Chapter

3 The Particle model

The particle model builds on the group theory presented in **Chapter 2.2**. The abstract theory is further refined and illustrated with diagrams. The relativistic fields, which are modeled as mathematical rotations, are to be simplified in such a way that precise quantization can be achieved simply by counting ratios. The global influence on matter is neglected in this chapter. Consequently, the optimal configuration is always orthogonal to the dimensional plane D_{56}.

3.1 Coupling of a fion with a particle sphere

This subchapter describes the transition from the state of a single invisible photon to a bundle of temporally synchronised photons rotating within a defined space. These invisible photons take on properties that require an explanation and modelling.

Axiom 13 states that photons only interact electrically with their environment once they exceed a certain **minimum coupling frequency** with $f > f_{min}$. Only then does the invisible photon enter into an electrical interaction with the photon field as a quantum.

Such photons are to be referred to as **fions**. Fions rotate as electromagnetic oscillations in the wave-field $F_{4\text{-}6}$ with the maximum speed $V_{max} = c$, interact with other particles and have an integer spin.

The mass of a single fion is also used to find the minimum coupling frequency at which the photon field can interact with the electron field. In order not to jump ahead, the concrete result will be presented in a later chapter.

Coupling mechanism of a fion with a sphere S:

A photon as a quantum is initially spread across the entire cosmic space. It needs a defined spatial area that spatially separates this photon from another photon. The photon exists in this limited space with a probability of 1. Since a photon is a rotating 4-dimensional hollow body, it makes sense to refer to the assigned spatial area as **sphere S**. Within a 6-dimensional sphere S, the photon is a 4-dimensional subspace of this sphere S. This means that every invisible photon has the possibility of coupling into sphere S when it transitions to a fion, figuratively speaking, of spinning into it. This happens at a much lower orbital velocity than the maximum velocity $V_{max} = c$. During the settling phase (**Figure 3.1)**, space-time mechanical settling forces act between the subspace U of the fion with of the sphere S until the rotation of the sphere S is synchronised each other.

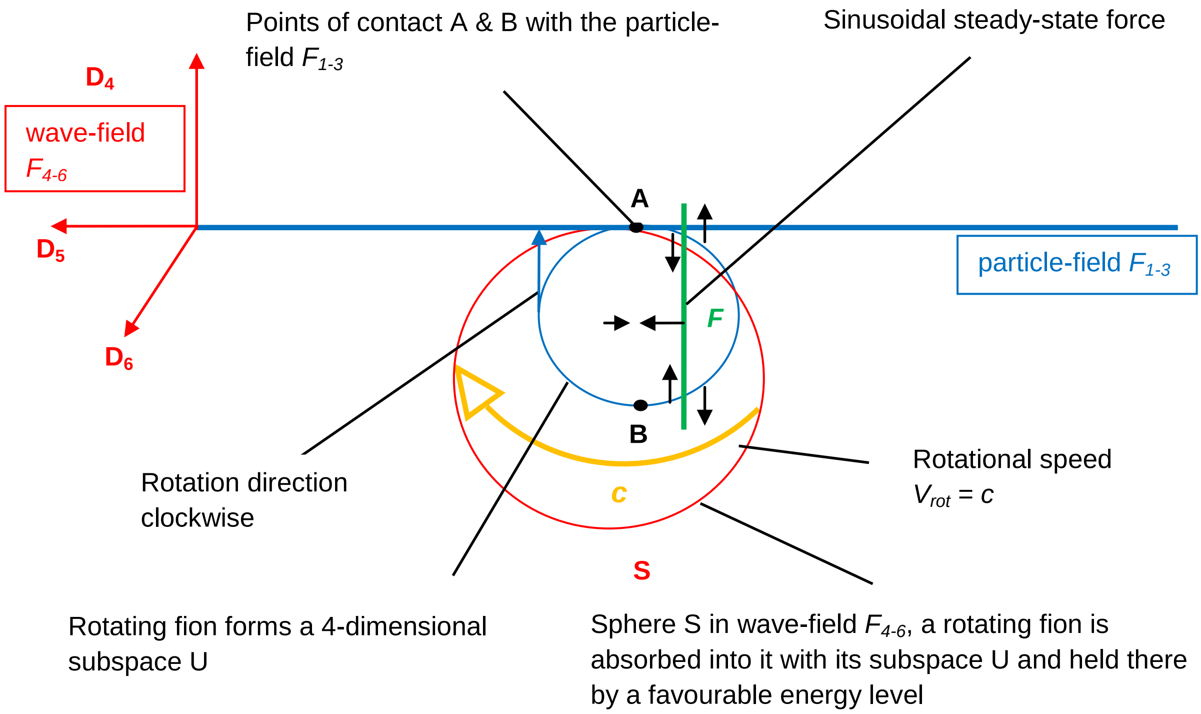

Figure 3.1: Representation of the transient behaviour of a rotating fion with subspace (U) in a sphere (S)

The oscillating forces generate a space-time deformation through interaction. The relevant component of the metric (**Chapter 2.2, Point 1. Metric**) is given by:

$$ds^2 \supset 2(A_\mu^a + \delta A_\mu^a)\, dy_a\, dx^\mu$$

- A_μ^a – vector field in 7D; geometrically, connects the wave-field with the particle-field; after compactification to 4D, it behaves as a gauge potential
- δA_μ^a – possibility of deviation, e.g., due to external disturbance via the particle-field; compensating forces counteract the disturbance
- $dy_a\, dx^\mu$ – geometric transition between the wave-field and the particle-field

After the settling phase, this fion has rotated completely into a sphere space S. The fion and the surrounding sphere rotate synchronously with each other. This means that there are no longer any compensating forces between them. The state is initially stable. This transition is shown in **Figure 3.2**.

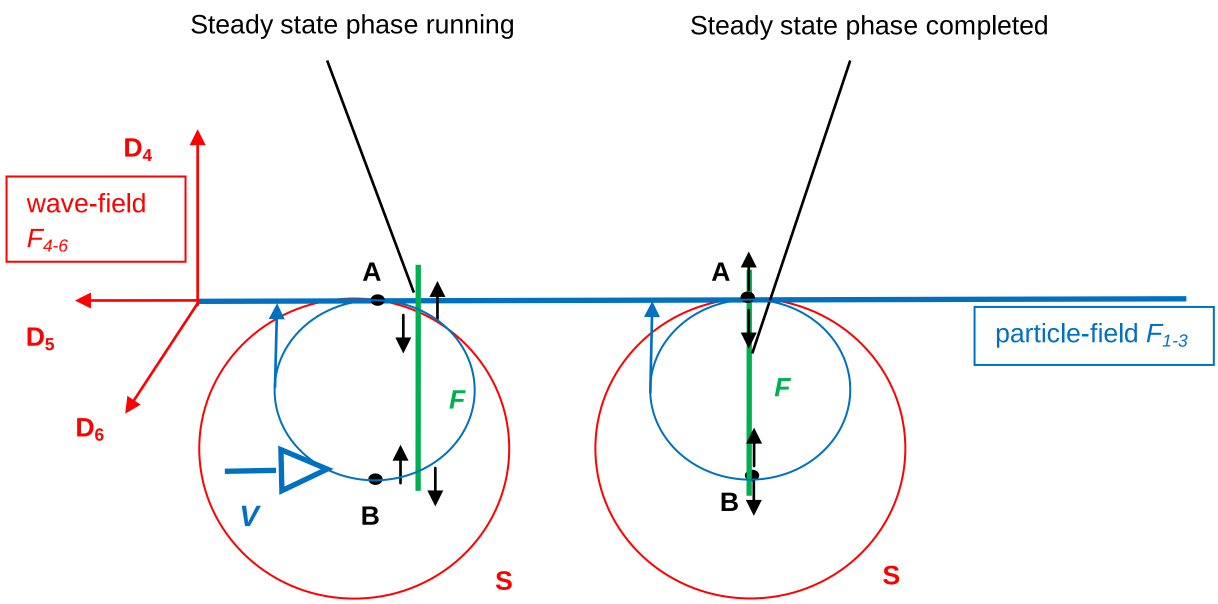

Figure 3.2: Continuation of the settling behaviour until synchronisation between the rotation of the fion and the sphere S

