Proposal to add 1 senior member to the Embry-Riddle Aeronautical University MOU with the LSC

Michele Zanolin
ER Gravitational Wave Astrophysics Group
(ERGWAG)

LIGO-070514-00-Z

- 4-year undergraduate institution specializing in science related to aerospace (~30 degree programs).

- Two residential campuses:
  Daytona Beach, FL, Prescott, AZ.

- Prescott campus has 10 full-time physics faculty (4 new hires this year !):

  2 GW-detection (LIGO),
  4 Observational Astronomy,
  1 Neutrino physics (MiniBoone),
  1 Remote sensing (Orbit tracking/effects/debris),
  1 Cosmology (theory)
  1 only teaching.

- Approx. 1700 students on Prescott campus of which approx. 80 are Space Physics majors.

- Faculty and Administration place great emphasis on participation of undergraduates in research.

Who is ERGWAG?

- ## Andri M. Gretarsson, *Asst. Prof. Physics*

- *Coating "Brownian" thermal noise*

- *Coating thermo-optic noise*

- *Non-gaussian sources of mechanical noise*

- *2-3 Undergraduates mainly from the ERAU's Space Physics Program*

- ## *Michele Zanolin, Asst. Prof. Physics (NEW ADDITION)*

- *All sky high frequency burst search*

- *Non-Gaussian sources of mechanical noise (overlap with A.G.)*

- *Adaptation of sonar techniques to the GW parameter estimation*

- *2-3 Undergraduates mainly from the ERAU's Space Physics Program*
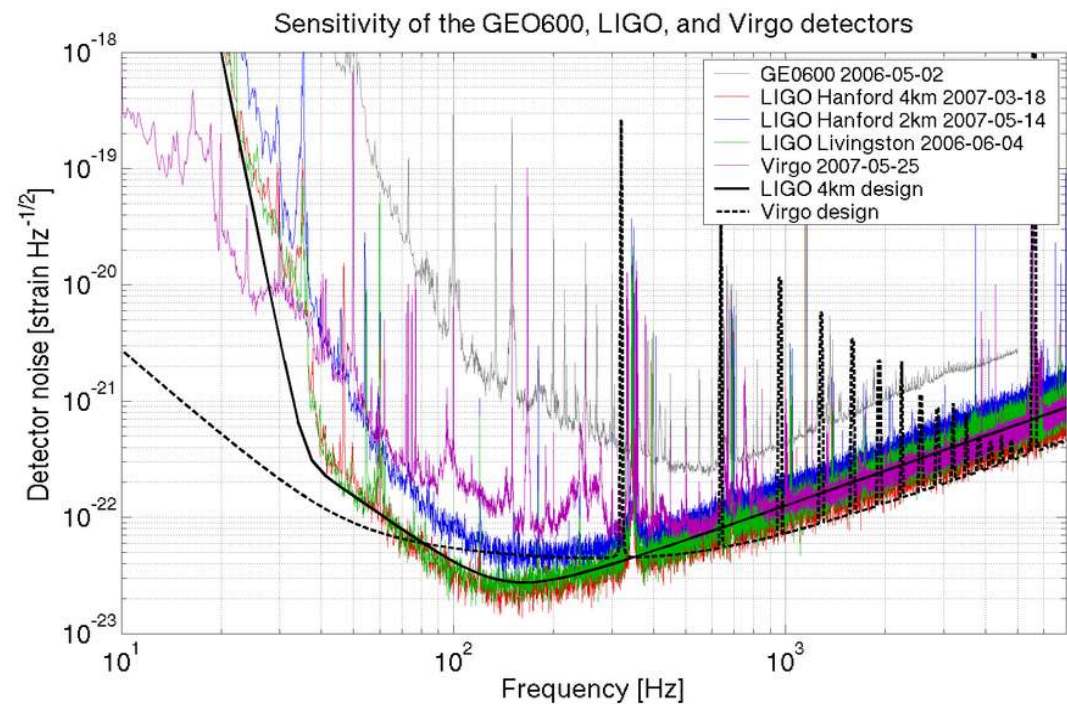
M.Z. Education and Affiliations

- 1997, Laurea in Physics, QFT thesis on renormalization group in SU(2), University of Parma (Italy).

- 2001, PhD in Physics form U. Parma on array technologies in acoustics (2 year exchange period at MIT in the underwater acoustic group of Prof N. Makris).

- 3 year post-doc in N. Makris group.

- Jan 2004 - June 2007 join the LSC in the MIT-LIGO lab as a post-doc under the supervision of Prof E. Katsavounidis.

