IOP Institute of Physics In Scotland

University of Glasgow

ASTRONOMY & PHYSICS EDUCATION

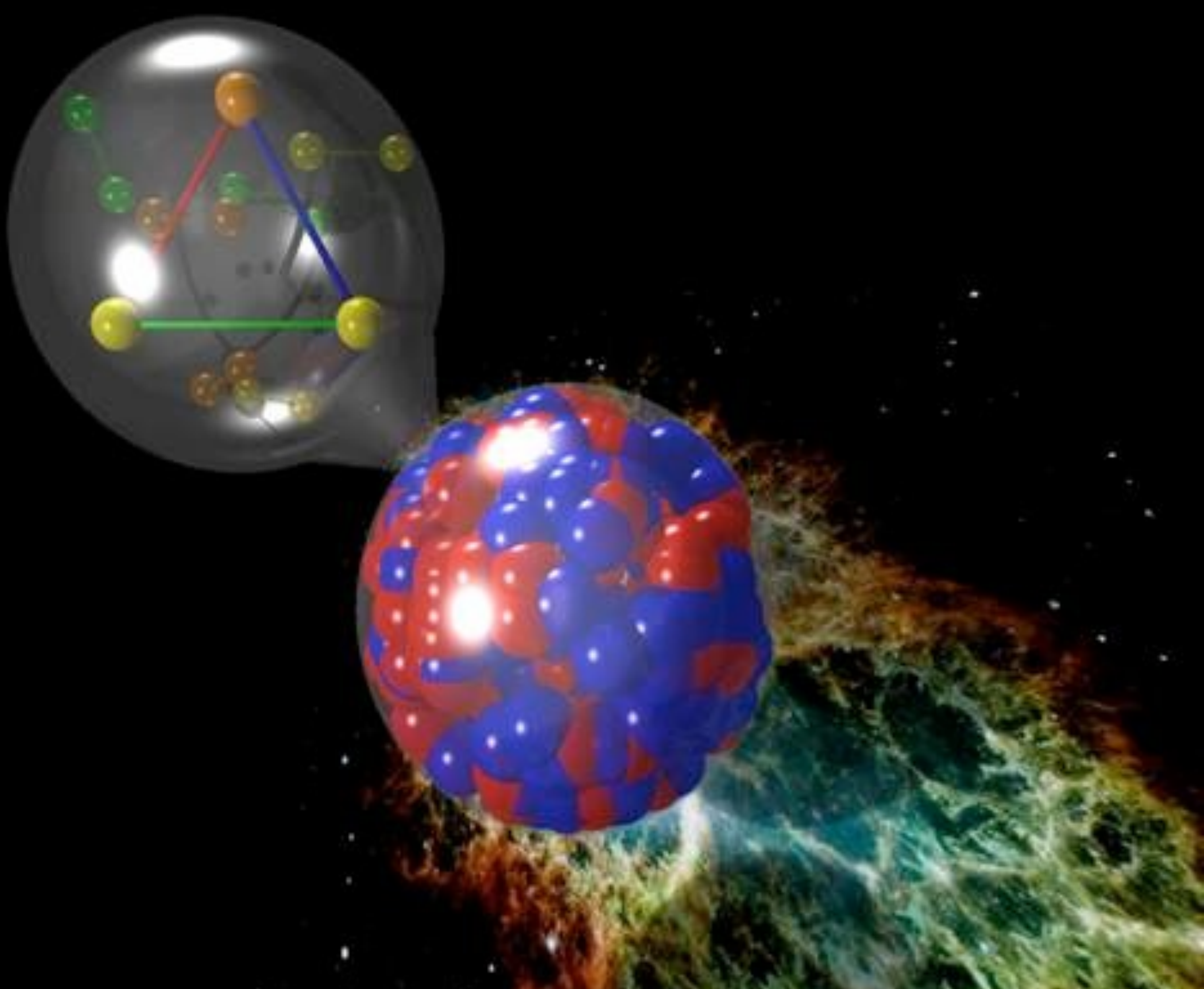
SCIENCE in STEWARTON

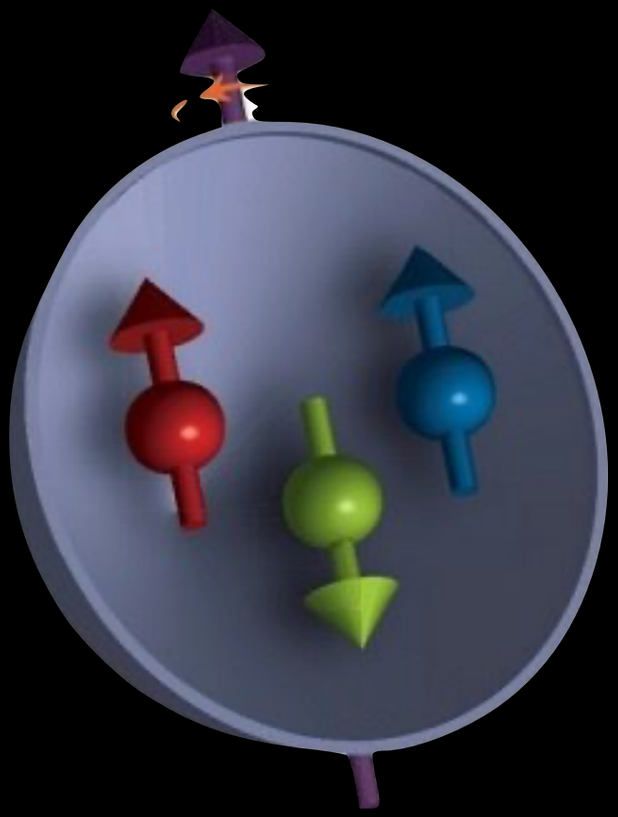
THURSDAY 23RD FEBRUARY
1830-2000

1+1+1>3:
When it comes to quarks, the whole is more than the sum of its parts

Dr Bjoern Seitz
Dr David Mahon, David Bennett,
Dr Rick Gray, Nia Hunter, Dr Francis Thomson
Nuclear and Hadron Physics Group, University of Glasgow

Information about this and other Science In Stewarton events can be found at:

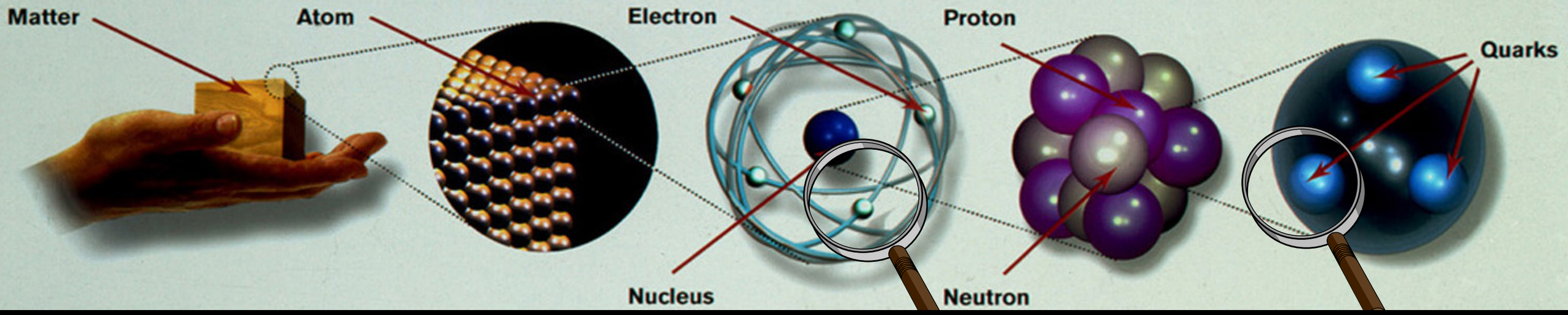


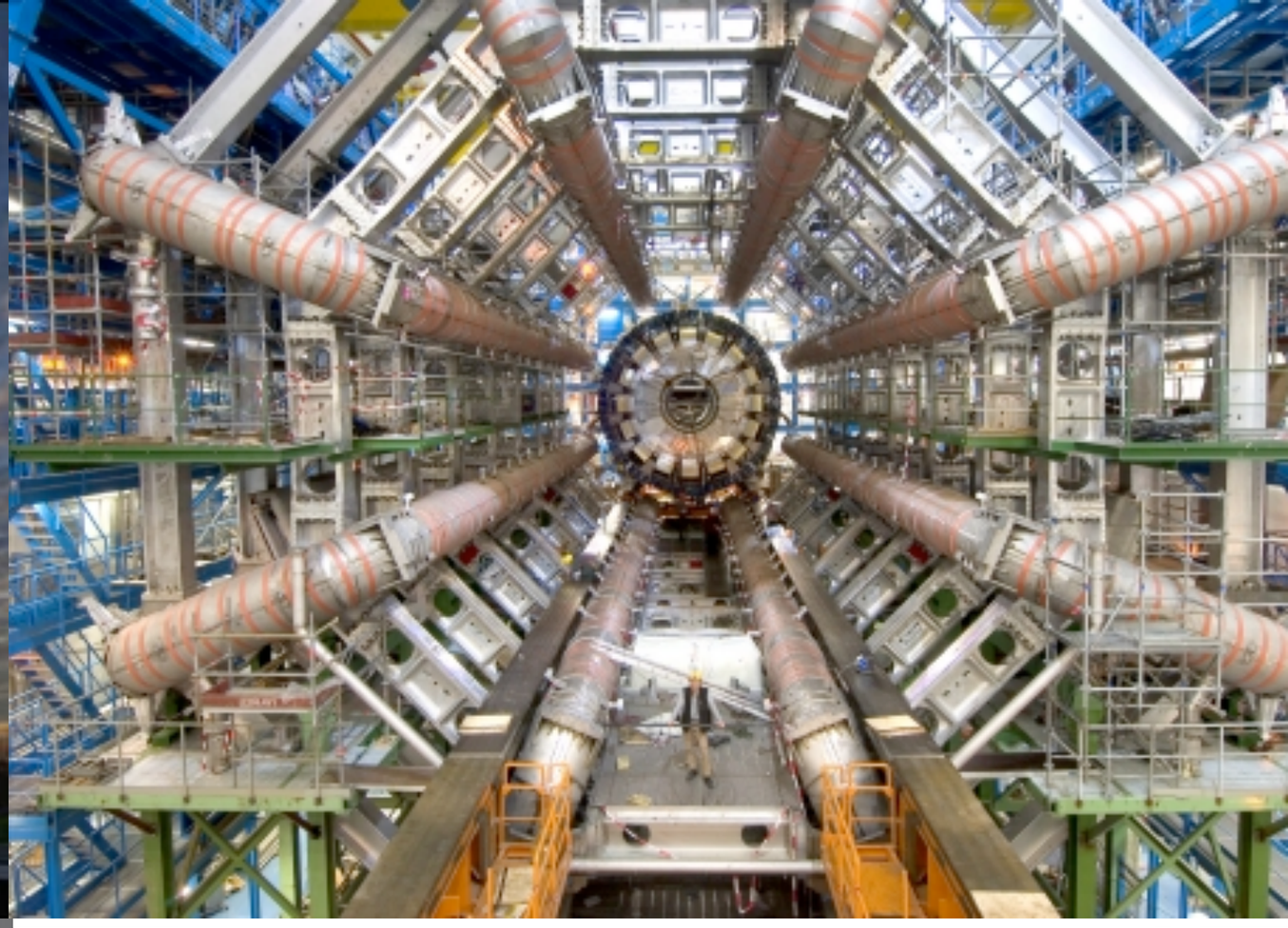


$$1 + 1 + 1 > 3$$

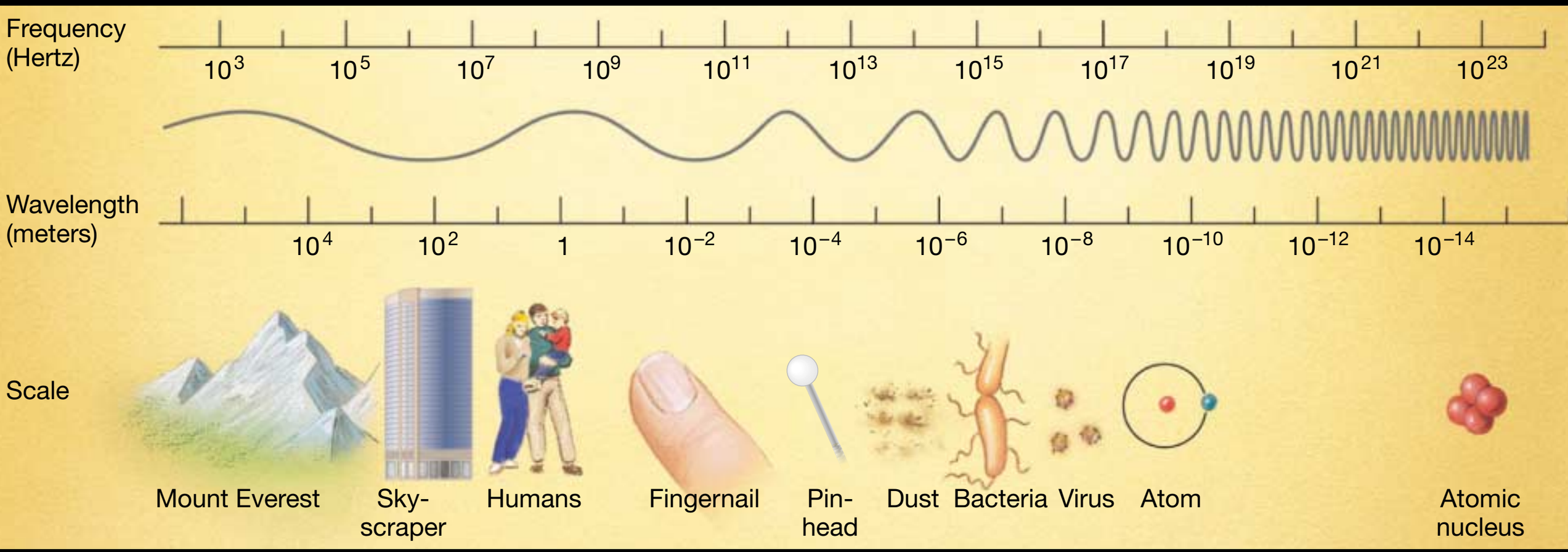
WHEN IT COMES TO QUARKS, THE WHOLE IS MORE THAN THE SUM OF ITS PARTS

WHAT IS THE WORLD MADE OF?

