

Yongwoo Lee

# Exponential Prelude

for Piano Trio  
and Live Electronics

2023

# PROGRAM NOTE

## 곡 해설

피아노 삼중주와 라이브 일렉트로닉스를 위한 곡 *Exponential Prelude*는 지수 함수(exponential function)를 적극 활용한 곡이다. 삼중주의 각 악기 소리에 반응하는 전자음향들은 시간(time)과 기울기를 매개변수로 하여, 다양한 그래프의 모양을 가지고 지수함수에서 옥타브를 등분 짓는 수(nums)에 따라 다양한 지점들의 비율을 얻어 리듬가와 음정을 얻어 실제 라이브 음원에 더하며 미분화된 미세한 소리를 다룬다. 즉, 지수 함수에서 나타나는 굴곡적인 그래프에서 발견한 함수적 특성을 악기의 음에 대응하는 인위적 하모닉스와 같은 전자음향을 만들어내는 수단으로서 활용한 것이다. 다양한 기울기(slope)와 매개변수 등으로부터 만들어지는 지수 함수에서 추출한 특정 비율의 값들은 악기의 소리 위에 마치 인위적인 배음과 같이 쌓이며, 각 배음의 리듬 또한 위의 비율에 의해 세분화된다.

함수로부터 비롯된 인위적인 배음렬(artificial harmonics series)들은 곡의 초기에는 마치 배음(overtone)의 의미와 같이 기음으로부터 점차 시간 간격을 두고 그 배음들이 나타나는 것과 같이 점진적으로 지수 함수의 기울기에 비례하여 나타난다. 그러던 전자음들은 점차 라이브 악기들의 소리에 자연 없이 즉각적으로 반응하며 연주의 라이브 음향과 딜레이를 두지 않고 인위적인 배음렬들이 실제 악기 소리와 합쳐져 하나의 음색이 되어버린다. 이러한 곡의 전개는 마치 지수 함수가 x값이 증가할수록 y값이 조밀해지는 것을 연상시키듯 리듬이 점차 조밀해지며 템포가 빨라지는 것으로 나타난 것이다. 더불어, 곡의 구성 상에 나타나는 상대적으로 협화적인 부분들은 이러한 인위적인 하모닉스들이 자연적인 배음렬로 환기되는 것을 의미하며, 이러한 특징들은 수학적인 정렬 상태와 비정렬 상태를 떠올릴 수 있게 한다.

\* 괄호 안의 영어는 맥스(max)에서 강조된 매개변수들을 확인하기 쉽게 하기 위해 첨가되었습니다.

\* 첨부된 시뮬레이션 음원은 사보프로그램 MIDI 음원으로부터 추출된 한계로 인해 extended technique을 비롯한 다양한 기법들이 제대로 적용되지 못하였고, 이 곡의 모든 전자음은 실제 악기에서부터 비롯된 소리이나 위와 같은 이유로 실제 공연에서의 소리와 동일하지 않습니다.

