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Go

- 
- [Quick Links](#)
- [Organization](#)
- [Publications](#)
- [Public Information](#)
- [Resources](#)
- [Ask Experts](#)
- [Menu](#) 
- [Home](#)
- [Quick Links](#)
  - [Home](#)
  - [Feedback](#)
  - [Members Only](#)
  - [Site Map](#)
  - [Types of Membership](#)
  - [How to Join](#)
  - [Dues Schedule](#)
  - [Apply Online](#)
  - [Upcoming Meetings](#)
  - [Meeting History](#)
  - [Meeting Texts](#)
  - [Midyear Abstracts](#)
  - [Order Midyear Proceedings](#)
  - [Annual Meeting Photos](#)
  - [Midyear Meeting Photos](#)
  - [Website & Publications Contacts](#)
  - [Society Business Office](#)
  - [Submit Comment](#)
  - [Website Editor](#)
  - [Webmaster](#)
- [Organization](#)
  - [Leadership](#)
  - [ATE Editors](#)
  - [Award Recipients](#)
  - [Interview Videos](#)
  - [In Memoriam](#)
  - [HPS Sections](#)
  - [Affiliates Listing](#)
  - [Buyers Guide](#)
  - [Chapters](#)
  - [Committees](#)
  - [Careers](#)
  - [Chapter Reports](#)
  - [Donate to the HPS](#)
  - [HPS Archives](#)
  - [Mission and Vision](#)
  - [Landauer Lecture Series](#)
  - [Moeller Lecture Series](#)

- [Morgan Lecture Series](#)
- [Our Heritage](#)
- [Strategic Plan](#)
- [The Lighter Side](#)
- [Publications](#)
  - [Submit Manuscript](#)
  - [Journal](#)
  - [Journal Highlights Archive](#)
  - [Journal Online](#)
  - [Submit Manuscript](#)
  - [Newsletter](#)
  - [Newsletter Highlights Archive](#)
  - [Operational Radiation Safety \(ORS\)](#)
  - [ORS Highlights Archive](#)
  - [ORS Online](#)
  - [Download Standards](#)
  - [Order Standards](#)
  - [Fact Sheets](#)
  - [Positions](#)
  - [Position Statements](#)
  - [Special Publications](#)
  - [Standards of Qualification](#)
  - [Topical Articles](#)
  - [Books by HPS Members](#)
- [Public Information](#)
  - [Ask the Experts](#)
  - [Ask a Question](#)
  - [Find Answers](#)
  - [FAQs](#)
  - [Meet the ATE Editors](#)
  - [Notes of Appreciation](#)
  - [Fact Sheets](#)
  - [Media Center](#)
  - [Position Statements](#)
  - [RadiationAnswers.org](#)
  - [Radiation Risk](#)
  - [Radiation Terms](#)
  - [Radionuclide Decay Data](#)
  - [Request Job Posting](#)
  - [HP Résumés](#)
  - [Human Capital Crises](#)
  - [HP Job Listings](#)
  - [Salary Information](#)
  - [Salary Survey](#)
  - [Current News](#)
  - [Fukushima News](#)
  - [Links](#)
  - [News Archive](#)
- [Resources](#)
  - [Student Branches](#)
  - [Career Information](#)
  - [Scholarships & Grants](#)
  - [Fellowships](#)
  - [Travel Grants](#)
  - [Mentoring Program](#)
  - [Volunteering Opportunities](#)
  - [Career Information](#)
  - [Classroom Safety](#)
  - [Demonstrations](#)
  - [Instrumentation & Sources](#)
  - [Lesson Plans](#)
  - [Academic Education Resources](#)
  - [Careers & Opportunities](#)
  - [Health Physics FAQs](#)
  - [Health Physics Video](#)
  - [Health Care Documents](#)
  - [Radiology O&A](#)
  - [Nuclear Medicine O&A](#)
  - [RadiationAnswers.org](#)
- [Ask the Experts](#)

## Answer to Question #4817 Submitted to "Ask the Experts"

Category: [Radiation Basics — Photons](#)

The following question was answered by an expert in the appropriate field:

Q

*What value should be taken as the average gamma energy of  $^{226}\text{Ra}$ ?*

A

Most of the significant gamma radiation from  $^{226}\text{Ra}$  decay comes from the radioactive progeny  $^{214}\text{Pb}$  and its daughter,  $^{214}\text{Bi}$ . These are produced following the decay of  $^{226}\text{Ra}$  to  $^{222}\text{Rn}$ , which then decays to  $^{214}\text{Pb}$ . Since  $^{222}\text{Rn}$  is a gas it will escape, to varying degrees, from unsealed sources, and the gamma radiation from the  $^{214}\text{Pb}$  and  $^{214}\text{Bi}$  may not be significant in such cases. In sealed sources that prevent leakage of  $^{222}\text{Rn}$ , the  $^{222}\text{Rn}$ ,  $^{214}\text{Pb}$ , and  $^{214}\text{Bi}$  each reach the same activity level as that of the  $^{226}\text{Ra}$  within a few weeks of preparation of the source. There are dozens of different gamma rays of varying energies and yields produced by the decay of  $^{226}\text{Ra}$  and its progeny; energies range from less than 50 keV to about 2.5 MeV. The energies and numbers of gamma rays that escape from the source depend on how the source is fabricated, in particular the type of material used for the source encapsulation and its thickness. Generally, for most practical sealed sources of  $^{226}\text{Ra}$ , photons with energies less than about 50 keV are not very important from a dose perspective. If we neglect photons lower in energy than 50 keV and also consider only photons with yields greater than 1%, we obtain an effective gamma energy of about 0.74 MeV (obtained by multiplying each photon energy by its respective fractional yield, summing up all such products, and dividing the result by the sum of all the photon yields). Herman Cember's text (*Introduction to Health Physics*, 3<sup>rd</sup> ed., McGraw Hill, 1996) gives the average energy as about 0.7 MeV, and Report 112 of the [National Council on Radiation Protection and Measurements](#) (Calibration of Survey Instruments Used in Radiation Protection for the Assessment of Ionizing Radiation Fields and Radioactive Surface Contamination, 1991) gives an effective gamma energy of 800 keV (p. 54).

Depending on the purpose for which the gamma radiation is being used, you may require better definition of the energy distribution from the source, in which instance you may have to make corrections for attenuation of photons of differing energies within the source materials or possibly make measurements of the gamma ray distribution being emitted from the source. The latter process requires use of a gamma spectrometric system and setup of the source to produce an acceptable photon fluence at the detector used, which would probably be a germanium detector in conjunction with a multichannel gamma analyzer. I hope this answer is sufficient for your needs.

George Chabot, PhD, CHP

Answer posted on 27 September 2005. The information posted on this web page is intended as general reference information only. Specific facts and circumstances may affect the applicability of concepts, materials, and information described herein. The information provided is not a substitute for professional advice and should not be relied upon in the absence of such professional advice. To the best of our knowledge, answers are correct at the time they are posted. Be advised that over time, requirements could change, new data could be made available, and Internet links could change, affecting the correctness of the answers. Answers are the professional opinions of the expert responding to each question; they do not necessarily represent the position of the Health Physics Society.

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