- Aug 2007 Assistant Professor, Embry-Riddle Aeronautical University

M.Z. Participation in LSC activities

- Active member of Burst (since S2) and glitch (since 2005) groups.

- Since 2004 chair of the Waveburst review committee (other members are Keith Ryles and Brian O' Reilly).

- August 2005 - August 2006 (co-chair with Gianluca Guidi) of the LIGO-Virgo working group – focus of the group is on comparing burst and inspiral methods and network configurations on simulated (now real) data.

- Developed with L. Cadonati a single interferometer parameter estimation (from a module of TFClusters written by J. Sylvestre).

- Developed an algorithm for a maximum likelihood source direction estimate from amplitude and timing information with J. Markowitz, L. Cadonati and E. Katsavounidis

- Currently involved in an all sky high frequency burst search with B. Hughey and E.Katsavounidis

- developing a distributional pipeline for burst detection with Y. Shi and E. katsavounidis

All sky untriggered high frequency burst search

- No other burst search is currently exploring above 2KHz (and only Waveburst ranges above 1 KHz)

- there are astrophysical sources (beside the usual "unexpected") that can populate the high frequency spectrum (see next slide).

- favourable spectral region to combine LIGO with european observatories

- Data analysis tools and calibration need to be revised
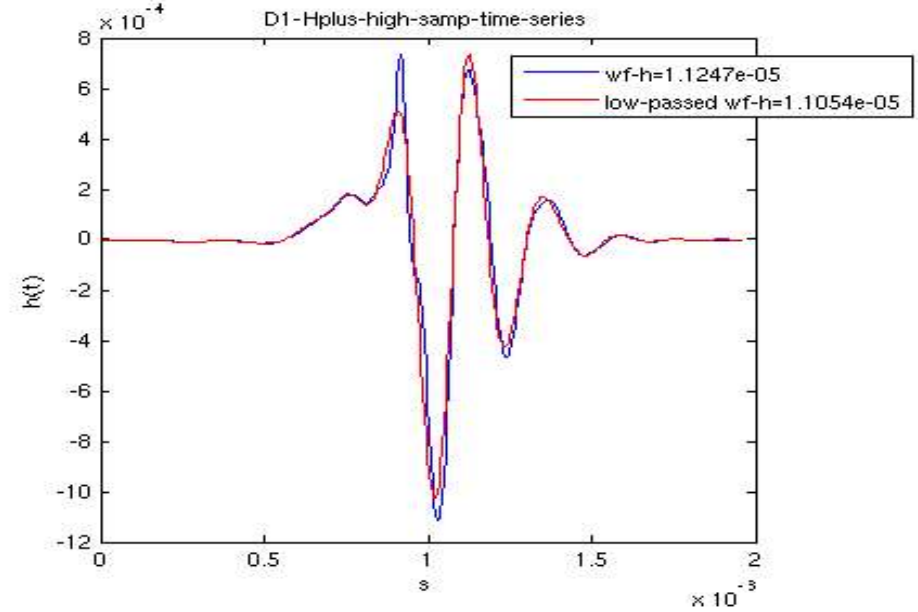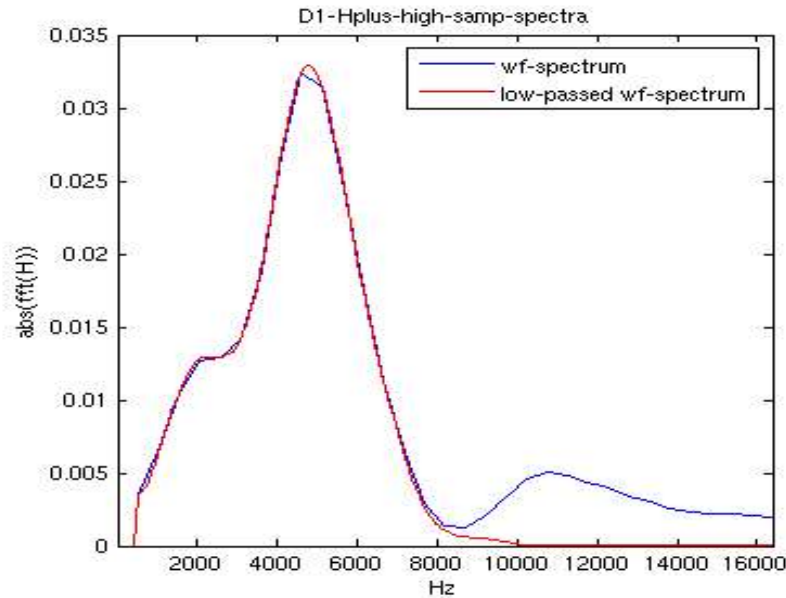
- different noise properties and families of glitches

