

International Symposium MIKROTÖNE ~ MICROTONES. SMALL IS BEAUTIFUL 2023. June 28<sup>th</sup> – July 2<sup>nd</sup> 2023.  
Mozarteum University Salzburg -- Sacellum, University Salzburg (Austria)

**mozarteum**  
**university** 

SACELLUM



ESTONIAN ACADEMY  
OF MUSIC AND THEATRE

**EKA** Eesti  
Kunstiakadeemia

**Hans-Gunter Lock**

Estonian Academy of Music and Theatre  
Estonian Academy of Arts  
Estonian Arnold Schönberg Society

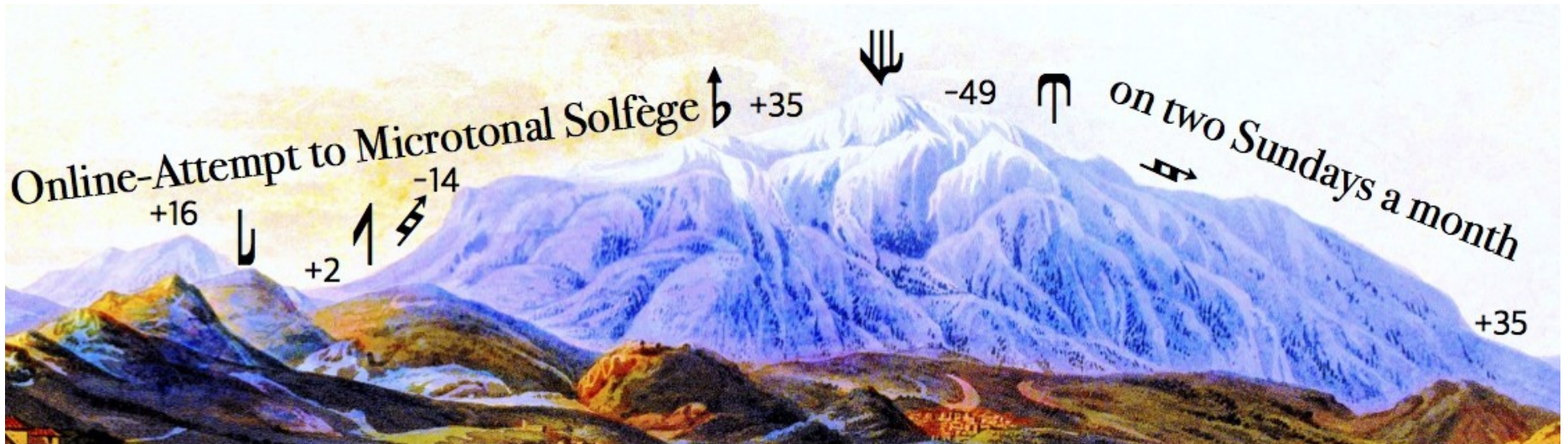
together with:

**Leonora Palu**

**Juhani Nuorvala**



# Practical Experiences in Composing and Performing with 22 Equal Division of the Octave



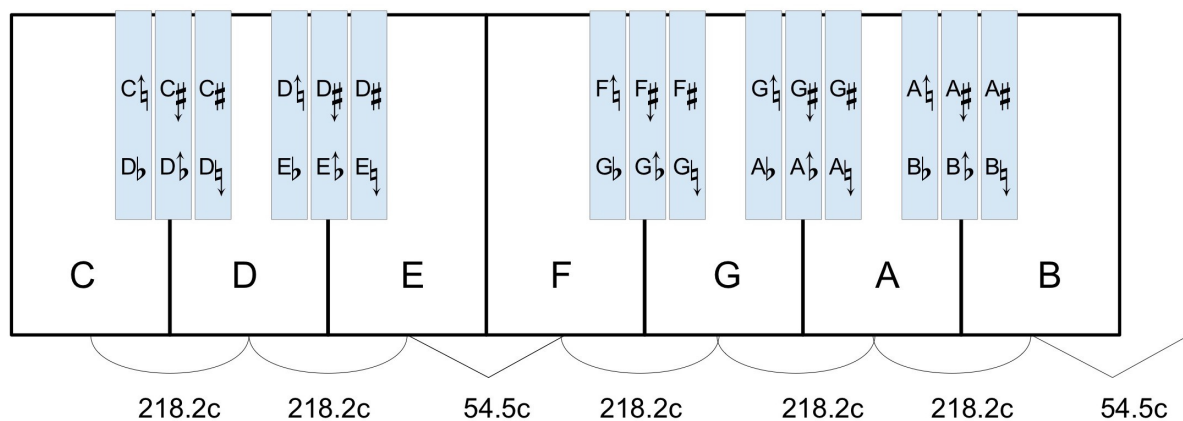
Supported by:



Hans-Gunter Lock – õppejõu  
loometegevuse toetamise  
stipendium

# 1. The 22-EDO System

- contains 22 steps within the octave (22-Equal Division of the Octave)
- the smallest step is 54.5 cents, roughly a quarter tone (100 cents = 1 semitone)
- in contrast to Western classical tuning systems it differentiates between a lesser and greater semitone (doesn't temper out the Syntonic comma  $81/80 \approx 21.5$  cents, but widens it to 54.5 cents)
- appears a 7-step diatonic subscale named Superpyth[7] containing greater whole tones and instead of semitones there are quarter tones steps
- numerous other subscales are possible, e.g. Porcupine[7] and [8], Orwell[9], Pajara[10], but also the ancient greek enharmonic tetrachord is fairly good represented
- contains also subscales of 11-EDO, e.g. Machine[6], Orgone[7]



**Figure 1.** Hypothetical keyboard based on Superpyth[7] scale at the White keys.



# 1. The 22-EDO System

Interval Name Abbrev.:	1/4T	ST	WT-	WT+	7Min3	Min3+	Maj3	7Maj3	P4	11L Trit	Trit	11G Trit
cents: 0	55	109	164	218	273	327	382	436	491	545	600	655
pitch classes: 0	1	2	3	4	5	6	7	8	9	10	11	12
	C ♮	C #	C #		D ♮	D #	D #			F ♮	F #	F #

P5	7Min6	Min6	Maj6-	7Maj6	7Min7	Min7+	Maj7	Maj7 +1/4T	P8
709	764	818	873	927	982	1036	1091	1145	1200
13	14	15	16	17	18	19	20	21	22
	G ♮	G #	G #		A ♮	A #	A #		

Figure 3. Up/down notation with enharmonic equivalents.

