تعامل فناوری ارتباطات و اطلاعات و فیزیک در عصر اینترنت

نعیم خادمی

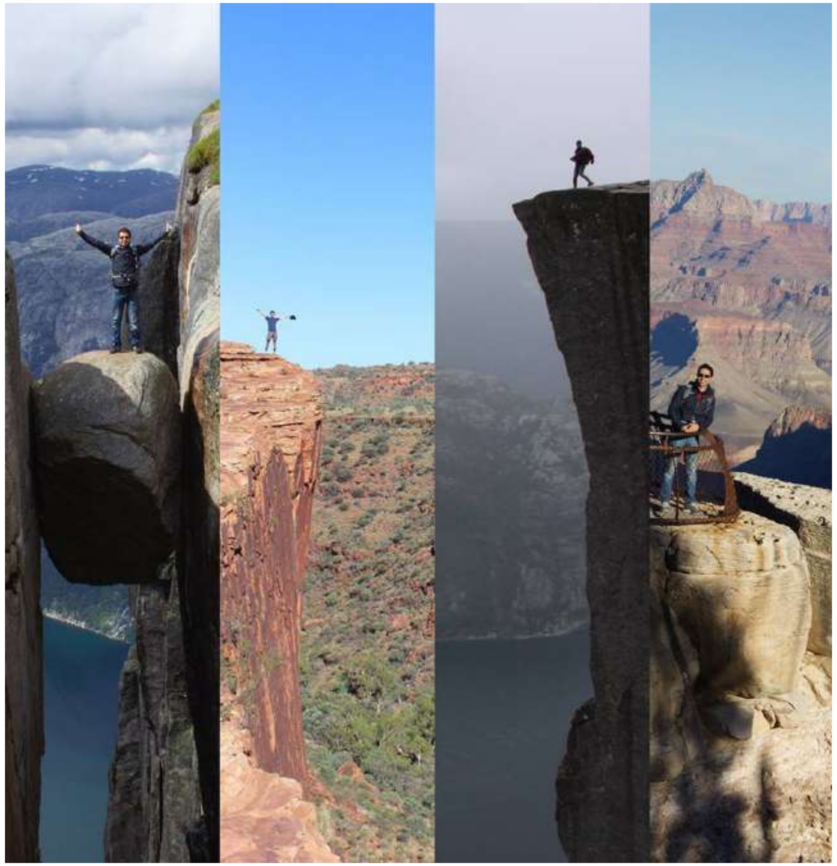
Associate Professor

University of Stavanger, Norway

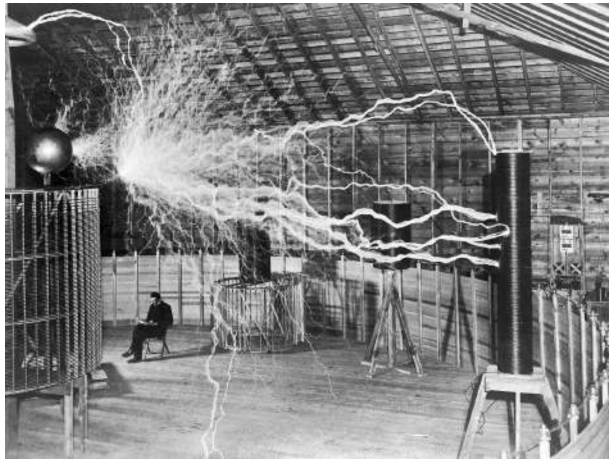
۱۶ ژانویه ۲۰۲۱ - ۲۷ دیماه ۱۳۹۹

اندکی درباره من...

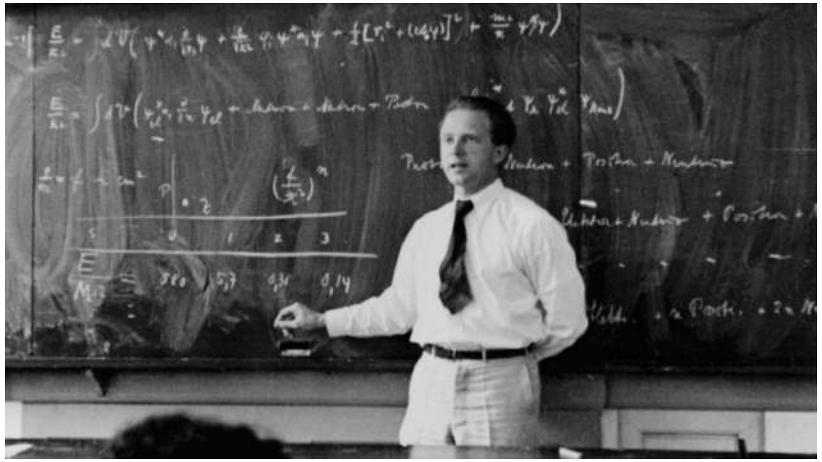
- متولد شیراز، ایران
- دکترای **علوم کامپیوتر**، گرایش **شبکه های کامپیوتری** (Computer Networks) از دانشگاه اسلو، نروژ (UiO) در سال ۲۰۱۵
- دوره فوق دکترای شبکه های کامپیوتری، دانشگاه اسلو، ۲۰۱۵-۲۰۱۸
- دانشیار (Associate Professor) دانشگاه استاوانگر، نروژ (UiS) ۲۰۱۹-اکنون
- فعال در زمینه تدوین، ارائه 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 ضروت ها به جای ابزارها و تکنیک ها



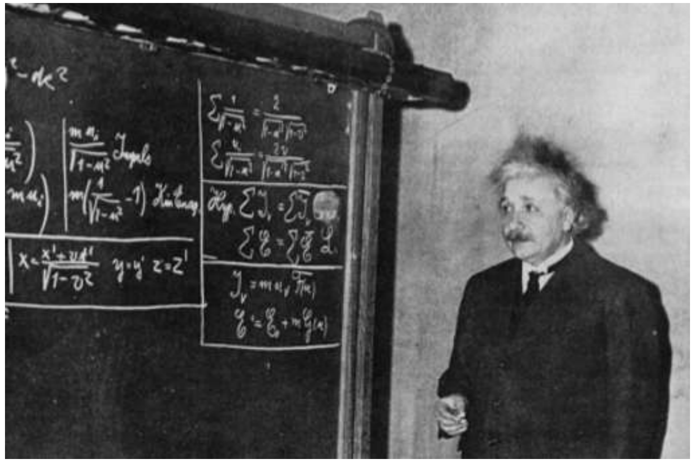
فیزیکدانان، گذشته و حال: شباهت و تفاوت مدل کاری



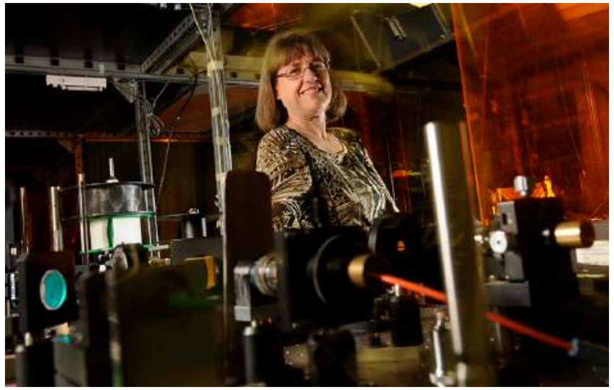
Credit: Dickenson V. Alley, Restored by Lošmi, CC-SA-4.0



