ABSTRACT

INJECTION SEEDING OF A Q-SWITCHED ALEXANDRITE LASER: STUDY OF FREQUENCY STABILIZATION

INTERN: LAMARR A. BROWN

MENTOR: GEARY SCHWEMMER

COORDINATOR: Dr. CLINTON LEE

AlGaAs diode lasers were used to injection seed a pulsed Q-switched alexandrite laser which produced a narrowband of radiation. Injection seeding is a method for achieving linewidths of less than 500 MHz in the output of broadband, tunable solid state lasers. Also, injection seeding made the frequency of the pulsed, Q-switched alexandrite laser stabilize. The AlGaAs diode lasers are available in wavelengths from 760 to 770 nm in the oxygen A band, which was used for the lidar remote sensing of atmospheric pressure and temperature. When the diode laser was set at a current of 59.8 mA and a temperature of 14.04 C, the wavelength was 767.6 nm. The average full width at half the maximum (AVG. FWHM) was 0.007 $\pm$ 0.001 cm^{-1} and the change in wavenumber was 0.045 cm^{-1}. When seeding the pulsed Q-switched alexandrite laser, the AVG. FWHM was 0.035 $\pm$ 0.009 cm^{-1} and the change in wavenumber was 0.021 cm^{-1}. The Q-switched alexandrite laser was injection seeded and frequency stabilization was studied. The linewidth requirement was met, but the stability requirement do to drifting in the feedback voltage to the laser diode was not. Improvements to the injection seeding of a Q-switched alexandrite laser should focus on increasing the feedback voltage to the laser diode, filtering the laser diode by using temperature controlled narrowband filters, and the use of diamond (SiC) grating placed inside the alexandrite laser's resonator cavity.

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BY

LAMARR A. BROWN
HOWARD UNIVERSITY, WASHINGTON D.C. 20059

GEARY K. SCHWEMMER
CODE 917, LABORATORY FOR ATMOSPHERES
NASA/GODDARD SPACE FLIGHT CENTER

COORG PRASAD
CODE 917, UNIVERSITIES SPACE RESEARCH ASSOCIATION
NASA/GODDARD SPACE FLIGHT CENTER

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OUTLINE

— *LIDAR (LIGHT DETECTION AND RANGING)*

- *USED IN THE STUDIED OF ATMOSPHERIC PRESSURE AND TEMPERATURE*
- *Q-SWITCHED ALEXANDRITE LASER*
- *INJECTION SEEDING*

— *WAVEMETER*

- *USED IN DETERMINING FREQUENCY STABILIZATION*

— *MEASUREMENT OF He-Ne (CALIBRATION), DIODE LASER, AND SEEDED Q-SWITCHED ALEXANDRITE LASER*

CONCEPT

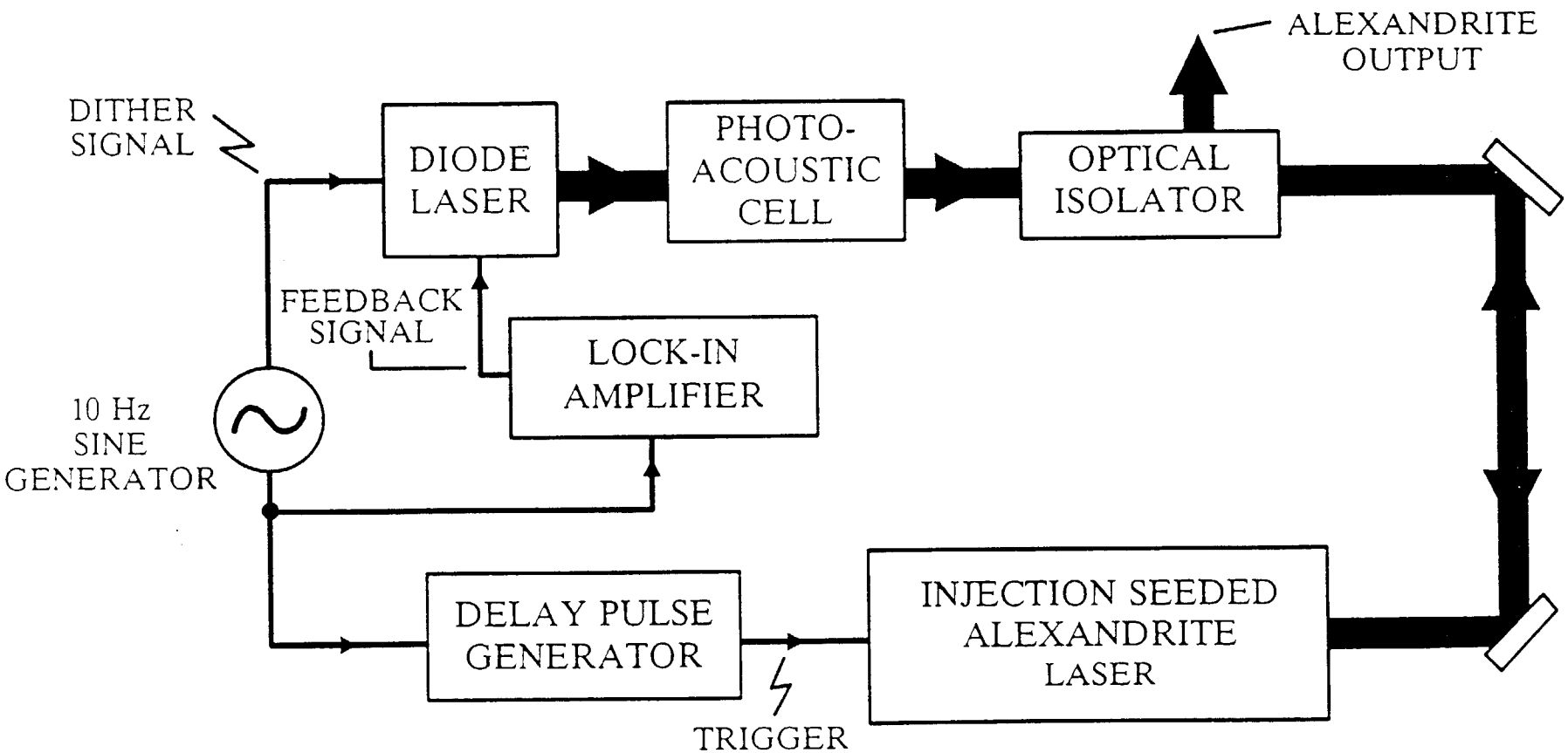
DIODE LASERS - LOW POWER, SINGLE MODE, CW

