SURROUNDING MATTER THEORY:
FIRST MATHEMATICAL DEVELOPMENTS

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Presentation

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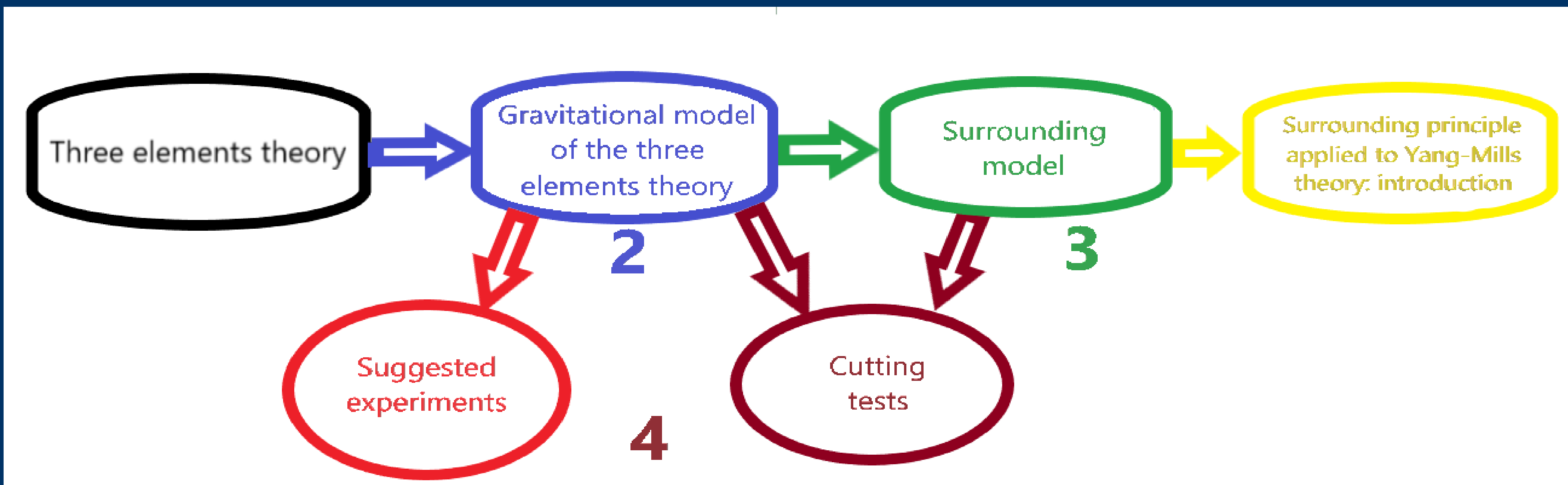
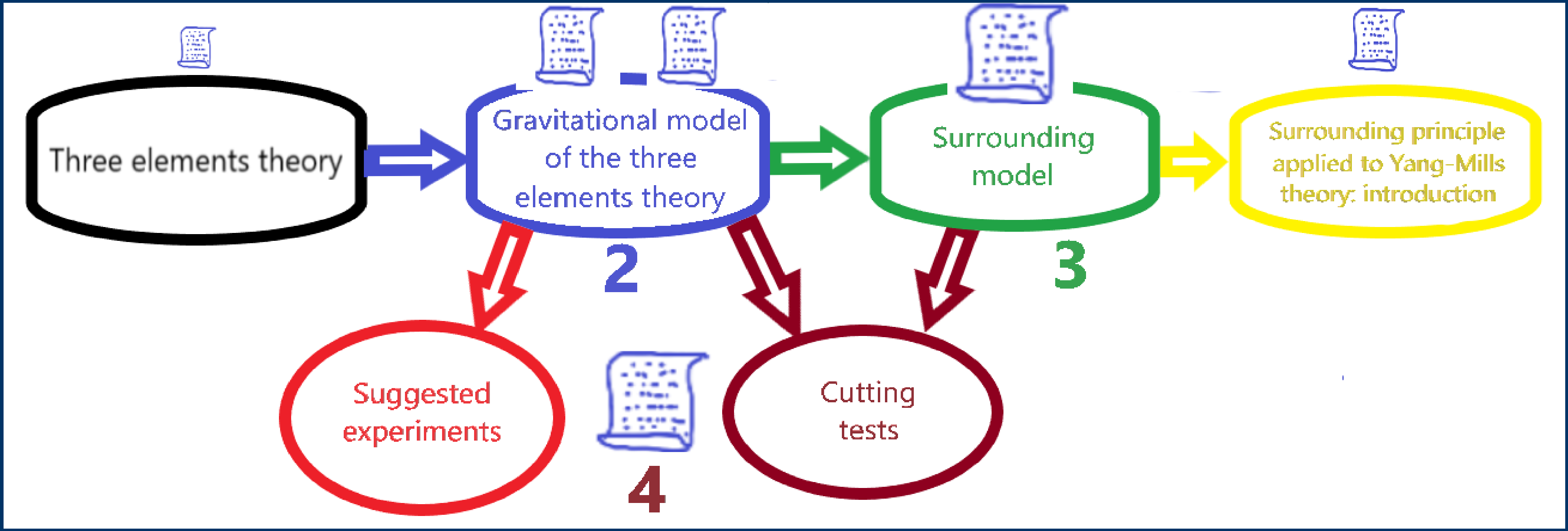
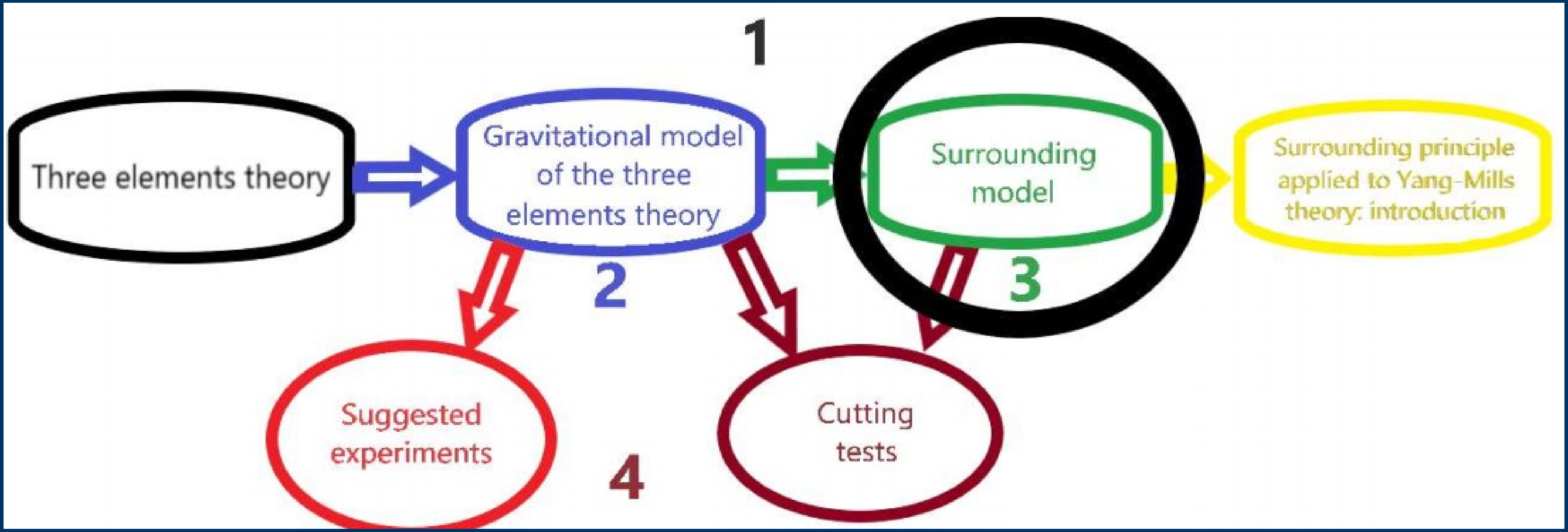
Prerequisite : the research