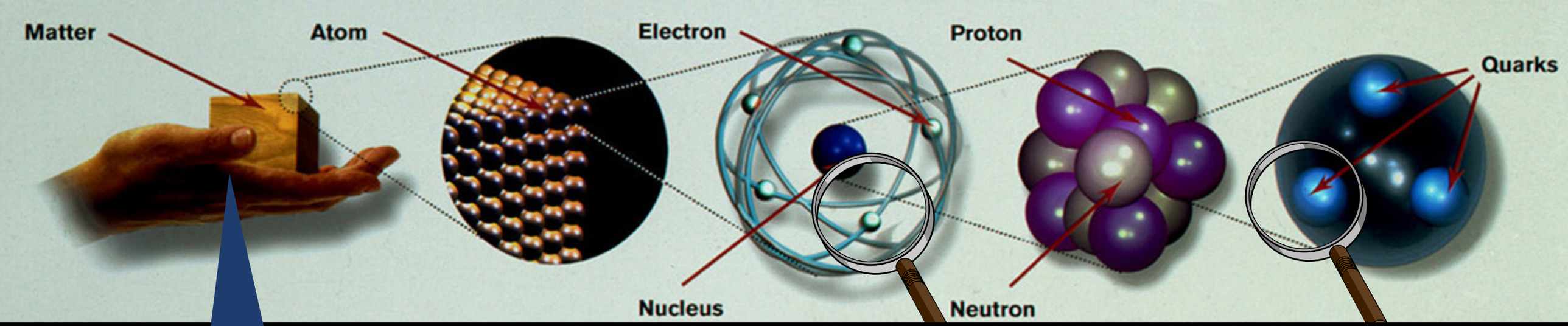

Matter
Atom
Electron
Proton
Quarks
Nucleus
Neutron

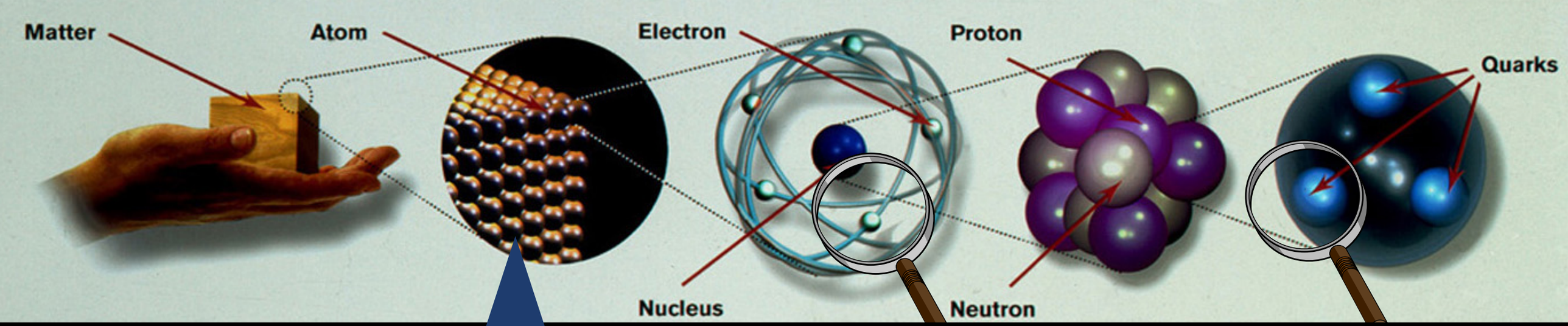


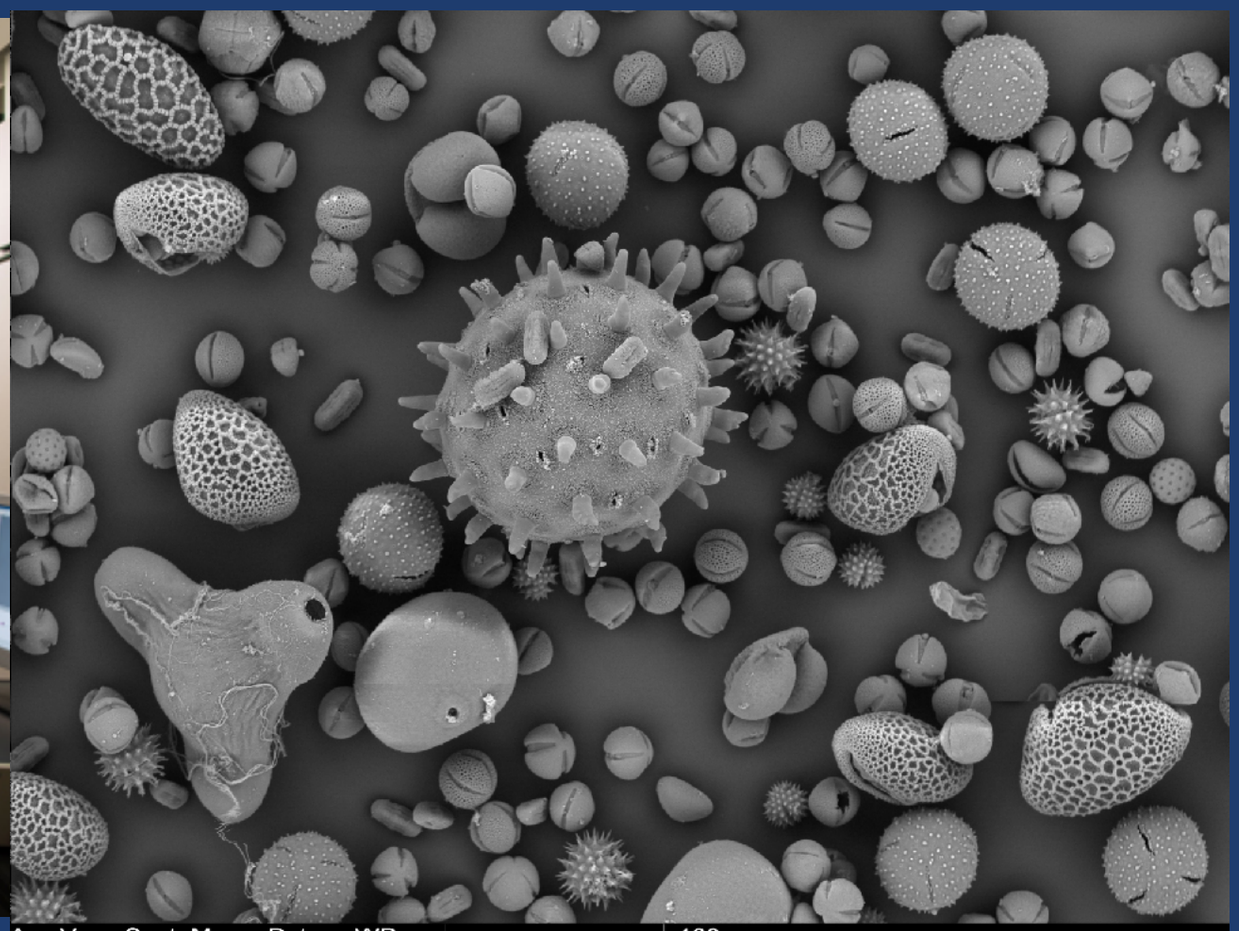
A QUESTION OF WAVELENGTH

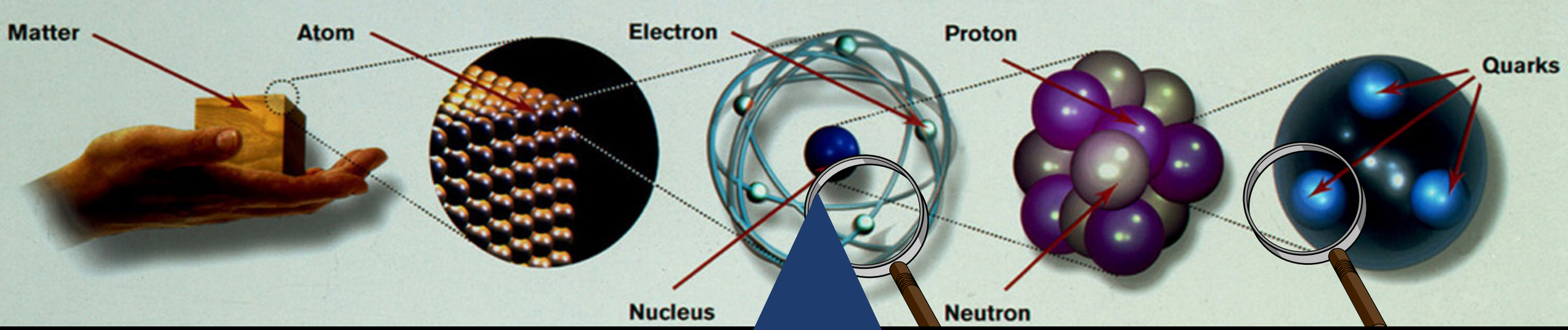


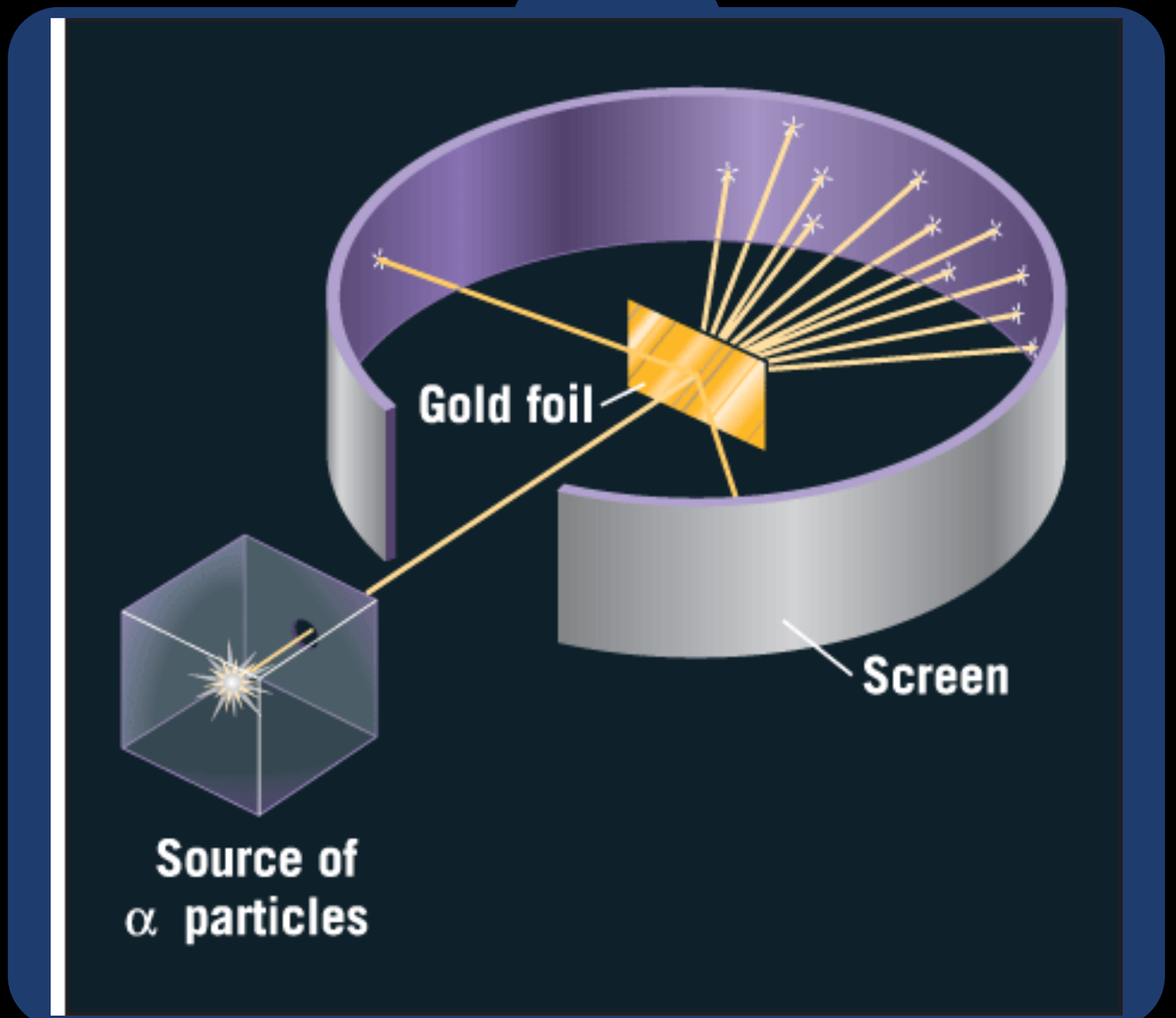
- Wavelength of probe needs to be (much) smaller then the object under investigation.

