

# Can the Hypothetical Protons Emitted by the Shroud's Man Furnish an *I(z)* Correlation?

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Recently, we have investigated the hypothesis radiative demonstrating that the two penetrated thicknesses (in air and linen) are not compatible with a single energy of the protons. Furthermore, we deduced that the distribution of energy, released by the above particles, on the burial linen has not a linear trend when the body-burial linen distance changes. Now, in this article we want to deduce the I(z) relationship, between the Image Intensity of the colour produced by protons on a linen and the z distance from the source (of Protons) and the same linen. To achieve the result in an analytical form and make a comparison with the same function extracted from the Shroud, we used the empirical expression Range-Energy for protons in air of Wilson-Brobeck. Thus, we obtain a result  $I(z) = I_m [1 - (z/R)^{5/9}]$  that is different from the one extracted from the Turin Linen  $I(z) = I_M (1 - z/R_0)$ . We have also the same information using the Range-Energy curves for protons of Rogozinski. The result is negative for the radiative hypothesis that is unable to produce the Shroud Body Image. Therefore, to investigate the above unknown process of formation, it is necessary to think about another one.

# **Keywords**

Hypothesis Radiative, Protons in the Matter, Energy Lost by Protons, I(z)Correlations, Comparison

# **1. Introduction**

The Shroud of Turin is the most studied archaeological find in the world. People have been waiting for an answer for decades about the distribution of the yellowed fibrils and the mechanism that produces them. In fact, it is the above distribution that forms the Body Image, as we see it on the Shroud of Turin, with his 2D characteristic [1]. In fact, the Shroud Image appears with inverted, colours and left with right. Exactly like a photographic negative. Before and after, other discoveries have been made and, in 1982, a new characteristic, the 3D has been added to 2D [2] [3]. These two characteristics are the ones that give charm to the Shroud.

In 1985, observing and analysing the results that come from the research on the Shroud, the scientist Lukasik deduced that a Photochemical Reaction would be the appropriate process to obtain an Image as the one presented on the Burial Linen of Turin [4]. In other words, the emission of an electromagnetic radiation of opportune wavelength (and hence energy) should cause the above Reaction in the surface of the linen fibrils. Thus, some scientists have considered radiations in the far ultraviolet region (for example [5]), others have looked nuclear particles such as protons (for example [6]).

The protons are subatomic particles with mass  $m_P = 1.672 \times 10^{-27}$  Kg, radius  $r_P = 10^{-15}$  m = 1 fm and a positive electrical charge  $e^+ = 1.602 \times 10^{-19}$  C. These particles are present in nuclei. In a nucleus the number of protons is equal to the Atomic Number Z that characterizes each element present on Earth: in the natural ones Z varies from 1 (Hydrogen, H) to 92 (Uranium, U); in those produced artificially by Nuclear Reactions, the Atomic Number Z varies from 93 (Neptunio, Np) to 118 (Oganesson, Og). Beyond, there are only theoretical hypotheses [7] [8]. These particles when penetrate the matter, due to the Coulomb Forces, have elastic and inelastic interactions with electrons and nuclei (with a cross section for electron greater than the one for nuclei). The effects are excitation, ionization, scattering, radiative losses and other possible nuclear processes. Despite the complexity of these processes, to affirm that the protons cross the matter ionizing the atoms is acceptable [9]-[11].

Now, it is necessary to consider that the protons, with ionization, take electrons away from the nuclei oxidizing the matter. In our case, at macroscopic level, the linen turns yellow. With these characteristics some scholars have thought that the protons, emitted from the body of the Nazarene, still wrapped in his burial linen in the Tomb, could be considered the source of energy in the formation of the Shroud Body Image.

The formation mechanism of the above Image is the goal of the research on the Linen of Turin. In fact, for several decades researchers and scientists have been working to achieve the desired result. Unfortunately, the obtained hypotheses, between theoretical studies and experiments, are a lot and can be divided into three groups: false mechanisms, Miracles and natural events. With this state of affairs and taking also into account that exists, and it is always present, a conflict of religious interests, the comparison becomes a clash among the different proposed mechanisms of the Body Image formation. Today, there is only confusion. We think that a true comparison of the ideas performed among various scientists is impossible.

### 2. *I*(*z*) Correlation Produced by Protons

In the years 1982/1984, Jackson et al. have extracted from the Shroud of Turin

13 pairs of values of Image Intensity I with the respective distance corpse-burial linen z in well-known points of the Image (points where the above distance had already been evaluated). The measures of Intensity of Image have been performed, using a microdensitometer, by Vernon Miller of the Brooks Institute of Photography, Santa Barbara, California [2] [3]. These pairs of values represented in an (I - z) plane appeared quite scattered. However, the fitting procedure provided a result: the I(z) Correlation for the Shroud Body Image, that was aligned best with the data, was a straight line, decreasing as z increased (a line with negative constant slope,  $dI/dz = -I_M/R_0$ ). In an analytical form, we can write it as follows:

$$I(z) = I_M \left( 1 - z/R_0 \right) \tag{1}$$

where I(z) is the Image Intensity (or the Yellowed Fibrils Density) at a z distance,  $I_M$  is the maximum value of Intensity present only in the contact areas (where  $R_0 = 0$ ) and  $R_0$  is the distance corpse-burial linen z that makes  $I(R_0) = 0$ . The distance corpse-linen z ranges between 0 and  $R_0$ . This last one represents the Discoloration Effects Range.

Unfortunately, we do not know with certain what kind of energy was involved in the formation mechanism that produced the Shroud Body Image. Today again, the choice of the radiative hypothesis prevails among the scientists. In fact, many are the supporters who accept the idea of a body (the corpse of the Nazarene) able to emit electromagnetic radiations in the far ultraviolet region (close to X-ray) or nuclear particles as the protons. On the contrary, we think that the only source of energy present, for a short time, in an ancient Sepulcher, is thermal energy.

