

JPL

Optical Communications at JPL

Presented

at

DARPA

Steered Agile Laser Beam Workshop

March 24 -25, 1999

by

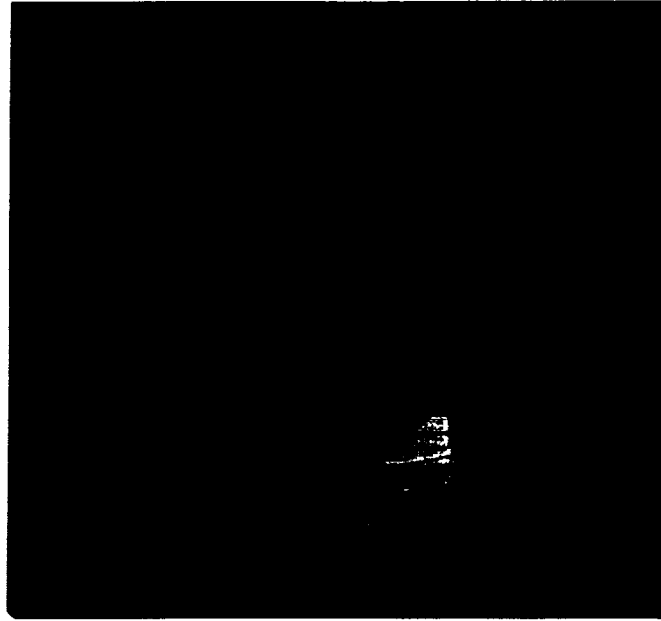
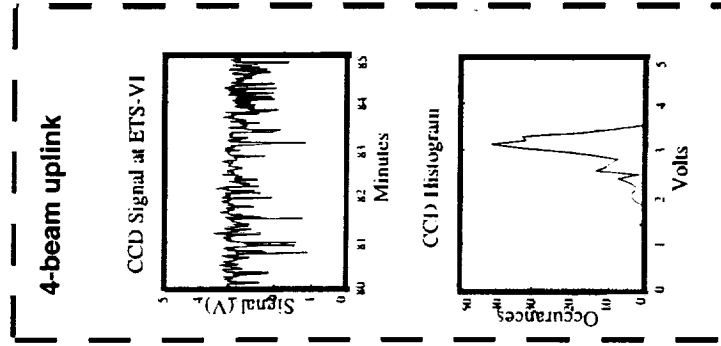
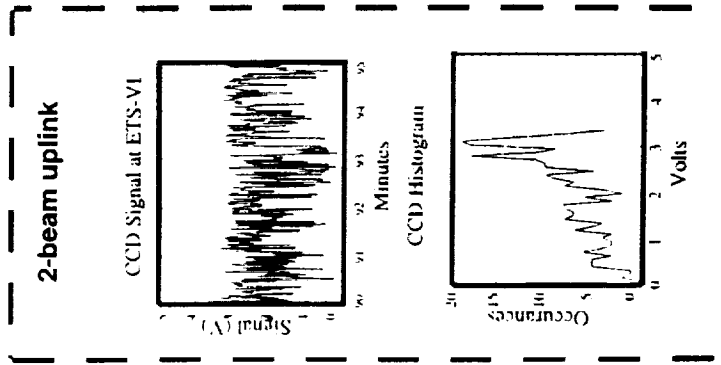
K. E. Wilson

Presentation Outline

- **Optical Communications Demonstrations**
- **Laser Communications Field-tests**
 - **Multi-beam Ground-to-space links**
 - **Horizontal Path Ground-to-ground links**
- **Atmospheric Visibility Monitoring**
- **Optical Communications Demonstrator**
- **Laser Com Terminal Test Station**
 - **LTES**
- **Future Optical Communications Developments**
 - **OCTL**
 - **International Space Station Demonstration**
- **Summary**