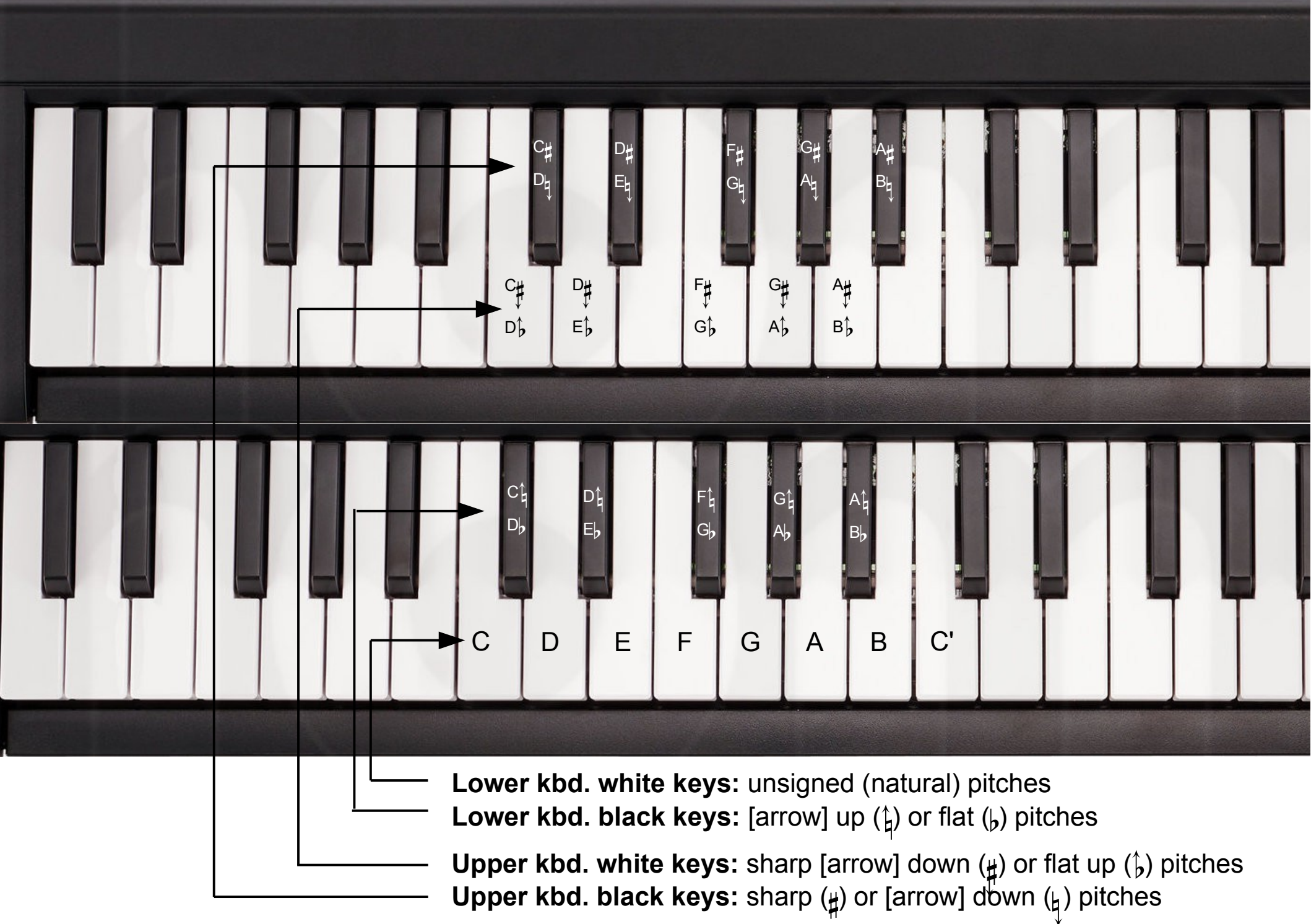
# 1. The 22-EDO System

- for practicing a solution with two stacked Korg Microkey 61 keyboard have been used, mimicking the hypothetical Superpyth[7] keyboard

**Thank you Juhani Nuorvala for this idea!**



**Figure 4.** Two KORG Microkey 61 keyboards for 22-EDO. The basic Superpyth[7] scale is mapped to the white keys of the lower keyboard.



**Figure 5.** Close view to the two KORG Microkey 61 keyboards. Mapping explained.

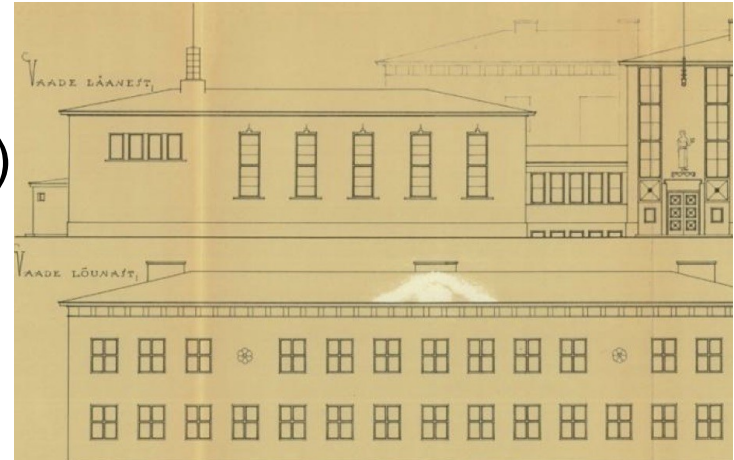
# 1. The 22-EDO System

<b>nr./ pitch class</b>	<b>interval name</b>	<b>abbr.</b>
0	unison	unis.
1	quarter tone	1/4T
2	semitone	ST
3	lesser wholetone	WT-
4	greater wholetone	WT+
5	septimal minor third	7Min3
6	greater minor third	Min3+
7	major third	Maj3
8	septimal major third	7Maj3
9	pure fourth	P4
10	lesser undecimal tritone	11L_Trit
11	(12-EDO) tritone	Trit
12	greater undecimal tritone	11G_Trit
13	slightly wider pure fifth	P5
14	septimal minor sixth	7Min6
15	minor sixth	Min6
16	lesser major sixth	Maj6-
17	septimal major sixth	7Maj6
18	septimal minor seventh	7Min7
19	greater minor seventh	Min7+
20	major seventh	Maj7
21	major seventh plus quarter tone	Maj7+1/4T
22	pure octave	P8

**Figure 6.** 22-EDO interval names as used for Gradus ad Parnassum

## 2. Pärnu Contemporary Music Days (PNP)

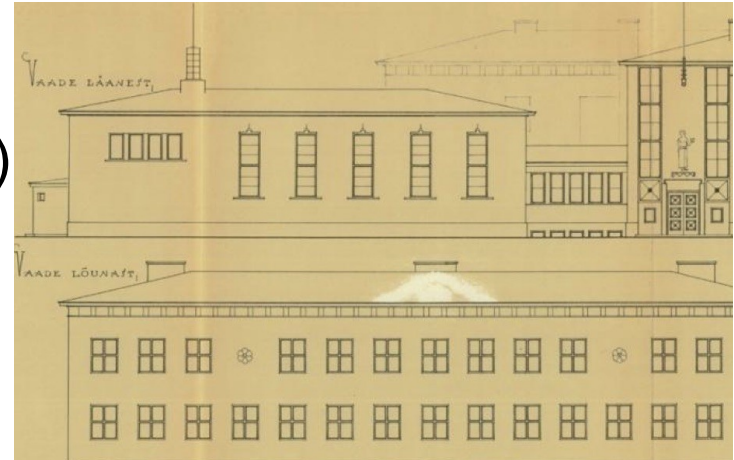
- yearly in January, a contemporary music festival in Pärnu (South-Western Estonia)
- founded by Estonian composer Andrus Kallastu, organized since 1998 by Estonian Arnold Schönberg Society ([www.schoenberg.ee](http://www.schoenberg.ee))





