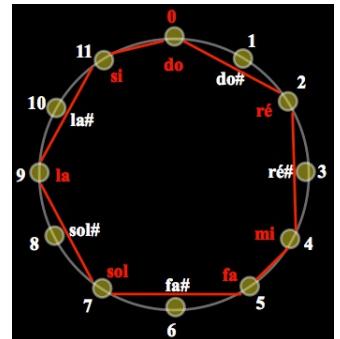
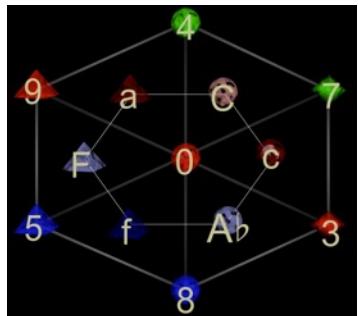


Music and maths: the reason of a match



Music&maths: parallel destiny or mutual influences?

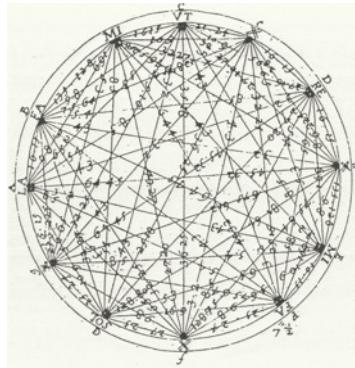


I. Xenakis
(1922-2001)

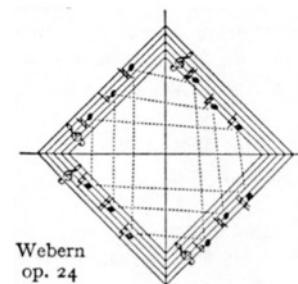
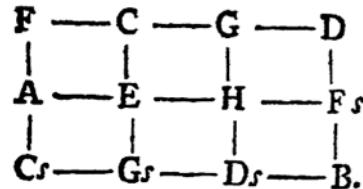
MUSIC	MATHS
500 B.C. Pitches and lengths of strings are related. Here music gives a marvelous thrust to number theory and geometry . <i>No correspondence in music.</i>	Discovery of the fundamental importance of natural numbers and the invention of fractions . Positive irrational numbers [...]
300 B.C. [...] Music theory highlights the discovery of the isomorphism between the logarithms (musical intervals) and exponentials (string lengths) more than 15 centuries before their discovery in mathematics; also a premonition of group theory is suggested by Aristoxenos.	No reaction in mathematics. [...]
1000 A.D. Invention of the two-dimensional spatial representation of pitches linked with time by means of staves and points [...] seven centuries (1635-37) before the magnificent analytical geometry of Fermat and Descartes.	<i>No parallel in mathematics.</i>
1500 No response or development of the preceding concepts.	Zero and negative numbers are adopted. Construction of the set of rationals.
1600 No equivalence, no reaction.	The sets of real numbers and of logarithms are invented.
1648 Invention of musical combinatorics by Marin Mersenne (<i>Harmonicorum Libri</i>)	Probability theory by Bernoulli (<i>Ars Conjectandi</i> , 1713)
1700 [...] The fugue , for example, is an abstract automaton used two centuries before the birth of the science of automata. Also, there is an unconscious manipulation of finite groups (Klein group) in the four variations of a melodic line used in counterpoint.	Number theory is ahead of but has no equivalent yet in temporal structures. [...]
1773 A first geometric and graph-theoretic representation of pitches (<i>Speculum Musicum</i>)	Invention of graph theory
1900 Liberation from the tonal yoke. First acceptance of the neutrality of chromatic totality (Loquin [1895], Hauer, Schoenberg).	The infinite and transfinite numbers (Cantor). Peano axiomatics. [...] The beautiful measure theory (Lebesgue, ...)
1920 First radical formalization of macrostructures through the serial system of Schoenberg.	No new development of the number theory.
1929 and 1937-1939 Susanne K. Langer and Ernst Krenek on the role of axioms in music	David Hilbert, <i>Die Grundlage der Geometrie</i> (1899)
1946 Milton Babbitt on group theory and integral serialism	Rudolf Carnap, <i>The Logical Syntax of Language</i> (1937)



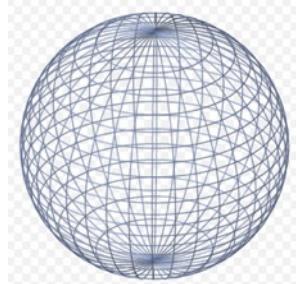
Pythagoras and the monochord,
VIth-Vth Century B.C.



Mersenne and
the ‘musical
clock’, 1648

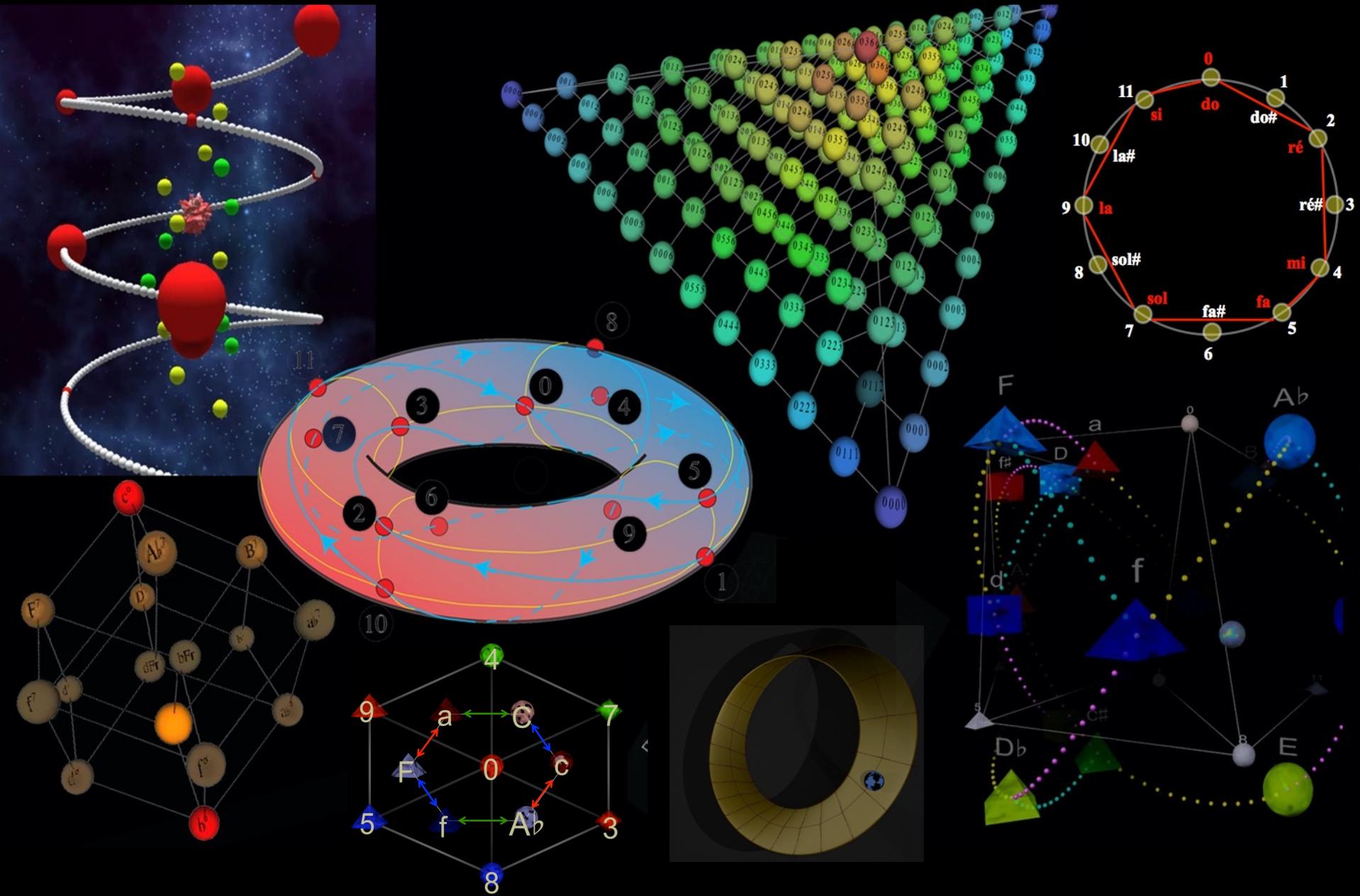


Webern
op. 24

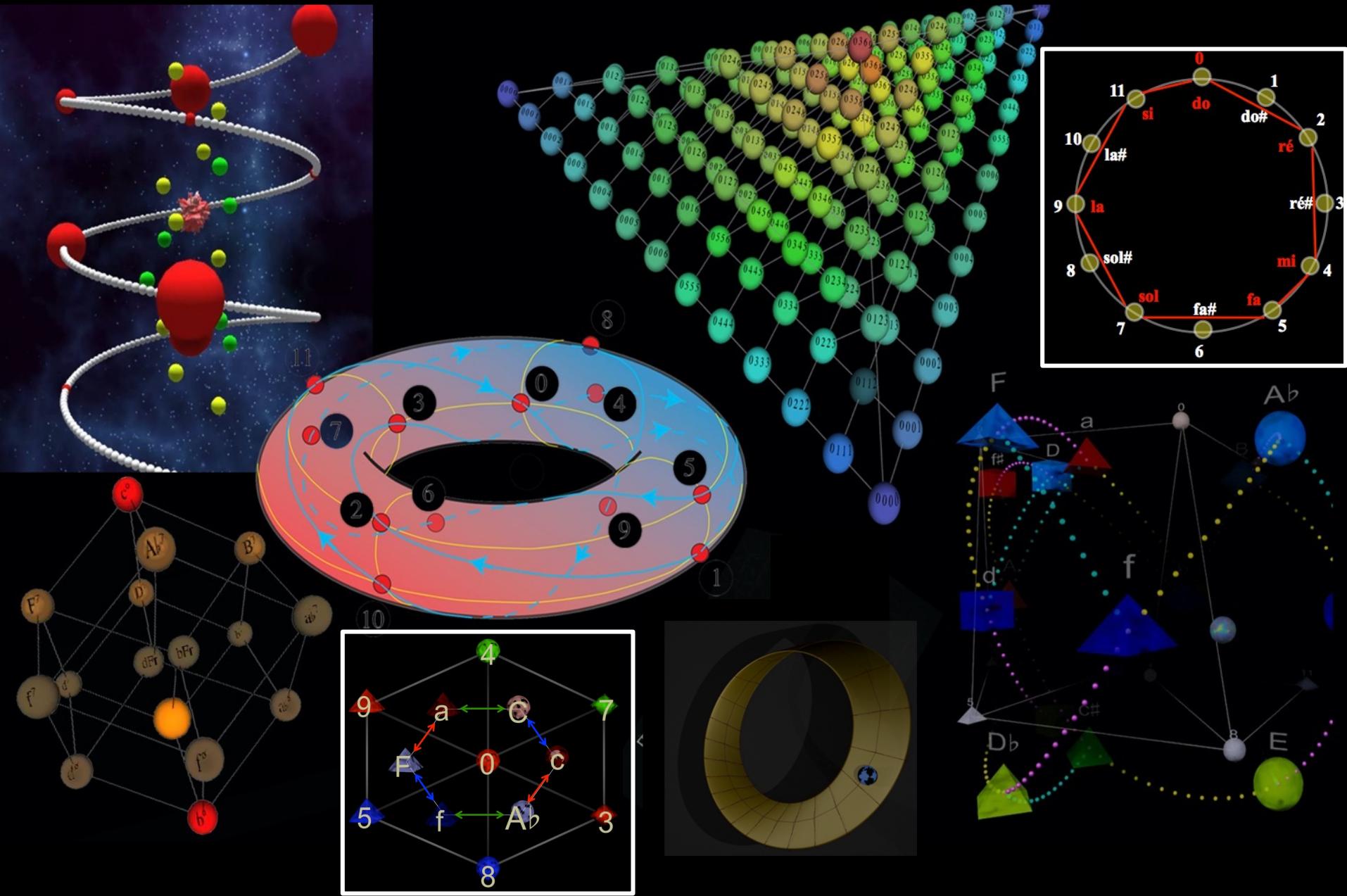


Euler and the
*Speculum
musicum*, 1773

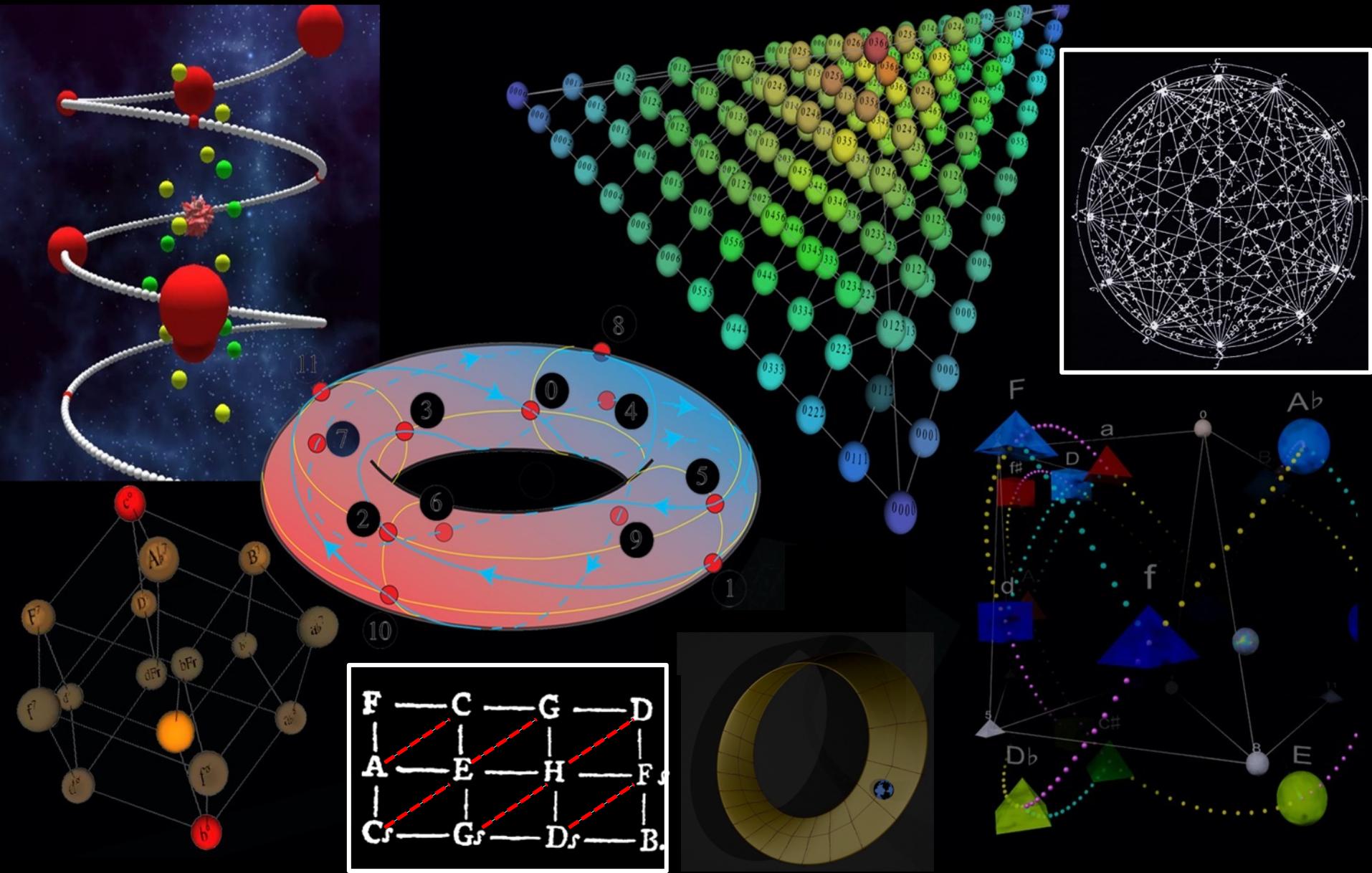
The galaxy of geometrical models at the service of music



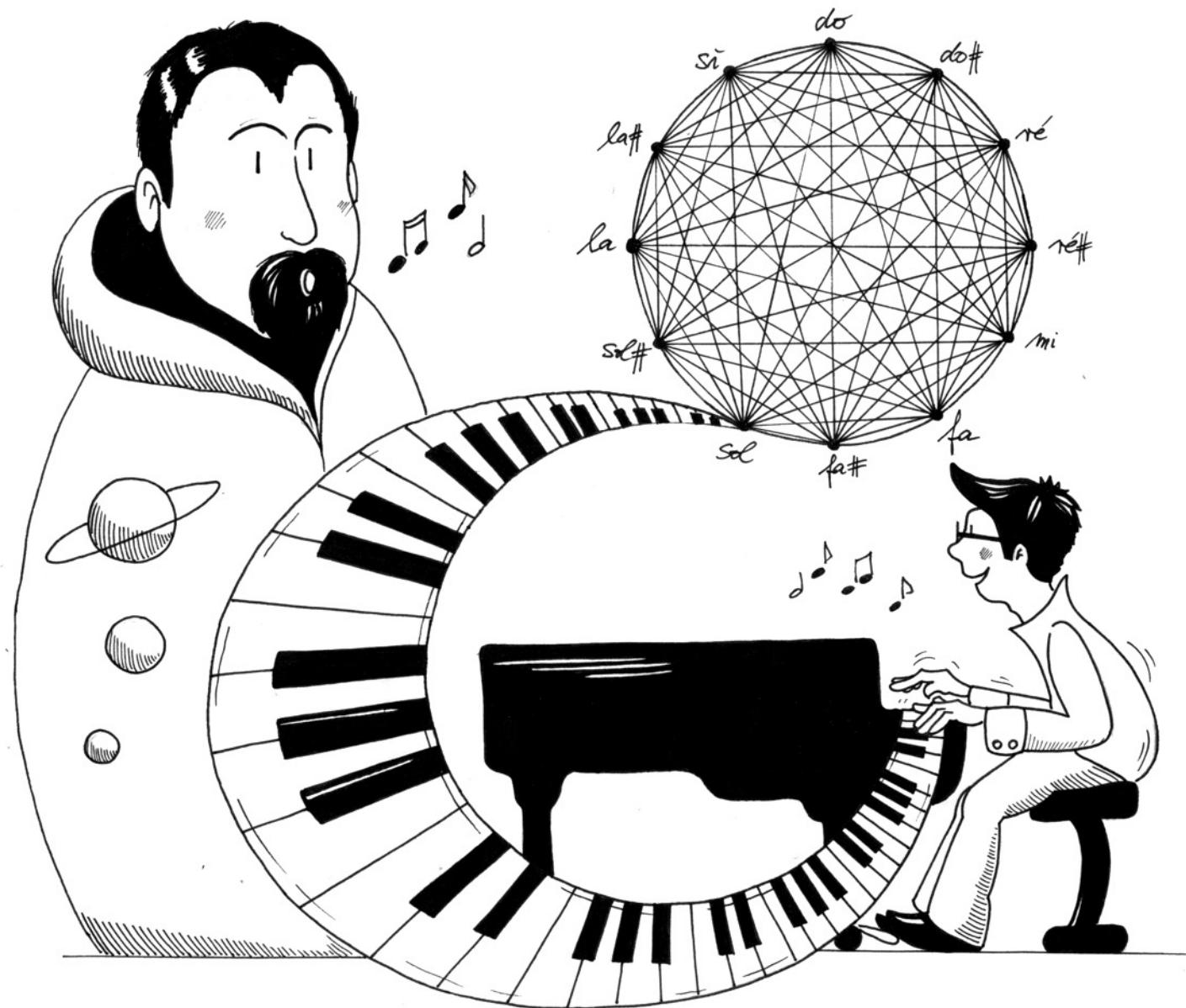
The galaxy of geometrical models at the service of music



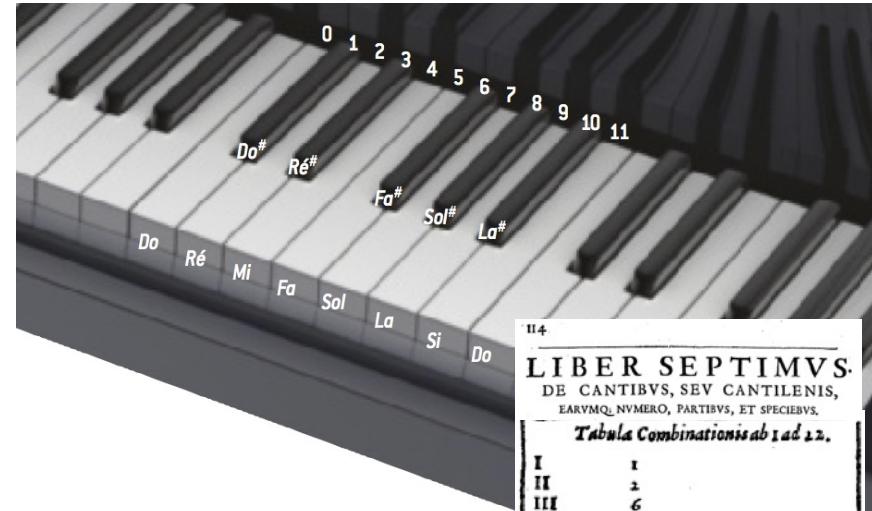
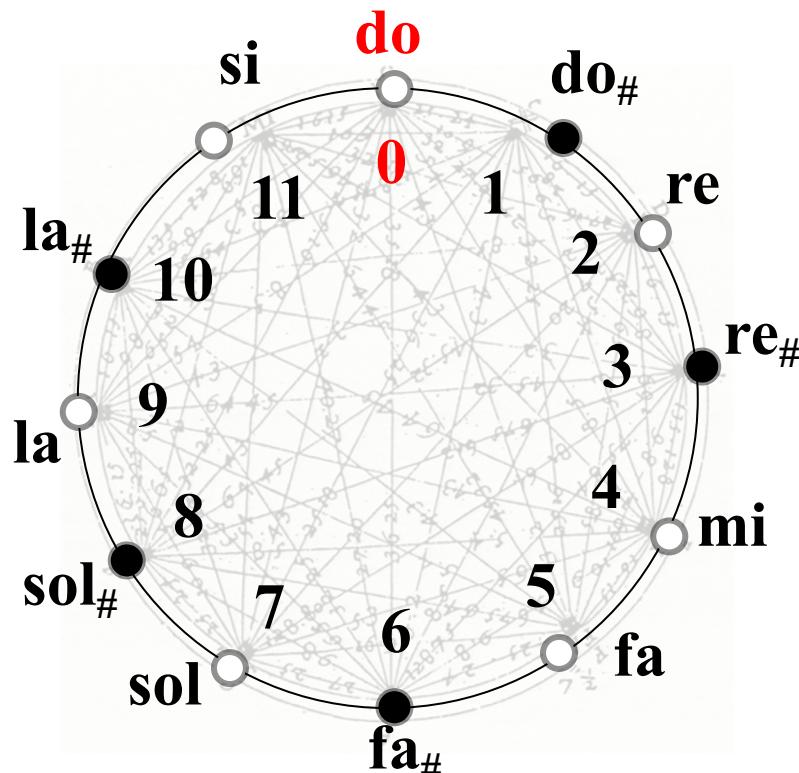
The galaxy of geometrical models at the service of music



Marin Mersenne, the father of combinatorics



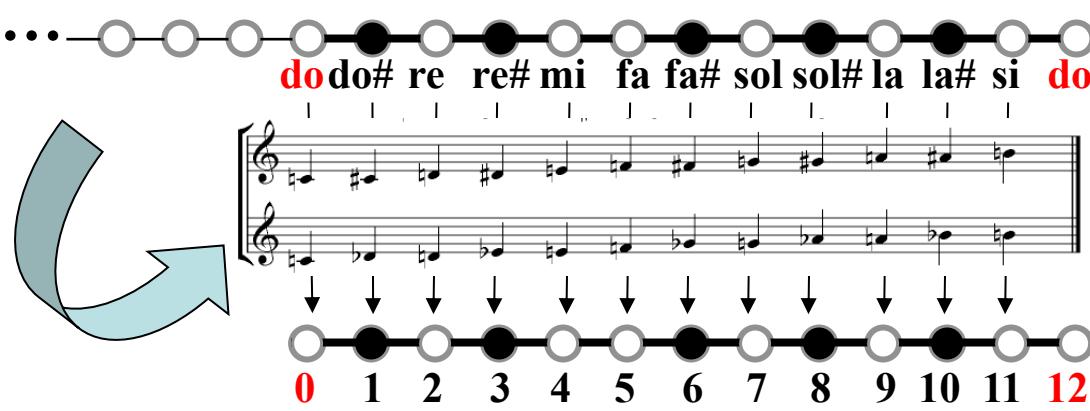
The circular representation of the pitch space



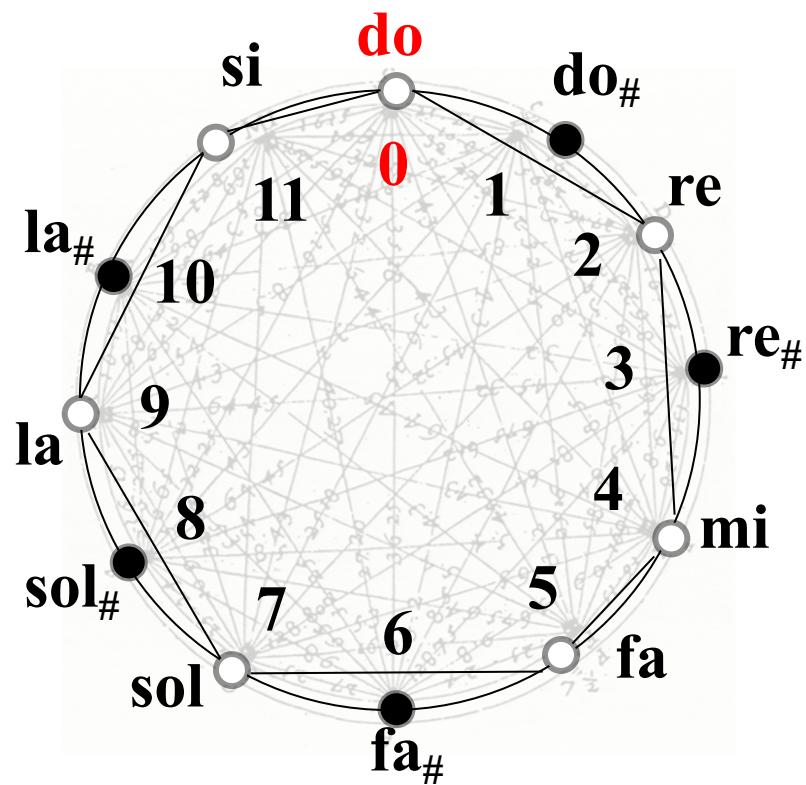
LIBER SEPTIMVS
DE CANTIBVS, SEV CANTILENIS,
EARVMQ; NVMERO, PARTIBVS, ET SPECIEBV.

Tabula Combinationis ab I ad XII.

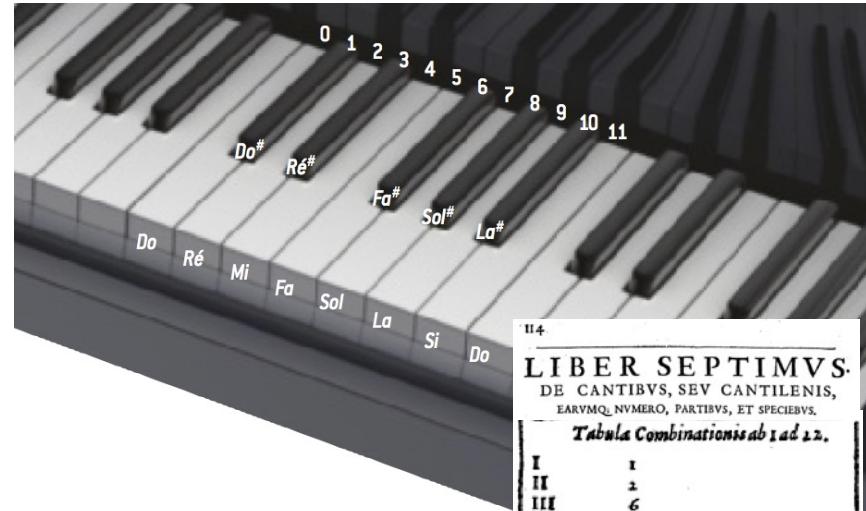
I	1
II	2
III	6
IV	24
V	120
VI	720
VII	1040
VIII	40320
IX	361880
X	3618800
XI	39916800
XII	479001600
XIII	617010800
XIV	87178191200
XV	1307674368000
XVI	2092278988000
XVII	335687418096000
XVIII	640373705718000
XIX	12164100408831000
XX	241290100876640000
XXI	51090942171709440000
XXII	11140007217777607680000



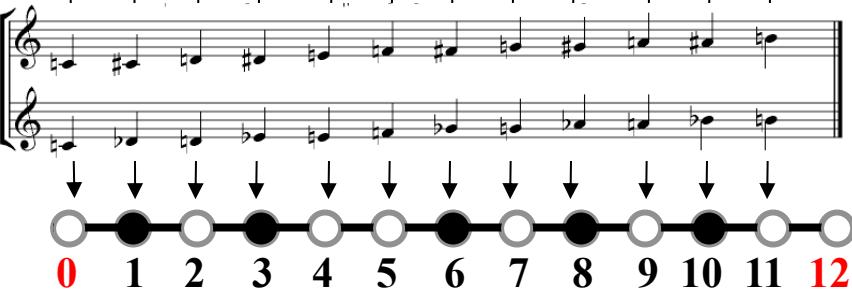
The circular representation of the pitch space



Harmonicorum Libri XII, 1648



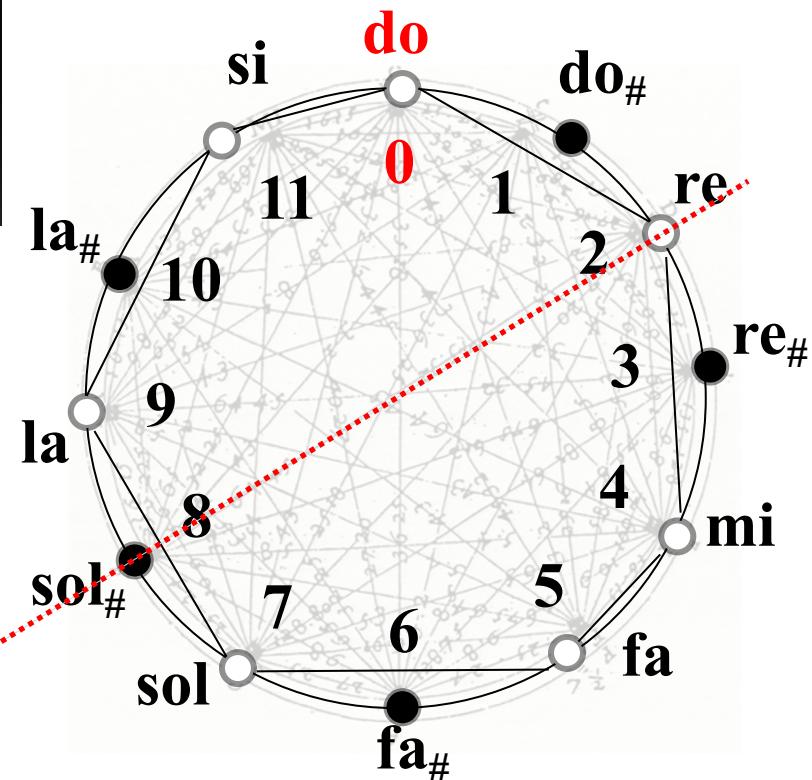
LIBER SEPTIMVS	
DE CANTIBVS, SEV CANTILENIS,	
EARVMQ; NVMERO, PARTIBVS, ET SPECIEBV.	
<i>Tabula Combinationis ab 1 ad 22.</i>	
I	1
II	2
III	6
IV	24
V	110
VI	720
VII	5040
VIII	40310
IX	361880
X	3618800
XI	39916800
XII	479001600
XIII	6179010800
XIV	87178191200
XV	1307674368000
XVI	20911788880000
XVII	331687418096000
XVIII	6401373705718000
XIX	12164100405831000
XX	24319008076640000
XXI	51090942171709440000
XXII.	114000727777607680000



The circular representation of the pitch space



C. Durutte



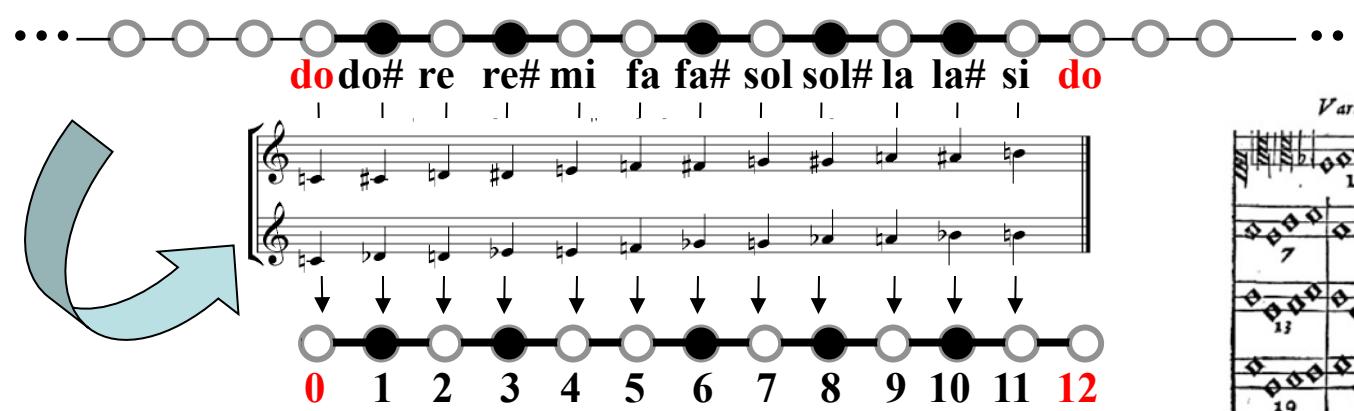
Harmonicorum Libri XII, 1648



LIBER SEPTIMVS
DE CANTIBVS, SEV CANTILENIS,
EARVMQ; NVMERO, PARTIBVS, ET SPECIEBV.

Tabula Combinationis ab I ad XII.

I	1
II	2
III	6
IV	24
V	120
VI	720
VII	5040
VIII	40320
IX	361880
X	3618800
XI	39916800
XII	479001600
XIII	617010800
XIV	87178191200
XV	1307674368000
XVI	20922789888000
XVII	335687418096000
XVIII	640373705718000
XIX	12164100408832000
XX	241290100876640000
XXI	51090942171709440000
XXII	11140007217777607680000



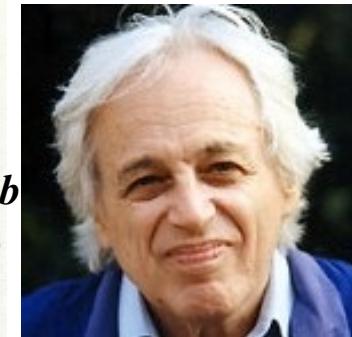
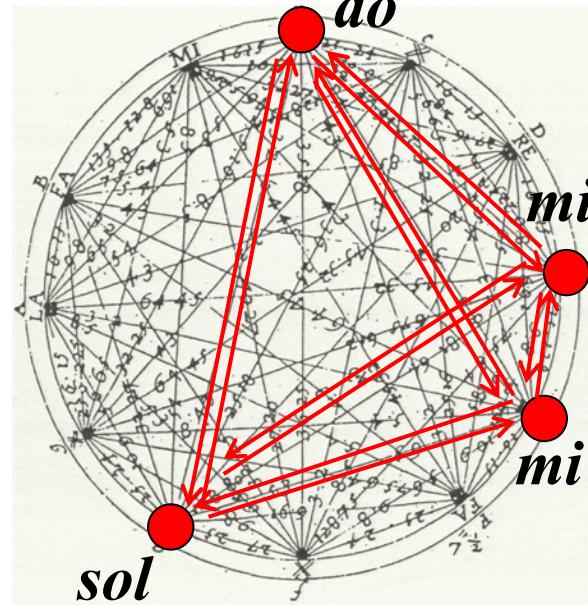
Permutational melodies in contemporary music

II.4. Marin Mersenne, *Harmonicorum Libri XII*, 1648

LIBER SEPTIMVS. DE CANTIBVS, SEV CANTILENIS, EARVMQ; NVMERO, PARTIBVS, ET SPECIEBVS.

Tabula Combinationis ab I ad 22.

I	1
II	2
III	6
IV	24
V	120
VI	720
VII	5040
VIII	40320
IX	361880
X	3618800
XI	39916800
XII	479001600
XIII	6117020800
XIV	87178191200
XV	1307674368000
XVI	20922789888000
XVII	335687418096000
XVIII	6401373705718000
XIX	12164510040881000
XX	2431901008176640000
XXI	51090942171709440000
XXII.	1114000717777607680000



Six Bagatelles
(G. Ligeti, 1953)

A musical score titled 'Varietas, seu Combinatio quathor notarum.' It consists of two staves of six-line musical notation. The first staff is numbered 1 through 6, and the second staff is numbered 7 through 12. Below these are two more staves, numbered 13 through 18, and at the bottom, two more staves, numbered 19 through 24. The notation uses small diamond shapes on the lines of the staff.



A permutteral song: one sentence, one note...

Una volta soltanto una storia d'amore finisce (M. Andreatta)

Una volta una storia d'amore
soltanto una storia

Una storia d'amore
soltanto una storia d'amore

Una storia
soltanto una storia

Una storia d'amore
soltanto

Una volta soltanto
una storia d'amore soltanto

Un amore soltanto una volta
soltanto una storia d'amore soltanto

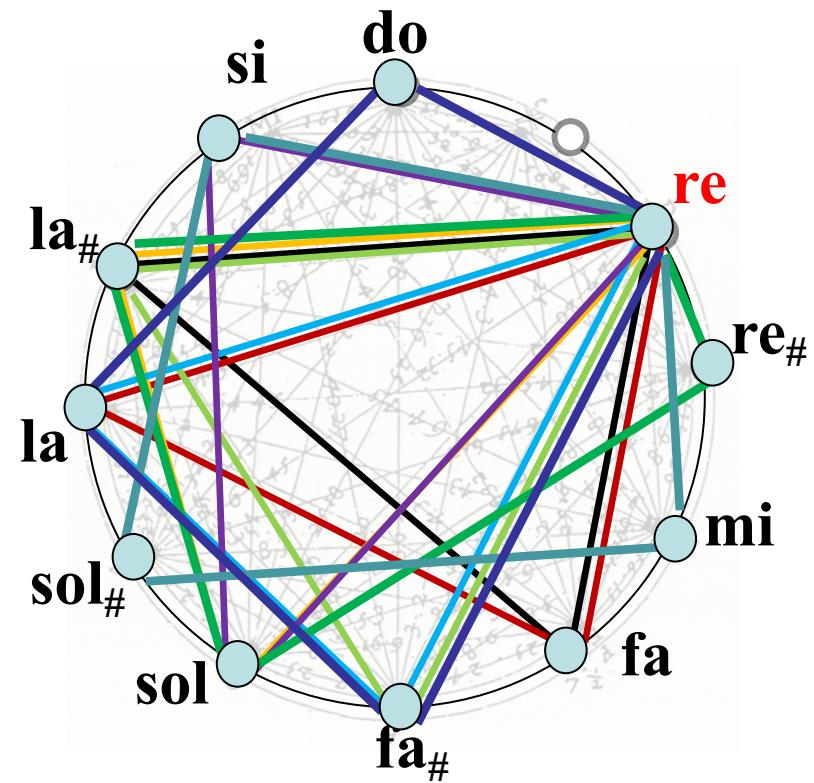
Una storia d'amore
soltanto una volta una storia

Un amore
una volta soltanto

Un amore finisce
soltanto

Una volta una storia d'amore finisce
Un amore soltanto

Una volta soltanto una storia d'amore finisce



A permutteral song: one sentence, one note (one note left!)

Una volta soltanto una storia d'amore finisce (M. Andreatta)

Una volta una storia d'amore
soltanto una storia

Una storia d'amore
soltanto una storia d'amore

Una storia
soltanto una storia

Una storia d'amore
soltanto

Una volta soltanto
una storia d'amore soltanto

Un amore soltanto una volta
soltanto una storia d'amore soltanto

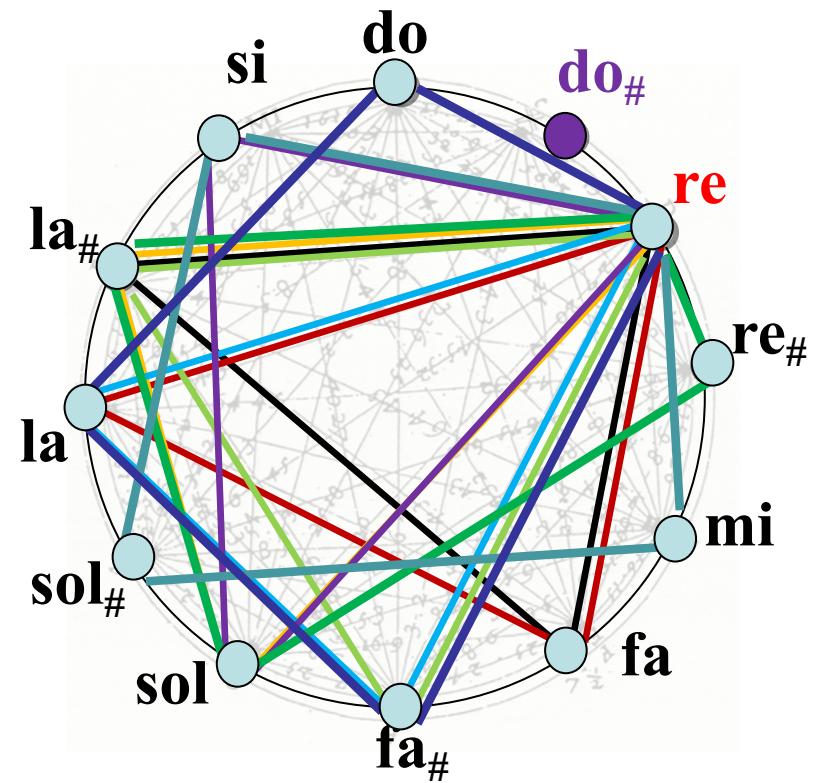
Una storia d'amore
soltanto una volta una storia

Un amore
una volta soltanto

Un amore finisce
soltanto

Una volta una storia d'amore finisce
Un amore soltanto

Una volta soltanto una storia d'amore finisce



A permutation song based on a permutational poem

Antes, despues (J. Cortazar / M. Andreatta)

Como los juegos al llanto
como la sombra a la columna
el perfume dibuja el jazmín
el amante precede al amor
como la caricia a la mano
el amor sobrevive al amante
pero inevitablemente
aunque no haya huella ni presagio

aunque no haya huella ni presagio
como la caricia a la mano
el perfume dibuja el jazmín
el amante precede al amor
pero inevitablemente
el amor sobrevive al amante
como los juegos al llanto
como la sombra a la columna

como la caricia a la mano
aunque no haya huella ni presagio
el amante precede al amor
el perfume dibuja el jazmín
como los juegos al llanto
como la sombra a la columna
el amor sobrevive al amante
pero inevitablemente

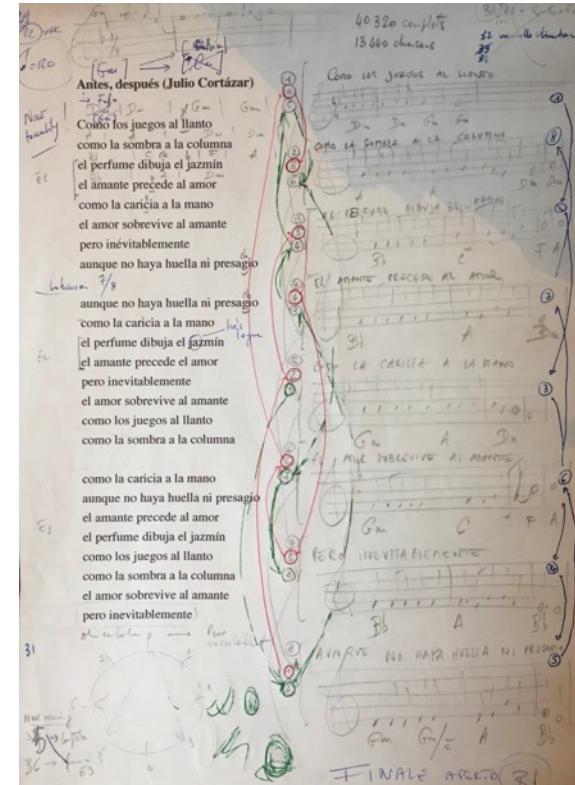
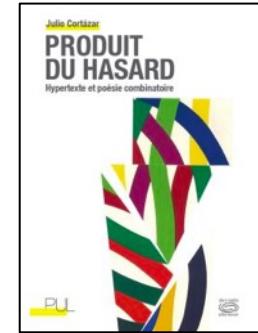
*Come i giochi le lacrime
come l'ombra la colonna
il profumo disegna il gelsomino
l'amante precede l'amore
come la carezza la mano
l'amore fa durare l'amante
ma allora inevitabilmente
Anche in assenza di traccia o di presagio*

*Anche in assenza di traccia o di presagio
come la carezza la mano
il profumo disegna il gelsomino
l'amante precede l'amore
ma allora inevitabilmente
l'amore fa durare l'amante
come i giochi le lacrime
come l'ombra la colonna*

*come la carezza la mano
anche in assenza di traccia o di presagio
l'amante precede l'amore
il profumo disegna il gelsomino
come i giochi le lacrime
come l'ombra la colonna
l'amore fa durare l'amante
ma allora inevitabilmente*



Julio Cortázar

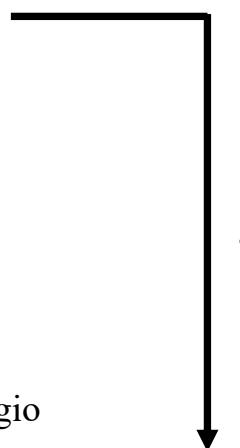


A double rhythmic constraints

Antes, despues (J. Cortazar / M. Andreatta)

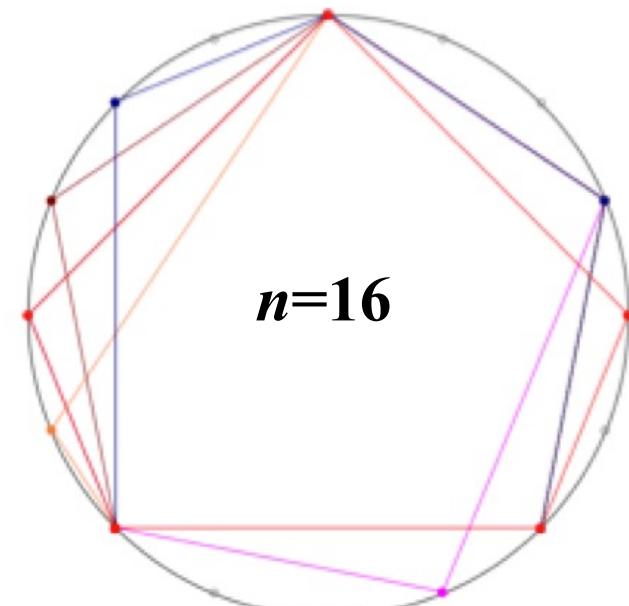
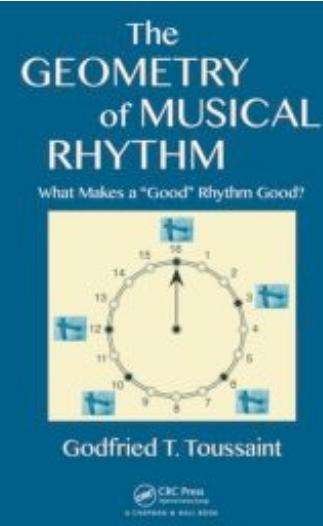
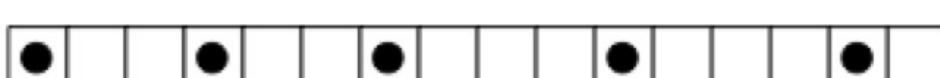
[Instrumental introduction]

Como los juegos al llanto
como la sombra a la columna
el perfume dibuja el jazmín
el amante precede al amor
como la caricia a la mano
el amor sobrevive al amante
pero inevitablemente
aunque no haya huella ni presagio



?

...



A double rhythmic constraints

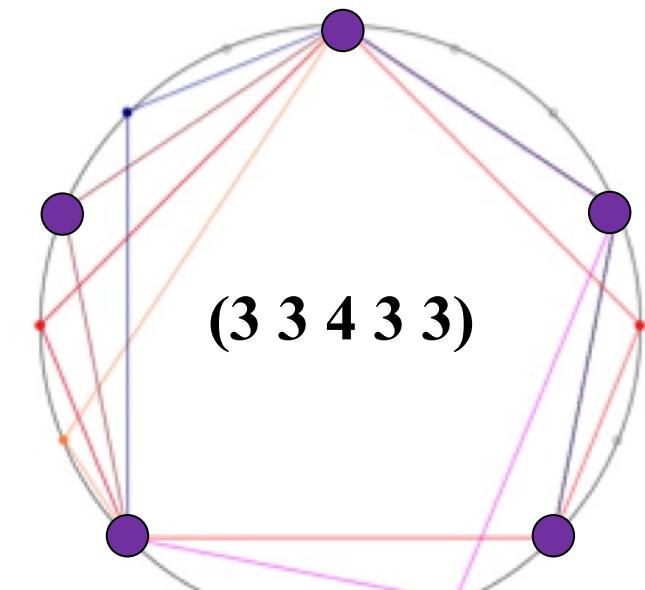
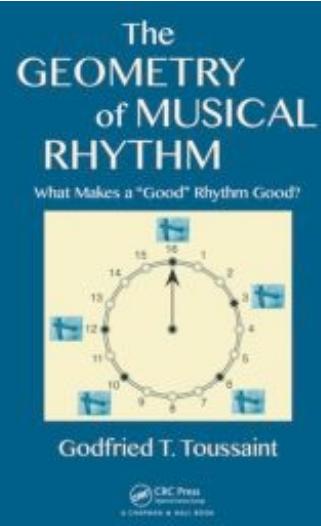
Antes, despues (J. Cortazar / M. Andreatta)

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como la caricia a la mano
el amor sobrevive al amante
pero inevitablemente
aunque no haya huella ni presagio



Shiko	● ● ● ●
Son	● ● ●
Soukous	● ●
Rumba	● ●
Bossa	● ●
Gahu	● ●



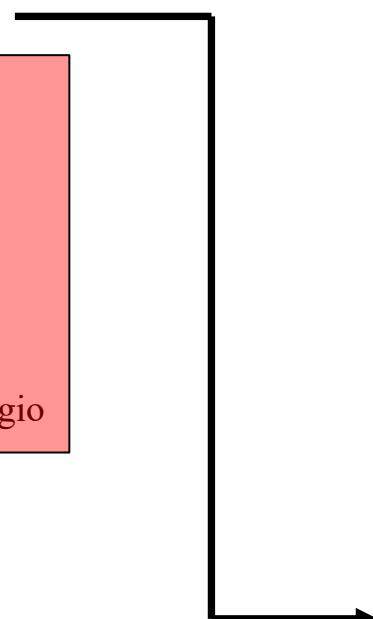
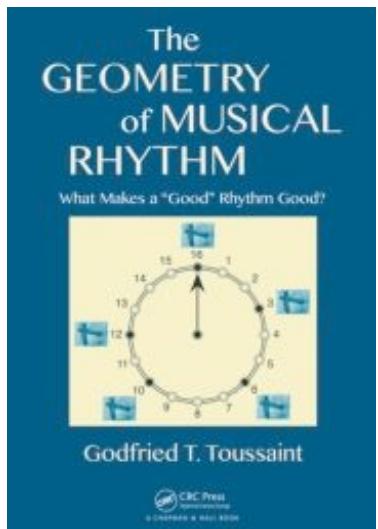
A double rhythmic constraints

Antes, despues (J. Cortazar / M. Andreatta)

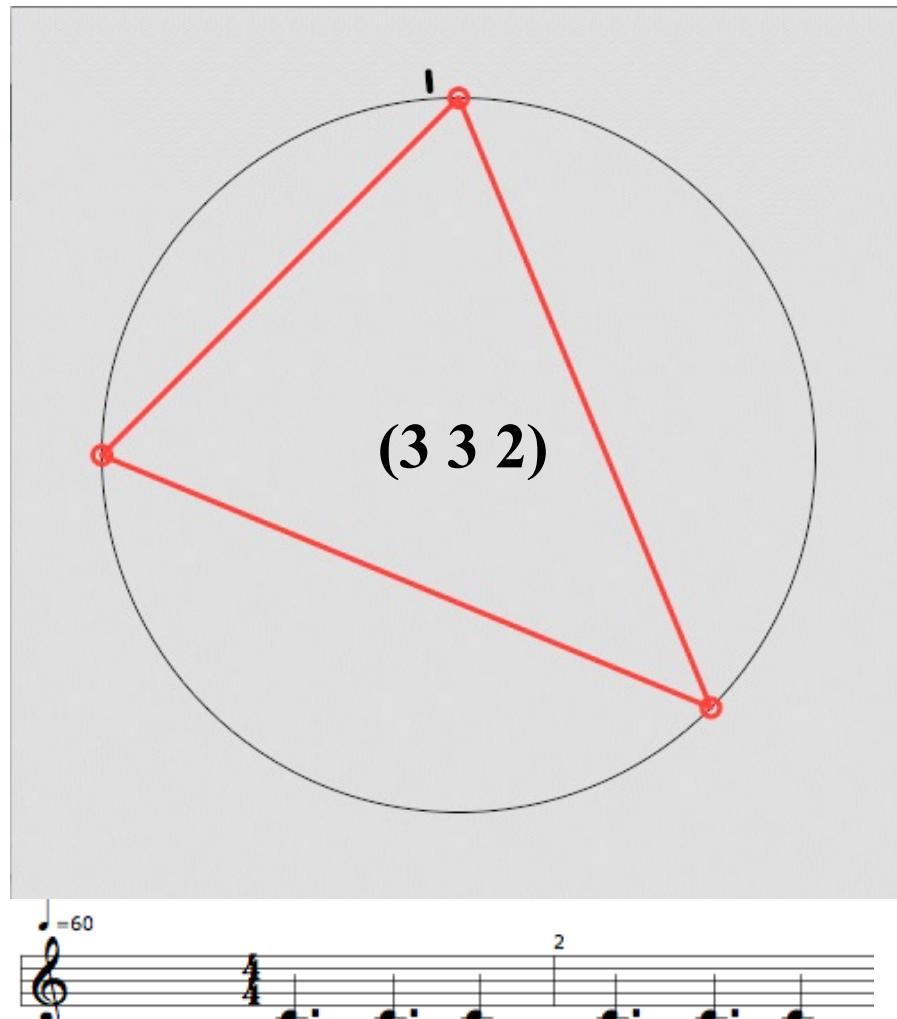
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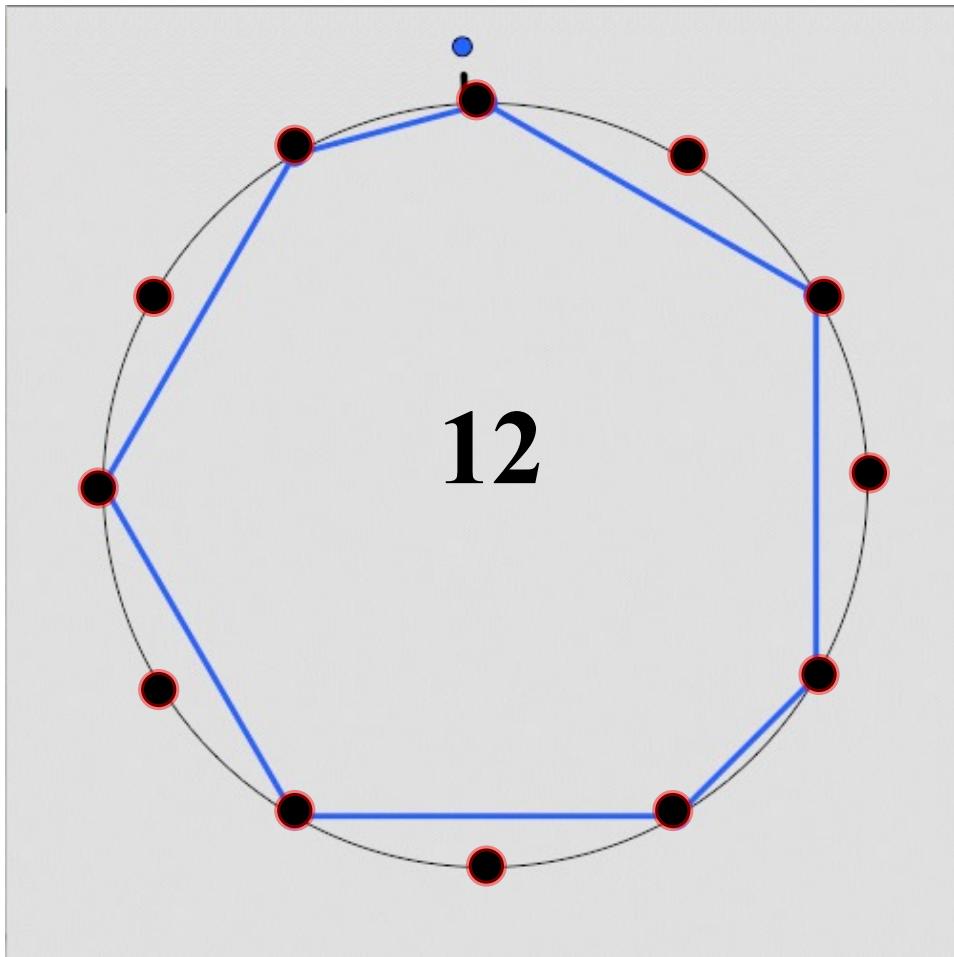
...



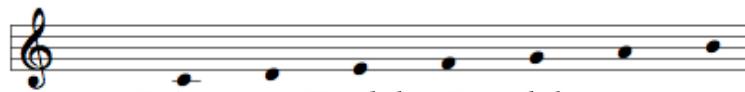
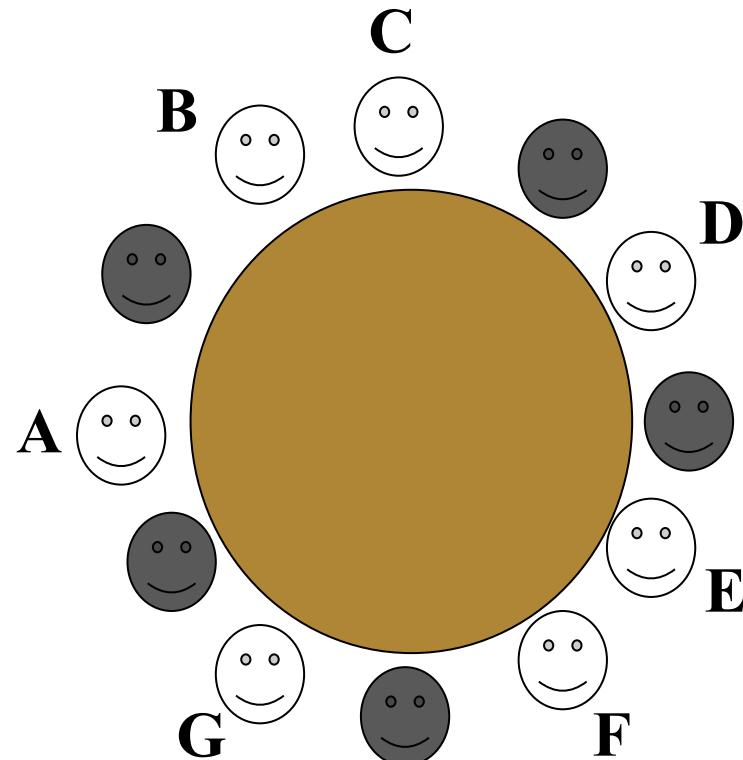
El trecillo



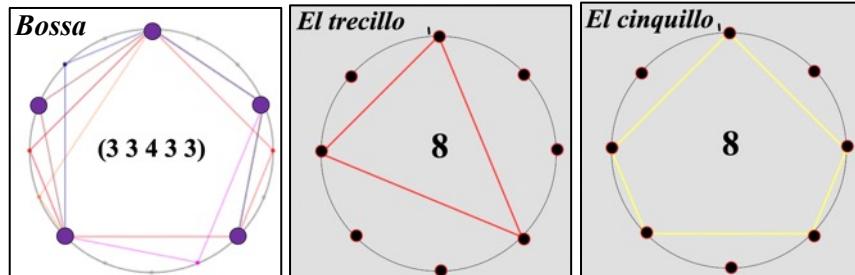
Maximally-Even rhythms and the Dinner Table Problem



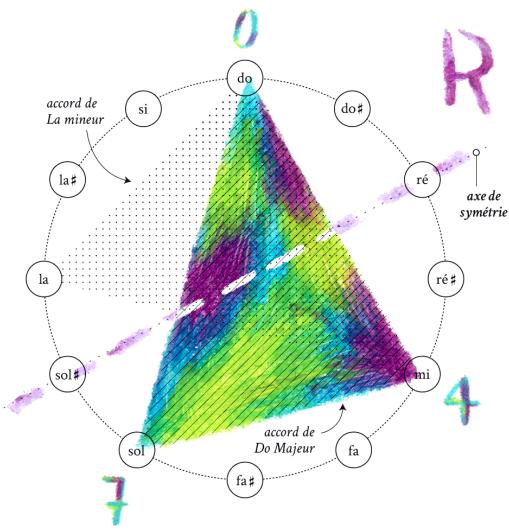
Abadja ou Bembé



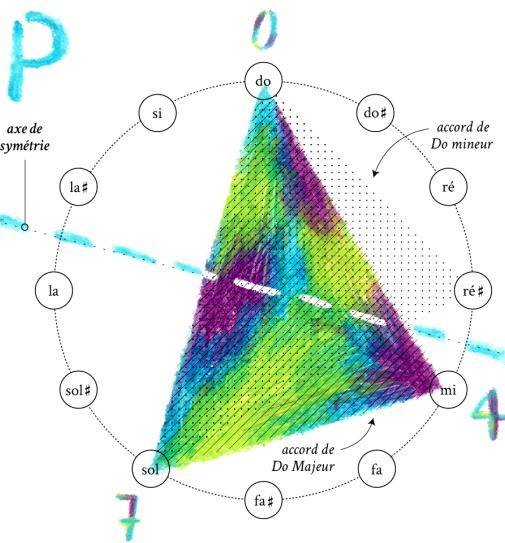
Dinner Table Problem



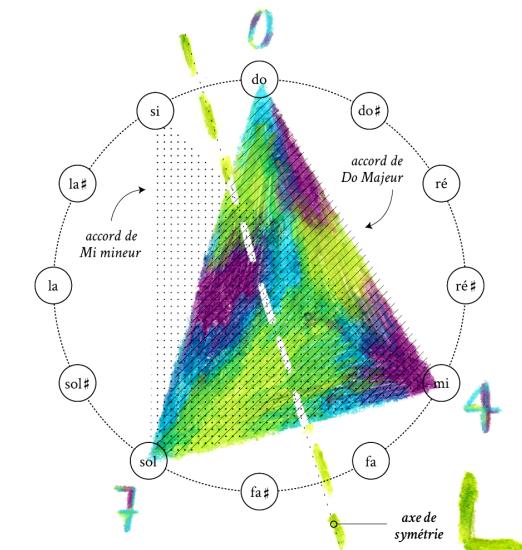
The three main major-minor symmetries



R as RELATIVE



P as PARALLEL



L as LEADING-TONE
(EXCHANGE)

C major



A minor

C major



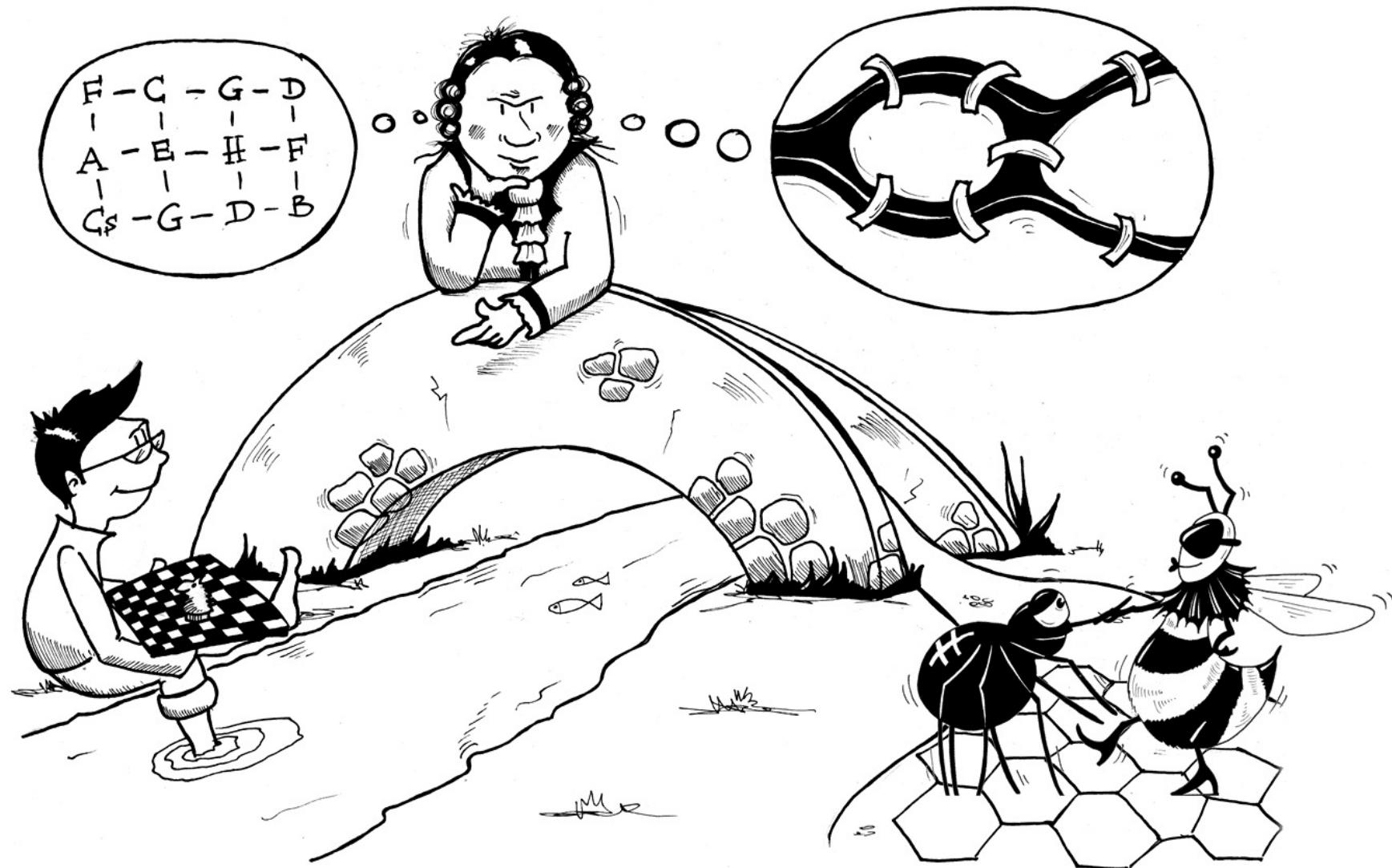
C minor

C major

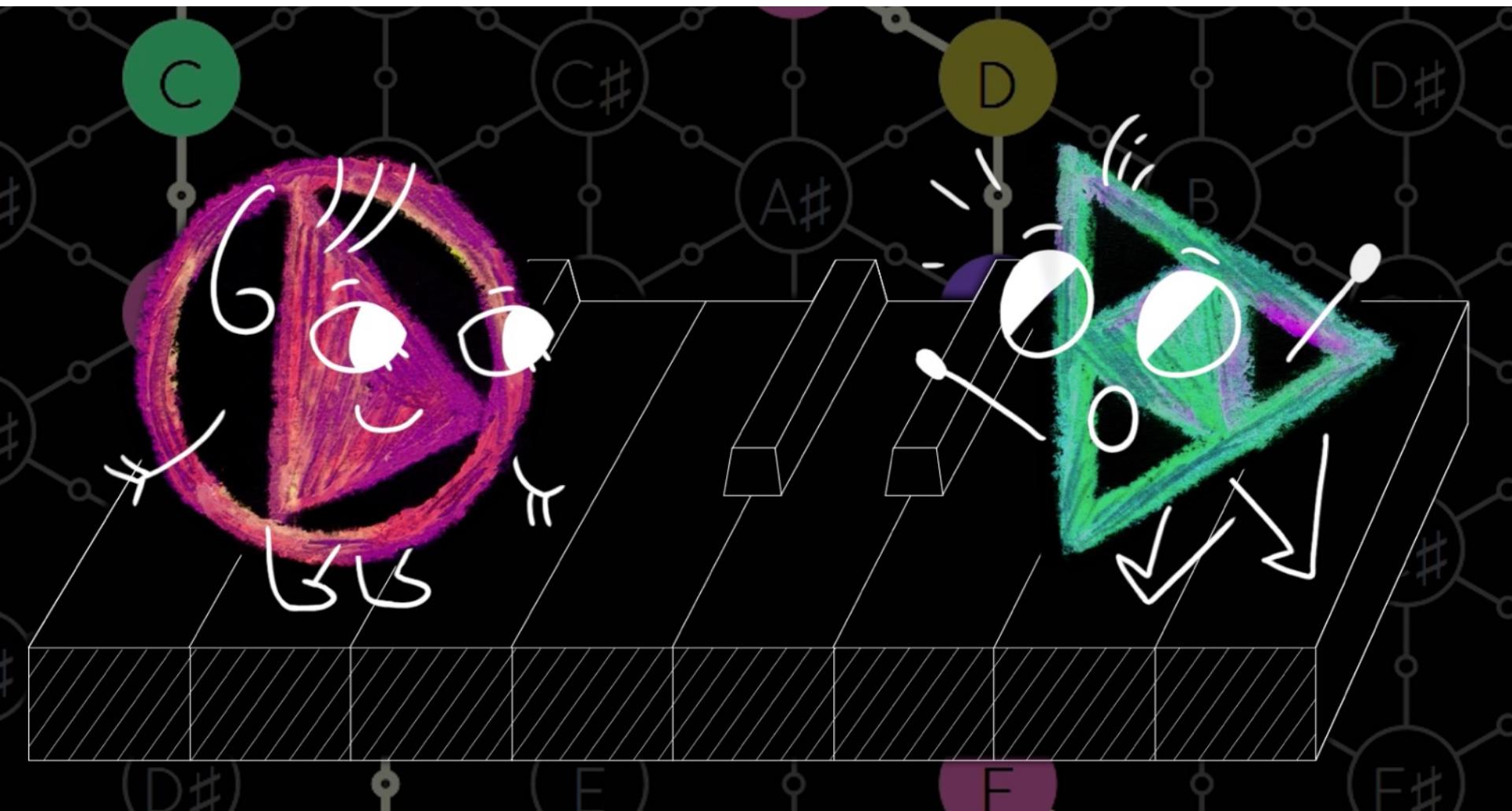


E minor

Leonhard Euler, the father of graph theory



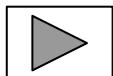
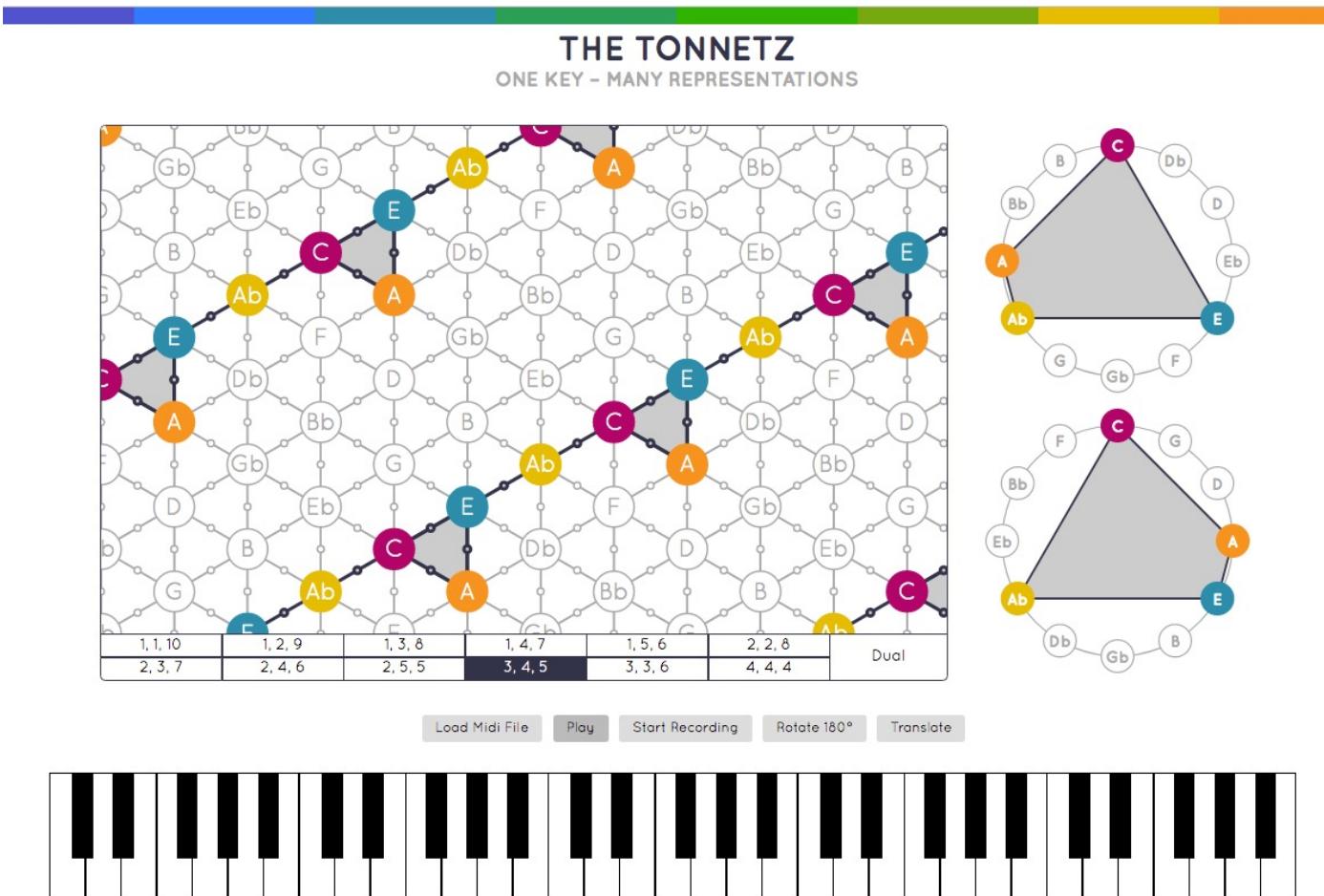
« Musique et mathématiques : histoire d'une rencontre »



A pedagogical film available at :

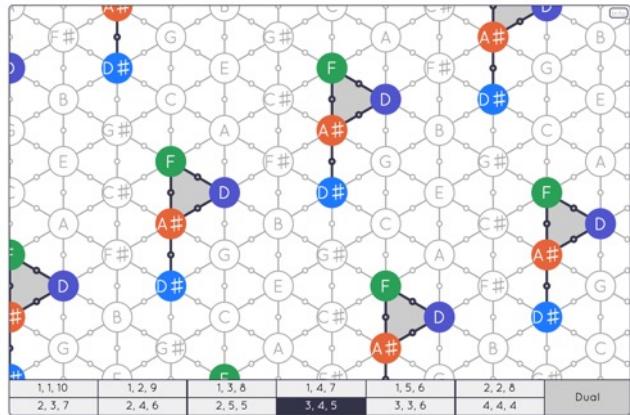
- AuDiMAT (CNRS)
- Youtube, ...

The *Tonnetz* web environment (© SMIR Project)

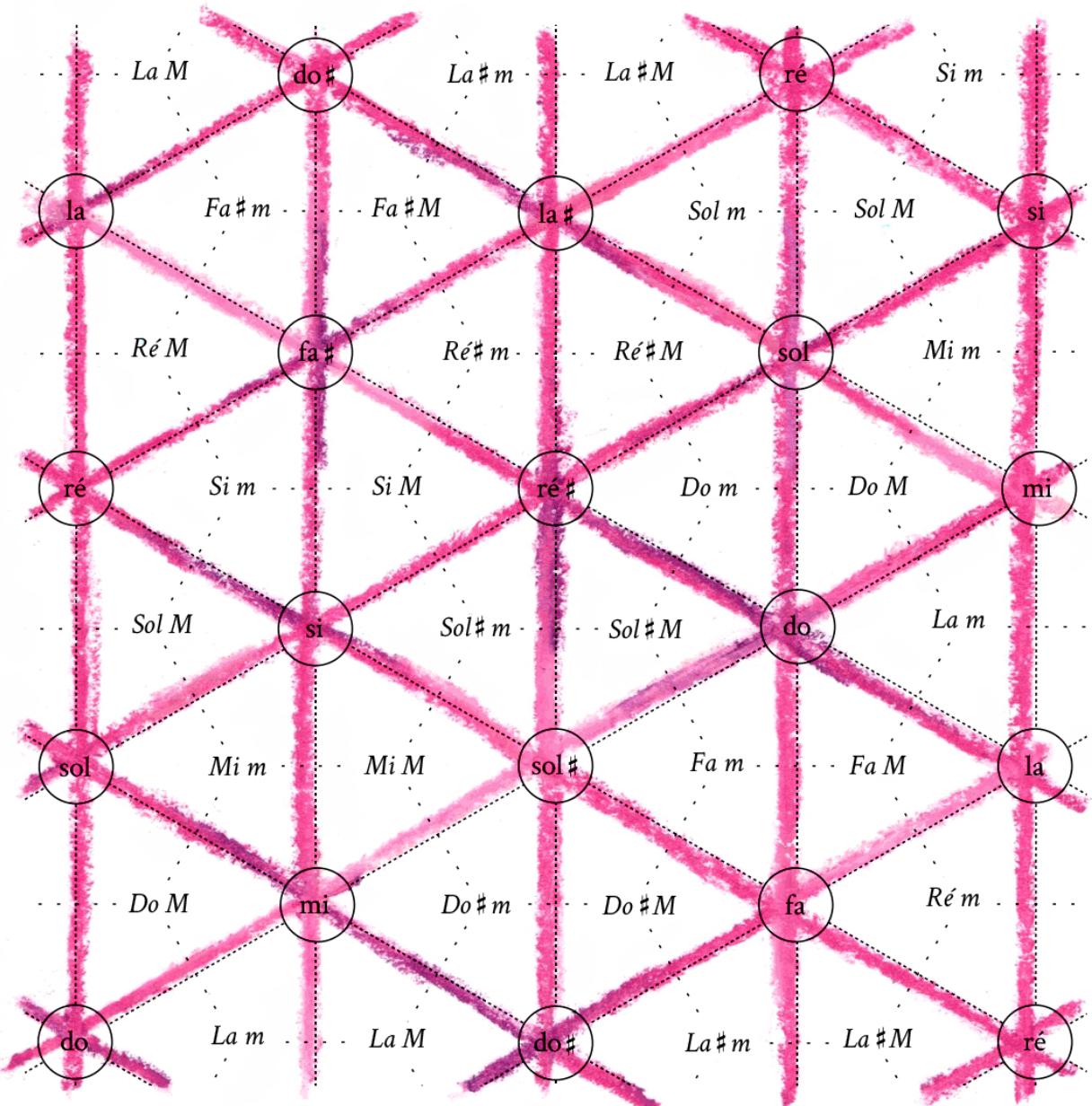
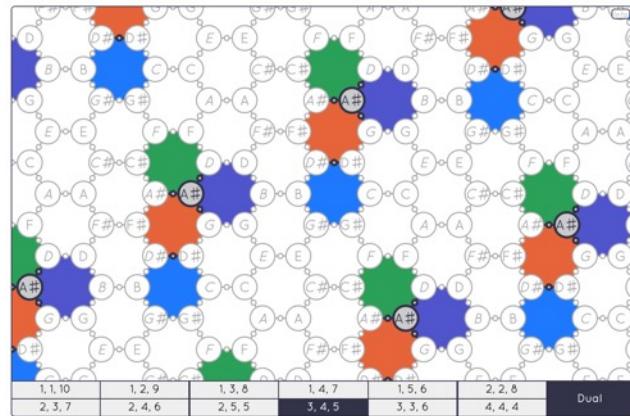


<https://morenoandreatta.com/software/>

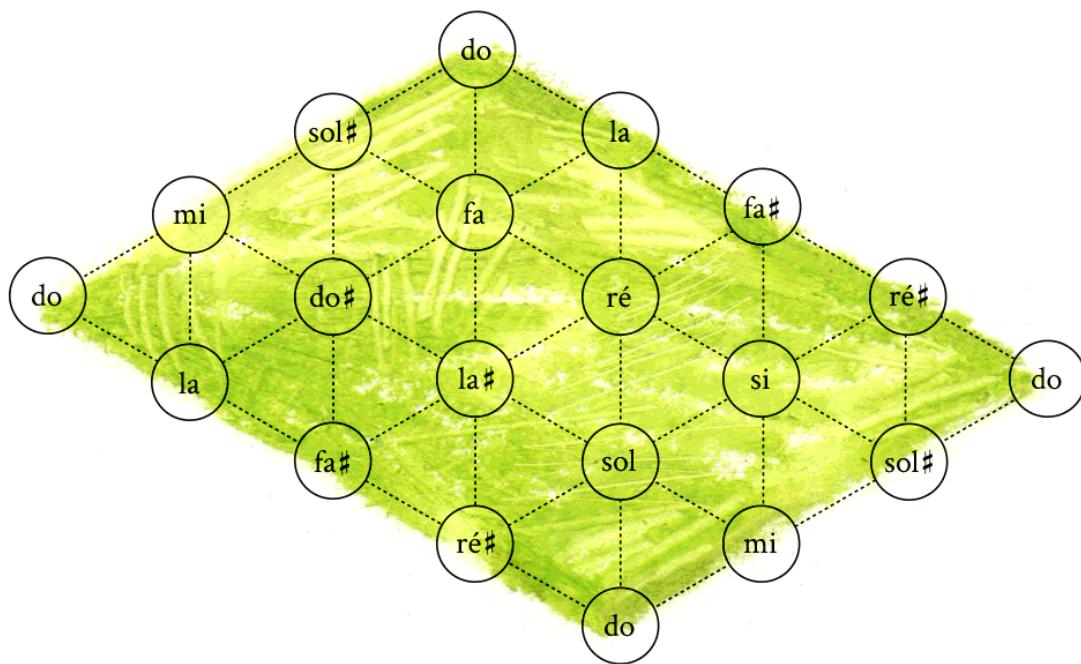
From the Tonnetz to the dual one



duality



The topological structure of the *Tonnetz*



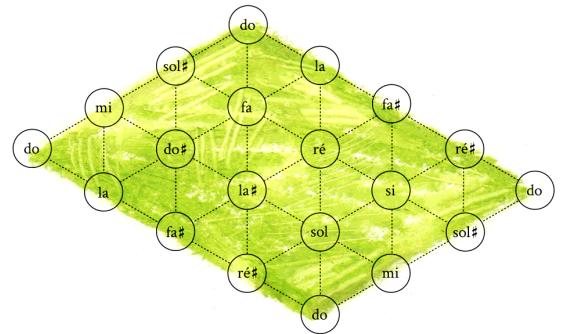
The topological structure of the *Tonnetz*



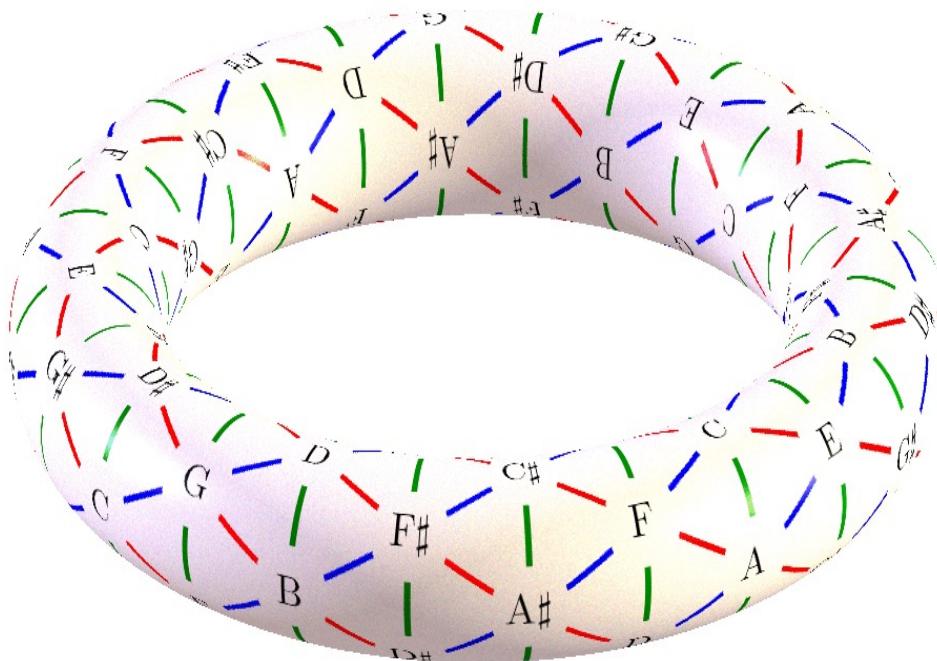
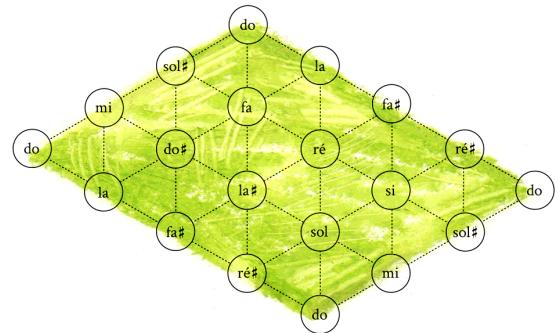
The topological structure of the *Tonnetz*



The topological structure of the *Tonnetz*

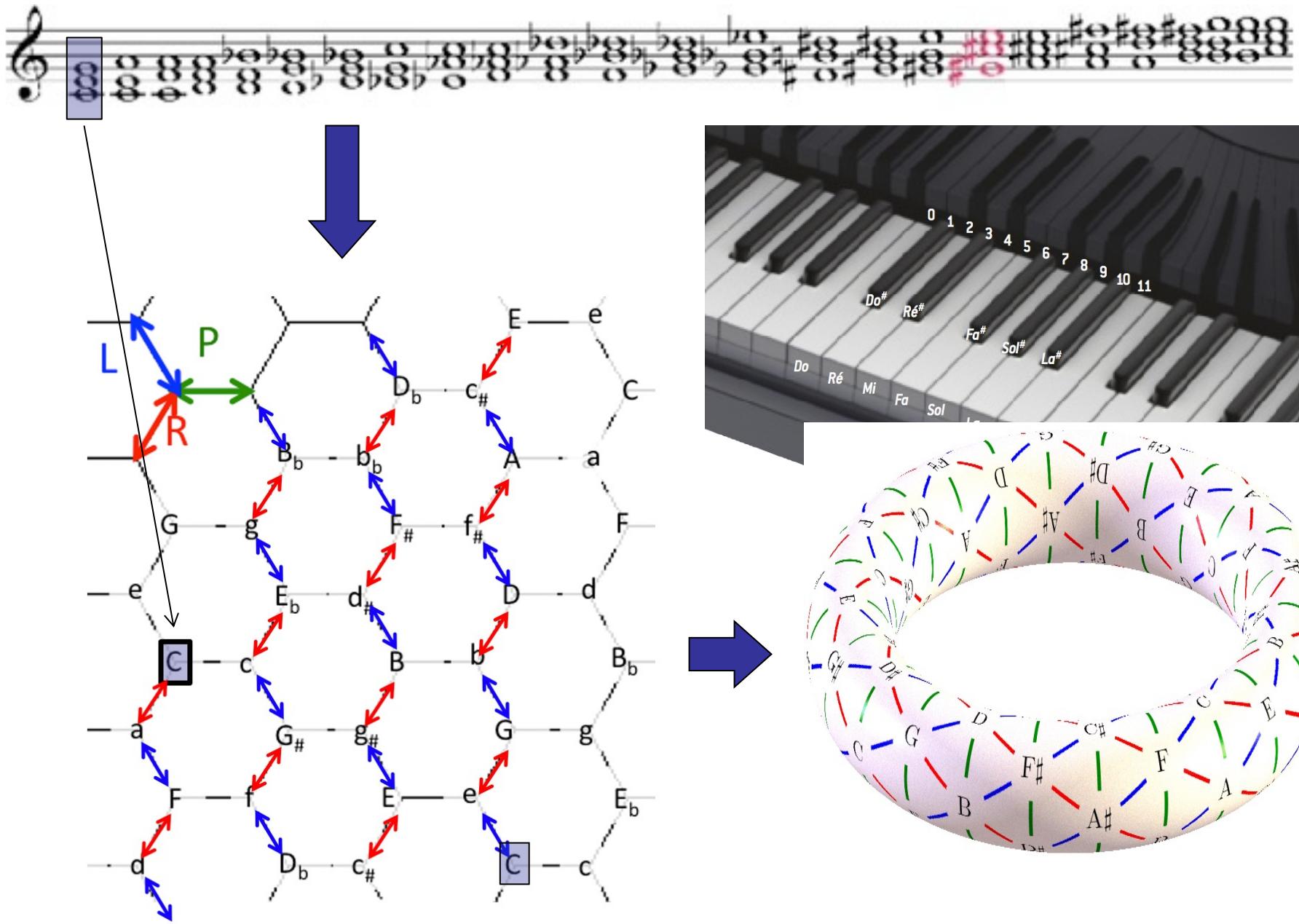


The topological structure of the *Tonnetz*

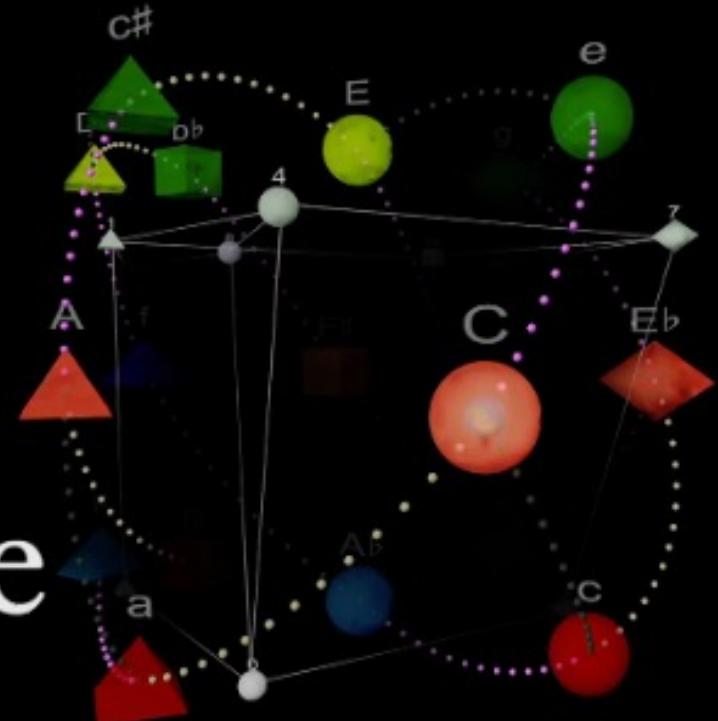


(Source: www.wikimedia.org/)

Harmonic progressions as spatial trajectories



Beethoven and the Hypersphere *(and the Tonnetz)*



Gilles Baroin 2016
www.MatheMusic.net



Gilles Baroin

Reading Beethoven backwards



Le Blé en Herbe

(Polo/Moreno/Dieu)

Plonger comme un enfant, cheveux au vent

Croiser matin dans l'herbe folle

Sous l'océan du blé en herbe

Deux tourterelles qui s'envolent

Marée d'épis couleur d'amande

Suivre les jeux des hirondelles

Qui tendent à caresser le ciel

Sur le paysage éternel

Algues tendres de mille plages

Sous l'océan

Erôlant le ventre des nuages

Du blé en herbe

Cheveux de pluie, dos de poissons

Qui frissonnent à l'unisson

Marché de fruits au goût amer

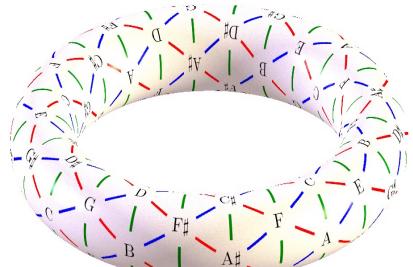
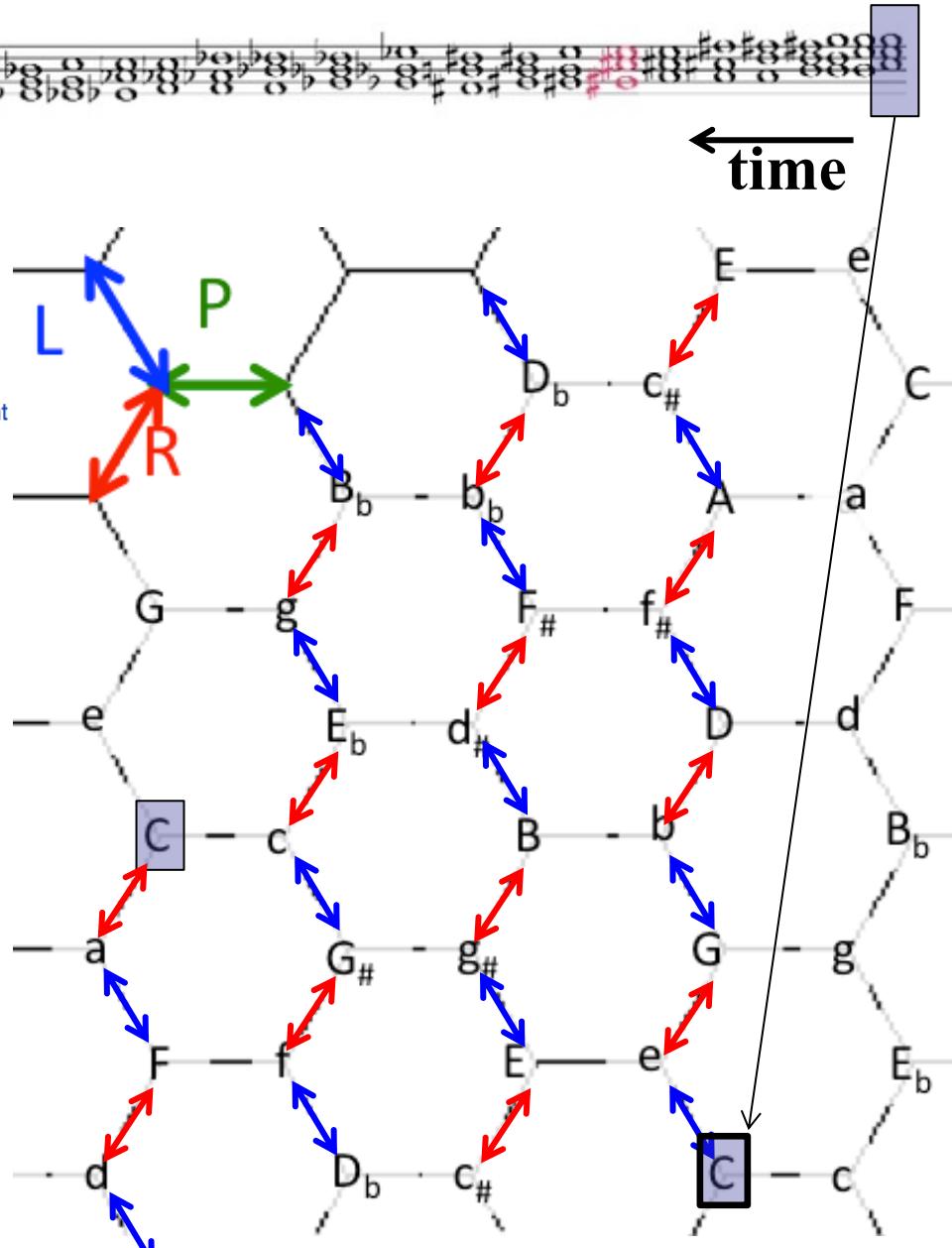
Suivre le bord des continents

Vers l'îlot d'un petit village

Réchercher le corail du pavot

Vers un château d'eau sur la plage

Dans la zone des coquilles





From poetry to song writing:

hamiltonian compositional strategies

A part (Andrée Chedid, poème tiré du recueil *Rhymes Collection Poésie/Gallimard* (n. 527), Gallimard, 2018)

ANDRÉE CHEDID

Rythmes



PF

Poésie/Gallimard

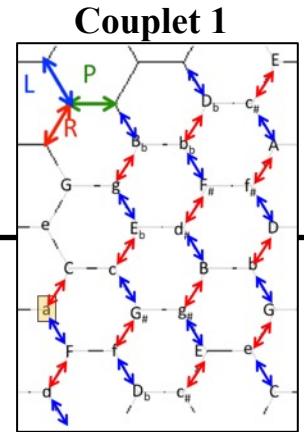
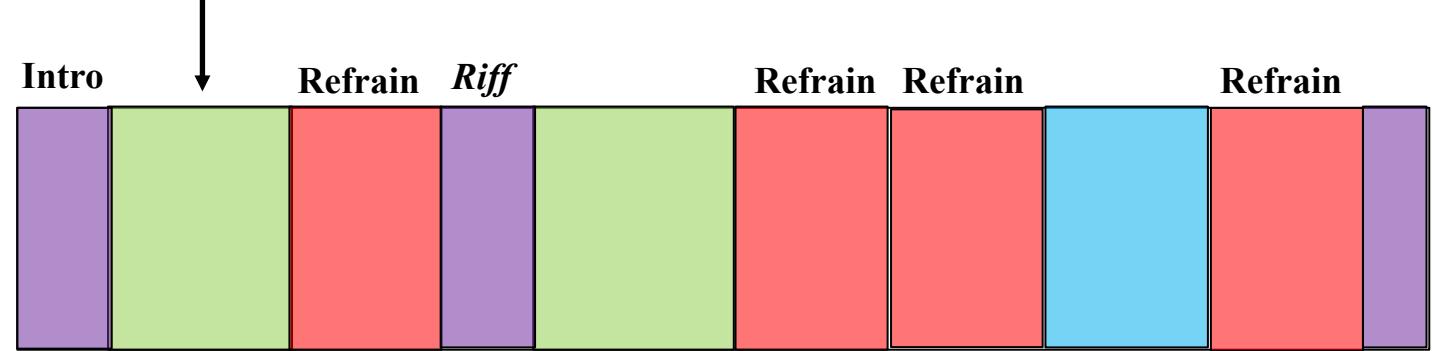


À part le temps
Et ses rouages
À part la terre
En éruptions
À part le ciel
Pétrisseur de nuages
À part l'ennemi
Qui génère l'ennemi

À part le désamour
Qui ronge l'illusion
À part la durée
Qui moisit nos visages

À part les fléaux
À part la tyrannie
À part l'ombre et le crime
Nos batailles nos outrages

Je te célèbre ô Vie
Entre cavités et songes
Intervalle convoité
Entre le vide et le rien



Less trivial Hamiltonian Cycles

8. C-Cm-Eb-Gm-Bb-Dm-F-Fm-Ab-Abm-B-Ebm-F#-Bbm-C#-C#m-E-Em-G-Bm-D-F#m-A-Am--PRLRLRPR
9. C-Em-E-Abm-Ab-Cm-Eb-Gm-G-Bm-B-Ebm-F#-Bbm-Bb-Dm-D-F#m-A-C#m-C#-Fm-F-Am--LPLPLR
10. C-Em-E-Abm-B-Ebm-Eb-Gm-G-Bm-D-F#m-F#-Bbm-Bb-Dm-F-Am-A-C#m-C#-Fm-Ab-Cm--LPLRLP
11. C-Em-G-Gm-Bb-Bbm-C#-C#m-E-Abm-B-Bm-D-Dm-F-Fm-Ab-Cm-Eb-Ebm-F#-F#m-A-Am--LRPRPRPR
12. C-Em-G-Gm-Bb-Bbm-C#-Fm-Ab-Cm-Eb-Ebm-F#-F#m-A-C#m-E-Abm-B-Bm-D-Dm-F-Am--LRPRPRLR



L P L P L R ...
 P L P L R L ...
 L P L R L P ...
 PL R L P L ...
L R L P L P ...
 R L P L P L ...

Luzi

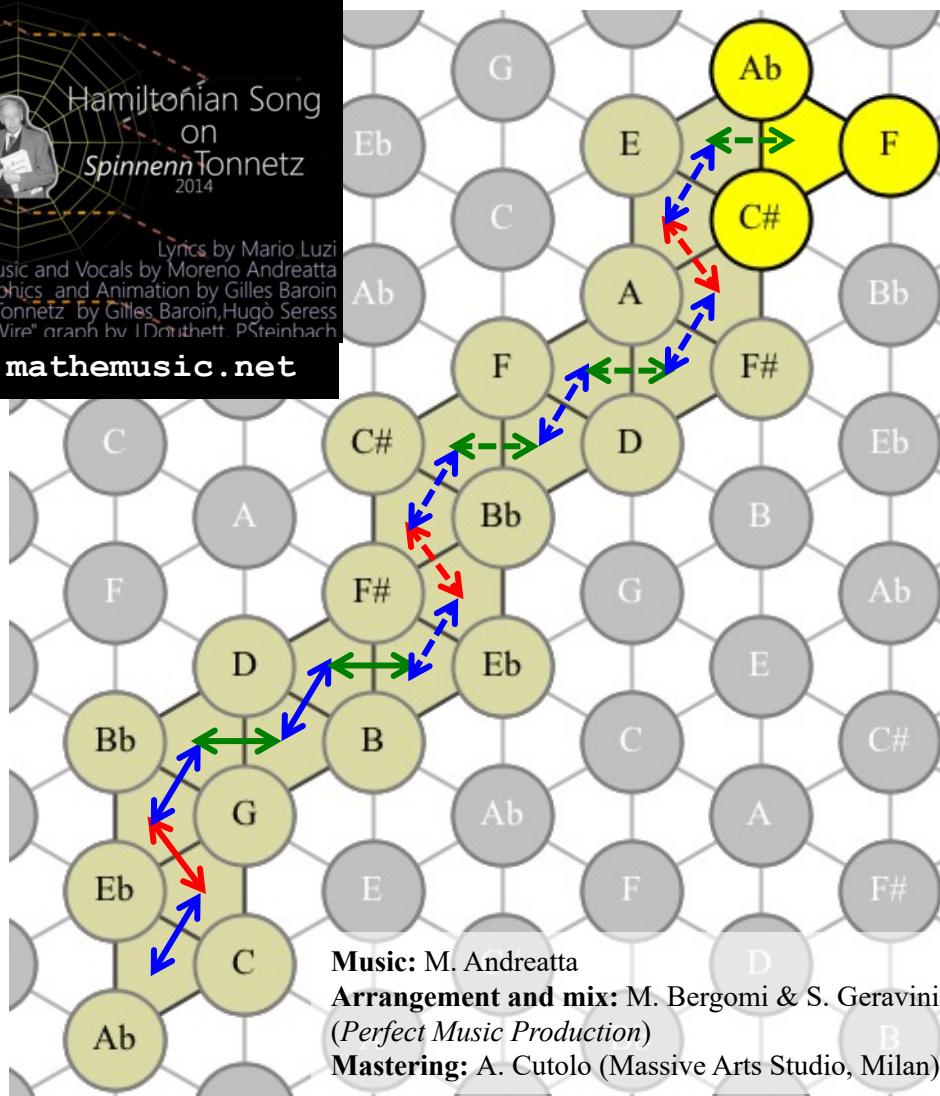
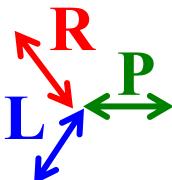


<http://www.mathemusic.net>

min. 1'02"



Base



La sera non è più la tua canzone
 (Mario Luzi, 1945, in *Poesie sparse*)

La sera non è più la tua canzone,
 è questa roccia d'ombra traforata
 dai lumi e dalle voci senza fine,
 la quiete d'una cosa già pensata.

Ah questa luce viva e chiara viene
 solo da te, sei tu così vicina
 al vero d'una cosa conosciuta,
 per nome hai una parola ch'è passata
 nell'intimo del cuore e s'è perduta.

Caduto è più che un segno della vita,
 riposi, dal viaggio sei tornata
 dentro di te, sei scesa in questa pura
 sostanza così tua, così romita
 nel silenzio dell'essere, (compiuta).

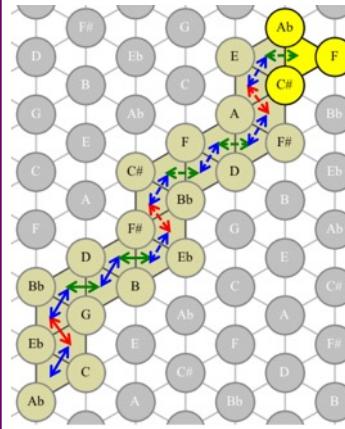
L'aria tace ed il tempo dietro a te
 si leva come un'arida montagna
 dove vaga il tuo spirito e si perde,
 un vento raro scivola e ristagna.



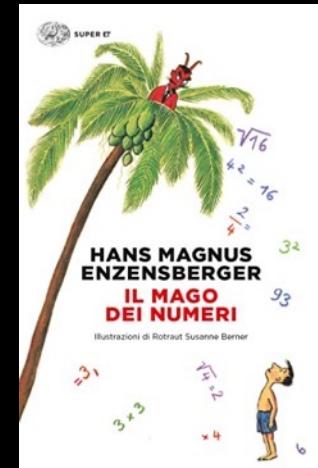
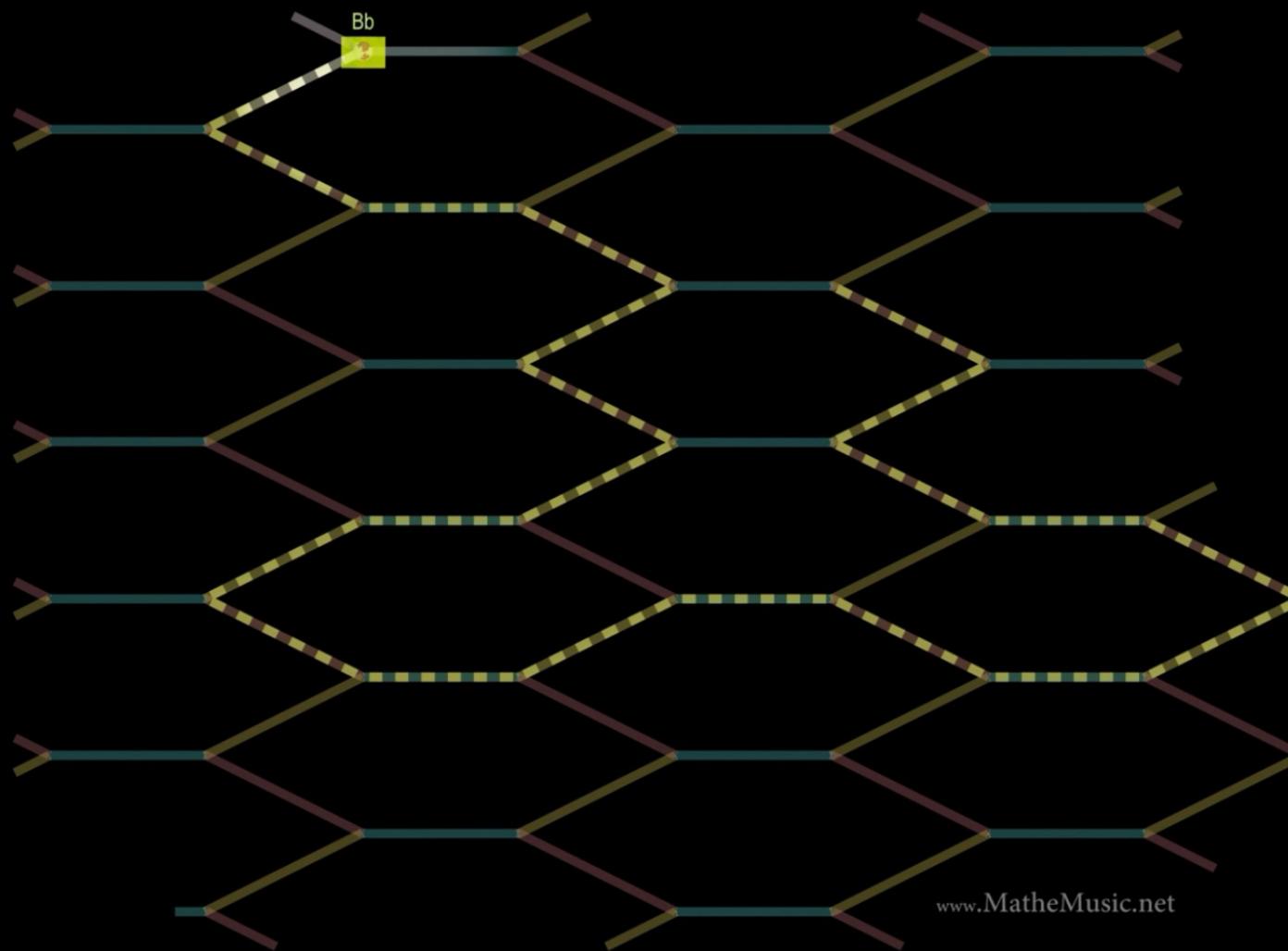
Exploring Hamiltonian trajectories in song writing

1. C-Cm-Ab-Abm-E-C#m-A-Am-F-Fm-C#-Bbm-F#-F#m-D-Dm-Bb-Gm-Eb-Ebm-B-Bm-G-Em--PLPLRL
2. C-Cm-Ab-Fm-C#-C#m-A-Am-F-Dm-Bb-Bbm-F#-F#m-D-Bm-G-Gm-Eb-Ebm-B-Abm-E-Em--PLRLPL
3. C-Cm-Eb-Ebm-F#-F#m-A-C#m-E-Em-G-Gm-Bb-Bbm-C#-Fm-Ab-Abm-B-Bm-D-Dm-F-Am--PRPRPRLR
4. C-Cm-Eb-Ebm-F#-Bbm-C#-C#m-E-Em-G-Gm-Bb-Dm-F-Fm-Ab-Abm-B-Bm-D-F#m-A-Am--PRPRLRPR
5. C-Cm-Eb-Ebm-F#-Bbm-C#-Fm-Ab-Abm-B-Bm-D-F#m-A-C#m-E-Em-G-Gm-Bb-Dm-F-Am--PRPRLRLR
6. C-Cm-Eb-Gm-Bb-Bbm-C#-C#m-E-Em-G-Bm-D-Dm-F-Fm-Ab-Abm-B-Ebm-F#-F#m-A-Am--PRLRPRPR
7. C-Cm-Eb-Gm-Bb-Bbm-C#-Fm-Ab-Abm-B-Ebm-F#-F#m-A-C#m-E-Em-G-Bm-D-Dm-F-Am--PRLR
8. C-Cm-Eb-Gm-Bb-Dm-F-Fm-Ab-Abm-B-Ebm-F#-Bbm-C#-C#m-E-Em-G-Bm-D-F#m-A-Am--PRLRLRPR
9. C-Em-E-Abm-Ab-Cm-Eb-Gm-G-Bm-B-Ebm-F#-Bbm-Bb-Dm-D-F#m-A-C#m-C#-Fm-F-Am--LPLPLR →
10. C-Em-E-Abm-B-Ebm-Eb-Gm-G-Bm-D-F#-Bbm-Bb-Dm-F-Am-A-C#m-C#-Fm-Ab-Cm--LPLRLP
11. C-Em-G-Gm-Bb-Bbm-C#-C#m-E-Abm-B-Bm-D-Dm-F-Fm-Ab-Cm-Eb-Ebm-F#-F#m-A-Am--LRPRPRPR
12. C-Em-G-Gm-Bb-Bbm-C#-Fm-Ab-Cm-Eb-Ebm-F#-F#m-A-C#m-E-Abm-B-Bm-D-Dm-F-Am--LRPRPRLR
13. C-Em-G-Gm-Bb-Dm-F-Fm-Ab-Cm-Eb-Ebm-F#-Bbm-C#-C#m-E-Abm-B-Bm-D-F#m-A-Am--LRPR
14. C-Em-G-Bm-B-Ebm-Eb-Gm-Bb-Dm-D-F#-Bbm-C#-Fm-F-Am-A-C#m-E-Abm-Ab-Cm--LRLPLP
15. C-Em-G-Bm-D-Dm-F-Fm-Ab-Cm-Eb-Gm-Bb-Bbm-C#-C#m-E-Abm-B-Ebm-F#-F#m-A-Am--LRLRPRPR
16. C-Em-G-Bm-D-F#m-A-C#m-E-Abm-B-Ebm-F#-Bbm-C#-Fm-Ab-Cm-Eb-Gm-Bb-Dm-F-Am--LR
17. C-Am-A-F#m-F#-Ebm-Eb-Cm-Ab-Fm-F-Dm-D-Bm-B-Abm-E-C#m-C#-Bbm-Bb-Gm-G-Em--RPRPRPRL
18. C-Am-A-F#m-F#-Ebm-B-Abm-Ab-Fm-F-Dm-D-Bm-G-Em-E-C#m-C#-Bbm-Bb-Gm-Eb-Cm--RPRPRLRP
19. C-Am-A-F#m-F#-Ebm-B-Abm-E-C#m-C#-Bbm-Bb-Gm-Eb-Cm-Ab-Fm-F-Dm-D-Bm-G-Em--RPRPRLRL
20. C-Am-A-F#m-D-Bm-B-Abm-Ab-Fm-F-Dm-Bb-Gm-G-Em-E-C#m-C#-Bbm-F#-Ebm-Eb-Cm--RPRLRPRP
21. C-Am-A-F#m-D-Bm-B-Abm-E-C#m-C#-Bbm-F#-Ebm-Eb-Cm-Ab-Fm-F-Dm-Bb-Gm-G-Em--RPRPL
22. C-Am-A-F#m-D-Bm-G-Em-E-C#m-C#-Bbm-F#-Ebm-B-Abm-Ab-Fm-F-Dm-Bb-Gm-Eb-Cm--RPRLRLRP
23. C-Am-F-Fm-C#-C#m-A-F#m-D-Dm-Bb-Bbm-F#-Ebm-B-Bm-G-Gm-Eb-Cm-Ab-Abm-E-Em--RLPLPL
24. C-Am-F-Dm-D-Bm-B-Abm-Ab-Fm-C#-Bbm-Bb-Gm-G-Em-E-C#m-A-F#m-F#-Ebm-Eb-Cm--RLRPRPRP
25. C-Am-F-Dm-D-Bm-B-Abm-E-C#m-A-F#m-F#-Ebm-Eb-Cm-Ab-Fm-C#-Bbm-Bb-Gm-G-Em--RLRPRPRL
26. C-Am-F-Dm-D-Bm-G-Em-E-C#m-A-F#m-F#-Ebm-B-Abm-Ab-Fm-C#-Bbm-Bb-Gm-Eb-Cm--RLRP
27. C-Am-F-Dm-Bb-Gm-G-Em-E-C#m-A-F#m-D-Bm-B-Abm-Ab-Fm-C#-Bbm-F#-Ebm-Eb-Cm--RLRLRPRP
28. C-Am-F-Dm-Bb-Gm-Eb-Cm-Ab-Fm-C#-Bbm-F#-Ebm-B-Abm-E-C#m-A-F#m-D-Bm-G-Em--RL

LPLPLR...
PLPRLR...
LPLRLP...
PLRLPL...
LRLPLP...



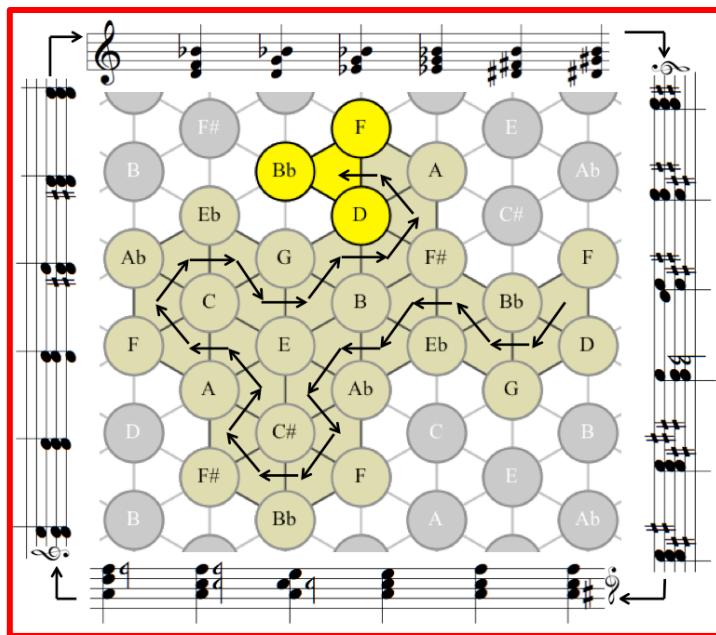
Hamiltonian Cycles without inner periodicity



Renzo Sicco
(Assemblea Teatro)



Aprile (d'après Gabriele D'Annunzio)



Do \leftarrow do_m \leftarrow Sol# \leftarrow fa_m \leftarrow Fa \leftarrow la_m \leftarrow La \leftarrow fa#_m \leftarrow Fa# \leftarrow sib_m \leftarrow Do# \leftarrow do#_m

mi_m \rightarrow Sol \rightarrow si_m \rightarrow Ré \rightarrow ré_m \rightarrow Sib \rightarrow sol_m \rightarrow Mib \rightarrow mib_m \rightarrow Si \rightarrow sol#_m \rightarrow Mi

Do \rightarrow mi_m \rightarrow Mi \rightarrow sol#_m \rightarrow Si \rightarrow ré#_m \rightarrow Re# \rightarrow do_m \rightarrow Lab \rightarrow fa_m \rightarrow Do# \rightarrow do#_m

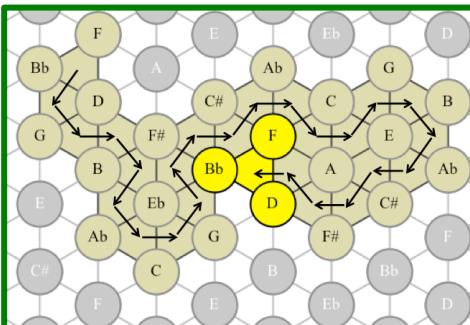
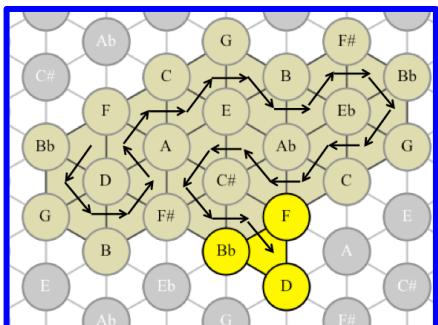
la_m \leftarrow Fa \leftarrow ré_m \leftarrow Ré \leftarrow si_m \leftarrow Sol \leftarrow sol_m \leftarrow Sib \leftarrow sib_m \leftarrow Fa# \leftarrow fa#_m \leftarrow La

Mi \leftarrow mi_m \leftarrow Do \leftarrow la_m \leftarrow Fa \leftarrow fa_m \leftarrow Reb \leftarrow sib_m \leftarrow Fa# \leftarrow mib_m \leftarrow Mib \leftarrow do_m

do#_m \rightarrow La \rightarrow fa#_m \rightarrow Ré \rightarrow ré_m \rightarrow Sib \rightarrow sol_m \rightarrow Sol \rightarrow si_m \rightarrow Si \rightarrow sol#_m \rightarrow Sol#

Aprile

4D & 2D Visualizations
Hamiltonian Cycles
M.Andreatta, G.Baroin 2013



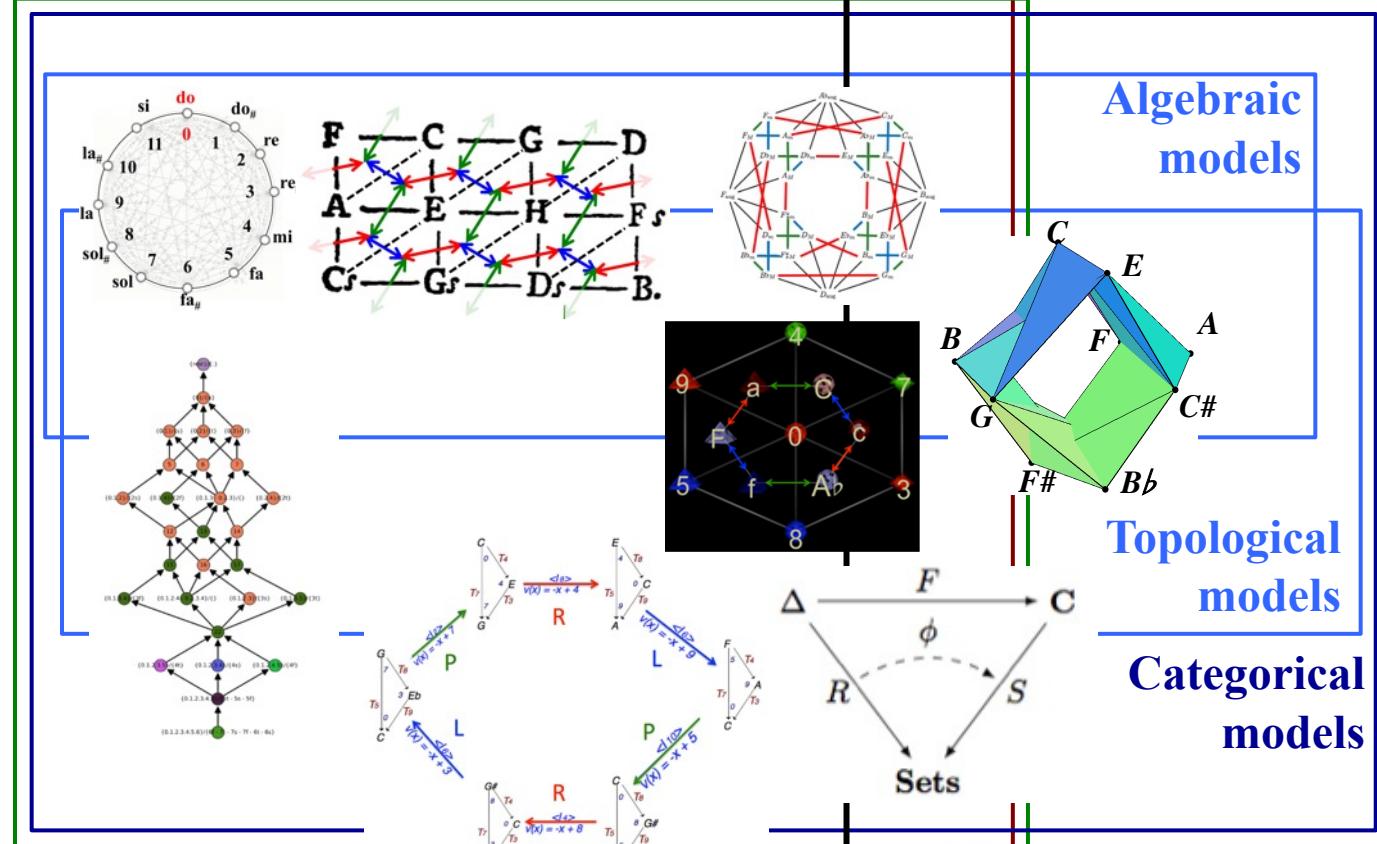
Lyrics: Gabriele d'Annunzio

Music and Vocals: Moreno Andreatta

Hypersphere and Ideogramms: Gilles Baroin
Original "Chicken Wire" graph: J.Douthett, P.Steinbach

<http://www.mathemusic.net>

The SMIR Project: advanced maths for the working musicologist

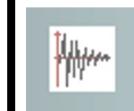


Computational models

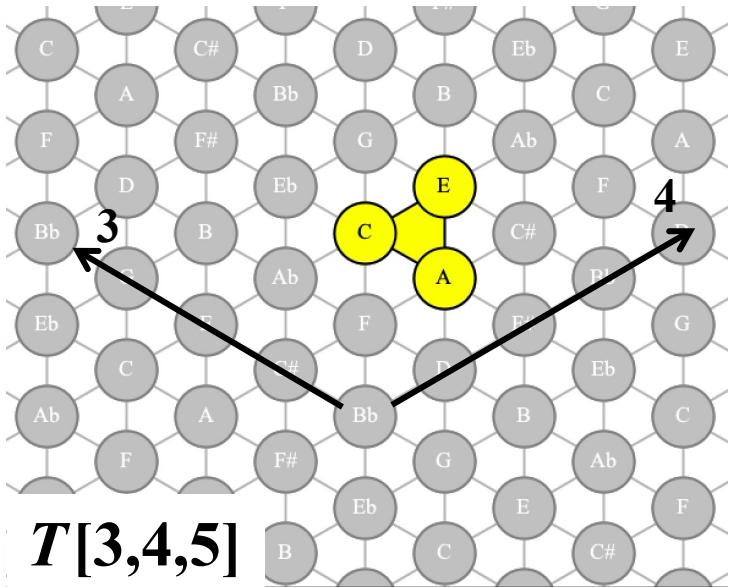
Cognitive models

Symbolic Music Information Research

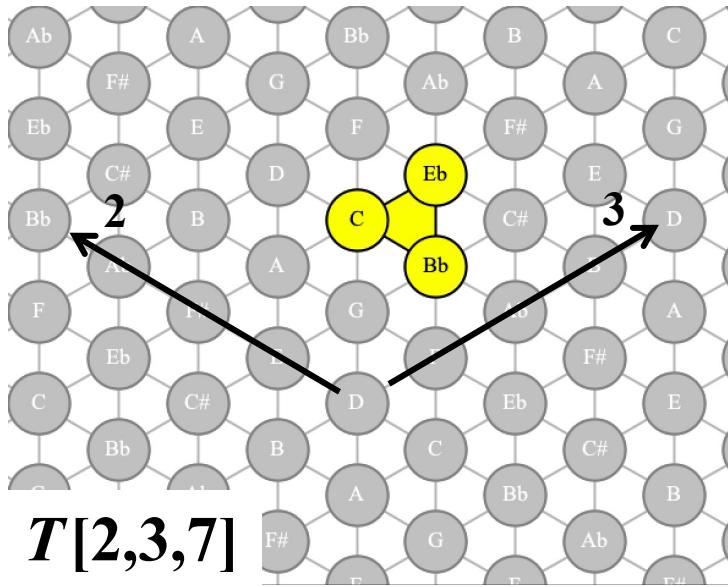
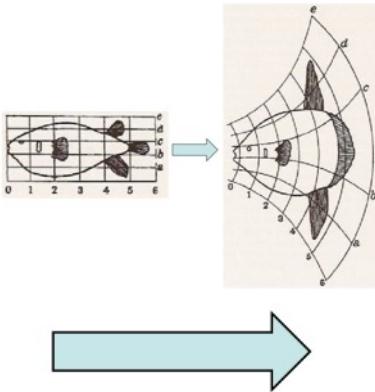
Signal-based Music Information Retrieval



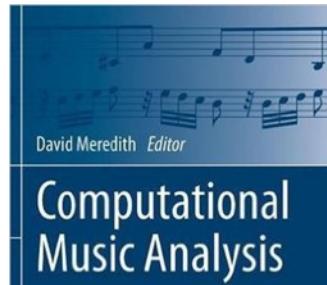
Musical style and space trajectories



$T[3,4,5]$



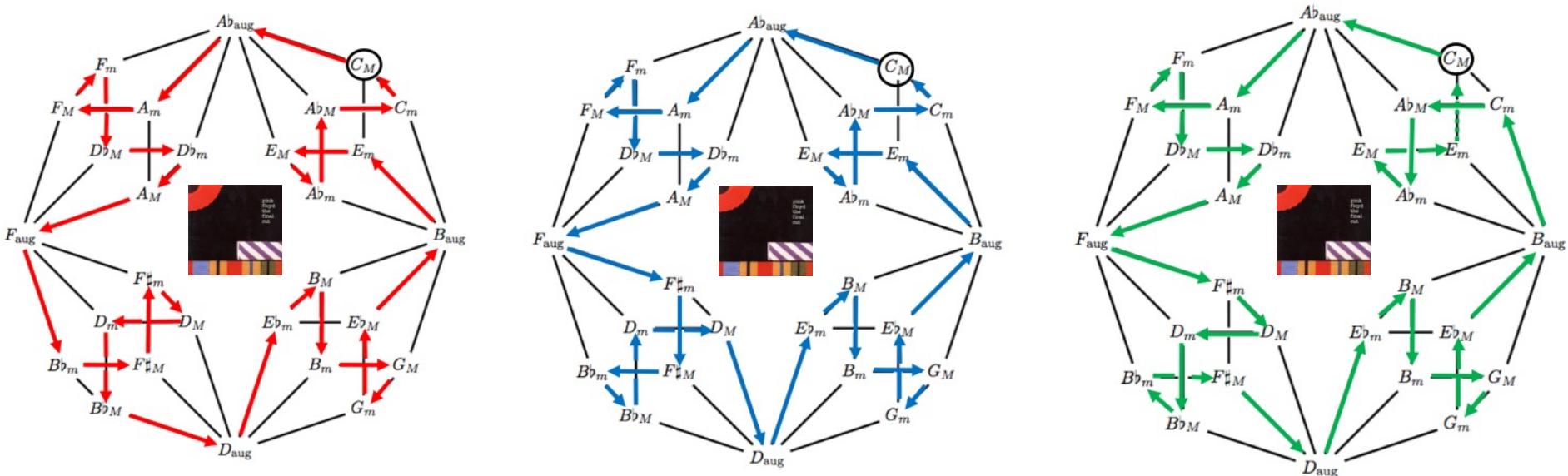
$T[2,3,7]$



Towards a geometry-based automatic musical style analysis

Bigo L., M. Andreatta (2015), Topological Structures in Computer-Aided Music Analysis, in D. Meredith (ed.), *Computational Music Analysis*, Springer

The Gunner's Hamiltonian Dream (a *OuMuPo* experience around Pink-Floyd)



The three Hamiltonian Cycles ($C_M = C$, $C_m = Cm$, $C_{aug} = C+$)

C-->C+-->Am-->F-->Fm-->C#-->C#m-->A-->F+->Bbm-->F#-->F#m-->D-->Dm-->Bb-->D+->Ebm-->B-->Bm-->-->G-->Gm-->Eb-->G+->Em-->E-->G#m-->G#-->Cm-->C

C-->C+-->Am-->F-->Fm-->C#-->C#m-->A-->F+->F#m-->F#-->Bbm-->Bb-->Dm-->D-->D+->Ebm-->B-->Bm-->-->G-->Gm-->Eb-->G+->Em-->E-->G#m-->G#-->Cm-->C

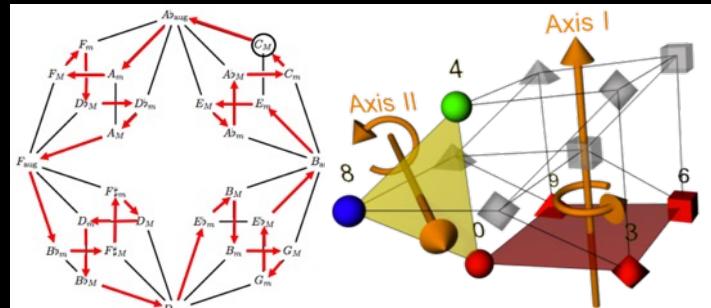
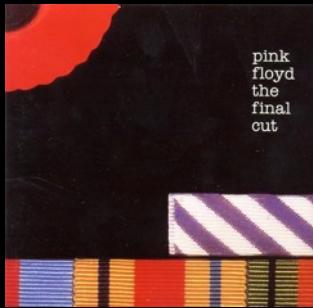
C-->C+-->Am-->F-->Fm-->C#-->C#m-->A-->F+->F#m-->D-->Dm-->Bb-->Bbm-->F#-->D+->Ebm-->B-->Bm-->-->G-->Gm-->Eb-->G+->Cm-->G#-->G#m-->E-->Em-->C

HamilFloyd

4D & 2D Visualizations
Hamiltonian Cycles
M.Andreatta, G.Baroin 2020

→ <http://mathemusic.net/>

Composition, Performance: Moreno Andreatta
Hypersphere, Graphics, Animations: Gilles Baroin
Original "Cube Dance" graph: J.Douthett, P.Steinbach



HamilFloyd

The Gunner's
Hamiltonian Dream



Moreno Andreatta
Gilles Baroin 2021



Thank you for your attention!

