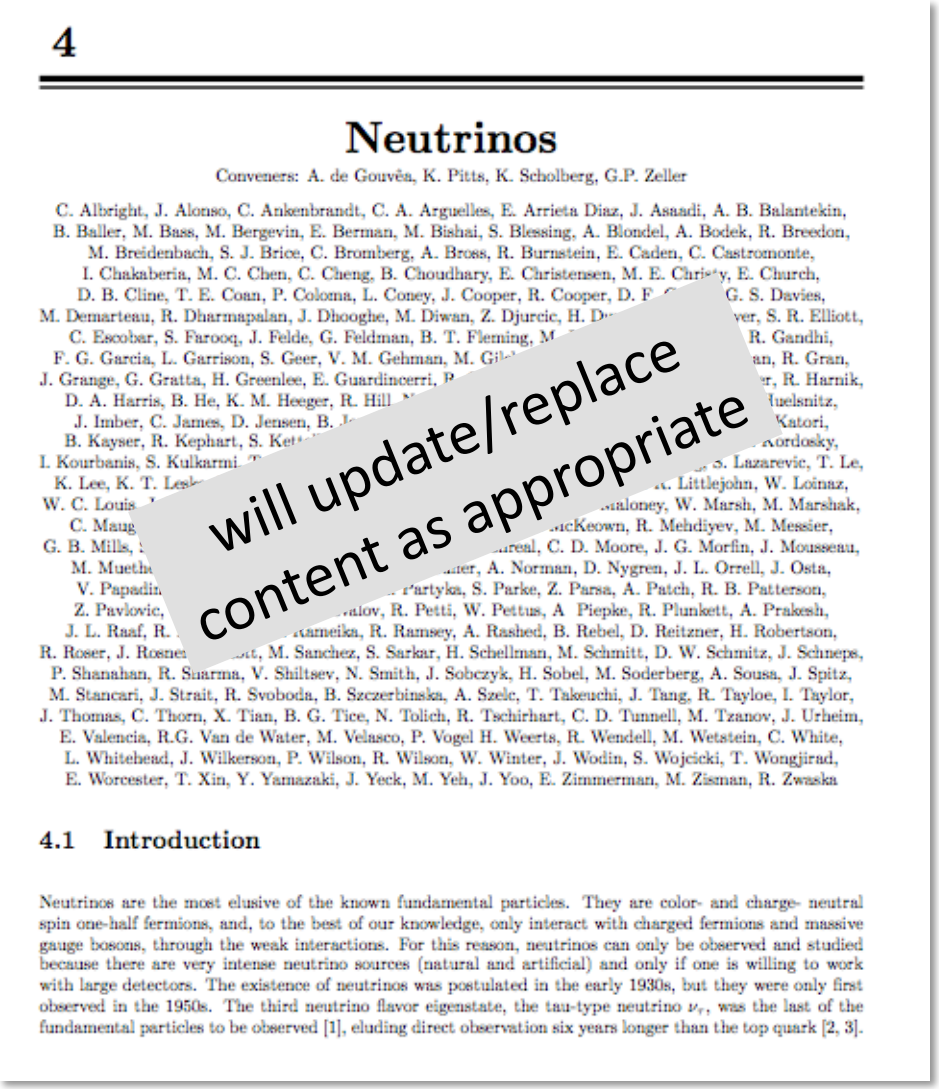
Introduction to Last Session

(example, Nu1 parallel session yesterday)

- very interesting and productive two days
- 7 neutrino subgroups
  - *many subgroups met jointly & some with CF*
- 19 parallel sessions
  - *83 whitepapers*
  - *64 presentations*
  - *6 hours of discussion*
- a lot of input – thank you!

What's Next?

- neutrino report
  - *~60 page document with sections for each of the 7 subgroups*
  - *to be written by subgroup conveners with community input*
- final document will be the result of over 1.5 year of activity
- <u>next</u>: subgroup presentations
  - *outline of subgroup chapters*
  - *list of any homework that came out of this meeting*
- <u>end</u>: schedule & opportunities for additional, continued input