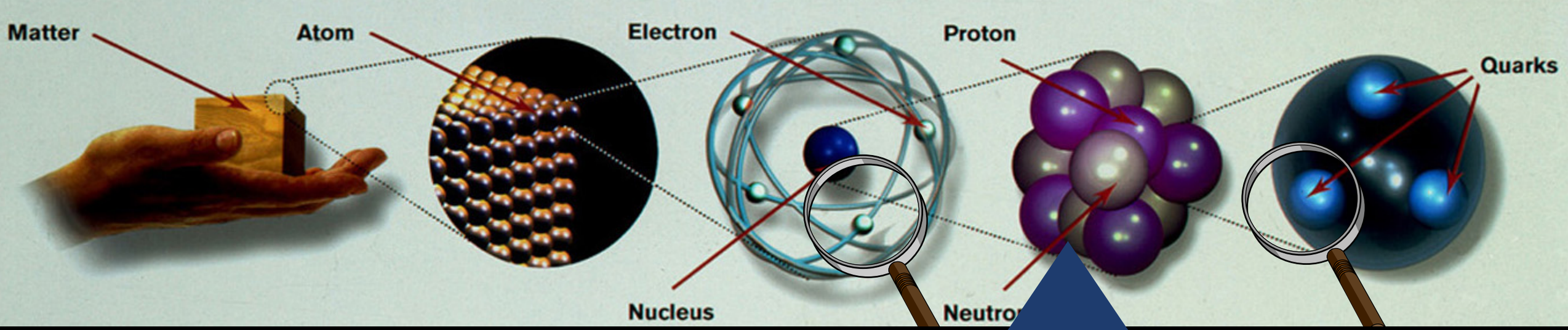

Matter
Atom
Electron
Proton
Quarks
Nucleus
Neutron

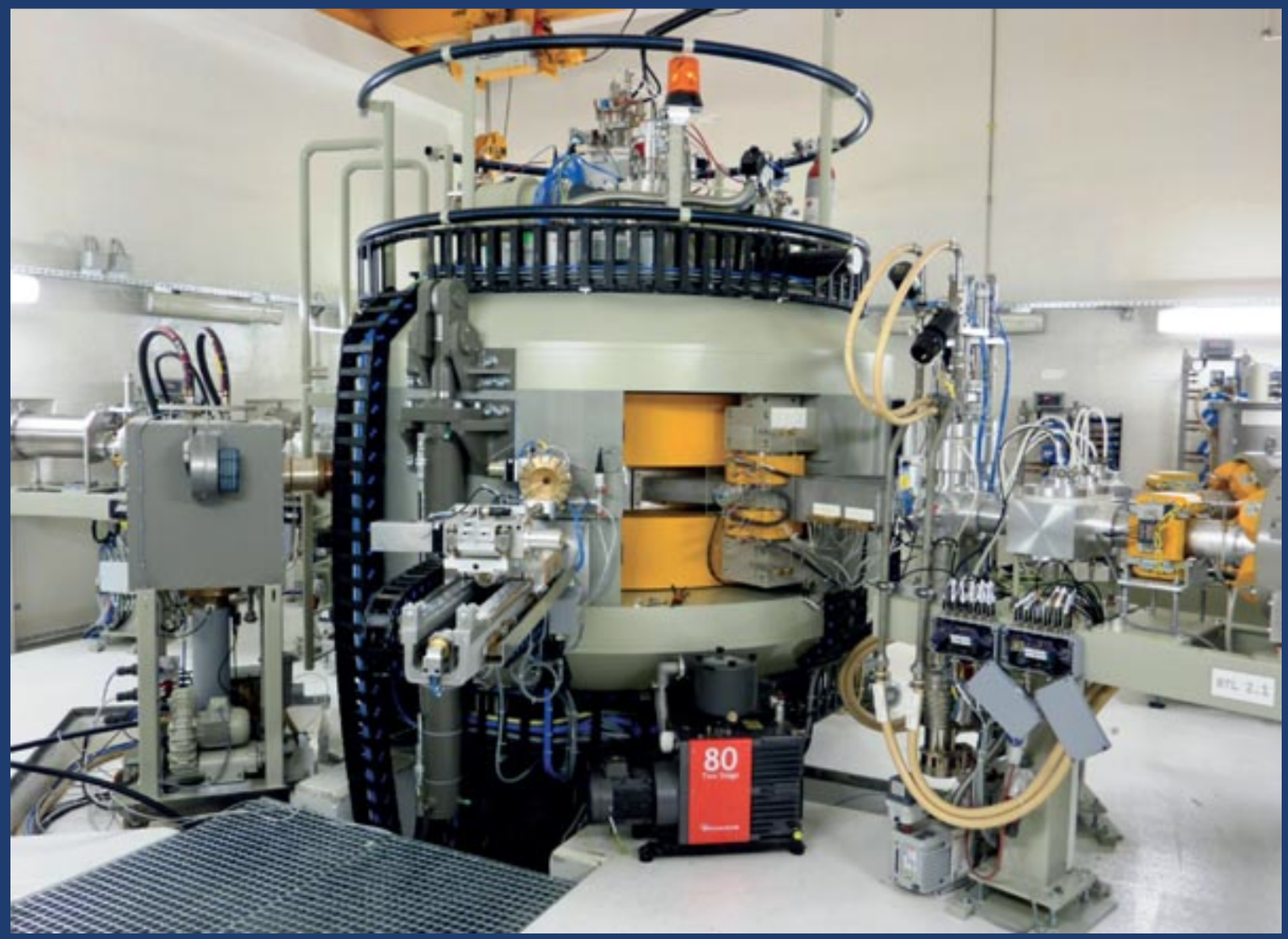

Matter
Atom
Electron
Proton
Quarks
Nucleus
Neutron

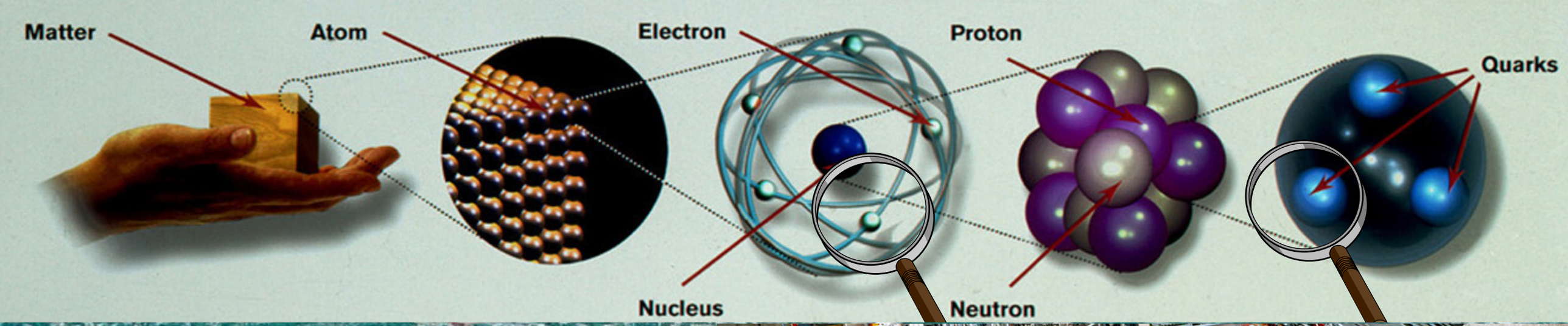

Acc.V Spot Magn Det WD
10.00 kV 3.0 222x NONE 7.2
100 µm
Dartmouth E. M. Facility

