PetcovFEST

Monday, **24 April 2023**
10 AM - 4:30 PM CEST

on **Zoom** and at **ICTP**
(Luigi Stasi seminar room)

https://agenda.infn.it/e/petcovfest

Invited speakers

- A. Azatov
- F. Feruglio
- I. Girardi
- S. Goswami
- E. Lisi
- H. Murayama
- P. Novichkov
- S. Profumo
- T. Schwetz
- F. Šimkovic
- J. Turner
- P. Ullio
- Y. Wang

Organising committee

- S. Pascoli (U. Bologna)
- J. Penedo (CFTP, U. Lisboa)
- A. Titov (U. Pisa)

Local organiser

- A. Azatov (SISSA)

SISSA

The Abdus Salam International Centre for Theoretical Physics (ICTP)

IAEA

Education

1973 Degree from
Moscow State University, USSR

1977 PhD from JINR, Dubna, USSR
(PhD advisor: S.M. Bilenky)

ОБЪЕДИНЕННЫЙ
ИНСТИТУТ
ЯДЕРНЫХ
ИССЛЕДОВАНИЙ
ДУБНА

E2 - 10176

S.T.Petcov

THE NEUTRINO MIXING
AND THE $\mu \to e + \gamma$, $\mu \to e + e + \bar{e}$
AND $\nu' \to \nu + \gamma$ DECAYS

1976

Volume 67B, number 3 PHYSICS LETTERS 11 April 1977

LEPTON MIXING, $\mu \to e + \gamma$ DECAY AND NEUTRINO OSCILLATIONS

S.M. BILENKY, S.T. PETCOV and B. PONTECORVO
Joint Institute for Nuclear Research, Laboratory of Theoretical Physics, Dubna, USSR

Received 22 February 1977

The $\mu \to e\gamma$ decay is investigated in a gauge theory with lepton mixing under the assumption that in nature there exist heavy leptons. It is shown that for lepton masses of the order of a few GeV the $\mu \to e\gamma$ decay probability may well be close to its experimentally determined upper limit. The relation between such a decay process and neutrino oscillations is briefly considered.

Career path

1977–1990	INRNE, Bulgarian Academy of Sciences
1979	Fellow at CERN
1982–1983	Visiting scientist at SLAC, Fermilab, BNL, LBL
1986	Visiting scientist at CERN

Building a network of friends and collaborators which spans all continents.