## 2. Pärnu Contemporary Music Days (PNP)

- contains a weeklong workshop and a two-day symposium
- the goal is to bring new knowledge for contemporary composers to Estonia
- different topics focused over the years:  
e.g. futurism, performativity, composition models



### 3. Pärnu Contemporary Music Days 2021 (PNP021)

- during 2020 plans for PNP2021 with the topic of microtonality

- decision to focus on 22-EDO, speakers from the US has been invited

- due to the global pandemic the the workshop and conference had to go completely online

- has led to an online singing training in 22-EDO

Goals:

- learning to sing in an unfamiliar scale with unfamiliar intervals
- training for to understand 22-EDO for composers rather than for professional singing training
- finding ways to discover the special compositional properties of 22-EDO specially in terms of voice leading
- use of a synthesizer for training by repeatedly listening and singing along with the synthesizer

GRADUS  
A D  
PARNASSUM,

Sive  
MANUDUCTIO

A D  
COMPOSITIONEM MUSICÆ  
REGULAREM,  
Methodo novâ, ac certâ, nondum antè  
tam exacto ordine in lucem edita :

*Elaborata à*

JOANNE JOSEPHO FUX,  
Sacræ Cæsareæ, ac Regiæ Ca-  
tholicæ Majestatis CAROLI VI. Ro-  
manorum Imperatoris  
SUPREMO CHORI PRÆFECTO.



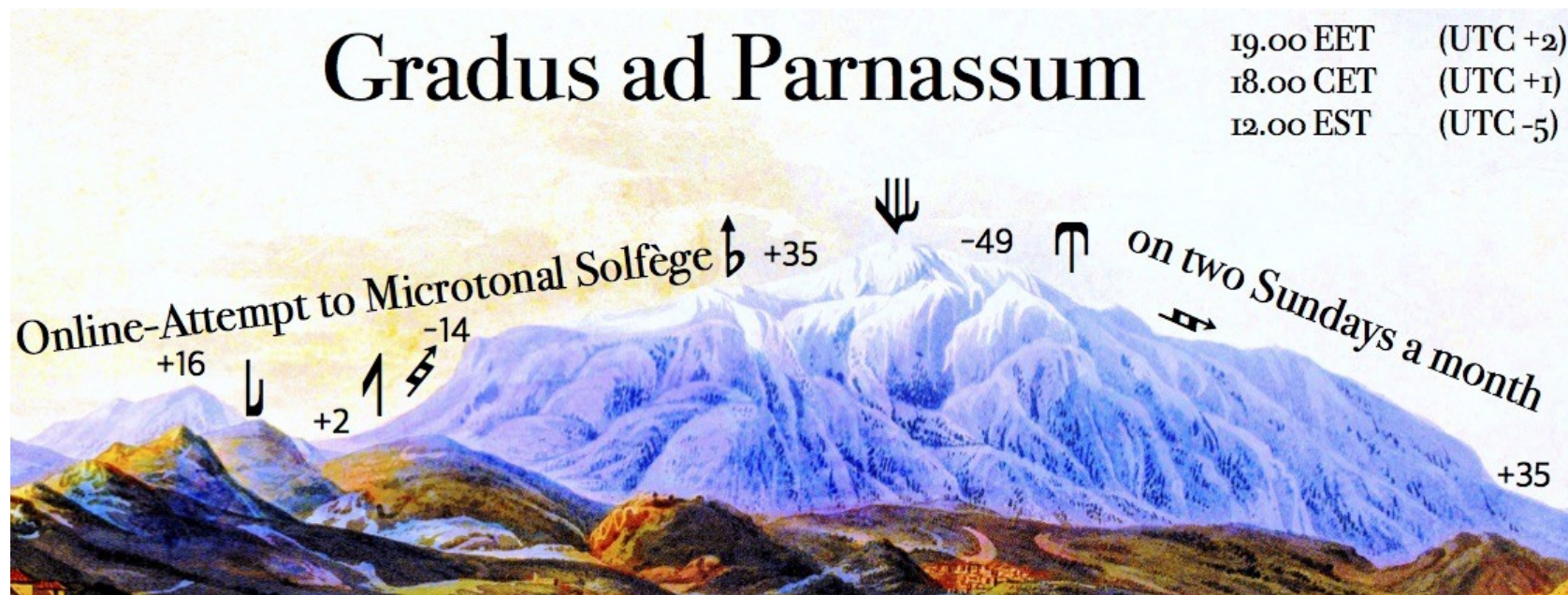
VIENNÆ AUSTRIÆ,

Typis Joannis Petri Van Ghelen, Sac. Cæs. Regiæque Catholicæ Ma-  
jestatis Aula-Typographi, 1725.

- the aspect of counterpoint  
and voice leading guides us to a similar  
historical composition teaching approach  
by Johann Joseph Fux' textbook

Gradus ad Parnassum (1725), from  
which we learnt the title of our workshop  
training program

## 4. Gradus ad Parnassum



- after Gradus ad Parnassum during PNP2021 (January) we decided to continue with 22-EDO microtonal online singing course under the same name as an international online solfège learning circle, organized by Estonian Arnold Schönberg Society
- every second Sunday and evening time, that also people from US East Cost could participate at a day time

[https://www.schoenberg.ee/?sitesig=SB&page=SB\\_030\\_Tegevus&subpage=2021\\_Gradus\\_ad\\_Parnassum](https://www.schoenberg.ee/?sitesig=SB&page=SB_030_Tegevus&subpage=2021_Gradus_ad_Parnassum)

## 4. Gradus ad Parnassum

- it took place three terms: Spring 2021, Autumn 2021 and Spring 2022
- technically every meeting we came together first in Jitsi video conference application, where we also shared musical notations. Then we used in parallel Cleanfeed audio online application for low latency and uninterrupted audio connection
- additionally we shared the audio material, theoretical explanations and music notation via google drive:  
[https://drive.google.com/drive/folders/1Y3HNijw4chz46uiV0Ei4i\\_38lGoWuE8v](https://drive.google.com/drive/folders/1Y3HNijw4chz46uiV0Ei4i_38lGoWuE8v)
- the theoretical material (explanations, scales, online synthesizer links), the exercises and little pieces of Spring 2021 term has been issued as online book Codex Paernuensis Vol. I  
[https://www.schoenberg.ee/SB\\_050\\_Publikatsioonid/Codex\\_Paernuensis\\_Vol\\_I.pdf](https://www.schoenberg.ee/SB_050_Publikatsioonid/Codex_Paernuensis_Vol_I.pdf)
- issuing of Vol. II and III are in preparation
- Composers who contributed exercises or shorter vocal pieces:  
Jacob Barton, Sebastian Dumitresco, Andrus Kallastu, Gerhard Lock, Hans-Gunter Lock, Joseph Monzo and Juhani Nuorvala

