$\boxed{K33}$ $y - x = t' u'$ $\quad t' = \tau(y - x)$

$\tau(x)$ időben $\Pi_u(x)$ u-térpontban lev.

$$\boxed{V_{u',u} = \frac{\Pi_u(y) - \Pi_u(x)}{\tau(y) - \tau(x)} = \frac{\Pi_u(y-x)}{\tau(y-x)} = \frac{\Pi_u(t' \cdot u')}{\tau(t' \cdot u')} = \frac{t'u' - u \cdot (\overbrace{\tau(t'u')}^{t'})}{\underbrace{\tau(t'u')}_{t'}} = u' - u \in \frac{S}{F}}$$

- Van $0 \in \frac{S}{F}$ Rel. seb.
- Van nagyságuk, szögük
- $V_{u',u} = -V_{u,u'}$
- $V_{u'',u} = V_{u'',u'} + V_{u',u}$
- $B_{u',u} V_{u',u} = -V_{u,u'}$

ARITM: $\tau : (1,0,0,0)$ $\quad \tau(x^0, x^1, x^2, x^3) = x^0$

$$\Pi_u = 1 - \begin{bmatrix} u^0 \\ u^1 \\ u^2 \\ u^3 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 \\ -u^1 & 1 & 0 & 0 \\ -u^2 & 0 & 1 & 0 \\ -u^3 & 0 & 0 & 1 \end{bmatrix}$$

$$B_{u',u} = 1 + \left(\begin{bmatrix} u'^0 \\ u'^1 \\ u'^2 \\ u'^3 \end{bmatrix} - \begin{bmatrix} u^0 \\ u^1 \\ u^2 \\ u^3 \end{bmatrix} \right) (1,0,0,0) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ u'^1 - u^1 & 1 & 0 & 0 \\ u'^2 - u^2 & 0 & 1 & 0 \\ u'^3 - u^3 & 0 & 0 & 1 \end{bmatrix}$$

$$V_{u',u} = \begin{bmatrix} 0 \\ u'^1 - u^1 \\ u'^2 - u^2 \\ u'^3 - u^3 \end{bmatrix}$$

K34 Téridő $\xrightarrow[\text{Vonatk. Rsz}]{\text{SZÉTHASÍTÁS}}$ Tér és Idő

$$V \longrightarrow V^{**}$$

$$i: v \longmapsto i(v): V^* \longrightarrow \mathbb{R}$$

$$(i(v))(f) = f(v)$$

$$v(f) = f(v)$$

$$\mathrm{Lin}(V,U) \longrightarrow \mathrm{Lin}(U^*,V^*)$$

$$L \longmapsto L^*: U^* \longrightarrow V^*$$

$$q \longmapsto q \circ L$$

$$\boxed{(L^*q)(v) = q(Lv)}$$

$$\boxed{Lv = vL^*}$$

$$\underbrace{(Lv)}(L^*q)(v) =$$

$$= \underbrace{vL^*}q$$

$$M \underset{u}{\overset{\tau}{\rightleftarrows}} \mathbb{T} \qquad u \in \frac{M}{\mathbb{T}} = M \otimes \mathbb{T}^*$$

$$M \underset{\pi_u}{\overset{i}{\leftrightarrows}} S \qquad i(q) = q$$

$$q \in S \subset M$$

$$M^* \underset{\tau^*}{\overset{u^*}{\leftrightarrows}} \mathbb{T}^* \ni e$$

ARITM: $\tau^* e = (e, 0, 0, 0)$

$$\tau^* e = e\tau$$

~~[illegible]~~ t_i

$$M^* \underset{\pi_u^*}{\overset{i^*}{\rightleftarrows}} S^* \qquad i^* k = k|_S$$

ARITM: $i^*(k_0, k_1, k_2, k_3) = (0, k_1, k_2, k_3)$

$$L^* g = gL$$

$$v(\underbrace{L^* g}) = \cancel{g}(L^* g)(v) = g(\underbrace{L \cancel{v}\, v})$$