1980's

with L. Wolfenstein
Pittsburgh

70th Anniversary
of B. Pontecorvo





Since 1990 SISSA and INFN, Trieste

Since 2007 Associate at IPMU, Tokyo

VBF production of the Higgs

Volume 84B, number 4 PHYSICS LETTERS 16 July 1979

HEAVY HIGGS BOSONS AT LEP

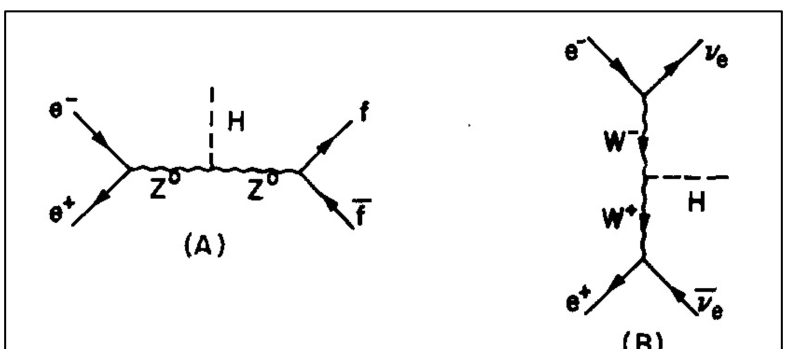
D.R.T. JONES
CERN, Geneva, Switzerland

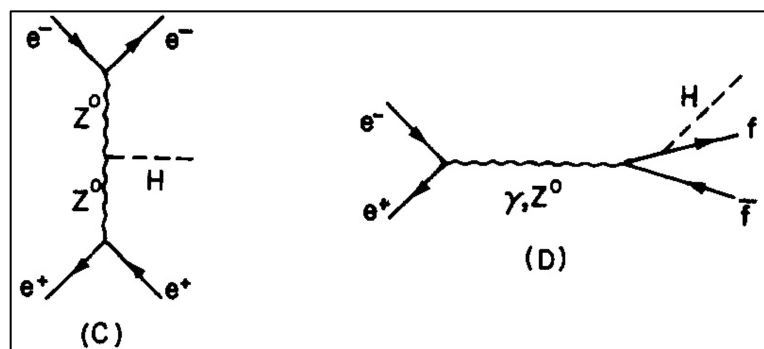
and

S.T. PETCOV
CERN, Geneva, Switzerland
and Institute of Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, Sofia, Bulgaria

Received 30 April 1979

Production of a heavy Weinberg–Salam-type neutral Higgs boson at LEP energies is considered. We conclude that the Higgs is unlikely to be detected at LEP if its mass is greater than 150 GeV.





Majorana phases

Volume 94B, number 4 PHYSICS LETTERS 25 August 1980

ON THE OSCILLATIONS OF NEUTRINOS WITH DIRAC AND MAJORANA MASSES

S.M. BILENKY, J. HOŠEK [1] and S.T. PETCOV [2]
Joint Institute for Nuclear Research, Dubna, USSR

Received 2 June 1980

Pontecorvo neutrino oscillations are discussed in the case of Dirac as well as Majorana neutrino mass terms. We prove that none of the possible experiments on neutrino oscillations including those on *CP* nonconservation, can distinguish between these two possibilities. Oscillations of neutrinos having both Dirac and Majorana mass terms are also considered.

the transformation (20). This invariance implies that the number of the *CP*-violating phases in the case of oscillations of neutrinos with Dirac or Majorana masses is always the same and is equal to $\frac{1}{2}(N-1)(N-2)$.

He discovered a new type of CPV in leptonic mixing, the Majorana phases, and later showed that these could be responsible for the baryon asymmetry of the Universe via the leptogenesis mechanism.

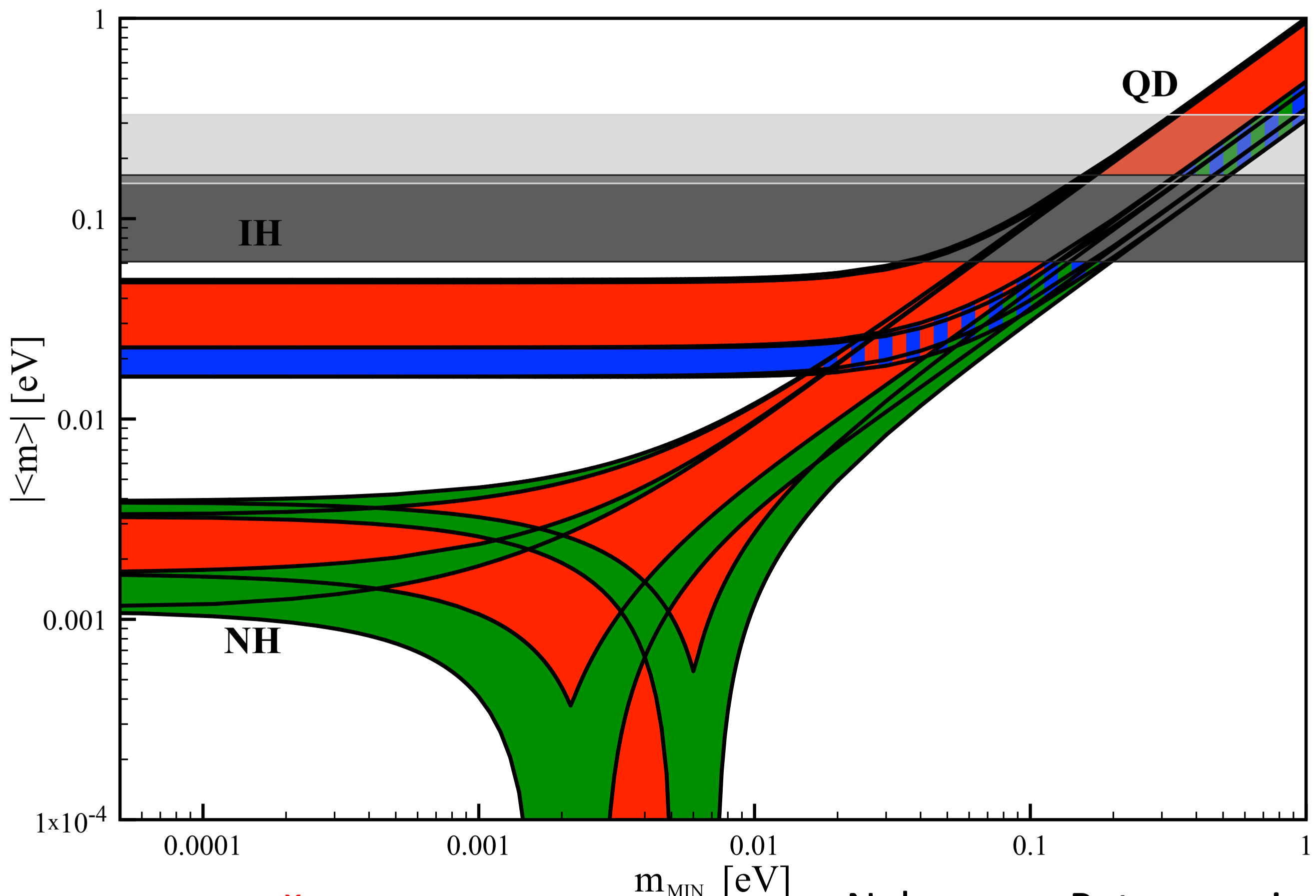
PHYSICAL REVIEW D **75,** 083511 (2007)