Settling behaviour of several fions in a sphere S:

If the fion is present within sphere S at a certain energy level, destabilising disturbances in the rotation may occur in sphere S after a period *T*. As the fion expands to include two additional fions, the energy in sphere S is distributed among three individual fions. The sphere S grows simultaneously in proportion to the existing spatial structure for three fions. After the energy has been distributed from one fion to several fions, the rotation of the fions stabilises again. Stability means that, during the periodic oscillatory motion of fions, there is a favourable energy for space-time that does not cause any additional space-time deformation. Scalar feedback potentials $V(\phi_n)$ perform this stabilization according to equation (2.96). The set of three fions gives rise to three 4-dimensional rotational paths between the dimensional planes $D_{45/46}$, which are projected onto the $D_{14/24/34}$ planes in the particle-field. The three fiones that have been created rotate within sphere S in their subspaces U on their respective rotational paths, initially

a) without interference,

b) at equal distances from each other, and

c) synchronously at the points of contact.

<u>Note:</u>

a) This applies until a certain amount of energy in this bundle causes a renewed disturbance, leading to a further division of the fions in sphere S.

b) The distance between their rotational paths is evenly aligned. If the angle is smaller or larger due to an external disturbance, space-time-mechanical repulsive compensating forces arise, which restore an even arrangement (marked in green).

c) The temporal synchronisation of the fions at the points of contact in the wave-field $F_{4\text{-}6}$ results in a uniform polarisation of all rotating fions within sphere S. Uniform polarisation in the bundle means uniform transmission of fields into the particle-field $F_{1\text{-}3}$.

Consequently, periodic interference occurs at the points of contact. **Figure 3.3** shows the transient behaviour within the aforementioned bundle of several fions in sphere S. Because of this forming, all fions have electrical potential in the photon field. The electron-internal fions that rotate as a bundle and can generate a partial potential are referred to as electrically **active fions**.

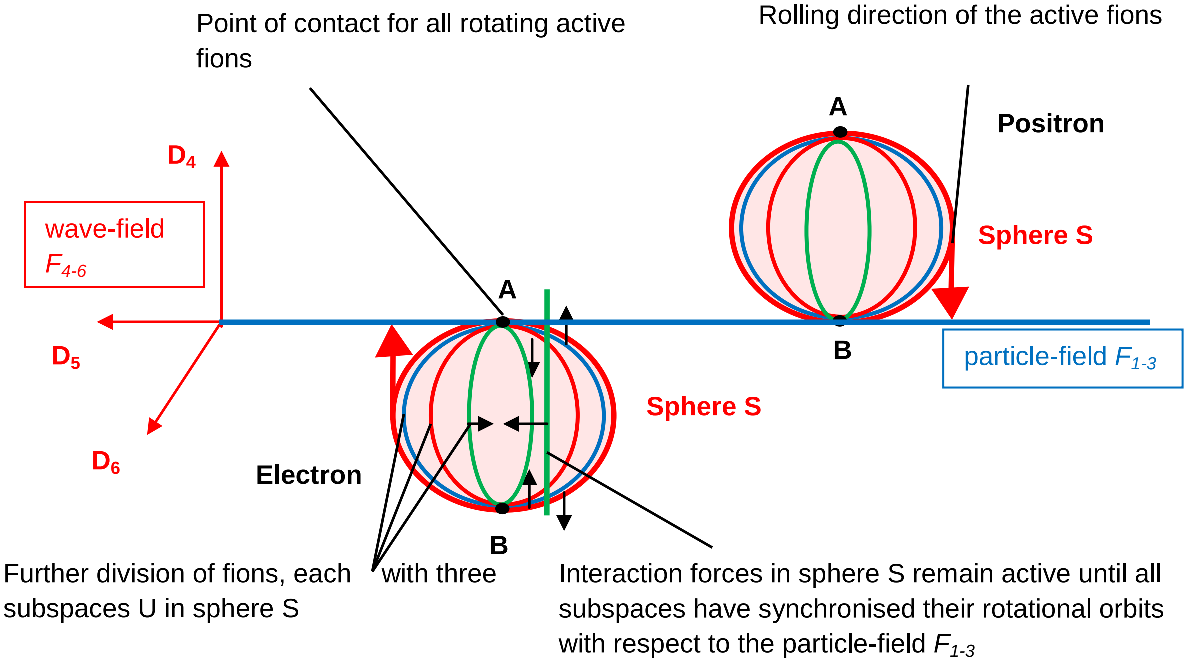

Figure 3.3: Representation of the settling behaviour of several rotating active fions in a sphere S in the wave-field $F_{4\text{-}6}$

Generation of a charge:

Parallel to the fourth spatial dimension D_4, the photon field as a whole has an electric potential in the form of a displacement current. A fionic potential is generated by its periodic electromagnetic rotational motion in the $F_{4\text{-}6}$ wave-field, which possesses a vector in the fourth dimension. The electrostatic separation occurs through the dimension plane D_{56}. This would be comparable to the friction electricity between a synthetic cloth and a plastic rod, known as the triboelectric effect. The three active fione, which can transmit their generated potential to the particle-field $F_{1\text{-}3}$, three via the dimensional levels $D_{14/24/34}$, each emit a **partial charge**. The magnitude of the **charge Q** is the result of the compactification from 7D to 4D when the phenomena are derived from the particle-field

With rotation **above** the dimension plane D_{56}, there is a positive potential gradient which generates finally a **positive charge** with the active fions, while active fions rotating **below** the dimension plane D_{56} slide down a negative potential gradient and generate a **negative charge**.

A potential difference arises between the active fions, which, once they come within a certain distance of each other, triggers an exchange of electric fields. This would be comparable to an electric arc in high-voltage technology. This process is referred to as **the close-range effect**. The close-range effect is examined in more detail in the section on the interaction between charges. The distance between the electrons is overcome via the **exchange fion**.

Assignment of a charge to the elementary particles:

In this example, the direction of travel of the active fions is represented by a red arrow in a clockwise direction. Points A and B show the common intersection point for all 4-dimensional rotational paths of the active fions within a sphere S. There is a stable **electron** below and a **positron** above the dimension plane D_{56}. If this is the case, then an electron consists of a 5-dimensional periodic hollow body vibration with three 4-dimensional rotational paths, which are occupied by the active fions.

Passive fions and the exchange fion:

If there are active fions that are formed orthogonally to the dimension plane D_{56}, then fions formed parallel to the dimension plane D_{56} should be called **passive** fions. Passive fions lose their polarisation with the remaining active fions when these rotate parallel to instead of orthogonal to the dimension plane D_{56}. In this state, they rotate at the maximum speed $V_{max} = c$ within the sphere S and have an integer spin. Due to their geometrical formation in the wave-field, passive fions also cannot find a rotational path to generate a charge. In this state, they take on the properties of dark matter.

Individual active fions may be able to spontaneously split into a **pair** of **exchange fions** and **passive fions** while maintaining the law of conservation of energy, and then recombine back into an active fion.

