	EXPERIMENTAL REPORT	Proposal №
BENSC	Title **Autoradiographs from "Girl with a Platter of Fruits" (c. 1555) by Tiziano Vecellio, called Titian 102 x 82 cm²**	Instrument B8 Local Contact Dr. B. Schröder-Smeibidl
	Name(s) Affiliation Principal Proposer: C. Laurenze-Landsberg, Gemäldegalerie Berlin (GMB) Experimental Team: C. Laurenze-Landsberg, C. Schmidt, (GMB), Dr. C.O. Fischer, Dr. B. Schröder-Smeibidl (HMI)	Date(s) of Experiment
	Date of Report	8.4.2001

Neutron activation autoradiography (NAAR) has turned out to be a suitable non-destructive method to investigate paintings. The advantages of (cold) neutrons in comparison to X-rays are:

- high penetration depth,
- activation cross section (n,β) depends on the isotope,
- nuclides with different half-life times: therefore different pigments could be figured on separated films ➔ contrast variation,
- less γ–irradiation (cold source).

After neutron activation of the painting the induced β-decay is used to blacken highly sensitive films or imaging plates to get the distribution of the pigments. The γ-spectroscopy with a Ge-detector delivers information about the composition of the elements in the pigments. The image plate technique (Fuji BAS 2000, 20x40 cm^2) allows direct digital processing. With this method conceptual changes and corrections of the painting become visible. In some cases decisions about the authenticity can be made. The art historian or the restorer receives valuable information about the brush of the artist and the actual condition of the painting.

The experimental principle is easy: The painting is fixed on a support in front of the neutron guide end (NL1A) with the open area 3.5 x 12.5 cm^2. The surface of the painting is adjusted under a small angle (< 5°) with respect to the axis of the guide (Instr. **B8**). Thus a 12.5 cm wide strip of the painting is illuminated by the neutrons ($\Phi_n=1\cdot10^9$ $cm^{-2}s^{-1}$). The main free path of the neutrons within the paint layer is much longer than in the case of perpendicular transmission. The support will be moved up and down with the velocity of a few cm/s in order to receive a uniform activation of the total area of the panel.

Titian (1488/90 – 1576) was a court painter of the republic of Venice and present at the crowning ceremony of the emperor Karl V. in Bologna 1530. In Titian's painting "Girl with a Platter of Fruits" (**Fig. 1**) a girl in a contemporary fashioned dress holds a silver platter with apples and lemons. This picture – formerly interpreted as a portrait of Titian's daughter Lavinia - seems to be an allegory of fertility. Well known was the X-ray radiography shown in **Fig. 2**

Figure 1: Tiziano Vecellio, "Titian" ,
The Girl with a Platter of Fruits (c. 1555),
Gemäldegalerie zu Berlin

which turned by 180° is interpreted as an official portrait of an old man, a representative like a Senator or Doge.

On the neutron autoradiography (**Fig. 3**) a further step of the genesis of this painting is shown. The radiation of the covered paint layers containing As and Sb reveal surprisingly, if the painting is turned on top, a lady sitting on a chair: her arm and elbow, her skirt over the arm and around the leg of the chair (**Fig. 4**). The specific γ-spectroscopy of these areas showed ^{75}As ($\tau_{1/2}$ = 26.5 h). Titian has employed the red pigment Realgar (As_2S_2) and the yellow colour Auripgment (As_2S_3) for the pleated dress. In addition it was observed a second outstanding and unexpected fact: the γ-radiation delivered the evidence of the two Sb isotopes: ^{122}Sb: $\tau_{1/2}$ = 2.7 h, ^{124}Sb, $\tau_{1/2}$ = 60 d. The exact microanalytic analysis shows that Titian has employed the pigment Neapel Yellow ($Pb_2Sb_2O_7$)

employed the pigment Neapel-Yellow ($Pb_2Sb_2O_6$). In the literature the name of this colour and a description

