On minimal Quasi Inertial Systems in Einstein Lifts

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Abstract:

In real Einstein-Lifts above resp. in radial gravitational-fields over planetary surfaces there appear tidal forces, which causes small deviations from real inertial systems because the Ricci-Tensor in the Lift is not equal to zero, caused by the non-parallelity of the gravity field lines. For these quasi-inertial-systems (defined now as QUIS) there can be calculated a relative minimal-seize, which only depends from heigth over and radius of the planetary mass.

Key-words: local inertial-system; QUIS; quasi inertial-system;minimal reference frames;planck-length; bending of Einstein-Lift.

1. Introduction:

In the previous paper [1.] there was marginally noted, that real QUIS has to have a minimal seize because of measuring the movement of a real particle like an electron, proton, neutrino etc. In real universe, even in flat Minkoswksi-space there can‘t be an „infinitesimal IS or QUIS“, because this concept is only a mathematical construction without any sense for physical reality. If an Einstein-Lift falls in a real radial gravitational-field, there can be calculated this minimal seize of the QUIS in an explicite way. This minimal QUIS can be interpreted as the „ fundamental quantum“ of other, greater QUIS in radial gravitational-fields involving Einstein-lifts in the same heigth over same surface of the same planetary mass. This definition doesn‘t mean a real quantization because there are no gravity forces quantized but only local geometrical coordinate-systems. In addition, a real Einstein-lift in radial fields is not a cube or a cuboid with plane planes above and below but possesses a form of bending in ground and upper plane of the lift (further discussion of this problem see Appendix B and picture 1.).The equivalence principle is only involved in the usual manner ([2.]-[8.]).

2.Calculation:

From elementary geometrical laws (with proportional lengths by equal angles) there can be derived following equation for minimal size of Einstein-Lifts, which is here also defined as minimal, relative size of the local used QUIS. The size of this QUIS x depends only from heigth over planet radial gravitational field and from planetary mass radius. Therefore a QUIS is never an absolute system but exists without changes only for equipotential „surfaces“ of the local gravitational radius-field of the causing mass. Nevertheless there can be defined a minimal QUIS for every of this equipotential surface. The size of the QUIS changes with heigth over planet, because of the existence of radial field-lines.

The equation for this QUIS is given by:

$$x=b+\sqrt{b^2+2\cdot b\cdot(h+r)} \qquad (1.)$$

concept-data for minimal QUISes:

b - Planck-length
r – radius of planetary or stellar mass (body)
h – heigth over defined body-surface
x – heigth, width and length of a relative, minimal, cubic Einstein-Lift (QUIS).

3. Some remarks on the measuring process:

Agreed was in this process (see paper [1]) that there are two or more downwards pointing lasers resp. light-beams in the edges of the middle-line of the upper plane of the Einstein-Lift or in the middle-line itself. In the middle-line of the lower ground plane there are photometres installed, which measure the deviation from parallelity. If technical laser-problems of focusing are primarily first of all ignored, there can be determined the difference of the lift-systems QUIS relative to a real IS of special relativity theory with measuring the deviations of the real gravity field over planetary surface relative to parallel field lines of a homogenious, ideal field, which doesn‘t occur in reality of nature. If the possible minimal deviations b are defined as planck-length r_{Pl}, then there can be derived the minimal seize of the QUIS in the condition of the given equipotential „surface“ over planetary distance $r+h$ .In this way all the local weak radial field of gravitation can be plastered with QUIS of minimal seize. There ergo is existing a form of „quantizing“ local space-time through its local minimal coordinate-systems, but this process isn‘t a real quantizing of forces. But the minimal QUIS can be interpreted as the „quantum“ of local geometrical space-time and they can be summed over to get greater QUISes because of $b=r_{PL}$.