The reason for this spontaneous pair formation is the close-range effect between two differently charged particles at a certain proximity, which causes a voltage breakdown. The total momentum for the exchange fion/passive fion pair is $P = P_1 + P_2 = 0$. The respective **exchange fion** is released from the bundle of active fions, which sets their rotational speed to $V_{max} = c$ parallel to the dimension plane D_{56}. The angular momentum P_1 or P_2 thus obtains an integer spin. Depending on the potential difference, the exchange fions rotate along the dimension plane D_{56} towards the neighbouring particle and recombine with the respective passive fion that remained behind to form a common active fion. During the actual exchange, the exchange fions rotate parallel to the dimension plane D_{56} and have the properties of visible photons. Due to their parallel formation to the dimension plane D_{56}, they have no potential, rotate at the maximum speed $V_{max} = c$ and have an integer spin.

Distinction between fions and gluons :

The term gluon is derived from the English word "glue". In quantum chromodynamics, gluons have the task of "gluing" quarks together in more complex particle structures, such as neutrons or protons. Gluons are therefore responsible for the exchange of interaction forces. This exchange connects two particles with each other and, during the exchange, leads to the interaction properties of the strong nuclear force. With their nuclear forces, they overcome the electrical repulsive forces between protons. Gluons thus hold the atomic nucleus together.

The fion model allows the processes of nuclear forces to be investigated more precisely than with gluons. Fions perform even more far-reaching tasks that go beyond the strong or weak nuclear force. When several active fions are combined, they rotate synchronously with each other as a bundle, forming a periodically oscillating hollow body structure. Individual active fions generate partial charges within an elementary particle relative to the particle-field. Beyond the multiple of an electron fion, the structural integrity of heavier particles begins. These relationships exceed the definition of the gluon to such an extent that they are replaced by fions within the framework of this model.

3.2 The Electron Model

Predicting particle masses requires a scalable multiple of the electron's properties as the fundamental particle with the lowest excitation (**Chapter 2.2, Point 17**).This makes it all the more important to describe the electron as an fundamental particle for all further modelling. The electron belongs to the particle group of fermions. All **fermions** are assigned a spin of $\frac{1}{2}$.

According to the FSM model, electrons, positrons and neutrinos are no longer point particles, as classical physics suggests. Rather, depending on their complexity, they consist of a hollow body vibration in a 6-dimensional field-space, in which three active fions rotate on their three 4-dimensional rotational orbits. There is always only one point of contact for the particle in the dimensional plane $D_{56,}$ in which a field from the wave-field $F_{4\text{-}6}$ can be periodically exchanged into the particle-field $F_{1\text{-}3}$. The fact that the electrons in the particle-field are registered as point particles can be attributed to the fact that the formation is orthogonal to the dimension plane D_{56} and its field is only emitted periodically at a point of contact in the particle-field from a bundle of active fions. The field exchange appears in the particle-field as a rapidly pulsating point source for its field force.

Formation of equal numbers of electrons and positrons :

Taking energy conservation into account, fions always occur in pairs and have their formation in the fourth dimension below and above the dimension plane D_{56}. For reasons of energy conservation, this means that for every active fion rotating above, there must also be an active fion below the dimension plane D_{56}. The spheres S, which carry a bundle of active fions **below** the dimension plane D_{56}, are identified with the known **electron**, while **positrons** rotate mirrored **above** the dimension plane D_{56} with a bundle of active fions. There must therefore be the same number of positrons for a given number of electrons.

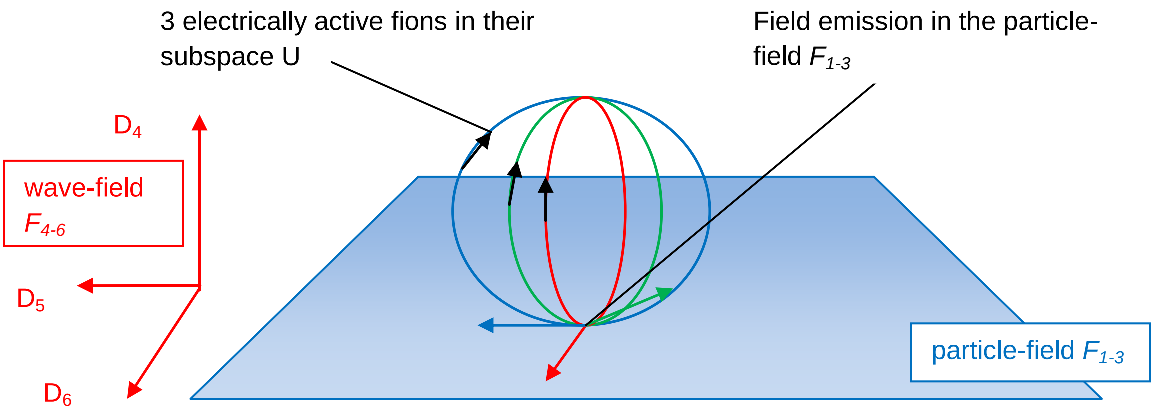

Figure 3.4: A positron rotates orthogonally to the dimension plane D_{56} and exchanges its field at the point of contact with the particle-field $F_{1\text{-}3}$

Figure 3.4 shows a positron consisting of three active fions, each of which projects a partial electric charge of $Q = +\frac{1}{3}$ *e* into the particle-field. A charge Q^+ or Q^- depends on its position relative to the dimension plane D_{56} whether it rotates below as an electron or above as a positron.

Extension of the electron sphere with a fourth and fifth active fion:

In **Figure 3.5**, the electron is shown below and the positron above, orthogonal to the dimension plane D_{56}. The dimension planes D_{45} and D_{46} enable the electron sphere to provide, in addition to the three already formed active fions, further rotating 4-dimensional orbits for active fions within sphere S. In this case, a fourth and fifth active fion are created. For reasons of energy conservation, each of the three active fions in the electron must transfer a portion of its energy equal to $\frac{1}{12}$ to a fourth active fion. Accordingly, each of the four active fions must transfer a portion of its energy equal to $\frac{1}{20}$ to a fifth active fion.

