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Towards small CM modules in dimension three.

Over a complete CM ring, Grothendieck duality enables us to study the local cohomology of a module. Moreover, the "dualizing" module is canonically defined, whence its eponymous name. Whereas duality fails over non CM rings, there is still a canonically defined module: the Matlis dual of the top local cohomology of the ring. However, the lower local cohomology modules do no longer vanish, so we should also study their Matlis duals. These are what I term the "i-th higher canonical modules"; this definition extends to modules as well.

After having proven the existence of big CM modules in equal characteristic, Hochster conjectured, with some reservation, that any complete local ring even admits a (small) maximal CM module (=module of the same depth as the dimension of the ring), but very little is known in dimensions three and higher. I will give a criterion for their existence in dimension three involving first higher canonical modules, namely, there has to be at least one module whose first higher canonical module has positive depth (of course, the higher canonical modules of a maximal CM are all zero, so the condition is clearly necessary). (Received January 29, 2014)