Connecting low energy leptonic *CP* violation to leptogenesis

S. Pascoli,[1,2] S. T. Petcov,[3] and Antonio Riotto[1,4]

Neutrinoless double beta decay

He extensively worked on neutrinoless double beta decay, showing that it can provide information on the neutrino mass spectrum, thanks to the non-maximal value of the solar mixing angle.



See the talk by Fedor Šimkovic

Nakamura, Petcov review in PDG

Pseudo-Dirac neutrinos

Volume 110B, number 3,4 PHYSICS LETTERS 1 April 1982

ON PSEUDO-DIRAC NEUTRINOS, NEUTRINO OSCILLATIONS AND NEUTRINOLESS DOUBLE β-DECAY

S.T. PETCOV
Institute of Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, 1184 Sofia, Bulgaria

Received 28 December 1981

The characteristic features of the models of neutrino mixing containing only pseudo-Dirac massive neutrinos are discussed in the case of negligible neutrino splitting. In this approximation the massive neutrinos appear to be Dirac particles possessing nonstandard magnetic moments. However, the neutrinoless double β-decay as well as all other processes usually associated with the existence of massive Majorana neutrinos are allowed.

Standard and non-standard neutrino oscillations

RESONANCE AMPLIFICATION AND *T*-VIOLATION EFFECTS IN THREE-NEUTRINO OSCILLATIONS IN THE EARTH

P.I. KRASTEV and S.T. PETCOV

are defined in eq. (7). From (18) and (19) we get

$$\mathcal{J}^m = \frac{1}{8} \sin \delta^m \sin 2\varphi^m_{12} \sin 2\varphi^m_{13} \sin 2\varphi^m_{23} \cos \varphi^m_{13} . \quad (20)$$

His work on neutrino oscillations covers all areas. He showed that they are controlled by the rephasing invariant of the Dirac phase, with P.I. Krastev, but they do not depend on Majorana phases in vacuum (with S. M. Bilenky and J. Hosek) nor in matter (with P. Langacker et al.).