# 4. Gradus ad Parnassum

2021-05-23 18-59-20.mp4

Gradus Ad Parnassum 1:17:34 8 HD

jitsi

Preview File Edit View Go Tools Window Help

Harjutus-Väiksed\_Orwelltertsid.pdf (1 page)

väiksed  
Harjutus: Orwelltertsid  
Hans-Gunter Lock

Orwell tempo  
3 2  
narrow whole-

Di - es i - t  
Dies

7Min3  
Te - ste...  
Te - ste Da

Quan -  
Quan - do

7Min3  
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01:06:58 -01:25:18

meet.jit.si is sharing your screen. Stop sharing HD

20:06  
23.05.2021



Figure 7. continuing: Gradus ad Parnassum's Interval Exercise

25 P5 7Min6 Min6

31 Maj6- 7Maj6 7Min7

37 Min7+ Maj7 Maj7 +1/4T P8



## 4. Gradus ad Parnassum

### Results

- Gradus ad Parnassum gave the ability to meet for musically professional and semiprofessional trained people with very special interest in singing and understanding the 22-EDO system
- the online format brought musicians together, which physically wouldn't have had the chance to meet so many times together
- it gave the challenge for composers to create exercises and shorter vocal pieces which could immediately tested and tried out
- disadvantages:
  - technically complicated to realize, it has been possible thanks to EKA New Media Department's Sound Studio
  - the delay allows only slow or very slow tempo, which was not a problem in this training situation, but limits the musical expressions and possibility. Under very long delay conditions (bad internet connection, far location as US West Coast) partly it became nearly impossible

## 5. Pärnu Contemporary Music Days 2023 (PNP2023)

### **Call for Scores in 22-EDO**

Deadline: January 3, 2023

Concert to be played: 27.1.2023 and 28.1.2023 at 19.00 Pärnu Central Library (Pärnu, Estonia), 29.1.2023 at 19.00 Estonian Centre of Contemporary Music (Tallinn, Estonia)

New piece or existing piece arranged for the following instruments:

flute / alto flute - Leonora Palu

guitar - Gonzalo Muruaga

double bass - Lass Kari

Possible lineup:

Trio - all three instruments

Duos from the aforementioned instruments

Solo pieces for one of the aforementioned instruments

Detailed information:

[https://www.schoenberg.ee/?sitesig=SB&page=SB\\_020\\_Uudised&subpage=221204\\_PNP\\_2023\\_CALL\\_FOR\\_SCORES](https://www.schoenberg.ee/?sitesig=SB&page=SB_020_Uudised&subpage=221204_PNP_2023_CALL_FOR_SCORES)

## 5. Pärnu Contemporary Music Days 2023 (PNP2023)

### **Call for Simple Scores in 22-EDO**

Deadline: January 21, 2023

22vjo töötoa teosed | 22edo works for workshop

Concert to be played: 28.1.2023 at 19.00 Pärnu Central Library (Pärnu, Estonia),  
29.1.2023 at 19.00 Estonian Centre of Contemporary Music (Tallinn, Estonia)

From February 21.-26. the PNP2023 workshop will take place focusing on composing and performing in 22-EDO. At this workshop we will compose and rehearse pieces in 22-EDO as much as it will be possible in that short time. We are all composers and the most of us not regular practicing performers with limited technical skills, and time is very limited. Therefore we will now call for simple scores (new, existing, arranged existing) we can try out during the workshop and maybe perform at the concert on January 28th. Due to time and technical restrictions we cannot guarantee that your piece will be performed. ...

#### Lineup:

Andrus Kallastu — keyboard, voice

Gerhard Lock — violin, voice (tenor/baritone)

Hans-Gunter Lock — violin, voice (tenor/baritone)

Leonora Palu — flute, alto flute

James Robinson — violoncello

Gonzalo Muruaga — 22edo classic guitar, 22-edo electric guitar

Kristjan Kannukene — viola, voice (tenor)

Matej Sloboda — voice (baritone)

Joseph Monzo — voice (bass)

#### Detailed information:

[https://www.schoenberg.ee/?sitesig=SB&page=SB\\_020\\_Uudised&subpage=230103\\_PNP\\_2023\\_CALL\\_FOR\\_SIMPLE\\_SCORES](https://www.schoenberg.ee/?sitesig=SB&page=SB_020_Uudised&subpage=230103_PNP_2023_CALL_FOR_SIMPLE_SCORES)

## 5. Pärnu Contemporary Music Days 2023 (PNP2023)

Reede | Friday 27.1.2023

19.00 kontsert | concert. Pärnu Keskraamatukogu | Pärnu Central Library (Akadeemia 3, Pärnu)

Pühapäev | Sunday 29.1.2023

19.00 kontsert | concert

Eesti Nüüdismuusika Keskus | Estonian Centre of Contemporary Music (Pühavaimu 9, Tallinn)

### 22vjo muusika osa 1 | 22edo music part 1 KAVA | PROGRAM

Joseph Monzo: Threesome for trio

Chase Jordan: Relinquished for trio with alto flute

Neil Thornock: Stone for trio with alto flute

Praveen S. Venkataramana: Five Presence Vignettes

Vignette 1. There are no better or worse times for flute and guitar

Vignette 2. There are no grim or amusing times for guitar and double bass

Vignette 3. There are no past or imminent times for flute and double bass

Vignette 4. There are no pointless times for trio

Andrus Kallastu: 22vjo uurimus intervallides. Solo for alto flute

Andrus Kallastu: 22vjo uurimus intervallides. Solo for guitar

Hans-Gunter Lock: Enharmonic Fragement for flute and double bass

Hans-Gunter Lock: Enharmonic Mirror Fragement for flute and double bass

Jakob Elkin: Passacaglia for trio

Andrus Kallastu: 22vjo uurimus intervallides. Trio for bass flute, guitar and double bass (2022)

Hans Straub: Porcupine Scherzo for flute and guitar

Juhani Nuorvala: Ostinato for trio

Juhani Nuorvala: Porcupine's Night Out

Joseph Monzo: Soft Latin for trio with alto flute and claves

Leonora Palu, flööt | flute

Lassi Kari, kontrabass | double bass

Gonzalo Muruaga, kitarr | guitar

Hans-Gunter Lock, kontserdi kuraator | curator of the concert

## 5. Pärnu Contemporary Music Days 2023 (PNP2023)

Laupäev | Saturday 28.1.2023 at 19.00

Pärnu Keskraamatukogu | Pärnu Central Library (Akadeemia 3, Pärnu)

Pühapäev | Sunday 29.1.2023 at 19.00

Eesti Nüüdismuusika Keskus | Estonian Centre of Contemporary Music (Pühavaimu 9, Tallinn)

### 22vjo muusika osa 2 | 22edo musicpart 2 KAVA | PROGRAM

Juhani Nuorvala: Solo for Flute (2022)

Juhani Nuorvala: Organum (Hallelujah) (G. ad P.) [G. ad. P. = vocal pieces from Gradus ad Parnassum]

Juhani Nuorvala: Dies irae (G. ad P.)