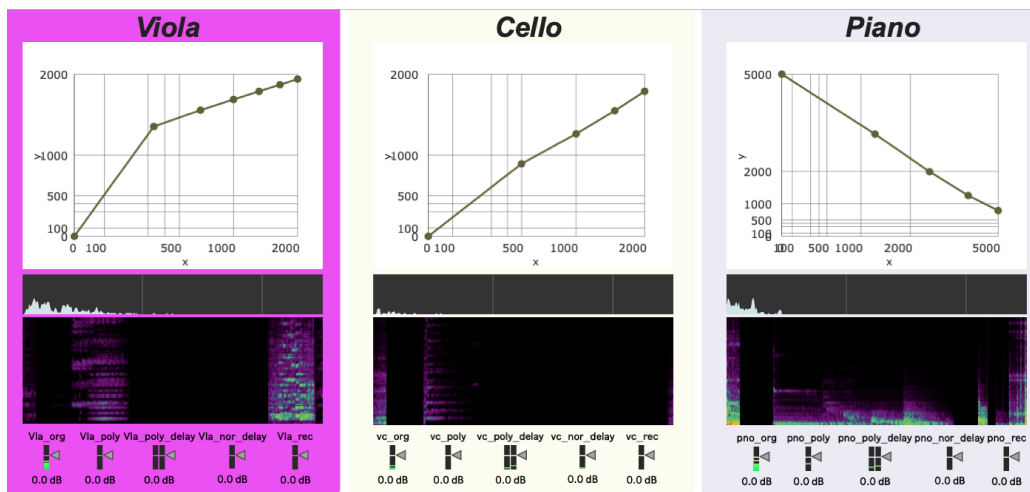
The piece *Exponential Prelude* for piano trio and live electronics extensively utilizes exponential functions. The electronic sounds, responsive to each instrument's sound in the trio, are parameterized by *time* and *slope*. They take on various shapes based on different graphs and divide octaves in the exponential function, obtaining ratios of various points according to the number of divisions (*nums*). These ratios contribute rhythm and pitch to the actual live audio, dealing with differentiated subtle sounds, microtones. Essentially, the piece employs the functional characteristics found in the exponential function, creating electronic sounds akin to artificial harmonics corresponding to an natural overtone series of instruments. The values extracted from the exponential function, derived from various *slopes* and parameters, are stacked upon the sound of the instruments, much like artificial overtones, and the rhythm of each electronics is also finely subdivided according to the above ratios.

The artificial harmonic series derived from functions gradually emerge in the initial stages of the piece, much like overtones gradually manifesting from a fundamental tone over time, in proportion to the slope of the exponential function. Meanwhile, the electronic sounds seamlessly and immediately respond to the live instruments without delay, blending the artificial harmonic series with the actual instrument sounds to form a distinctive and unified timbre. The development of the piece is reminiscent of how, as the x-values increase in an exponential function, the function's y-values become denser, just like in music, where the rhythm gradually densifies and the tempo accelerates. Additionally, the relatively consonant sections in the composition signify the transition of these artificial harmonics into natural harmonic series, evoking both ordered and disordered mathematical states.

\* The italic font indicates the parameter values of Max so that they can be checked.

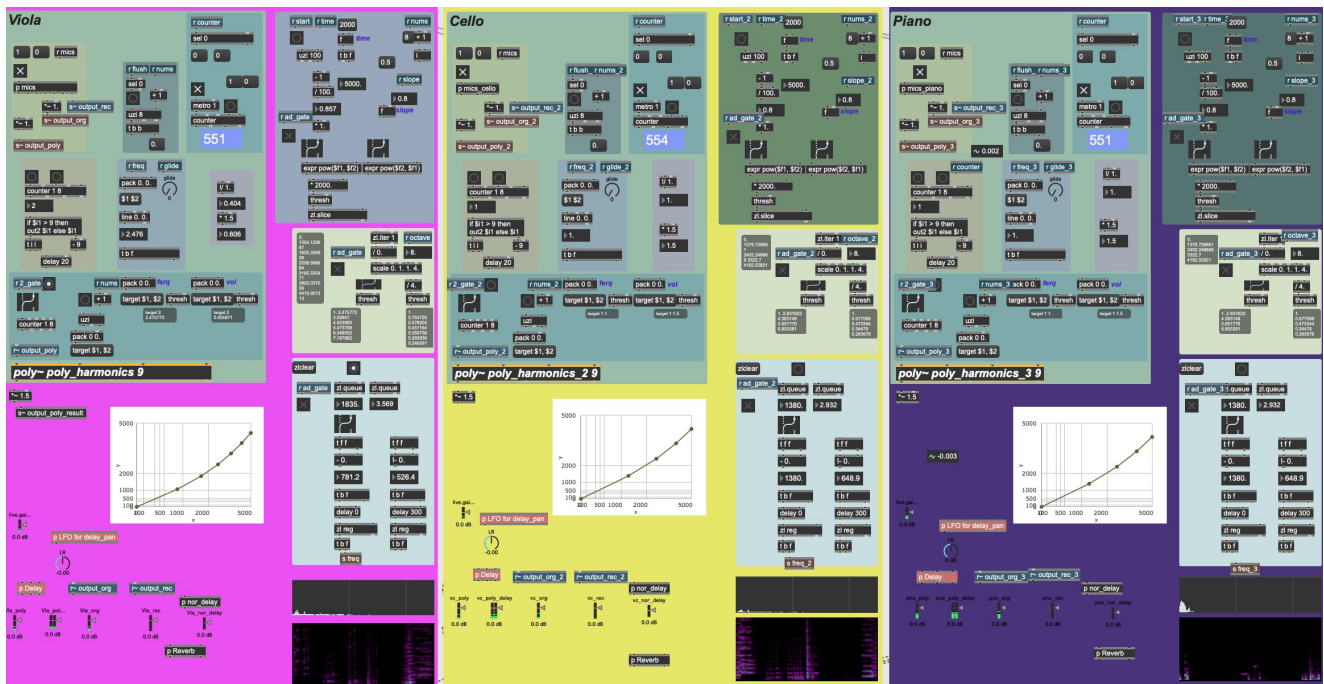
\* The attached simulation sound source was not properly applied with various techniques, including extended techniques, due to the limitations extracted from the program MIDI sound source, and all electronic sounds of this piece are not the same as those of the actual performance for the above reasons.

