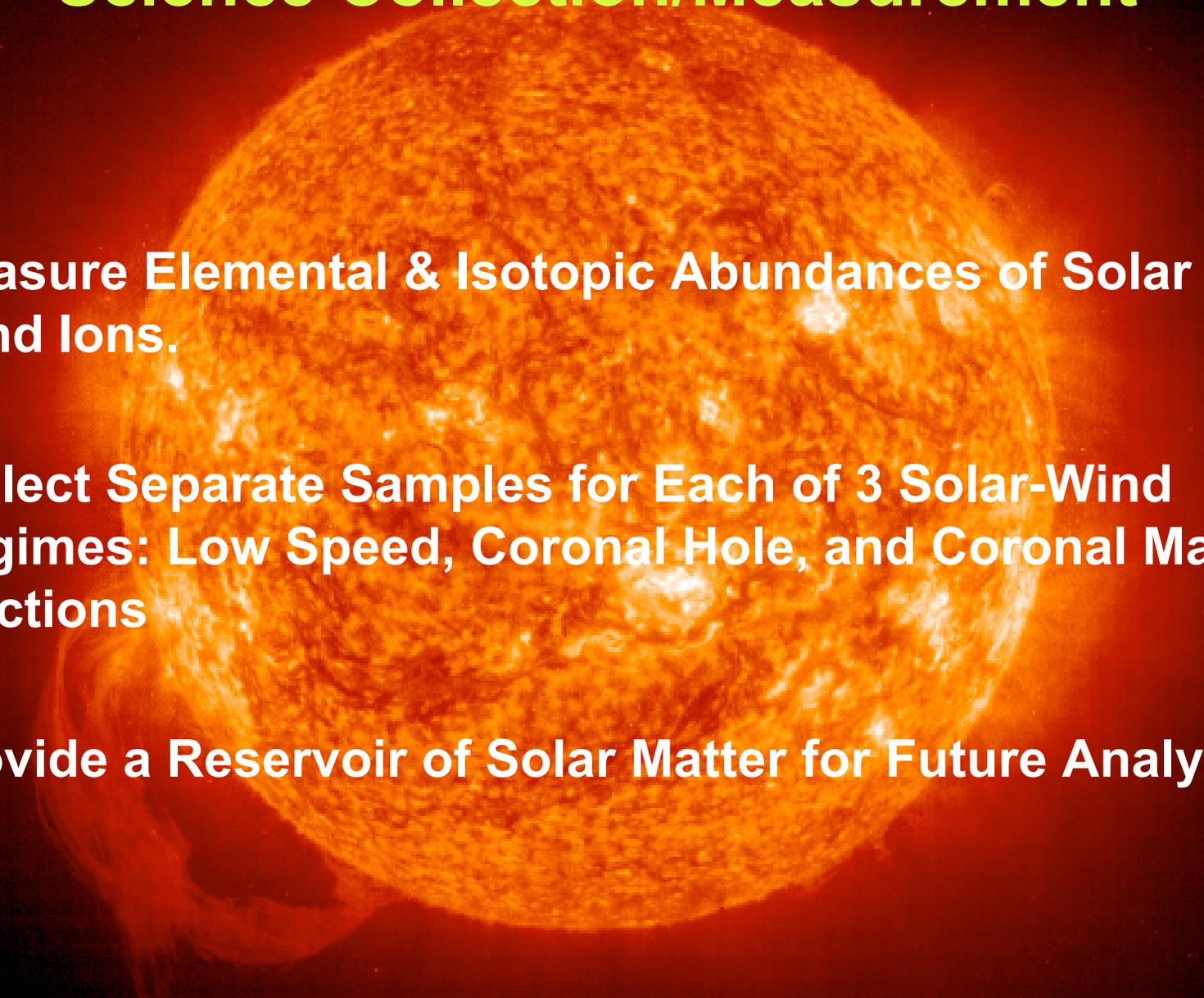
A Small Number of Elements Have Quoted Errors of $\pm 10\%$ But Overall, There Are Large Uncertainties

Meteorite Analysis Depend On Knowledge Of Its "Background Noise"

Genesis – Ion Recipe

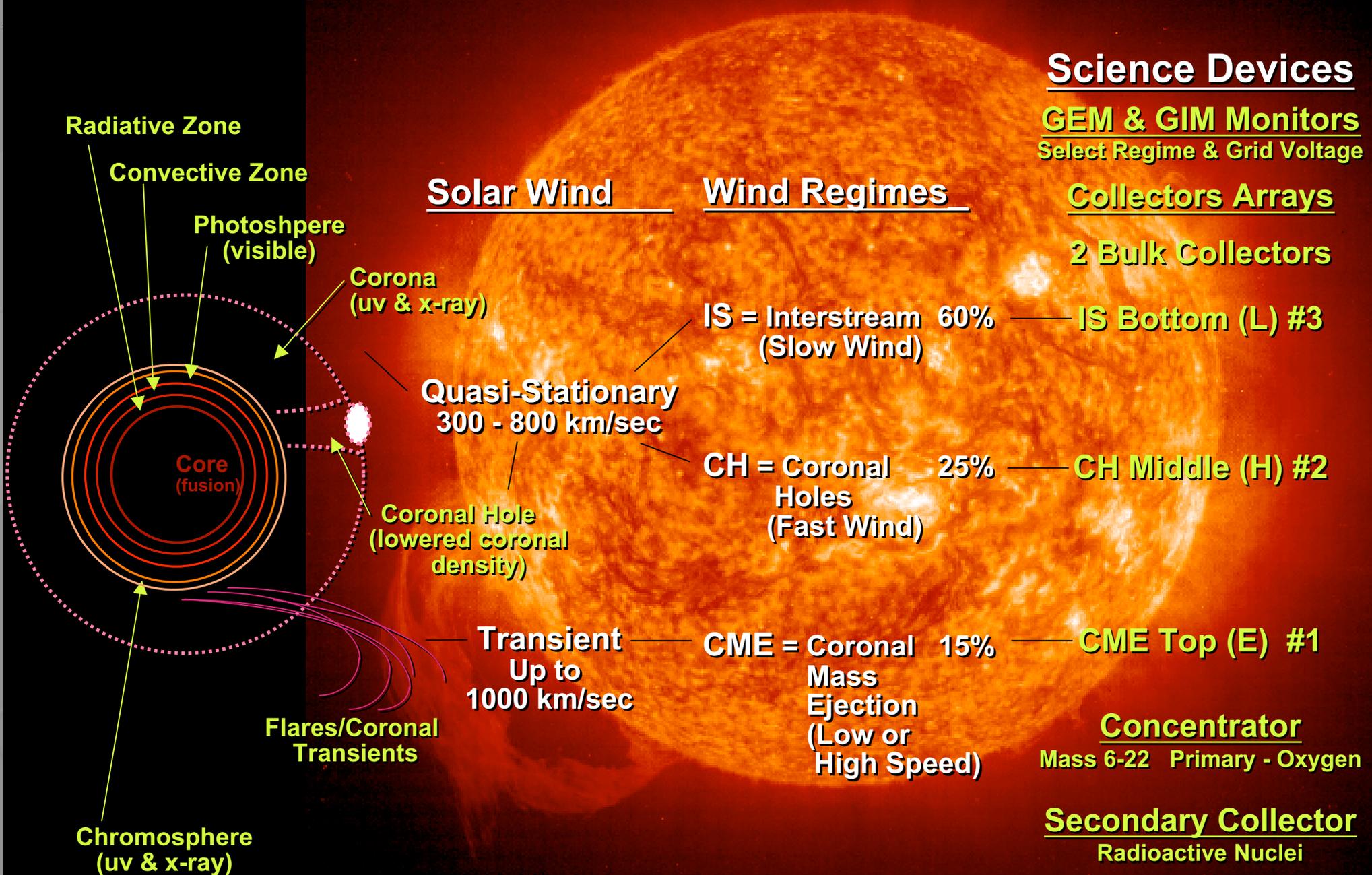


Science Collection/Measurement



- **Measure Elemental & Isotopic Abundances of Solar Wind Ions.**
- **Collect Separate Samples for Each of 3 Solar-Wind Regimes: Low Speed, Coronal Hole, and Coronal Mass Ejections**
- **Provide a Reservoir of Solar Matter for Future Analysis**

