



Learning in
Retirement
Feb. 9, 2023
Chuck Lahmeyer



What is the Jet Propulsion Laboratory, JPL?

NASA Centers and Facilities

Ames Research Center Moffatt Field, CA
Armstrong Flight Research Center (formerly Dryden) Edwards AFB, CA
Glenn Research Center (formerly Lewis) Ohio
Goddard Space Flight Center Greenbelt, MD
Goddard Institute of Space Studies
Katherine Johnson IV and V Facility Ohio
Jet Propulsion Laboratory Pasadena, CA
Johnson Space Center Houston
Kennedy Space Center Cape Canaveral
Langley Research Center Langley AFB, VA
Marshall Space Flight Center Huntsville, AL
Mary W. Jackson NASA Headquarters downtown Washington DC
Michoud Assembly Facility New Orleans
NASA Engineering and Safety Center
NASA Safety Center
NASA Shared Services Center
Neil A. Armstrong Test Facility (formerly Plum Brook Station)
Stennis Space Center Mississippi
Wallops Flight Facility
White Sands Test Facility New Mexico



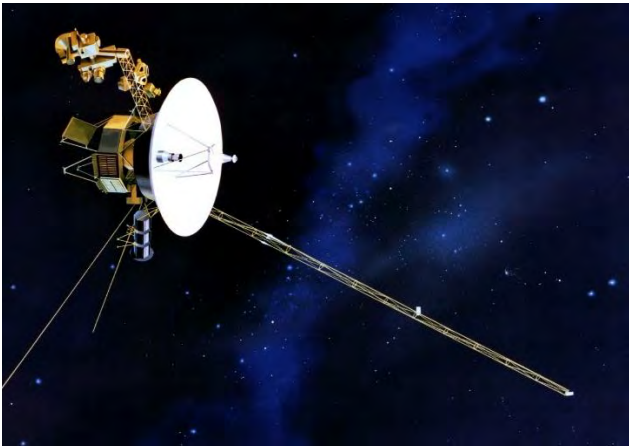
JPL Director
Laurie Leshin
Since May 2022

Bottom Line: JPL is a research laboratory of the California Institute of Technology, CalTech

Its work is almost entirely for NASA

So what does JPL do?

Space research, primarily Deep Space (space beyond Earth and Moon)



Voyager



Viking Lander



Perseverance rover

But formerly it built rocket boosters for jet assisted takeoff JATO (weapon)

And it built Americas first nuclear missiles (weapons)



Origins of JPL

Caltech, Pasadena, CA

Parent institution of JPL



Sergeant and Corporal rockets

Disclaimer:
JPL has no connection
with MANNED spaceflight
Nor with rocket propulsion

originally Throop Institute founded 1893



the Gene Pool

Beckman Auditorium

Caltech has had 76 Nobel prize winners, MIT 97

**Caltech founded an aeronautical laboratory in 1926,
called the Guggenheim Aeronautical Laboratory GALCIT**



Its director was Dr. Theodore von Karman

Von Karman sponsored a rocket research project that came to be known as the “Suicide Squad” for their dangerous projects.

For this they were booted off campus and found a place to do their testing in a dry creek bed called the Arroyo Seco.



First rocket test in the Arroyo Seco, Oct 31, 1936, considered by some as the founding event of JPL. Seated left to right: Rudolph Schott, Apollo Smith, Frank Malina (white shirt, dark pants), Ed Forman and Jack Parsons (right, foreground) Road tar.

JPL developed a Jet Assisted Takeoff (JATO) rocket for assisting airplane takeoffs.



The Army wanted large quantities of these JATO engines and JPL was not a manufacturing facility, so a company, called Aerojet, was founded to

facilitate production. This company exists today as



JPL went on to develop several stand-alone rockets, among them were the Private, the Corporal and the Sergeant.



Sergeant and Corporal JPL campus. Both are nuclear weapons capable

In 1957 the Russians launched Sputnik, the first man-made satellite.

