

GREAT WOMEN ASTRONOMERS AND PHYSICISTS

Michael Albrow (Fermilab, Scientist Emeritus)

March 3, 2019

Why this talk?

**Great Women astronomers & physicists
before Marie Curie:
their stories and science**

**Great Women astronomers & physicists
of the 20th Century:
their stories and science**

The times, they are a-changing ...



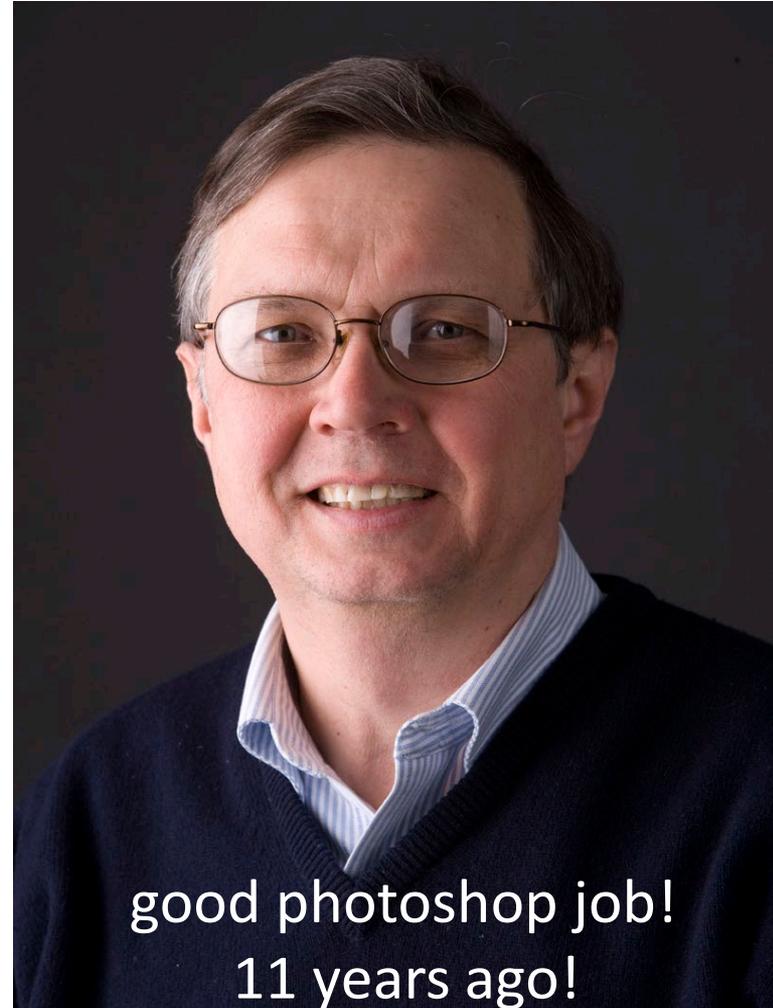
GREAT WOMEN ASTRONOMERS AND PHYSICISTS

Michael Albrow
cant' be here



Two old guys, what do we know?

Peter Garbincius will try to
read/present Mike's talk



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Paraphrasing what Mike sez, our message is to *Get Women into Science!*

A large part of this presentation are stories of Nobel Prizes, both awarded and not given. However, in any case, nobody should be motivated to do science research by the “impossible dream” of such a prize, and I don’t suppose anyone is. I think (I hope) we are all motivated by our love of the subject, our enthusiasm and the excitement of being part of the search for new knowledge. It’s fun, and it’s a privilege to be part of it. Admittedly, especially later, there will be times when it not fun, frustrating, things don’t work out or a project does not get approved or “people get in the way.” But my message to young people is find whatever you love to do, whether it is physics or biology or music or art – and do it as well as you can and someone may pay you to do it. And girls can do physics just as well as boys and obviously often much better! They specially need encouragement.

You can do it!

At end 2017

Women Nobel Laureates | Prize Category

Peace Prize	Chemistry	Physiology or Medicine	Physics	Literature	Economic Sciences
Wangari Maathai	Ada E. Yonath	Elizabeth H. Blackburn	Maria Goeppert-Mayer	Herta Müller	Elinor Ostrom
Shirin Ebadi	Dorothy Crowfoot Hodgkin	Carol W. Greider	Marie Curie	Doris Lessing	
Jody Williams	Irène Joliot-Curie	Françoise Barré-Sinoussi	Donna Strickland 2018	Elfriede Jelinek	
Rigoberta Menchú Tum	Marie Curie	Linda B. Buck		Wisława Szymborska	
Aung San Suu Kyi	Frances Arnold 2018	Christiane Nüsslein-Volhard		Toni Morrison	
Alva Myrdal		Gertrude B. Elion		Nadine Gordimer	
Mother Teresa		Rita Levi-Montalcini		Nelly Sachs	
Betty Williams		Barbara McClintock		Gabriela Mistral	
Mairead Corrigan		Rosalyn Yalow		Pearl Buck	
Emily Greene Balch		Gerty Cori		Sigrid Undset	
Jane Addams				Grazia Deledda	
Bertha von Suttner				Selma Lagerlöf	
Nadia Murad 2018					

Gabrielle-Emilie Le Tonnelier de Breteuil

1706 - 1749



(The Granger Collection, New York)

French of high birth, at 19 married the Marquis de Chatelet.

Began studying mathematics and then physics.

