SUBSTRUCTURE of Fundamental PARTICLES ?

33 years collaboration between USTC – ETHZ.

From L3, CMS to data analysis of Fundamental PARTICLES (FP)

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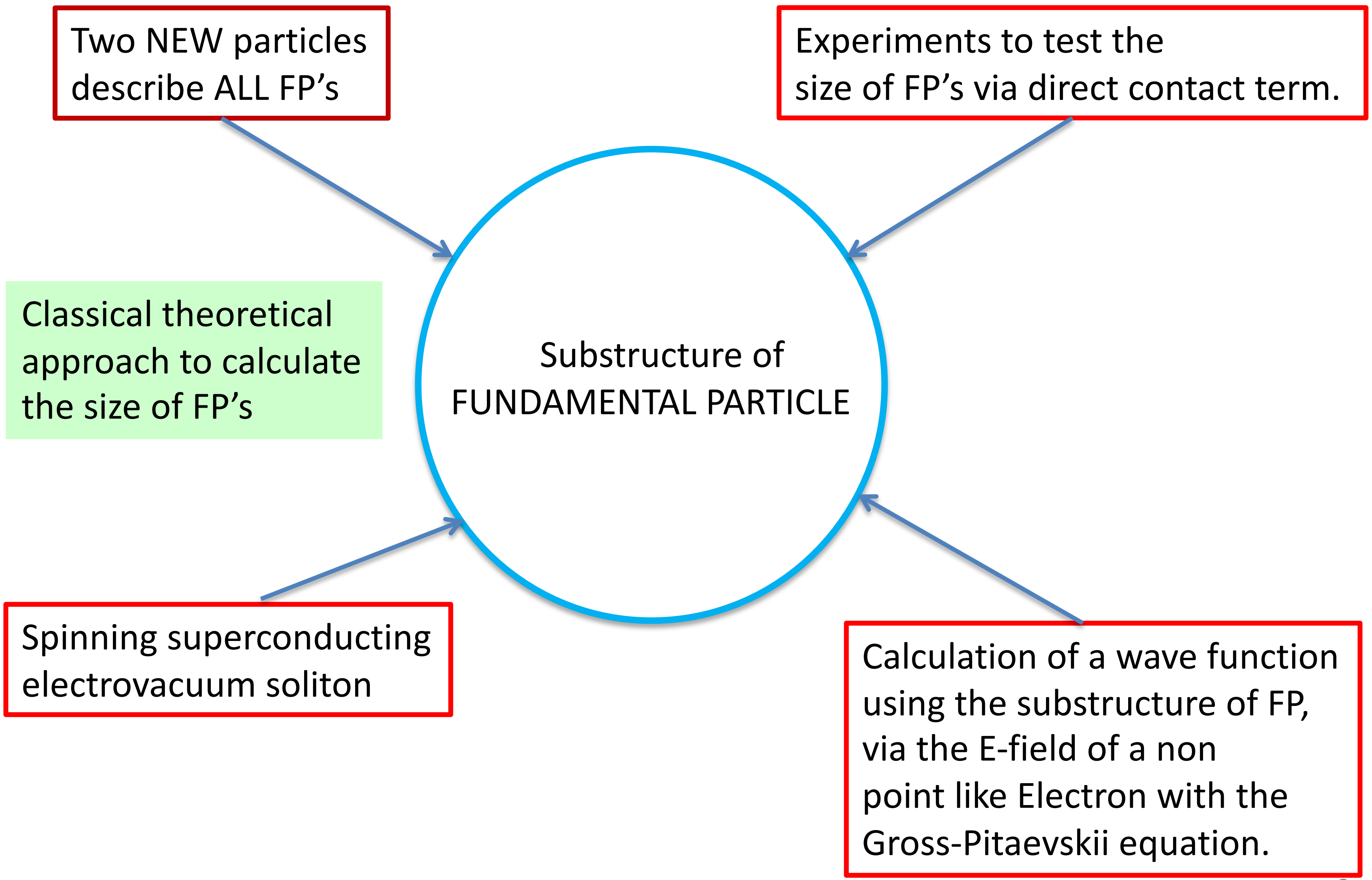
INTRODUCTION



A) Two NEW particles describe ALL FUNDAMENTAL PARTICLES

To introduce these NEW PARICLE it is first necessary to discuss a possible micro structure of Fundamental Particles. For this reason a

Empirical Toy Model Ansatz about a Microstructure of Fundamental Particles

ETAMFP-model

will be discussed first.

Eine Idee die nicht zuerst absurd erscheint taugt nichts. A.E.

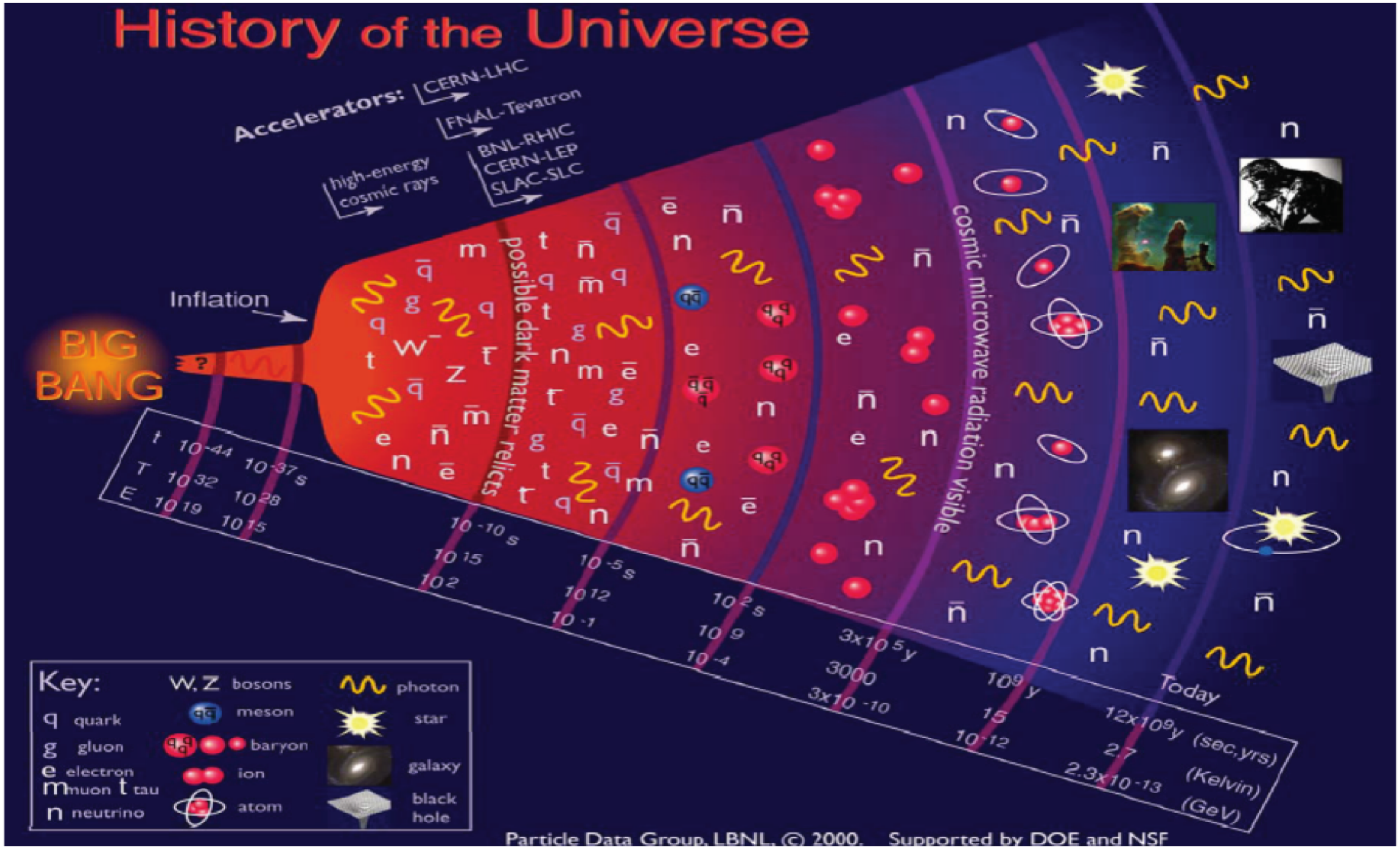
An idea which does not look in the first view absurd isn't much good. A.E.

The history of micro structure of Fundamental Particles extents from J. Michell 1783 with the introduction of Black Holes. Followed by many authors introducing Monopols, Skyrmions, charged scalar fields, Sphalerons, Dilatons, Solitons and until today the search for not point-like behaviour of Fundamental Particles.

The basic idea of the ETAMFP - model

To test the point character of a FP it is necessary to decrease the test size λ to zero. The size λ is direct inverse proportional to the test energy E_{CM} like $\lambda \sim f(1/E_{CM})$ This request leads to infinite high test energies.

Such an experiment will after the running coupling constant of the Standard theory (SM) and the Big Bang (BBM) model change dramatically the physical conditions of the experiment.

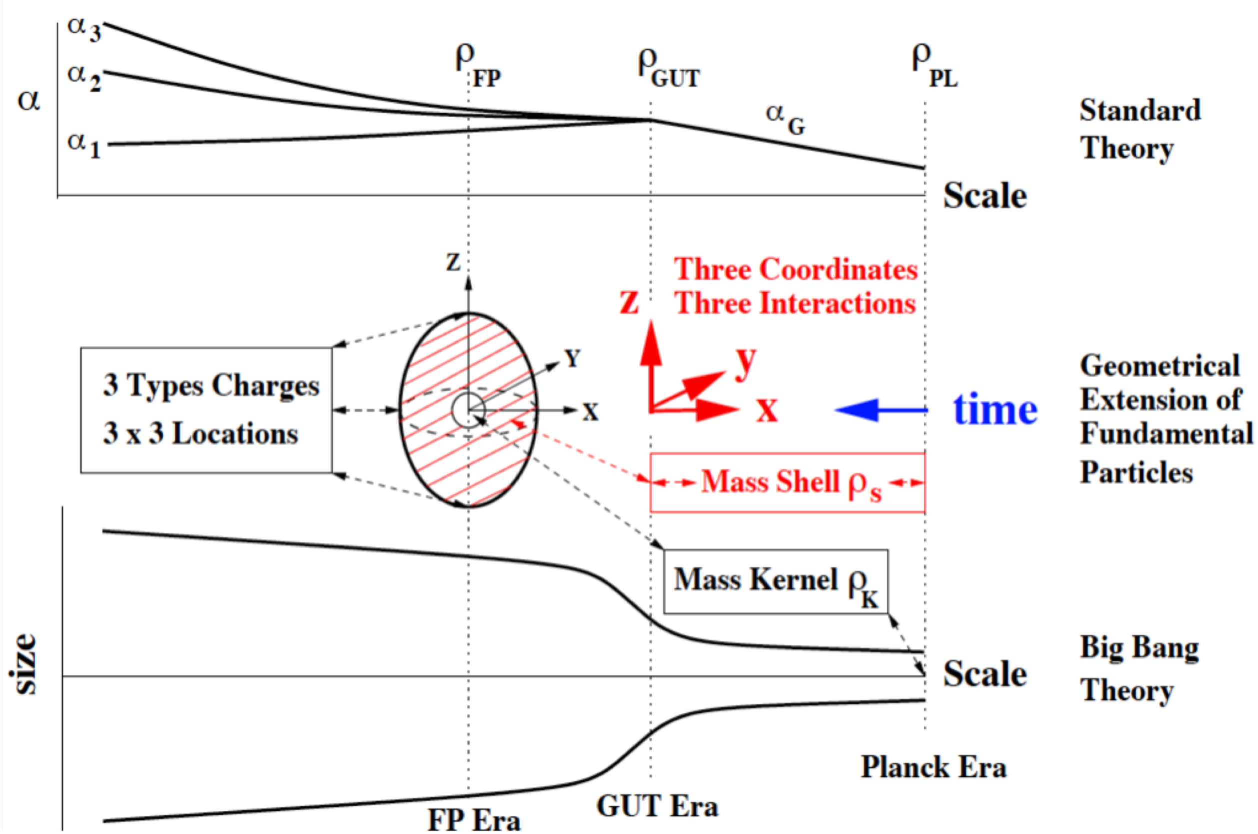


If time reverse invariance hold until infinite test energy, it would be possible to read the microstructure direct from the time development of the SM and BBM model.

The shape of fundamental particles would be connected to the course of history of the universe.

The geometrical approach

The ETAMFP-model of a fundamental particle assumes that the particle contains every energy state a cross of its radius which the universe passed through during its evolution.



FP’s stabilize in the FP Era, the internal structure is for this reason a RESIDUEL of the time development of the SM and Big Bang model.

The TIME in the LINK " Interaction – Space "

At time $t > t_{GUT}$ ($E < E_{GUT}$):

- 4 interactions (Strong, EM, Weak, Gravitation) and 4 coordinates (x, y, z, t), exist. (x, y, z) -> Invariance Angular Momentum Conservation, t –> invariance defines Energy Conservation.

Between $t_{Gut} > t > t_{Planck}$ ($E_{GUT} < E < E_{Planck}$):

- 3 interactions (Strong, EM, Weak), unify to one. Gravitation (Mass), link time is left. Coupling constant of Gravitation get close to Strong, EM, Weak interaction.

Between $t_{Planck} > t > 0$ ($E_{Planck} < E < E_{Big\ Bang}$):

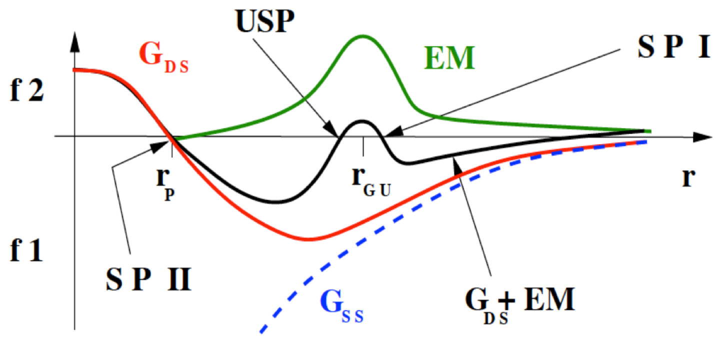
- 1 interaction exist. Gravitation (Mass) time is dominant. Coordinates (x, y, z) are not existing or very small. Size of universe $l_{Planck} = 10^{-33}$ cm.

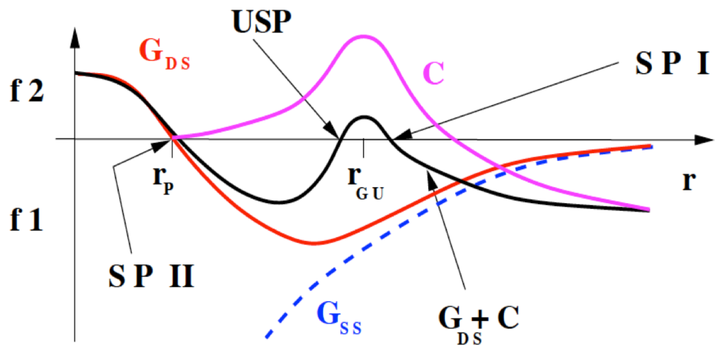
Volume explosion $t \sim 0$:

- Uniform universe, red shift, mass-energy equivalence $E = m \times c^2$, Micro wave background, quantum fluctuation $\Delta E \times \Delta t \sim \bar{h}$. Total spin of universe ZERO.

Forces and Stability

From experiment it is known that e.g in the case of the electron with a mean life time of $\tau > 4.6 \times 10^{26}\,y$ extreme stable distance dependences of the forces acting in the FP’ s must lead to such highly stable conditions. It is for this reason interesting to develop a general scenario of a possible radius dependence of the known four forces what could lead to such extreme highly stable conditions.





SP I and SP II are stable positions for charges.

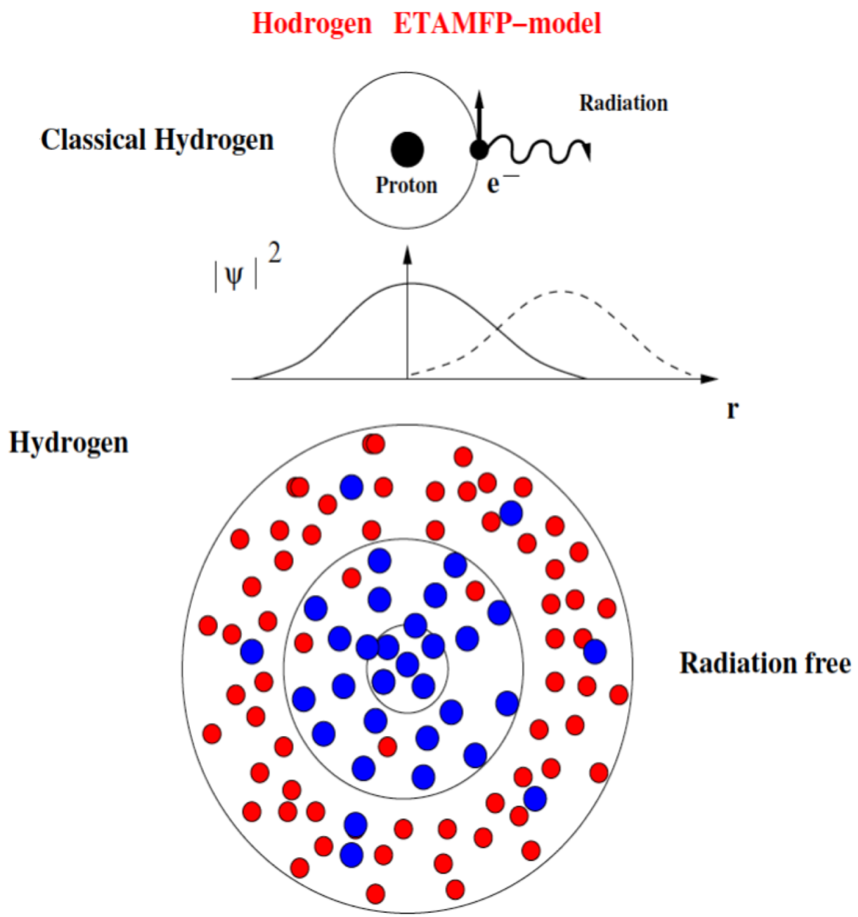
The flashing vacuum

For the electron with a life time of $\tau > 4.6 \times 10^{26}\, yr$ a radiation free path must exist (N.Bohr 1913).

Statistical fluctuations between ON shell and OFF shell.

Vacuum opens the possibility to introduce a microscopic picture for the probability function. $|\Psi|^2$ of Hydrogen or ETAMFP-electron.

The charge in the ETAMFP electron oscillates between ON shell and OFF shell (vacuum) and circle in this manner radiation free the centre.



Scheme for Extended Fermions and Bosons

- In the Standard Model are e.g. the parameters mass, spin, magnetic moment, electric dipole moment of the fundamental particles measured or calculated under the assumption the particles are mathematical points.

  As consequence the fermions with a finite rest mass would have in the centre an infinite density and with a Schwarzschild radius of about $R_s = 2 \times G \times m / c^2 \sim 10^{-55} cm$ behave like Black Holes.

- The ETAMFP model of extended Fundamental Particle would permit to avoid this difficulty and opens the possibility to describe the discussed parameters of the fundamental particles in a microscopic picture.