Example given:

For conditions of

$r=6{,}378\cdot 10^6 m$, $h=1\cdot 10^5 m$, $b=1{,}616255\cdot 10^{-35} m=r_{Pl}$ there is a minimal seize of the QUIS of: $x=1{,}4470729\cdot 10^{-14} m$

For more exact information on the variation of minimal QUIS with height, see tables $1.-4.$ below.
Of course, with the existence of QUIS, there are no longer any concepts of „potential planes “ or „potential surfaces“ in gravity fields of planets and stars but there is to speak by QUIS of „minimal potential volume-shells“. Summing over all volume shells with increasing radius then leads to the whole gravity-field of the cosmic body to the limiting distance to which should be calculated. Disturbations from other cosmic bodies are not included yet but must have to be calculated to be more exactly.(Eg.:Earth-Moon-system or Sun-Jupiter).

4. Data of QUIS , belonging to planet earth:

Heigth h in m over planetary radius r (earth):	Minimal seize of QUIS x in 10^{-14} m:

0	1,435860327 surface-value (defined as absolute minimal QUIS for planet earth in its outer space, not inside the planet for planetary equatorial radius of 6378 km.).
10.000	1,436985521
20.000	1,438109835
30.000	1,439233271
40.000	1,44035583
50.000	1,441477516
60.000	1,442598329
70.000	1,443718272
80.000	1,444837347
90.000	1,445955555
100.000	1,4470729

Table 1: *Listed are some sizes of minimal QUIS over earth-surface dependend from h between 0-100 km in distances of 10 km.*

Appendix A:

QUIS-data for Earth, Jupiter and Sun.

Shown is the minmal length of QUIS in dependence of heigth over planetary gravity field-lines with increasing distance from planet in different intervalls.

1.Earth:

distance from surface in m	Minimal size/heigth of QUIS in 10^{-14} m
100.000	1,447070662
200.000	1,458197003
300.000	1,469239089
400.000	1,480198804
500.000	1,491077966
600.000	1,501878324
700.000	1,512601567
800.000	1,523249323
900.000	1,533823165

1000.000	1,54432461

Table 2: *Shown is the minimal seize of QUIS over earth-surface in interval of 100km-1000km.*

2.Jupiter:

distance from surface in m	Minimal size/heigth of QUIS in 10^{-14} m
0	4,807264191 (minimal defined QUIS for Jupiter on hypothetical surface of 71492 km equator-radius).
1.000.000	4,840768431
2.000.000	4,874042367
3.000.000	4,907090686
4.000.000	4,939917914
5.000.000	4,972528431
6.000.000	5,004926473
7.000.000	5,037116139
8.000.000	5,0691014
9.000.000	5,100886099
10.000.000	5,132473965

Table 3: *Shown is the minimal seize of QUIS over jupiter-surface in interval of 1000 km – 10.000km.*

3.Sun:

distance from surface in m	Minimal size/heigth of QUIS in 10^{-13} m
0	1,499942319 (minimal defined QUIS for Sun on hypothetical photosphere-surface of 696000 km equator-radius).
10.000.000	1,510679337
20.000.000	1,52134058
30.000.000	1,531927629
40.000.000	1,542442012
50.000.000	1,552885205

60.000.000	1,563258635
70.000.000	1,573563682
80.000.000	1,58380168
90.000.000	1,593973921
100.000.000	1,604081656

Table 4: *Shown is the minimal seize of QUIS over sun-surface in interval of 10.000 km – 100.000km.*

Appendix B:

Tidal-force caused material bending through planetary gravity-fields in Einstein-Lift

1.The forces:

Because the gravity-field is weak, there can be calculated over Newton, Ricci-tensors aren‘t necessary.
In picture 2 is seen, that there is bending in Einstein-Lift, because the middle-Force $F_1 < F$,which works at the orthogonal middle-line center of the lift, is shorter than the field-lines, which leads to the upper or lower corners of the lift. In the corners there works the force F .
So there are the following relations:

$$F_1 = \frac{m \cdot M \cdot G}{(r+h+x)^2} = \frac{m \cdot M \cdot G}{R_1^{\,2}} \quad (2a.)$$