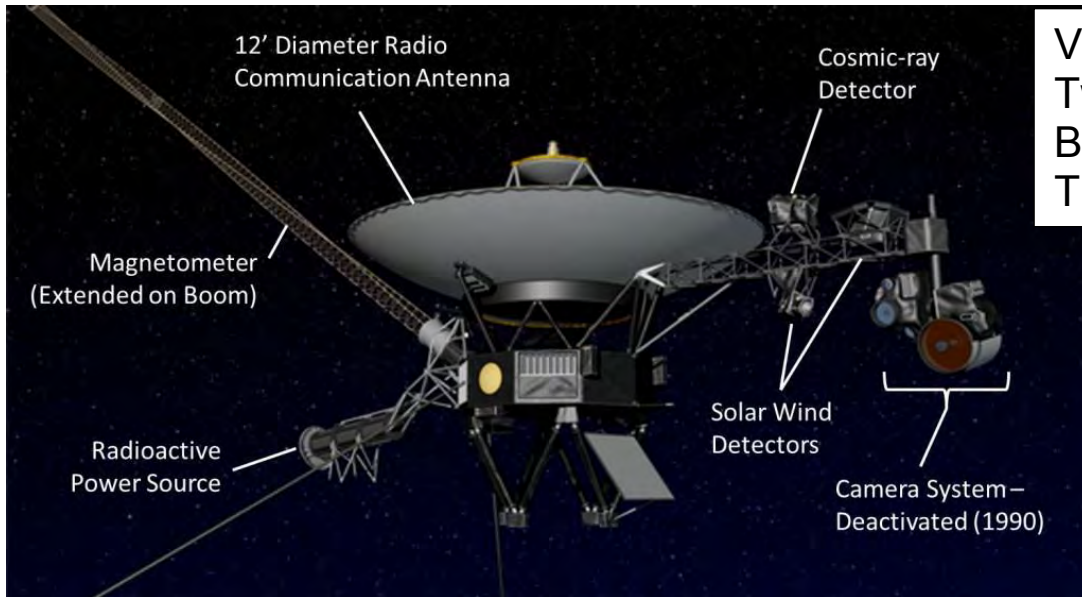
In 1958 NASA was formed to help compete with the Russians. Several NASA facilities were created and JPL was given the assignment for space exploration. **The US first satellite, Explorer I, was built by JPL** and launched by a Jupiter C rocket, developed at the Marshall Spaceflight Center in Huntsville, AL. This was Werner von Braun's organization.



