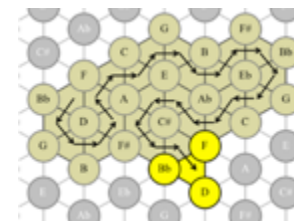
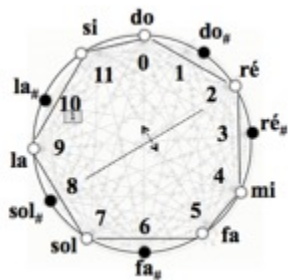


Modèles mathématiques et computationnels dans la chanson

Analyse de la musique et des répertoire III :
Musiques actuelles

(partie IV : modèles mathématiques et computationnels)



Moreno Andreatta

IRMA & ITI CREAA, Université de Strasbourg

Equipe Représentations Musicales

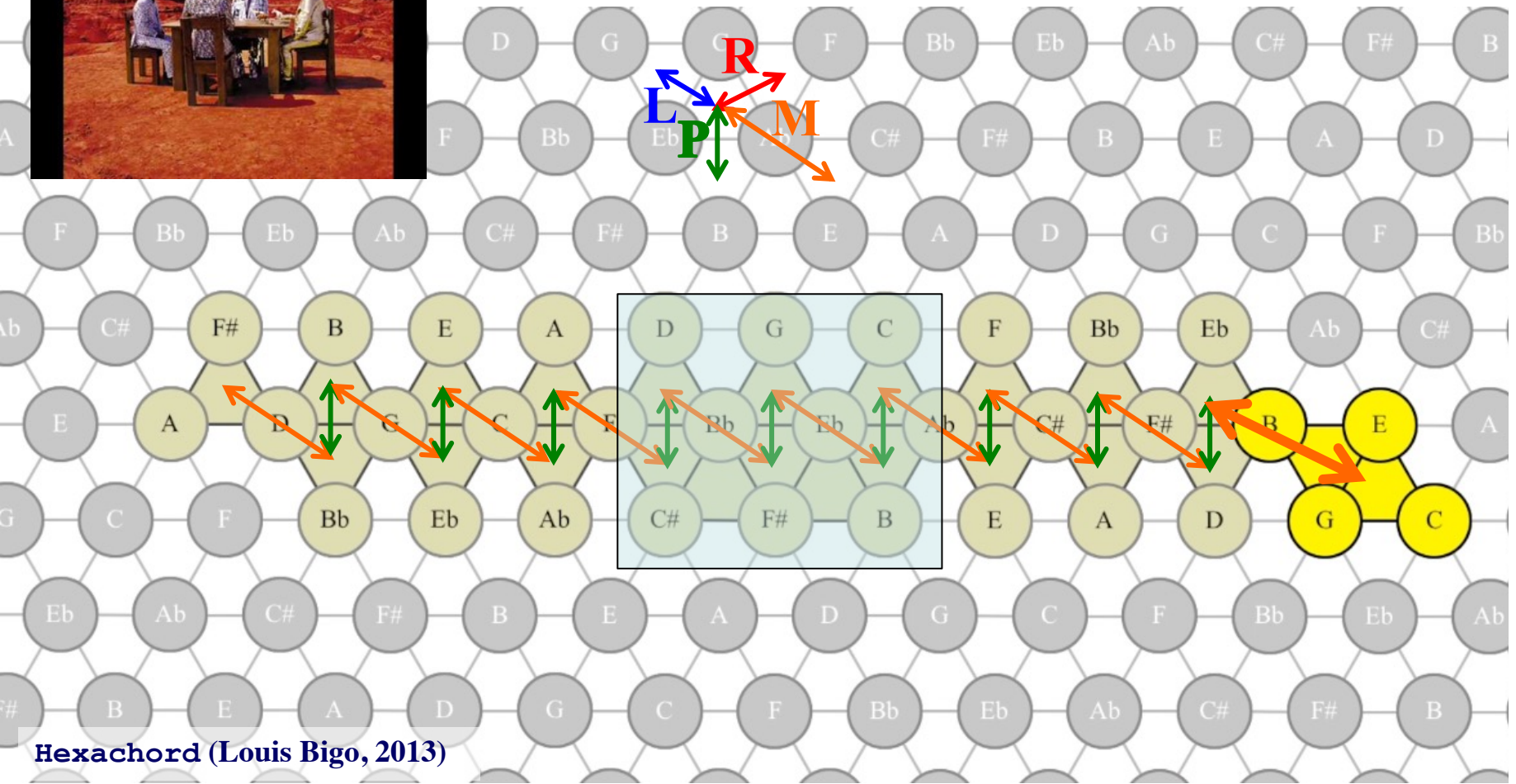
IRCAM / CNRS UMR 9912 / Sorbonne Université



Utilisation inconsciente (?) des symétries chez *Muse*

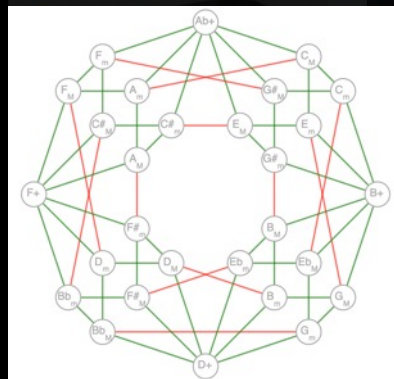
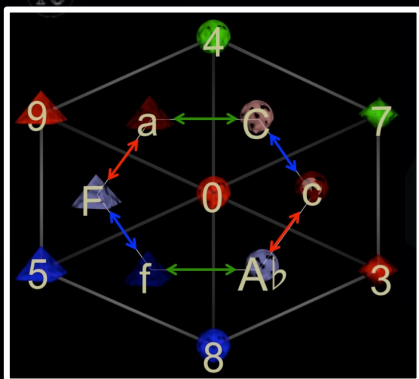
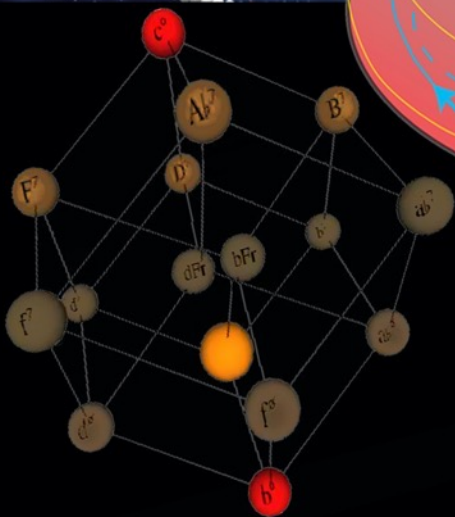
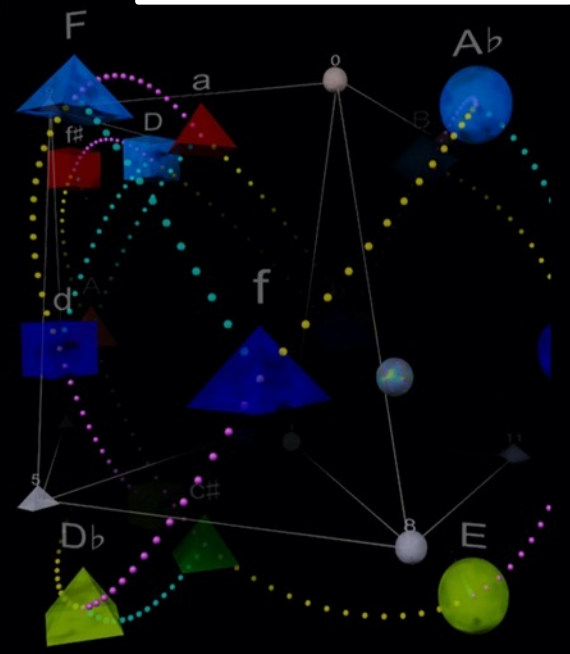
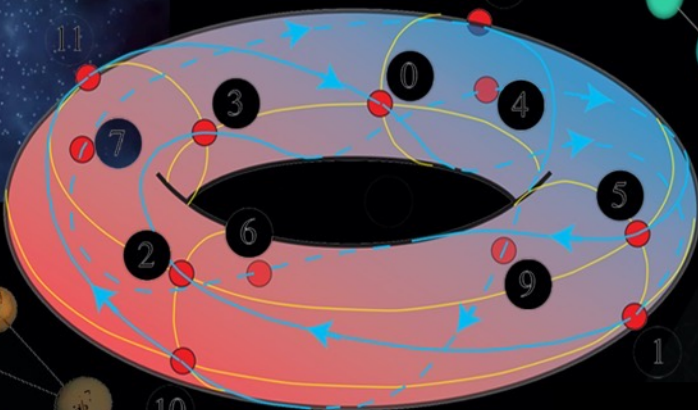
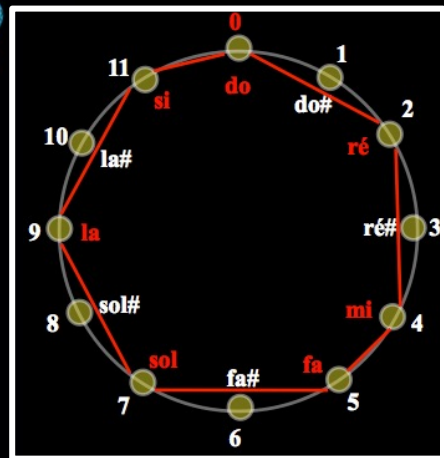
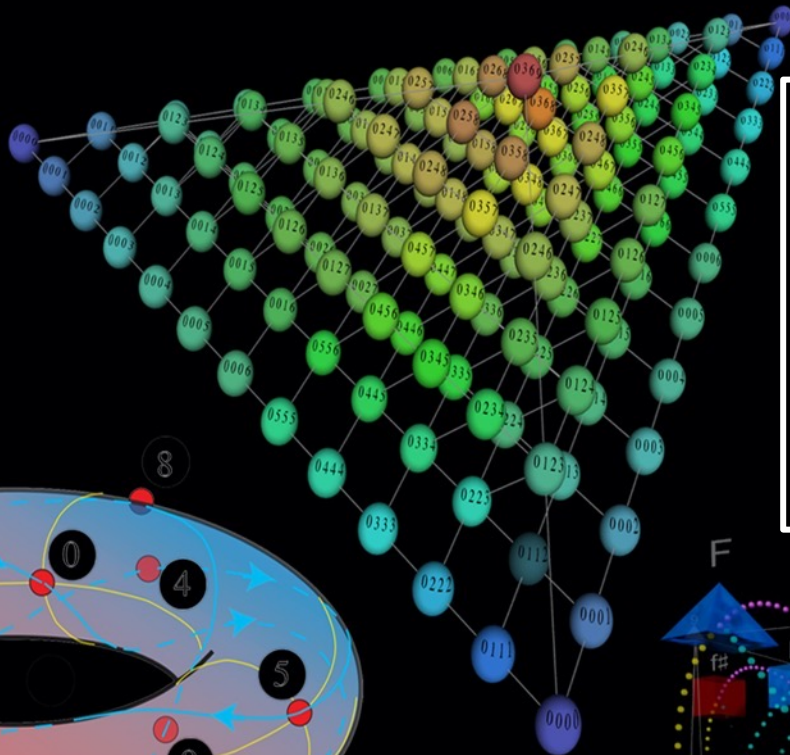
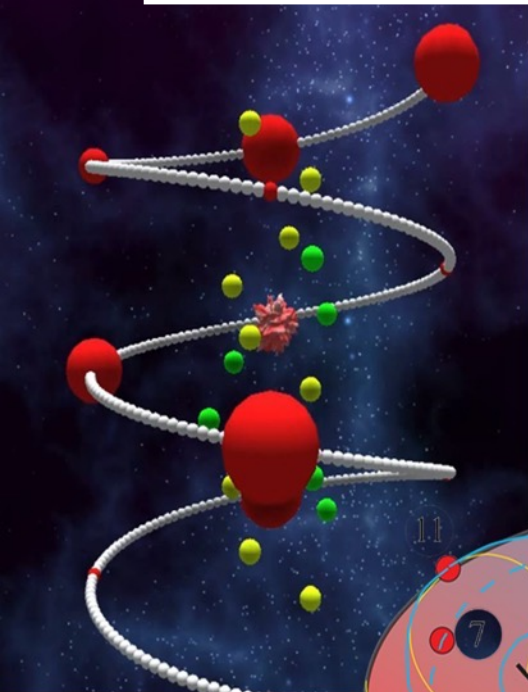


“Take a bow” (*Black Holes and Revelations*, 2006)

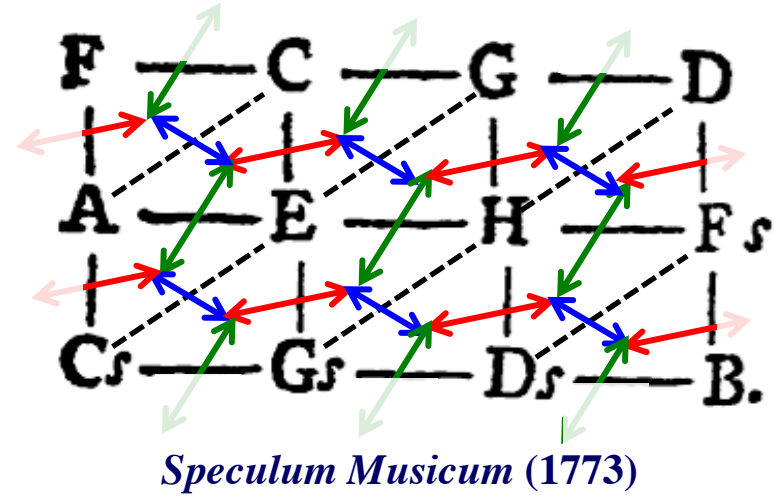
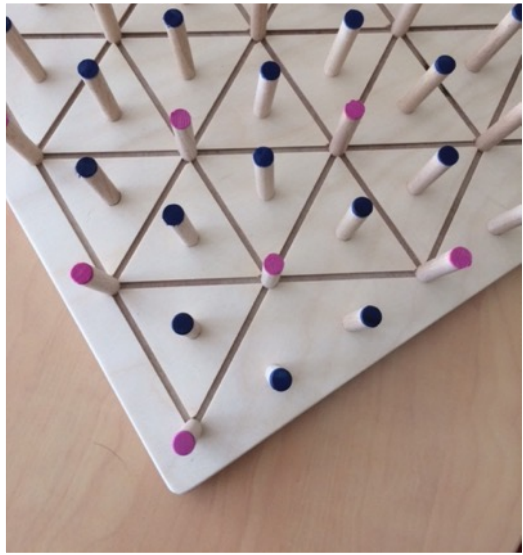
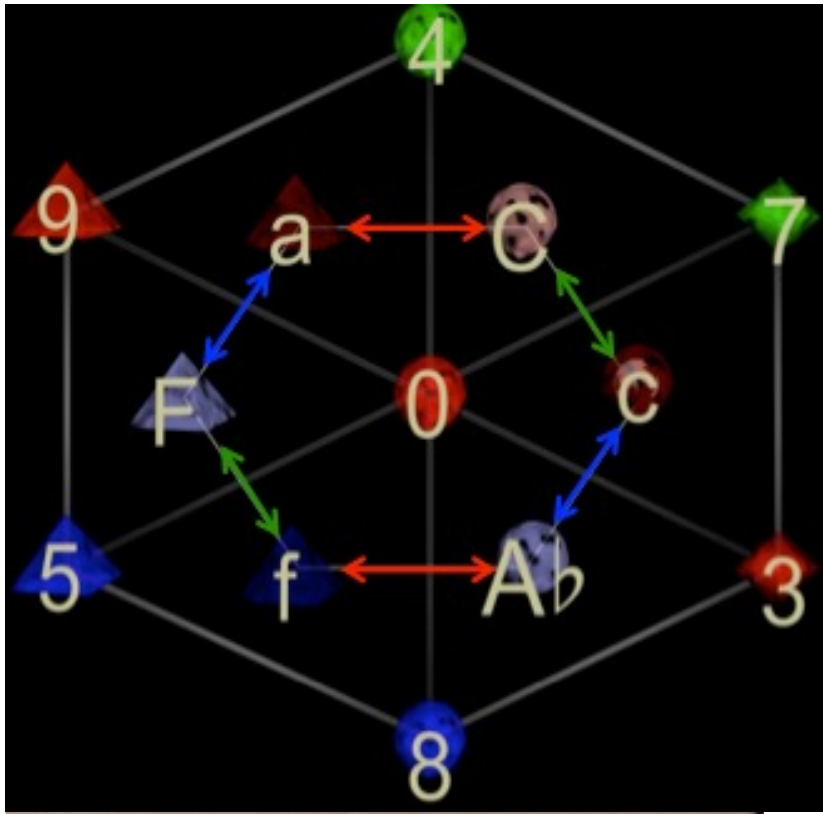


→
axe temporel

La galaxie des modèles géométriques au service de la musique



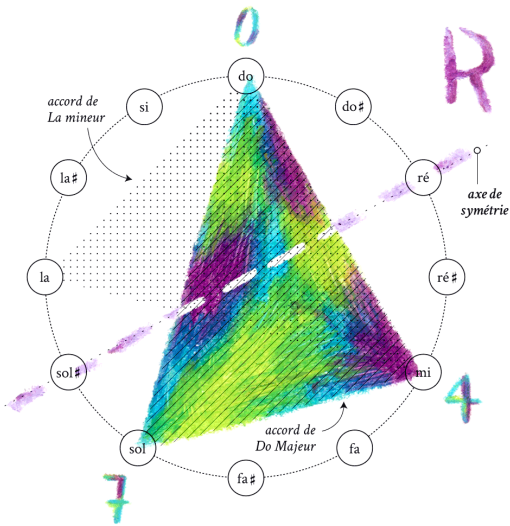
Le Tonnetz (ou nid musical d'abeilles)



Leonhard Euler

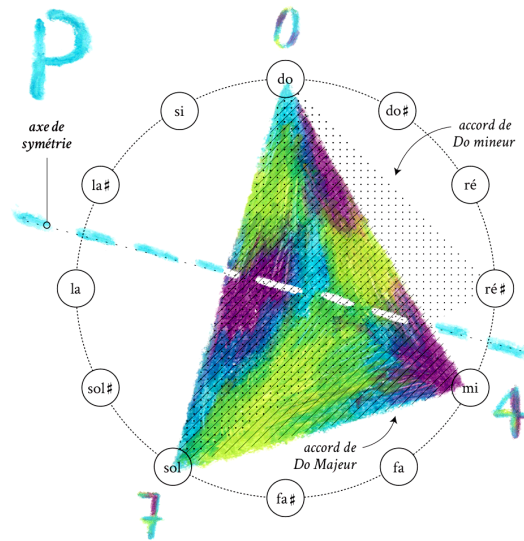
Speculum Musicum (1773)

Les trois symétries néo-riemanniennes



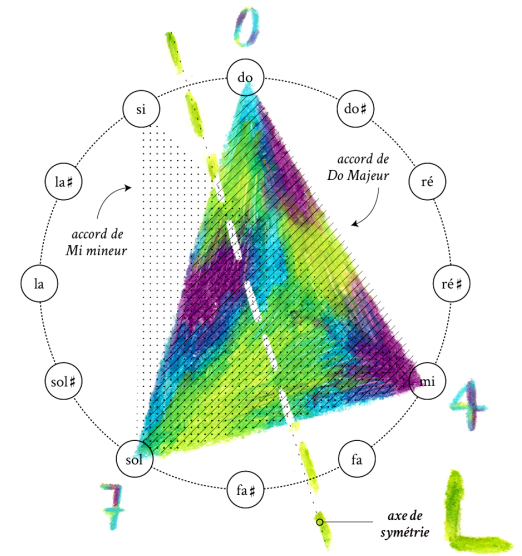
R = RELATIF

C majeur
 ↑↓
A mineur



P = PARALLÈLE

C majeur
 ↑↓
C mineur



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

C majeur
 ↑↓
E mineur

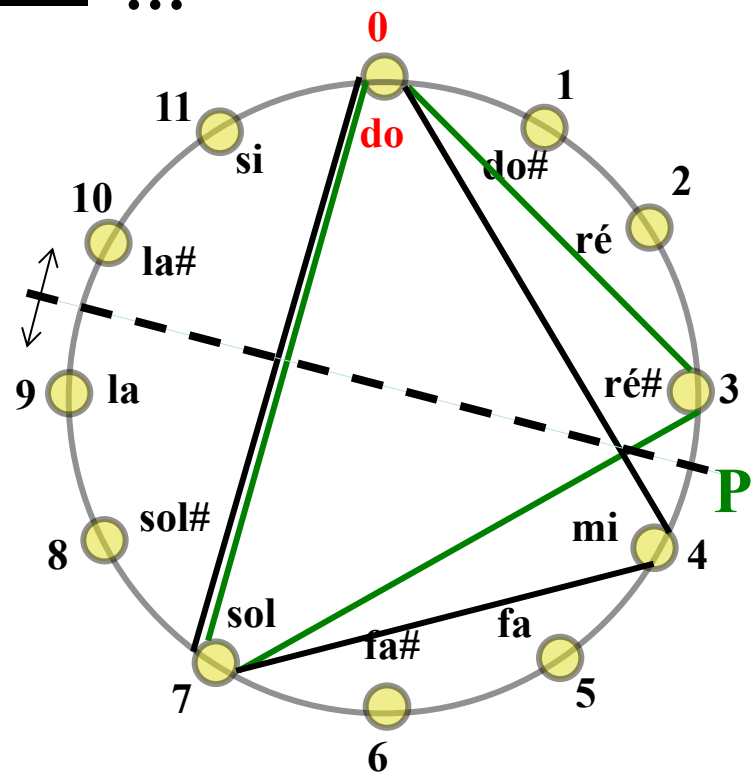
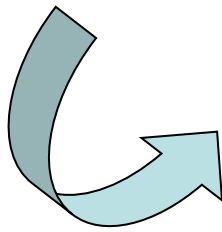
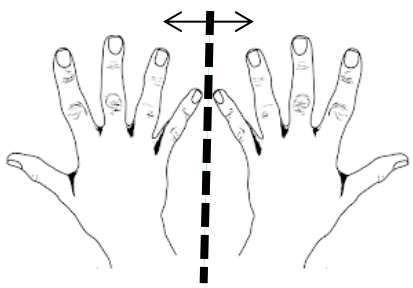
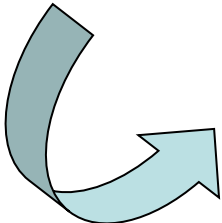
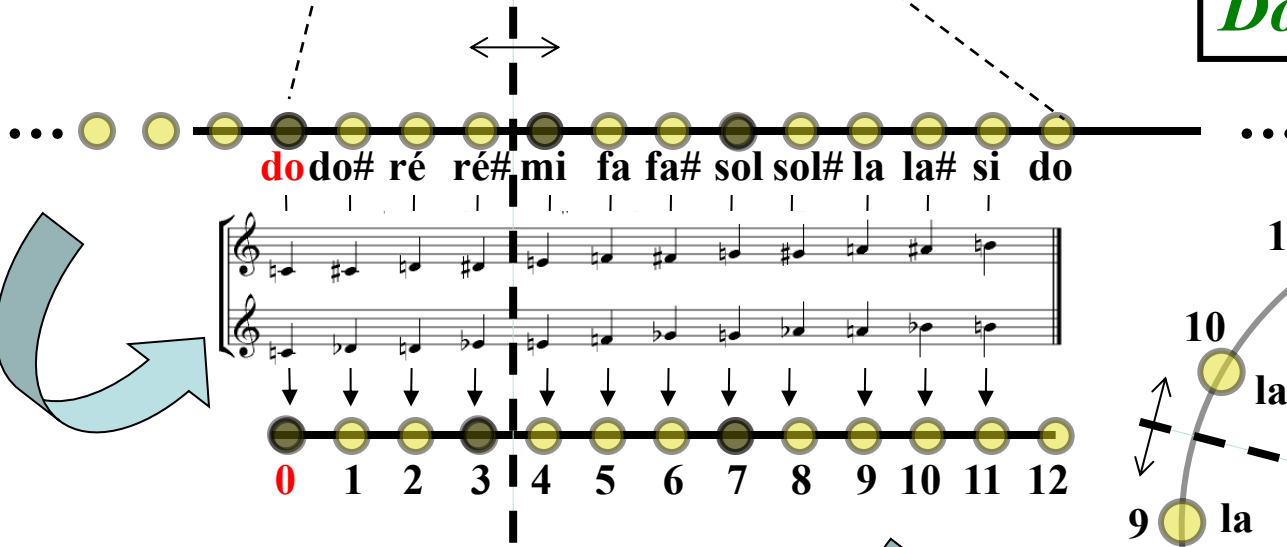
Les inversions sont des symétries axiales