Prerequisite : the research



Prerequisite : the research



Surrounding or « Surrounding Matter Theory » (SMT)

Reference : F. Lassiaille, Surrounding Matter Theory, EPJ Web Conf., 182 03006, 2018

Prerequisite : Surrounding

GR equation is modified using the **surrounding matter** at the location where the force is **exerted** :

Surrounding equation :

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

What is this $C_\mu^l C_\nu^m$ « surrounding » factor ?

- Matter density at the location where the force is exerted.
- It depends of the scale.
- Astrophysic scale → calculated in the 15 kpc ray sphere.

A new representation of relativity

A new representation of relativity

- Reference: F. Lassiaille, Journal of Modern Physics, Vol. 4 No. 7, pp. 1027-1035, 2013
- An euclidean representation of space-time inverting the metric coefficients :

  - *Minkowskian metric :*

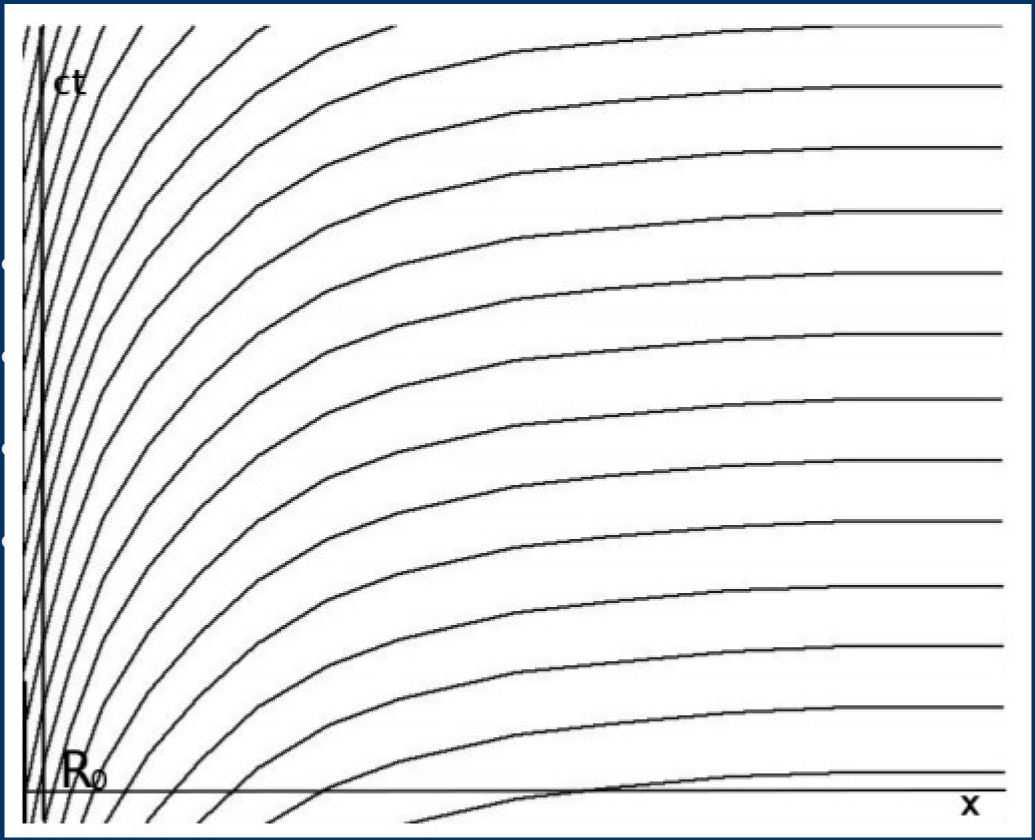
$$ds^2 = \left(1 - \frac{M}{x}\right) c^2 dt_b{}^2 - \left(1 - \frac{M}{x}\right)^{-1} dx_b{}^2$$

  - **This euclidean representation :**

$$ds'^2 = \left(1 - \frac{M}{x}\right)^{-1} c^2 dt_b{}^2 + \left(1 - \frac{M}{x}\right) dx_b{}^2$$

A new representation of relativity

- The space-time deformations are viewed :



in a « human sensitive » manner.

