Lasers in Space Applications

Cheryl Asbury

Jet Propulsion Laboratory,

California Institute of Technology

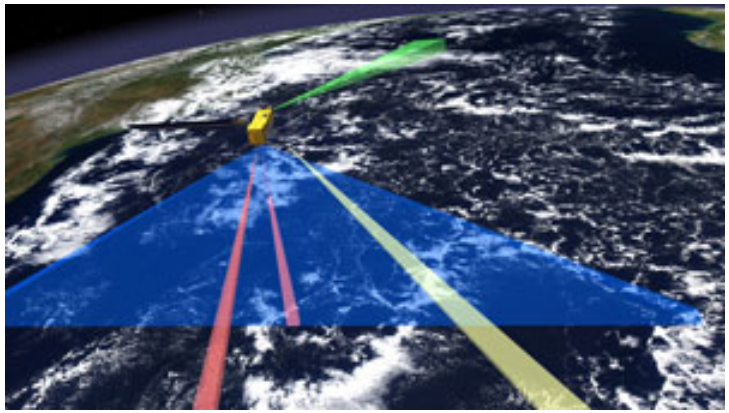
National Aeronautics and Space Administration

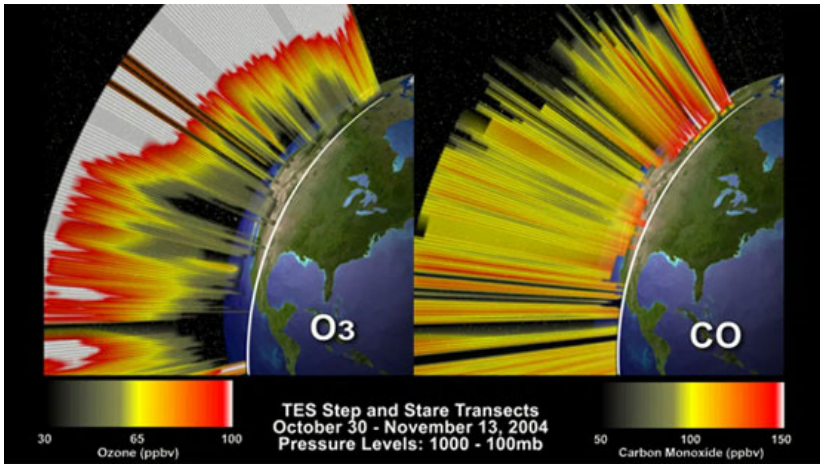
JPL

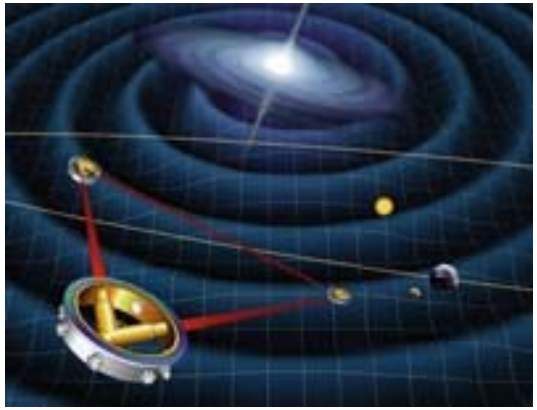
National Aeronautics and Space Administration