P comme **parallèle**

Do maj = {0,4,7}

Do min = {0,3,7}

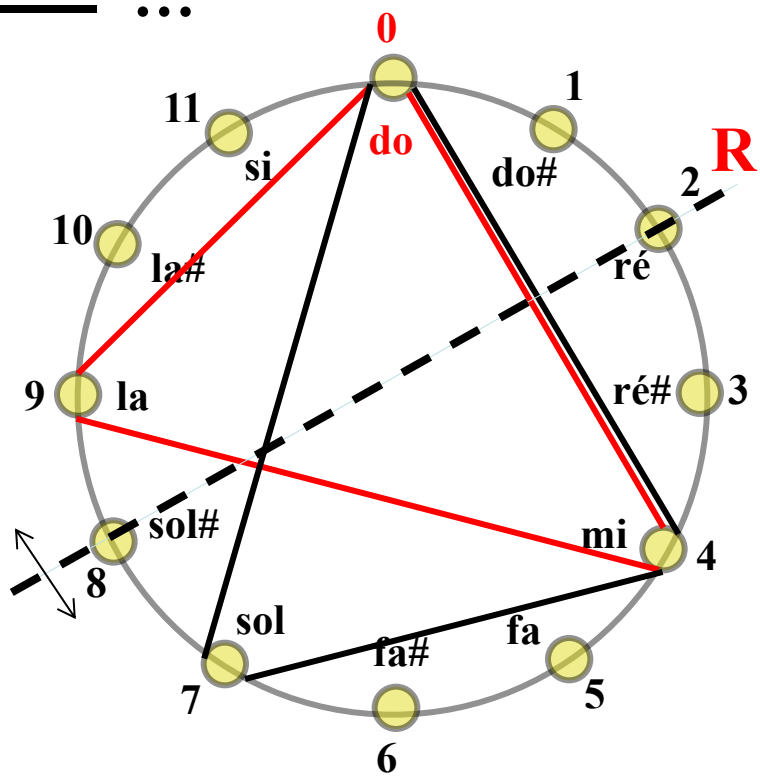
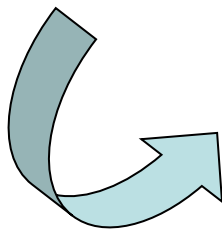
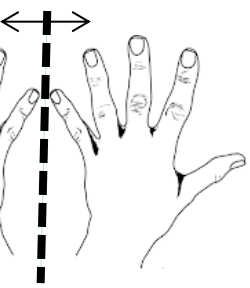
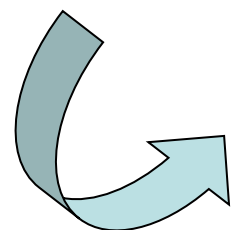
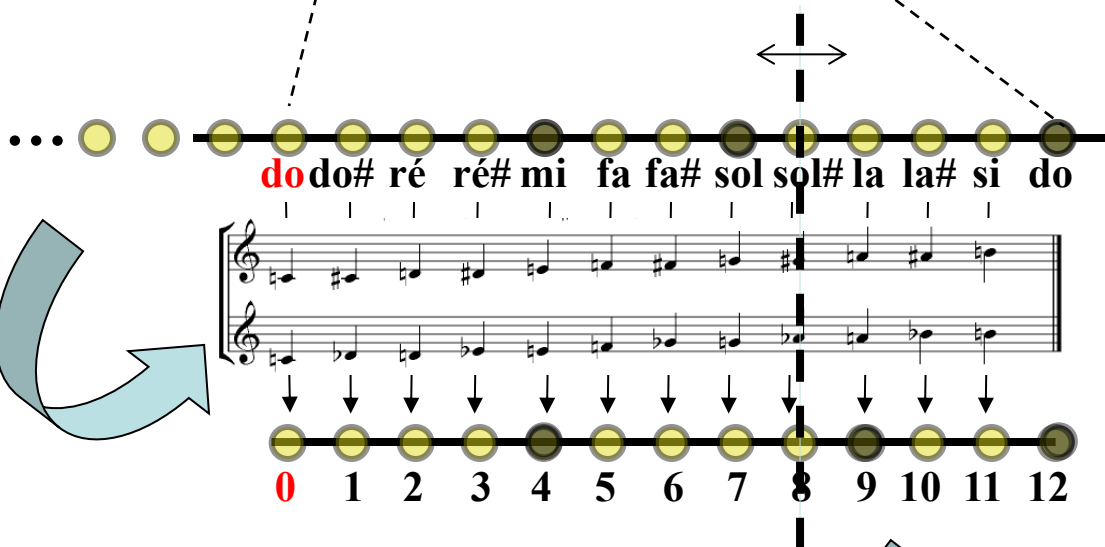


Les inversions sont des symétries axiales



R comme **relatif**

Do maj = {0,4,7}
La min = {0,4,9}

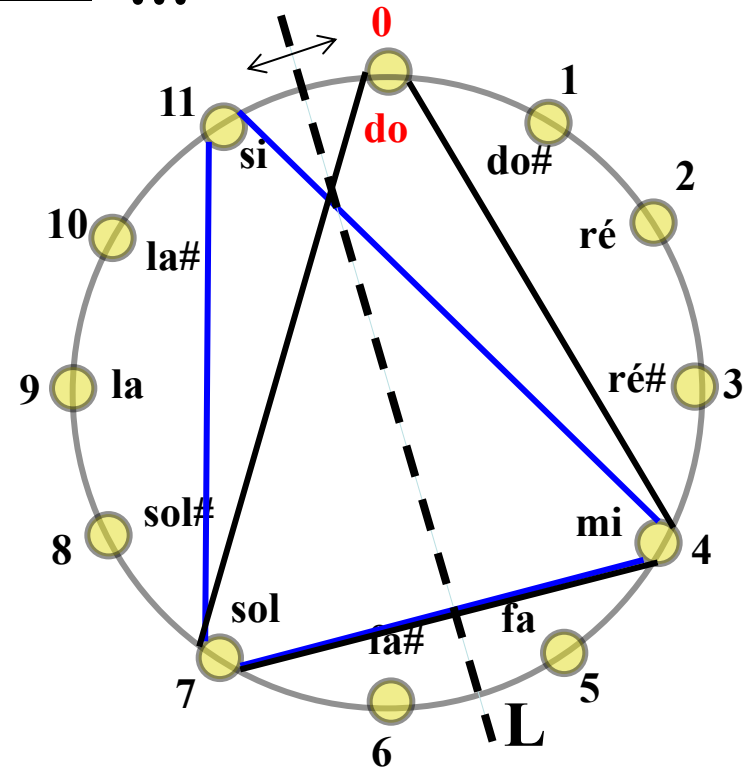
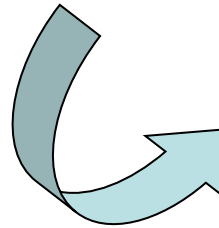
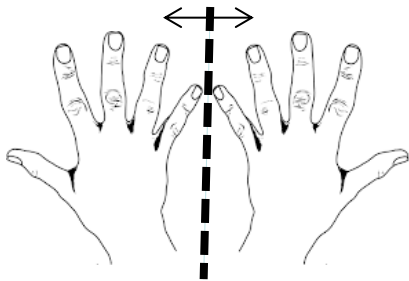
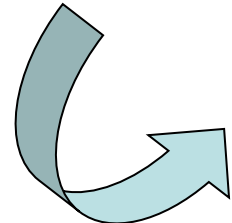
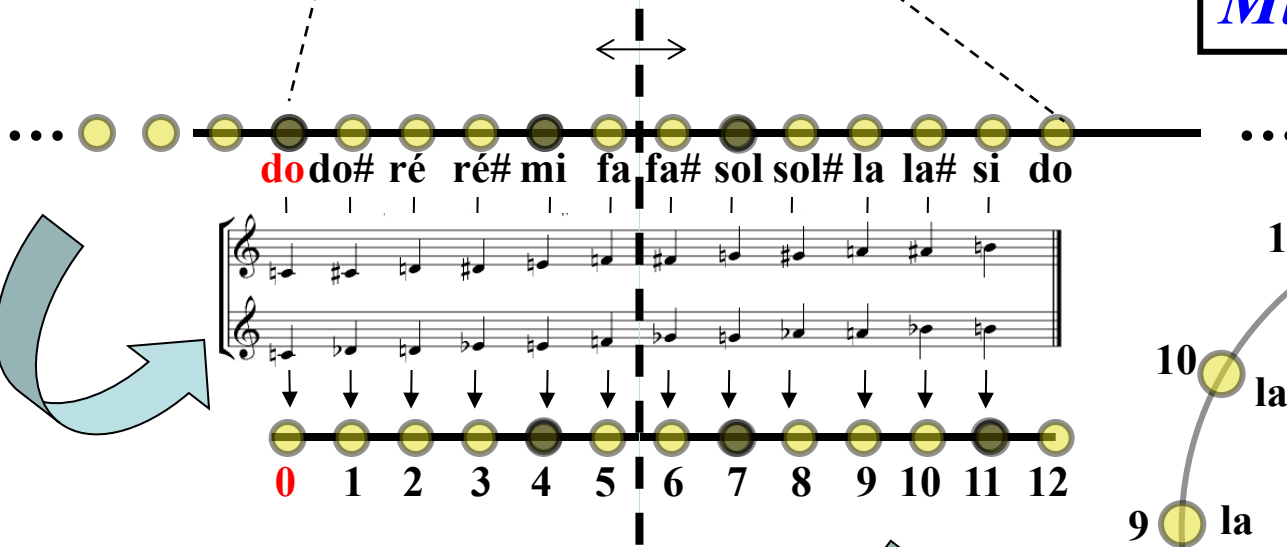


Les inversions sont des symétries axiales



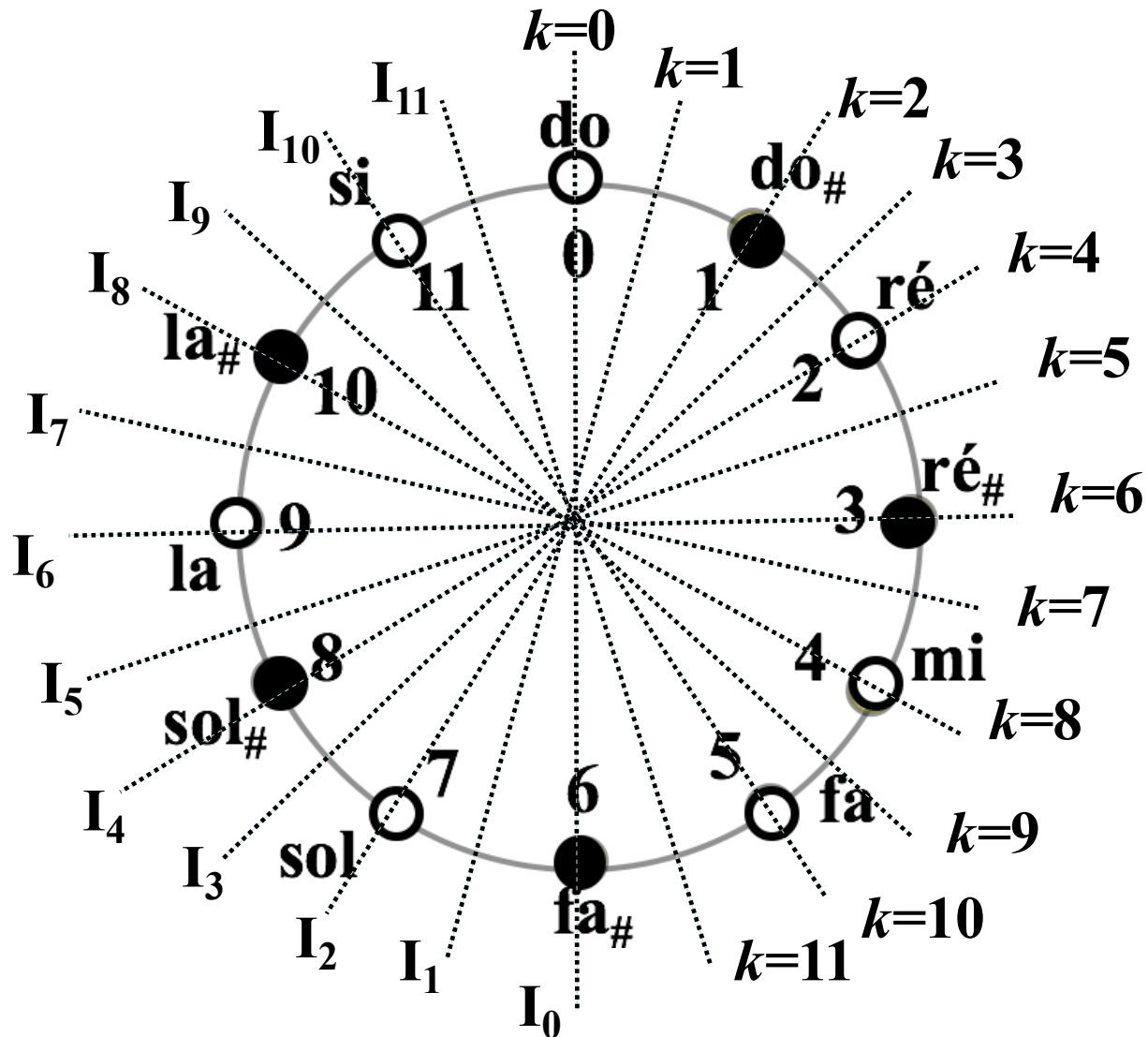
L = Leading Tone

Do maj = {0,4,7}
Mi min = {4,7,11}



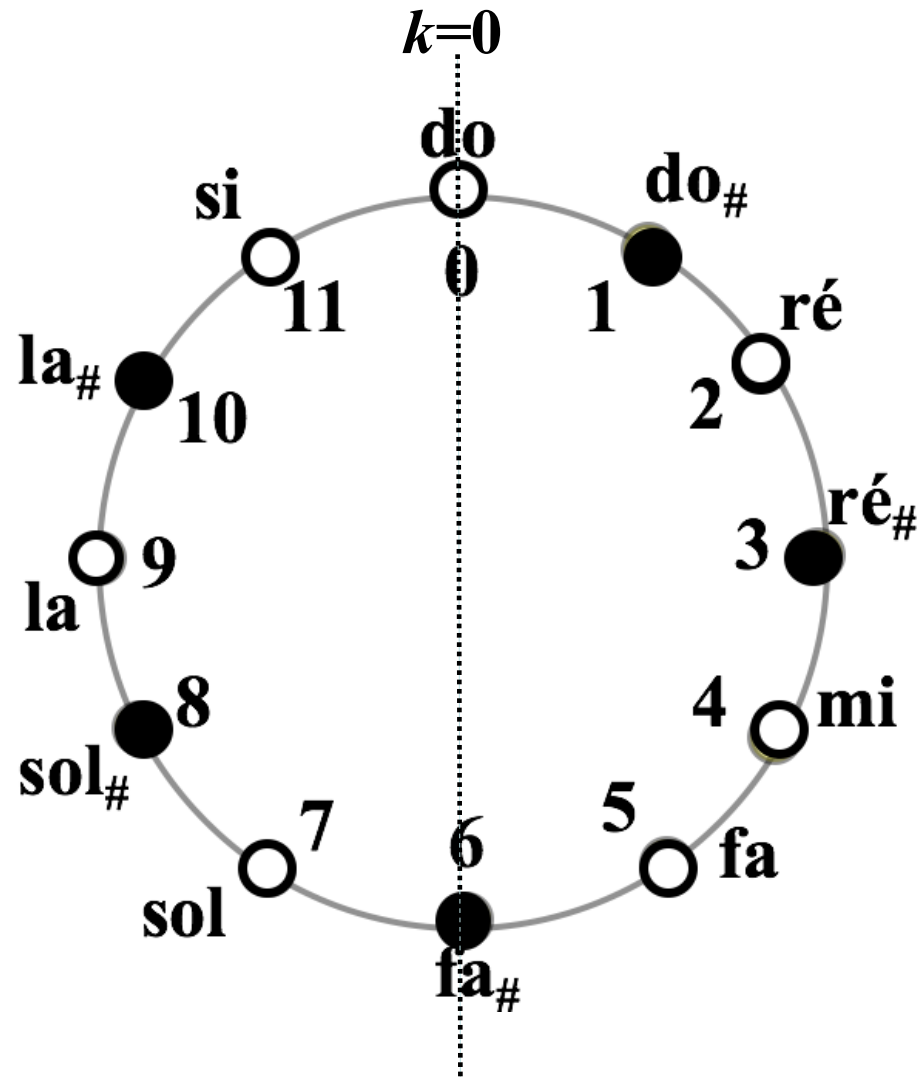
Les inversions sont des symétries axiales généralisées