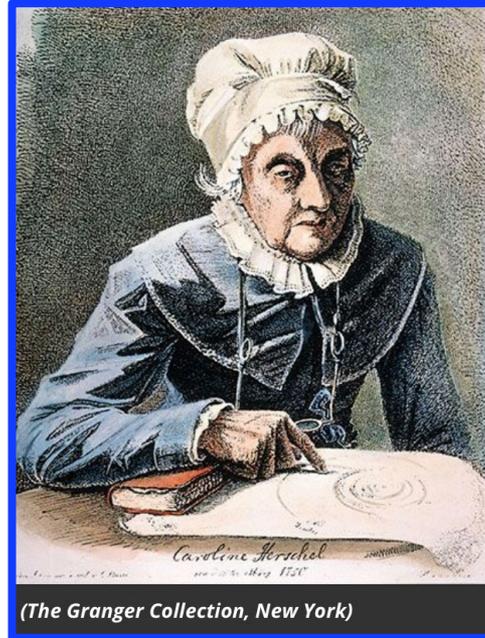
Had an affair with Voltaire (Ferney-Voltaire) and they set up a laboratory in her *chateau*.

Did experiments together.

Translated Newton's Principia from English into French, a major accomplishment!

Caroline Herschel

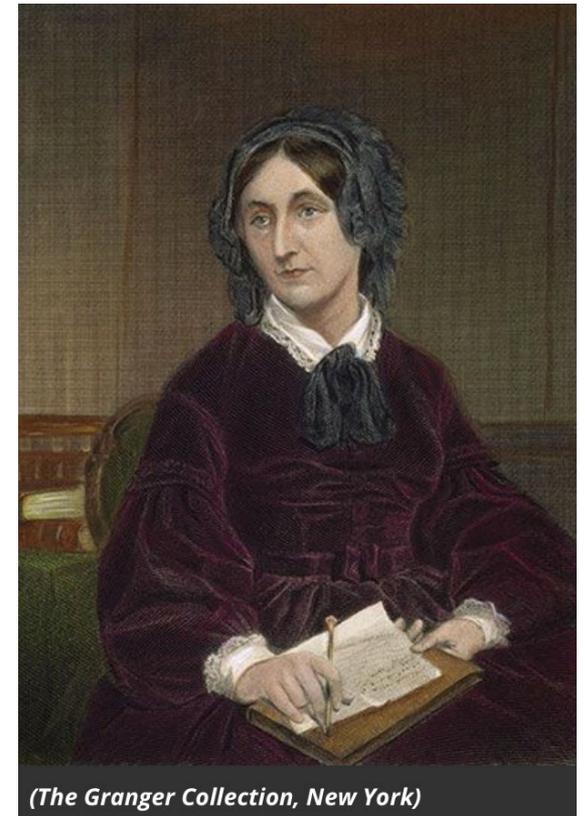
(1750 - 1848 - age 97!)



Caroline was “the Cinderella of the family”, household drudge), until at age 22 her brother William brought her to Bath, England to run his household. William became an astronomer, and after helping him with his observations Caroline became a brilliant astronomer herself. When she was 22, William discovered the planet Uranus. He became the king’s personal astronomer (foreshadowing the Astronomer Royal) and he persuaded the king to pay his assistant a salary. So she became the first paid woman scientist. She discovered 8 comets (the first by a woman) and to distinguish moving comets from non-moving “clouds” = nebulae she catalogued those and star clusters, 2500 of which only 100 were previously known. She received many honors, including the Gold medal of the Royal Astronomical Society.

Mary Somerville

1780 – 1872 (aged 92!)



(The Granger Collection, New York)

Studied Math as a girl, in spite of her father.

Married William Somerville at 32, he supported her.

Mary hosted an “Intellectual circle”, including Charles Babbage (computing engine) and astronomer John Herschel (Caroline’s nephew – William’s son).

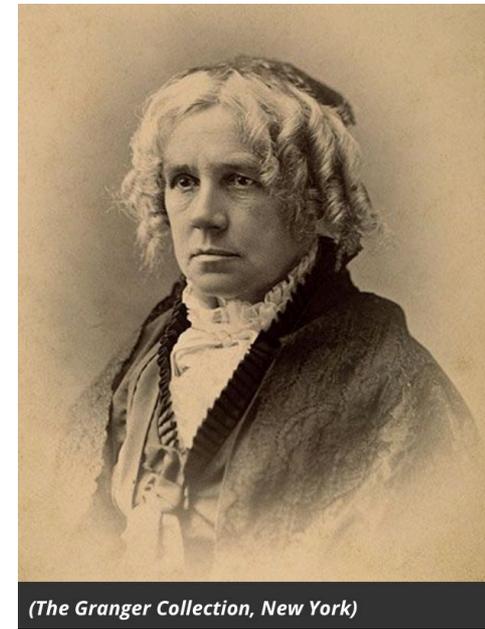
Did experiments on magnetism and wrote about physics and astronomy.

Translated from French to English Laplace’s “Mechanism of the Heavens” which became a major textbook. Honorary member of the Royal Astronomical Society.



Maria Mitchell

1818 - 1889



(The Granger Collection, New York)

Mitchell became the first female astronomy professor in the United States at Vassar College. Her father taught her to measure star positions, which he did to test the accuracy of chronometers for Nantucket Massachusetts whalers, and when 12 she helped him timing an eclipse. When Maria was 17 she started her own school for girls, teaching science and math. At 29 (1847) with her telescope she discovered a comet, which made her world famous. She was the first woman elected to the American Academy of Arts and Sciences, received a medal from the King of Denmark. Maria continued studies of the Sun, travelling 2000 miles to see a total solar eclipse.

