TRANSFORMATIONS IN ART

(excerpt from “The Wave Particle of Art”, Libero Acerbi, 2009)

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If we want to describe an elementary event of Art and we are calculating the probability amplitudes for the pure states of Art (base states), **we can start from a different representation.**

In other words, the angles between the filters of Art, that are of maximum relevance, can be observed with different perspectives. That is, someone else chooses to use a different set of axes.

Suppose we start with the same elementary event of Art ψ, we say state ψ, but we will describe it in terms of the three probability amplitudes $\langle iA \mid \psi\rangle$ that ψ goes into our base states of Art **in our representation** A, whereas another observer will describe it by the three probability amplitudes $\langle jB \mid \psi\rangle$ that the state ψ goes into his base states of Art **in his different representation** B.

We have:

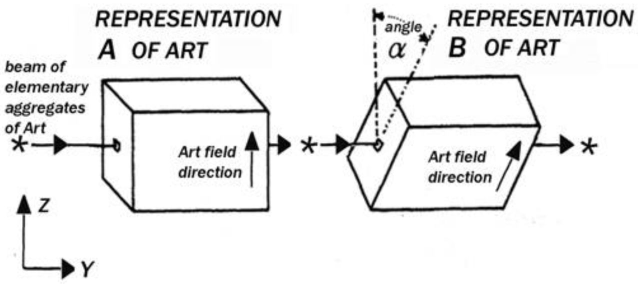
$$\langle jB \mid \psi\rangle = \sum_j \langle jB \mid iA\rangle\langle iA \mid \psi\rangle$$

and to relate the two representations we need **the nine complex numbers of the matrix** $\langle jB \mid iA\rangle$.

<u>Concerning an elementary event of Art, this matrix tells us how to transform from one set of base states to another</u>. It is the transformation matrix from representation A of Art to representation B of Art.

For the case of **SPIN ONE** elementary aggregates of Art, we need three amplitudes because we have three base states transforming like a vector from one set of axes to another. We call this vector: **vector of an elementary transformation of Art**.

FIRST CASE:



The two representations have the same y axis, along which the Artons move, but representation B is rotated about the common y axis by the angle α.

To transform from the set of coordinates x, y, z of representation of Art (or apparatus of Art) A to the x', y', z' coordinates of the representation B we have this relation:

$$x' = x \cos\alpha - z \,\mathrm{sen}\,\alpha,\ y'$$

Then, in this first case, the transformation amplitudes are:

$$\langle +B \mid +A \rangle = \tfrac{1}{2}(1 + \cos\alpha)$$

$$\langle 0B \mid +A \rangle = -\frac{1}{\sqrt{2}} \sin\alpha$$

$$\langle -B \mid +A \rangle = \tfrac{1}{2}(1 - \cos\alpha)$$

$$\langle +B \mid 0A \rangle = +\frac{1}{\sqrt{2}} \sin\alpha$$

$$\langle 0B \mid 0A \rangle = \cos\alpha$$

$$\langle -B \mid 0A \rangle = -\frac{1}{\sqrt{2}} \sin\alpha$$

$$\langle +B \mid -A \rangle = \tfrac{1}{2}(1 - \cos\alpha)$$

$$\langle 0B \mid -A \rangle = +\frac{1}{\sqrt{2}} \sin\alpha$$

$$\langle -B \mid -A \rangle = \tfrac{1}{2}(1 + \cos\alpha)$$

SECOND CASE:

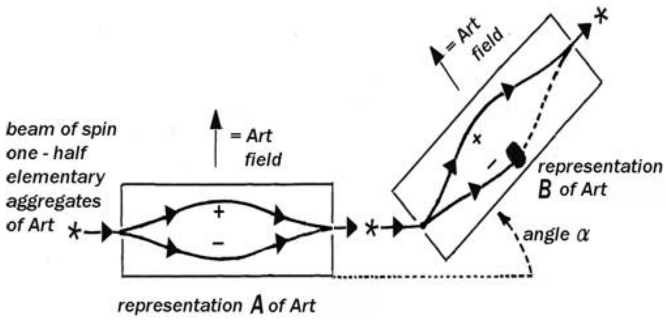
The two representations of Art have the same z-axis but are rotated around the z-axis by the angle β.

Then the transformation amplitudes are just three (Artons do not move along z-axis):

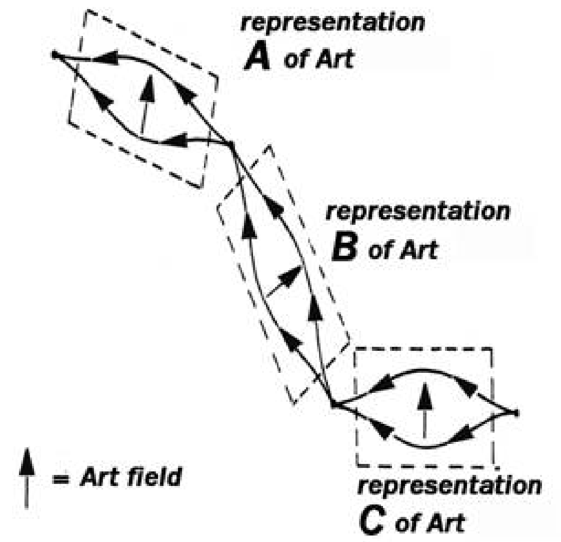
$$\langle +B \mid +A \rangle = e^{+i\beta}$$
$$\langle 0\,B \mid 0\,A \rangle = 1$$
$$\langle -B \mid -A \rangle = e^{-i\beta}$$
$$\text{all other amplitudes} = 0$$

NOTE THAT ANY ROTATION OF B WHATEVER CAN BE MADE UP OF THE TWO ROTATIONS (AND TRANSFORMATION AMPLITUDES) DESCRIBED.

We consider an **apparatus of Art filtering a beam of SPIN ONE-HALF elementary aggregates of Art**. This beam, entering at the left, would be split into two beams (there were three beams for spin one). There is no zero state.



Suppose to make an experiment of Art adding a third filtering apparatus of Art:



Now what is the $A \to B \to C$ transformation of Art? We have a double transformation:

$$Z_k^* = \sum_i \sum_j R_{kj}^{CB} R_{ji}^{BA} Z_i$$

where:

Z_k^* = the probability amplitudes to be in the base states k of representation C of Art.

Z_i = the probability amplitudes to find any state of Art in every one of the base states i of a base system (representation) A of Art.

R_{ji}^{BA} = the transformation (rotation) matrix from representation A of Art to representation B of Art.

R_{kj}^{CB} = the transformation (rotation) matrix from representation B of Art to representation C of Art.

But all the beams in B are unblocked and the state coming out of B is the same as the one that went in. So three Art apparatuses work like two and we could write:

$$Z_k^* = \sum_i R_{ki}^{CA} Z_i$$