Radiation Hardness Assessment of DFB and Widely Tunable Lasers

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Overview

- Evaluate radiation hardness of emerging laser technologies – DFB, DBR, SG-DBR.

- Examine: threshold, wavelength, SMSR, linewidth, modulation.

- Proton irradiation

  1) 2-year LEO, 4mm Al shielding
     Energy = 10 MeV
     Fluence = 4×10^{9} cm^{-2}

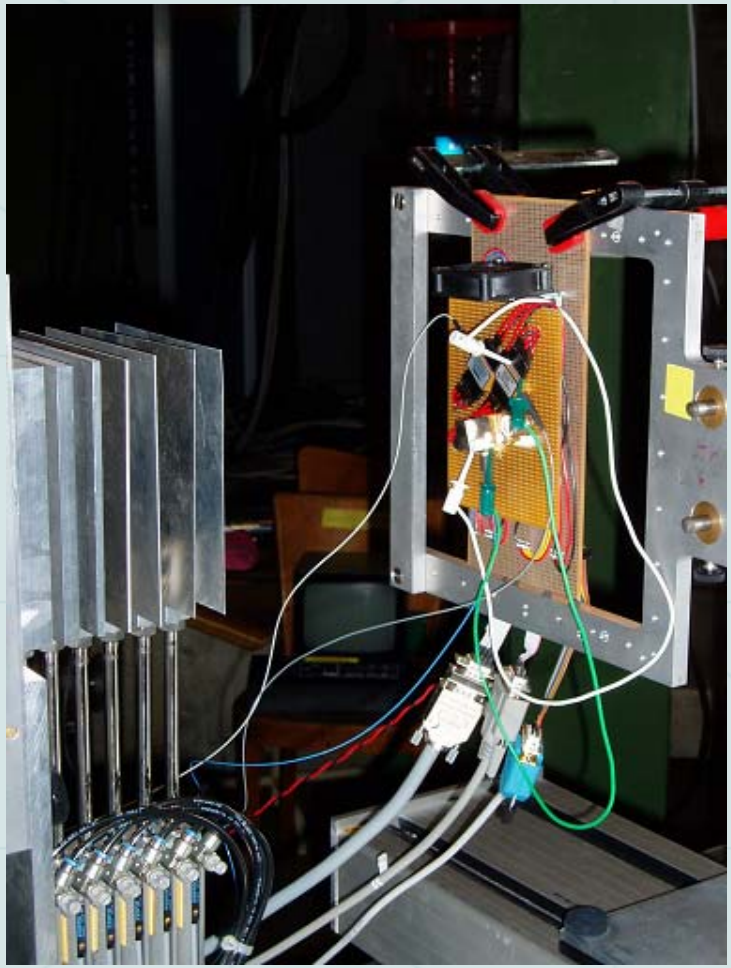
  2) High energy exposure
     Energy = 50 MeV
     Fluence = 2×10^{13} cm^{-2}

Selected lasers

Type	Package	Wavelength
DFB	TO-8 w/ TEC	935nm
DFB	TO-9 No TEC	935nm
DFB	Butterfly	1550nm
DBR	Butterfly	1550nm
SG-DBR	Butterfly	1550nm

