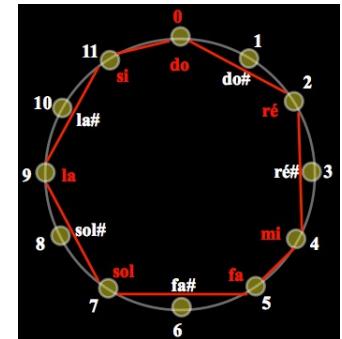
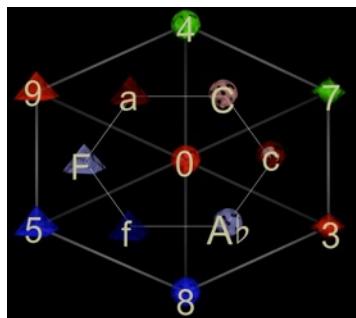


# Rules and constraints in song writing: a focus on some Oumupian experiences



CNRS / IRMA / Université de Strasbourg  
IRCAM / Sorbonne Université

[www.morenoandreatta.com](http://www.morenoandreatta.com)



# Antes, despues

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

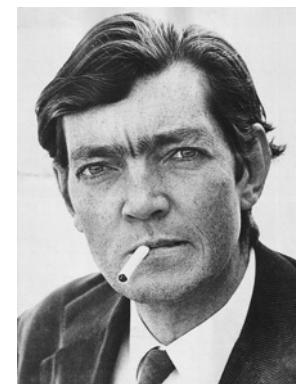
aunque no haya huella ni presagio  
como la caricia a la mano  
el perfume dibuja el jazmín  
el amante precede al amor  
pero inevitablemente  
el amor sobrevive al amante  
como los juegos al llanto  
como la sombra a la columna

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*

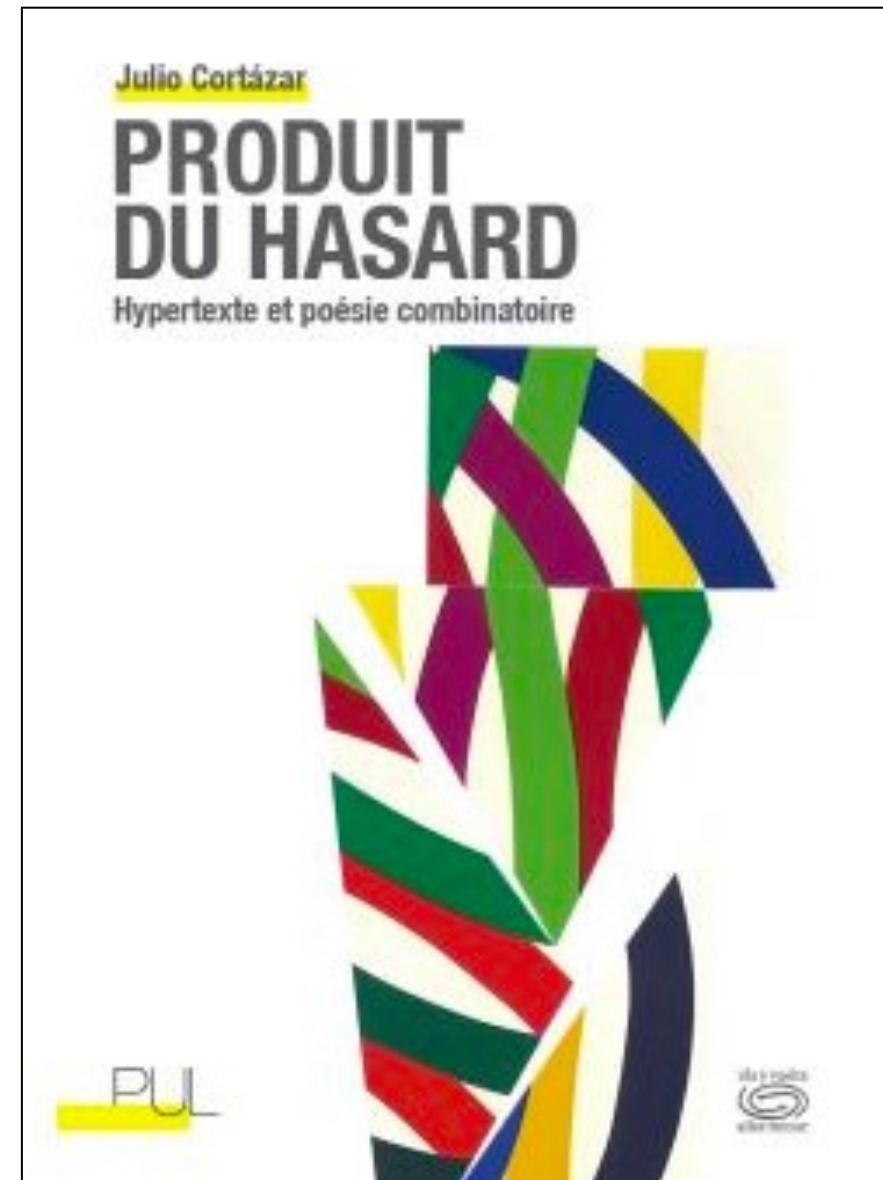
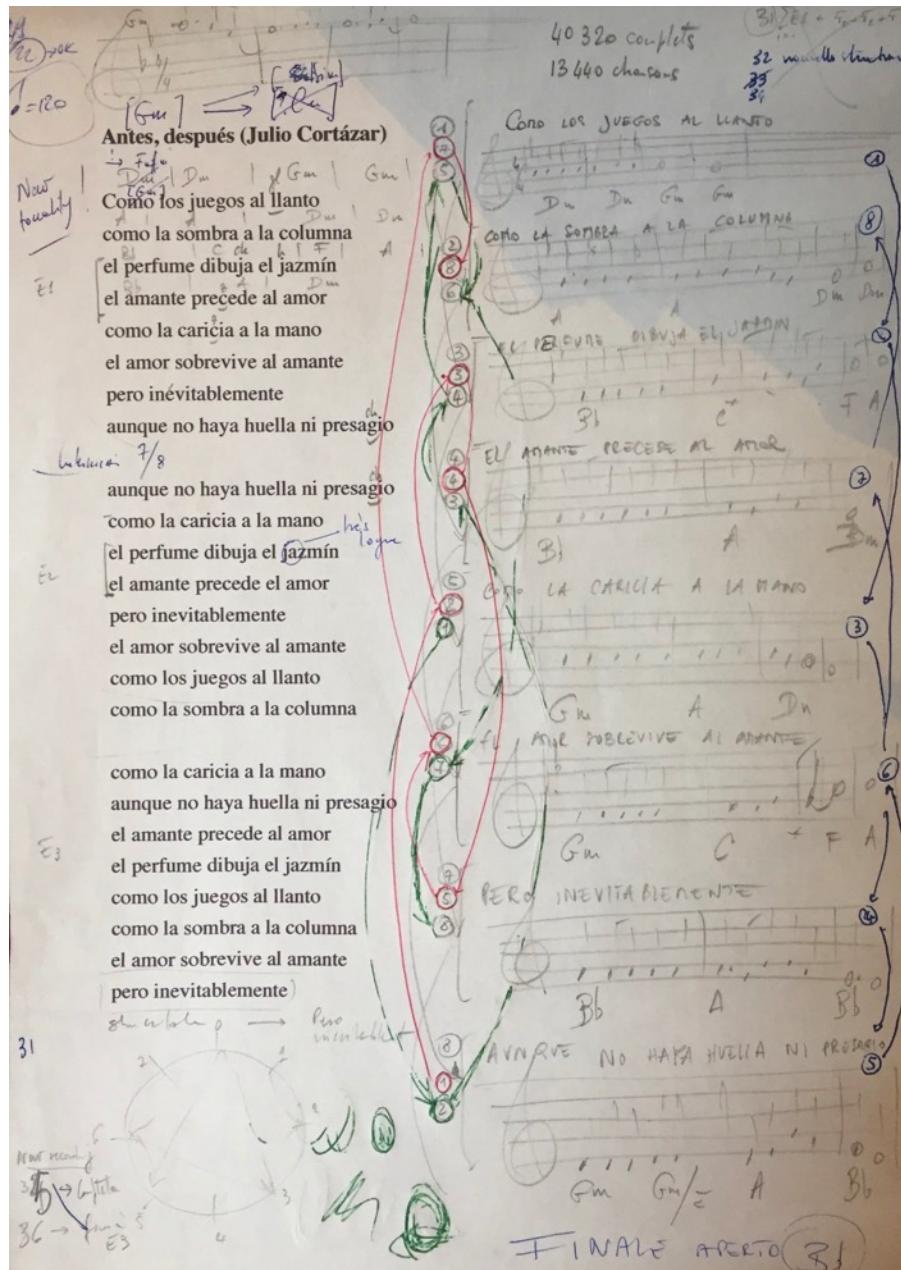
*Anche in assenza di traccia o di presagio  
come la carezza la mano  
il profumo disegna il gelsomino  
l'amante precede l'amore  
ma allora inevitabilmente  
l'amore fa durare l'amante  
come i giochi le lacrime  
come l'ombra la colonna*

*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

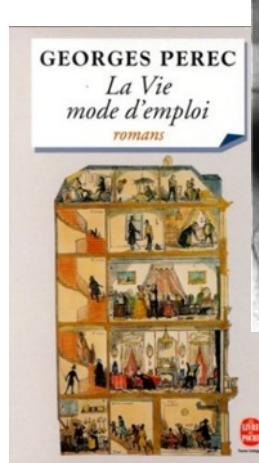
# A permutation song based on a permutational poem



# Rules and constraints in the artistic process



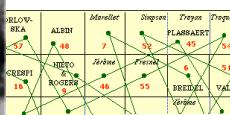
*Cent mille milliards de poèmes*, 1961



*La vie mode d'emploi*,



Georges Perec



OuLiPo (Ouvroir de  
Littérature Potentielle)

Georges  
Perec

Roman

La disparition

Les Lettres Nouvelles

Denoël



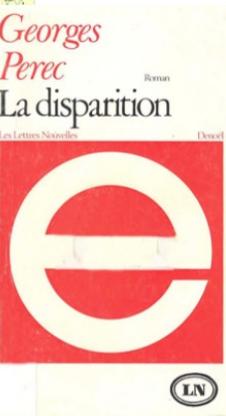
Raymond Queneau



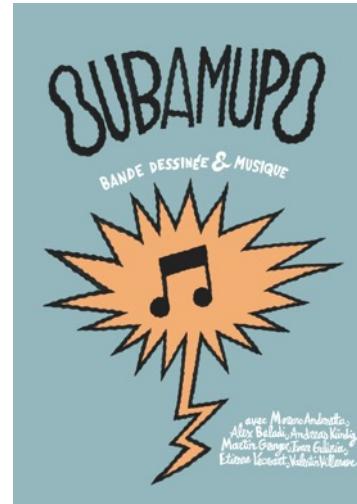
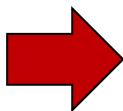
Italo Calvino  
*Il castello dei destini incrociati*, 1969



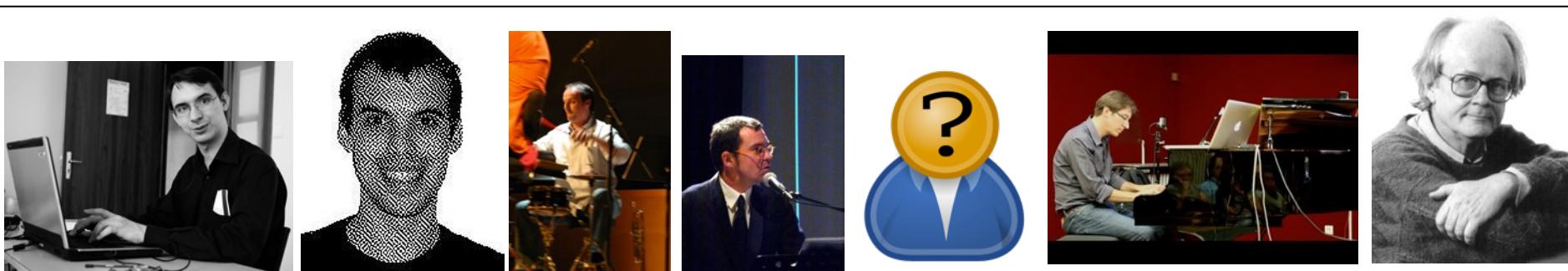
# From the OuLiPo to the OuMuPo (ouvroir de musique potentielle)



Raymond Queneau



<http://oumupo.org/>



Valentin Villenave

Mike Solomon

Jean-François  
Piette

Martin  
Granger

Joseph Boisseau

Moreno Andreatta

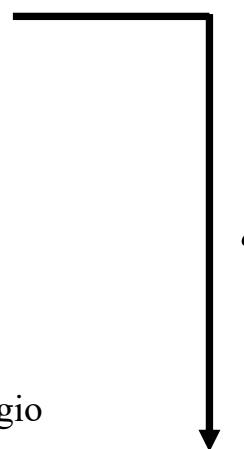
Tom Johnson

# A double rhythmic constraints

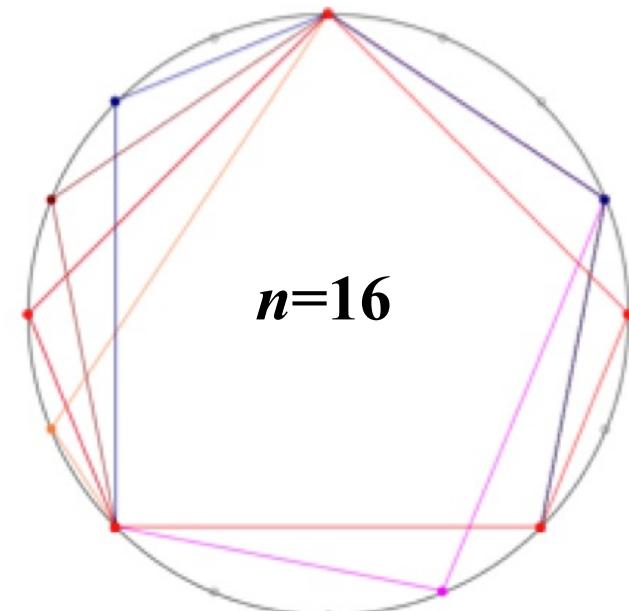
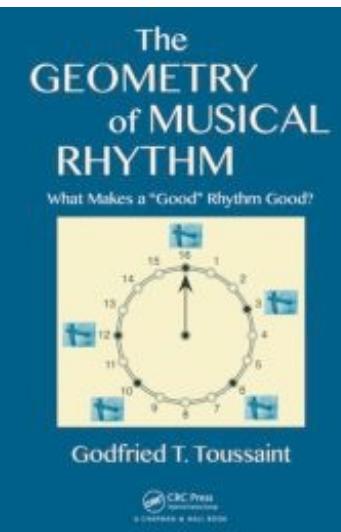
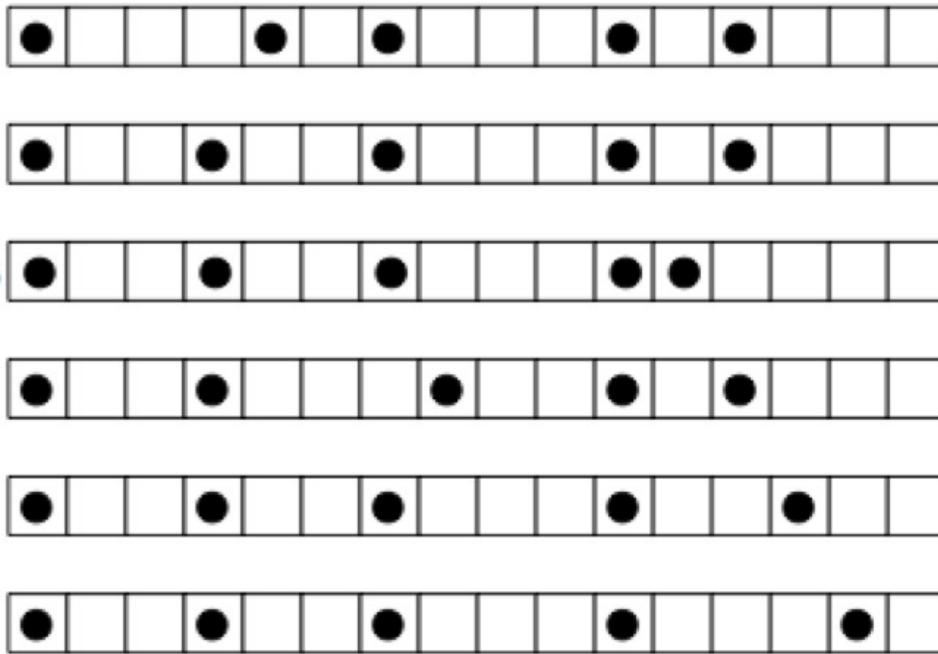
Antes, despues (J. Cortazar / M. Andreatta)

