

تعامل فناوری ارتباطات و اطلاعات و فیزیک در عصر اینترنت

نعیم خادمی

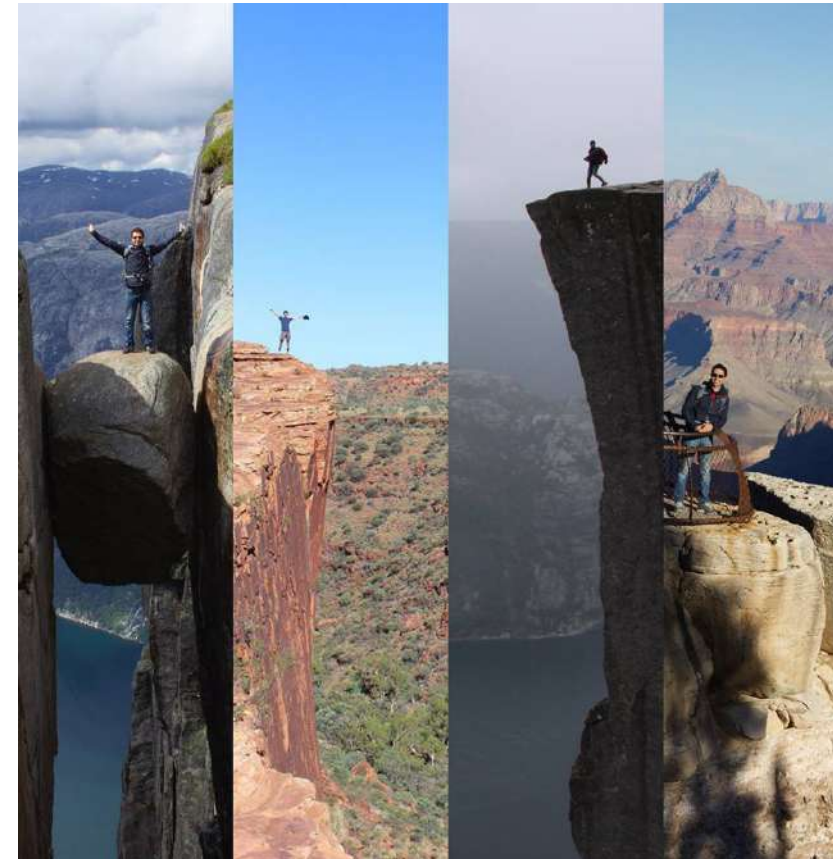
Associate Professor

University of Stavanger, Norway

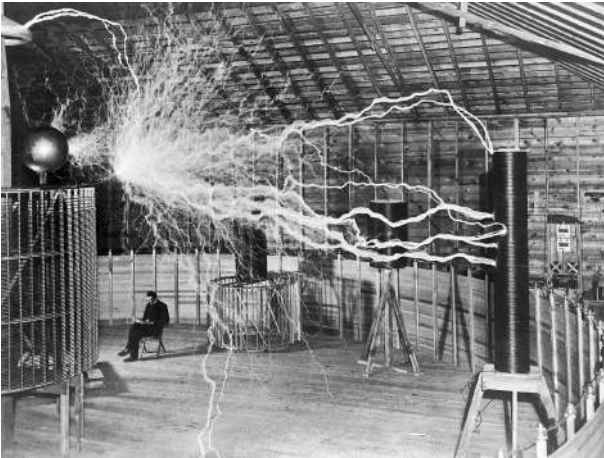
۱۶ ژانویه ۲۰۲۱ – ۲۷ دیمه ۱۳۹۹

اندکی درباره من...

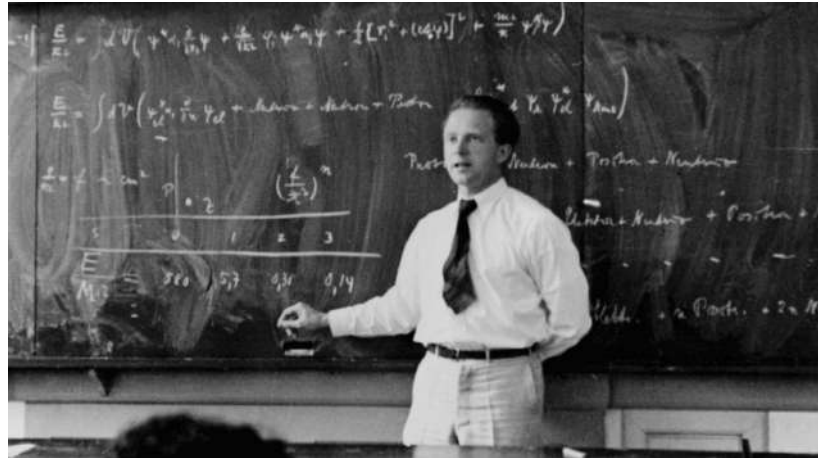
- متولد شیراز، ایران
- دکترای علوم کامپیوتر، گرایش شبکه های کامپیوتری [Computer Networks] از دانشگاه اسلو، نروژ [UiO] در سال ۲۰۱۵
- دوره فوق دکترای شبکه های کامپیوتری، دانشگاه اسلو، ۲۰۱۵-۲۰۱۸
- دانشیار [Associate Professor] دانشگاه استوانگر، نروژ [UiS] ۲۰۱۹-اکنون
- فعال در زمینه تدوین، ارائه و وضع استانداردهای اینترنتی در Internet Engineering Task Force [IETF]
- علاقه مند به کوه پیمایی، اخترشناسی، تاریخ، ...
- **فیزیکدان/متخصص فیزیک نیستم!**
- مثال های این ارائه بیشتر از اخترفیزیک و فیزیک ذرات خواهد بود! تمرکز روی مفاهیم و ضرورت ها به جای ابزارها و تکنیک ها



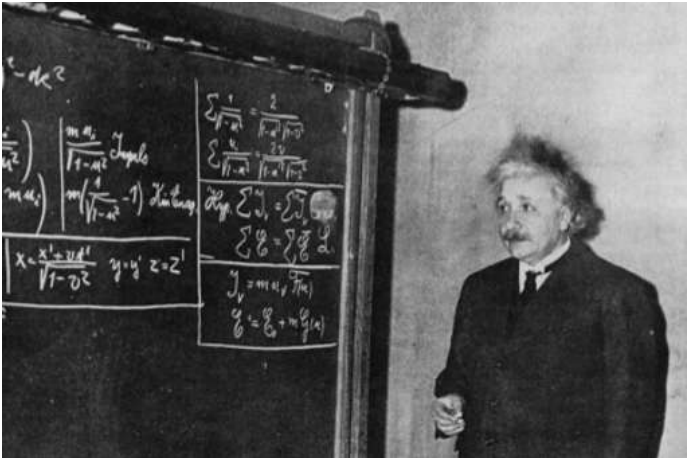
فیزیکدانان، گذشته و حال: شباهت و تفاوت مدل کاری



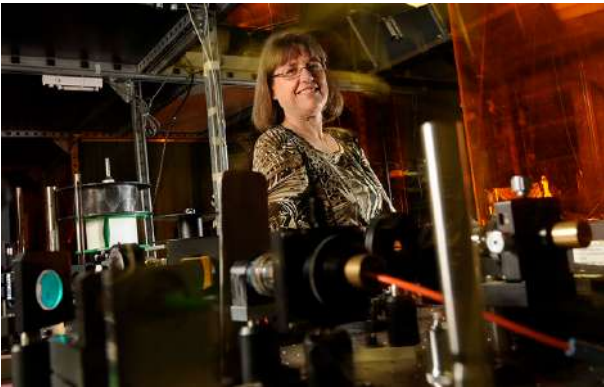
Credit: Dickenson V. Alley, Restored by Lošmi, [CC-SA-4.0](#)



Credit: <http://www.renegadetribune.com>



Credit: Pittsburgh Sun-Telegraph/Dwight Vincent and David Topper



Donna Strickland

Donna Strickland; Credits: Waterloo Region Record photo/Peter Lee



Source: [Ecto Storm](#)