Four building block of microscopic picture

- Three coordinates x, y, z plus time.
- Three plus one interactions : STRONG, EM, EW and (Gravitation)

- Three CHARGES: COLOUR C -----> R G B
  ELECTRIC Q -----> 0 ; 1/3 ; 2/3
  WEAK T3 ---→ 0; 1/2 ; 1

- Plus pseudo CHARGE MASS: time

$$F_Q = \frac{1}{4\pi\varepsilon}\frac{Q_1 Q_2}{r^2}$$

$$F_M = \frac{1}{4\pi\mu}\frac{p_1 p_2}{r^2}$$

$$\rightarrow F_G = G\frac{m_1 m_2}{r^2}$$

- Three FAMILIES of fundamental particles

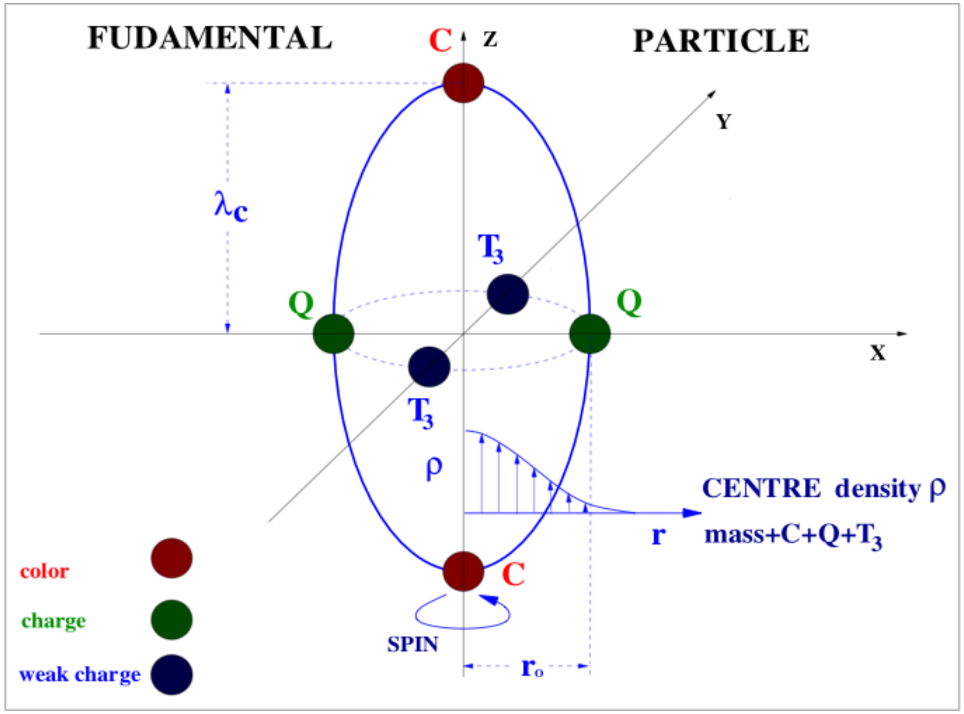
- Three quarks form one proton/neutron

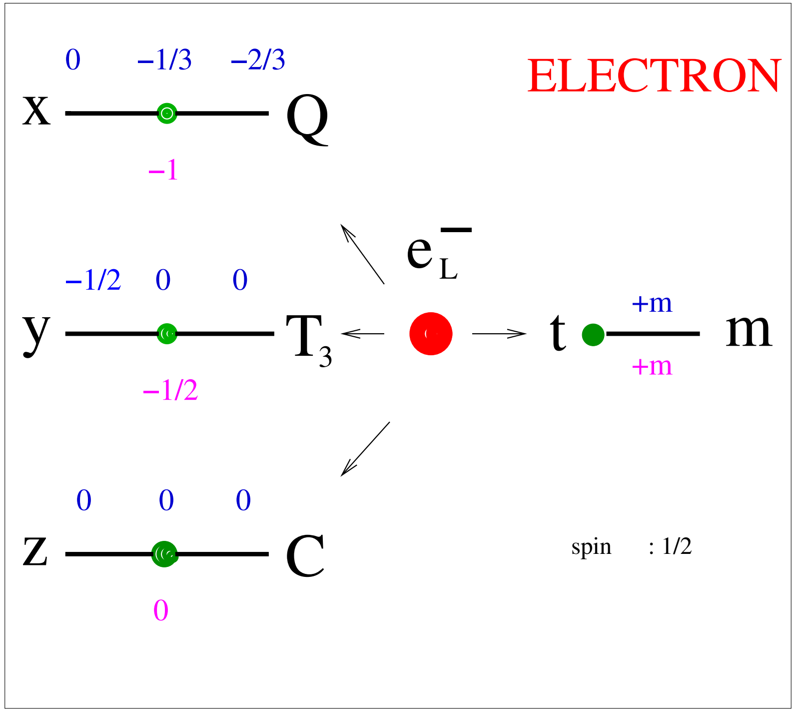
The introduction of TWO NEW Particles

PARTICLE A → Charge ± 2/3 Spin 1/2

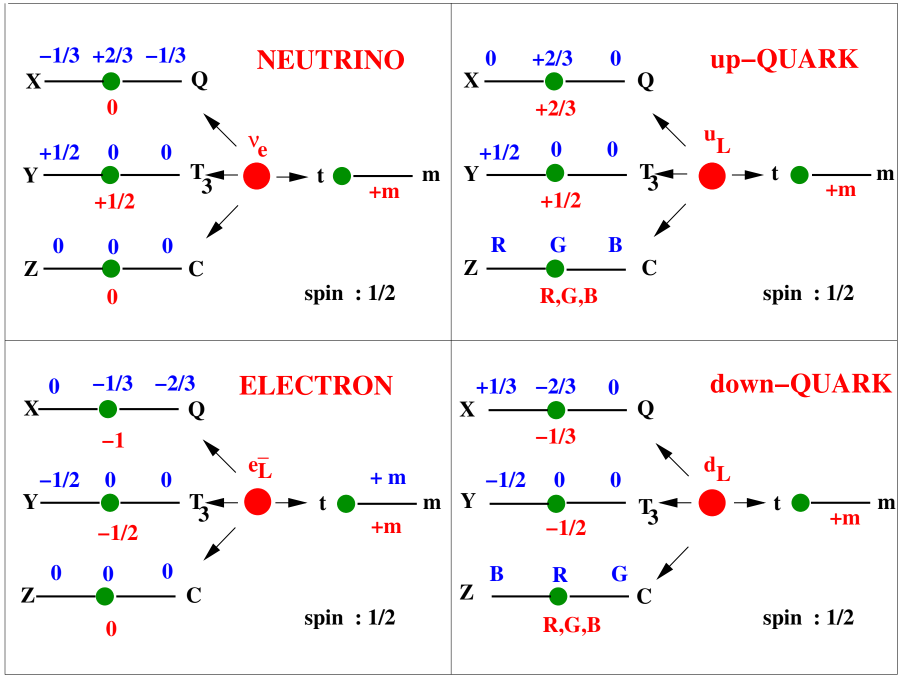
PARTICLE B → Charge ± 1/3 Spin 0

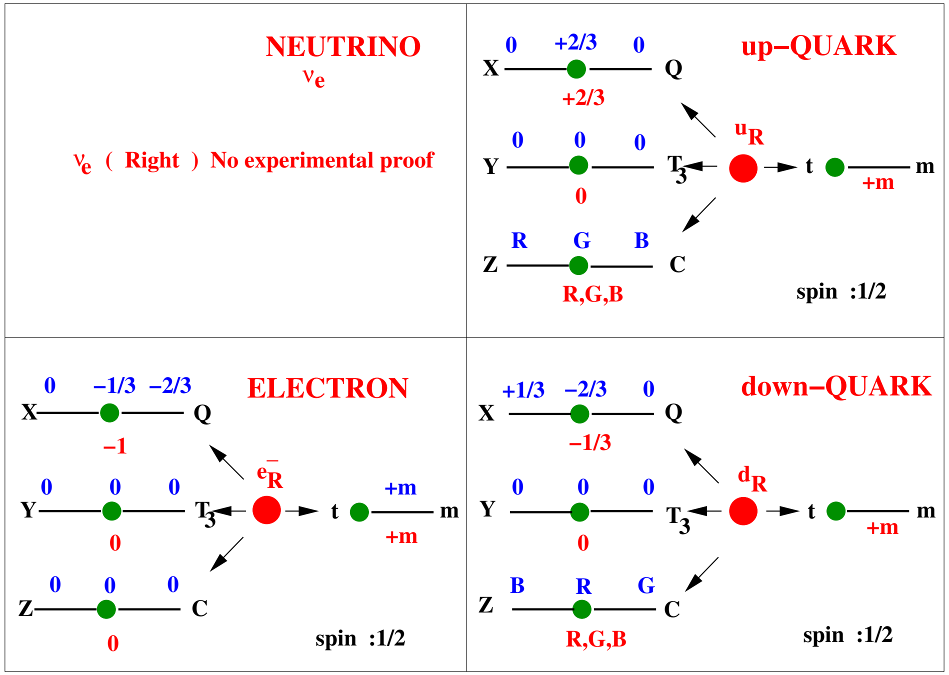
Scheme of the General Principle





Scheme of lightest left and right handed FERMIONS



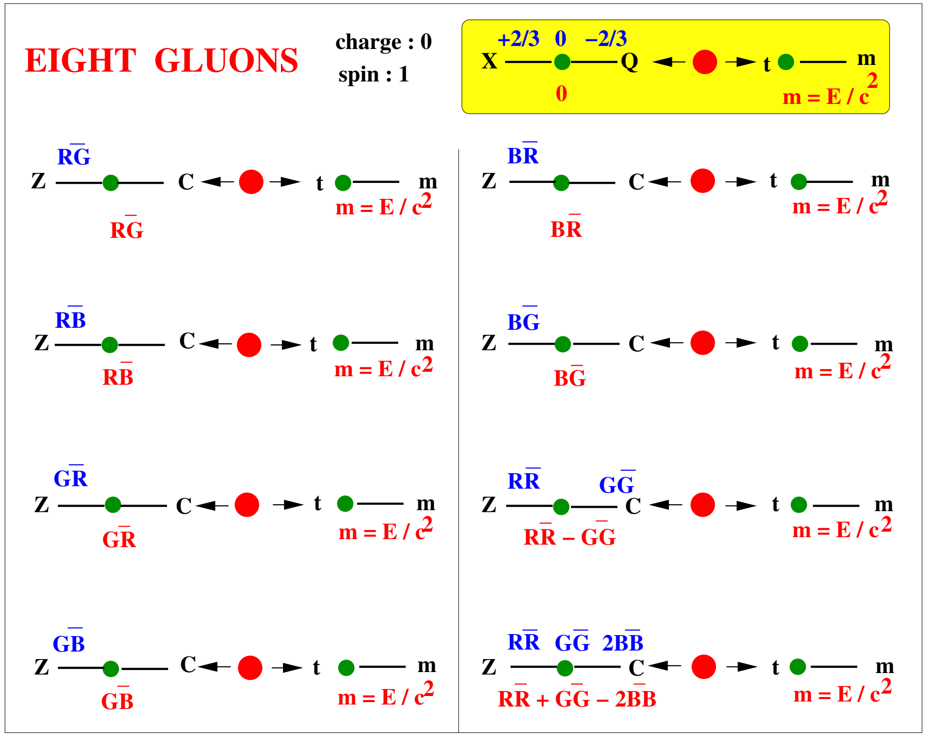


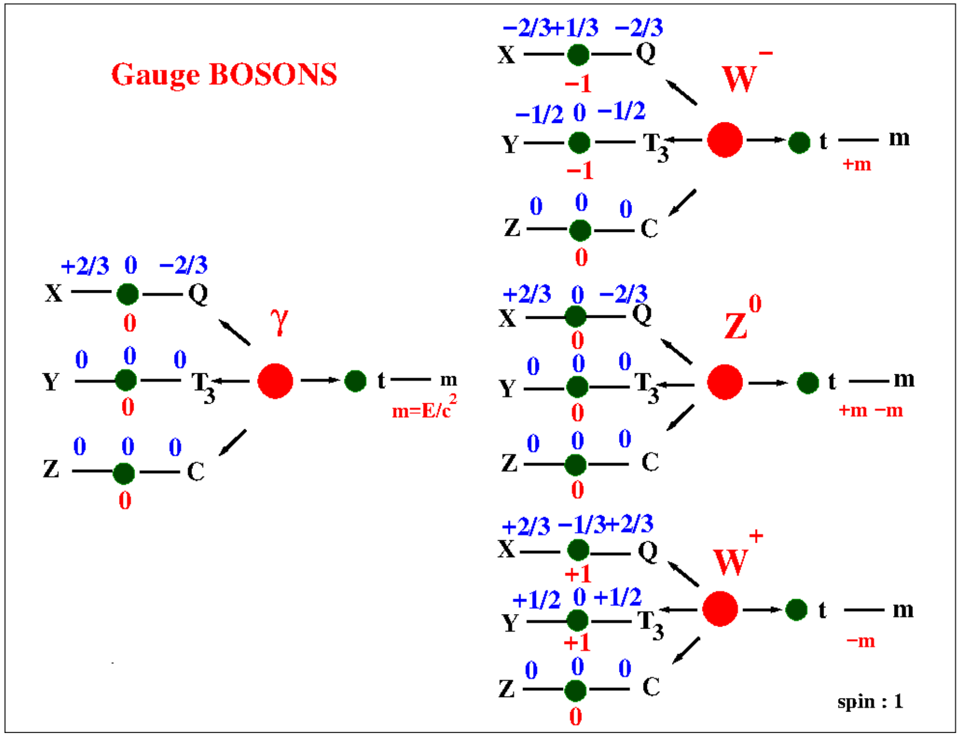
The SCHEME requests:

- Electron carries magnetic moment and electric dipole moment.Weak moments are possible.
- The up quark carries a magnetic moment.Weak magnetic moment is possible.18 colour combinations are possible.(RRR,GGG etc)
- The down quark could carry a magnetic and / or Weak magnetic moment. 18 colour combinations are possible.(RRR,GGG etc)

The QUARKS are the ONLY particles where all possible free positions for CHARGES are occupied. The QUARKS have a confined structure.

Scheme of the bosons





The SCHEME requests:

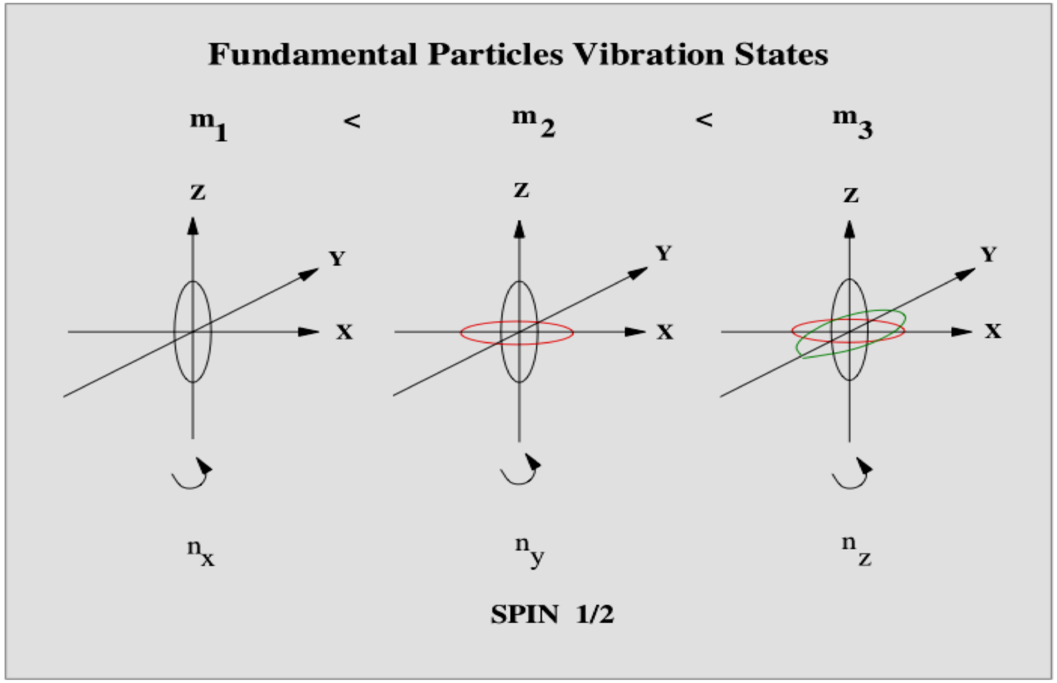
- Colour and anti-colour are located at one point.
- Eight gluons match on the z-axis.
- The bosons gamma and Z are only distinguished in the mass.

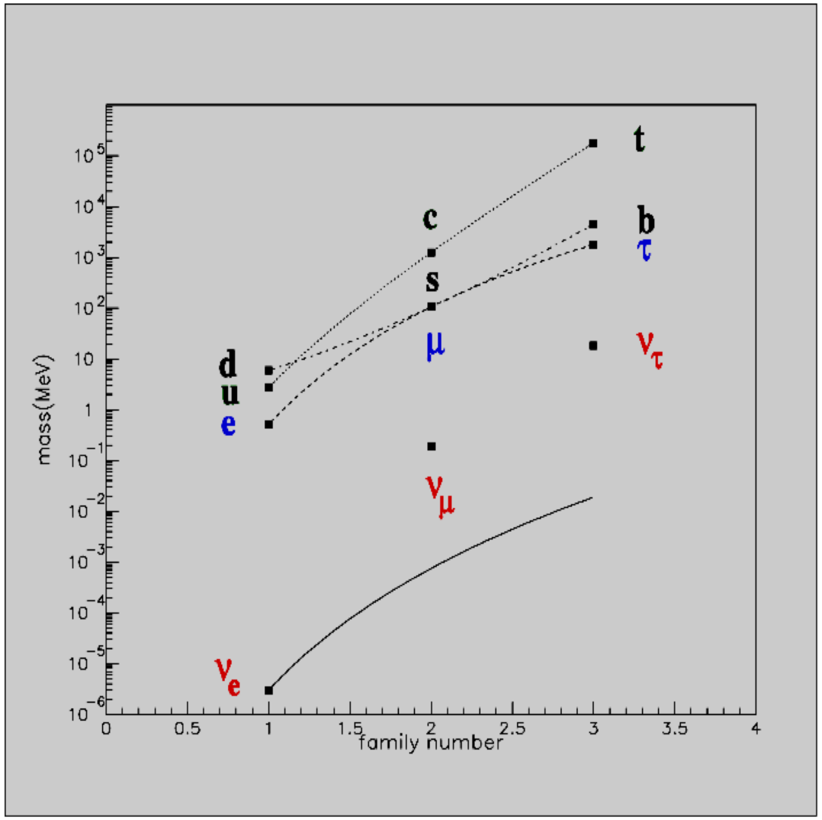
The Higgs is very simple. It would be composed of particle B Charge + 1/3 ; -1/3 Spin 0

The combination red/anti-red, green/anti-green,blue/anti-blue generates a confined structure.

Fermions and Bosons couple to the TOTAL Spin ZERO. $\boxed{2 \times \frac{\vec{1}}{2} + \vec{1} = \vec{0}}$

The first three vibration states of fermions





$$E = \hbar\omega_o(n_x + n_y + n_z + 1/2)$$

$$E(k_i;Q) = (A + B|Q| + CQ^2 + D|Q|^3)(k_i)^{f(Q,k_i)}$$

$$f(Q,k_i) = \left[R + |Q|V(k_i - 1) + |Q|(|Q| - 1)\left\{S(|Q| - 1/3) + W(|Q| - 1/3)(k_i - 1) + T(|Q| - 2/3) + Z(|Q| - 2/3)(k_i - 1)\right\}\right]$$

$$2 - Parameters \rightarrow CARGE = Q - and - FAMILYnumber = k_i = (1,2,3)$$

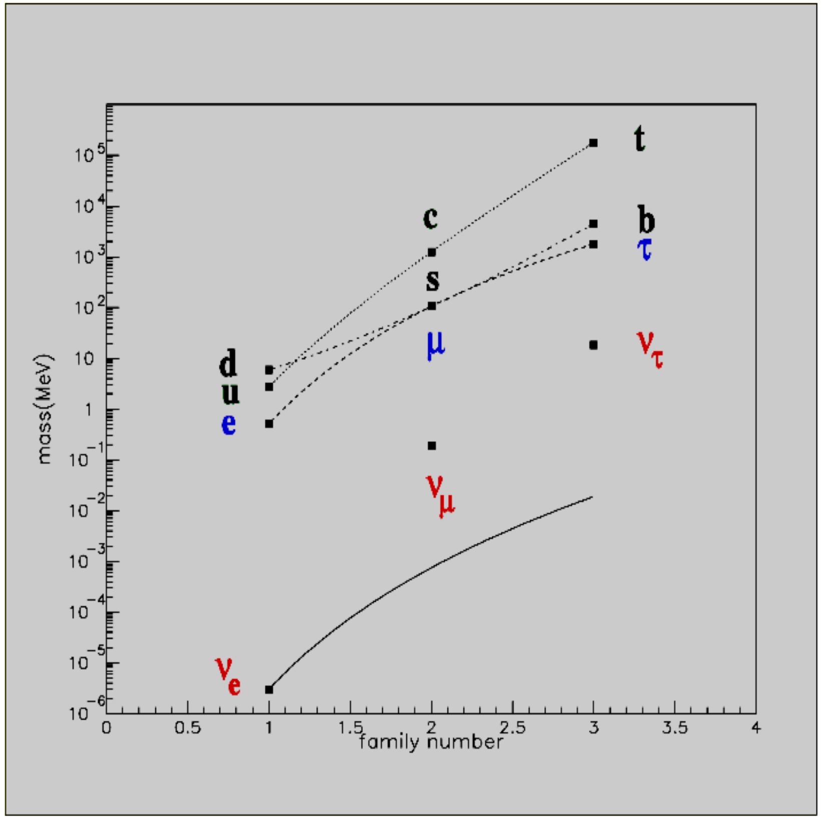
Constants $A < 3\times 10^{-6}\,MeV$ B=42.1 MeV,C=-87.8 MeV,D=46.2 MeV,R=7.96,V=-0,27,S=5.25,W=-19.38,T=-77.34 and Z=26.82

Pseudo CHARGE MASS - Time - Dimension 4 - Flavour

The Pseudo CHARGE MASS defines the quantum numbers:
Charm C , Strageness S, Topness T and Bottomness B’ and
the related quantum numbers: Baryon B and Lepton L.

With the Hypercharge $Y = (B + S + C + B' + T)$ also the
Isospin $Y = 2 (Q - I_3)$ is defined.

Compared to the three coordinates x, y, z is the time, axis an absolute positive vector related to the development of the temperature of the universe. This temperature or energy can generate different masses.



Flavour in particle physics

Flavour quantum numbers

- Isospin: **I** or I_3
- Charm: C
- Strangeness: S
- Topness: T
- Bottomness: B'

Related quantum numbers

- Baryon number: B
- Lepton number: L
- Weak isospin: **T** or T_3
- Electric charge: Q
- X-charge: X

Combinations

- Hypercharge: Y
  - $Y = (B + S + C + B' + T)$
  - $Y = 2\,(Q - I_3)$
- Weak hypercharge: Y_W
  - $Y_W = 2\,(Q - T_3)$
  - $X + 2Y_W = 5\,(B - L)$

Flavour mixing

- CKM matrix
- PMNS matrix
- Flavour complementarity

V • T • E

Wikipedia

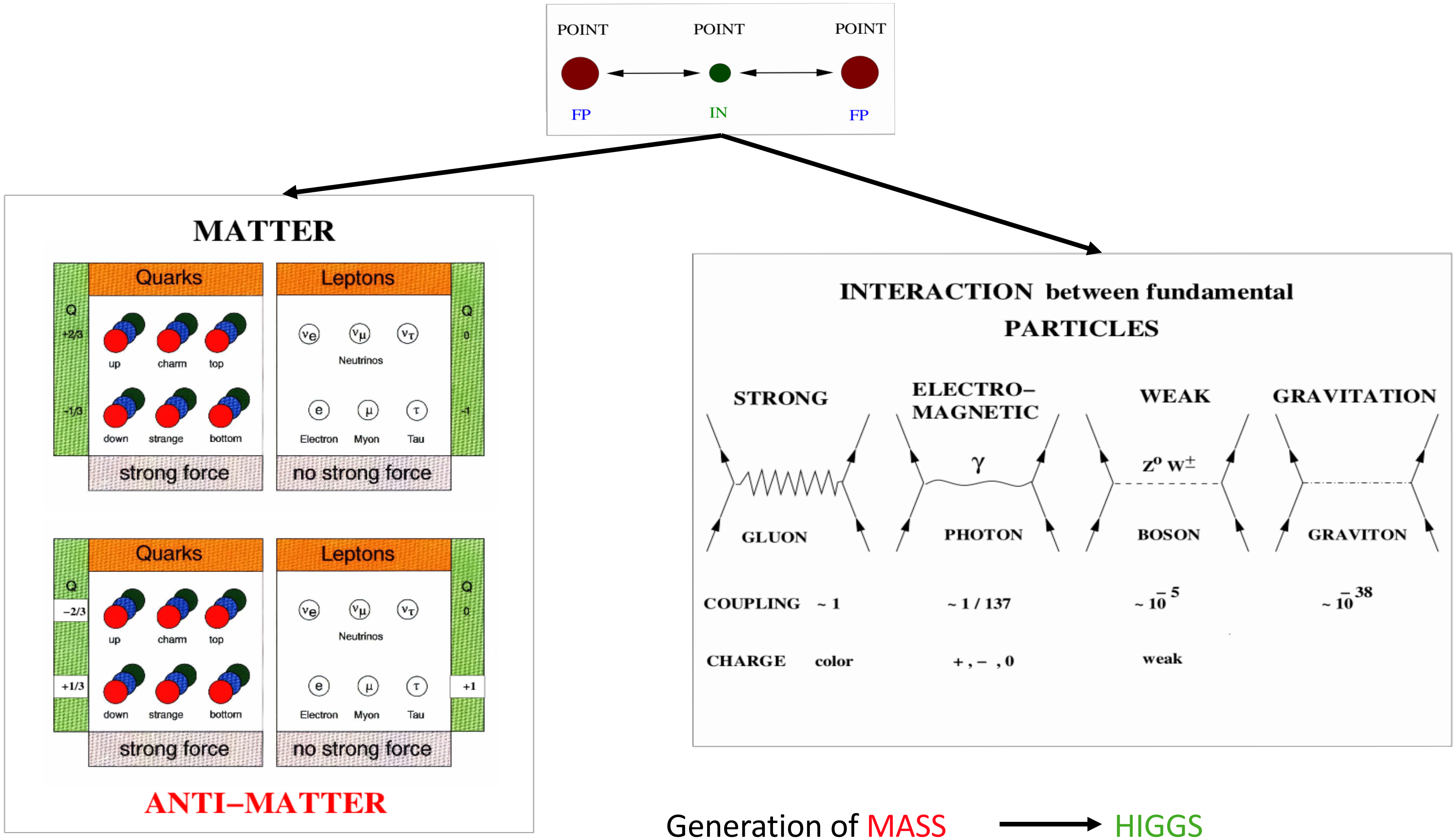
Conclusion of the new PATTERN

The introduction of the TWO new PARTICLES A and B allow to construct the light 20 FUNDAMENTAL PARTICLES with the PARTICLE A and B. A reduction of a factor 10.