PHYSICAL REVIEW D, VOLUME 63, 073003

Enhancing mechanisms of neutrino transitions in a medium of nonperiodic constant-density layers and in the Earth

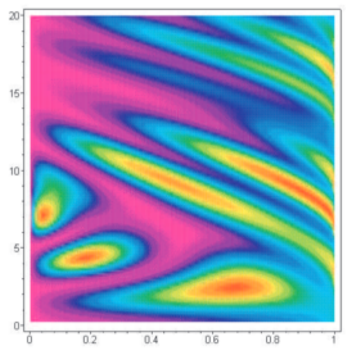


Figure 6: The probability P_{e2} in the case of $\nu_e - \nu_{\mu(\tau)}$ mixing as a function of $\sin^2 2\theta$ (horizontal axis) and $\Delta m^2/E$ [10^{-7} eV^2/MeV] (vertical axis) and for (solar) neutrinos crossing the Earth (core) along the trajectory with $h = 13°$. The ten different colors correspond to values of P_{e2} in the intervals: 0.0 - 0.1 (violet); 0.1 - 0.2 (dark blue); ...; 0.9 - 1.0 (dark red). The points of total neutrino conversion (in the dark red regions), $P_{e2} = 1$, correspond to solution $A^{\oplus}$, eq. (74).

He then considered oscillations in matter, uncovering a novel mechanism of oscillations for Earth mantle-core transitions, that can shed light on the properties of the Earth core in future experiments.

Going beyond 3-neutrino mixing, he studied NSI (with M. Guzzo and A. Masiero).

Mass ordering at reactors & JUNO

ELSEVIER

PHYSICS LETTERS B

Physics Letters B 533 (2002) 94–106

www.elsevier.com/locate/npe

The LMA MSW solution of the solar neutrino problem, inverted neutrino mass hierarchy and reactor neutrino experiments

S.T. Petcov [1], M. Piai

SISSA/INFN, Via Beirut 2-4, I-34014 Trieste, Italy

Received 11 December 2001; received in revised form 14 March 2002; accepted 18 March 2002