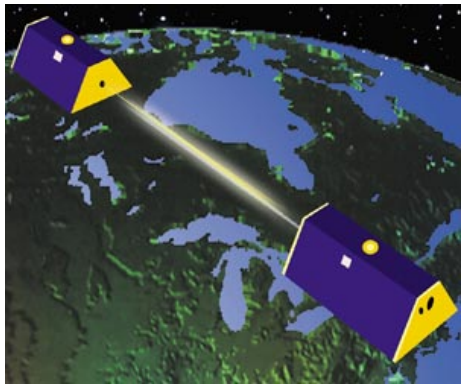
JPL

Understand our home planet & universe…









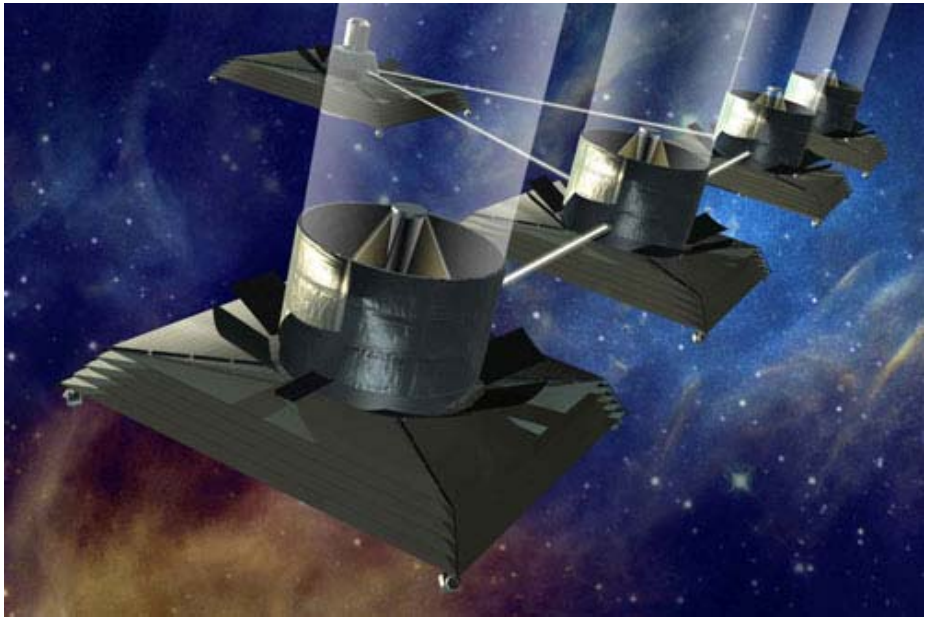
2006 25TH INTERNATIONAL CONGRESS ON APPLICATIONS OF LASERS & ELECTRO-OPTICS
ICALEO®
OCTOBER 30 - NOVEMBER 2 • DOUBLETREE PARADISE VALLEY RESORT • SCOTTSDALE, AZ USA

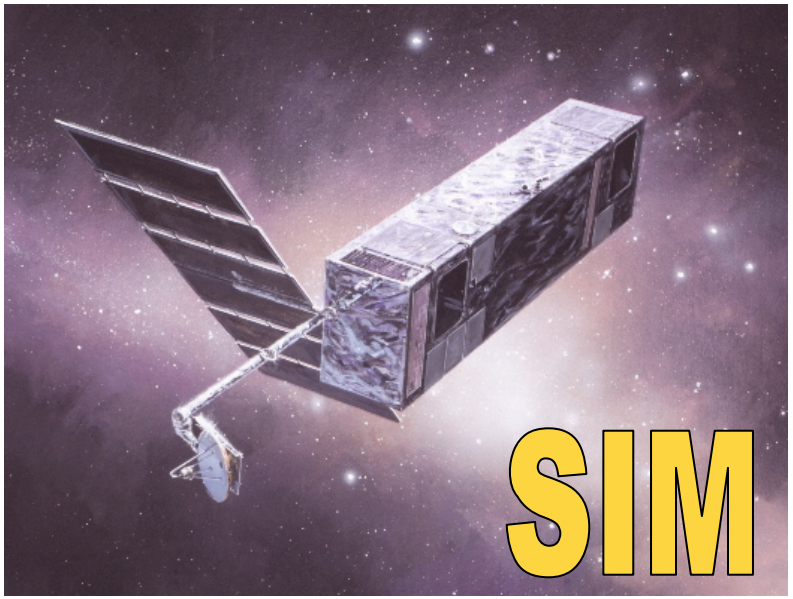
ICALEO® 2006
October 30 - November 2, 2006
Scottsdale, Arizona USA