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Neutrinos

Conveners: A. de Gouvêa, K. Pitts, K. Scholberg, G.P. Zeller

C. Albright, J. Alonso, C. Ankenbrandt, C. A. Arguelles, E. Arrieta Diaz, J. Asaadi, A. B. Balantekin, B. Baller, M. Bass, M. Bergevin, E. Berman, M. Bishai, S. Blessing, A. Blondel, A. Bodek, R. Breedon, M. Breidenbach, S. J. Brice, C. Bromberg, A. Bross, R. Burnstein, E. Caden, C. Castromonte, I. Chakaberia, M. C. Chen, C. Cheng, B. Choudhary, E. Christensen, M. E. Chris[illegible]y, E. Church, D. B. Cline, T. E. Coan, P. Colorna, L. Coney, J. Cooper, R. Cooper, D. F [illegible] G. S. Davies, M. Demarteau, R. Dharmapalan, J. Dhooghe, M. Diwan, Z. Djurcic, H. D[illegible] [illegible]ver, S. R. Elliott, C. Escobar, S. Farooq, J. Felde, G. Feldman, B. T. Fleming, M [illegible] R. Gandhi, F. G. Garcia, L. Garrison, S. Geer, V. M. Gehman, M. Gi[illegible] [illegible]an, R. Gran, J. Grange, G. Gratta, H. Greenlee, E. Guardincerri, R [illegible] [illegible]er, R. Harnik, D. A. Harris, B. He, K. M. Heeger, R. Hill, [illegible] [illegible]uelsnitz, J. Imber, C. James, D. Jensen, B. J[illegible] [illegible] Katori, B. Kayser, R. Kephart, S. Ket[illegible] [illegible] Kordosky, I. Kourbanis, S. Kulkarni, T [illegible] [illegible] S. Lazarevic, T. Le, K. Lee, K. T. Lesh[illegible] [illegible] Littlejohn, W. Loinaz, W. C. Louis, [illegible] [illegible]aloney, W. Marsh, M. Marshak, C. Maug[illegible] [illegible]cKeown, R. Mehdiyev, M. Messier, G. B. Mills, [illegible] [illegible]real, C. D. Moore, J. G. Morfin, J. Mousseau, M. Mueth[illegible] [illegible]ner, A. Norman, D. Nygren, J. L. Orrell, J. Osta, V. Papadi[illegible] [illegible] Partyka, S. Parke, Z. Parsa, A. Patch, R. B. Patterson, Z. Pavlovic, [illegible]alov, R. Petti, W. Pettus, A Piepke, R. Plunkett, A. Prakesh, J. L. Raaf, R. [illegible]ameika, R. Ramsey, A. Rashed, B. Rebel, D. Reitzner, H. Robertson, R. Roser, J. Rosne[illegible] [illegible], M. Sanchez, S. Sarkar, H. Schellman, M. Schmitt, D. W. Schmitz, J. Schneps, P. Shanahan, R. Sharma, V. Shiltsev, N. Smith, J. Sobczyk, H. Sobel, M. Soderberg, A. Sousa, J. Spitz, M. Stancari, J. Strait, R. Svoboda, B. Szczerbinska, A. Szelc, T. Takeuchi, J. Tang, R. Tayloe, I. Taylor, J. Thomas, C. Thorn, X. Tian, B. G. Tice, N. Tolich, R. Tschirhart, C. D. Tunnell, M. Tzanov, J. Urheim, E. Valencia, R.G. Van de Water, M. Velasco, P. Vogel H. Weerts, R. Wendell, M. Wetstein, C. White, L. Whitehead, J. Wilkerson, P. Wilson, R. Wilson, W. Winter, J. Wodin, S. Wojcicki, T. Wongjirad, E. Worcester, T. Xin, Y. Yamazaki, J. Yeck, M. Yeh, J. Yoo, E. Zimmerman, M. Zisman, R. Zwaska

will update/replace content as appropriate

4.1 Introduction

Neutrinos are the most elusive of the known fundamental particles. They are color- and charge- neutral spin one-half fermions, and, to the best of our knowledge, only interact with charged fermions and massive gauge bosons, through the weak interactions. For this reason, neutrinos can only be observed and studied because there are very intense neutrino sources (natural and artificial) and only if one is willing to work with large detectors. The existence of neutrinos was postulated in the early 1930s, but they were only first observed in the 1950s. The third neutrino flavor eigenstate, the tau-type neutrino ν_τ, was the last of the fundamental particles to be observed [1], eluding direct observation six years longer than the top quark [2, 3].

arXiv:1205.2671

Neutrino Subgroups

- **Nu1: Neutrino Oscillations and the Three-Flavor Paradigm**
  subgroup conveners: Mary Bishai, Karsten Heeger, Patrick Huber

- **Nu2: The Nature of the Neutrino: Majorana vs. Dirac**
  subgroup conveners: Steve Elliott, Lisa Kaufman

- **Nu3: Absolute Neutrino Mass**
  subgroup conveners: Hamish Robertson, Ben Monreal

- **Nu4: Neutrino Interactions**
  subgroup conveners: Jorge Morfin, Rex Tayloe

- **Nu5: Anomalies and New Physics**
  subgroup conveners: Boris Kayser, Jon Link

- **Nu6: Astrophysical and Cosmological Neutrinos**
  subgroup conveners: Kara Hoffman, Cecilia Lunardini, Nikolai Tolich

- **Nu7: Neutrinos and Society**
  subgroup conveners: Jose Alonso, Adam Bernstein