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

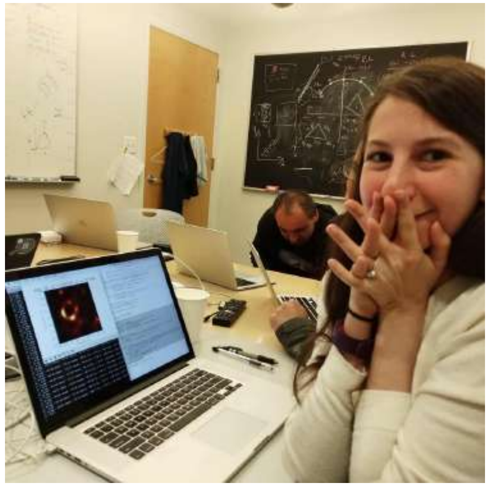
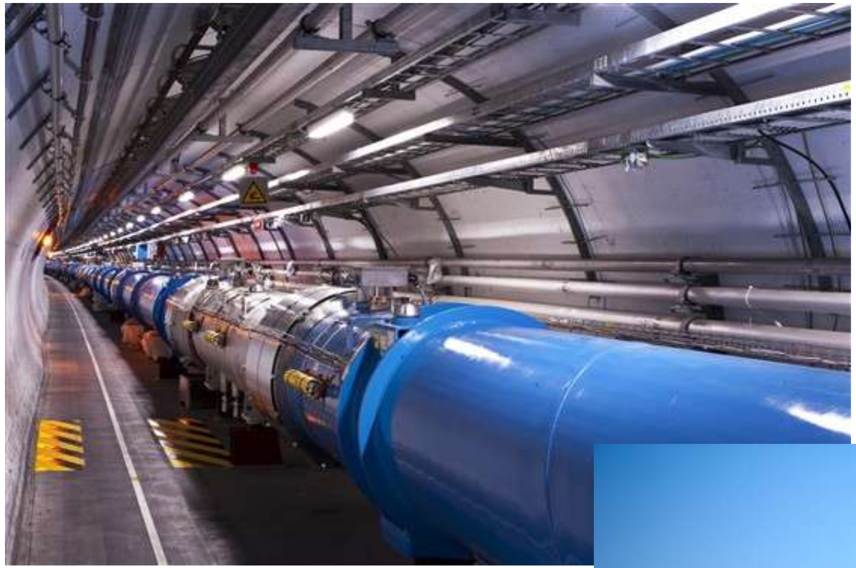


Image courtesy of Katie Bouman

تجهیزات آزمایشگاهی و ابزار اندازه گیری

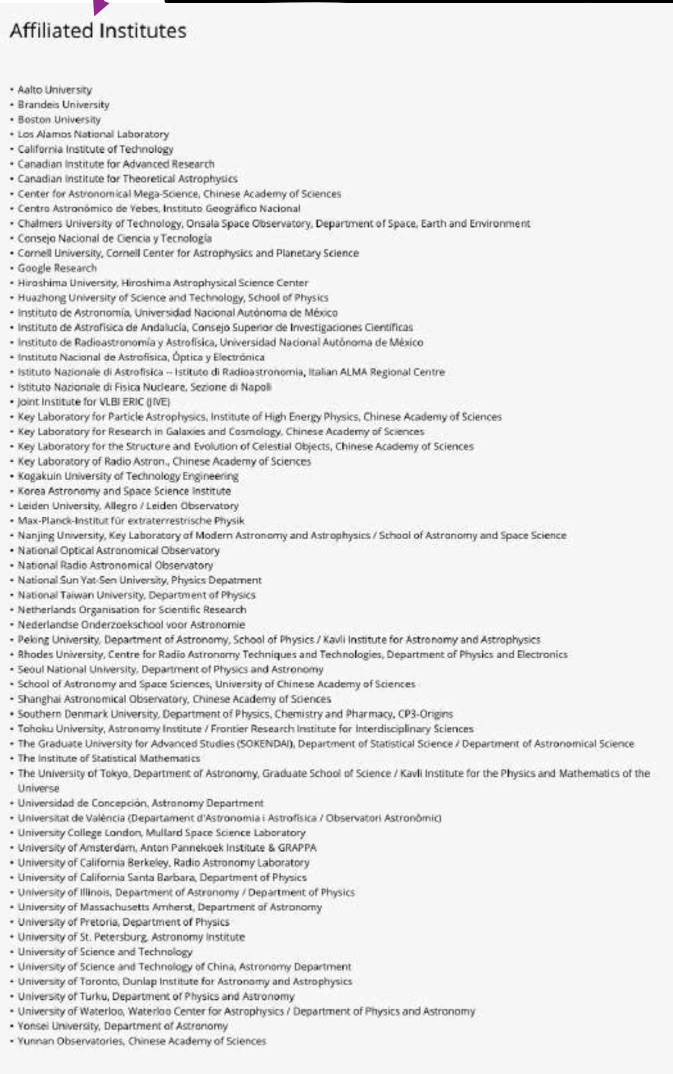


شیوه کار محققین فیزیک

- 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 غالبا قابل دسترسی عموم در **بانک داده آنلاین**
  - **Software libraries و سورس کد** در Github.org یا Gitlab
- باز تولید نتایج علمی یکدیگر!

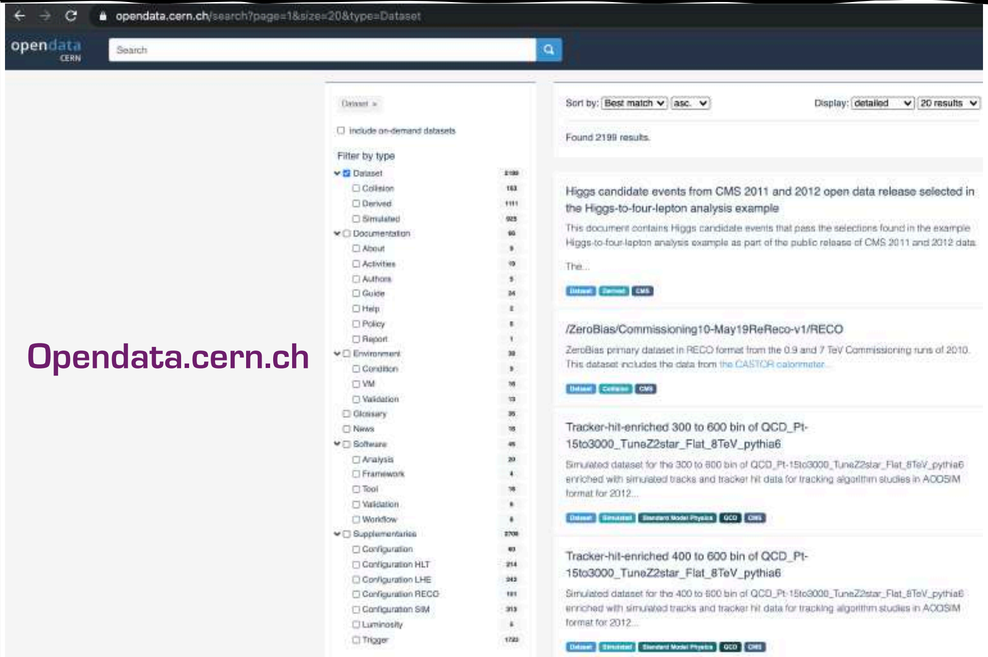
لیست مراکز تحقیقاتی مشارکت کننده در پروژه EHT

بانک داده خام و نرم افزار CERN



Affiliated Institutes

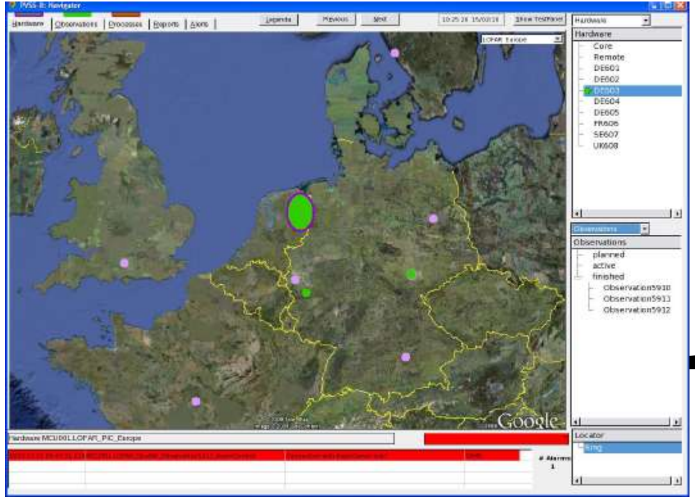
- Aalto University
- Brandeis University
- Boston University
- Los Alamos National Laboratory
- California Institute of Technology
- Canadian Institute for Advanced Research
- Canadian Institute for Theoretical Astrophysics
- Center for Astronomical Mega-Science, Chinese Academy of Sciences
- Centro 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 Depatment
- 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