The 8 heavy fermions are described also by these two particles. The are distinguished only be the mass from the light fermions. A possible vibration state would further reduce 8 parameters to two.

B) Experiments to test the size of FP’s via direct contact term.

Reminder Standard Model



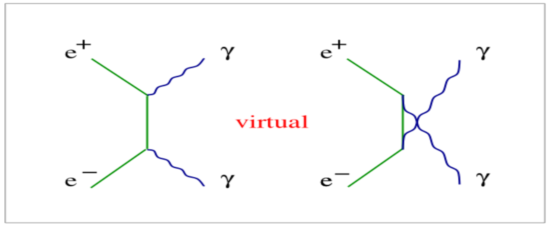
Generation of MASS ⟶ HIGGS

Electromagnetic Interaction

- In the case of electromagnetic interaction the process

$$e^+e^- \longrightarrow \gamma\gamma(\gamma)$$

is ideal to test the QED because it is in the initial and final state not interfered by the Z^0 decay.



- the Lagrangian for the electromagnetic interaction in QED is

$$L_{\text{int}} = -e\bar{\psi}\gamma^\mu\psi A_\mu$$

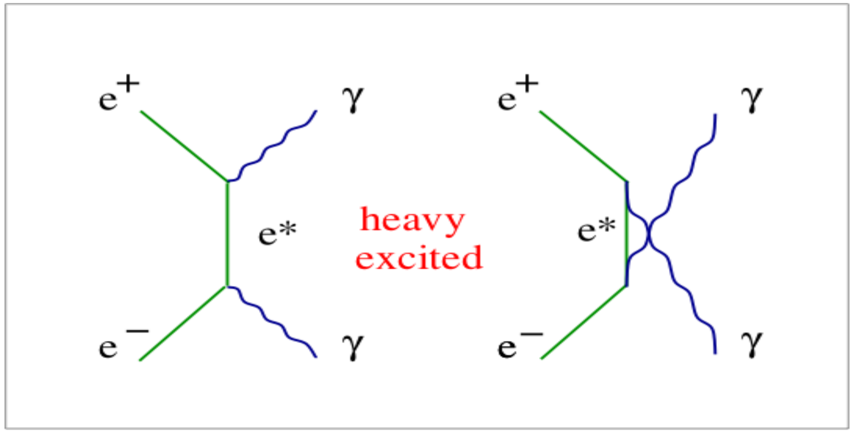
- the Born level cross section

$$\frac{d\sigma^0}{d\Omega} = \frac{\alpha^2}{s}\frac{1+\cos^2\Theta}{1-\cos^2\Theta}$$

- the third order cross section

$$\boxed{\left(\frac{d\sigma}{d\Omega}\right)_{\alpha^3} = \left(\frac{d\sigma^0}{d\sigma}\right)_{\alpha^2}(1+\delta_{virt}+\delta_{sb}+\delta_{hb})}$$

Heavy excited electron with mass m*



$$L_{excited} = \frac{e\lambda}{2m_{e^*}} \bar{\psi}_{e*} \sigma_{\mu\nu} \psi_e F^{\mu\nu}$$

λ is the coupling constant, $F^{\mu\nu}$ the electromagnetic field tensor, Ψ_{e*} and ψ_e are the wave functions of the heavy electron and electron respectively

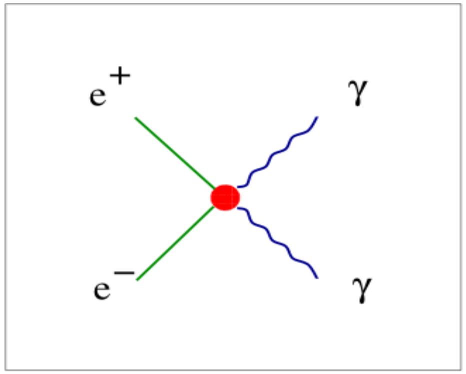
$$\frac{d\sigma}{d\Omega} = \left(\frac{d\sigma}{d\Omega}\right)_{O(\alpha^3)} (1 + \delta_{new})$$

$$\boxed{\delta_{new} \cong \pm \frac{s^2}{2} \left(\frac{1}{\Lambda_{\pm}^4}\right) (1 - \cos^2 \Theta)}$$

For $s / m_{e*}^2 << 1$ the mass of the excited electron is given by

$$\Lambda_+^2 = m_{e*}^2 / \lambda$$

For NON-point like interaction



$$L_{contact} = i\bar{\psi}_e \gamma_\mu (D_\nu \psi_e)\left(\frac{\sqrt{4\pi}}{\Lambda_6^2} F^{\mu\nu} + \frac{\sqrt{4\pi}}{\tilde{\Lambda}_6^2} \tilde{F}^{\mu\nu}\right)$$

The effective Lagrangian chosen for our case has an operator dimension 6, the wave function of the electron is ψ_e , the QED covariant derivative is D_ν ,the tilde on $\tilde{F}^{\mu\nu}$ and $\tilde{\Lambda}_6$ stands for dual.

$$\frac{d\sigma}{d\Omega} = \left(\frac{d\sigma}{d\Omega}\right)_{O(\alpha^3)} (1 + \delta_{new})$$

$$\boxed{\delta_{new} = \frac{s^2}{2\alpha}\left(\frac{1}{\Lambda_6^4} + \frac{1}{\tilde{\Lambda}_6^4}\right)(1 - \cos^2\Theta)}$$

For the fits it is taken $\Lambda_6 = \tilde{\Lambda}_6$

Λ_6 indicates the range of interaction r

$$\boxed{r = \hbar c / \Lambda_6}$$

GLOBAL FIT I

The measured differential cross section is a function of the

Number of measured events N_i

pin of measured angle $\Delta\left(\left|\cos\theta\right|\right)_i$

Luminosity L

Efficiency ε_i

$$\boxed{\left(\frac{d\sigma}{d\Omega}\right)_i = \frac{1}{2\pi\Delta(\left|\cos\theta\right|)_i}\frac{N_i}{L\varepsilon_i}}$$

GLOBAL FIT II

We used all published differential cross sections $\frac{d\sigma}{d\Omega}(e^+e^- \to \gamma\gamma(\gamma))$ for a global $\chi^2 - TEST = f(1/\Lambda^4)$ including the luminosity L for all Energies.

GeV	VENUS 1/pb	TOPAS 1/pb	ALEPH 1/pb	DELPHI 1/pb	L3 1/pb	OPAL 1/pb
55	2.34					
56	5.18					
56.5	0.86					
57	3.70					
57.6		52.26				
91			8.5	36.9	140	7.2
133				5.92		
162				9.58		
172				9.80		
183				52.9	54.8	55.6
189				151.9	175.3	181.1
192				25.1	28.8	29.0
196				76.1	82.4	75.9
200				82.6	67.5	87.2
202				40.1	35.9	36.8
205					74.3	79.2
207					138.1	136.5

VENUS Z.Phys.C45 175 (1989)

TOPAS Phys.Lett.B284 144 (1992)

ALEPH Phys.Rept.216 253 (1992)

DELPHI Phys.Lett.B327 386 (1994)

DELPHI Phys.Lett.B433 429 (1998)

DELPHI Phys.Lett.B491 67 (2000)

L3 Phys.Lett.B531 28 (2002)

OPAL Phys.Lett.B275 531 (1991)

OPAL Eur.Phys.J.C26 331 (2003)

The parameter number of events N_i, efficiency ε_i, pin of the $\Delta\left(\left|\cos\theta\right|\right)_i$ and Energy we take from the mentioned papers above, here for example from L3 Phys.Lett.B531 28 (2002) table 4

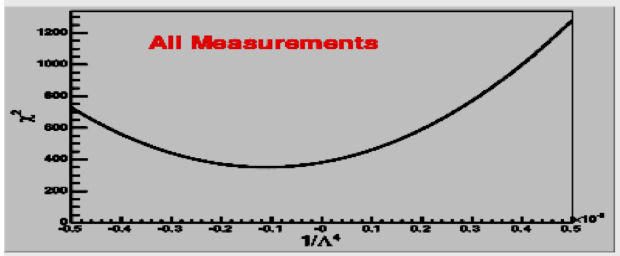
Table 4
Number of events, efficiency and radiative correction factor applied to the data as a function of $\sqrt{s}$ and of the event polar angle, $\cos\theta$. The values at $\sqrt{s} = 183$ and 189 GeV [5] are also listed. The uncertainty on the radiative correction factor ranges from 5% (first $\cos\theta$ bin) to 1% (last $\cos\theta$ bin) and is due to the finite Monte Carlo statistics

$\cos\theta$	Data events/Efficiency [%] ($\sqrt{s}$ in GeV)								Radiative correction
	183	189	192	196	200	202	205	207	factor
0.00–0.05	15/91.7	35/87.9	5/81.0	13/88.4	12/87.6	10/90.9	17/89.1	24/88.6	0.78
0.05–0.10	14/89.0	21/87.7	9/91.7	15/85.6	14/88.1	5/96.7	14/85.3	28/86.0	0.79
0.10–0.15	10/85.9	37/88.1	4/82.5	10/87.6	7/88.8	7/86.0	11/84.7	28/88.7	0.80
0.15–0.20	9/89.4	37/87.1	7/87.8	15/89.6	10/85.3	5/87.9	14/84.3	25/88.8	0.81
0.20–0.25	10/90.2	46/88.6	5/92.1	16/88.7	15/86.1	5/91.4	14/86.9	15/85.2	0.81
0.25–0.30	18/88.5	48/88.4	6/80.2	20/89.5	11/89.7	5/91.2	12/90.8	14/88.7	0.82
0.30–0.35	16/90.7	35/86.0	0/82.9	16/89.0	13/86.8	8/82.5	9/87.4	27/89.4	0.82
0.35–0.40	13/88.5	45/86.7	4/91.6	23/89.2	16/89.0	9/89.6	13/92.4	24/89.9	0.82
0.40–0.45	13/87.7	41/86.0	8/77.8	19/87.5	10/87.2	9/92.0	17/88.4	31/87.9	0.83
0.45–0.50	12/88.5	57/88.6	10/93.2	20/90.3	12/89.5	7/83.3	16/86.8	37/89.4	0.84
0.50–0.55	23/88.8	74/88.4	5/85.2	23/87.8	14/92.7	7/85.5	21/88.6	47/88.4	0.84
0.55–0.60	17/86.6	50/86.6	8/84.4	20/88.8	18/86.1	11/84.6	27/84.4	41/87.7	0.85
0.60–0.65	31/82.5	73/82.9	10/82.6	31/84.1	26/85.1	15/82.9	24/86.4	47/82.1	0.86
0.65–0.70	21/77.7	66/77.9	9/76.8	29/77.5	32/78.3	15/76.7	28/76.3	61/75.2	0.87
0.70–0.75	8/17.0	27/16.3	2/15.4	11/17.3	7/17.8	6/16.0	9/16.5	10/16.7	0.87
0.75–0.80	5/14.3	20/13.5	2/11.6	11/12.3	10/14.7	3/14.9	5/13.2	20/12.6	0.88
0.80–0.85	38/53.5	103/52.5	19/55.8	41/53.2	27/49.7	20/47.1	40/52.1	61/50.4	0.89
0.85–0.90	78/79.8	223/80.7	26/73.6	92/74.9	74/74.3	33/74.9	72/76.3	137/76.7	0.91
0.90–0.95	73/66.8	258/66.6	45/65.6	114/66.0	83/66.0	36/67.4	83/63.9	154/63.7	0.95
0.95–0.96	35/69.1	78/67.2	16/67.4	33/66.7	28/66.3	11/66.1	24/63.7	61/62.9	1.00

GLOBAL FIT III

Including this information it is possible to perform the global fit $\chi^2 - TEST = f(1/\Lambda^4)$

$$\chi^2 = \sum_{i,j} \left\{ \frac{\dfrac{d\sigma}{d\Omega}^{meas}(|\cos\theta|_i, E_j) - \dfrac{d\sigma}{d\Omega}^{QED+new}(|\cos\theta|_i, E_j, \Lambda)}{\Delta\left[\dfrac{d\sigma}{d\Omega}^{meas}(|\cos\theta|_i, E_i)\right]} \right\}^2$$



The error for ± Λ is calculated in the common way for ONE σ

$$\chi^2 = \chi^2_{\min} + \sigma^2$$

Results of the overall FIT

The table shows differential cross sections are used to perform a fit for the hypothesis of a heavy electron e* and the assumption of a possible finite size of interaction area.

The use of an overall data set results in a significance of 5.5 x σ.

The smaller data set of D. Bourilkov, Phys.Rev. D64 (2001) R071701 results in 2.6 x σ.

Heavy electron e*	$(1/\Lambda^4) = -(1.11 \pm 0.20) \times 10^{-10} GeV^{-4}$ $\chi^2 / dof = 351/287$	$\Lambda = \Lambda_+ = m(\lambda = 1) = 308 \pm 56 GeV$	
Finite size of e	$(1/\Lambda^4) = -(4.05 \pm 0.73) \times 10^{-13} GeV^{-4}$	$\Lambda = \Lambda_6 = 1253.2 \pm 226.1 GeV$	$r = 15.7 \times 10^{-18} cm$

$$\boxed{\Lambda = \Lambda_6 = 1253.2 \pm 226.1 GeV}$$

$$\boxed{r = 15.7 \times 10^{-18} cm}$$

C 1) Spinning superconducting electrovacuum soliton

I. Dymnikova Phys. Lett. B 639 3-4 (2006) 368

A) Self gravitating particle-like structure with de Sitter vacuum core
for spin = 0 particles.

De Sitter-Schwarzschild geometry has appeared as describing a black hole whose singularity is replaced with de Sitter core of some fundamental scale. Poisson and Israel analysed de Sitter-Schwarzschild transitions and came to the conclusion that a layer of " non-inflationary " material should be introduced. This material was specified as a spherically symmetric anisotropic vacuum (inflationary in the radial direction, $p_r = -\rho$), with the continuous density and pressure, responsible for a class of regular metrics asymptotically de Sitter at the centre.

The main steps to find this solution are to insert the spherically symmetric metric

$$ds^2 = e^{\nu} c^2 dt^2 - e^{\mu} dr^2 - r^2 (d\theta^2 + \sin^2\theta d\phi^2)$$

into Einstein equation

$$\boxed{R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}}$$

which takes the form

$$\boxed{\frac{-e^{\mu}}{r^2} + \frac{\mu' e^{-\mu}}{r} + \frac{1}{r^2} = \frac{8\pi G}{c^4} T_t^t}$$

$$\boxed{\frac{-e^{\mu}}{r^2} - \frac{\nu' e^{-\nu}}{r} + \frac{1}{r^2} = \frac{8\pi G}{c^4} T_r^r}$$

$$\boxed{\frac{1}{2} e^{-\mu} (\nu'' + \frac{\nu'^2}{2} + \frac{\nu' - \mu'}{r} - \frac{\nu' \mu'}{2}) = \frac{8\pi G}{c^4} T_\theta^\theta = \frac{8\pi G}{c^4} T_\phi^\phi}$$

It exist a class of solutions which connect smoothly the de Sitter metric to the Schwarzschild metric outside. In this class asymptotical behaviour of of a stress-energy tensor is $T_{\mu\nu} \to 0$ as $r \to \infty$ and $T_{\mu\nu} \to \rho_{vac} g_{\mu\nu}$ as $r \to 0$, with ρ_{vac} as de Sitter vacuum density at r = 0. The algebraic structure of the stress-energy tensor $T_{\mu\nu}$ is.

$$T_t^t = T_r^r \quad and \quad T_\theta^\theta = T_\phi^\phi$$

The stress-energy tensor of this structure describes a spherically symmetric (anisotropic) vacuum, invariant under the boosts in the radial direction (Lorentz rotation in (r, t) plane).The requirement of regularity and weak energy condition leads to the existence of a family of spherically symmetric solutions. It smoothly connects the de Sitter vacuum at the origin with the Minkowski vacuum at infinity, and satisfies the equation of state.

$$p_r = -\rho \quad p_\perp = p_r + \frac{r}{2}\frac{dp_r}{dr}$$

Where $p_r = -T_r^r$ is the radial pressure and $p_\perp = -T_\theta^\theta = -T_\phi^\phi$ is the tangential pressure. In this class of solution the metric takes the form

$$ds^2 = (1 - \frac{R_g(r)}{r})dt^2 - (1 - \frac{R_g(r)}{r})^{-1} dr^2 - r^2 d\Omega^2$$

With $d\Omega^2$ is the metric on the unit two-sphere, and

$$R_g(r) = \frac{2GM(r)}{c^2} \quad and \quad M(r) = \frac{4\pi}{c^2}\int_0^r \rho(r) r^2 dr$$

In the model the density profile $T_t^t(r) = \rho(r)c^2$ has been chosen as

$$\boxed{\rho = \rho_{vac} e^{-4\pi\rho_{vac} r^3 / 3m}}$$

$$\boxed{R_g(r) = r_g(1 - e^{-4\pi\rho_{vac} r^3/3m}) = r_g(1 - e^{-r^3/(r_0^2 r_g)})}$$

De Sitter radius $r_0^2 = \frac{3c^2}{8\pi G\rho_{vac}}$, Schwarzschild radius $r_g = \frac{2Gm}{c^2}$ and $R_g(r)$ inserted in

$$R_g(r) = \frac{2GM(r)}{c^2} \quad and \quad M(r) = \frac{4\pi}{c^2}\int_0^r \rho(r) r^2 dr$$

$$\boxed{ds^2 = (1 - \frac{R_g(r)}{r})dt^2 - (1 - \frac{R_g(r)}{r})^{-1} dr^2 - r^2 d\Omega^2 = g_{tt} dt^2 - \frac{dr^2}{g_{tt}} - r^2 d\Omega^2}$$

Gives the metric $\boxed{g_{tt} = 1 - \frac{R_g(r)}{r} \to (1 - \frac{r^2}{r_0^2})_{deSitter} \to (1 - \frac{r_g}{r})_{Schwarzschild}}$

Particle like structure for

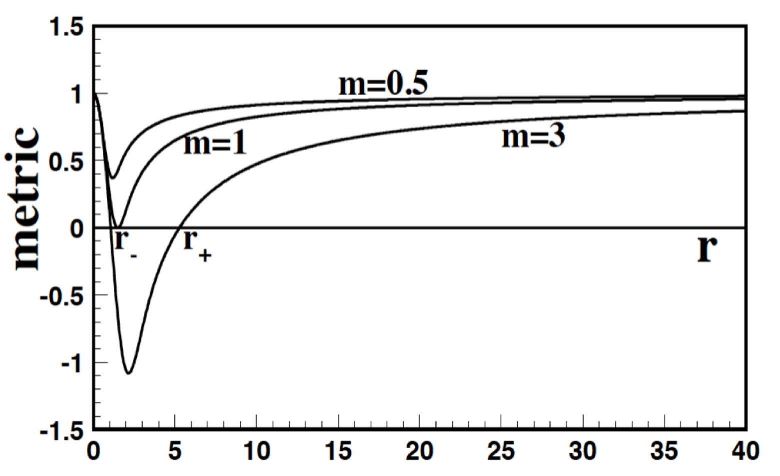
$$m < m_{cr} \simeq 0.3 m_{PL} \sqrt{\frac{\rho_{PL}}{\rho_{vac}}}$$

Self gravitating material.

For $\quad m > m_{cr}$

Schwarzschild Black Hole.