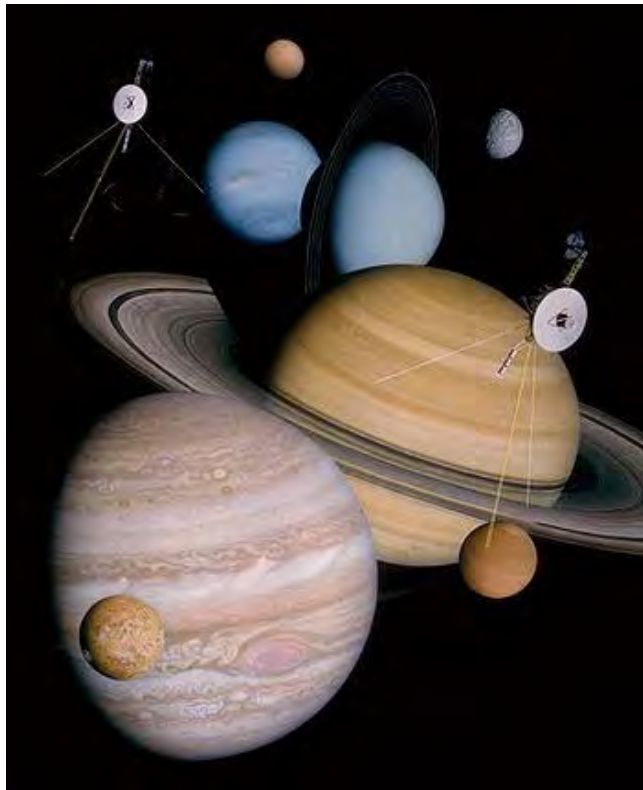
William Pickering

James van Allen

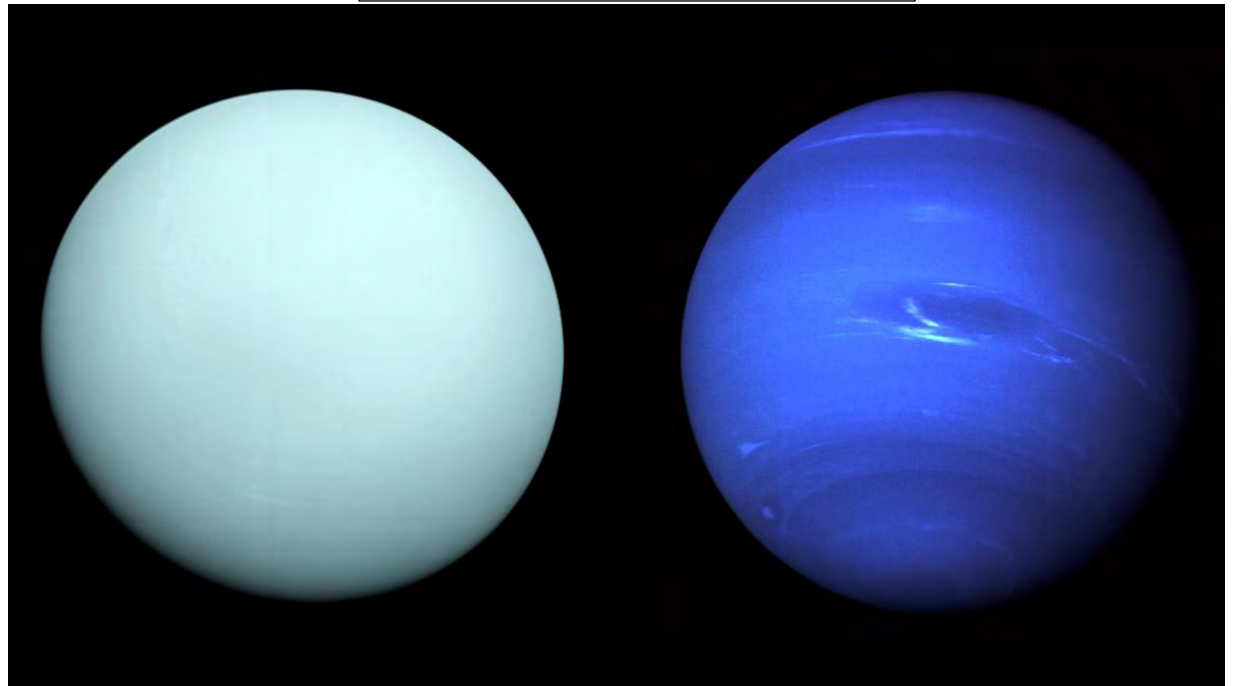
Werner von Braun



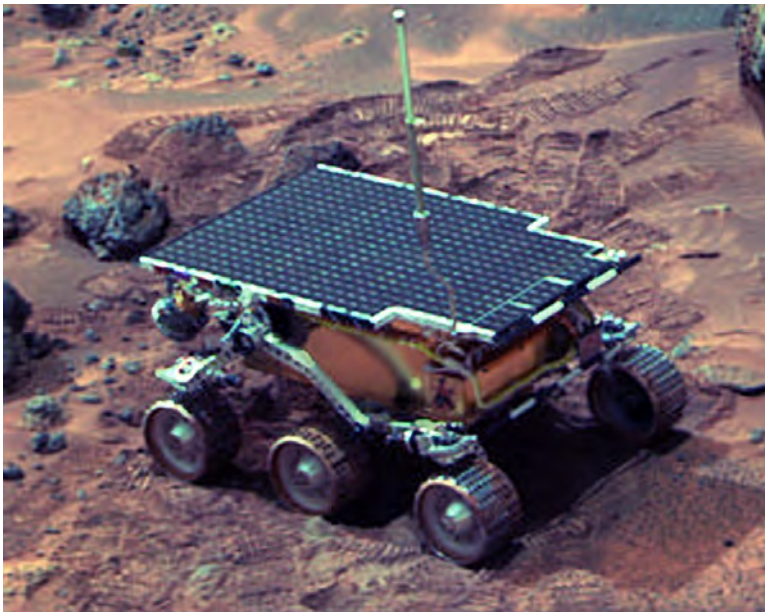
Voyager Spacecraft
Two were built, launched 1977
Both are still communicating after 46 years.
They are 11.5 and 14 BILLION mi from earth



