

$$\begin{array}{ccc}
 \pi_1(S^1, x_0) & \xrightarrow{(gj)_*} & \pi_1(S^1, gj(x_0)) \\
 & \searrow j_* & \nearrow (g|_{S_+^2})_* \\
 & \pi_1(S_+^2, j(x_0)) &
 \end{array}$$