Michel Mayor

Source: NobelPrize/Twitter

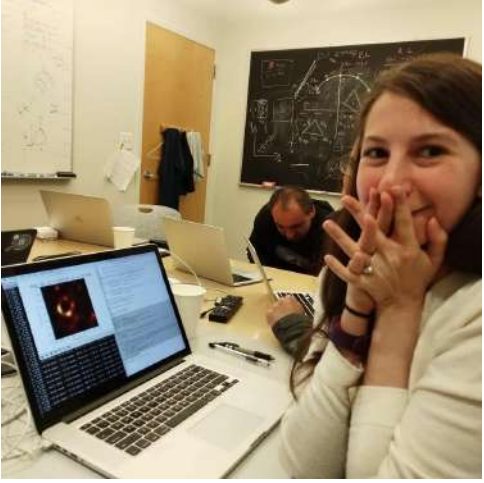
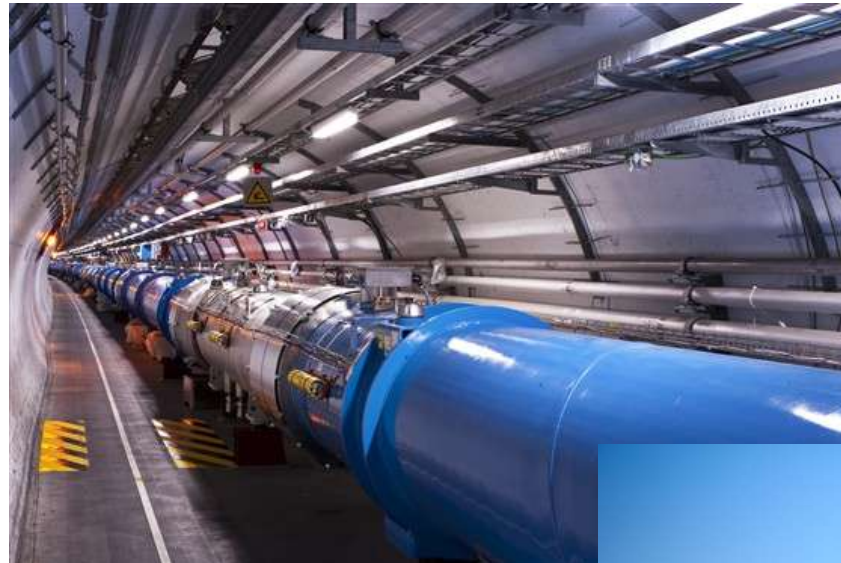


Image courtesy of Katie Bouman

تجهيزات آزمایشگاهی و ابزار اندازه گیری



Welcome Collection [CC-BY-4.0](#)



Source: [Maximilien Brice](#) [CC BY-SA 4.0](#)



Source: Murray Foubister, [CC BY-SA 2.0](#), via Wikimedia Commons

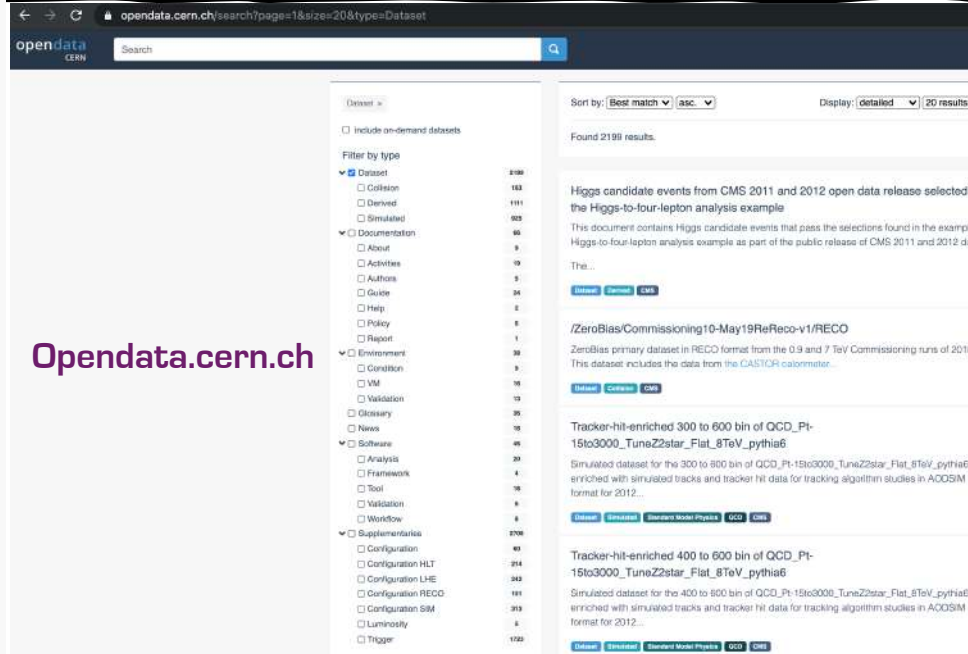
شیوه کار محققین فیزیک

بانک داده خام و نرم افزار CERN

لیست مراکز تحقیقاتی مشارکت کننده در پروژه EHT

Affiliated Institutes

- Aalto University
- Brandeis University
- Boston University
- Los Alamos National Laboratory
- California Institute of Technology
- Canadian Institute for Advanced Research
- Canadian Institute for Theoretical Astrophysics
- Center for Astronomical Mega-Science, Chinese Academy of Sciences
- Centro Astronómico de Yebes, Instituto Geográfico Nacional
- Chalmers University of Technology, Onsala Space Observatory, Department of Space, Earth and Environment
- Consejo Nacional de Ciencia y Tecnología
- Cornell University, Cornell Center for Astrophysics and Planetary Science
- Google Research
- Hiroshima University, Hiroshima Astrophysical Science Center
- Huazhong University of Science and Technology, School of Physics
- Instituto de Astronomía, Universidad Nacional Autónoma de México
- Instituto de Astrofísica de Andalucía, Consejo Superior de Investigaciones Científicas
- Instituto de Radioastronomía y Astrofísica, Universidad Nacional Autónoma de México
- Instituto Nacional de Astrofísica, Óptica y Electrónica
- Istituto Nazionale di Astrofisica - Istituto di Radioastronomia, Italian ALMA Regional Centre
- Istituto Nazionale di Fisica Nucleare, Sezione di Napoli
- Joint Institute for VLBI ERIC (JIVE)
- Key Laboratory for Particle Astrophysics, Institute of High Energy Physics, Chinese Academy of Sciences
- Key Laboratory for Research in Galaxies and Cosmology, Chinese Academy of Sciences
- Key Laboratory for the Structure and Evolution of Celestial Objects, Chinese Academy of Sciences
- Key Laboratory of Radio Astron., Chinese Academy of Sciences
- Kogakuin University of Technology Engineering
- Korea Astronomy and Space Science Institute
- Leiden University, Allegro / Leiden Observatory
- Max-Planck-Institut für extraterrestrische Physik
- Nanjing University, Key Laboratory of Modern Astronomy and Astrophysics / School of Astronomy and Space Science
- National Optical Astronomical Observatory
- National Radio Astronomical Observatory
- National Sun Yat-Sen University, Physics Department
- National Taiwan University, Department of Physics
- Netherlands Organisation for Scientific Research
- Nederlandse Onderzoekschool voor Astronomie
- Peking University, Department of Astronomy, School of Physics / Kavli Institute for Astronomy and Astrophysics
- Rhodes University, Centre for Radio Astronomy Techniques and Technologies, Department of Physics and Electronics
- Seoul National University, Department of Physics and Astronomy
- School of Astronomy and Space Sciences, University of Chinese Academy of Sciences
- Shanghai Astronomical Observatory, Chinese Academy of Sciences
- Southern Denmark University, Department of Physics, Chemistry and Pharmacy, CP3-Origins
- Tohoku University, Astronomy Institute / Frontier Research Institute for Interdisciplinary Sciences
- The Graduate University for Advanced Studies (SOKENDAI), Department of Statistical Science / Department of Astronomical Science
- The Institute of Statistical Mathematics
- The University of Tokyo, Department of Astronomy, Graduate School of Science / Kavli Institute for the Physics and Mathematics of the Universe
- Universidad de Concepción, Astronomy Department
- Universitat de València (Departament d'Astronomia i Astrofísica / Observatori Astronòmic)
- University College London, Mullard Space Science Laboratory
- University of Amsterdam, Anton Pannekoek Institute & GRAPPA
- University of California Berkeley, Radio Astronomy Laboratory
- University of California Santa Barbara, Department of Physics
- University of Illinois, Department of Astronomy / Department of Physics
- University of Massachusetts Amherst, Department of Astronomy
- University of Pretoria, Department of Physics
- University of St. Petersburg, Astronomy Institute
- University of Science and Technology
- University of Science and Technology of China, Astronomy Department
- University of Toronto, Dunlap Institute for Astronomy and Astrophysics
- University of Turku, Department of Physics and Astronomy
- University of Waterloo, Waterloo Center for Astrophysics / Department of Physics and Astronomy
- Yonsei University, Department of Astronomy
- Yunnan Observatories, Chinese Academy of Sciences



Opendata.cern.ch



- همکاری های بین المللی در قالب پروژه های چند ملیتی

Open research, publicly available data, open-source code, open hardware

- مقالات قابل دسترسی در Google Scholar, Academia.edu, Arxiv.org
- داده های خام غالباً قابل دسترسی عموم در بانک داده آنلاین
- Software libraries و سورس کد در Github.org یا Gitlab

- باز تولید نتایج علمی یکدیگر!