The geodesics are not the correct one.

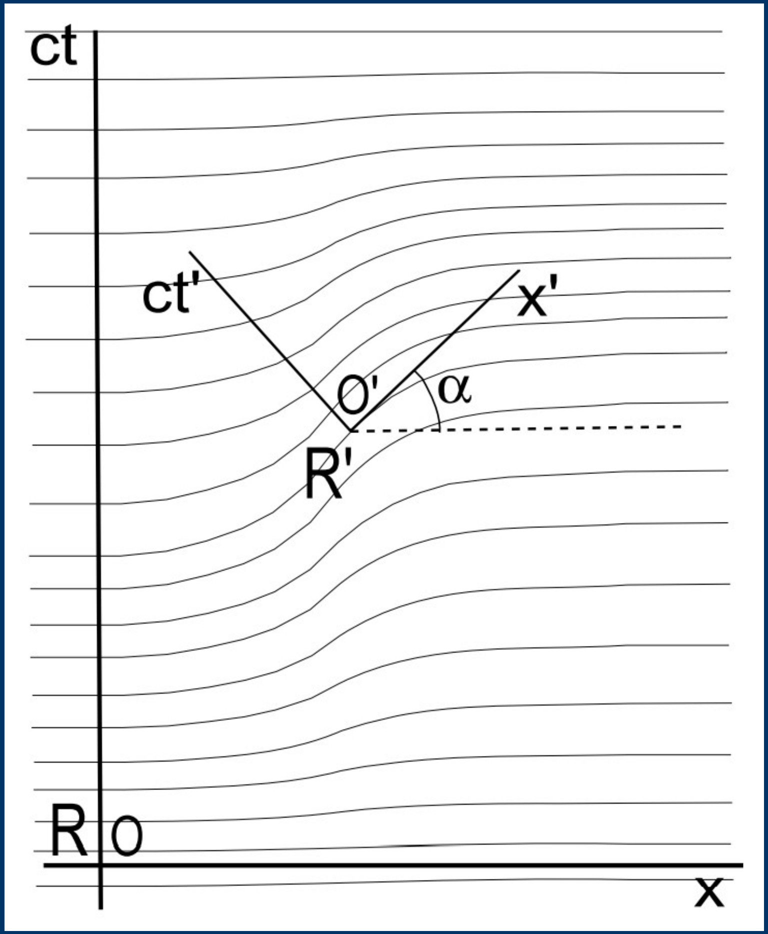
They are correct only for the weak deformations.

But they are viewed immediatly.

Some GR features are more « visual ».

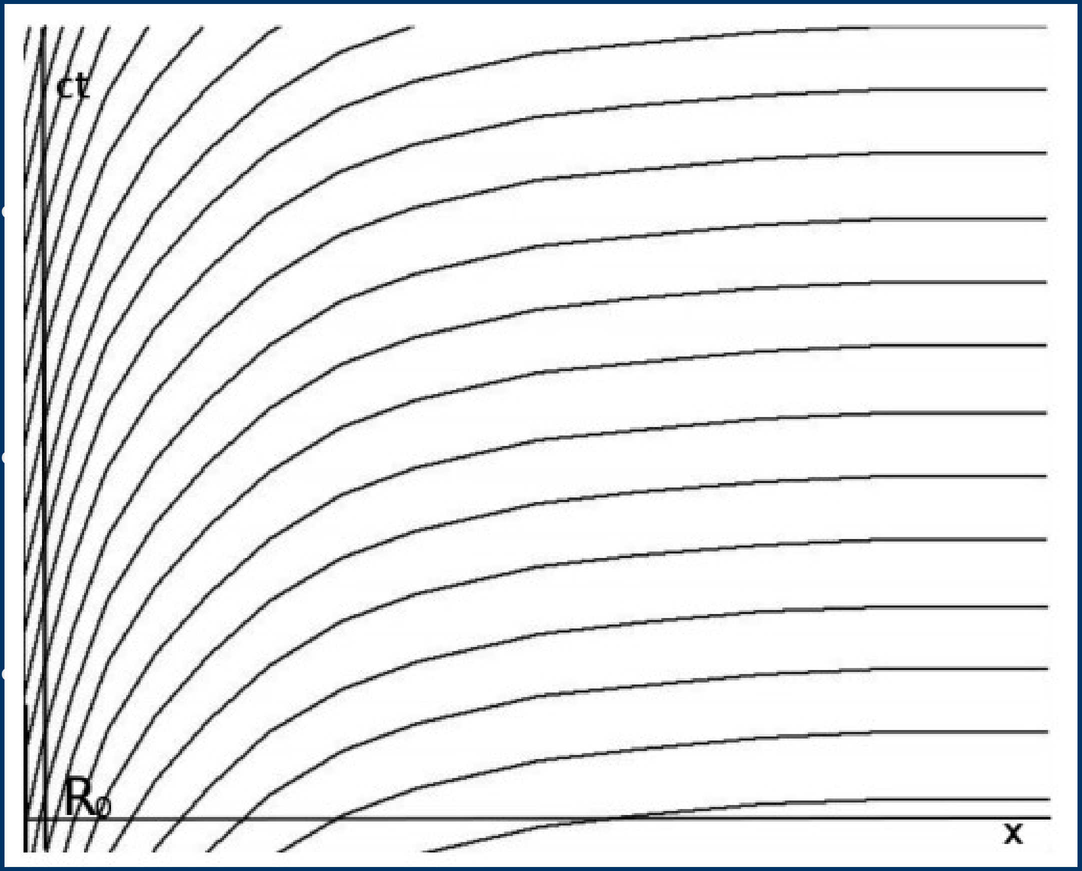
A new representation of relativity

- A Lorentz Transform is a space-time deformation :



A new representation of relativity

- One given global space-time deformation can be the result of :



- GR Lagrangian conservation in vacuum.
- Matter in motion.
- Gravitational waves ?