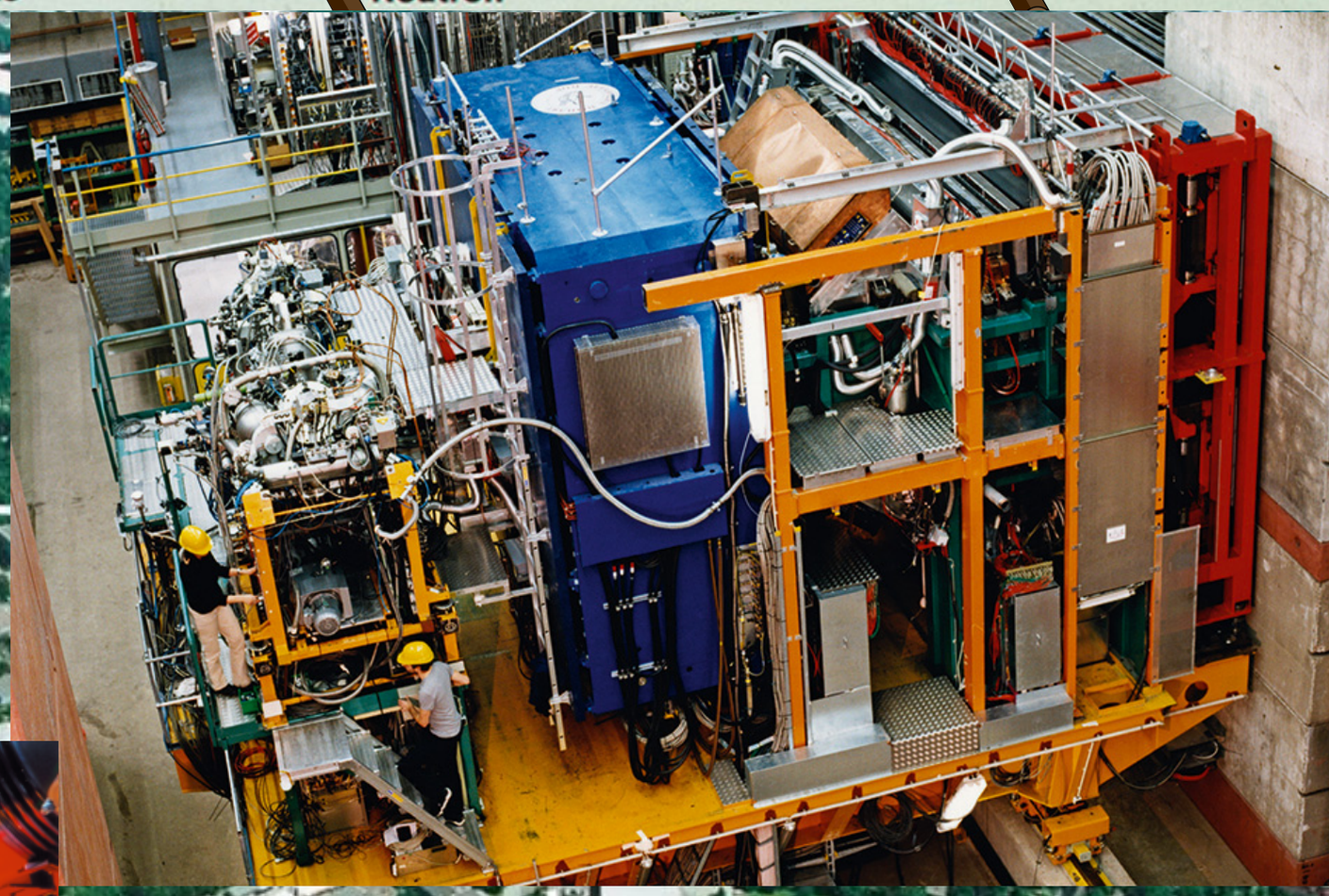

Matter
Atom
Electron
Proton
Quarks
Nucleus
Neutron

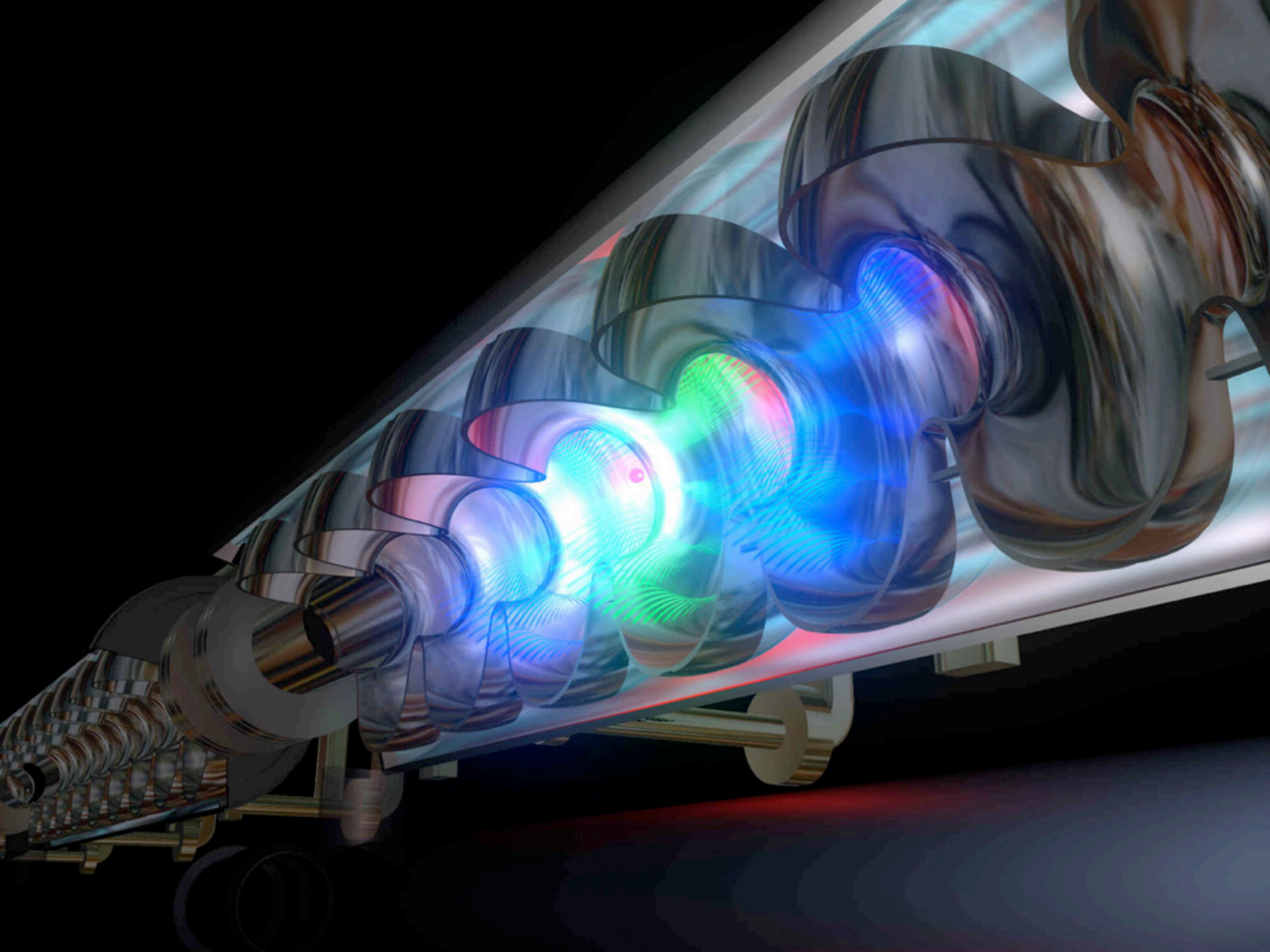

Gold foil
Screen
Source of
α particles


Matter
Atom
Electron
Proton
Quarks
Nucleus
Neutron


80


Matter
Atom
Electron
Proton
Quarks
Nucleus
Neutron





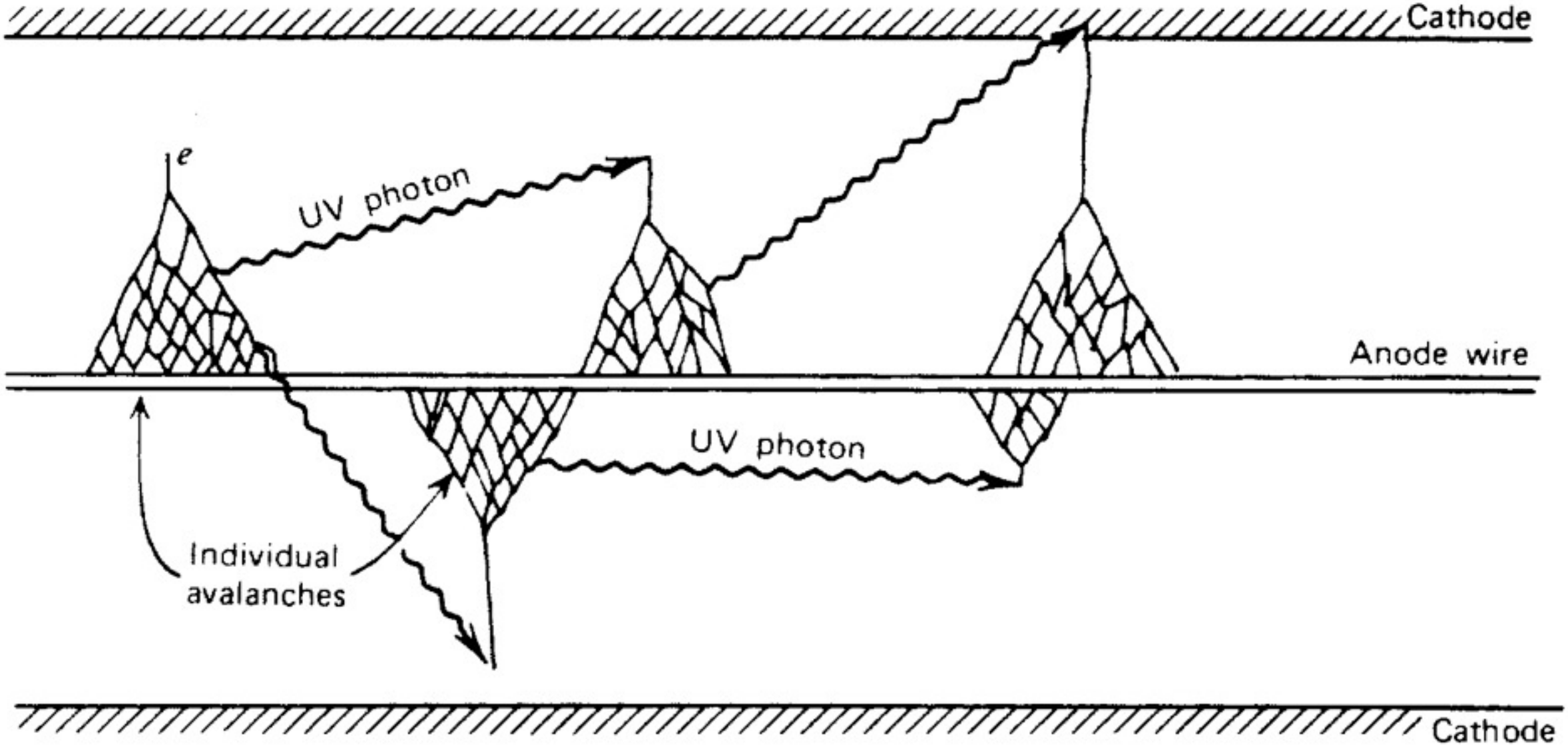

GILBERT
U-239
PROSPECT FOR
URANIUM and other
RADIOACTIVE ORES!
GEIGER COUNTER
SAFE! EXCITING! INSTRUCTIVE!
PROSPECT FOR URANIUM!
Developed at the Gilbert Hall of Science with country's leading atomic energy scientists. Counter clicks rapidly when radioactive material is near; clicks are heard through earphone. Neon light indicator recessed in Geiger Counter top also indicates radioactivity by means of flashes.
$10,000.00 REWARD!
That's what the United States Government will pay to anyone who discovers substantial deposits of Uranium Ore! Full details are given in the booklet "Prospecting for Uranium," packed with the Geiger Counter inside this box.
another GILBERT HALL OF SCIENCE product