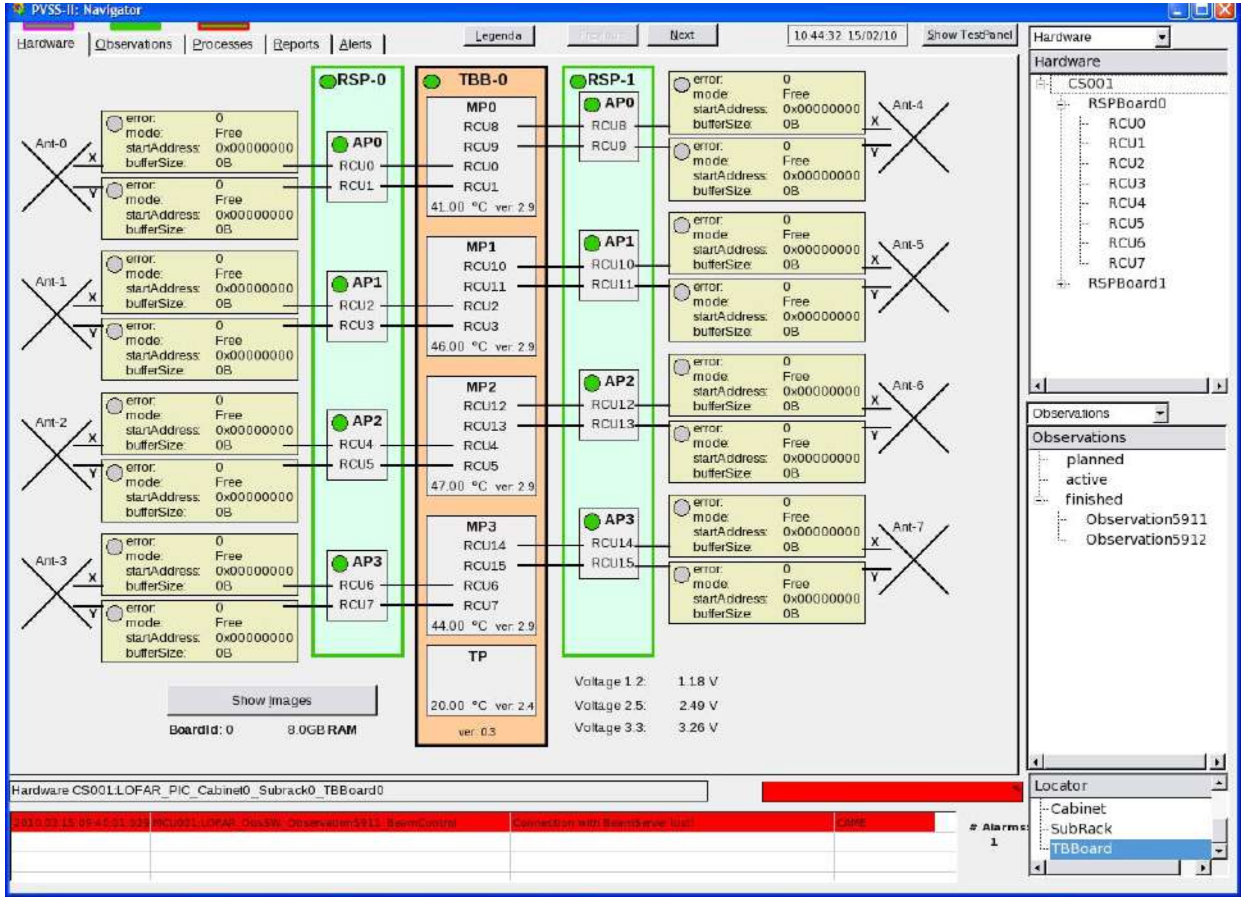
EHT Global Team
Source: [Smithsonian Mag]

نکات مشترک و ساختاری (۱)



LOFAR site locations
Source: winccoa.com

- سامانه <u>سرپرستی و گرد آوری داده</u> **(SCADA)** از طریق <u>شبکه داخلی و / یا اینترنت</u> (مثال: **LOFAR**)
- Low-Frequency Array Radio Telescope (<250 MHz)
- مشاهده رادیویی اولین ستاره ها و کهکشان ها بعد از بیگ بنگ



Source: winccoa.com

LOFAR/ASTRON, [CC BY 3.0](CC BY 3.0), via Wikimedia Commons

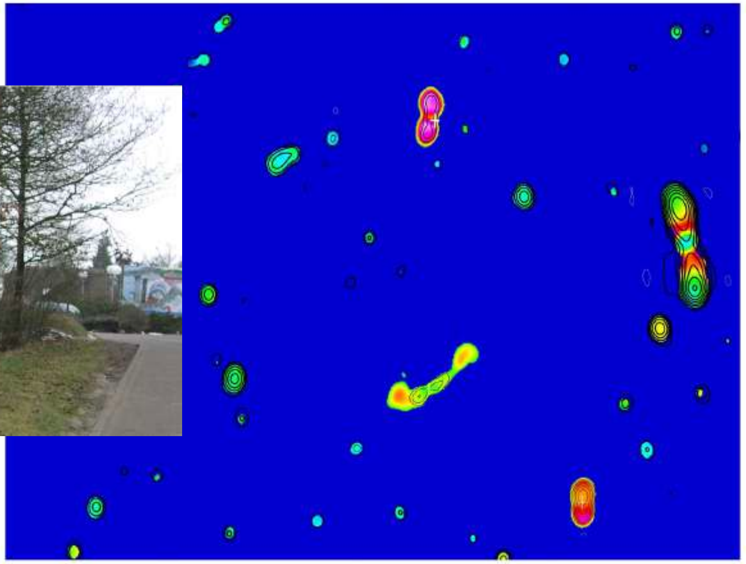
نکات مشترک و ساختاری (۲)

- **مسیر اطلاعات:** انتقال داده (data transfer)، تجمیع 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**)

