“The Hitchhiker’s Guide to the...Universe”

**INFN**

**IN**ternational **S**chool on modern **P**hysics and **R**esearch


Online edition

**Directors**
Catalina Curceanu, Rossana Centoni

**Organization**
Camilla Paola Maglione, Debora Bifaretti, Sara Arnone

In this difficult situation generated by COVID-19, we want to give you some positive message, a hope for the future: INSPIRE 2020 is here for you, to inspire and guide you into the beauty of science.

In 2020 INSPIRE – INternational School on modern Physics and Research – celebrates 10 years since its birth. The 2020 INSPIRE edition, “The Hitchhiker’s Guide to the...Universe”, is dedicated to the hottest topics and challenges in Modern Physics, from particles to cosmology. Through a series of online talks, we’ll guide our travellers in a fantastic journey from quarks to black holes, from gravity to quantum physics and technologies, up to the main experimental facilities of LNF and CERN. Get ready to be INSPIRED!
INSPYRE 2019:
About 90 students
of 15 nationalities
from 46 schools
all around the world!

INSPYRE 2020: 100 students registered!
Quantum Technologies Timeline

- Atomic Quantum Clock
- Quantum Sensor
- Inter-facility Quantum Link
- Quantum Simulator
- Quantum Avionics
- Universal Quantum Computation

2015

2035
Hands-on
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EVERYTHING HAPPENS FOR A REASON AND THAT REASON IS
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Physics

Nuclear Physics

Condensed Matter Physics

Acoustical Physics

Astronomy

General Relativity

Thermodynamics

Particle Physics

Econophysics

Thermodynamics

Econophysics

Statistical Physics

Biophysics

Electromagnetism

Cosmology

Astrobiology

Agrophysics

Medical Physics

Radiophysics

Ocean Physics

Quantum Mechanics

Special Relativity

Superconductivity
Inside LNF-INFN
Modern Physics:

Pillars:

Relativity
Quantum Mechanics
Relativity

Imagine travelling through space on a beam of light at the speed of light.

Albert Einstein, theory of relativity, gravity, velocity, energy, mass, speed, time, \( E=mc^2 \), Albert Einstein
SCHRÖDINGER'S CAT
Experiment #001
RESULTS
☐ DEAD
☐ ALIVE
☒ BOTH
Quantum Teleportation
atom \sim 10^{-8} \text{ cm}

nucleus \sim 10^{-12} \text{ cm}

proton (neutron) \sim 10^{-13} \text{ cm}

electron < 10^{-16} \text{ cm}

quark < 10^{-16} \text{ cm}
The Standard Model of Particle Physics

Does not include Gravity!
General relativity - for gravity
Relatività generale

La materia dice allo spazio come curvarsi, lo spazio dice alla materia come muoversi.
Spaghettification!

To Black Hole
Huge BH
(no spaghettification)
Black Hole – mass about 17 miliarde di volte massa Sole
Interstellar?
Black Holes Are Passage To Another Universe
To understand BH we need quantum gravity?!
A new theory of space and time
Dark Matter and Energy
REFERENCE:
Saul Perlmutter,
Physics Today,
April 2003, pp. 53-60.
Dark Energy
Dark Energy 73%

Dark Matter 23%

“Normal Matter” 4%
La nascita dell'INFN

1951
4 University Sections
Milano, Torino, Padova, e Roma

1957
Laboratori Nazionali di Frascati

Frascati

INFN
Laboratori del Sud (Catania)

19 Sections
11 Related Groups
4 National Laboratories

Gran Sasso

Legnaro

INFN today
VIRGO-EGO
European Gravitational Observatory
What are the activities performed at Laboratori Nazionali di Frascati?

Fundamental research

• Studies of the ultimate matter structure
• Search for gravitational waves
• Developments of theoretical models

• Development and construction of particle detectors
• Studies and development of accelerating techniques
• Material studies and bio-medical research with the synchrotron light
• Development and support for computing systems and nets
Matter-antimatter colliders

LEP al CERN di Ginevra 1988

LHC at Cern (pp)
Could strangeness play a role in neutron stars?
KLOE2 – where antimatter disappeared?

(KLOng Experiment)
Synchrotron light (DAΦNE-luce)
New acceleration technique

Laser pulse creates a wave

Particles get accelerated

In few cm electrons get accelerations as in present accelerators of hundred meters
Accelerator on a Chip?
Fig. 3 – Confronto fra una mammografia monocromatica (sinistra) con una tradizionale (destra).
INSPYRE 2020 Program

Monday 30 March – Chair Catalina Curceanu
12:00 – 13:15  Where is everybody? Searching for life in the Universe (Amedeo Balbi – Univ. Tor Vergata, Roma)

Tuesday 31 March – Chair Danilo Domenici
10:30 – 11:45  The second Quantum revolution (Fabio Sciarrino – Univ. Sapienza, Roma)
12:00 – 13:15  What is time? Answers from modern physics (Lorenzo Maccone – Univ. di Pavia)

Wednesday 1 April – Chair Paola Gianotti
10:30 – 11:45  Bionanotechnologies (Stefano Bellucci – INFN-LNF)
12:00 – 13:15  Bionanotechnologies and other application: From synthesis to device (Antonino Cataldo – INFN-LNF)
INSPYRE 2020 Program

Thursday 2 April – Chair Pasquale Di Nezza
10:30 – 11:45  Micro and macro-physics with gravitational waves in the next decades
(Viviana Fafone – Univ. and INFN Tor Vergata)
12:00 – 13:15  Strangeness in the Neutron stars investigated at the DAFNE accelerator
(Catalina Curceanu – INFN-LNF)

Friday 3 April – Chair Barbara Sciascia
10:30 – 11:45  Big machines, high energies, and tiny particles: Physics at the femtoscale
(Frederik Van Der Veken – CERN)
12:00 – 13:15  The 21st century news jungle: food for thought to survive  (Matteo Martini
– FrascatiScienza – INFN-LNF – UniMarconi)
INSPYRE 2020 team:
Sara Reda, Camilla Paola Maglione, Sara Arnone, Debora Bifaretti. Elisa Santinelli. Elena Patrignanelli. Susanna Bertelli
Media Partner:

[Logo of Frascati Scienza]
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The Hitchhiker’s Guide to the Universe