

## Universe to go weekly

Newsletter for Lab will expand to include events, multimedia and content from “This Week”; retirees will continue receiving a monthly PDF edition.

The monthly Universe newsletter is about to become a more frequent, interactive and informative publication for JPLers.

Starting July 2, the new Universe will hit inboxes every Monday with the latest news, upcoming events, multimedia content, announcements and other features.

The improvements in frequency, timeliness and range of content make up the first major upgrade of Universe since the end of the print edition in 2014. Since then, Universe has been issued digitally in a format that mimics a print edition and lacks the interactive features of online publications.

Universe will link to select stories,

events and videos on JPL Space. The newsletter also will provide access to content formerly listed in “This Week,” as well as to classifieds and to a new section on JPL Space, Family News, that will list retirements and passings.

The last issue of “This Week” will come out on Friday, June 29, followed by the first weekly Universe the next Monday.

Information from “This Week,” such as promotions and appointments, will remain accessible through Universe. For example, Human Resources has created a site for managers to submit personnel appointments and have them displayed in a searchable 12-month rolling list.

Universe will remain accessible to re-

tirees and other external subscribers through a monthly edition in PDF, since the source content in JPL Space can only be accessed by active personnel.

Because the new Universe will gather and highlight events in one email, Lab-wide emails for upcoming talks and seminars will be discontinued. All events will continue to be featured on JPL Space.

JPL’s newsletter has a long history at the Lab. It was first published as “Galcit-Ear” in 1944 by the Guggenheim Aeronautical Library of the California Institute of Technology (GALCIT). Since then, the way Lab news is shared has gone through several iterations, both in name and style.

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# Record number of JPL mission launches in May

May was the busiest single month in JPL history, with seven JPL missions launching from California's Vandenberg Air Force Base and the Wallops Flight Facility in Virginia. The missions were the InSight mission to Mars and the MarCO CubeSats (May 5), the Cold Atom Laboratory instrument and three Earth-observing CubeSats (May 21), and the GRACE Follow-On mission (May 22).

JPL has had years with more mission events, but in those years the events were spread more evenly throughout the year. The closest the Lab has come to a similarly-packed month was in December 1999, with four significant mission events: the launches of the ASTER and MISR instruments on the Terra satellite on Dec. 18, the launch of AcrimSat on Dec. 20, and the end of the Mars Polar Lander mission on Dec. 3.

JPL's **Mars Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight)** mission is on a 300-million-mile (483-million-kilometer) trip to Mars to study for the first time what lies deep beneath the surface of the Red Planet. Scheduled to land on Mars on Nov. 26, the InSight lander will probe and collect data on marsquakes, heat flow from the planet's interior and the way the planet wobbles, to help scientists understand what makes Mars tick and the processes that shaped the four rocky planets of our inner solar system.

The twin **Mars Cube One (MarCO)** CubeSats are a technology demonstration that launched with InSight. The goal for these communications-relay satellites is to provide the ability to quickly transmit status information about InSight as it lands on Mars.



Clockwise, from left: GRACE-FO launch, Cold Atom Lab illustration, Raincube illustration.

The **Cold Atom Laboratory (CAL)**, a new physics experiment for the International Space Station, creates a temperature 10 billion times colder than the vacuum of space, then uses lasers and magnetic forces to slow down atoms until they are almost motionless. In the micro-gravity environment of the space station, CAL can observe these ultra-cold atoms for much longer than is possible on Earth. Results of this research could lead to a number of improved technologies, including sensors, quantum computers and atomic clocks used in spacecraft navigation. CAL was designed and built at JPL.

The three Earth-observing CubeSats that launched this month were **RainCube** — short for “Radar in a CubeSat” — a miniaturized precipitation-studying radar instrument, and the first active radar instrument to be flown on a CubeSat; **CubeRRR**, the **CubeSat Radiometer Radio Frequency Interference Technology Validation** mission, which will test a technology to reduce radio frequency interference; and the **TEMPEST-D (Temporal**

**Experiment for Storms and Tropical Systems Demonstration)** satellite, which will validate a miniaturized radiometer technology that could make it possible to use fleets of CubeSats to study developing storms, and provide data to the ground over shorter time intervals than what's possible with large, individual satellites. The principal investigator for RainCube is JPL's Eva Peral, and JPL collaborated on the other two CubeSats.