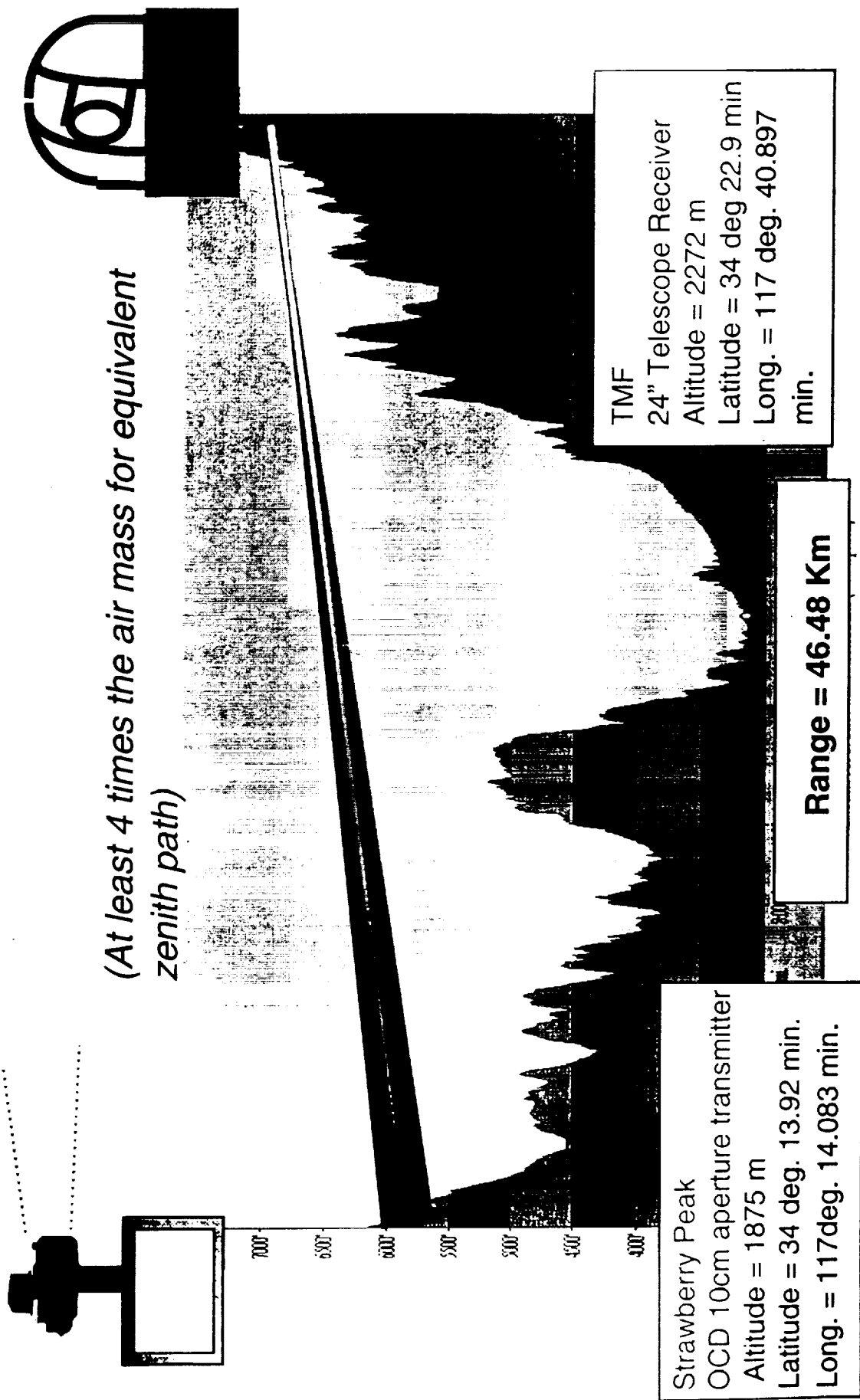
Multiple-beam Ground-to-Space Link

- Multiple-beam transmission mitigates effects of scintillation-induced fades on ground-to space link



