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Improving reproducibility in geochronology: application in gamma spectrometry.

52%

is the percentage of researchers who consider that we are experiencing a **reproducibility crisis**, according to a study published in Nature (1576 respondents) [1, 2, 3].

Overcoming this crisis requires a deep change in our practices of publication and diffusion of research tools and data. Reproducible research requires a shift from proprietary software to open source software whose source code can be accessed, reviewed and modified if needed.



A challenging context

The processing of gamma-ray spectra requires a large number of steps (correction of energy shift, detection of peaks, corrections related to physical phenomena, etc.). This is generally done using proprietary software such as genie2000®, which is only available under Windows®.

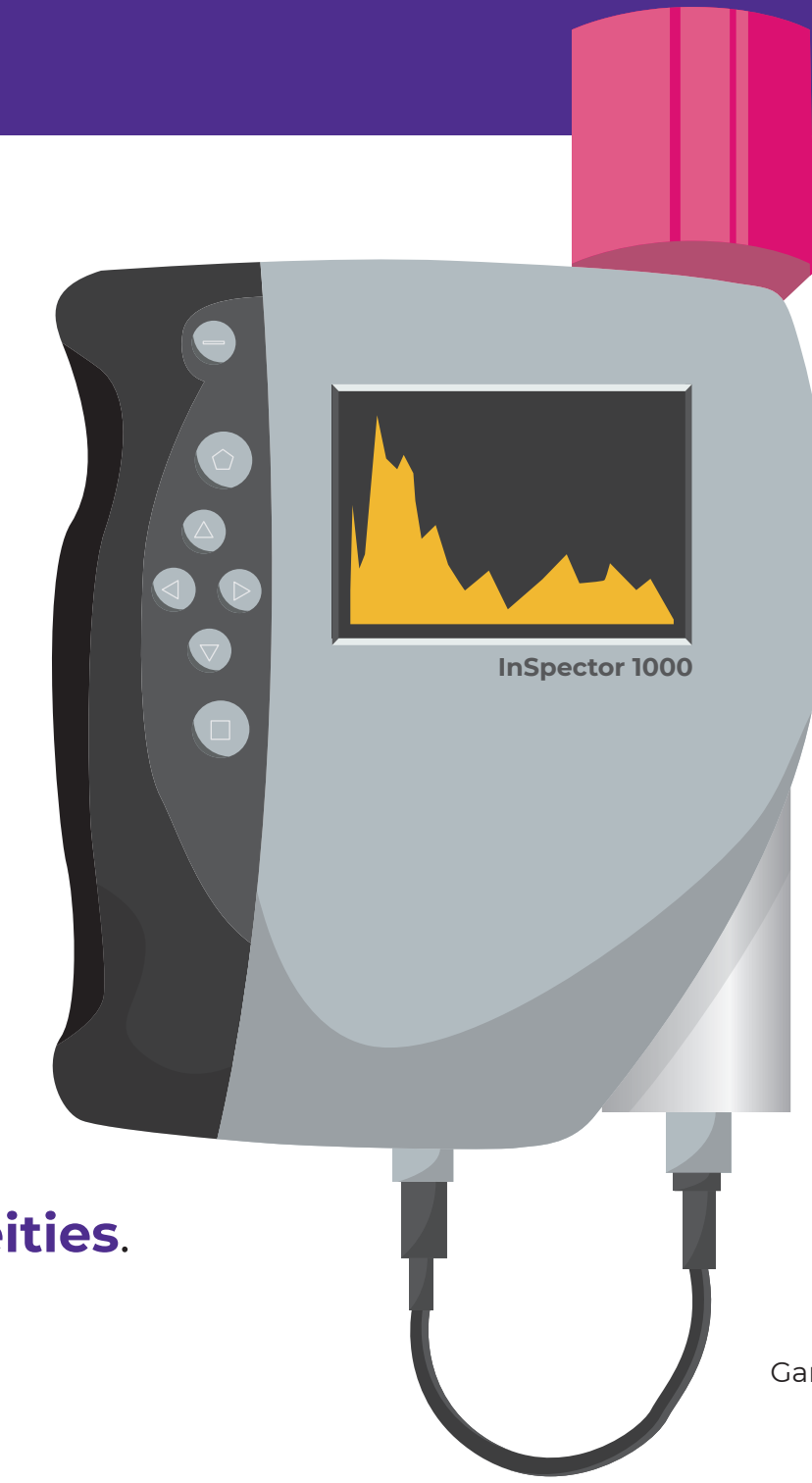
In-house solutions are implemented, such as Visual Basic Advance® macros in Microsoft Excel®. This workflow raises two challenges.

« So far, there is no easy-to-use solution to carry out these steps. »

Gamma spectrometry

Gamma-ray spectrometry is an essential tool for paleodosimetric dating method such as OSL. It allows the determination of radioelement content for the calculation of the **dose rate** (uranium, thorium and potassium). It is also a valuable tool for studying possible imbalances in the uranium series.

In-situ gamma spectrometry allows the estimation of gamma dose rates directly in the field, which is especially useful for complex dosimetric environments with **dose rate heterogeneities**.

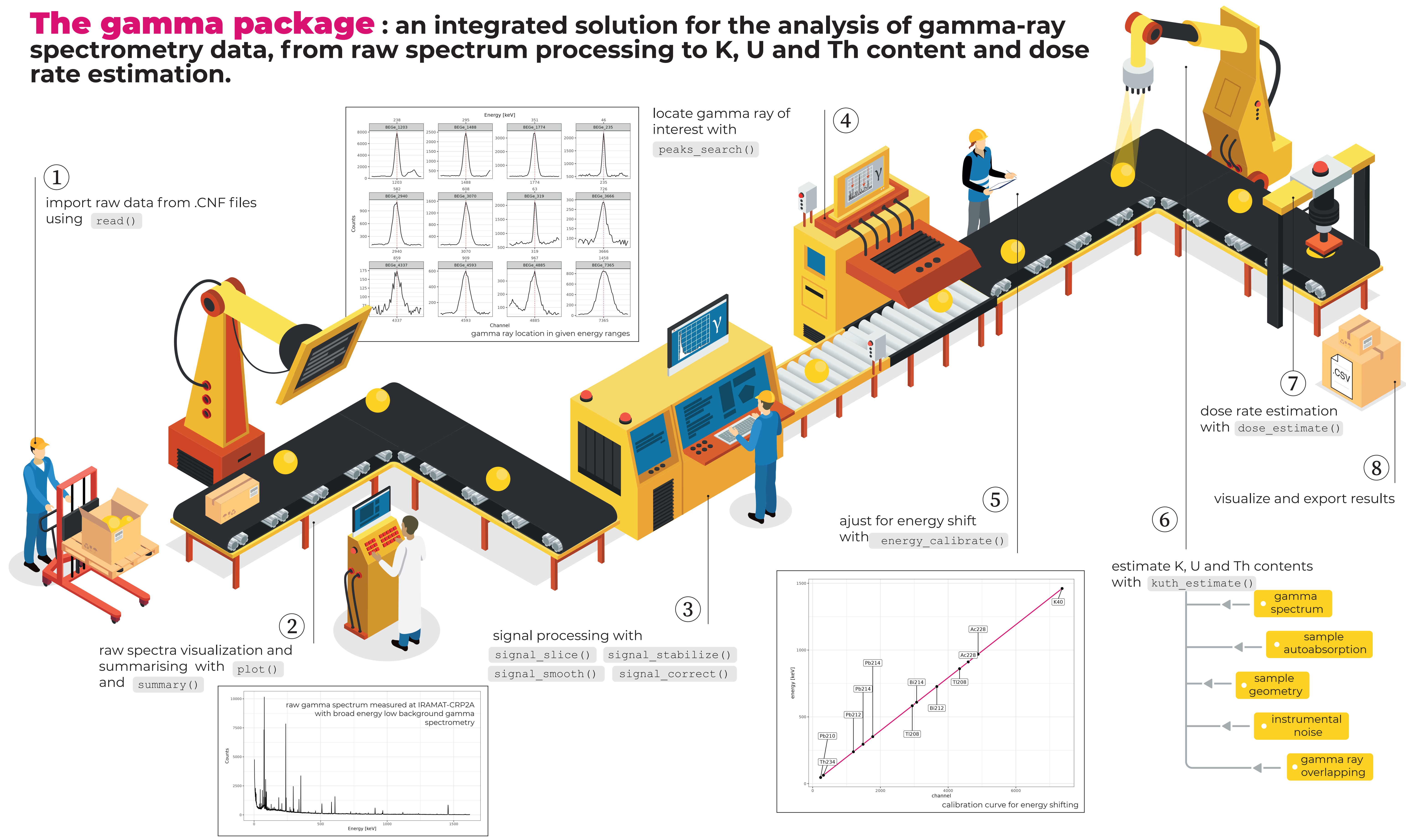


Gamma spectrometer in use at IRAMAT-CRP2A; right : broad energy and low background Germanium; left : Canberra InSpector1000.

Lack of transparency: details of the spectrum processing are not presented in publications and in-house solutions are not made available to the community. This severely limits the reproducibility and reliability of the measurements; see [4] for a broader discussion in the field of luminescence dating.

Access problem: the use of proprietary, commercial software is a limiting factor for community members, which restricts collaborations and futur developments.

The gamma package : an integrated solution for the analysis of gamma-ray spectrometry data, from raw spectrum processing to K, U and Th content and dose rate estimation.



Gamma is written in R. R has many advantages, such as being easy to learn and use. It is available on all platforms and its community offers efficient support. **R is free and open source**, which guarantees transparency and modularity [6].



read the doc!



download Lebrun et al., 2020

Work in progress

This work enhances a previous work allowing field gamma spectrometry spectra processing [5]. All these functionalities will be released by the end of 2021. Learn more at crp2a.github.io/gamma

Join us!

Source code and installation instructions are available online. Users are invited to contribute, share feedback, request new features or report bugs on GitHub.

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[3] Pashler, H., Wagenmakers, E. (2012). Editors' Introduction to the Special Section on Replicability in Psychological Science: A Crisis of Confidence? Perspectives on Psychological Science, 7(6):528-530.

[4] Kreutzer, S., Burow, C., Dietze, M., Fuchs, M. C., Fischer, M., and Schmidt, C. Software in the Context of Luminescence Dating: Status, Concepts and Suggestions exemplified by the R Package 'Luminescence'. Ancient TL, 35(2):1-11, 2017.

[5] Lebrun, B., Frerebeau, N., Paradol, C., Guérin, C., Mercier, N., Tribolo, C., Lahaye, C., Rizza, M. (2020). gamma: An R Package for Dose Rate Estimation from In-Situ Gamma-Ray Spectrometry Measurements. Ancient TL, In press.

[6] R Core Team. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria, 2020.

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