GALILEO INFRARED OBSERVATIONS OF THE SHOEMAKER-LEVY 9 G AND R FIREBALLS AND SPLASH

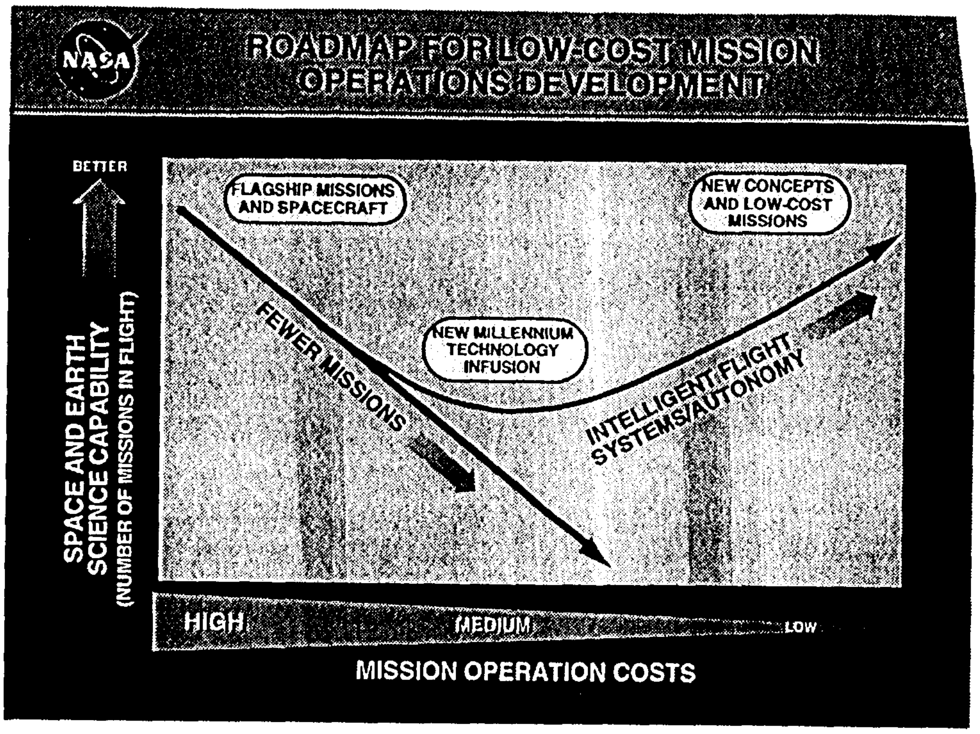
R.W. Carlson, P.R. Weissman, J. Hui, M. Segura, W.D. Smythe, K.H. Baines and T.V. Johnson (Jet Propulsion Laboratory), P. Drossart and T. Encrenaz (DESPA, Observatoire de Paris), F. Leader and R. Mehlman (Institute of Geophysics, UCLA)

The Galileo spacecraft was fortuitously situated for a direct view of the impacts of comet Shoemaker-Levy 9 in Jupiters atmosphere and measurements were recorded by the Near Infrared Mapping Spectrometer (NIMS) instrument for several of the impact events. Seventeen discrete wavelength channels were used between 0.7 to 5.0 microns, obtained with a time resolution of 5 seconds. Two phases of the impact phenomona are found in the data: the initial fireball, which was evident for one minute, and subsequent fallback of impact ejects onto the atmosphere, starting six minutes after fireball initiation.

Preliminary analysis of the G event data shows a fireball appearing at 07:33:37 UT (as would be observed from the Earth) with a temperature of 4000 K or greater and an effective source diameter of 20 km orless. These spectra show absorption by methane and molecular hydrogen whose strength place the fireball in the upper troposphere, above the ammonia clouds. As time progresses, the fireball cools and the effective diameter increases about 2 km/see. The strength of the hydrogen and methane absorption decreases with time, indicating that the radiating surface is rising supersonically. The fireball appears to expand adiabatically, with an adiabatic index of 1.2. After about 30 seconds, the spectra indicate a multiple temperature or opacity structure.

A second phase of strong IR emission for the G event was detected beginning at 07:39:41 UT, which we interpret as impact ejects, supersonically ejected in the fireball and plume, falling back upon the atmosphere. The resulting infrared emission steadily brightened over 2 minutes following its first detection. The timing of the event implies a minimum ejection velocity of 4 km/see.

