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Could the VUV Radiation Yield the Shroud Body Image?

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Abstracts

We investigate the Vacuum UV radiation with the aim to understand if a radiative mechanism is able to produce the Shroud Body Image. The ENEA team showed that a radiation (with λ = 193 nm) penetrated the linen fibrils for about 200 nm (the primary cell wall) as it is for the Shroud. The inner part remained colorless. With the same radiation, the above scientists obtained a latent Shroud-like coloring with the right hue. Now, in order to investigate the VUV radiative hypothesis for the Body Image formation, we underline that: i) the corpse emits radiation on the linen, directly and indirectly crossing the air; ii) the same radiation has a strong interaction with the air located between corpse and sheet. Consequently, the air quickly absorbs the VUV radiation which penetrates for a few microns. In such a case, only the corpse-sheet contact areas will be colored, while the others will appear with the background optical density as in the off-image area. Thus, the above radiation is a right tool to obtaining the Shroud-like coloring but, at the same time, it is unable to produce a complete Body Image.

Keywords: Turin Shroud; Body Image; VUV Radiation; Penetration depth; Linen; Air

Introduction

The formation mechanism of the Body Image, that appears on the Shroud of Turin, has interested, without obtaining a definitive result, various scholars with many hypotheses for over a century. Currently, many scientists show great interest for the radiative hypotheses confident of achieving the result. Their initial approach involves the emissions of protons or vacuum ultraviolet radiations from the corpse wrapped in the burial linen. However, for the Natural Sciences it is not possible to accept the idea that a corpse (which can only emit thermal radiations up to thermal equilibrium with the sheet that wraps it) emits electromagnetic radiations or sub-atomic particles. Events of this nature have never happened in the history of humanity.

The Shroud of Turin is the most studied archaeological find in the world. In fact, we are in front of a sheet of great complexity: a burial linen with traces of blood, serum and bile pigments, burns and scorches, water stains and a body image (due to the yellowed linen fibrils) of a scourged and crucified man. The blood image is due to the body-sheet contact, while for the body image the mechanism of formation is still unknown. In the off-image region, of the same burial linen, the optical density of the linen fibrils is that due to a natural exposure to electromagnetic radiations. This represents the background color [1-3].

In the region where the image lies there are mixed together fibrils with background color and others more yellowed fibrils with almost the same optical density value. The yellowed ones that produce the Body Image have a distribution that it is not random. This distribution contributes to obtain a correlation between the density of the fibrils (or Image Intensity) and the body-sheet distance. The trend is that of a linear regression [4,5]. Recently, we demonstrated that the protons cannot have contributed to the formation of the Shroud Body Image [6]. Our article was written about the "Proton Model" of Rinaudo [7,8]: a hypothesis that enjoys of a remarkable interest of many scientists but, above all, of readers.

We, in a simple way with a crude approach, showed that the protons (that in linen have a penetration depth of about 200 nm [9]) in the no-contact areas, penetrate a thickness of air for a few hundred μm. Therefore, no complete coloring of the linen in the region where the image should lie. In fact, the color cannot appear for corpse-sheet distance greater than the one deduced by the Bragg-Kleeman rule application [10]. Consequently, the protons are not able to explain the formation of the Image on the Turin Shroud. The same result would have been obtained using proton-like particles (deuterons, ^{3}H, ^{3}He, α-particles).

VUV Radiation-Matter Interaction

The UV radiations are a portion of the electromagnetic spectrum with wavelengths between 400 and 100 nm. They border on the visible light and X-ray. These last ones have wavelength values that are less than 100 nm, while for visible light the above values are greater than 400 nm. However, our interest is for the VUV radiations which have wavelength values between 200 and 100 nm. With a radiation of 193 nm, available through ArF excimer laser, we are in the far UV region, close to the X-ray spectrum (soft X-ray). With this wavelength value, the radiation can be considered made by particles of light without mass: the photons. Their energy $E = h \cdot c/\lambda$, with $h = 4.135 \times 10^{-15}$ eV x s (constant of Plank) and $c \approx 3 \times 10^{8}$ m/s (speed of light), is about 6.4 eV.