Synchronisation of clocks and foliation : the question

Synchronisation of clocks and foliation

- Reference: E. Minguzzi J. Phys.: Conf. Ser. 306 012059, 2011 :
- In Special Relativity (SR) the historical synchronisation of clocks supposes that light travel times are the same from left to right and right to left.
- But this is only true in one given frame of reference.
- What is this frame ?
    - SR does not answer to this question.
    - **Does General Relativity (GR) answer the question ?**

Synchronisation of clocks and foliation

Supposing a symetrical synchronisation (mathematical convention) :

- The meaning of a frame exists.
- Relativity can be constructed.
- It follows that there exists a privileged frame, the frame in which time elapses the most.
- From this the different synchronisation conventions are deduced from each other
  - Using the Lorentz Transform.

Synchronisation of clocks and foliation

Supposing a symetrical synchronisation (mathematical convention) :

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It remains the question :

Which convention must be used for the frame in which time elapses the most ?

- No formal answer.
- But **supposing** a **non** symetrical convention in this frame :
  - The corresponding frame with symmetrical convention has no closed loop trajectory. « Nobody will know ».
- The symetry of the configuration suggests to choose a symetrical convention.

Non null vectors versus null vectors duality

Non null vectors versus null vectors duality

- Minkowskian metric *in a* non null vectors base **B** (**ct**, **x**):

$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \qquad ds^2 = c^2dt^2 - dx^2$$

- In the **D** (**u**,**v**) = $(ct+x)/\sqrt{2},\ (ct-x)/\sqrt{2}$ null vectors base:

$$\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \qquad ds^2 = 2\,dXdY$$

- $d\vec{x} = c\,dt\ \vec{t} + dx\ \vec{x}$ in the **B** base, $d\vec{x} = dX\ \vec{u} + dY\ \vec{v}$ in the **D** base.

$$dX = (dt+dx)/\sqrt{2},\ dY = (dt-dx)/\sqrt{2}$$

- **F** : **E^** → **CXC** (**C** is the set of null vectors)
  dx |-> ($dX\,\vec{u},\ dY\,\vec{v}$)

- To any **dx** vector in **E**, the 4D space-time, which is not parallel to **ct**, **F** goes to an unordered couple of null vectors ($dX\,\vec{u},\ dY\,\vec{v}$). This such defined unordered couple is unique.

Non null vectors versus null vectors duality : Isotropic symetric form and simplectic form

- Let's give **f**, a 2D symetric form having one null dimension.
  There exists an orthonormal and orthogonal base **B**=(**i**,**j**) in which the **f** matrix is diagonal :

$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \qquad f(U,U) = x^2 - y^2 \qquad f(U,V) = xx' - yy'$$

- In the **D**= (**u**,**v**) = ($(i+j)/\sqrt{2},\ (i-j)/\sqrt{2}$) null vectors base, the **f** matrix becomes

$$\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \qquad f(U,U) = 2XY \qquad f(U,V) = XY' + X'Y$$

- From it one can construct the **g** simplectic form having the following matrix in **D**:

$$\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} \qquad g(U,U) = 0 \qquad g(U,V) = XY' - X'Y$$

Non null vectors versus null vectors duality

- Interesting features of null vectors :
  - Energy equation calculation is a surfacic version of pythagore equation:
    - Energy equation $Em^2 = Et^2 - Emvt^2$
    - In **B** base $ds^2 = c^2dt^2 - dx^2$
    - In **D** base $2XY = \left(\frac{X+Y}{\sqrt{2}}\right)^2 - \left(\frac{X-Y}{\sqrt{2}}\right)^2$ Minkowskian metric is «detailed»
  - Boost Lorentz transform equations are simplified:

In the **B** base :

$$LT = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\begin{bmatrix} 1 & -\frac{v}{c} \\ -\frac{v}{c} & 1 \end{bmatrix}$$

In the **D** base :

$$LT = \begin{bmatrix} D & 0 \\ 0 & \frac{1}{D} \end{bmatrix} \qquad D = \frac{\sqrt{1-\frac{v}{c}}}{\sqrt{1+\frac{v}{c}}}$$

Non null vectors versus null vectors duality

- Interesting features of these null vectors (following):
  - Morphism between four momentums and boosts.
  - Base of barycentric formulation of boosts. Algebraic structure.
  - Coherence between energy and waves :
    - This energy travels at light speed
    - Waves also
    - They are naturally equivalent

- **<u>It gives the idea of another GR formulation</u>**

GR version using null vectors

GR version using null vectors

Resulting equation

Equation:

$$D^{\mu}(x) = \sum_{n=0}^{\infty} \delta(\|x - y_n\|_3 - x^0 + y_n^0) f(\|x - y_n\|_3) C^{\mu}(y_n)$$

where :

$$D^{\mu}(x) = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \frac{E}{c} \left(1, \frac{v_x}{c}, \frac{v_y}{c}, \frac{v_z}{c}\right)$$

$$C^{\mu}(y_n) = \frac{E(y_n)}{c} \left(1, \frac{c_x}{c}, \frac{c_y}{c}, \frac{c_z}{c}\right)$$

GR version using null vectors (following)

Now, from $$D^{\mu}(x) = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\frac{E}{c}\left(1, \frac{v_x}{c}, \frac{v_y}{c}, \frac{v_z}{c}\right)$$

