

# Physics discovers the secrets of Saint Francis

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The tunic believed to have been worn by Saint Francis of Assisi preserved in the Church of Saint Francis in Cortona (Province of Arezzo) dates back to the period in which the saint lived, whereas the tunic preserved in the Church of Santa Croce in Florence was made after his death.

Carbon 14 measurements, which allow a relic to be dated, show that the tunic in Santa Croce dates back to some time between the late 13th century and late 14th century and thus could not have belonged to the "Poor Man of Assisi", who died in 1226. These and other discoveries were made possible through the analysis of the relics with a tandem particle accelerator, which was performed by the Laboratory of Nuclear Techniques for Cultural Heritage (LABEC) of the INFN of Florence.

The results of the study were presented in Florence at the European Conference on Accelerators in Applied Research and Technology (ECAART) and will be published in the volume "L'eredità del Padre: le reliquie di San Francesco a Cortona" (which will be released in a few weeks by Edizioni Messaggero di Sant'Antonio). The volume will include the complete results of an interdisciplinary investigation which included both scientific and humanist research and which was promoted by the Tuscany Province Chapter of the Franciscan Order "Friars Minor Conventual".

The analyses were conducted with a radiocarbon method, measuring the radiocarbon using Accelerator Mass Spectrometry (AMS). From each tunic, researchers took from 5 to 7 samples of fabric, each of which was smaller than one square centimetre and weighed around 10 milligrams. Multiple samples were taken to avoid doubts or ambiguities (due to, for example, the presence of patches that were added to the tunic at a later time), thus increasing the analysis' validity.

Each sample of wool was then treated so as to extract only the carbon, obtaining a small graphite

pellet weighing about 0.8 milligrams. The pellet was then placed in the accelerator's chamber, where it was exposed to a beam of cesium ions, "scratching" the pellet's surface and extracting carbon isotopes 12, 13, and 14. The accelerator used by the INFN separately measured the quantity of the three isotopes. Relics are dated by calculating the ratio of carbon 14 to carbon 12, the quantities of which are "counted" in the accelerator's detectors. Both great delicacy and exceptional sensitivity are required for taking these measurements; in fact, the ratio of carbon 14 to carbon 12 is only around one to one trillion, or even lower.

The analysis of the tunic preserved in the Basilica of Santa Croce in Florence showed that it dates back to a period between the end of the 1200s and the end of the 1300s, revealing that it was made at least 80 years after Saint Francis' death and thus could not have belonged to him.

By contrast, the dates of all of the fragments taken from the tunic in the church in Cortona coincide with the period of Saint Francis' life (the average results show that the tunic was made between 1155 and 1225). The tunic is one of three Franciscan relics, which also include a finely embroidered cushion and a book of gospels believed to have been brought to Cortona by Friar Elia, Saint Francis' first successor as leader of the order.

LABEC researchers also analysed the composition of the precious metal thread used to embroider the cover of the cushion on which the Saint's head was placed upon his death, and they used the carbon 14 method to date the fabric of the cushion itself. Moreover, the book of gospels was subjected to in-depth codicological and paleographic investigations by researchers at the University of Siena. Based on both the scientific evidence and humanistic research, the cushion and the book of gospels were also found to date back to the period

in which Saint Francis lived.

Source: INFN

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