**She travelled to Europe, meeting Mary Somerville. Of her Mitchell said:
“I could not help but admire [her] as a woman. The ascent of the steep and rugged path of science has not unfitted her for the drawing room circle; the hours of devotion to close study have not been incompatible with the duties of wife and mother.”**

MARIE CURIE

1867 – 1934

Nobel Prize in Physics – 1903

first woman Nobel Laureate
with Pierre Curie & Henri Becquerel for
joint research on radiation phenomena
(radioactivity)

Nobel Prize in Chemistry – 1911

1st person to be awarded 2 Nobels
for discovery of the elements
radium & polonium



She was born in Warsaw in 1867 and educated at a private boarding school for girls and then a state Lycee from which she graduated with a gold medal. Until she was 24 she worked as a private tutor while her elder sister went to Paris to study medicine, and there was an ailing father to look after. When her sister married, Maria was able to go to Paris and stay with her and start her studies in physics. It was tough because she a lot to catch up but, her autobiography read, “It was like a new world opened for me, the world of science, which I was at last permitted to know in all liberty.”

MARIE CURIE

continued



From Wikipedia:

If Curie's work helped overturn established ideas in physics and chemistry, it has had an equally profound effect in the societal sphere. To attain her scientific achievements, she had to overcome barriers, in both her native and her adoptive country, that were placed in her way because she was a woman. This aspect of her life and career is highlighted in [Françoise Giroud](#)'s *Marie Curie: A Life*, which emphasizes Curie's role as a feminist precursor.

HARRIET BROOKS

1876 - 1933

https://en.wikipedia.org/wiki/Harriet_Brooks



In 1898, Ernest Rutherford invited Harriet to join his group at McGill University in Montreal. Harriet was his first graduate student and the first Canadian nuclear physicist.

In January 1900: Rutherford reported that thorium gave out radioactive « emanation »

Was it a Gas? Vapor? Powder? Asked Harriet to study it.

It was a Gas with lower molecular weight than thorium => one of discoverers of *radon*, which demonstrated the TRANSMUTATION of elements.

In a joint paper to Royal Society of Canada, Brooks and Rutherford discussed radiations from thorium, uranium, radium, polonium.

Showed that beta-rays were negatively charged particles with high speeds irrespective of source, the same as J.J. Thompson's electrons.

Decrease of radioactivity with time – exponential decays – different nuclei

Sequential transmutations of elements

HARRIET BROOKS

Moved to women's college Bryn Mawr, Fellowship in 1901 – continuing research with ER.
Fellowship at Cavendish, Cambridge – worked with J.J. Thomson
Measured the half-life of thorium emanation at about 1 minute (correct => radon-220)
Alpha particle emission causes nucleus to recoil (conservation of momentum)

At the beginning 20th century, there were ≥ 20 women doing research in nuclear physics.
She was the most outstanding. Rutherford quotes:

"next to Mme Curie she is the most prominent woman physicist in the department of radioactivity. Miss Brooks is an original and careful worker with good experimental powers and I am confident that if appointed she would do most excellent research work in Physics".

Harriet co-authored one paper with Rutherford (assumption that she assisted)

In a single-author paper, Rutherford acknowledged her contribution.

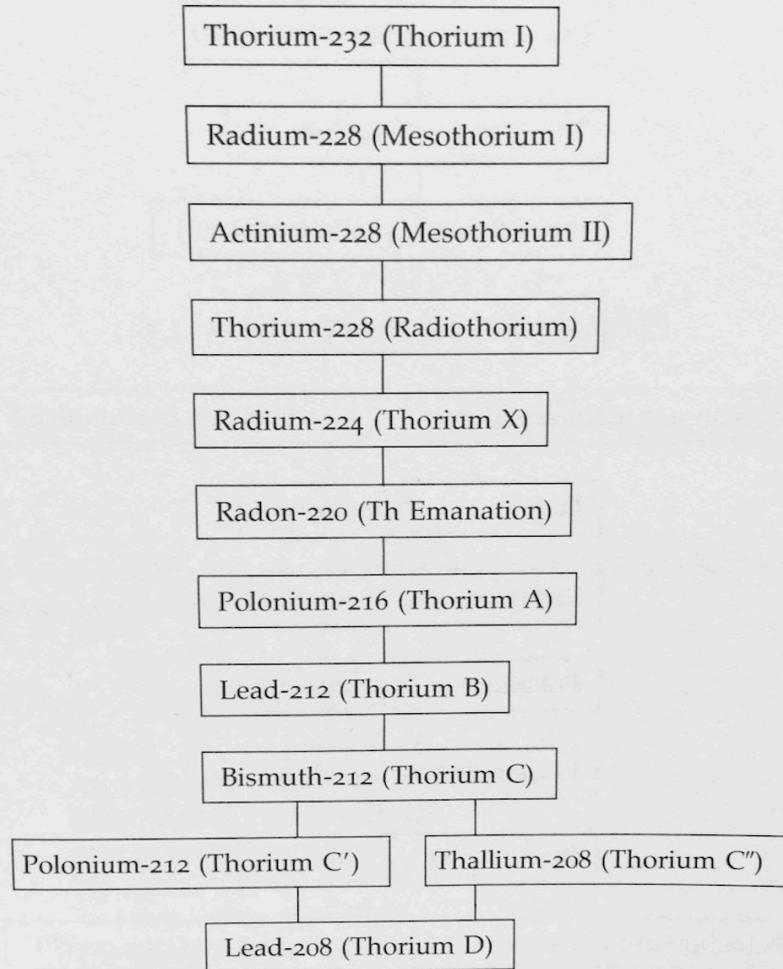
Several papers with Harriet Brooks as single author – overlooked

Extremely modest – low self-esteem (clear in letters to Rutherford)

« I am afraid I am a terrible bungler in research work » - but Rutherford was impressed.