The **GRACE Follow-On** mission is the next iteration of the GRACE mission that operated for 15 years, from March 2002 to November 2017. A joint mission with the German Research Centre for Geosciences (GFZ), JPL's GRACE-FO will provide critical measurements that will be used together with other data to monitor the movement of water masses across the planet and mass changes within Earth itself. Monitoring changes in ice sheets and glaciers, underground water storage, and sea level provides a unique view of Earth's climate and has far-reaching benefits.

# InSight makers release their craft

By Carl Marziali

By the time Mars InSight ripped through the marine layer at Vandenberg Air Force Base, its builders were long ready to send it off.

A mission with one of the longest gestation periods in history will arrive at Mars after Thanksgiving. Its centerpiece is an acutely sensitive seismometer that will pick up clues to the planet's interior. The findings should help answer basic questions about how planets form.

## A long time coming

Bruce Banerdt has been asking those questions for most of his career. He proposed a seismometer mission to Mars three decades before the May 5 launch.

And kept on proposing.

"There's been I don't know how many times along the way that I've said, this isn't going to happen, just give up," he said in von Karman Auditorium after a briefing in the weeks leading to launch. "And then there would be some glimmer of hope, there would be this opportunity a year from now. OK, I'll try one more time. And at some point it became almost a habit."

Systems engineer Brian Bone has only been with InSight since the winning proposal in 2012. When the mission was delayed two years ago due to a problem with the seismometer, he led a team that helped solve the issues in the hiatus between launch windows.

"It's unlike any other launch that I've been a part of. It felt like we were doubling down in some ways, because we tried very hard to launch in 2016. It didn't go wasted, because they solved and worked through a lot of problems back then to help us even have a chance.



The May 5 InSight launch to Mars, as seen from Mount Wilson.

"It's very exciting to see this go, be off to Mars, especially after the hiatus."

Farah Alibay worked both on InSight and on the MarCo cubesats that will orbit the Red Planet. They are the only interplanetary missions of her young career as payload engineer, and all three went on the same rocket.

"The scary part for me is putting everything that you've worked on on what is essentially a barely controlled bomb," she said with a smile of relief after the bomb and her life's work had separated.

## A west coast first

InSight also carries microchips bearing the names of more than 2 million space enthusiasts. A few thousand of them clustered near Vandenberg in the early morning of May 5.

There were John and John Fairweather, father and middle-schooler son, who drove down the 101 from Arroyo Grande to the hillside patio of St. Mary's Episcopal Church in Lompoc. John Jr. made planets out of play-doh when he was 5, "so here we are," said his dad.

An entering Stanford student came because his dream is to go to Mars. A proud father was there because one of his sons works as a range controller for launches at Vandenberg.

Seven-year-old Owen Warner, from the Inland Empire, came well-briefed about InSight's heat probe and radio science experiment.

"One of them digs down into the ground, and one of them shoots a beacon at Earth so we know how it's spinning."

The first interplanetary launch from the Foggy Coast was invisible but crowd-pleasingly loud and — as far as the mission team was concerned — perfect.

"I'm just completely thrilled," said Banerdt afterwards. "We're now on a perfect trajectory to Mars."

The day before, he had gone to the launch pad for a last look.

"I saw them roll the tower back, and looking at the rocket with that nose cone containing the spacecraft, I'm thinking, where you want to be is in space, and on Mars, and I'm with you all the way."



# 3-D metal manufacturing put to the test

By Taylor Hill

The cavernous main hall of JPL's fabrication shop may look the same as ever, but detour into a side room and you will see the future of manufacturing at the Lab.

JPL's onsite 3-D printing has worked mainly in polymers, but two new 3-D metal printing machines now fill room 170-137. The investment is part of the Lab's goal to innovate and adapt to new technologies.