Juhani Nuorvala: Enharmonic Organum (G. ad P.)

Juhani Nuorvala: Study in Pajara (G. ad P.)

Juhani Nuorvala: Porcupine Progression (G. ad P.)

Joseph Monzo: Hedgehog[8] March (2021.1101)

Joseph Monzo: Doublewide[10] Bossanova (2022.0117)

Joseph Monzo: Bebop (2010.0912)

Joseph Monzo: Hedgehog[14] Study (2021.1231) (G. ad P.)

Joseph Monzo: Hedgehog[8] Chorale (2021.1118) (G. ad P.)

Hans-Gunter Lock: O Magnum Mysterium for male choir (2022) (G. ad P.)

Hans-Gunter Lock: Credo for male choir (2022) (G. ad P.)

Ralph Lewis: Uneven as You Do

Allen Wu: Lullaby

Juhani Nuorvala: Pieni valssi

Juuso Salonen: Buddha kuuna

Gerhard Lock: Pajara Circle: Kites and Dart. Exercise No 1 (2022)

Juhani Nuorvala: L'homme armé

Leonora Palu flööt | flute Gonzalo Muruaga 22vjo kitarr | 22edo guitar

Matej Sloboda\* hääl | voice Joseph Monzo\*\* hääl | voice

Andrus Kallastu hääl | voice, klahvpill | keyboard Gerhard Lock hääl | voice, viiul | violin

Hans-Gunter Lock, vokaal | vocal, viiul | violin, kontserdi kuraator | curator of the concert

James Robinson hääl | voice, tšello | cello Lassi Kari kontrabass | double bass

\*participates in the framework of the project "Activities of the civic association "Ensemble Spectrum" in 2023", supp. by Slovak Arts Council

\*\*supported by Jonathan and Elizabeth Glasier (Glacier Music Consultants)

## 5. Pärnu Contemporary Music Days 2023 (PNP2023)

### Video Snippets from the Concerts

#### **Trio Project**

1. Joseph Monzo. Threesome for Flute, Guitar and Double Bass
2. Jakob Elkin. Passacaglia for Flute, Guitar and Double Bass
3. Andrus Kallastu: 22vjo uurimus intervallides. Trio for bass flute, guitar and double bass
4. Hans Straub: Porcupine Scherzo for flute and guitar

#### **Gradus ad Parnassum**

5. Juhani Nuorvala. Enharmonic Organum
6. Juhani Nuorvala. Study in Pajara
7. Juhani Nuorvala. Porcupine Progression
8. Joe Monzo. Hedgehog[14] Study
9. Joe Monzo. Hedgehog[8] Chorale
10. Hans-Gunter Lock. O Magnum Mysterium (Porcupine and Superpyth)
11. Hans-Gunter Lock. Credo (Pajara)

#### **Ensemble**

12. Juuso Salonen. Buddha Kuuna for flute and strings
13. Praveen S. Venkataramana: A Little Serenade for flute, two violins and electric guitar

**THANK YOU ANDRUS KALLASTU** for the audio and video documentation!

## 5. Acoustic instruments and 22-EDO

### 5.1 Guitars

#### 5.1.1 Two restrunged guitars

(system created by Agustín Castilla-Ávila for PNP2022 festival)

- both guitars are restrunged for a special *scordatura*
- the open strings are tuned in 54.5 cents steps, giving 12 pitches out of the 22
- the remaining pitches are accessible through the 6<sup>th</sup> fret (tritone) on each string

Agustín Castilla-Ávila --

[Annatavindriya for alto flute and one guitarist on two guitars \(2022\)](#) [snippet]

First performance at PNP2022 festival

Leonora Palu – Alto Flute

Agustín Castilla-Ávila – guitars

## 5. Acoustic instruments and 22-EDO

### 5.1 Guitars

#### 5.1.2 Refretted Guitars



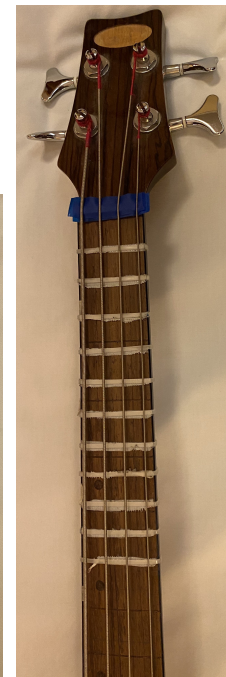
a)



b)



c)



**Figure 8.** Refretted guitars. a) Hans-Gunter Lock's Thomann classic guitar refretted by Timo Tuhkanen (Finland), b) Gonzalo Muruaga Olguin with his electric 22-EDO guitar, neck refretted by Timo Tuhkanen c) a fretless acoustic bass guitar, experimental zip tie frets by Hans-Gunter Lock



# 5. Acoustic instruments and 22-EDO

## 5.1 Guitars

### 5.1.2 Refretted Guitars

- playing refretted guitars needs a certain amount of learning for the guitarist (left hand technique in conjunction with reading 22-EDO notation)
- Subscale exercises would be a good training material (work in progress)

#### 1. Porcupine[7] over two octaves

Porcupine[7] 3333334

Porcupine definition: In 22-EDO we reach with three slightly wider minor thirds (Min3+) the same pitch as with two pure fourths (P4).

Fret distances: WT- 3 WT- 3 WT- 3 WT- 3 WT- 3 WT- 3 WT+ 4

The image displays two staves of musical notation for a Porcupine scale in 22-EDO. The first staff shows the scale from the first fret to the eighth fret. The fret distances are indicated as WT- 3, WT- 3, WT- 3, WT- 3, WT- 3, WT- 3, WT- 3, and WT+ 4. Brackets below the staff label the intervals as Min3+ and P4. The second staff shows the scale from the fifth fret to the twelfth fret, starting with a '5' above the first note. The notation includes various accidentals and articulation marks such as slurs and accents.

