

Previous lecture

- Kinematics, 4-momentum
 - ▶ details on handout
- neutrino properties
 - ▶ neutrino mass

ν mass references

Winter: pp. 9-11, 127-131

Perkins (2nd Ed.): pp. 220-226

Burcham + Jobes: pp 165-167

1 History

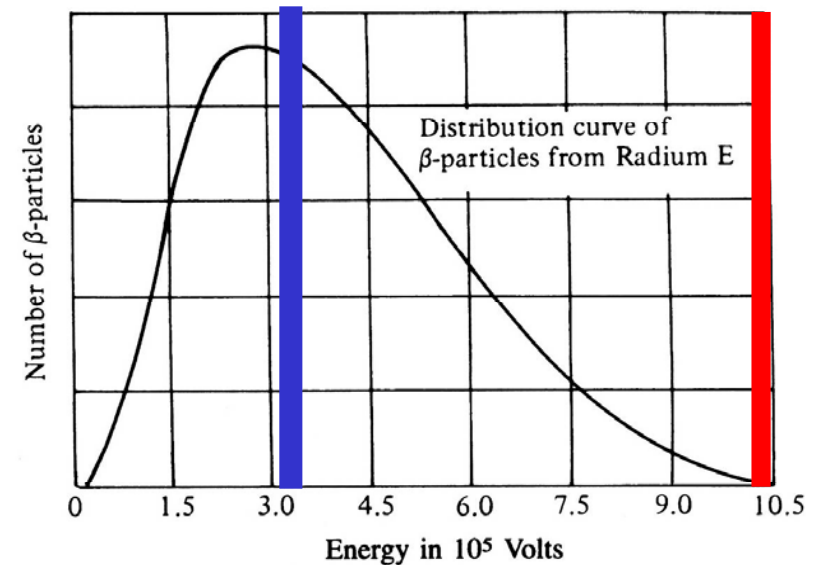


Fig. 1 Continuous beta spectrum of RaE.

Lecture Content

■ Approx. lecture content

1. PP intro
2. PP intro.
Feynman diagrams; strong/e.m./weak
3. ν props 1: , baryon and lepton numbers; no. neutrino generations
4. ν props 2: ν existence
Examples of decay/production
5. Neutrino mass
Fermi-Kurie plot
Phase space kinematics/4-momentum
6. Parity and CP violation... (why so important in lepton sector?)
Wu et al., ^{60}Co experiment
7. Detection & observation
Liquid, solid, bubble chamber
"Direct" methods (DONUT)
8. Solar and atmospheric neutrinos
Puzzle: relative abundances \neq SSM prediction
Two-flavour neutrino oscillation formalism
9. Neutrino oscillations and mixing
Possible solutions to solar/atm. ν problems
10. Current and future experiments
SK, SNO, KAMLAND, CHOOZ
MINOS, miniBOONE,..
NDBD (NEMO, etc.)
JPARC, νF ,
11. Implications for cosmology
Open vs. closed scenarios. various m_ν regions
 ν as DM candidate?
Subject outlook (JPARC, MICE, Neutrino Factory, ...)

Today

- Neutrino mass, conference results → web

- Kinematics - handout to lecture 5

- Parity symmetry

 - ▶ test of parity in weak decay

Halzen+Martin: p254

Perkins (2nd Ed.): 6.4, 6.5

Sutton: pp 44-50

Summary of lecture questionnaire results

Course homepage

Y2Neutrinos < General < TWiki - Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://www.ep.ph.bham.ac.uk/twiki/bin/view/General/Y2Neutrinos

ILC Enterprise WebEx Site Y2Neutrinos < General < TWiki LHC startup OP Vistars

RSS Feed
Statistics
Preferences

Webs

- ALICE
- ATLAS
- CALICE
- Computing
- General
- Main
- NA48
- Sandbox
- TWiki
- Welcome

- [Reading List](#)
- Useful (not exhaustive) collection of web pages

Written lecture notes are not distributed but all transparencies/handouts are given below.

- [Lecture 1](#)
- [Lecture 2](#)
 - [Review of Quark Model](#), in *2008 Particle Data Group Review of Particle Physics*, C. Amsler et al., published in [Physics Letters B667, 1 \(2008\)](#).
- [Lecture 3](#)
 - *The Number Of Neutrino Species*, D. Denegri, B. Sadoulet, M. Spiro, published in [Rev.Mod.Phys.62:1.1990](#).
 - Feynman diagrams (for documentation, not calculations), see also Halzen+Martin: p8, p77.
 - Neutrino existence discussion, see also Winter: Sect. 2.1, 2.3, Sutton: pp.10-31.
- [Lecture 4](#)
 - Ellis and Wooster experiment: [Nature 119, 563–564 \(1927\)](#)
- [Lecture 5](#)
 - [Handout on basic kinematics/system of units](#):
 - *Evidence for oscillation of atmospheric neutrinos*, Super-Kamiokande Collaboration (Y. Fukuda et al.), published in [Phys.Rev.Lett.81:1562-1567.1998](#).
 - Neutrino mass, see also Winter: pp. 9-11, 127-131, Perkins (2nd Ed.): pp. 220-226, Burcham + Jobes: pp 165-167
- [Lecture 6](#)
 - Parity: See also Halzen+Martin: p254, Perkins (2nd Ed.): Sect. 6.4,6.5, Sutton: pp 44-50, Martin, pg. 189.
- [Lecture 7](#)
- [Lecture 8](#)
 - *Evidence for muon neutrino oscillation in an accelerator-based experiment*, K2K? Collaboration: E. Aliu et al, [Phys.Rev.Lett. 94 081802 \(2005\)](#)
 - *Measurement of Neutrino Oscillation with KamLAND? : Evidence of Spectral Distortion*, Kamland Collaboration: T.Araki et al, [Phys. Rev. Lett. 94, 081801 \(2005\)](#)
 - [2 flavour neutrino oscillations handout](#)
- [Lecture 9](#)
- [Lecture 10](#)
 - [SNO detector and \$\nu\$ interactions in D₂O](#)
 - [2002 Nobel Prize in Physics](#), Raymond Davis Jr., Masatoshi Koshiba and Riccardo Giacconi
 - 2002 Nobel article, [How the sun shines](#), J.N.Bahcall
 - 2002 Nobel article, [Solving the Mystery of the Missing Neutrinos](#), J.N.Bahcall
- [Lecture 11](#)
 - *Next generation double beta decay experiments: metrics for their evaluation*, E.T. Aigner III et al [2005 New J. Phys. 7 6](#)

Done

www.ep.ph.bham.ac.uk

Free format comments

- Questionnaire given out too early for good judgement on problems and reading list
- Notes on board too bullet point like
- More quantitative/numerical examples
- Are lecture notes on WebCT
- Graphs/data showed a little hard to understand
- Go a little slower/explain graphs in more detail
- Notes on board not self-conclusive, sometimes hard to follow
- Give more theoretical background to material
- Quark content of certain particles hard to determine
- Print out of slides very small so hard to read