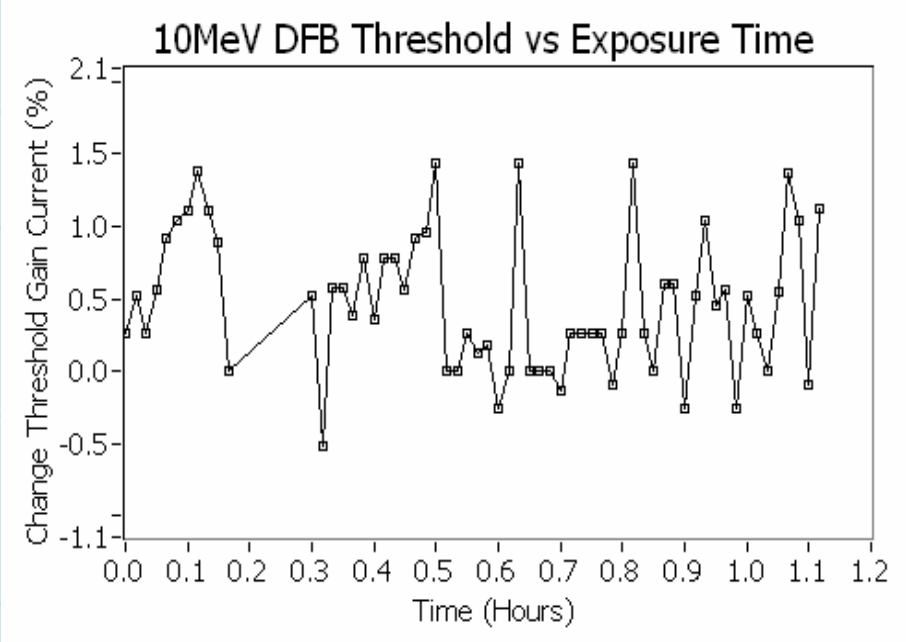
- 2 batches of lasers for both low- and high-energy irradiation
- In situ testing of DFB and DBR. Results shown here.
- Lasers exposed to high-energy protons are still too active to return even after 7 months.

Radiation testing
On Site Pictures

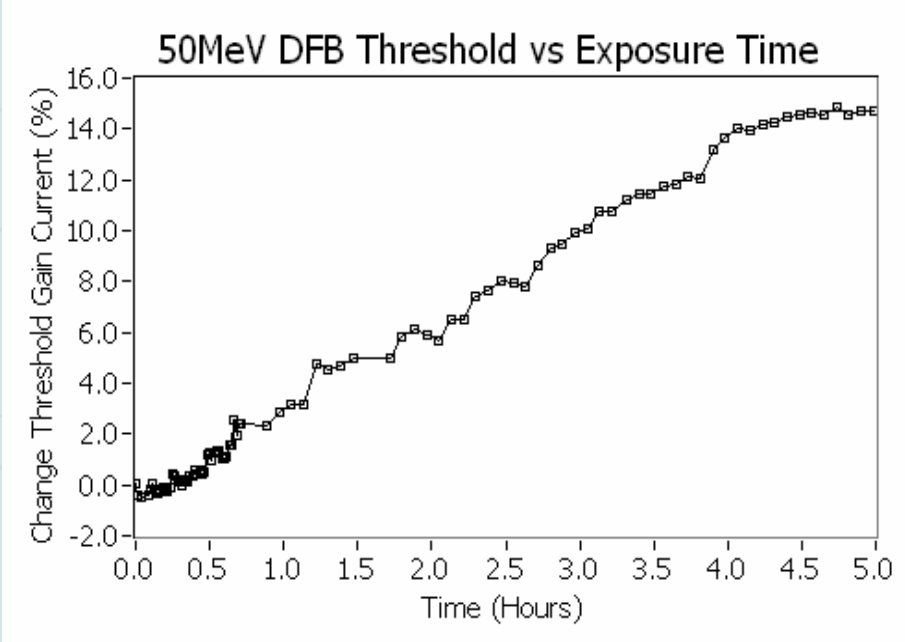


Threshold Deterioration (DFB)