$$x \xrightarrow{I_k} k-x \text{ modulo } 12$$



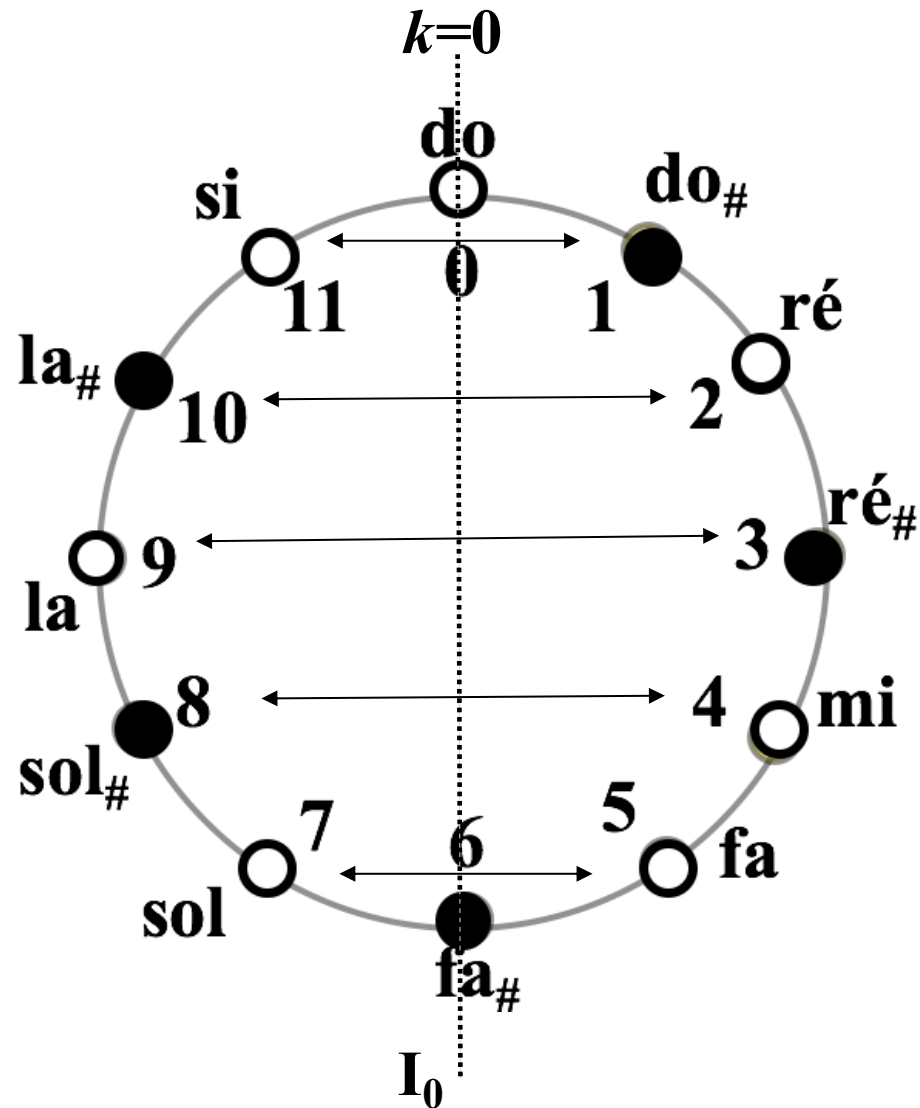
Quelques exemples

$$x \xrightarrow{I_0} -x \text{ modulo } 12$$



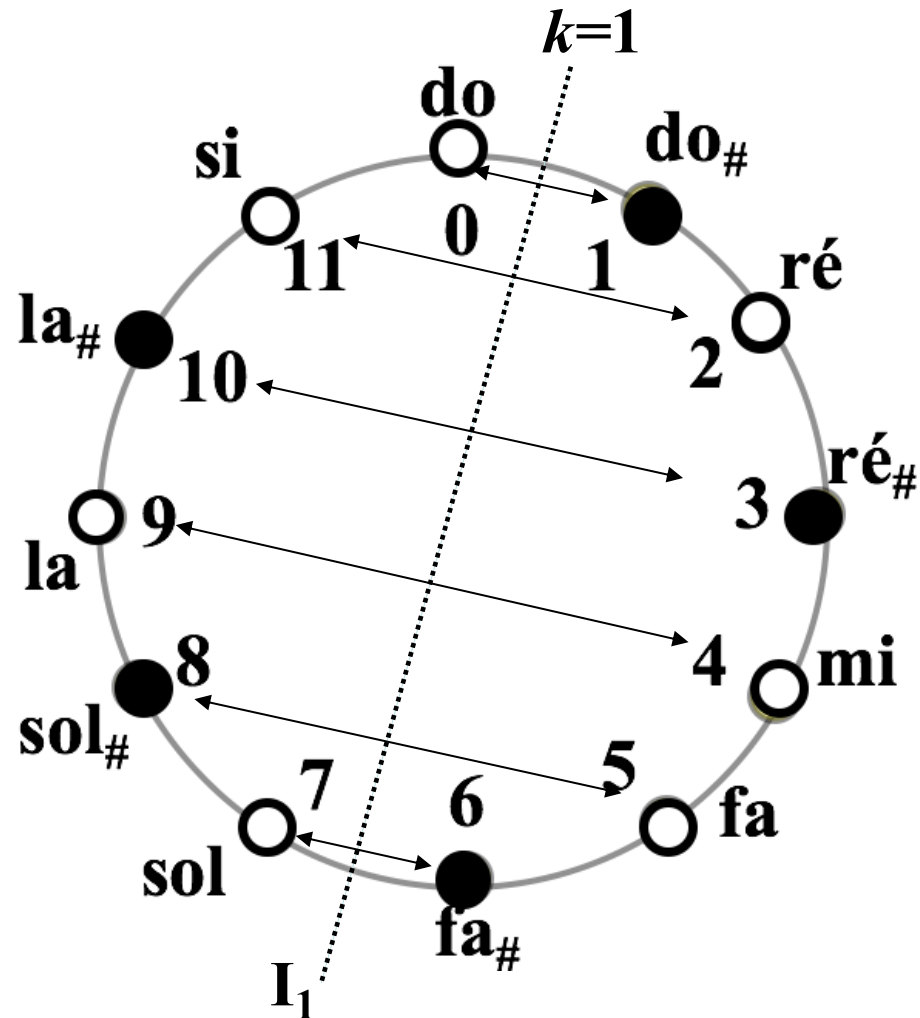
Quelques exemples

$$x \xrightarrow{I_0} -x \text{ modulo } 12$$

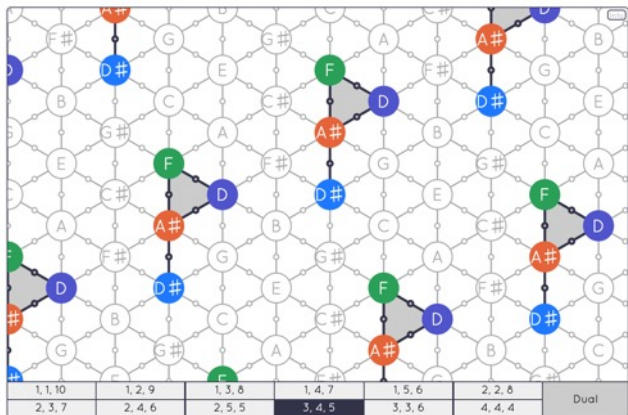


Les inversions sont des symétries axiales généralisées

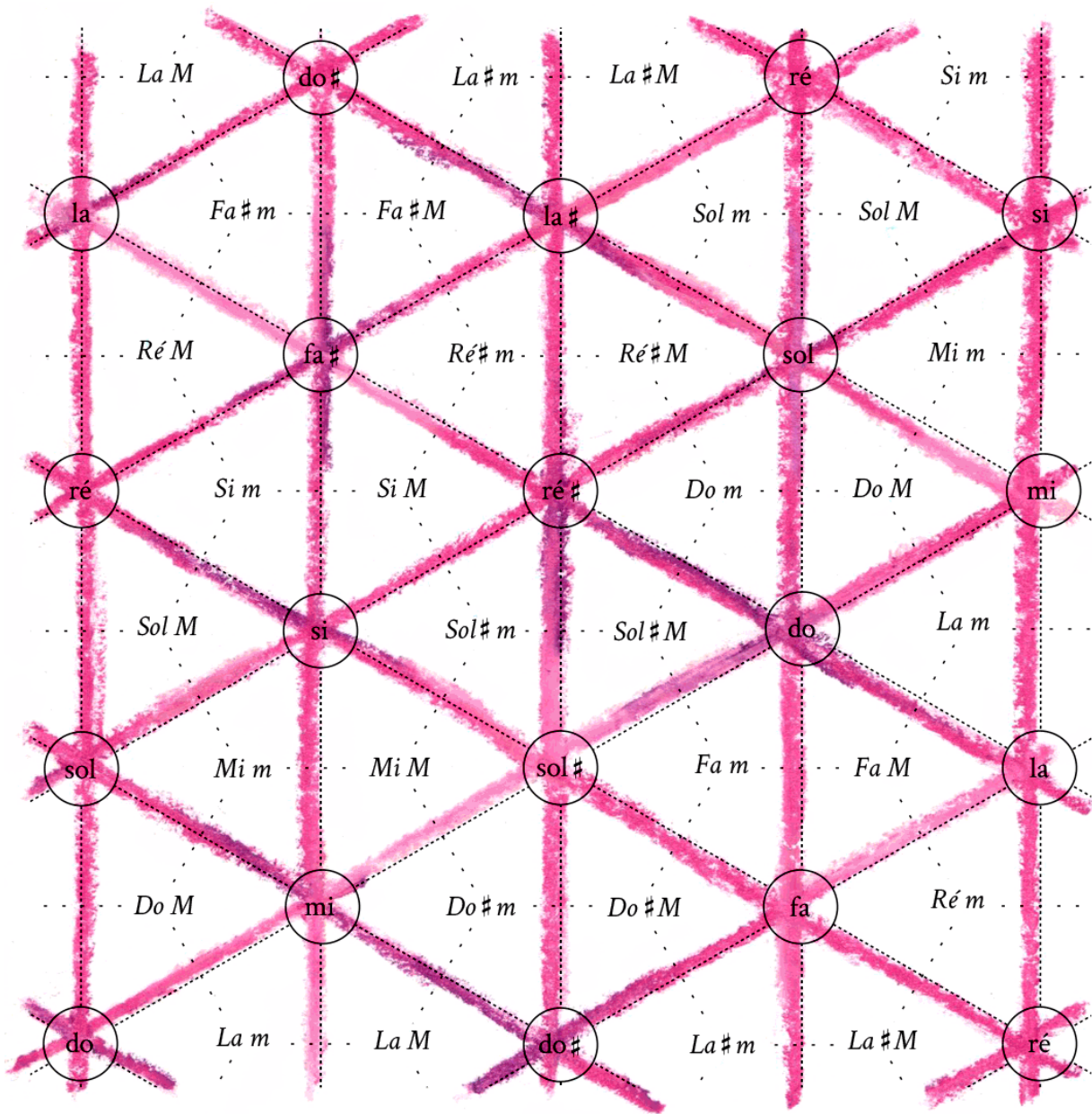
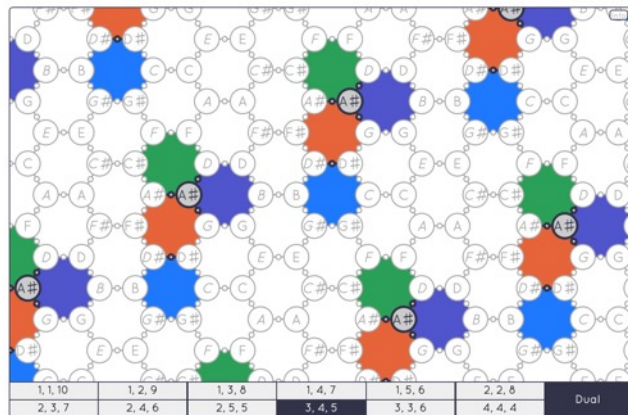
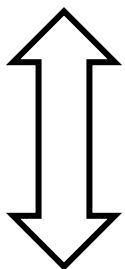
$$x \xrightarrow{I_1} 1-x \text{ modulo } 12$$



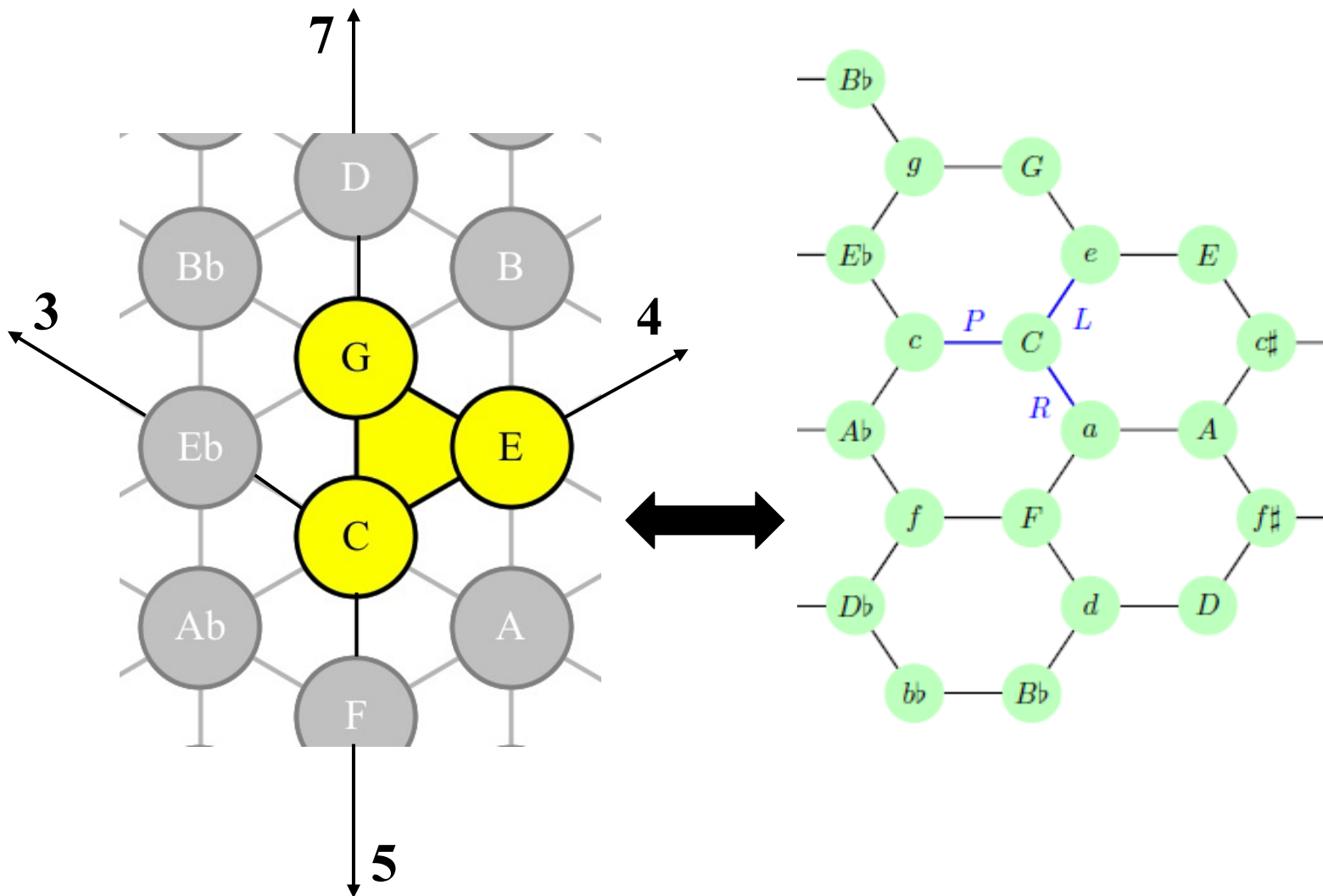
Du Tonnetz à l'espace dual



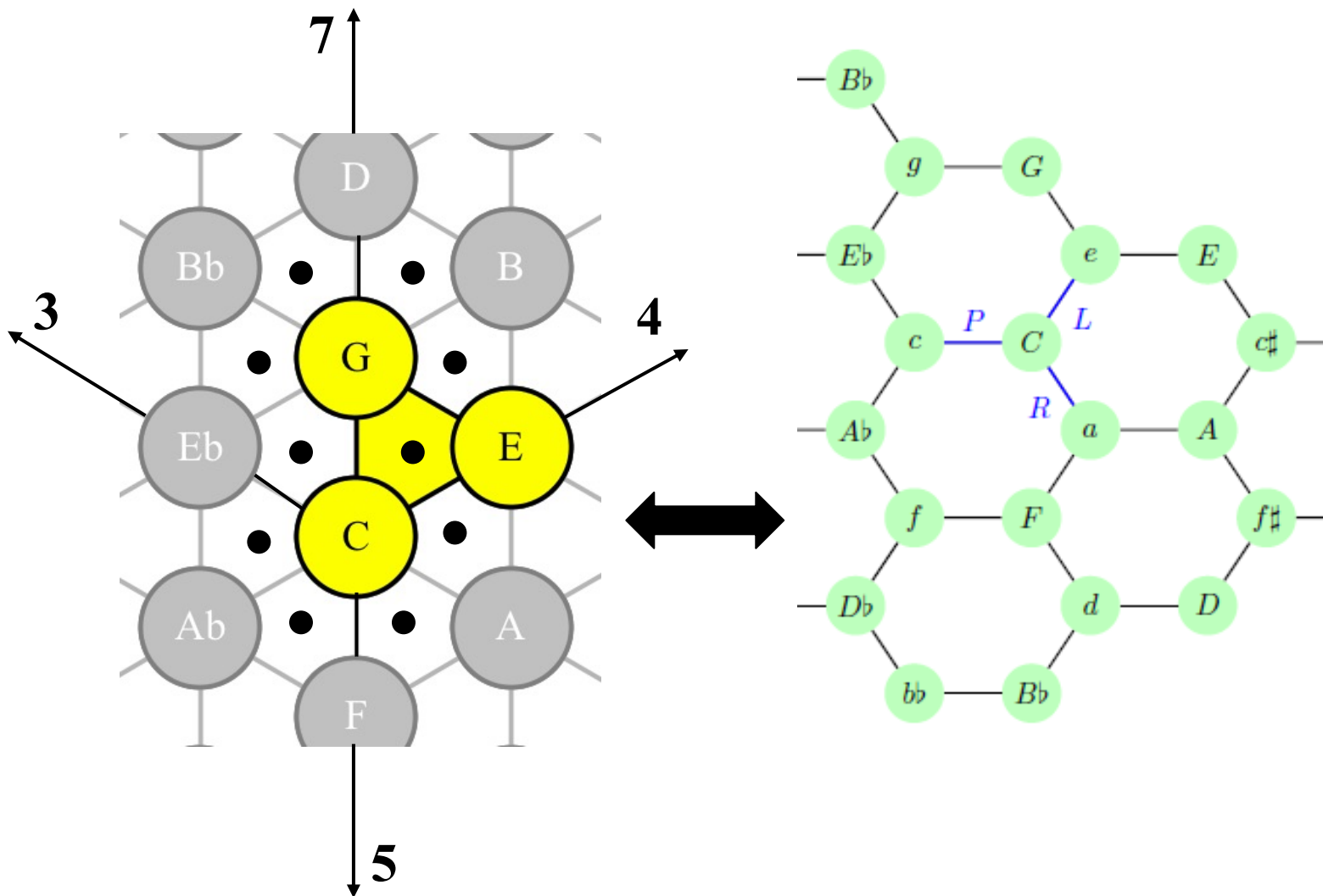
duality



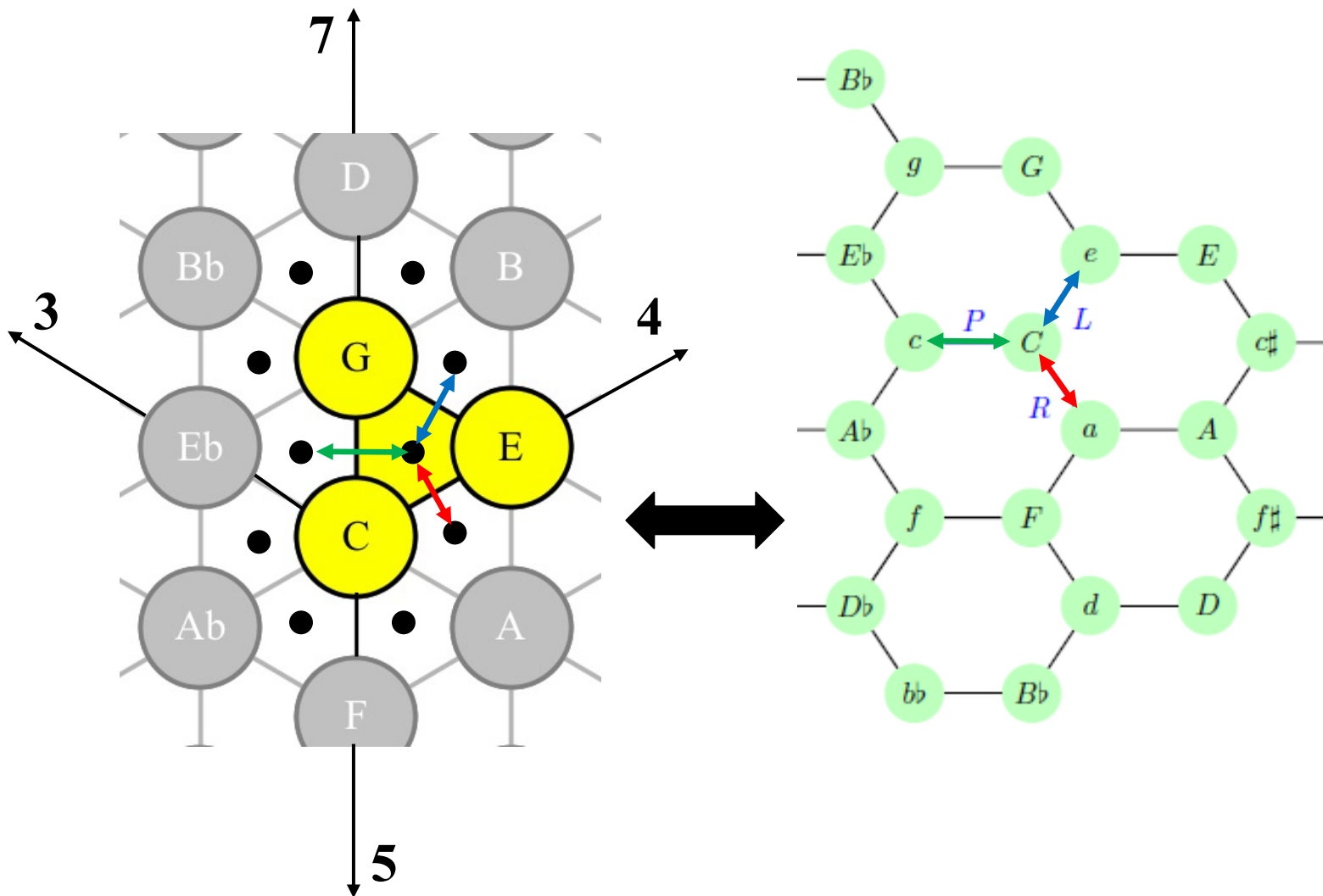
Construction du maillage hexagonal à partir du Tonnetz



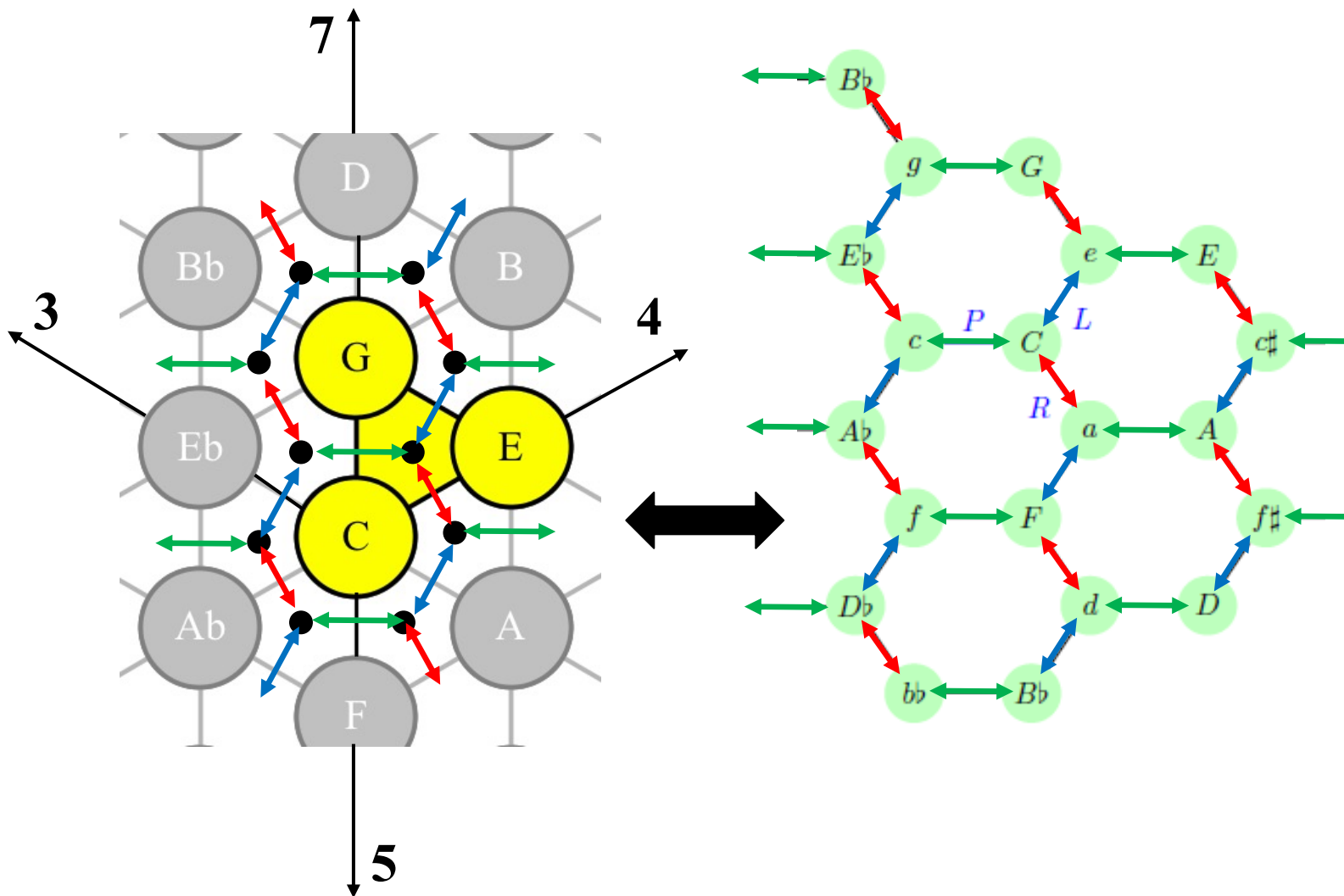
Construction du maillage hexagonal à partir du Tonnetz