Sensitivity of the GEO600, LIGO, and Virgo detectors

GE0600 2006-05-02
LIGO Hanford 4km 2007-03-18
LIGO Hanford 2km 2007-05-14
LIGO Livingston 2006-06-04
Virgo 2007-05-25
LIGO 4km design
Virgo design

credits:

Examples of possible sources

Baiotti Rezzolla Phys. Rev. Lett. 94 (2005) 131101
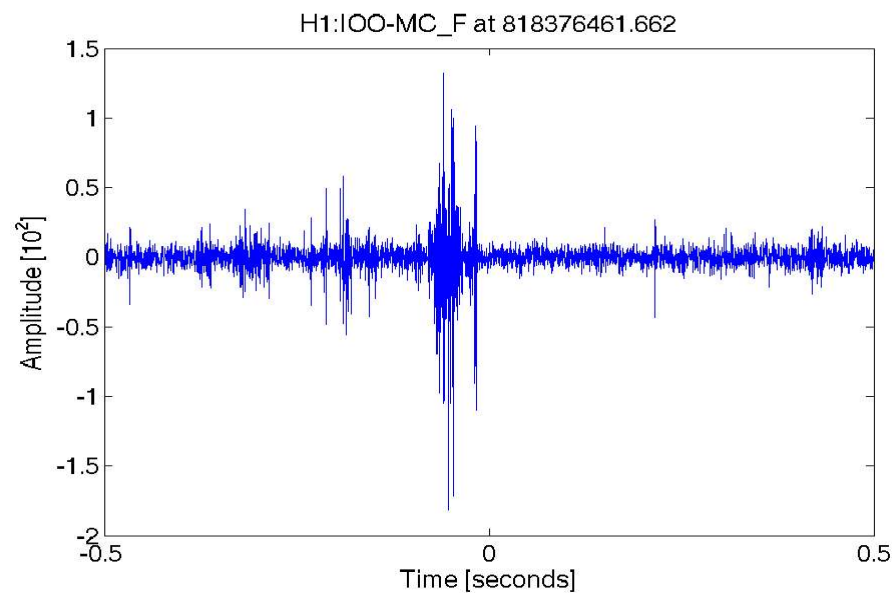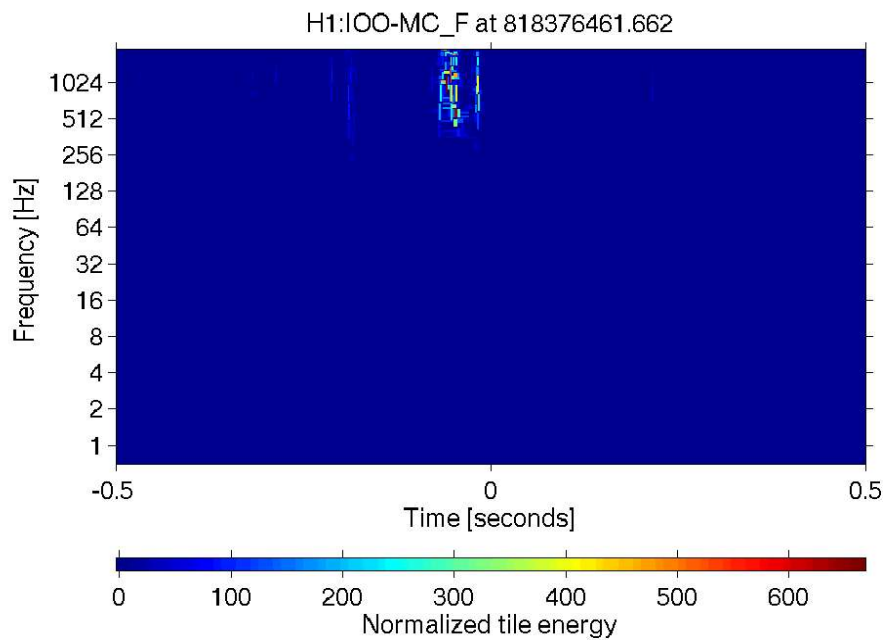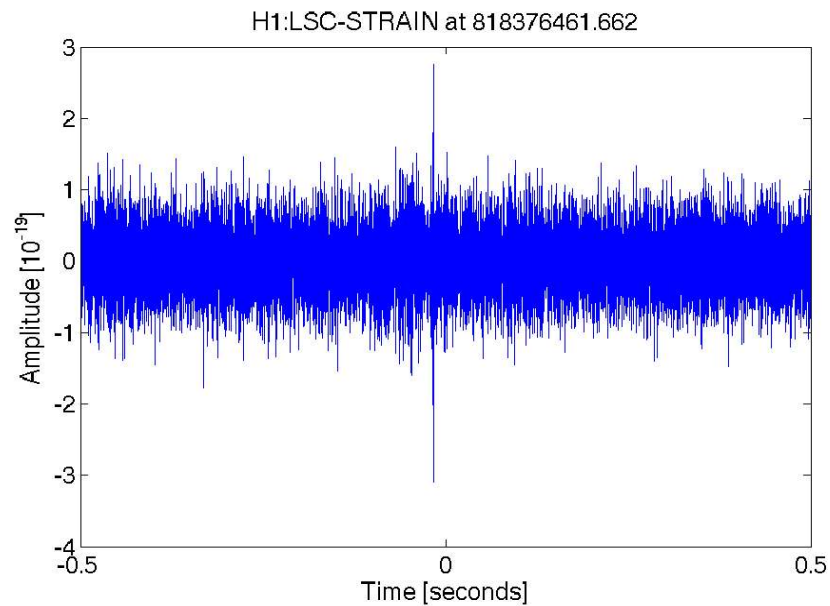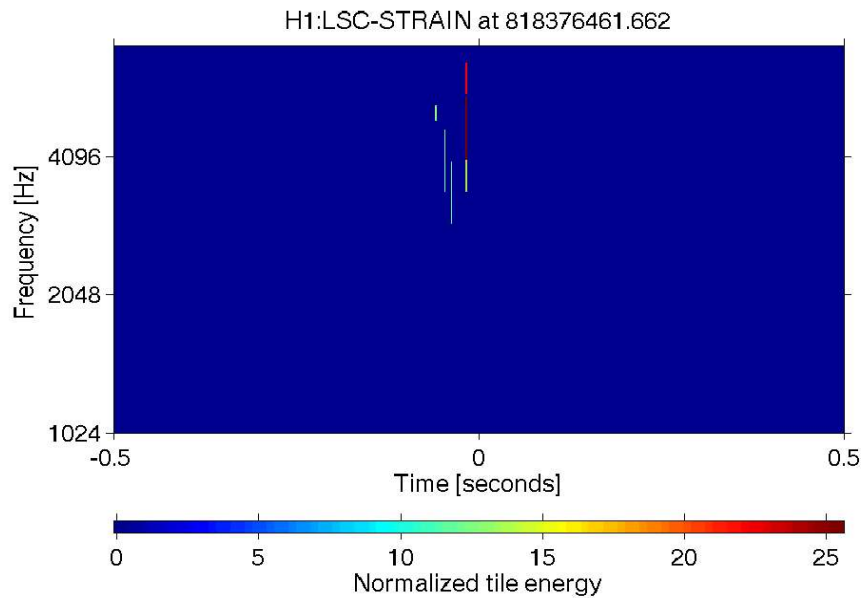