Four-beam uplink to ETS-VI spacecraft

JPL Horizontal Path Tests of Optical Com Demonstrator

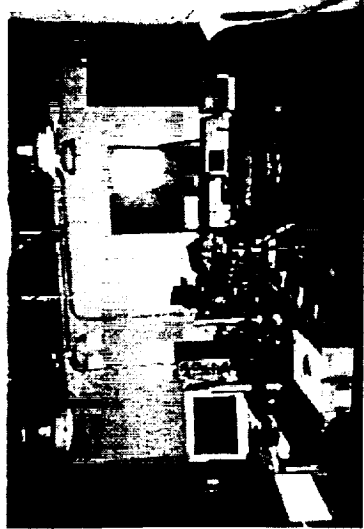


JPL Strawberry Peak and TMF Stations

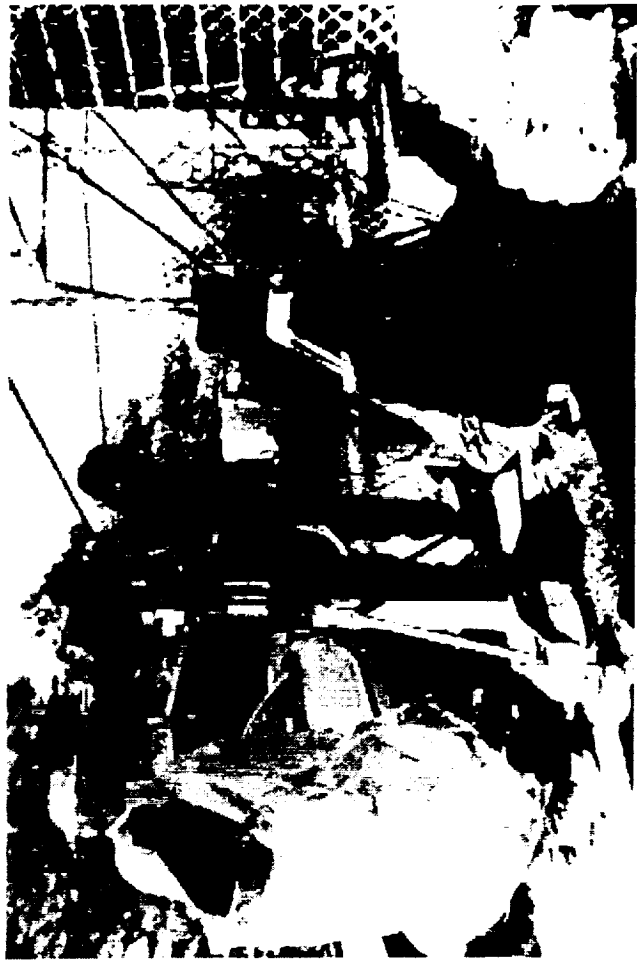


TMF 24" telescope dome used as receiver

TMF was used in SP



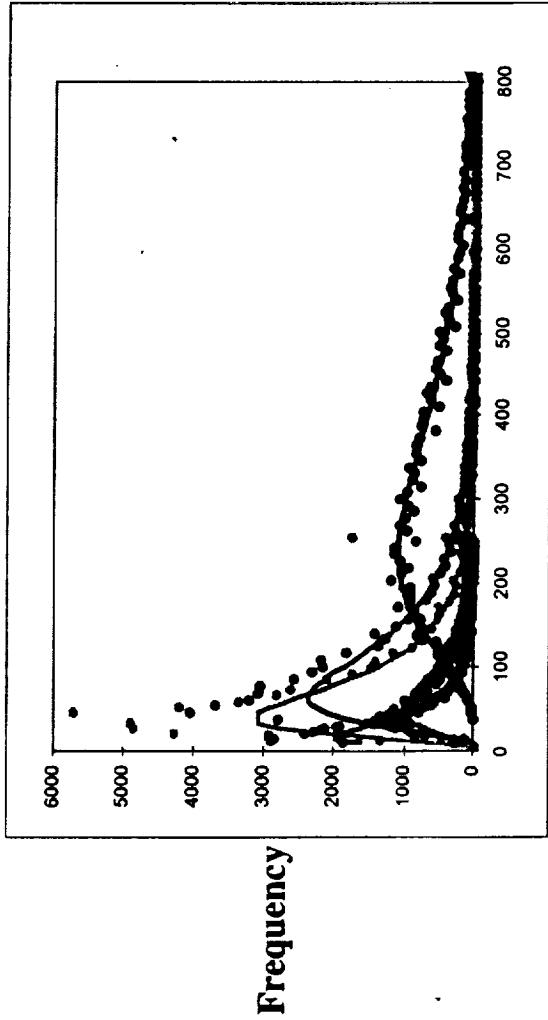
Coude Room Optical Assembly



OCD set up at Strawberry Peak

Multi-Beam Scintillation Measurements

- Scintillation index of N beams should decrease as $1/N$
 ($N=4$ for demo)