Construction du maillage hexagonal à partir du Tonnetz

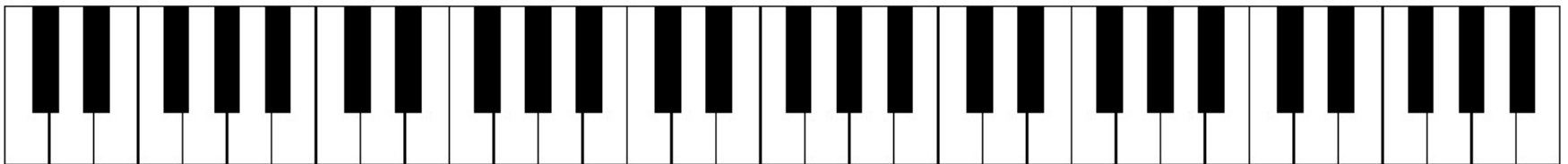
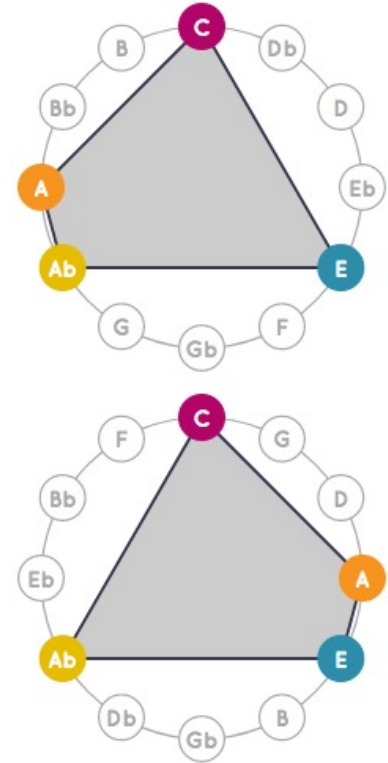
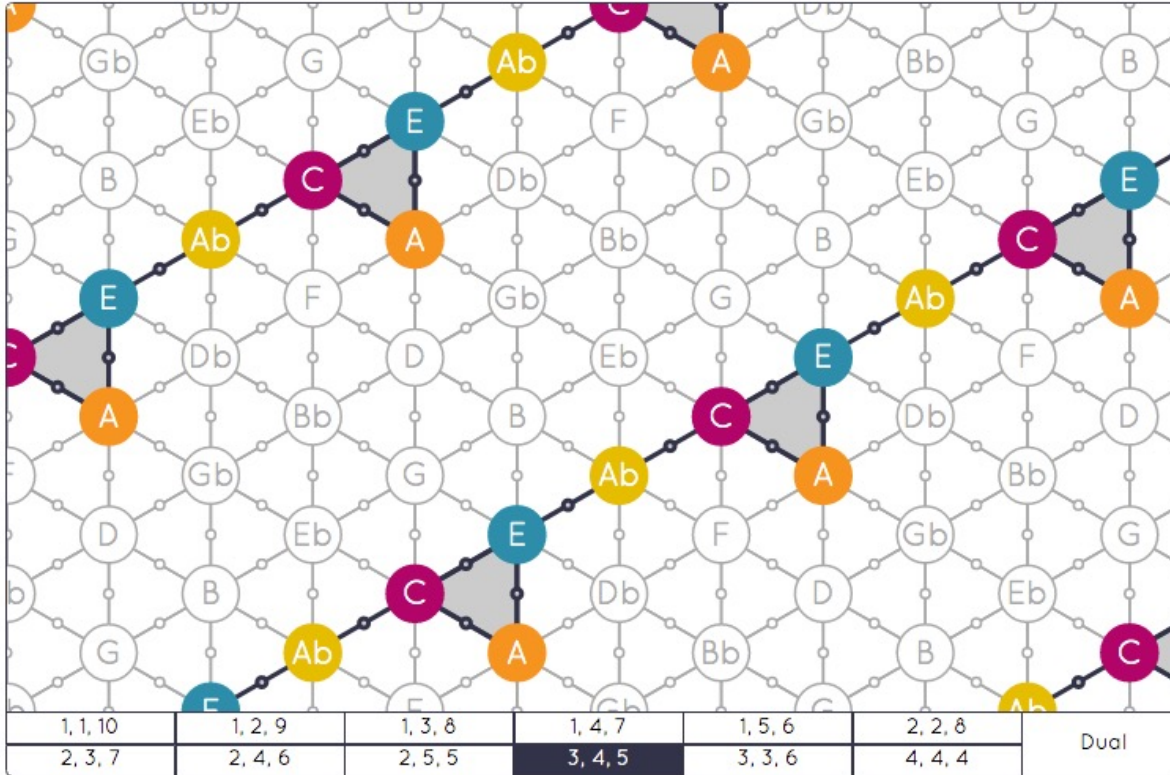


Construction du maillage hexagonal à partir du Tonnetz



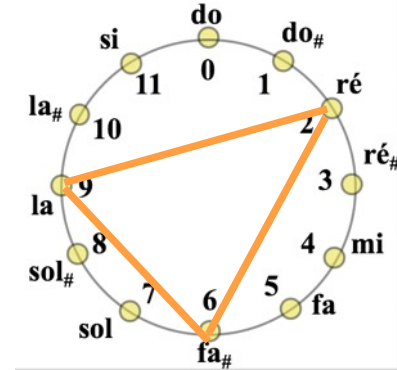
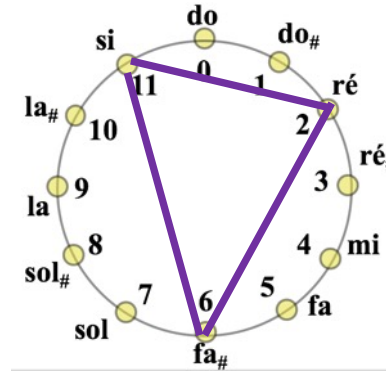
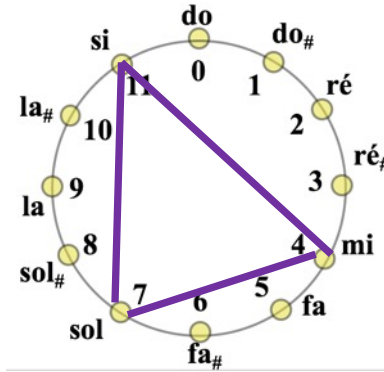
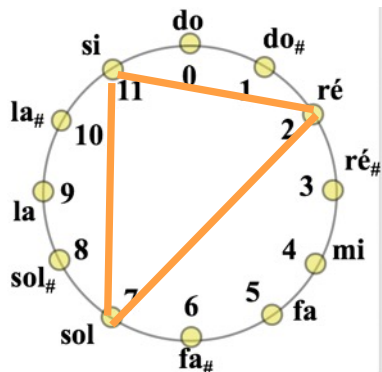
Modèles computationnels : The Tonnetz

THE TONNETZ ONE KEY - MANY REPRESENTATIONS

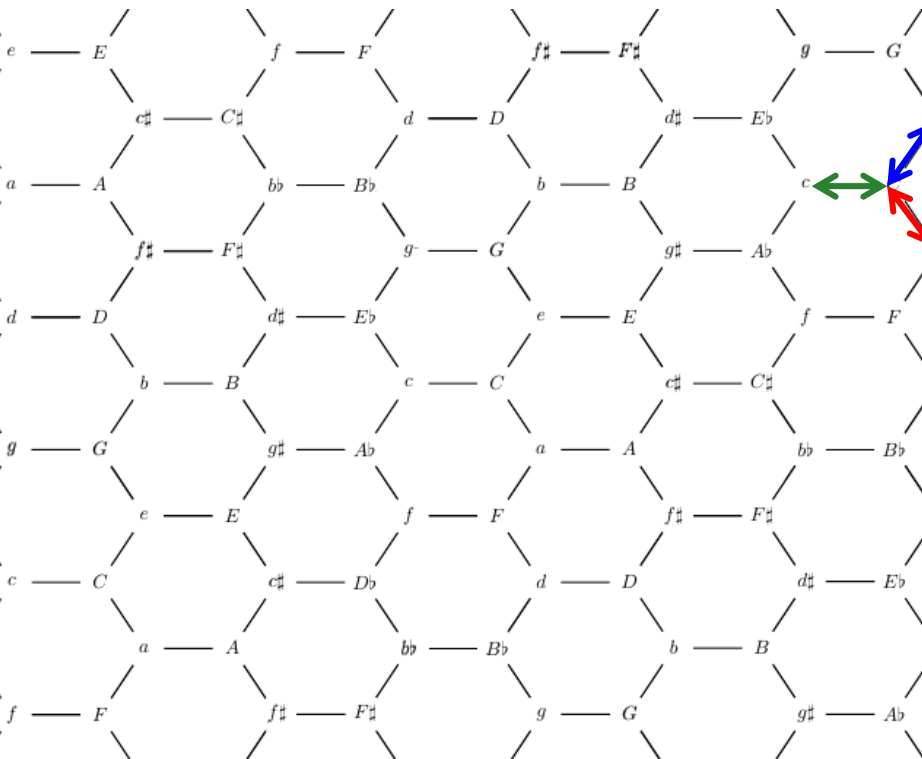


➔ www.thetonnetz.com

Quelques exemples analytiques : une Anatole...



G



iii → V → I → vi

V → I → vi → iii

I → vi → iii → V

vi → iii → V → I

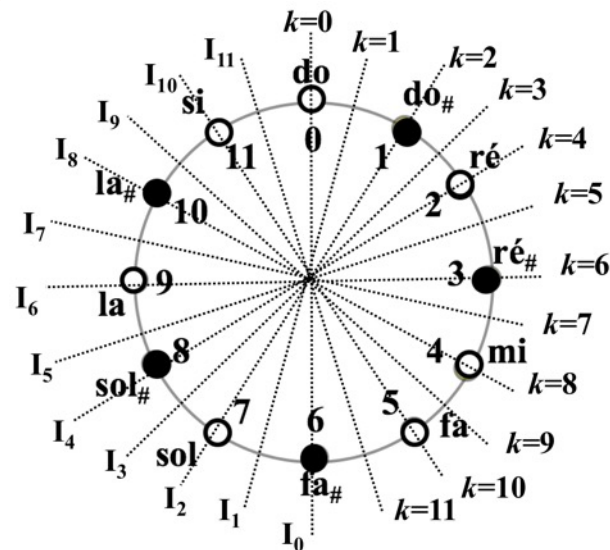
Em



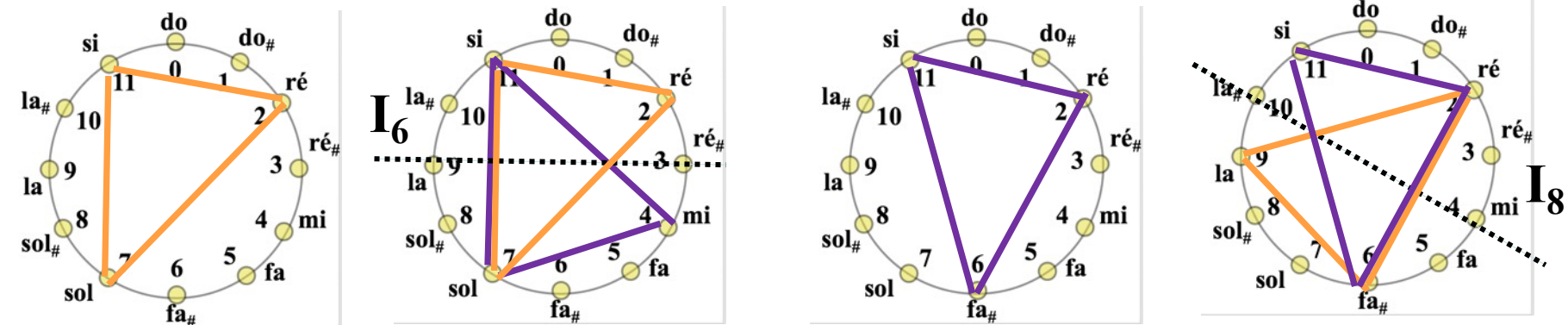
Bm



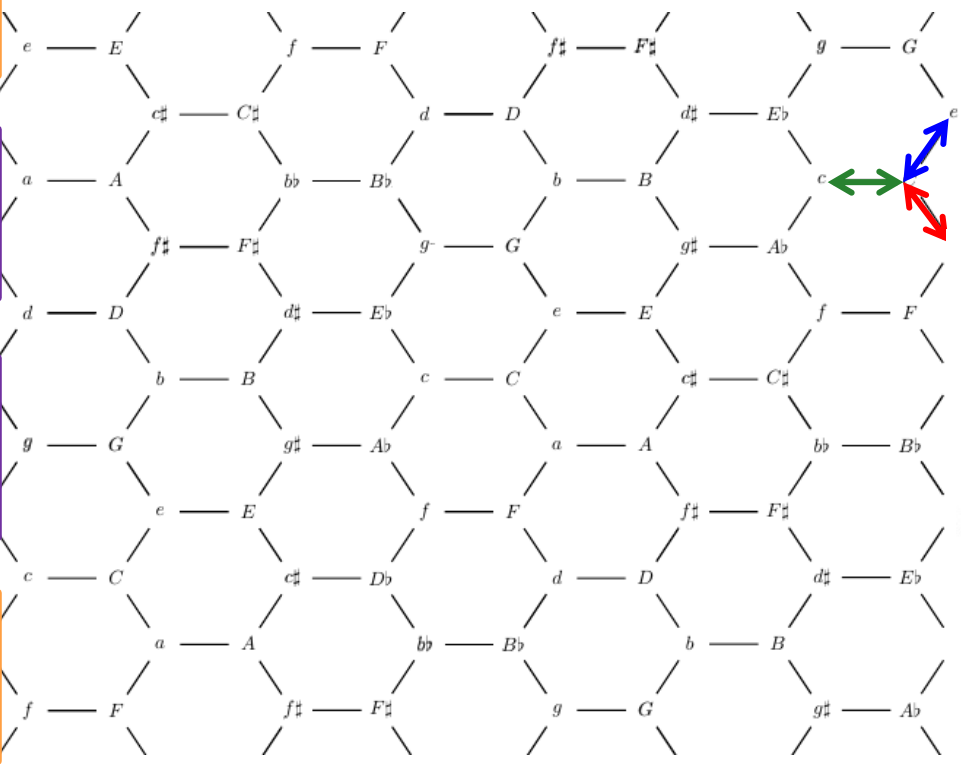
D



Quelques exemples analytiques : une Anatole...



G



iii → V → I → vi

V → I → vi → iii

I → vi → iii → V

vi → iii → V → I

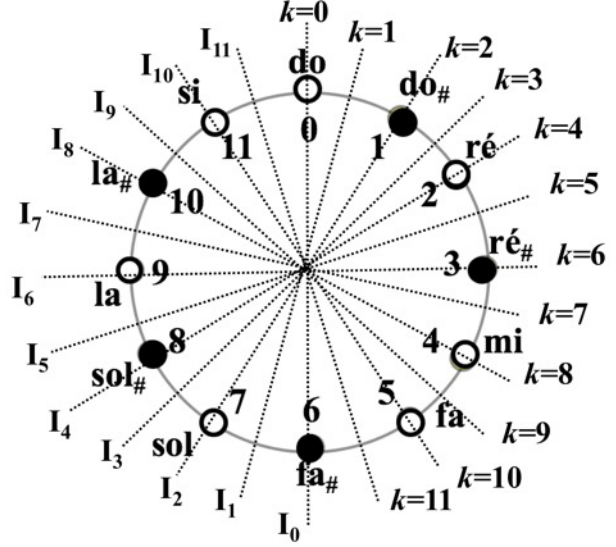
Em



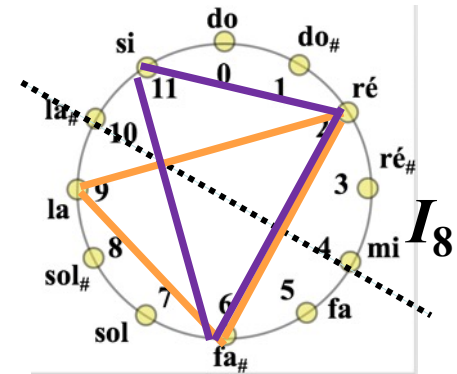
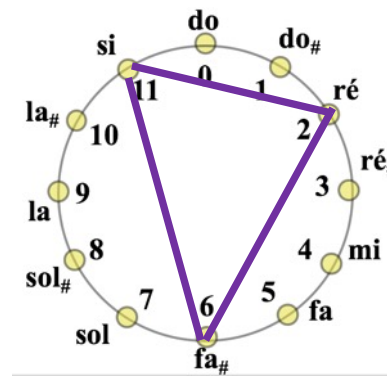
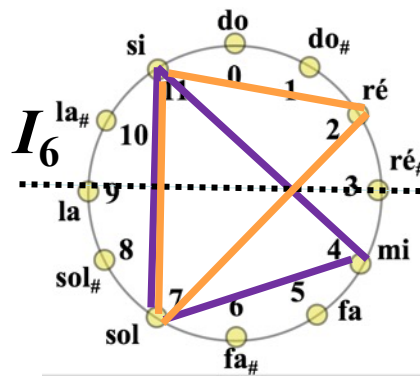
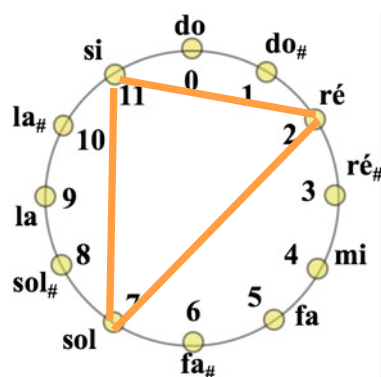
Bm



D



Quelques exemples analytiques : une Anatole...



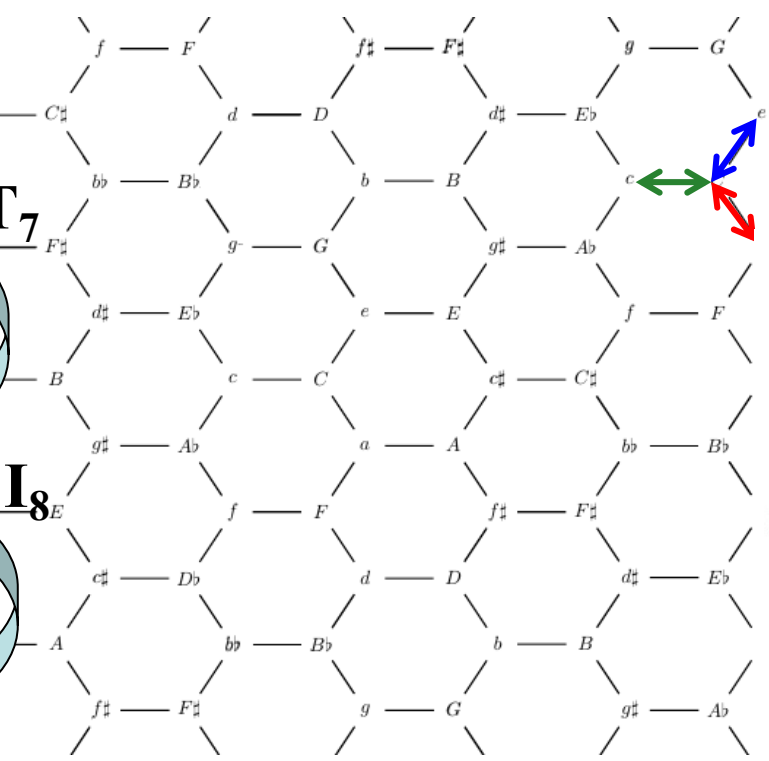
G

Em

Bm

D

Diagram showing four musical staves (G, Em, Bm, D) with arrows pointing to a central chromatic circle. The arrows are labeled with intervals I6, T7, I8, and I6 respectively.

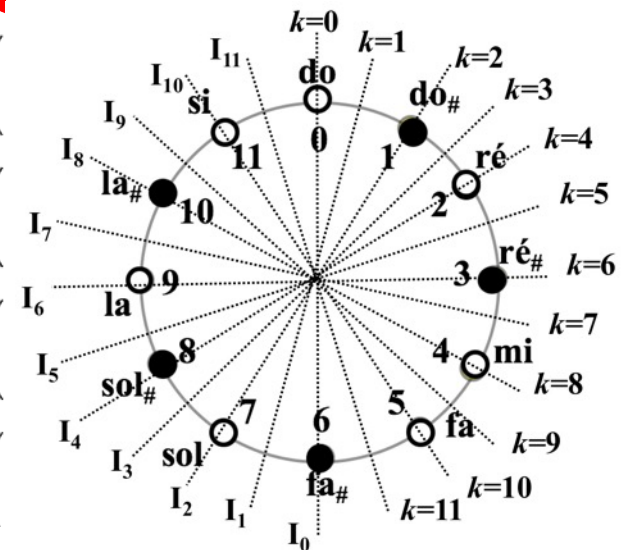


iii → V → I → vi

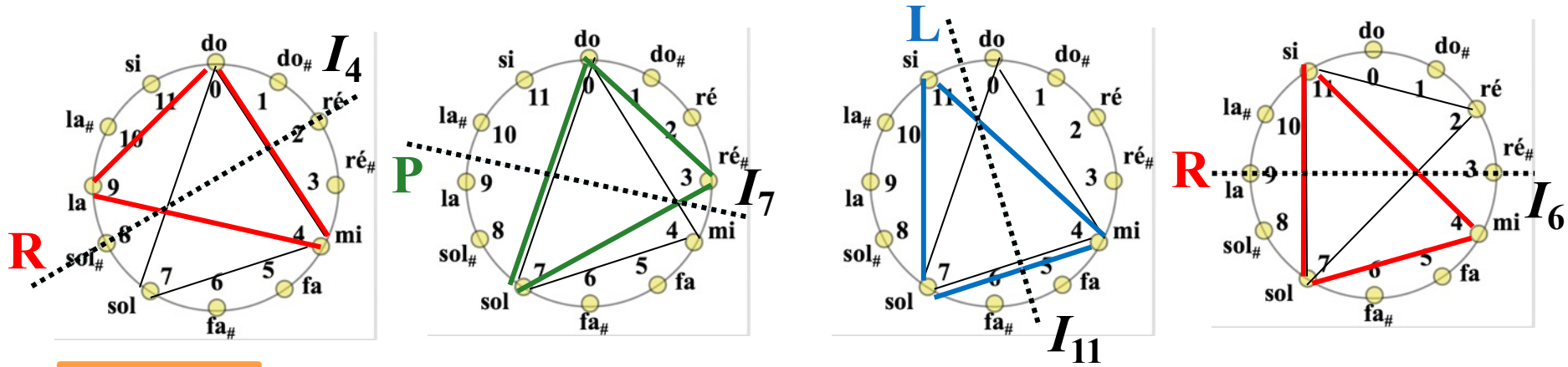
V → I → vi → iii

I → vi → iii → V

vi → iii → V → I



Quelques exemples analytiques : ...chez Paolo Conte



This block shows a musical score with four systems of staves and a corresponding chord progression diagram.

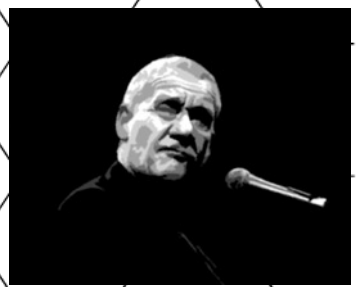
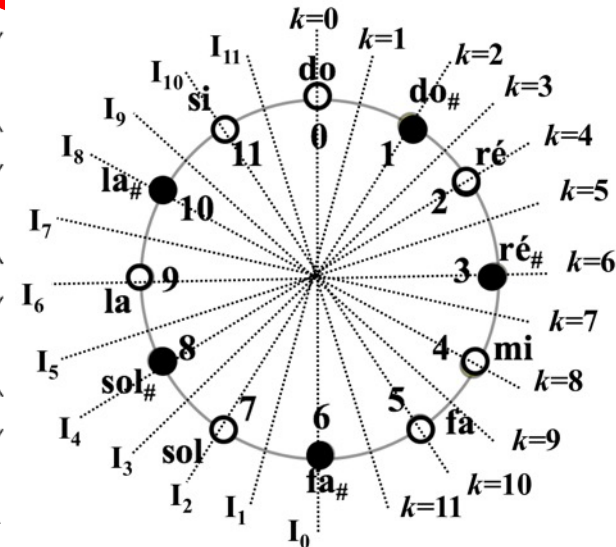
- Staff 1 (G):** Orange box, contains a treble clef and a single note.
- Staff 2 (Em):** Purple box, contains a treble clef and a single note.
- Staff 3 (Bm):** Purple box, contains a treble clef and a single note.
- Staff 4 (D):** Orange box, contains a treble clef and a single note.
- Chord Progression Diagram:** A grid of chords with arrows indicating transitions:
 - Vertical arrows: G (orange) ↔ Em (purple) ↔ Bm (purple) ↔ D (orange).
 - Horizontal arrows: C (orange) ↔ F (orange) ↔ B (purple) ↔ E (purple) ↔ A (orange).
 - Diagonal arrows: C (orange) ↔ D (orange) ↔ B (purple) ↔ A (orange).
 - Diagonal arrows: F (orange) ↔ G (orange) ↔ E (purple) ↔ D (orange).
 - Diagonal arrows: B (purple) ↔ G (orange) ↔ E (purple) ↔ D (orange).