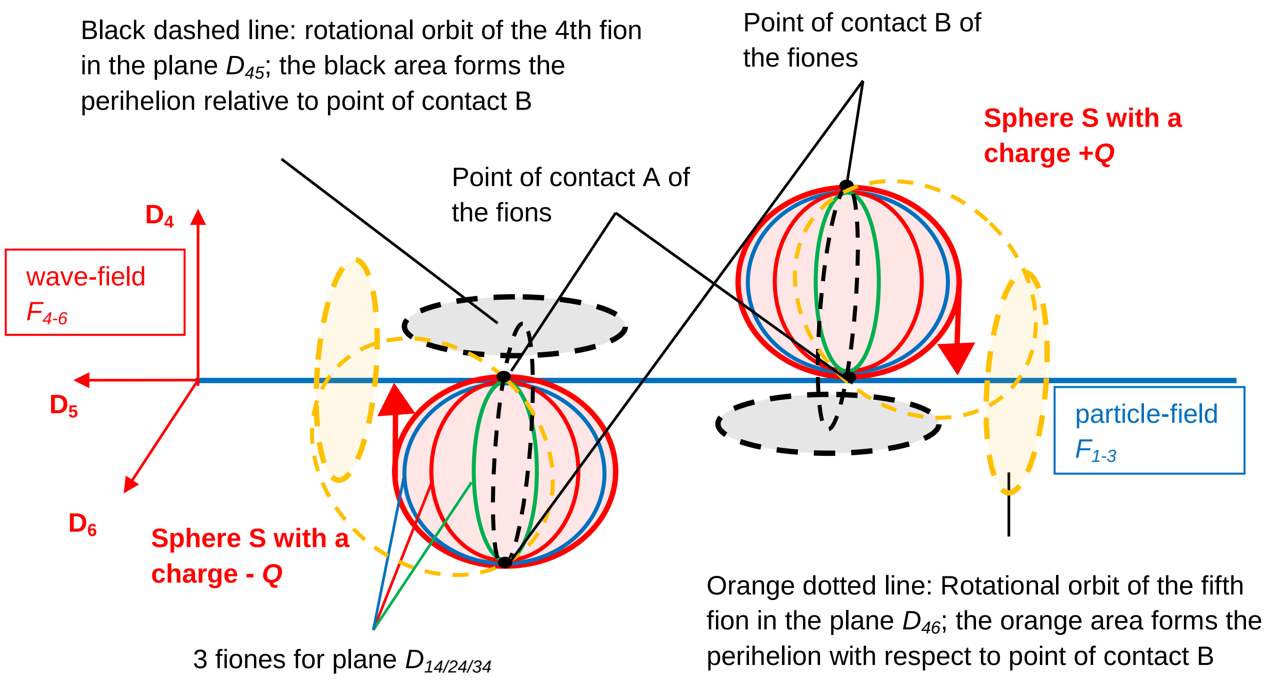

Figure 3.5: Representation of a positively and negatively charged particle in the wave-field F_{4-6} with the occupation of a fourth and fifth fion

The fourth and fifth fion partially rotate outside sphere S along elliptical paths, because sphere S can hold only three 4-dimensional rotational paths that interact with the particle-field F_{1-3} in the dimensional planes $D_{14/24/34}$. The total charge can still only consist of **three partial charges**. The additional active fions contribute by dividing the total mass not only into thirds, but also into quarters or fifths. The fourth fion is shown in black and rotates in the dimensional plane D_{45}, while the fifth fion is outlined in orange and rotates in the dimensional plane D_{46}. This means that individual particles can basically contain up to five active fions if all six spatial dimensions are included.

The electron is the simplest charged elementary particle and contains all three partial charges. Depending on the charge fractions rotating in the sphere S in its subspaces U, their active fions contribute to the total charge registered in the particle-field $F_{1\text{-}3}$ with:

$$Q = N_{aF}\,\frac{e}{3} \qquad\qquad N \in \mathbb{N} \qquad\qquad (3.01)$$

Q – electrical charge with $[Q]$ = As = C

e – electric charge of the elementary particle electron

e = 1,6022 10^{-19} C

N_{aF} – number of active fions along to the rotation planes $D_{14/24/34}$

Electron structures with three active fions provide the lowest and most favored energy states, which is why these are probably the most common in nature. Higher energy states resulting from modeling the electron with a larger number of active fions within its sphere S, on the other hand, are likely to be less common in nature.

<u>Side Note: Quark Charge:</u>

Quark types arise from an initial electron structure with varying numbers of active fions. Quarks never exist as isolated particles. In the FSM, they are part of a boson composed of a quark and its exchange particle. The exchange fion is created by the reduction of an active fion in the electron, which carries a partial charge in the particle-field.

$$Q = \pm(3 - N_{F/A})\,\frac{e}{3} \qquad\qquad (2.151)$$

- Q – total load, unit: C; results in a fractional charge
- $\frac{e}{3}$ – one-third of the base load; unit: C; one-third of the 3D wave-field (SU(3)) symmetry, implicitly
- $N_{F/A}$ – Number of active fions resulting from conversion into exchange fions or passive fions, or those that do not generate a potential in the wave-field relative to the dimensional plane D_{56}

Rotational speed of active fions:

The fiones in the subspaces require a period $T > 1$ to rotate to the common point of contact in order to occupy a favourable multiple of the comprehensive frequency. Otherwise, they would rotate at a maximum speed of c with a possible variance of $V > c$. Therefore, the speed must be a multiple smaller than the maximum possible orbital speed. The smallest possible and fastest recurring period for all fions would be period $2T$, followed by $3T$, etc. Assuming that the subspaces allow a maximum number of contacts per period, only contacts with a maximum period of $2T$ are possible. For the combination of several fions, this means that the individual subspaces U within the sphere S have a maximum orbital velocity of $V_{rot} = \frac{c}{2}$. With regard to the respective subspace in the wave-field $F_{4\text{-}6}$ and the particle-field $F_{1\text{-}3}$, trigonometry yields a resulting velocity of

$$V_{rot}^2 = V_{14}^2 + V_{24}^2 + V_{34}^2 \qquad (3.02)$$

V_{rot} – resulting rotational velocity of the bundle from active fions in sphere S

$V_{14/24/34}$ – speed of active fions along their respective 4-dimensional rotational paths in the dimension planes D_{14}, D_{24}, D_{34}.

With respect to the respective subspace in the wave-field $F_{4\text{-}6}$ and the particle-field $F_{1\text{-}3}$, the trigonometric calculation provides a resulting rotational speed for an electron of

$$V_{rot}^2 = (\frac{c}{2})^2 + (\frac{c}{2})^2 + (\frac{c}{2})^2$$

$$V_{rot} = \frac{\sqrt{1^2 + 1^2 + 1^2}}{2}\, c = \frac{\sqrt{3}}{2}\, c$$

for periodic contact at location A or B. With four subspaces in sphere S relative to the particle-field $F_{1\text{-}3}$, this would be $V_{rot} = \frac{\sqrt{4}}{2} c$ and theoretically $V_{rot} = \frac{\sqrt{5}}{2} c$ for the fifth subspace. Since the rotational speed $V_{rot} = \frac{\sqrt{5}}{2} c > c$, the rotation will either occur at the speed $V_{rot} = \frac{\sqrt{5}}{3} c$, or the rotation will only take place in four subspaces. As will be shown, a dimension reduction factor applies in these cases, which has the task of continuing to enable the rotation of five partial charges in the 6-dimensional space with $V_{rot} = \frac{c}{2}$.

Establishing the ground state for the electron:

After a field exchange, a field can only influence the particle-field $F_{1\text{-}3}$ if the velocity of the emitted field is greater than its intrinsic velocity. The optimal situation would therefore be a vector rest position of the electron, so that its field in the fifth dimension can be emitted at the maximum velocity $V_{max} = c = V_5$. In order to establish the aforementioned resting state in the wave-field $F_{4\text{-}6}$, the sphere S also rotates mechanically at a maximum rotational speed of $V_{rot} = \frac{c}{2}$ orthogonal to the dimension plane D_{56}. This ensures two independent rotation matrices on the dimension planes with $\overrightarrow{e_6}\, dD_4 dD_5 = \overrightarrow{dA} = D_{45}$ and $\overrightarrow{e_5}\, dD_4 dD_6 = \overrightarrow{dA} = D_{46}$, whereby the point of contact between A and B changes every period T. The fions rotating in sphere S therefore change direction every period T. On average, the following applies for periods $2T$:

$$\frac{\sqrt{3}}{2}c - \frac{\sqrt{3}}{2}c = 0 \qquad (3.03)$$

The stationary electron is now modelled between the reference fields $F_{1\text{-}3}$ and $F_{4\text{-}6}$. A field can then be exchanged with the maximum speed $V_{max} = c$.

The periodic change of the points of contact determines the spin direction of the particle. With an odd number of fions within the sphere S, this can be either $+\frac{1}{2}$ or $-\frac{1}{2}$. The axioms for rotating photons are considered to be fulfilled, since all three fions in an electron meet at a maximum of two periods T at a point of contact A and B.

Note:

The change in spin direction for an elementary particle with $V_{rot} = \frac{c}{2}$ occurs so quickly that it would be misguided to predict a specific spin state at a specific point in time on a macroscopic level. However, the phenomena of entanglement apply (**Chapter 2.2, Point 18, Spin-0-Pair Theory**).