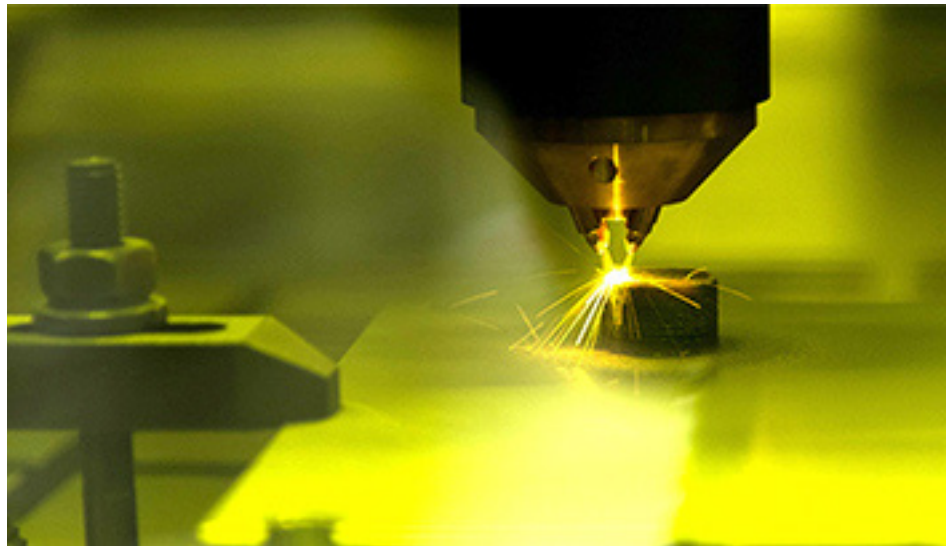
The new Additive Manufacturing Center is now open for business following a ribbon-cutting ceremony held on May 21 in the fabrication shop.

"Additive manufacturing is the next level of machining," says Andre Pate, prototype and R&D machining services mechanical engineer. And while production of flight-ready 3-D printed parts is still in the works, Pate says the potential benefit to JPL is worth the investment.

## Lighter is better

"We have an interest in making parts that are lighter, so we can put more science and instruments into space," Pate said, and there are times when the additive manufacturing process can create a part with less mass, yet just as capable as a traditionally machined part. "Our hope is that just by being here on Lab, we're going to educate people, give designers a chance to understand the process, and become experts in manufacturing the part with this method."

The two machines both use 3-D printing technology, but make parts using different techniques. The first is an EOS M290 laser powder bed fusion printing machine. The 4-laser 3-D printing system works with extremely fine aluminum powder. This powder is pulled across a plate by a squeegee-like device. After each new powder layer is laid down, lasers heat up



and melt the powder tracing a specific design. In this way, layers of the part are built up slice by slice.

This technique allows for new levels of flexibility in designing parts for spacecraft.

"Advantages to this process include saving mass by using lattices, combining assemblies to reduce part count, and making multifunctional parts," said Samad Firdosy, technologist in JPL's Materials Development and Manufacturing Group. "So, you get benefits that you wouldn't get when you think about a normal subtractive machining process, where you start with a large billet of metal and then machine everything from the outside."

The second, and larger, of the two machines is the RPM 222—a directed energy deposition machine of which only a handful exist. The RPM 222 uses metal powder like the EOS process, but instead of a bed of powder, the material is placed in containers, called "hoppers" on the outside of the machine. Thin tubes direct the metal powder from the hopper into the machine, with argon gas pushing the powder until it meets the laser.

If the EOS powder bed method is like a pen drawing a design on a piece of

paper, the RPM 222 laser is like the ink flowing from the pen. This process allows objects to be created in a sort of airbrushing technique—but in three dimensions instead of two.

## Multiple metals accommodated

The RPM 222 is ideal for testing different materials and alloys, since multiple metals can be run through the powder feeders and blended together into the same part.

Firdosy says that can be an advantage for parts that require different properties in different locations.

"With this machine, you could take an alloy that's good at resisting heat, and you could use that material for the business end of a rocket nozzle," Firdosy said. "However, those types of metals are typically heavy, so at the other end of that nozzle, where you don't need the high temperature resistance, you could grade to an alloy that's much lighter and has better structural properties like titanium."

The team hopes to achieve flight-ready hardware in the next year or two. In the meantime, Pate said JPLers are already utilizing the additive machines for re-

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## Passings

Lloyd Nessler, 81, a retired aerospace engineer, died April 24.

Nessler worked at JPL from 1962 to 2002. He was a mechanical designer in the Engineering Design Services Section 356 for the majority of his JPL career. Among the many flight projects he worked were Voyager, Galileo and Shuttle Imaging Radar-C.

