



Science and Technology of Materials, Interfaces, and Processing Southern California Chapter

Winter 2017

Quarterly Newsletter

Special points of interest:

- LIGO Talk and Tour
- Hyperloop Competition
- 2017 SCCAVS Equipment Exhibition: Exhibitor & Sponsor Registration now open
- AVS Short Courses at ICMCTF San Diego

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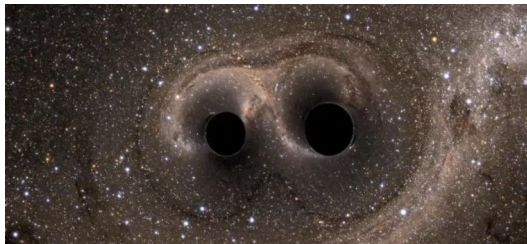
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The Engineering Behind LIGO—Talk & Tour March 28th, 2017

Contributed By Dennis Coyne, Chief Engineer & Jon Feicht, Senior Vacuum Engineer (LIGO)

In September 2015, the Advanced LIGO observatory initiated the era of gravitational wave astronomy, a new window on the universe. In its first 4 months of operation, Advanced LIGO made the first two direct detections of gravitational waves. Each of these events were the result of the merger of a pair of black holes into a single larger black hole. The first detected system consisted of two black holes of about 30 solar masses each that merged 400 Mpc away or 1.4 billion years ago.



The Advanced LIGO gravitational wave detectors are second generation instruments designed and built for the two LIGO observatories in Hanford, WA and Livingston, LA. These two identically designed instruments employ coupled optical cavities in a specialized version of a Michelson interferometer with 4 kilometer long arms. Fabry-Perot cavities are used in the arms to increase the interaction time with gravitational waves. Power recycling is used to increase the effective laser power and signal recycling is used to improve the frequency response. In the most sensitive frequency region around 100 Hz, the displacement sensitivity is 3×10^{-21} meters rms, or about 100,000 times smaller than a proton.

In order to achieve this unsurpassed measurement sensitivity, Advanced LIGO employs a wide range of cutting-edge, high performance technologies, including an ultra-high vacuum system, an extremely stable laser source, multiple stages of

active vibration isolation, super-polished and ion milled, ultra-low loss, fused silica optics with high performance multi-layer dielectric coatings, wavefront sensing, active thermal compensation, very low noise analog and digital electronics, complex, nonlinear multi-input, multi-output control systems, and a custom, scalable and easily re-configurable data acquisition and state control system.



The Southern California Chapter of the AVS invites you to a presentation and tour on **Engineering behind the Laser Interferometer Gravitational-wave Observatory (LIGO)** at Caltech. This event will begin on **Tuesday, March 28th 2017, at 6:30 pm at Caltech.**

The design and fabrication of Advanced LIGO will be presented. Among the cutting-edge technologies discussed will be an ultra-high vacuum system, laser source, active vibration isolation, ultra-low loss fused silica optics, active thermal compensation, and very low noise analog and digital electronics.

The speakers will be Dennis Coyne and Jon Feicht. Dennis Coyne is the Chief Engineer for the LIGO Laboratory at Caltech. He leads the system engineering and engineering development activities. Prior to joining Caltech, Dennis worked for Kaman Sciences Corp. and Bell Laboratories. Dennis received a BSME from UMass and an MSME from UC Berkeley. He is a fellow of the ASME, a fellow of the APS, a recipient of OSA's 2016 Forman Team Engineering (Cont'd on page 4)



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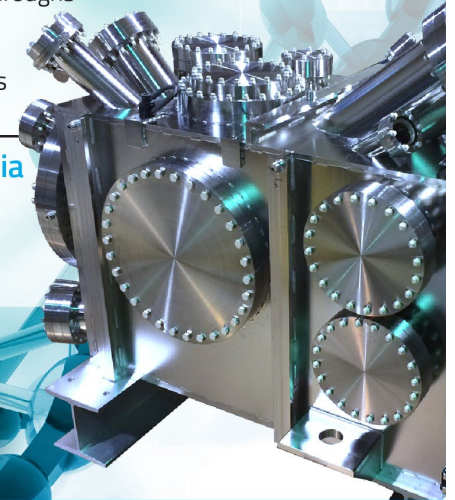
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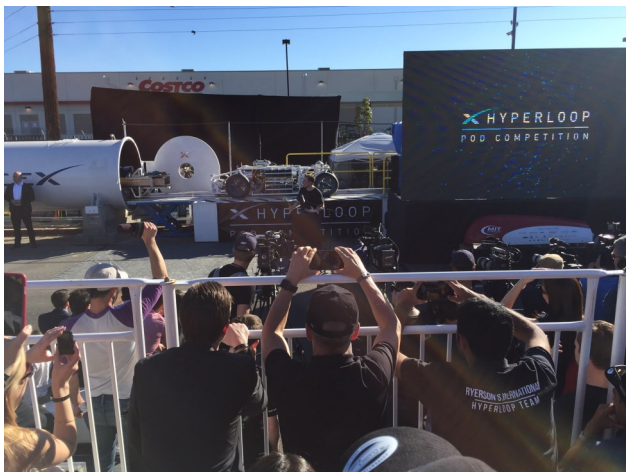


