

## PARTICLE PHYSICS

# Makes a Difference in Your Life

### Global science, local impact

**Particle physics** is a global discovery science central to the modern innovation ecosystem. It drives national, regional, and local progress in science and industry. And it improves your quality of life.





Here are just a few examples of the ways **particle physics** works for you:

## MEDICINE



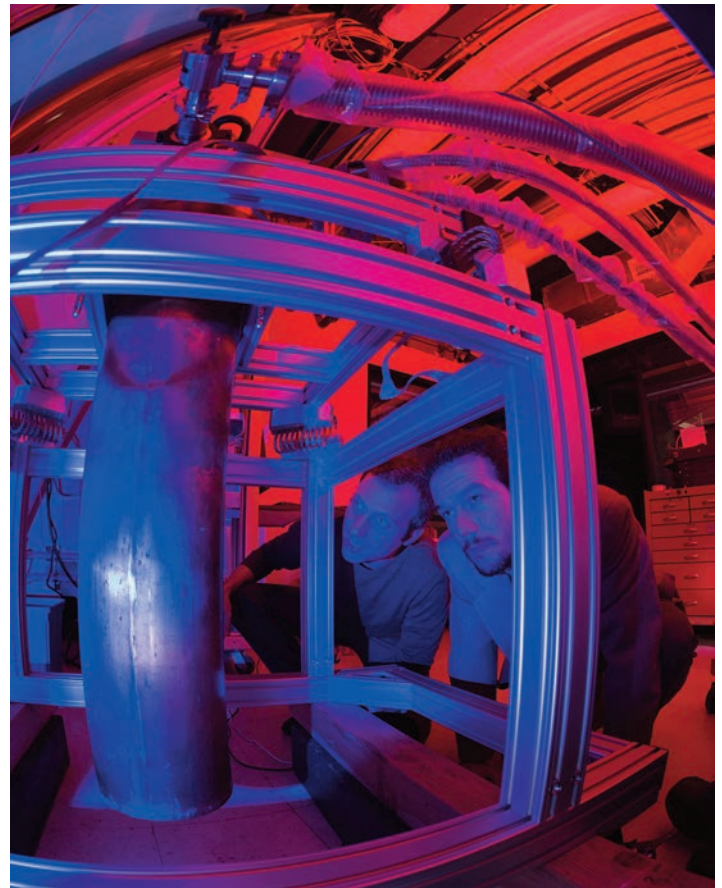
*Mechanical ventilator, image courtesy MVM Collaboration*

- ▶ Advanced technologies and expertise from the particle physics community are **helping in the fight against COVID-19**. A simplified ventilator design was taken from concept through U.S. FDA approval. Computing resources are helping determine how the virus proteins fold.
- ▶ **The pharmaceutical industry** uses X-ray beams created by particle accelerators to develop more effective drugs to fight disease.
- ▶ Next-generation **medical imaging devices** are being powered by detectors and computational methods developed for particle physics experiments.
- ▶ **Radiation treatment plans for cancer** are powered by software originally developed to model particle detectors, and treatments with gamma rays and protons are delivered using particle accelerator technology.



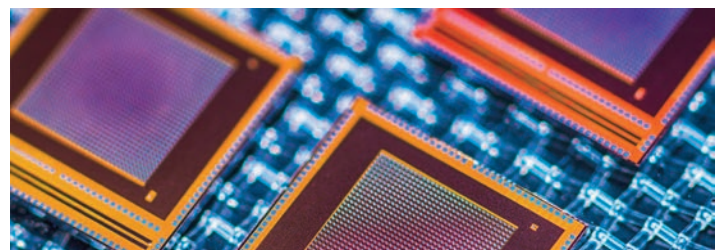
*Proton therapy for cancer*

## SENSORS



*Advanced sensor development*

- ▶ Custom silicon sensors developed for Large Hadron Collider experiments **drive industrial applications** including X-ray and medical imaging, testing of new materials, and radiation dosimetry aboard the International Space Station.
- ▶ **Developments in quantum sensors** provide opportunities for experiments to study previously inaccessible areas of science.
- ▶ **Chemistry, biology, and materials science** researchers use sensors developed for particle physics in cameras that collect signals from visible and infrared light and from X-rays.



*X-ray sensors*

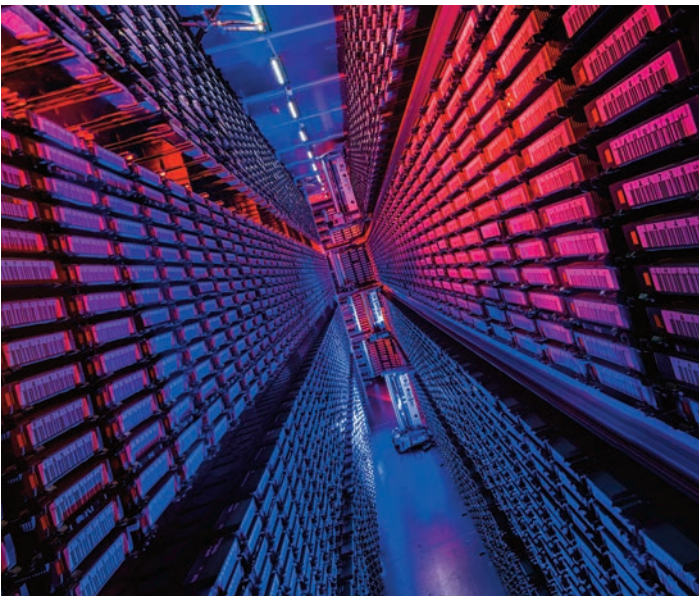


## COMPUTING AND SIMULATION



*Simulating radiation exposure*

- ▶ **The World Wide Web** was first developed by particle physicists to share information quickly and effectively around the world. Particle physicists continue to push the frontiers of big data analysis with global grids and cloud computing.
- ▶ **Radiation exposure for spacecraft** is simulated using software originally developed to model particle detectors.
- ▶ **Atomic and nuclear physics advances** benefit from precise mathematical techniques developed by particle physicists, now used to predict new materials and molecules.
- ▶ Particle physics theorists are developing foundational concepts that will **advance quantum information science** and enable quantum simulation experiments that will provide new ways to explore scientific problems.



*High performance computing*

## MANUFACTURING



*Manufacturing durable materials*

- ▶ **Precise, customized medical implants** are manufactured using electron beams from particle accelerators.
- ▶ **The food industry** has used particle accelerators for decades to produce the sturdy, heat-shrinkable film that turkeys, fruits, vegetables, and baked goods come wrapped in.
- ▶ **Ink curing companies** use particle accelerators as an environmentally friendly way to produce the colorful packaging on many grocery store items, including cereal boxes.



*Ink curing for packaging*





Screening at cargo ports

## NATIONAL SECURITY

- ▶ Particle physics detector technology improves homeland security by enabling **advanced cargo screening**.
- ▶ The WATCHMAN experiment, a U.S.-UK partnership, will demonstrate the use of neutrino detectors to remotely monitor nuclear reactors, **supporting nonproliferation efforts**.
- ▶ U.S. scientists helped create a muon detector system to **safely look inside the nuclear reactors** in Fukushima after the earthquake and tsunami in Japan.



Muon scanning at Fukushima

Images courtesy Fermilab, NASA, TEPCO, Shutterstock

**For more examples of particle physics in society:**  
[www.symmetrismagazine.org/applied](http://www.symmetrismagazine.org/applied)



usparticlephysics.org

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