

# Lecture no. 12.

$M$  time-oriented Lorentzian  
mfd

## Notation 2-12

For  $\Omega \subset M$ ,  $A \subset \Omega$

$$I_{+}^{\Omega}(A) := \left\{ q \in \Omega \mid \exists p \in A : \underbrace{p \ll q}_{\text{in } \Omega} \right\}$$

$$J_{+}^{\Omega}(A) := \left\{ q \in \Omega \mid \exists p \in A : \underbrace{p \leq q}_{\text{in } \Omega} \right\}$$

Definition: A subset  $A$  is called ...

1) achronal (in  $M$ )  $\Leftrightarrow$  there is no timelike curve in  $M$   
from a point in  $A$  to a point in  $A$ .

$$\Leftrightarrow I_{+}^M(A) \cap A = \emptyset \Leftrightarrow \nexists p, q \in A : p \ll q$$

2) acausal (in  $M$ )  $\Leftrightarrow$  there is no causal curve in  $M$   
from a point in  $A$  to a point in  $A$

$$\Leftrightarrow \nexists p, q \in A : p < q$$