He is survived by his husband, Edmond Khachi, and sisters CloReon Ehalt, Betty Ehalt and Ruth Becklund.

Geophysicist Jean Dickey, 72, died May 9.

Dickey had been with JPL since 1980. She made seminal contributions on Earth rotation, including polar motion and length of day, and their relationship to weather, sea level and space exploration.



Jean Dickey

Dickey chaired the National Research Council Committee on "Earth Gravity from Space," con-

tributing significantly to the selection and later launch of the GRACE mission and its follow-on.

In 1993 she became the first woman to give the American Geophysical Union's Bowie Lecture, and was the first woman to serve as president of the AGU Geodesy Section. She was elected Fellow of the American Geophysical Union and the International Association of Geodesy, and received NASA's Exceptional Scientific Achievement Medal and Exceptional Service Medal.

Dickey is survived by two sons, two grandchildren, three sisters and two brothers. Services were held May 14 at St. Philip the Apostle Catholic Church in Pasadena.

## Retirees

The following JPL employees recently announced their retirements:

### March

**Charles Barnes**, 28 years, Section 5140; **Stephen Noland**, 28 years, Section 397D; **Dean Wiberg**, 22 years, Section 8221; **Guy Webster**, 18 years, Section 1871; **Lynne Pertum**, 13 years, Section 2720.

### April

**Phil Salomon**, 51 years, Section 3535; **Chris Jones**, 49 years, Directorate 1000; **Robert Menzies**, 48 years, Division 3800; **Jeffrey Smith**, 41 years, Section 2513; **R. Walter Boyd**, 34 years, Section 252E; **Valerie Matthews**, 33 years, Section 3014; **Charlayne Fliege**, 28 years, Section 1630; **David Losh**, 28 years, Section 333K; **Padma Varanasi**, 27 years, Section 398D; **Rudolph Vargas Jr.**, 27 years, Section 386B; **Susan Adamiak**, 10 years, Section 348B.

### May

**Michael Orr**, 40 years, Section 393F; **Gary Ureda**, 32 years, Section 2131; **Parvin Forouhar**, 30 years, Section 3890; **Pam Glatfelter**, 29 years, Section 3217; **Dana Adler**, 17 years, Section 2640.

### June

**Edward Kopf**, 53 years, Division 3400; **Marc Montgomery**, 39 years, Section 1080; **Benjamin Saldua**, 36 years, Section 333H; **Deborah Drake**, 33 years, Section 386B; **Bradley Drake**, 31 years, Section 5142; **Michael Britcliffe**, 29 years, Section 333K; **Vernon Piette**, 29 years, Section 172K; **Raymond "Glenn" Putnam**, 14 years, Section 3570; **Lewis Soloway**, 14 years, Directorate 3000; **Mandel Eller**, 11 years, Section 393E.

## Letters

My family and I would like to thank all my JPL/Earth Science and Technology family for all the lovely flowers, plants, cards and warm thoughts regarding the recent passing of my pop, Manuel Morales. He was proud of the work we do here at JPL/Caltech for NASA and that I was a part of it. Thank you so much for your support, guidance and patience through this difficult time.

**Debra Higuera**

### 3-D METAL *Continued from page 4*

search and development, prototyping, and test parts—which can help reduce the workload for the machine shop's traditional equipment.

Having the machines at JPL—instead of outsourcing—should also speed up the production process. Engineers are able to provide feedback to designers more frequently and identify problem areas earlier in the process, which should ultimately lower costs for the Lab.

Both machines require added safety precautions, which JPL has taken great care to observe. The equipment is housed separately in an 8,200-square-foot room next door to the main shop area. An upgraded HVAC system pushes six to 10 air changes per hour through the facility, ensuring rapid ventilation in case of any leaks from the machines. Ultra-fine aluminum powder can be flammable, and argon is a colorless, odorless gas that if inhaled displaces oxygen from the lungs. The facility is outfitted with argon-detecting sensors at knee level, and electrostatic dissipative flooring to prevent static sparks.

It's been a multi-year process to get the 3-D metal printing facility—and accompanying safety installation—up and running at JPL, but Pate sees it as key to keeping JPL from staying at the front of the additive manufacturing curve.