Angular momentum and spin of the electron :

The angular momentum of particles is also called "spin". It is determined in units of Planck's constant h divided by the maximum angle measure of 2π. A photon thus has a maximum angular momentum of $L_{Max} = \frac{h}{2\pi}$. Its spin is an integer for 2π. For all particles, the result of the spin is important, whether it is half-integer or integer. This determines whether the Pauli principle applies to the particle or whether particles are allowed to interfere. The Pauli principle will be discussed in more detail in the section on interaction properties between differently charged particles. In the Standard Model of particle physics, certain particles are defined as having half-integer spin and are subject to this Pauli principle.

A single freely rotating fion, such as the exchange fion, rotates outside an electron sphere at the maximum speed $V_{max} = c$, while the rotational speed of an active fion as a partial charge within an electron sphere is limited to a maximum of $V_{rot} = \frac{c}{2}$. A complete periodic rotation of an active fion around its own axis therefore takes twice as long as that of an exchange fion. This results in an angular momentum for each active fion in the electron with $L_{fion} = \frac{h}{4\pi}$. According to the conservation of angular momentum, the total angular momentum is composed of all individual angular momenta. This is determined with respect to the particle-field $F_{1\text{-}3}$ using Pythagoras' theorem. If the angular momentum is determined to be a half number, this also applies to its spin. The same applies to the integer case.

$$L_{n\,fions}^{2} = \sum_{0}^{n} \left(\frac{h}{4\pi}\right)_{n}^{2} \qquad n \in \mathrm{N} \qquad [L] = \mathrm{Js} \qquad (3.04)$$

The spin for three fions involved is determined as a half-integer via the resulting angular momentum:

$$L_{3fions}^{2} = \left(\frac{h}{4\pi}\right)^{2}_{fion1} + \left(\frac{h}{4\pi}\right)^{2}_{fion2} + \left(\frac{h}{4\pi}\right)^{2}_{fion3}$$

$$L_{3fions} = \frac{\sqrt{1^2 + 1^2 + 1^2}}{4\pi}\,\mathrm{h} \qquad \rightarrow \text{half-integer}$$

L_{3fions}	– angular momentum for three active fions
Index $_{fion1/2/3}$	– stands for the individual active fion
h	– Planck's constant

$$L_{4fions} = \frac{\sqrt{1^2 + 1^2 + 1^2 + 1^2}}{4\pi}\,h \qquad \rightarrow \text{integer}$$

$$L_{5fions} = \frac{\sqrt{1^2 + 1^2 + 1^2 + 1^2 + 1^2}}{4\pi}\,h \qquad \rightarrow \text{half-integer} \qquad \text{(see note)}$$

Note: Group theory (**Chapter 2.2, Point 15**) uses examples from geometry to explain why fermions must always have half-integer spin.

This model makes it possible to predict the half-integer spin of fermions and the integer spin of bosons.

Temporary incorporation of external fions into the electron sphere:

It is very likely that there is an indefinite amount of free active fions that have exceeded the minimum coupling frequency but do not have enough energy to expand into an electron. These fions require interference with other fions in order to obtain sufficient energy for an electron structure. Such fions could temporarily transition into an electron sphere with a suitable resonance frequency. When operating at a suitable resonance frequency, such fions are capable of forming a temporary bond with an electron sphere.

The mechanical process could occur as shown in **Figure 3.2**. Since the electron seeks the favourable state as an elementary particle with only three active fions within its bundle, the absorbed external fion does not become part of the bundle and does not form any further partial charge within it, but is released again after a short time. The time span of synchronisation with the rest of the fion bundle is not bound to the period $2T$. During this time, the mass of the electron has nevertheless increased with this additional external fion. It cannot be ruled out that such a fion reception could not also take place twice at the same time. This property is particularly important for the structure of particles. In this situation, the electron receives a short-term integer spin via the resulting angular momentum to the outside, as if it consisted of four active fions.

Visible and hidden particles:

The **visible particles** refer to coupling, **registering matter** that has a common point of contact for the above-mentioned bundle of fions exactly in the dimension plane D_{56} and thus convey a registering field T-periodically into the particle-field $F_{1\text{-}3}$. The synchronous rotation of such a bundle of fions is shown in **Figure 3.6 on the left** as a positron.

Hidden particles belong to the group of coupling, **hidden matter** and are attributed to fions and bundles of fions as shown in **Figure 3.6 on the right**. These exhibit a deviation with a deviation angle β, such that the rotation at the point of contact with the dimensional plane D_{56} is $\cos(kt + \beta)$. They exchange their fields either via a weak interaction or not at all. Nevertheless, it is important to take their existence into account, because according to the FSM, more complex particles such as the neutron do interact with hidden matter. As will be explained in detail in the next chapter, the hidden particles are the presumed reason for the limitation of the number of neutrons in an atomic nucleus.

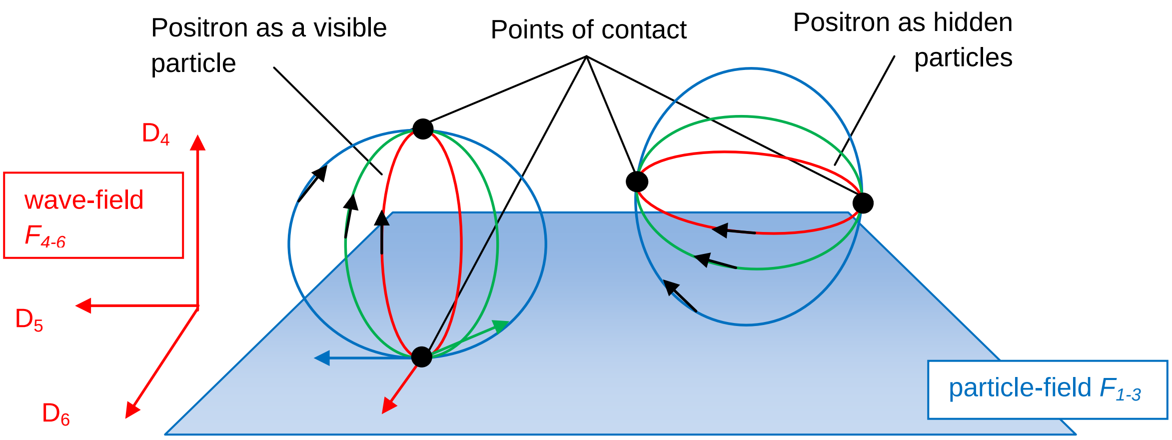

Figure 3.6: Left: Formation of the positron with a common point of contact on the dimension plane D_{56}; right: the points of contact of the positron are not in the dimension plane D_{56} on

Number of possible 4-dimensional rotational paths:

Taking into account visible and hidden matter, we will now investigate how many different 4-dimensional rotational orbits the fions can occupy. The common field body of the sphere S in the wave-field $F_{4\text{-}6}$ has a maximum adhesion of two spatial dimensions for fions with 4-dimensional subspaces. For fions in the field $F_{1\text{-}3}$ there are at least two spatial dimensions. **Table 3.1** provides an overview of all possible combinations that lead to 4-dimensional rotational orbits.