For m = 1 Hawking temperature drops to zero.



$$r = \frac{r}{r_0} \quad and \quad m = \frac{m}{m_{cr}}$$

C 2) Spinning superconducting electrovacuum soliton

To describe the mane steps of the development this subject with spin s , it is similar to Self gravitating particle-like structure with de Sitter vacuum core, necessary to introduce a new metric for the spinning core. The Boyer-Lindquist coordinates

$$\boxed{ds^2 = \frac{2f - \sum}{\sum} dt^2 + \frac{\sum}{\Delta} dr^2 + \sum d\Theta^2 - \frac{4af \sin^2\theta}{\sum} dt d\phi + \left(r^2 + a^2 + \frac{2fa^2 \sin^2\Theta}{\sum}\right) \sin^2\Theta d\phi^2}$$

The spherical coordinates are r, Θ and Φ. The electric charge is e, the mass of the object m, the angular momentum is J = ma and the magnetic moment μ = ea . For an electron with l = 0 is a = (l + s)/m = s/m a direct function of the spin s.

$$\boxed{f = mr - e^2/2} \qquad \boxed{\sum = r^2 + a^2 \cos^2\Theta}$$

$$\boxed{\Delta = r^2 + a^2 - 2f}$$

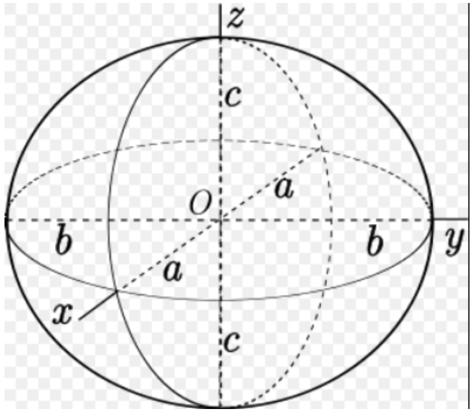
The spherical coordinates r, Θ and Φ. from the Boyer-Lindquist coordinates are related to the Kerr-Newman x, y, z coordinates via the equation:

$$x^2 + y^2 = (r^2 + a^2)\sin^2\theta \quad z = r\cos\theta$$

This forms in the Kerr-Newman geometry an oblate ellipsoid:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$$

With a = b > c —> oblate ellipsoid



related to the condition of the equation from Kerr-Newman

$$r^4 - (x^2 + y^2 + z^2)r^2 - a^2z^2 = 0$$

If the spin is ZERO a = b = 0 the ellipsoid collapses to ZERO

In Elementary Superconductivity is the basic equation in nonlinear electrodynamics coupled to gravity obtained from the Lagrangian S.

$$\boxed{S = \frac{1}{16\pi G}\int d^4x\sqrt{-g}\left[R - L(F)\right]}$$

The electromagnetic tensor R is $R \equiv F = F_{\mu\nu}F^{\mu\nu}$ and L(F) is an arbitrary function in the Maxwell weak field limit L(F) -> F for large r.

The dynamical equation is

$$\nabla_\mu = (L_F F^{\mu\nu}) = 0$$

with $L_F = dL/dF$ and the Bianchi identities given by (Asterisk Hodge dual)

$$\nabla^*_\mu F^{\mu\nu} = 0$$

The non-zero field components with axial symmetry F01, F02, F13 and F23 are

$$aF_{23} = (r^2 + a^2)F_{02} \qquad F_{31} = a\sin^2\theta F_{10}$$

The field invariant $F = F_{\mu\nu}F^{\mu\nu}$ reduces under these conditions to

$$F = 2\left(\frac{F_{20}^2}{a^2\sin^2\Theta} - F_{10}^2\right)$$

The vector field is than defined as

$$\boxed{E = \left\{F_{\beta 0}\right\} \quad D = \left\{L_F F^{0\beta}\right\} \quad B = \left\{{}^{*}F^{\beta 0}\right\} \quad H = \left\{L_F^{*} F_{0\beta}\right\}}$$

Superconductive conditions on the DISC

In the discussed de Sitter region it is $\varepsilon_r = \varepsilon_\Theta = L_F$ $\mu_r = \mu_\Theta = L_F^{-1}$ what leads to the equations

$$\boxed{L_F \Sigma^2 F_{10} = e(r^2 - a^2 \cos^2\theta) \quad L_F \Sigma^2 F_{20} = -era^2 \sin(2\Theta)}$$

The stress-energy tensor of a nonlinear electromagnetic field from the lagrangian L(F)

$$\kappa T_\nu^\mu = 2 L_F F_{\nu\alpha} F^{\mu\alpha} - \frac{1}{2}\delta_\nu^\mu L$$

and the equation of state in the co-rotating frame ($\kappa = 8\pi G$, p pressure, ρ density)

$$\kappa(p_\perp + \rho) = 2\left(L_F F_{10}^2 + L_F \frac{F_{20}^2}{a^2 \sin^2\theta} \right)$$

allows to investigate the behaviour of the fields on the de Sitter vacuum disc.

For spherically symmetric solutions, regularity requires together with the equation of state on the disk that the pressure rectangular to the disk surface $p_\perp$ is equal to the density $-\rho$ on the disc.

$$\boxed{p_\perp = -\rho}$$

This condition requests that the components of the field tensors F_{10} and F_{20} in

$$\kappa(p_\perp + \rho) = 2\left(L_F F_{10}^2 + L_F \frac{F_{20}^2}{a^2 \sin^2\theta} \right)$$

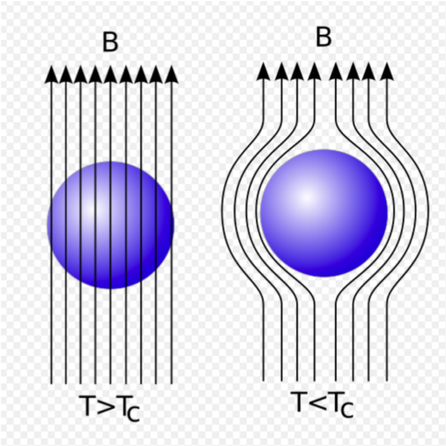
must vanish on the disk independently of L_F to zero

$$\boxed{L_F \frac{F_{20}^2}{a^2 \sin^2\theta} = 0 \quad L_F F_{10}^2 = 0}$$

The magnetic induction B will be zero on the disc independently of the magnetic permeability as shown below

$$\frac{2e^2(B^r)^2}{\kappa(p_\perp+\rho)(r^2+a^2)^2}=0 \qquad \frac{2e^2(B^\theta)^2}{\kappa(p_\perp+\rho)a^2\sin^2\theta}=0$$

This is only possible B vanishes faster than $(p_\perp+\rho)$. The Meissner effect takes place for a single spinning soliton and occurs at its de Sitter vacuum disc. This is requests a superconductor behaviour on the disc.



On the equatorial plane is

$$\boxed{L_F = \frac{2e^2}{\sum^2 \kappa(p_\perp + \rho)}}$$

what leads with

$$p_\perp = -\rho$$

On the disc to

$$\boxed{\varepsilon_r = \varepsilon_\theta = L_F \to \infty}$$

$$\boxed{\mu_r = \mu_\theta = L_F^{-1} \to 0}$$

Calculation of the E and B – Field in cgs units

1. E and B-Field

From Phys. Lett. Eq. 36PLB, 2PLB, 34PLB and 41PLB using Boyer-Lindquist coordinates

$$\overline{E} = \left\{F_{\beta 0}\right\} = \begin{pmatrix} F_{10} \\ F_{20} \\ F_{30} \end{pmatrix} = \begin{pmatrix} E_r \\ E_\Theta \\ E_\phi \end{pmatrix} \qquad \overline{B} = \left\{{}^*F^{\beta 0}\right\} = \begin{pmatrix} {}^*F^{10} \\ {}^*F^{20} \\ {}^*F^{30} \end{pmatrix} = \begin{pmatrix} B_r \\ B_\theta \\ B_\varphi \end{pmatrix} \qquad (1)$$

$$E_r = F_{10} \qquad B^r = \frac{F_{23}}{\sum \cdot \sin\theta}$$

$$E_\theta = \frac{F_{20}}{\sum} \qquad B^\theta = \frac{F_{31}}{\sum \cdot \sin\theta} \qquad (2)$$

2) Er – Eθ Field in De Sitter Region

$$E_r = F_{10} = \frac{e(r^2 - a^2 \cdot \cos^2 \Theta)}{L_F \cdot \sum^2} \qquad E_\theta = \frac{F_{20}}{\sum} = \frac{-e \cdot r \cdot a^2 \cdot \sin 2\theta}{L_F \sum^3} \qquad (3)$$

$$\begin{array}{lll} e = charge & J = a \cdot m & J = AngularMomentum \\ r = radius & \mu = e \cdot a & \mu = GyromagneticRatio \\ a = parameter & \theta = PolarAngle & \sum = r^2 + a^2 \cdot \cos^2 \theta \\ L_F = arbitrary - function = \varepsilon_r = \varepsilon_\theta & & \end{array} \qquad (4)$$

Inserting equ. 4 in equ. 3 using equ. 41PLB gives equ. 5 and 6

$$E_r = f(r,\theta,\varepsilon_r) = \frac{e \cdot (r^2 - a^2 \cdot \cos^2 \theta)}{\varepsilon_r \cdot (r^2 + a^2 \cdot \cos^2 \theta)^2} \qquad E_\theta = f(r,\theta,\varepsilon_r) = -\frac{e \cdot r \cdot a^2 \cdot \sin 2\theta}{\varepsilon_r \cdot (r^2 + a^2 \cdot \cos^2 \theta)^3} \qquad (5)$$

$$E_r = f(r,\theta,\varepsilon_\theta) = \frac{e \cdot (r^2 - a^2 \cdot \cos^2 \theta)}{\varepsilon_\theta \cdot (r^2 + a^2 \cdot \cos^2 \theta)^2} \qquad E_\theta = f(r,\theta,\varepsilon_\theta) = -\frac{e \cdot r \cdot a^2 \cdot \sin 2\theta}{\varepsilon_\theta \cdot (r^2 + a^2 \cdot \cos^2 \theta)^3} \qquad (6)$$

3) B_r – B_θ Field in De Sitter Region

$$B^r = \frac{F_{23}}{\sum \cdot \sin\theta} = \frac{(r^2 + a^2)}{1} \cdot \frac{e \cdot r \cdot a \cdot \sin 2\theta}{L_F \cdot \sum^3 \sin\theta} \qquad B^\theta = \frac{F_{31}}{\sum \cdot \sin\theta} = a \cdot \sin\theta \cdot \frac{e \cdot (r^2 - a^2 \cos^2\theta)}{L_F \cdot \sum^3} \qquad (12)$$

$$\mu_r = \mu_\theta = L_F^{-1} \qquad (13)$$

$$\mu_r = magnetic - permeability - r \qquad \mu_\theta = magnetic - permeability - \theta$$

Inserting equ. 13 and equ.4 in equ. 12 with equ. 34PLB and 41PLB gives equ. 14 and 15

$$B^r = f(r,\theta,\mu_r) = e \cdot \mu_r \frac{r \cdot a \cdot (r^2 + a^2)}{(r^2 + a^2 \cdot \cos^2\theta)^3} \cdot \frac{\sin 2\theta}{\sin\theta} \qquad B^\theta = f(r,\theta,\mu_r) = e \cdot \mu_r \frac{a \cdot (r^2 - a^2 \cos^2\theta)}{(r^2 + a^2 \cos^2\theta)^3} \cdot \sin\theta \qquad (14)$$

$$B^r = f(r,\theta,\mu_\theta) = e \cdot \mu_\theta \frac{r \cdot a \cdot (r^2 + a^2)}{(r^2 + a^2 \cdot \cos^2\theta)^3} \cdot \frac{\sin 2\theta}{\sin\theta} \qquad B^\theta = f(r,\theta,\mu_\theta) = e \cdot \mu_\theta \frac{a \cdot (r^2 - a^2 \cos^2\theta)}{(r^2 + a^2 \cos^2\theta)^3} \cdot \sin\theta \qquad (15)$$

4. ELECTRON data in the E and B field in cgs units

4.1 ELECTRON parameters

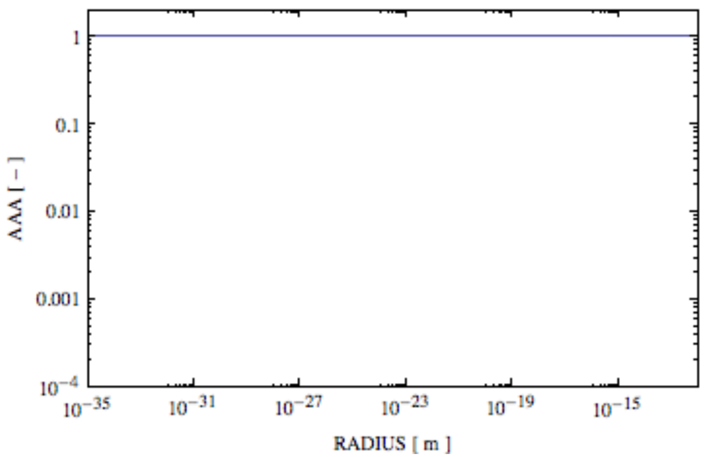
$$e = 1.602 \cdot 10^{-19} \quad [A \cdot s] \qquad c = 2.99 \cdot 10^{8} \quad \left[\frac{m}{s}\right] \qquad r_Q = \sqrt{\frac{e^2 \cdot G}{4 \cdot \pi \cdot \varepsilon \cdot c^4}} = 1.38815 \cdot 10^{-36} \quad [m]$$

$$\varepsilon = 8.85 \cdot 10^{-12} \quad \left[\frac{A \cdot s}{V \cdot m} = \frac{A^2 \cdot s^4}{kg \cdot m^3}\right] \qquad \hbar = \frac{6.62606957 \cdot 10^{-34}}{2 \cdot \pi} \quad [J \cdot s] \qquad AAA = \frac{(r^2 + a^2)}{(r^2 - r_s \cdot r + a^2 + r_Q^2)} = 1.000 \quad [-] \qquad (34)$$

$$\mu = 4 \cdot \pi \cdot 10^{-7} \quad \left[\frac{V \cdot s}{A \cdot m}\right] \qquad J = \frac{1}{2} \cdot \hbar \quad [J \cdot s]$$

$$m_e = 9.109 \cdot 10^{-31} \quad [kg] \qquad a = \frac{J}{m_e \cdot c} = 1.936 \cdot 10^{-13} \quad [m]$$

$$G = 6.674 \cdot 10^{-11} \quad \left[\frac{N \cdot m^2}{kg^2}\right] \qquad r_s = \frac{2 \cdot G \cdot m_e}{c^2} = 1.36002 \cdot 10^{-57} \quad [m]$$



The parameter AAA = 1 of equ. 34 simplifies

$$\varepsilon_r = \varepsilon_\theta = \varepsilon = L_F \quad (DeSitter - Common\,Region) \qquad \mu_r = \mu_\theta = \mu = L_F^{-1} \quad (DeSitter - Common\,Region)$$

4.2 Electron E-field B-field for AAA=1

The parameter AAA = 1 for the Electron in the range $10^{-35}(m) < r < 10^{-11}(m)$ reduces the eight equations of the E – field (equ. 22 to 27) to equ. 35 and 36 and the eight equ. of the B – field (equ. 28 to 33) to equ. 37 and 38.

$$E_r = f(r,\theta,\varepsilon) = \frac{e\cdot(r^2 - a^2\cdot\cos^2\theta)}{\varepsilon\cdot(r^2+a^2\cdot\cos^2\theta)^2}\cdot\frac{1}{4\cdot\pi}\quad\left[\frac{V}{m}\right] \qquad (35)$$

$$E_\theta = f(r,\theta,\varepsilon) = -\frac{e\cdot r\cdot a^2\cdot\sin 2\theta}{\varepsilon\cdot(r^2+a^2\cdot\cos^2\theta)^3}\cdot\frac{1}{4\cdot\pi}\cdot\sqrt{\frac{G\cdot\hbar}{c^3}}\quad\left[\frac{V}{m}\right] \qquad (36)$$

$$B^r = f(r,\theta,\mu) = e\cdot\mu\frac{r\cdot a\cdot(r^2+a^2)}{(r^2+a^2\cdot\cos^2\theta)^3}\cdot\frac{\sin 2\theta}{\sin\theta}\cdot\frac{c}{4\cdot\pi}\quad[T] \qquad (37)$$

$$B^\theta = f(r,\theta,\mu) = e\cdot\mu\frac{a\cdot(r^2-a^2\cos^2\theta)}{(r^2+a^2\cos^2\theta)^3}\cdot\sin\theta\cdot\frac{1}{4\cdot\pi}\cdot\sqrt{\frac{G\cdot\hbar}{c}}\quad[T] \qquad (38)$$

The parameters of the Electron do not distinguish between DeSitter and Common region in the E – field and B - field.

The comparison of the classical E – Field of the Electron equ. 39 with the Soliton – Electron Field of equ. (35) and (36) is shown in fig.2 for θ=5°,45°,85°and 88°. For obvious mathematical reasons it is not possible to display the field in a linear scale because the variation of the field E = f (r , θ) is to big to allow a linear display. For this reason is in fig.2 Etot after equ. 40 shown in loglin-scale (left) and in a loglog-scale (right). In the loglog-scale are of course only positive values of Etot possible. The tip in the functions displays the zero transition.

$$E_{tot} = \sqrt{E_r^2 + E_\theta^2} \quad \left[\frac{V}{m}\right] \qquad (40)$$

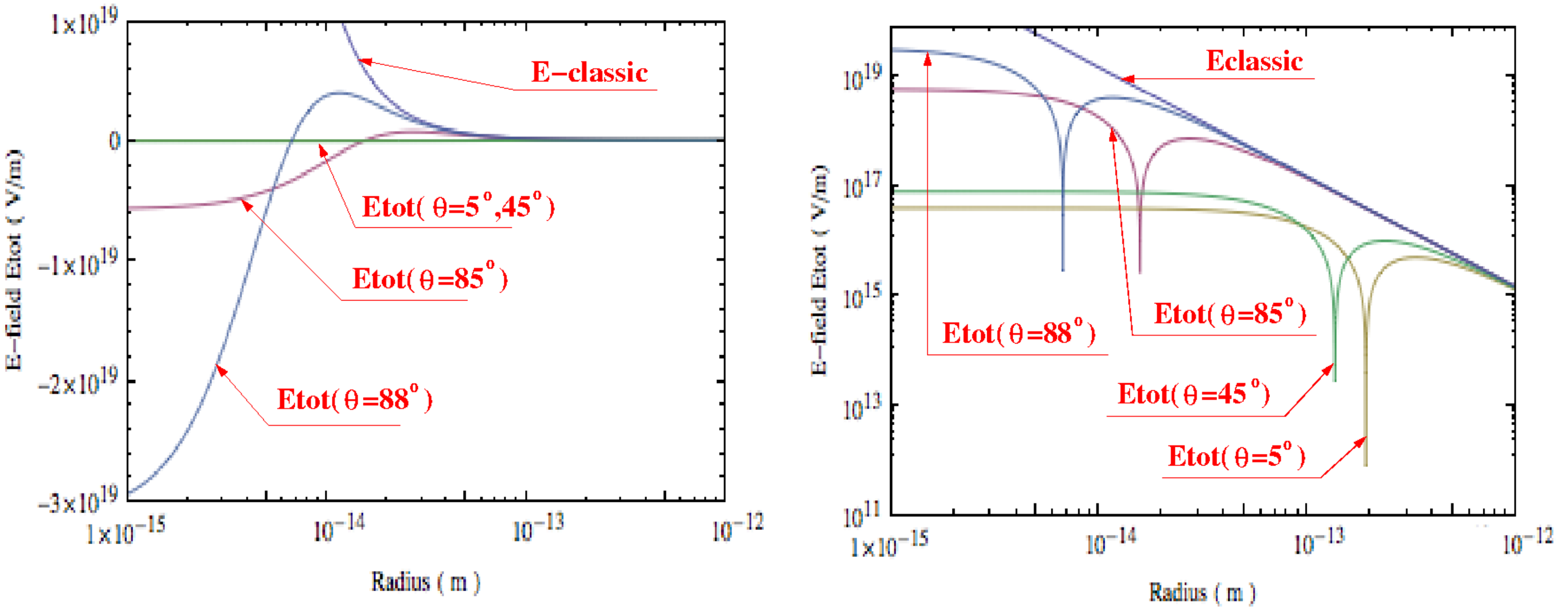


Fig. 1 Comparison of the classical E- Field with Soliton Electron Etot-Field (left loglin-scale right loglog-scale).

4.3) The VECTOR Plot of the E - field

Fig. 16 summarizes the information of fig. 8 to fig. 15. The E – field changes the sign at the line E = 0.0 V/m for the same sign of the charge in fig. 16 according equ. 35 ($r = a \cdot \cos\theta$). The field increase from the common region at $E \approx 10^{15} \quad V/m$ to the disc for r -> 0 to $E \approx 10^{30} \quad V/m$ and higher values. The field is close to the Planck length and θ -> 90° highly increasing. This is a hint to a charge kernel.

To respect the dramatic changes in the E – field strenght the vector plot is calculated in a log – scale and the length of the arrows is adjusted respectively.

E – Field Soliton Electron

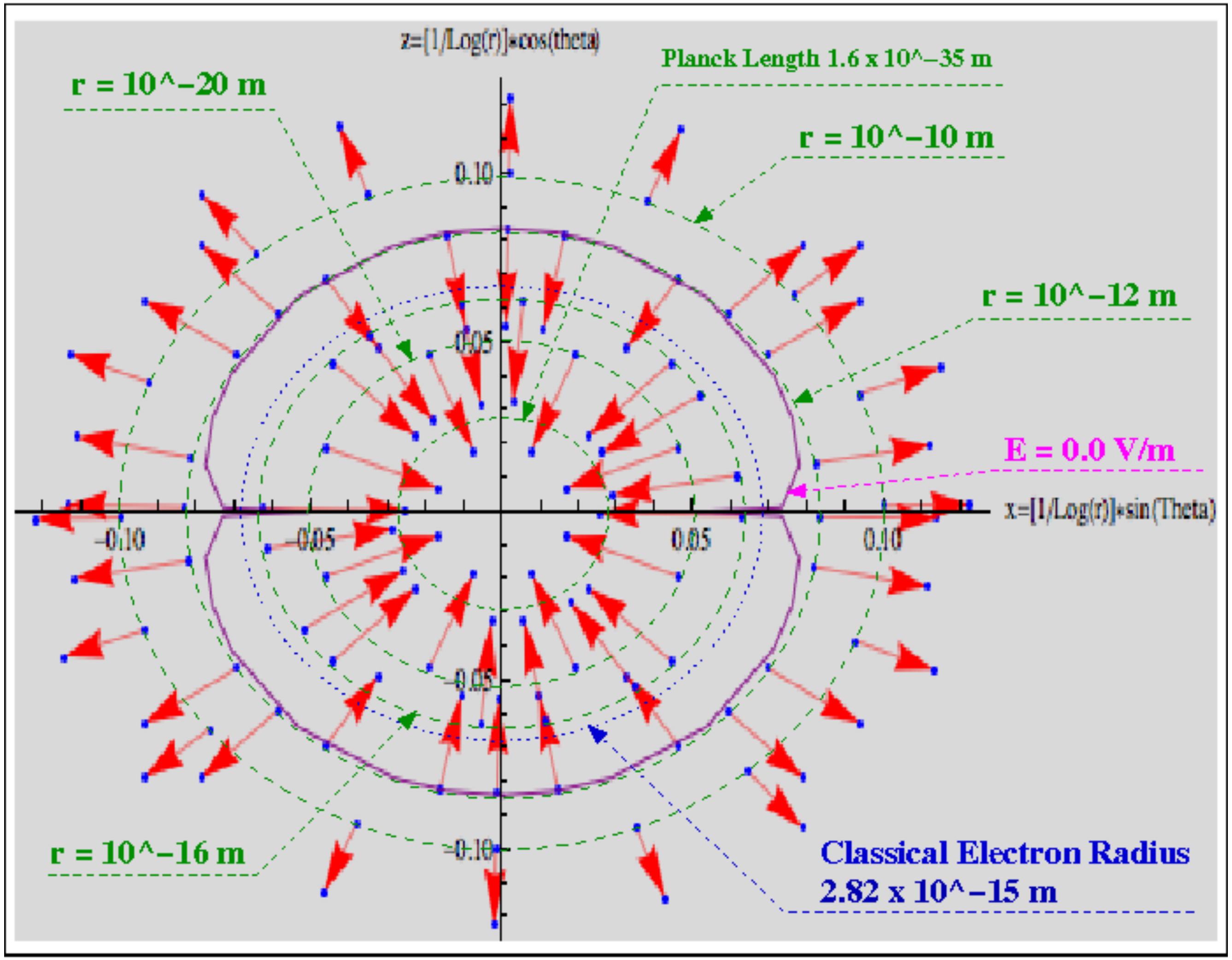


Fig. 2 Vector Plot of E - field

5) SKETCH to compare the E – field of the ETAMFP with SOLITON Model

The ETAMFP Model suggest an E - field shape what changes the direction of the field force from out side to the centre of the electron. But without changing the sign of the charge. Similar to the behaviour of the De Sitter gravitational field. Such an assumption would lead to a stable condition of an extended electron. The model also requests a non rotating kernel in the centre.