EHT Global Team

Source: [Smithsonian Mag](#)

نکات مشترک و ساختاری (۱)

- سامانه سرپرستی و گرد آوری داده [SCADA] از طریق شبکه داخلی و/یا اینترنت (مثال: LOFAR)

• Low-Frequency Array Radio Telescope (<250 MHz)

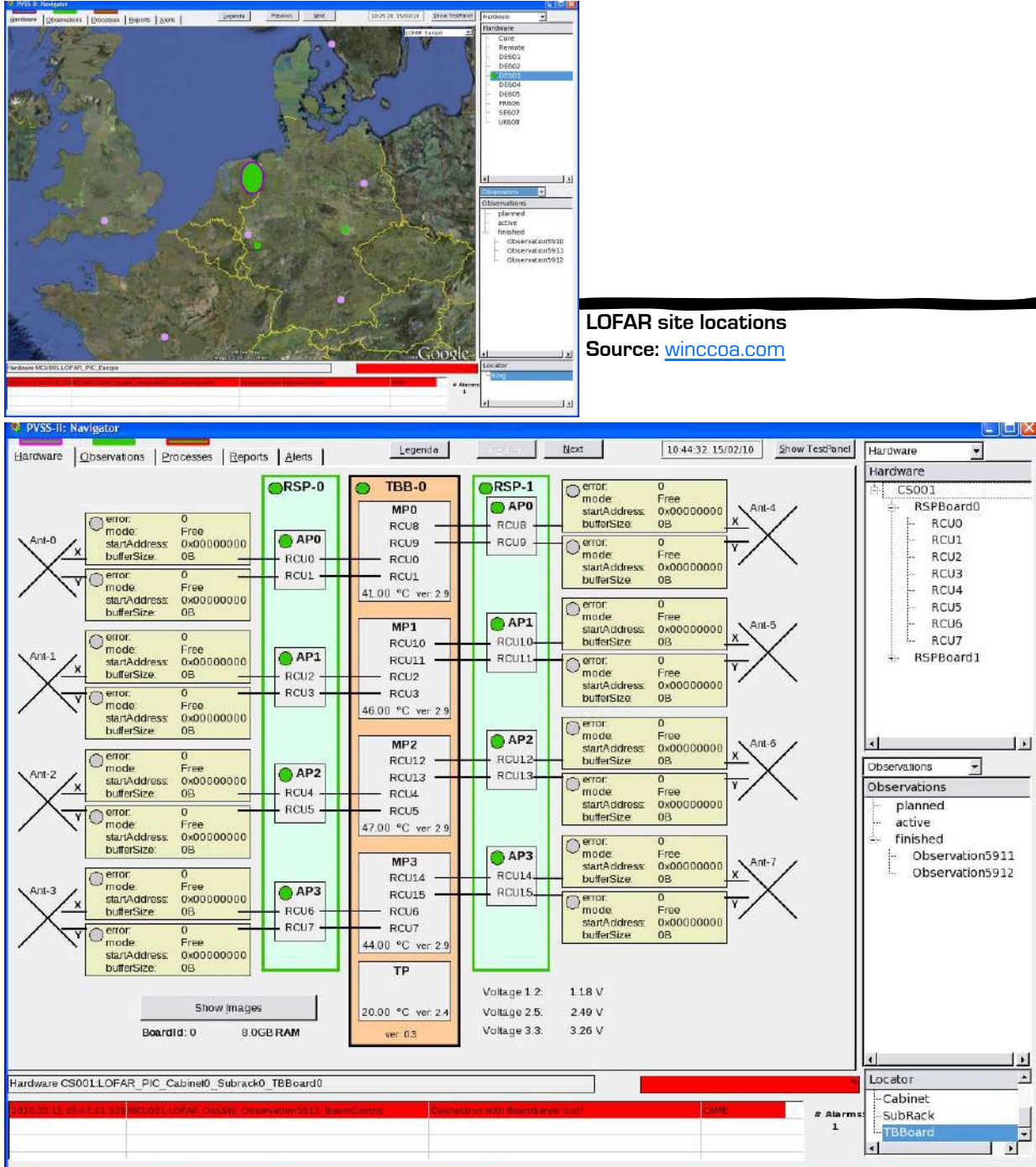
- مشاهده رادیویی اولین ستاره ها و کهکشان ها بعد از بیگ بنگ



LOFAR/ASTRON, [CC BY 3.0](https://creativecommons.org/licenses/by/3.0/), via Wikimedia Commons

LOFAR site locations

Source: winccoa.com

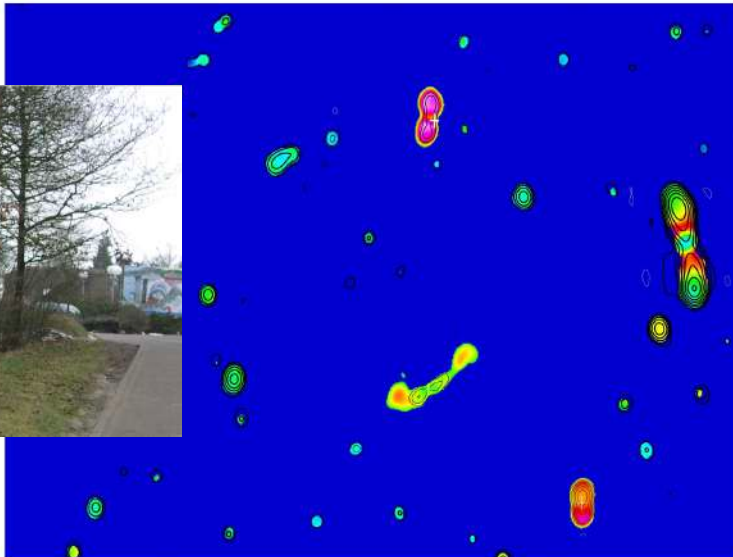


نکات مشترک و ساختاری (۲)

Example: LOFAR requirements

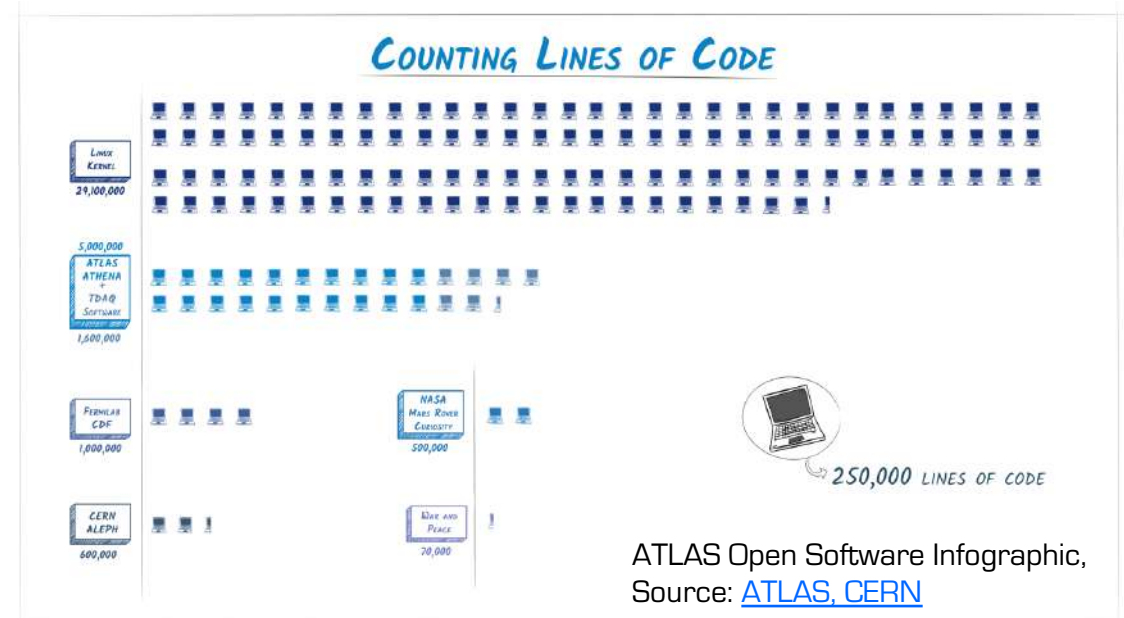
Sampling at 200 MHz: aggregate raw data **13 Tbytes/s**
Long-range data transport: **150 Gbps**
Dedicated **10 Gbps** fibre-optic links

M. P. van Haarlem, et al., "LOFAR: The LOw-Frequency Array", A&A, 556 (2013) A2



Sample LOFAR image; Source & Copyright: [ASTRON](#)

- مسیر اطلاعات: انتقال داده [data transfer]، تجميع داده [data aggregation]، آنالیز داده [data processing]، ارائه داده [data presentation]
- پروسس حجم گسترده اطلاعات تولید شده توسط آزمایشگاه های فیزیکی روش های جدیدی را می طلبد! (**Big Data, faster networks, better software**)



Messier 87*
By the Numbers



53 million light-years
Separate Earth and the M87* Supermassive black hole.