K35

$$M \ni x = u(\underbrace{\tau(x)}_{t}) + i\,\underbrace{\pi_u(x)}_{\in S}$$

$$\underbrace{}_{T \cdot u}$$

$$\varphi_u : M \longrightarrow T \times S$$

$$x \longmapsto \varphi_u(x) = (\tau(x), \pi_u(x))$$

Abs. időrészi   u-térrészi

$$\varphi_u = (\tau, \pi_u)$$

$$\varphi_u^{-1} : T \times S \longrightarrow M$$

$$(t, q) \longmapsto \varphi_u^{-1}(t, q) = u \cdot t + i^* q$$

$$\varphi_u^{-1} = (u, i)$$

$$M^* \ni k$$

$$\eta_u = (\varphi_u^*)^{-1} = (u^*, i^*) : M^* \longrightarrow \vec{T}^* \times S^*$$

$$k \longmapsto \eta_u(k) = (u^*(k), i^*(k))$$

$$= (k(u), k(i))$$

ABS. térrészi komp   u-idősz.

$$\eta_u^{-1} = \varphi_u^* = (\tau^*, \pi_u^*) : \vec{T}^* \cancel{\times m} S^* \longrightarrow M^*$$

$$(e, p) \longmapsto \tau^*(e) + \pi_u^*(p) =$$

$$= e\tau + p\,\pi_u$$

$$\varphi_u(x) = (t, q)$$

$$\eta_u(k) = (e, p)$$

$$(k|x) = (\eta_u(k) | \varphi_u(x)) = ((e,p)|(t,q)) = (e|t) + (p|q)$$

$\boxed{K36}$ ARITM: $x=(x^0,x^1,x^2,x^3)\in M$

időszerű: $\tau(x)=x^0$

$u=(1,0,0,0)$-térszerű: $\pi_u(x)=(0,x^1,x^2,x^3)$

$u=(1,v,0,0)$-térszerű: $\pi_u(x)=(0,x^1-vx^0,x^2,x^3)$

$\xi_u(x)=(x^0,(0,x^1-vx^0,x^2,x^3))$

$\xi_u^{-1}(t,(0,q^1,q^2,q^3))=(t,q^1+t\cdot v,q^2,q^3)$

$k\in(k_0,k_1,k_2,k_3)\in M^*$

~~tér~~ $S^*\ni i^*(k)=(0,k_1,k_2,k_3)$

$u=(1,0,0,0)$-időszerű: $u^*(k)=ku=k_0$

$u=(1,v,0,0)$-időszerű: $u^*(k)=ku=k_0+vk_1$

$\eta_u^{-1}(e,(0,p_1,p_2,p_3))=(e-vp_1,p_1,p_2,p_3)$

$\boxed{K37}$ Transzf. <u>SZABÁLY</u>

$$(t',q') = \varrho_{u'}\left(\varrho_u^{-1}(t,q)\right) = \varrho_{u'}\left(t\cdot u+q\right) = \left(\tau(t\cdot u+q),\ \pi_{u'}(tu+q)\right)$$

$$= \left(t,\ tu+q - u'\,\underbrace{\tau(tu+q)}_{t}\right) =$$

$$= \left(t,\ q+tu-tu'\right) = \left(t,\ q - t\overbrace{(u-u')}^{v_{u',u}}\right)$$

$$\begin{tikzcd}
 & {} \arrow[dl, "\varrho_u"'] \arrow[dr, "\varrho_{u'}"] & \\
\bar{\bar{T}}\times S \arrow[rr, "\boxed{\varrho_{u',u} = \varrho_{u'}\varrho_u^{-1}}"'] & & \bar{\bar{T}}\times S
\end{tikzcd}$$

$$(t,q) \qquad\qquad (t',q')$$

$$\varrho_{u',u} = \begin{bmatrix} 1 & 0 \\ -v_{u',u} & 1 \end{bmatrix} : \bar{\bar{T}}\times S \longrightarrow \bar{\bar{T}}\times S$$

$$\eta_{u',u} = \begin{bmatrix} 1 & v_{u',u} \\ 0 & 1 \end{bmatrix} : \bar{\bar{T}}^{*}\times S^{*} \longrightarrow \bar{\bar{T}}^{*}\times S^{*}$$