The SOLITON Model confirms the assumption of the change of the field direction with the same sign of the charge, but in General relativity. The point-like charge is replaces by superconducting disc. The E – field shows a kernel at r -> 0 and θ -> 90°.

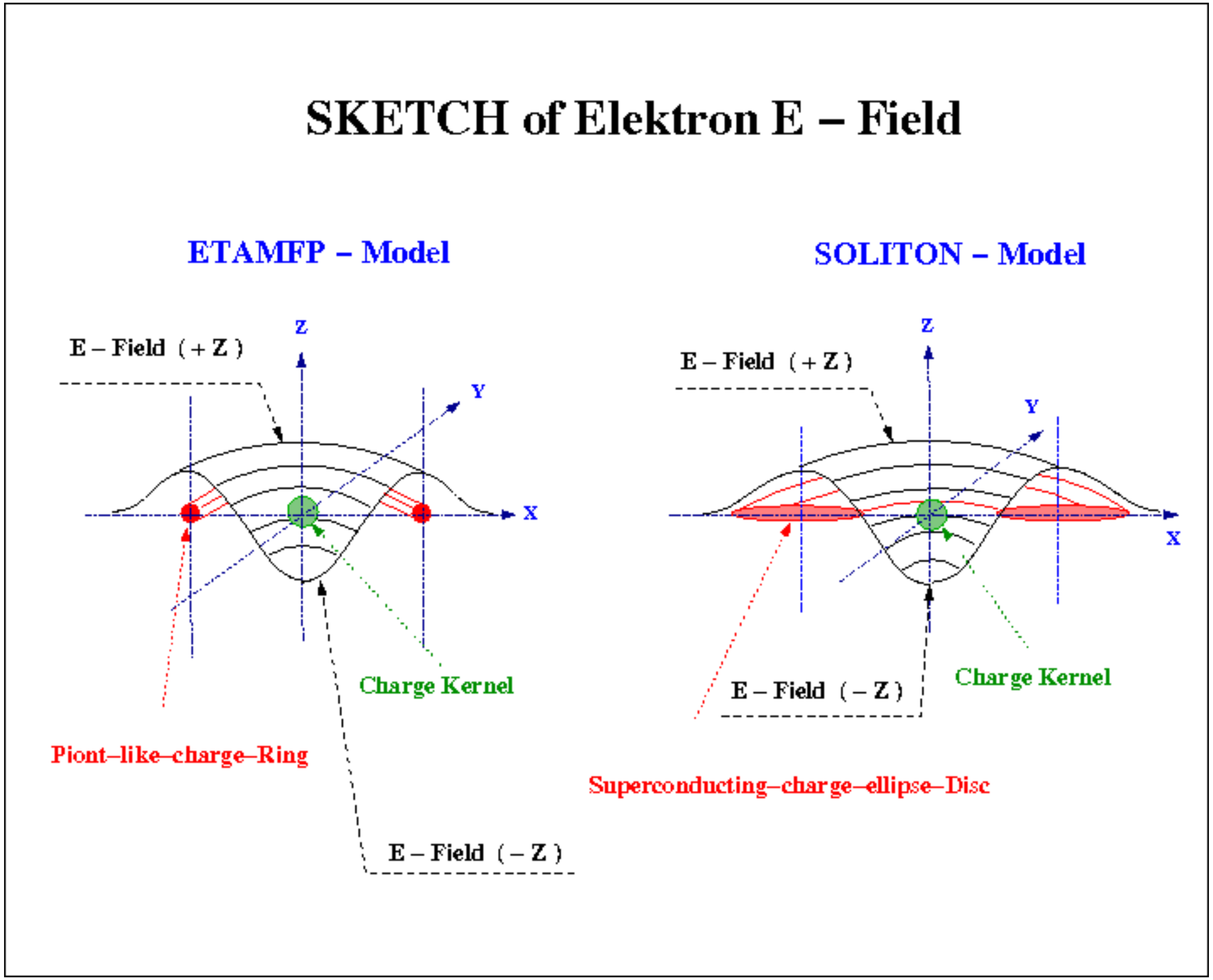


Fig. 3 Comparison of ETAMFP and SOLITON model

6) The VECTOR Plot of the B – field common region

Fig. 30 summarizes the information from fig. 18 to fig. 25. The B – field changes the sign at θ = 90° for the same sign of the charge. The transition of the B –field at θ = 90° is performed with a high gradient. The field is in the common region $B \approx 10^{8} \quad T$
Close to the disc for r -> 0 to and θ -> 90° up to $B \approx 10^{40} \quad T$
The field circles right hand at θ = 90° and left hand at θ = 270° forming an elliptic tube about the angle ϕ.

To respect the dramatic changes in the B – field strenght the vector plot is calculated in a log – scale and the length of the arrows is adjusted respectively.

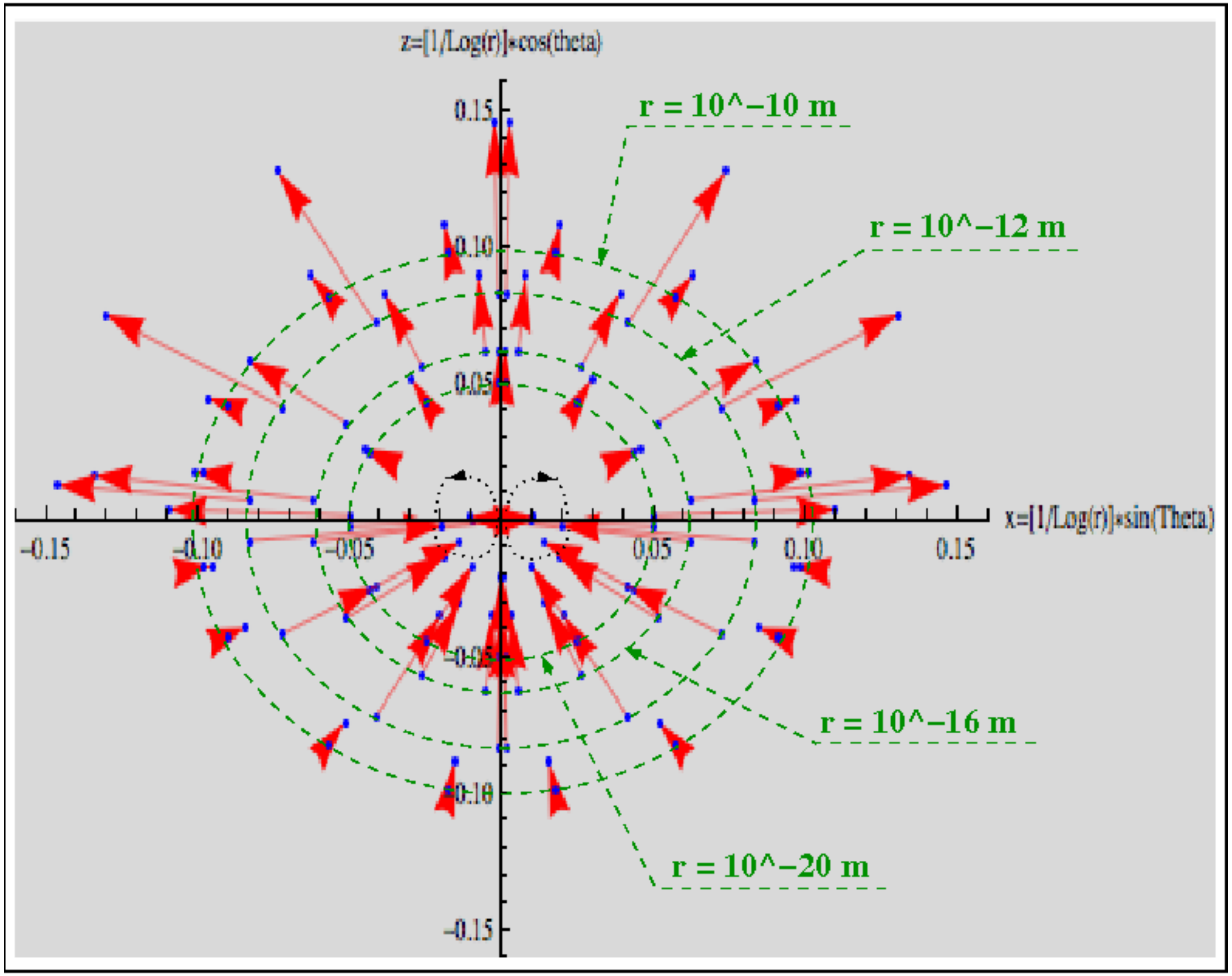


Fig. 4 Vector plot of B - field

7) The VECTOR Plot of the B – field inner region

More obvious to the behaviour of the E – field in the centre of the electron displays the plot in fig. 27 a change of the direction of the B – field close to the Planck scale. The right handed circling behaviour from the common region get overlaid by a left handed behaviour visible at $r = 10^{-28}\ m$ and $r = 10^{-35}\ m$. It suggest that an inner part of the superconducting disc generates an B – field in opposite rolling direction to the common behaviour in the out site region. The reason for this effect is the increase of the Bθ – field compared to the Br – field close to the centre of the electron.

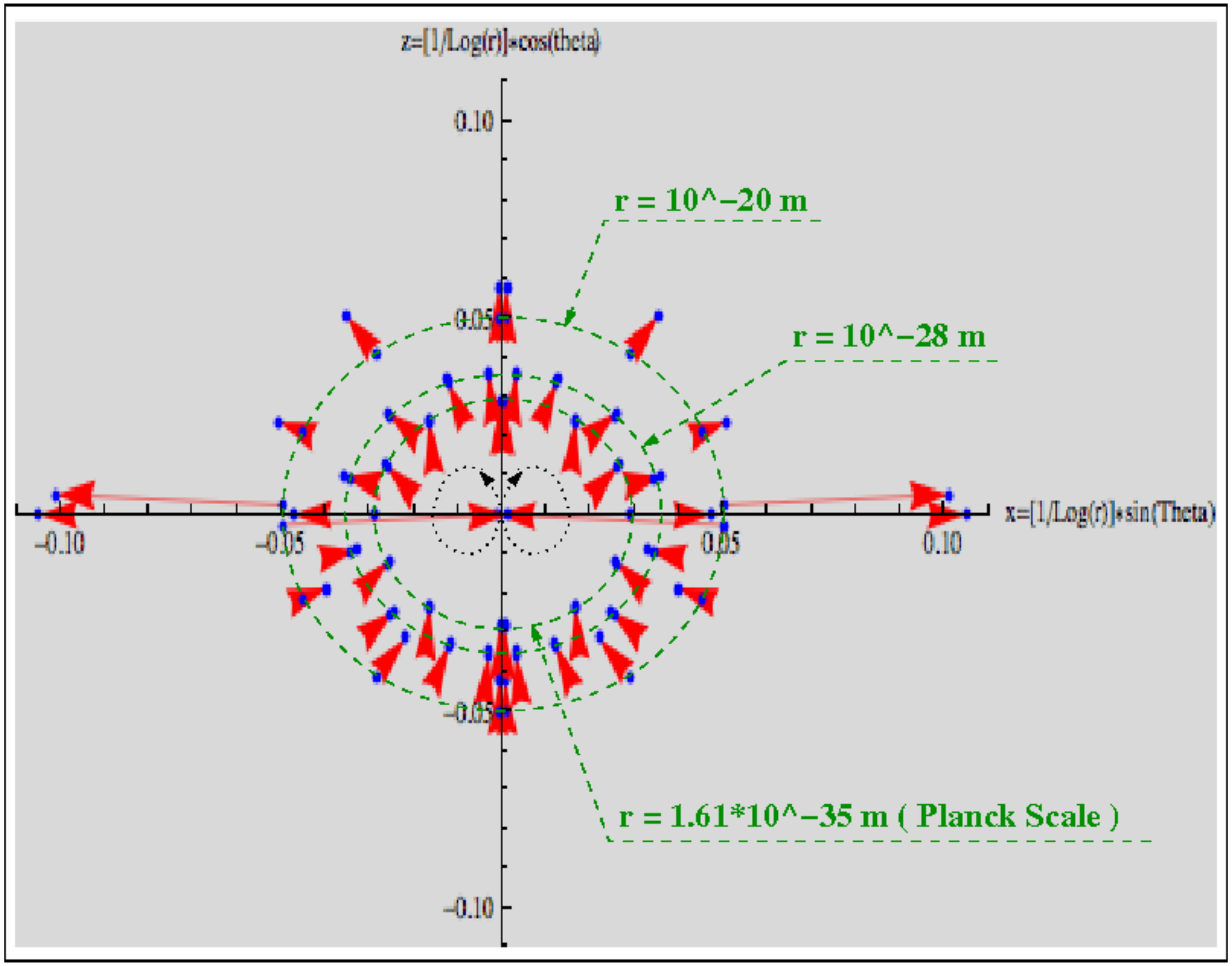


Fig. 5 Vector plot of B – field inner region

8) SKETCH to compare the B – field of the ETAMFP with SOLITON Model

The ETAMFP Model suggest an B – field circling the point-like charge at the outer region of the electron. Forming a tube shape of a B – field around the centre of the electron. It also suggest a non-rotating centre of the electron.

The SOLITON Model replaces the point-like charge by a superconducting disc. The B – field is an elliptic tube surrounding the centre of the electron. But the behaviour is the result of General relativity, a complete different ansatz as in the ETAMFP Model. In particular fig. 27 confirms a centre of the electron with an opposite rolling direction of the B – field compared to the centre of the electron. This supports the possibility of an non or less rotating centre of the electron.

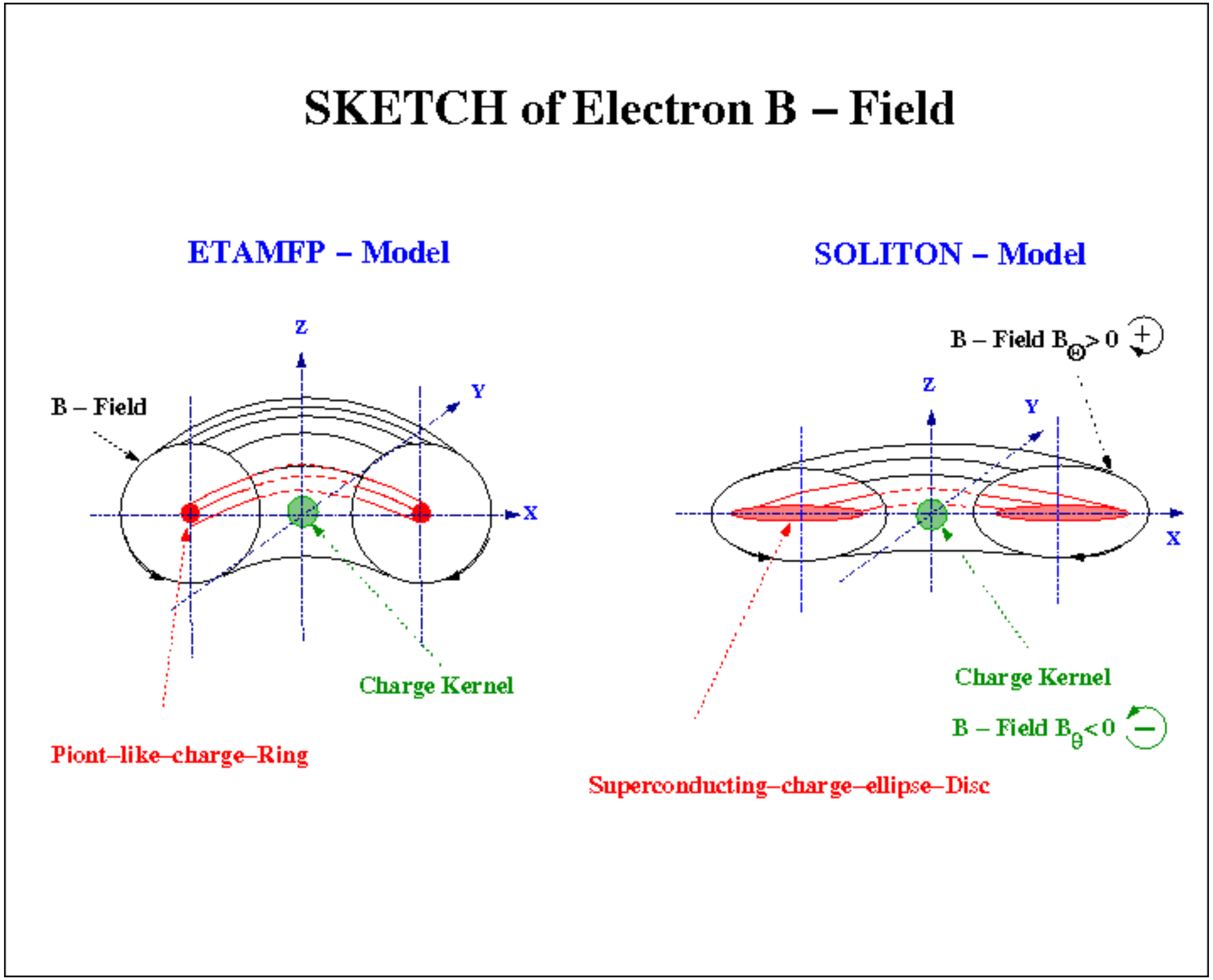


Fig. 6 Comparison of ETAMFP and SOLITON model

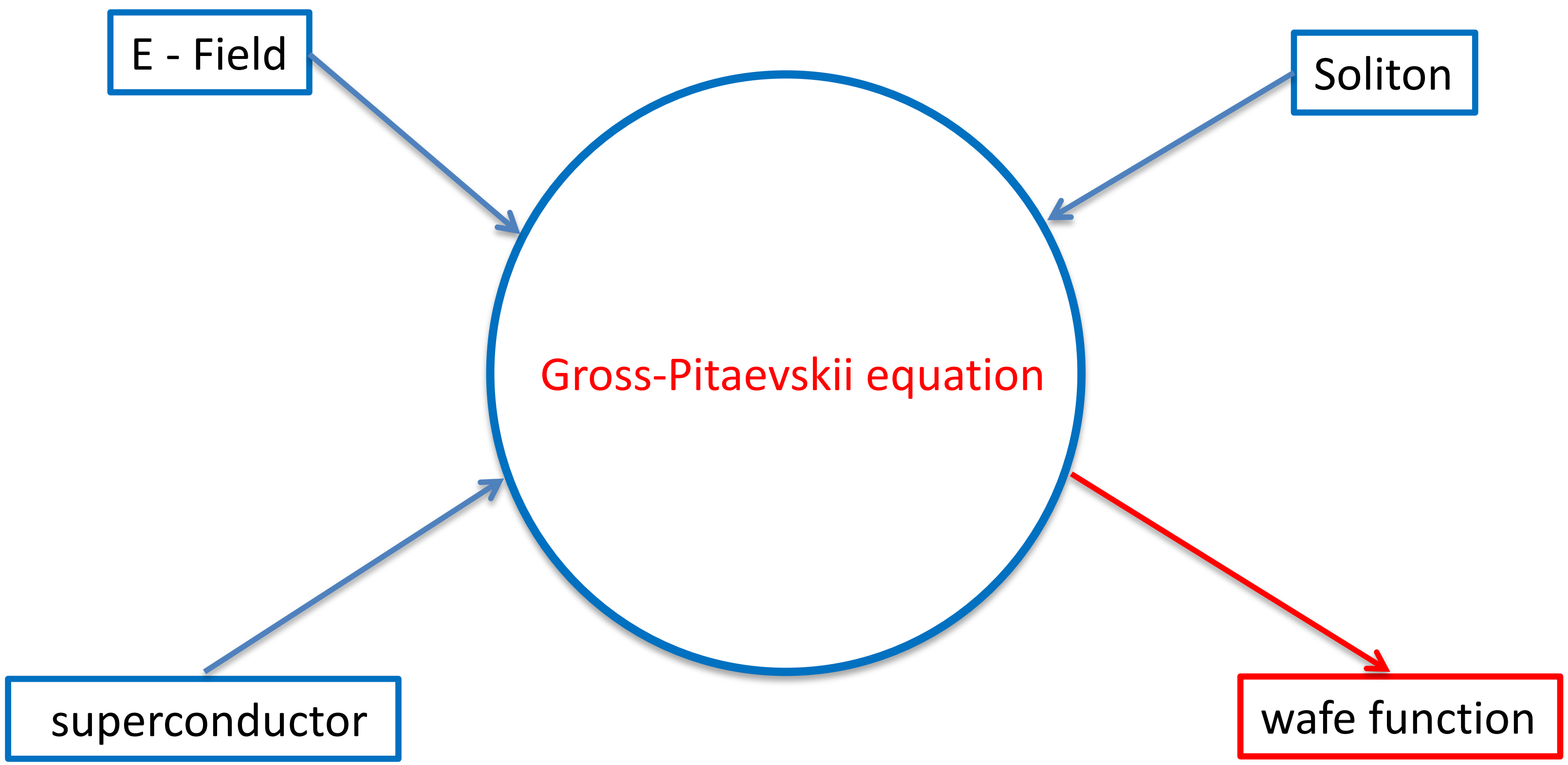
9. Conclusion

The comparison of the ETAMFP model with the SOLITON model shows an the general behaviour an agreement. The electron behaves like a rotating gyroscope. It is absolute obvious that this classical ansatz is only an overall approximation of the idea of an extended electron. As the size of the object is bigger as the Planck scale, where the quantisation of the fields get absolute important, it looks like the discussed models describe to an certain extent the real possibility of an extended electron beyond the standard model.