# MAX Patch



맥스로 표현된 위의 그래프는 함수의 기울기에 따라 달라지는 곡선과 그에 따른 시간과 음정의 비율을 포인트의 개수에 따라 등분하여 나타냈다. 함수에서 얻어진 다양한 포인트들은 poly~ 오브젝트를 통해 라이브 음원을 다양한 시간의 간격과 마이크로한 음정으로 pfft~를 통해 각기 프로세싱되었다. 이 곡은 4개의 마이크(vla vc, 1개씩, pno 2개)를 필요로 하며, 2ch 스테레오 환경을 대상으로 작곡되었다.

The graph above, depicted in Max, illustrates the curve that varies based on the function's slope, indicating the number of points affecting the ratio of time and pitch. The function's multiple points were processed using pfft~ with diverse time intervals and micro pitches via the poly~ object. This composition necessitates the use of four microphones (one for the viola, one for the cello, and two for the piano), and it was designed for a two-channel stereo environment.



# NOTATION

## Strings (for vla, vc.)



damping the string to make white noise (w.n.)



bowing on the bridge (o.t.b.)



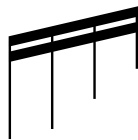
bowing behind the bridge (b.t.b.)



circular bowing (c.b.)



a highest note



notes of indefinite pitch  
relating with chance music



rub the bow up and down  
on the string

## Piano



tap the wood located at front below the keyboard



pluck the string inside



sweep the surface of the white keys  
with the fingernails to produce the noise



knock a fallboard with knuckles

## Common

" *mp* "

action dynamics: intensity of playing,  
not related to the absolute volume

# Exponential Prelude

for Piano Trio and Live Electronics

이 용 우 (yongwoo lee)

1 **Tranquillamente** ♩ = 60

Viola

Violoncello

Piano

Cue

damping the string to make white noise (on the fingerboard) *con sord.* → o.t.b. (on the bridge) → b.t.b. (behinde the bridge)

*pppp*

damping the string to make white noise (on the fingerboard) *con sord.* → o.t.b. (on the bridge) → b.t.b. (behinde the bridge) → w.n. (white noise) *sul pont. (s.p.)*

*pppp* *ppp*

5 *sul pont. (s.p.)* *ppp* *gliss.* *w.n.* *pppp* *pp*

*gliss.* *w.n.* *gliss.* *s.p.* *III* *ppp*

3 4 5 6

## Exponential Prelude

11

col legno  
ord. w.n. → sul tasto

s.p. → b.t.b. → s.p.

o.t.b.  
ord.

1/4 (half sharp)

*ppp* *pppp*

*ppp* *ppp*

ord.

*mp* pizz.