Then the boost is deduced $$B^{\mu}_{\nu}(x) = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \begin{matrix} 1 & -v_x/c & -v_y/c & -v_z/c \\ -v_x/c & 1 & 0 & 0 \\ -v_y/c & 0 & 1 & 0 \\ -v_z/c & 0 & 0 & 1 \end{matrix}$$

and the evolution of the metric $$g_{\alpha\beta}(x) = B^{\rho}_{\alpha} B^{\kappa}_{\beta} S^{\mu}_{\rho} S^{\nu}_{\kappa} g_{\mu\nu}(x')$$

GR version using null vectors (following)

The metric evolution is driven by the evolution of

the frame in which time elapses the most :

$$g_{\alpha\beta}(x) = B_\alpha^\rho B_\beta^\kappa S_\rho^\mu S_\kappa^\nu g_{\mu\nu}(x')$$

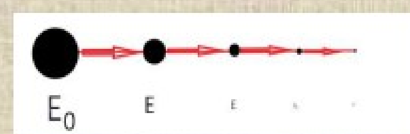
GR version using null vectors (following)

The whole picture

Four momentum of an IP (Indivisible Particle):

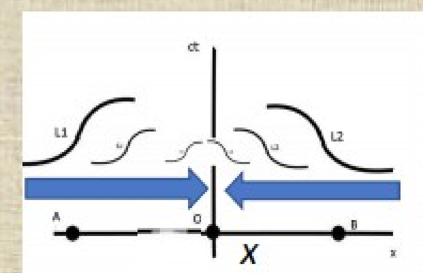
$$D_0^{\mu}(y) = \frac{E_0}{c}(1,-1,0,0)$$

It propagates a *potential* space-time deformation



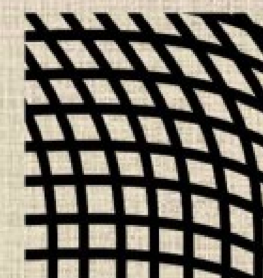
$$D^{\mu}(y) = \frac{E}{c}(1,-1,0,0)$$

Space-time structure is given at each encounter of waves:



what is going on at x location

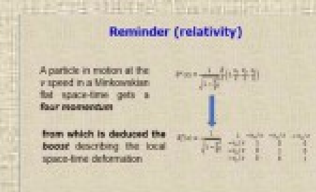
$$\frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\frac{E}{c}\left(1,\frac{v_x}{c},\frac{v_y}{c},\frac{v_z}{c}\right) = D_1^{\mu}(x) + D_2^{\mu}(x)$$

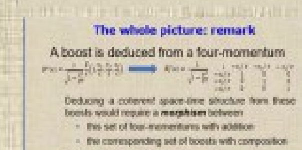


Invariance break

A boost is deduced at x location

$$B_{\nu}^{\mu}(x) = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\begin{matrix} 1 & -v_x/c & -v_y/c & -v_z/c \\ -v_x/c & 1 & 0 & 0 \\ -v_y/c & 0 & 1 & 0 \\ -v_z/c & 0 & 0 & 1 \end{matrix}$$





Privileged frame

$$g_{\alpha\beta}(x) = B_{\alpha}^{\rho} B_{\beta}^{\kappa} S_{\rho}^{\mu} S_{\kappa}^{\nu} g_{\mu\nu}(x')$$

GR version using null vectors (following)

When it comes to physics :

- The specification of the waves is tough
- A discrete model is mandatory
- Passing from the discrete model to the continuous macroscopic metric is
  - Complicated
  - Not completed yet
  - Similarities with the path integral

GR version using null vectors (following)

Nevertheless from a mathematical perspective,

- The **surrounding behaviour** of the model will remain

  the **fondamental behaviour**

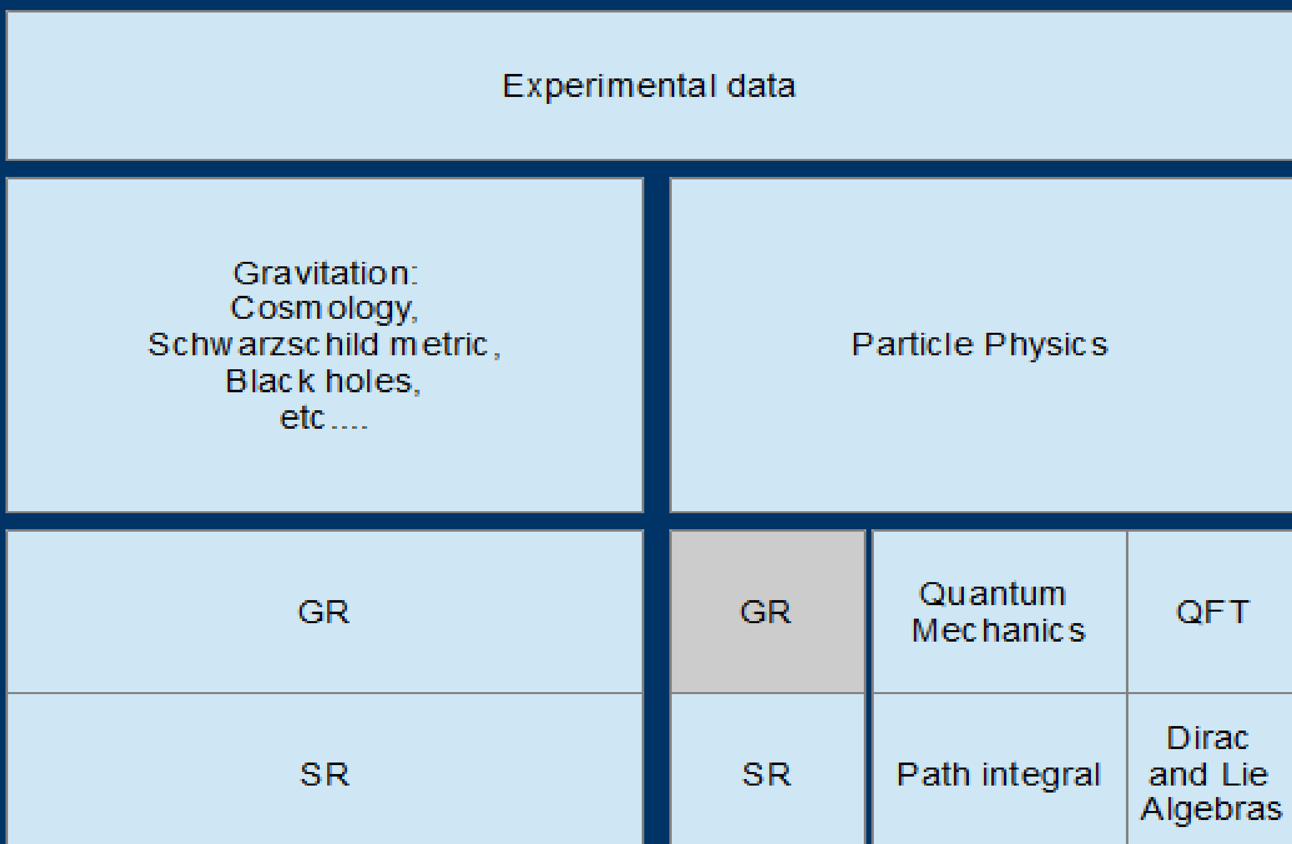
  whatever the physics will tell.

