NSF Proposal: "Experimental Gravitational Research with LIGO"

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Goals of Experimental Program

- Short-term
  - analysis of microseismic data
  - analysis of first gravity gradient measurements
  - design next gravity gradient configuration
  - move, install and turn on MIT SIM at LaTech
- Long -term
  - make more elaborate, finer-grained gravity gradient measurement
  - determine seasonal variation of micro-seismic peak
  - establish program of LIGO residual gas research at LaTech

Funding Requests

- Support for PI, 2 Co-PI's, 1 postdoc, 2 grad. Students, and 2 undergraduate students
- Annual budget: ~$170 k

Microseismic Peak

- represents the maximum noise amplitude for which the servo-control feedback in the seismic isolation system must compensate
- at the LLO, this critical design specification is based on a one-time set of seismology measurements taken over a short period of time
- characterization of the microseismic peak seasonal variations at the LLO is needed

Gravity Gradient Noise

- ambient ground motion density fluctuations, which give rise to fluctuating Newtonian forces on the mirrors: a source of noise in the interferometer
- not a major noise source for LIGO I, it limits the sensitivity at low frequencies in advanced LIGO interferometers

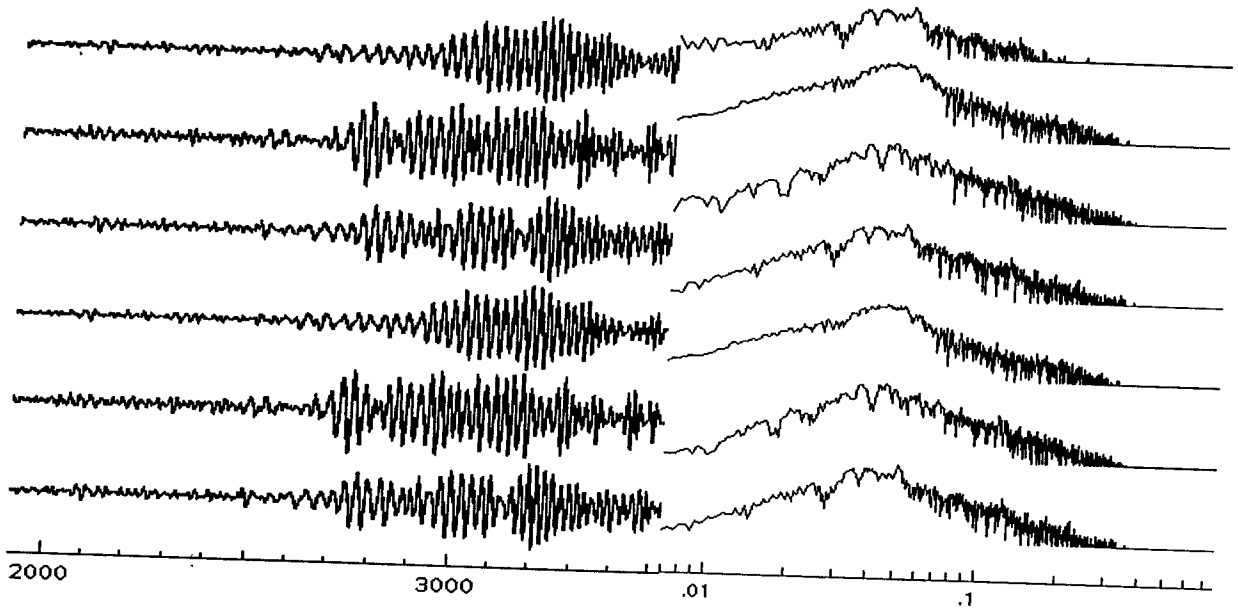
Measurements during 1999

- Grant for support during summer and fall
- PASSCAL (Program for the Array Seismic Studies of the Continental Lithosphere)
- 4 Guralp CMG-3ESP's
  - sensitivity of 2000 V/m/s (2.5 x CMG-40T)
  - excellent for f < 1 HZ, i.e., microseismic noise
  - overkill for gravity gradient noise (1-30HZ)