"It's a relatively new and complex pro-

cess with many variables and can result in production of parts with poor material properties if not well understood," Pate said. "Having metal additive manufacturing machines in-house is critical for us so that we can intimately understand the process and ensure our parts have excellent quality and material properties. This applies in both cases—printing our flight parts here at JPL or having parts made at service providers outside of JPL."

As additive manufacturing gains traction at JPL, what does the future hold for the tried-and-true machining techniques the Lab has relied on since putting Explorer 1 into orbit? Next door in the shop's main area, prototype and R&D machining services supervisor Don Scudamore sees the rise of 3-D metal printing as just another tool in JPL's toolbox—not a replacement.

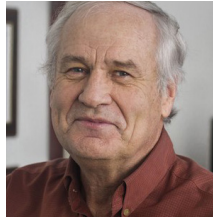
"I don't see it as taking away from subtractive machining, I see it as just another way to make parts," Scudamore said.

Pate agrees, noting that every part that comes out of the additive manufacturing shop has to be run through, or "finished," on subtractive machines.

"There remain limitations to the surface finishes and dimensional tolerances you can achieve in 3-D metal printing now, so subtractive machining continues to be a key part of the process," Pate said. "And now, we can utilize both processes right here on Lab."

## Stephens named Royal Society Fellow

Graeme Stephens, director for JPL's Center for Climate Sciences, has been elected as a Fellow of the Royal Society.



Graeme Stephens

Stephens, the principal investigator of JPL's CloudSat mission, was

elected into the U.S. National Academies of Engineering in 2015 and received the Jule G. Charney award of the American Meteorological Society.

The Royal Society, a fellowship of many of the world's most eminent scientists, is the oldest scientific academy in continuous existence.

## Communication honor to Buratti

Bonnie Buratti, supervisor of the Asteroids, Comets & Satellites Group, has been awarded the Carl Sagan Medal for excellence in public communication by the American Astronomical Society's Division for Planetary Sciences.



Bonnie Buratti

The award honors Buratti for her effective education and public outreach "with a measured and demonstrably high impact." She is noted for conducting teachers' workshops, delivering popular public talks, and writing in encyclopedias, blog posts, and a recently published popular book on planetary science, "Worlds Fantastic, Worlds Familiar."

## Seven straight tech honors for JPL

JPL has been named a CIO 100 honoree for the seventh year in a row. CIO magazine recognizes the top 100 organizations for their innovative use of technology to deliver genuine business value.

"We are excited and honored to again be a recipient of the CIO100 recognition and award," said JPL CIO Jim Rinaldi. "We strive to provide IT that matters and appreciate we can present some of the exciting things we are doing for this amazing award."

Honorees will receive the awards at the CIO 100 Symposium in August in Rancho Palos Verdes.

# Honorary NYU degree to Voyager pioneers

JPL's Interplanetary Network Director Suzanne Dodd, former Chief Engineer John Casani, and former Lab Director Ed Stone on May 16 received a joint honorary degree from New York University in recognition of their achievements as part of the historic Voyager mission team.

The trio accepted the joint degree of doctor of science at the university's commencement ceremony at Yankee Stadium.

Stone has been Voyager's project scientist since the start of the mission. Casani was the project manager from 1975 to 1977. Dodd, once a sequence design engineer for Voyager, is now managing the project.

Voyager 1 and 2 celebrated their 40th anniversaries this year from deep in space, as the spacecraft continue on their paths as the farthest from Earth of all human-built objects. Voyager 1 has crossed the heliopause,



From left: Ed Stone, Suzy Dodd, John Casani.

the region where the sun's influence wanes, and is now in interstellar space. Voyager 2 is likely to enter interstellar space in the next several years.

## UNIVERSE *Continued from page 1*

The newest iteration responds to a desire across Lab for increased internal communication, as voiced by participants in last fall's values dialogues, as well as other forums. JPLers have said they would like to hear more about, among other topics:

- Goings-on around Lab
- The Lab's strategic goals, and its plan for continued success in a competitive landscape
- JPL culture and identity

Most importantly, Universe belongs to the Lab family, and should strive to reflect it. The Institutional Communications team in the 18x directorate would like to hear from you as we continue to adapt the newsletter to meet the needs of our community.

We invite you to email us at [instcomm@jpl.nasa.gov](mailto:instcomm@jpl.nasa.gov) with your ideas and sugges-

tions.