10 MeV

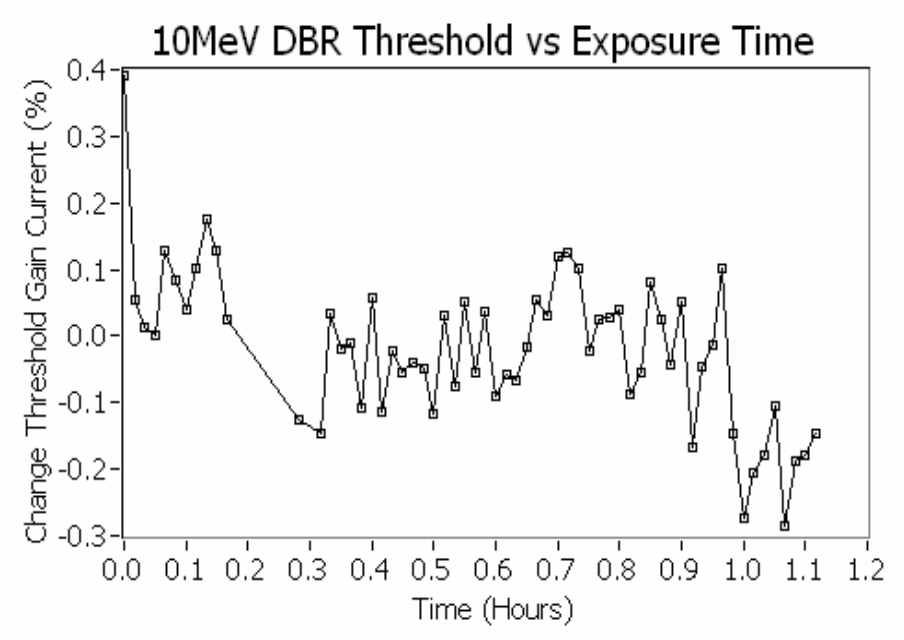


50 MeV

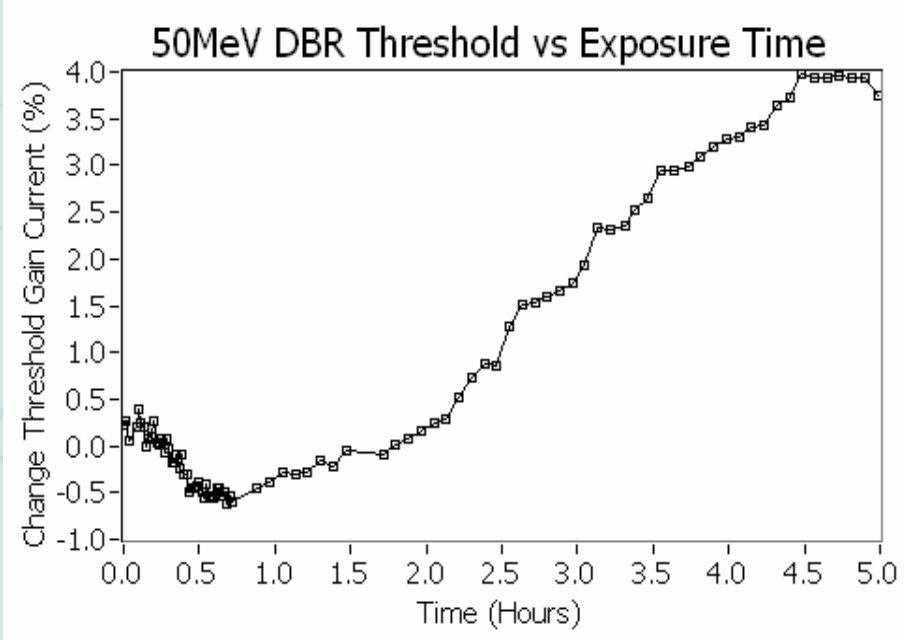


Threshold Deterioration (DBR)