That's far.
12.5 million times farther than the closest star to our solar system, Proxima Centauri.

Source: [Western Digital](#)

8 telescopes
around the world collected the data over several days in April 2017.

The project involved...

- 200** researchers
- 60** scientific institutions
- 20** countries

350 terabytes collected each day

~4.5 petabytes of data collected total

960 hard drives stored that data

That much data is equivalent to taking **4,000** photos a day for almost **200** years on your cellphone.

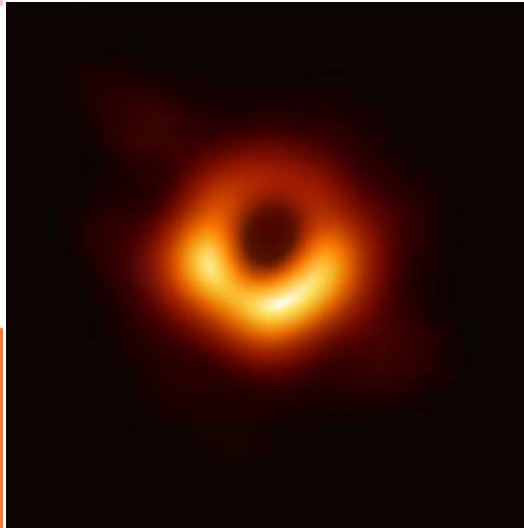
Trucks and planes delivered the hard drives to data centers in **Cambridge, MA** and **Bonn, Germany**.

Transferring all of that data over the Internet would've taken **~25 years**

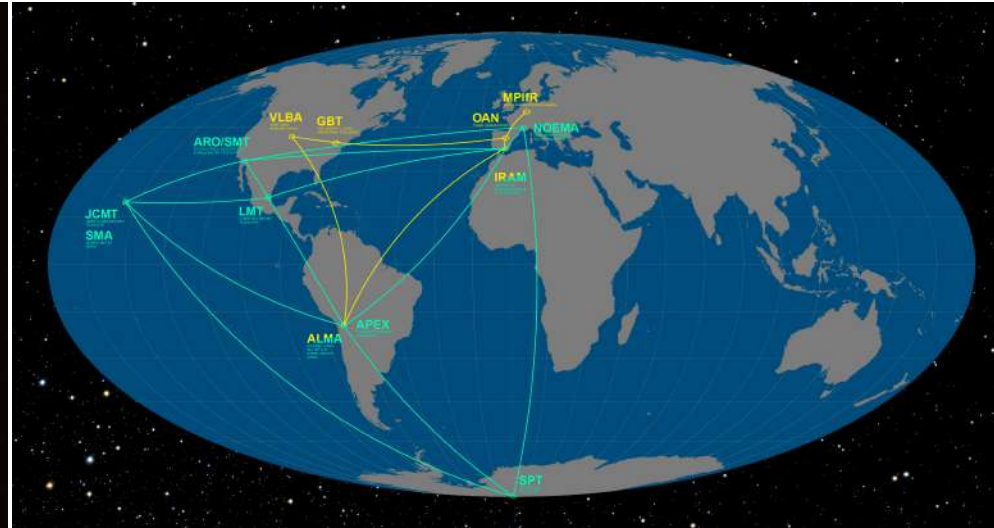
4 computer-imaging algorithms were used by 4 independent groups of experts to help eliminate bias in reviewing the findings.

The result?
1 history-making photo.

DATA HAKS PROBLEMS READ LAB Western Digital.



Event Horizon Telescope, [CC BY 4.0](#), via Wikimedia Commons



ESO/O. Furtak, [CC BY 4.0](#), via Wikimedia Commons



Source: [extremetech.com](#)



نکات مشترک و ساختاری (۳)

- پروسس حجم گسترده اطلاعات تولید شده توسط آزمایشگاه های فیزیکی روش های جدیدی را می طلبد!

Big Data

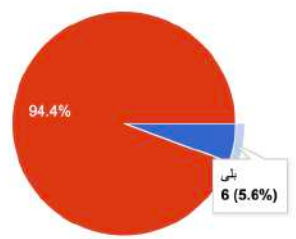
Faster networks

Better software

...

1 Petabyte = 1024 * 1024 Gigabyte

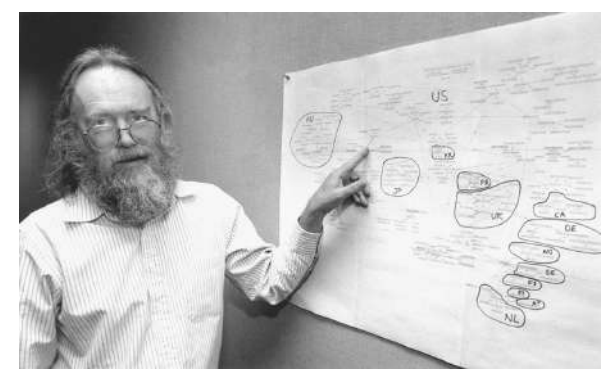
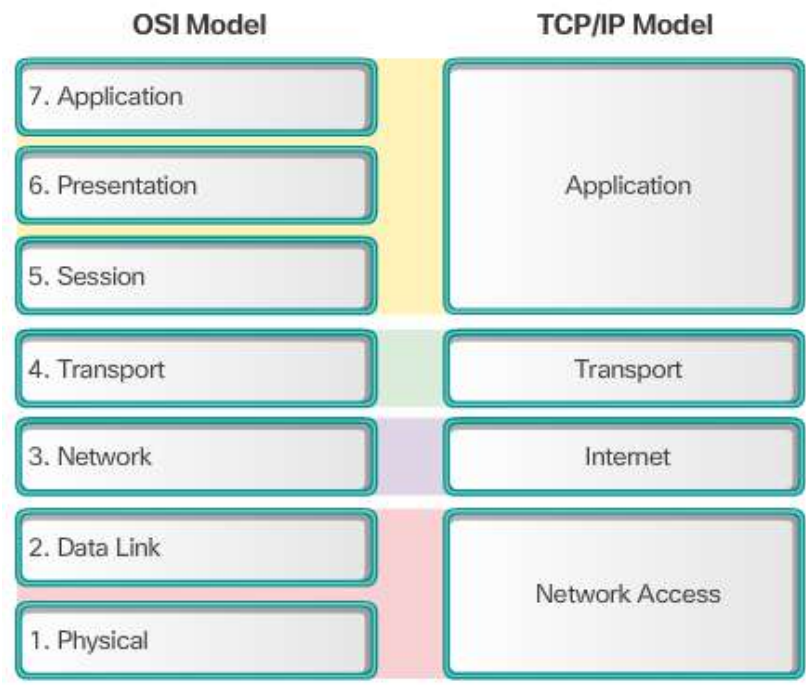
NASA and The Hubble Heritage Team (STScI/AURA), Public domain, via [Wikimedia Commons](#)



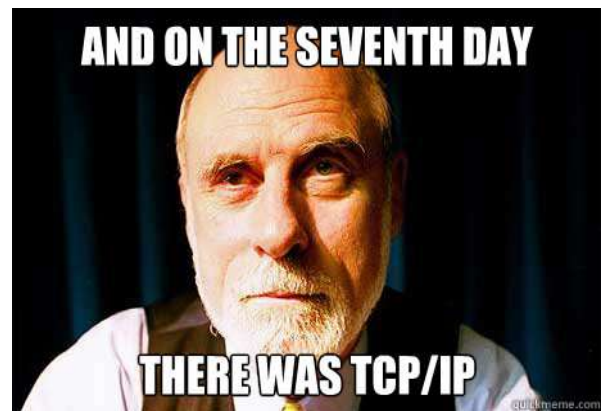
تکوین فناوری اطلاعات و ارتباطات از آغاز پیدایش اینترنت (۱)

Open Systems Interconnection (OSI) by ISO & ITU
Developed/adopted Late 70's, early 80's