- Because :

$$\frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\left(1,\frac{v_x}{c},\frac{v_y}{c},\frac{v_z}{c}\right)=\frac{D^\mu(x)}{E/c}=\frac{\sum_{n=0}^{\infty}\delta\left(\left\|x-y_n\right\|_3-x^0+y_n{}^0\right)f\left(\left\|x-y_n\right\|_3\right)C^\mu(y_n)}{\sum_{n=0}^{\infty}\delta\left(\left\|x-y_n\right\|_3-x^0+y_n{}^0\right)f\left(\left\|x-y_n\right\|_3\right)E(y_n)/c}$$

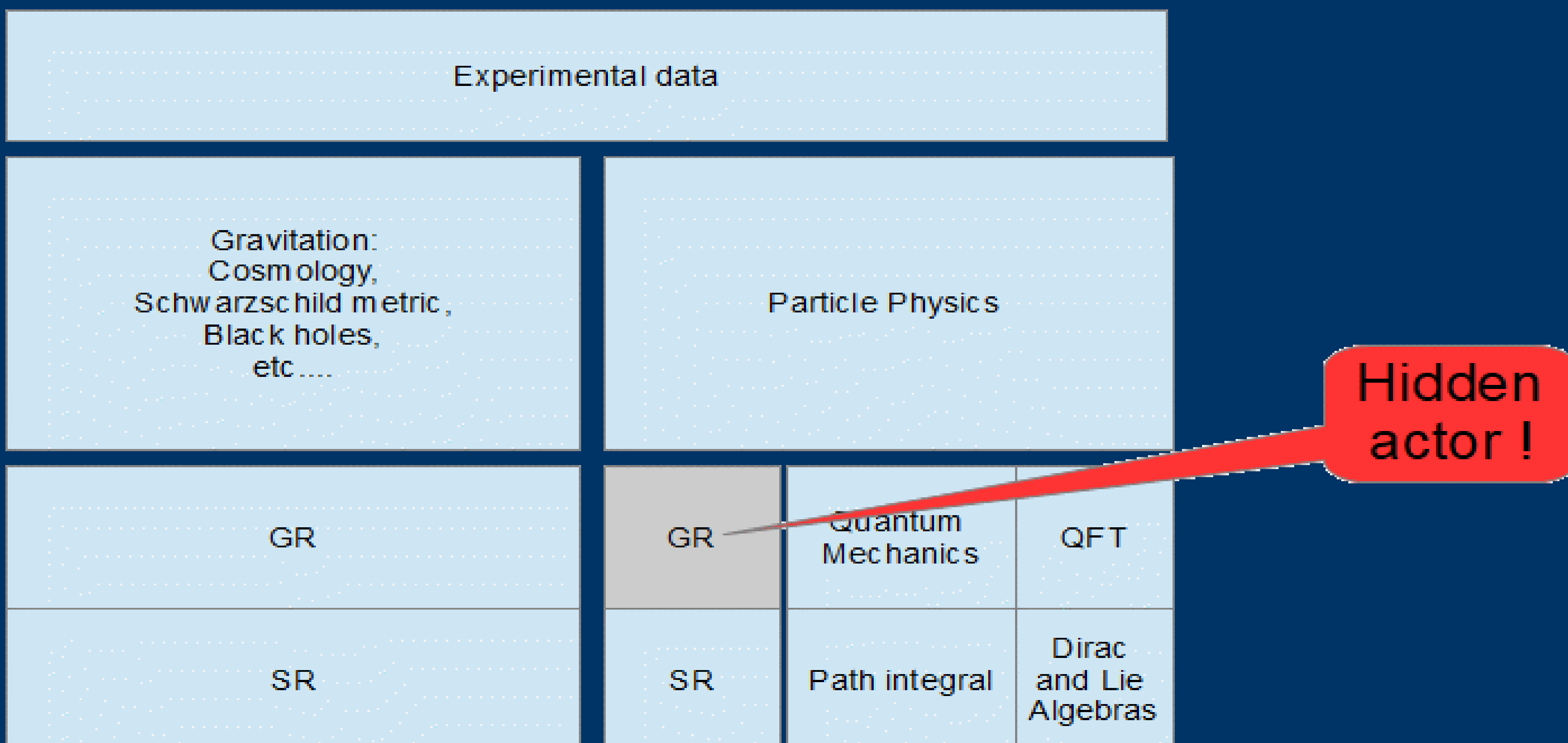
Surrounding equation in the context of Particle Physics