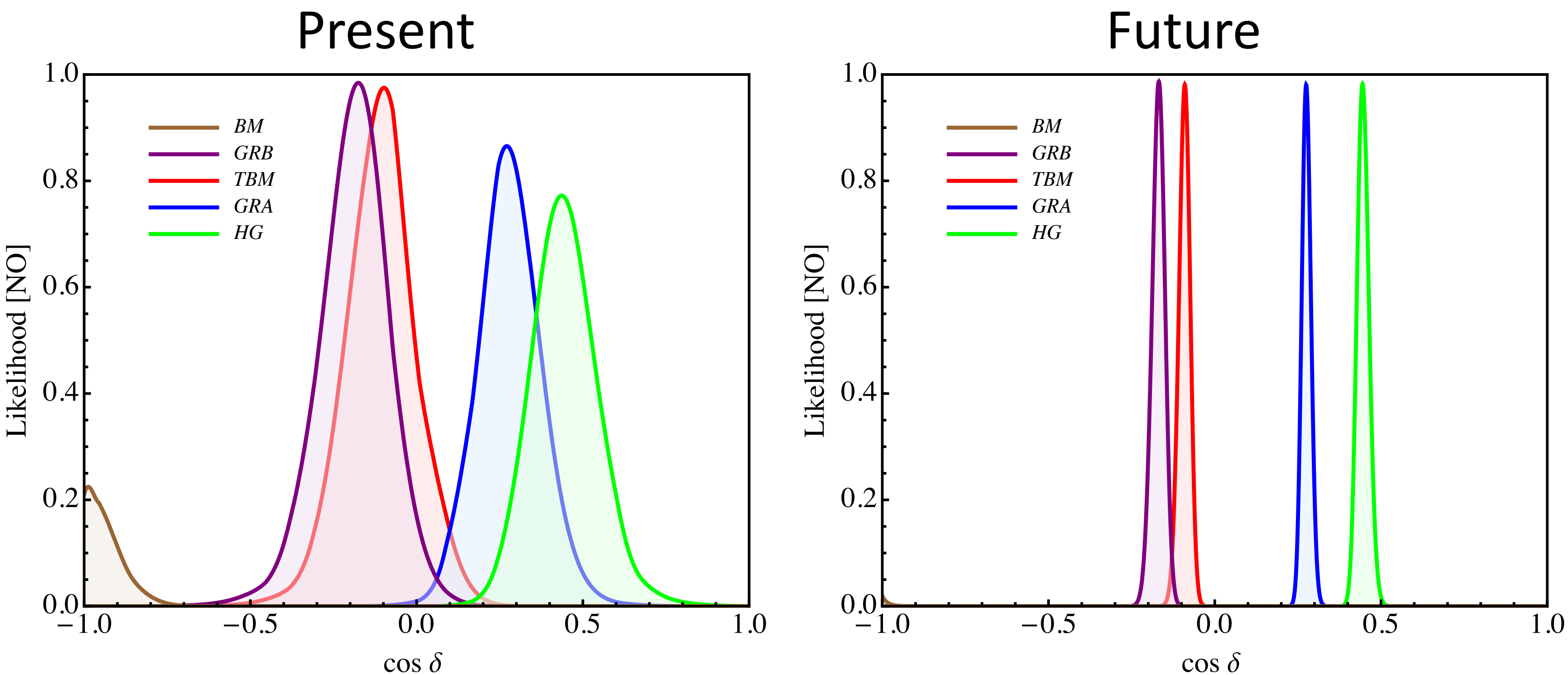
Editor: G.F. Giudice

This work laid a basis for the large reactor neutrino experiment JUNO, which will provide crucial information on the neutrino mass ordering in the coming years.

See the talk by Yifang Wang

Flavour symmetries

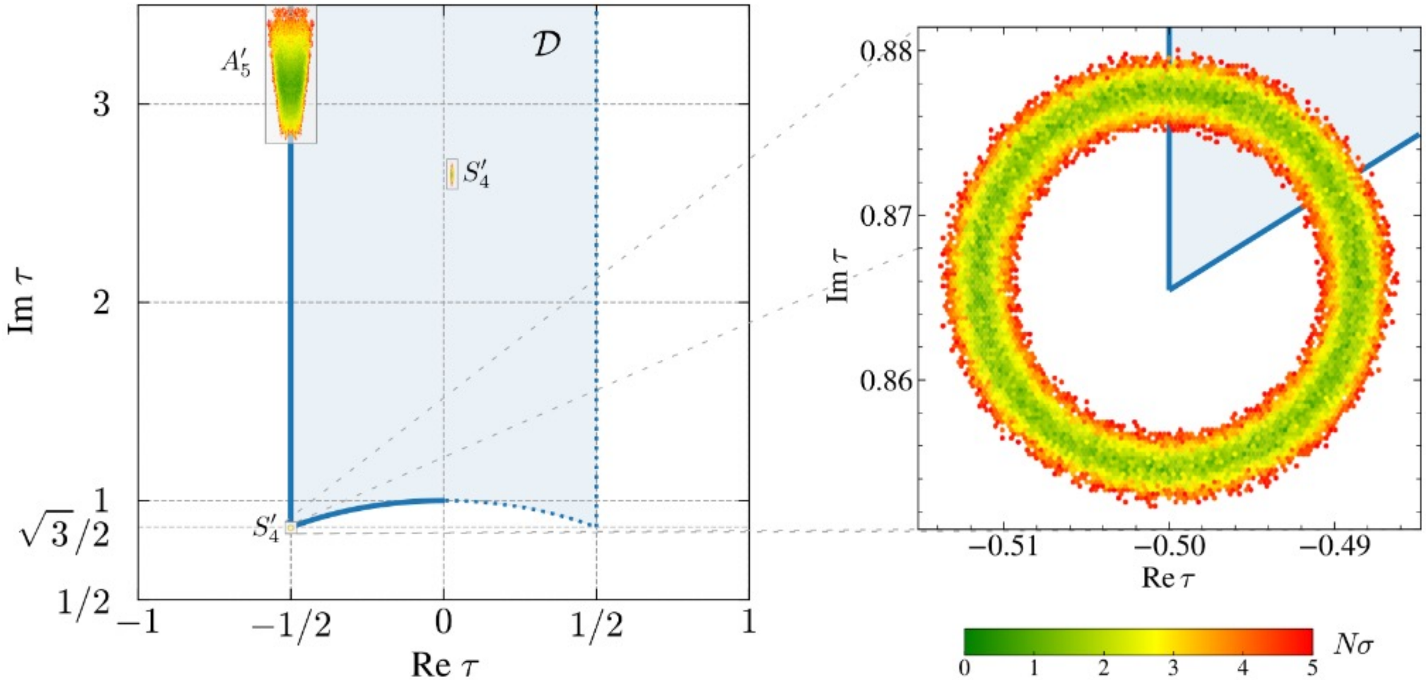
He made significant contributions to the non-Abelian discrete symmetry approach to the lepton flavour problem, which, in particular, allow to test its validity.



