

Eye Safety for Space Borne Lidar

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The currently approved program in NASA for a space borne lidar free flight mission is the GLAS (Geoscience Laser Altimetry System) mission. The eye safety standard and heritage for the GLAS mission is currently considered to be the levels (Couch, 1992) that were approved for the Lidar in space Technology Experiment flown and operated on the NASA space shuttle. The basic standard used in the space shuttle mission was the ANSI Standard z136.1-1986 for permissible exposure to laser emission. A safety ratio is defined as the ratio of the given energy density exposure to the maximum permissible exposure standard defined by ANSI z136.1. For the NASA shuttle mission the safety ratio was a factor of 500 for ground based unaided viewing. For an observer viewing with 50 mm optics the ratio was 10. The ratio was 1 for viewing with 20 cm optics and thus still in compliance with the ANSI standard. The approved safety analysis for the shuttle mission stated that a ground based observer viewing through optics of greater than 20 cm could exceed the ANSI standard, but it is recognized that there is a very large margin in the ANSI standard and measured levels of laser energy density which cause damage in cadaver tests.

R. H. Couch, "Ground observer eye safety analysis for the lidar in-space technology experiment," (person communication from D. M. Winker, NASA Langley Research Center).

Eye Safety

U. S. Standard:

American National Standard for Safe Use of Lasers

ANSI Standard Z136.1 - 1986

Maximum Permissible Exposure (MPE)

1064 nm	20 ns	$5 \times 10^{-6} \text{ J/cm}^2$
532 nm	20 ns	$5 \times 10^{-7} \text{ J/cm}^2$

LITE Safety

• Safety Ratio: Unaided Viewing - 500

50 mm Optics 10

20 cm Optics 1

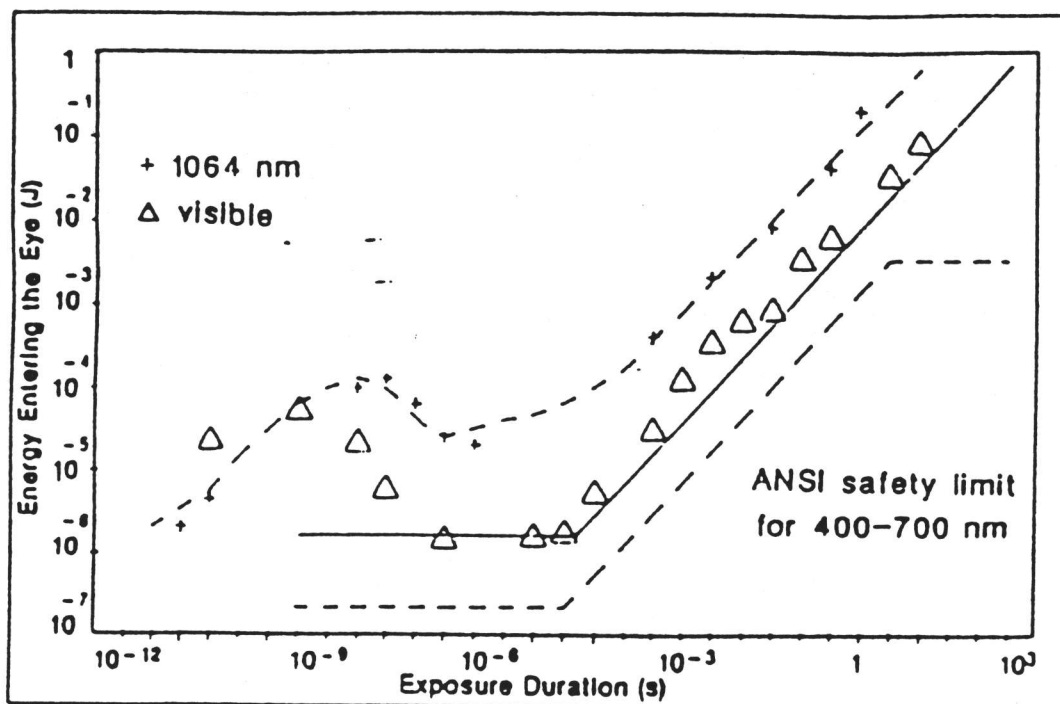


Figure +1. Retinal Injury Threshold for Rhesus Monkeys as a Function of Total Laser Energy versus Exposure Duration