There was great pressure for women in their 30's to marry, have children, and give up their career. It happened to Harriet Brooks.

THE THORIUM SERIES

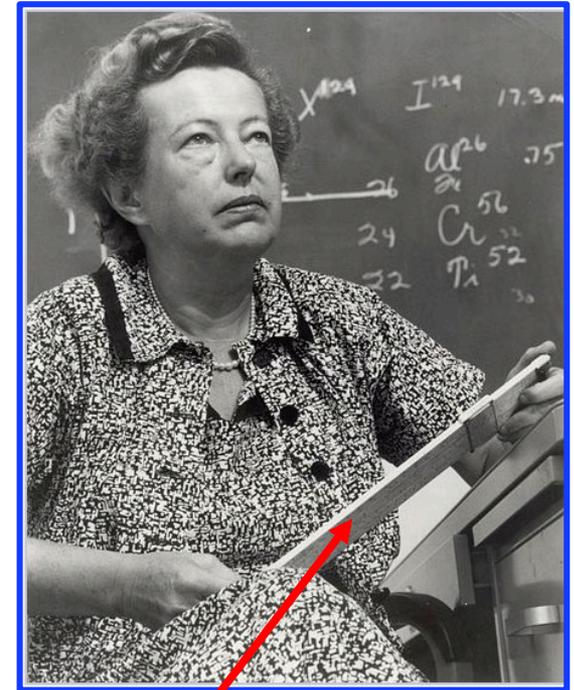


MARIA GOEPPERT-MAYER

1906 – Nobel Prize 1963 - 1972



Maria Goeppert Mayer walking into the Nobel ceremony with King Gustaf VI Adolf of Sweden in 1963



Does anyone know what this is?

MARIA GOEPPERT-MAYER

The first female Nobel Laureate since Marie Curie in 1903, was Maria Goeppert-Meyer more than 50 years ago (1963). She discovered the shell structure of the nucleus, shared with two men who did related, but separate, work. She worked as a volunteer researcher at the University of Chicago in the 1940s. Her husband was on the faculty. Perhaps she was not hired because of an anti-nepotism policy. This so-called “two-body problem” is still an issue although many places make a special effort to get scientific “power couples”. I don’t think it is a problem at Fermilab (is it?).

Maria Goeppert-Mayer was turned down at Columbia and Johns Hopkins, two other prestigious universities, but got a part-time job at Argonne National Lab, which was associated with the University of Chicago. In her spare time she made her brilliant and groundbreaking discovery of the nucleus shell structure. She was then quickly hired in 1960 as a full professor at the new University of California at San Diego, and got the prize only 3 years later, after having been nominated 27 times in 8 years, apparently.

MARIA GOEPPERT-MAYER

From her Nobel acceptance lecture

At that time Enrico Fermi had become interested in the magic numbers. I had the great privilege of working with him, not only at the beginning, but also later. One day as Fermi was leaving my office he asked: « Is there any indication of spin-orbit coupling? » Only if one had lived with the data as long as I could one immediately answer: « Yes, of course and that will explain everything. » Fermi was skeptical, and left me with my numerology.

I do not know how many false starts my German colleagues made, but I had certainly made many. This one was not. The magic numbers from 28 on can definitely not be obtained by any reasonable extrapolation from the lower numbers, but form a different sequence. There are two different series of numbers, 2, 8, 20, 40... , of which 40 is no longer noticeable, and another, 6, 14, 28, 50, 82, 126 of which the first two at 6 and 14 are hardly noticeable. The second series is due to spin-orbit coupling. In ten minutes the magic numbers were explained, and after a week, when I had written up the other consequences carefully, Fermi was no longer skeptical. He even taught it in his class in nuclear physics.

At about the same time Haxel, Jensen and Suess had the same idea.

Maria the 1963 Physics Nobel with Jensen (for shell theory of nuclei) and Wigner (for symmetries for nuclei and elementary particles).

MARIA GOEPPERT-MAYER

Magic number nuclides

Number of protons	2	8	20	28	50	82	126
	⁴ He	¹⁶ O	⁴⁰ Ca	⁵⁸ Ni	¹¹² Sn	²⁰⁴ Pb	
		¹⁷ O	⁴² Ca	⁶⁰ Ni	¹¹⁴ Sn	²⁰⁶ Pb	
		¹⁸ O	⁴³ Ca	⁶¹ Ni	¹¹⁵ Sn	²⁰⁷ Pb	
			⁴⁴ Ca	⁶² Ni	¹¹⁶ Sn	²⁰⁸ Pb	
			⁴⁶ Ca	⁶⁴ Ni	¹¹⁷ Sn		
			⁴⁸ Ca		¹¹⁸ Sn		
					¹¹⁹ Sn		
					¹²⁰ Sn		
					¹²² Sn		
					¹²⁴ Sn		
Number of neutrons	2	8	20	28	50	82	126
	⁴ He	¹⁵ N	³⁶ S	⁴⁸ Ca	⁸⁶ Kr	¹³⁶ Xe	²⁰⁸ Pb
		¹⁶ O	³⁷ Cl	⁵⁰ Ti	⁸⁷ Rb	¹³⁸ Ba	²⁰⁹ Bi
			³⁸ A	⁵¹ V	⁸⁸ Sr	¹³⁹ La	
			³⁹ K	⁵² Cr	⁸⁹ Y	¹⁴⁰ Ce	
			⁴⁰ Ca	⁵⁴ Fe	⁹⁰ Zr	¹⁴¹ Pr	
					⁹² Mo	¹⁴² Nd	
						¹⁴⁴ Sm	

Fig. 1. The magic numbers.

