

Lemma 2.11  $p \in M$ ,  $\gamma: [0, b] \rightarrow D_p$  with  
piecewise  $C^1$

$$\gamma(0) = 0, \quad c := \exp_p \circ \gamma.$$

If  $c$  is timelike and future directed,

then  $\gamma(t) \in \underline{I}_+^{T_p M}(0) := \underline{I}_+^{T_p M}$

$= \{ X \in T_p M \text{ timelike and future directed} \}$

for all  $t \in [0, b]$ .