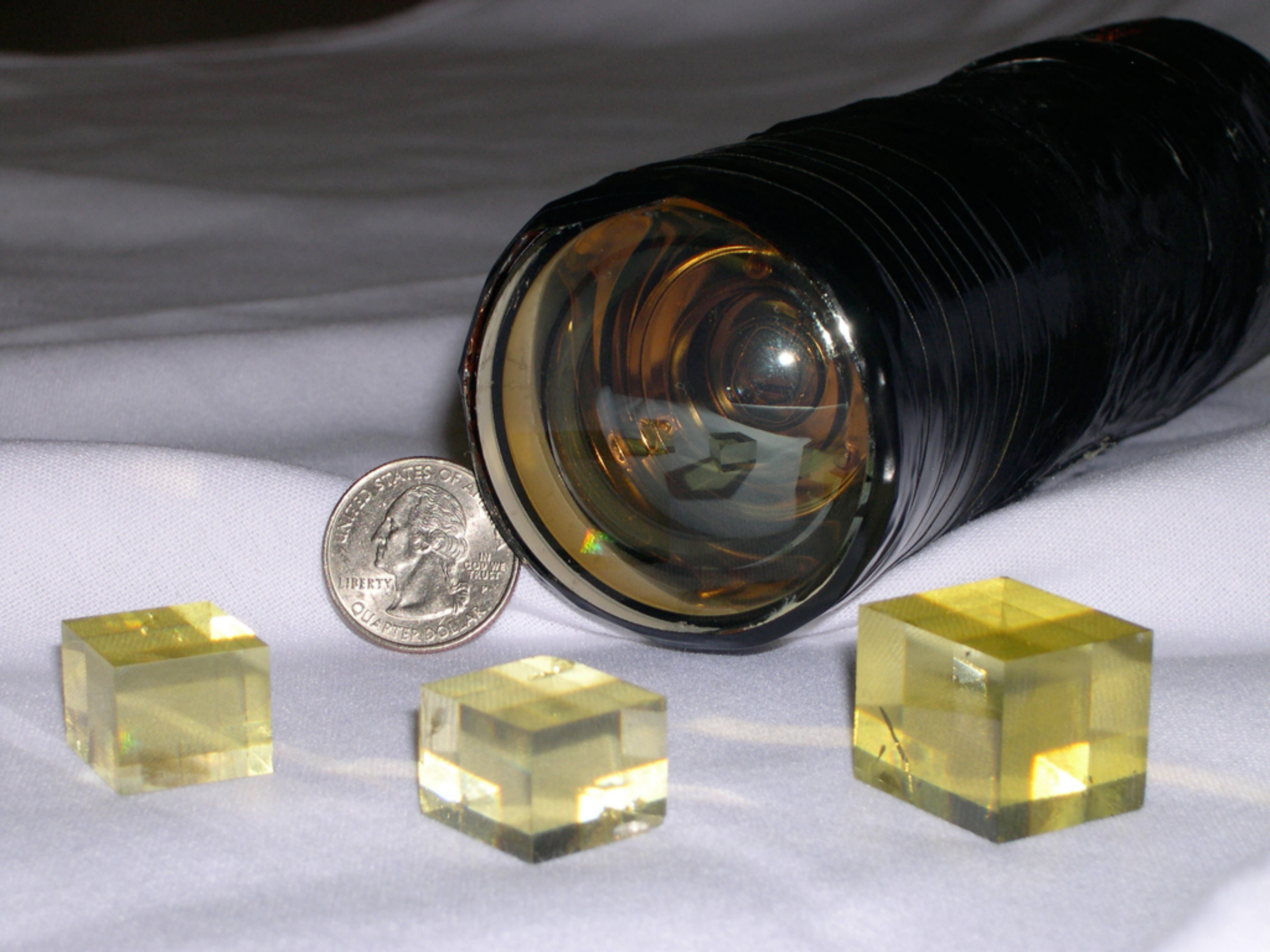
University of Glasgow

Enhancing the senses - radiation detectors in a nutshell

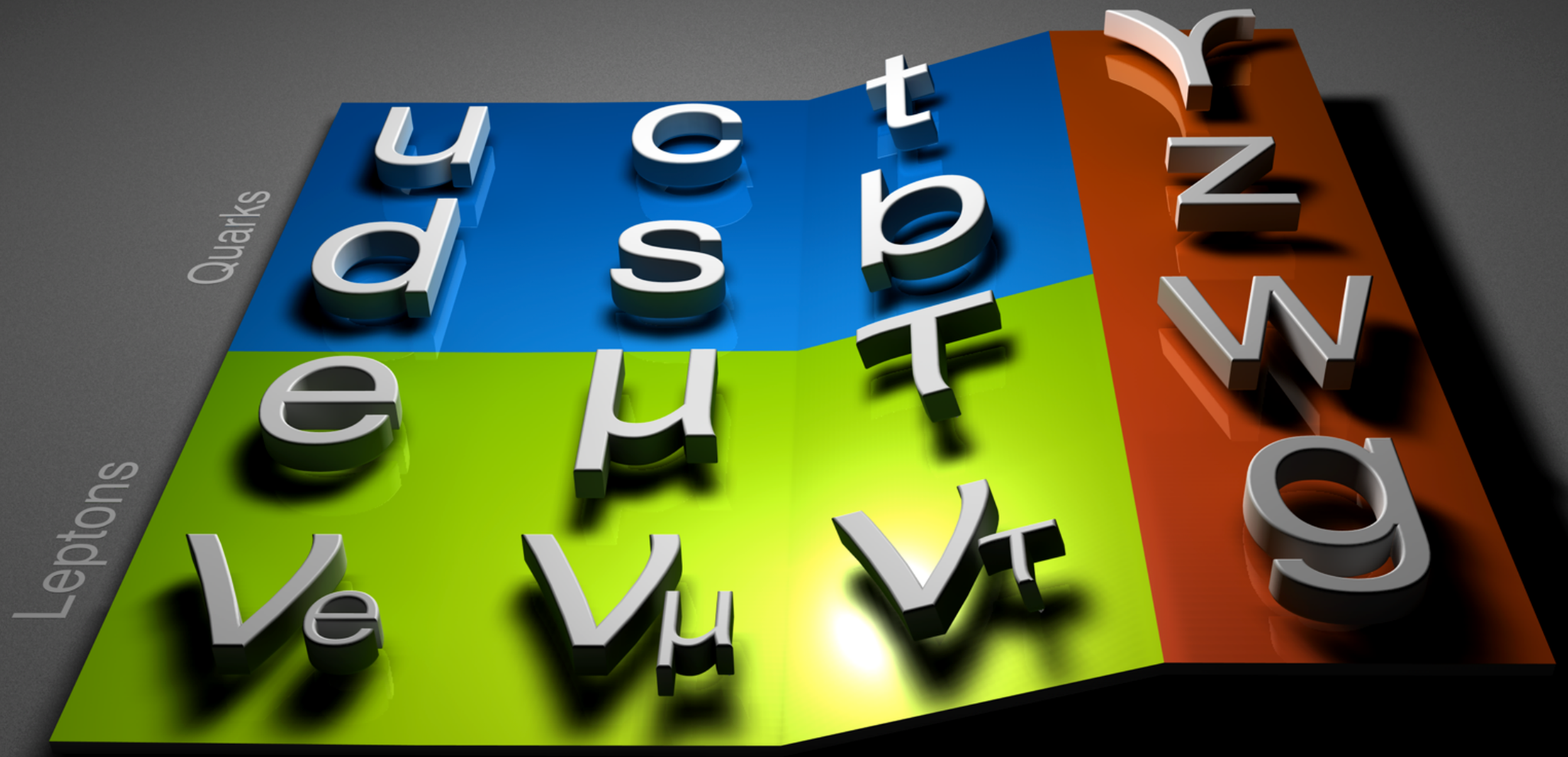
University of Glasgow

Enhancing the senses - radiation detectors in a nutshell




UNITED STATES OF AMERICA
LIBERTY
IN GOD WE TRUST
QUARTER DOLLAR

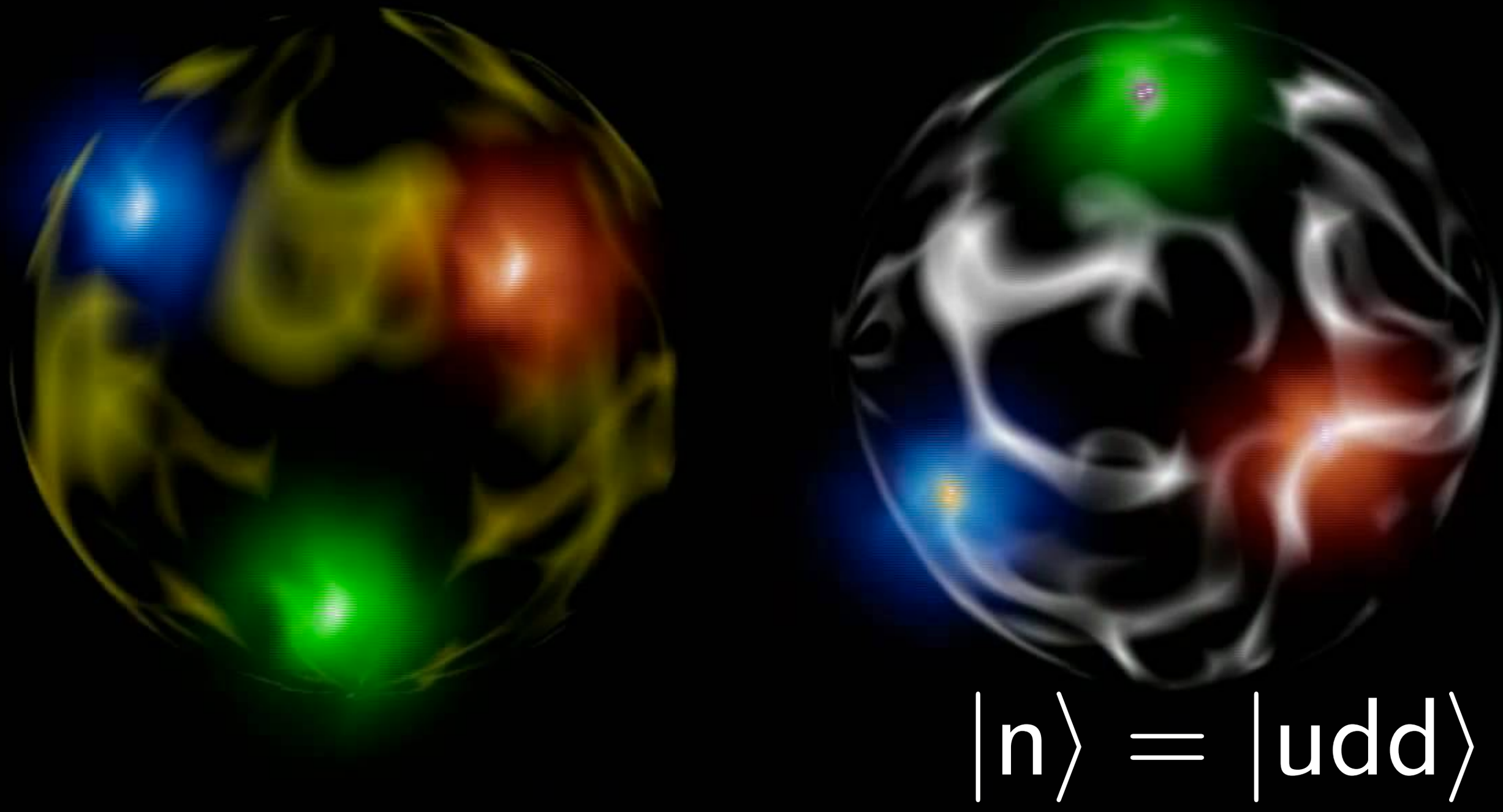
TRIUMPH OF PHYSICS
THE STANDARD MODEL



The Standard Model

TRIUMPH OF PHYSICS ?
THE STANDARD MODEL

$$|\mathrm{p}\rangle = |\mathrm{uud}\rangle$$



$$|\mathrm{n}\rangle = |\mathrm{udd}\rangle$$

WHAT ABOUT ...

$$|p\rangle = |uud\rangle$$

SHAPE?

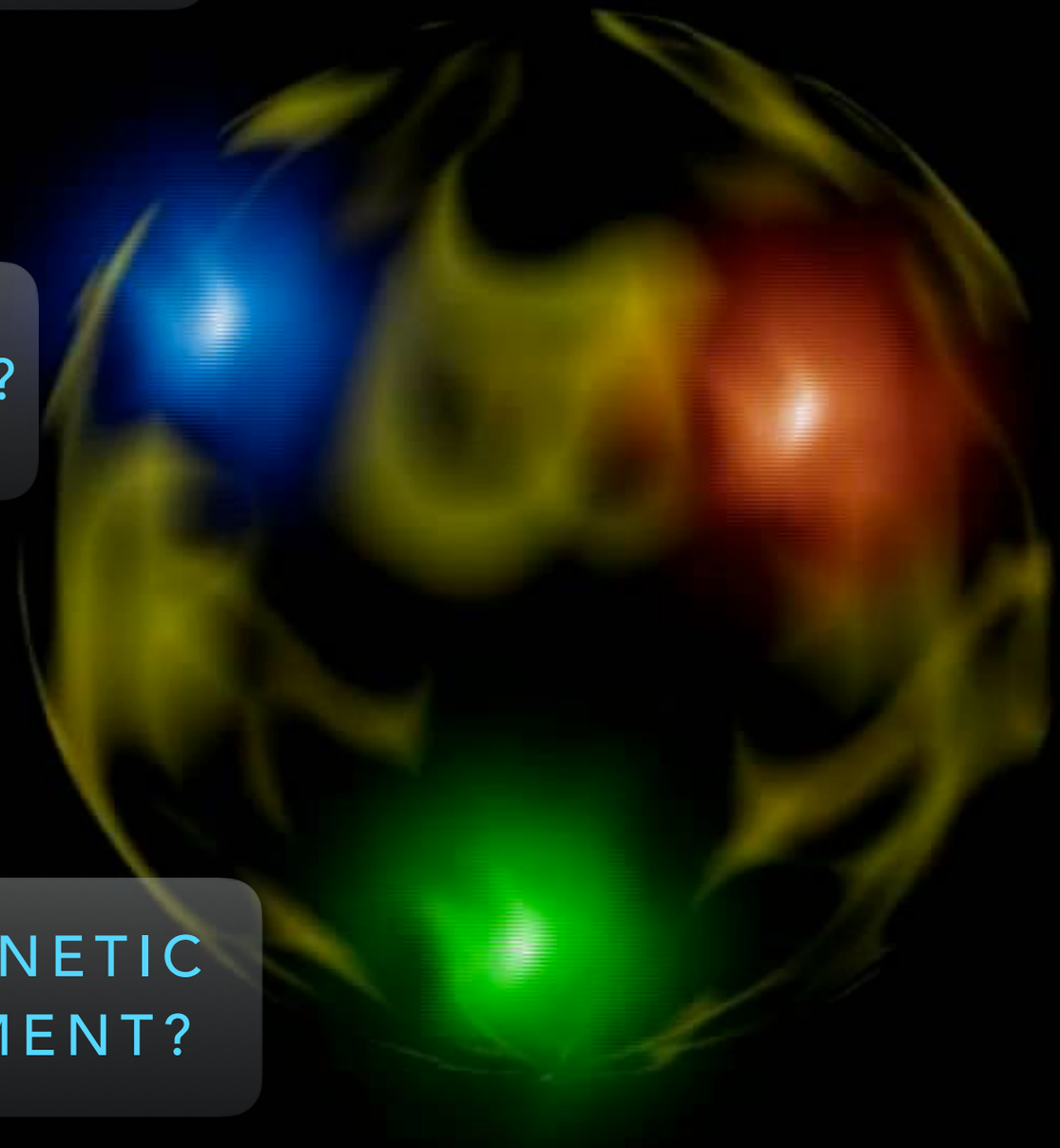
SIZE?

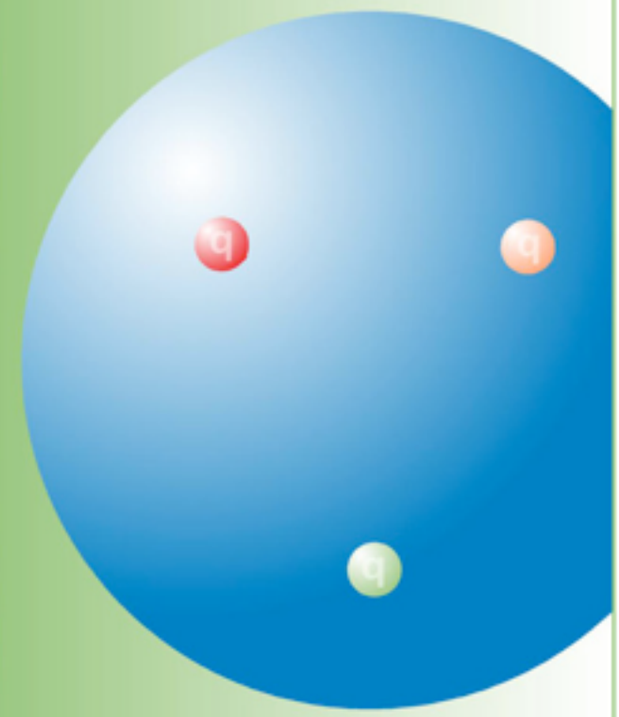
SPIN?

MASS?

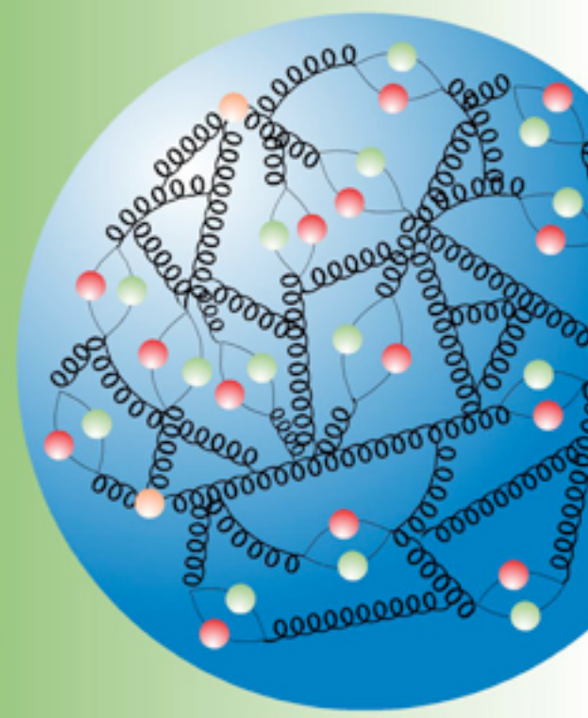
CHARGE?

MAGNETIC MOMENT?