Uranus and Neptune



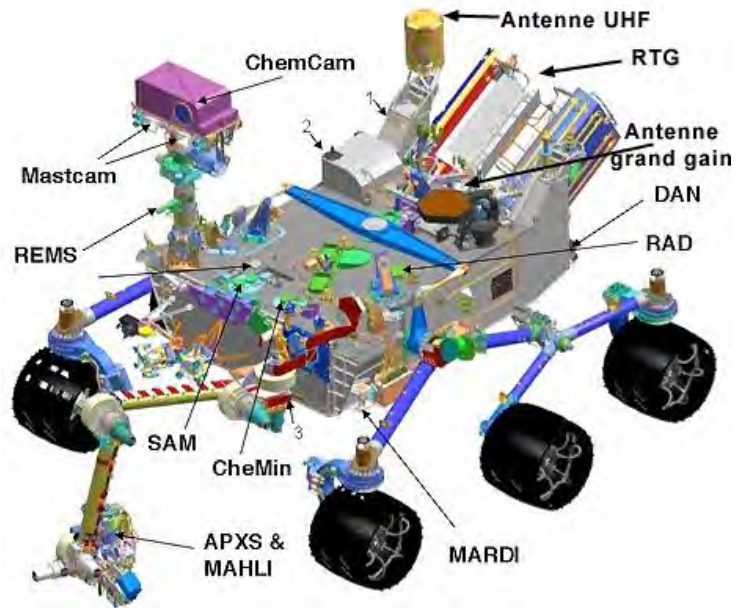
Mars Rovers



Pathfinder 1997
2 ft long, 23 lbs

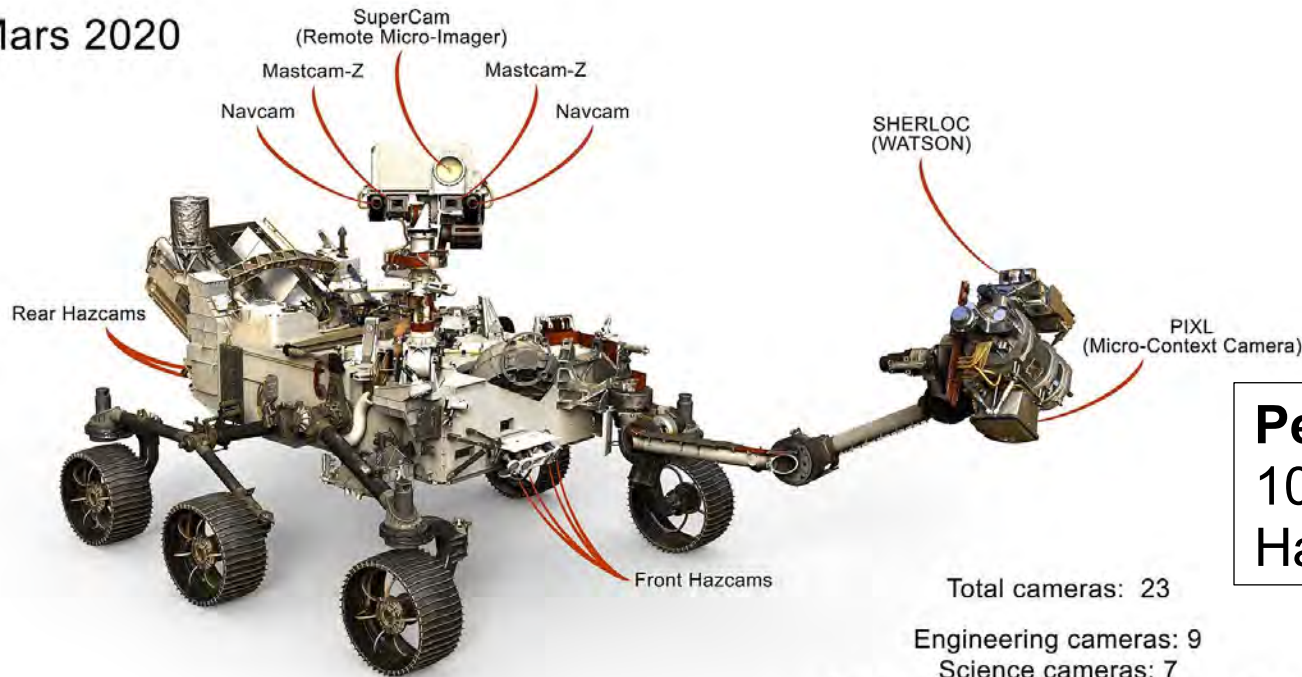


Spirit and Opportunity 2005
6 ft long, 400 pounds



Curiosity 2.9 ft long, one ton

Mars 2020



Perseverance 2021
 10 ft long, 2 tons
 Had its own helicopter

Total cameras: 23
 Engineering cameras: 9
 Science cameras: 7
 Entry, descent and landing cameras: 7

Break

Partial list of JPL space missions

Explorer, several earth orbiting satellites Pioneer to Jupiter

Ranger, Moon investigations

Mariner, several Mars flyby craft

Surveyor, Moon landers

Viking, Mars landers

Voyager, outer planet explorers

Seasat, explore the oceans

Magellan to explore Venus

Galileo to Jupiter

Ulysses, mission to the sun

Mars Observer

WIFPIC 2 (servicing Hubble Space Telescope)

Mars Global Surveyor

Mars Pathfinder (first rover, Sojourner)

Cassini (Huygens probe of Titan)

Mars Odyssey

Genesis

GRACE and GRACE-FollowOn, gravity explorers

Spirit and Opportunity, Mars rovers

Juno to Jupiter

Curiosity, Mars rover

Perseverance, Mars rover

Europa Clipper, launches 2024

What did Chuck do at JPL?