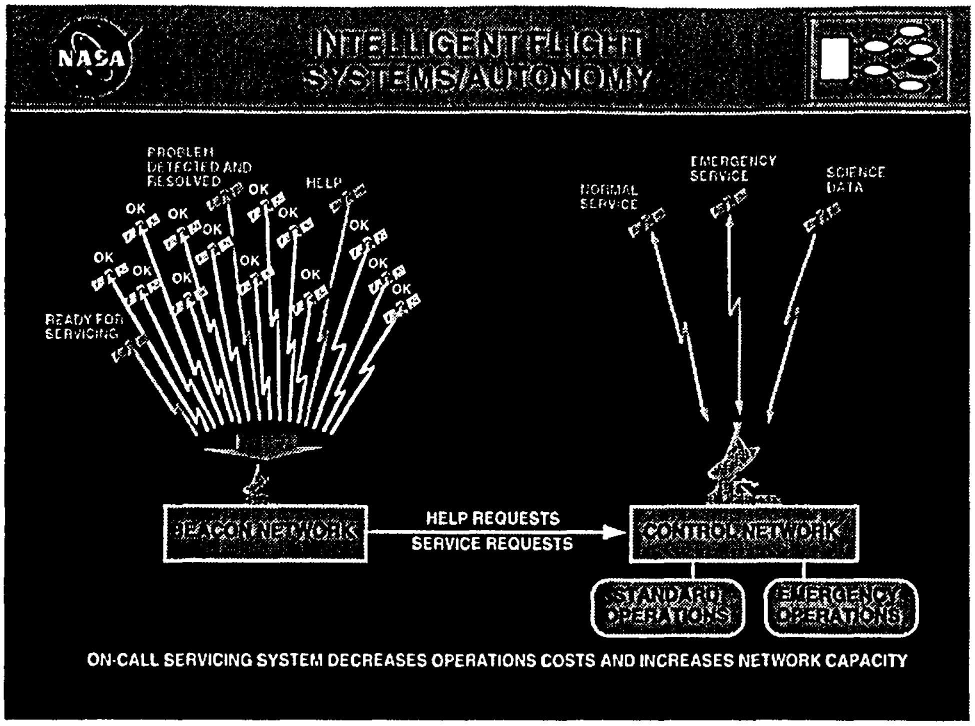
Data from the R event are currently being returned from the spacecraft, and will be discussed and compared to the G event results.



F 12

The costs of operating spacecraft are a significant portion of the costs of any mission. Mission operations costs could be reduced by simply flying fewer missions. Unfortunately, this direction is opposite our vision, which calls for greatly increased numbers of missions creating a virtual presence in space. How, then, can we afford to operate 30 or more missions at a time? . . . Through an infusion of technology and new ways of doing business, we can use intelligent flight systems and autonomy to reduce the number of people required to operate and monitor spacecrafts thereby decreasing operation costs.

Fig 12



INTELLIGENT FLIGHT SYSTEMS/AUTONOMY

ON-CALL SERVICING SYSTEM DECREASES OPERATIONS COSTS AND INCREASES NETWORK CAPACITY

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Revolutionary new concepts for ground operations take advantage of "economy of scale" of large numbers of semiautonomous spacecraft. Assuming that, at any given time, most spacecraft are healthy and require no ground intervention, the costly approach of a dedicated operations team for each spacecraft can be transformed into a low-cost "on-call" system that provides service only when needed. This approach also increases the capacity of the Deep Space Network (DSN) to handle a much larger number of missions simultaneously.

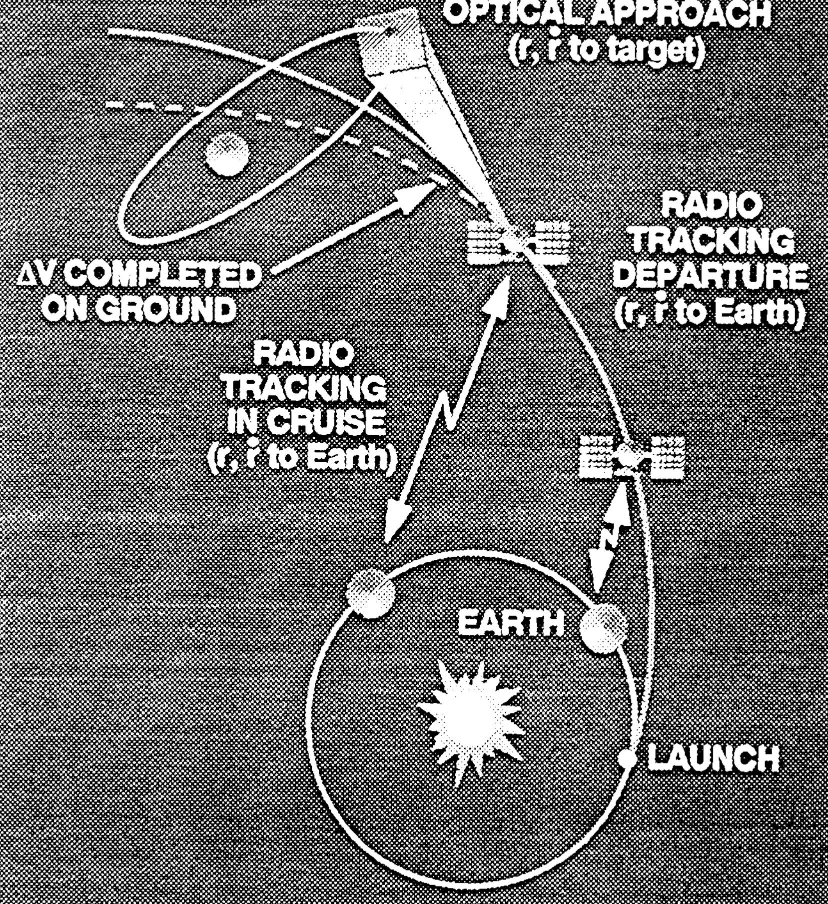
The concept includes a low-fidelity beacon network to monitor messages from the spacecraft that are limited to four simple options, "I'm OK"; "Problem detected and resolved"; "I'm ready for normal servicing"; and the occasional, "Help!" Only when required, the high-fidelity DSN is used to receive science data, to provide normal service, or to provide human intervention in an emergency situation beyond the capabilities of the spacecraft.

