Appendix S to:
A Theoretical Investigation to the Physical Constraints for Light Velocity in Empty Euclidian Space and first Consequences for Long-distance Physics.
Referred equations: (35), (36), (37), (38), (39)

*Space and time transformation symmetry for force-free moving systems.*

Symmetry implies, that the transformation equations (35), (36) and (37) when applied to transformed coordinates with a set of matching parameters should come down the original situation. The matching parameters will be indicated with a star.

Space symmetry in the x-coordinate requires, applying equation (36) to transformed coordinates:

(S.1) $$x \equiv x^*(T^*_{or},d^*_\infty;x^*,y^*,T^*) = \gamma^2 \frac{(x^*-d^*_\infty)\,T^* + d^*_\infty T^*_{or}}{(\gamma^2 - x^* d^*_\infty)\,T^* - \Delta t^*_{or}/\Theta^*_{or}}$$

so that

(S.2) $$x\left[\gamma^2 T^* - d^*_\infty x^* T^* - \Delta t^*_{or}/\Theta^*_{or}\right] \equiv \gamma^2\left[x^* T^* - d^*_\infty T^* + d^*_\infty T^*_{or}\right]$$

Inserting equations (35), (36):

(S.3) $$x\left[\gamma^2\{\Theta_{or}(\gamma^2 - x\,d_\infty)\,T - \Delta t_{or}\} - d^*_\infty \Theta_{or}\gamma^2\{(x-d_\infty)\,T + d_\infty T_{or}\} - \Delta t^*_{or}/\Theta^*_{or}\right]$$
$$\equiv \gamma^2\left[\Theta_{or}\gamma^2\{(x-d_\infty)\,T + d_\infty T_{or}\} - d^*_\infty\{\Theta_{or}(\gamma^2 - x\,d_\infty)\,T - \Delta t_{or}\} + d^*_\infty T^*_{or}\right]$$

Because both parts have to be identical, all terms with different combinations of the variables $x$, $T$ have to be equal at both sides. For the terms $x^2 T$:

(S.4) $$-\gamma^2 \Theta_{or} d_\infty - d^*_\infty \Theta_{or}\gamma^2 = 0 \quad\Rightarrow\quad d_\infty + d^*_\infty = 0$$

The terms $x\,T$:

(S.5) $$\gamma^2 \Theta_{or}\gamma^2 + d^*_\infty \Theta_{or}\gamma^2 d_\infty = \gamma^2 \Theta_{or}\gamma^2 + \gamma^2 d^*_\infty \Theta_{or} d_\infty \qquad \text{is o.k.}$$

The terms $x$:

(S.6) $$-\gamma^2 \Delta t_{or} - d^*_\infty \Theta_{or}\gamma^2 d_\infty T_{or} - \Delta t^*_{or}/\Theta^*_{or} = 0 \quad\Rightarrow\quad \gamma^2 \Theta^*_{or}\Theta_{or} d^*_\infty d_\infty T_{or} + \gamma^2 \Theta^*_{or}\Delta t_{or} + \Delta t^*_{or} = 0$$

The terms $T$:

(S.7) $0 = -\gamma^2 \Theta_{or}\gamma^2 d_\infty - \gamma^2 d^*_\infty \Theta_{or}\gamma^2$ - is o.k. for $d_\infty + d^*_\infty = 0$ as found above

The constant terms:

(S.8) $$0 = \gamma^2 \Theta_{or}\gamma^2 d_\infty T_{or} + \gamma^2 d^*_\infty \Delta t_{or} + \gamma^2 d^*_\infty T^*_{or} \quad\Rightarrow\quad \gamma^2 \Theta_{or} d_\infty T_{or} + d^*_\infty(\Delta t_{or} + T^*_{or}) = 0$$

These results are summarized in equation (38). Then, for the transformation symmetry in $y$, applying equation (37) to transformed coordinates and inserting equations (35) – (37):