- Reminder of today's picture :



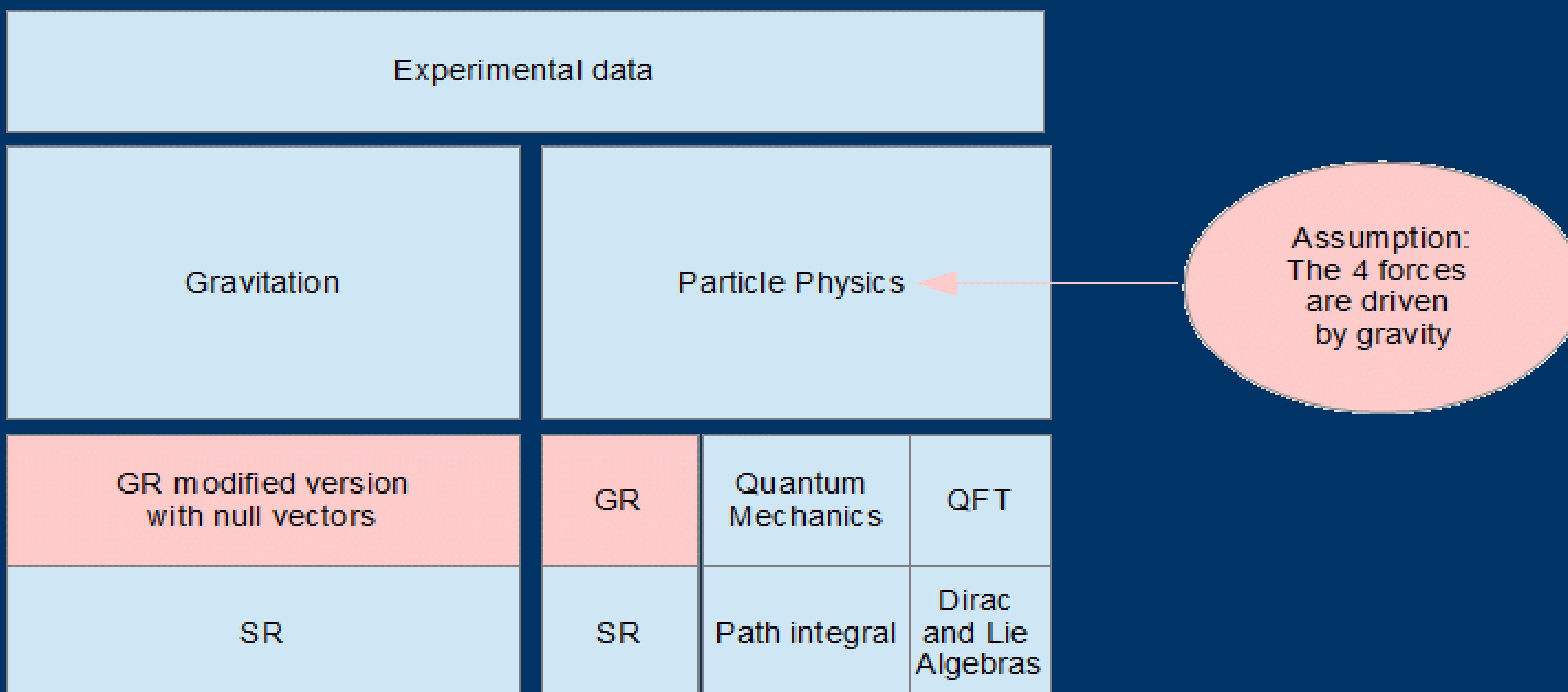
Surrounding equation in the context of Particle Physics

- The today's picture contain a **hidden actor**:



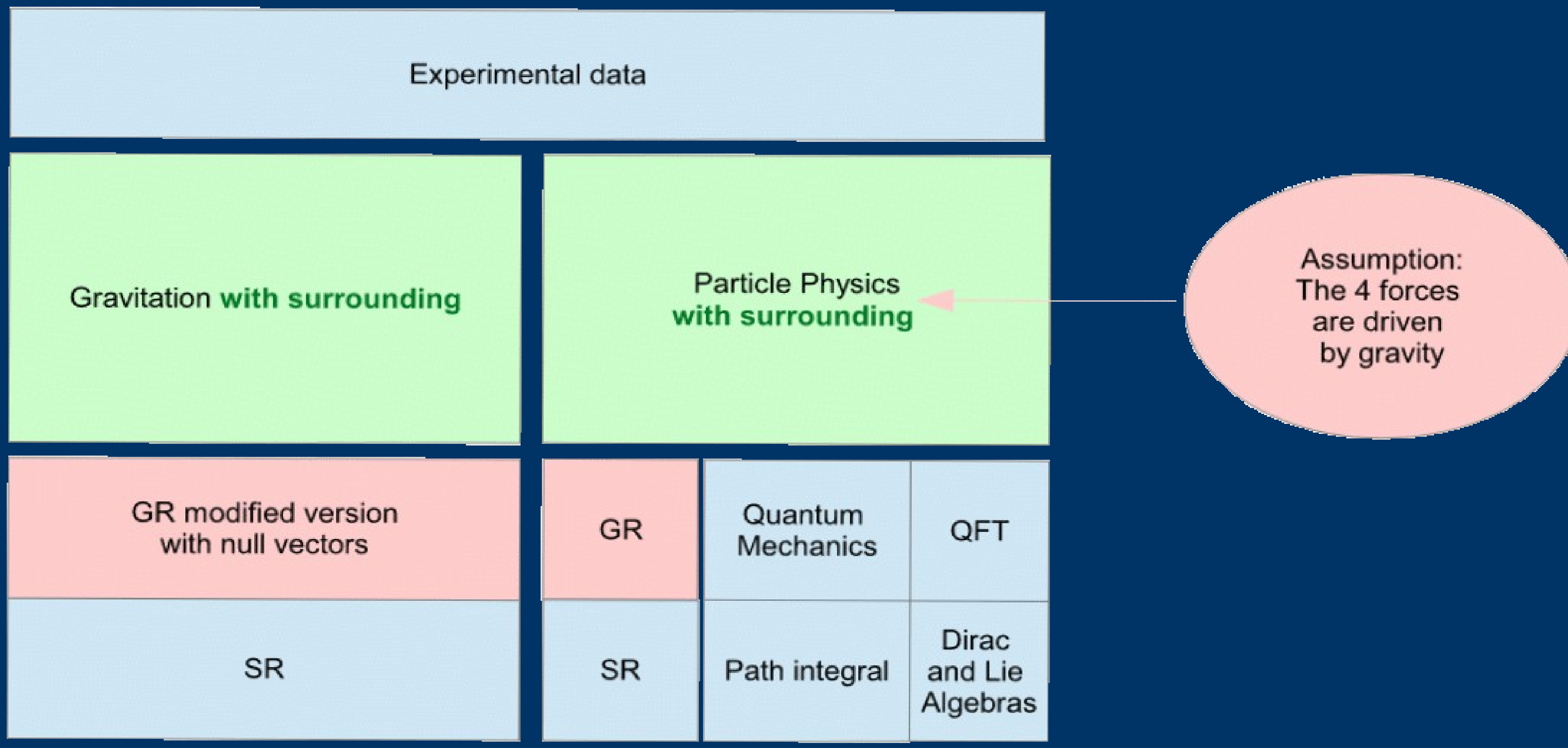
Surrounding equation in the context of Particle Physics