Single Beams

- Beam 1 1.04
- Beam 2 0.76
- Beam 3 0.75
- Beam 4 0.72

4-Beams

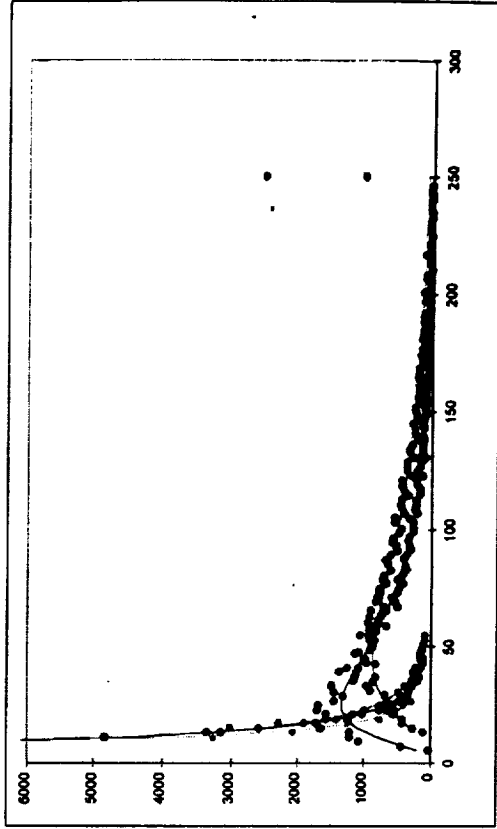
0.34 (0.20 predicted)

Measured standard deviations of
 intensity (Normalized)

- Single Beams Beam 1 0.50
- Beam 2 0.82
- Beam 3 0.68
- Beam 4 0.73

4- Beams

0.22 (0.17 predicted)



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Autonomous Visibility Monitoring Instrumentation at TMF

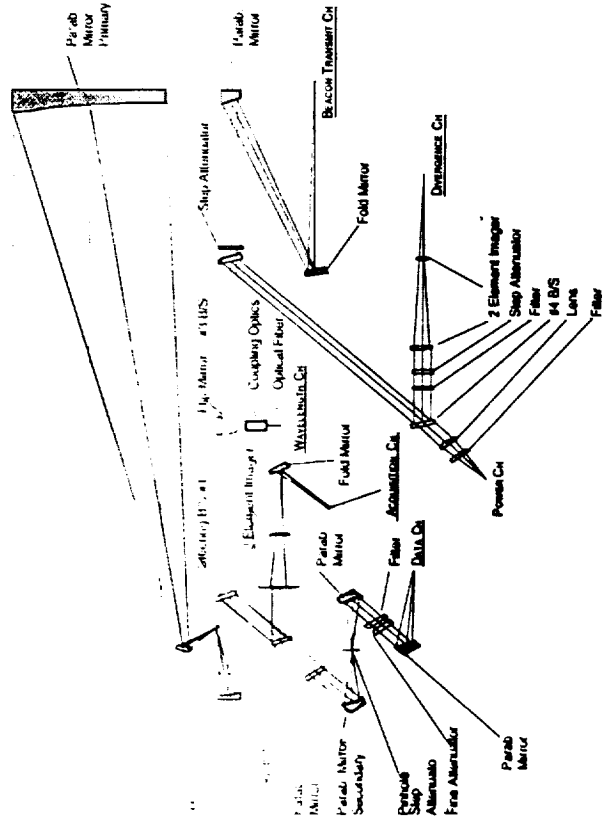
- Visibility monitoring stations at Mt. Lemmon AZ, Goldstone CA and Table Mountain CA autonomously measure atmospheric transmission at visible and near-IR wavelengths