* Rotating NS collapsing in a BH

* Short duration ZM supernovae

* Low mass BH binaries

(SNR and rates uncertain)
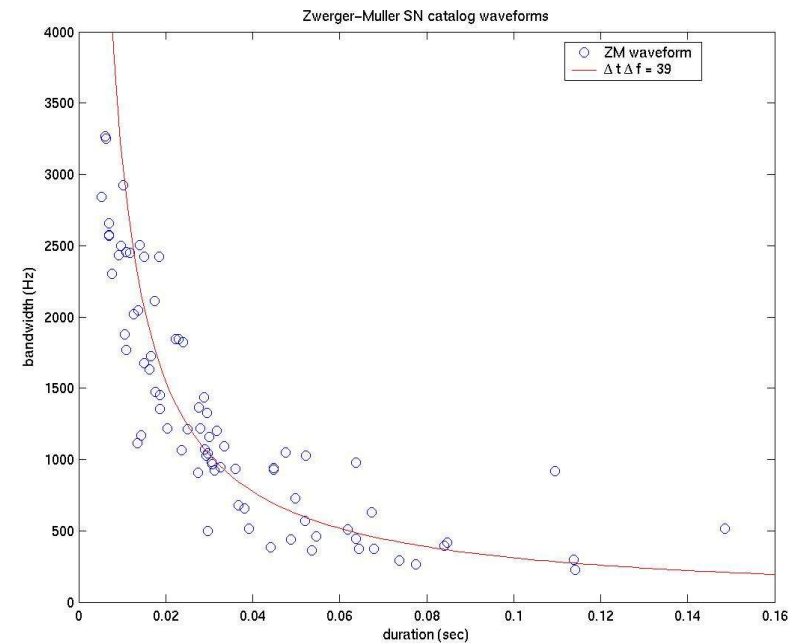
Examples of new glitches

Transients and excess noise from suspensions

- Goals:
  - Investigate transients from upper AdLIGO suspension (possible installation in LASTI).
  - Set limits on the level of suspension induced non-Gaussian noise from clamp rubbing in S5/S6.
  - Produce templates for suspension induced transients.

