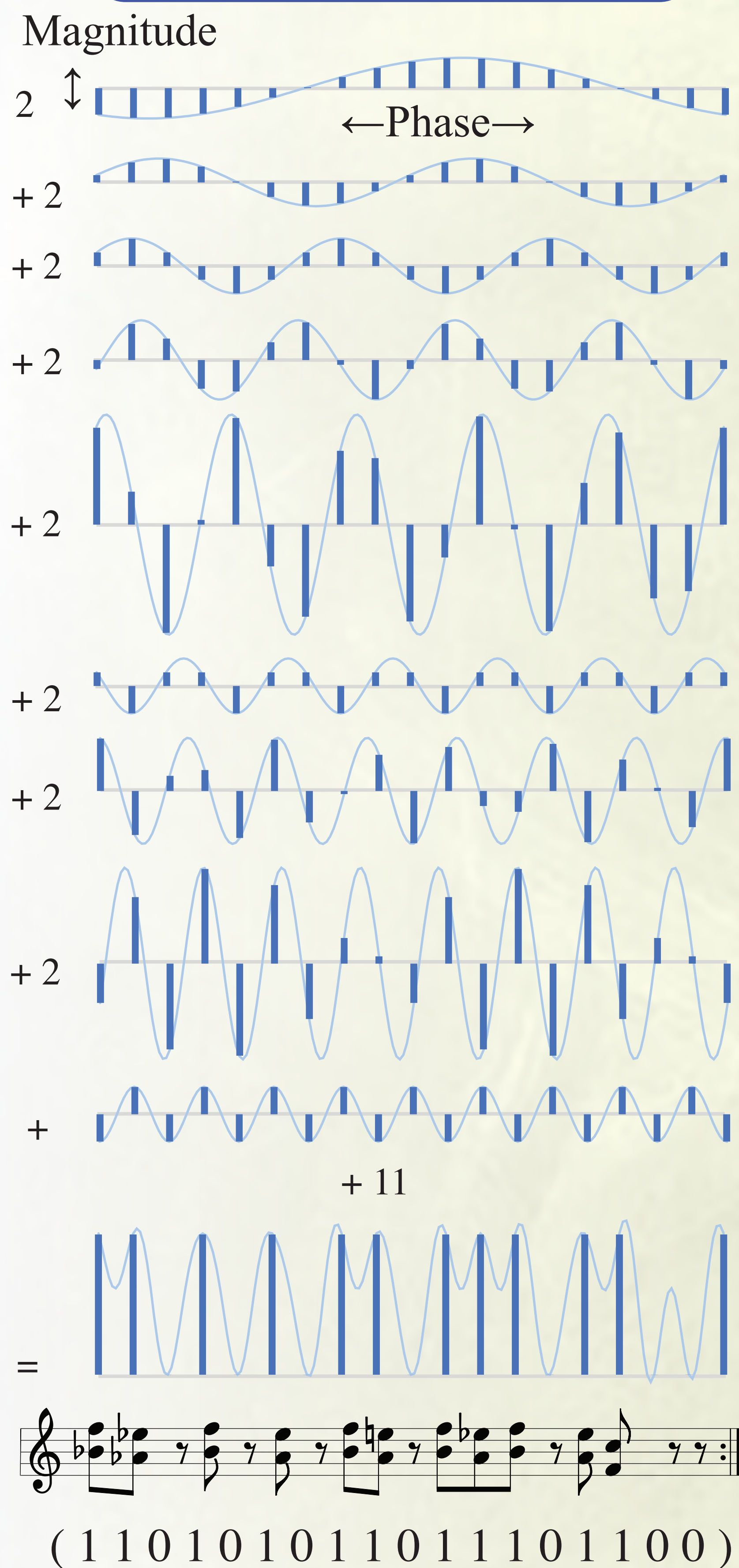


# Interacting Periodicities in the Music of Ligeti and The Bad Plus

Jason Yust

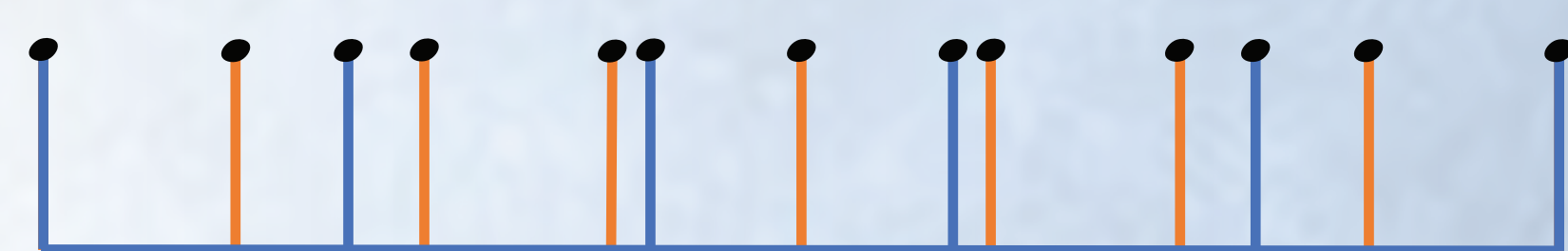


DFT converts a rhythm into a sum of **periodic functions**

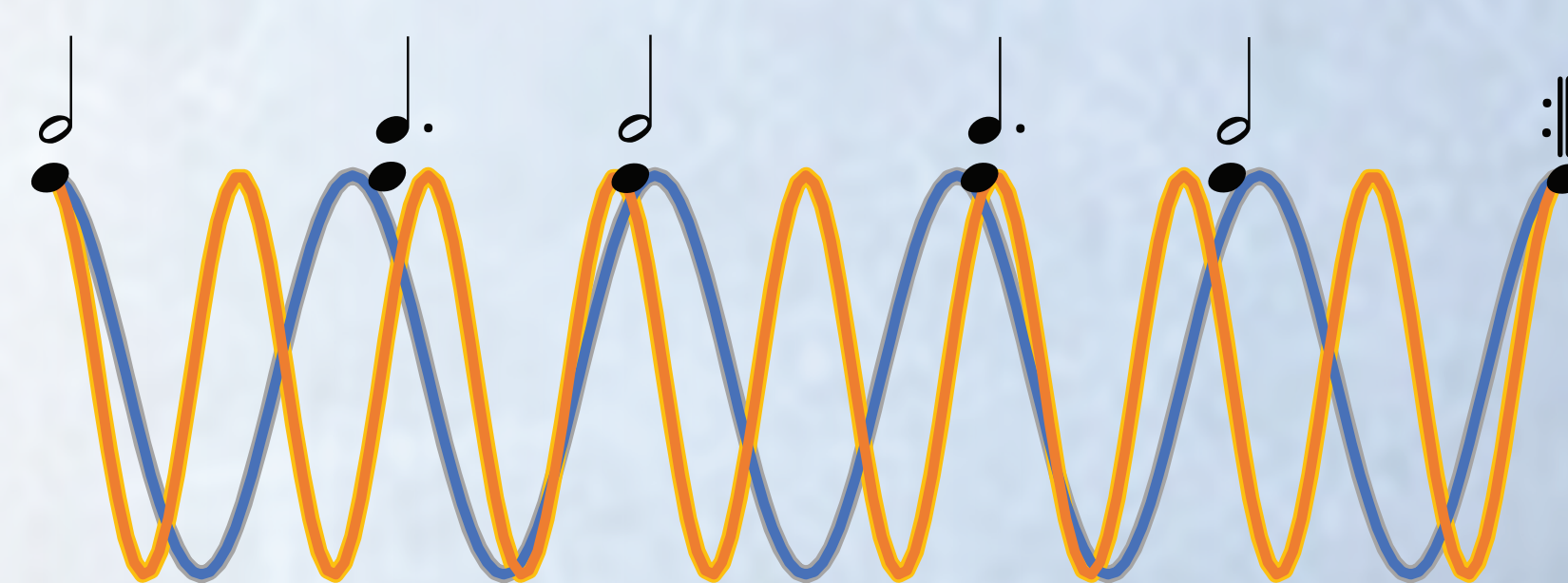


## Traditional polyrhythm vs. FT:

Traditionally we think of polyrhythm as sum of discrete functions (5-against-8)



The FT sums continuous periodic functions.



A rhythm reinforces them if onsets are close to peaks of both (functions with period 5 and 8).