Girardi, Petcov, Titov, *NPB* **894** (2015) 733

Modular invariance

In the recent years, he made fundamental contributions to the development of the modular invariance approach to the flavour problem.



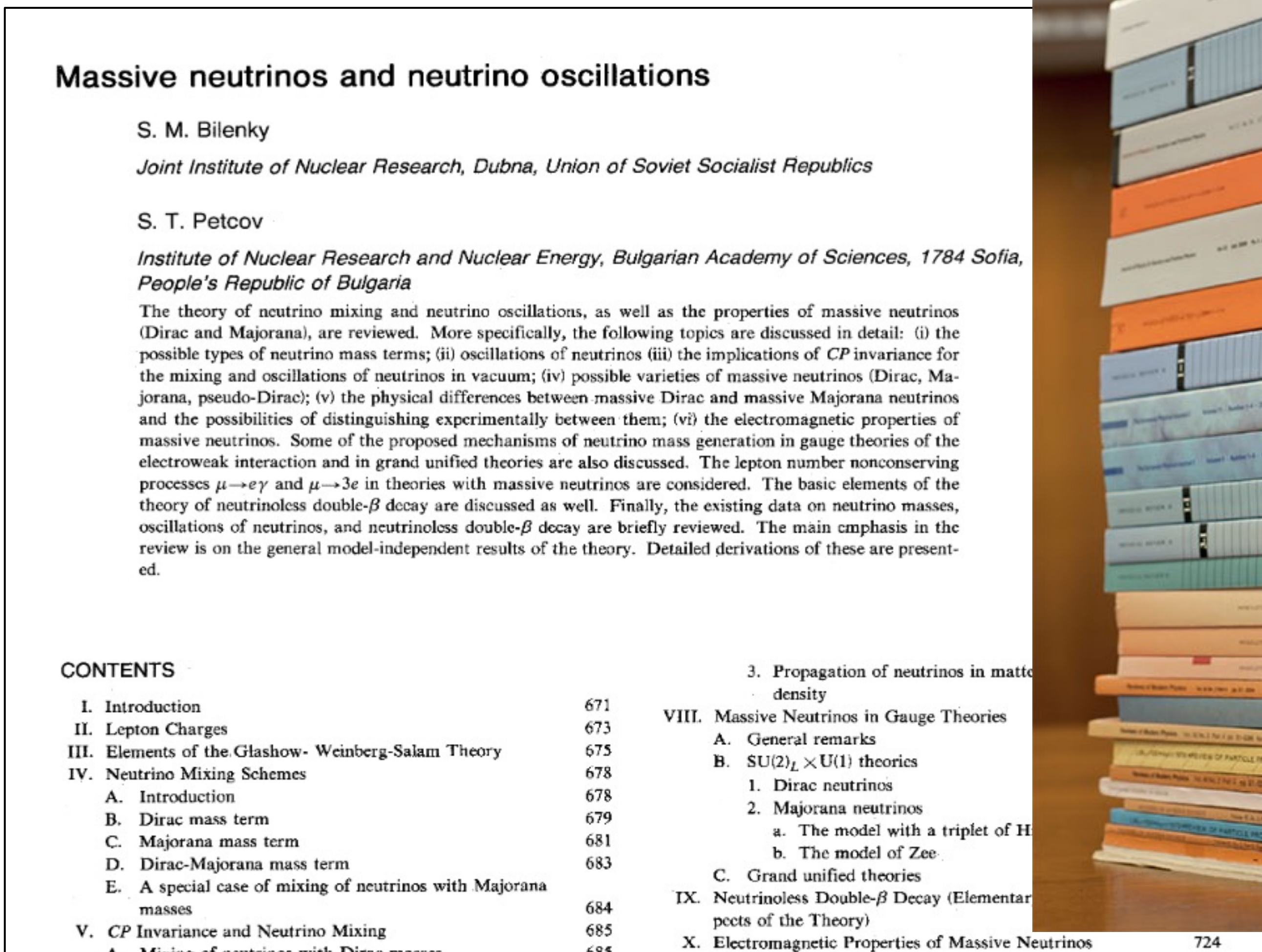
Novichkov, Penedo, Petcov, *JHEP* **04** (2021) 206