$$F = \frac{m \cdot M \cdot G}{R^2} \quad (2b.)$$

$$F_2 = \frac{m \cdot M \cdot G}{(r+h)^2} \quad (2c.)$$

$$R = \sqrt{(r+h+x)^2 + \left(\frac{x}{2}\right)^2} \quad (3a.)$$

$$R_1 = r+h+x \quad (3b.)$$

$$k = R - R_1 \quad (3c.)$$

$$\frac{F_1}{F}=\frac{R_1}{R}=\frac{(R-k)^2}{R^2} \quad (3d.)$$

This leads to: $k=1{,}92*10^{-6}\,m$

This value of k is the length-difference between the gravitational field-lines in the upper corners of the lift (see picture 2) and the field-line in the middle of the lift.In analogy there can be constructed a value of k for the lower plane of the lift in the same clear method, which isn‘t done here now but the bending in both planes of the lift is calculated below.
There follows for the force in the middle-line of the upper plane:

$$F_1=\frac{F}{1+5{,}957400266*10^{-13}} \quad (3e.)$$

2.Bending of lift planes:

The material volume of cubic supposed Einstein-lift is (numerical data below):

$$V=x_1^3-x_2^3 \quad (4.)$$

$$V=2{,}997001\,m^3 \quad .$$

The mass is with

$$m=V\cdot\varrho \quad , \text{ adding:} \quad (5.)$$

$$m_2=100\,kg$$

for the lift-passenger with space-suit and the material density for steel of the lift (iron):

$$\varrho=7{,}86\cdot10^3\,\frac{kg}{m^3}$$

This leads to whole lift-mass of

$$m=2{,}365642786\cdot10^4\,kg.$$

Therefore the gravity force in the middle of the upper-deck of Einstein-lift is:

$$F_1=223750{,}8375\,N \quad .$$

There follows the bending of upper deck with:

$$\Delta u_1=\frac{F_1\cdot x_1^3}{48\cdot E\cdot I_y} \quad (6.)$$

where E is the modulus of elasticity (Young-modul) for Iron/Steel (Fe) and I_y the area-moment of inertia:

$$E=2{,}1\cdot10^{11}\,\frac{N}{m^2} \quad , \quad I_y=\frac{1}{12}\cdot(x_1^4-x_2^4) \quad (7.)$$

and the bending for the lower deck with:

$$\Delta u_2 = \frac{F_2 \cdot x_1{}^3}{48 \cdot E \cdot I_y} \tag{8.}$$

Therefore are the bendings in Einstein-Lift (calculated with whole lift-mass, not only with the upper and lower plane) of:

$\Delta u_1 = 6{,}669756012 \cdot 10^{-6} m$ for the upper plane of lift and

$\Delta u_2 = 6{,}69744662 \cdot 10^{-6} m$ for the lower one.

The difference between the two bendings in the middle of the lift from upper and lower deck is:

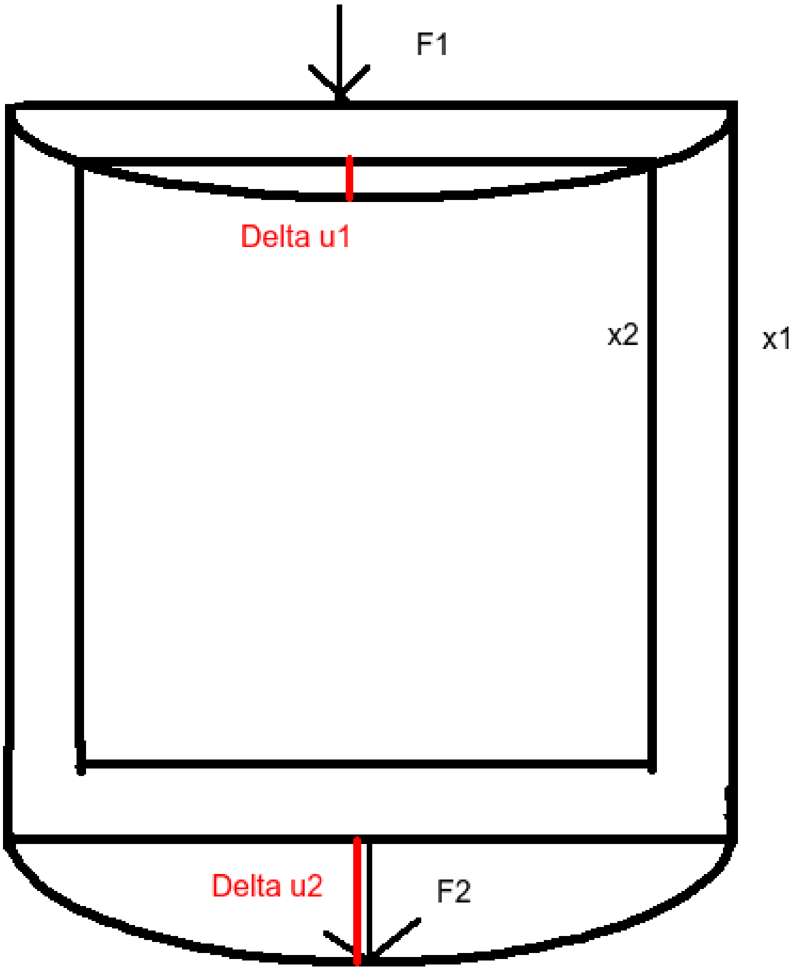
$\Delta(\Delta u_1 - \Delta u_2) = 2{,}0678 \cdot 10^{-11} m$,

This value is, in principle, measurable by the passengers two light beams along the field-lines of gravity field between the edge and the middle of the lift by measuring the running-time of his laser-beams because it occurs in the middle but not at the edges of the lift.

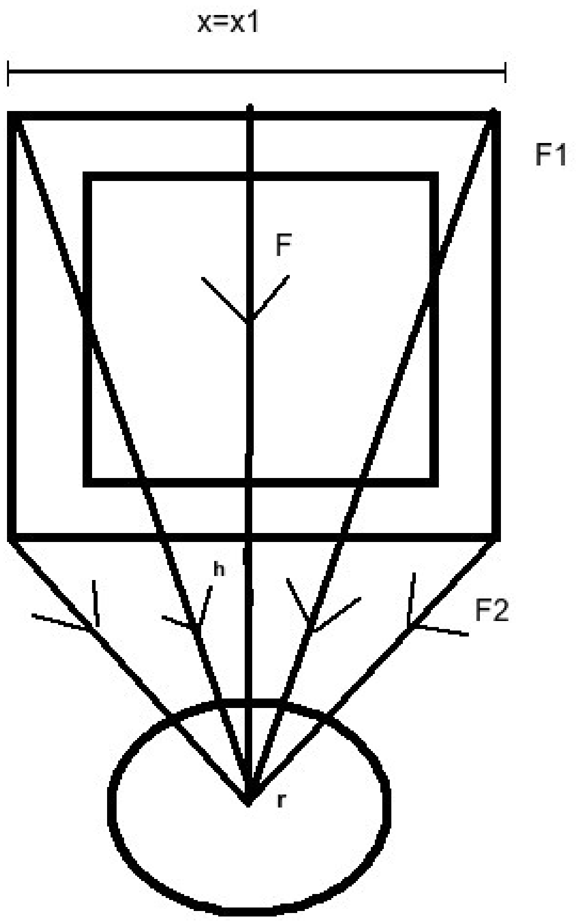
For calculation used numerical data:

$M = M_E = 5{,}9742 \cdot 10^{24} kg$
$r = r_E = 6{,}378 \cdot 10^6 m$
$h = 1 \cdot 10^5 m$
$x_1 = 10 m$
$x_2 = 9{,}99 m$
$G = 6{,}672041 \cdot 10^{-11} \frac{m^3}{kg \cdot s^2}$

picture 1: *tidal-forced material bending in real Einstein-Lift meaning bending of Einstein-lift planes in real gravity-field. Drawed are only the bendings of the lower planes but the upper bends either..*



picture 2: *effective gravity forces in real Einstein-Lift*



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