## With simultaneous rhythms, nearly aligned periodicities create slow phase shifts

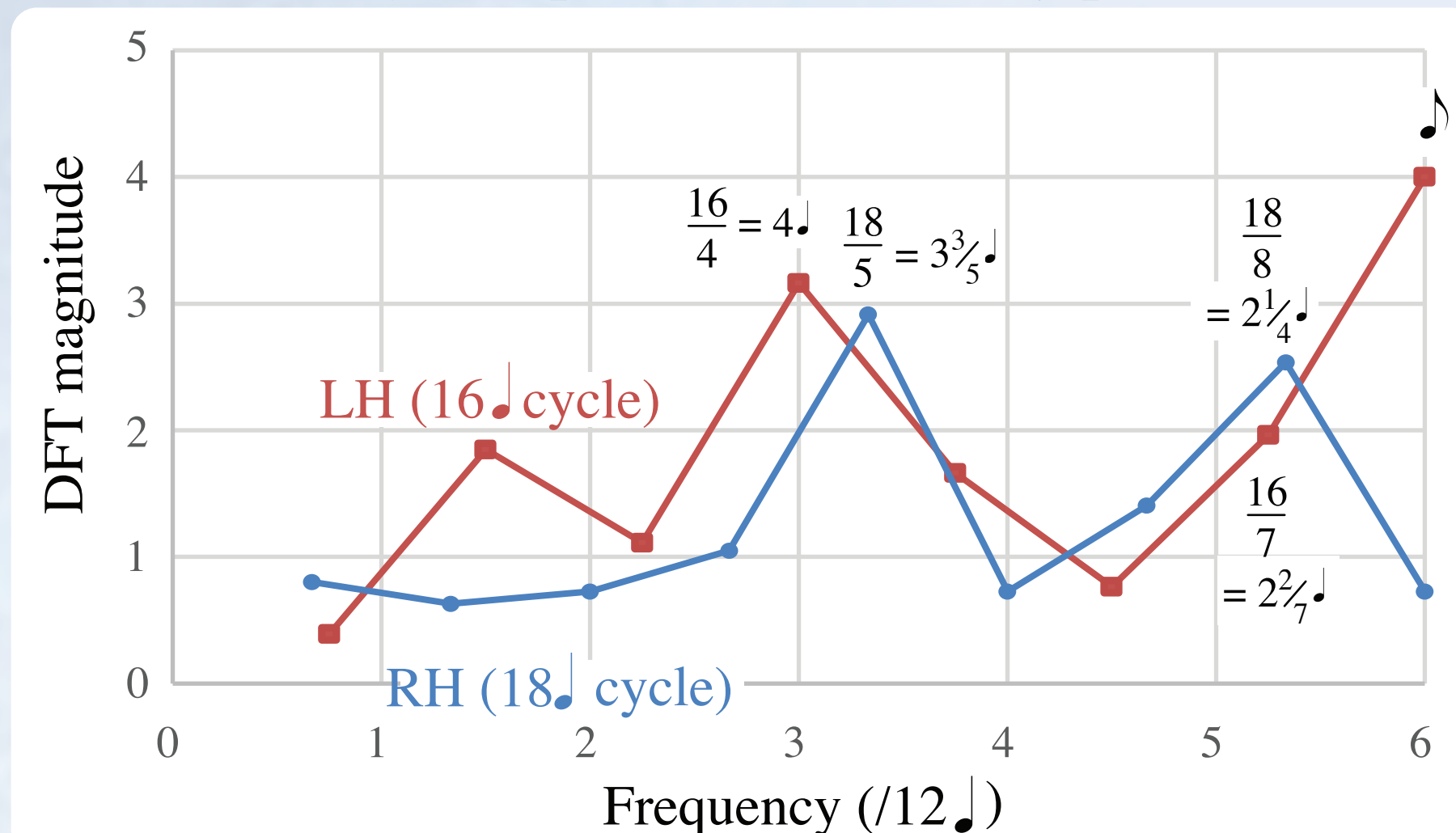
The effect is analogous to difference tones or beats (Frequency of phase shift = frequency difference)

### Ligeti, "Fem" (Etude 8)

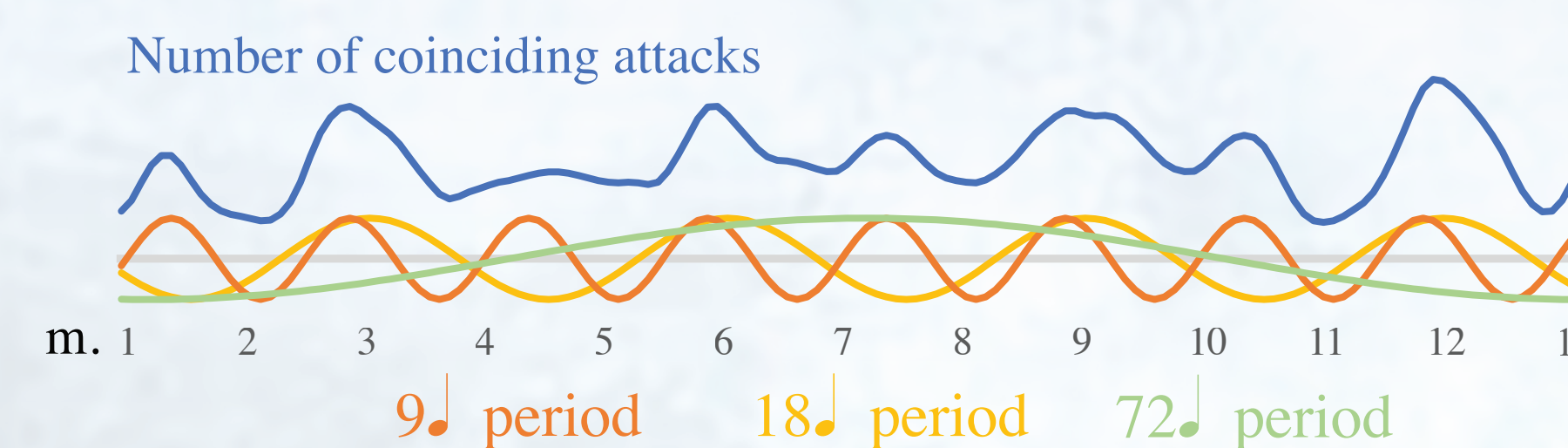
Based on two rhythms that repeat at different rates:



Aligned spectra show nearby peaks:

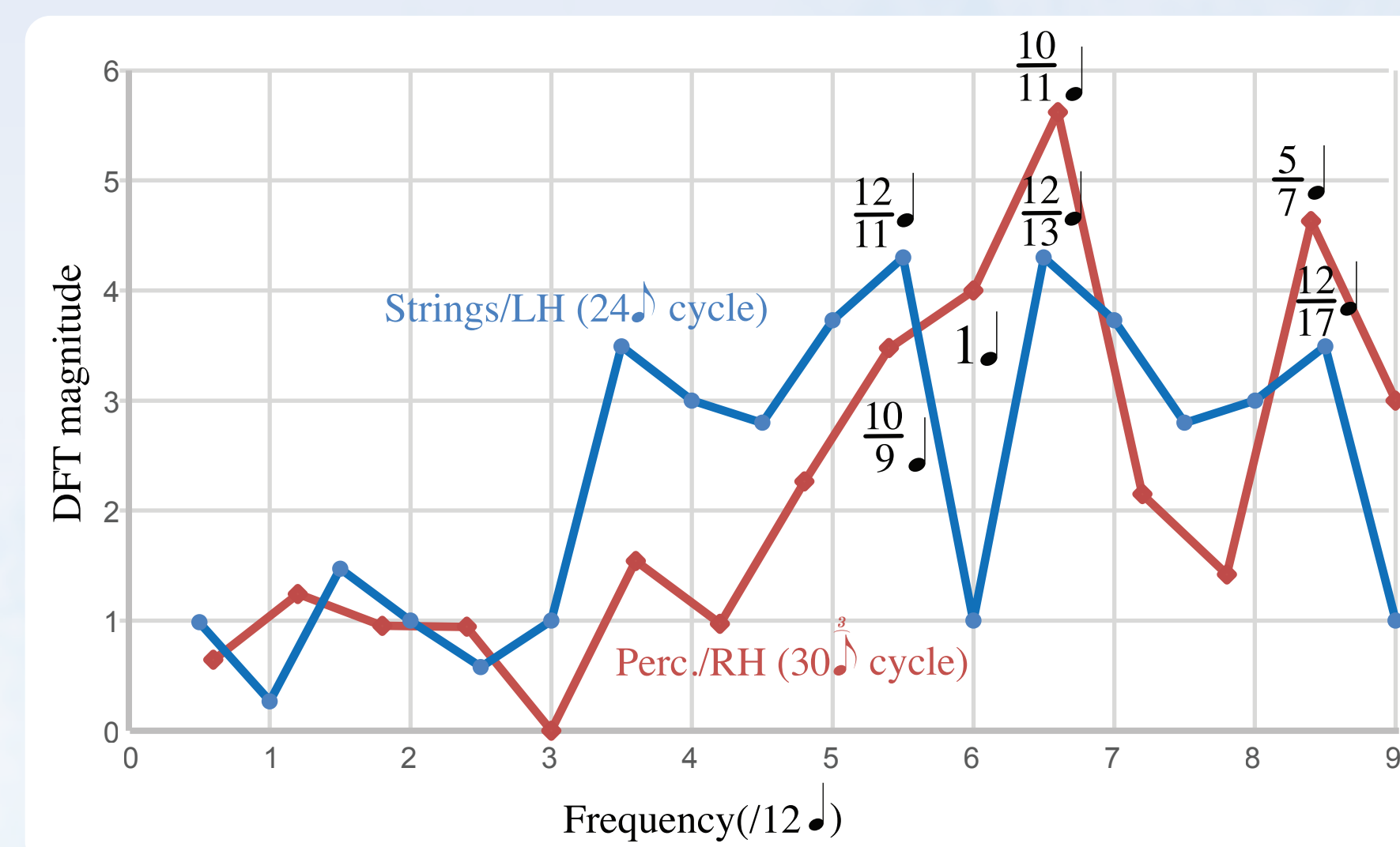
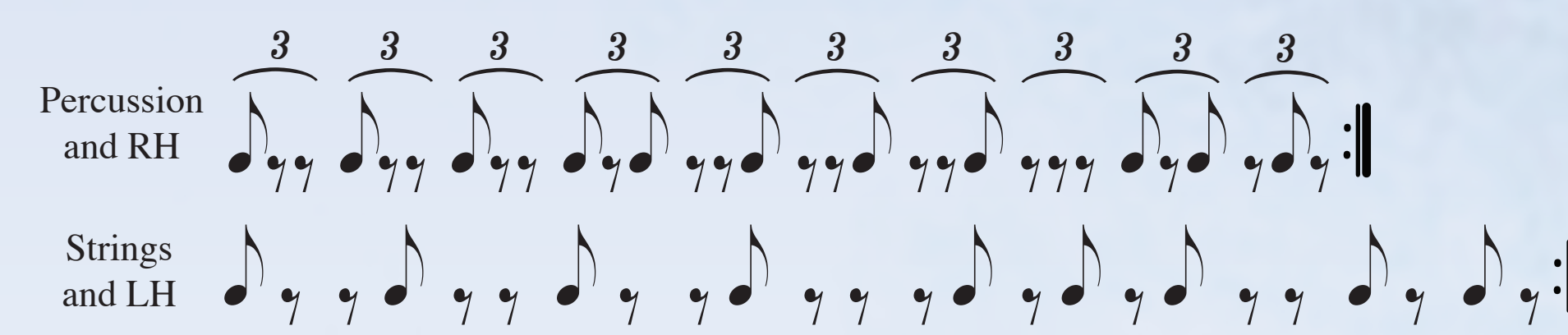