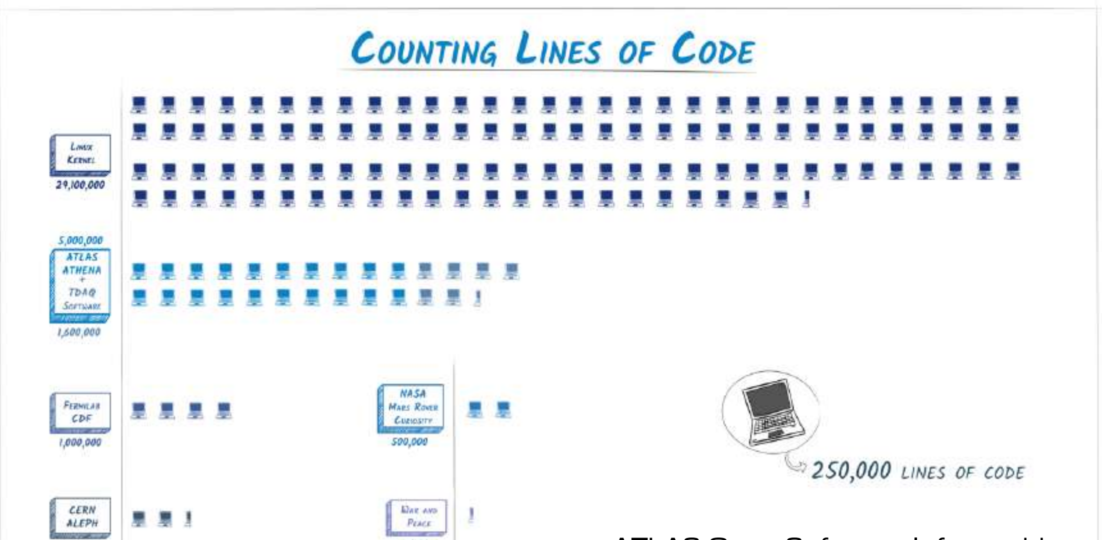
Example: LOFAR requirements

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

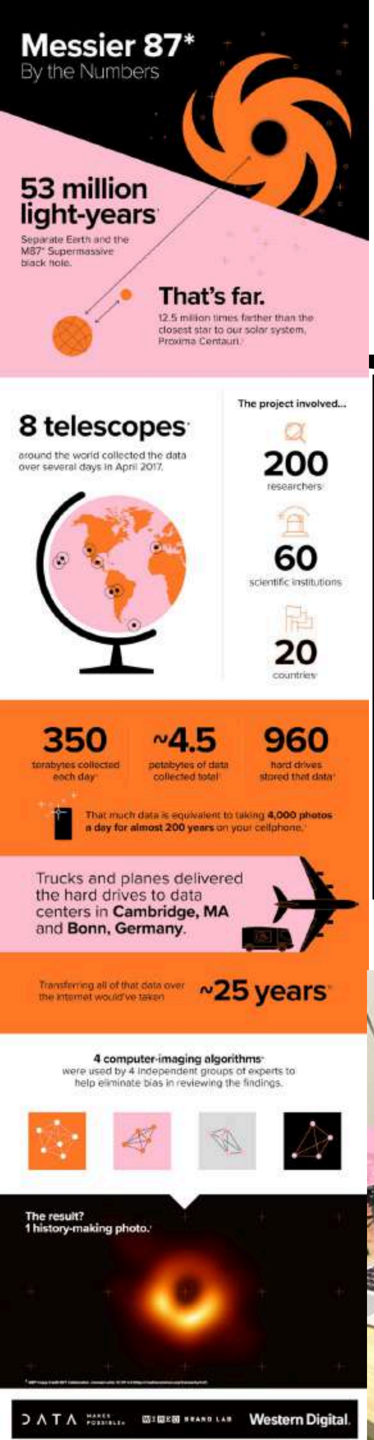


ATLAS Open Software Infographic,
Source: ATLAS, CERN

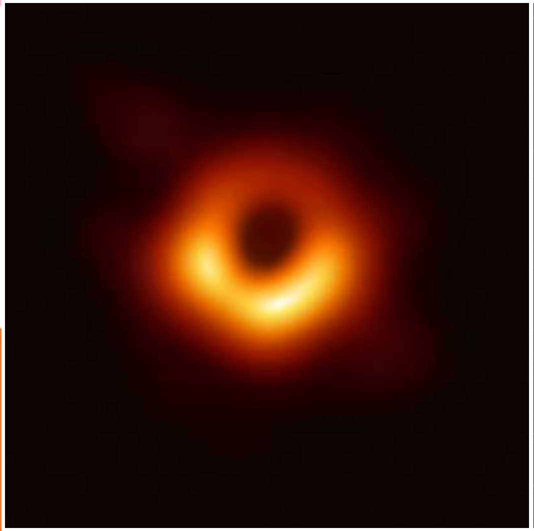
نکات مشترک و ساختاری (۳)

- پروسس حجم گسترده اطلاعات تولید شده توسط آزمایشگاه های فیزیکی روش های جدیدی را می طلبد!
  - Big Data
  - Faster networks
  - Better software
  - ...

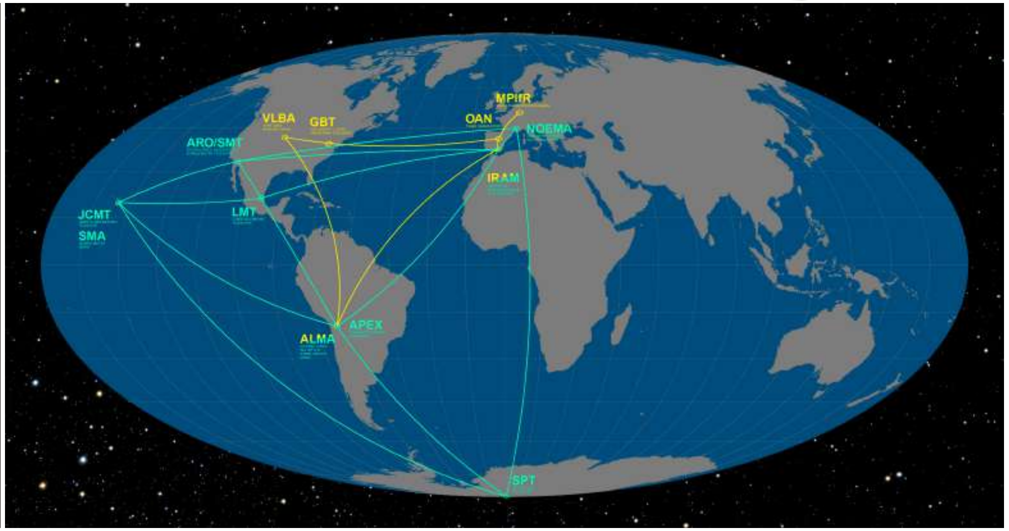
1 Petabyte = 1024*1024 Gigabyte



Source: Western Digital

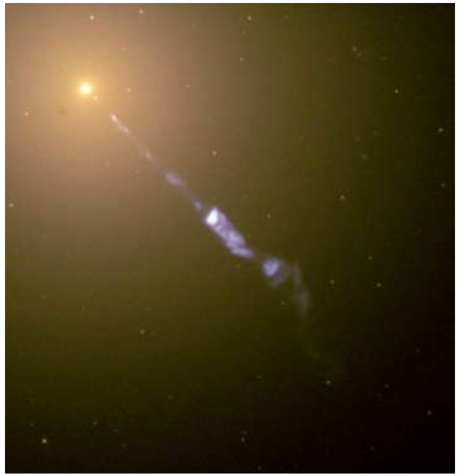


Event Horizon Telescope, CC BY 4.0, via Wikimedia Commons

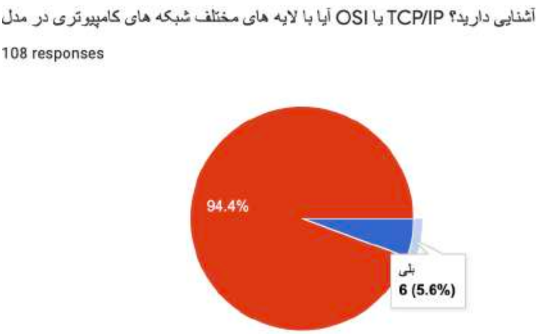


ESO/O. Furtak, CC BY 4.0, via Wikimedia Commons

Source: extremetech.com



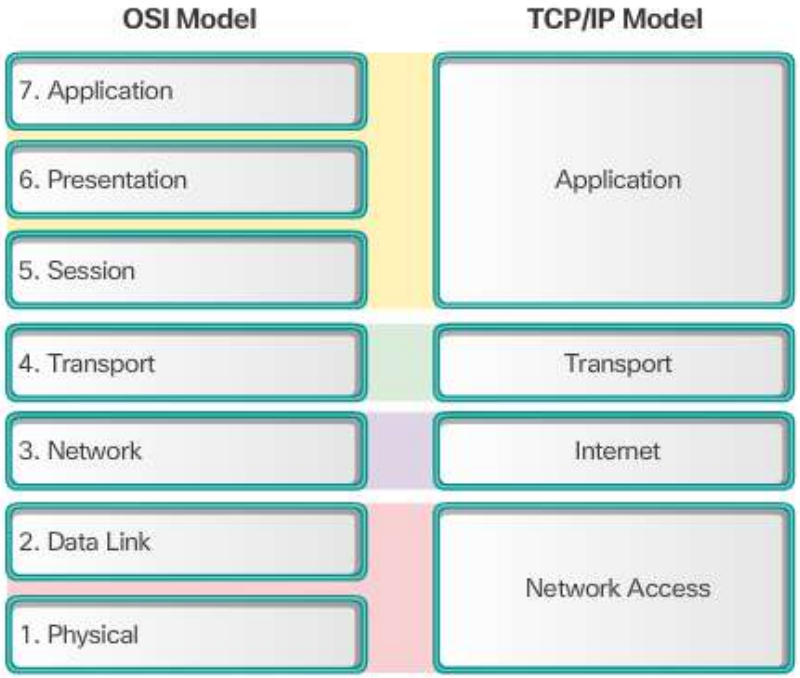
NASA and The Hubble Heritage Team (STScI/AURA), Public domain, via Wikimedia Commons

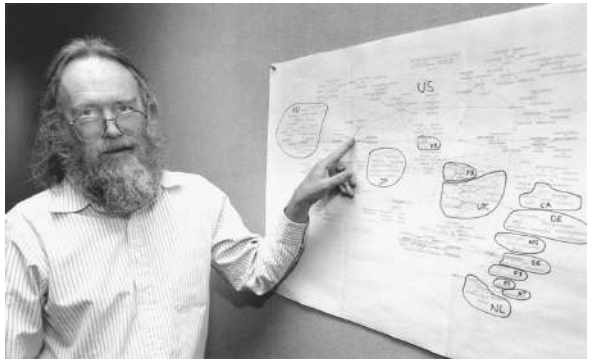


تکوین فناوری اطلاعات و ارتباطات از آغاز پیدایش اینترنت (۱)