LISA MEITNER

1878 - 1958



1906



1946



(The Granger Collection, New York)

LISA MEITNER

Lisa Meitner was sitting on a log on a snowy December day in Sweden with her nephew Otto Frisch doing calculations. She had just had the crazy idea that a uranium nucleus could be split in two when hit by a neutron, releasing a lot of energy. It was December 1938 and Meitner, a German Jew, had escaped from Nazi Germany where she was a respected professor. Her collaborator in Germany, Otto Hahn, was trying to make elements heavier than uranium by bombarding it with neutrons, and finding an isotope of lighter barium. He was incredulous, and wrote to Meitner for ideas. So being paid the salary of a junior assistant, Lisa Meitner discovered nuclear fission, leading to all our nuclear energy and bombs, which she refused to work on. The 1944 Nobel Prize in Chemistry was awarded to Hahn alone.

LISA MEITNER



**Lise Meitner and Otto Hahn
in their laboratory**

**A reconstruction of Lise Meitner's
apparatus - Deutsche Museum**

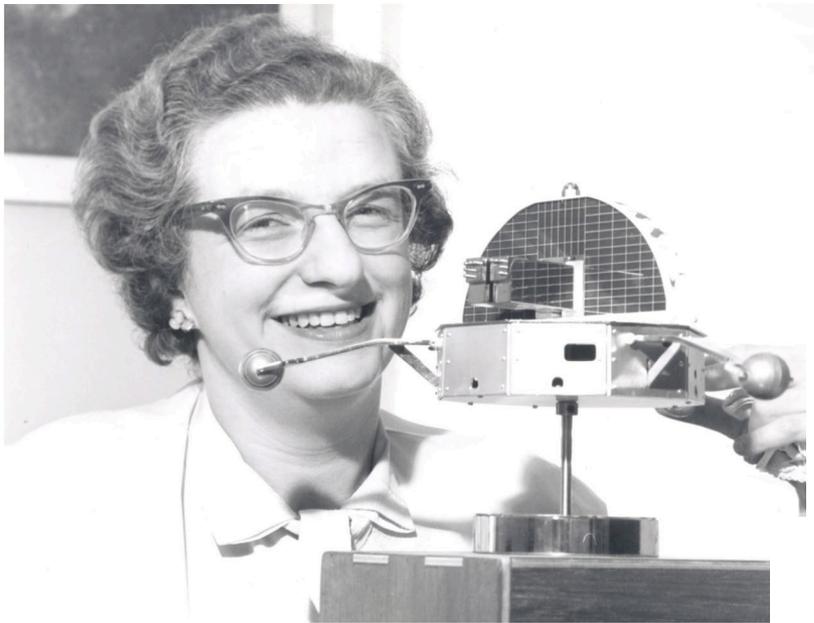


NANCY ROMAN

1925 - 2018

The New York Times Dec 31st 2018

Nancy Roman, 'Mother of the Hubble' Telescope, Dies at 93



Nancy Grace Roman with a model of an orbiting solar observatory in 1962. She was NASA's first director of astronomy and a leading advocate for the Hubble Space Telescope. NASA

Ph.D. Chicago (1949)
Joined new NASA in 1959

At age 11 in Reno (clear skies!) formed an astronomy club with friends.

**Became NASA's first chief of astronomy,
First woman in NASA leadership.**

**Hubble Space Telescope: Spitzer's dream (1946)
She organized HST and convinced Congress.**

"I still remember asking my high school guidance teacher for permission to take a second year of algebra instead of a fifth year of Latin," she recalled. "She looked down her nose at me and sneered, 'What lady would take mathematics instead of Latin?' That was the sort of reception that I got most of the way," she told the Voice of America.

In her later years, Dr. Roman passed on her love for space research to young people and especially sought to inspire girls to pursue a career in science. She taught astronomy to fifth graders at Shepherd Elementary School in Washington in the late 1990s.

As she put it: "One of the reasons I like working with schools is to try to convince women that they can be scientists and that science can be fun."