Collecting Solar Wind



Science Devices

GEM & GIM Monitors
Select Regime & Grid Voltage

Collectors Arrays

2 Bulk Collectors

IS Bottom (L) #3

CH Middle (H) #2

CME Top (E) #1

Concentrator

Mass 6-22 Primary - Oxygen

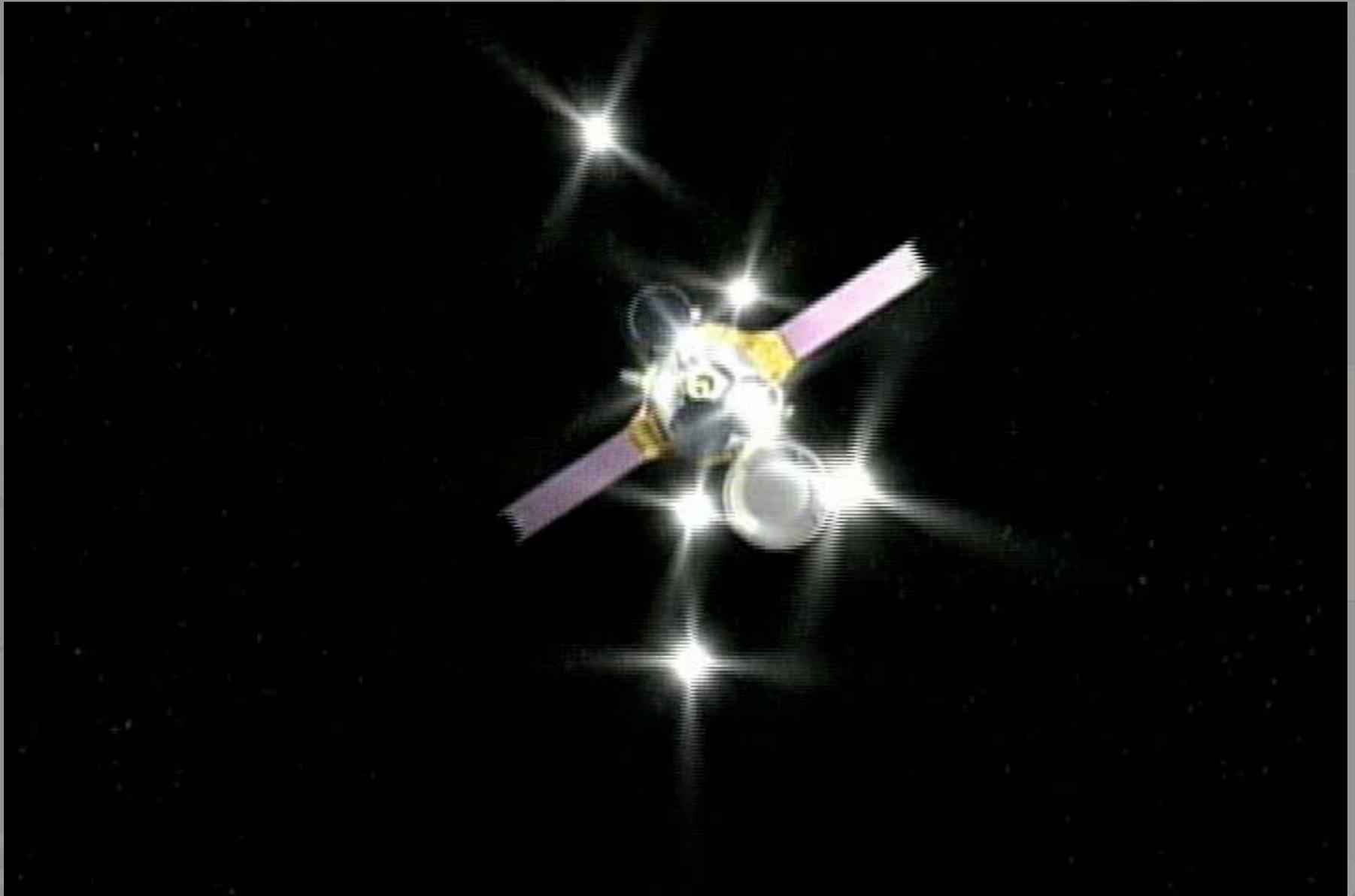
Secondary Collector

Radioactive Nuclei

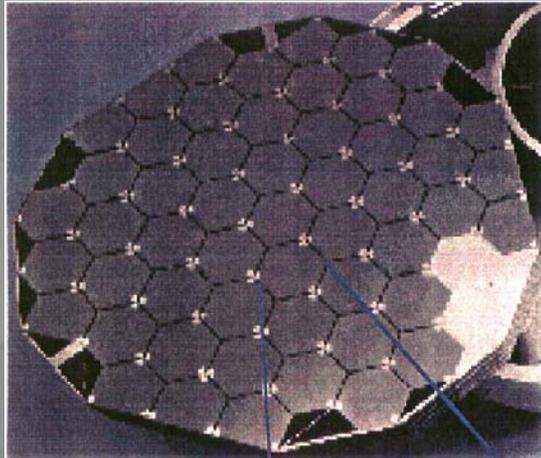
Solar Wind

Wind Regimes

Genesis – Flying Ions



Collector Array Design

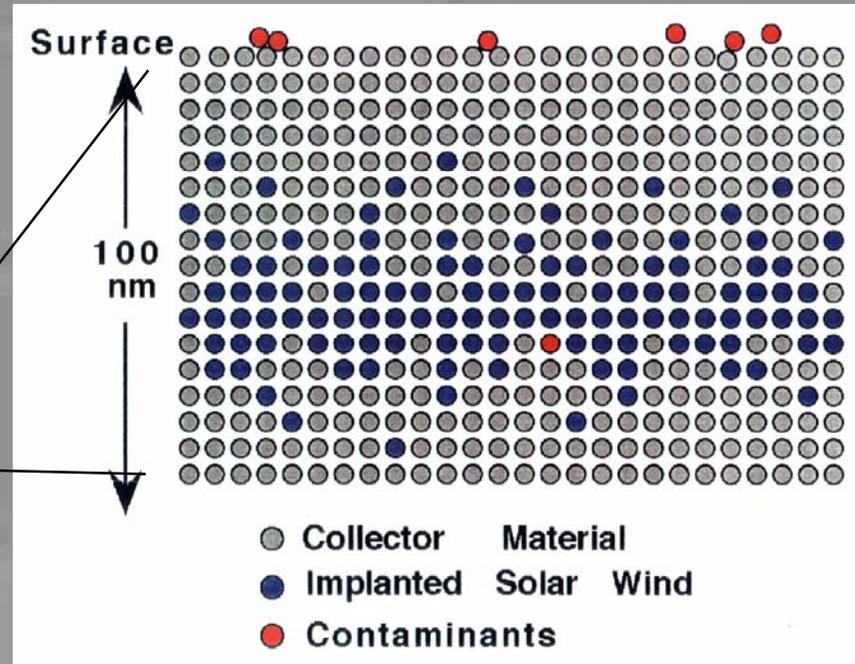


Array

- 55 Standard
- 6 Partial

Wafer

Schematic View of Top 100 nm



Requirements on Collectors:

- Bulk Solar-Wind Collector Area, $> 0.6 \text{ m}^2$
- Each of 3 Special-Regime Collector Areas, $> 0.3 \text{ m}^2$
- Material From Each Array Shall Be Uniquely Identifiable In Case Material is Dislodged.
- Radioactive Nuclei Collectors Exposed in Lid of SRC.