Dimensions / 4-dim. rotational orbits	field $F_{1\text{-}3}$			field $F_{4\text{-}6}$		
	D_1	D_2	D_3	D_4	D_5	D_6
1	X	X	X	X	/	/
2	X	X	X	/	X	/
3	X	X	X	/	/	X
4	X	X	/	X	X	/
5	X	/	X	X	X	/
6	/	X	X	X	X	/
7	X	X	/	X	/	X
8	X	/	X	X	/	X
9	/	X	X	X	/	X
10	X	X	/	/	X	X
11	X	/	X	/	X	X
12	/	X	X	/	X	X
13	X	I	/	X	X	X
14	/	X	/	X	X	X
15	/	/	X	X	X	X

Table 3.1: Shows a 6-dimensional field matrix for all possible 4-dimensional rotation paths in R^6

"X" means the spanning of a 4-dimensional subspace U, while "/" means that no spatial direction is spanned for this dimension. Blue: the visible matter in the field F_{1-3} as a transverse wave (1-3) and a longitudinal wave (4-6); Green: uncharged exchange fions interacting with the field F_{1-3} and F_{4-6}; Grey: the hidden particles in the field F_{4-6}.

Theoretically, 15 different 4-dimensional rotational orbits would be available in a 6-dimensional space with one intersection point at one location. Nine of these are exchange fions that have their intersection in 2 dimensions in the field F_{1-3} and F_{4-6}. Three 4-dimensional rotational orbits are attributable to fions that have a 3-dimensional intersection with the reference field F_{1-3}, and three further 4-dimensional rotational orbits are attributable to photons that have a 3-dimensional intersection with the reference field F_{4-6}.

Figure 3.7 shows the result of this investigation, which consists of the different positions of the rotational orbits with different interactions. Six 4-dimensional rotational orbits correspond directly to visible particles. Three further inactive exchange fions can interact with both visible matter and hidden matter. Six further rotational orbits correspond to hidden particles that exist exclusively in the wave-field F_{4-6}.

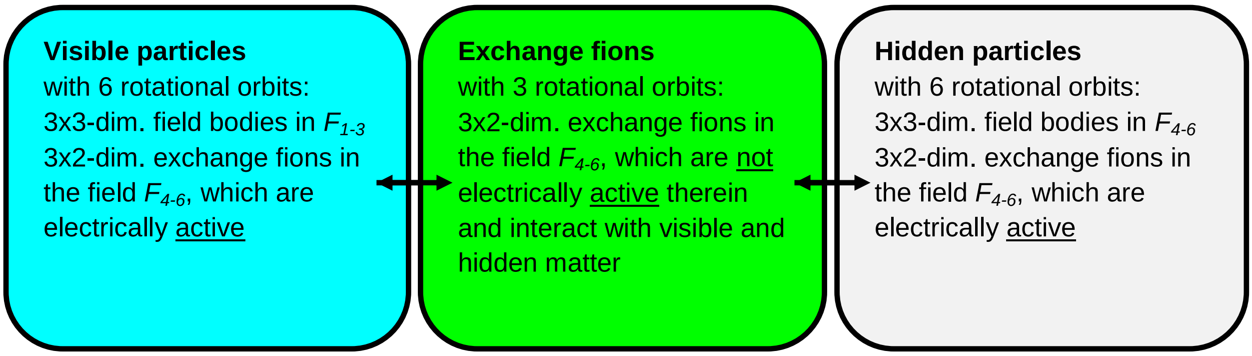

Figure 3.7: Distribution of the 15 x 4-dimensional rotational orbits in R^6

The 6-dimensional space structure can be used to model numerous of particles, including those that interact with hidden particles.

Interaction between charged particles:

The total charge of an electron consists of three active fions with their respective partial charges of total:

$$Q = 3 \cdot \frac{1}{3} e.$$

Several charged particles can encounter each other within the energetic influence of atomic nuclei. In such cases, an electron in the relative proximity of another particle is able to provide one of its third charges $Q = \frac{e}{3}$ as an exchange fion by splitting an active fion into an exchange fion/passive fion pair. Due to their unsuitable position in sphere S, the remaining passive fions continue to rotate at maximum speed $V_{max} = c$ without any potential. The exchange fions are available for exchange with another particle. An active fion with a partial charge $Q = \frac{e}{3}$ is now missing from the total charge of the particle. The respective exchange fion is released in order to exchange fields. The exchange fion can migrate with the property of a free fion outside sphere S along the dimension plane D_{56} to the next point of contact with the neighbouring particle at the maximum speed $V_{max} = c$. During the actual rotation, the exchange fion cannot emit any fields into the particle-field $F_{1\text{-}3}$ that would be greater than its own speed due to its rotational speed of $V_{max} = c$. The exchange fion thus behaves like a visible photon along the path to be traversed. With the absorption of the exchange fion into the receiving particle at the point of contact, the transition from free rotation at the maximum speed $V_{max} = c$ to feedback to a total charge occurs by resetting itself to the speed of $V_{rot} = \frac{c}{2}$. The reset of the exchange fion takes place at a multiple resonance frequency of the actual particle. The respective exchange fion and the respective remaining passive fion recombine in the respective electron to form an active fion again. The matter pulse for the electron with $P = M_e\ c$ is transferred to the particle-field exactly during this reset.

Since the circular frequency k and the maximum velocity $V_{max} = c$ remain invariant during a field deformation, the parameter for the field propagation velocity V_5 in space-time must decrease in opposition to this reset in order to absorb the momentum P with a larger field propagation velocity V_4. The mediated interaction fields and masses increase their magnitudes to a multiple factor for the required resonance frequency between the exchange fion and the electron. A particle such as the electron obtains its characteristic mass and the strength of its specific interaction field. This process always takes place during the exchange of interaction fields between particles and is examined in more detail in **Chapter 3.4** with the *particle-exchange fion-particle-coupling*.

The Pauli principle of Quantum Mechanics states that two fermions – particles with half-integer spin – cannot be in the same place at the same time (exclusion principle). In FSM, this principle is specifically traced back to the dimension-dependent exclusion conditions for an intersection of several 4-dimensional subspaces in the field-space. Two fermions with the same spin occupy six 4-dimensional subspaces at the same intersection point, which results in an overshoot of the natural geometric limit.

The close-range effect in the FSM model corresponds to Michael Faraday's definition. Applied to the field-space particle model, it means that space itself can trigger an interaction with the presence of particles. The fion exchange begins between charged particles whose fields come close enough to influence each other. The process could occur, for example, like an electric arc between two charged spheres in high-voltage technology, which are connected to each other by their electric field. In the $F_{4\text{-}6}$ wave-field, all particles are interconnected by the surrounding photon field. When particles come within a certain proximity to one another, an electrical potential equalization occurs, which is registered as an interaction within the particle-field. Like the surrounding photon field, the exchange field is also electromagnetic. The triggering of equipotential bonding with the help of an exchange fion begins with the distance between the particles, which ensures that after the exchange fion arrives at the receiving particle, its active fions are also at the point of contact in order to interfere with it. In accordance with quantum principles, the distance between the particles is assumed to be a multiple of its wavelength of $\frac{\lambda}{2}$. Of particular interest are cases involving more complex particle structures, which require a much smaller wavelength and a much earlier onset of interaction.

Depending on the electromagnetic wavelength of the exchange fion, which recombines in the wave-field $F_{4\text{-}6}$, two-dimensional fields are transmitted via the matter pulse into the particle-field $F_{1\text{-}3}$, which the observer registers as an electric field or strong/weak interaction.

Note on the following illustration:

The real rotation of exchange fions takes place parallel to the dimension plane D_{56}. This is difficult to illustrate. For illustrative purposes, the exchange fions are therefore shown as well orthogonal to the dimension plane D_{56}.

Particles with unequal charges attract each other, if

a) their exchange fions rotate in the similar direction and can merge with the respective recipient particle, and

b) the active fions of both particles rotate in the same direction above and below the dimension plane D_{56}.