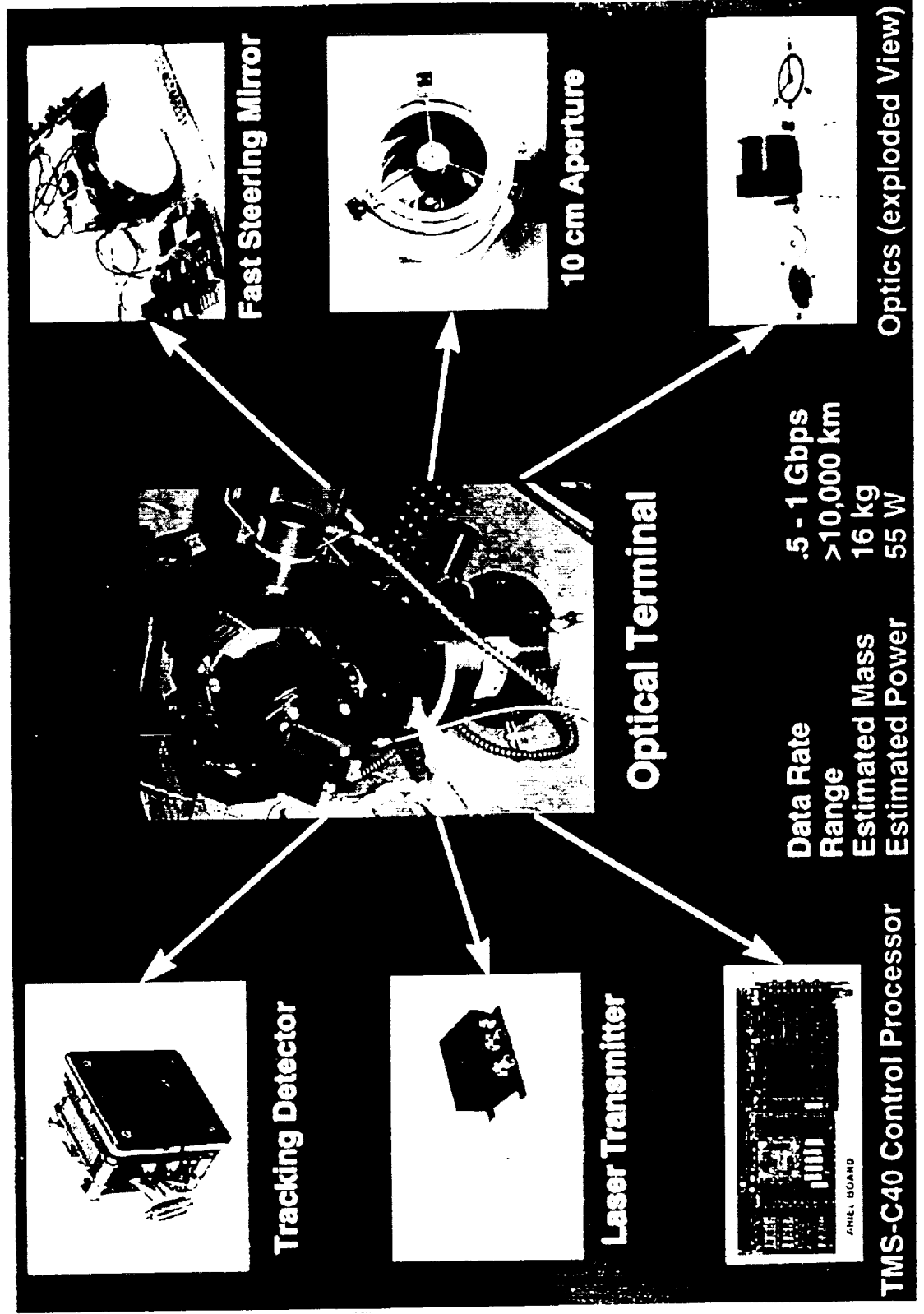
AVM at TMF

Laser Terminal Evaluation Station

- LTES is a high optical quality instrument that has been used to characterize the performance of STRV-2 and OCD laser communications terminals
 - Measures divergence, acquisition and tracking performance, optical output power, and BERs of Lasercom terminals up to 1.4 Gbps data rates
 - Replacement of appropriate of beamsplitters and detectors allows operating to extend out to 2 μm