Collecting Solar Wind Ions

	Green = SNR > 100
	Blue = SNR > 10
	Blank = SNR < 10 expected

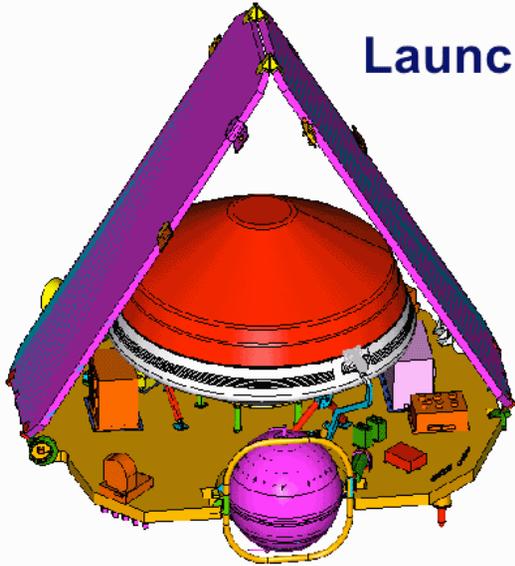
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg 7											Al	Si 5,6	P 2	S 1	Cl	Ar 3,4
K	Ca 7	Sc	Ti 7	V	Cr 7	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr 3,4
Rb	Sr	Y	Zr	Nb	Mo		Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe 3,4
Cs	Ba 7	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi			
		Ce	Pr	Nd		Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu		
		Th		U													