- Plan:
  - First, in-house experiment. Drive pendulum mode look for upconversion.
  - Second, possible installation on LASTI penultimate suspension fibers. Characterize upper suspension glitch level and v. low amplitude transfer functions.

Rubbing

Rubbing excites the violin modes.

Pendulum mode
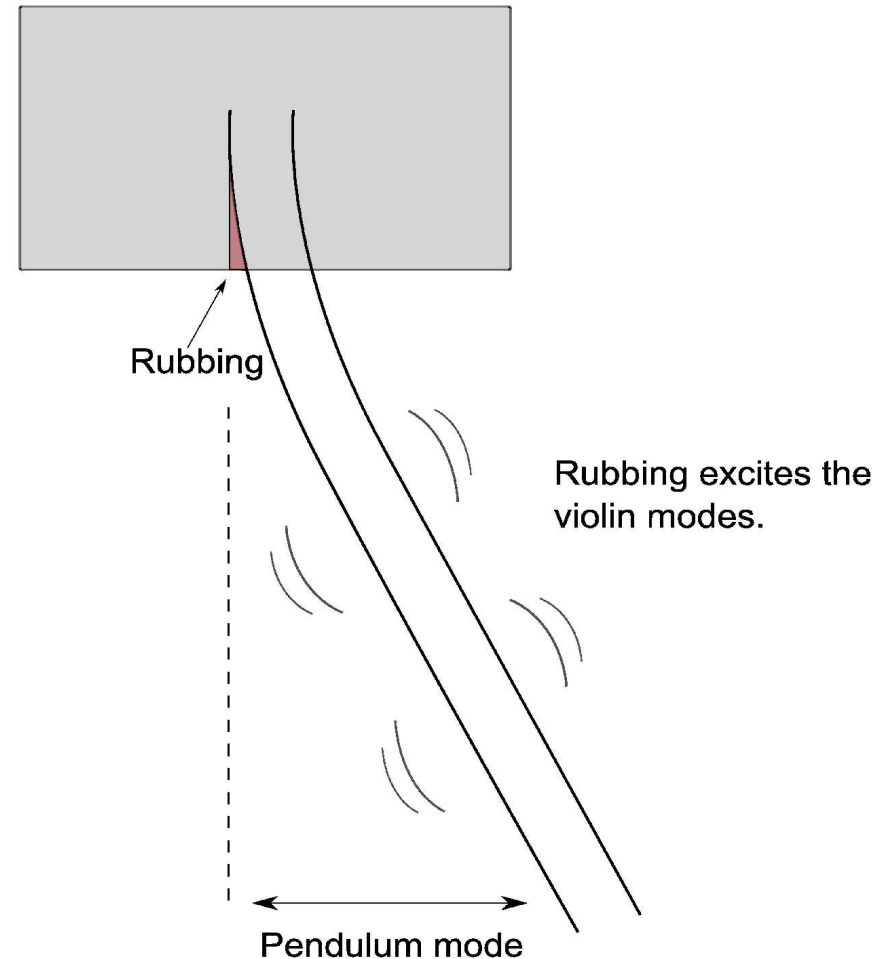
Algorithm development

- Evaluate analytically errors in matched filter parameter reconstructions using asymptotic expansion techniques (in acoustics they helped to shed light on the relationship between SNR waveform properties and dimension of the parameter space)

  EG: M.Zanolin, I.Ingram, A.Thode, N. Makris, 116 2031 (2004)

- In GW could be applied to understand analytically achievable performances on parameter estimations from inspiral waveforms

Teaching Duties

2 sections of E.M. for undergrad. engineers (~ 60 students total).
(Could increase to 3 sections if no funding).

Priority and funding plans

- Initial focus on HFS and teaching.

- Gradually increase involvment in suspension induced glitches and glitch modelling in early 2008

- Tranfer "Sonar like" algorithms to GW data analysis.

- Participation to Burst, glitch group activities, and service to the LSC on a continuous base.

- We would like to submit a joint ERAU proposal to the NSF