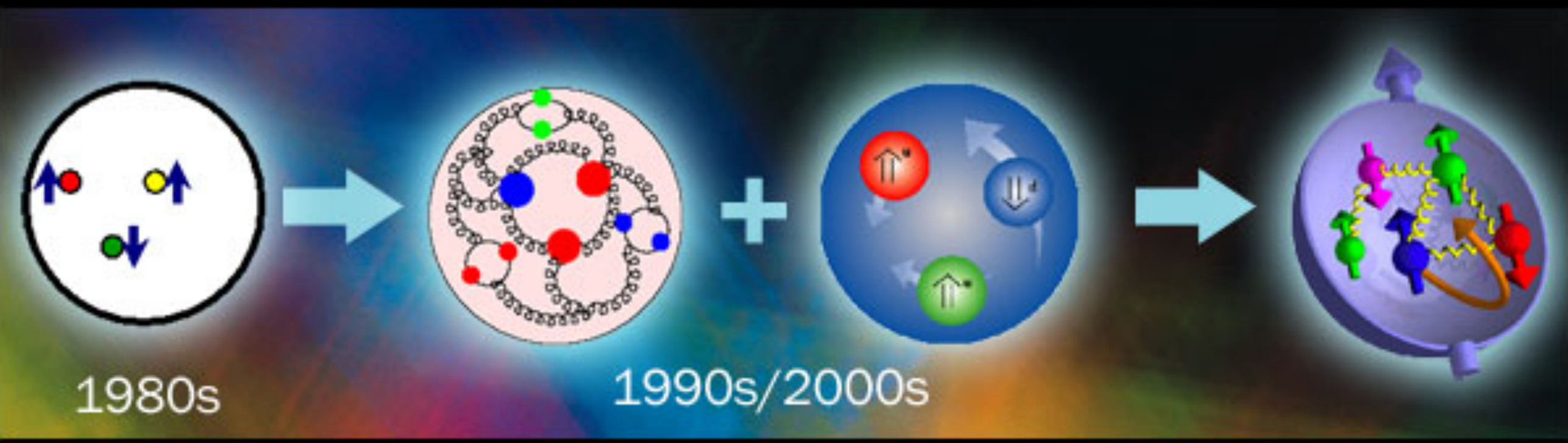




A QUESTION OF RESOLUTION

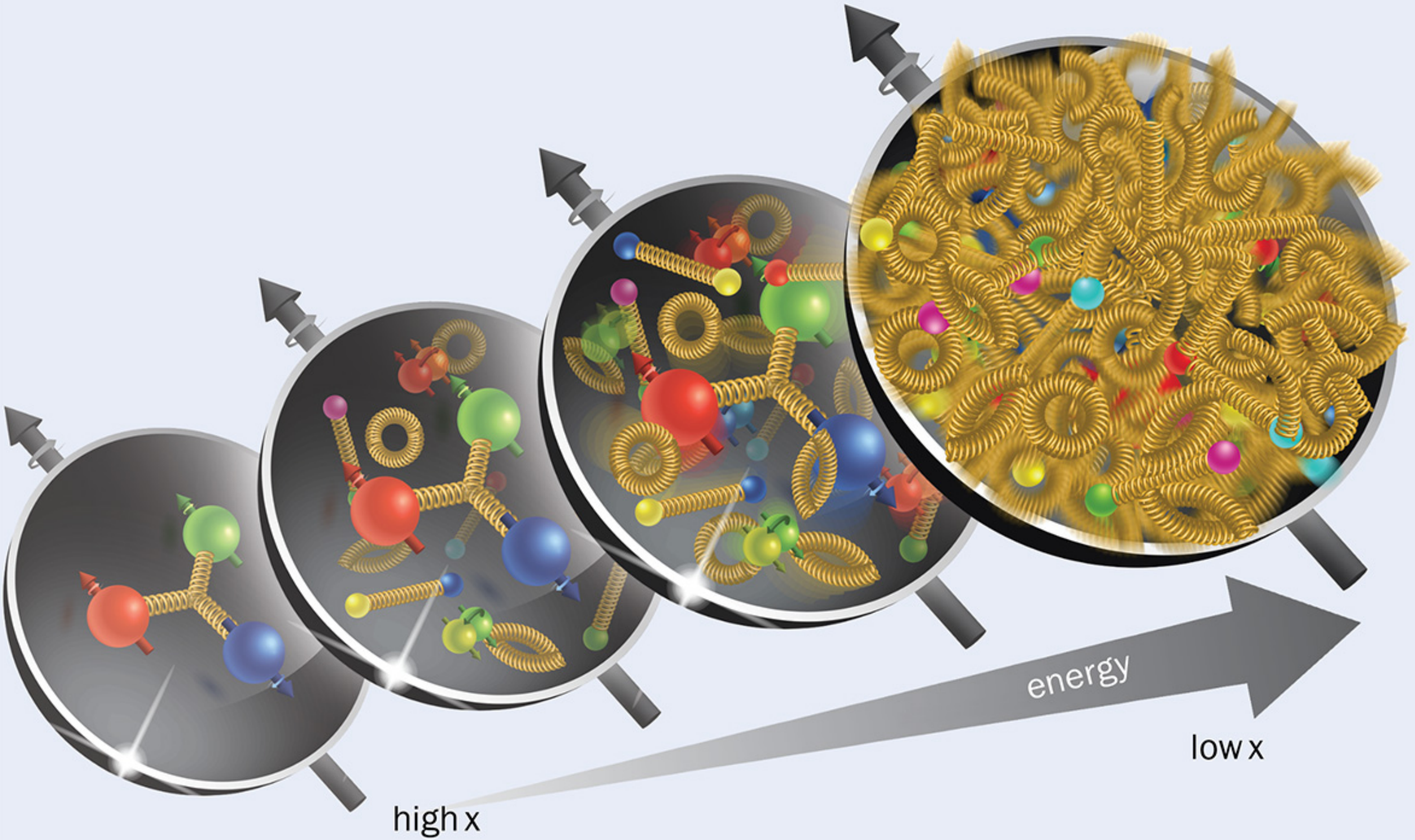


THE OPEN QUESTIONS



- We started simple and all was fine : 1+1+1 = 3
- We learned more and found more questions: 1+ 1+1 > 3
- Now we don’t seem to understand it at all - mass, size, spin, magnetic moment, movement of quarks & gluons

THE OPEN QUESTIONS



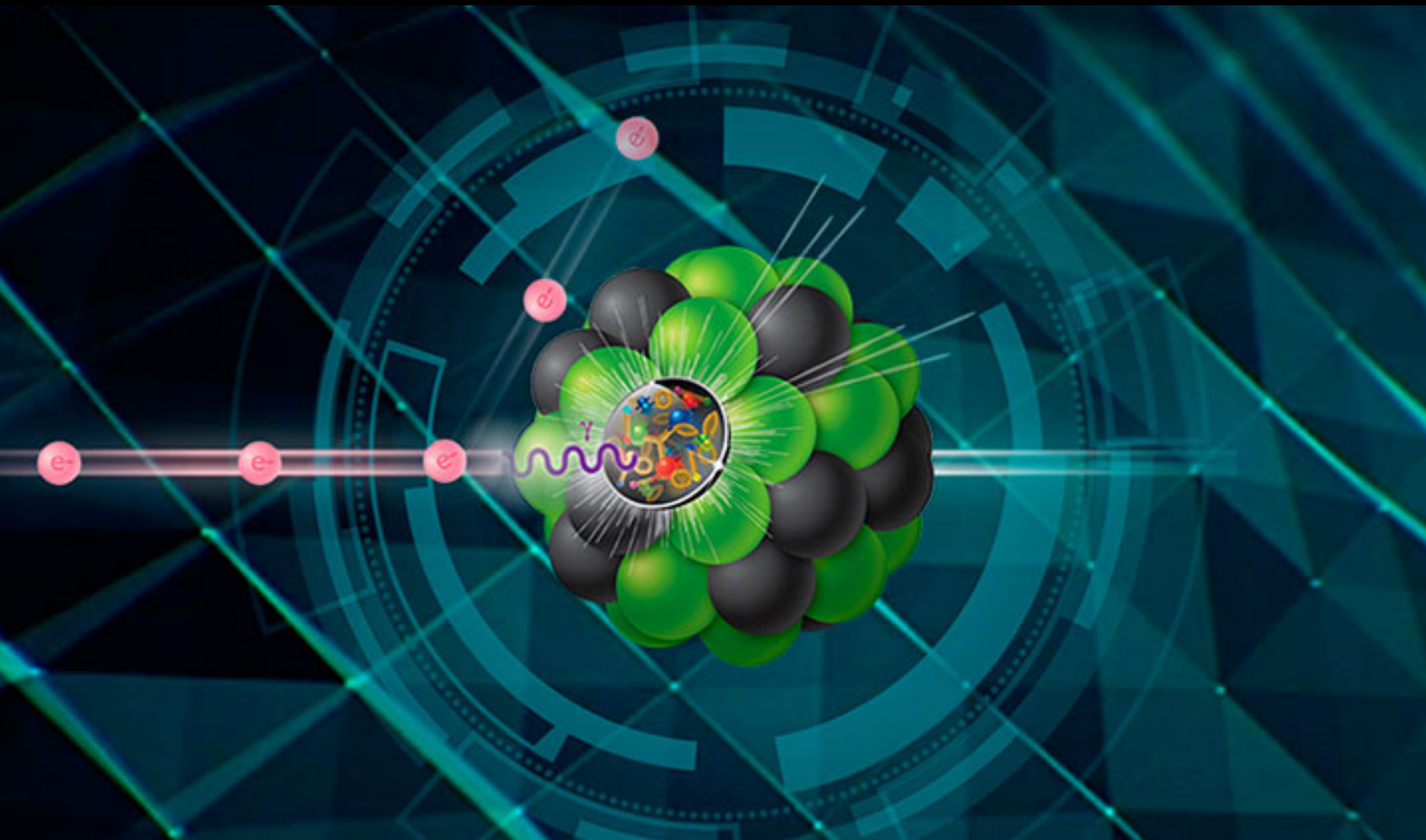
STUDYING EMERGENT PROPERTIES
AMBER AT CERN

AMBER

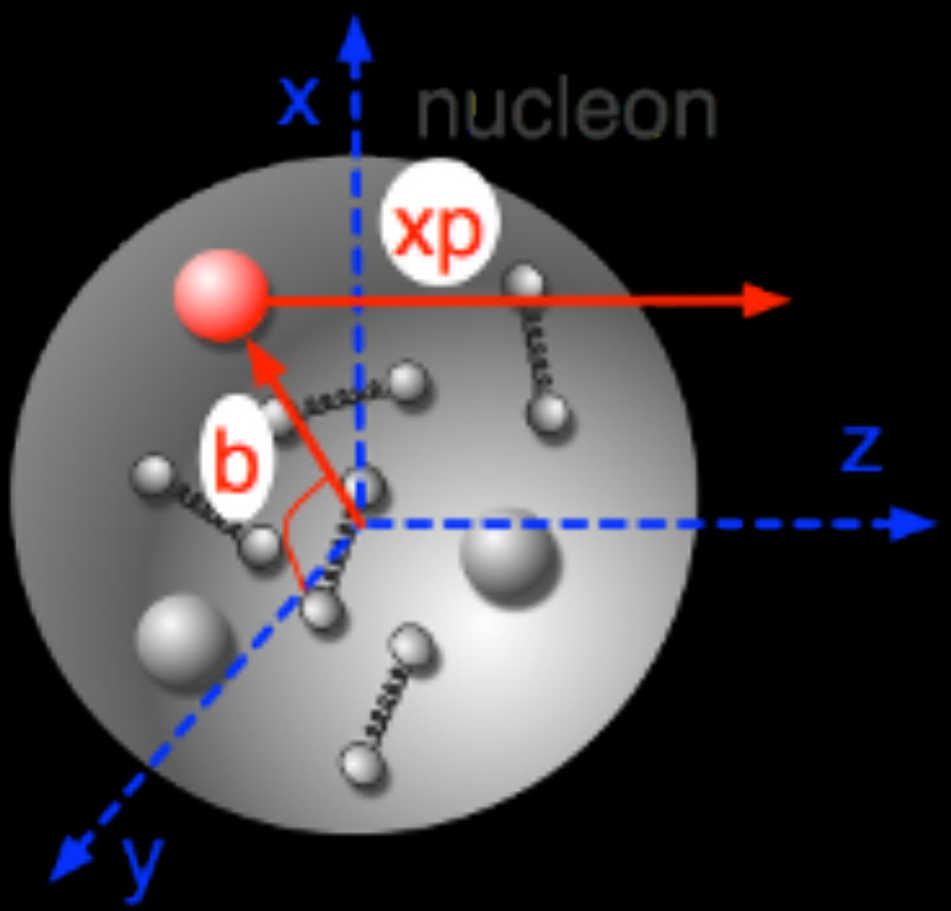
Apparatus for Meson and Baryon
Experimental Research