Completed Flight H-Array in Clean Room

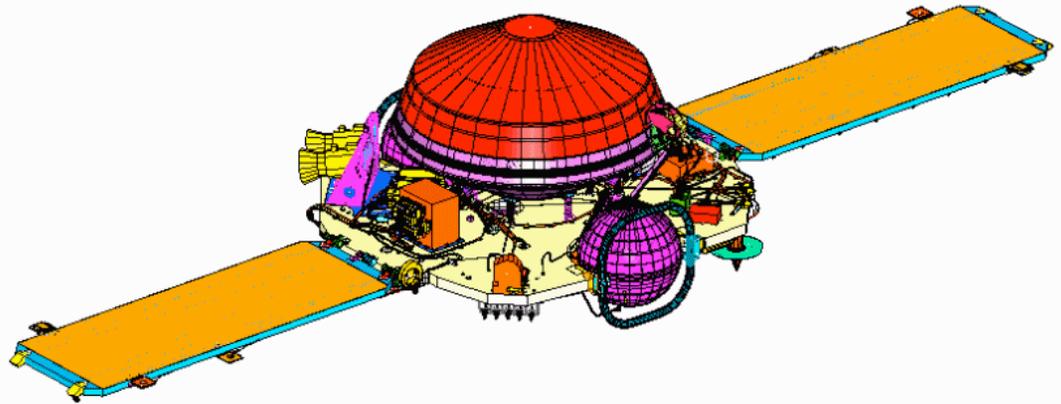


Spacecraft Configurations

Launch



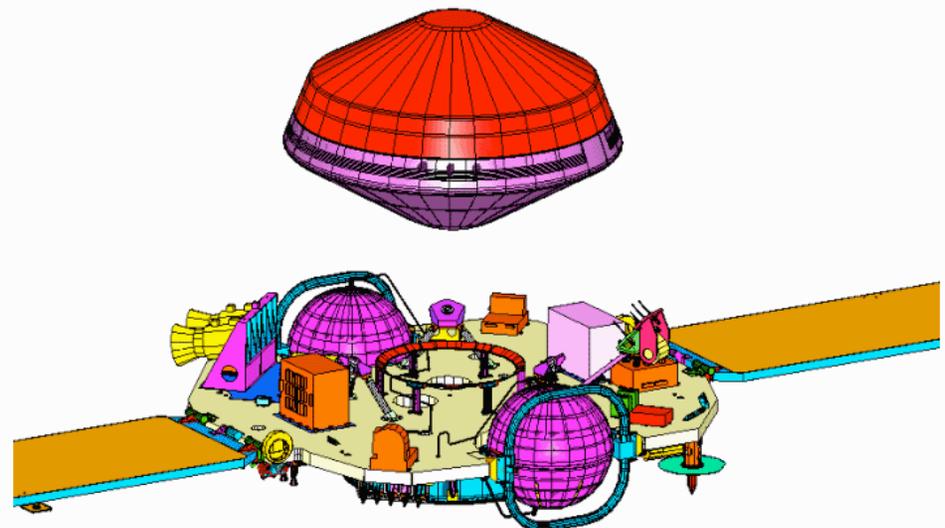
Cruise



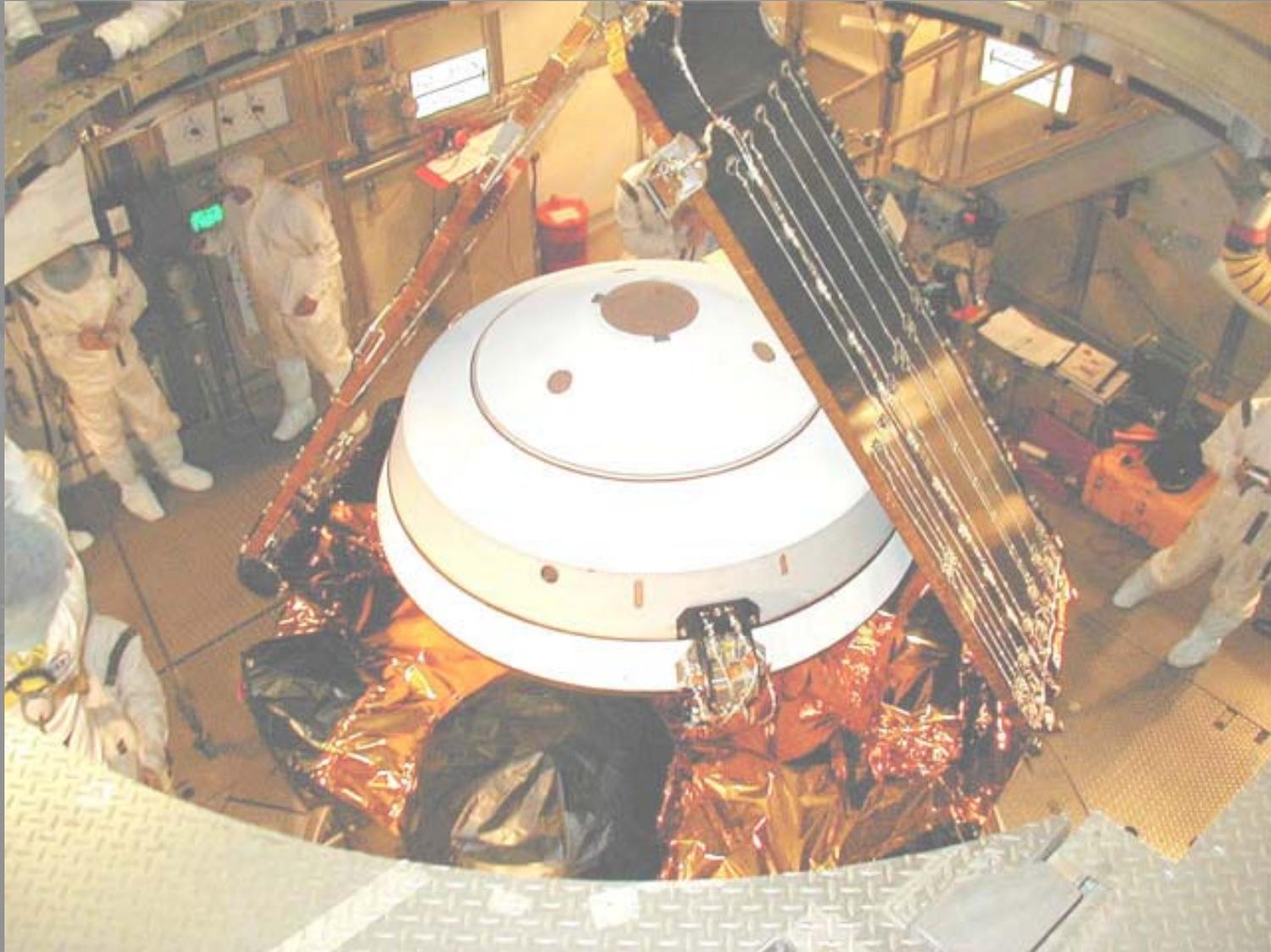
Science Collection



Separation @ Earth