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HYPERLOOP Competition

Contributed By Tom Anderson

The oft-reported Hyperloop competition came to climatic finish on Saturday, January 29th at the SpaceX facility in Hawthorne to the delight of all of the participants and dignitaries in attendance. The victorious team was Team Delft from the Netherlands with Germany's Team Warr placing second and USA's MIT capturing a 3rd place finish. Several teams including local entrants from UCLA, USC and our own SCCAVS sponsored UC Irvine (See Photo) were on hand to showcase their designs, exchange ideas and enjoy the festival atmosphere complete with a live feed from the tube, live music, food trucks and games. Also on hand to address the crowd were SpaceX Senior Launch Engineer Steve Davis and Los Angeles Mayor Eric Garcetti, and a keynote address was given by SpaceX CEO Elon Musk (see Photo). (Cont'd on page 3)



Pod being inserted into the vacuum test track



Pod built by HyperXite at UCI

SOUTHERN CALIFORNIA
CHAPTER OF THE AVS :
THE SCIENCE &
TECHNOLOGY OF
MATERIALS,
INTERFACES, AND
PROCESSING

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Upcoming Events

ICMCTF '17
International Conference
on Metallurgical Coat-
ings & Thin Films

April 24-28, 2017

Town & Country Hotel
San Diego, CA



SVC TechCon 2017

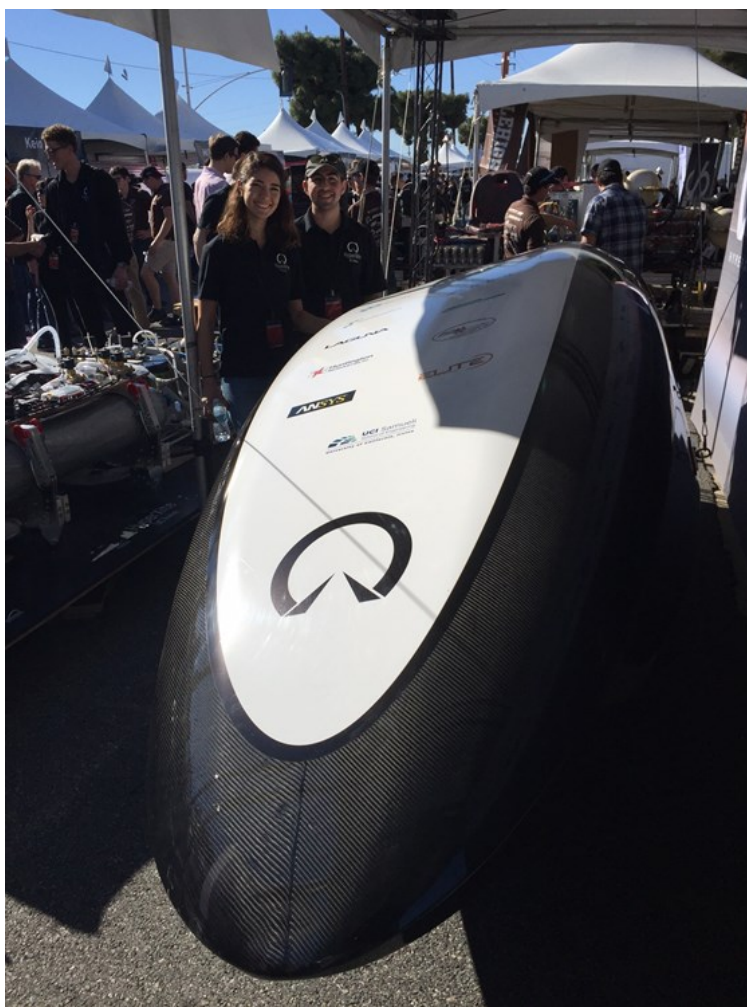
April 29-May 4

Rhode Island Con-
vention Center
Providence, RI

Chapter Activities

Hyperloop Competition (cont'd from p. 2)

The Hyperloop Competition was sponsored and launched by Elon Musk, the maverick CEO of SpaceX. Over 130 Universities submitted white paper concepts for the innovative transportation with 30 of those proposals being invited to build & deliver their concept "pod" to the SpaceX facility to compete for the best design. Of those 30 teams, 3 actually made it to the final step of launching their Pod into the one mile long vacuum test track (see photo on p. 2). The vacuum chamber was the 3rd largest ever built and was pumped to a base pressure of 15 Torr using 20 sets of Drypump/blower packages furnished by SCCAVS board member Tom Anderson.



Pod built by HyperXite at UCI



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Chapter Announcements

LIGO Talk & Tour (cont'd from p. 1)

Excellence Award and the 2016 Breakthrough Prize in fundamental physics.