$iii \rightarrow V \rightarrow I \rightarrow vi$

$V \rightarrow I \rightarrow vi \rightarrow iii$

$I \rightarrow vi \rightarrow iii \rightarrow V$

$vi \rightarrow iii \rightarrow V \rightarrow I$



La trajectoire spatiale de l'Anatole

Harmonic Progressions

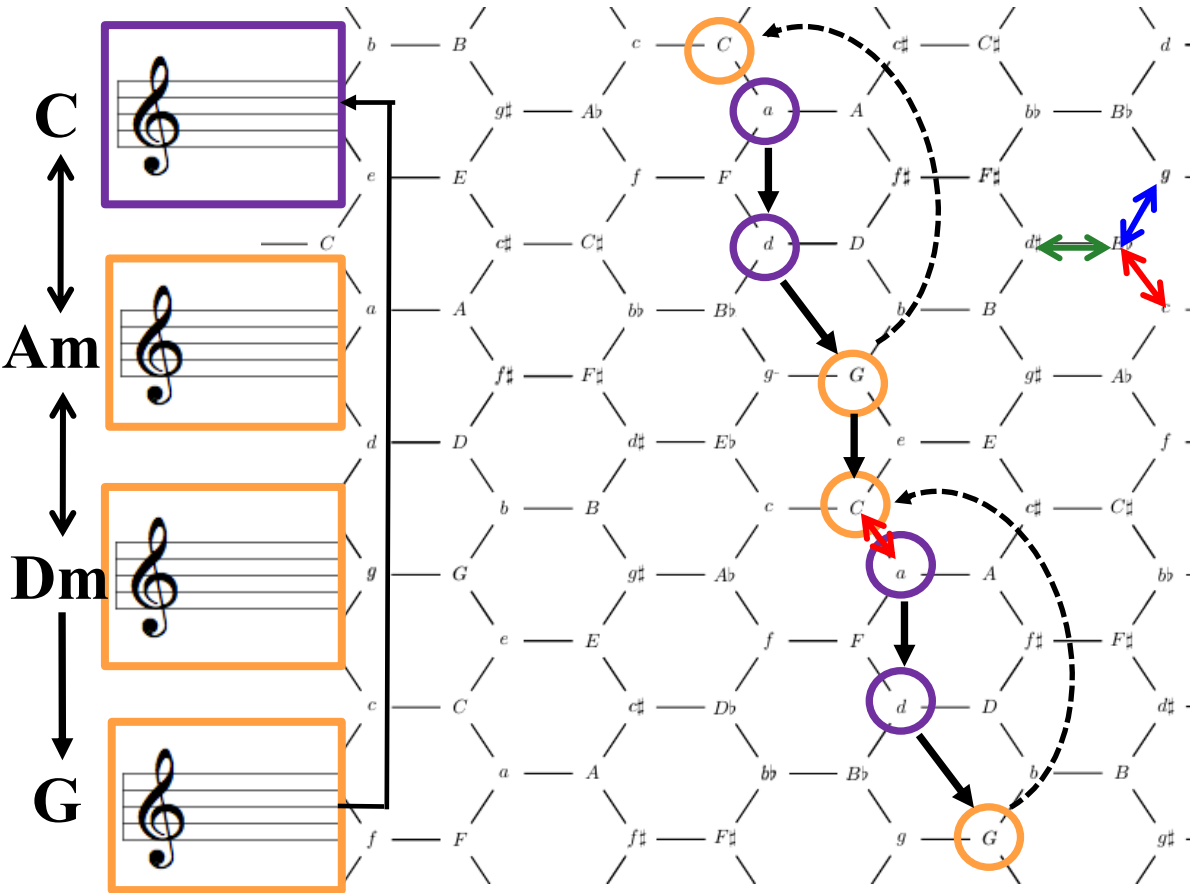
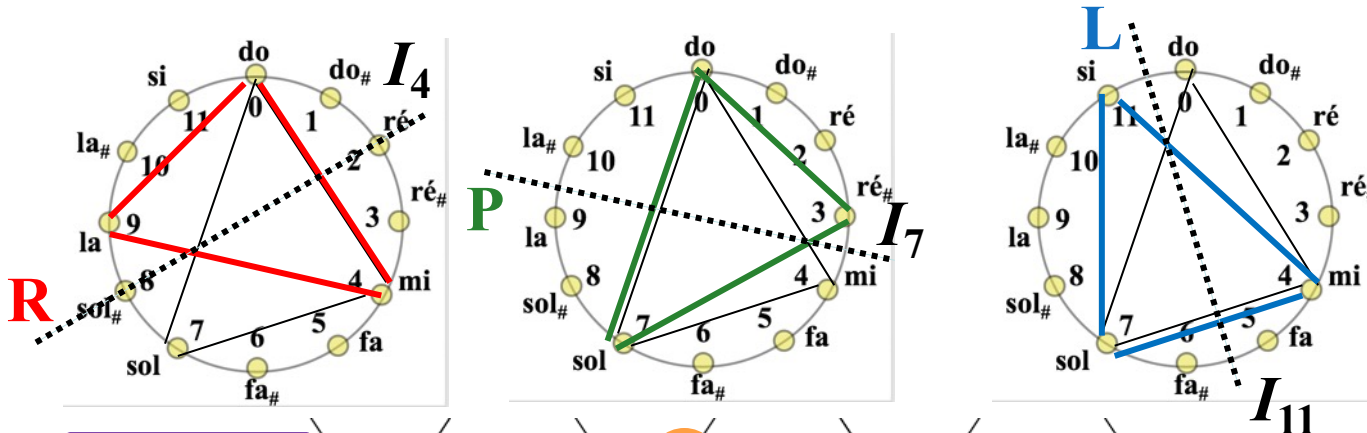
In Paolo Conte

Sotto le Stelle del Jazz



Supervision Moreno Andreatta
Modelisation Gilles Baroin 2016

Autres Anatoles et autres trajectoires

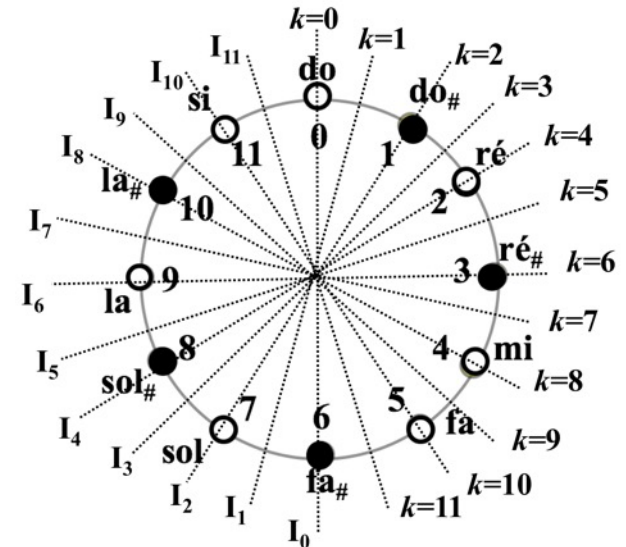


ii → V → I → vi

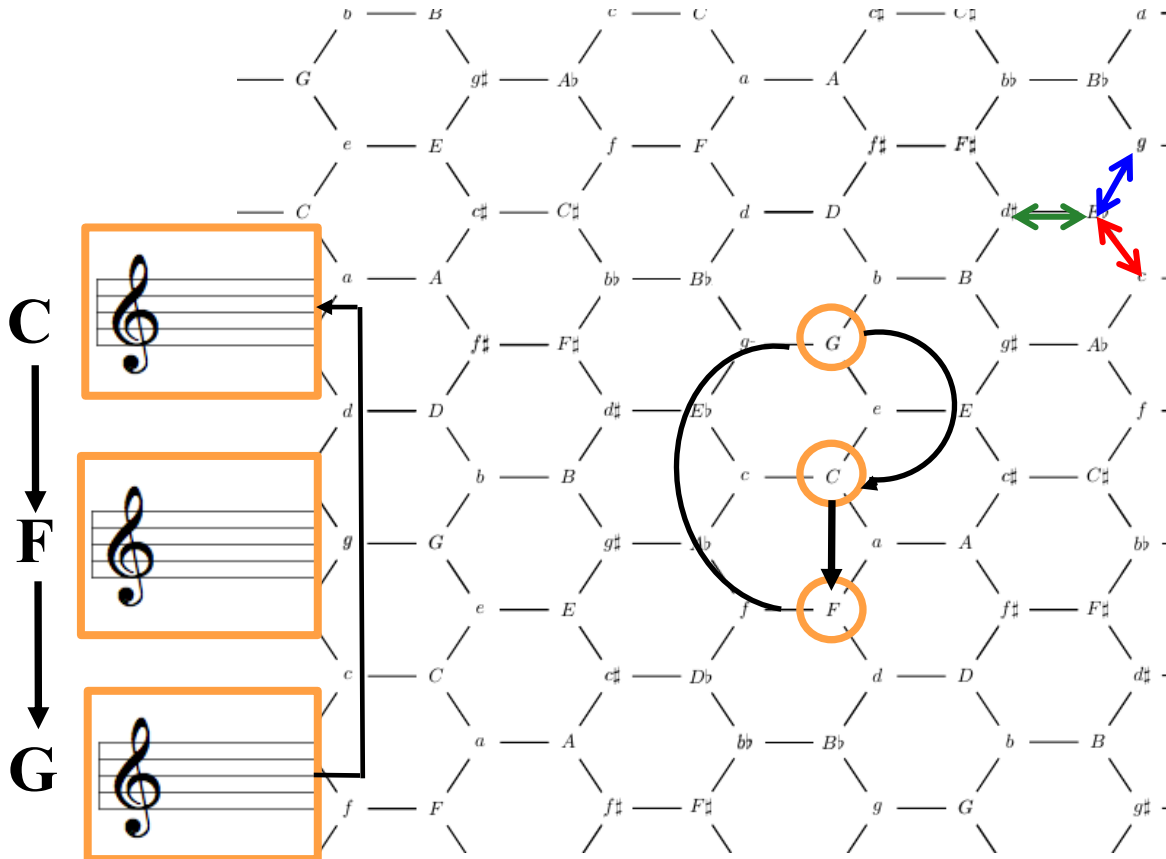
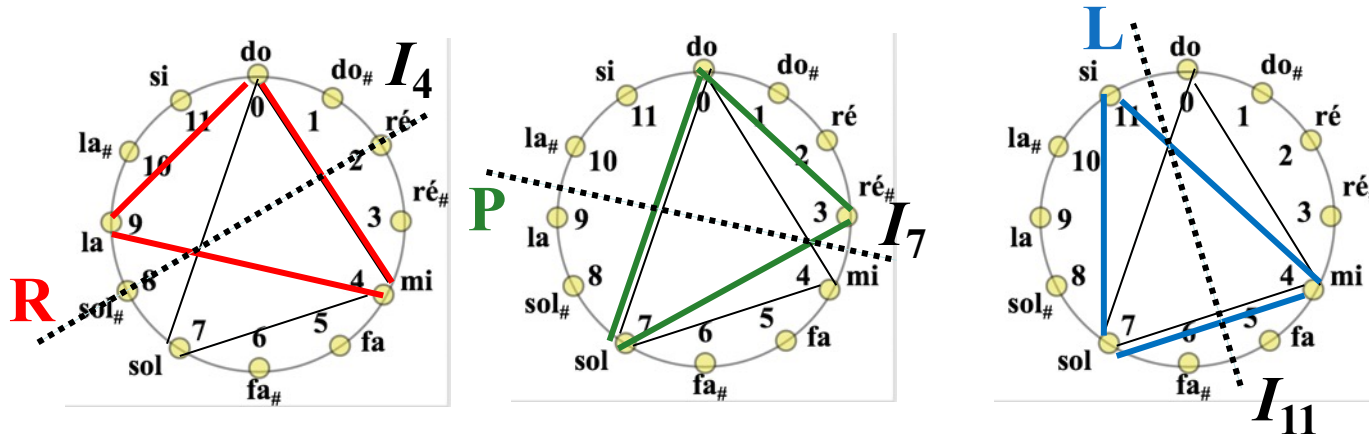
V → I → vi → ii

I → vi → ii → V

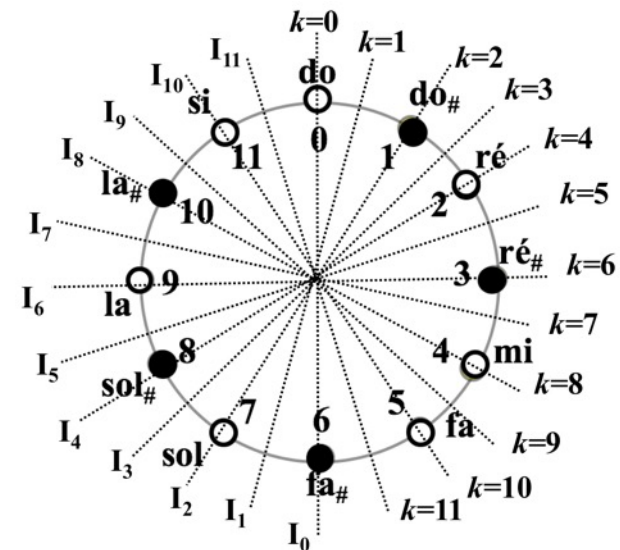
vi → ii → V → I



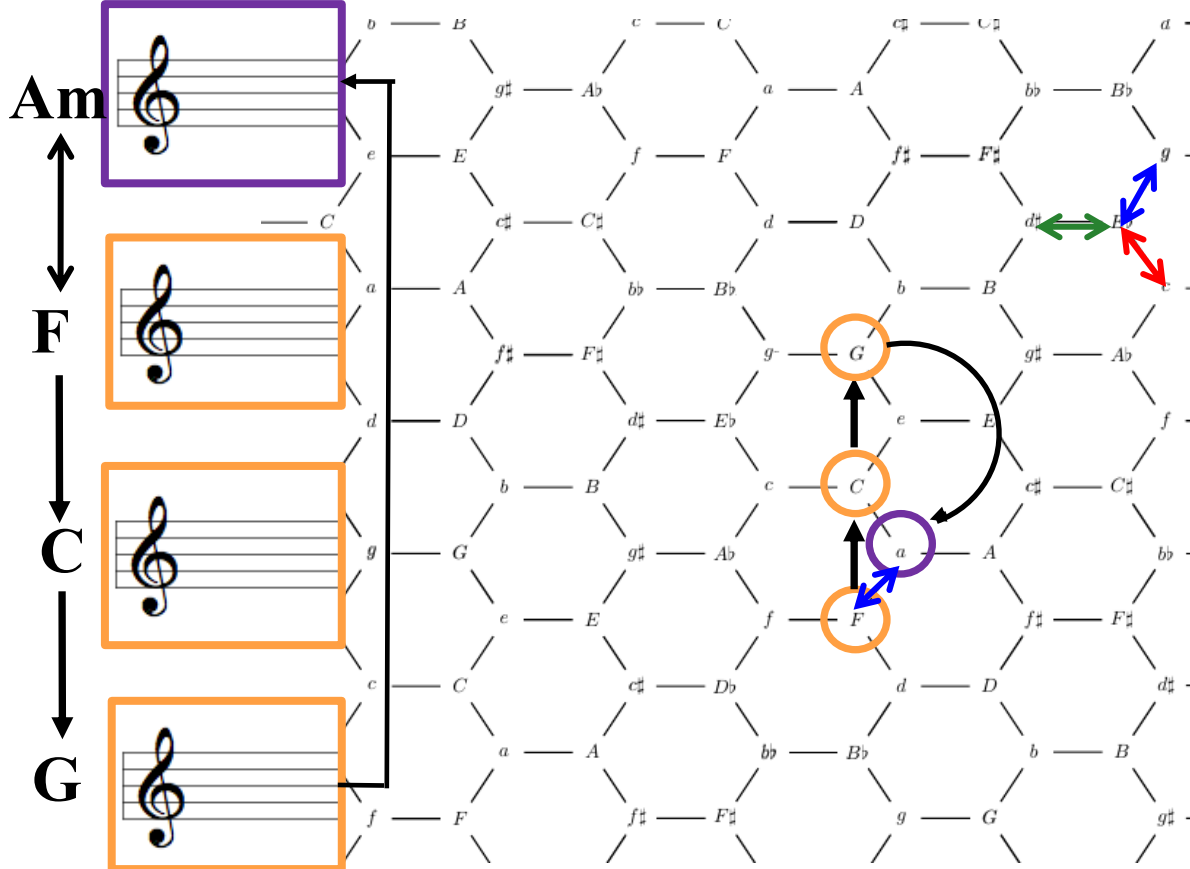
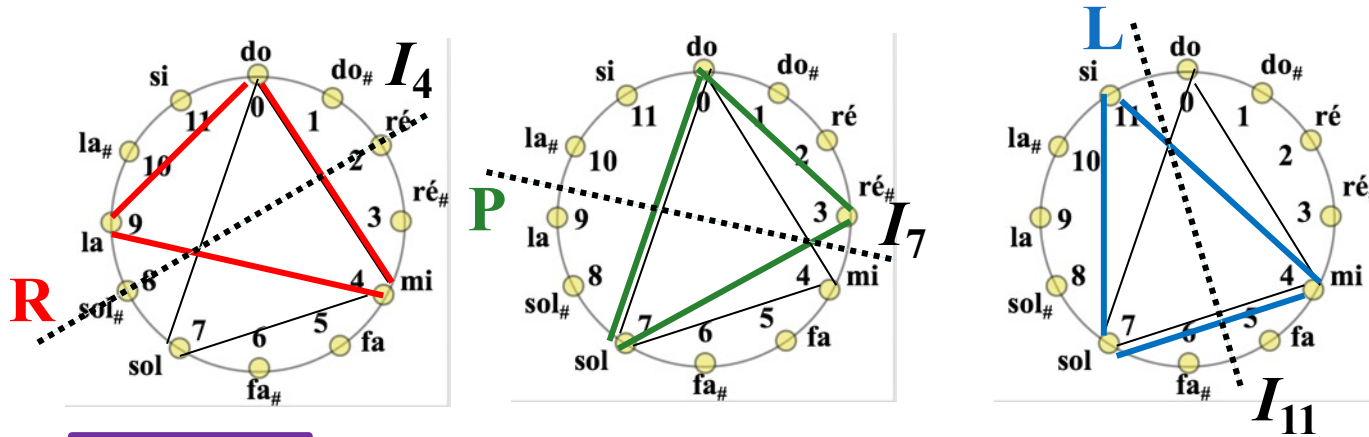
Boucles harmoniques dans la pop



$I \rightarrow IV \rightarrow V$
 $IV \rightarrow V \rightarrow I$
 $V \rightarrow I \rightarrow IV$



Boucles harmoniques dans la pop

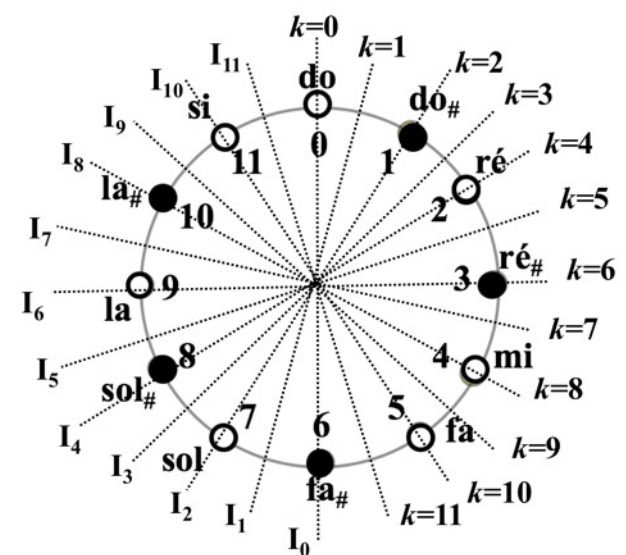


vi → IV → I → V

IV → I → V → vi

I → V → vi → IV

V → vi → IV → I



Mise en évidence des symétries dans la musica pop

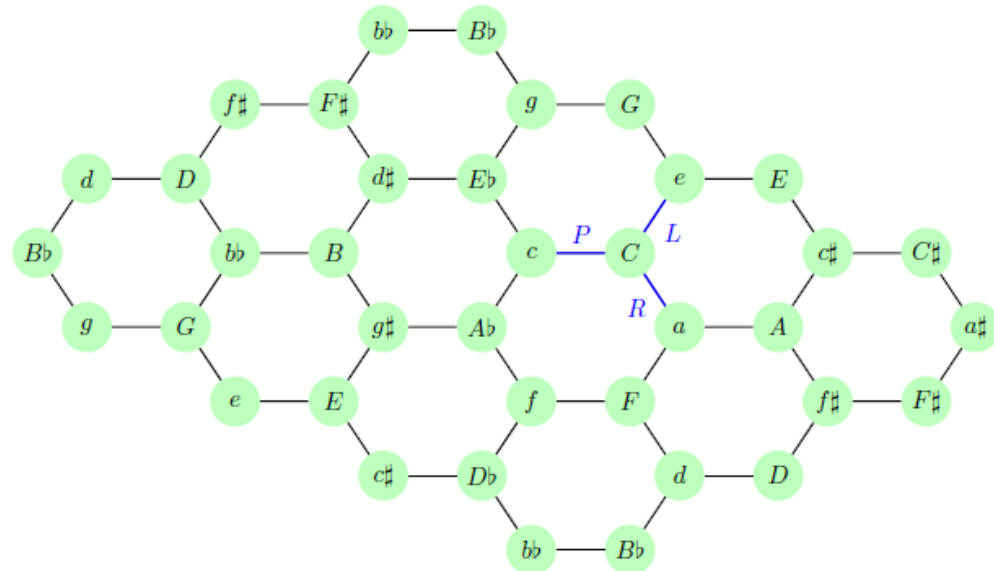
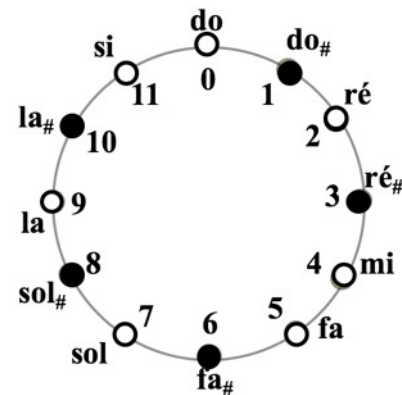
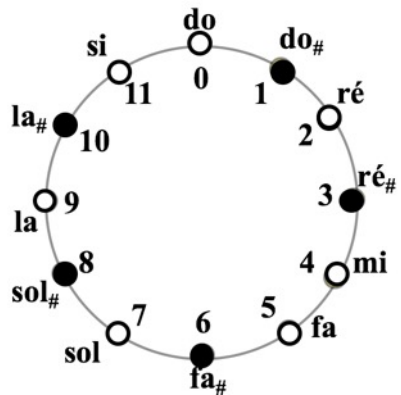
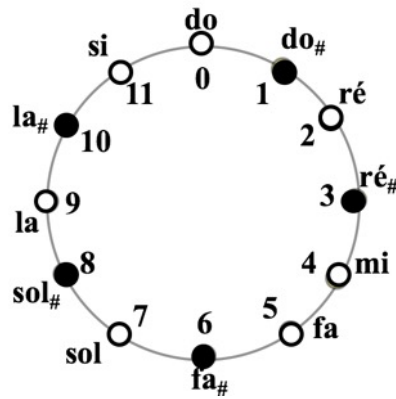
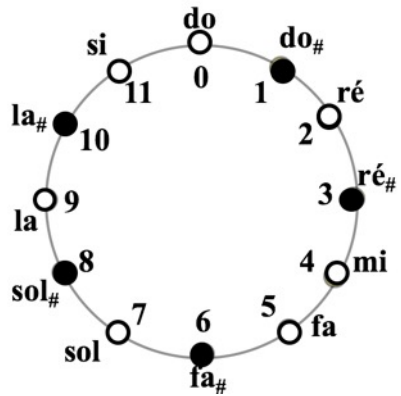
- Guy Capuzzo, "Neo-Riemannian Theory and the Analysis of Pop-Rock Music", Music Theory Spectrum 26(2), p. 177-199, 2004