*pp*

pizz.

8<sup>ba</sup> Red.

8<sup>ba</sup> Red.

7

17

A

rub the bow up and down on the string

w.n. (circular bowing, c.b.)

ord.

*mp*

*pp*

rub the bow up and down on the string

w.n. (circular bowing, c.b.)

ord.

*mp*

*ppp* *pp*

ord.

*mp* pizz.

*mp* pizz.

*mp*

8<sup>ba</sup> Red.

8<sup>ba</sup> Red.

8

9

# Exponential Prelude

3

from indeterminate notes  
to the white noise sound

21

mp

pp

w.n.

p

mf

"mp"

ppp

15ma bassa

mf

Led.

10

11

25

1/4 (half flat)

pp

mp

"mp"

(ord.)

p

col legno

mp

"mp"

p

mp

sf

12

## Exponential Prelude

29 *col legno* *p* *c.b. ord.* *mf* *f*

*ord.* *ppp* *p* *c.b.* *mf* *f*

*mp* *mf* *mp* *f*

*sf* *8ba*

13

33 *accel.* *mp* *mp*

*mp* *mp*

*mf* *(mf)* *pp mf* *sf* *8ba*

*rec* 14



## Exponential Prelude

5

[illegible]

39

3

*mp* *mf*

highest pitch

w.n.

*p* *f*

3

*mf* *sf*

8<sub>ba</sub>

16

17

42

pizz. *mp* w.n. arco *pp* *sf* pizz. *f* w.n. arco *p* *f* highest pitch s.p.

ord. *sf* *pp* *f* *mp* *pp* *f*

15<sup>ma</sup> *pp* *f* *pp* *f* 3

*sf* *sf* *f* *sf* 8<sup>ba</sup> *sf* *sf*

18

45

w.n. *mp* circular bowing (c.b.) w.n.

*mf* *f* *p*

15<sup>ma</sup> *mf* *f* *mp*

8<sup>ba</sup> *sf* *Red.*

19

# Exponential Prelude

7

47

w.n. (c.b.)

Musical score for measures 47-50. The score is written for three staves: a single staff at the top, a single staff in the middle, and a grand staff (bass and treble clef) at the bottom. The time signature is 3/4. Measure 47: Top staff has a melodic line starting with a half note, marked *mp*. Middle staff has a whole note, marked *mp*. Bottom staff has a complex rhythmic pattern. Measure 48: Top staff has a whole note, marked *mp*. Middle staff has a whole note, marked *mp*. Bottom staff has a complex rhythmic pattern. Measure 49: Top staff has a whole note, marked *mp*. Middle staff has a whole note, marked *mp*. Bottom staff has a complex rhythmic pattern. Measure 50: Top staff has a whole note, marked *mp*. Middle staff has a whole note, marked *mp*. Bottom staff has a complex rhythmic pattern. The score includes various dynamic markings: *mp*, *sf*, *mf*, *p*, *ppp*, and *gliss.*. There are also performance instructions like "w.n. (c.b.)" and "gliss."

50

Musical score for measures 51-54. The score is written for three staves: a single staff at the top, a single staff in the middle, and a grand staff (bass and treble clef) at the bottom. The time signature is 3/4. Measure 51: Top staff has a melodic line starting with a half note, marked *mp*. Middle staff has a whole note, marked *mp*. Bottom staff has a complex rhythmic pattern. Measure 52: Top staff has a whole note, marked *mp*. Middle staff has a whole note, marked *mp*. Bottom staff has a complex rhythmic pattern. Measure 53: Top staff has a whole note, marked *mp*. Middle staff has a whole note, marked *mp*. Bottom staff has a complex rhythmic pattern. Measure 54: Top staff has a whole note, marked *mp*. Middle staff has a whole note, marked *mp*. Bottom staff has a complex rhythmic pattern. The score includes various dynamic markings: *mp*, *p*, *mf*, and *ppp*. There are also performance instructions like "w.n. (c.b.)" and "gliss."