Vint Cerf and Robert Kahn (1974); standards maintained by the IETF

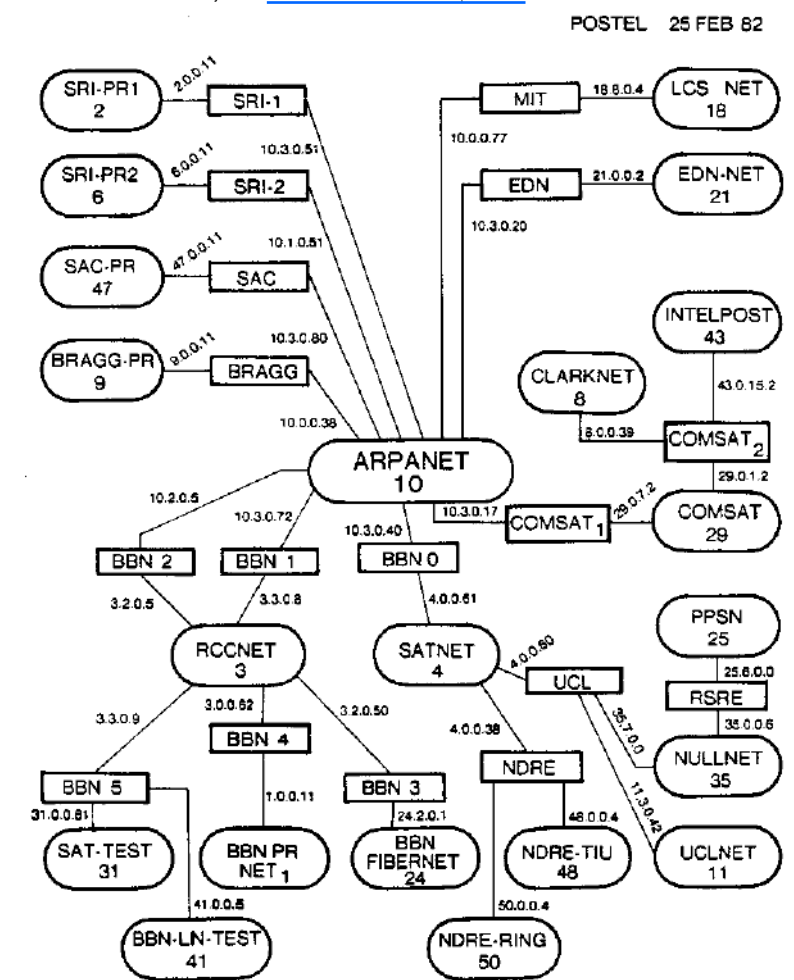


Postel in 1994; Irene Fertik, USC News Service. © 1994, USC., Attribution, via Wikimedia Commons

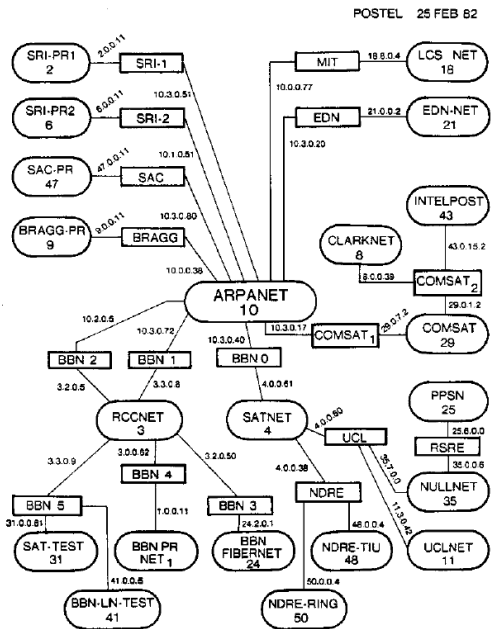


Packet Pushers

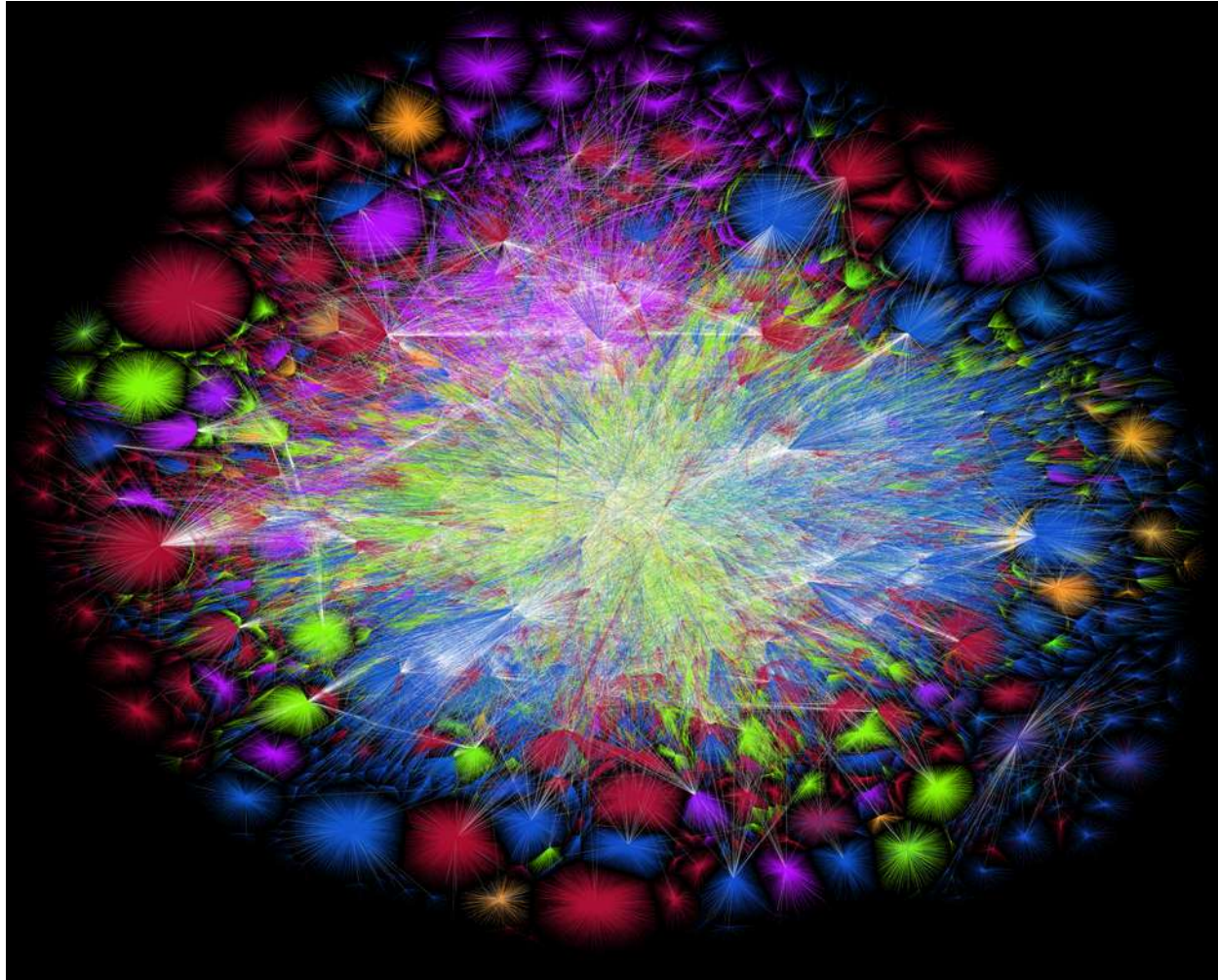
Map of the Internet, created by Jon Postel in 1982, Public domain, via [Wikimedia Commons](#)



تکوین فناوری اطلاعات و ارتباطات از آغاز پیدایش اینترنت (۲)

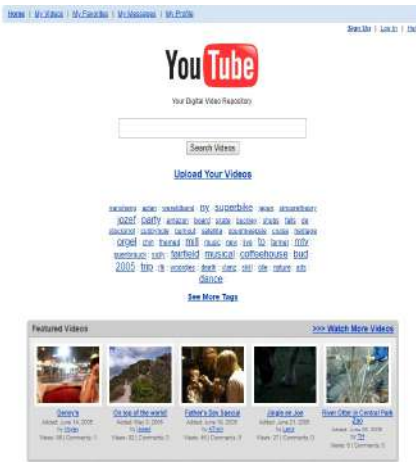


Map of the Internet, created by Jon Postel in 1982, Public domain, via [Wikimedia Commons](#)



Internet map in 2015; Source: [Opte project](#)

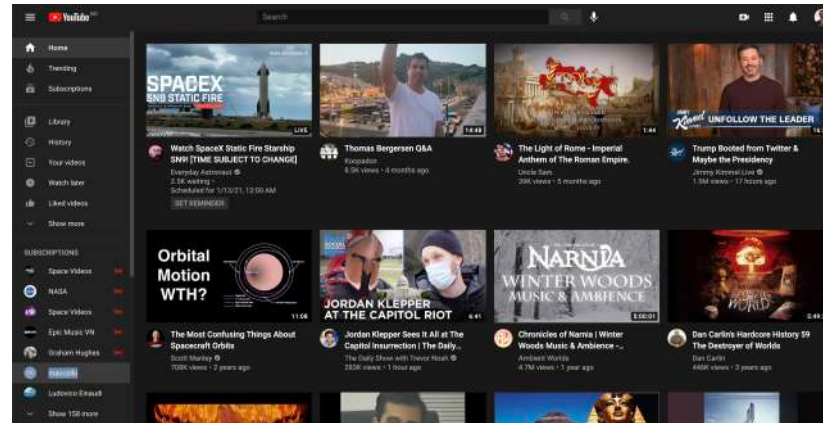
تكوين فناوری اطلاعات و ارتباطات از آغاز پیدایش اینترنت (۳)



YouTube in 2005; source: versionmuseum.com



This [NeXT Computer](http://en.wikipedia.org/wiki/NeXT_Computer) used by [Tim Berners-Lee](http://en.wikipedia.org/wiki/Tim_Berners-Lee) at CERN became the world's first web server!