VERA RUBIN

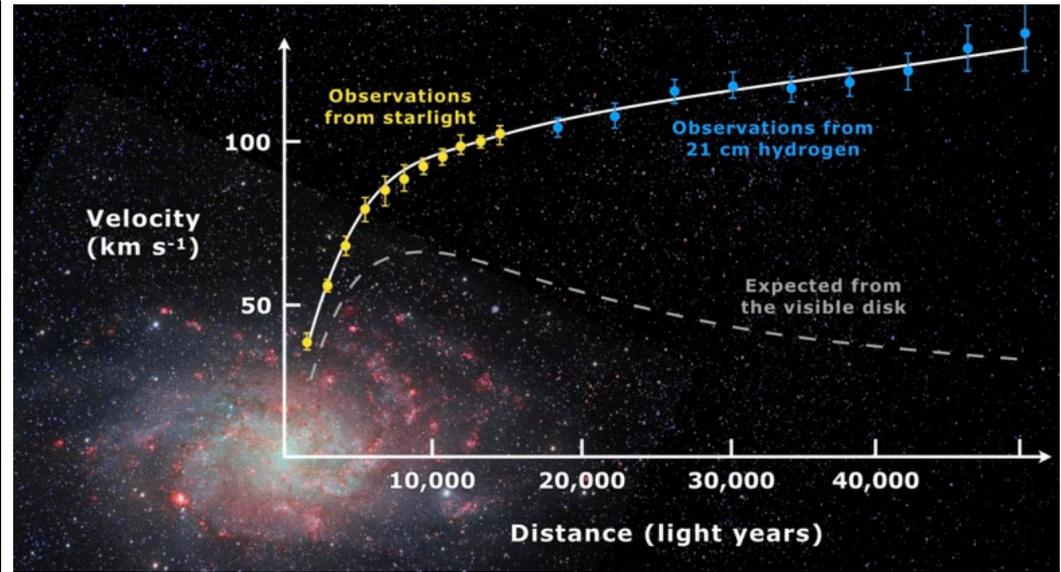
1928 - 2016



« A woman's place is in the dome »



Vera Rubin



Vera Rubin measured the rotation of hundreds of galaxies: red shift – blue shift

Vera Rubin showed in the 1970's that there is about five times more matter in galaxies than in stars, planets, etc. by studying the rotation of galaxies. This is mysterious "dark matter". We suppose it is made of still-to-be discovered particles. She received many honors, including the National Medal of Science and the Gold Medal of the Royal Astronomical Society, but not the Nobel Prize. Which just goes to show ...

Vera Rubin

Vera was born in Pennsylvania in 1928, daughter of Jewish immigrants from Poland. She developed an interest in astronomy age 10 and built a crude telescope. She was advised by a high school science teacher to drop science and become an artist. She earned a bachelors degree in astronomy at the all-girls Vassar College, and her application to enroll in a graduate astronomy program at Princeton was turned down because of her gender. That was their rule for another 27 years! She went to Cornell and earned a Masters degree, studying the motions of 109 galaxies and finding deviations from Hubble's law – Hubble flow (how the galaxies move apart from one another). She was 23 and pregnant when studying for a Ph.D. at Georgetown Univ, the only one that offered a graduate degree in astronomy. Her thesis gave the first evidence for galaxy clusters.

Throughout her graduate studies, she experienced discouraging sexism, including an incident where she was not allowed to meet with her advisor in his office, because women were not allowed in that area of the university.

JOCELYN BELL BURNELL

b. 1943 (10 July)



little green men?

Jocelyn Bell Burnell was a 23-year-old graduate student in Cambridge, England, looking at a chart recorder of radio signals from space, when she noticed a “bit of scruff” that repeated itself regularly. Pulsing about once a second, she established that it was coming from the sky. It turned out to be a rapidly spinning very compact star, 100 trillion times denser than iron, a pulsar. Bell’s thesis supervisor Hewish was awarded the Nobel Prize for the discovery, together with astronomer Ryle. They allow up to three. This year she was awarded a Special Breakthrough Prize of \$3 million and is donating it all to help women, ethnic minority and refugee students become physics researchers.

HENRIETTA SWAN LEAVITT

1868 - 1921



Henrietta Swan Leavitt showed how to measure the distance to certain variable stars, which led Hubble to show that the great nebula in Andromeda was far outside the Milky Way.

EMMY NOETHER

1882 - 1935

Emmy Noether



EMMY NOETHER proved that:

Energy must be conserved if physical phenomena do not depend on ***when*** you do your observation. Similarly,

Momentum must be conserved if physical phenomena do not depend on ***where*** you do your observation.

Angular Momentum must be conserved if physical phenomena do not depend on ***which direction*** you do your observation.

Invariance \Leftrightarrow ***Conservation Laws*** \Leftrightarrow ***Symmetries***

Fermilab Colloquium on 100 years of Noether's Theorem, check

<http://events.fnal.gov/colloquium/archive-2018/>

August 15th 2018 Chris Quigg video:

<http://vms.fnal.gov/asset/detail?recid=1956510>

And hundreds of other outstanding talks on video

Emmy Noether

Her father was a famous mathematician. At age 25, Emmy completed her dissertation at the University of Erlangen, where she did mathematics for 7 years without pay; women were largely excluded from academic positions. She attracted the attention of two great mathematicians at University of Gottingen, and they recruited her to that world-renowned mathematics center, but the faculty objected. She went and lectured for 4 years under Prof. Hilbert's name. In 1919, age 37, she at last obtained a privatdozent position and could get paid. She only left Gottingen in 1933 when the Nazi government dismissed all Jews from university positions, and she went to the US to Bryn Mawr College.

In mathematics, abstract algebra and many other fields she started, she was among the few great mathematicians of the 20th century.

A former student of hers said, "Completely unegotistical and free of vanity, she never claimed anything for herself, but promoted the works of her students above all."

Many amazing women in STEM now



Dr. Gabriela Gonzalez: Spokesperson for LIGO Laser Interferometer Gravitational-Wave Observatory which detected first gravitational waves



Orbiting black holes, spiral in and merge -> gravity waves (Artist impression)



X-ray sources in distant galaxy



Dr. Fiona Harrison is leader of the Nuclear Spectroscopic Telescope Array (NuSTAR) X-ray team studying supernova remnants, neutron stars, supermassive black holes, etc.