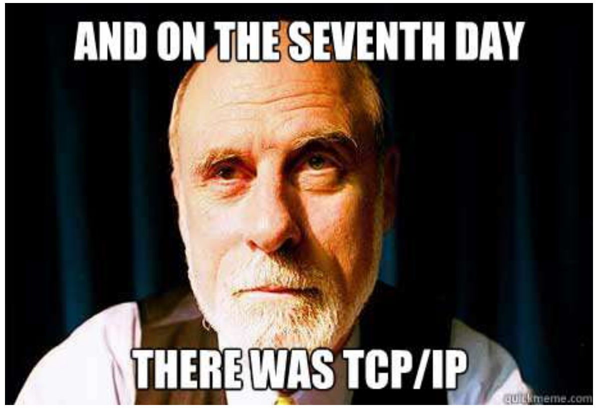
Open Systems Interconnection (OSI) by **ISO & ITU**
Developed/adopted Late 70's, early 80's

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



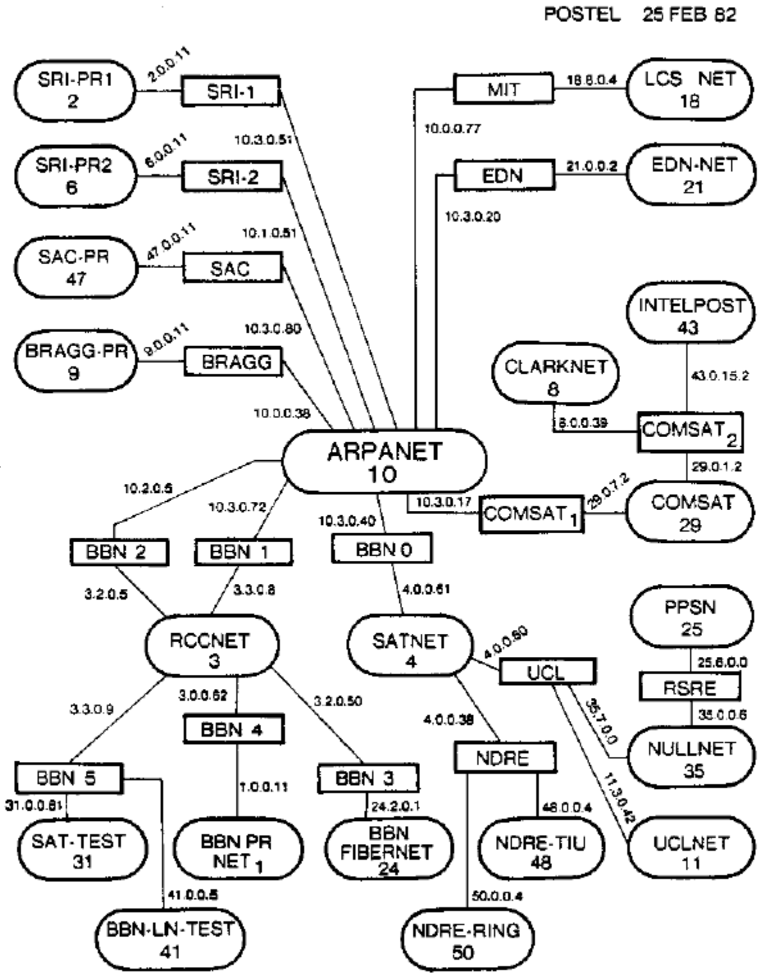


Postel in 1994; Irene Fertik, USC News Service. © 1994, USC., Attribution, via Wikimedia Commons

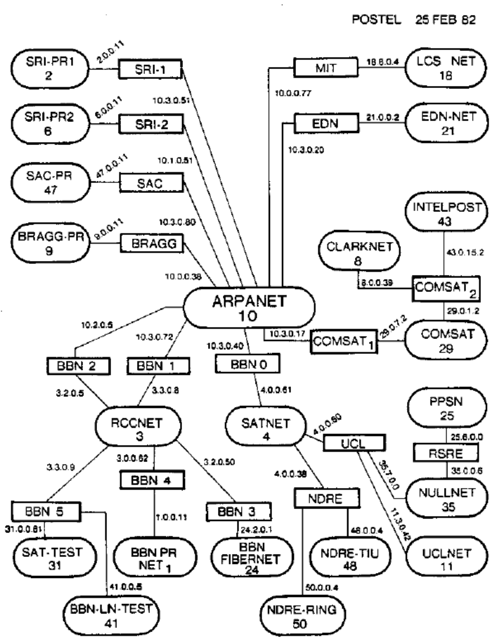


Packet Pushers

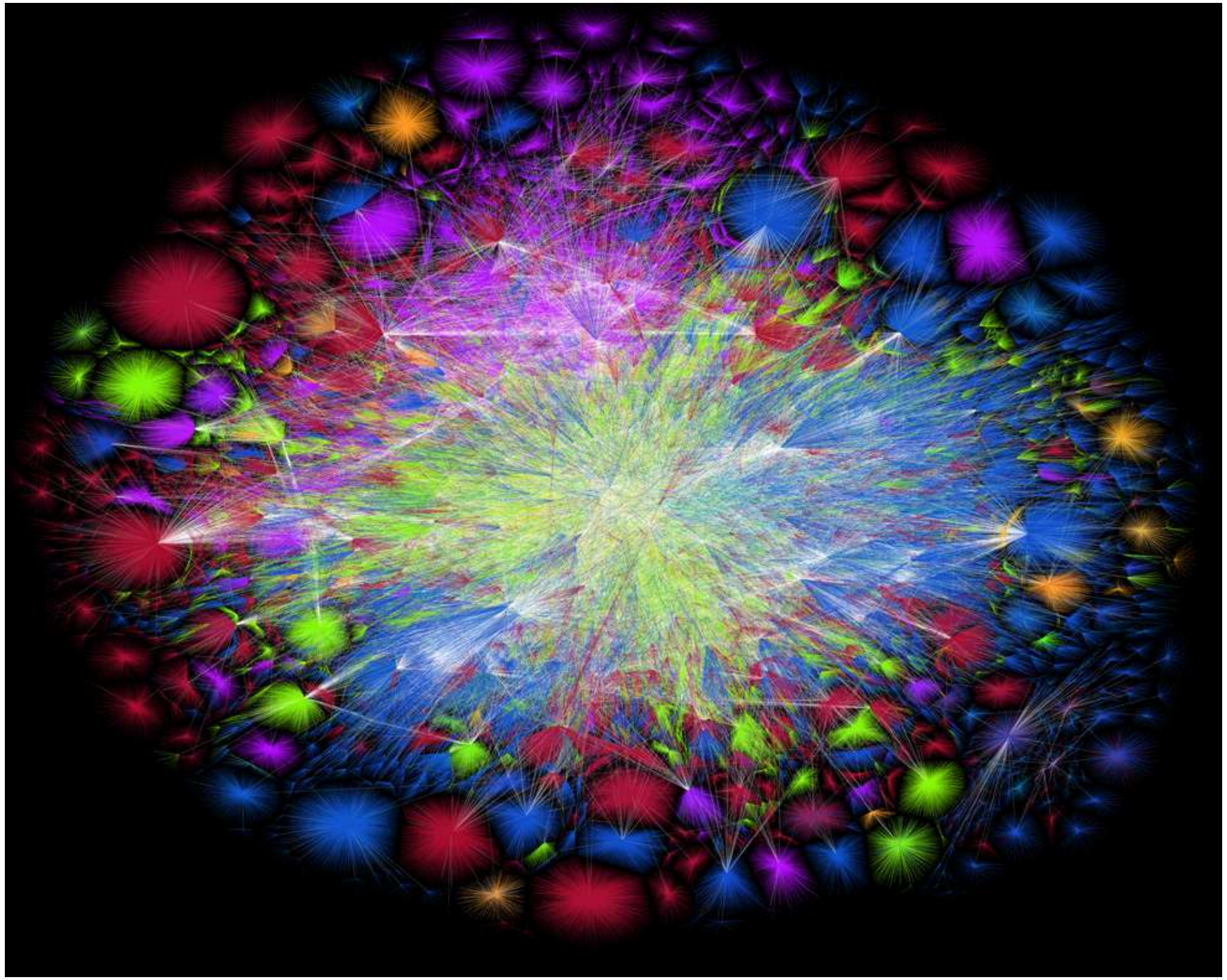
Map of the Internet, created by Jon Postel in 1982, Public domain, via [Wikimedia Commons]