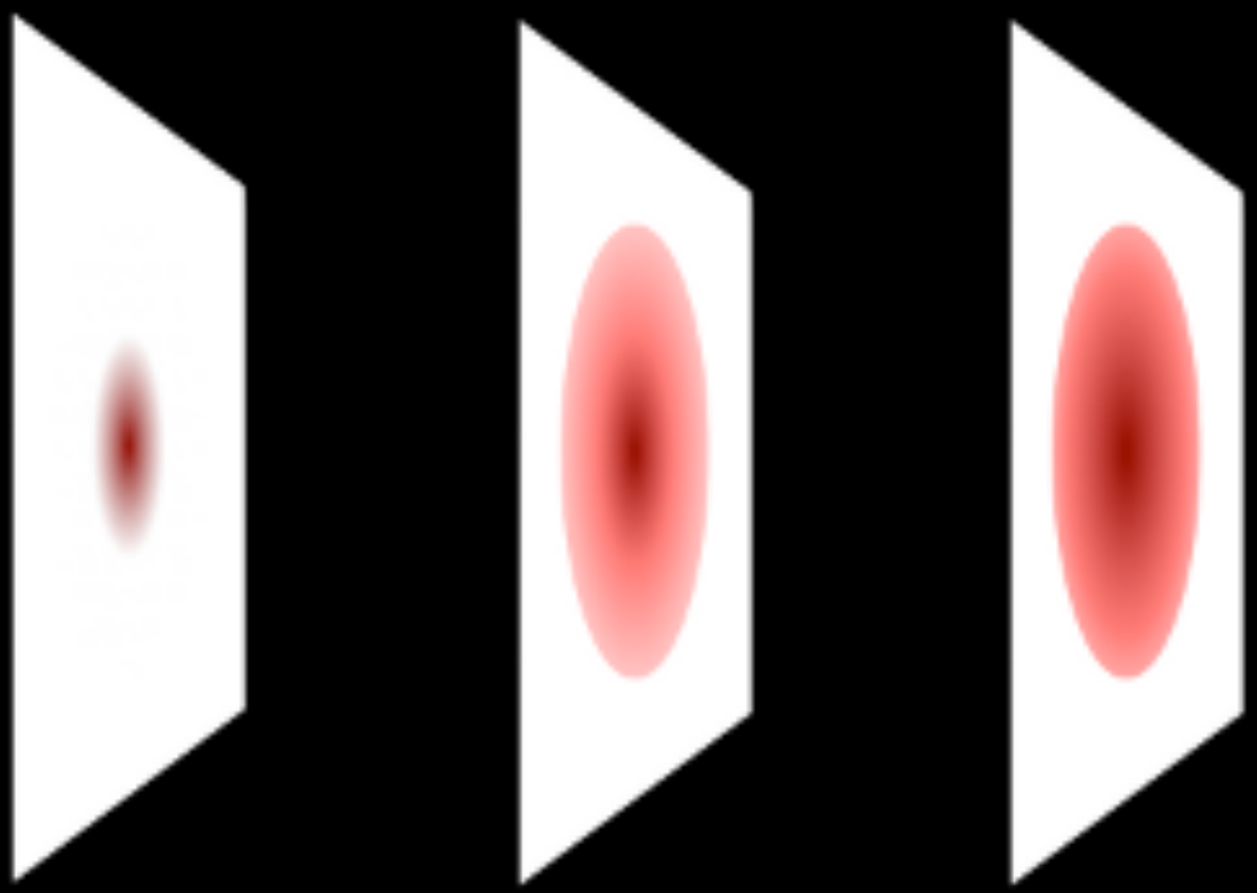
CERN

THE IDEA - TOMOGRAPHY OF QUARKS AND GLUONS

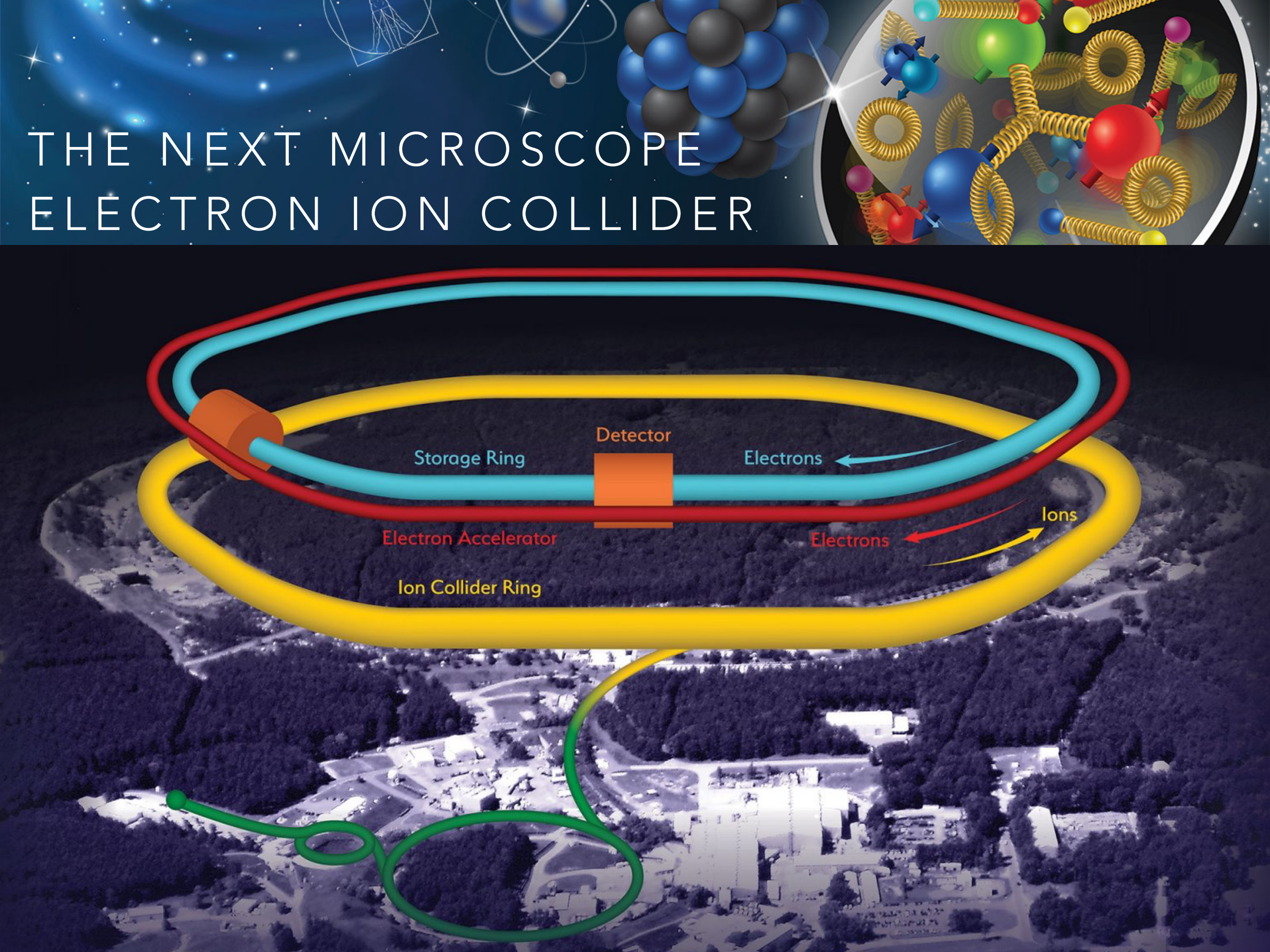


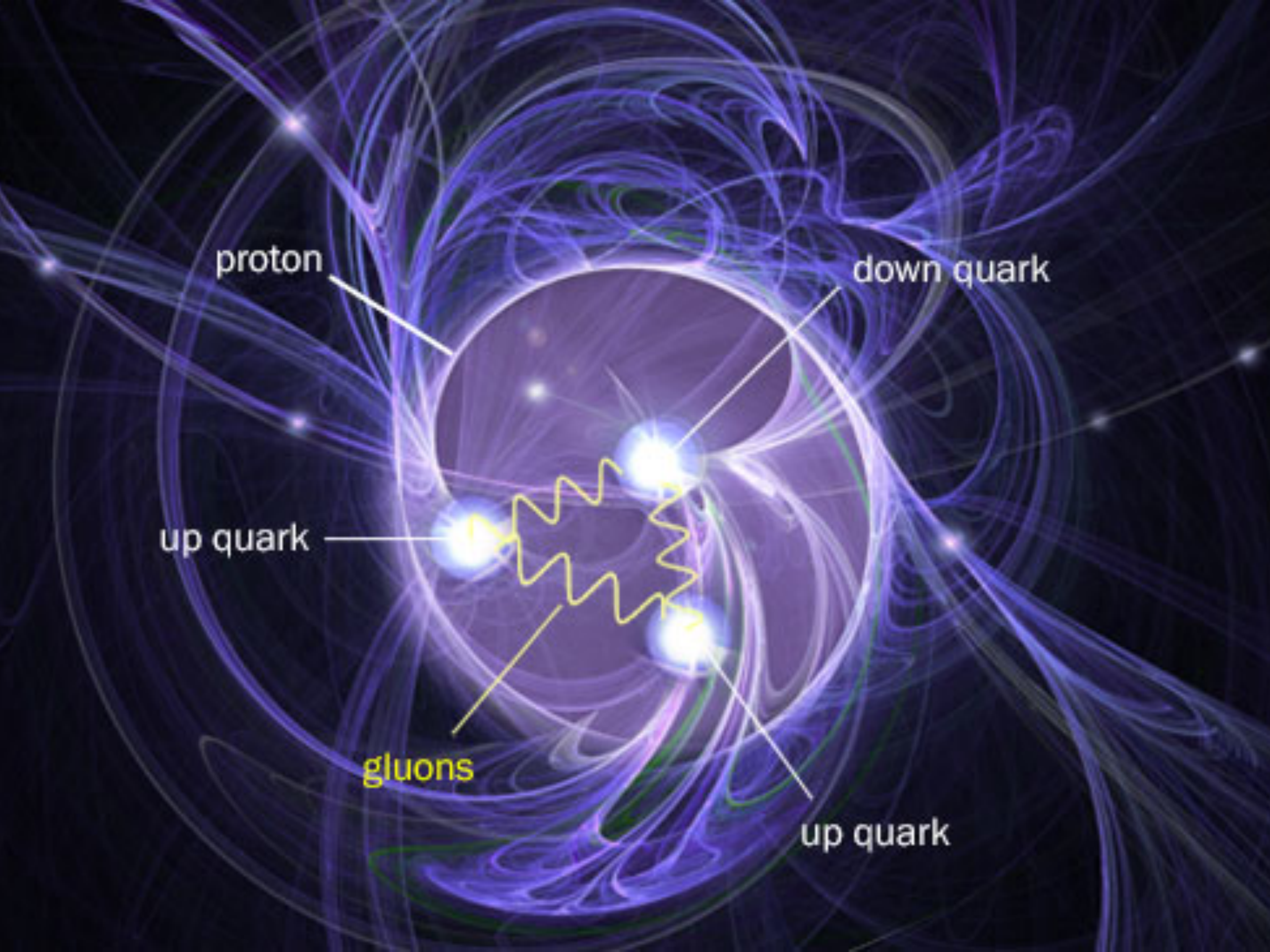
THE IDEA - TOMOGRAPHY OF QUARKS AND GLUONS





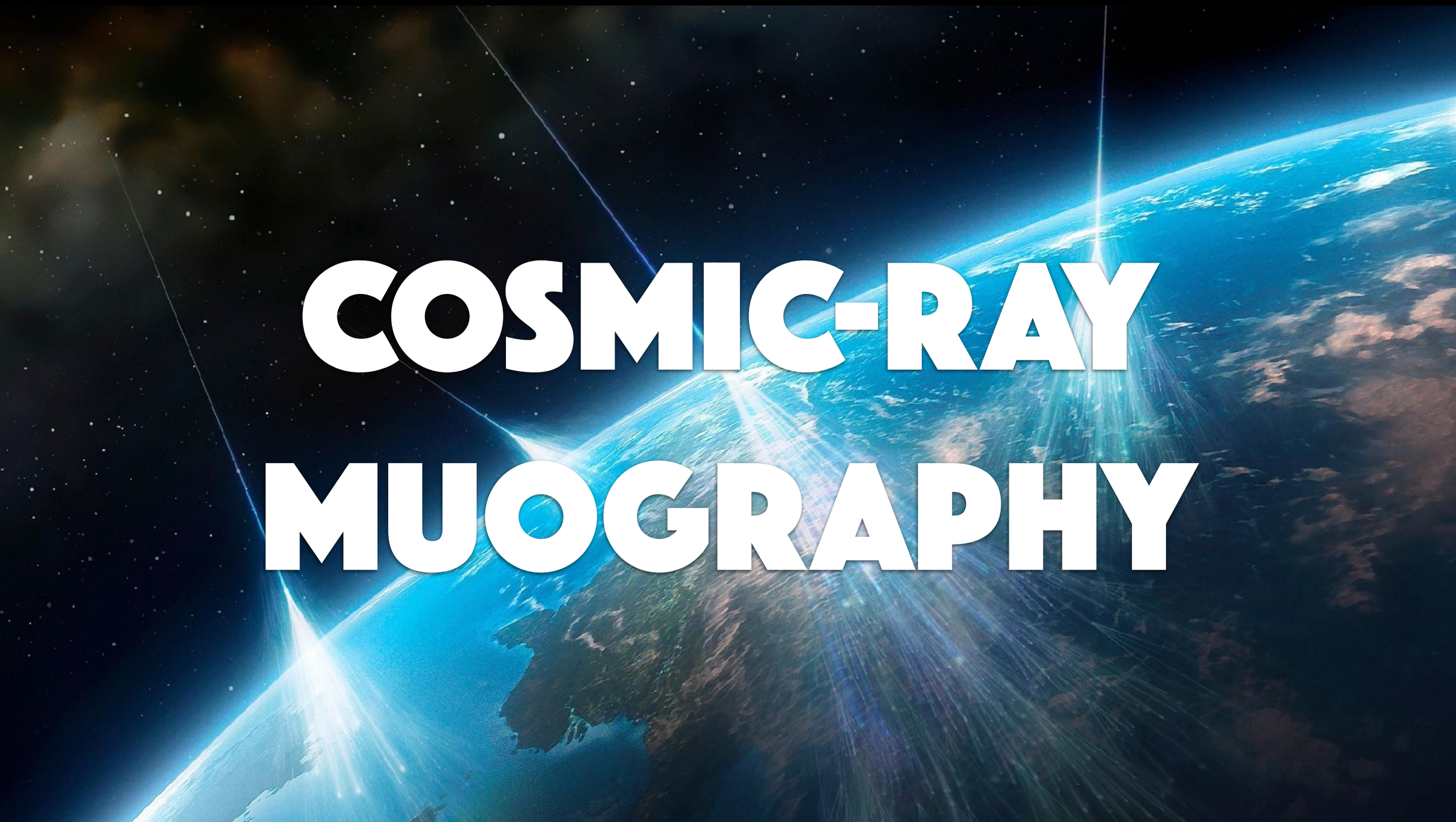
THE NEXT MICROSCOPE
ELECTRON ION COLLIDER