This paradigm shift can be viewed as equivalent to making an emergency room available to a community, rather than having a complete medical team in each home.

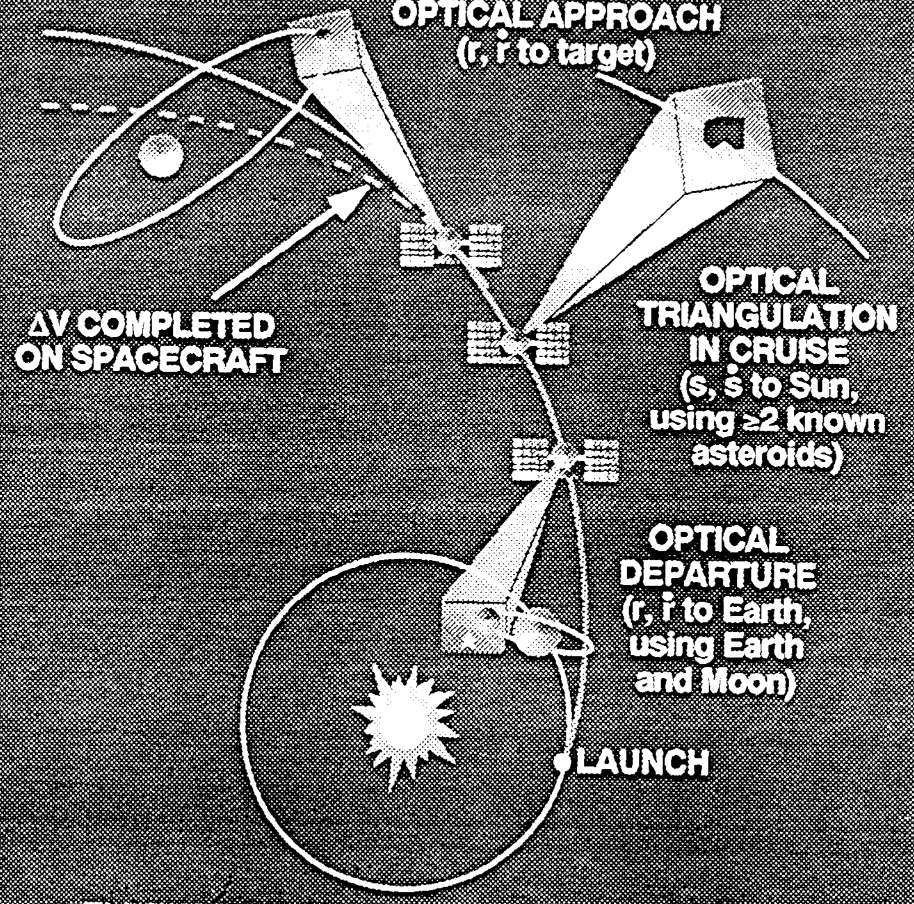
Fig 13

FUTURE DIRECTION: AUTONOMOUS OPTICAL NAVIGATION

CURRENT NAVIGATION



FUTURE NAVIGATION



- ELIMINATION OF:
  - YEARS OF RADIO TRACKING FOR NAVIGATION
  - YEARS OF RADIO DATA GROUND PROCESSING
  - RADIO TRANSPONDER
- ENHANCED MISSION SCIENCE

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