Particles and fields

particles : are maps  $N \xrightarrow{s} M$ = space-time

EG. 1) $N = \mathbb{R}$ (proper time), M = Mink space $\mathbb{R}^4 \overset{\text{"}}{=} \mathbb{R} \times \mathbb{R}^3$ (universal time × univ. space) $\longmapsto$ relativistic particle

2) $N = \mathbb{R}$ (univ time), $M = \mathbb{R} \times \mathbb{R}^3$ (univ time × univ sp.), $pr_1 \circ s = id \longmapsto$ classical particle

3) $N = \mathbb{R} \times S^1 \longmapsto$ string theory of 1 particle

4) N = Riem surf  $\longmapsto$ string theory of several particles

fields : are maps $s : M \longrightarrow E$ where $\begin{matrix} E \\ \downarrow \pi \\ M \end{matrix}$ fibre bundle

("spacetime")

w/ fiber F = space of internal states & $\pi \circ s = id$

EG : 1) Electro-magn field $E = T^*M$

2) field attached to quantum particle $E = \mathbb{C} \times M$, $s(x) = \psi(x)$ ↑ wave fcn

3) gravitational field $E = S^2 T^*M$.