Helen Edwards

1936 – 2016

our local heroine

Fermilab Tevatron

**which, for 25 years, was the
world's highest energy accelerator**

US Particle Accelerator School Prize – 1985

E.O. Lawrence Award - 1986

Mac Arthur Foundation Fellowship (Genius Award) -1988

Elected to National Academy of Engineering - 1988

National Medal of Technology (w Dick Lundy, Rich Orr, Alvin Tollestrup) - 1989

Robert R. Wilson Prize of APS for the Physics of Accelerators - 2003

Came to Fermilab in 1970 with Founding Director Robert R. (Bob) Wilson

Design, construction, commissioning and operation of the Fermilab Tevatron

Associate Director - Superconducting Super Collider (SSC) in Texas

Development of high-gradient superconducting linear accelerators

and high brightness electron sources

[https://en.wikipedia.org/wiki/Helen T. Edwards](https://en.wikipedia.org/wiki/Helen_T._Edwards)

FABIOLA GIANOTTI

b. 1960

Fabiola is the first woman to serve as the Director General of the world's highest energy physics laboratory, CERN in Geneva, Switzerland, used by over 10,000 scientists of 100 nationalities.

born 1960, Rome

Inspired by biography of Marie Curie -> physics
humanities – music and philosophy

Ph.D. Milan 1989.

CERN Fellowship (post doc)

Fabiola built detectors and software for series of experiments
culminating in ATLAS, elected spokesperson.

ATLAS is a collaboration of around 3,000 physicists from
180 institutions in 38 countries.

ATLAS co-discovered the Higgs boson in 2012 with CMS



Fabiola insists that she has never faced discrimination because of her gender, “I cannot say myself that I ever felt discriminated against,” she said. “Perhaps I was but I didn’t realize it.” Even though she feels that she was never discriminated against because she was a female, she is helping break down barriers the male dominated field created for aspiring female scientists. She specifically wants to give women more support when having children. She feels that she was never given enough support, and for this reason, never had children, a decision she now regrets.



I include Fabiola because this is today’s world, times have changed. Especially in big science like particle physics, thousands of physicists, may play an important role in a discovery like that of the Higgs boson.

No more than 3 can get the Physics Nobel, so neither the top quark discovery at Fermilab (1995) nor the Higgs boson discovery at CERN (2012) is likely to lead to a Nobel Prize, although the W and Z bosons discovery at CERN (1984) gave two leading men the prize (1996 – very fast).

DONNA STRICKLAND

b. 1959 (Canada) – Nobel Prize 2018



“Everybody should get to do what they want to do.”

DONNA STRICKLAND

Attended McMaster University: Engineering physics program included lasers.

One of 3 women in class of 25 (typical!)

Ph.D. at University of Rochester (1989)

Developed a clever technique to increase the peak power of lasers.

Previous limitation: powers of gigawatts per square cm damaged amplifying part.

Trick: Stretch each laser pulse in time and wavelength, amplify it, then recompress.

Chirped pulse amplification. This was accomplished while Donna was a graduate student.

Ultrashort pulses of terawatt intensity, led to « tabletop terawatt lasers »

NP 2018 with Ph.D. advisor Gerard Mourou. Only then applied for full professorship (hadn't bothered before!) And got it, of course, Univ. Waterloo (1st full time woman prof)

**Applications: Extremely precise laser cutting,
corrective eye surgery (millions),
micromachining, fundamentals of optics.**

Pushing boundaries of ultrafast pulses to UV and IR ranges

Daughter Hannah is a graduate student in astrophysics 😊

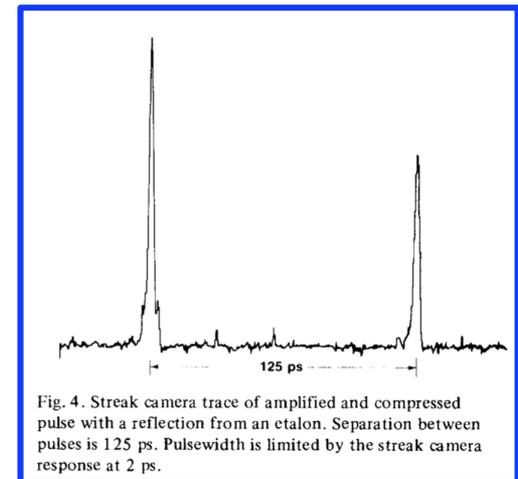


Fig. 4. Streak camera trace of amplified and compressed pulse with a reflection from an etalon. Separation between pulses is 125 ps. Pulwidth is limited by the streak camera response at 2 ps.

Peter's Bottom Line:

History shows that there's lots of female talent out there.

We recognize that this talent pool is underutilized.

We are working (and need to do better) to develop & support women in science.

**That's easier said than done,
but things are changing:**

International Day of Women and Girls in Science – February 11, 2019

- In 2015, the United Nations General Assembly adopted a resolution to establish February 11 as the International Day of Women and Girls in Science

<http://www.un.org/en/events/women-and-girls-in-science-day/index.shtml>

- Annual => 2019 theme: ***Inclusive Green Growth***
- My daughter, a Postdoctoral Research Associate in Physiology at Temple University, never heard of it
- Apparently not generally observed at Fermilab!
only mentioned in FermiNews:

<http://news.fnal.gov/2018/02/coding-has-no-gender/>

- More observed in Europe

Celebrating women and girls in science



By [Fabiola Gianotti](#)

Fabiola Gianotti is the
Director-General of CERN.

February 11 was the International Day of Women and Girls in Science. This year, it was marked by a joint statement celebrating women's achievements in science from Europe's eight EIROforum laboratories.

12 FEBRUARY, 2019

Yesterday was the International Day of Women and Girls in Science, an annual event that CERN is proud to support. This year, as part of an initiative of CERN, the University of Geneva and EPFL, some 57 women from CERN will be going into local 146 school classes throughout this week to discuss careers in science with groups of young people, boys as well as girls, between the ages of 7 and 15.