[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

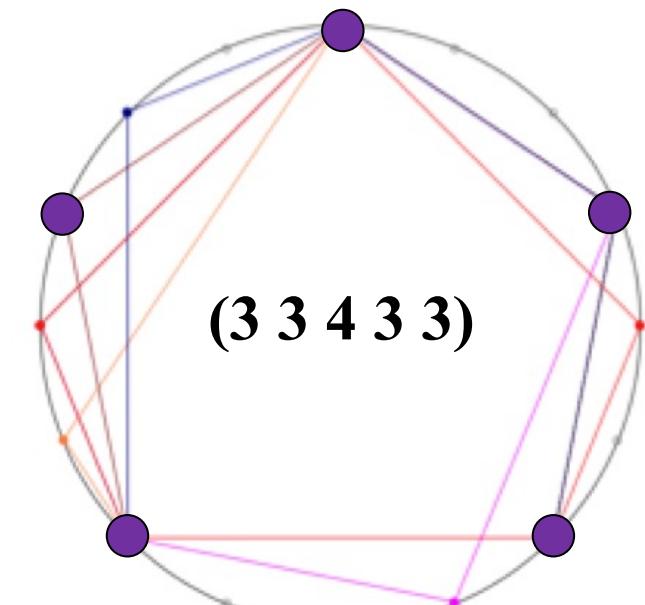
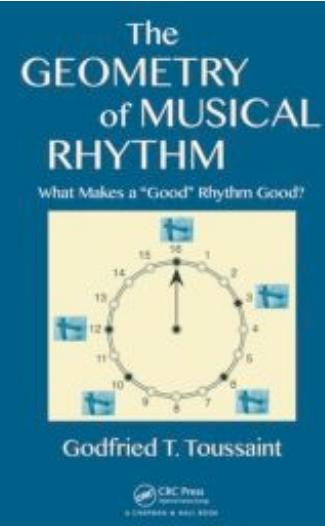
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el amor sobrevive al amante  
pero inevitablemente  
aunque no haya huella ni presagio



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



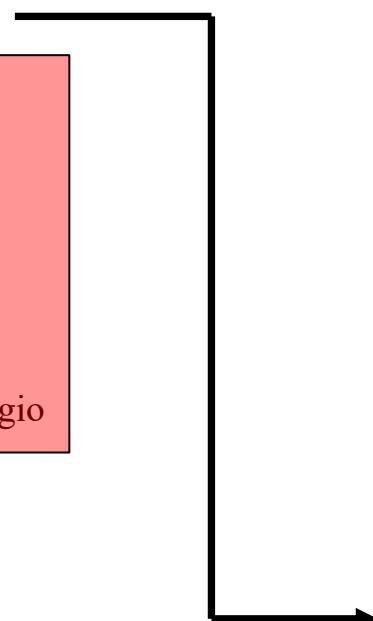
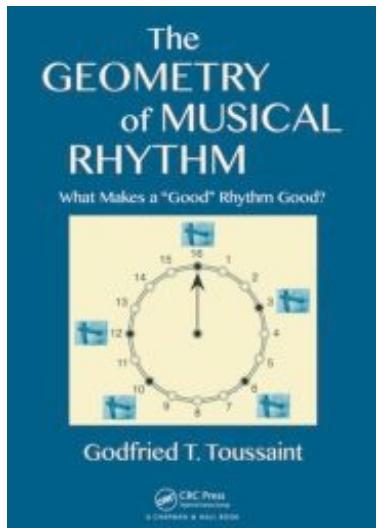
# A double rhythmic constraints

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

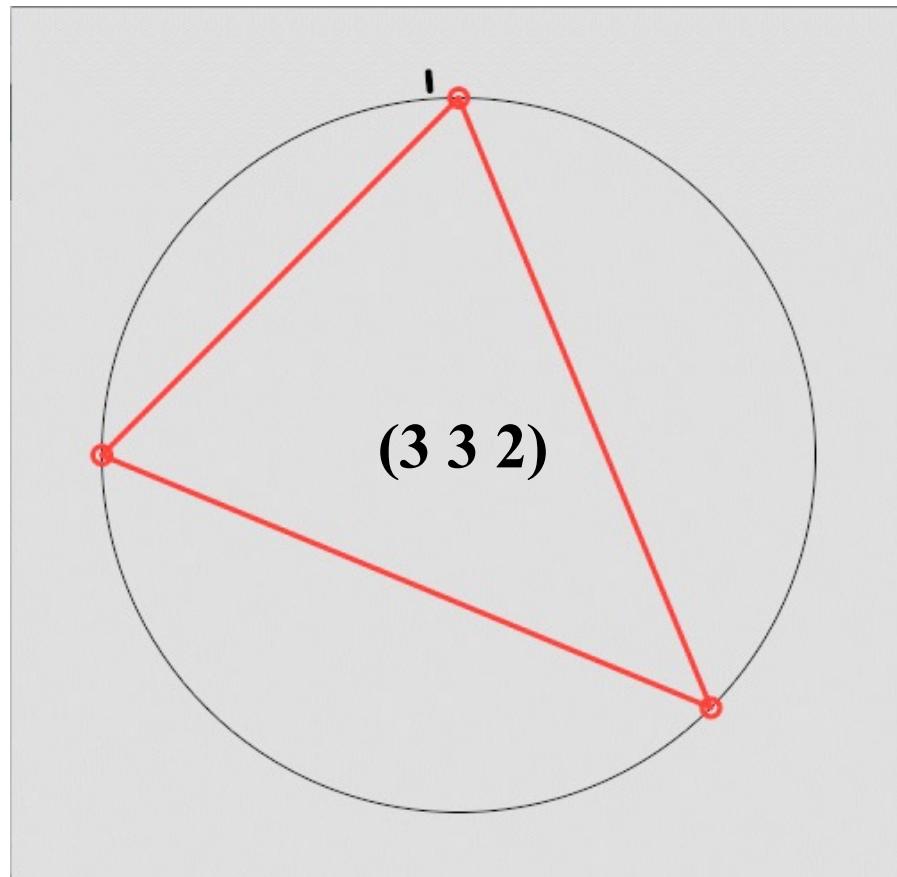
[Instrumental introduction]

Como los juegos al llanto  
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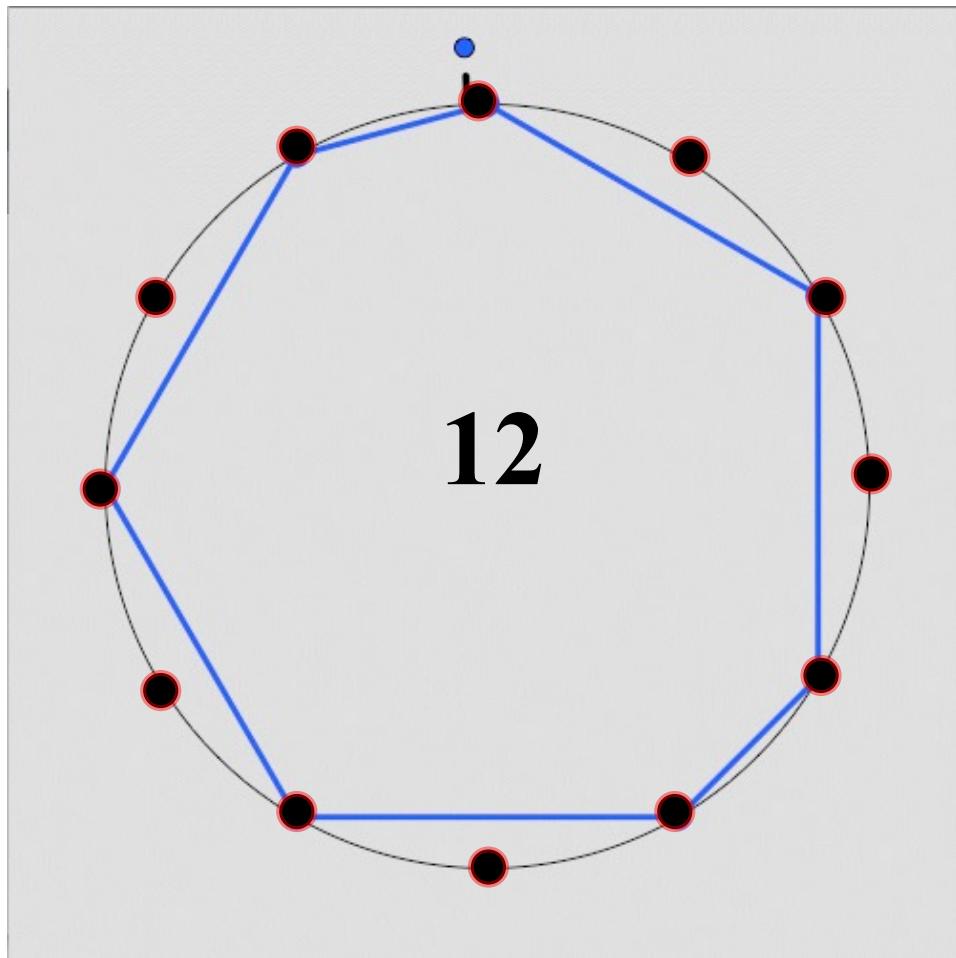
...



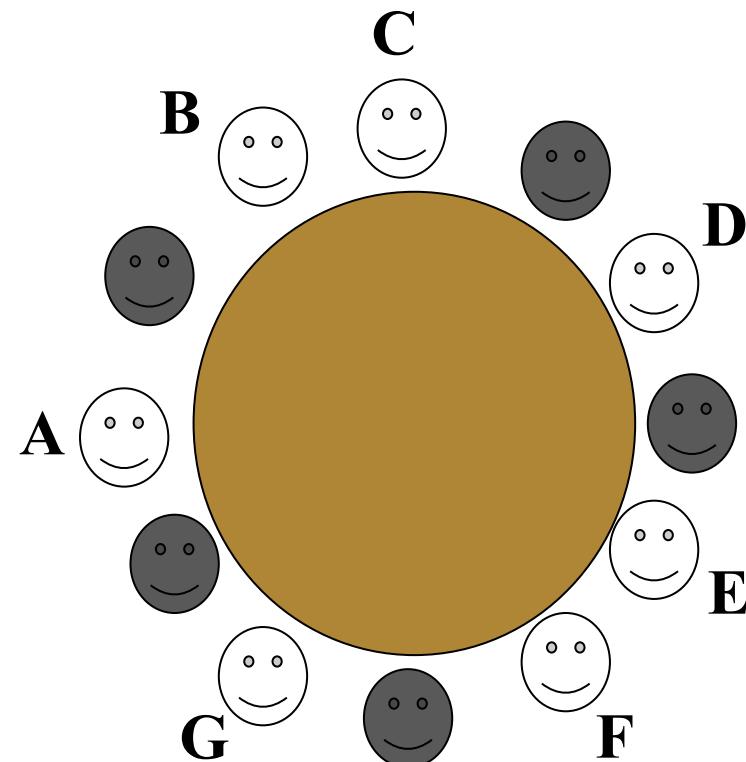
## *El trecillo*



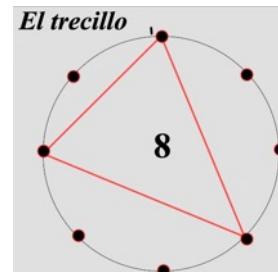
# Maximally-Even rhythms and the Dinner Table Problem



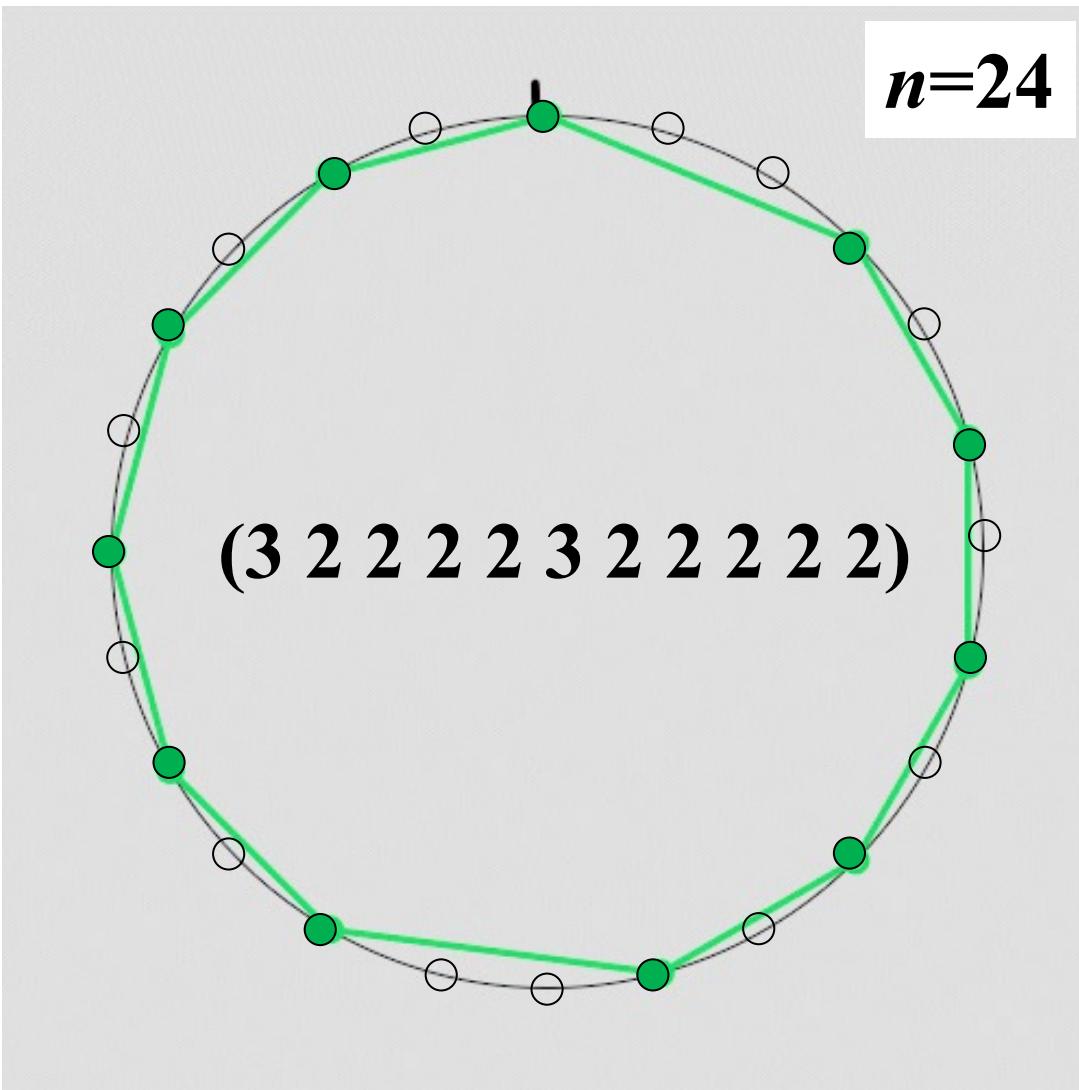
Abadja ou Bembé



*Dinner Table Problem*



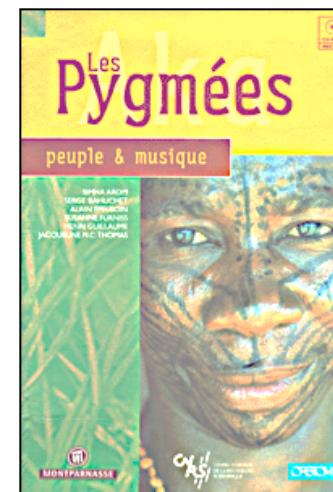
# Odditive property of orally-trasmitted practices



Simha Arom



Marc Chemillier

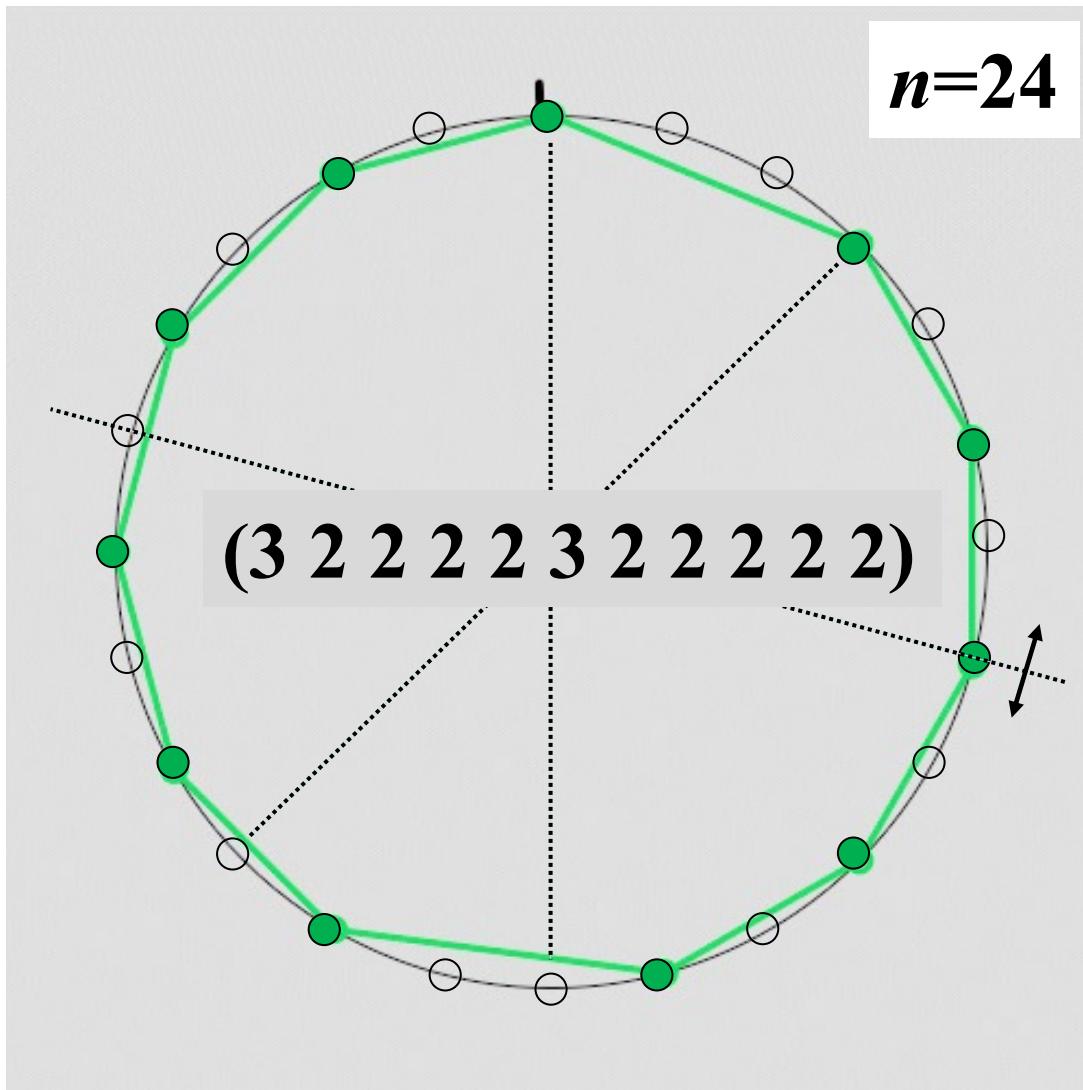


musimédiane

publiée avec le concours de la SFAM

revue audiovisuelle et multimédia d'analyse musicale

# Odditive property of orally-trasmitted practices



$n=24$

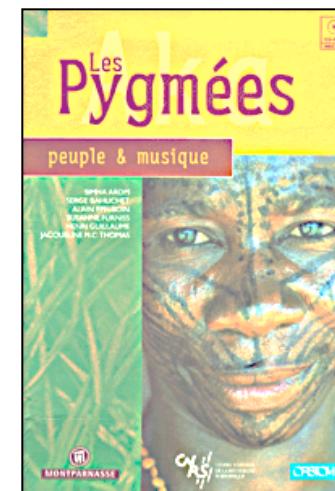
$(3 \ 2 \ 2 \ 2 \ 2 \ 2 \ 3 \ 2 \ 2 \ 2 \ 2 \ 2)$



Simha Arom



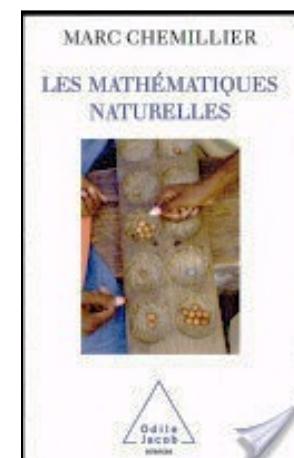
Marc Chemillier



**musimédiane**

publiée avec le concours de la SFAM

revue audiovisuelle et multimédia d'analyse musicale



# Algorithmic processes vs algorithmic music

## Minuet

Musical score for a Minuet, showing four systems of music. The measures are numbered as follows:

- System 1: M8, M84, M114, M63
- System 2: M28, M37, M106, M100
- System 3: M65, M139, M150, M29
- System 4: M137, M115, M44, M93

Here is your piece...

Your piece is composed of the following measures:

MINUET:

3 84 114 53 28 37 106 100 35 139 150 29 137 115 44 93

TRIO:

18 3 16 68 4 27 52 80 11 20 93 48 12 23 78 21



(<http://sunsite.univie.ac.at/Mozart/dice/>)

# Algorithmic processes vs algorithmic music

M3 M84 M114 M53

M28 M87 M105 M100

M55 M139 M150 M29

M137 M115 M144 M93

**Here is your piece...**

Your piece is composed of the following measures:

**MINUET:**

3 84 114 53 28 37 106 100 35 139 150 29 137 115 44 93

**TRIO:**

18 3 16 68 4 27 52 80 11 20 93 48 12 23 78 21

M96 M15 M171 M56

M80 M87 M110 M94

M25 M20 M108 M132

M112 M108 M173 M172

**Here is your piece...**

Your piece is composed of the following measures:

**MINUET:**

96 95 171 156 80 37 110 94 25 20 108 132 112 38 173 172

**TRIO:**

72 82 16 53 65 27 26 61 9 92 24 84 30 23 78 10

# Algorithmic processes vs algorithmic music

Here is your piece...

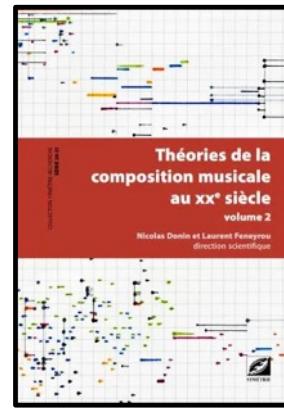
Your piece is composed of the following measures:

**MINUET:**

3 84 114 53 28 37 106 100 35 139 150 29 137 115 44 93

**TRIO:**

18 3 16 68 4 27 52 80 11 20 93 48 12 23 78 21



Here is your piece...

Your piece is composed of the following measures:

**MINUET:**

96 95 171 156 80 37 110 94 25 20 108 132 112 38 173 172

**TRIO:**

72 82 16 53 65 27 26 61 9 92 24 84 30 23 78 10

# Quartet No. 4 for strings (*Illiad Suite*, 1957)

L. Hiller & L. M. Isaacson, *Experimental Music: Composition With an Electronic Computer*, McGraw-Hill, New York, 1959.

(A) *ADAGIO, MA NON TROPPO LENTO*

(B)

(C)

(D)

(E)

(F)

(G)

(H) CODA



A · M · I · C · V · S  
ART MUSICA ILLICIA CONSIDERATIONES VARIIS INSTRUMENTIS  
PERIODUS CLASSIQUE  
Domus Germanique, I

Johann Joseph Fux

Gradus ad Parnassum (1725)

Texte original intégral  
Imitation réalisée à nous par  
Jean-Philippe Navarre



M A R D A G A

Lejaren Hiller and Leonard M. Isaacson, *Illiad Suite* (1957): experience 2. Eight sections, every section introducing a new rule :

- (A) Stochastic music (no rules)
- (B) Rule of the parsimonious movement and no more than one note repetition
- (C) *Cantus firmus* that starts with the note C and a C major chord.
- (D) Rule of octave attribution
- (E) Only consonant chords with the exception of chords in 6-4 position (second inversion)
- (F) Unisons, octave, fifths and parallel fourths
- (G) Parallel fifths and chords in 6-4 position and containing the interval of 10th
- (H) The « Best counterpoint »

# Algorithmic music and the « artificial composer »

« La musique algorithmique se distingue [...] des musiques concrète ou électronique [...] en ce qu'elle se veut **résolument systématique**. C'est, en d'autres termes, la recherche, l'élaboration et le classement des processus de mécanisation possibles sur des êtres sonores, une tentative d'industrialisation de la composition musicale. [...] Il s'agit :

1° d'établir un contrôle rigoureux des analyses des structures sonores qui constituent la musique, contrôle dont le critère ne peut être aujourd'hui que la possibilité de **mécanisation** ;

2° de mieux comprendre la nature de la création musicale en isolant expérimentalement son aspect objectif **formalisable** de son aspect proprement « humain » ;

3° de laisser la « machine » pousser à son extrême limite **la logique d'un système** dont elle fournirait un **modèle abstrait** sur lequel on peut encore s'interroger du point de vue « subjectif », mais en évitant [...] de confondre les problèmes de syntaxe avec ceux d'esthétique ;

4° d'**alléger le travail matériel du compositeur** et de simplifier et enrichir les méthodes d'enseignement de la composition musicale [...]

(P. Barbaud, Musique algorithmique, *Esprit*, 280, 1960, p. 92-96).



P. Barbaud (1911-1990)

## ESPRIT

La ville à trois vitesses :  
gentrification, exilisation, périurbanisation



Daniel Bégin, Catherine Belotti, Nathalie Bouchard, Jacques Brault,  
Frédéric Bruneau, Philippe Buteau, Dominique Berger, Philippe Bourassa,  
L'André Bérubé, Sébastien Bégin, Michel Blouin, Monique Charron, André Chalouan,  
Pierre Gagnon, André Gaudreault, Daniel Gélinas, André Guay, André Gosselin,  
Hélène Graveline, Marie-Hélène Hamelin, Hélène Papineau, André Paquin, Leslie Pignal

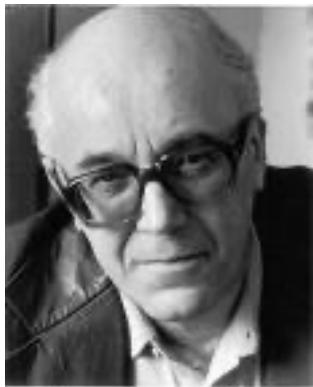
Éditions : métropolitaine et régionale, de périphérie et d'urbanité de l'île  
Île aux îles de Montréal, les délocalisations et celle des îles ? René Allard, l'île et le Québec,  
Les îles, la politique régionale, Georges Tremblay et l'organisation de la périphérie

Montréal 2001

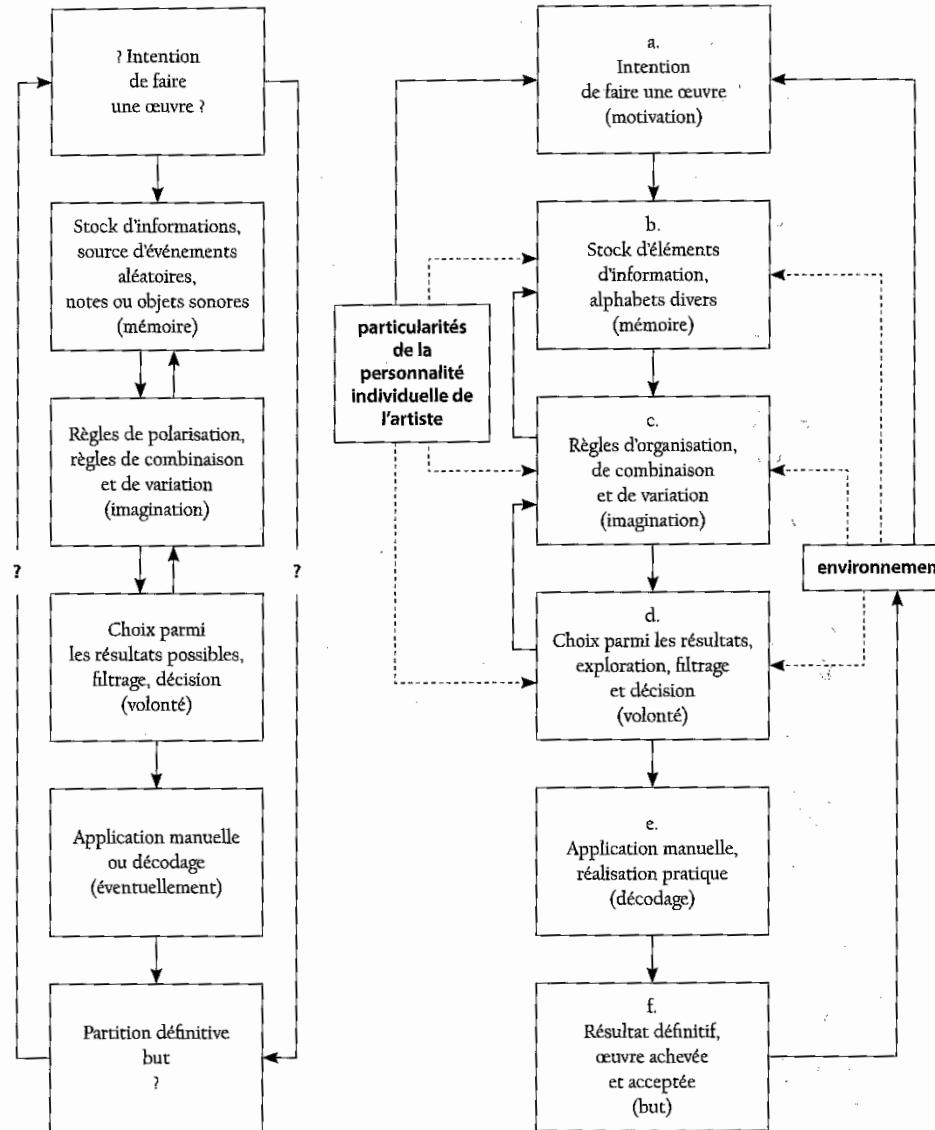
« But de ces recherches : **réduire au minimum** le travail fastidieux du compositeur et, à la limite, **remplacer celui-ci** »

(Comptes-rendus par M. Barbut du Séminaire sur les modèles mathématiques dans les sciences sociales, 1960-61, EPHE).

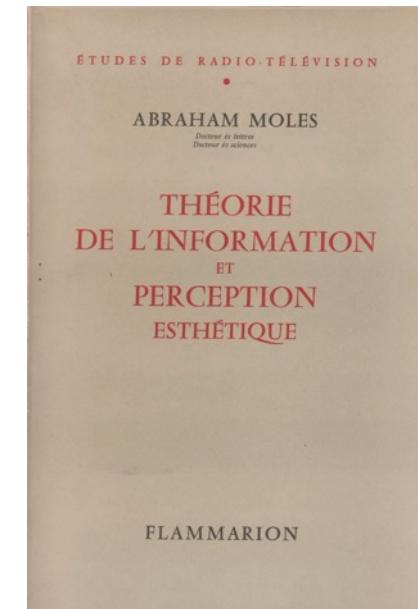
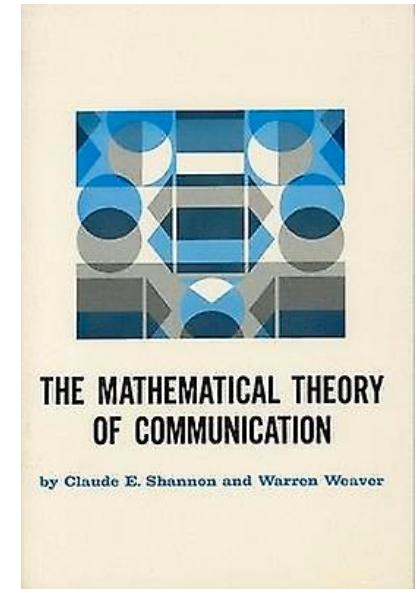
# Michel Philippot and the information theory paradigm



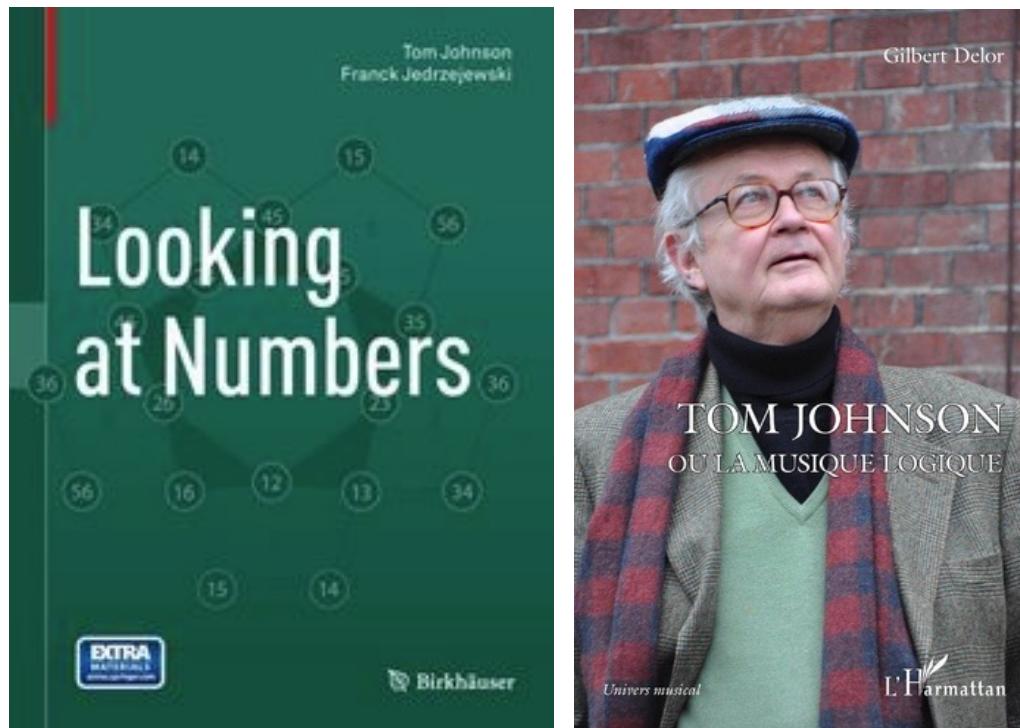
M. Philippot (1925-1996)



Exemple 3. Michel Philippot, « Le devoir d'inhumanité » (1960) et « À propos de mécanismes de création esthétique » (1966), évolution du diagramme fonctionnel de la composition musicale<sup>35</sup>.



# Tom Johnson's algorithmic composition: combinatorics



## The Chord Catalogue (for keyboard)

TOM JOHNSON

The 78 two-note chords possible in one octave:

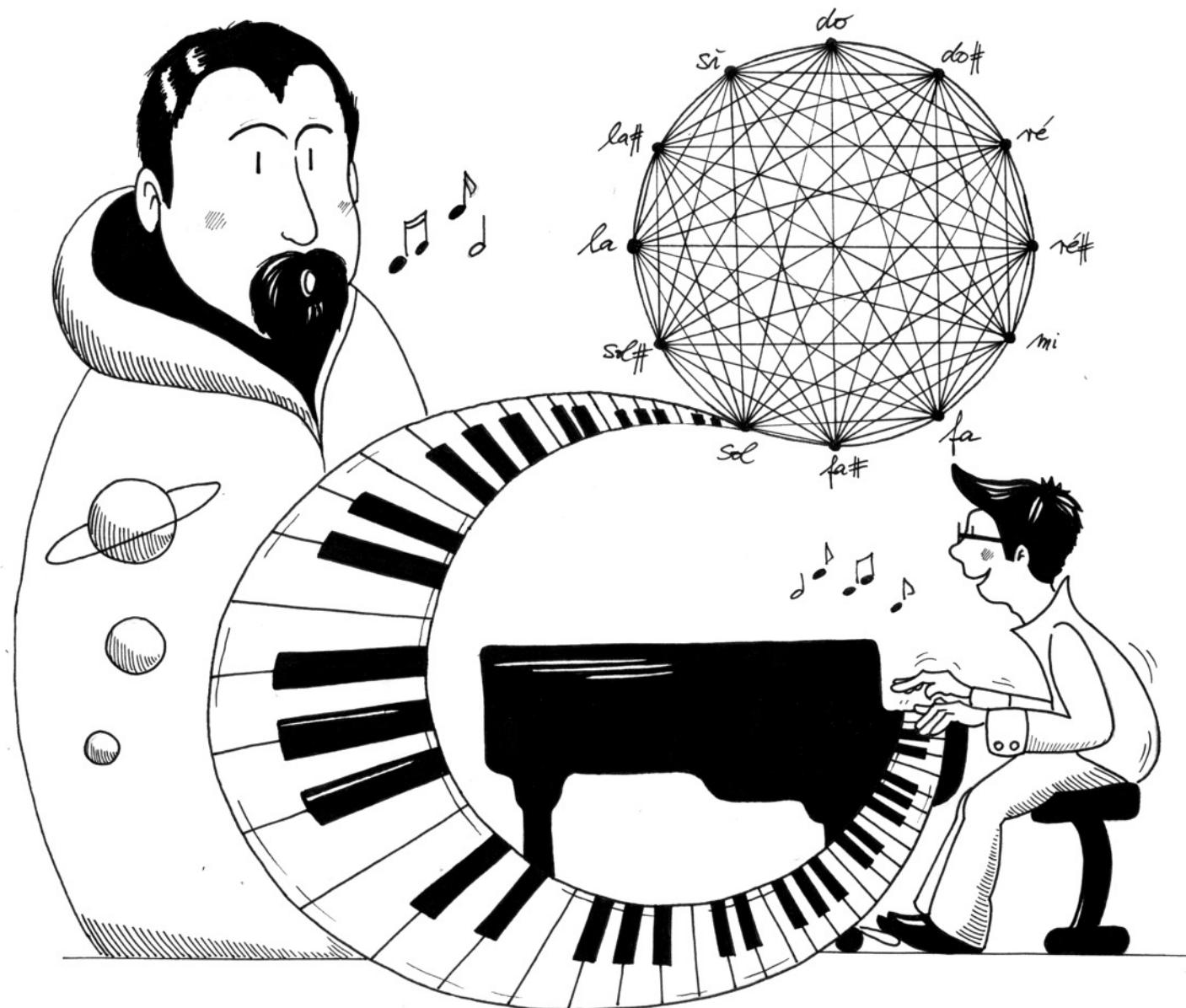
A musical score for a keyboard instrument showing 78 two-note chords arranged in a grid. The chords are represented by pairs of notes on a staff, with each pair having a unique pitch combination within the range of one octave.

The 286 three-note chords possible in one octave:

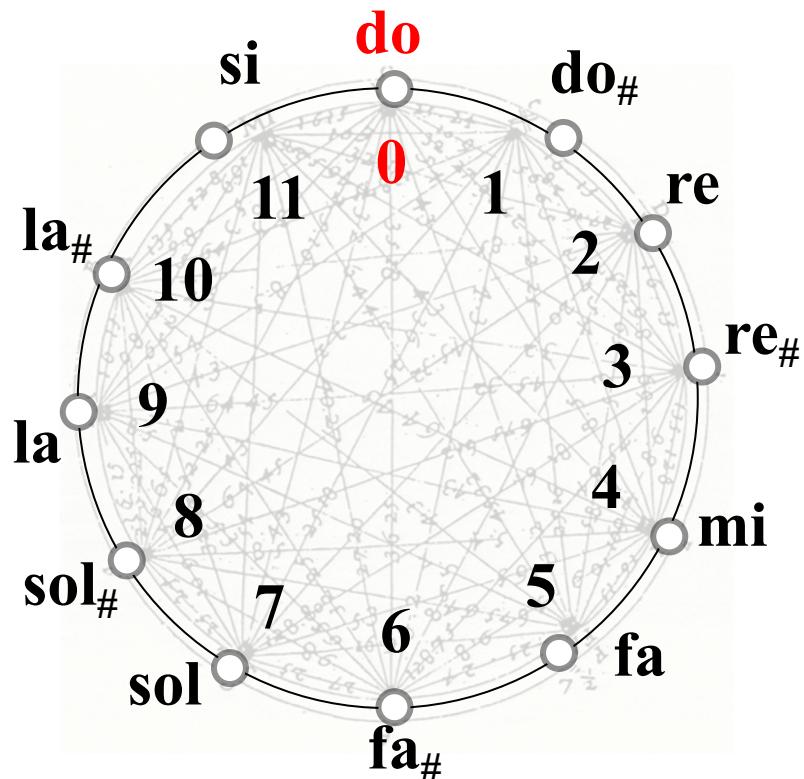
A musical score for a keyboard instrument showing 286 three-note chords arranged in a grid. The chords are represented by triplets of notes on a staff, with each triplet having a unique pitch combination within the range of one octave.

# Marin Mersenne, the father of combinatorics

---



# The circular representation of the pitch space

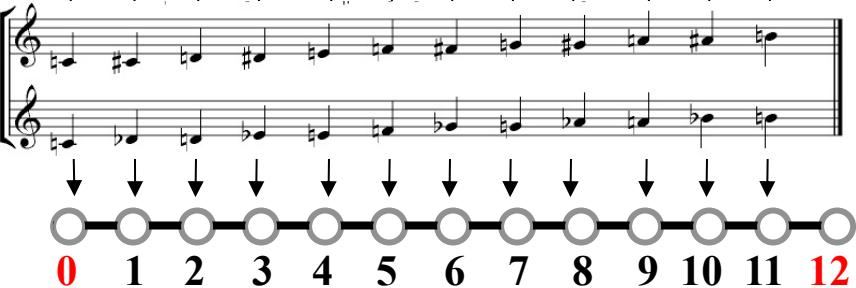


*Harmonicorum Libri XII, 1648*



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	20921789888000
XVII	335687418096000
XVIII	640373705718000
XIX	12164100408831000
XX	241290100876640000
XXI	51090942171709440000
XXII	11140007217777607680000

*Varietas, seu Combinatio quator notarum.*



# 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

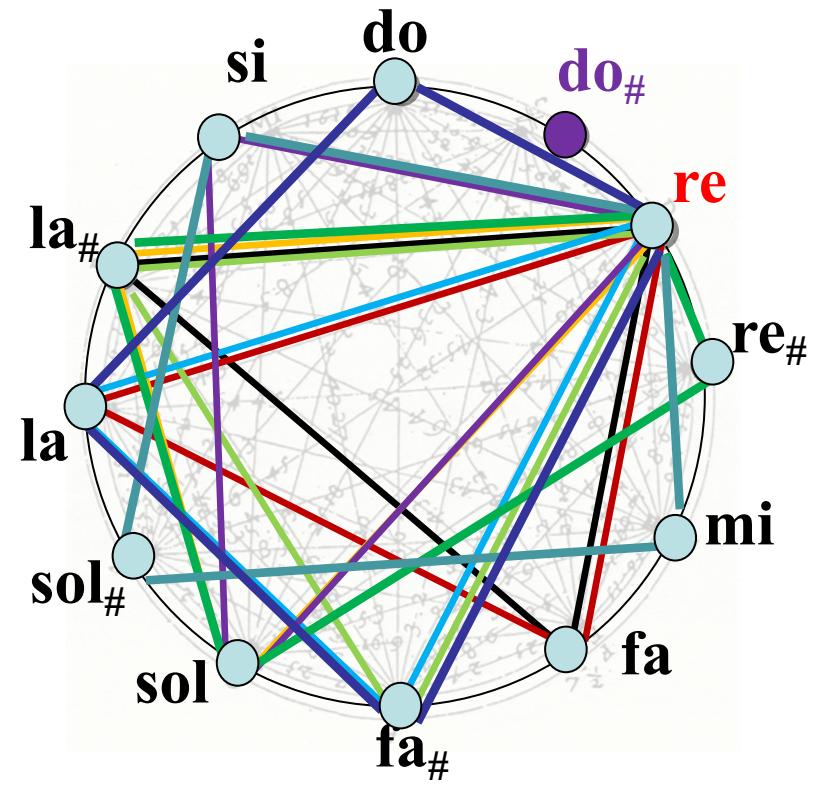
Una storia d'amore  
soltanto una volta una storia

Un amore  
una volta soltanto

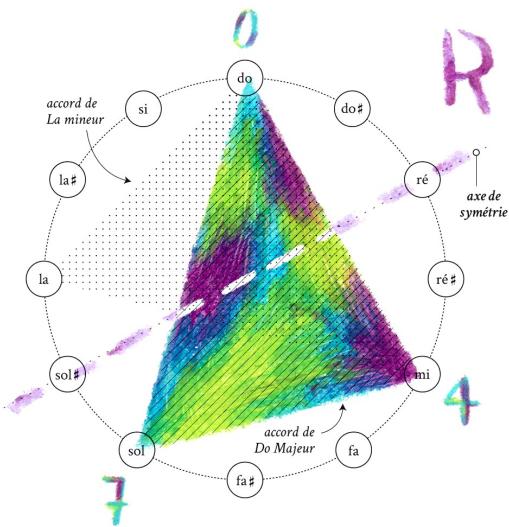
Un amore finisce  
soltanto

Una volta una storia d'amore finisce  
Un amore soltanto

Una volta soltanto una storia d'amore finisce



# The three main major-minor symmetries

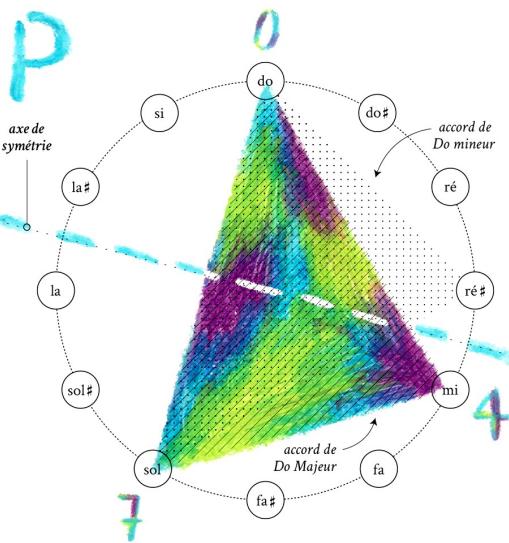


**R as RELATIVE**

C major



A minor

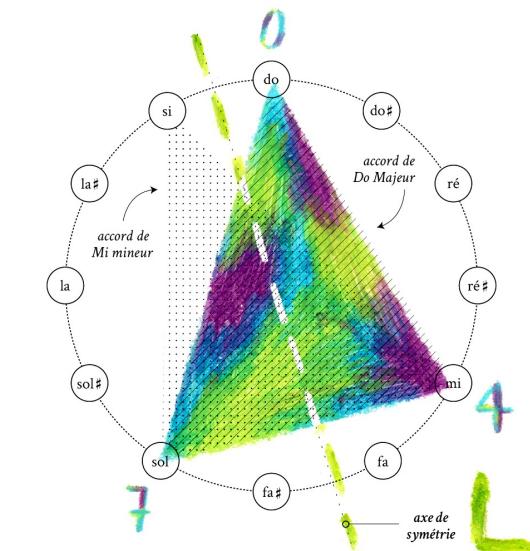


**P as PARALLEL**

C major



C minor



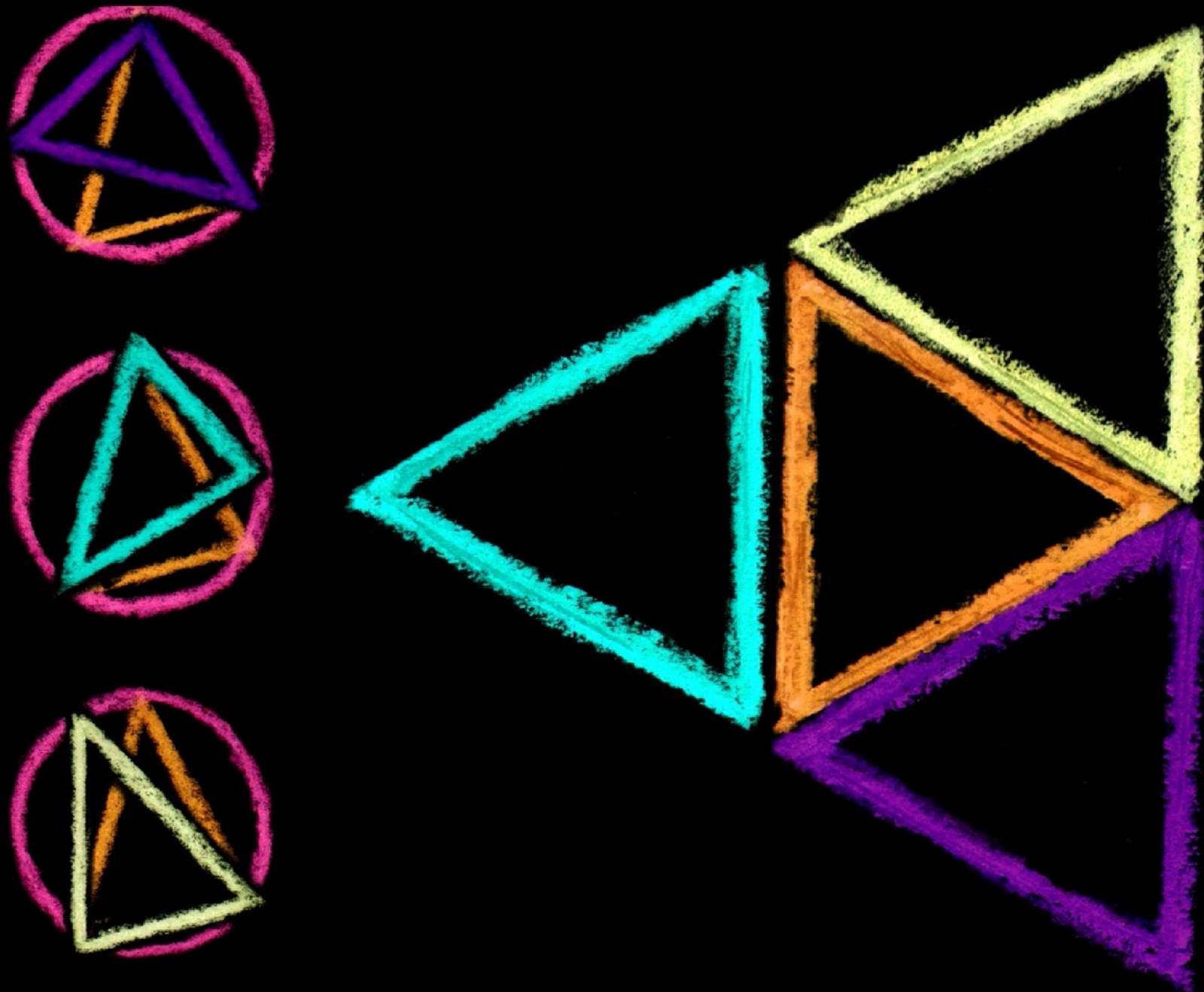
**L as LEADING-TONE  
(EXCHANGE)**

C major

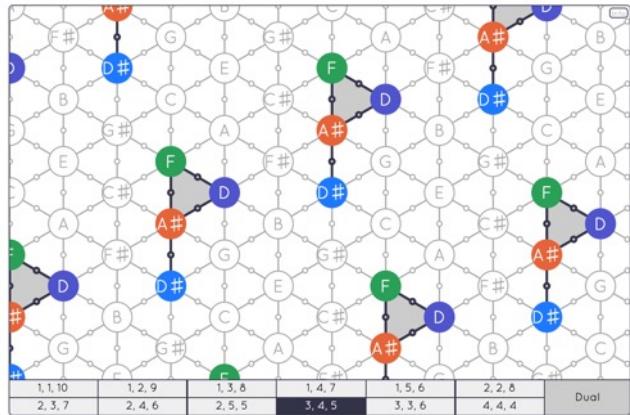


E minor

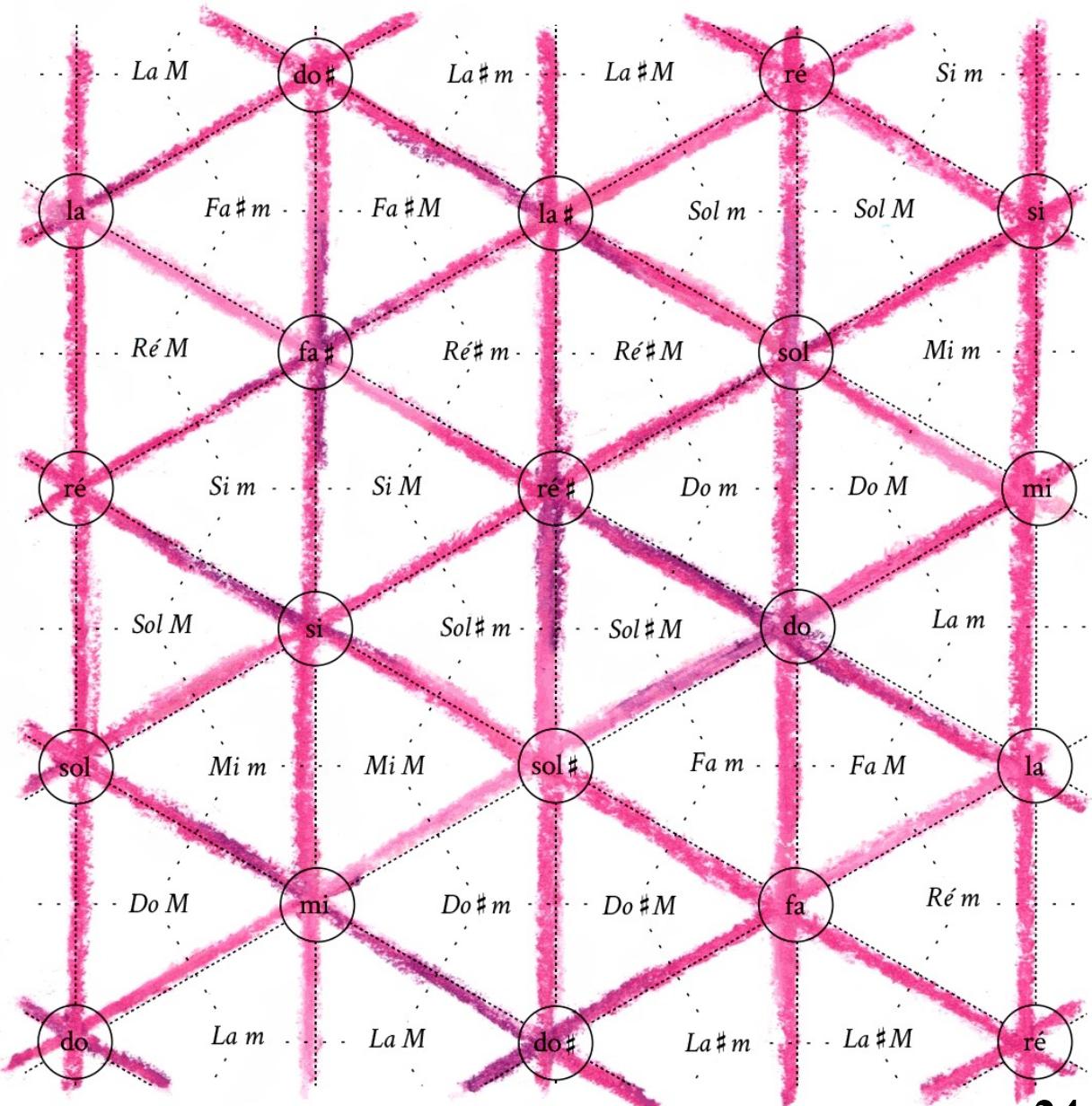
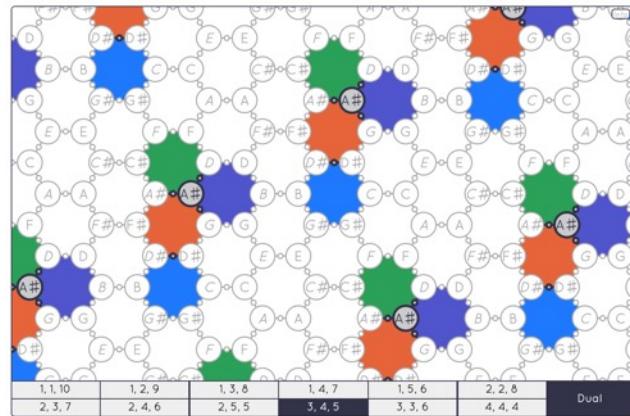
# From the circular representation to the *Tonnetz*



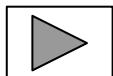
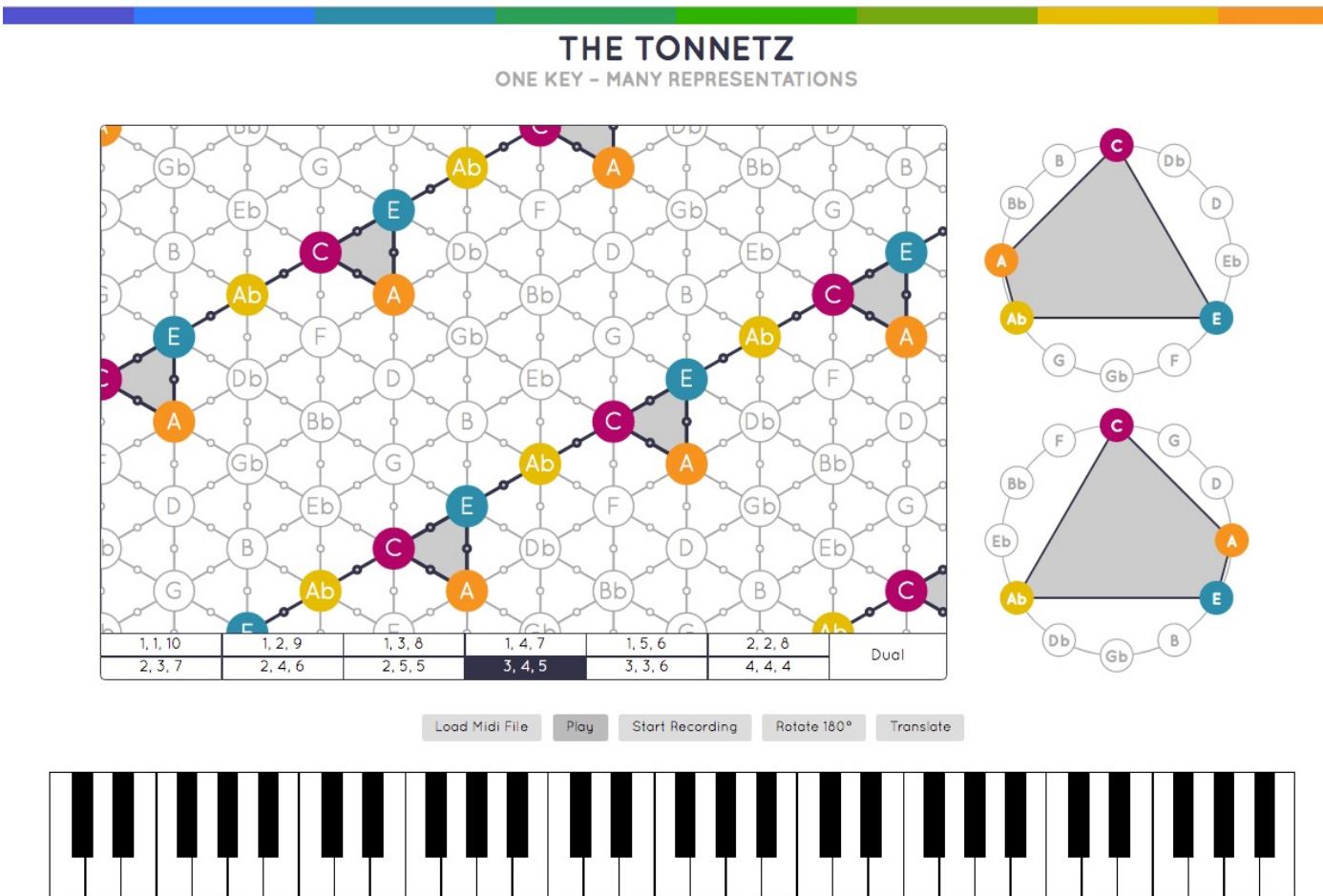
# From the Tonnetz to the dual one



duality

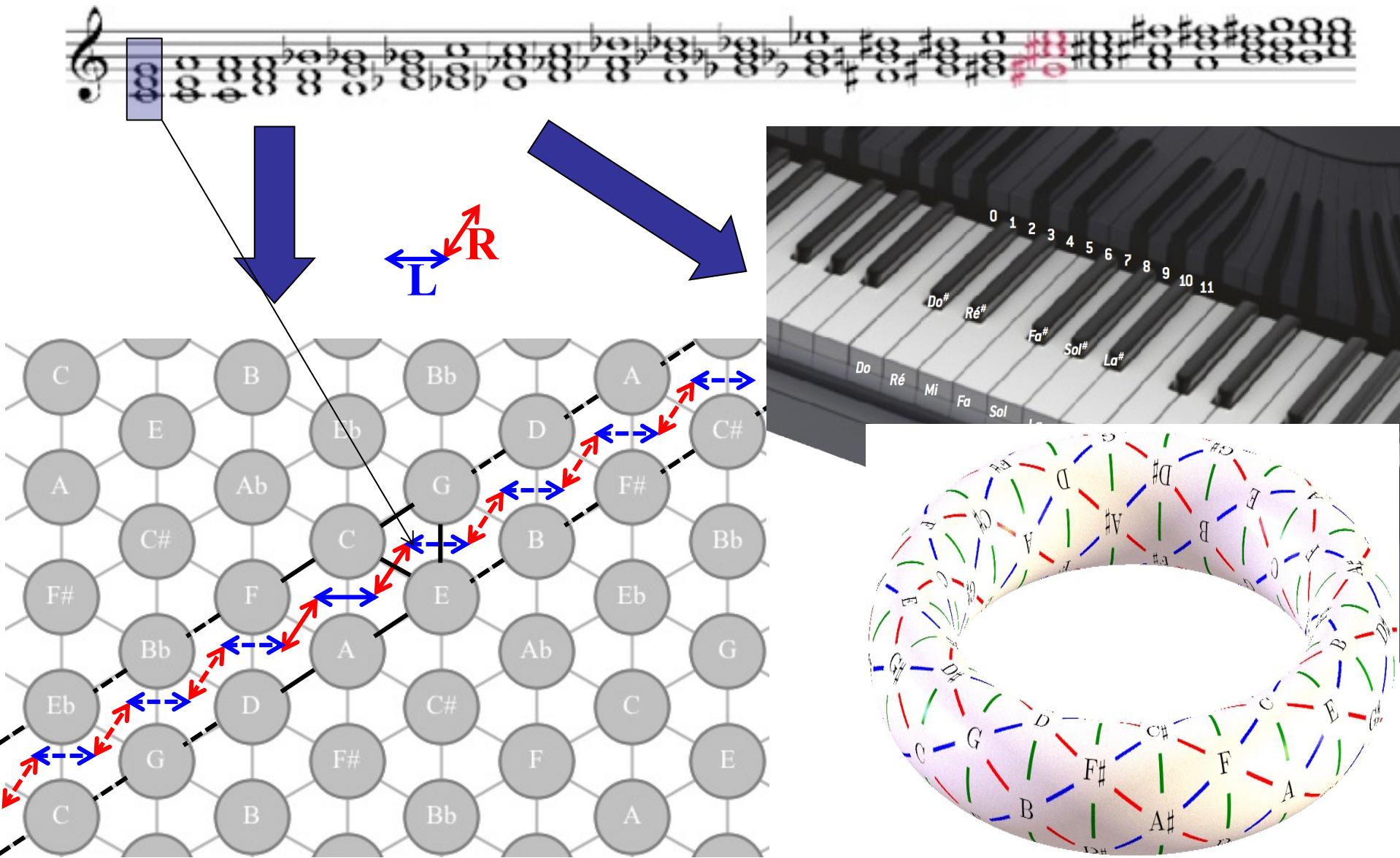


# The *Tonnetz* web environment (© SMIR Project)

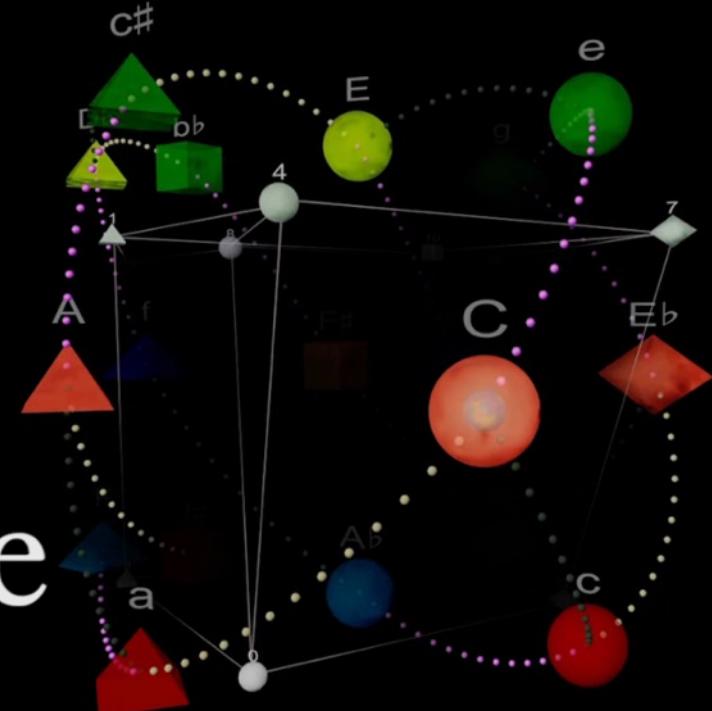


<https://morenoandreatta.com/software/>

# Harmonic progressions as spatial trajectories



# Beethoven and the Hypersphere *(and the Tonnetz)*



Gilles Baroin 2016  
[www.MatheMusic.net](http://www.MatheMusic.net)





# From poetry to song writing:

## hamiltonian compositional strategies

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

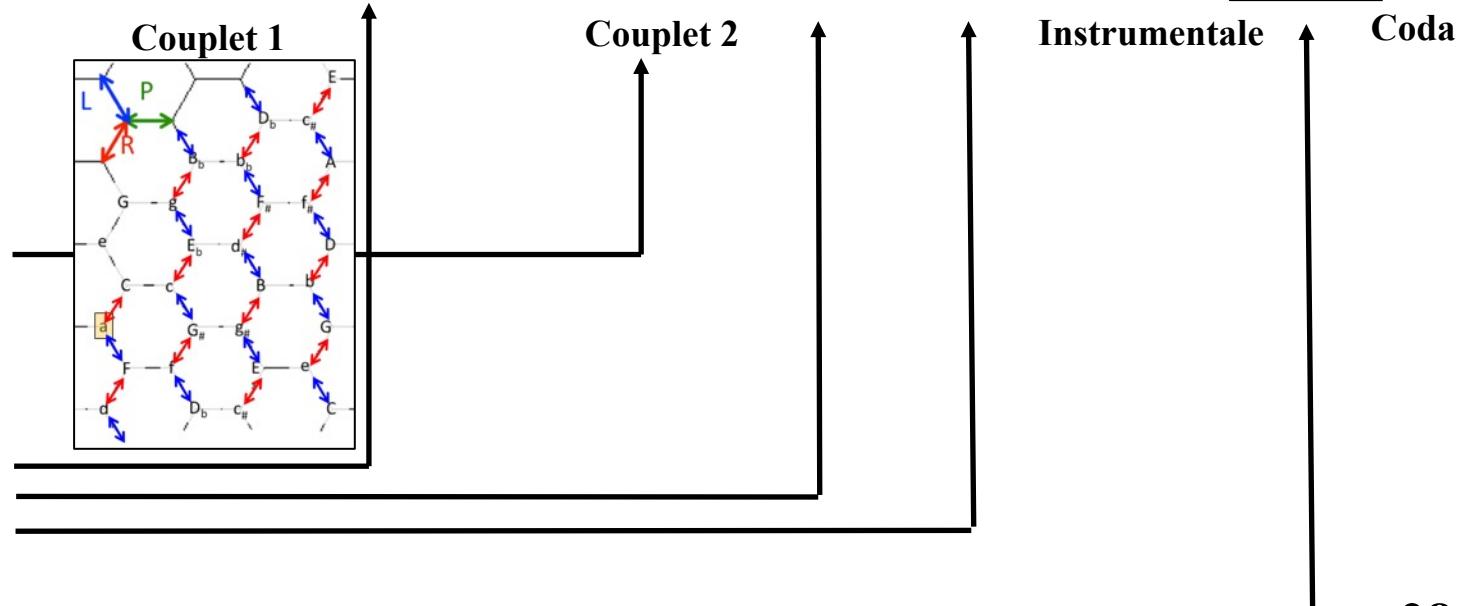
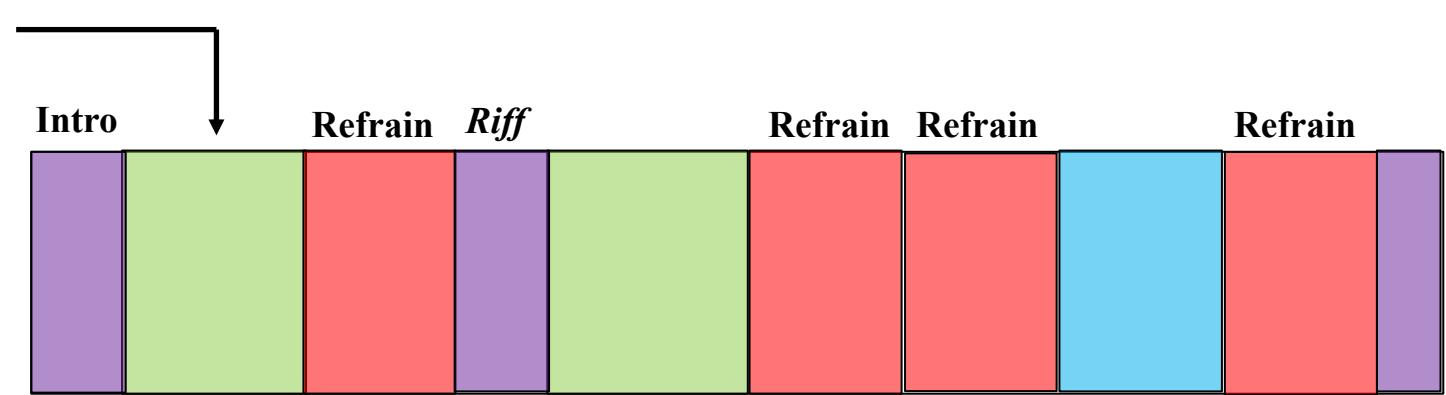
➔ [http://repmus.ircam.fr/\\_media/moreno/prix\\_chedid\\_2018\\_moreno.mp3](http://repmus.ircam.fr/_media/moreno/prix_chedid_2018_moreno.mp3)

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

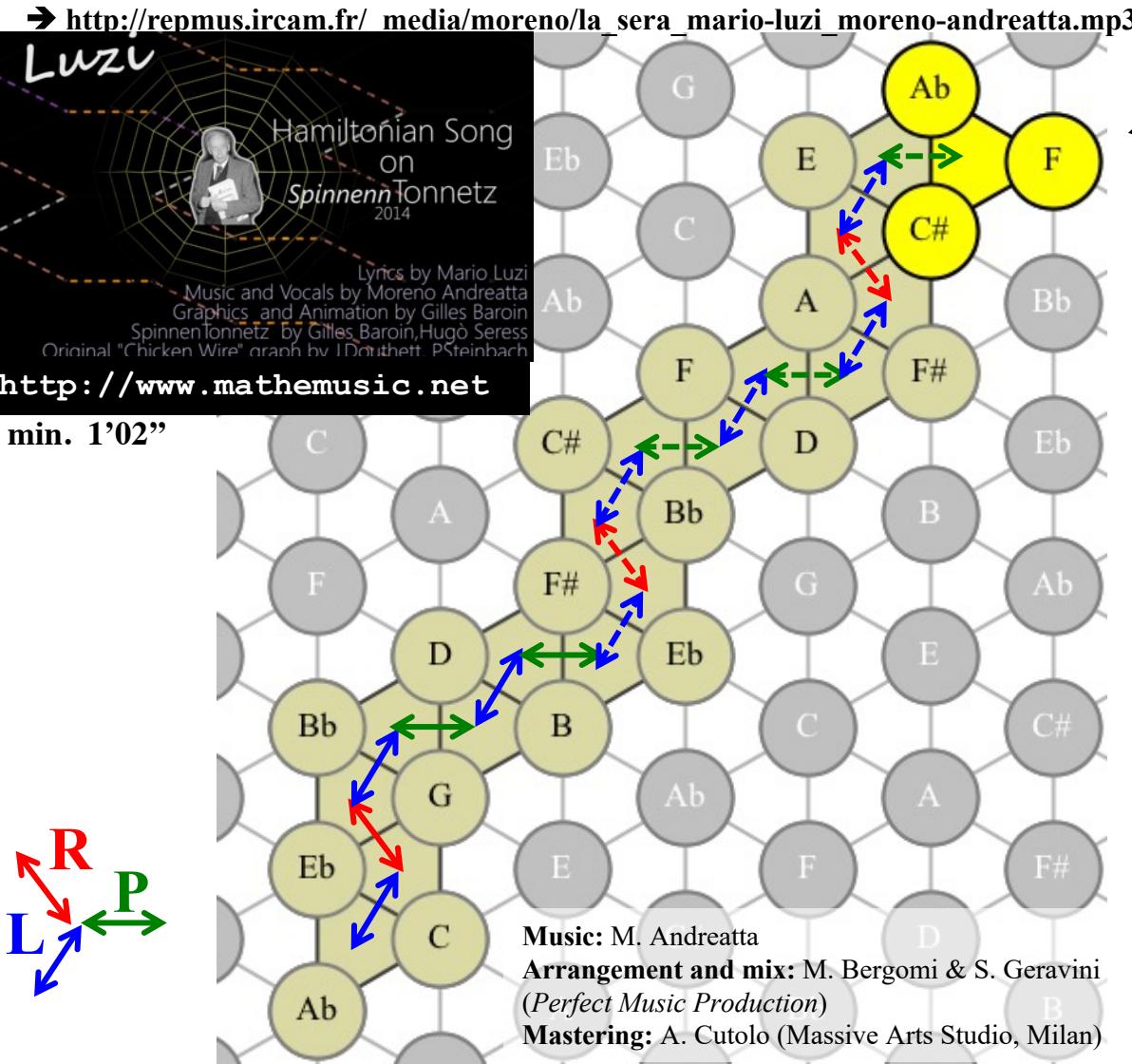


# Less trivial Hamiltonian Cycles

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-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 ...



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.

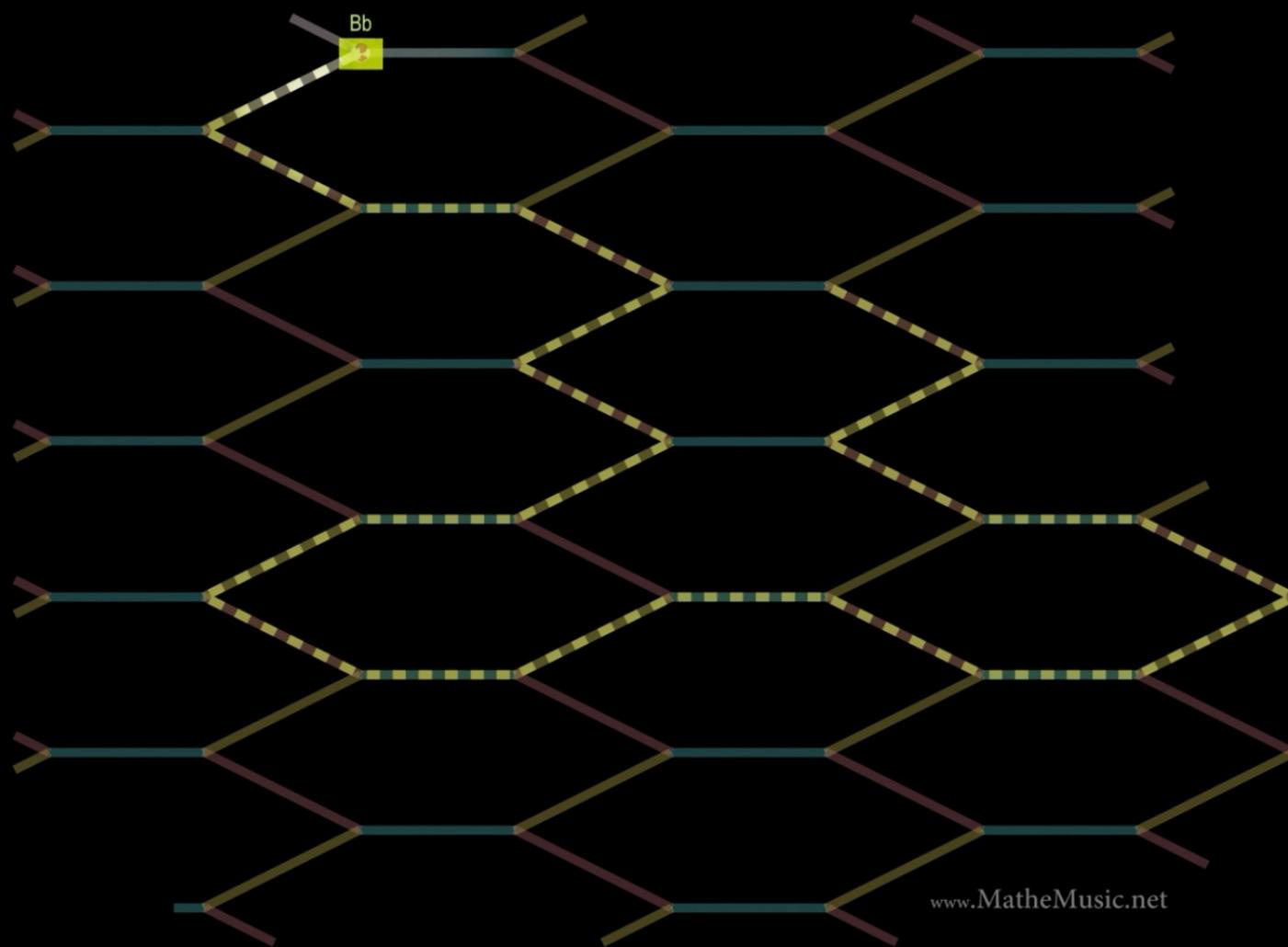
Ah questa luce viva e chiara viene  
 solo da te, sei tu così vicina  
 al vero d'una cosa conosciuta,  
 per nome hai una parola ch'è passata  
 nell'intimo del cuore e s'è perduta.

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).

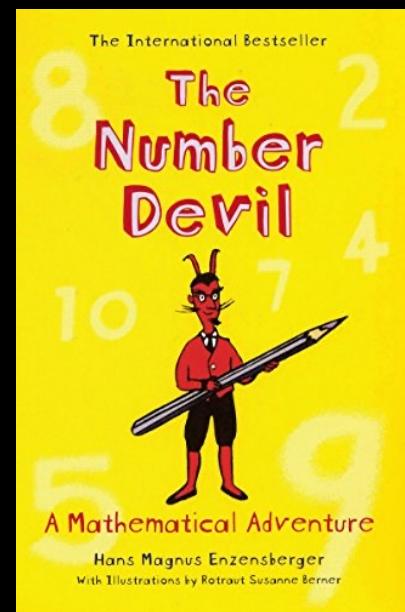
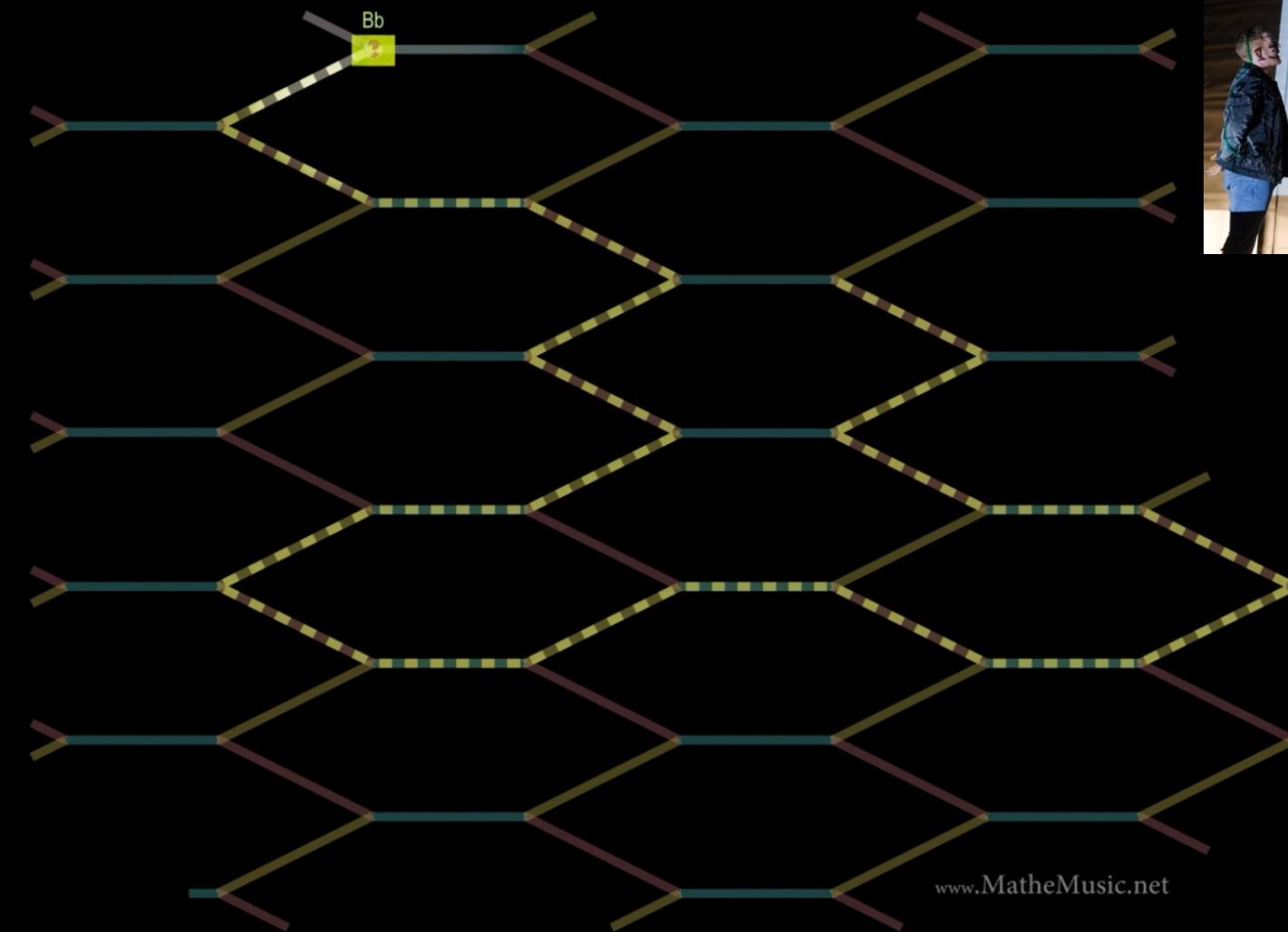
L'aria tace ed il tempo dietro a te  
 si leva come un'arida montagna  
 dove vaga il tuo spirito e si perde,  
 un vento raro scivola e ristagna.

# Hamiltonian Cycles without inner periodicity

---

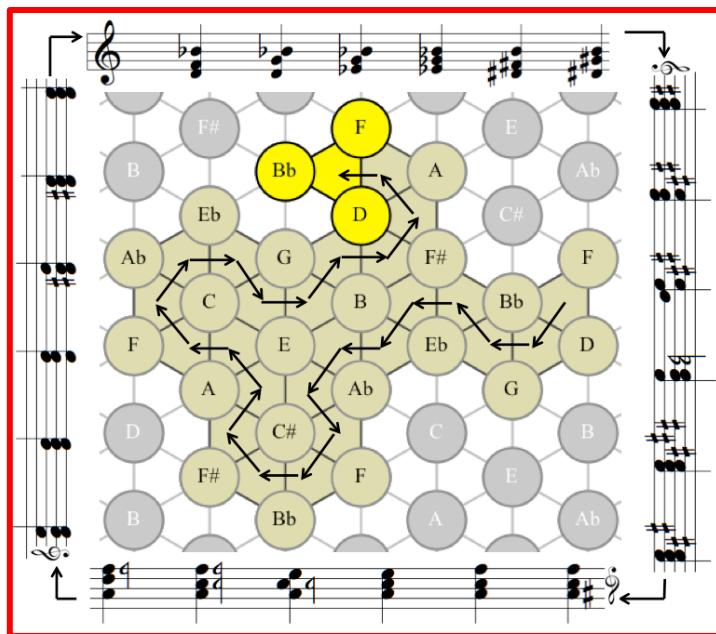


[www.MatheMusic.net](http://www.MatheMusic.net)



## Aprile (d'après Gabriele D'Annunzio)

→ [https://www.youtube.com/watch?v=AB8By7ghTkU&feature=emb\\_logo](https://www.youtube.com/watch?v=AB8By7ghTkU&feature=emb_logo)



Do ← do<sub>m</sub> ← Sol# ← fa<sub>m</sub> ← Fa ← la<sub>m</sub> ← La ← fa#<sub>m</sub> ← Fa# ← sib<sub>m</sub> ← Do# ← do#<sub>m</sub>

↓  
mi<sub>m</sub> → Sol → si<sub>m</sub> → Ré → ré<sub>m</sub> → Sib → sol<sub>m</sub> → Mib → mib<sub>m</sub> → Si → sol#<sub>m</sub> → Mi

Do → mi<sub>m</sub> → Mi → sol#<sub>m</sub> → Si → ré#<sub>m</sub> → Re# → do<sub>m</sub> → Lab → fa<sub>m</sub> → Do# → do#<sub>m</sub>

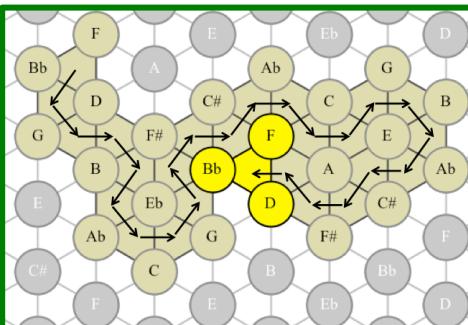
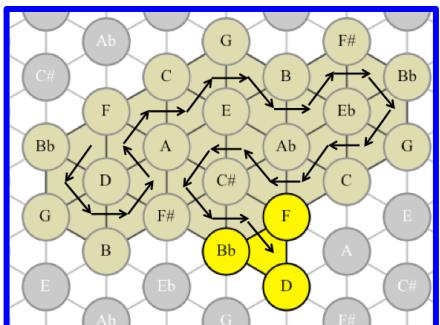
↑  
la<sub>m</sub> ← Fa ← ré<sub>m</sub> ← Ré ← si<sub>m</sub> ← Sol ← sol<sub>m</sub> ← Sib ← sib<sub>m</sub> ← Fa# ← fa#<sub>m</sub> ← La

Mi ← mi<sub>m</sub> ← Do ← la<sub>m</sub> ← Fa ← fa<sub>m</sub> ← Reb ← sib<sub>m</sub> ← Fa# ← mib<sub>m</sub> ← Mib ← do<sub>m</sub>

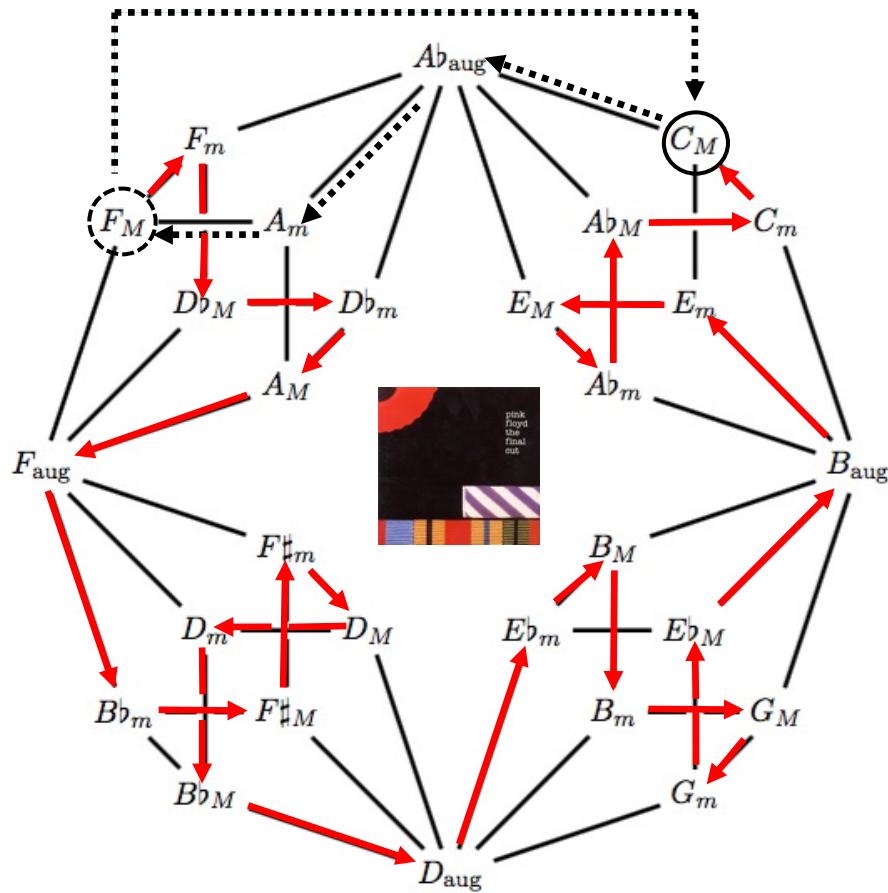
↓  
do#<sub>m</sub> → La → fa#<sub>m</sub> → Ré → ré<sub>m</sub> → Sib → sol<sub>m</sub> → Sol → si<sub>m</sub> → Si → sol#<sub>m</sub> → Sol#

Aprile

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



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



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

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

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

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

The Gunner's dream (R. Waters, 1983 / M. Andreatta, 2018)

(C)

C+

Floating down through the clouds

Am

F

Memories come rushing up to meet me now.

Fm

In the space between the heavens

C#

C#m

and in the corner of some foreign field

A

F+

Bbm

I had a dream.

F#

F#m

I had a dream.

Bb

Good-bye Max.

D+

Good-bye Ma.

Ebm

B

After the service when you're walking slowly to the car

Bm

G

And the silver in her hair shines in the cold November air

Gm

You hear the tolling bell

Eb

And touch the silk in your lapel

G+

Em

And as the tear drops rise to meet the comfort of the band

G#

Cm

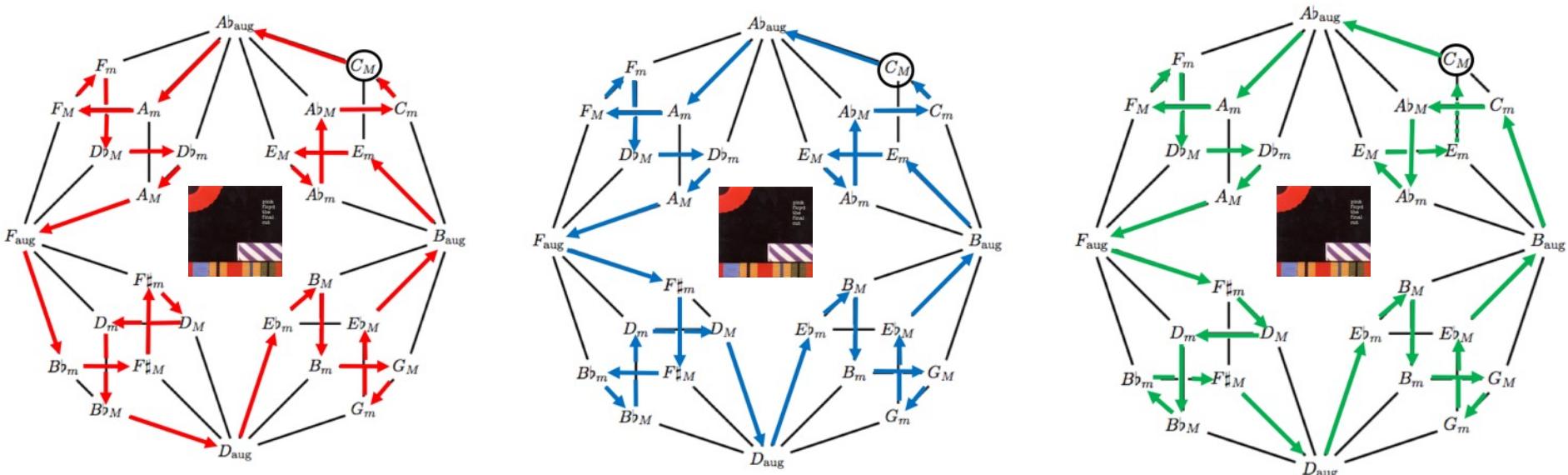
You take her frail hand

(C)

And hold on to the dream.



# 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

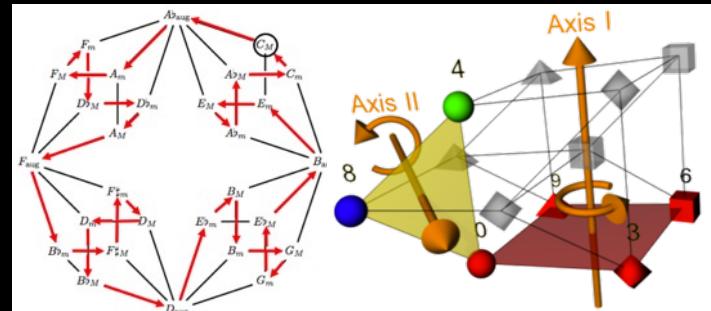
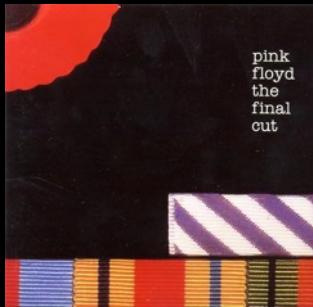
C-->C+-->Am-->F-->Fm-->C#-->C#m-->A-->F+->F#m-->D-->Dm-->Bb-->Bbm-->F#-->D+->Ebm-->B-->Bm-->G-->Gm-->Eb-->G+->Cm-->G#-->G#m-->E-->Em-->C

# HamilFloyd

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

To be posted soon at <http://mathemusic.net/>

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

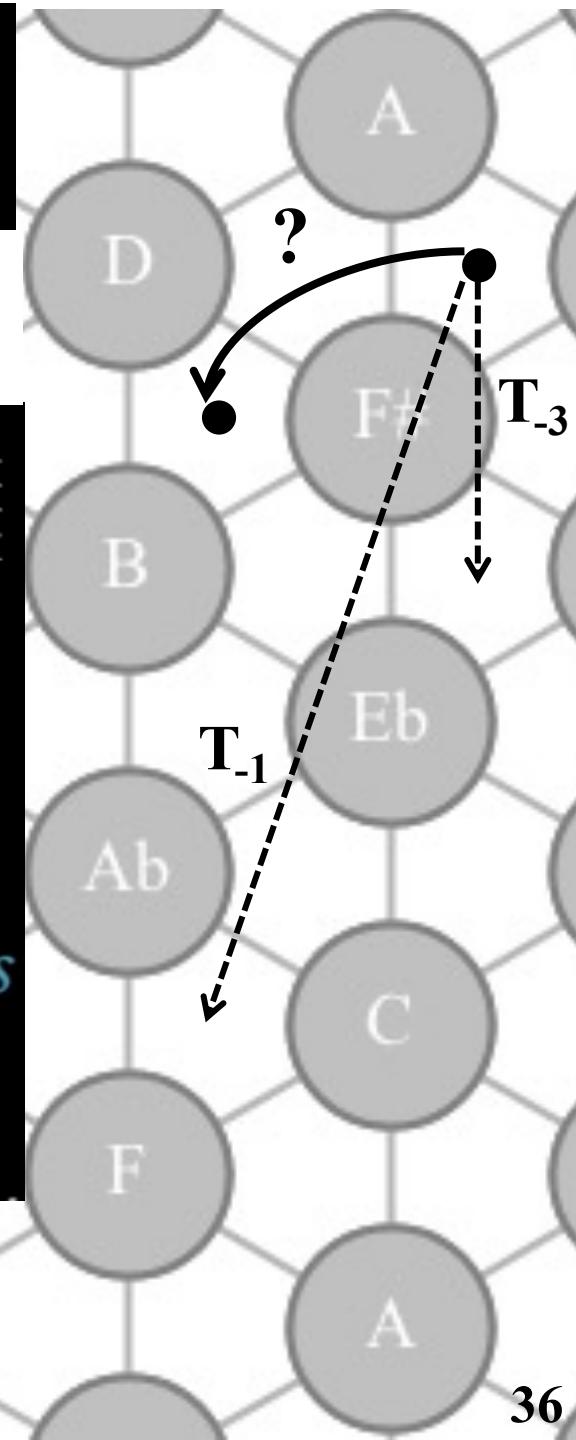


# DOMENEDIO

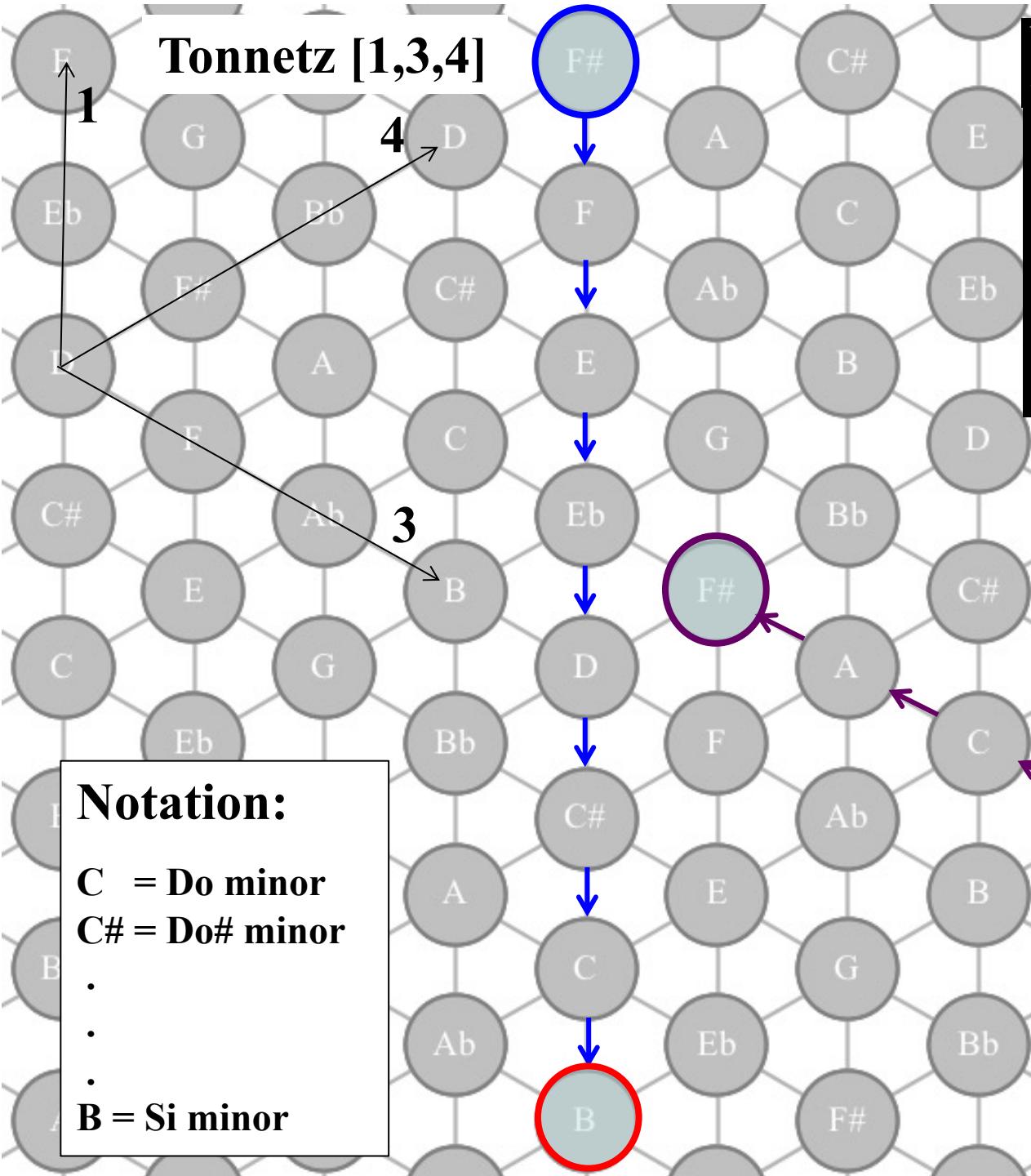
(« Canzone aperta », based on a poem by Livio Andeatta)



*Find all Hamiltonian Mathemusical Paths  
that modulate through all minor triads  
from f# min to b min, using only -1 or -3*



# Tonnetz [1,3,4]



## Notation:

**C** = Do minor

**C#** = Do# minor

.

.

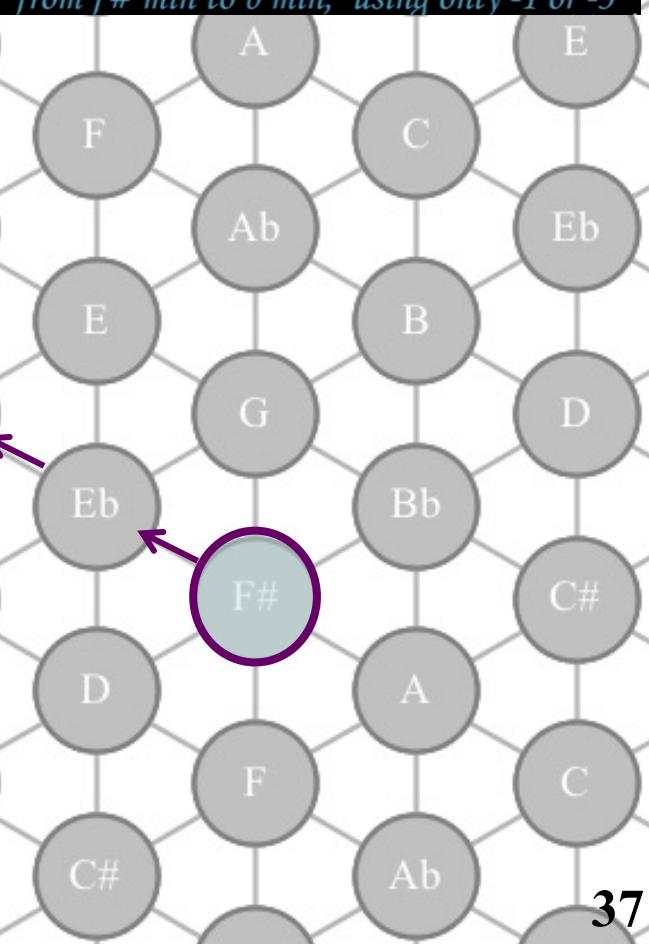
.

**B** = Si minor

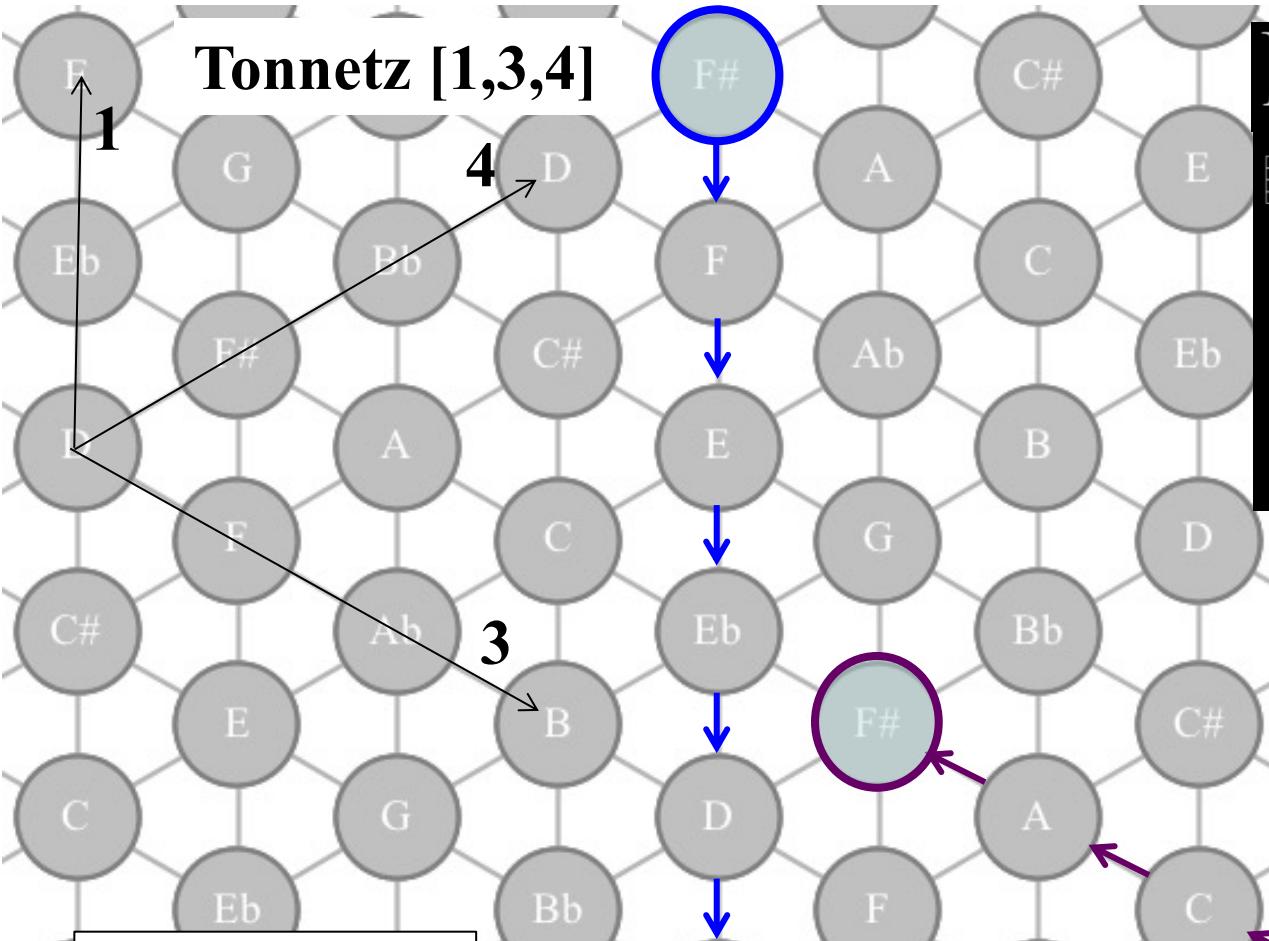
# DOMENEDIO



*Find all Hamiltonian Mathematical Paths that modulate through all minor triads from f# min to b min, using only -1 or -3*



# Tonnetz [1,3,4]



## Notation:

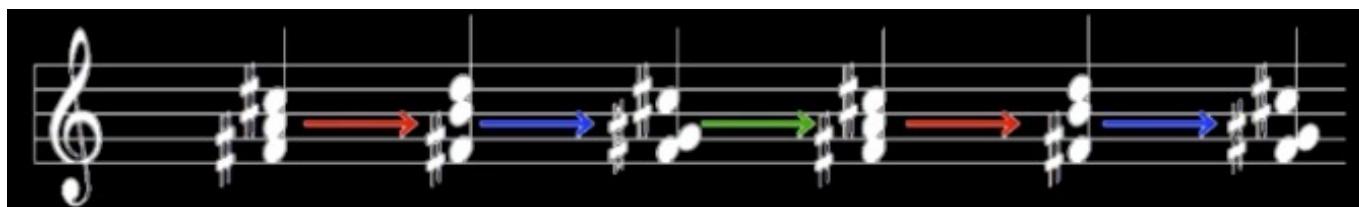
C = Do minor  
 C# = Do# minor  
 .  
 .  
 .  
 B = Si minor

# DOMENEDIO

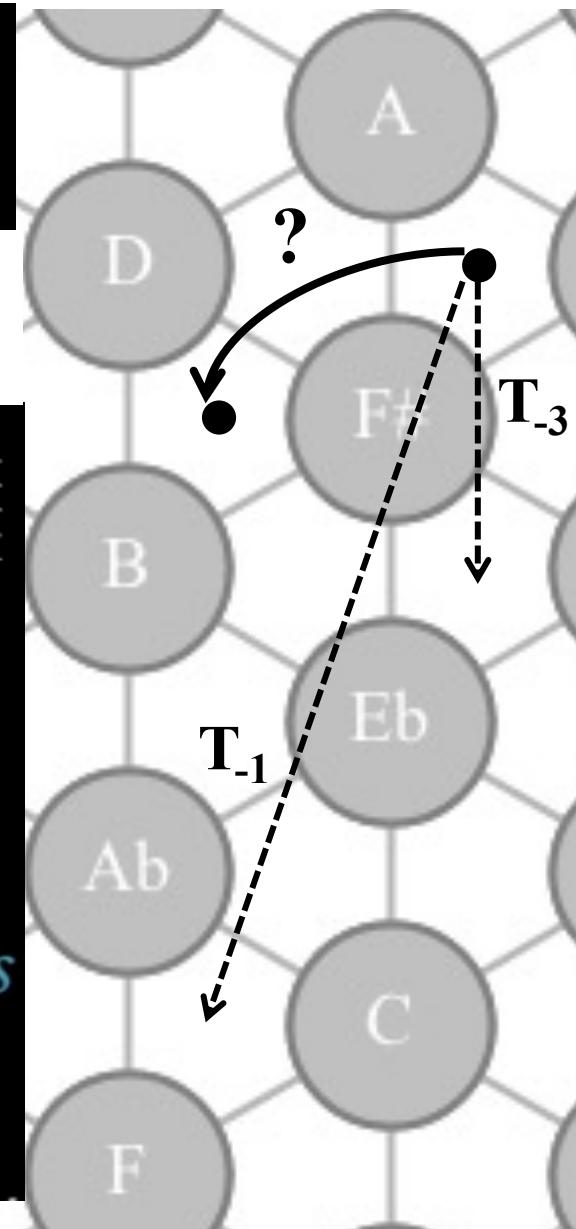
Find all Hamiltonian Mathematical Paths that modulate through all minor triads from f# min to b min, using only -1 or -3

# DOMENEDIO

(« Canzone aperta », based on a poem by Livio Andreatta)



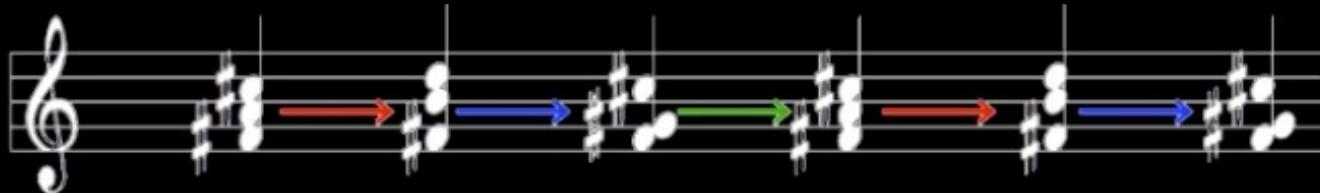
*Find all Hamiltonian Mathemusical Paths  
that modulate through all minor triads  
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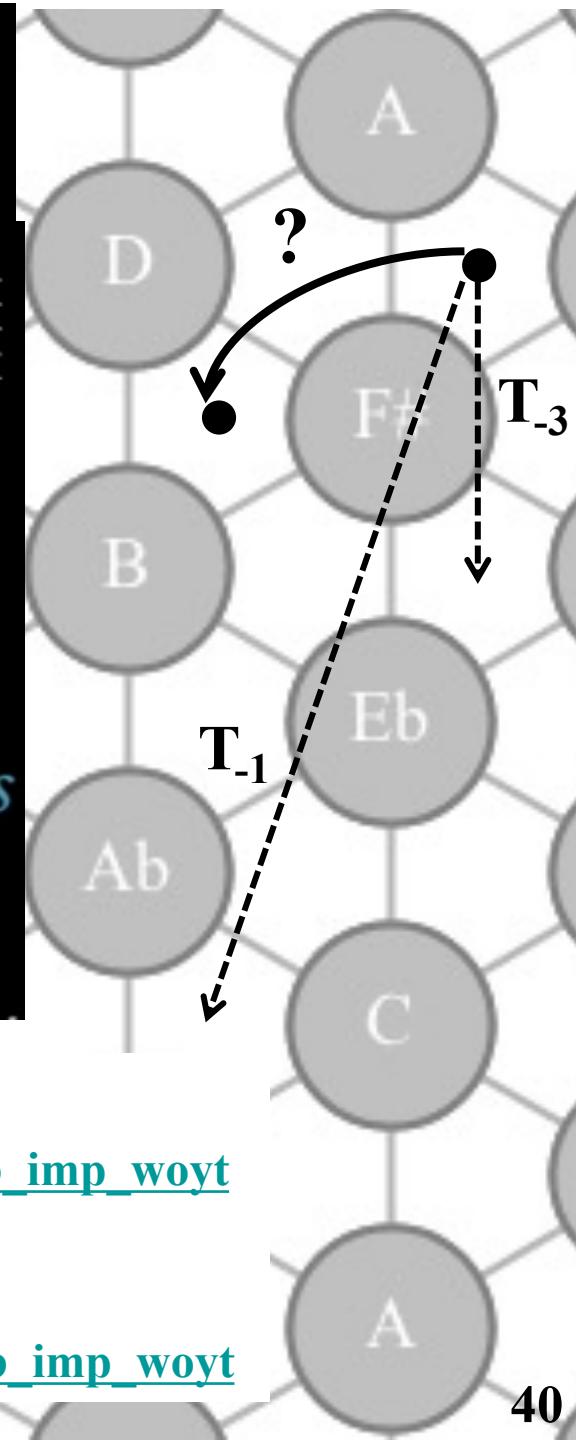
→ [http://repmus.ircam.fr/\\_media/moreno/04\\_domenedio\\_livio\\_andreatta.mp3](http://repmus.ircam.fr/_media/moreno/04_domenedio_livio_andreatta.mp3)



# DOMENEDIO



*Find all Hamiltonian Mathemusical Paths  
that modulate through all minor triads  
from f# min to b min, using only -1 or -3*



→ visualisation of the correct solution

[https://www.youtube.com/watch?v=GB88cj-BeHo&feature=emb\\_imp\\_woyt](https://www.youtube.com/watch?v=GB88cj-BeHo&feature=emb_imp_woyt)

→ visualisation of the “tricky” solution

[https://www.youtube.com/watch?v=igdVT6pTdh8&feature=emb\\_imp\\_woyt](https://www.youtube.com/watch?v=igdVT6pTdh8&feature=emb_imp_woyt)

# Thank you for your attention!