YouTube on 12.01.2021; source: youtube.com



[Connie Zhou for Google](http://en.wikipedia.org/wiki/Google)



Thomas Schanz, [CC BY-SA 4.0](http://creativecommons.org/licenses/by-sa/4.0/), via Wikimedia Commons



تکوین فناوری اطلاعات و ارتباطات از آغاز پیدایش اینترنت (۴)

Cloud Computing & Storage

کلاود کامپیوتینگ: انتقال ذخیره اطلاعات و انجام محاسبات از ماشین کاربر (کامپیوتر شخصی، موبایل، لپتاپ) به دیتاسنتر های بزرگ در سرتاسر دنیا! سرعت بالاتر (زمان پاسخ دهی کوتاه تر)، بازدهی بهتر، مدیریت آسانتر منابع نرم افزاری و سخت افزاری، تحمل بالاتر آسیب پذیری و قابلیت بازیابی اطلاعات...

SaaS: Dropbox, Google apps

PaaS: Google App Engine, AWS Elastic Beanstalk

IaaS: AWS, Google Compute Engine

Cloud Service Providers



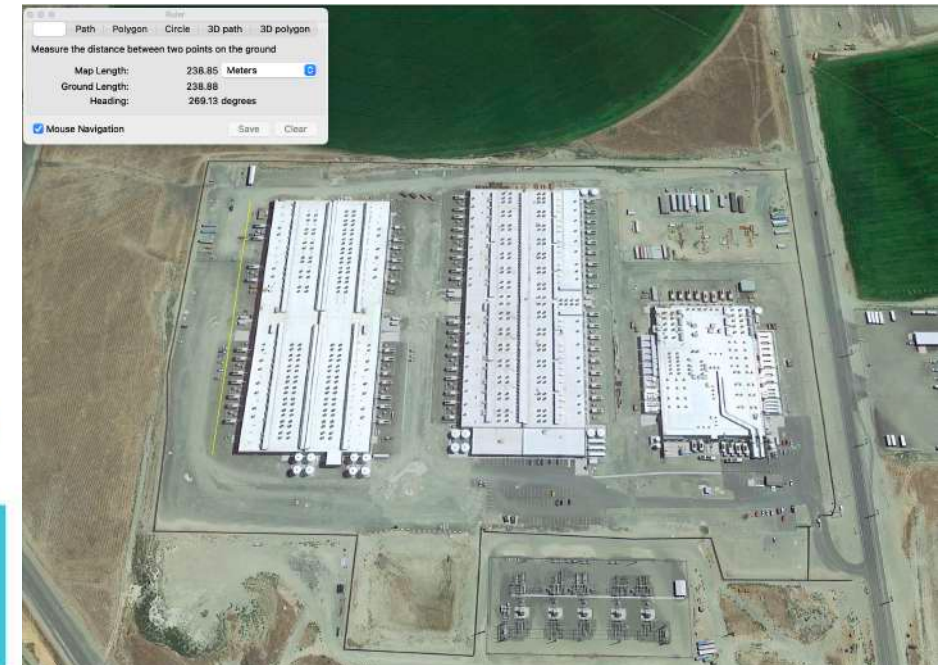
Google Cloud Platform



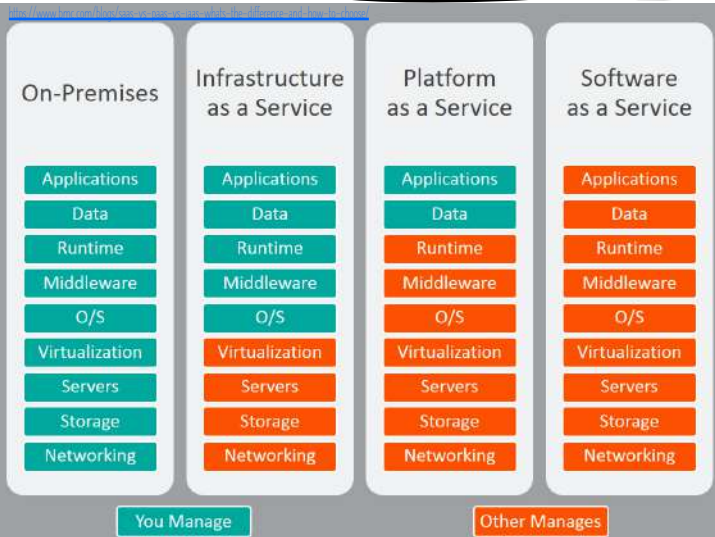
openstack



the open cloud company



Amazon's AWS US West (Oregon) cloud centre; Source: Google Earth



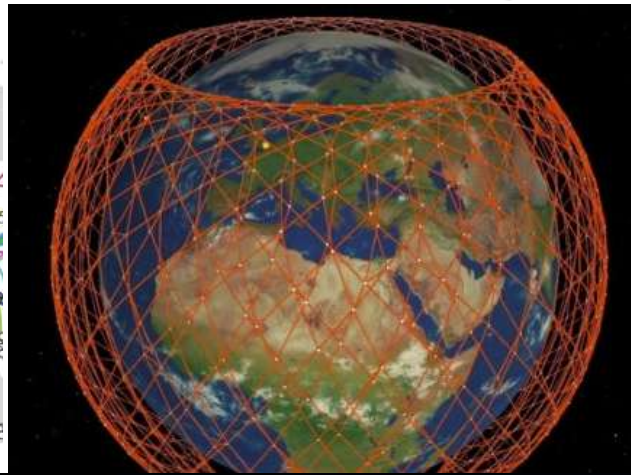
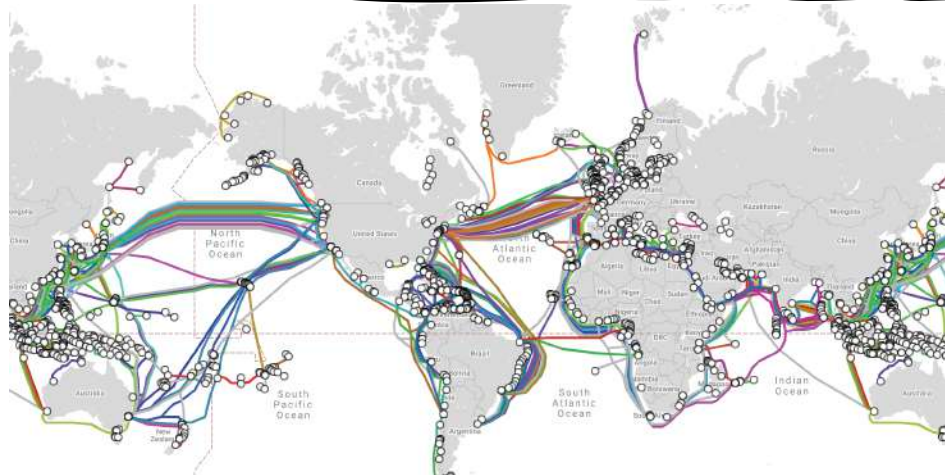
تکوین فناوری اطلاعات و ارتباطات از آغاز پیدایش اینترنت (۵)

نقشه کابل های فیبرنوری در بستر اقیانوس

Source: submarinecablemap.com

Starlink project by SpaceX

Source: vpchothuegoldenking.com



- سرعت نور در فیبرنوری ۳۱٪ کندتر است از خلا!
- ماهواره های GEO (مدار ۳۶۰۰۰ کیلومتر، ۷۰۰ میلی ثانیه رفت و برگشت) دارای تاخیر زمانی زیاد و پرهزینه هستند (نامناسب برای تماس صوتی و ویدیویی، گیم، معاملات بورس)
- SpaceX LEO constellation = Starlink