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



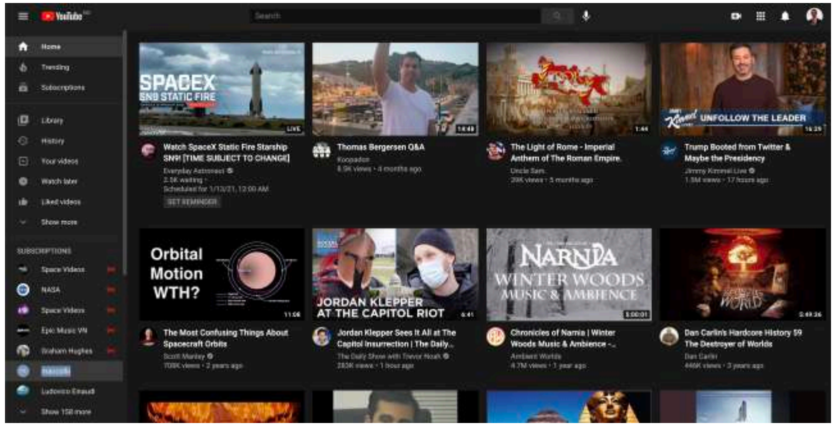
Map of the Internet, created by Jon Postel in 1982, Public domain, via Wikimedia Commons



Internet map in 2015; Source: Opte project

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

YouTube in **2005**; source: [versionmuseum.com]



YouTube on 12.01.2021; source: [youtube.com]

This [NeXT Computer] used by [Tim Berners-Lee] at CERN became the **world's first web server**!

[Connie Zhou for Google]

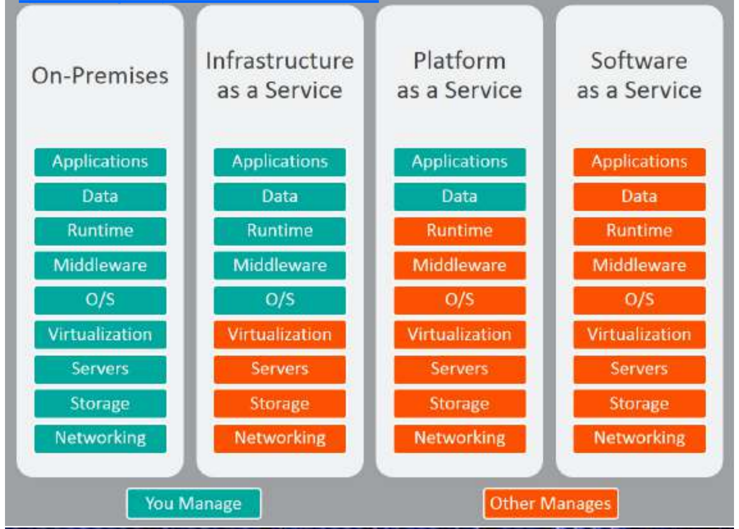
Thomas Schanz, [CC BY-SA 4.0], via Wikimedia Commons

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...

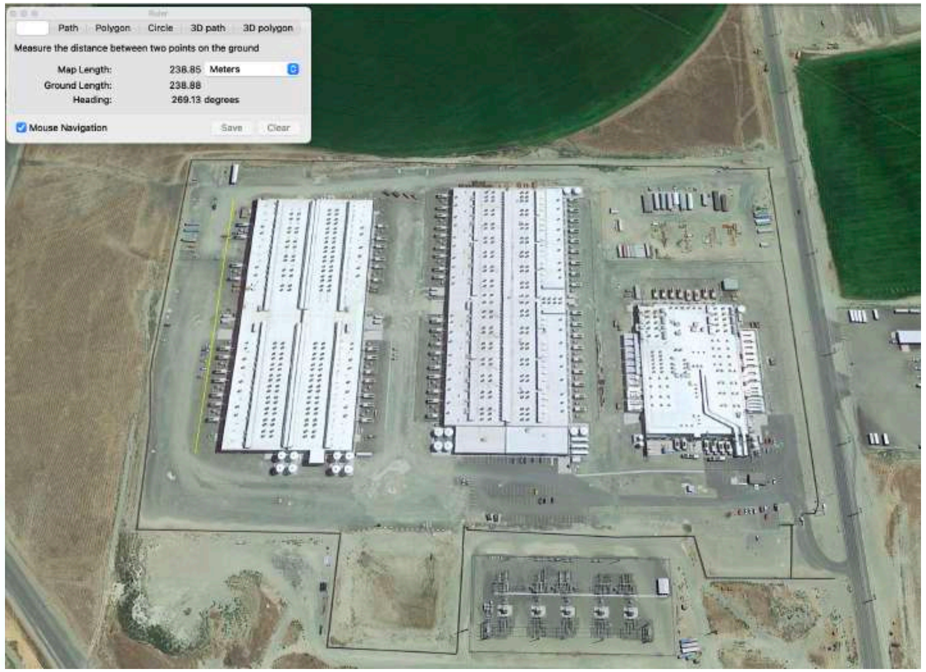
https://www.bmc.com/blogs/saas-vs-paas-vs-iaas-whats-the-difference-and-how-to-choose/



Saas: Dropbox, Google apps
PaaS: Google App Engine, AWS Elastic Beanstalk
IaaS: AWS, Google Compute Engine

Cloud Service Providers

Connie Zhou for Google

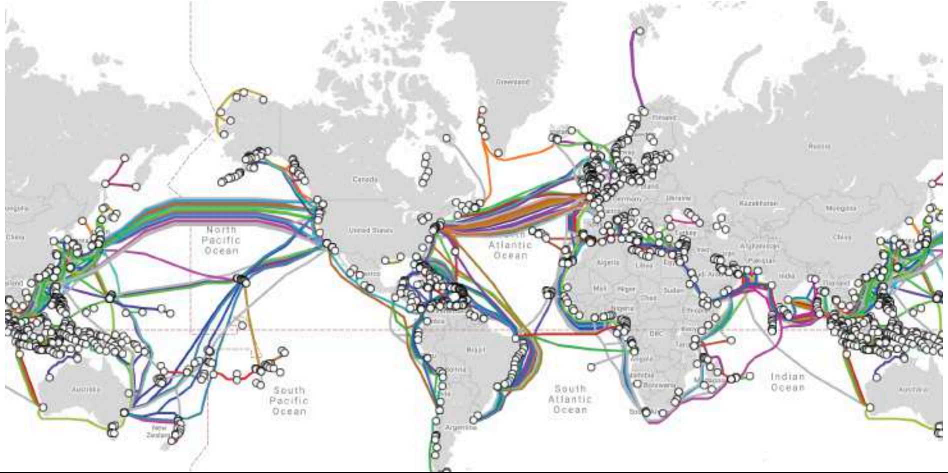


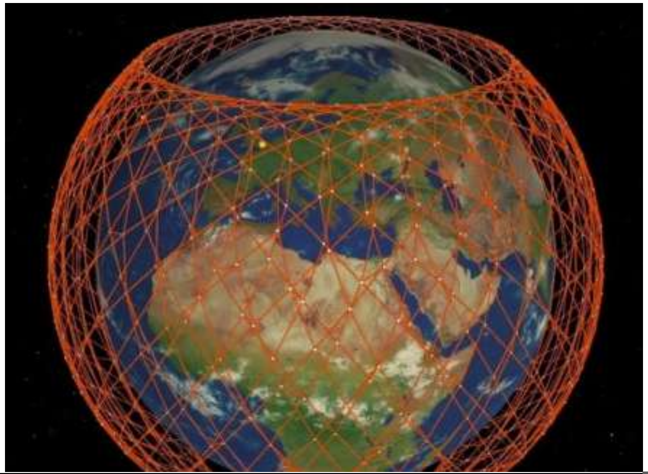
Amazon's AWS US West (Oregon) cloud centre; Source: Google Earth