Nearly aligned periodicities create gradual phase shifts taking the rhythms in and out of alignment.

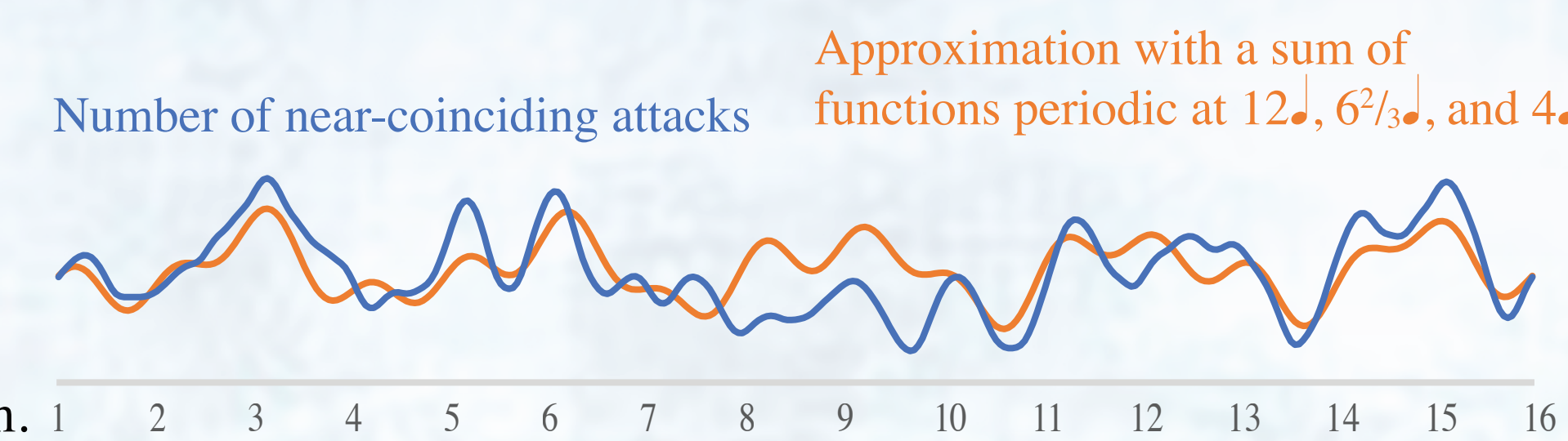


### Ligeti, Piano Concerto mvt. 1

The movement is based on these ostinati:



Frequency differences of  $1/60$ , create phase shifts over the full 60 cycle



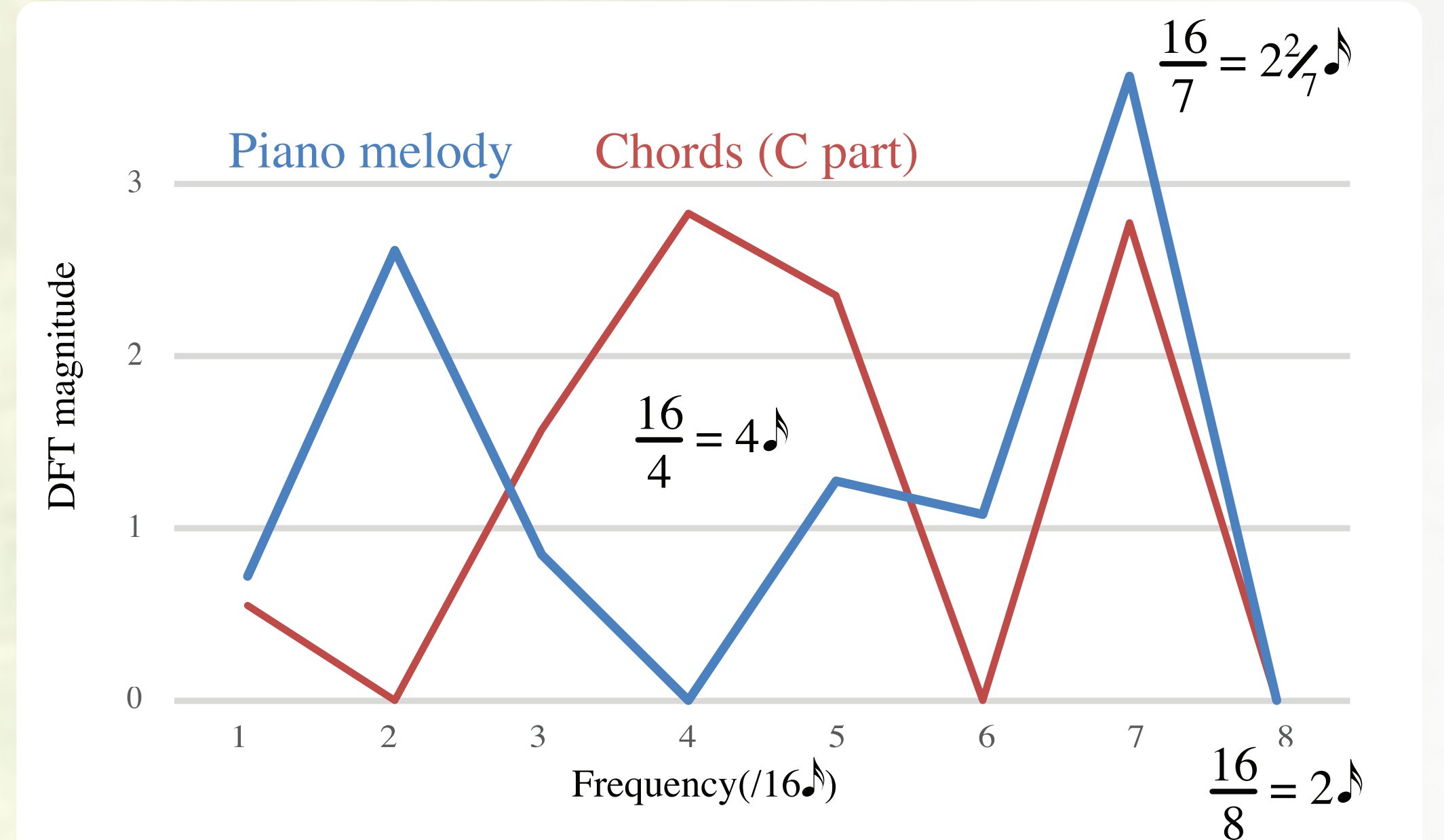
## Irregular periodicities can conflict with regular ones

### The Bad Plus, "As This Moment Slips Away"

B part:



An irregular periodicity in the melody ( $2^2/7$ ) conflicts with the metrical layer ( $2$ )



The C part drops the metrical layers in favor of an irregular layer that matches the  $2^2/7$  periodicity of the melody.

C part: (1111110101111010) etc.