Spacecraft on Launch Vehicle



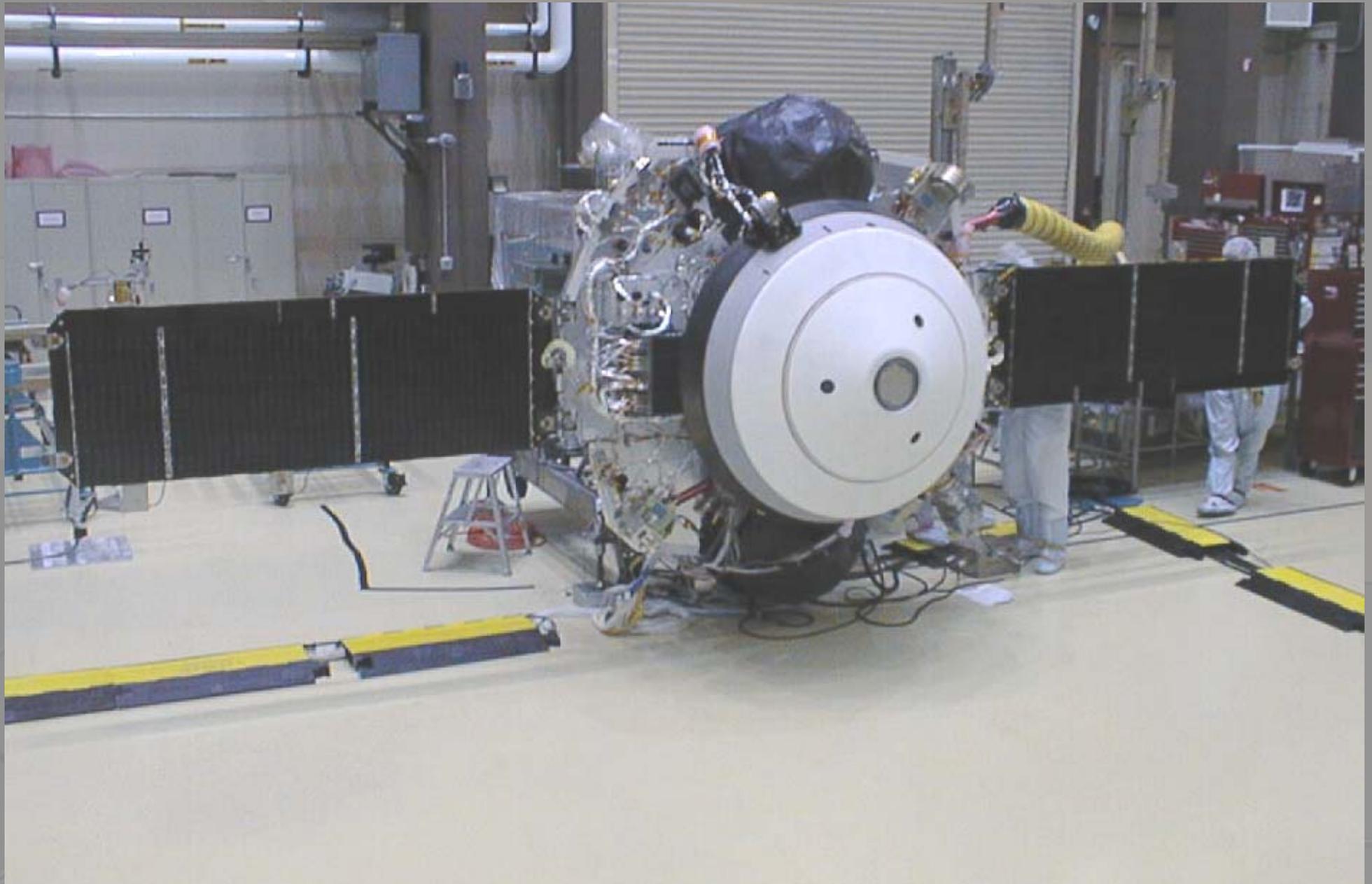
Spacecraft in Launch Vehicle Faring



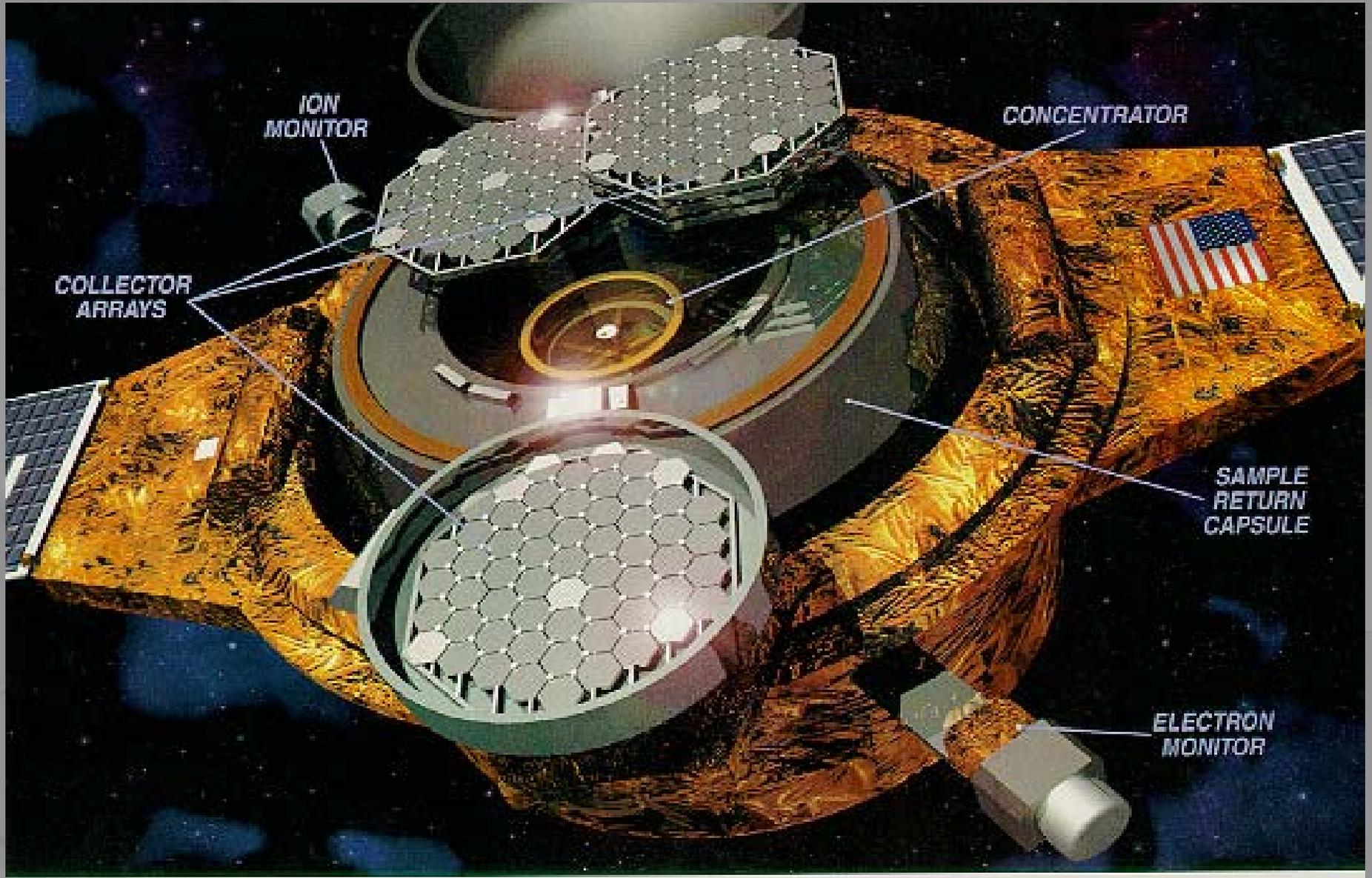
Spacecraft on Launch Pad at KSC



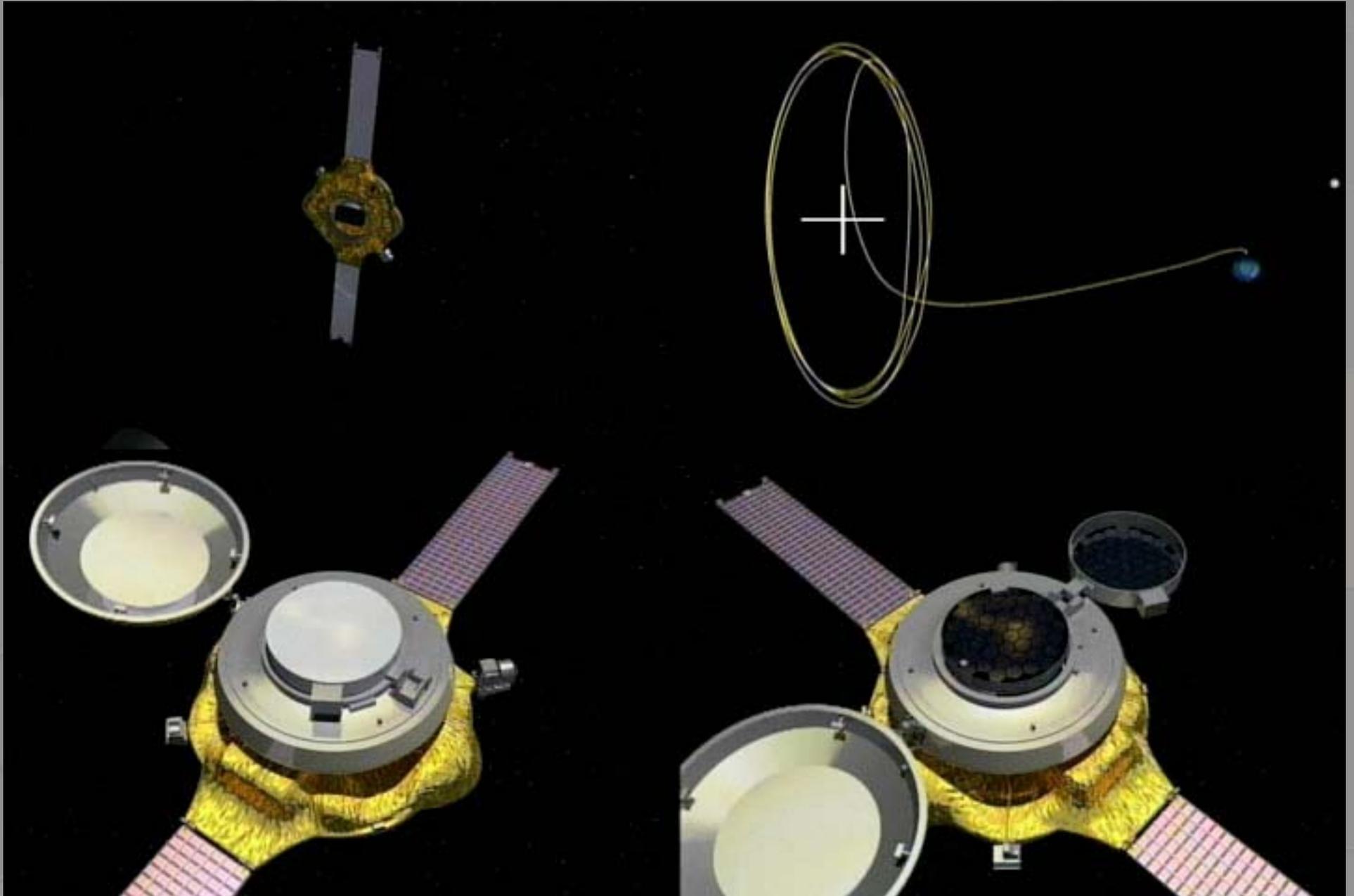
Spacecraft in Clean Room



The *GENESIS* Payload