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

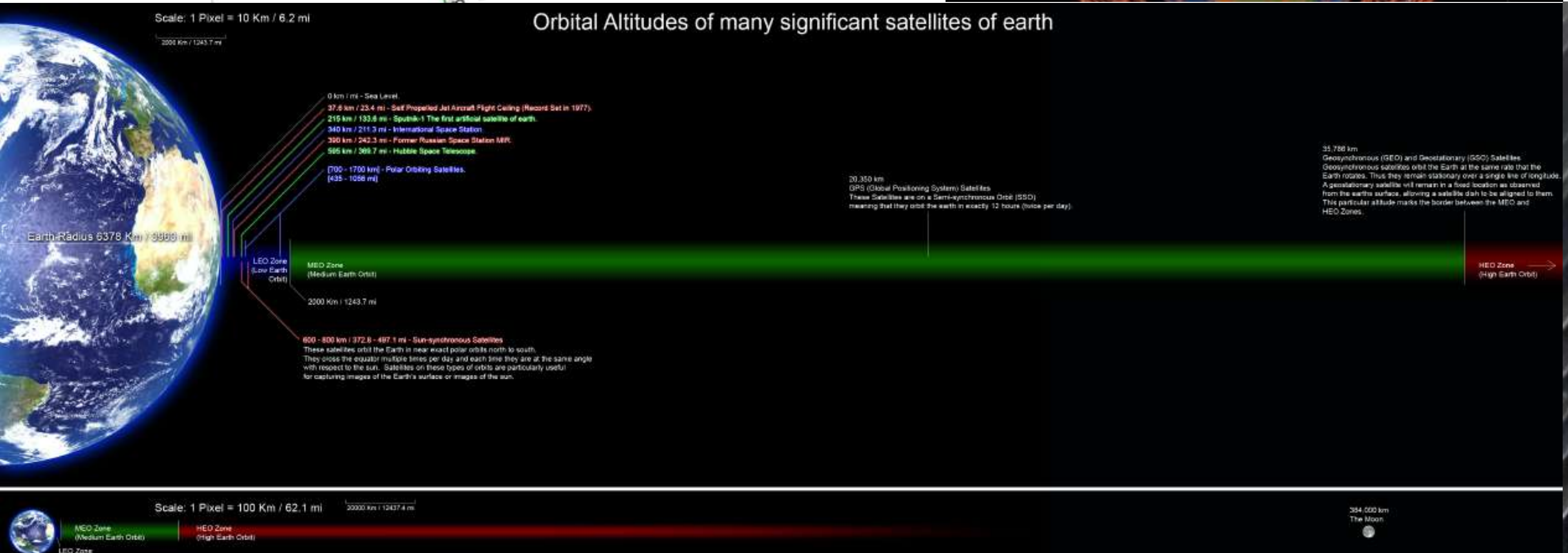
نقشه کابل های فیبرنوری در بستر اقیانوس
Source: submarinecablemap.com

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

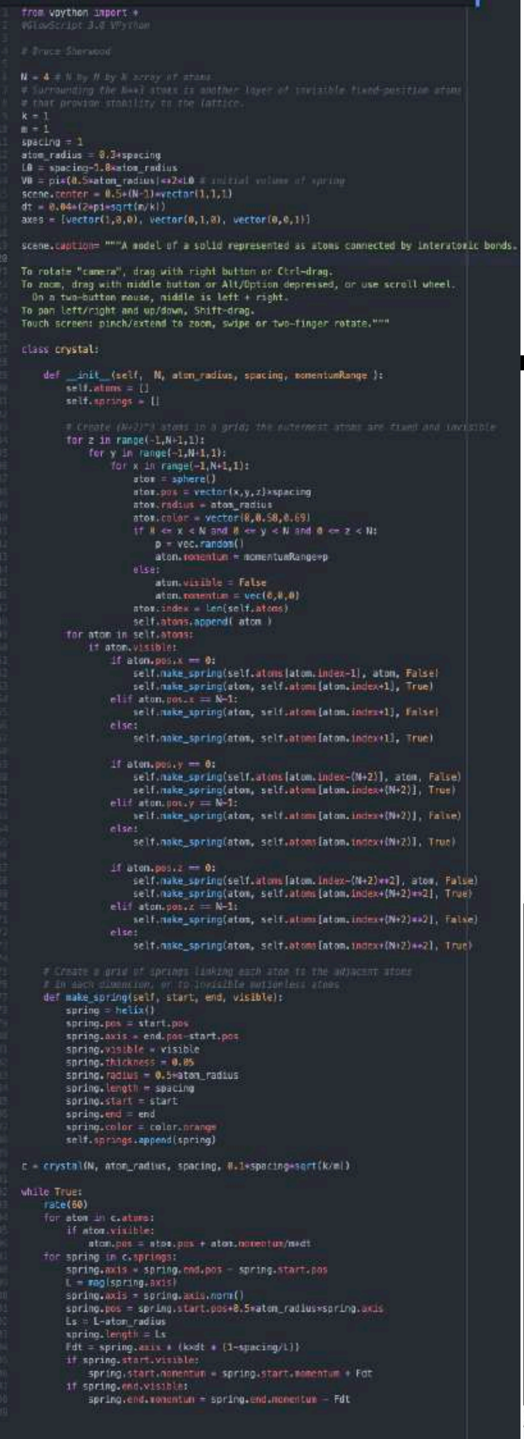


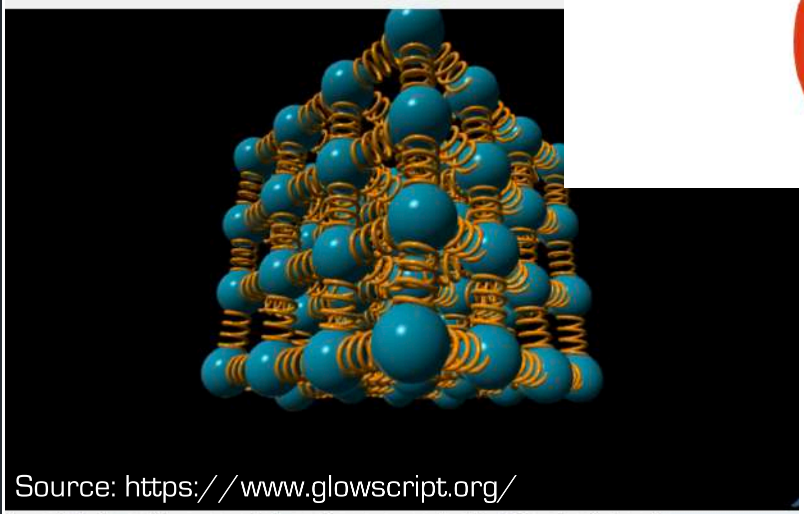
https://upload.wikimedia.org/wikipedia/commons/8/82/Orbitalaltitudes.jpg

Image: © Victoria Girgis/Lowell Observatory

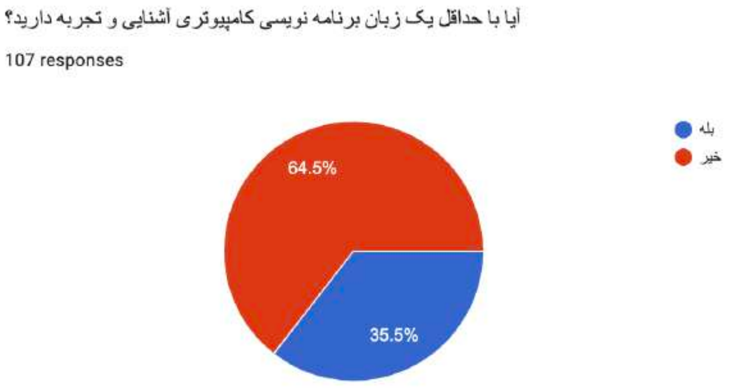
اینترنت، فناوری اطلاعات و آموزش فیزیک (۱)