Jon Feicht is a senior vacuum engineer at the LIGO Laboratory at Caltech where he is leading efforts to improve LIGO's UHV system and model non-equilibrium gas dynamics. Prior to joining Caltech, Jon was senior staff physicist at L-3 ETI (formerly Hughes Aircraft) and at Hughes Research Laboratories, working on vacuum processing of materials, UHV engineering, thin film coatings and modeling RF-plasma and electron resonance phenomena in high power microwave devices. Jon received the BS in Physics from CSU Long Beach.

After the presentation, there will be a tour of the 1/100th scale (40 m) interferometer system. The event costs \$15 (\$10 students) and includes a pizza dinner. Registration is required.



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Short Courses at the ICMCTF 2017



Sunday - Thursday, April 23 - 27, 2017—Town & Country Hotel, San Diego, CA

1. Sunday, April 23: **Arc and HiPIMS Plasmas for Thin Film Deposition**
Instructors: **André Anders**, Lawrence Berkeley National Lab., Berkeley, CA, USA
Arutjun Ehiasarian, Sheffield Hallam University, Sheffield,
2. Monday, April 24: **Thin Film Nucleation, Growth, and Microstructural Evolution**
Instructor: **Joe Greene**, University of Illinois, Urbana-Champaign, IL., USA,
Linköping University, Linköping, Sweden, and
National Taiwan University of Science and Technology, Taipei, Taiwan
3. Tuesday, April 25: **Physics and Chemistry of Plasmas for Thin Film Deposition**
Instructor: **André Anders**, Lawrence Berkeley National Lab., Berkeley, CA, USA
4. Wednesday, April 26: **Nanomechanics and Tribology of Thin Films and Coatings**
Instructors: **Steve Bull**, Newcastle University, Newcastle upon Tyne, UK
Adrian Leyland, The University of Sheffield, Sheffield, UK
5. Wednesday, April 26: **Advanced Thin Film Characterization**
Instructor: **Jörg Patscheider**, Empa, Dübendorf, Switzerland
6. Thursday, April 27: **Understanding and Control of Stresses in PVD Thin Films**
Instructor: **Grégory Abadias**, Université de Poitiers, Poitiers, France

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March/April 2017

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	13	14	15	16	17  Happy St. Patrick's Day! 	18
19	20	21	22	23	24	25
26	27	28 <i>LIGO Tour</i>	29	30	31	1 
2	3	4	5	6	7	8
9	10	11 <i>SCCAVS Meeting at Renato's 6pm</i>	12	13	14	15



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2017 SCCAVS Equipment Exhibition, Short Course Program, and Student Poster Session
—EXHIBITOR REGISTRATION NOW OPEN—

The annual **SCCAVS Equipment Exhibition** will once again be held at The Holiday Inn Hotel & Convention Center - Buena Park (7000 Beach Blvd., Buena Park, CA 90620) from **Monday, October 2nd to Wednesday, October 4th**

Monday, October 2—Wednesday, October 4, 2017

Short Course Program
8:00AM—5:00PM

Tuesday, October 3, 2017

Equipment Exhibition & Student Poster Session
12:00—6:00PM

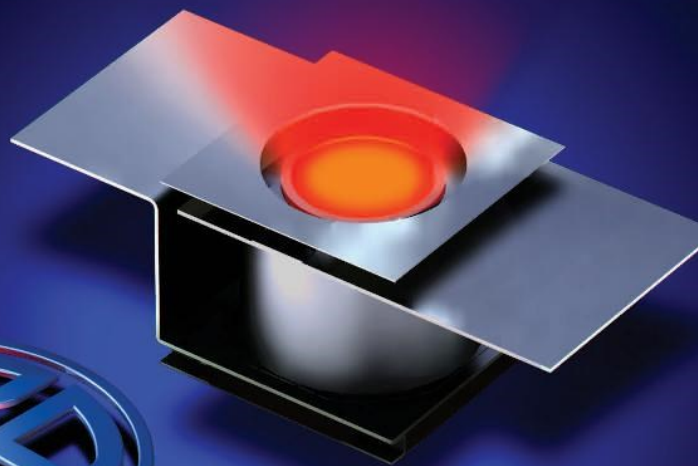
EXHIBITORS!!! Booth Registration is OPEN. Booth cost is \$525, and includes skirted table, 2 chairs, and lunch for up to two (2) booth staff. Additional sponsorship opportunities are available at the \$100 and \$500 levels.

Please visit <http://www.sccavs.org/symposium2017.html> for more information and registration.

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Submission Requirements:

Articles for submission must be in English, of subject matter appropriate for our audience, well-written and clear. It is important that papers be copy-edited carefully before submission. Drafts are not acceptable. In order to ensure diversity of subject matter, approaches, and voices, papers by authors who have not published in the SCCAVS Newsletter for at least a year prior to submission are normally given precedence. In submitting work to the SCCAVS, authors agree to the policies of this newsletter, including free access and use of the material published in it with, of course, proper acknowledgment of authorship and source. If you have any questions about whether your article is appropriate for SCCAVS, send it directly to chair@sccavs.org for a preliminary review.

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