## Exponential Prelude

C

53

*pp* *pp* *ppp* *p*

pizz. s.p. arco s.p.

*pppp* sweep w/ nails

ord.

sweep the surface of the white keys with the fingernails to produce the noise

22

58

*mp* *mp* *pp* *pp* *mp*

III s.p. w.n. b.t.b. ord.

sweep w/ nails sweep w/ nails ord.

"ppp" < "mp" > ppp

8ba mp Red.

23

62 *sul pont.* **Adagietto** ♩ = 72

*p* *mp* *mp*

*p* *pizz.* *mf*

*mp* *pp* *mp*

*sweep w/ nails* *ord.* *pp* *mf* *8ba* *sf* *ppp* *mp*

*(slide fingernails on wood when they're reached note 'E' then play it)*

*ord.* *mf*

*w.n. ord. arco*

24

66 *accel.*

*pp* *ppp* *f* *f* *f* *mp* *sf*

*highest pitch*

*col legno* *f* *mp* *sf*

*ppp* *f* *ppp* *mp* *ppp* *mp* *p* *mf* *mp* *f*

*(ord.)* *gliss.* *gliss.* *gliss.* *gliss.* *gliss.* *gliss.* *gliss.* *gliss.* *gliss.* *gliss.*

*ppp* *mp* *ppp* *mp* *p* *mf* *mp* *f*

*(ord.)* *gliss.* *gliss.* *gliss.* *gliss.* *gliss.* *gliss.* *gliss.* *gliss.* *gliss.* *gliss.*

*ppp* *mp* *ppp* *mp* *p* *mf* *mp* *f*

25

## Exponential Prelude

69 Adagio ♩ = 60

Furioso ♩ = 72

arco

*sf*

*p*

pizz.

arco

*mp*

*ppp* *f*

highest pitch

*mp*

*sf*

*pp*

8va

Red.

26

72

*pizz.*

*p*

*p*

27

75 (pizz.) accel.....

*sf* *sf* *sf*

pizz. *pp* arco

*mp* *p* *mf* tap the wood located at front below the keyboard

*sf* *sf* *sf*

28

78 (pizz.) rit..... Adagietto ♩ = 76

*p*

pizz. *p*

tap the wood located at front below the keyboard

*ppp* *p*

*sf* *sf*

## Exponential Prelude

82 (pizz.) *sf* *sf* *sf* *pp* *mf-pp* *accel.* *arco* *pizz.* *p* *mf-pp*

*mf* *p sub.*

29 30

86 *col legno* *pp mp* *pp mp cre* *pizz.* *sf cre* *knock a fallboard with knuckles* *mp* *sf* *cre*

31 32



Adagio ♩ = 60

90

ord.

scen

pp mp

do

arco

sf

scen

do

knock a fallboard with knuckles

E accel.

93

f

3

p

mf

3

3

f

3

3

sf

33

.....  
97 **Furioso** ♩ = 72

*f* > *p* < *mp*

*f* > *p* < *mp*

*pizz.*

*arco*

*p*

*f* *mp* *mf* *p*

*gliss.* *gliss.* *gliss.*

*sf* *sf*

glissando only the lowest note of the chord  
(in this case, note 'C') with side palm of the hand

34

101 **accel.**.....

*p* *ppp* < *mf* *mp*

*o.t.b.*

*o.t.b.* *b.t.b.* *o.t.b.*

*mp* *f* *ppp*

*f* *p cresc.* *sf*

*gliss.*

34

105 b.t.b. → o.t.b. o.t.b. → b.t.b.

*f* → *ppp* *mp* *f* sul pont.

o.t.b. b.t.b. → o.t.b. *mp* *f* → *ppp* *pp* *sf* 8va

3 *gliss.* 3 *sf* *mf* 3

35

108 o.t.b. → b.t.b. → o.t.b.