National Aeronautics and Space Administration

JPL

Search for life…





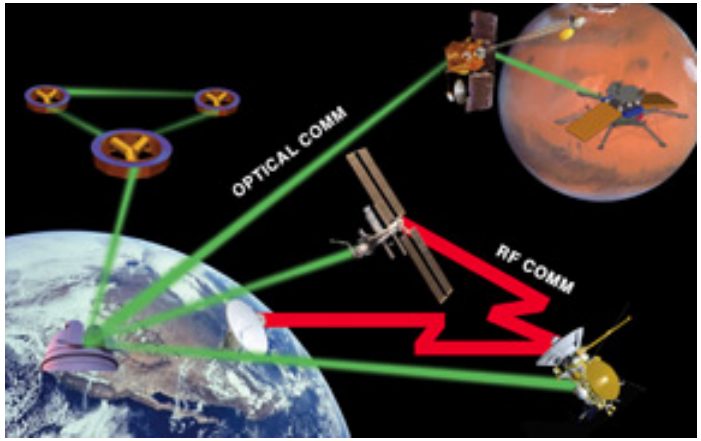
2006 25TH INTERNATIONAL CONGRESS ON APPLICATIONS OF LASERS & ELECTRO-OPTICS
ICALEO®
OCTOBER 30 - NOVEMBER 2 • DOUBLETREE PARADISE VALLEY RESORT • SCOTTSDALE, AZ USA

ICALEO® 2006
October 30 - November 2, 2006
Scottsdale, Arizona USA

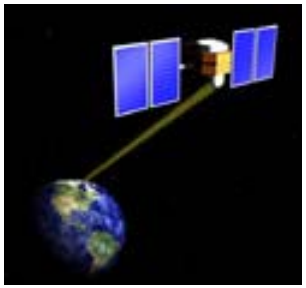
National Aeronautics and Space Administration