Among the many questions you can help us answer:

- What do you want to see in JPL Space?
- What do you like or don't like about the stories and listings on JPL Space?
- Would you like to see more videos and multimedia content?
- How does the newsletter render on your mobile phone?
- Do you want to hear more from your directors about the Lab's mission and strategy?
- Would you like to contribute your own stories?
- Would you like to be able to comment on JPL Space postings?

We look forward to hearing from you, and to sending you the new Universe.



## Classifieds

Ads submitted May 17–24.

### For Sale

**VIDEO GAME SYSTEM:** Vintage Playstation 2 with two games: Grand Turismo (full garage) and ATV Offroad Fury. xanderpascual@gmail.com.

### Vehicles / Accessories

'09 AUDI A3 Quattro, 75K miles, Aruba blue pearl w/gray interior, excellent condition (<https://i.imgur.com/lAzmqsl.jpg>). \$10.2k. Call or email and I can send AutoTrader link w/ photos. knaviaux@yahoo.com, 818-406-9312.

SCHWINN Scour kid's mountain bike, 26" wheel, lightweight aluminum, 21-speed with 63 mm suspension fork. Text 847-826-8040.

### Wanted

SPACE INFO/memorabilia from U.S. & other countries, past & present, for personal use (see <http://www.youtube.com/watch?v=S7PvjGp7mCU>). mrayman @alumni.princeton.edu, 818-790-8523, Marc Rayman.

### Real Estate for Sale

LEBEC-area mountaintop retreat, spectacular views, 4 bedrooms/2 baths, 2,600 sq. ft. custom-built house on 20 acres, surrounded by vast fields of wildflowers in spring but stunning year-round; only about an hour from JPL north on I-5; includes spacious workshop or artist's studio; see <http://tours.tourfactory.com/tours/tour.asp?t=1308594&idx=1>; \$515,000. 805-358-1626 or Robert.A.Preston@icloud.com.

### For Rent

ALTADENA studio, walking distance from JPL, private entry in a quiet backyard setting; 400 sq. ft., queen bed, bathroom with shower, kitchen with

fridge, stove, oven, microwave etc., wall a/c, desk, nice bright interior, fast WiFi; all utilities included, no pets, available July, August; \$540/week, \$1,600/month. 626-644-2472, Theresa.

GRANADA HILLS house for lease, 4 bedrooms, 1.75 baths, 1,486 sq. feet, in quiet neighborhood near Knollwood Country Club, central air, 2-car attached garage with laundry hookup, new carpet, tiles; \$2,500/month plus security deposit, no pets. homarellc@gmail.com.

PASADENA, furn. room in a lovely 4-bd./2-bath house, big backyard, hardwood floor, big closet, shared bathroom, kitchen & laundry privileges; 2 miles to JPL, close to public transport; short- or long-term lease available; must like dogs and be very clean; \$900 + \$900 deposit. 818-960-8654.

TEMPLE CITY, newly renovated 3 bed / 2 bath house with bonus storage room / bath behind attached garage, central air, alarm system, hardwood floors, stove, refrigerator and dryer included, walk to public transport, shops, restaurants, local award-winning schools; \$2,600/mo. 949-829-3090.

### Vacation Rentals

MAMMOTH, Snowcreek, 2 bd., 2 ba. + loft, sleeps 6-8, fully equip'd kitchen incl. microwave, D/W, cable TV, VCR, phone, balcony w/mtn. vw., Jacz., sauna, streams, fishponds, close to Mammoth Creek, JPL discount, no pets. 626-798-9222, 626-840-3749 or valeriee@caltech.edu.

MAMMOTH, Snowcreek, beautiful updated condo, 2 bd., 2 ba. + loft (sleeps 6-8), near pond/meadow, new appliances, TVs, DVD players, free wireless internet, washer/dryer, no pets. 818-952-2696 or BigMtnPrettySky@gmail.com.

MAMMOTH, remodeled 2 bed/2 bath + loft, short walk to Canyon Lodge; Courchevel 6 features full kitchen, cable/Internet TV, DVD, Blu-Ray, wireless hi-speed Internet, 2-car garage, Jacuzzi, grill, pool; no pets. <http://Courchevel6.com>.

# Universe

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