Synthesizer

D- ↔ F- ↔ Db+ ↔ Bb+ ↔



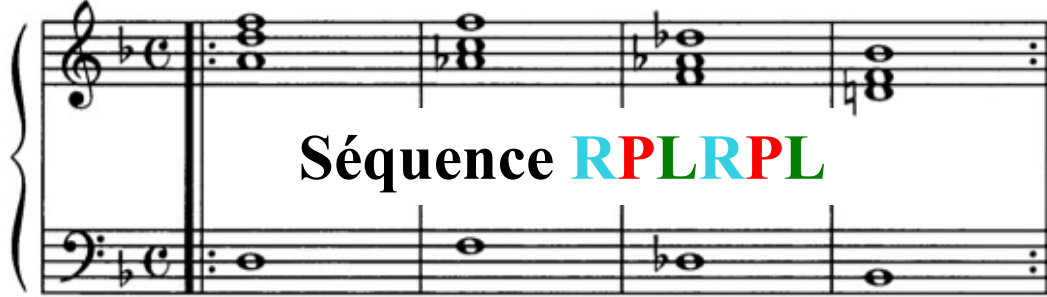
Shake the disease - 1985
(Depeche Mode) – min. 2'17''



Mise en évidence des symétries dans la musica pop

- Guy Capuzzo, "Neo-Riemannian Theory and the Analysis of Pop-Rock Music", Music Theory Spectrum 26(2), p. 177-199, 2004

$D- \xleftrightarrow{RP} F- \xleftrightarrow{L} Db+ \xleftrightarrow{RP} Bb+ \xleftrightarrow{L}$

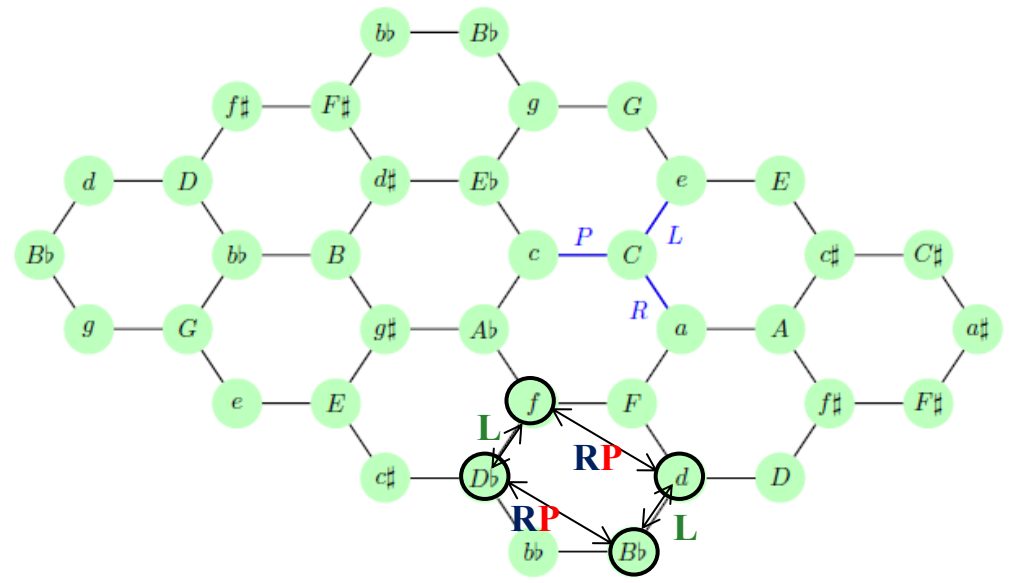
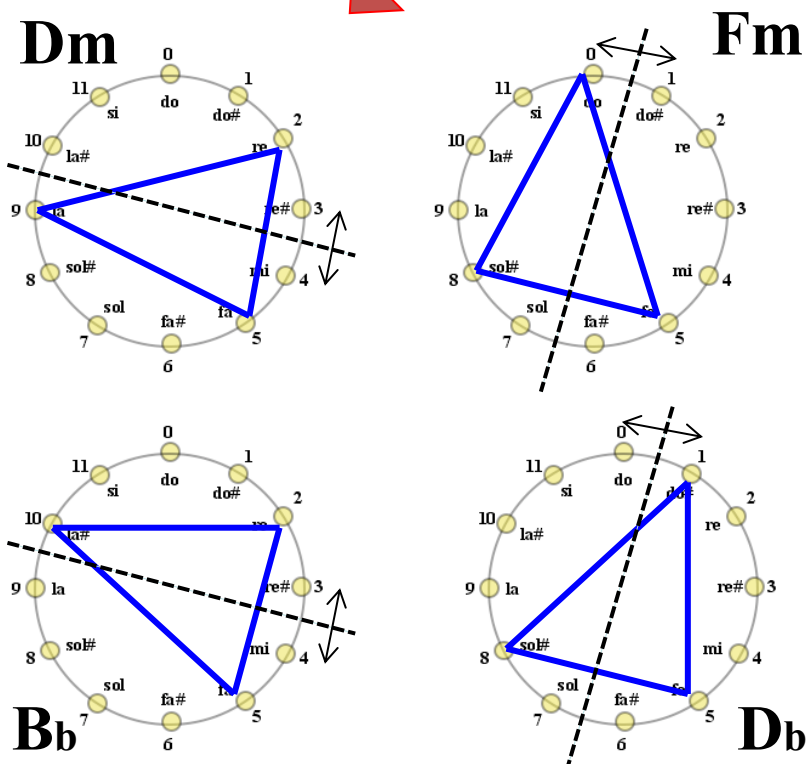


Synthesizer

Séquence **RPLRPL**

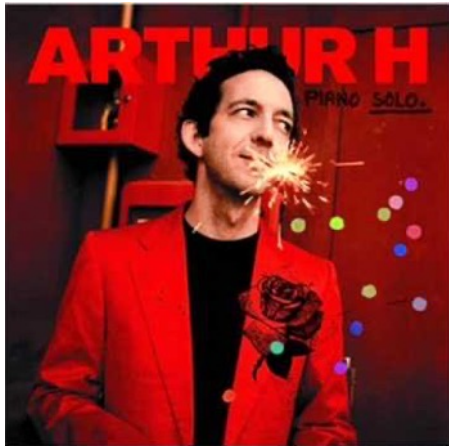


Shake the disease - 1985
(Depeche Mode) – min. 2'17"

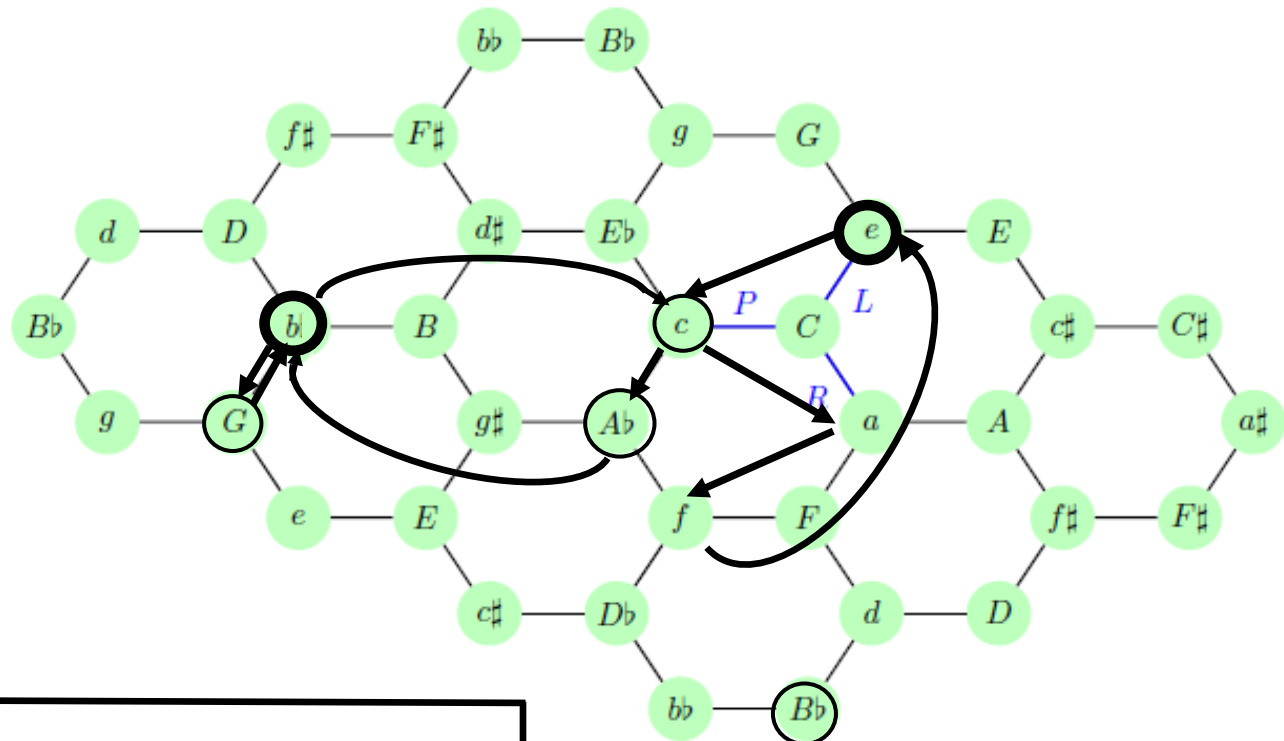


(Source <http://www.mathsintheair.org/>)

Parcours harmoniques chez Arthur H



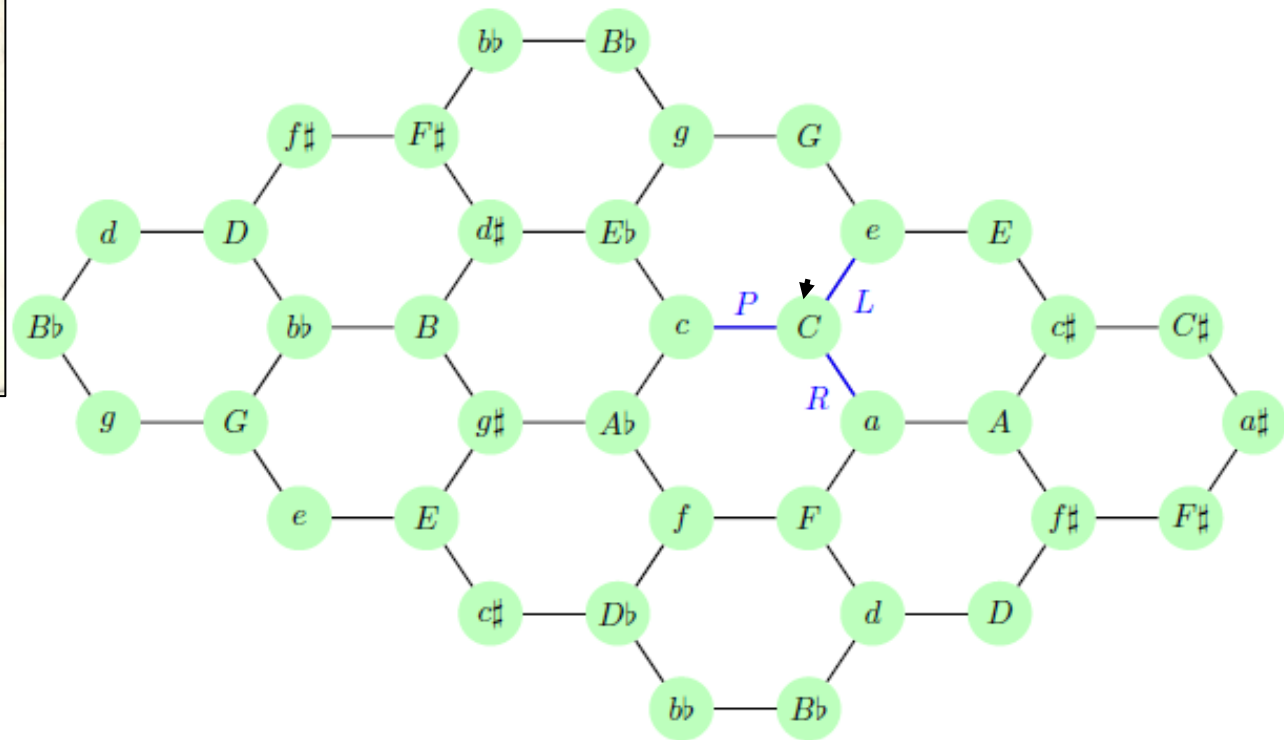
Le Baron noir
(album *Piano solo*, 2002)



Cycle 1 : $Bm \xrightarrow{PLPR} Cm \xrightarrow{L} Ab \xrightarrow{PRP} Bm \xrightarrow{L} G \xrightarrow{L} Bm \xrightarrow{L} G \xrightarrow{L} Bm$

Cycle 2 : $Em \xrightarrow{LP} Cm \xrightarrow{PL} Em \xrightarrow{LP} Cm \xrightarrow{PR} Am \xrightarrow{LP} Fm \xrightarrow{PLRL} Em$

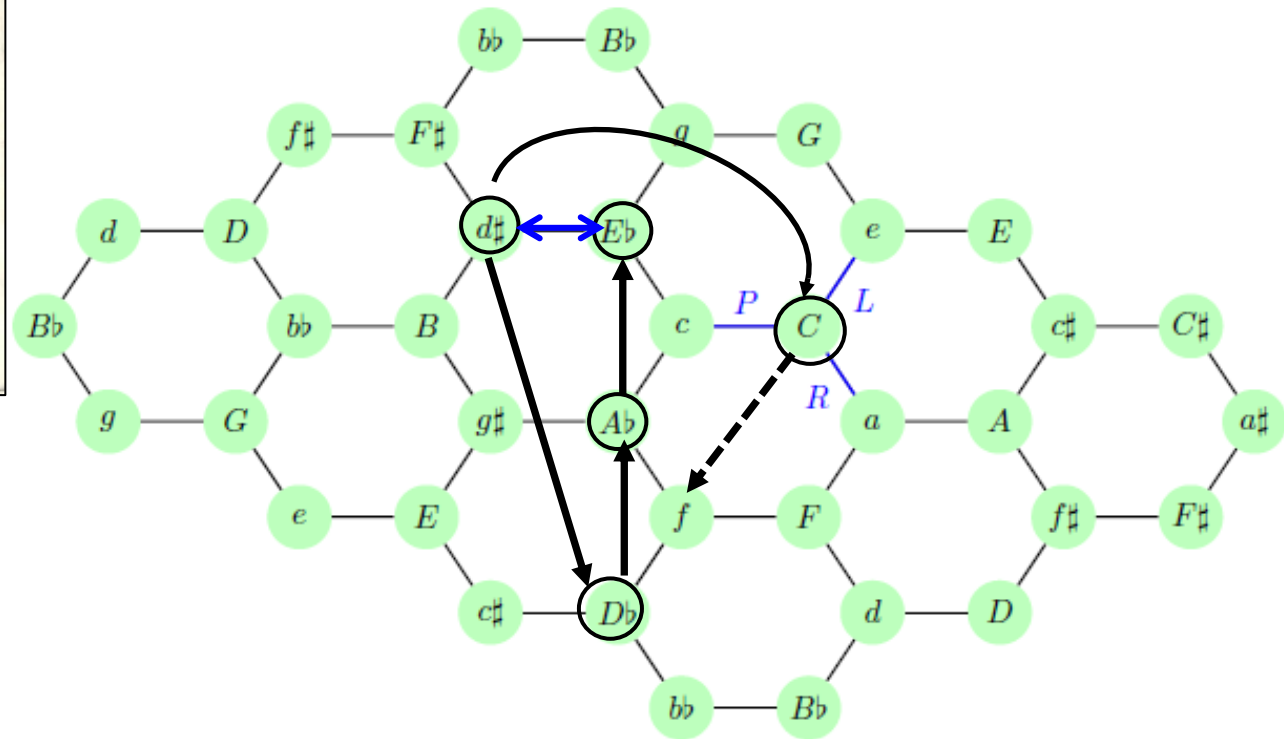
Parcours harmoniques chez William Sheller



min. 0'33''

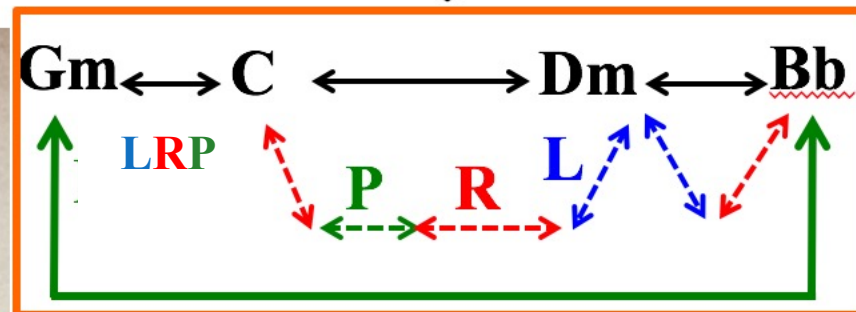
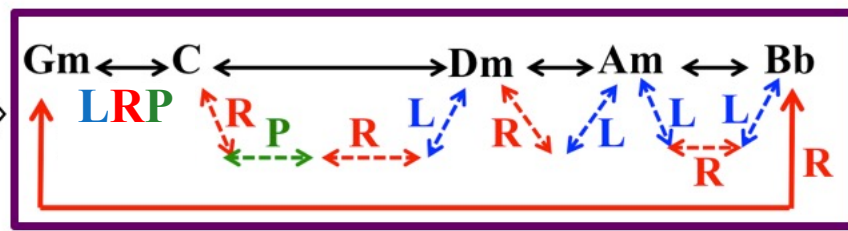
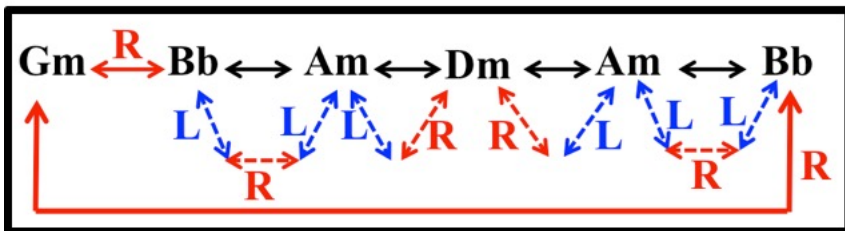


Parcours harmoniques chez William Sheller



min. 0'33''





MON APACHE

(Arman Méliès)

Cette promesse, c'est de l'or
que tu caches
en attendant les apaches
et leurs centaures

D'où vient la soie de ton ventre
et d'où vient
l'ardeur de ces beaux élans
que tu défends

les vaisseaux
logés au creux de ta peau
couleur d'encre

O mon inouïe amazone
tu nous quittes
et l'été se fait automne
black light, white heat

O mon inouïe antilope
dans tes flancs
et leurs reflets roux d'enfance
dort un cyclope

Où vont les flots noirs
de cendre

Une flèche en plein cœur
un ciel à la dérive
et je meurs
de nous survivre

Une flèche en plein cœur
un ciel à la dérive
et je meurs
de nous survivre

Un aiezan sur la grève
de nouveau enfin libre
et je crève
de nous survivre

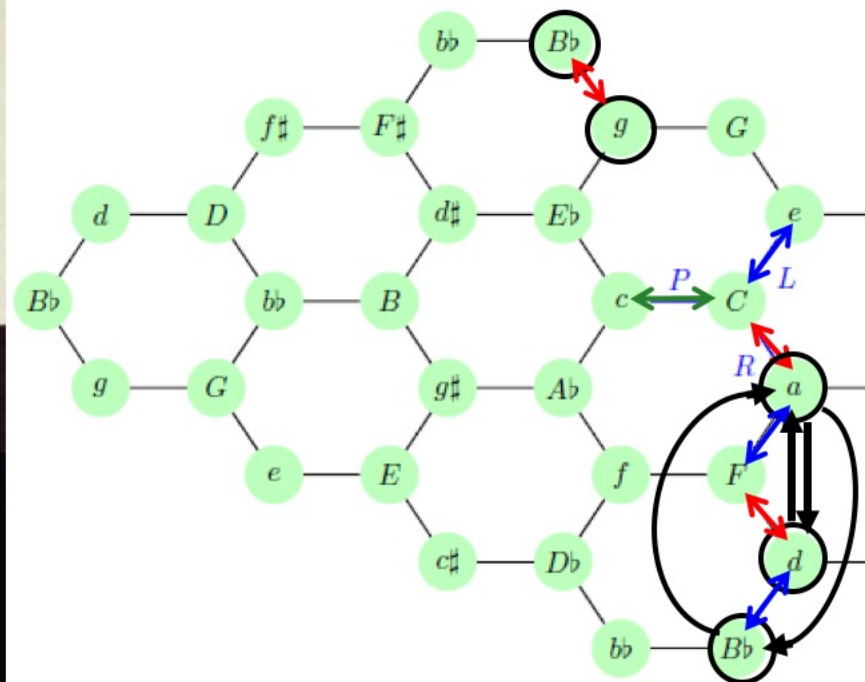
Un aiezan sur la grève
de nouveau enfin libre
et je crève
de nous survivre

Cette lueur plus encore
tu la caches
en attendant les apaches
et leurs trésors

Cette promesse c'est de l'or
que tu caches
en attendant
les apaches

Cette promesse c'est de l'or
que tu caches
moi je t'attends

Mon apache



LØVE
Julien Doré

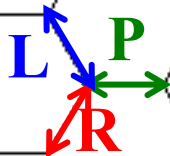
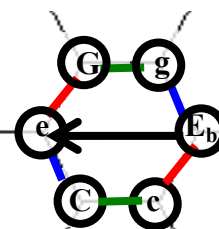
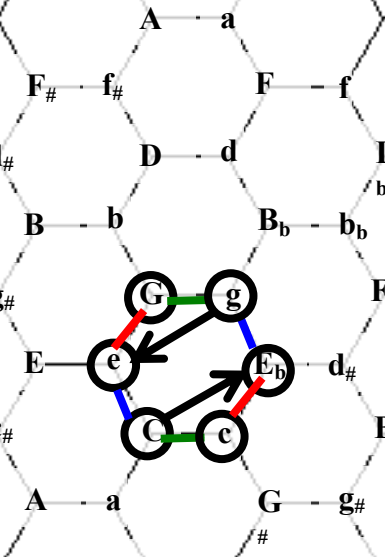
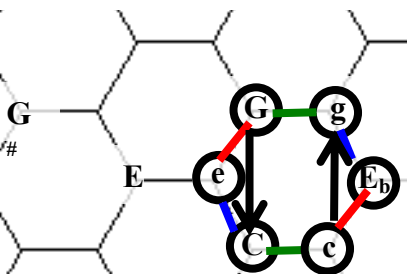
Un cycle et ses raccourcis...