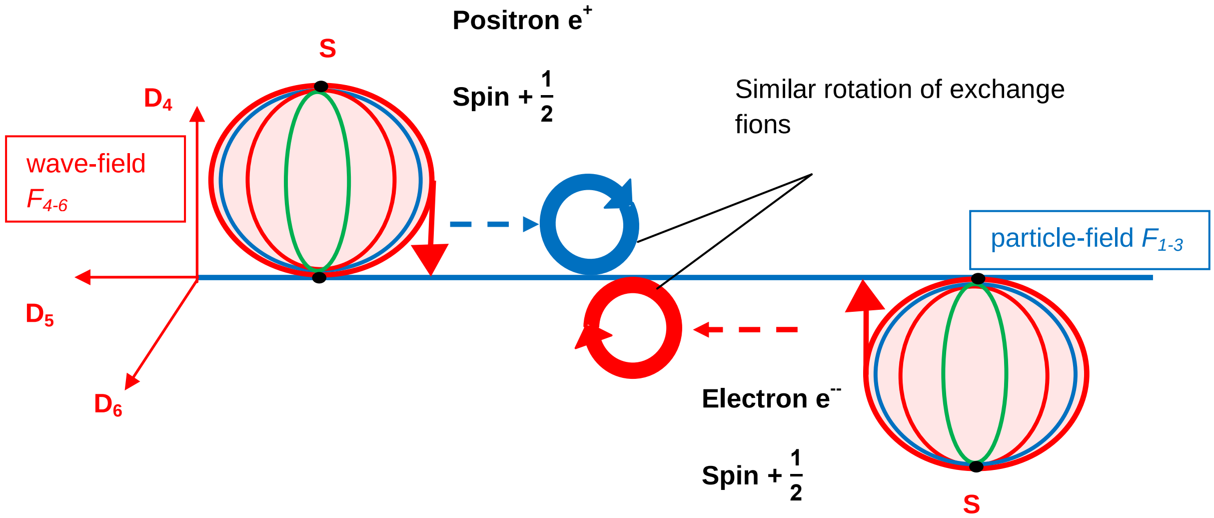

Figure 3.8: The interaction in the case where particles with opposite charges and the same spin attract each other

Particles with the same charge repel each other, if

c) the exchange fions rotate differently and thus ignore each other, and

d) the active fions rotate in the same direction with their subspaces in the sphere S.

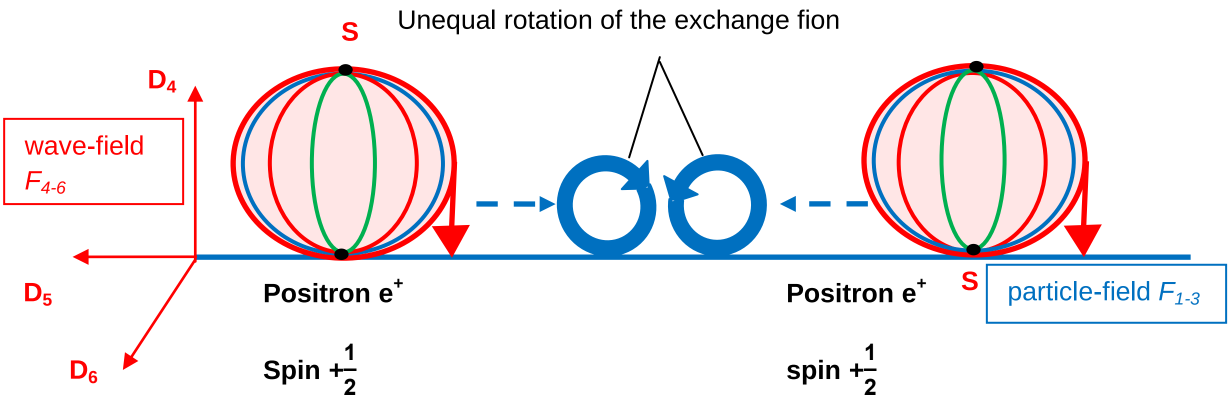

Figure 3.9: The interaction in the case where particles of the same charge and spin repel each other

The repulsion is caused by the fact that sphere S cannot accommodate any further three active fions in the same direction of rotation in its existing spatial dimensions. Otherwise, the particle would have six 4-dimensional rotational paths at one location, which would require a seventh spatial dimension. In this model, the limited number of dimensions is the reason for the effect of the Pauli principle.

Particles with the same charge can ignore each other, if

e) the exchange fions rotate differently and thus ignore each other, and

f) all active fions of the respective other particle rotate in opposite directions at one location with their subspaces U. Thus, in a sphere S, the condition would be fulfilled at every location that fewer than six active fions rotate in one direction within an overlap zone.

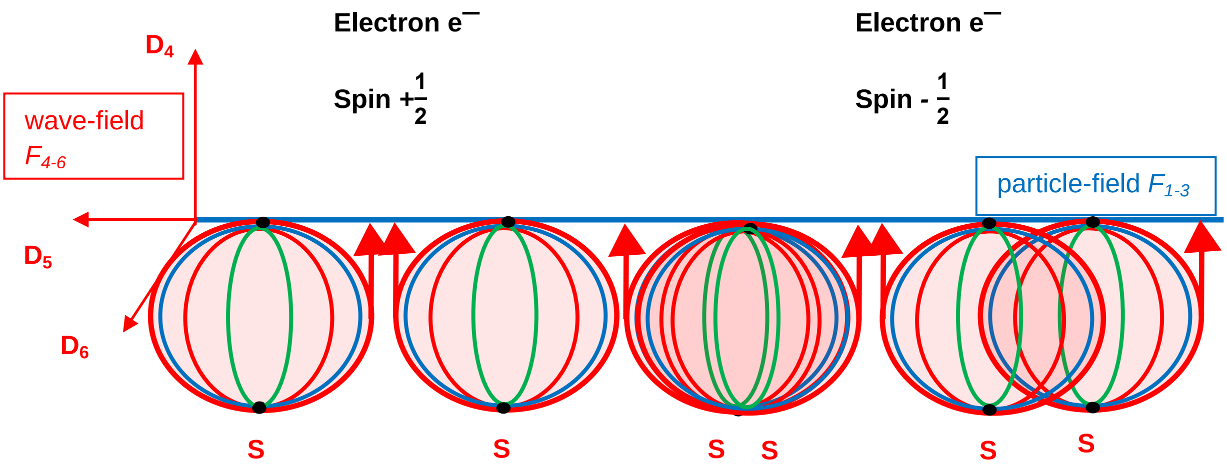

Figure 3.10: The interaction in the case where particles with the same charge but different spins ignore each other

As described above, the spin of the electron will assume a spin of $\pm\frac{1}{2}$. When electrons with different spins occur, they simply pass each other because they do not exert any attractive or repulsive forces on each other. In such an overlap zone with oppositely rotating fions in the particle spheres, the Pauli principle is not violated.

Annihilation reaction:

A destruction reaction requires a specific spatial structure between two differently charged particles. The active fions from an electron rotate below and the active fions from a positron rotate above the dimension plane D_{56} so that a fion exchange can take place. The rotation of their spheres S takes place antiparallel to the dimension plane D_{46}. These two particles come too close to each other and meet at their respective points of contact in such a way that their fions are exactly or almost in phase at the respective points of contact, see **Figure 3.11 on the left.** The contact between the two particles triggers a direct field exchange of the respective exchange fions and stops any further movement in the wave-field F_{4-6}. On average, both particles are at rest relative to each other and no longer require any further orthogonal shaping to the dimension plane D_{56} in order to exchange their fields beyond the short-range effect. The more precisely the individual active fions face each other, the more perfectly they synchronise their movements, which cancels out their respective orthogonal shaping to the dimension plane D_{56}. Both particles now tangent the dimension plane D_{56} (take a view at **Figure 3.11 on the right**).