In this picture the electron would be an extended rotating gyroscope with an superconducting centre. The centre would be the result of an SOLITON. This would be ideal to explain the extreme long lifetime of the electron of $\tau_e > 4.6 \cdot 10^{26} \quad y$.

The agreement of the absolute simple classical ETAMFP model with the SOLITON model of General Relativity is surprising. The absolute independence of the models support the idea of an non pointe-like electron.

D) Calculation of a wave function using the substructure of FP, via the E-field of a non point like Electron with the Gross-Pitaevskii equation



The Gross-Pitaevskii equation

The Gross–Pitaevskii equation is a model equation for the single-particle wavefunction in a Bose–Einstein condensate. The Electron has a life time close to infinite. For this reason the solution of the Gross-Pitaevskii equation should not depend about the time. For this reason it is important to use time independent Gross–Pitaevskii equation.

$$\mu\Psi(r) = \left(-\frac{\hbar^2}{2m}\nabla^2 + V(r) + g\left|\Psi(r)\right|^2 \right)\Psi(r)$$

Where μ is the chemical potential, ψ is the wave function, $\hbar$ is the Planck's constant, m the mass of the object, V(r) is the external potential and g the coupling constant.

The electron as soliton has no external potential V(r) = 0 . The chemical potential μ ≈ 0 . This simplifies the Gross–Pitaevskii equation to the equation:

$$0 = \left(-\frac{\hbar^2}{2m}\nabla^2 + g\left|\Psi(r)\right|^2 \right)\Psi(r)$$

Wave function SOLUTION for a SOLITON

A one-dimensional soliton can form in a Bose–Einstein condensate. If the interaction is attractive or repulsive, there is either a bright or dark soliton.

If the BEC is repulsive, so that $g > 0$ then a possible solution of the Gross–Pitaevskii equation is,

$$\boxed{\psi(x) = \psi_0 \tanh\left(\frac{x}{\sqrt{2\zeta}}\right)}$$

Ψ_0 is the weave function of the condensate at ∞ and $\zeta = \hbar / \sqrt{2mn_0 g}$ the coherence length.

For an attractive interaction $g < 0$ the solution is

$$\boxed{\psi(x,t) = \psi(o)e^{-i\mu t/\hbar}\frac{1}{\cosh\left[\sqrt{2m|\mu|/\hbar^2}\,x\right]}}$$

The chemical potential for the bright soliton is $\mu = g\left|\psi(0)^2\right|/2$

Mathematical Engineering of a toy model for an ELECTRON as SOLITON

The very long lifetime of the ELECTRON could be explained by stable SOLITON. As discussed it would be necessary to form and object with an repulsive and attractive interior. If this two interaction compensate each other an infinite lifetime would be possible.

The g > 0 and g < 0 behavior of the BEC would just fulfill this condition. For this reason we use for the toy ansatz of the wave function for

the repulsive part g > 0 the equation:

$$\boxed{\psi(x) = C_1 \tanh\left(C_2 \cdot x\right)}$$

and for the attractive part of the function g < 0 the equation:

$$\boxed{\psi(x) = C_3 \frac{1}{\cosh\left[C_4 \cdot x\right]}}$$

The constants C_1, C_2, C_3 and C_4 must be adjusted the the parameters of the Electron.

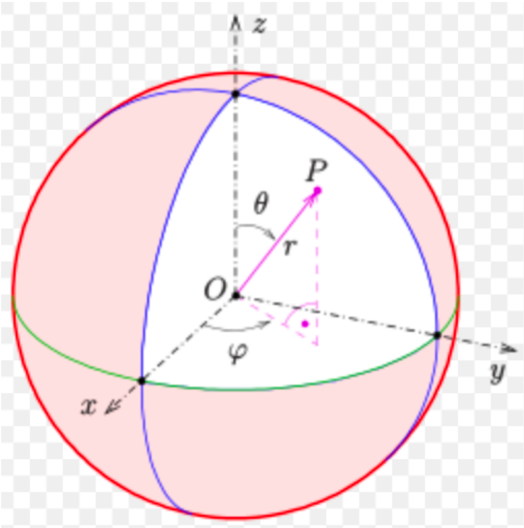
The electric field of the discussed SOLITON solution solution was

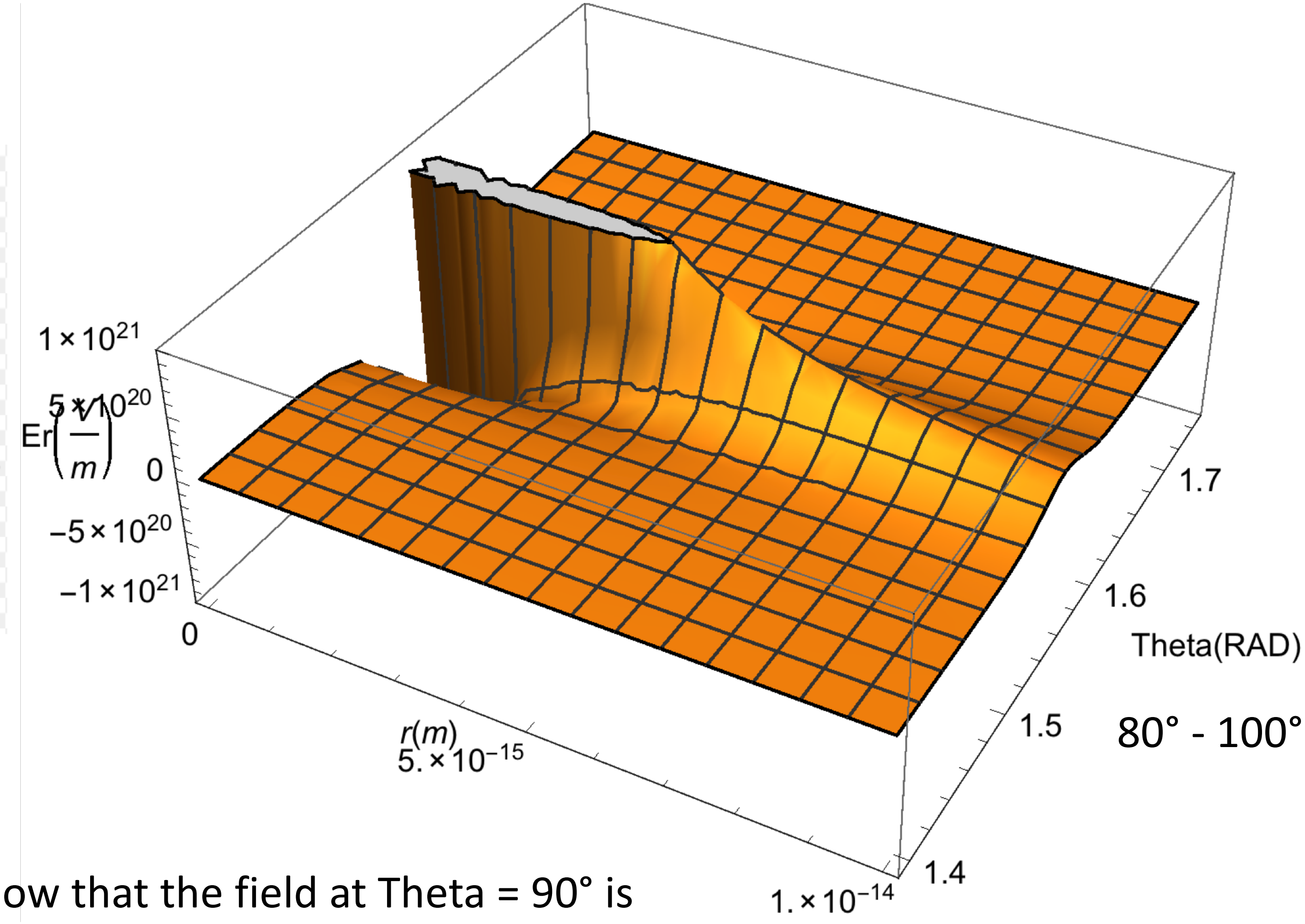
$$E_r = f(r,\theta,\varepsilon) = \frac{e \cdot (r^2 - a^2 \cdot \cos^2\theta)}{\varepsilon \cdot (r^2 + a^2 \cdot \cos^2\theta)^2} \cdot \frac{1}{4 \cdot \pi} \quad \left[\frac{V}{m}\right]$$

For the ELECTRON is the charge e = 1.602*10^19 [A*s] , ε = 8.85*10^-12 [F/m],
hbar = 1.04724*10^-34, Mass Electron m = 9.109*10^-31 [kg], the speed of light
cc = 2.99*10^8 [m/s], angular momentum of the Electron J = (1/2)*hbar = 5.2362*10^-35
and a = J/(m*cc) = 1.92253*10^-13.

Inserting this number in the E_r equation it is possible to plot this function in 3 D.

In this plot it clear visible that the field is attractive and repulsive and has a very high maximum from more as 10^21 [V/m] at r = 10^-15 m and Theta = 90 °.





80° - 100°

The plot also show that the field at Theta = 90° is not ZERO because an constant ε is used.

In the discussion before it was demonstrated that at Theta = 90° $\varepsilon_r = \varepsilon_\theta = L_F \rightarrow \infty$
this sets the E-field at Theta = 90 ° to zero. In the equation of E_r is ε not a function of r and the angle Theta. This function is NOT known so far.

For this reason it is necessary to introduce such a function ε = f (r , Theta) which sets the field E_r = 0 at Theta = 90 °. We used the following test function

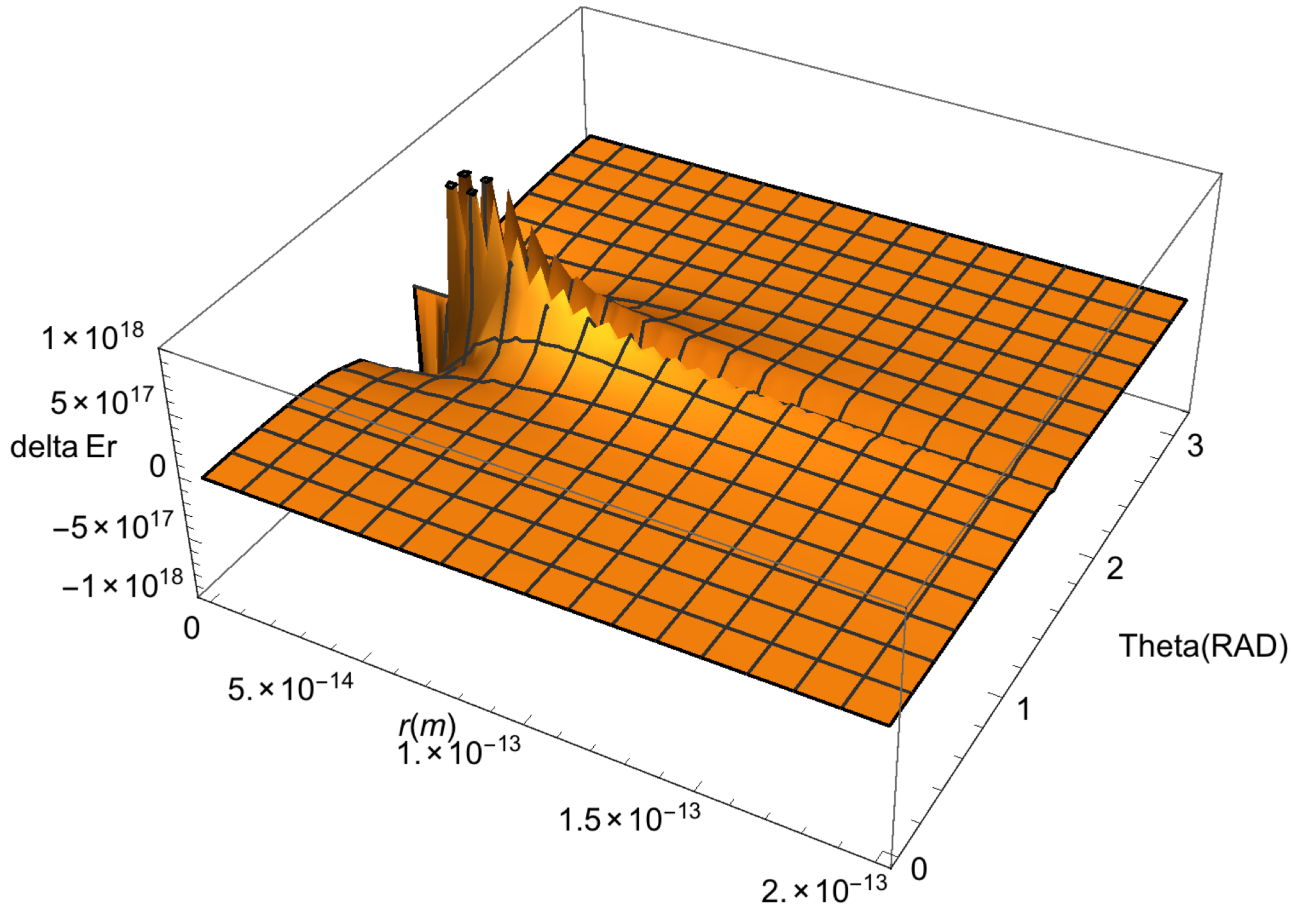
$$\boxed{\varepsilon(r,\theta) = 1 - Sech[m(\theta - \pi / 2)]}$$

This function runs r from 0 < r < ∞ , Sech is for Θ = 90 ° equal one what sets ε to zero as requested. m is a constant to define the width of this delta function.

Important is the condition r from 0 < r < ∞ . This condition will set the E_r field even at r = ∞ to zero. The constant m will be adjusted later.

In the plot below the effect of this test function for

m = 1000 is shown



Clear visible at Theta = 90 ° (Pi / 2) is the field Er = 0 from 0 < r < ∞ as requested.

After this introduction of a function what full fills the condition of the Gross–Pitaevskii equation repulsive for g > 0 , attractive for g < 0 and superconductivity at Theta = 90 ° it possible to introduce a test function for the wave function of the Gross–Pitaevskii equation.

We inserted the E_r field in a simple form in the solutions of the wave function for a one-dimensional soliton Bose–Einstein condensate discussed before.

$$\boxed{E_r = f(r,\theta,\varepsilon) = \frac{e\cdot(r^2 - a^2\cdot\cos^2\theta)}{\varepsilon\cdot(r^2 + a^2\cdot\cos^2\theta)^2}\cdot\frac{1}{4\cdot\pi}\quad\left[\frac{V}{m}\right]}$$

$$\boxed{E(r)_{Test} = K_{01}\varepsilon(r,\theta)K_{02}\frac{(r^2 - a^2(\cos[\theta])^2)}{(r^2 + a^2\cos[\theta]^2)^2}}$$

The $E(r)_{Test}$ function contains the two constants K_{01}, K_{02}, the constant (a) and the function $\varepsilon(r,\theta)$.

$$\boxed{E(r)_{Test} = K_{01}\varepsilon(r,\theta)K_{02}\frac{(r^2 - a^2(\cos[\theta])^2)}{(r^2 + a^2\cos[\theta]^2)^2}}$$

After extensive test of possible wave functions for a SOLITON ELECTRON the product of the solution for $g > 0$ and $g < 0$ give the most simple solution.

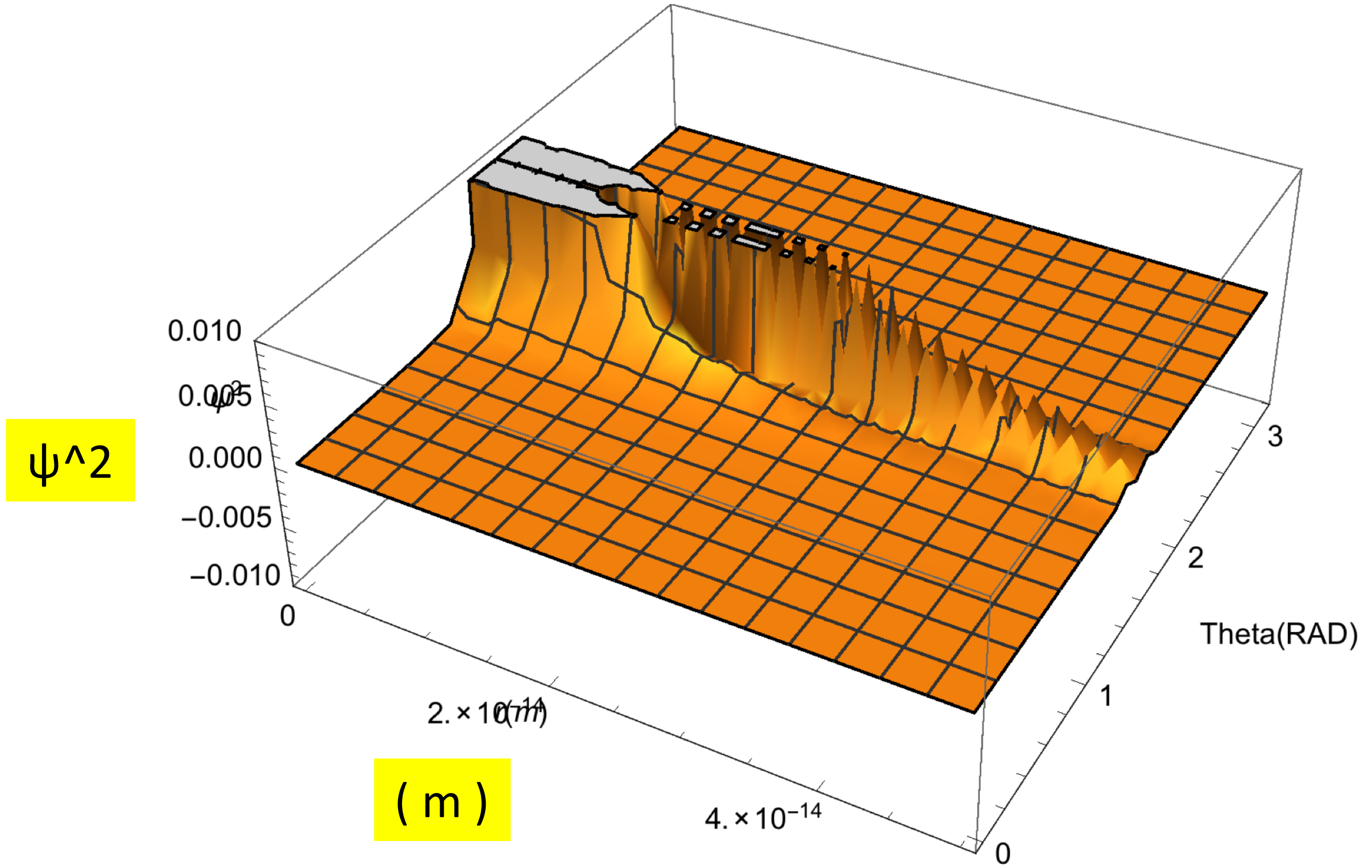
$$\boxed{\psi^2 = (\frac{1}{\cosh[E(r)_{Test}]})^2 \cdot (\tanh[E(r)_{Test}])^2}$$

$$\boxed{\psi(x) = C_3\frac{1}{\cosh[C_4 \cdot x]}} \qquad \boxed{\psi(x) = C_1\tanh(C_2 \cdot x)}$$

It is possible to plot Ψ^2 including the following constants

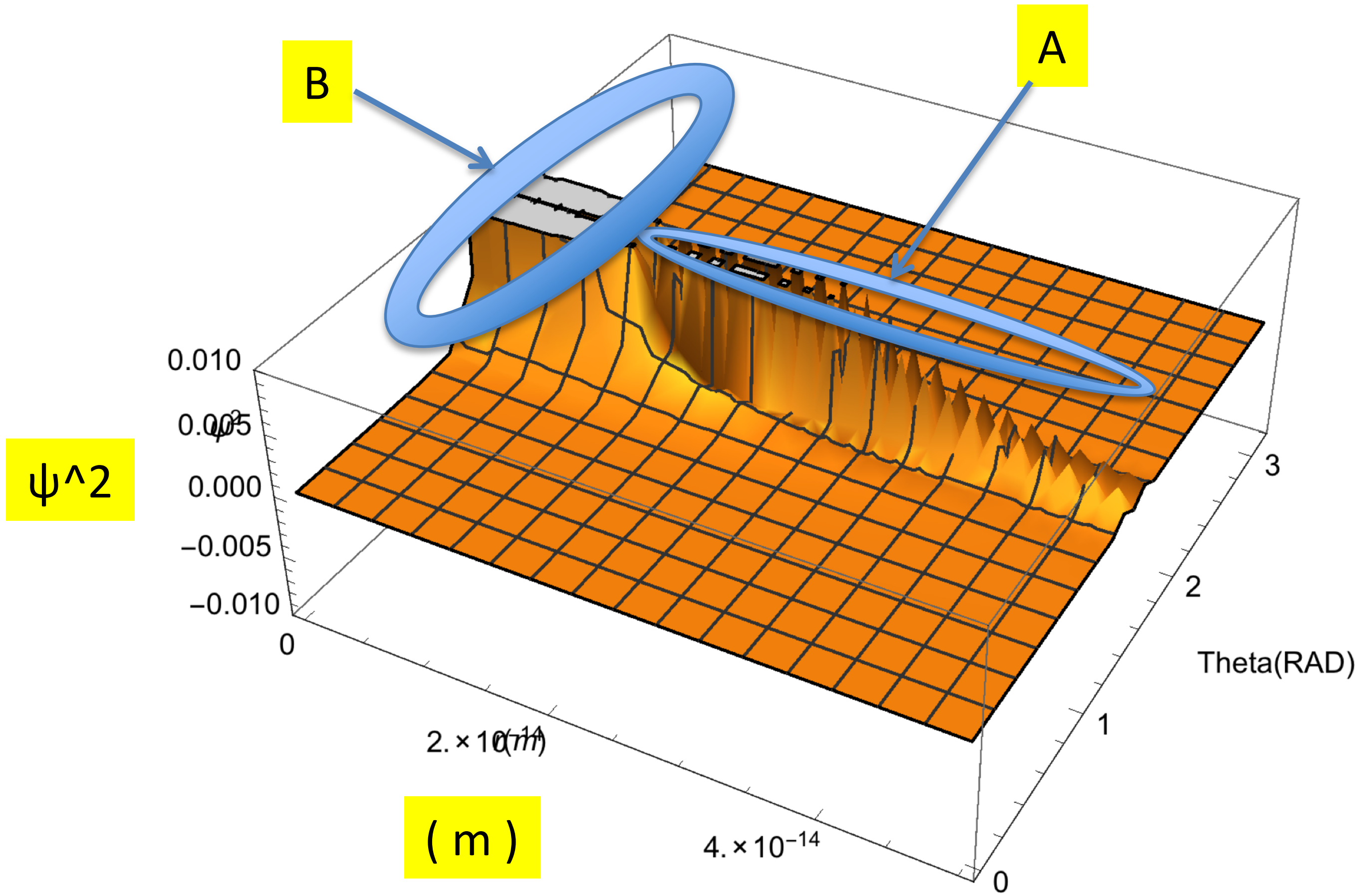
m = 1.0*10^7 K_{01} = 9.0*10^-20,

K_{02} = e/(4 π ε) = 1.44049*10^-9 a = 1.936*10^-13 .