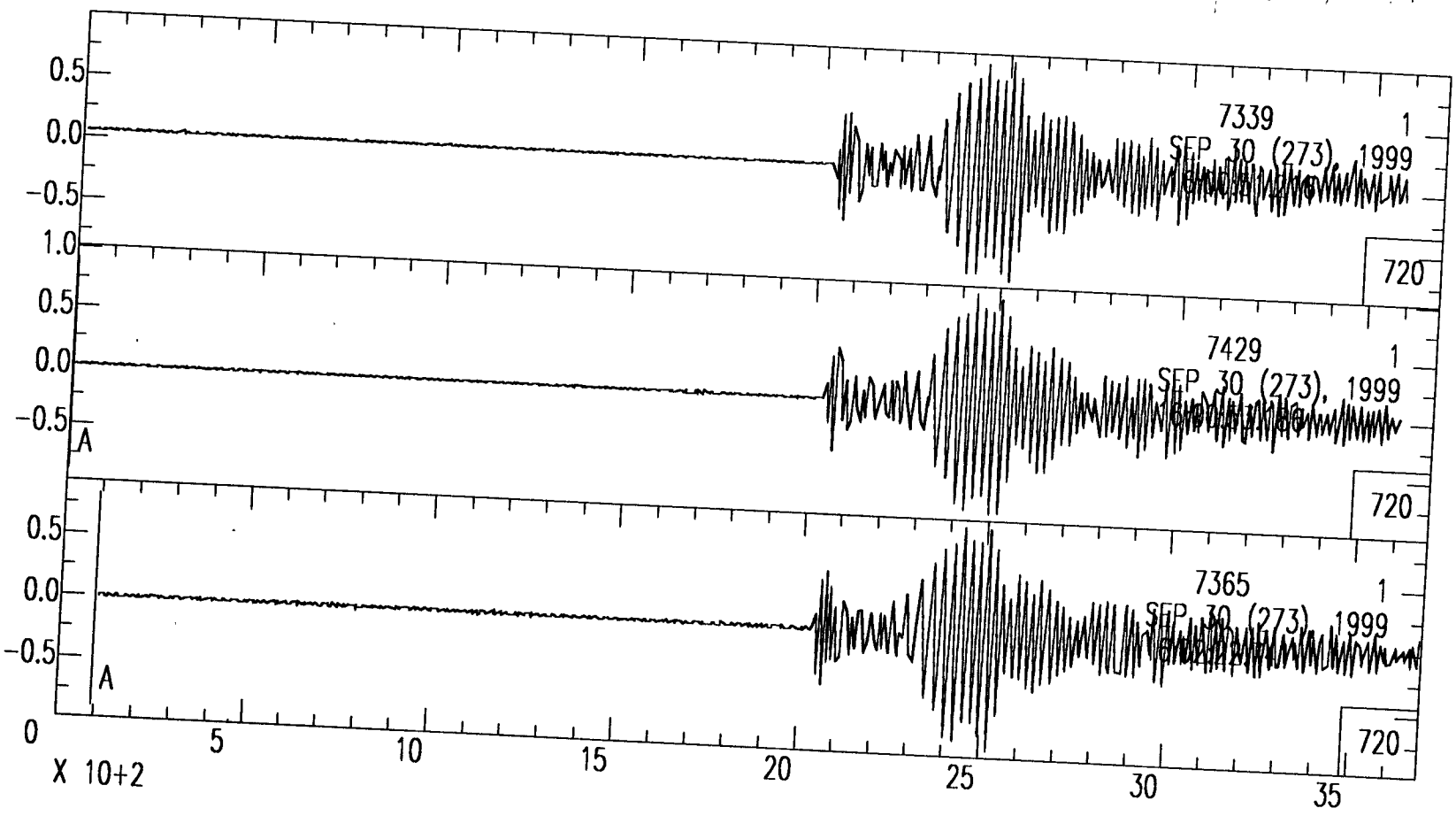
Data

Dates	Config	7339	7429	7440	7365
6/24-7/6	Huddle	SES	SES	SES	SES
7/7-7/12	Micro-I	SES	SES	Corner tunnel	WES
8/6-8/9	Grav. Grad. I	Stag. Area	Stag. Area	Stag. Area	Stag. Area
8/19-8/30	Grav. GradII	Tri. Center	Tri. Pt. 2	Tri. Pt. 1	Tri. Pt. 3
9/29-10/5	Micro-II	LVEA	SES	WES	EXT.