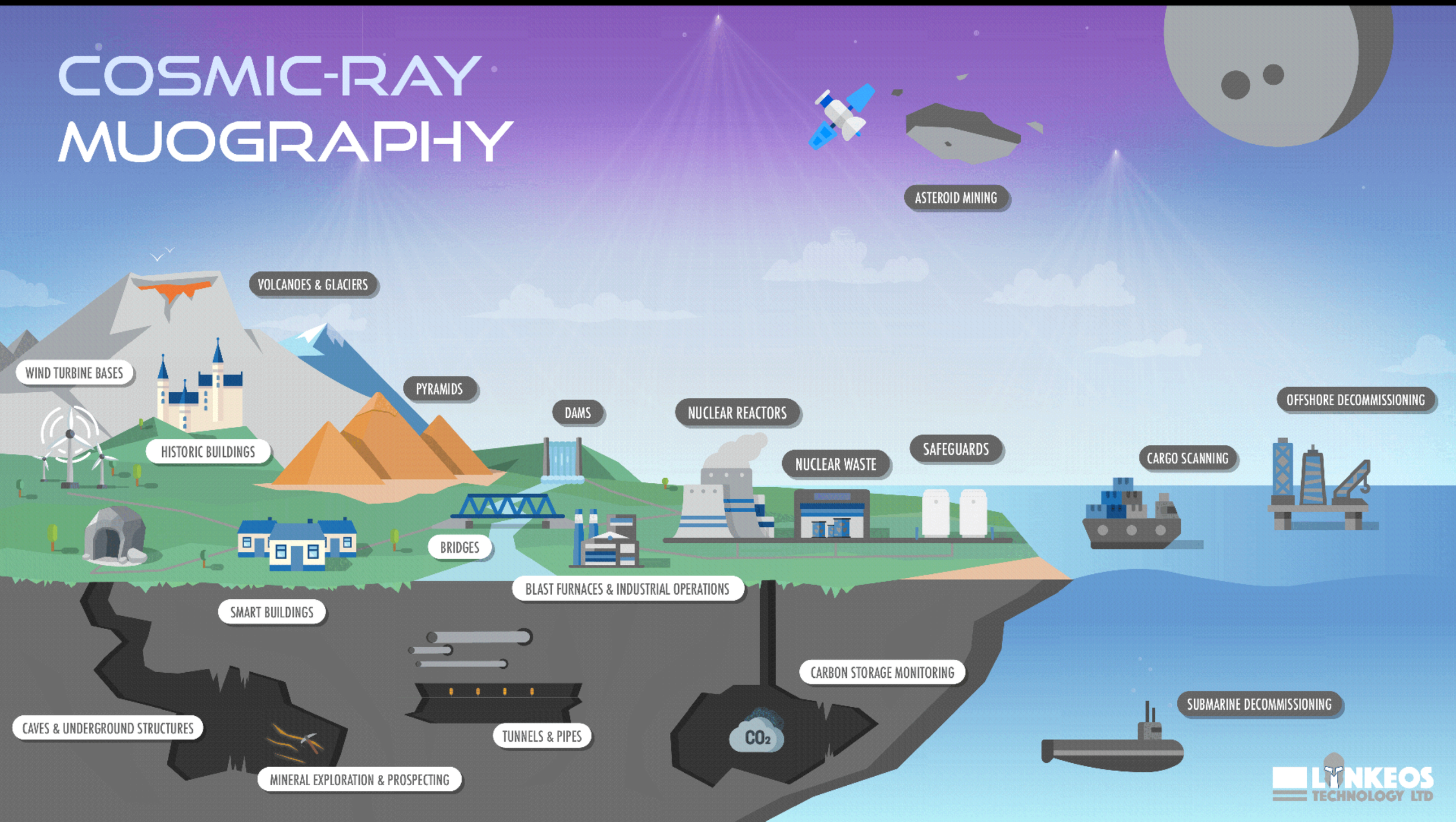

proton
down quark
up quark
gluons
up quark

WHY IS IT IMPORTANT?

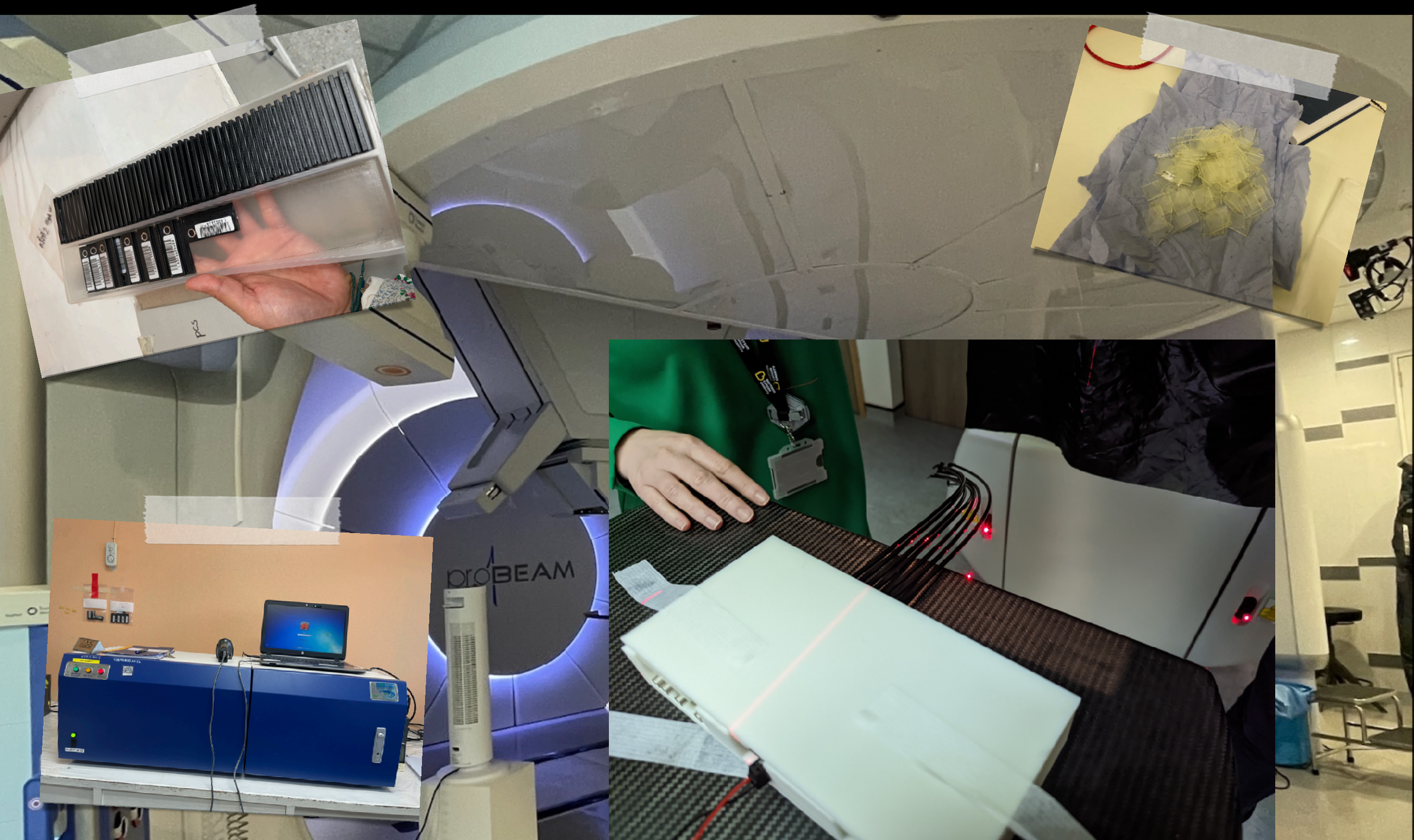
ONE TOOL - MANY APPLICATIONS



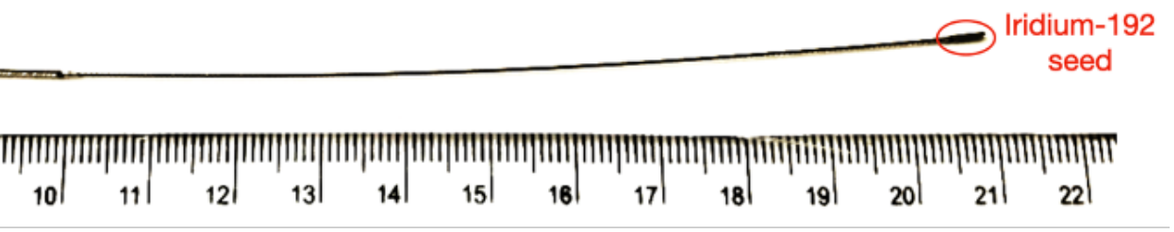
ONE TOOL - MANY APPLICATIONS

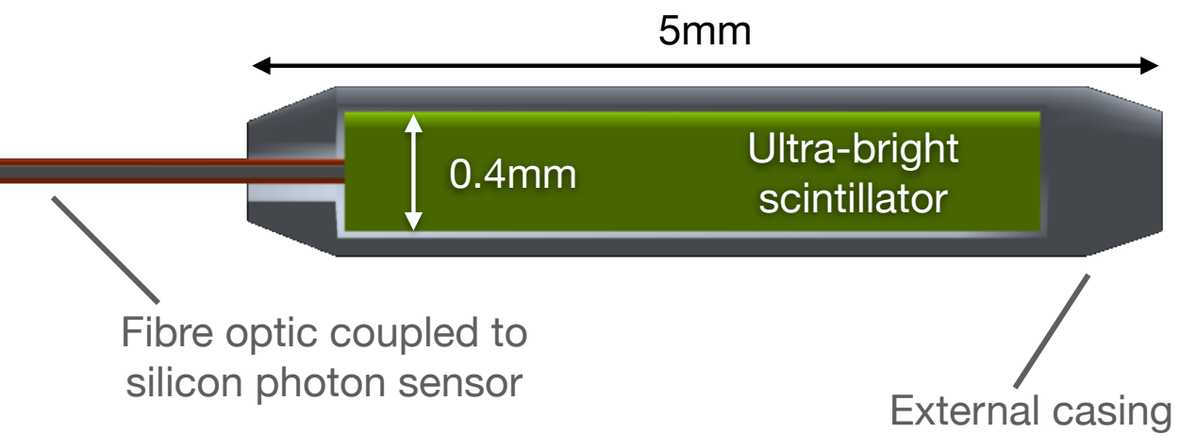


MAKING SURE CANCER TREATMENT WORKS



MAKING SURE CANCER TREATMENT WORKS





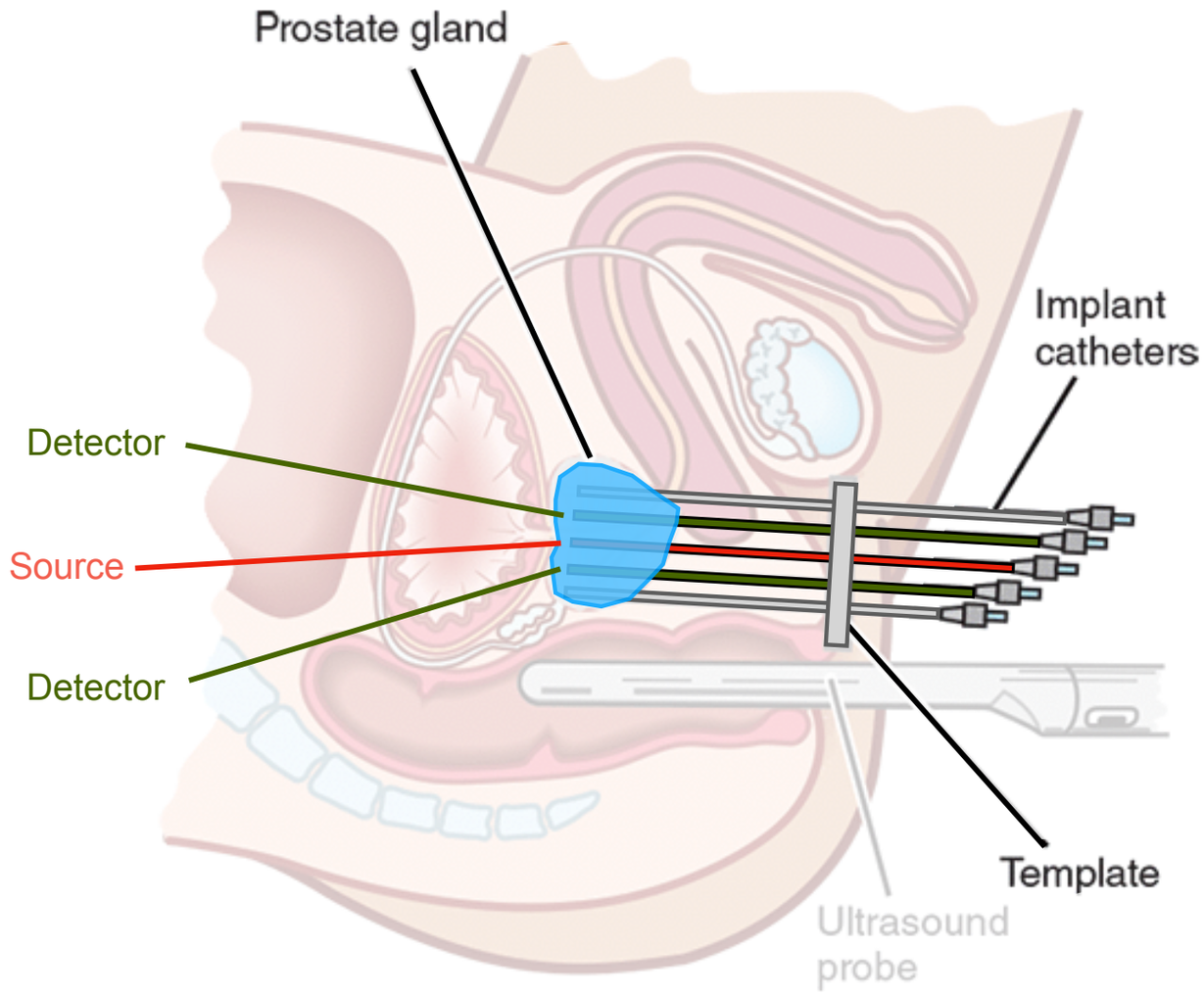
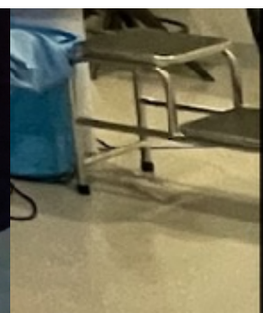


Image edited from website of NHS MEDICAL PHYSICS Royal Surrey County Hospital NHS Foundation Trust St. Luke's CANCER CENTRE



IOP Institute of Physics In Scotland

University of Glasgow

ASTRONOMY & PHYSICS EDUCATION

SCIENCE in STEWARTON

THURSDAY 30th MARCH
1830-2000

The lives of the particles

Dr Sophie Renner

Particle Physics Theory, University of Glasgow

Information about this and other Science in Stewarton events can be found at: