Application of autoradiography to paintings

After irradiation, the neutron-induced radioactivity decays with time. About a dozen different light and heavy isotopes – emitting β- (electrons) and γ-radiation – are created (the most important isotopes and their half-lives are presented in table 1). The induced β-decay is used to blacken highly sensitive films or imaging plates to reveal the spatial distribution of the pigments. It is a big advantage of neutrons that different pigments can be represented on separate films. This is due to a contrast variation created by the differences in the half-life times of the isotopes.

Isotope	Half life	Pigment
^{56}Mn	2.6 h	Brown colours, Umber, Ocre
^{64}Cu	13 h	Azurite, Malachite
^{76}As	1.1 d	Smalt, Realgar, Auripigmente
^{122}Sb ^{124}Sb	2.7 d 60 d	Naples-Yellow
^{32}P	14 d	Bone-black
^{203}Hg	47 d	Vermilion
^{60}Co	5.3 a	Smalt

The γ-spectroscopy via a Ge-detector provides information about the element composition of the pigments. The image plate technique allows for direct digital analysis and processing. With this method conceptual changes and corrections (”pentimenti”) during the creation of the painting become visible. In some cases decisions about the authenticity can be made. The art historian or restorer receives valuable information about the brush technique of the artist and the actual condition of the painting.

External cooperation partners for joint research projects are the Painting Gallery of the Berlin State Museum (Staatliche Museen Preussischer Kulturbesitz, Gemäldegalerie zu Berlin) and the Prussian Palaces and Gardens Foundation Berlin-Brandenburg (Stiftung Preussischer Schlösser und Gärten Berlin-Brandenburg) in Potsdam.