One of the mathematical challenges of TGD is the construction of the homology of "world of classical worlds" (WCW). The generalization of Floer homology looks rather obvious in the zero ontology (ZEO) based view about quantum TGD. ZEO, the notion of preferred extremal (PE), and the intuitive connection between the failure of strict non-determinism and criticality are essential elements. The homology group is defined in terms of the free group formed by preferred extremals $PE(X^3,Y^3)$ for which X^3 is a stable maximum of Kähler function K associated with the passive boundary of CD and Y^3 associated with the passive boundary is a more general critical point.

The identification of PEs as minimal surfaces with lower-dimensional singularities as loci of instabilities implying non-determinism allows to assign to the set $PE(X^3,Y_i^3)$ numbers $n(X^3,Y_i^3 \rightarrow Y_j^3)$ as the number of instabilities of singularities leading from Y_i^3 to Y_j^3 and define the analog of criticality index (number of negative eigenvalues of Hessian of function at critical point) as number $n(X^3,Y_i^3) = \sum_j n(X^3,Y_i^3 \rightarrow Y_j^3)$. The differential d defining WCW homology is defined in terms of $n(X^3,Y_i^3 \rightarrow Y_j^3)$ for pairs Y_i^3,Y_j^3 such that $n(X^3,Y_j^3) - n(X^3,Y_i^3) = 1$ is satisfied.