See the talk by Ferruccio Feruglio

Reviews

Neutrino Masses, Mixing, and Oscillations
with K. Nakamura, in PDG 2010-2019

Massive neutrinos and neutrino oscillations
with S.M. Bilenky, 1987



Massive neutrinos and neutrino oscillations

S. M. Bilenky

Joint Institute of Nuclear Research, Dubna, Union of Soviet Socialist Republics

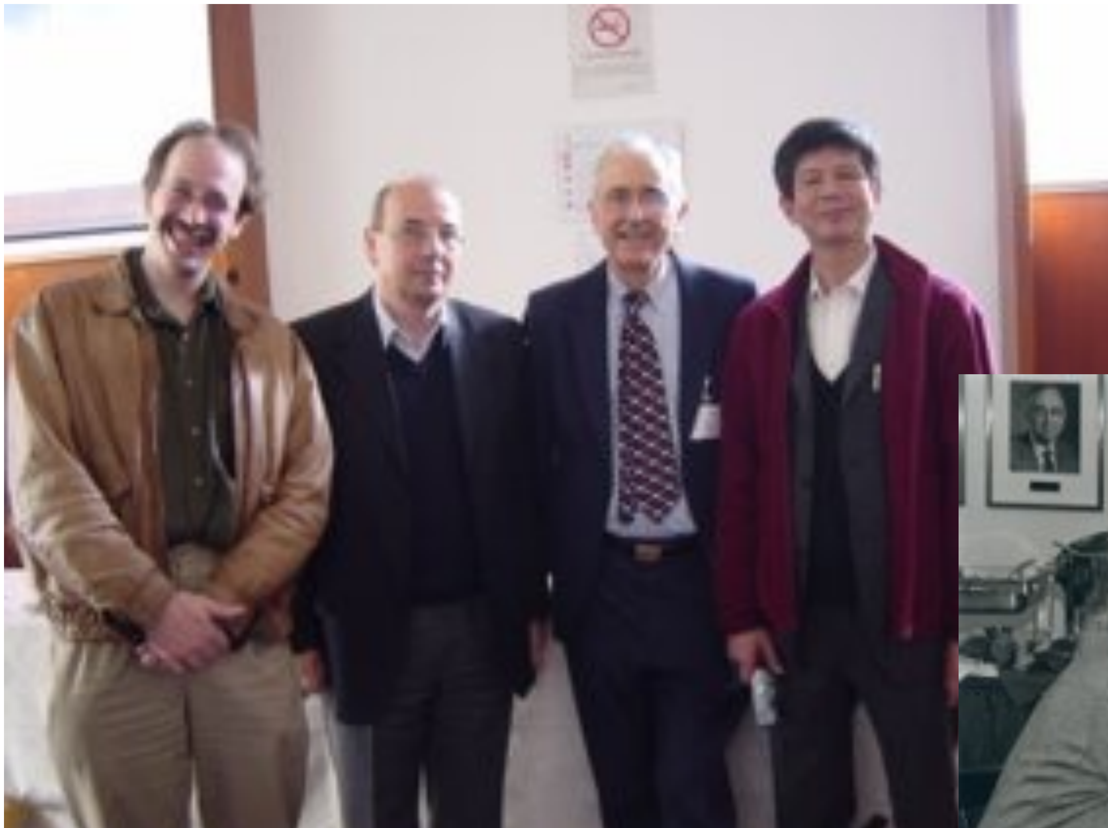
S. T. Petcov

Institute of Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, 1784 Sofia, People's Republic of Bulgaria