*mp* *mf* → *ppp* *arco* *mf-p* *sf* *mp*

o.t.b. b.t.b. → o.t.b. *f* *mp* *f* → *ppp* 3 *gliss.* 3 *gliss.* 3 8va 8va 8va

*sf* *pp* 3 *gliss.* 3 8va

4/4

rit.

pluck the string from the fingerboard  
to the right above the bridge then  
back to the fingerboard

111

pizz.

o.t.b.

position ord. (pizz.)

mf > ppp

ppp

36

115 Adagietto ♩ = 72

(pizz.)

mf

mf

sf

pp

3

mp

mf

8va

8va

8va

8va

37

119

Musical score for measures 119-121. The score is written for three staves: two for the upper right hand (treble and alto clefs) and one for the lower left hand (bass clef). The key signature has one flat (B-flat). Measure 119 features a triplet of eighth notes in the right hand and a single eighth note in the left hand. Measure 120 continues the triplet pattern. Measure 121 features a triplet of eighth notes in the right hand and a triplet of eighth notes in the left hand, with a glissando marking. The dynamic markings are *f mp* for the right hand and *f mp* for the left hand. A box containing the number 38 is located below the left hand staff.

122 **F** Più mosso ♩ = 90

Musical score for measures 122-124. The score is written for three staves: two for the upper right hand (treble and alto clefs) and one for the lower left hand (bass clef). The key signature has one flat (B-flat). Measure 122 features a triplet of eighth notes in the right hand and a single eighth note in the left hand. Measure 123 features a triplet of eighth notes in the right hand and a single eighth note in the left hand. Measure 124 features a triplet of eighth notes in the right hand and a triplet of eighth notes in the left hand, with a glissando marking. The dynamic markings are *mp* for the right hand and *mp* for the left hand. The tempo marking is **F** Più mosso ♩ = 90. The articulation marking is (pizz.). The dynamic marking is *mp dolce*.

125

Musical score for measures 125-139. The score is written for three staves: Treble, Bass, and Piano. The key signature is one flat (B-flat), and the time signature is 2/4. The Treble staff features a melodic line with triplets and accents, marked *sf*. The Bass staff features a melodic line with triplets and accents, marked *mf* and *sf*. The Piano part features a complex texture with sixteenth-note runs and triplets, marked *sf* and *mp*. A box containing the number 39 is located below the Piano staff.

128

**G** Adagietto ♩ = 72

Musical score for measures 128-141. The score is written for three staves: Treble, Bass, and Piano. The key signature is one flat (B-flat), and the time signature is 2/4. The Treble staff features a melodic line with triplets and accents, marked *f* and *mp*. The Bass staff features a melodic line with triplets and accents, marked *f* and *mp*. The Piano part features a complex texture with sixteenth-note runs and triplets, marked *f* and *mp*. A box containing the number 40 is located below the Piano staff, and a box containing the number 41 is located below the Bass staff.

highest pitch

132

*f* *mf* *fp* *f* *f* *mf* *ff*

*f* *fp* *f* *f* *mf* *ff*

*f* *sf* *f*

*gliss*

*gliss*

*sf*

15ma bassa  
Rdo.

2/4 3/4 2/4

highest note

135

*sf* *f*

*sf*

*f* *sf* *sf*

(15)  
(Rdo.) *sf*

42

2/4 3/4

138

Musical score for measures 138-140. The score is written for three staves: Treble, Bass, and Grand Staff. The time signature changes from 2/4 to 3/4. Measure 138 features a forte (*f*) dynamic in the Treble staff and a piano (*p*) dynamic in the Bass staff. Measure 139 features a forte (*f*) dynamic in the Treble staff and a piano (*p*) dynamic in the Bass staff. Measure 140 features a forte (*f*) dynamic in the Treble staff and a piano (*p*) dynamic in the Bass staff. The Grand Staff features a forte (*sf*) dynamic in the Treble staff and a forte (*sf*) dynamic in the Bass staff. A 15th measure rest is indicated in the Bass staff.