Joint Statement for International Day of Women and Girls in Science



*Video Credits: **UN Women**. "Despite progress in ensuring opportunities for women in STEM fields, women and girls continue to be systematically underrepresented as users and leaders in the fields of science, technology, engineering and mathematics. In order to achieve the sustainable development goals, we need to ensure full and equal access to and participation in science for women and girls."*

On 11 February, the world marks the International Day of Women and Girls in Science.

And the EIROforum Director Generals have used the occasion to release a joint statement expressing their commitment to ensuring that Women and Girls are afforded equal opportunities to be part of the STEM fields.

CERN collects and reports gender data through which we observe an increase both in the representation of women among fellows and students as well as in the proportion of women who are senior staff. Overall, women now represent 21% of CERN staff, compared to 14% in 1995. The overall percentage of women across the scientific population at CERN is about 18%, compared to 8% in 1995. This shows good progress, but there's still much to be done, which is why I'm personally proud to support the International Day of Women and Girls in Science.

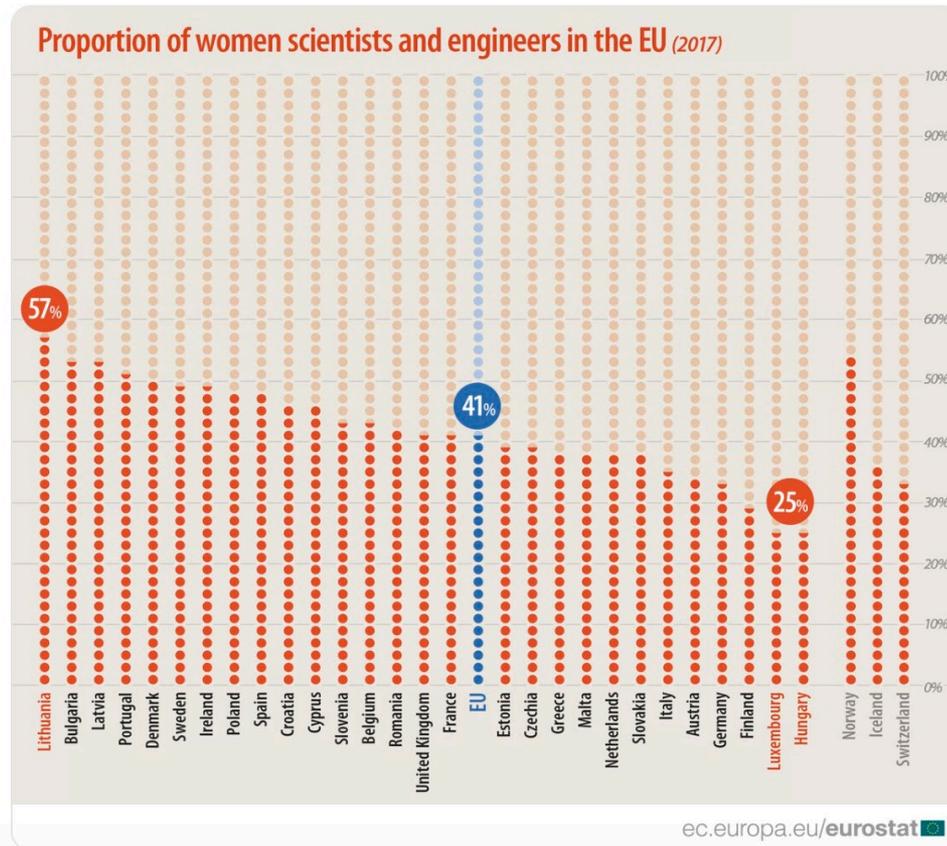
- continued from Fabiola's statement



INTERNATIONAL DAY OF WOMEN AND GIRLS IN SCIENCE

FEBRUARY 11

Majority of scientists and engineers are women in  Lithuania,  Bulgaria and  Latvia,  Portugal and  Denmark 
#WomenInScience #WomenInScienceDay



Mattel Is Launching Astrophysicist Barbie This Year (an Astronaut, Too!)

By [Kassandra Brabaw](#) 21 hours ago [Entertainment](#)

Astrophysicist Barbie was developed by Mattel and National Geographic to inspire kids to pursue STEM fields.



GOOD NEWS!

The times, they are a-changing ... but maybe not quickly enough!

Computing

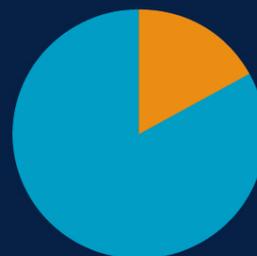
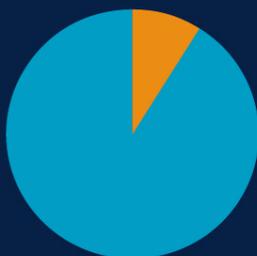
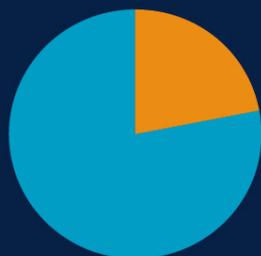
Engineers

Postdocs

Scientists

Technical

Mission Support



Female %

22%

9%

25%

17%

13%

50%

Male %

78%

91%

75%

83%

87%

50%

1787 employees - 25% Female

Includes regular and fixed term employees

Data: January 26, 2018

THANK YOU

QUESTIONS?