Data from Earthquake in Turkey
Time and power series

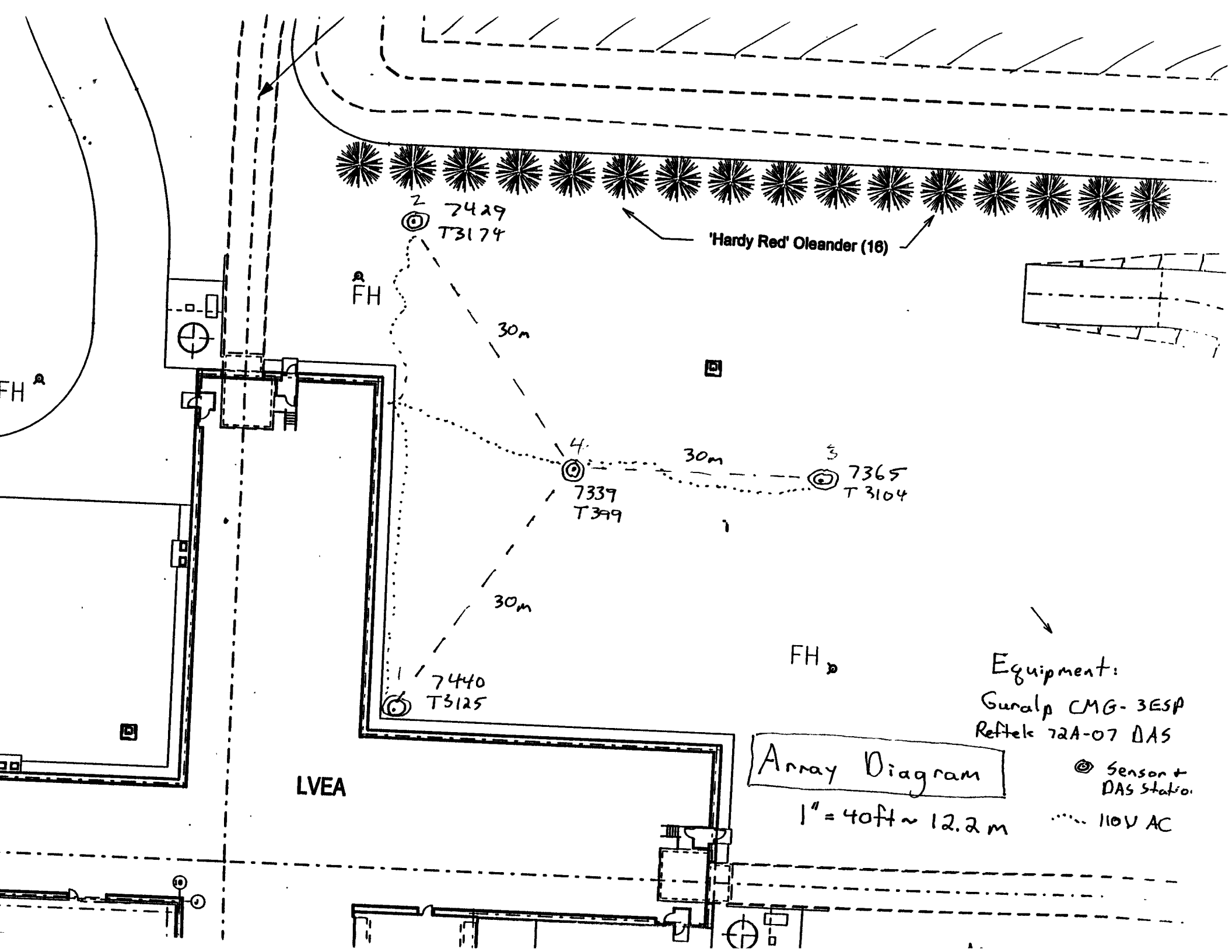


Mexican Earthquake - Sept. 30, 1999



Speed and Wavelength Ranges in the Grav. Grad. Spectral Region

Freq. (HZ)	Speed (m/s)	Wavelength (m)
3	300-3000	100-1000
10	250-3000	25-300
30	200-20000	7-70


2
7429
T3174
'Hardy Red' Oleander (16)
FH
30m
FH
4
30m
3
7365
T3104
7339
T399
30m
1
7440
T3125
FH
LVEA
Equipment:
Guralp CMG-3ESP
Reftek 72A-07 DAS
Array Diagram
1" = 40ft ~ 12.2 m
Sensor + DAS Station
110V AC