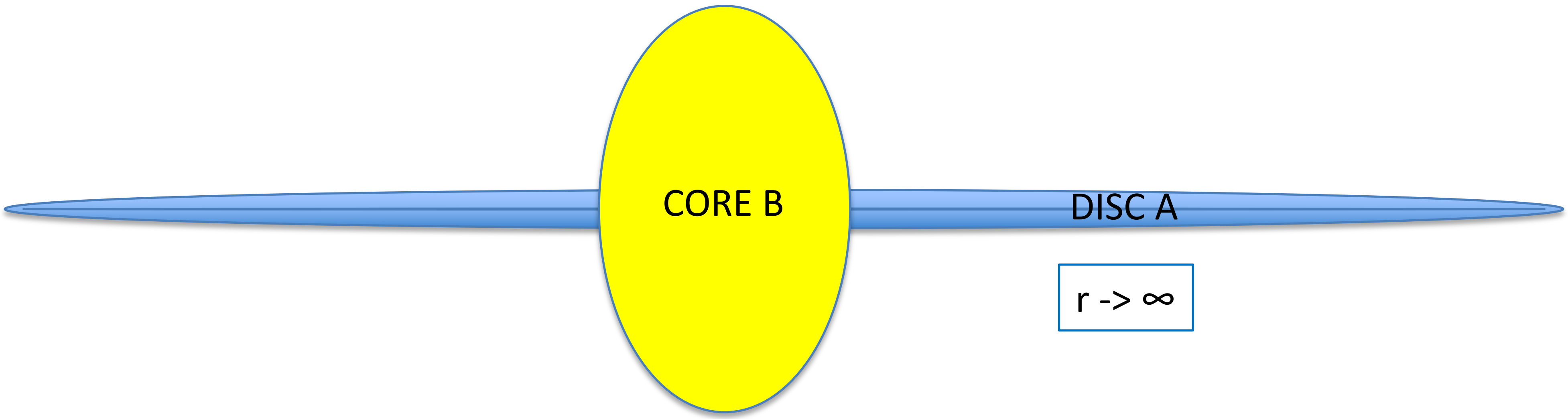
The free parameter m adjust the with of zero Er field at Theta = 90 °, the parameter K_{01} is necessary to damp down the very strong Er field to use it mathematical in the tanh and cosh function. The constants K_{02} and (a) get defined from the electron.

The wave function ψ^2 shows two structures A and B



With the knowledge from the discussion before it exist a superconducting disc at Theta = 90 ° with g < 0 and a repulsive superconducting core with g > 0 for r > 0 .

If we follow the picture of a superconducting structure of the ELECTRON with a superconducting attractive disc and a superconducting repulsive core like:



The structure A of the wave function ψ^2 > 0 close to the Theta = 90 ° disc would be originated from the superconducting attractive g < 0 disc A.

The structure B of the wave function ψ^2 > 0 close to r > 0 would be originated from the superconducting repulsive g > 0 core.

g - function SOLUTION for a SOLITON

After the introduction of a wave function for the the Gross-Pitaevskii equation. It is important to investigate that the g – function is finite and shows a g < 0 attractive g > 0 repulsive behaviour.

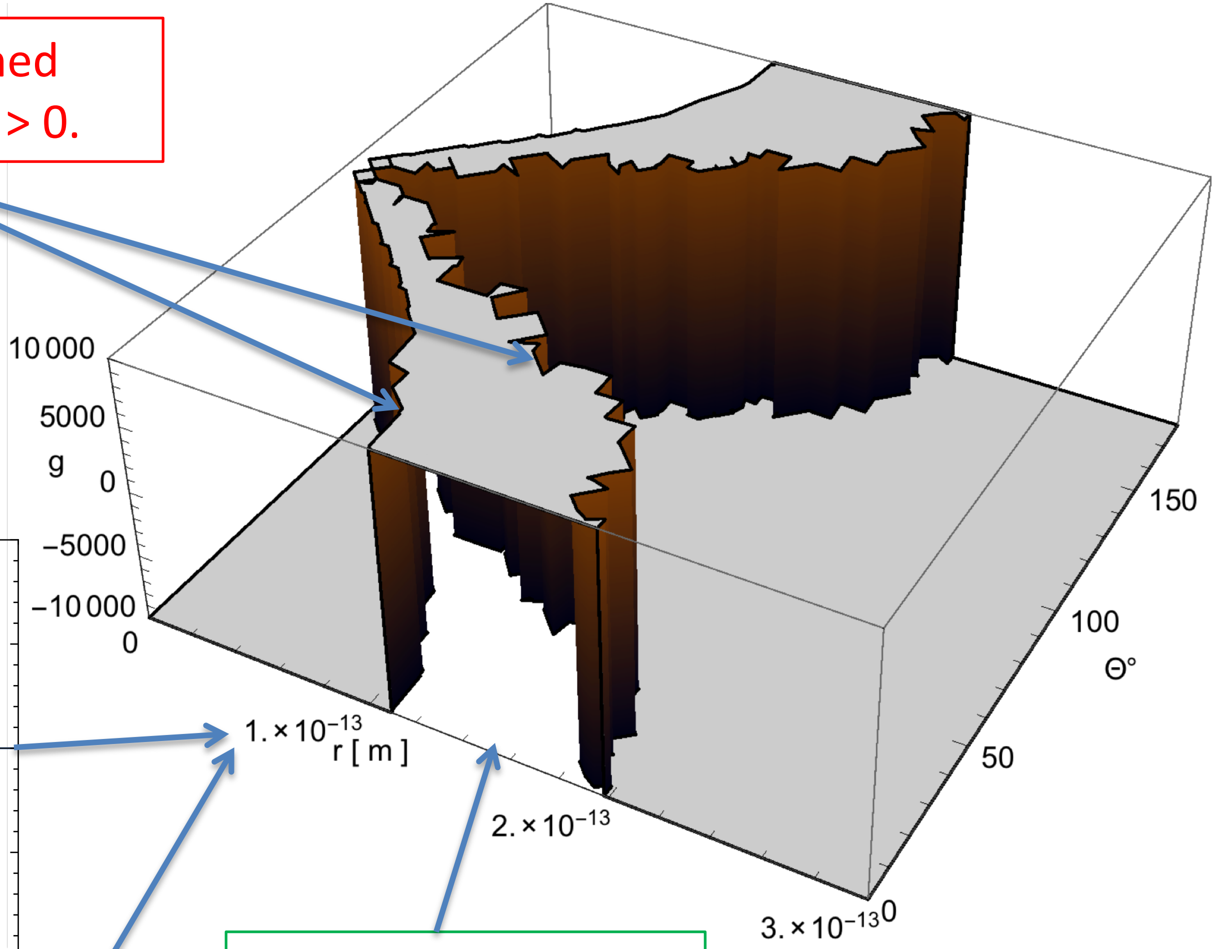
$$\boxed{g = \frac{\hbar^2}{2m} \frac{\Delta\psi}{|\psi|^2 \psi}}$$

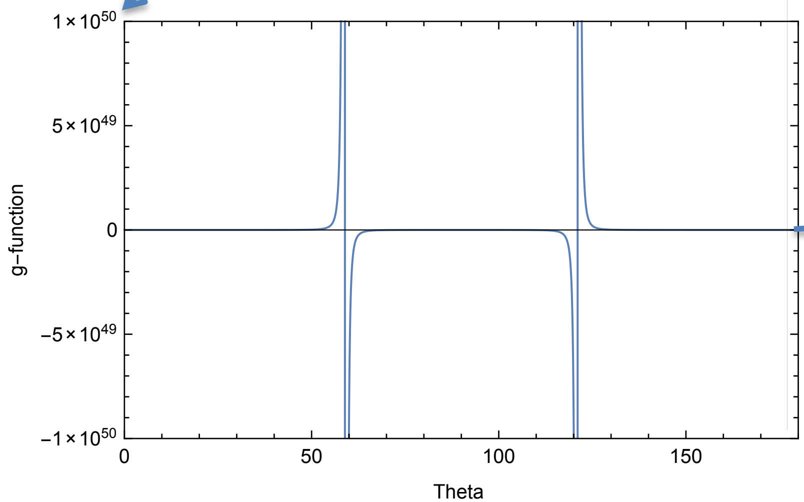
With the constant ħ^2/2m = 6.10426*10^-39 and the just used parameters for the wave function m and K_{01} and constants (a) and K_{02} , it is possible to plot in 3D the g – function.

3 – D plot of g – function between 1.0*10^-14 < r < 3.0*10^-13 [m]

Finite Walls formed from g < 0 and g > 0.

$g_{max} = \pm 1*10^{50}$



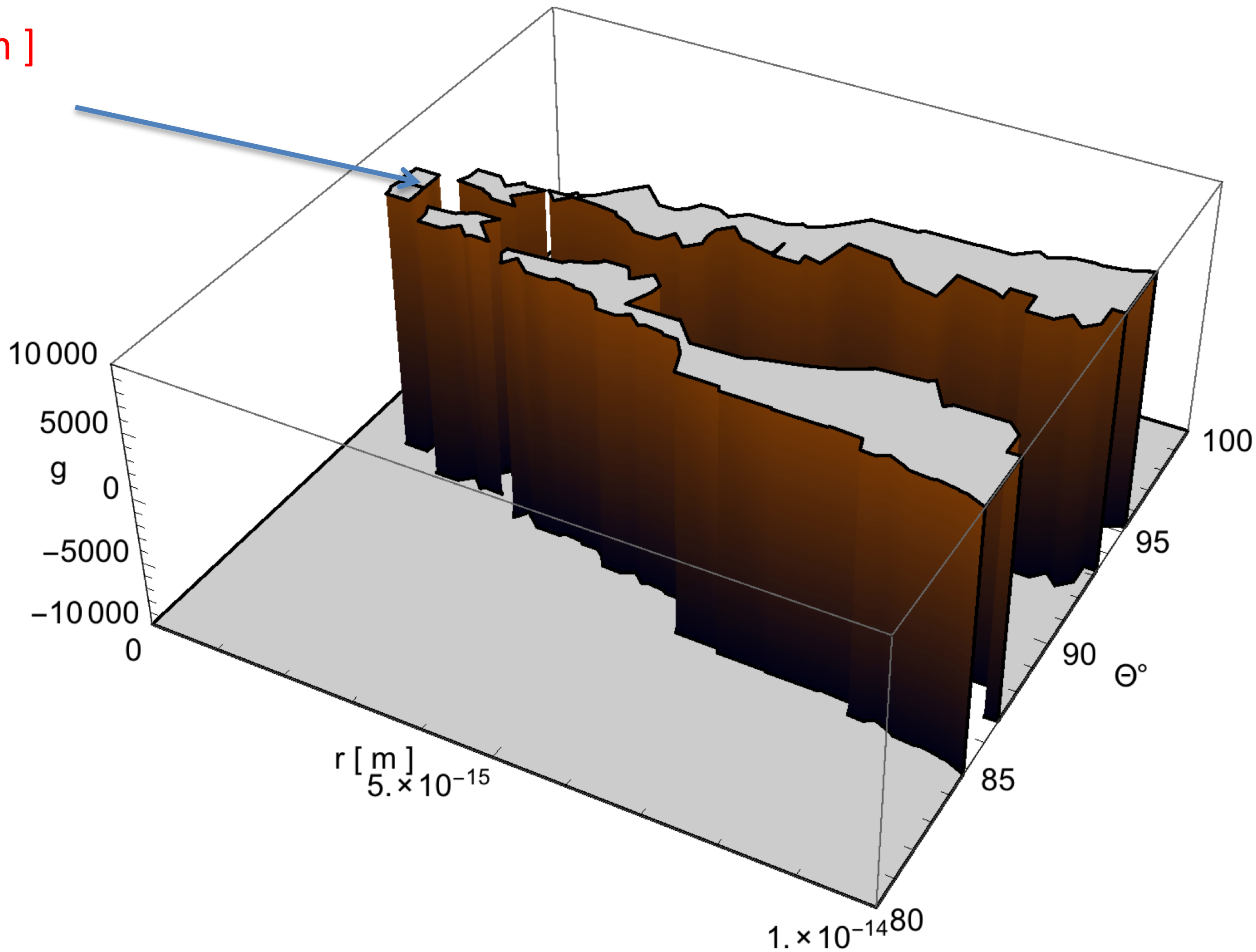


g-function for r = 1.0*10^-13 [m]
0° < Theta < 180°

The wave function of the disk are between this walls.

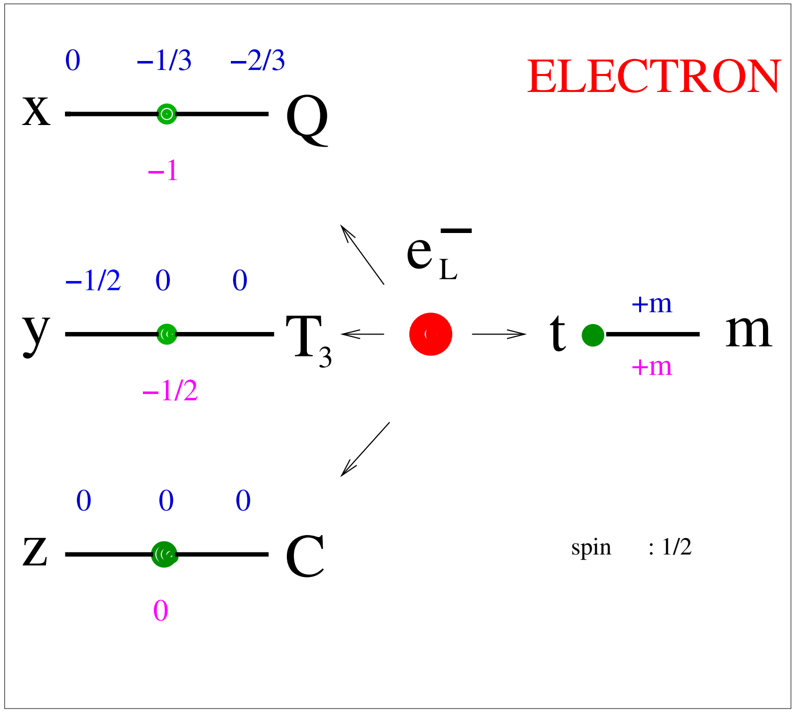
3 – D plot of g – function between 1.0*10^-15 < r < 1.0*10^-14 [m]

Below r < 1.0*10^-15 [m]
a wall appear what
closes the disc structure
and points to sphere.



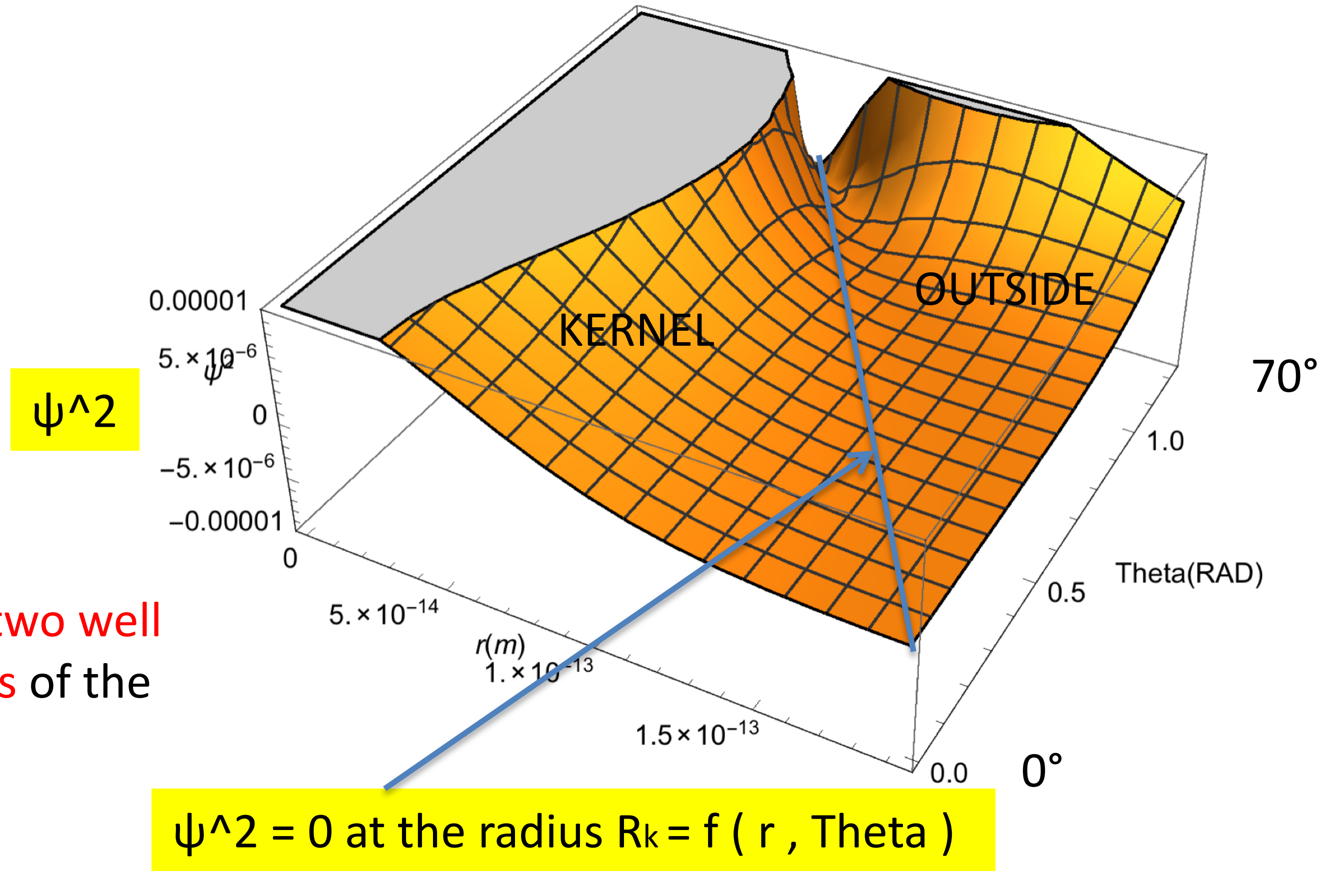
Test of the correlation of the ELECTRON charge e = 1
1 / 3*e KERNEL and 2 / 3*e OUITSIDE

In the discussion of the scheme of extended fundamental particles the ELECTRON had a charge distribution of a charge of the KERNEL of (1 / 3)*e and (2 / 3)*e OUTSIDE.



The question is does the toy wave function ψ^2, what is a function of the Er – field follow this 1 / 3 <-> 2 / 3 behavior and what is the geometrical extension of this wave function in radius r compared the experiment.

The plot below shows a 3-D plot of ψ^2 for 1.0*10^-14 < r < 2.0*10^-13 [m] and 0° < Theta < 70°.



Clear visible are two well separated regions of the wave function.

To test the radio 1 / 3 to 2 / 3 we numerical integrated ψ^2 in the range

0 < r < Rk = f (r , Theta) = > The radius of the KERNEL area
0 < Theta < 180°

and

0 < r < ∞ the total size of the structure
0 < Theta < 180°

$$\boxed{INT(R_k) = \iiint\limits_{0<R_k;0<\theta<180^0;0<\varphi<180^0} \psi^2 \, dr \, d\theta \, d\varphi}$$

$$\boxed{INT(tot) = \iiint\limits_{0<r<\infty;0<\theta<180^0;0<\varphi<180^0} \psi^2 \, dr \, d\theta \, d\varphi}$$

$$\boxed{RATIO(Kernel) = \frac{INT(R_k)}{INT(tot)}}$$

In the above discussed limits is the

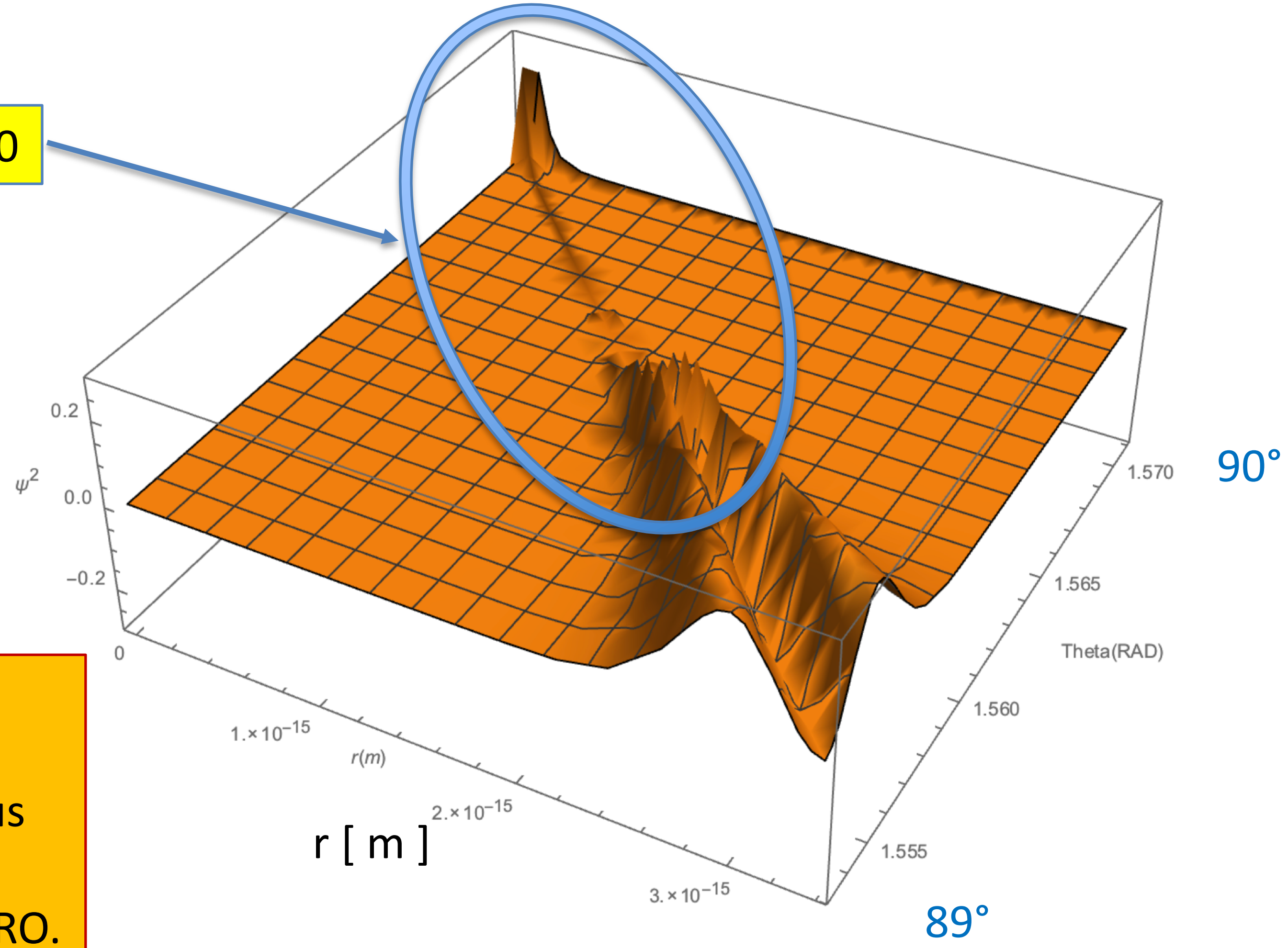
$$RATIO(Kernel) = \frac{INT(R_k)}{INT(tot)} \approx 46\%$$

This is approximately 13 % above the expected value of 33 %.