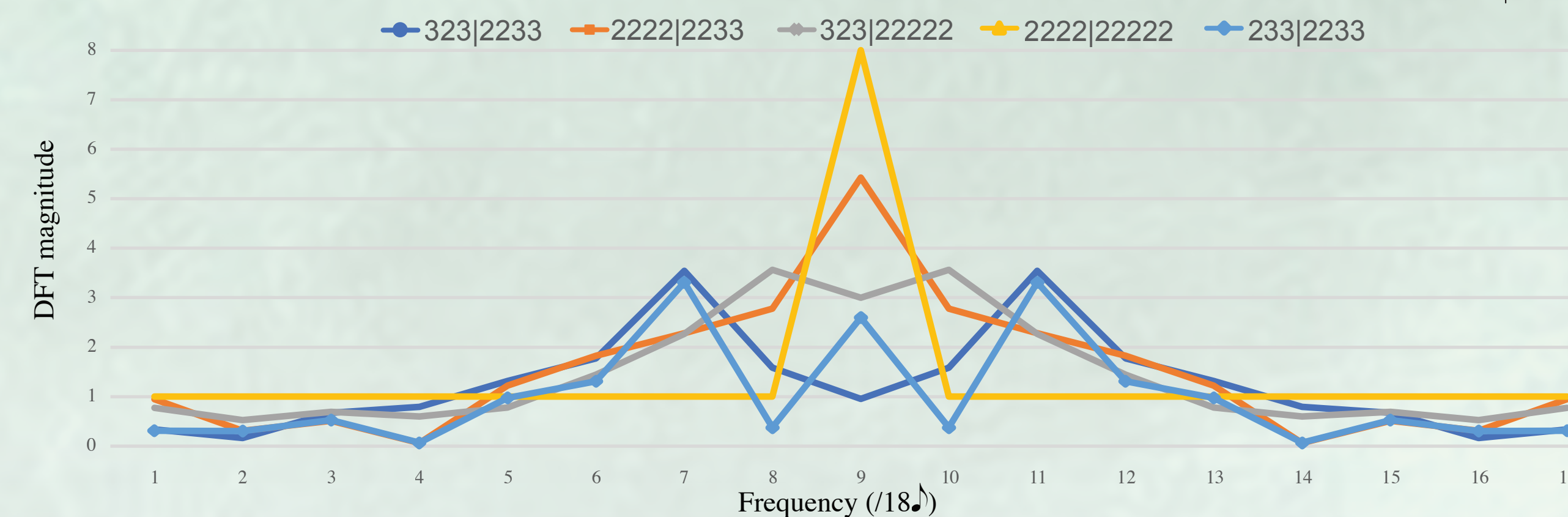
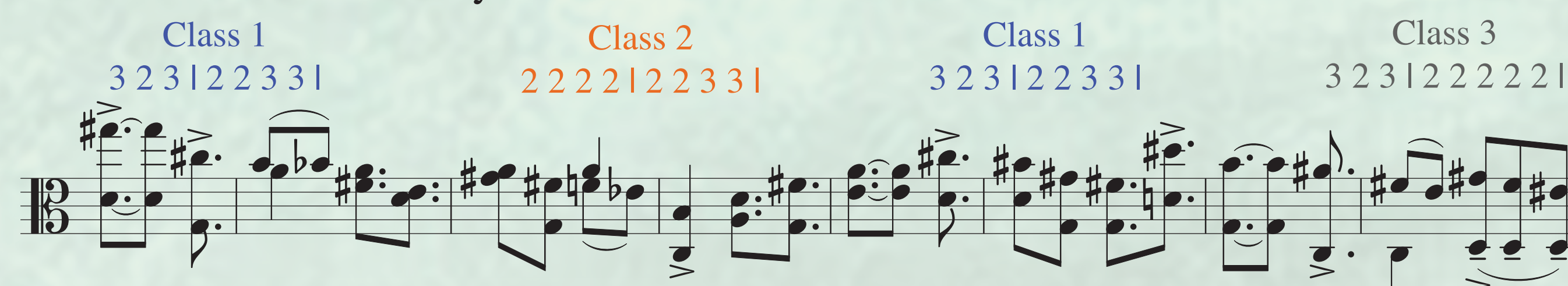


## A periodicity can shift within a fixed cycle

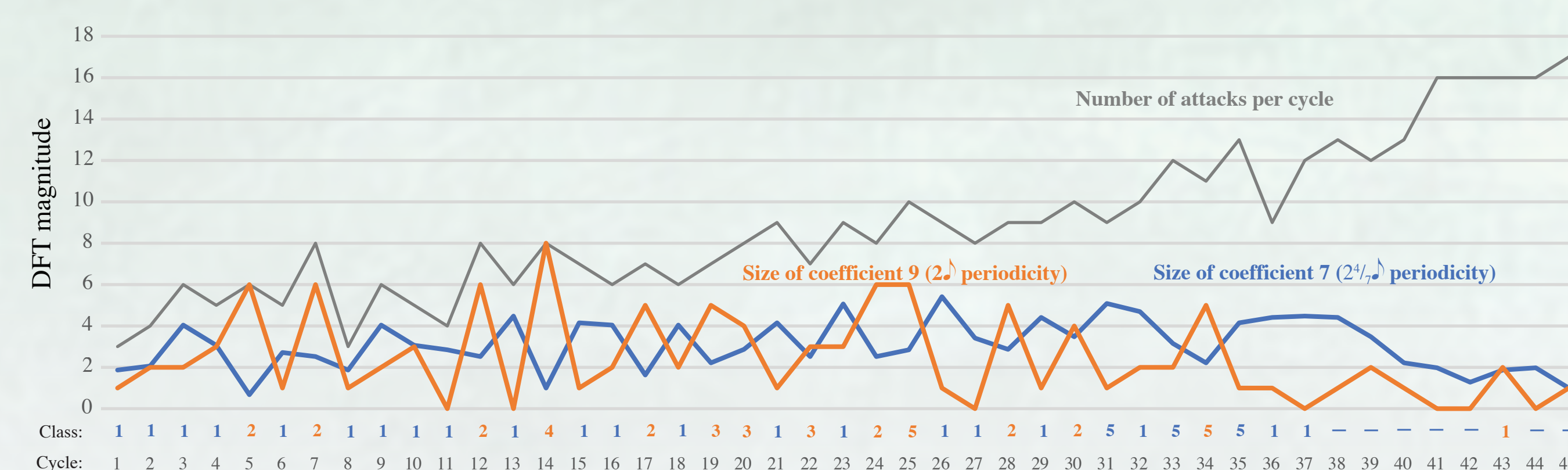
### Ligeti, "Loop" (Viola Sonata Mvt. 2)