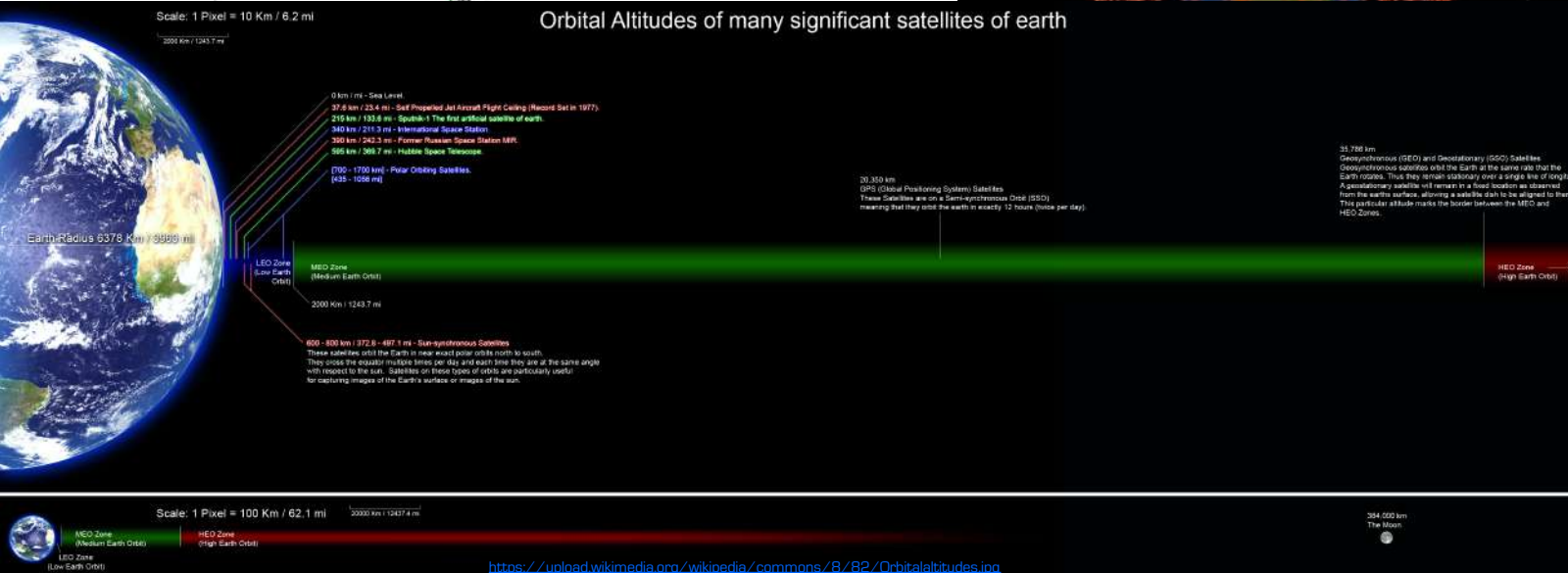


Image: © Victoria Girgis/Lowell Observatory

اینترنت، فناوری اطلاعات و آموزش فیزیک (۱)

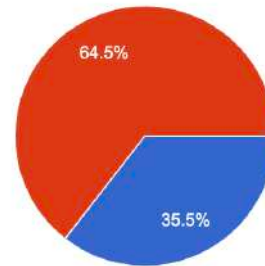
- شبکه های کامپیوتری (م. اینترنت) و سیستم های فناوری اطلاعات (م. نرم افزاری) تسهیل کننده توسعه علمی در فیزیک (و سایر علوم)
- نه تنها در تحقیقات علمی بلکه همچنین در آموزش فیزیک!
- برنامه نویسی (Coding) به عنوان بخشی از کار روزمره یک محقق فیزیک! و شاید در آینده (و تا حدودی هم الان) خیلی نزدیک معلم فیزیک!

• شروع با Python scripting

• شبیه سازی و حل مسائل فیزیک

آیا با حداقل یک زبان برنامه نویسی کامپیوتری آشنایی و تجربه دارید؟

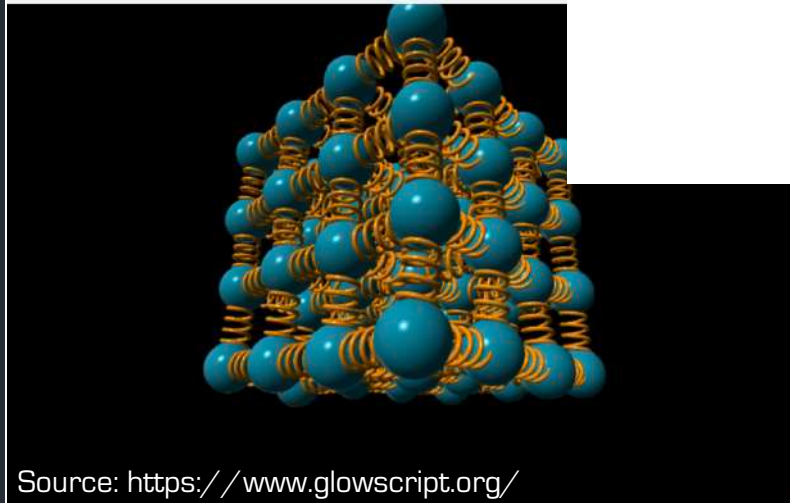
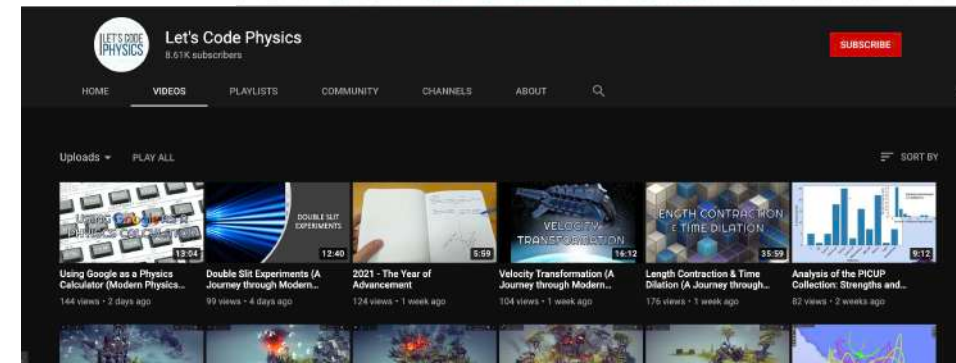
107 responses



بله
خیر

کانال یوتیوب!

LET'S CODE | PHYSICS



Source: <https://www.glowscript.org/>

A model of a solid represented as atoms connected by interatomic bonds.

```
python import:
GlowScript 3.8 Python

# Bruce Sherwood

N = 4 # N by N by N array of atoms
# Surrounding the N=N atoms is another layer of invisible fixed-position atoms
# that provide stability to the lattice.
K = 1
m = 1
spacing = 1
atom_radius = 0.5*spacing
ls = spacing*1.5*atom_radius
Vb = pi*(0.5*atom_radius)**2*ls # initial volume of spring
scene.center = 0.5*(N-1)*vector(1,1,1)
dt = 0.001*(2*pi*sqrt(x/k))
axes = [vector(1,0,0), vector(0,1,0), vector(0,0,1)]

scene.caption= ""A model of a solid represented as atoms connected by interatomic bonds.

To rotate "camera", drag with right button or Ctrl-drag.
To zoom, drag with middle button or Alt/Option depressed, or use scroll wheel.
On a two-button mouse, middle is left + right.
To pan left/right and up/down, Shift-drag.
Touch screen: pinch/extend to zoom, swipe or two-finger rotate.""

class crystal:

    def __init__(self, N, atom_radius, spacing, momentumRange):
        self.atoms = []
        self.springs = []

        # Create (N/2)**3 atoms in a grid; the outermost atoms are fixed and invisible
        for z in range(-1,N-1,1):
            for y in range(-1,N-1,1):
                for x in range(-1,N-1,1):
                    atom = sphere()
                    atom.pos = vector(x,y,z)*spacing
                    atom.radius = atom_radius
                    atom.color = vector(0,0.50,0.69)
                    if 0 <= x < N and 0 <= y < N and 0 <= z < N:
                        p = vec.random()
                        atom.momentum = momentumRange*p
                    else:
                        atom.visible = False
                        atom.momentum = vec(0,0,0)
                        atom.radius = len(self.atoms)
                        self.atoms.append(atom)
        for atom in self.atoms:
            if atom.visible:
                if atom.pos.x == 0:
                    self.make_spring(self.atoms[atom.index-1], atom, False)
                    self.make_spring(atom, self.atoms[atom.index+1], True)
                elif atom.pos.x == N-1:
                    self.make_spring(atom, self.atoms[atom.index+1], False)
                    self.make_spring(self.atoms[atom.index+1], True)
                elif atom.pos.x == 0:
                    self.make_spring(self.atoms[atom.index-(N+2)], atom, False)
                    self.make_spring(atom, self.atoms[atom.index+(N+2)], True)
                elif atom.pos.x == N-1:
                    self.make_spring(atom, self.atoms[atom.index+(N+2)], False)
                    self.make_spring(self.atoms[atom.index+(N+2)], True)
                if atom.pos.y == 0:
                    self.make_spring(self.atoms[atom.index-(N+2)], atom, False)
                    self.make_spring(atom, self.atoms[atom.index+(N+2)], True)
                elif atom.pos.y == N-1:
                    self.make_spring(atom, self.atoms[atom.index+(N+2)], False)
                    self.make_spring(self.atoms[atom.index+(N+2)], True)
                if atom.pos.z == 0:
                    self.make_spring(self.atoms[atom.index-(N+2)*2], atom, False)
                    self.make_spring(atom, self.atoms[atom.index+(N+2)*2], True)
                elif atom.pos.z == N-1:
                    self.make_spring(atom, self.atoms[atom.index+(N+2)*2], False)
                    self.make_spring(self.atoms[atom.index+(N+2)*2], True)

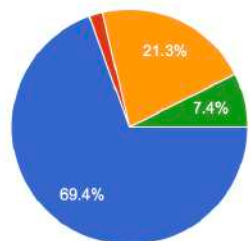
        # Create a grid of springs linking each atom to the adjacent atoms
        # in each dimension, or to invisible outermost atoms.
        def make_spring(self, start, end, visible):
            spring = helix()
            spring.pos = start.pos
            spring.axis = end.pos-start.pos
            spring.visible = visible
            spring.thickness = 0.05
            spring.radius = 0.5*atom_radius
            spring.length = spacing
            spring.start = start
            spring.end = end
            spring.color = color.orange
            self.springs.append(spring)

c = crystal(N, atom_radius, spacing, 0.1*spacing*sqrt(k/m))

while True:
    rate(60)
    for atom in c.atoms:
        if atom.visible:
            atom.pos = atom.pos + atom.momentum/m*dt
    for spring in c.springs:
        spring.axis = spring.end.pos - spring.start.pos
        l = mag(spring.axis)
        spring.axis = spring.axis/norm(l)
        spring.pos = spring.start.pos+0.5*atom_radius*spring.axis
        ls = l-atom_radius
        spring.length = ls
        fdt = spring.axis * (ls*dt * (1-spacing/l))
        if spring.start.visible:
            spring.start.momentum = spring.start.momentum + fdt
        if spring.end.visible:
            spring.end.momentum = spring.end.momentum - fdt
```