C-c-E_b-g-G-e-C → [PRLPRL]

C-c-----g-G---C → [P(RL)P(RL)]

C-c-E_b-g-G-e-C → [PRLPRL]

C-c-E_b-----e-C → [PR(LPR)L]



C-c-E_b-g-G-e-C → [PRLPRL]

C-----E_b-g-----e-C → [(PR)L(PR)L]

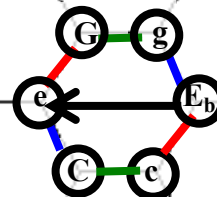
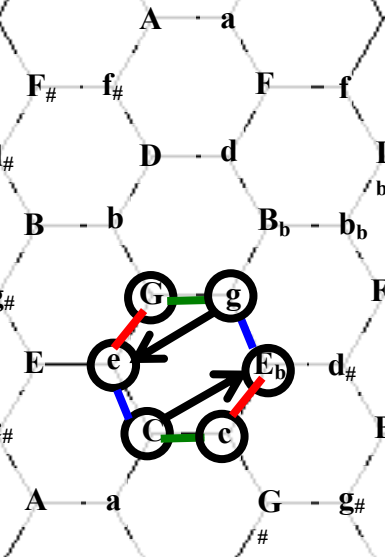
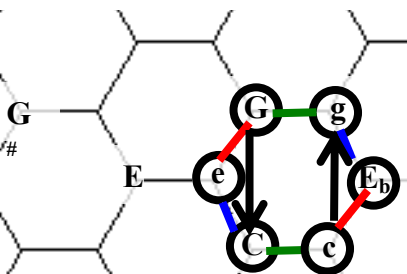
Un cycle et ses raccourcis...

C-c-E_b-g-G-e-C → [PRLPRL]

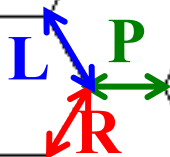
C-c-----g-G---C → [P(RL)P(RL)]

C-c-E_b-g-G-e-C → [PRLPRL]

C-c-E_b-----e-C → [PR(LPR)L]



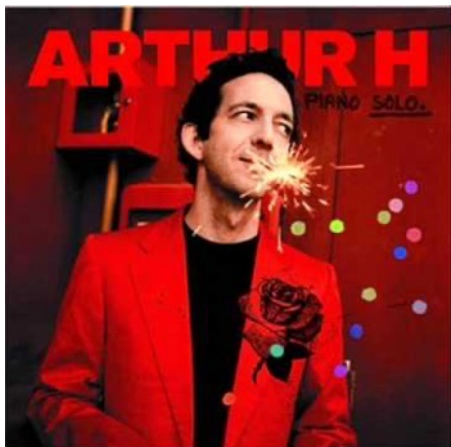
LPR = SLIDE



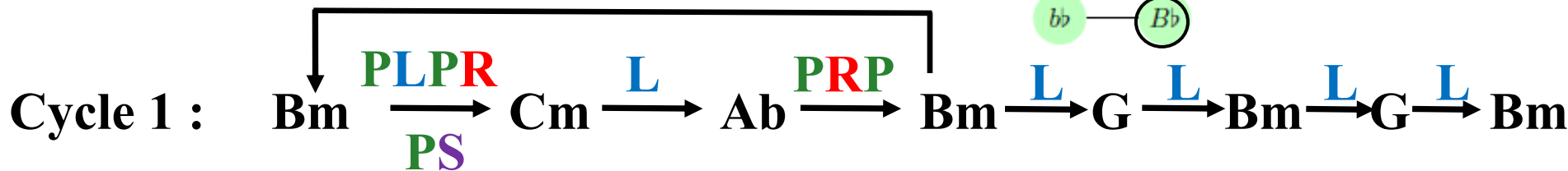
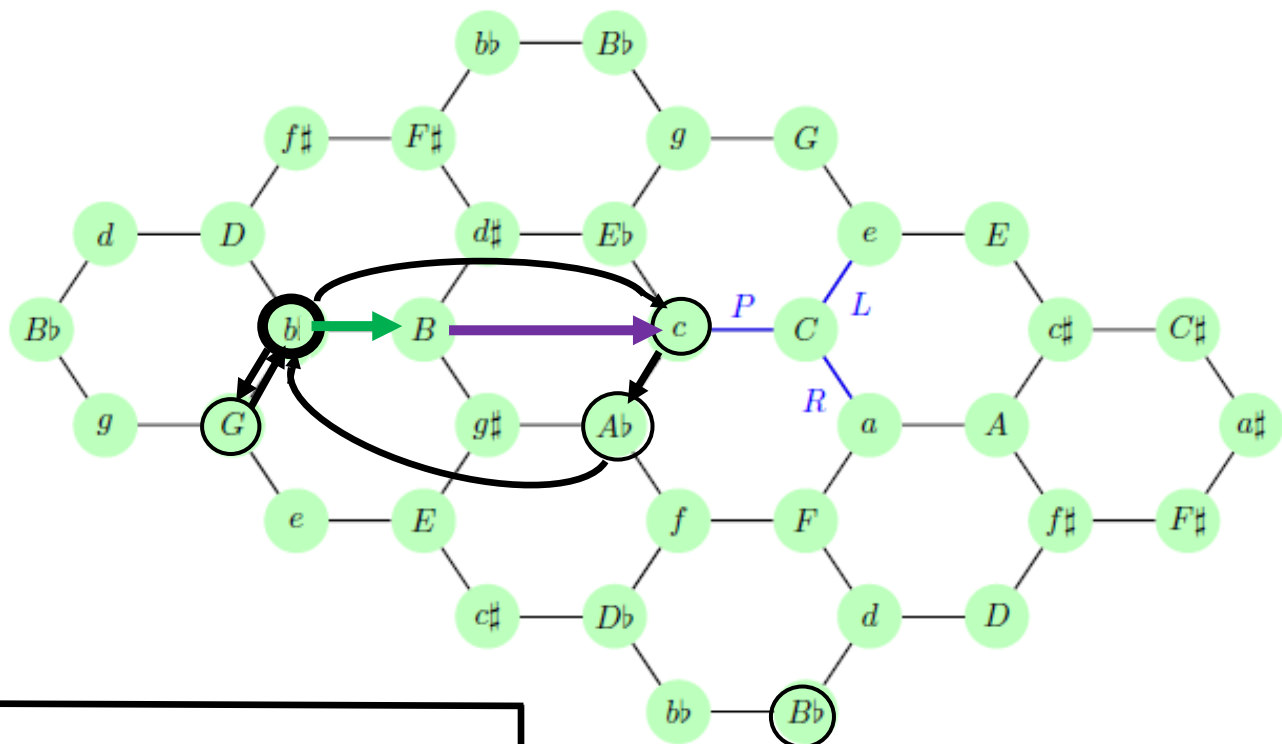
C-c-E_b-g-G-e-C → [PRLPRL]

C-----E_b-g-----e-C → [(PR)L(PR)L]

Le SLIDE chez Arthur H



Le Baron noir (album *Piano solo*, 2002)



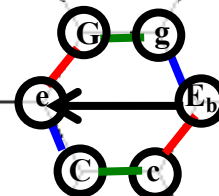
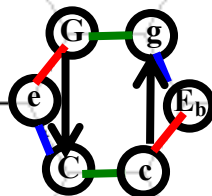
Un cycle et ses raccourcis : SLIDE et NEBENVERWANDT

C-c-E_b-g-G-e-C → [PRLPRL]

C-c-----g-G---C → [P(RL)P(RL)]

C-c-E_b-g-G-e-C → [PRLPRL]

C-c-E_b-----e-C → [PR(LPR)L]

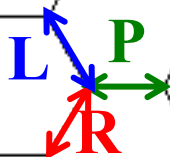


LPR = SLIDE

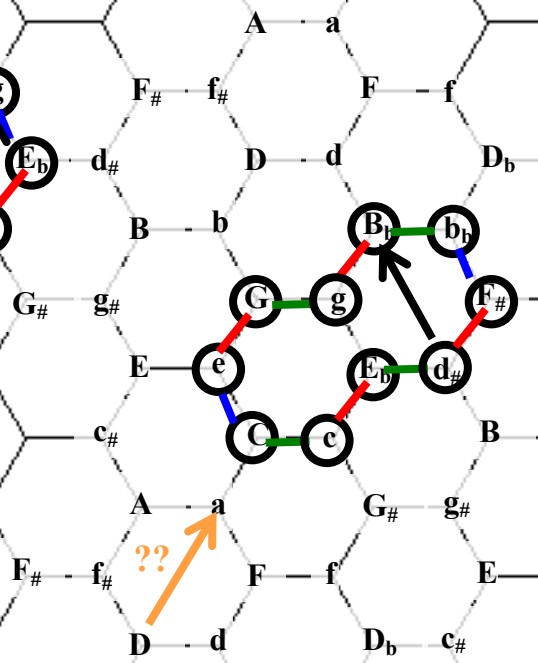
C-c-E_b-d_#-F_#-b_b-B_b-g-G-e-C

C---E_b-d_#-----B_b-g---e-C

RLP = NEBENVERWANDT



LRP = ??



Les zig-zag du *Nebenverwandt* chez Paolo Conte

IL REGNO DEL TANGO (Paolo Conte)



Non son neanche del paese

ho una valigia di carton

sono vestito, sì in borghese,

ma dentro c'è il bandoneon...

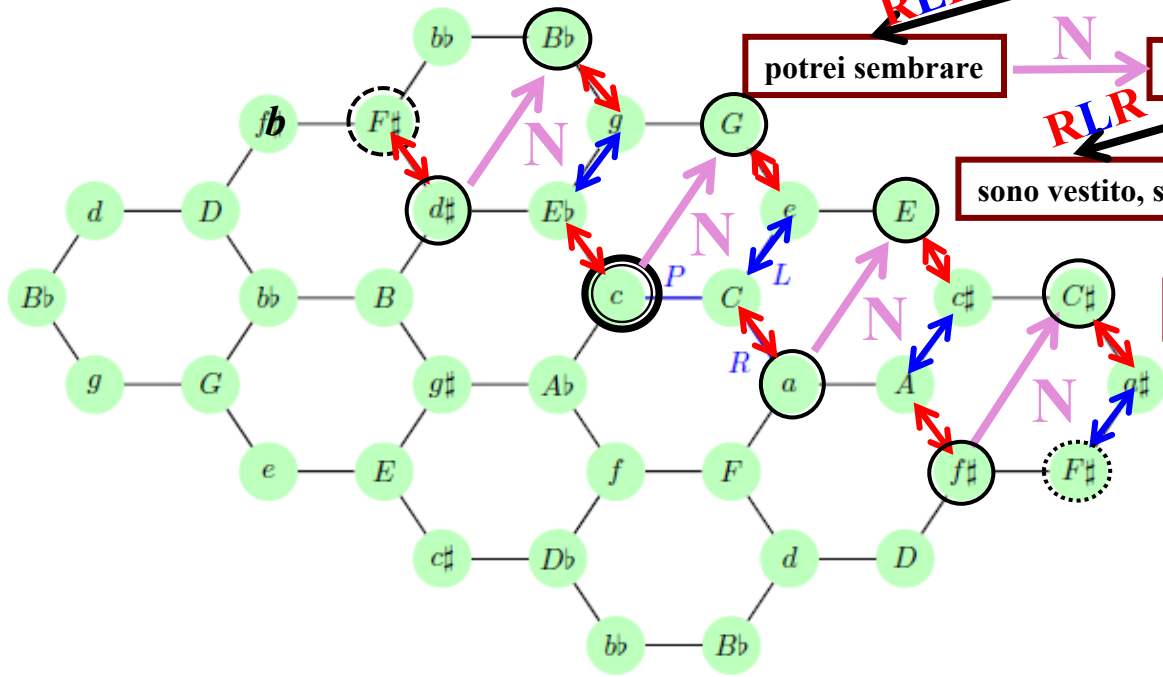
potrei sembrare in borghese,

sono vestito, sì un ragioniere,

anche un geometra potrei,

ma un tango sento io gridare

in fondo ai sentimenti miei



Harmonic Progressions

In Paolo Conte

Il Regno del Tango

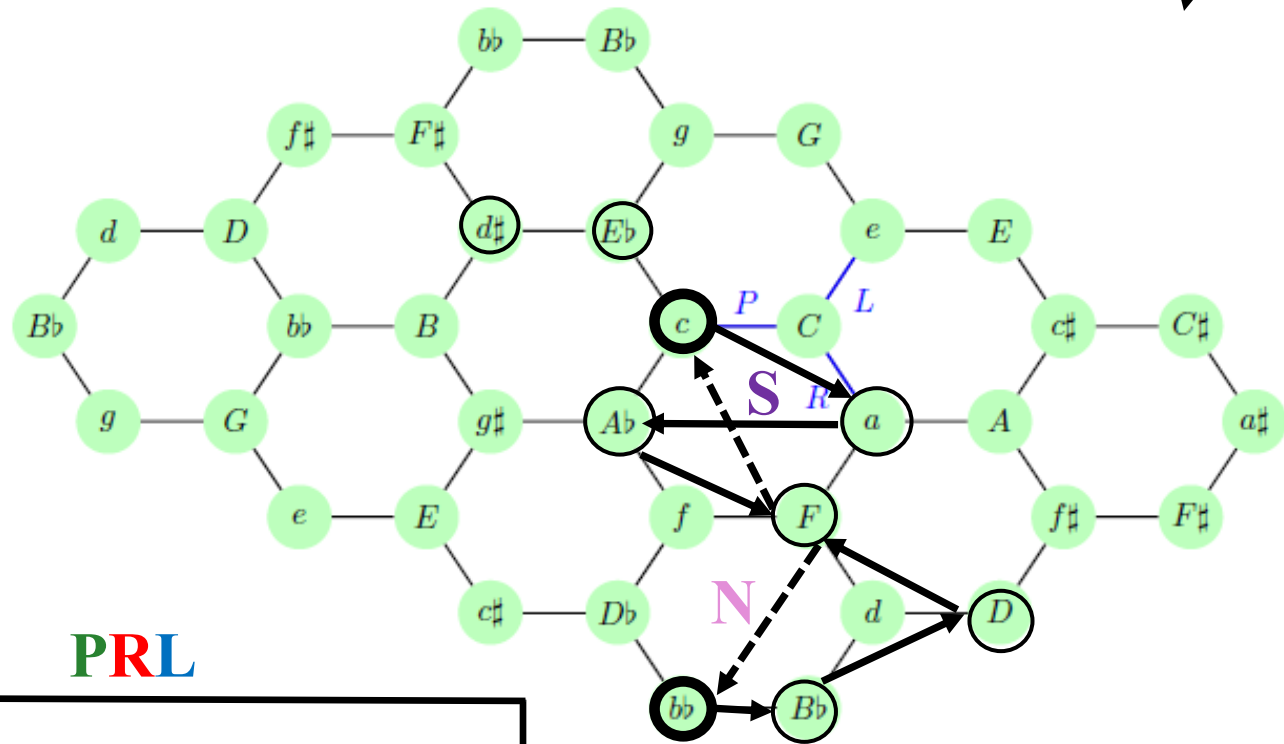


M.Andreatta G.Baroin
www.MatheMusic.net 2016

Parcours harmoniques chez Arthur H



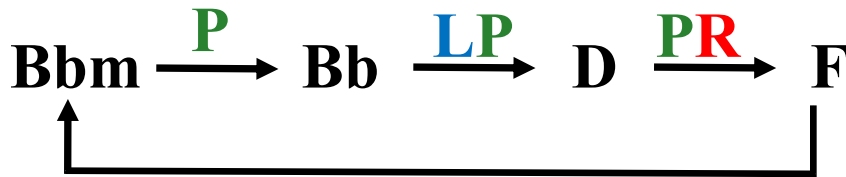
Les Parures Secrètes (album *Pour Madame X*, 2000)



Cycle 1 :



Cycle 1 :



PLR=N

Nebenverwandt comme principe modulante



Playlist Spotify
« Cours chanson »

GIURAMENTO (L. Mello / M. Andreatta)

01:29

non ci saranno stelle già sfinite
a raccontare stanche i nostri inizi
non ci saranno immagini sfuocate
dell'alba fatta dolce degli abbracci

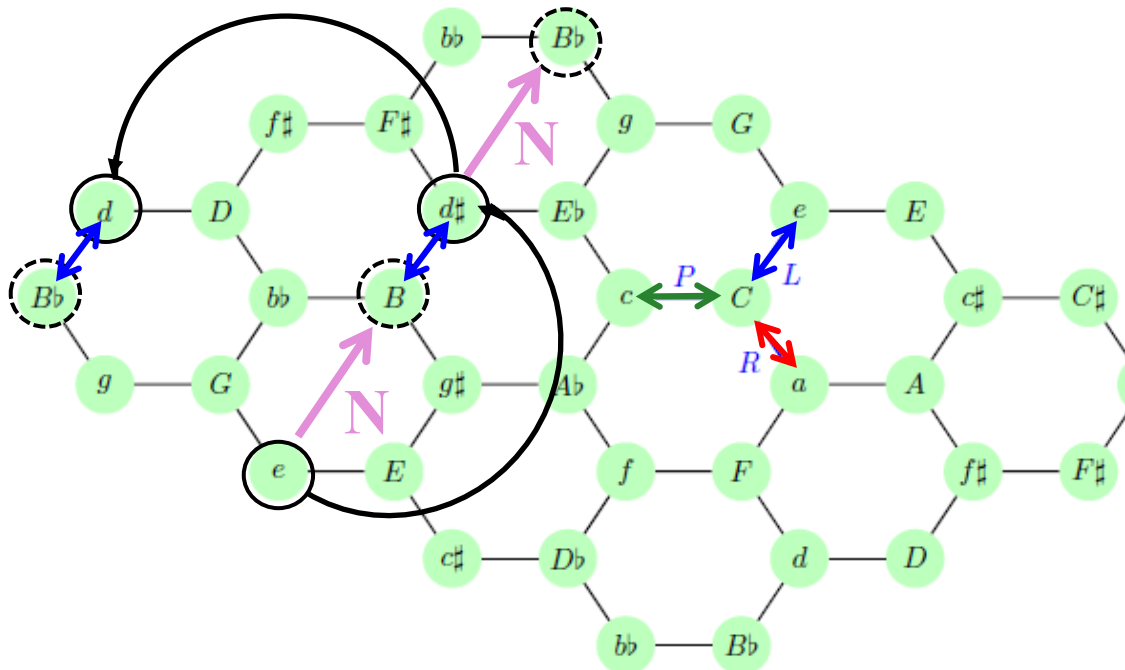
non ci saranno frasi come lame
e baci di un raccolto più prezioso
non sagome di vetro a cancellare
la schiuma del tuo volto che compare

nel mio respiro fragile d'argilla
non ci sarà la notte a distanziare
la brace dei tuoi angoli di labbra
la luce che nel tuo danzare brilla

sg
↓
e
↓
N
↓
B
↓
L
↓
d#
↓
N
↓
Bb
↓
L
↓
d

NL

NL



Nebenverwandt comme principe modulante



Playlist Spotify
« Cours chanson »

FRANGIFLUTTI (L. Mello / M. Andreatta)

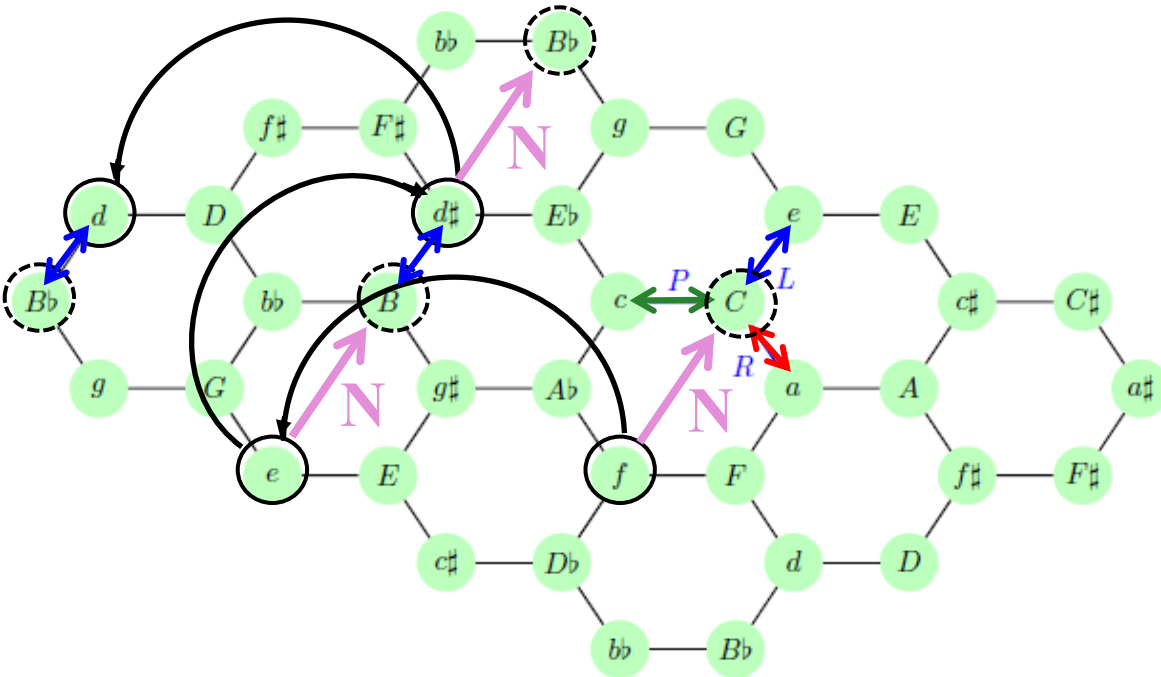
01:29

Nel rifrangere i nostri cuori,
– gente nata che esige cura –
sono stato tra i meno bravi
nella tua favola insicura.

Ora è tardi lo so oramai
venti freddi come una fiaba
però tengo a cantare il canto
Eva sola che resta maga.