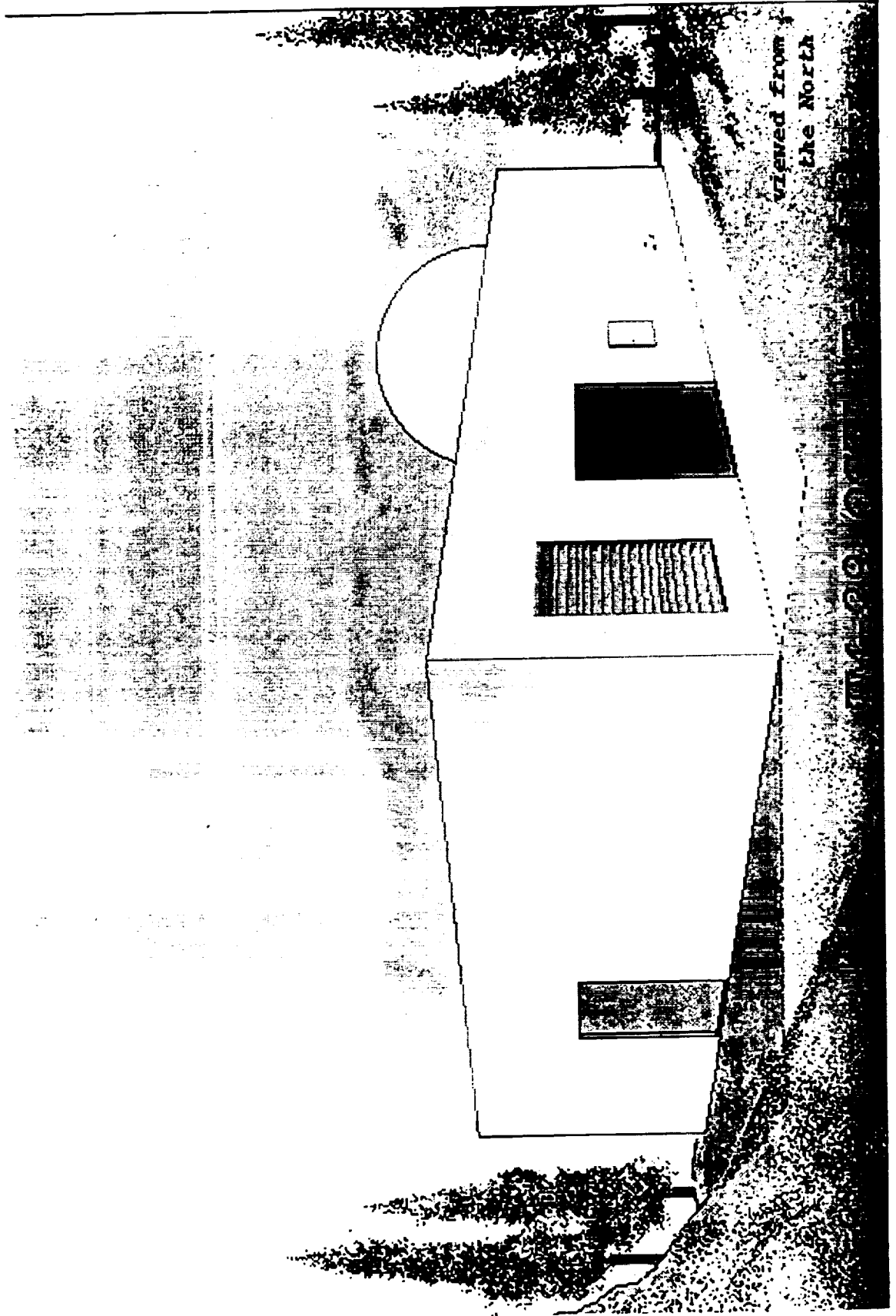


Optical Communications Demonstrator



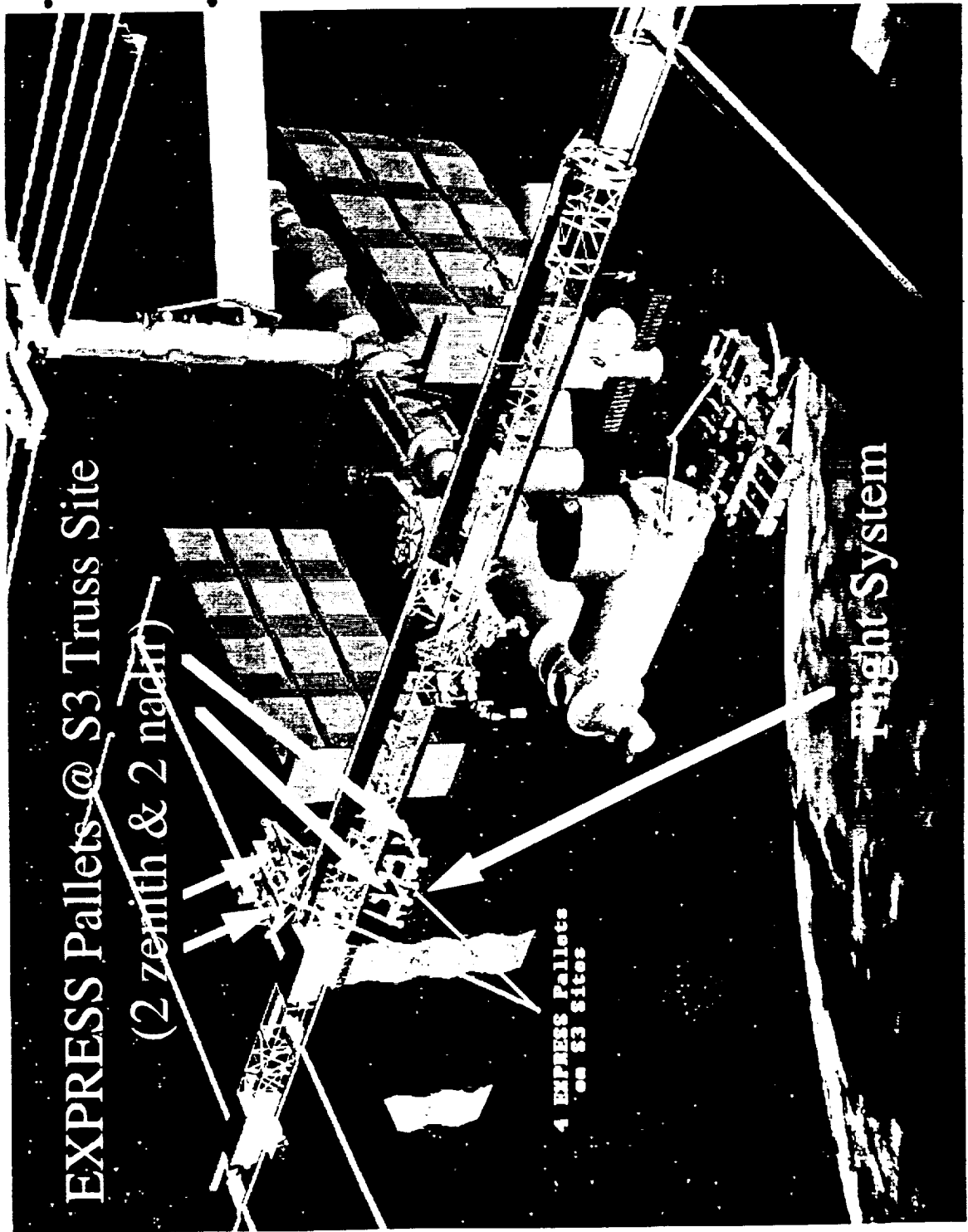
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Artist's Concept of OCTL



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International Space Station



EXPRESS Pallets @ S3 Truss Site

(2 zenith & 2 nadir)

4 EXPRESS Pallets
on S3 Sites

Flight System

Flight System

integrate

nadir facility

EXPRESS

Pallet

Adapt

Summary

- **JPL's optical communications program has:**
 - **Demonstrated optical communications to spacecraft at deep space and geostationary ranges**
 - **Demonstrated advantages of multi-beam transmissions in ground-to-ground and ground-to space experiments**
 - **Developed an optical communications terminal that is readily converted from deep space to Earth-orbiting applications**
 - **Developed laboratory and field capabilities to evaluate optical communications terminal performance**
- **The program is supporting:**
 - **Construction of an optical communications laboratory at its TMF to support future demonstrations (ground-to-ground to space-to-ground)**
 - **Continuing development of visibility models from statistics acquired from autonomous monitoring stations in the southwestern US.**
 - **Development of optical com terminal for space-to-ground link form ISS in 2002**