First assignment was doing engineering maintenance for the Deep Space Network



10^{-19} watts

Mars antenna 230 ft diameter at the Goldstone tracking station

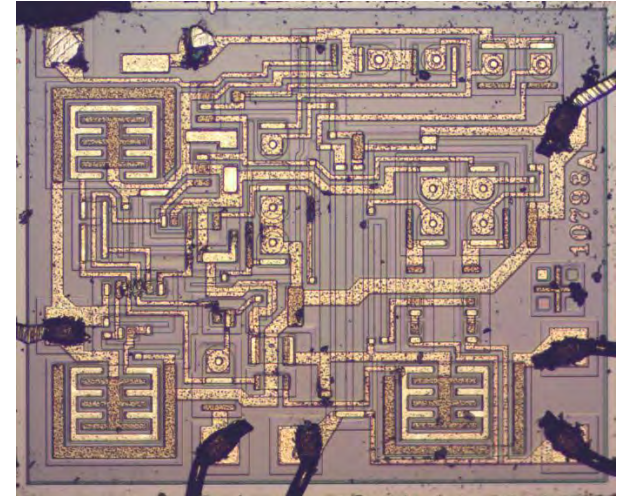
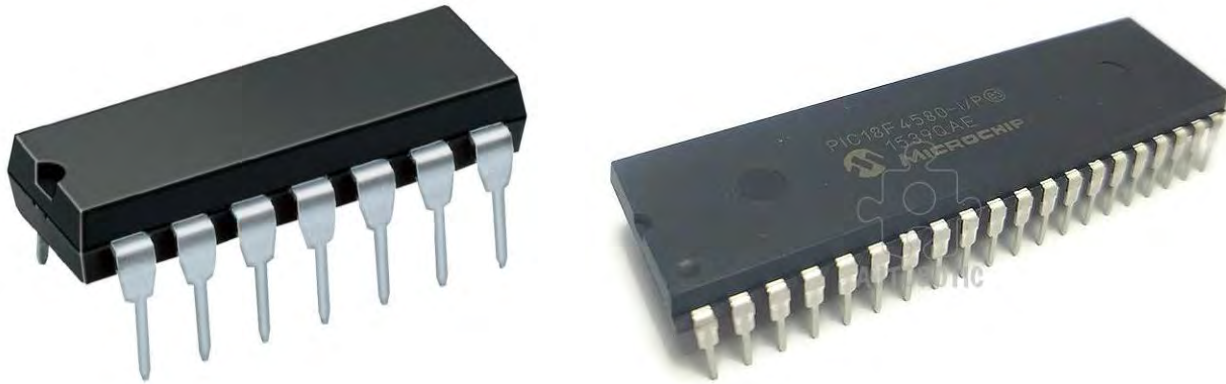
Later worked on ground support equipment for the Voyager mission, two spacecraft. Built several items of use to Voyager, principle among them was the **Reed-Solomon decoder**. Its use was to correct errors in the data received from Voyager, thereby improving image quality, and permitting a greater number of images to be captured. For this work, two patents were issued. Development took 2 years and cost about a million dollars

