«ETTORE MAJORANA» FOUNDATION AND CENTRE FOR SCIENTIFIC CULTURE

1963–2023

60th ANNIVERSARY OF ACTIVITIES

INTERNATIONAL SCHOOL OF SUBNUCLEAR PHYSICS

SEARCHING FOR THE UNEXPECTED: ENERGY, LUMINOSITY, PRECISION, SMALL SIGNALS

59th Course – ERICE-SICILY: 14 – 23 JUNE 2023

Sponsored by the: · Italian Ministry of Education, University and Scientific Research · Sicilian Regional Government · Academies of Sciences of Estonia, Georgia, Lithuania, Russia and Ukraine · Chinese Academy of Sciences · Commission of the European Communities · European Physical Society · Italian National Institute for Nuclear Physics · Weizmann Institute of Science · World Federation of Scientists · World Laboratory

PROGRAMME AND LECTURERS

OPENING SESSION

Fifty years of asymptotic freedom
- F.A. WILCZEK, MIT, Cambridge, MA, US

THEORY, PHENOMENOLOGY & EXPERIMENTS

Phenomenology with Massive Neutrinos
- M.C. GONZALEZ-GARCÍA, SUNY at Stony Brook, Stony Brook, NY, US; ICREA, Universitat de Barcelona, Barcelona, ES

Are neutrino and antineutrino different particles?
- J.J. GÓMEZ CADENAS, Donostia International Physics Center (DIPC), Donostia-San Sebastián, Gipuzkoa, ES

Theoretical outlook on dark matter searches
- G. BERTONE, GRAPPA Institute, University of Amsterdam, NL

Perspectives for future accelerators
- C. LLEWELLYN SMITH, University of Oxford, UK

Axions in Particle Physics and Cosmology
Invisible' Axion Search Methods
- P. SIKIVIE, University of Florida, Gainesville, FL, US

Highlights of Particle Cosmology
- G, SERVANT, DESY and Hamburg University, Hamburg, DE

Highlights on leptonic precision physics at PSI
- A, PAPA, PSI-Paul Scherrer Institute, Villigen, CH; University of Pisa and INFN, Pisa, IT

Leptonic Dipoles in the Standard Model and Beyond
- P. PARADISI, University of Padova and INFN, Padova, IT

Theoretical approaches to the muon magnetic moment
- G. COLANGELO, Universität Bern, CH

What is cosmology telling us on neutrinos?
- S. HANNESTAD, University of Aarhus, DN

Novelties from Flavour Physics
- F. DE FAZIO, INFN and University of Bari, IT

Very high-energy cosmic rays
- P. BLASI, Gran Sasso Science Institute (GSSI), L'Aquila, IT

Nobel Unfolded: From quantum foundation to quantum communication
- G.M. PALMA, University of Palermo, Palermo, IT

Gravitational waves
- G. LOSURDO, INFN, Pisa, IT

Outlook on New Physics beyond the Standard Model
- C. GROJEAN, DESY and Humboldt University, Berlin, DE

Holography
- A. ZAFFARONI, Milan Bicocca University and INFN, Milan, IT

Primordial black holes and gravitational waves
- P. PANI, Sapienza University of Rome and INFN, Rome, IT

Highlights from SuperK ICRR
- M. NAKAHATA, ICRR, The University of Tokyo; Super-Kamiokande Collaboration, Kashiwa City, Chiba, JP

HIGHLIGHTS

ALICE
- M. VAN LEEUWEN, University of Utrecht, Utrecht, NL

ATLAS and CMS
- L. SILVESTRIS, CERN, Geneva, CH; INFN, Bari, IT

FAIR
- P. GIUBELLINO, GSI and FAIR, Institute für Theoretische Physik, Darmstadt, DE

ICE CUBE
- M. ACKERMANN, DESY, Zeuthen, DE

LHCb
- M. PEPE ALTARELLI, CERN, Geneva, CH

LNGS
- A. ZOCCOLI, INFN, Rome, IT

CLOSING REMARKS

- A. ZICHICHI, CERN, Geneva, CH; University of Bologna & INFN, IT

INVITED SCIENTISTS

- L. CIFARELLI, University and INFN of Bologna, IT
- F. FERRONI, Gran Sasso Science Institute and INFN, L'Aquila, IT
- D. HAIDT, DESY, Hamburg, DE
- C.P. KORTHALS-ALTES, CNRS-Luminy, Marseille, FR
- Q. SHAFI, Bartol Institute, Delaware University, Newark, DE, US

ONE OF THE AIMS OF THE SCHOOL is to encourage and promote young physicists to achieve recognition at an international level. A worldwide competition is open to select **New Talents**. Young fellows who think they have the ability to compete are invited to apply. At the end of the School the Diplomas to the **Best New Talents** will be awarded by a Committee composed by the Lecturers and the Invited Scientists.

SPECIAL SESSIONS FOR NEW TALENTS. Each student may propose a contribution for open presentation. The Board of Lecturers and Invited Scientists will select the best proposals. The selection will be based solely on "scientific excellence", without favour to geographical distribution, the Laboratory or the University of origin. Priority will be given to the new material of either experimental or theoretical nature, especially if the candidate has made an important contribution to the results to be presented. A review paper has lower priority and, as before, will only be selected if the candidate can point out some new features in the field reviewed. There will be poster sessions whereby each student will have the privilege of presenting the results of current studies and interacting with other participants to their mutual benefit.

BOARD OF LECTURERS AND INVITED SCIENTISTS. In addition to the Lecturers, a group of distinguished physicists is invited to contribute to the lively intellectual atmosphere of the School by participating in the discussions following the Lectures. Lecturers and Invited Scientists will take part in the selection of the **New Talents** and in the award of the various scholarships and grants open for competition.