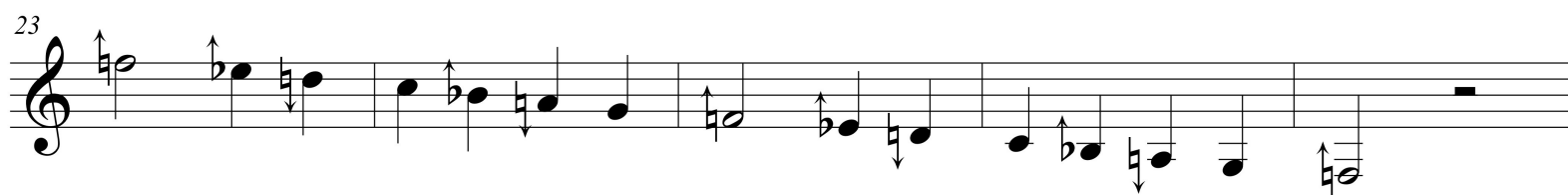
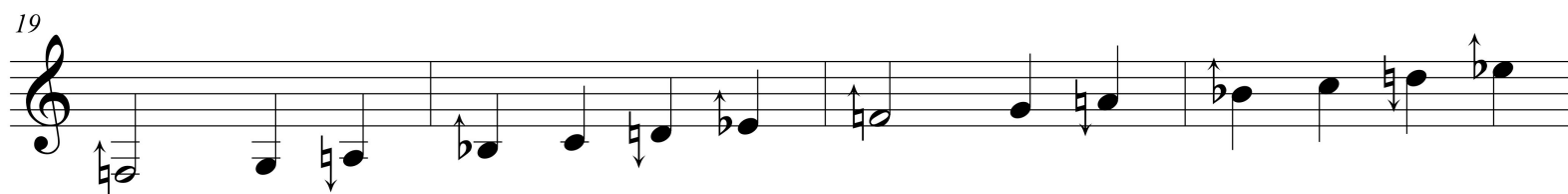
**Figure 9.** Porcupine scales for 22-EDO guitar

# 5. Acoustic instruments and 22-EDO

Figure 9. Porcupine scales for 22-EDO guitar

## 5.1 Guitars

### 5.1.2 Refretted Guitars

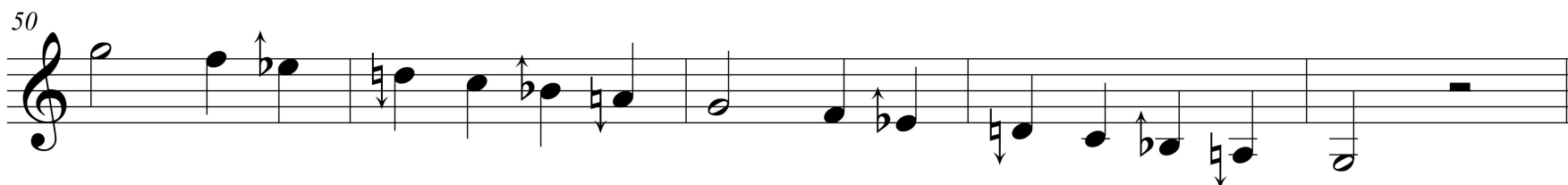


# 5. Acoustic instruments and 22-EDO

Figure 9. Porcupine scales for 22-EDO guitar

## 5.1 Guitars

### 5.1.2 Refretted Guitars



## 5. Acoustic instruments and 22-EDO

### 5.2 Bowed String Instruments

Players of bowed string instruments from the traditionally unfretted violin family need special 22-EDO intonation ear training exercises.

The exercises (still work in progress) have been issued for violin, viola, violoncello and double bass.

Also audio guide tracks are needed for listening and play-along. As the most flexible solution came out Reaper session with separate tracks for click, played pitch and open strings to be compared.

**At the moment ready:** Exercises Section A: Chromatic steps resting on a longer pitch related to the Superpyth[7] or Porcupine[7] scale

**Future planes:**

Exercises Section B: chromatically up and down, resting on a longer pitch related to the Superpyth[7] or Porcupine[7] scale

Exercises Section C: Would be like the fretted guitar exercise, i.e. Subscales like Superpyth[7], Porcupine[7], Orwell[9] and other MOS scales, but also enharmonic teatrachord scale

Imaginary Fret Nr.: 0 1 2 3 4 5 6 7 8 9 10 11 12 13

Superpyth Major

Mode Finger Nr.:

Porcupine Finger Nr.:

0	1.1	1.2	1.3	1.4	2.2	2.3	2.4	2.5	3.3	4.1	4.2	4.3	4.4
0	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	●

**Figure 10. Fingering System for Violin**

E

0 1 2 3 4 5 6 7 8 9 10 11 12 13

Superp.:0

Porcup.:0

1.1	1.2	1.3	1.4	2.2	2.3	2.4	2.5	3.3	4.1	4.2	4.3	4.4
1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	●

A

0 1 2 3 4 5 6 7 8 9 10 11 12 13

Superp.:0

Porcup.:0

1.1	1.2	1.3	1.4	2.2	2.3	2.4	2.5	3.3	4.1	4.2	4.3	4.4
1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	●

D

0 1 2 3 4 5 6 7 8 9 10 11 12 13

Superp.:0

Porcup.:0

1.1	1.2	1.3	1.4	2.2	2.3	2.4	2.5	3.3	4.1	4.2	4.3	4.4
1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	●

