$$\frac{1}{2}E_j''(0) = -\int_0^1 \langle V_j, V_j'' + R(\gamma', V_j)\gamma' \rangle$$

$$\overset{e_j \text{ parallel}}{=} -\int_0^1 \Big\langle (\sin \pi t) e_j, -\pi^2 \sin \pi t \cdot e_j + R(\ell e_n, (\sin \pi t) e_j)\ell e_n \Big\rangle$$

$$= \int_0^1 \sin^2 \pi t \left(\pi^2 - \ell^2 K(e_n, e_j) \right)$$

Summing over j

$$\frac{1}{2}\sum_{j=1}^{n-1} E_j''(0) = \int_0^1 \sin^2 \pi t \left[(n-1)\pi^2 - \ell^2 \cdot (n-1) \operatorname{Ric}_{\gamma(t)}(e_n(t)) \right]$$

$$\leq \int_0^1 \sin^2 \pi t \cdot (n-1) \underbrace{\left[\pi^2 - \ell^2 \cdot \frac{1}{r^2} \right]}_{<0}$$

$$< 0$$

$\therefore\ \exists j$, s.t.

$E_j''(0) < 0 \implies \gamma$ cannot be minimizing. #

Corollary. M complete, $\operatorname{Ric} \geq \delta > 0$. Then the universal cover of M is compact and $\pi_1(M)$ is finite.