JPL

Explore other worlds…

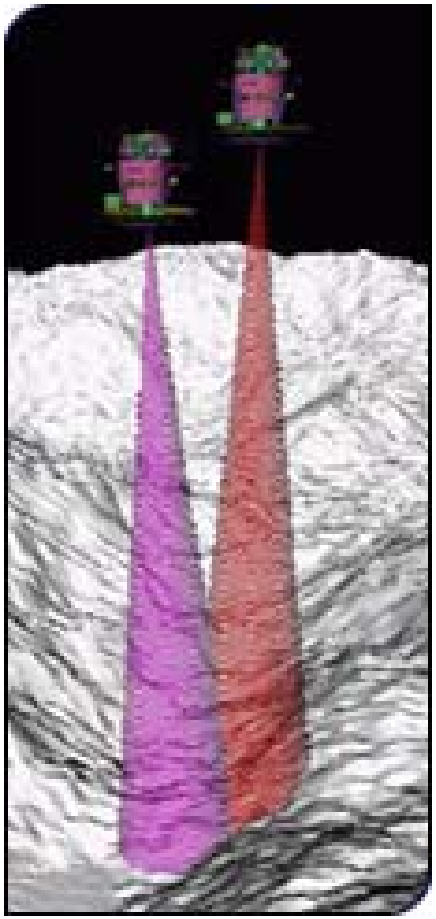


LIBS



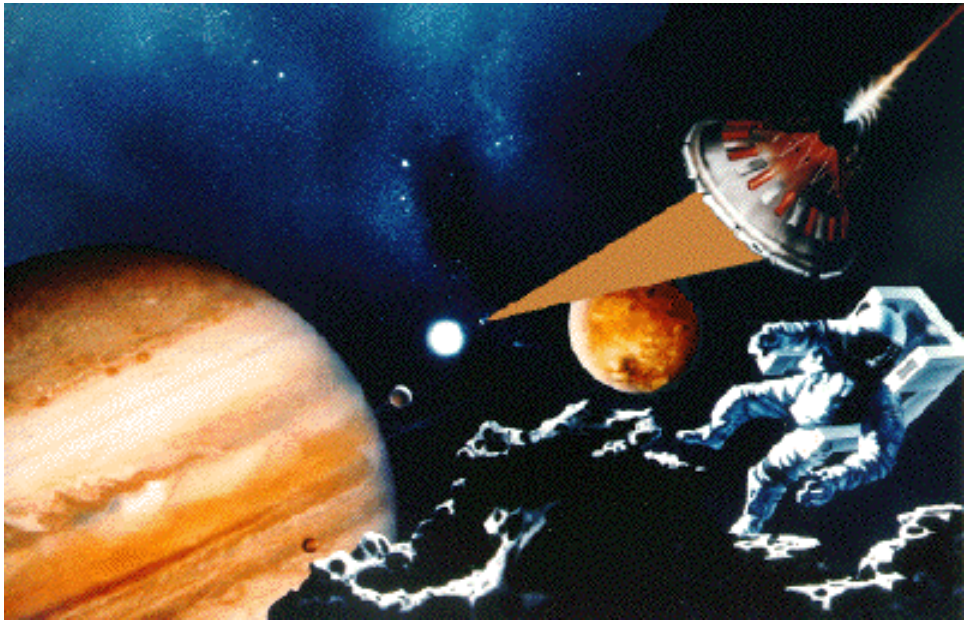
MARVEL

TLS



2006 25TH INTERNATIONAL CONGRESS ON APPLICATIONS OF LASERS & ELECTRO-OPTICS
ICALEO®
OCTOBER 30 - NOVEMBER 2 • DOUBLETREE PARADISE VALLEY RESORT • SCOTTSDALE, AZ USA

ICALEO® 2006
October 30 - November 2, 2006
Scottsdale, Arizona USA



… the number of applications for lasers in space is limited only by our imagination

2006
25TH INTERNATIONAL CONGRESS ON APPLICATIONS OF LASERS & ELECTRO-OPTICS
ICALEO®
INDUSTRY GOVERNMENT EDUCATION
OCTOBER 30 - NOVEMBER 2 • DOUBLETREE PARADISE VALLEY RESORT • SCOTTSDALE, AZ USA

But what does it take?

National Aeronautics and Space Administration

JPL

Qualification Requirements

	Vibration	Temp Cycles	Vacuum	Radiation	Diagnostics	long life	Reliability	Remote or Self-repair	Documentation
Research and Development					X	X			
Manufacturing/OEM		X	X		X	X	X		
Medical lasers					X				X
Land-based defense	X	X			X		X		X
Aerospace defense	X	X			X	X	X		X
Space	X	X	X	X	X	X	X	X	X

2006 25TH INTERNATIONAL CONGRESS ON APPLICATIONS OF LASERS & ELECTRO-OPTICS
ICALEO®
OCTOBER 30 - NOVEMBER 2 • DOUBLETREE PARADISE VALLEY RESORT • SCOTTSDALE, AZ USA

ICALEO® 2006
October 30 - November 2, 2006
Scottsdale, Arizona USA

What does all this mean?

…Design

- Vibration resistant structures – not only for strength, but for alignment
- Thermally stable mounting structures
- Low out-gassing materials
- Vacuum-stable materials or reliable operation in a hermetically sealed environment
- Radiation resistant materials or shielding for those materials that aren't
- Adequate diagnostics
- Turn-key operation or remote active alignment capability
- Thorough, detailed understanding of failure modes

National Aeronautics and Space Administration

JPL

…Build & Test

- System for documenting traceability of materials/components/processes in real time
- NASA review of build process
- Frequent inspection points with NASA rep
- Accurate and thorough documentation
- Demonstration of reliability with EMs

…Documentation

- Up-to-Date As-Designed parts lists for parts evaluations
- As-built Parts List, put together as laser is built
- Lot numbers on all parts and materials – including materials lots, processing lots, and assembly lots
- Manufacturing Travelers for all processes and assemblies documenting
- Inspection point reports
- Documented destructive parts analysis on all designs
- Documented parts and materials analyses (radiation, worst case analysis, fault tree, Failure Mode Effects and Criticality Analysis,

Scope of Documentation Work

Commercial Laser	50 pages
1 TES Laser	500+ pages
10 TES Lasers	5000+ pages

Pic of EIDP

Pic of Design Book

National Aeronautics and Space Administration

JPL

What I wish someone had told me

- Start a documentation system before you start building. Harder to do after the fact, or while you are trying to build.
- Write everything down as you do it – don't try to remember it later, because you won't.
- Try to make as many documentation things be automatic as possible
- Think about where your laser light is going after it leaves the laser
- If you want the system to work, you may have to adjust the design to compensate for the weaknesses in the rest of the optics train
- Set the definition of "lifetime" up front – there are lots of different ways to define it – make sure there is agreement.
- Do a FMECA early – NASA probably won't ask you to do it until it's too late to change anything

National Aeronautics and Space Administration

JPL

Lasers help to fulfill NASA's Mission:

- To understand and protect our home planet
- To explore the universe and search for life
- To inspire the next generation of explorers

- …as only NASA can.