(S.9) $$y^*(T^*_{or},d^*_\infty;x^*,y^*,T^*) = \frac{\gamma\sqrt{\gamma^2 - d^{*2}_\infty}\; y^* T^*}{(\gamma^2 - x^* d^*_\infty)\,T^* - \Delta t^*_{or}/\Theta^*_{or}}$$
$$= \frac{\gamma\sqrt{\gamma^2 - d^{*2}_\infty}\;\gamma\,\Theta_{or}\sqrt{\gamma^2 - d_\infty^2}\; y\,T}{\gamma^2\{\Theta_{or}(\gamma^2 - x\,d_\infty)\,T - \Delta t_{or}\} - d^*_\infty\Theta_{or}\gamma^2\{(x-d_\infty)\,T + d_\infty T_{or}\} - \Delta t^*_{or}/\Theta^*_{or}}$$
$$= \frac{\gamma^2 \Theta_{or}\sqrt{(\gamma^2 - d^{*2}_\infty)(\gamma^2 - d_\infty^2)}\; y\,T}{\gamma^2 \Theta_{or}(\gamma^2 + d^*_\infty d_\infty)\,T - \gamma^2\Theta_{or}(d_\infty + d^*_\infty)\,x\,T - \gamma^2\Delta t_{or} - d^*_\infty\Theta_{or}\gamma^2 d_\infty T_{or} - \Delta t^*_{or}/\Theta^*_{or}}$$

So that with the above found results indeed:

(S.10) $$y^*(T^*_{or},d^*_\infty;x^*,y^*,T^*) = \frac{\gamma^2\Theta_{or}(\gamma^2 - d_\infty^2)\,y\,T}{\gamma^2\Theta_{or}(\gamma^2 - d_\infty^2)\,T} = y$$

When inserting $d^*_\infty = -d_\infty$, equation (S.8) also can be written as:

(S.11) $$\Delta t_{or} = \gamma^2 \Theta_{or} T_{or} - T^*_{or}$$

And its counterpart, star and no-star exchanged, as:

(S.12) $$\Delta t^*_{or} = \gamma^2 \Theta^*_{or} T^*_{or} - T_{or}$$

These two forms and $d^*_\infty = -d_\infty$ can be inserted into the rightmost form of equation (S.6):

(S.13) $$0 = -\gamma^2\Theta^*_{or}\Theta_{or} d_\infty^2 T_{or} + \gamma^2\Theta^*_{or}(\gamma^2\Theta_{or}T_{or} - T^*_{or}) + \gamma^2\Theta^*_{or}T^*_{or} - T_{or} = \gamma^2\Theta^*_{or}\Theta_{or}(\gamma^2 - d_\infty^2)\,T_{or} - T_{or}$$

so that:

(39) $$\gamma^2\Theta^*_{or}\Theta_{or}(\gamma^2 - d_\infty^2) = 1$$

Finally, for the transformation symmetry in $T$, applying equation (35) to transformed coordinates and inserting equations (35), (36), (38), (39):

(S.14) $$T^*(T^*_{or},d^*_\infty;x^*,y^*,T^*) = \Theta^*_{or}(\gamma^2 - x^* d^*_\infty)\,T^* - \Delta t^*_{or}$$
$$= \Theta^*_{or}\gamma^2\{\Theta_{or}(\gamma^2 - x\,d_\infty)\,T - \Delta t_{or}\} - \Theta^*_{or} d^*_\infty \Theta_{or}\gamma^2\{(x-d_\infty)\,T + d_\infty T_{or}\} - \Delta t^*_{or}$$

$= \Theta^*_{or}\, \gamma^2\, \Theta_{or}\, (\gamma^2 + d^*_\infty\, d_\infty)\, T - \Theta^*_{or}\, \gamma^2\, \Theta_{or}\, (d_\infty + d^*_\infty)\, x\, T - \Theta^*_{or}\, \gamma^2\, \Delta t_{or} - \Theta^*_{or}\, d^*_\infty\, \Theta_{or}\, \gamma^2\, d_\infty\, T_{or} - \Delta t^*_{or}$
$= \Theta^*_{or}\, \gamma^2\, \Theta_{or}\, (\gamma^2 - d_\infty{}^2)\, T = T$

so that this symmetry appears to be fulfilled also, without further assumptions.