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Cohomology Rings of Finite Fundamental Groups of 3-Manifolds

Thanks to the recent work of Perelman and his successors, it is now known that any 3-manifold with finite fundamental group G arises from a free orthogonal action of G on S^3. It is thus one of the groups found around 1930 by Hopf and Seifert–Threlfall. In particular the 3-manifold $M = S^3/G$ is an orientable Seifert manifold (known as a spherical space form). For orientable Seifert manifolds with G infinite, the cohomology ring $H^*(M\ ;\ A)$ was determined around 2000 by Bryden, Hayat, Zieschang, and the author. There are important differences when G is finite, related to the group cohomology $H^*(G\ ;\ A)$, which is now 4-periodic (for G infinite $H^*(M\ ;\ A) \approx H^*(G\ ;\ A)$ and hence vanishes in dimensions greater than 3). The cases where G is finite, recently studied by Tomoda and the author, will be the main subject of this talk. Applications such as degree one maps and Lusternik–Schnirelmann category will be mentioned.