آیا در طول دوران کرونا دانش کامپیوتری خود را افزایش داده اید و مطالعه داشته اید؟

108 responses



- بله، مطالعه شخصی داشتم
- بله، در دوره های آموزشی مصوب آموزش و پرورش شرکت کردم
- خیر، از قبل بلد بودم
- خیر فرصتی نداشتم

اینترنت، فناوری اطلاعات و آموزش فیزیک (۲)

Resources for Teaching Physics Online

Submitted by kcoore on Tue, 03/17/2020 - 17:46

Friday FlyerNews

The COVID-19 pandemic has caused many physics classrooms to go online. QuarkNet has collected resources to help teachers in this situation. We do not officially endorse these resources but rather make them available for teachers to evaluate themselves. We do add comments where appropriate.

We've added some "Hat Tip" (HT) to folks who have contributed resources. This really is a QuarkNet-and-beyond team effort.



<https://www.aapt.org/>

- اینترنت فضایی را برای آموزش آنلاین/مجازی فیزیک مهیا کرده /میکند!

- منابع **متعدد** و **متنوع** برای آموزش فیزیک از راه دور

- پندمیک COVID-19 به عنوان تسهیل کننده جبری توسعه آموزش مجازی

- General Resources for Online Physics:
- This **AAPT Florida site** has both good practices and good resources: it seems like a great place to start. *HT Adam LaMoe.*
 - GoLab** is an EU online project. It has many online labs (more than we have time to check out). *HT Barbara Gulelova.*
 - The **Physics Classroom** has been around for awhile and can serve as the basis of an online physics class. *HT Deborah Roudsbush.*
 - CompPADRE** has online APS physics education resources, including a good K-12 collection.
 - Physlet Physics** is organized as a physics textbook but has interactive "physlets" for students to investigate different phenomena and problems. *HT Deborah Roudsbush.*
 - HTML5 Simulations** from Andrew Duffy of Boston University. They look pretty useful. *HT Carol Lund.*
 - OpenStax** online science textbooks, including AP Physics. *HT Deborah Roudsbush.*
 - PhET** - lots of nice simulations; may need some intro to students.
 - Remote Learning with PhET Simulations**. This is essentially a companion guide to PhET, above, to help teachers find the right sim for the right lesson. *HT Deborah Roudsbush.*
 - NOVA Physical Science** - a good collection of online resources. *HT Karen Bardeen.*
 - The **Physics Aviary** is another source of online labs and more.
 - Missouri physics teacher Joe Milano has compiled an impressive Google drive full of resources for teaching online. Read his **recent tweet about it** and request access on **this Google form**.
 - Perimeter Institute has a number of activities. Here they explain how they can be **adapted for online use**.
 - Physics Girl YouTube Channel** (enough said)
 - QuarkNet Wednesday Webinars (QW2)** - Recordings of several talks on a variety of physics topics from the 2020 QW2 series.
 - Home-Adapted Interactive Lecture Demos** by David Schlooff.
 - An app can connect your phone camera to your computer for online labs and demos. With iPhone or iPad, there is **Camo**. With Android, there are **alternatives**.

Resources from Fermilab:

- Fermilab Particle Physics at Home**
- Fermilab Virtual Tours**
- Resources for Families and Educators**
- Lederman Science Center Exhibit tweets
 - Guess the shape of the hidden target
 - Another scattering video
 - How to see a star behind a galaxy
 - Bending a beam of particles
 - Small cosmic ray detector
- Fermilab YouTube Channel** (including Don Lincoln videos)
- The Particle Nature of Light in Modern Physics**

Particle Physics Resources

- QuarkNet**. We think you've heard of this. Navigate from here for the Cosmic Ray and CMS e-Labs, Masterclasses, and the Data Activities Portfolio. Log in to add content to your center group or leave comments.
- Comments on Adapting Data Activities to Teaching Online** lists QuarkNet Data Activities which have been checked for adaptability to online remote teaching. Any Comments about how to make these adaptations are normally only viewable by logging in to the QuarkNet site but are reproduced here and available to all.
- International Masterclasses** and **CERN Open Data**. Explore the experiments and the data.
- Cosmic@Web** gives students the ability to make plots from DESY Zeuthen cosmic ray experiments. *HT Uta Blom.*
- The Particle Adventure**. Venerable. Still useful, still nicely done, still updated.
- Resources for Cosmic Ray Analyses Online**. The QuarkNet Cosmic Ray e-Lab is a great place for students and teachers to work with authentic data in the classroom or at home. This gives you a start.
- Physics Travel Guide**. This site directed at all sorts of physics topics, including particle physics. It looks like a good resource for students and teachers alike. *HT Marje Bardeen.*
- World Wide Day Day** registration is now open. Find all you need at quarknet.org > MASTERCLASSES > WORLD WIDE DAY DATA. The registration deadline is November 6 and the big day is November 12.

URL: <https://quarknet.org/content/resources-teaching-physics-online>

Questions or suggestions? Contact:

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Shane Wood: swood@nd.edu

PhET INTERACTIVE SIMULATIONS | University of Colorado Boulder

https://phet.colorado.edu/sims/html/balancing-act/latest/balancing-act_en.html

Bricks: 5 kg, 10 kg, 15 kg, 20 kg

Meters: 2, 1.75, 1.25, 0.75, 0.25, 0.25, 0.75, 1, 1.25, 1.5, 1.75, 2

Controls: Show (Mass Labels, Forces from Objects, Level), Position (None, Rulers, Marks)

BU Physics | <http://physics.bu.edu/~duffy/classroom.html>

Time: 0

x vs. Time

y vs. Time

a vs. Time

Angular frequency: w = 1.0 w = 0.6

play pause <<step step>> reset

و پایان کلام...

- یادگیری مهارت های آنلاین و ارتقای سطح آموزگاران فیزیک در **فیلد ICT** باعث **ارتقا کیفی و کمی** آموزش میشود!

- در آینده نزدیک، و بالاخص در دوران کرونا، این یک **ضرورت مهم** است و نه تفنن اختیاری!

- استفاده **بهینه** و **به جا** از منابع آنلاین موجود! تمیز اینکه چه چیزی مطلوب و چه چیزی غیرضروری و یا غیرمفید در بین گستره بزرگ منابع است! (تشکیل گروه کاری؟)

- مهارت های **برنامه نویسی** و **زبان انگلیسی** به عنوان دو بال پرواز! (تشکیل کارگاه ها و دوره های آموزشی)

- تولید **نرم افزارهای آموزشی** توسط خود معلمان علاقه مند بر اساس نیاز و تجربه!





سوال؟