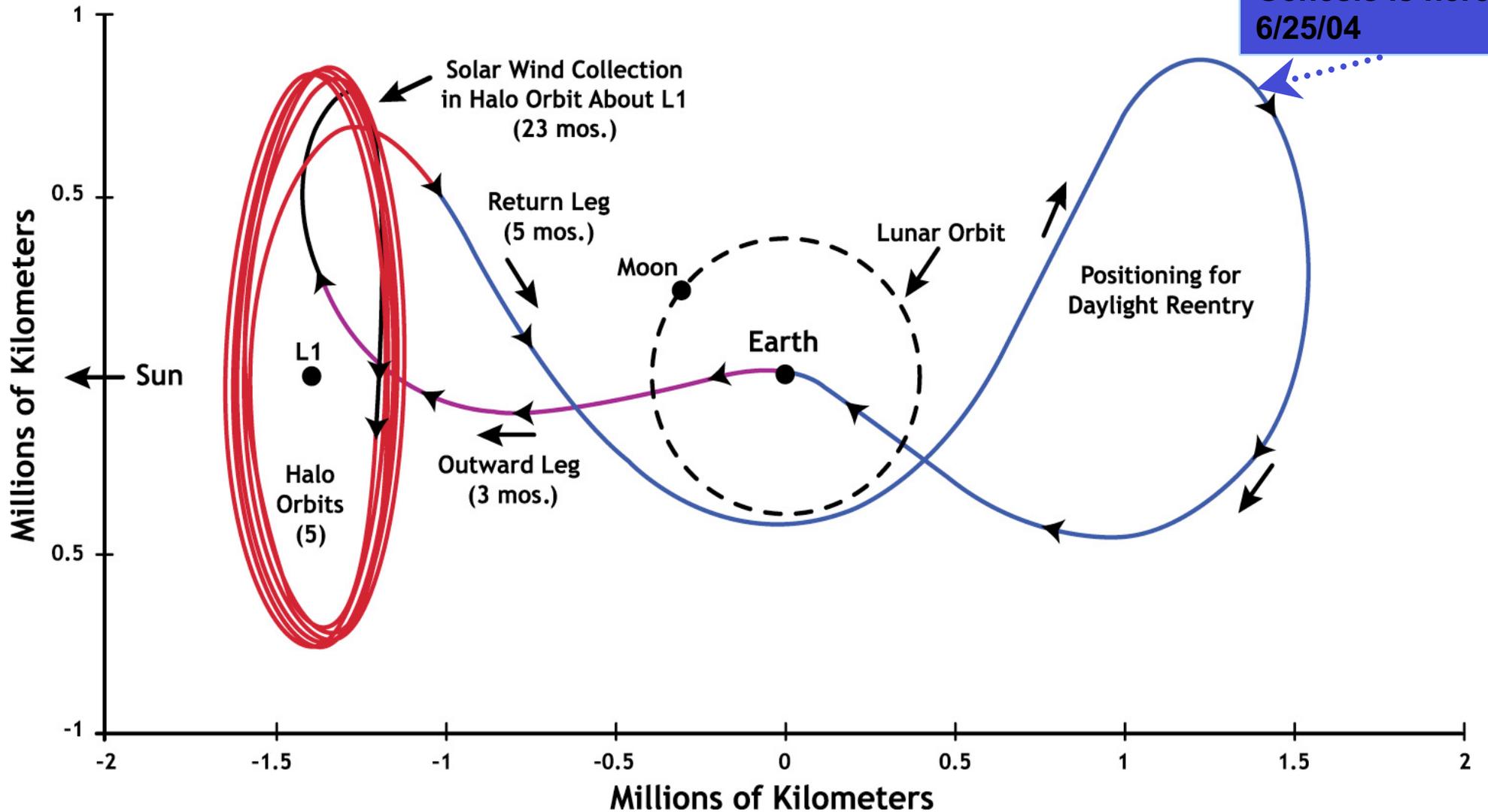


Genesis



Mission Trajectory

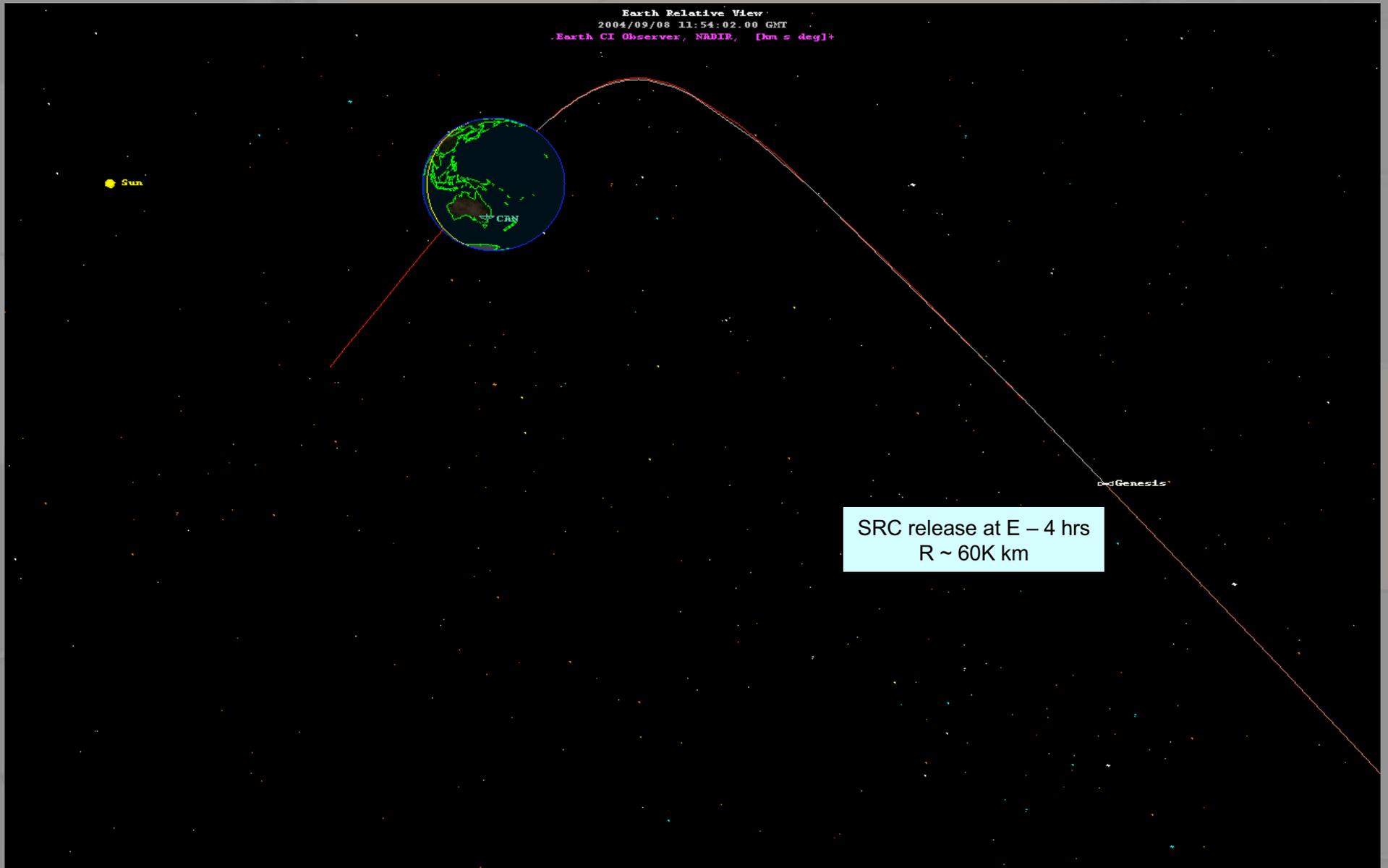
GENESIS MISSION TRAJECTORY: 2001 — 2004



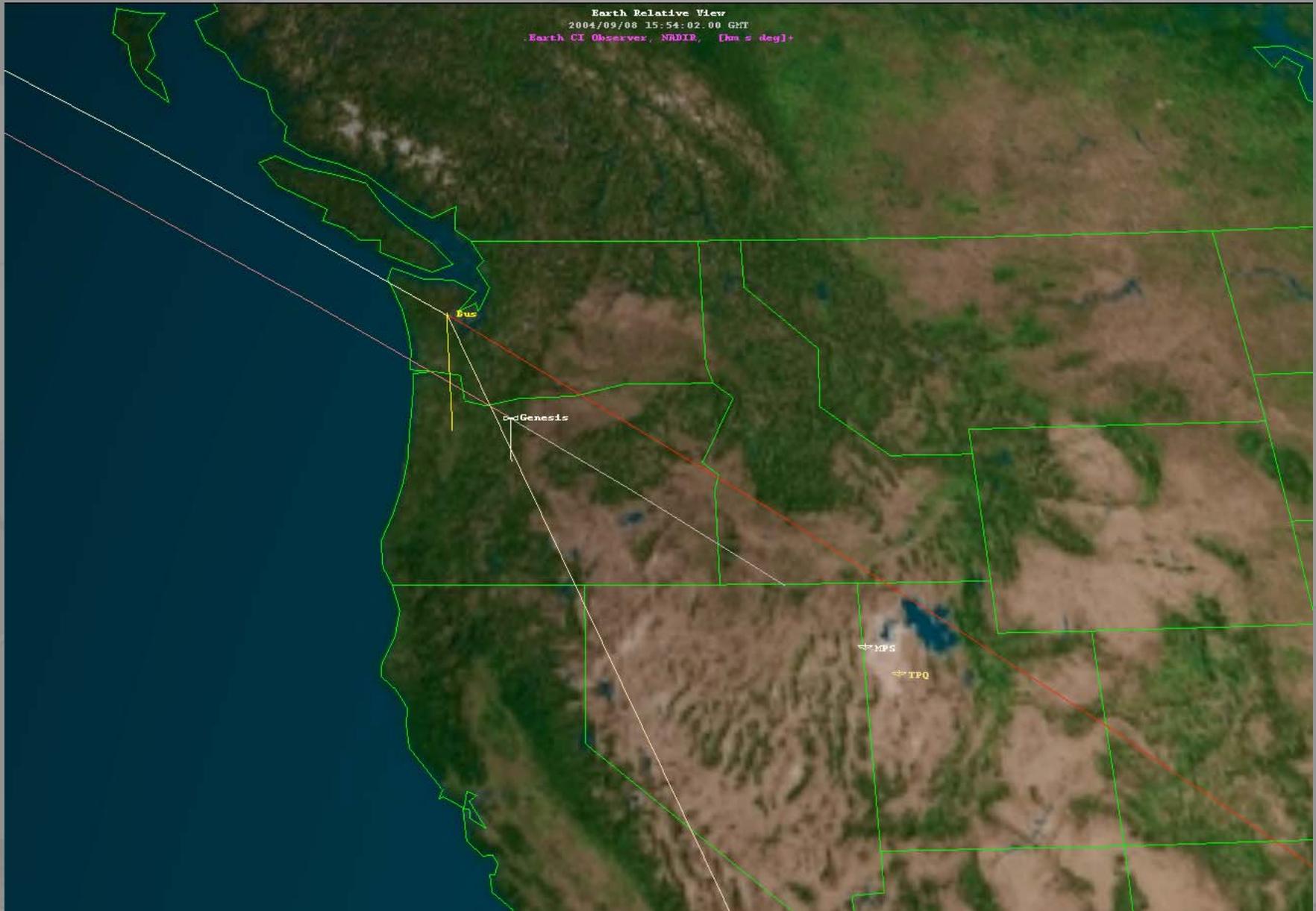
Mission Events

- **Launch** **8/8/2001**
- **Start of Sample Collection** **10/21/2001**
- **Halo Orbit Insertion** **11/16/2001**
- **Completion of Sample Collection** **4/2/2004**
 - **Sample material collected**
~10²⁰ ions
~0.5 milligrams
- **Earth “Flyby” on way to L2** **5/2/2004**
- **Sample Capsule Return to Earth** **9/8/2004**

