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# Proposal to NSF: “Research in Gravitational Wave Detection with LIGO”

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# Outline

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History of the Syracuse group

Proposed Work

Personnel

Budget

# History of the Syracuse group

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**Funded since Aug 1991.**

present funding level about \$300k/yr.

**Research on thermal noise in interferometers:**

- fluctuation-dissipation theorem
- materials properties relevant to thermal noise

**Highlights:**

- demonstration of F-D Thm for internal friction
- world's highest  $Q$  of fused silica
- first measurements of mirror coating internal friction

# LIGO I participation

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## Charter members of LIGO I Working Group.

- During 2000, P.I. served as LLO Interferometer Commissioning Leader
- P.I. continued visits to LLO through 1st half of 2001, at 1 week/month duty cycle.  
to resume starting with E7
- P.I. co-chairs the Upper Limit Group for Burst Signals  
with Sam Finn
- Postdoc Steve Penn active in DetChar WG

# Theme of present proposal

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We would like to shift from fundamental research on thermal noise to an emphasis on *the search for gravitational waves with LIGO I.*

Aspects of the proposed program:

- role in operation of LIGO I interferometers
- data analysis, especially vetoes for burst search
- supporting experiments at Syracuse
- develop LIGO teaching laboratory

We plan to send 3 members of the group to LLO @ 1 week/month (3/4 FTE .)

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# Help in operating LIGO I

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## Help with remaining commissioning

Our expertise is strongest on suspension- and vibration-related issues

Near term: LLO seismic noise fix(es)

## Commitment to manning Science Run shifts

3/4 FTE approximates commitment expected of LIGO Lab members

## DetChar in support of data analysis

search for transient “spurions”

study of global correlations of PEM signals

# Data analysis for bursts

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## Burst search has several steps:

scientific goal, filter design, interferometer diagnostics, event analysis (coincidences and vetoes), and scientific interpretation

We propose to focus on *ways to rule out candidate burst events*.

Understand interferometer.

Optimize monitor software.

Sort transients: spurions vs. candidates.

Use knowledge to improve interferometer.

# Supporting experiments at Syracuse

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To help us understand anomalies in interferometer behavior.

Install copies of LOS and SOS (LIGO I) suspensions, and equip them with Gretarsson's violin mode sensor.

Search for burst noise in pendulum wires.

Available for other experiments.

- 2 bell jars @ 1.0m tall by 0.75m diam
- 1 bell jar @ 1m by 0.4m
- several smaller chambers



# “Physics of LIGO” Teaching Lab

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## Develop lab exercises for LIGO technology

- pendulums
- Michelson interferometers
- Fabry-Perot cavities
- vibration isolation
- feedback
- thermal noise and shot noise

If this development succeeds, we'll propose in future to run an annual 1- or 2-week School.

# Personnel

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Propose to keep the group at its present size:

P.I., 2 postdocs, and 2 Ph.D. students

P.I. and postdocs to each spend 1 week/month at LLO.

Turnover:

(postdoc Gregg Harry went to MIT at start of 2001)

postdoc Steve Penn expects to leave this year, as do both Ph.D. students

only postdoc Sasha Ageev to remain from present staff

# Budget

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Proposing \$440 k to \$450 k/yr for 3 years

Large items:

## Equipment

Year 1 has \$40 k for DMT computing equipment

Year 2 has \$15 k for computers, \$13 k for pump upgrade

Year 3 has \$25 k for equipment for LIGO Teaching Lab

## Travel

about \$50 k per year for travel of 3 personnel to LLO

Cost sharing from SU: \$20 k/yr

\$10 k/yr for Teaching Lab development

\$10 k/yr in grad student tuition

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