In the discussion of the electron, we concluded that the wave function of the electron is originated from the superconducting disc of the electron and a superconducting KERNEL. Following the rules of the SUPERCONTACTIVITY, the wave function on the disc and the INNER-KERNEL R_{k0} should be ZERO.

It is important to refine the microstructure of the Electron. So far the wave-function was on the disc at Theta = 90° ZERO. The plot below shows a 3-D plot of ψ^2 for 0.0 < r < 3.5*10^-15 [m] and 89° < Theta < 90°. But very close to Theta = 90° and r = 0 [m] the wave function is NOT ZERO very good visible on the plot below.

Wave-function > 0



It is necessary to include an INNER-KERNEL radius R_{k0} to set the wave function to ZERO.

To follow this request, we introduce explicit, a $E(r)_{test}$ function where the REPULSIVE core B includes a radius region $0 < r < R_{k0}$ [m] with the wave function ZERO. For simplicity a Unit-Step function was used.

$$STEP(R_{k0}) = UnitStep[r - R_{k0})$$

To introduce this STEP(R_{k0}) function give a modification of $E(r)_{test}$ to $E(r)_{testA}$

$$\boxed{E(r)_{TestA} = STEP(R_{k0})K_{01}\varepsilon(r,\theta)K_{02}\frac{(r^2 - a^2(\cos[\theta])^2)}{(r^2 + a^2(\cos[\theta])^2)}}$$

This also change the wave function ψ^2 to the equation below.

$$\boxed{\psi^2 = (\frac{1}{\cosh[E(r)_{TestA}]})^2 \cdot (\tanh[E(r)_{TestA}])^2}$$

The following parameters and constant factors give the the ration below.

Open Parameters:

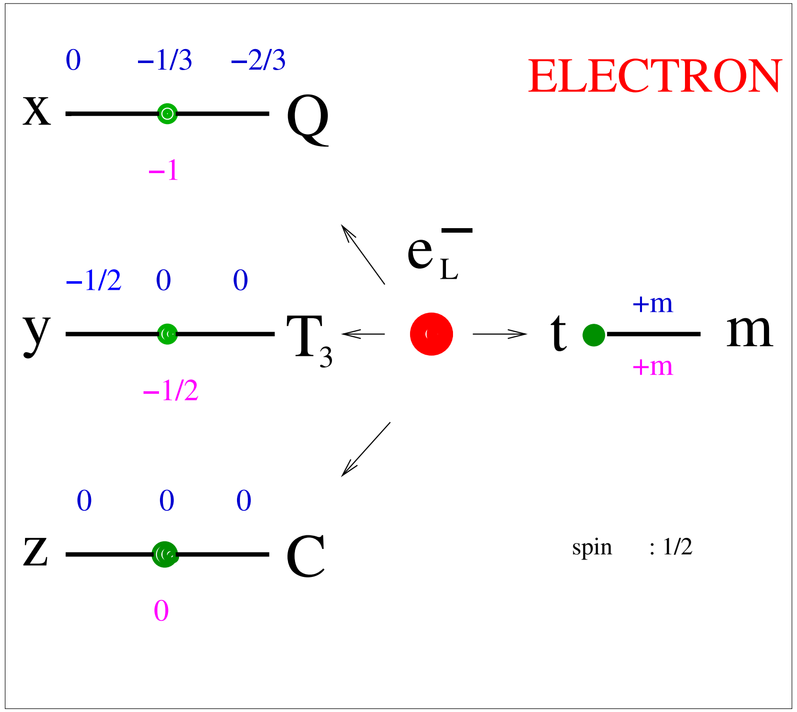
R_{k0} = 3.3*10^-15 [m] Superconducting INNER-Kernel RADIUS
m = 1.0*10^7 Superconducting disc width
K_{01} = 9.0*10^-20 Mathematic reason (CUT infinity)

Constant factors from the ELEKTRON:

K_{02} = e/(4 π ε) = 1.44049*10^-9
a = 1.936*10^-13 Spin mass of the ELECTRON

$$\boxed{RATIO(Kernel) = \frac{INT(R_k)}{INT(tot)} = 33.42\%}$$

In the discussion of the scheme of extended fundamental particles the ELECTRON had a charge distribution of a charge of the KERNEL of (1 / 3)*e and (2 / 3)*e OUTSIDE.



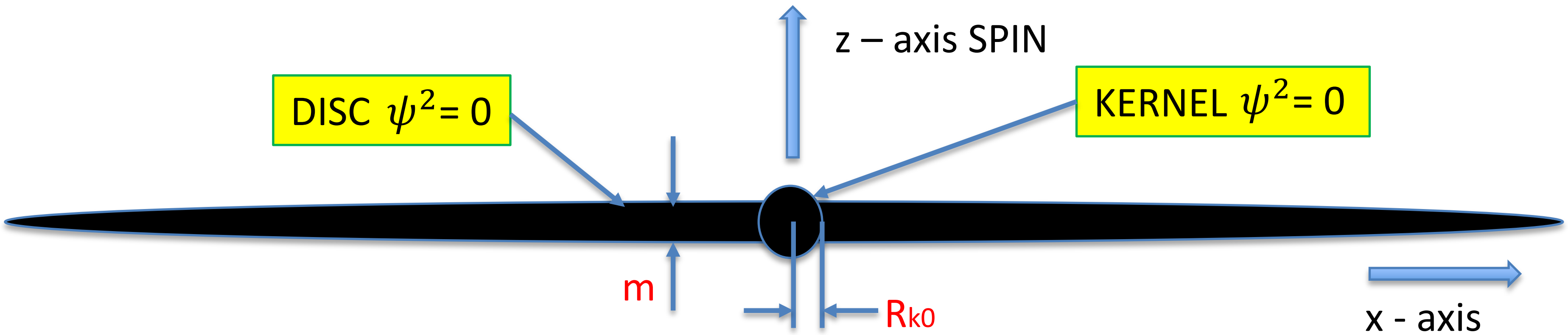
RATIO(Kernel) = 1 / 3 = 33.3333 %

Both RATIOS agree numerical very well. The result is not sensitive to m and K_{01}. For R_k = 0 the RATIO(Kernel) would increase approximately 10 %.

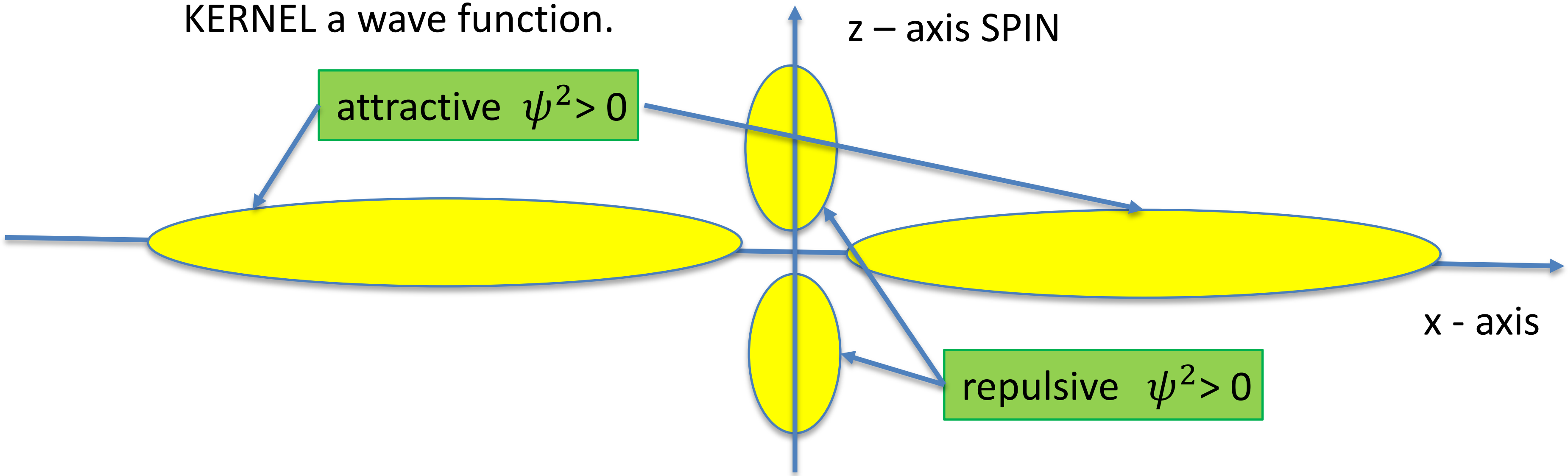
$$\boxed{RATIO(Kernel) = \frac{INT(R_k)}{INT(tot)} = 33.42\%}$$

After the findings so far, the shape of the electron decays in TWO geometrical REGIONS.

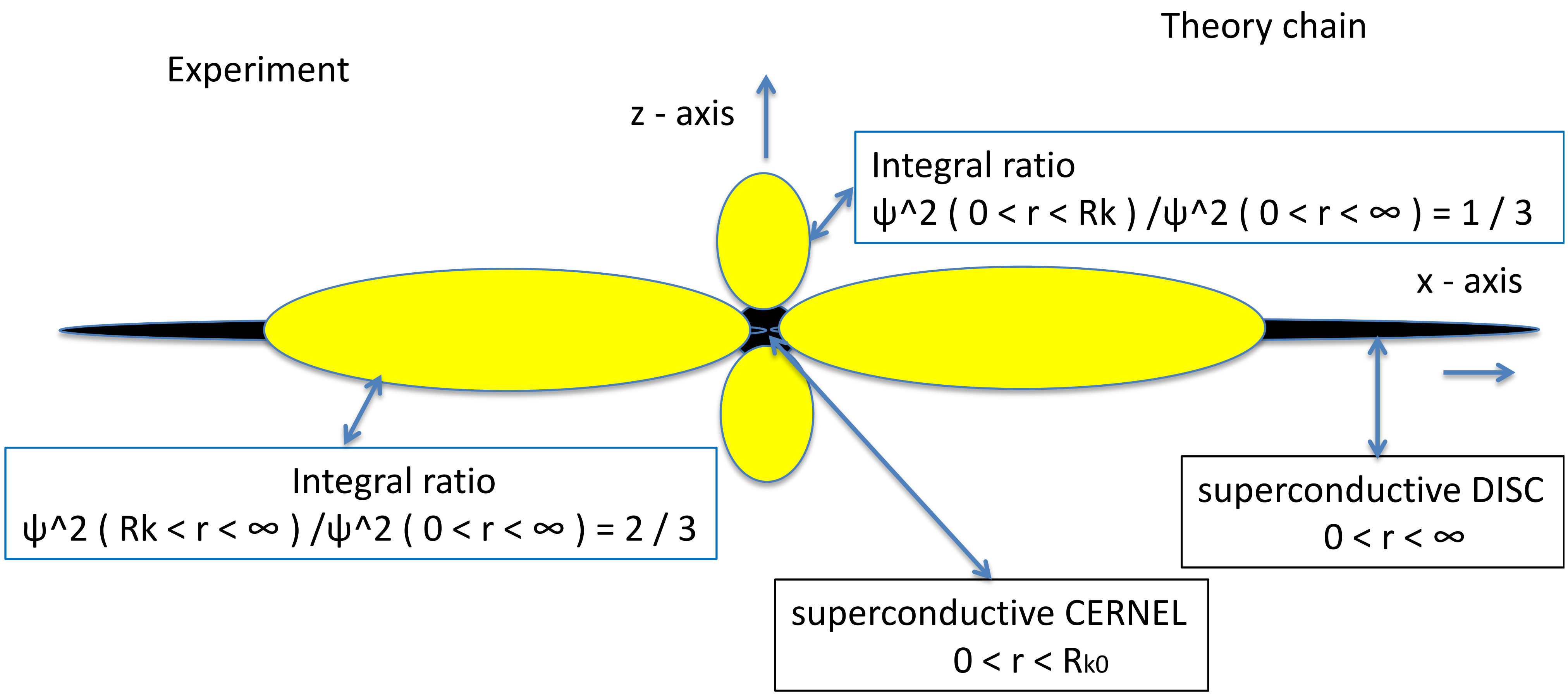
A === > A superconductive DISC with a width defined from the parameter m
plus a KERNEL with radius R_{k0} where the wave function is ZERO.



B === > The superconductive DISC and the KERNEL generate outside the DISC and
KERNEL a wave function.



Sketch SPAPE of the ELECTRON



Comparison of the EXPERIMENT with the theoretical CALCULATIONS of the size of the ELECTRON.

If the ELECTRON is a geometrical extended object in the experiment with energies 55 GeV – 207 GeV the Electron will be polarized in the e+ and e- BEAM longitudinal. It means the Electrons will contact each other at a radius r at Theta = 0.0 °.

The Electron will be Lorentz contracted at the radius at Theta = 0° after the well known equations:

$$l = l_0 \sqrt{(1-(v/c)^2)}$$

$$\boxed{l_0 = l_{\text{experiment}} * \frac{m}{m_0} = l_{\text{experiment}} * \frac{E_{tot}}{E_0}}$$

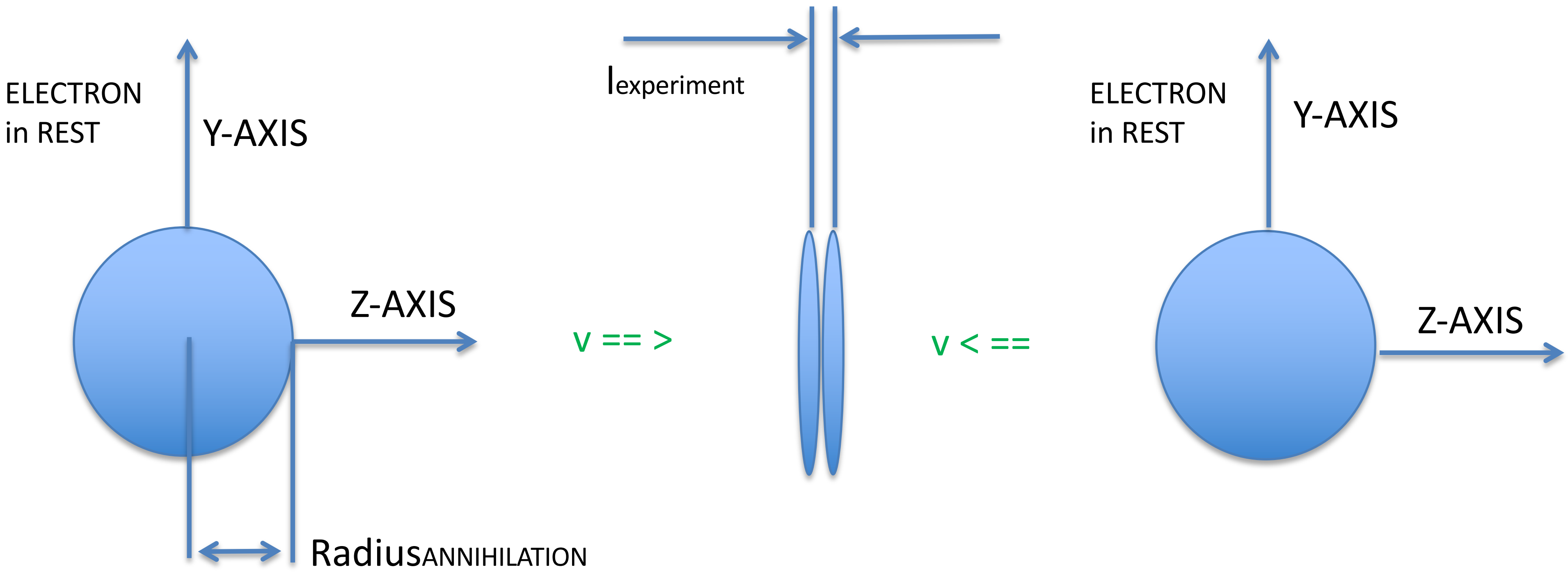
$$\sqrt{(1-(v/c)^2)} = m_0 / m$$

With l as length with the velocity v, l_0 length at rest, m_0 mass in rest m mass at velocity v

The in the experiment measured annihilation length is

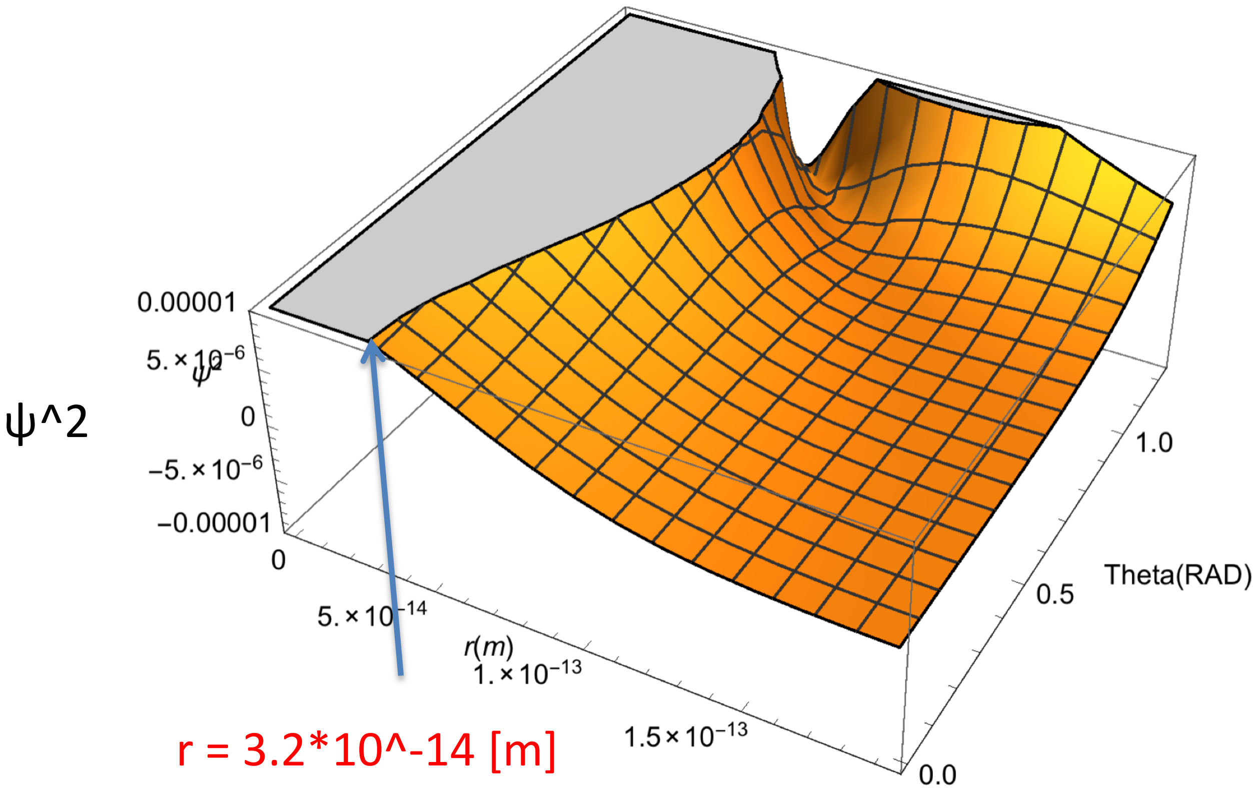
$l_{experiment}$ = 1.57*10^-19 m

At E_{tot} = 207 GeV the highest luminosity was collected what defines the upper limit of the length where the annihilation could start.



$$\boxed{Radius_{ANNIHILATION} = \frac{1}{2} l_{experiment} * \frac{E_{tot}}{E_0} = \frac{1}{2} * 1.57 * 10^{-19} * \frac{207000}{0.51099} = 3.18 * 10^{-14} [m]}$$

If we study the radius in the 3 D plot from the wave function ψ^2 at Theta = 0° at r = 2.0*10^-13 the wave function ψ^2 = 0. It means NO annihilation at this radius.



The annihilation would start after the increase of ψ^2 of approximately 0.001 % compared to ψ^2 = 0.0 at r = 3.2*10^-14 [m] and Theta = 0° (Spin axis)

CONCLUSION

Theory chain:

NEW Scheme of FB

General Relativity

SOLITON

Superconductivity

Gross-Pitaevskii equation

Wave function

Lorenz contraction

RADIUS ANNIHILATION starts

Experiment chain:

e+ e- Experiment at CERN

Direct contact TERM

5 – σ EFFECT

ANNIHILATION RADIUS

R ~ 1.57*10^-19 [m]