- **2 modifications :**



Surrounding equation in the context of Particle Physics

- **Consequences**

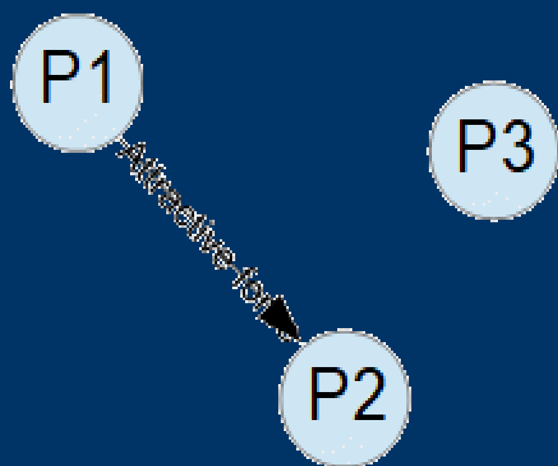


Surrounding equation in the context of Particle Physics

- **Consequences** in the domain of particle physics
  - Surrounding effect prevails.
  - It does **not** manifest itself in a **2 body (baryons)** interaction :
    - Electromagnetism
    - Weak interaction
  - It manifests itself **only** in a **3 body** interaction :
    - Strong force
  - The result is confinement and mass gap :
    - an increase of the strong force,
    - only this force,
    - with distance.

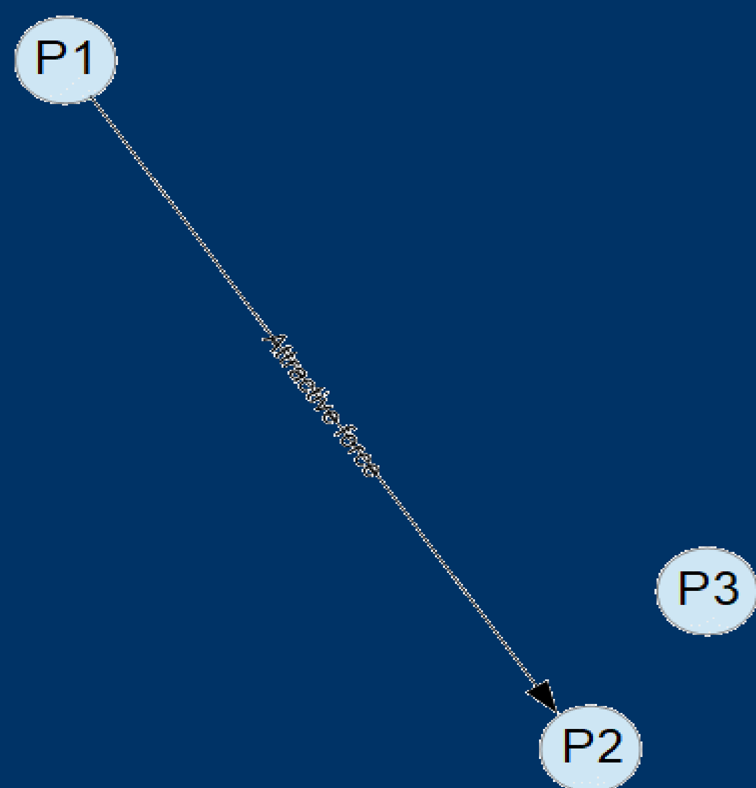
Surrounding equation in the context of Particle Physics

- Attractive force from P1 to P2 is weak because P3 is in the surrounding of P1



Surrounding equation in the context of Particle Physics

- Attractive force from P1 to P2 is stronger because P3 is no longer in the surrounding of P1



Conclusion

The particular euclidean representation of relativity

- Helps understanding GR mechanisms

Non null vectors versus null vectors duality

- exists under the choice of a particular base,
- this base is the frame of GR in which time elapses the most.
- It allows to try another mathematical construction of GR

This new construction of GR

- For gravitation, yields the Surrounding gravitational model (SMT).
- In the context of Particle Physics, it suggests a solution to the Yang-Mills Millenium Problem, confinement and mass gap.

Discussion