

Kon der ma SO-bundel
(SO-kov. derivace)

Def. A_M SO-bundle
 D kov. derivace

$$DH = 0$$

$$\Downarrow$$

$$D_\xi(\phi, \psi) = (D_\xi \phi, \psi) + (\phi, D_\xi \psi)$$

Lemma
 \Downarrow kov. trivializace E_n kov. s H

$$\partial H = 0$$

$$\partial_m H_{AB} = \partial_m (H_{MN} E_A^M E_B^N) = 0$$

Věta

D je kov. s H dána
vekt. pot A_m^k máci \circ

$$\Downarrow D = \partial + A_m$$

$$\Downarrow A_m^T = -A_m$$

ditž

$$DH = \partial H = 0$$

$$\Rightarrow 0 = A_m^k H_{AB} = -A_m^{kA} H_{kA} - A_m^{kA} H_{kA}$$

$$A_m + A_m^T = 0$$

Věta

D je kov. s H

$$\Downarrow F_m^k \text{ tenzor kv. } D$$

$$\Downarrow F_m^T = -F_m$$

ditž

$$DH = 0 \Rightarrow D DH = 0$$

$$\Rightarrow 0 = [D_m D_n - D_n D_m + T_m^k D_k] H_{AB} = F_m^k H_{AB}$$

$$\Rightarrow F_m + F_m^T = 0$$

Kov der ma SO-Bundel
(SO-Kov. derivative)

Def. AM SO-Bundle
D Kov. derivative

$$DH = 0$$

\Leftrightarrow

$$D_{\xi}(\phi, \psi) = (D_{\xi}\phi, \psi) + (\phi, D_{\xi}\psi)$$

Lemma Kov. trivialisace Γ_A Kov. ψH

$$\partial H = 0$$

$$\partial_{\underline{m}} H_{\underline{AB}} = \partial_{\underline{m}} (H_{MN} E_{\underline{A}}^M E_{\underline{B}}^N) = 0$$

Věta

D je konz. oH dána
vekt. pot A_m^k vici \odot

$$D = \odot + A_m$$

$$\Downarrow A_m^T = -A_m$$

duř

$$DH = \partial H = 0$$

$$\Rightarrow 0 = A_m H_{AB} = -A_m^k{}_A H_{kB} - A_m^k{}_B H_{Ak}$$

$$A_m + A_m^T = 0$$

Vite

D je konz. oH

\underline{F}_{mn}^k tenzor ži. D

$$\Downarrow \underline{F}_{mn}^T = -\underline{F}_{mn}$$

ditz:

$$D \cdot H = 0 \Rightarrow DDH = 0$$

$$\Rightarrow 0 = [D_n D_n - D_n D_n + T_{mn}^k D_k] H_{AB} = \underline{F}_{mn} H_{AB}$$

$$\Rightarrow \underline{F}_{mn} + \underline{F}_{mn}^T = 0$$

Def Kalibr. transf. zw. der.
 neuen transf. R
 $\phi \rightarrow \tilde{\phi} = R \cdot \phi$

man zw. der transf. potenziale

$$\tilde{D}\tilde{\phi} = \widetilde{D\phi}$$

Verten

$$\tilde{D} = D + \Lambda \quad \Lambda = -(DR) \cdot R^{-1}$$

direkt

$$\begin{aligned} \tilde{D}(R \cdot \phi) &= D(R \cdot \phi) + \Lambda \cdot R \cdot \phi \\ &= (DR) \cdot \phi + \underline{R \cdot (D\phi)} + \Lambda \cdot R \cdot \phi = \underline{R \cdot (D\phi)} \end{aligned}$$

$$\Lambda \cdot R = -DR$$

Verten A_{μ}^{κ}
 D, \tilde{D} sowie kal. transf.
 nicht stetig ∂ dann verhält sich A_{μ}, \tilde{A}_{μ}

$$\begin{aligned} \tilde{A}_{\mu} &= R \cdot A \cdot R^{-1} - (\partial R) \cdot R^{-1} \\ &= A - (DR) \cdot R^{-1} = A - R^{-1} \cdot (DR) \end{aligned}$$

direkt:

$$\begin{aligned} D\phi &= \partial\phi + A \cdot \phi & \tilde{D}\phi &= \partial\phi + \tilde{A} \cdot \phi \\ \tilde{D}\phi &= D\phi - (DR) \cdot R^{-1} \cdot \phi \\ &= \partial\phi + (A - (DR) \cdot R^{-1}) \cdot \phi \end{aligned}$$

