

Artinian level algebras of codimension 3

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In this paper, we continue the study of which h -vectors $H=(1,3,\dots, h_{d-1}, h_d, h_{d+1})$ can be the Hilbert function of a level algebra by investigating Artinian level algebras of codimension 3 with the condition $\beta_{2,d+2}(I^{\text{lex}})=\beta_{1,d+1}(I^{\text{lex}})$, where I^{lex} is the lex-segment ideal associated with an ideal I . Our approach is to adopt an homological method called {it Cancellation Principle}: the minimal free resolution of I is obtained from that of I^{lex} by canceling some adjacent terms of the same shift.

We prove that when $\beta_{1,d+2}(I^{\text{lex}})=\beta_{2,d+2}(I^{\text{lex}})$, R/I can be an Artinian level k -algebra only if either $h_{d-1}<h_d<h_{d+1}$ or $h_{d-1}=h_d=h_{d+1}=d+1$ holds. We also apply our results to show that for $H=(1,3,\dots, h_{d-1}, h_d, h_{d+1})$, the Hilbert function of an Artinian algebra of codimension 3 with the condition $h_{d-1}=h_d<h_{d+1}$,

- (a) if $h_d \leq 3d+2$, then h -vector H cannot be level, and
- (b) if $h_d \geq 3d+3$, then there is a level algebra with Hilbert function H for some value of h_{d+1} .

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