Reed Solomon Decoder

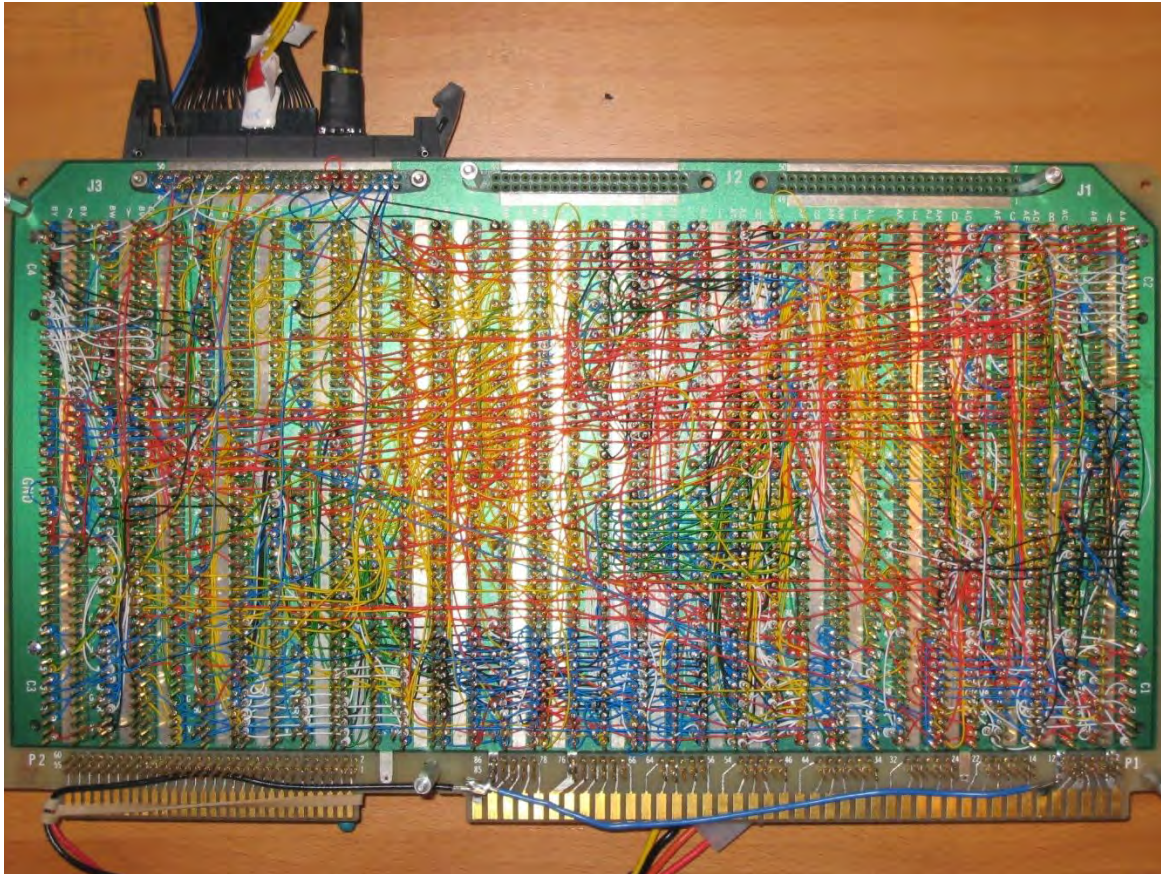


Named for Irving Reed and Gus Solomon, the machine had 565 integrated circuits.
Work was done 1980 thru 1982.
Show handbook