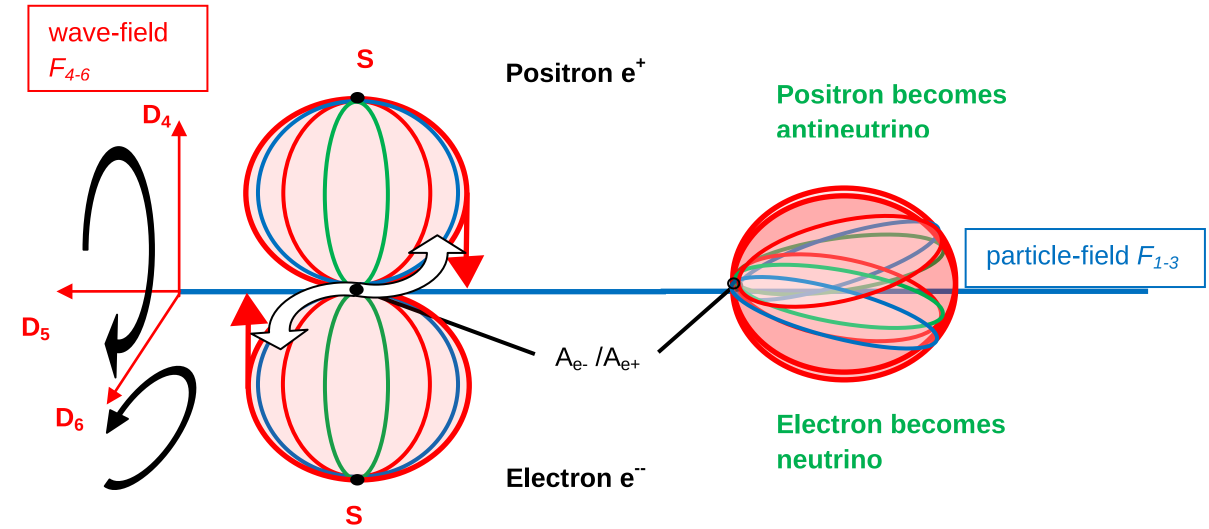

Figure 3.11: Pair annihilation reaction of electron and positron

The conservation of angular momentum requires that the final product has the same angular momentum as the initial product.

In case A, the electron and positron rotate in exactly the same phase. Both reach the dimension plane D_{56} simultaneously and touch each other at one point. As a result, all fions superimpose to form a large rotating unstable photon, which, due to the available space, finds itself at this location with too much excess energy. This leads to a fluctuation, which emits its energy to the environment. Photons with integer spin are generated, which contain the energy of both particles. Due to their formation parallel to the dimension plane $D_{56,}$ these photons are registered as visible photons in the particle-field $F_{1\text{-}3}$.

Case B occurs during contact between the particles due to a slight phase shift between the fions. There is only one common point of contact between all fions on the dimension plane D_{56}. In this case, the sphere S of both particles can remain intact because no permanent fusion takes place. Although both particles can behave like a photon with minimal decelerating effect in the entire field-space, additionally they have lost their charge properties due to their lack of orthogonal formation in the wave-field $F_{4\text{-}6}$ to the dimension plane D_{56}. No more charge is generated. This reaction transforms the electron into a neutrino and the positron into an antineutrino, which, like photons, travel at the field propagation speed $V_3 = V_5 = c$ without potential in the particle-field $F_{1\text{-}3}$ (**Figure 3.11** shows case B).

Matter pulse :

The matter pulse is a mechanism for modelling several processes occurring simultaneously. It is of particular interest for technical applications. It describes the process of periodic field exchange during an interaction between the wave-field $F_{4\text{-}6}$ and the particle-field $F_{1\text{-}3}$, which takes place in the dimensional plane D_{56}. In this process, the particle-field absorbs this matter pulse in the form of, for example, electrical pulses. The term 'matter' is therefore used to symbolise that an invisible interaction from the wave-field $F_{4\text{-}6}$ leads to a detectable field force in the particle-field $F_{1\text{-}3}$. Once separated, fields retain their form. This gives rise to the discrete state of objects as field-compressed entities. A particle appears as matter, although it is in fact a two-dimensional hologram.

The 'pulse' describes the periodic repetition over time of the transmission of fields into the particle-field $F_{1\text{-}3}$. In the process, the active fions T transition periodically, for a very brief moment, to an energetically favoured state at intervals equal to a multiple of their wavelength (λ ~ 0); they then separate again and continue to rotate. From the perspective of the particle-field $F_{1\text{-}3}$, only a point source is detected, from which a 2-dimensional field emanates like a longitudinal wave. As this matter pulse has a frequency in the exa-Hz range (**Chapter 3.5**), the observer perceives the matter pulse as a constant field source. Modelling of the matter pulse can, for example, be used for the technical generation of plasma.

In the microcosm, the metric vector component is dominant:

$$ds^2 \supset [\frac{G\,M}{c^2\,r}(1 + \cos(kt + \beta))\,(c^2\,dt^2 + dx^2 + dy^2 + dz^2)] + 2(A^a_\mu + \delta A^a_\mu)\,dy_a\,dx^\mu$$

- $dy_a\,dx^\mu$ – is, in metric terms, the transition between the wave-field and the particle-field

The wave equations (**Chapter 2.2, Point 11**) provide the following components, which describe the matter pulse as a wave with all its degrees of freedom:

The transverse wave (2) remains with: $h_{\mu\nu} = 0$ Masse = 0

Transverse vector wave (6): $\Box_{(4)} A^a_\mu - \partial_\mu (\partial^\nu A^a_\nu) + 4\pi^2 m_a^2 \frac{c^2}{h^2} A^a_\mu = 0$ massive

Longitudinal vector wave (3): $\Box_{(4)} A^a_\mu - \partial_\mu (\partial^\nu A^a_\nu) + 4\pi^2 m_a^2 \frac{c^2}{h^2} A^a_Z = 0$ massive

Longitudinal scalar wave (3) ist: $\Box_{(4)} \phi_n + m_n^2 \phi_n = 0$ Mass-dependent mode n

The real potential:

$\phi(x, y^a) = \sum_{n=1}^{3} \phi_n(x) \cos(\frac{ny^a}{R})$; depending on the mode (2.87)

leads to the object mass and the effective calibration potential using:

$m_{obj}(t) = \frac{n\,h}{2\pi\, c\, R_{obj}} \cos(kt + \beta)$ (2.91) $A^a_{eff,\,0} = \frac{Q}{4\pi\, \epsilon_0\, R} \cos(kt + \beta)\, \delta^a_4\, \delta^0_\mu$ (2.69)

Cos($kt = 0$) indicates contact in the dimensional plane D_{56} and, at the same time, the state of maximum elongation:

$m_{obj} = \frac{n\,h}{2\pi\, c\, R_{obj}}$ (2.90) $\phi(x) = \frac{Q}{4\pi\, \epsilon_0\, R}$ (2.149)

If the periodic maximum elongation at the point of contact in the dimensional plane D_{56} is considered in isolation, then a field emission from the wave-field $F_{4\text{-}6}$ into the particle-field $F_{1\text{-}3}$ will appear as a moving body.

The process does not have to originate solely from the wave-field $F_{4\text{-}6}$ into the particle-field $F_{1\text{-}3}$. Control from the particle-field $F_{1\text{-}3}$ to the field source can also trigger a feedback pulse that has a disruptive effect on a particle. For example, additional energy could be supplied from the particle-field $F_{1\text{-}3}$ to a proton with a suitable coupling frequency, which would have a disruptive effect on its structure. Alternatively, an object velocity V_3 could also have a relativistic disruptive effect on the rotational orbit of the fions.