We have always been against these hypotheses [12] [13] which smacks of the miraculous, and Physics with Theology do not agree with them. For Rogers, an authoritative chemical scientist and STURP member, the above radiative processes are pseudoscience [14]. Also, we believe in a natural process: the Stochastic one [15]. Therefore we want to see when the hypothetical emitted protons reach the Burial Linen leaving their kinetic energy, what kind of I(z) Correlation there will be. To obtain this result, with an acceptable reliability, at first, we will use the empirical formula Range-Energy for protons in air of Wilson and Bobreck:  $R(E_p) = (E_p/9.3)^{1.8}$ . This expression, where the energy is measured in MeV and the air distance in meter [16], it has already been used in one of our article [17], because furnishes acceptable different values from those obtained using the Bethe calculation. So, we can write:

$$E_p(z) = 9.3z^{5/9} \tag{2}$$

where  $E_p(z)$  is the energy that the protons lose to cross a space z in air. The corpse-burial linen distance z ranges between 0 and R. Now, it is evident that the energy transferred to the linen at a z distance, to make it yellow, is the difference between the one of emission  $E_m$  and the lost one through the thickness of air equal to z:

$$E_p(z) = E_m - 9.3z^{5/9} \tag{3}$$

The I(z) Image Intensity (or the Yellowed Fibril Density) is proportional to the energy that the protons, after passing through the air, transfer to the linen:  $I(z) = C \times E_m - C \times 9.3 \times z^{5/9}$ , where *C* is a constant. Therefore, the Intensity of Image, also considering that we want the distance *z* expressed in mm, can be written as:  $I(z) = I_m - C \times 9.3 \times 10^{-15/9} \times z^{5/9}$ . Here, when z = R, the Intensity of Image becomes I(R) = 0 and we deduce  $I_m = C \times 9.3 \times 10^{-15/9} \times R^{5/9}$  Therefore, the I(z) Correlation produced by using protons, emitted from the corpse of the Man of the Shroud, with kinetic energy  $E_m$  can be written:

$$I(z) = I_m \left[ 1 - \left( z/R \right)^{5/9} \right] \tag{4}$$

Also, without a graphic representation, we can see the Correlation produced by the protons is different from the one extracted from the Shroud of Turin. We think that the  $I_m$  and R values, in general, are different from  $I_M$  and  $R_0$ , respectively. The trend of the (4) is not the one of a linear regression and has a slope  $dI(z)/dz = -(5 I_m/9 R^{5/9}) \times z^{-4/9}$ . This is a very important result of our work: the slope is not constant. The Image Intensity ranges between  $I = I_m$  (when z = 0) and I = 0 (when z = R). This last distance, which we do not know, represents the Discoloration Effects Range when the source, to obtain a colouring on a linen, is of protons. However, the radiative hypothesis to be accepted it should produce a distribution of Image Intensity values and a Discoloration Effects Range equal to the ones deduced of the Shroud of Turin.

After the measurements of Image Intensity in 13 points and a fitting procedure made by Jackson *et al.* [2] [3], we have accepted the values  $R_0 = 37$  mm, as best as possible given the scattered of the measured data. This value is an important characteristic of the Shroud of Turin and it has been obtained experimentally. Therefore, we look at the function (4) inserting both the value of  $R_0$  in place of R and the one of  $I_M$  in place of  $I_m$ :  $I(z) = I_M [1 - (z/R_0)^{5/9}]$ .

Subsequently, we also used the Rogozinski formula that describes the Range-Energy curves for protons [18]. In this formula  $R(E_p) = a^{-1.8} \times (E_p)^{1.8}$  the protons energy is measured in MeV and  $R(E_p)$ , the depth penetration in matter, in g/cm<sup>2</sup>. The matter is characterized by "a" parameter; in the air its value is equal to 29. The penetration depth is measured in g/cm<sup>2</sup>. The ratio between this value and the density of the crossed matter expressed in g/cm<sup>3</sup> furnishes the value of R in centimeters. The use of this formula to obtain the above Correlation in the case of protons has furnished the same result of the Wilson-Bobreck formula.

Thus, only observing the two functions (1) and (4), it is natural not to consider the radiative process as a possible formation mechanism of the Shroud Body Image.

#### 3. Conclusions

After what was written in "I(z) Correlation produced by Protons", it is necessary to underline that the radiative model has many other problems. Some of these

are insurmountable:

1) The emission, in this case of protons, from the corpse of the Nazarene when it was still wrapped in his burial linen placed in the Sepulcher.

2) These particles, as happens also with the electromagnetic radiations, are unable to distinguish the fibrils that must be affected to form the Shroud Body Image from those that must maintain the background optical density (as the one of the fibrils that are outside the Image).

3) The yellowed fibrils, those that formed the Body Image on the Shroud, they should have the same optical density.

4) The resolution of coloration obtained by radiative process, it should be the same of the one of the Body Image.

5) Both, Physics and Theology, are contrary to the radiative hypotheses because they cannot accept the above emissions from a corpse or a body. An emission of this nature has never been seen in the History of Humanity.

6) When the kinetic energy of the protons is able to penetrate the linen only for 200 nm [19], at same time, it is unable to reach the Discoloration Effects Range Value in air that is 3.7 cm. [2] [3]. In this case, we may not have complete colour because some areas may not be reached by the protons.

This article is made to demonstrate to the people that the above miraculous hypothesis is not supported by common sense, by Physics and Theology. We do not know how much this sentence is worth and how it will be considered. For us it is the Truth, therefore, we underline it.

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#### **Conflicts of Interest**

Regarding the publication of this article, the author declares no conflict of interest.

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