141

Musical score for measures 141-143. The score is written for three staves: Treble, Bass, and Grand Staff. The time signature is 3/4. Measure 141 features a piano (*p*) dynamic in the Treble staff and a mezzo-forte (*mf*) dynamic in the Bass staff. Measure 142 features a piano (*p*) dynamic in the Treble staff and a mezzo-forte (*mf*) dynamic in the Bass staff. Measure 143 features a mezzo-forte (*mf*) dynamic in the Treble staff and a mezzo-forte (*mf*) dynamic in the Bass staff. The Grand Staff features a mezzo-forte (*mf*) dynamic in the Treble staff and a mezzo-forte (*mf*) dynamic in the Bass staff. A 44th measure rest is indicated in the Bass staff.



145 *accel.*..... *Moderate with tension* ♩ = 90

*p*

*p*

*p*

*pizz.*

*8ba*

*45*

150

*arco*

*mf sf*

*pizz.*

*arco*

*pizz.*

*mf*

*8ba*

*46*

knock a fallboard  
with knuckles

155

arco *f* *sf* gliss.

arco *f* *sf* gliss.

*15ma bassa* *sf* *mp* *mf*

*Red.*

157

**H** Lento ♩ = 60  
w.n.

*sf* *ppp*

*sf* *pizz.* *p*

*f* *p* *8va* *p dolce*

*15ma bassa* *sf* *mp* *mf*

47

161

Musical score for measures 161-164. The score is written for three staves: Treble, Bass, and Grand Staff. The key signature is one flat (B-flat). The time signature is 4/4. The music features a variety of textures and dynamics. Measure 161 has a Treble staff with a long note and a Bass staff with a triplet. Measure 162 has a Treble staff with a long note and a Bass staff with a triplet. Measure 163 has a Treble staff with a long note and a Bass staff with a triplet. Measure 164 has a Treble staff with a long note and a Bass staff with a triplet. The dynamics are *mp* (mezzo-piano) and *ppp* (pianissimo). The markings *sul tasto arco* and *pizz.* are present. A repeat sign is shown at the bottom of the page.

*mp*

*ppp*

*sul tasto arco*

*pizz.*

*mp*

(8)

(20.)

165

accel.....

Musical score for measures 165-168. The score is written for three staves: Treble, Bass, and Grand Staff. The key signature is one flat (B-flat). The time signature is 4/4. The music features a variety of textures and dynamics. Measure 165 has a Treble staff with a long note and a Bass staff with a triplet. Measure 166 has a Treble staff with a long note and a Bass staff with a triplet. Measure 167 has a Treble staff with a long note and a Bass staff with a triplet. Measure 168 has a Treble staff with a long note and a Bass staff with a triplet. The dynamics are *mf* (mezzo-forte) and *sf* (sforzando). The marking *accel.* is present. A repeat sign is shown at the bottom of the page.

*mf*

*mf*

*sf*

*sf*

*3*

*3*

*3*

*3*

*4/4*

## Exponential Prelude

Più mosso ♩ = 72

168

Musical score for measures 168-171. The score is written for three staves: Treble, Bass, and Piano. The key signature is B-flat major (two flats). The time signature is 4/4. Measure 168 starts with a treble staff entry. Measure 169 features a bass staff entry with a triplet of eighth notes and a piano staff entry with a triplet of eighth notes. Measure 170 includes a glissando in the piano staff and a triplet of eighth notes in the bass staff. Measure 171 ends with a box containing the number 48. The tempo marking 'Più mosso' and the tempo indicator '♩ = 72' are at the top right.

171

Musical score for measures 171-174. The score is written for three staves: Treble, Bass, and Piano. The key signature is B-flat major (two flats). The time signature is 3/4. Measure 171 starts with a treble staff entry marked 'mf'. Measure 172 features a treble staff entry with a triplet of eighth notes and a bass staff entry with a triplet of eighth notes. Measure 173 includes a glissando in the piano staff and a triplet of eighth notes in the bass staff. Measure 174 ends with a box containing the number 3. The tempo marking 'rit.' is at the top right.

174

just act like to play the notes  
but do not produce the sound

*pp*

just act like to pizz. the notes  
but do not produce the sound

*pp*

3

just act like to play the notes  
but do not produce the sound

3