The theory of neutrino mixing and neutrino oscillations, as well as the properties of massive neutrinos (Dirac and Majorana), are reviewed. More specifically, the following topics are discussed in detail: (i) the possible types of neutrino mass terms; (ii) oscillations of neutrinos (iii) the implications of *CP* invariance for the mixing and oscillations of neutrinos in vacuum; (iv) possible varieties of massive neutrinos (Dirac, Majorana, pseudo-Dirac); (v) the physical differences between massive Dirac and massive Majorana neutrinos and the possibilities of distinguishing experimentally between them; (vi) the electromagnetic properties of massive neutrinos. Some of the proposed mechanisms of neutrino mass generation in gauge theories of the electroweak interaction and in grand unified theories are also discussed. The lepton number nonconserving processes $\mu \rightarrow e\gamma$ and $\mu \rightarrow 3e$ in theories with massive neutrinos are considered. The basic elements of the theory of neutrinoless double-β decay are discussed as well. Finally, the existing data on neutrino masses, oscillations of neutrinos, and neutrinoless double-β decay are briefly reviewed. The main emphasis in the review is on the general model-independent results of the theory. Detailed derivations of these are presented.

CONTENTS

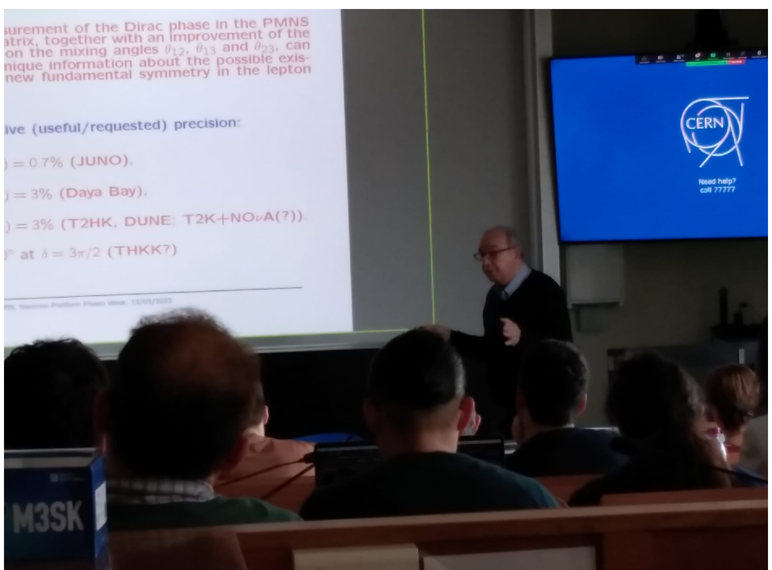
He has been a major actor, most importantly, in the "golden age" of neutrino physics…



…and he is recognised as a pioneer and a key figure in the field.

He was awarded the Pontecorvo Prize 2010

He trained more than one generation of neutrino physicists…



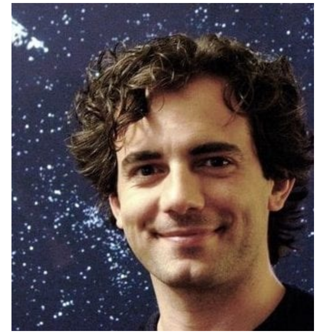

MultiOpticas
TEZENIS


CERVEJAS

…in particular his PhD Students

Pascoli (2002)

Piai (2002)



Profumo (2004)

Yaguna (2005)

Molinaro (2010)

Meroni (2013)

Girardi (2016)

Titov (2017)

Penedo (2018)

Novichkov (2021)

Granelli (2022)

Moretti (1993)
Dinh (2013)

As your students, we would like to thank you for all you have taught us and for the constant and precious guidance you have given us.

It was (and is) a privilege, an honour and a pleasure to work with you on the fabulous universe of neutrinos.