Acknowledgements

I would like to thank several colleagues for their reading and suggestions, in particular L. Pape, P. Janot, R. Barate and I. Timmermans.

About the author

Daniel Treille is a senior physicist at CERN and a former spokesman of the DELPHI experiment.

References

[1] G. Kane, in *Scientific American*, June 2003, for a brief reminder of the SM and Supersymmetry Basics can be found in H. Georgi, *Scientific American*, April 80, p 104, G. t'Hooft, ibid., June 80, p 104

[2] All EW results are those provided by the LEP EW Group

[3] *CERN Courier*, Jan-Feb 02, article 6, p7

[4] F.J.M. Farley, *Europhysics News*, (2001) Vol. 32 No.5, *CERN Courier* Jan-Feb. 2004, article 2. The last g-2 result is from hep-ex/0401008

[5] M. Davier *et al.*, *Eur.Phys.J.*C 31, 503 (2003), S. Ghozzi and F. Jegerlehner, hep-ex/0310181

[6] M.A. Bouchiat, L. Pottier, *Scientific American*, June 1984

[7] Y. Karyotakis, G. Hamel de Monchenault, *Europhysics News*, (2002) Vol. 33 No.3

[8] J.F. Grivaz, *Europhysics News*, (2003) Vol. 34, No. 1

[9] *CERN Courier*, June 03, article 2, p6, July-Aug 03, article 6, p8, Sept 03, article 6, p9

[10] *CERN Courier*, Sept 03, article 1, p5, and a review by R. Jaffe and F. Wilczek, hep-ph/0401034

[11] K. Lane, Two lectures on Technicolour, hep-ph/0202255

[12] *CERN Courier*, Dec. 2000, article 19 *CERN Courier*, Jan-Feb. 2002, article 15

[13] *CERN Courier*, March 1991, article 1

[14] *CERN Courier*, Sept 02, article 17, ibid. Sept 03, article 17

[15] P. Binetruy, *Europhysics News*, (2002) Vol.33 No.2 *Scientific American*, August 2000, *CERN Courier*, March 2000, article 6

[16] *CERN Courier*, vol.43, n06, article 15 by I.Antoniadis

[17] B. Greene, The elegant Universe, H. Haber and G. Kane, Scientific American, April 83, p56, M. Green, *Scientific American*, Sept. 86, page 44, *CERN Courier*, April 99, article 11

[18] F. Wilczek, QCD made simple, *Physics Today*, Aug. 2000, *CERN Courier*, April 03, article 15

[19] *CERN Courier*, Jan-Feb. 2002, article 16, HERA with polarized e: *CERN Courier*, April 03, article 1, p5, HERMES: *CERN Courier*, Nov 01, article 18, COMPASS: *CERN Courier*, Sept. 99, article 19, RHIC: *CERN Courier*, April 02, p8, Jan-Feb 03

[20] *CERN Courier*, Jan-Feb 03, article 1, July-Aug 03, article 2

[21] *CERN Courier*, April 01, article 15, may 2002, article 2, see also reference 7

[22] KTeV: *CERN Courier*, April 99, article 2, July-Aug. 2001, article 1, E787: *CERN Courier*, March 2002, article 2, p4 KLOE: *CERN Courier*, Sept. 99, article 23 NA48: *CERN Courier*, Sept. 99, article 2, July-Aug. 2001, article 1

[23] *Europhysics News*, (2000) Vol. 31, No. 3, *CERN Courier*, Oct. 2002, article 13

[24] *CERN Courier*, Sept. 03, article 18

[25] *CERN Courier*, May 1999, article 7

Physics in daily life: Hear, hear...

L.J.F. Hermans, Leiden University, The Netherlands

Even a tiny cricket can make a lot of noise, without having to "refuel" every other minute. It illustrates what we physicists have known all along: Audible sound waves carry very little energy. Or, if you wish: the human ear is pretty sensitive—if the sound waves are in the right frequency range, of course.

How exactly our ears respond to sound waves has been sorted out by our biophysical and medical colleagues, and is illustrated by the familiar isophone plots that many of us remember from the textbooks. They are reproduced here for convenience. Each isophone curve represents sound that seems to be equally loud for the average person.

The figure reminds us that the human ear is not only rather sensitive, but that it also has an astonishingly large range: 12 orders of magnitude around 1 kHz. This is, in a way, a crazy result, if we think of noise pollution. It means that if we experience noise loud enough to reach the threshold of pain, and we assume a $1/r^2$ decay of the sound intensity, we would have to increase the distance from the source by a factor of 10^6 to get rid of the noise. Or, if we stand at 10 m from the source, we would have to walk away some 10 000 km.

Illustration by Wiebke Drenckhan

All this assumes that the attenuation can be neglected, since we have been taught that sound wave propagation is an adiabatic process. Obviously, real life isn't that simple. There are several dissipative terms. For example, think of the irreversible heat leaks between the compressed and the expanded areas: the classical absorption coefficient is proportional to the frequency squared, which makes distant thunder rumble. Then there is attenuation by obstacles. There is the curvature of the earth. There is the curvature of the sound waves themselves, usually away from the earth due to the vertical temperature gradient. Without loss terms like these, forget a solid sleep.

A second feature worth noticing is the shape of the curves. Whereas the pain threshold is relatively flat, the threshold of hearing increases steeply with decreasing frequency. If we turn our audio amplifier from a high to a low volume, we tend to loose the lowest frequencies. The "loudness" control is supposed to compensate for this.

Finally, it is interesting to notice the magnitude of the sound intensity. How much sound energy do we produce when we speak? Let us assume that the listener hears us speak at an average sound level of 60 dB, which corresponds to 10^{-6} W/m² as seen from the right-hand vertical scale. Assuming that the listener is at 2 m, the sound energy is smeared out over some 10 m². This means that we produce, typically, 10^{-5} W of sound energy when we talk. That is very little indeed. During our whole life, even if we talk day and night and we get to live 100 years, we will not talk more than 10^6 hours. With the above 10^{-5} W, this means a total of 10 Wh. Even with a relatively high price of 50 Eurocents/kWh, this boils down to less than one cent for life-long speaking. Cheap talk, so to speak.