10 MeV

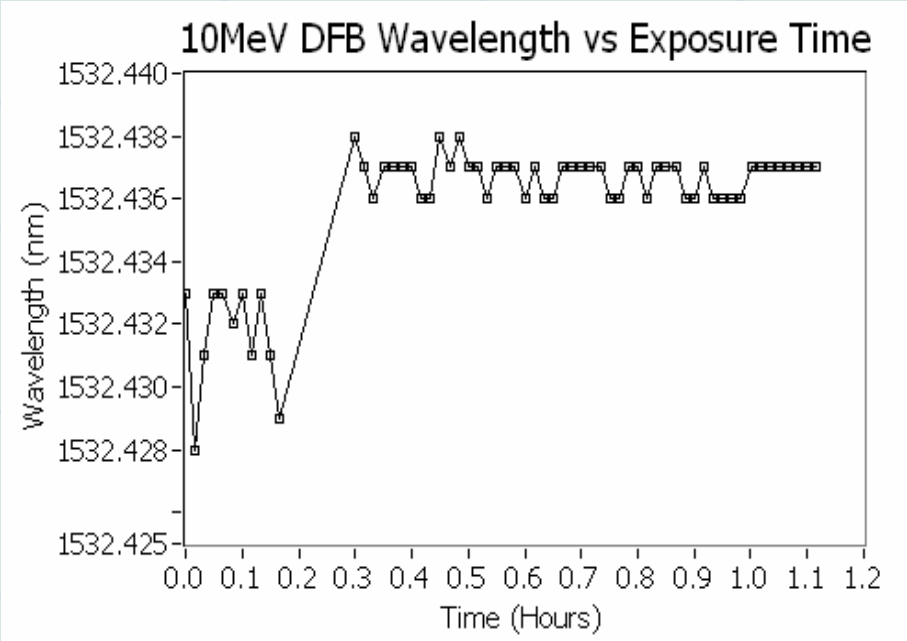


50 MeV

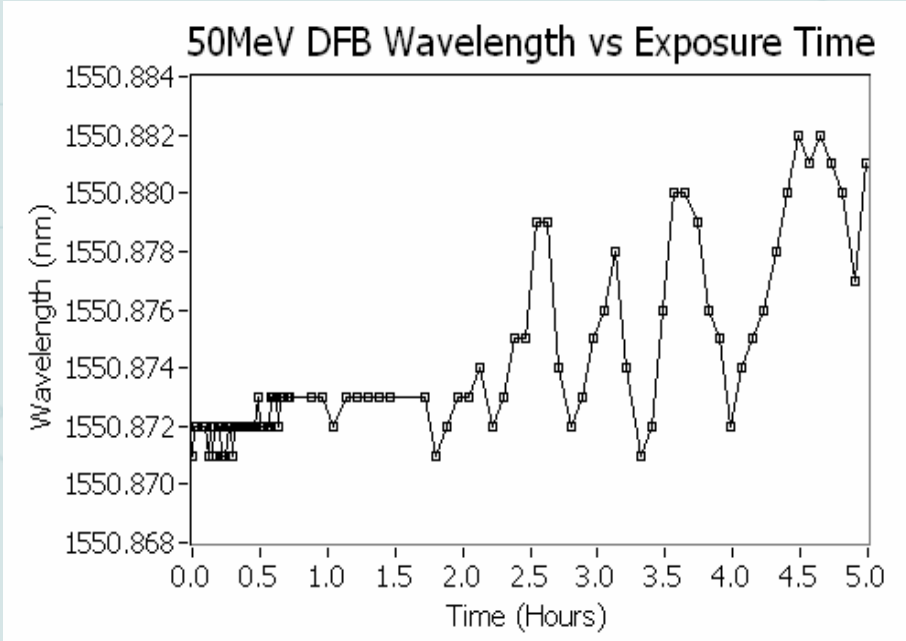


Wavelength Shift (DFB)