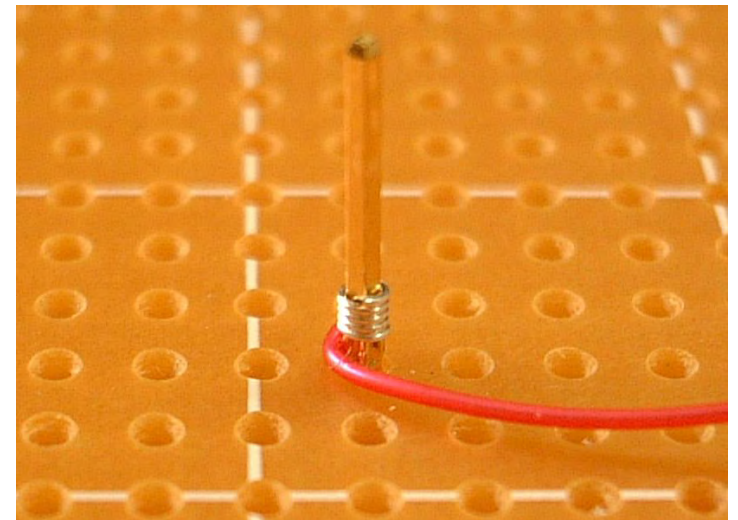
1980s era integrated circuits



A silicon die inside the IC

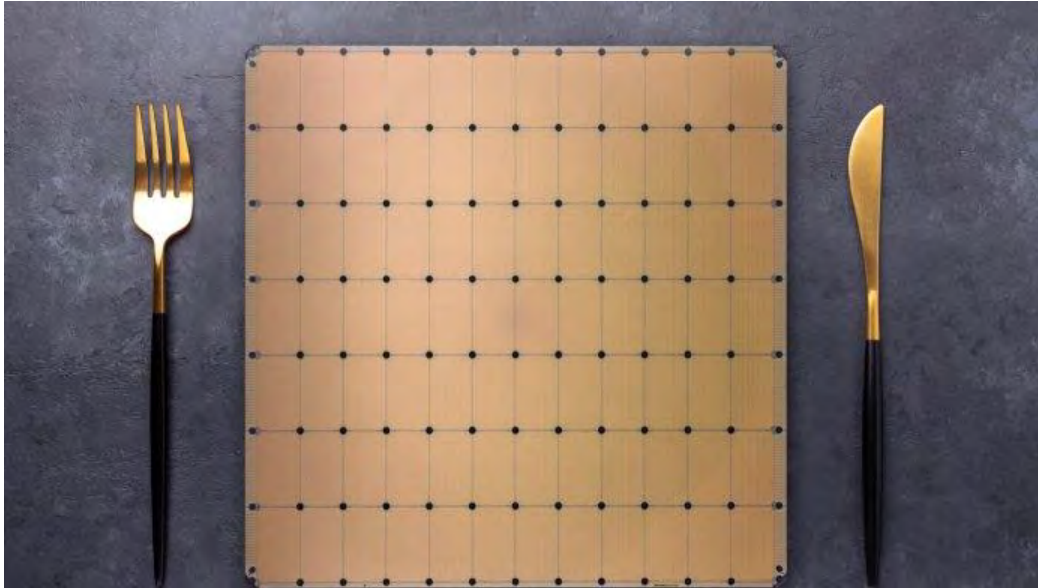


Wire wrap technology



The World's Biggest Computer Chip Now Comes With 2.6 Trillion Transistors

April 25, 2021



2,600,000,000,000
Transistors
850,000 processors

The world's biggest AI chip just doubled its specs



1 Quintillion instructions per second
1,000,000,000,000,000,000 flops

Who invented the integrated circuit?

Featured Stories



JPL Chief of Staff Gail Robinson. Photo credit: Dan Goods.

Gail Robinson's Inevitable Path to the 9th Floor

By Vince Robbins

Every workday, JPL Chief of Staff Gail Robinson leaves her office on the 9th floor of Building 180, walks to



Gail and Bill Robinson. Bill was my predecessor in the position I accepted in 1978. I inherited much of his work and carried it forward. He had toyed with the design of a Reed Solomon decoder. I met Gail but never met Bill.

The following JPL employees recently announced their retirements:

50+ Years:

Gail K. Robinson, Section 1000, 50 years

40+ Years:

Cynthia L. Kahn, Section 3000, 43 years

Flora Wilcox, Section 171A, 43 years

30+ Years:

Peter Kahn, Section 3100, 35 years

Sally Heapy, Section 1430, 34 years

20+ Years:

Alex Perez, Section 352H, 28 years

Mary Ann Hall, Section 8010, 27 years

THE MOSIS SERVICE

Since 1981, A pioneer in Multi Project Wafer (MPW) fabrication services.

MOSIS was one of the earliest and successful implementations of electronic commerce via the Internet (pre WWW) receiving designs via electronic mail and then providing access via the “Web” and “MOSAIC” commencing in 1993.

In the almost 40 years of service, The MOSIS Service has had over 50 US Government laboratories and agencies, 800 domestic and foreign colleges and Universities, and over 100 commercial companies submit designs for fabrication.

The University of Southern California through The MOSIS Service is committed to providing value add services to the microelectronics community into the future.

I did integrated circuit design using the MOSIS service, produced several prototypes which were never put into production. The work did lead to a trip to Puerto Rico to visit the scientists at the Arecibo Radio Telescope, a 1000 foot radio telescope antenna. It fell down on Dec. 1, 2020.

Show chips



THE MOSIS SERVICE



Arecibo Radio Telescope
Puerto Rico
1000 ft diameter



Cables snapping
Dec 1, 2020

1991-1996 Worked on a Star Wars project called MSTI, an infrared detector in orbit to help identify enemy rocket launches. I was on loan to the Air Force and worked at the Phillips Lab on Edwards Air Force base. Three MSTI satellites were built and successfully launched. My circuit board designs were on each of the satellites. Lived in California City, CA, just 10 miles north of Edwards. Saw several Space Shuttles land at Edwards. Met Chuck Yeager and several other famous pilots. Became acquainted with the story of Pancho Barnes and her notorious ranch.

(Show circuit board)





Edwards Air Force Base
Seen from above





The End