The scientists of the ENEA team more than all other researchers have gotten to the bottom of the radiative hypothesis problems [11-13]. We believe they operated with two targets in mind: the former is the one to obtain experimentally a Shroud-like color on a piece of linen; the latter is a study aimed at understanding the formation mechanism of the Shroud Body Image. In fact, they would not have worked for so many years if there was not a more important result to be obtained.

The investigation performed on the protons [6] highlights how important it is considering the presence of air. This gas mixture is ionized at the expense of the energy of the protons. Consequently, due to their low energy of emission deduced by penetration depth in linen (about a hundred KeV), the above particles are unable to reach the most distant areas of the sheet. So, also in the case of the ultraviolet radiation, we must evaluate only the depth of penetration in air as for the linen is known: about 200 nm against the 0.34 mm thickness of the sheet. A very superficial image with the discoloration that involves only the primary cell wall of the linen fibrils. The inner part, as already affirmed, remains colorless. It could be argued that the Body Image floats in the fabric.

Now, due to the fact that the actions of the radiations also depend on the matters passed through, the air- and linen-penetration depth are different. Therefore, we underline how it has already been written in Introduction: The Linen of Turin, in the region where the image lies (in part in contact with the body and in part with the air) has been penetrated, at any point, with the same depth (about 200 nm).

Thus, in a hypothetical experiment with a corpse, wrapped in a sheet, that emits VUV radiation, the presence of linen and air, both penetrated by the above radiation, would bring to two different situations: the first one with the direct photons passage from corpse to the linen, the second one with an indirect photons passage because between corpse and linen there is air. In this last case the photons will be strongly absorbed by molecular oxygen which has a binding energy of about 5.16 eV. Therefore, due to the presence of oxygen (about 20.95 %) in the air, the Vacuum UV 193 nm radiation is absorbed for a depth of a few microns [14].

The correlation between fibrils density and body-sheet distances deduced for the Shroud of Turin foresees the presence of yellowed fibrils until 37 mm [4,5]. This value represents the range of the effects on the Shroud. It has been deduced by the intersection of the regression line, obtained after fitting procedure, with the average cloth background intensity. In our hypothetical experiment, the yellowed fibrils distribution should furnish a correlation between its density and the body-sheet distance. Unfortunately, this result, which should guarantee an Image with codified information on the body-sheet distance, is impossible to obtain.

Therefore, only the corpse-sheet contact areas would be colorful. In the other areas with corpse-sheet values different than zero (no contact regions) there would be neither coloring and, obviously, nor image; only background optical density. With this state of affairs, we can affirm that the Vacuum UV 193 nm radiation, able to obtain a Shroud-like coloring [11], it is not the right tool to obtain a complete image.

Furthermore, the characteristics of the Body Image that appear on the Shroud of Turin highlight other problems for the radiative hypothesis. For example, the inability to not be skilled to distinguish, among all the fibrils present in the Image region, the ones that must be yellowed to product a Body Image from the others that must maintain the background optical density. To conclude, it is also very important to remember that the experiments should begin with the emission, from a corpse wrapped in a burial linen, of Vacuum UV radiation. This is strongly forbidden as does not exist a science or an area of human knowledge which can accept such an inexistent hypothesis. Consequently, the radiative experiments are unable to reproduce an Image as the one on the Shroud of Turin.

Conclusion

The real difficulty in the use of radiative processes, as attempt to explain the Shroud Body Image formation, is the presence of two matters, linen and air. So, it has been necessary to investigate also the effects of the air present between body and sheet during the passage of Vacuum UV radiation. Furthermore, the knowledge of the penetration depth in the linen greatly limits the choice among the subatomic particles and their energies and the one among the electromagnetic radiations and their wavelengths.

The molecular oxygen, as it is known, has a strong interaction with the Vacuum UV radiations. This latter is quickly absorbed by the air and, consequently, the penetration depth is about a few microns. In these conditions, the coloring affects the corpse-sheet contact regions, excluding the others that will keep the background color. Finally, due to the constant value of the penetration depth in the Shroud Body Image, the presence of air (even if only in the no-contact region) prevents ionizing particles and electromagnetic radiations from obtaining a complete coloration.

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Conflict of Interest

The author of this manuscript declare that he has no conflict of interest.

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