DIPLOMAS FOR THE BEST NEW TALENTS

The following Diplomas have been established in honour of distinguished physicists who have participated in the activities of our School:

GUIDO ALTARELLI
RICHARD ARNOWITT
JOHN S. BELL
PATRICK M.S. BLACKETT
NICOLA CABIBBO
JAMES CHADWICK
SIDNEY COLEMAN
RICHARD H. DALITZ
AMOS DE-SHALIT
PAUL A.M. DIRAC
SIDNEY D. DRELL
BRUNO FERRETTI
RICHARD P. FEYNMAN
VLADIMIR N. GRIBOV
ROBERT HOFSTADTER
GUNNAR KÄLLEN
SEYMOUR J. LINDENBAUM
LEV N. LIPATOV
TOM MASSAM
YOICHIRO NAMBU
YUVAL NE'EMAN
GIUSEPPE P.S. OCCHIALINI
ORESTE PICCIONI
BRUNO PONTECORVO
GIAMPIETRO PUPPI
ISIDOR I. RABI
GIULIO RACAH
NORMAN F. RAMSEY
BRUNO ROSSI
GIORGIO SALVINI
JULIAN S. SCHWINGER
VICTOR F. WEISSKOPF
EUGENE P. WIGNER
ARTHUR S. WIGHTMAN
BJORN H. WIIK
KENNETH G. WILSON
CHIEN SHIUNG WU
BRUNO ZUMINO

These Diplomas will be awarded at the end of the Course by the Board of Lecturers and Invited Scientists.

VICTOR WEISSKOPF COMMEMORATIVE FUND. The *WORLD FEDERATION OF SCIENTISTS* (WFS) has established this **fund** to support needy students. At the time of the application to the School, students who need financial support should apply for this **fund**, specifying their needs (i.e. fee only, or full board and lodging, or low-cost travel expenses).

PURPOSE OF THE SCHOOL

This year, as usual, the school is focused on the most recent discoveries in all the world over in theoretical and experimental subnuclear physics. Highlights from the major Labs will be presented by their leaders. The lectures will cover complementary approaches to new physics, ranging from the high energy to the high luminosity frontier, from cosmology to the very low background and to the high precision experiments. As usual, the afternoon sessions are dedicated to students' presentations and to ample discussion sessions of the morning lectures.

The Ettore Majorana Foundation and Centre for Scientific Culture (EMFCSC) started in 1961 when Antonino Zichichi first discussed with John Bell and Patrick Blackett the problem of creating a bridge between university courses and research activities in advanced physics laboratories such as CERN.

THE BRIDGE BETWEEN UNIVERSITY TEACHING AND ADVANCED PHYSICS LABS SUCH AS CERN

A year later on May 8th in Geneva, at CERN, Bell, Blackett, Victor Weisskopf, Isidor Rabi and Zichichi formally established the existence of the EMFCSC.

The International School of Subnuclear Physics at Erice, Sicily in 1963 was the Centre's first activity. Since then, every year the School has witnessed and celebrated the major advances in this field, gathering in the magic and exclusive atmosphere of the Erice pre-mediaeval city world famous scientists and students who are eager to receive the latest knowledge directly from its authors.

PLEASE NOTE

Participants must arrive in Erice on June 14, not later than 5 p.m.

More information about the other activities of the "ETTORE MAJORANA" FOUNDATION AND CENTRE FOR SCIENTIFIC CULTURE can be found on the WWW at the following address:
https://ettoremajoranafoundation.it

POETIC TOUCH

According to legend, Erice, son of Venus and Neptune, founded a small town on top of a mountain (750 metres above sea level) more than three thousand years ago. The founder of modern history — i.e. the recording of events in a methodic and chronological sequence as they really happened without reference to mythical causes — the great Thucydides (~500 B.C.), writing about events connected with the conquest of Troy (1183 B.C.) said: «*After the fall of Troy some Trojans on their escape from the Achaei arrived in Sicily by boat and as they settled near the border with the Sicanians all together they were named Elymi: their towns were Segesta and Erice*.» This inspired Virgil to describe the arrival of the Trojan royal family in Erice and the burial of Anchise, by his son Enea, on the coast below Erice. Homer (~1000 B.C.), Theocritus (~300 B.C.), Polybius (~200 B.C.), Virgil (~50 B.C.), Horace (~20 B.C.), and others have celebrated this magnificent spot in Sicily in their poems. During seven centuries (XIII-XIX) the town of Erice was under the leadership of a local oligarchy, whose wisdom assured a long period of cultural development and economic prosperity which in turn gave rise to the many churches, monasteries and private palaces which you see today. In Erice you can admire the Castle of Venus, the Cyclopean Walls (~800 B.C.) and the Gothic Cathedral (~1300 A.D.). Erice is at present a mixture of ancient and medieval architecture. Other masterpieces of ancient civilization are to be found in the neighbourhood: at Motya (Phoenician), Segesta (Elymian), and Selinunte (Greek). On the Aegadian Islands — theatre of the decisive naval battle of the first Punic War (264-241 B.C.) — suggestive neolithic and paleolithic vestiges are still visible: the grottoes of Favignana, the carvings and murals of Levanzo.

Splendid beaches are to be found at San Vito Lo Capo, Scopello, and Cornino, and a wild and rocky coast around Monte Cofano: all at less than one hour's drive from Erice.

APPLICATIONS

Interested candidates should send a letter to the Director of the School:
Professor Antonino ZICHICHI
CERN, CH-1211 GENEVA 23, Switzerland

Needed: i) date of birth and present activity; ii) nationality; iii) letter of recommendation from a senior physicist.

A. BETTINI – A. MASIERO
DIRECTORS OF THE COURSE

A. ZICHICHI – A. ZOCCOLI
DIRECTORS OF THE SCHOOL