FREQUENCY STABILIZED - LOCKED TO ATMOSPHERIC ABSORPTION LINES

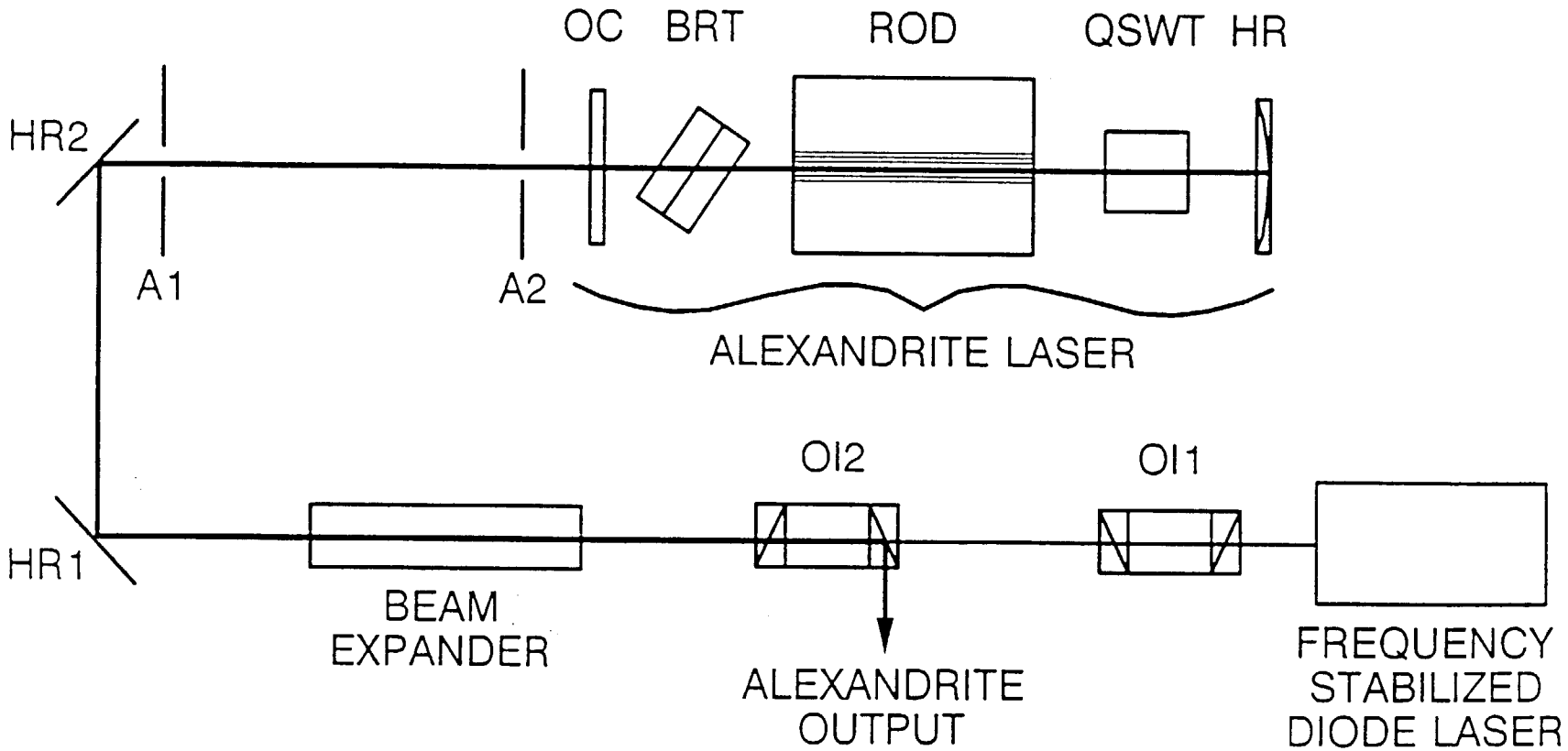
PURPOSE/ADVANTAGES:

- INJECTION SEED PULSED LASERS
- FREQUENCY STABILIZE INTERFERENCE FILTERS
- ABSOLUTE FREQUENCY REFERENCE

PULSED LASER FREQUENCY STABILIZATION



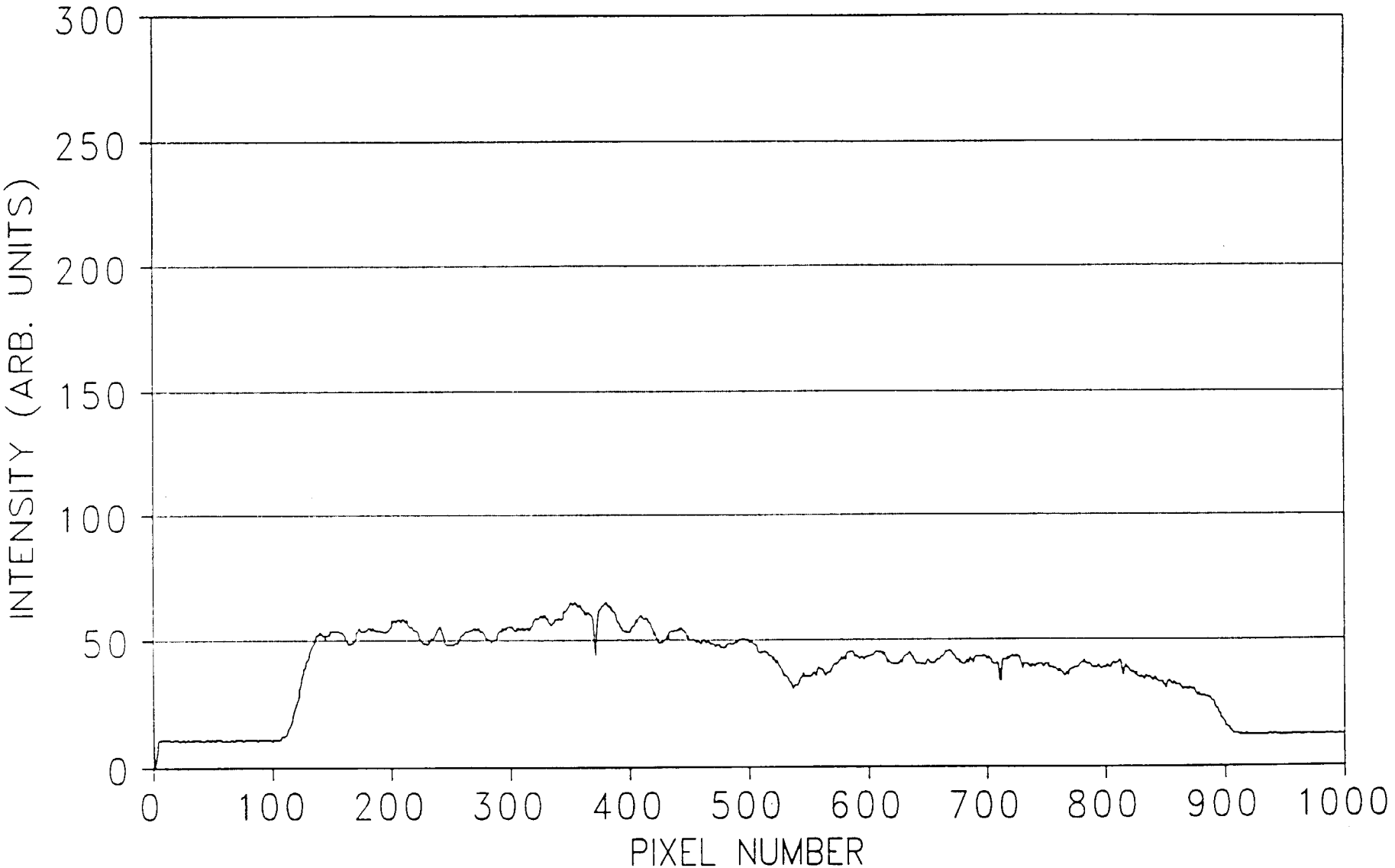
F71.001


OC
BRT
ROD
QSWT
HR
HR2
A1
A2
ALEXANDRITE LASER
OI2
OI1
HR1
BEAM
EXPANDER
ALEXANDRITE
OUTPUT
FREQUENCY
STABILIZED
DIODE LASER

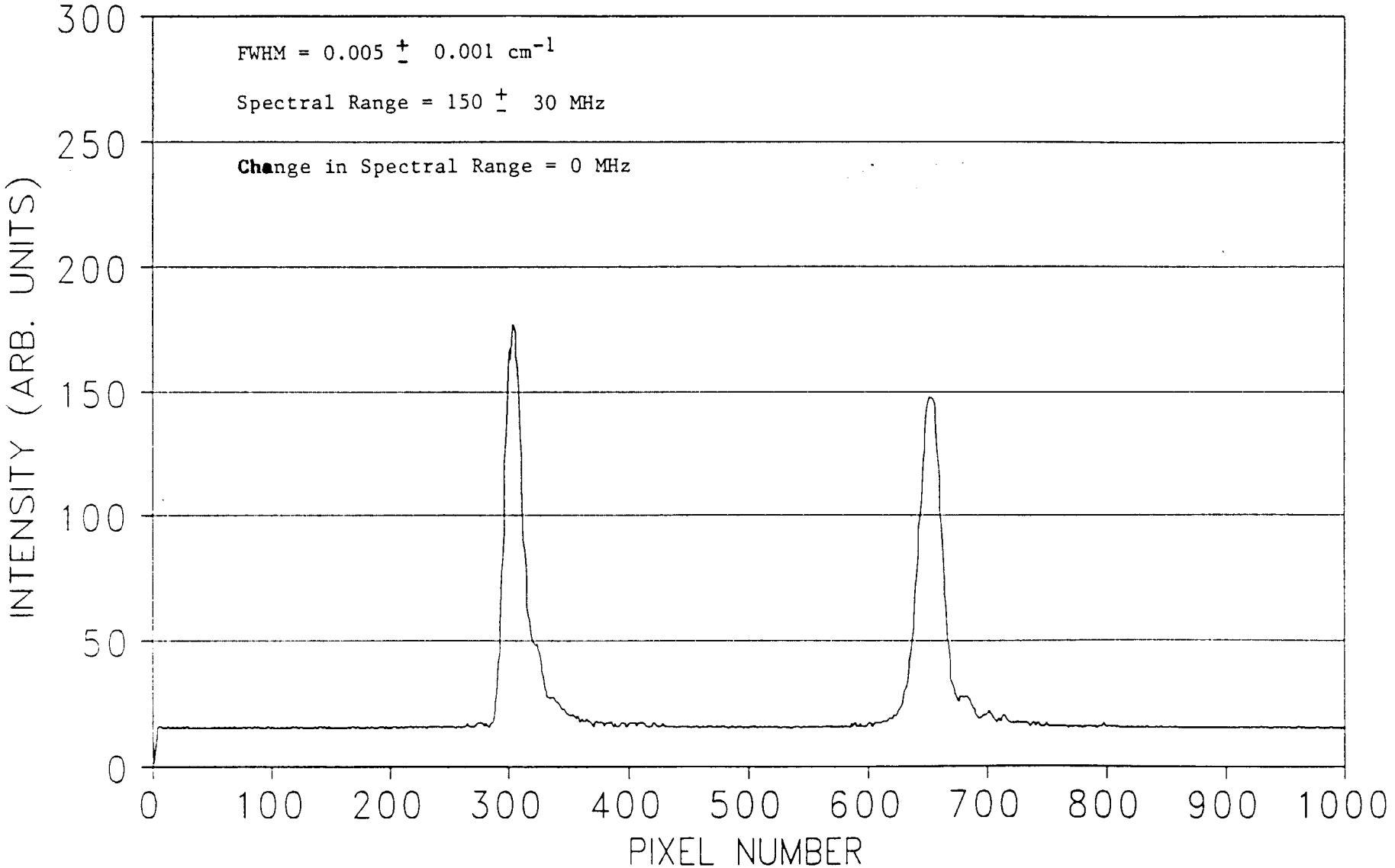
F278.003

ALEX.710

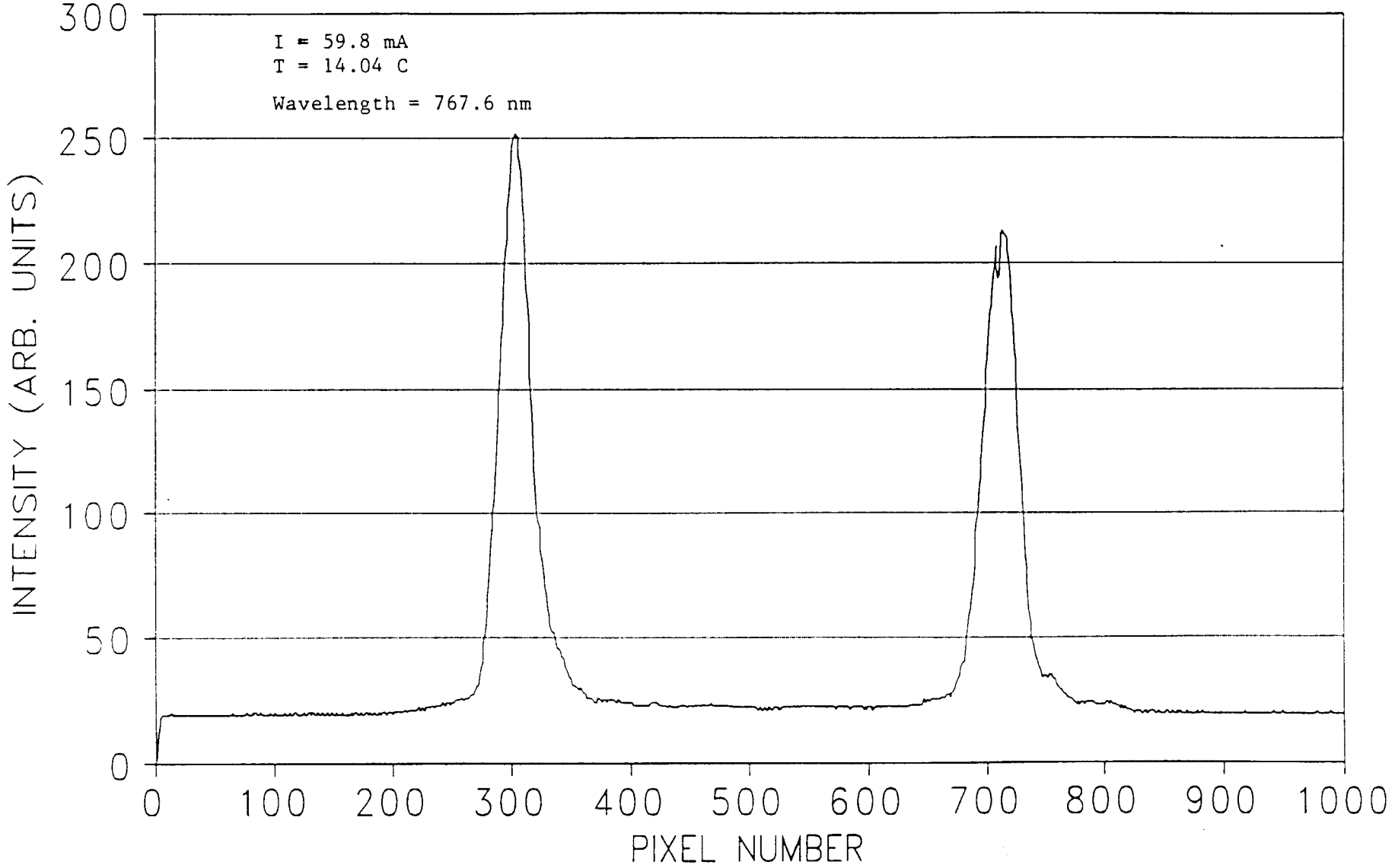
AVG. DATA



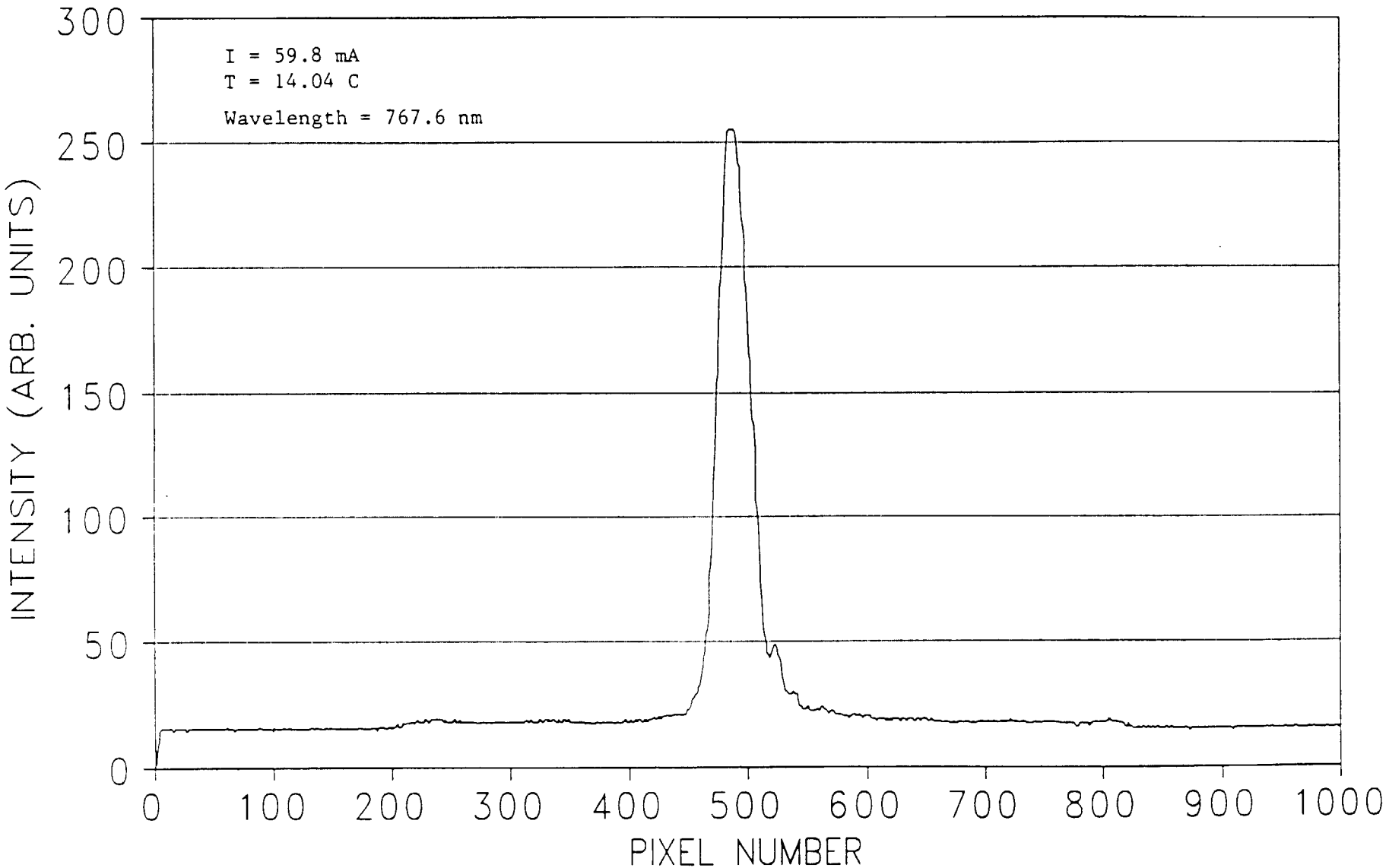
HENE627
AVG. DATA



DIOD628.1
AVG. DATA



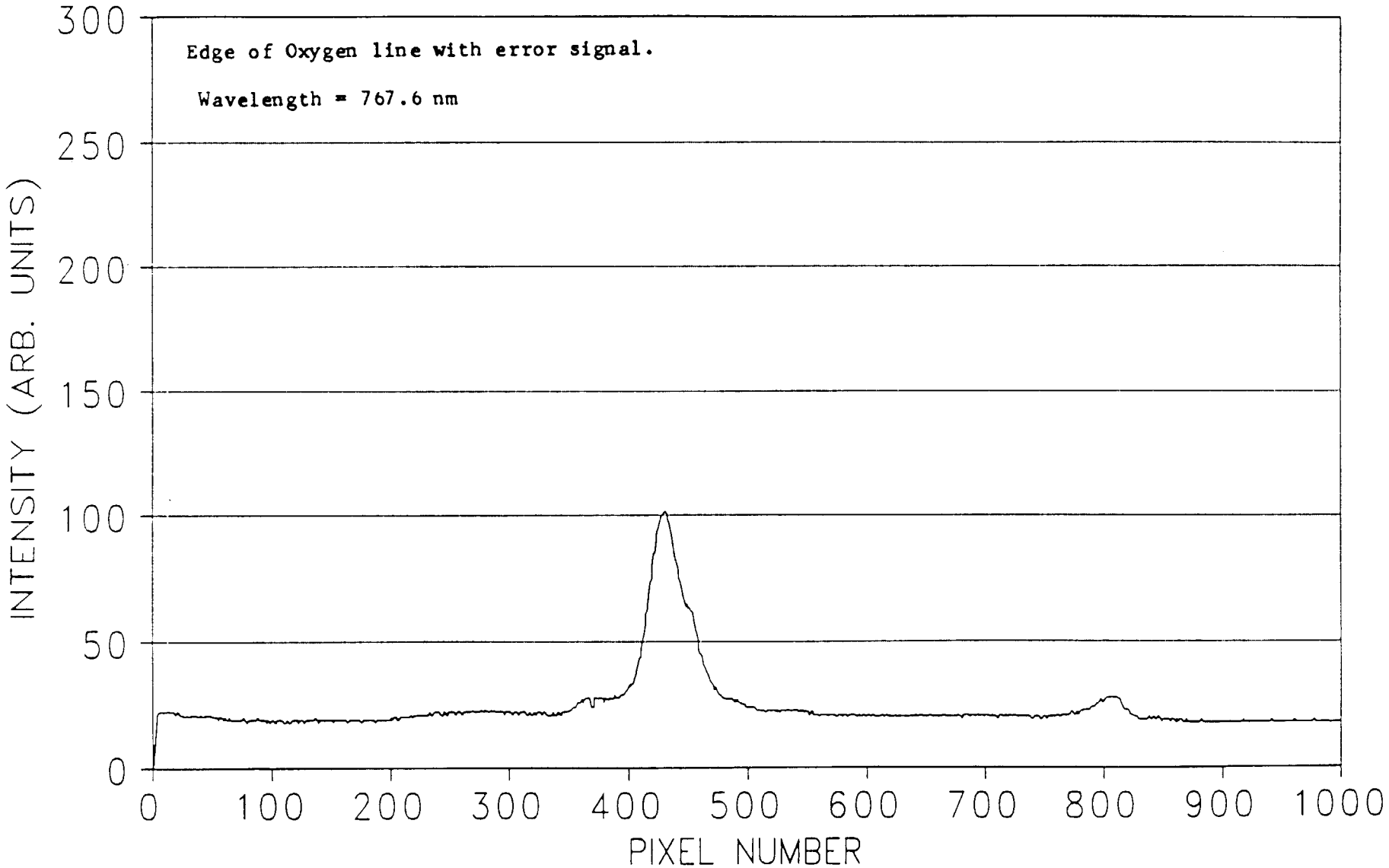
DIOD628.2
AVG. DATA



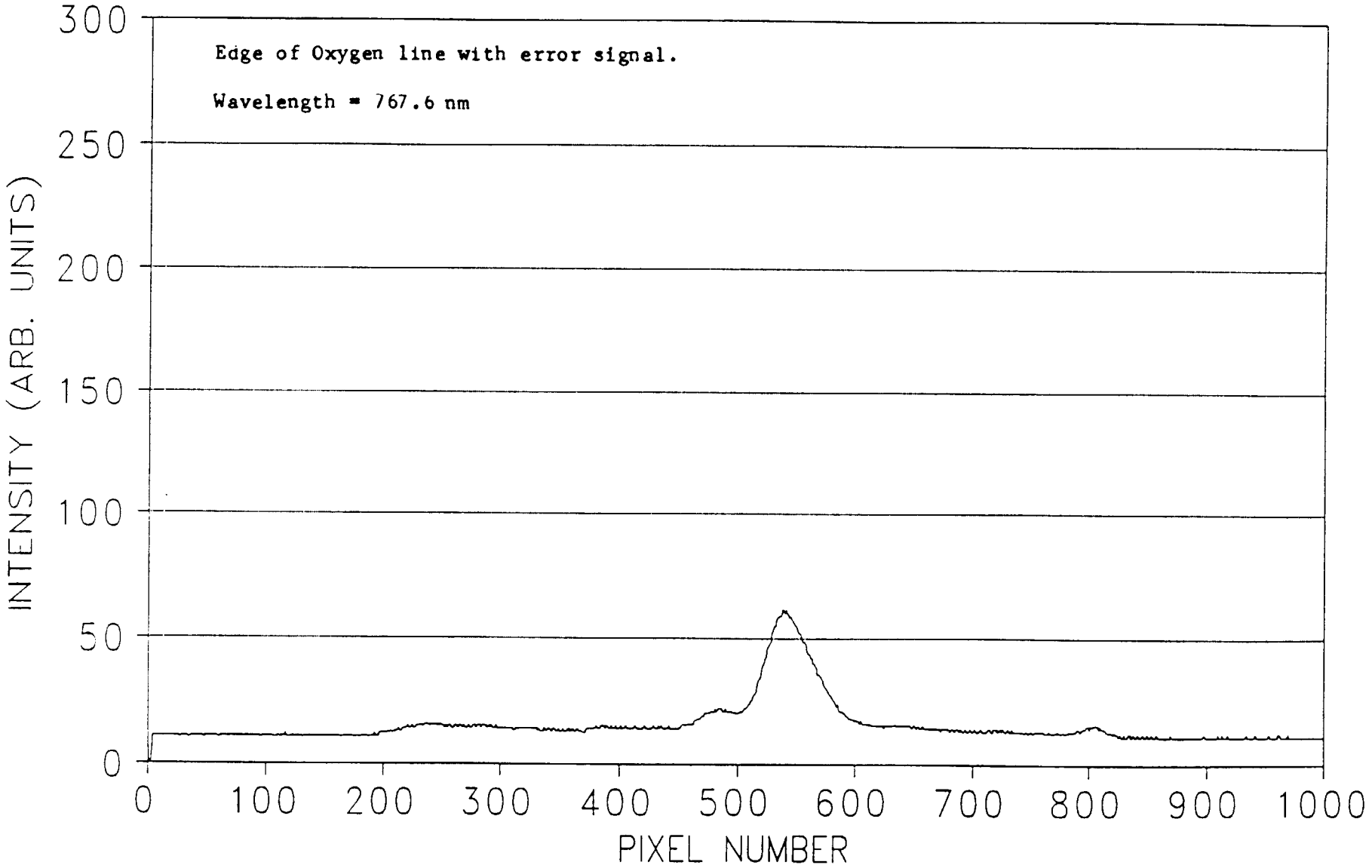
LASER DIODE	AVG. FWHM (cm**-1)	SPECTRAL RANGE (MHz)	CHANGE IN WAVENUMBER (cm**-1)	CHANGE IN SPECTRAL RANGE (MHz)
DIOD627.X I = 60.0 mA T = 14.05 C WAVE- LENGTH = 766.0 nm	0.009 ± 0.001	270 ± 30	0.010	300
DIOD628.X I = 59.8 mA T = 14.04 C WAVE- LENGTH = 767.6 nm	0.007 ± 0.001	210 ± 30	0.045	1350
*DIOD709.X T = 10.89 C WAVE- LENGTH = 759.5 nm	0.008 ± 0.001	240 ± 30	0.003	90
**DIOD710.X I = 60.5 mA T = 10.83 C WAVE- LENGTH = 759.6 nm	0.008±0.001	240 ± 30	0.027	810
**DIOD716.X WAVE- LENGTH = 760.4 nm	0.007 ± 0.001	210 ± 30	0.005	150

* For DIOD709.X I = 60.7 mA ; *New Laser Diode; **Same current and Temperature.

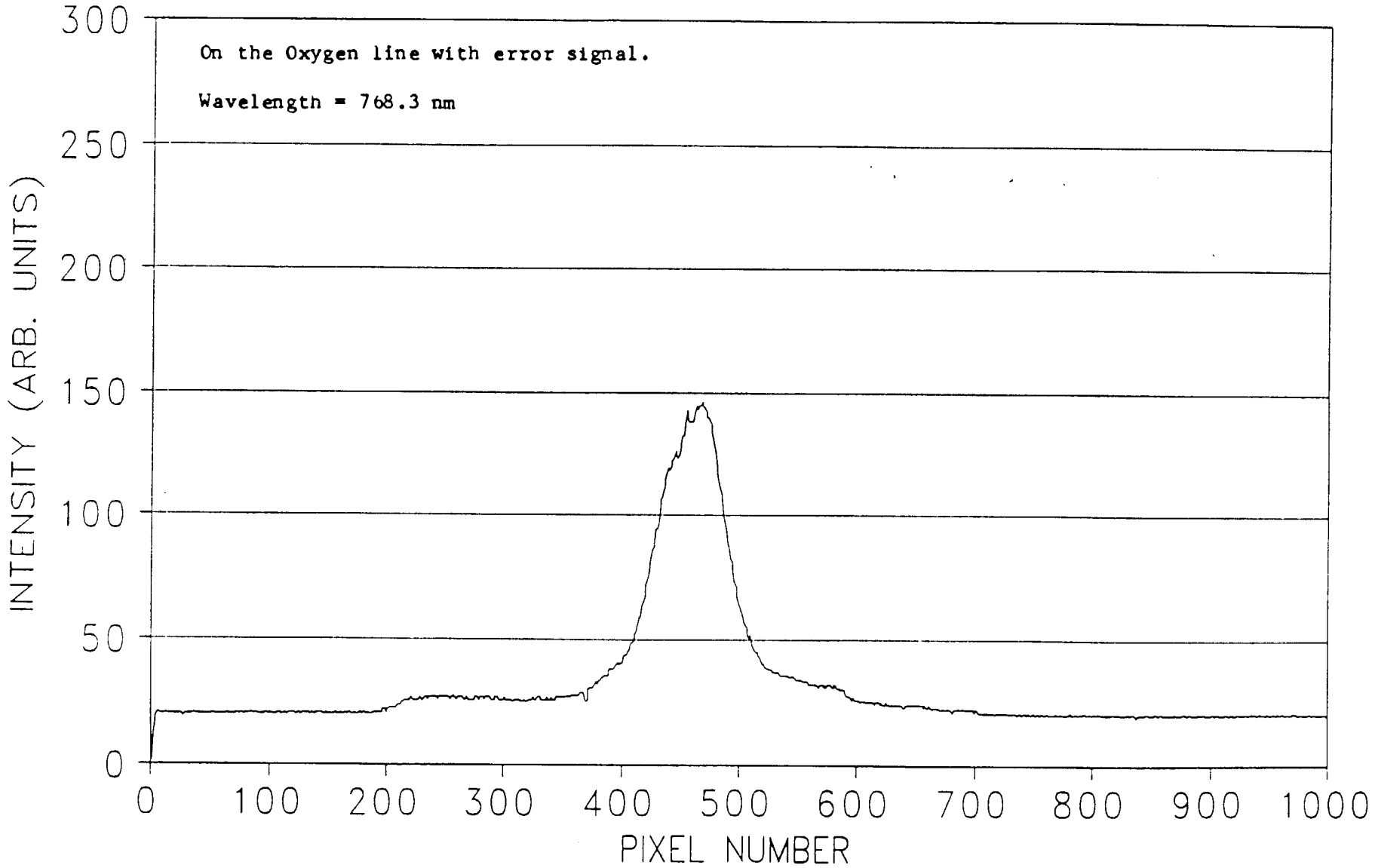
SEED628.1
AVG. DATA



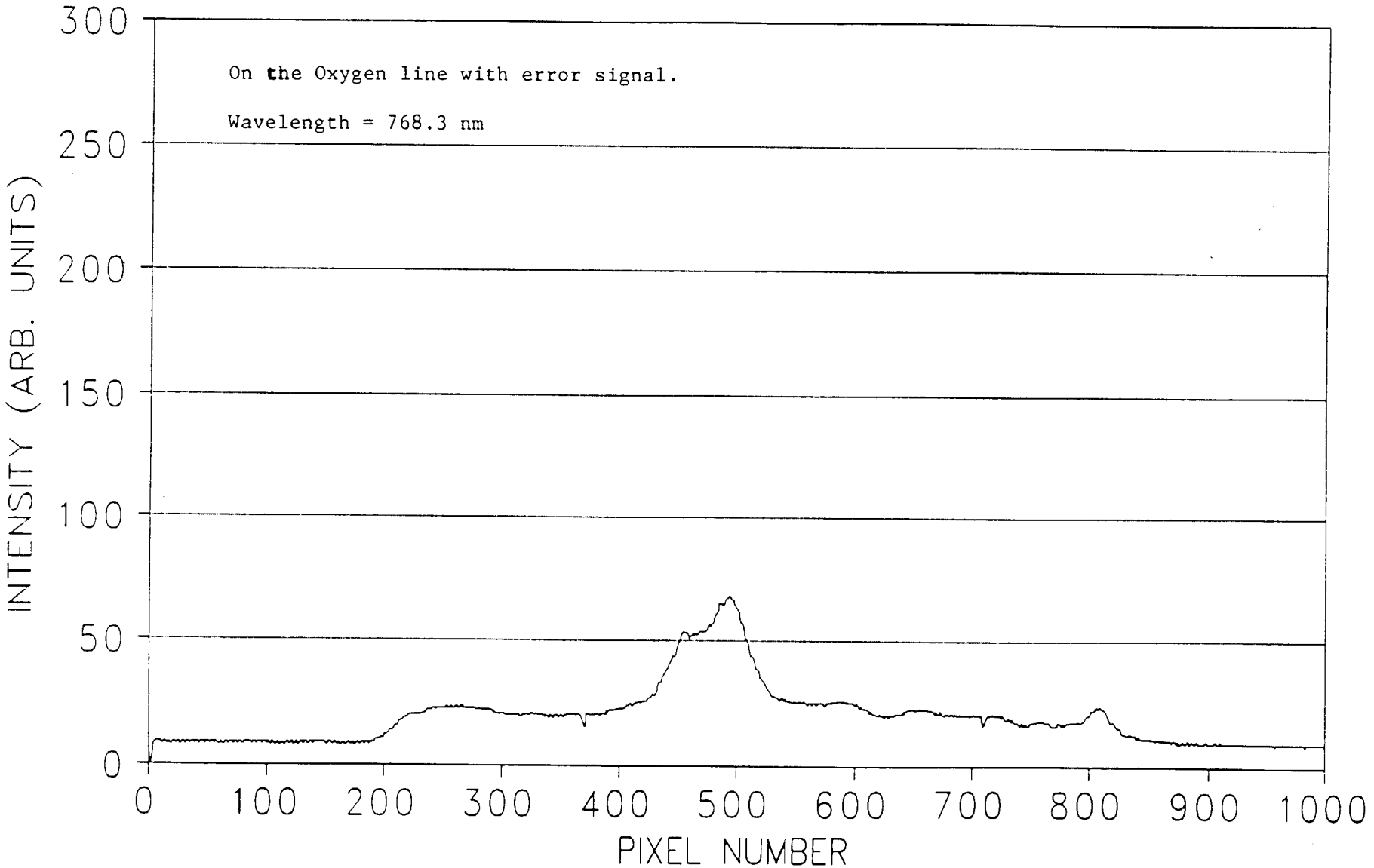
SEED628.4
AVG. DATA



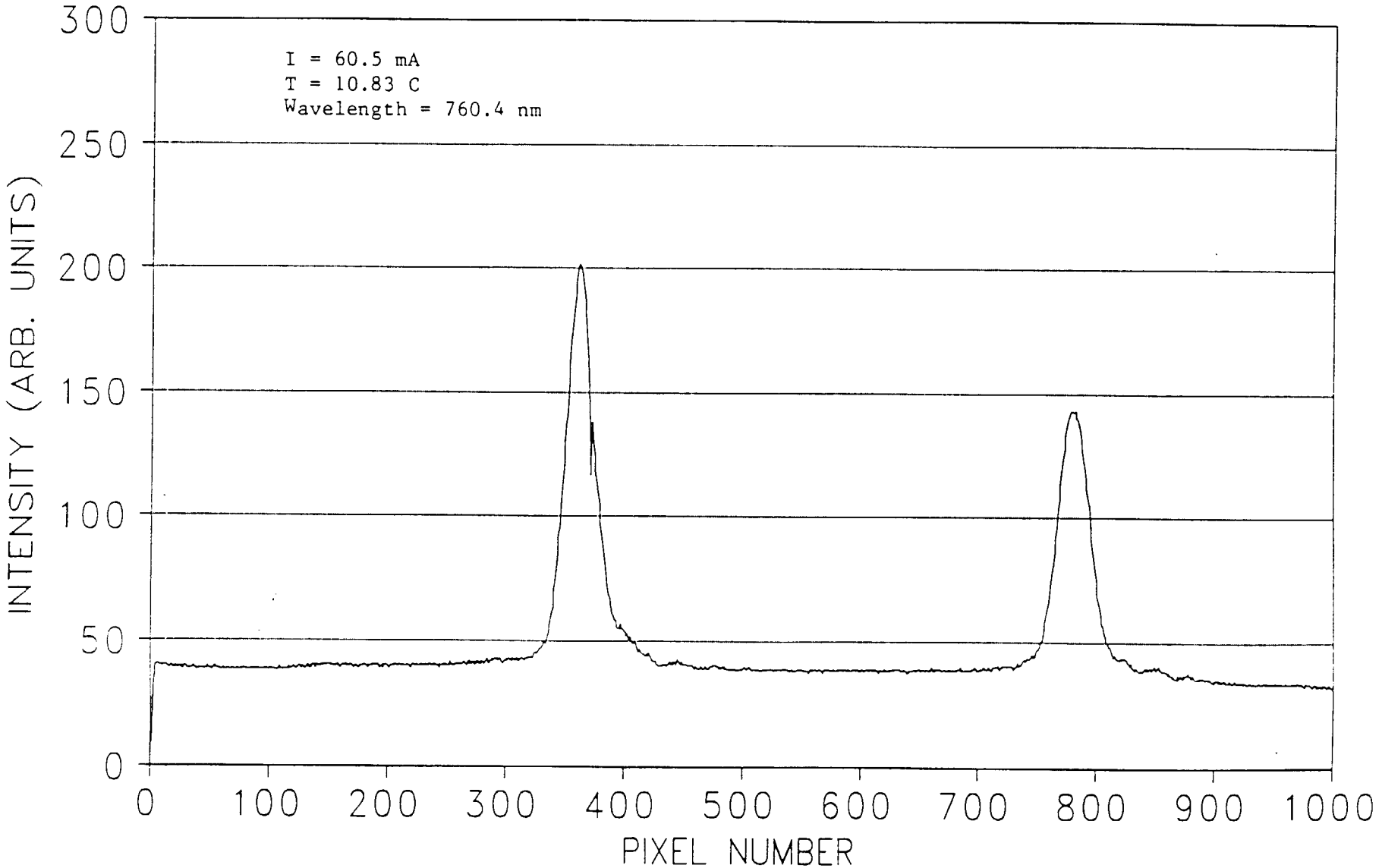
SEEDN702.1
AVG. DATA



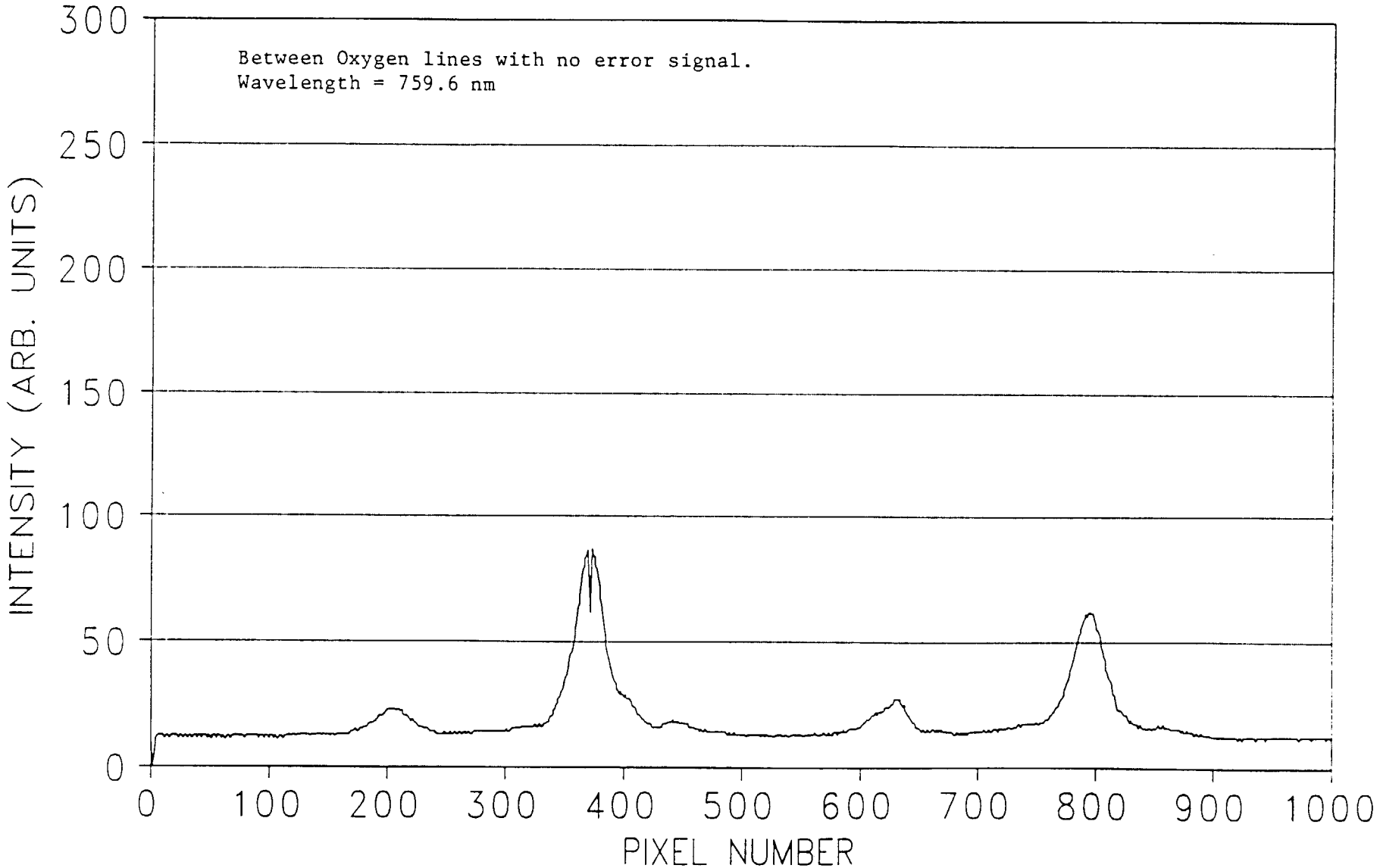
SEEDN702.7
AVG. DATA



DIOD7 16.1
AVG. DATA



SEED7 10.5
AVG. DATA



SEED LASER	AVG. FWHM (cm**-1)	SPECTRAL RANGE (MHz)	CHANGE IN WAVENUMBER (cm**-1)	CHANGE IN SPECTRAL RANGE (MHz)
SEED628.X WAVE-LENGTH = 767.6 nm EDGE OF OXYGEN LINE WITH ERROR SIGNAL	0.014 ± 0.003	420 ± 90	0.027	810
SEEDN628.X WAVE-LENGTH = 767.6 nm ON THE OXYGEN LINE WITH ERROR SIGNAL	0.035 ± 0.009	1050 ± 270	0.021	630
SEEDN702.X WAVE-LENGTH = 768.3 nm ON THE OXYGEN LINE WITH ERROR SIGNAL	0.018 ± 0.007	540 ± 210	0.007	210
*SEED710.X WAVE-LENGTH = 759.6 nm BETWEEN OXYGEN	0.008 ± 0.002	240 ± 60	0.030	900

*shows several modes.

CONCLUSIONS:

— *SUCCESSFUL INJECTION SEEDING OF ALEXANDRITE LASER*

— *MET THE LINEWIDTH REQUIREMENT*

- *BUT FAILED STABILITY REQUIREMENT - DRIFTING*

— *IMPROVEMENTS TO INJECTION SEEDING Q-SWITCHED ALEXANDRITE LASER:*

- *INCREASED FEEDBACK VOLTAGE TO THE LASER DIODE*
- *FILTER LASER DIODE*
  - *TEMPERATURE CONTROLLED NARROWBAND FILTERS*

— *ALEXANDRITE LASER:*

- *DIAMOND GRATING (SiC, GROOVED BY EXCIMER LASER)*