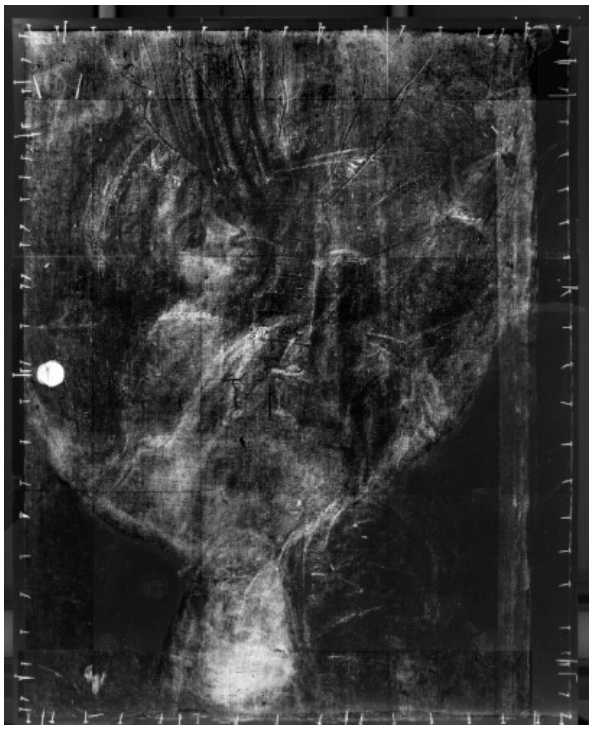

Figure 2: TizianoVecellio "Titian" ,
X-ray radiography, with permission of the Gemäldegalerie Berlin
(K. Slusallek, Rathgenlabor GMD)

of the contents was at first mentioned in 1702. The discovery that Titian has applied this colour already in 1555, 150 years earlier, was a little sensation.

Fig. 3: 2nd neutron autoradiography, composed of 12 imaging plates, exposure 1d 7 h to 1d 11 h after activation.

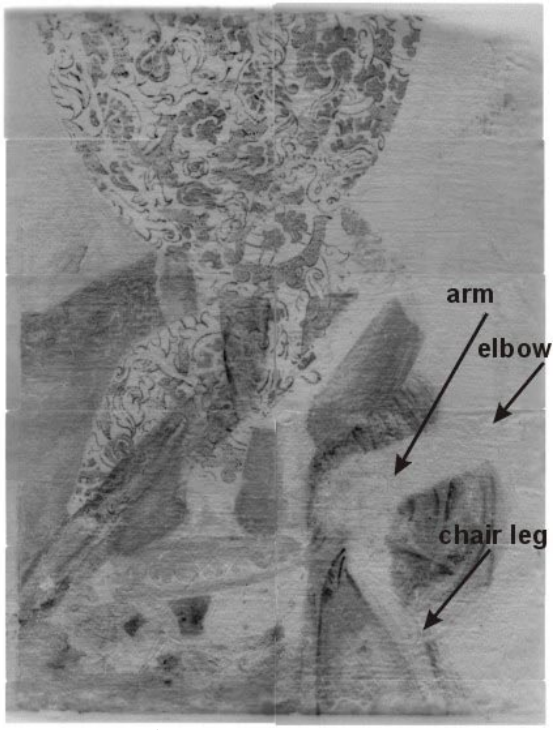

Figure 4: 2nd autoradiograph: turned by 180°

The pigments of the visible brocade dress contain a lead-tin mixture, which cannot be activated by cold neutrons and therefore no darkening can be seen. But the precise pattern could be observed (**Fig. 5**). It was supposed that Titian had worked with templates. But the examination could exclude this assumption and confirm that it really was a pure freehand drawing.

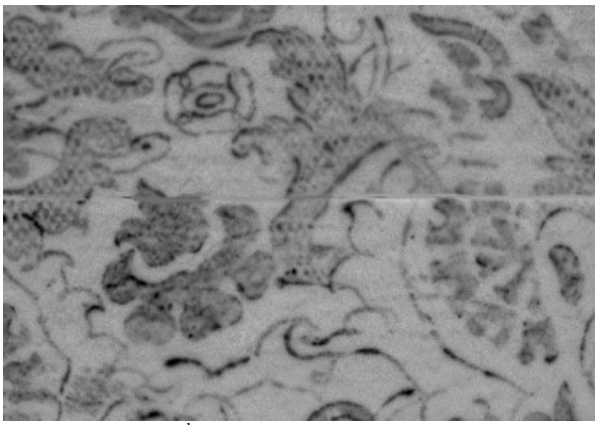

Figure 5: 2nd autoradiograph: zooming of the brocade dress: detail of the pattern.

Since this NAAR-investigation this painting is published as earliest evidence and Titian is considered as first user of the pigment Neapel-Yellow.

This project is part of a long-term research programme and was carried out in co-operation between the Gemäldegalerie Berlin, Stiftung Preußischer Kulturbesitz Berlin (C. Laurenze-Landsberg, C. Schmidt, J. Kelch, K. Slussalek) and the Hahn-Meitner-Institut Berlin (W. Leuther, C.-O-Fischer, L.A. Mertens, B. Schröder-Smeibidl).

C.-O. Fischer et. al., Restauro 105 (1999) 426