$$\begin{aligned} \tilde{A} &= A - (DR) \cdot R^{-1} \\ &= A - (\partial R) \cdot R^{-1} - \cancel{A \cdot R \cdot R^{-1}} + R \cdot A \cdot R^{-1} \\ &= R \cdot A \cdot R^{-1} - (\partial R) \cdot R^{-1} \end{aligned}$$

$$D \leftrightarrow \tilde{D} \quad A \leftrightarrow \tilde{A} \quad R \leftrightarrow R^{-1}$$

$$A = \tilde{A} - (\tilde{D}R^{-1}) \cdot R \quad \tilde{A} = A + (DR^{-1}) \cdot R = \tilde{A} - R^{-1} \cdot DR$$

Verten F, \tilde{F} transf. zw. D, \tilde{D}

$$\tilde{F} = R \cdot F \cdot R^{-1}$$

$$\tilde{F}_{\mu\nu}^{\kappa} = R_{\mu}^{\kappa} R_{\nu}^{\lambda} F_{\lambda\mu}^{\eta}$$

$$\tilde{D}\tilde{\phi} = \widetilde{D\phi}$$

$$\tilde{D}\tilde{D}\tilde{\phi} = \widetilde{D D\phi}$$

$$\tilde{F} \cdot \tilde{\phi} = \widetilde{F \cdot \phi}$$

$$\tilde{F} \cdot R \cdot \phi = R \cdot F \cdot \phi$$

$$\tilde{F} = R \cdot F \cdot R^{-1}$$

Def Kalibr. transf kov. der.

wiejue transf R

$$\phi \rightarrow \tilde{\phi} = R \cdot \phi$$

von kov. der transf ~~kov. der~~

$$\tilde{D}\tilde{\phi} = \widetilde{D\phi}$$

Definieren

$$\tilde{D} = D + \Lambda \quad \Lambda = -(DR) \cdot R^{-1}$$

dieses.

$$\tilde{D}(R \cdot \phi) = D(R \cdot \phi) + \Lambda \cdot R \cdot \phi$$

$$= (DR) \cdot \phi + \underline{R \cdot (D\phi)} + \Lambda \cdot R \cdot \phi = \underline{R \cdot (D\phi)}$$

$$\Lambda \cdot R = -DR$$

Věta

D, \tilde{D} souvisí kal. transf. A_m^k
nůci stejné ∂ dány vešit, A_m, \tilde{A}_m

$$\begin{aligned}\tilde{A}_m &= R \cdot A \cdot R^{-1} - (\partial R) \cdot R^{-1} \\ &= A - (DR) \cdot R^{-1} = A - R^{-1} \cdot (\tilde{D}R)\end{aligned}$$

důk:

$$D\phi = \partial\phi + A \cdot \phi \quad \tilde{D}\phi = \partial\phi + \tilde{A} \cdot \phi$$

$$\tilde{D}\phi = D\phi - (DR) \cdot R^{-1} \cdot \phi$$

$$= \partial\phi + (A - (DR) \cdot R^{-1}) \cdot \phi$$

$$\tilde{A} = A - (DR) \cdot R^{-1}$$

$$= A - (\partial R) \cdot R^{-1} - \cancel{A \cdot R \cdot R^{-1}} + R \cdot A \cdot R^{-1}$$

$$= R \cdot A \cdot R^{-1} - (\partial R) \cdot R^{-1}$$

$$D \Leftrightarrow \tilde{D} \quad A \Leftrightarrow \tilde{A} \quad R \Leftrightarrow R^{-1}$$

$$A = \tilde{A} - (\tilde{D}R^{-1}) \cdot R \quad \tilde{A} = A + (\tilde{D}R^{-1}) \cdot R = \tilde{A} - R^{-1} \cdot DR$$

Def 2

F, F^{\sim} linear forms D, D^{\sim}

$$\Leftrightarrow F = R \cdot F^{\sim} \cdot R^{-1}$$

$$F_{m \times n}^{\sim k} = R_{m \times n}^k R_{n \times n}^{-1} F_{m \times n}$$

$$D^{\sim} \tilde{\phi} = D \phi$$

$$D^{\sim} D^{\sim} \tilde{\phi} = D D \phi$$

$$F^{\sim} \tilde{\phi} = F \phi$$

$$F^{\sim} \cdot R \cdot \phi = R \cdot F \cdot \phi$$

$$F^{\sim} = R \cdot F \cdot R^{-1}$$