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**Growth-rate dependent effects on bacterial gene expression**[1]

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For fast growing bacteria, which can adapt to wildly different growth conditions, changes in gene expression are often accompanied by changes in growth rates. Because the macroscopic composition of bacteria (e.g., cell size, ribosome concentration, gene copy number) is known to vary greatly for bacteria grown at different rates, significant changes in gene expression may arise 'passively' just due to the growth rate change alone. Towards a quantitative understanding of these passive effects, we analyzed quantitatively available data for the growth rate dependence of various macroscopic parameters affecting gene expression in E. coli, and predicted the growth-rate dependence of gene expression for various simple genetic circuits. For a constitutively expressed gene, the expressed protein concentration is decreased at faster growth, while weak growth-rate dependence is obtained for autorepressing genes and genes under negative control by an autorepressor. We also studied the growth-rate dependence of bistable genetic circuits and determined conditions such that bistability is found over a wide range of growth rates. Our results demonstrate that growth-rate dependent effects play an important role and must be taken into account when analyzing gene expression data under different condition. Buffering against these growth rate dependent effects may be an important requirement underlying the robust operation of endogenous genetic circuits in these bacteria, and should be a prime factor to consider in the design of robust, synthetic circuits.

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