- 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

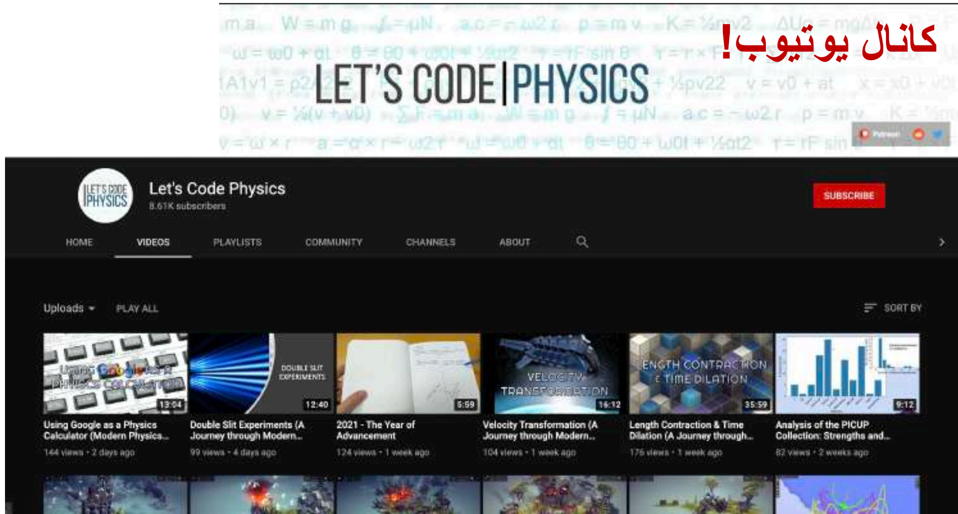


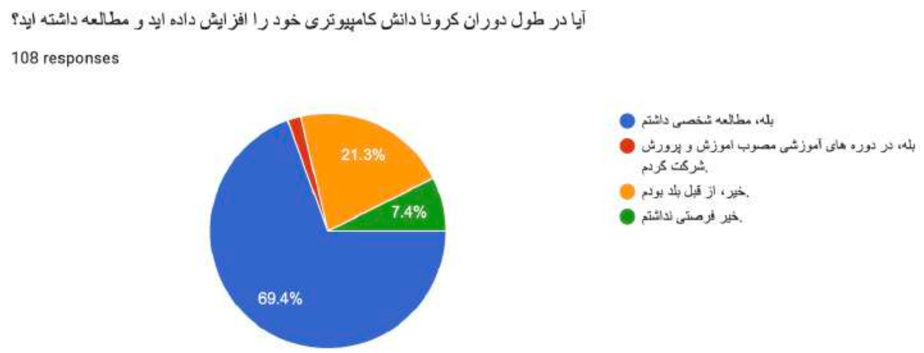


A model of a solid represented as atoms connected by interatomic bonds.



کانال یوتیوب!





اینترنت، فناوری اطلاعات و آموزش فیزیک (۲)

- 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

Resources for Teaching Physics Online

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

Friday Flyer/News

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 Tips" (H/T) to folks who have contributed resources. This really is a QuarkNet-and-beyond team effort.

General Resources for Online Physics:

- This **AAPT Florida site** has both good practices and good resources: it seems like a great place to start. *H/T Adam LaMee.*
- **GoLab** is an EU online project. It has many online labs (more than we have time to check out). *H/T Barbora Gulelova.*
- **The Physics Classroom** has been around for awhile and can serve as the basis of an online physics class. *H/T Deborah Roudebush.*
- **ComPADRE** 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. *H/T Deborah Roudebush.*
- **HTML-5 Simulations** from Andrew Duffy of Boston University. They look pretty useful. *H/T Carol Lund.*
- **OpenStax** online science textbooks, including AP Physics. *H/T Deborah Roudebush.*
- **PhET** - lots of nice siumlations; 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. *H/T Deborah Roudebush.*
- **NOVA Physical Science** - a good collection of online resources. *H/T Karen Bardeen.*
- **The Physics Aviary** is another source of online labs and more.
- Missouri physics teacher Joe Milliano 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 thy 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 Sokoloff.
- 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 those 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. *H/T Uta Bilow.*
- **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. *H/T Marge Bardeen.*
- **World Wide Day Day** registration is now open. Find all you need at quarknet.org > MASTERCLASSES > WORLD WIDE DATA DAY. 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:

Mark Adams: **adams@fnal.gov**
Ken Cecire: **kcecire@nd.edu**
Spencer Pasero: **spasero@fnal.gov**
Shane Wood: **swood5@nd.edu**

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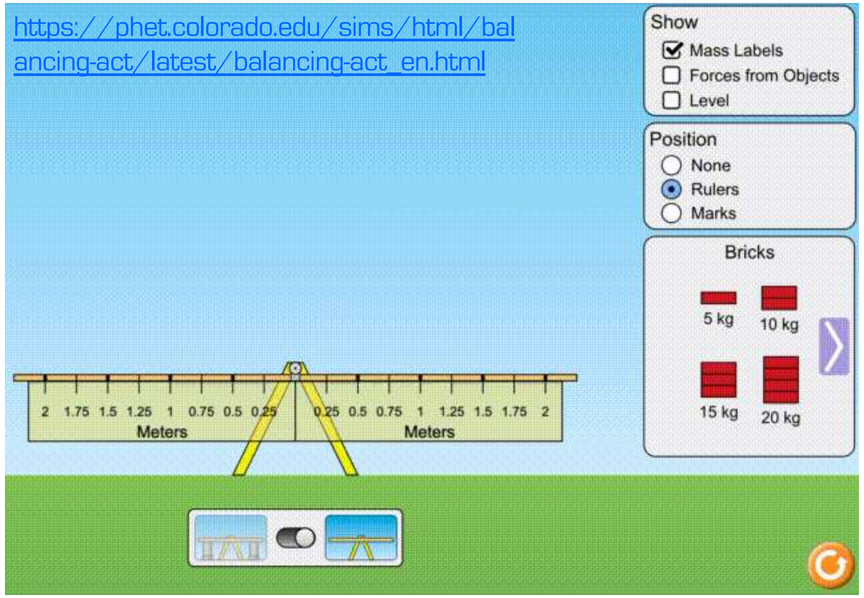
https://www.aapt.org/

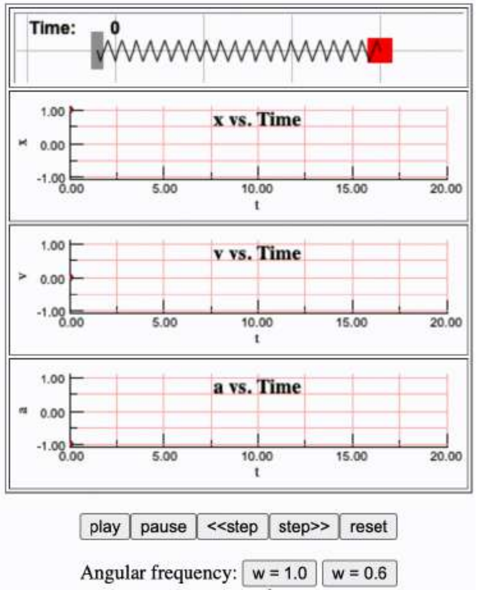
PhET INTERACTIVE SIMULATIONS | University of Colorado Boulder

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

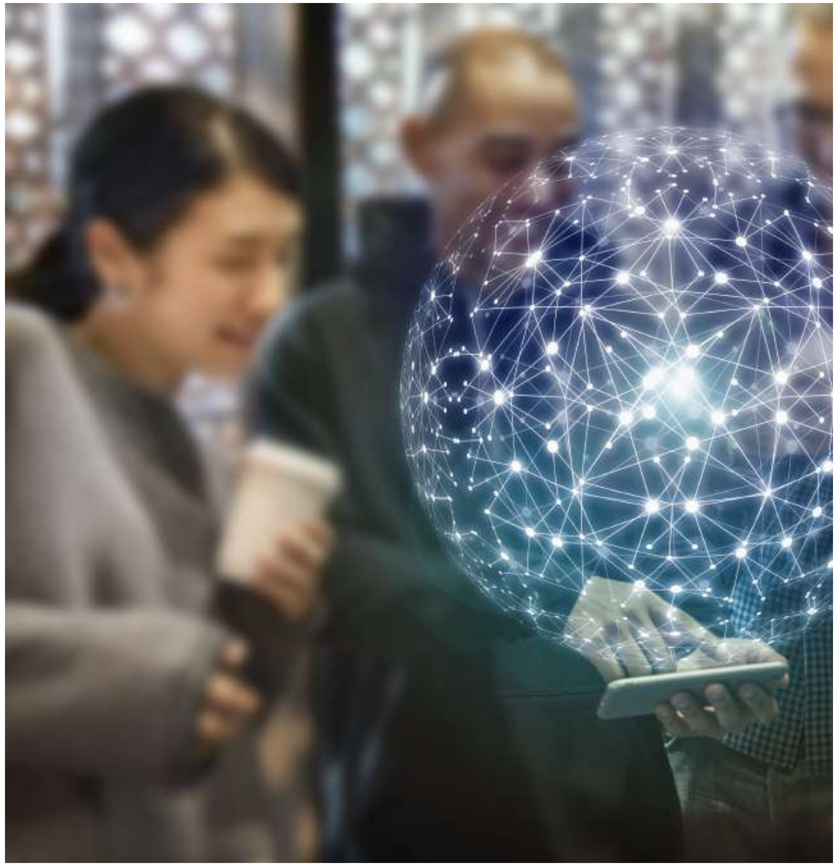


BU Physics

http://physics.bu.edu/~duffy/classroom.html



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؟