Based on an 18 cycle with varying irregular divisions by 2s and 3s

Define 5 rhythmic classes based on subdivision scheme:



Changing subdivisions shift energy between the 7th and 9th coefficients ( $2^4/7$  and  $2$ )



Periodicities  $2^4/7$  and  $2$  alternate as attack density increases and cycle remains fixed

## An irregular periodicity can stay roughly constant over a shift of cycle

### Dave King, "You Can't Say 'Poem in Concrete'":

Ostinato, B part (Guitar and drums):



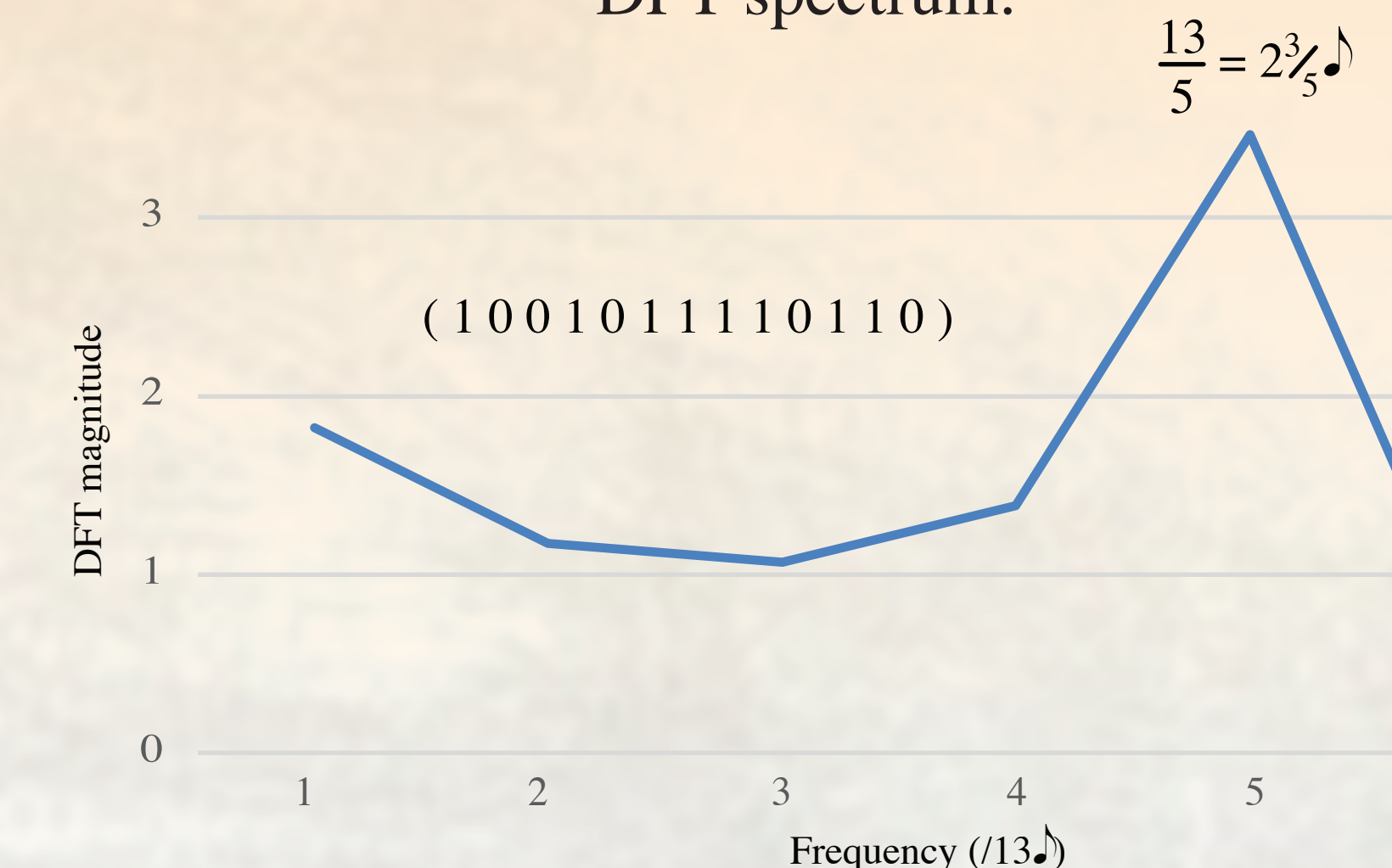
DFT spectrum (guitar):



Ostinato, C part:



DFT spectrum:



Despite the large change of cycle ( $32$  to  $13$ ) and attack density, the underlying periodicity is approximately constant.