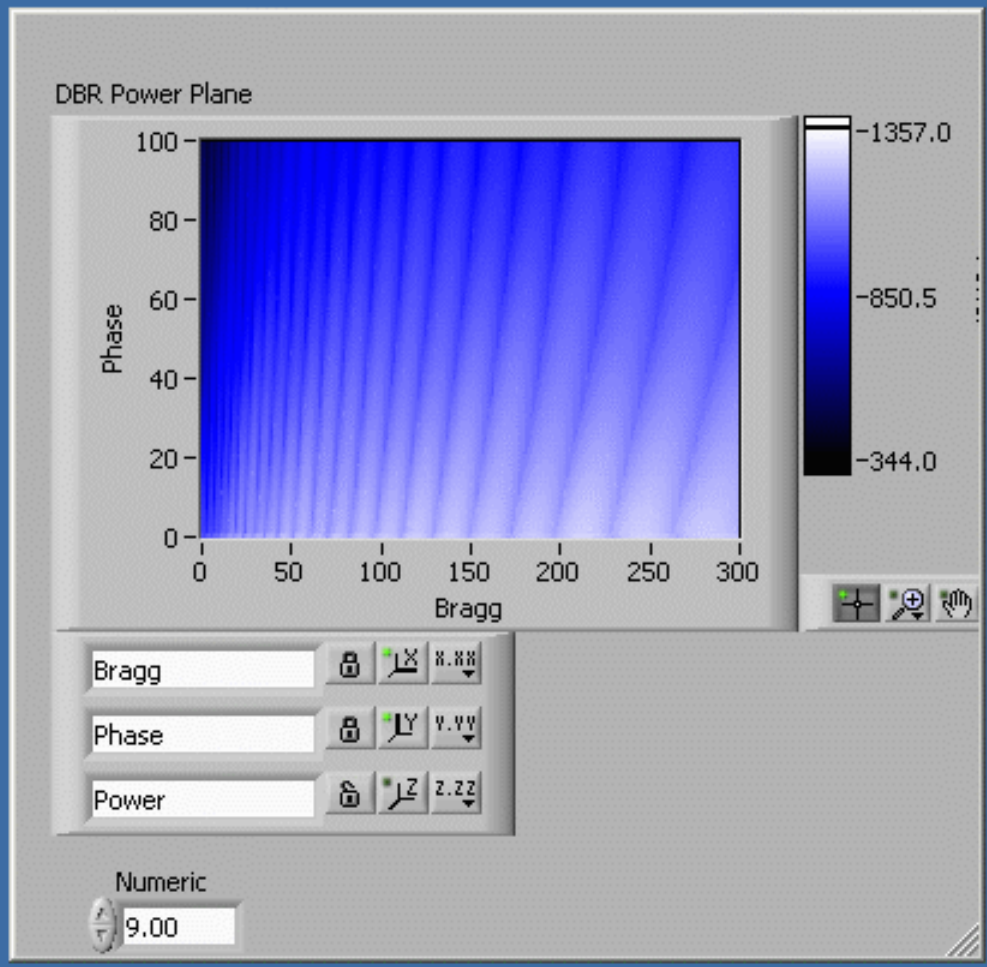
10 MeV



50 MeV

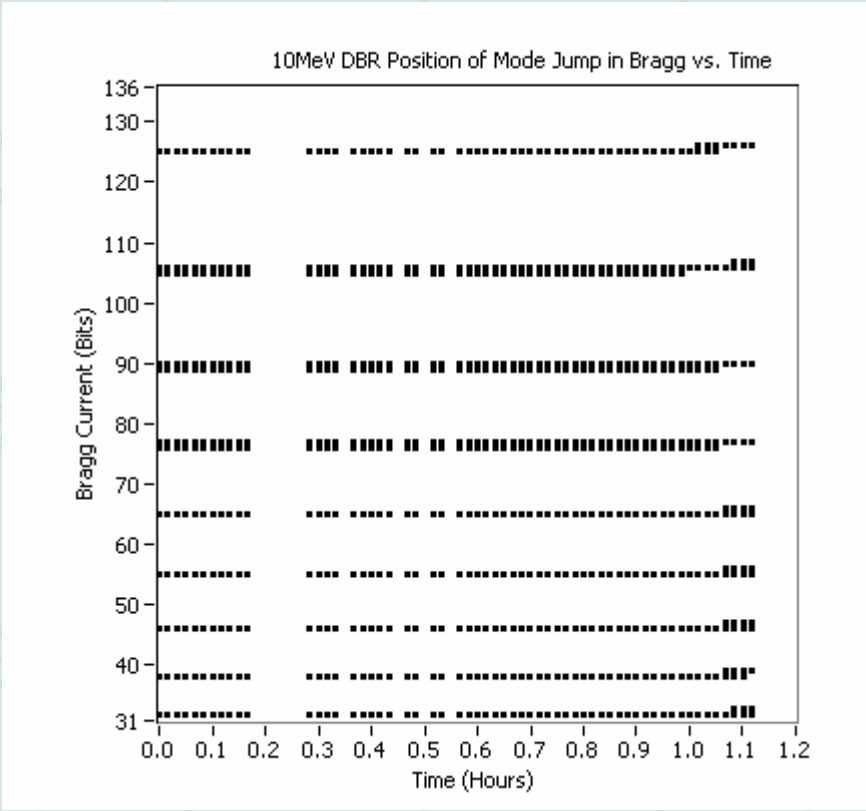


DBR Modal Structure

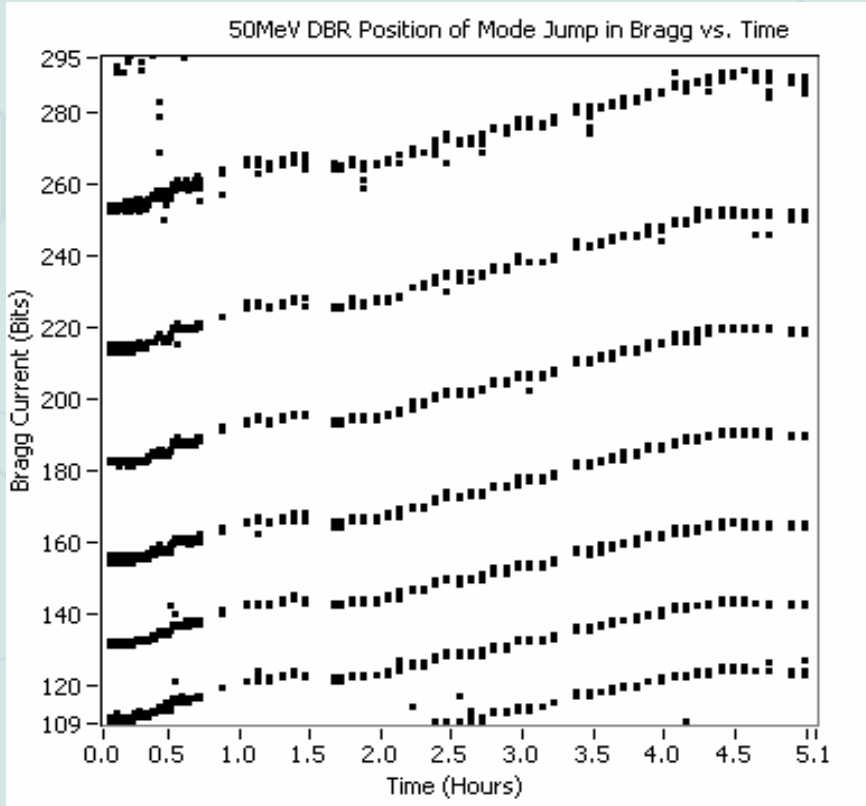


Mode Jump Movement (DBR)

10 MeV



50 MeV



Radiation Assessment

- The tests indicate minimal deterioration of tunable lasers at low exposure (10 MeV).
- Modest degradation in the lasing threshold of both device types at high exposures.
- Inceasing wavelength instability (10pm) of DFB with increasing exposure (>$1x10^{13}$ cm^{-2}, 50 MeV).
- Modal structure of the DBR laser is preserved despite high energy exposures.
- Final analysis is not completed. Expected Nov 2005.