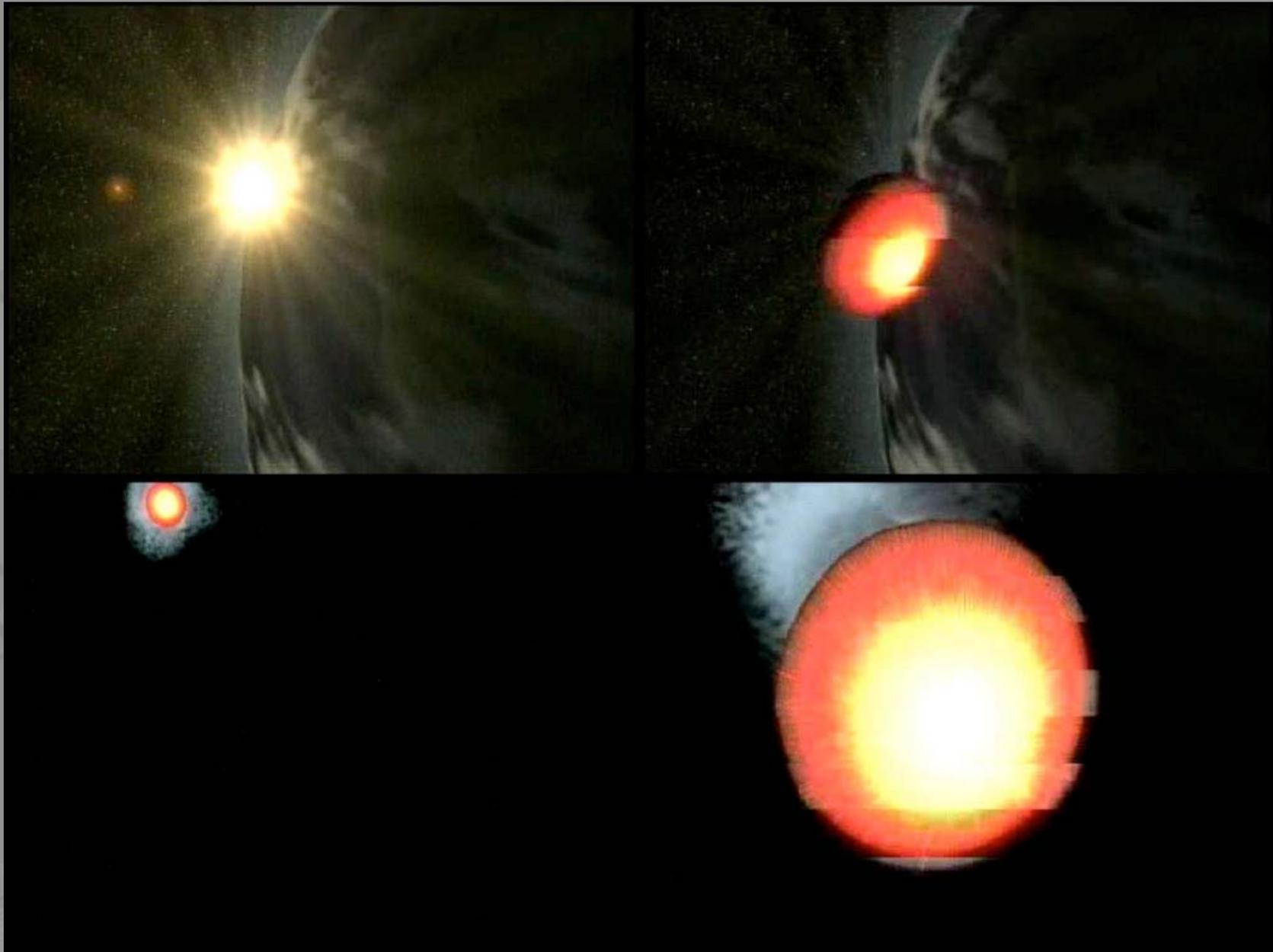
SRC Separation



Entry



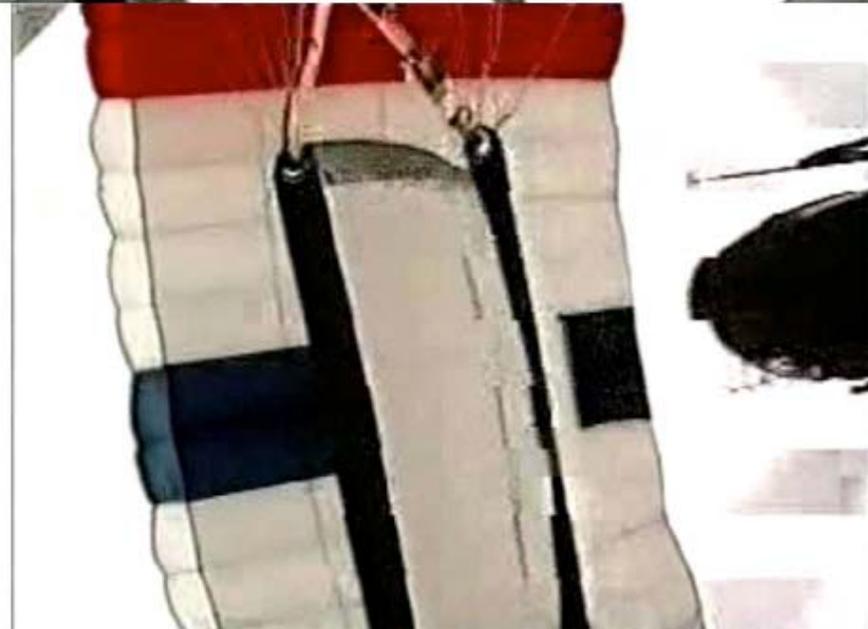
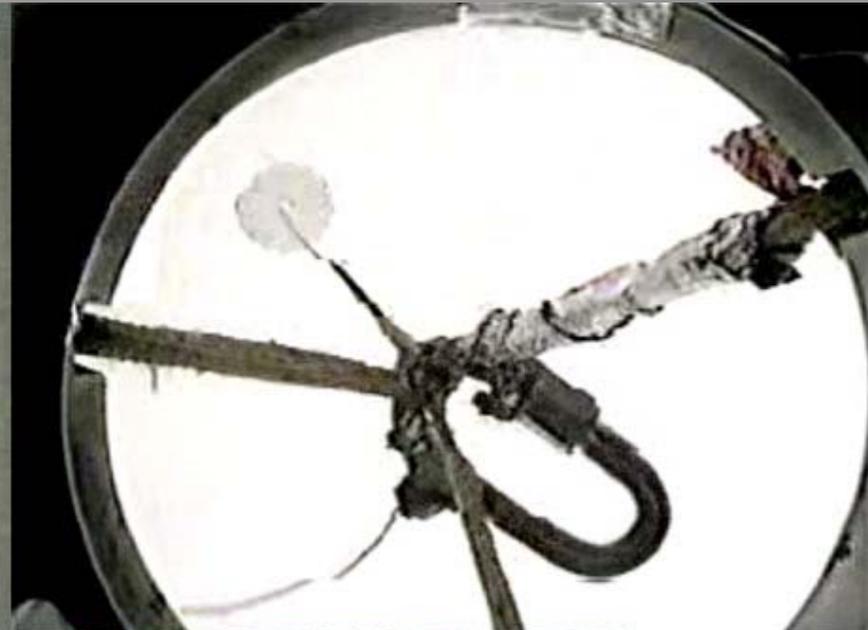
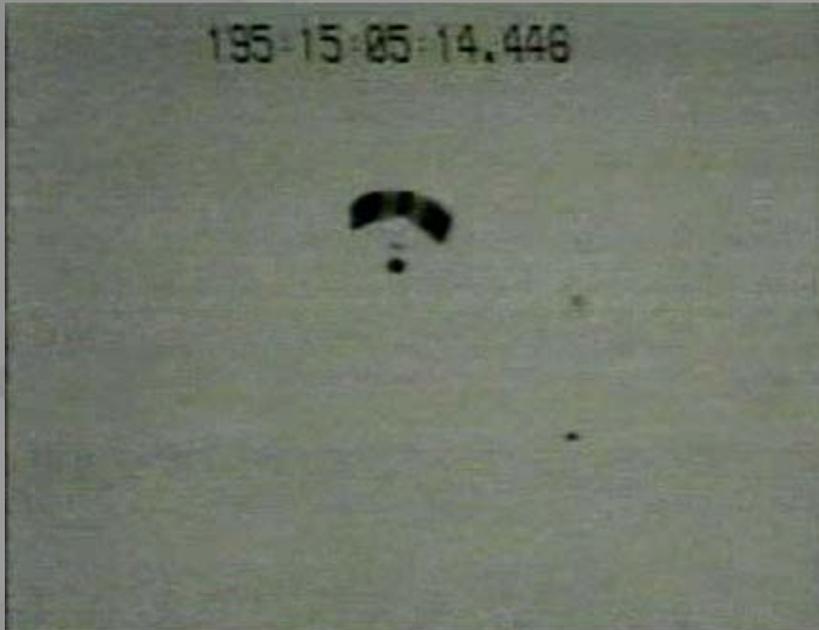
Genesis – Atmospheric Entry



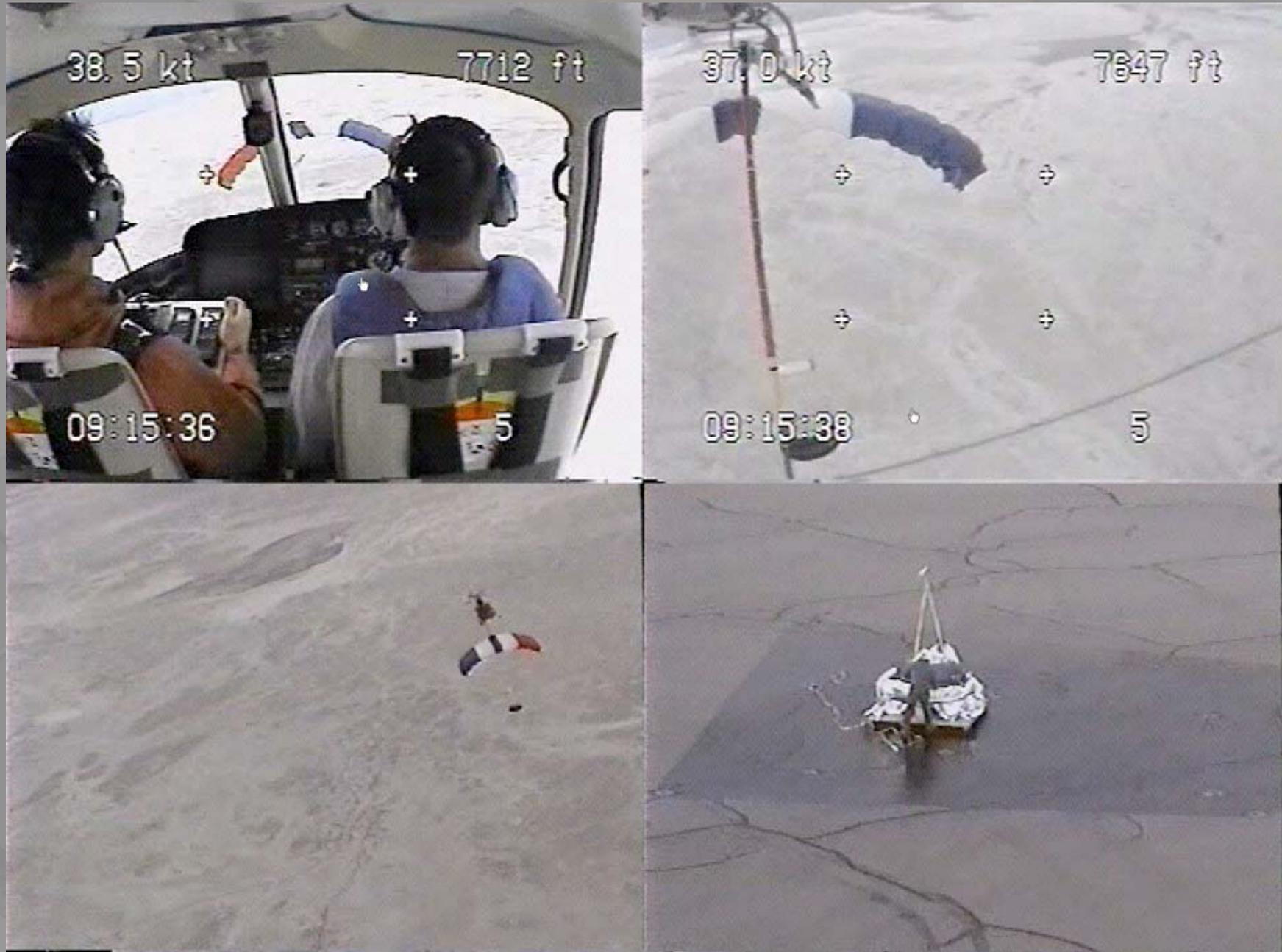
Genesis Safe Arrival Zone Utah Test & Training Range



Genesis – Drogue & Parafoil & view from SRC



Genesis Mid-Air Capture - View from Helo



Genesis Search for Origins

40° 09.223' North 113° 21.920' West