G

2. Superpyth[7] Minor up to the fifth (4144 or WT+ 1/4T WT+ WT+)

17

P5 11G Trit 11L Trit P4 7Maj3 Maj3 Min3+ 7Min3 WT+ WT- ST 1/4T

WT+ 1/4T WT+ WT+

0 1.1 1.2 1.3 1.4 2.2 3.0 3.1 3.2 3.3 4.1 4.2 4.3 4.4/0

D-String

1/4T ST WT- WT+ 7Min3 Min3+ Maj3 7Maj3 P4 11L Trit Trit 11G Trit P5

P5 7Min6 Min6 Maj6- 7Maj6 7Min7 Min7+ Maj7 Maj7 +1/4T P8 P8 +1/4T P8 +WT-

21

P5 11G Trit 11L Trit P4 7Maj3 Maj3 Min3+ 7Min3 WT+ WT- ST 1/4T

WT+ 1/4T WT+ WT+

0 1.1 1.2 1.3 1.4 2.2 3.0 3.1 3.2 3.3 4.1 4.2 4.3 4.4/0

G-String

1/4T ST WT- WT+ 7Min3 Min3+ Maj3 7Maj3 P4 11L Trit Trit 11G Trit P5

P5 7Min6 Min6 Maj6- 7Maj6 7Min7 Min7+ Maj7 Maj7 +1/4T P8 P8 +1/4T P8 +WT-

25

P5 11G Trit 11L Trit P4 7Maj3 Maj3 Min3+ 7Min3 WT+ WT- ST 1/4T

WT+ 1/4T WT+ WT+

0 1.1 1.2 1.3 1.4 2.2 3.0 3.1 3.2 3.3 4.1 4.2 4.3 4.4/0

A-String

1/4T ST WT- WT+ 7Min3 Min3+ Maj3 7Maj3 P4 11L Trit Trit 11G Trit P5

P5 7Min6 Min6 Maj6- 7Maj6 7Min7 Min7+ Maj7 Maj7 +1/4T P8 P8 +1/4T P8 +WT-

29

P5 11G Trit 11L Trit P4 7Maj3 Maj3 Min3+ 7Min3 WT+ WT- ST 1/4T

WT+ 1/4T WT+ WT+

0 1.1 1.2 1.3 1.4 2.2 3.0 3.1 3.2 3.3 4.1 4.2 4.3 4.4/0

E-String

1/4T ST WT- WT+ 7Min3 Min3+ Maj3 7Maj3 P4 11L Trit Trit 11G Trit P5

P5 7Min6 Min6 Maj6- 7Maj6 7Min7 Min7+ Maj7 Maj7 +1/4T P8 P8 +1/4T P8 +WT-

Figure 11. Superpyth[7] minor mode up the fifth exercise for violin

3. Porcupine[7] until an added fifth (3333[1] or WT- WT- WT- WT- [1/4T])

Figure 12. Porcupine[7] up the added fifth exercise for viola

G-String

33

0 1 2 3 4 5 6 7 8 9 10 11 12 13

0 1 1 1 2 2 2 3 3 3 4 4 4 0

1/4T ST WT- WT+ 7Min3 Min3+ Maj3 7Maj3 P4 11L Trit 11G

P5 7Min6 Min6 Maj6- 7Maj6 7Min7 Min7+ Maj7 Maj7 +1/4T P8 P8 +1/4T P8 +ST P8 +WT-

C-String

38

0 1 2 3 4 5 6 7 8 9 10 11 12 13

0 1 1 1 2 2 2 3 3 3 4 4 4 0

1/4T ST WT- WT+ 7Min3 Min3+ Maj3 7Maj3 P4 11L Trit Trit 11G

P5 7Min6 Min6 Maj6- 7Maj6 7Min7 Min7+ Maj7 Maj7 +1/4T P8 P8 +1/4T P8 +ST P8 +WT-

D-String

43

0 1 2 3 4 5 6 7 8 9 10 11 12 13

0 1 1 1 2 2 2 3 3 3 4 4 4 0

1/4T ST WT- WT+ 7Min3 Min3+ Maj3 7Maj3 P4 11L Trit Trit 11G

P5 7Min6 Min6 Maj6- 7Maj6 7Min7 Min7+ Maj7 Maj7 +1/4T P8 P8 +1/4T P8 +ST P8 +WT-

A-String

48

0 1 2 3 4 5 6 7 8 9 10 11 12 13

0 1 1 1 2 2 2 3 3 3 4 4 4 0

1/4T ST WT- WT+ 7Min3 Min3+ Maj3 7Maj3 P4 11L Trit Trit 11G

P5 7Min6 Min6 Maj6- 7Maj6 7Min7 Min7+ Maj7 Maj7 +1/4T P8 P8 +1/4T P8 +ST P8 +WT-





# 1. Superpyth[7] Major up to the fifth (4414 or WT+ WT+ 1/4T WT+)

**Figure 14.** Superpyth[7] major mode exercise for double bass

Interval to upper open string: P4 7Maj3 Maj3 Min3+ 7Min3 WT+ WT- ST 1/4T P4 7Maj3 Maj3 Min3+ 7Min3

Subscale consecutive intervals: WT+ WT+ 1/4T WT+

Finger Pos.: 0 1 2 3 4 5 6 7 8 0 1 2 3 4

Finger Nr.:

**A/D-String**

Interval to root pitch: 1/4T ST WT- WT+ 7Min3 Min3+ Maj3 7Maj3 P4 11L Trit 11G Trit P5

Int. to lower open string: P4 11L Trit Trit 11G Trit P5 7Min6 Min6 Maj6- 7Maj6

P4 7Maj3 Maj3 Min3+ 7Min3 WT+ WT- ST 1/4T P4 7Maj3 Maj3 Min3+ 7Min3

WT+ WT+ 1/4T WT+

5 0 1 2 3 4 5 6 7 8 0 1 2 3 4

**E/A-String**

1/4T ST WT- WT+ 7Min3 Min3+ Maj3 7Maj3 P4 11L Trit Trit 11G Trit P5

P4 7Maj3 Maj3 Min3+ 7Min3 WT+ WT- ST 1/4T P4

WT+ WT+ 1/4T WT+

9 0 1 2 3 4 5 6 7 8 0 1 2 3 4

**D/G-String**

1/4T ST WT- WT+ 7Min3 Min3+ Maj3 7Maj3 P4 11L Trit Trit 11G Trit P5

P4 11L Trit Trit 11G Trit P5 7Min6 Min6 Maj6- 7Maj6

WT+ WT+ 1/4T WT+

13 0 1 2 3 4 5 6 7 8 0 1 2 3 4

**G-String**

1/4T ST WT- WT+ 7Min3 Min3+ Maj3 7Maj3 P4 11L Trit Trit 11G Trit P5

P4 11L Trit Trit 11G Trit P5 7Min6 Min6 Maj6- 7Maj6

## 5. Acoustic instruments and 22-EDO

### 5.3 Flute

The Estonian flutist Leonora Palu made a research for finding the fingerings for These 22-EDO pitches we use in Gradus and Parnussum and in the instrumental pieces

## 5. Acoustic instruments and 22-EDO

### 5.3 Flute

H.-G. Lock: Describe your research finding the flute fingerings for 22-EDO. What difficulties did you encounter?

L. Palu: Good news is, that it's possible to find and play 22-EDO scale on regular 12-tone flute. It was very interesting in the beginning (I started in the end of 2021) when you start to look your instrument with „new eyes“ or through new „22-EDO classes“. Its like to be archeologist. I couldn't invest to this research enough time, but during PNP 2022 in peaceful old school in Massiaru i was sitting in my room 3-4 days with my flute and tuner searching-experimenting-searching-experimenting.

I found for each pitch one or more ways how to play. Few pitches can be played traditionally, some with special „false“ fingerings (like fingerings for multiphonics), some fingerings are very special or so to say – tricky. I have to mention, that as well as for Quarter-tone music flute has possibilities to use differently instruments keys – you can close a whole key, or less if you press only the edge or closing only the half of the hole in the center of the key. Some pitches you can play only with changing mouthpiece position (if you turn the instrument toward yourself or the other direction. First one makes your note lower and second higher. I also marked for myself 3 degrees by both directions). For some pitches I had to use combination of special fingering+specific mouthpiece position. It took time, and every next day i found something new to add or to correct my earlier findings. During this process I was not yet conscious or even worried what will happen in the real world – when you have to start to use this findings to play actual 22-EDO music.

## 5. Acoustic instruments and 22-EDO

### 5.3 Flute

H.-G. Lock: How you have learned these fingerings?

L. Palu: I can describe my idea, how to learn, because I myself have learned so far only during discovery process and by playing new pieces. It is not difficult to play one or other fingering, but it is tricky to play them in the row. I must say that ideally first the flutist must practice the scale and try to remember all fingerings, also different possibilities, because by playing some written music you can choose between different fingerings (if there are). Very useful could be also some exercises for intervals and for different kind of technical aspects, which I have not developed yet.

H.-G. Lock: What was essential during practicing the newly composed 22-EDO pieces?

L. Palu: For beginners of course, it is better to start with slower pieces. Tempo is critical aspect at first for sure. That's why Juhani's and Agustins pieces were good to begin with. Agustins „Annatavindriya“ is for alto flute, in this case I must say, that Alto has less possibilities with fingerings, because this instrument does not have holes in keys like regular C or B flute. So I had more movings with mouthpiece.

## 5. Acoustic instruments and 22-EDO

### 5.3 Flute

H.-G. Lock: How did you learn the newly composed 22-EDO pieces? What difficulties did you have?

L. Palu: I learned most of them very slowly, bar by bar, note by note. And it took a lot of time. I must say, at first you need at least 10 times more time in comparison to 12-tone music, maybe 5 times more than quarter tone music. There are lots of difficulties. I mentioned already the need to practice scales in order to learn quicker. If this mountain is crossed, then you'll face sound problems, because some ways to play, some fingerings or some mouth positions produce quite hollow or quiet sound. Composer might not know that, so there can be sometimes come contradictions between composers ideas (about Dynamics etc.) and real possibilities.

H.-G. Lock: What is your conclusion? What would you recommend to composers who want to compose for 22-EDO flute?

L. Palu: It depends, who is the player, how experienced. It is always good to communicate with musician, to get info. Very important ist to find aesthetics that work for 22-EDO. It is not interesting from my opinion, when the neoclassical-like music is „translated“/“transformed“ to 22-EDO. That is certain that player must practice like lunatic, BUT composer must feel and respect the instrument and think through why he/she uses 22-EDO and why with this or that instrument.

## 6. Juhani Nuorvala

H.G. Lock: How did you come to 22-EDO and what do you particularly like about it?

J. Nuorvala: In 2016 or so, violinist Pasi Eerikäinen and pianist Emil Holmström asked if I'd write a piece for them, for violin and electronic keyboard, specifically in some microtonal tuning; they later commissioned it. I had seen the interest in 22-EDO in the microtonal community, and heard the music of Brendan Byrnes and Sevish, and I'd read Paul Erlich's paper on 22-equal. Previously I'd composed in Just Intonation, 31-EDO, 1/4-comma meantone etc., and I decided to write the new piece in 22-equal. I had already written two works that made use of the so-called Porcupine temperament: the music for a dance theater work for tenor sax and kantele, and a solo-piece for Carrillo piano. Both these works were in another tuning, 96-EDO, but Porcupine is very well supported by 22-EDO, and one of my favorite regular temperaments. (We sang many exercises and pieces in it in Gradus!).

Before the violin-keyboard piece (Sonata for Violin and Keyboard, my largest-scale chamber music work to date) I wrote the music for a TV documentary, and asked these same performers to play it. The sonata was based on this film music. I have also written a suite for Elisa Järvi's quarter-tone keyboard, also in 22-EDO (not premiered yet but it's being recorded by her).

## 6. Juhani Nuorvala

The appeal of 22-equal for me:

- improved 5-limit harmony from 12-EDO
- enables 7- and 11-limit harmony (and is consistent in the 11(-odd-)limit)
- not a meantone temperament, so it forces us into different chord progressions and out of habits
- tempers out commas such as 64:63 (Archy!) and 250:243 (Porcupine!), and this results in novel, fascinating combinations of intervals and chords. 7-limit or 11-limit harmony is mixed in with 5-limit and 7 and 11 are always close at hand (low complexity).

I like to write tonal music using, not only higher-limit or overtone chords and such but also familiar, consonant chords such as triads, and 22-EDO lets me do this in a way that sounds fresh and inspiring to me.

- 24-EDO does not behave like this at all even if the melodic steps are almost of the same size. It has none of the features listed above.

But I like quarter-tones. I like using microintervals in melodies, and as voice-leading intervals - such as in a favorite of mine, a chord progression with 36:35 in the voice leading. But the diesis in 31-EDO is a bit too narrow; often it's not clear enough. Quarter-tones are clearer and more singable, and the slightly wide quartertones of 22-EDO even more so.

## 6. Juhani Nuorvala

- The neutral tone of three steps ("lesser whole tone", Porcupine generator,  $\sim 10/9 = \sim 11/10$ ) is interesting melodically and adds some Middle-Eastern flavor. Splittig the fourth into three equal parts (Porcupine again) is a delight.
- 22-EDO is practical enough for performers - not too many notes, notation is not too complicated (it can even be notated enharmonically without any microtonal accidentals which is useful for keyboards such as Lumatone), it works very well on two-manual keyboards such as harpsichord (used in the film music I mentioned) or Elisa Järvi's quarter-tone keyboard. Fits on one MIDI channel (almost 6 octaves) so it's synthesizer/software-friendly.
- as we have learned in Gradus: supports many excellent temperaments and has numerous interesting MOS scales



## 6. Juhani Nuorvala

H.-G. Lock: What experiences did you have with it during the Gradus ad Parnassum online training and the PNP2023 festival? What influence do our collaborations have on your further compositional work?

J. Nuorvala: It is extremely valuable and important to learn to sing the intervals of a non-standard tuning system (and great fun). We learned to read the notation, and we learned the characteristic intervals. MOS scales are very useful, beautiful musical resources but they're also excellent pedagogical tools, as the number of pitches, intervals and step sizes is restricted, and they teach us the characteristic intervals and melodic patterns.

In our solfège sessions we learned what is difficult to sing, intone or read and what is less so, and we learned something about how the music can be written so as to help and support the singers. As a composer of music for others to play or sing, this is great preparation for helping and coaching the musicians in the tuning system and its notation. And if I am able to sing from the notation myself, I can expect professional musicians to find the pitches, too.

## 6. Juhani Nuorvala

In addition to all of the above, the Pärnu symposium was a wonderful get-together of microtonal musicians, and there was a lot of inventive and varied music. It led or will lead to further collaborations, amongst others with the double bass and violone player Lassi Kari.

Concentrating on a single tuning system was a great idea, particularly as 22-EDO is in many ways new and unusual but gaining popularity; it's not too weird or idiosyncratic, or complex, and it's open to all styles of music. And it's practical in the many ways I explained in my first answer.

**THANK YOU FOR YOUR ATTENTION!!!**



Juhani Nuorvala. L'homme armé (in Porcupine) for 22-EDO ensemble

# Online Resources

Estonian Arnold Schoenberg Society:  
[www.schoenberg.ee](http://www.schoenberg.ee)  
Youtube channel

PNP2021 festival  
PNP2022 festival  
PNP2023 festival

Gradus ad Parnassum page  
Gradus ad Parnassum materials  
CODEX PÆRNUENSIS

PNP2023 22-EDO exercises for string instruments  
PNP2023 22-EDO works for flute, guitar and double bass  
PNP2023 22-EDO works for workshop