Eva cenno di ribellione
Eva fascio pronto all'addio
Eva donna che sa parlare
Al silenzio fatto d'oblio.

Sai parole da incatenare
sai sorridere per piacere
sai scappare senza tornare
sai ferire e sai far l'amore.



Le jeu des modulations dans *Madeleine* de Paolo Conte

Preludio *Moderato*

Lab→Réb/Fa→Sib⁷→Mib⁷/Réb

Chorus

Lab Réb/Fa Sib⁷ Mi⁷/Réb Si/Ré# Mi Do# Fa#

Qui, tut - to il meglio è già qui, non ci so - no pa
 Tan - to io ca - pi - sco sol - tan - to si il tat - to del - le tue
 [Ma] qual - che vol - ta è co - che qual - cu - no è tor

Re/La Sol Mi⁷ La⁷ Re Lab⁷ Réb Do⁷ Mib⁷

ro - le per spie ga re ed in - tui - re e ca - pi - re, Ma de - leine, e se mai ri - cor - da - re...
 ma - ni e la can - zo - ne per du - ta e ri - tro - va - ta, come un' al - tra un' al - tra vi - ta...
 na - to sot - to cer - te ca - rez - ze...

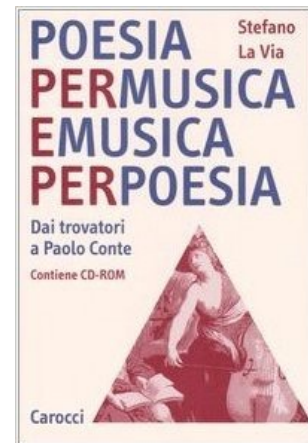
Lab→Réb/Fa→Sib⁷→Mib⁷/Réb

Si/Ré#→Mi→Do#→Fa#

Ré/La→Sol→Mi⁷→La⁷

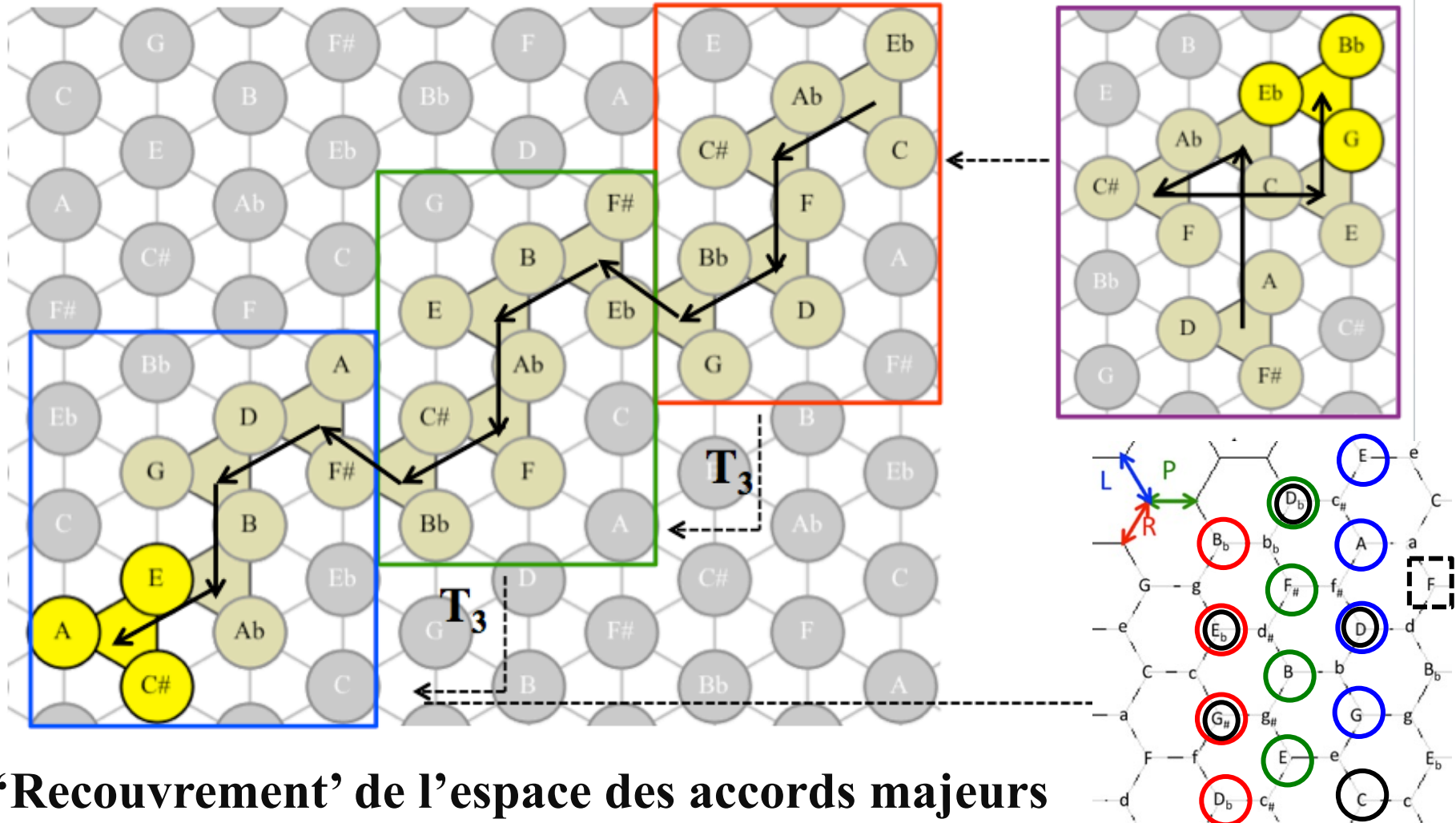
Ré→Lab⁷→Réb→Do⁷→Mib⁷

Stefano La Via, *Poesia per musica e musica per poesia. Dai trovatori a Paolo Conte*, Carocci, 2006



Le jeu des modulations dans *Madeleine* de Paolo Conte

La_b Re_b Si_b Mi_b Si Mi Re_b Fa_# Re Sol Mi La Re La_b Re_b Do Mi_b

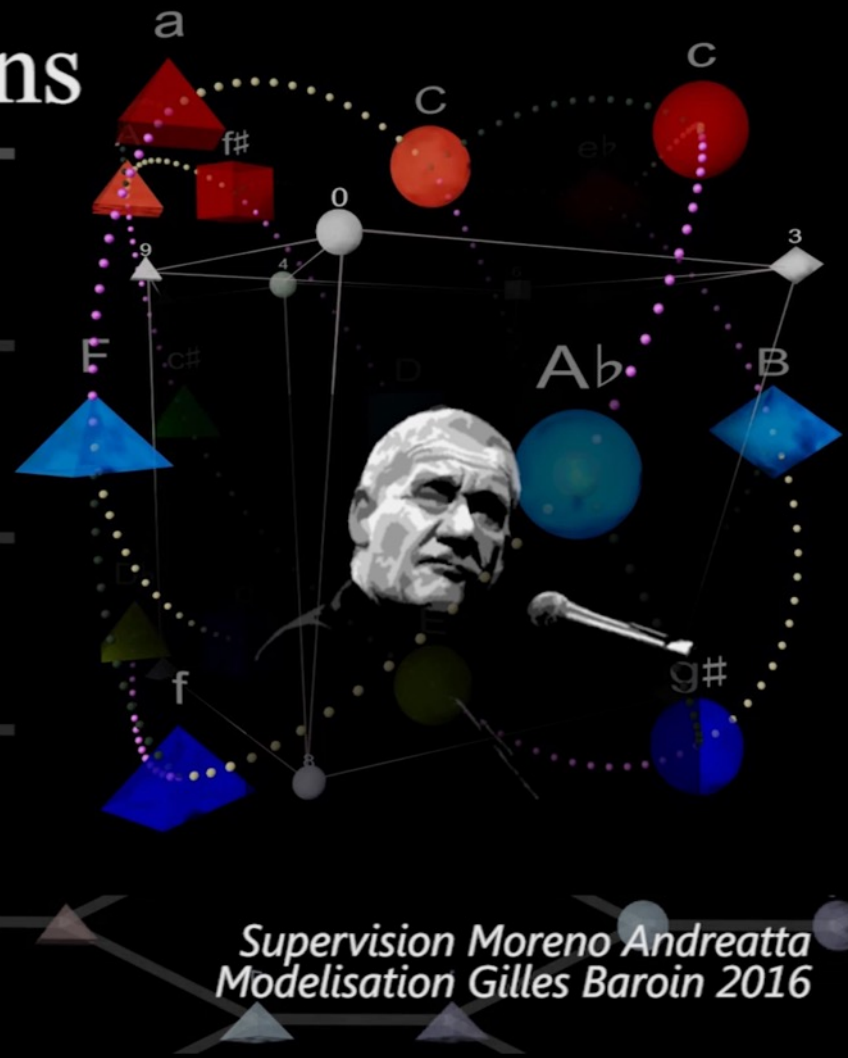


‘Recouvrement’ de l’espace des accords majeurs

Harmonic Progressions

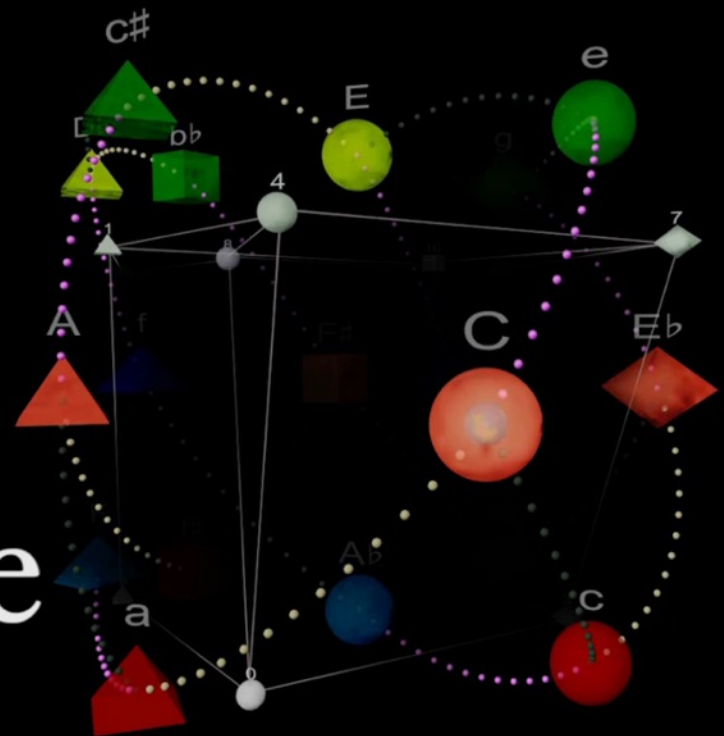
In Paolo Conte

Madeleine



Beethoven and the Hypersphere

(and the Tonnetz)



Gilles Baroin 2016
www.MatheMusic.net

➔ www.mathemusic.net

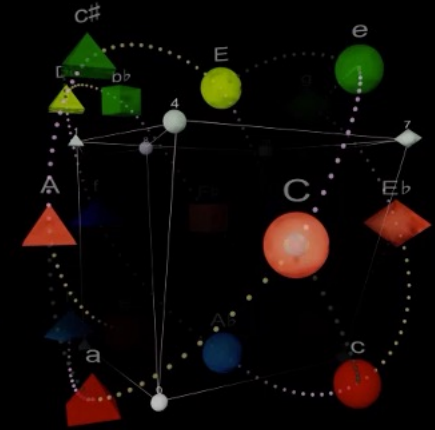


Gilles Baroin

Hamiltonian Song

www.MatheMusic.net

Le Blé en Herbe



Lyrics, music and performance by Polo
Mathemusical supervision by Moreno Andreatta
Hyperspheres and animation by Gilles Baroin, 2016



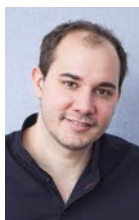
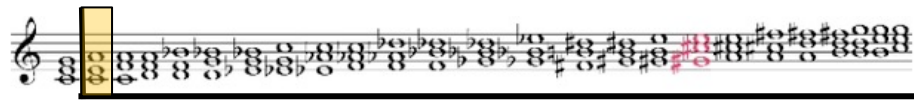
Polo Lamy



Gilles Baroin



Choix de la tonalité à partir du zig-zag



A part (Andrée Chedid, poème tiré du recueil *Rythmes*, Gallimard, 2018)

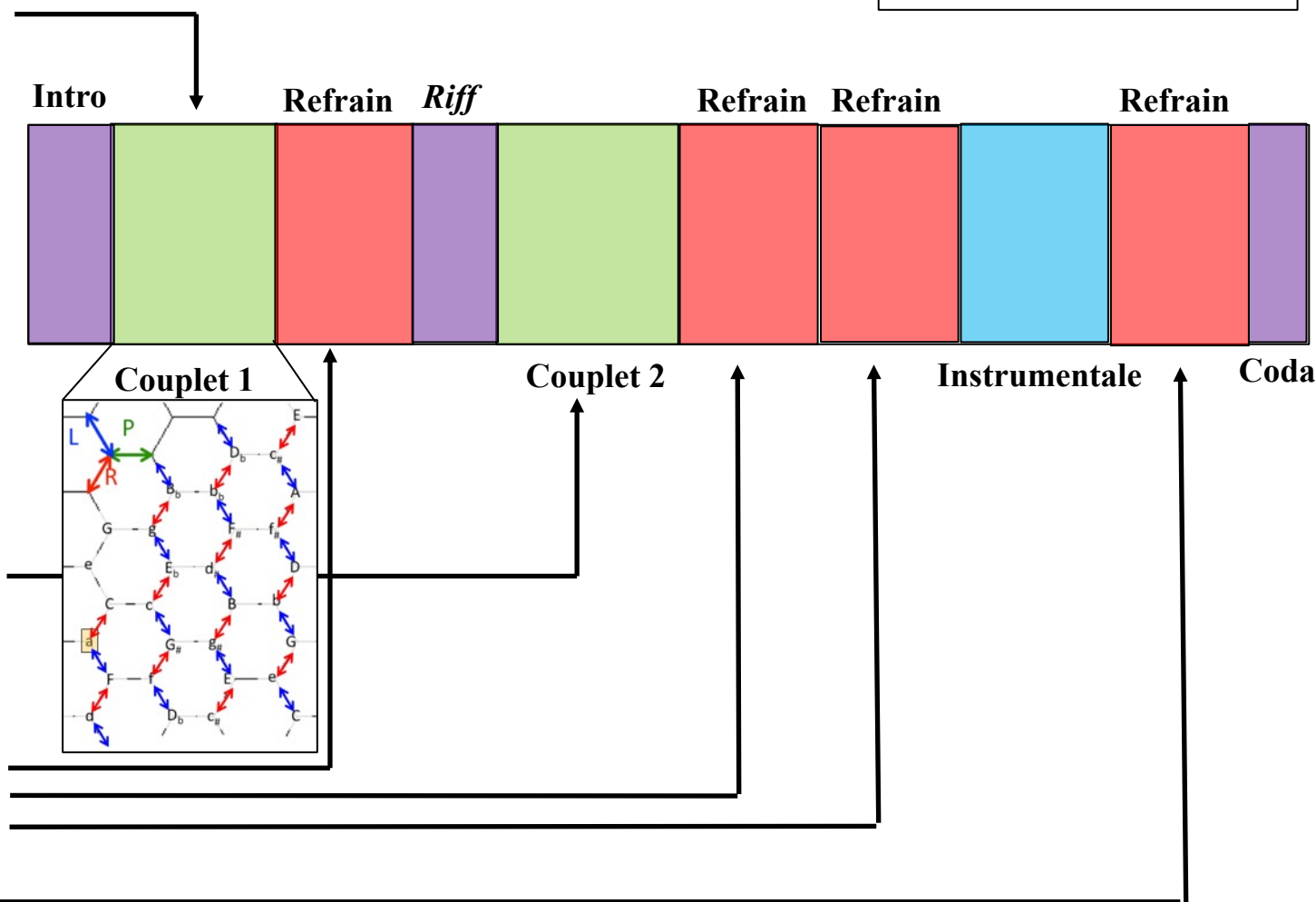
Composition : Moreno Andreatta
Arrangement : Benoît Messinger
Mixage : Didier Houbre
(studio Downtown, Strasbourg)

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



Arrang. : B. Messinger

Cycles hamiltoniens avec périodicité interne

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--LRPRRPRR
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--LRPRRLR

L P L P L R ...

P L P L R L ...

L P L R L P ...

P L R L P L ...

L R L P L P ...

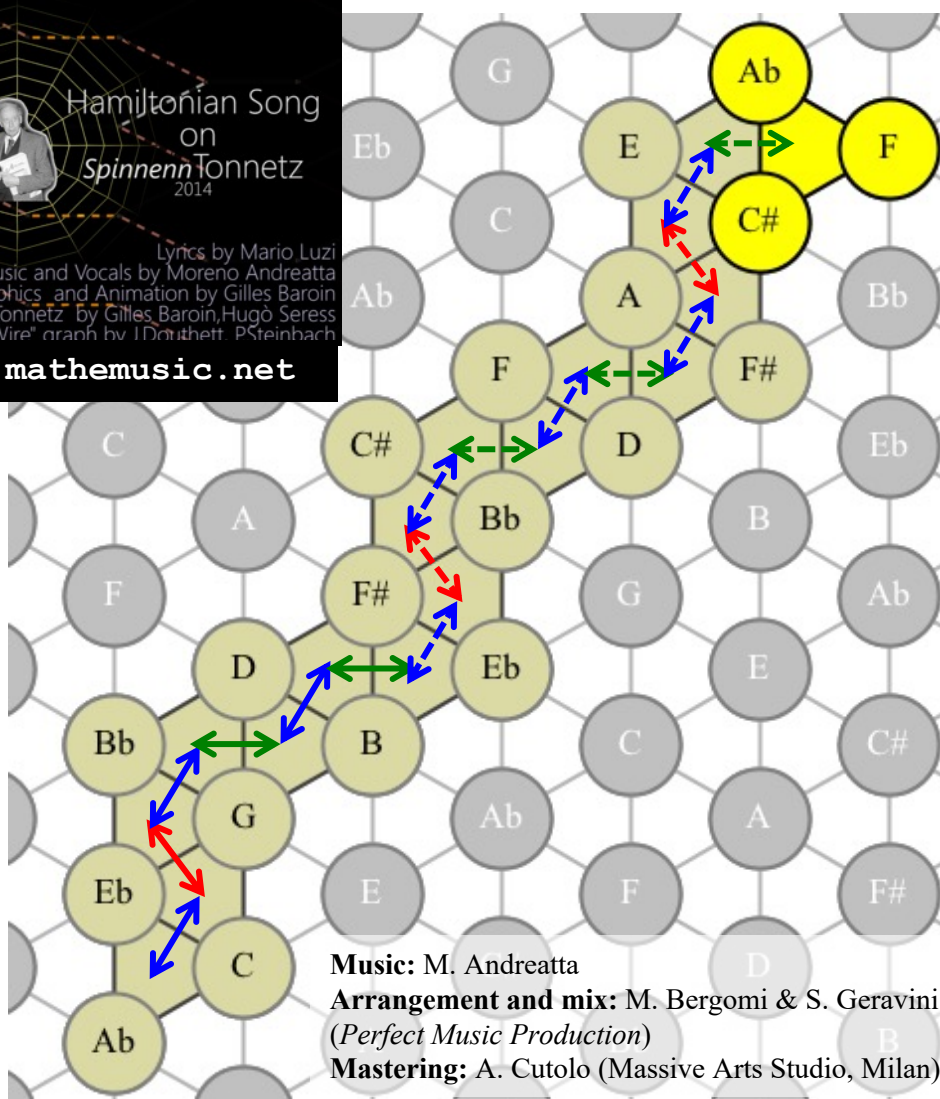
R L P L P L ...

Luzi
Hamiltonian Song
on
Spinnennetz
2014

Lyrics by Mario Luzi
Music and Vocals by Moreno Andreatta
Graphics and Animation by Gilles Baroin
Spinnennetz by Gilles Baroin, Hugò Serres
Original "Chicken Wire" graph by IDruthett PSteinhach

<http://www.mathemusic.net>

min. 1'02"



Music: M. Andreatta
Arrangement and mix: M. Bergomi & S. Geravini
(Perfect Music Production)
Mastering: A. Cutolo (Massive Arts Studio, Milan)

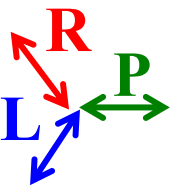
La sera non è più la tua canzone
(Mario Luzi, 1945, in *Poesie sparse*)

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.



Luzi



Hamiltonian Song
on
Spinnennetz
2014

Lyrics by Mario Luzi
Music and Vocals by Moreno Andreatta
Graphics and Animation by Gilles Baroin
SpinnenNetz by Gilles Baroin, Hugò Seress
Original "Chicken Wire" graph by J.Douthett, P.Steinbach

La collection des 28 cycles hamiltoniens « redondants »

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--PRPRRLR
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--PRRLRPR
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#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--LRPRRLR
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#m-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--RPRL
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



Le Blé en Herbe



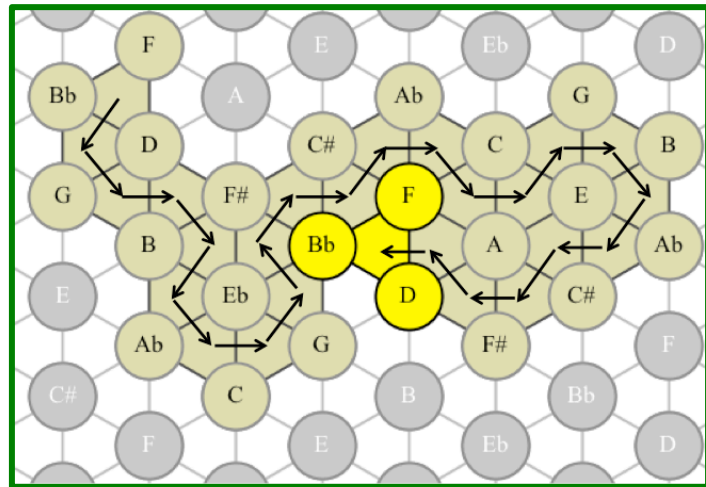
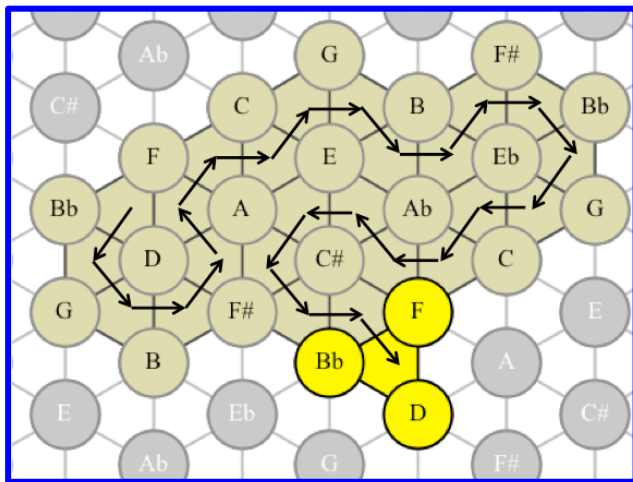
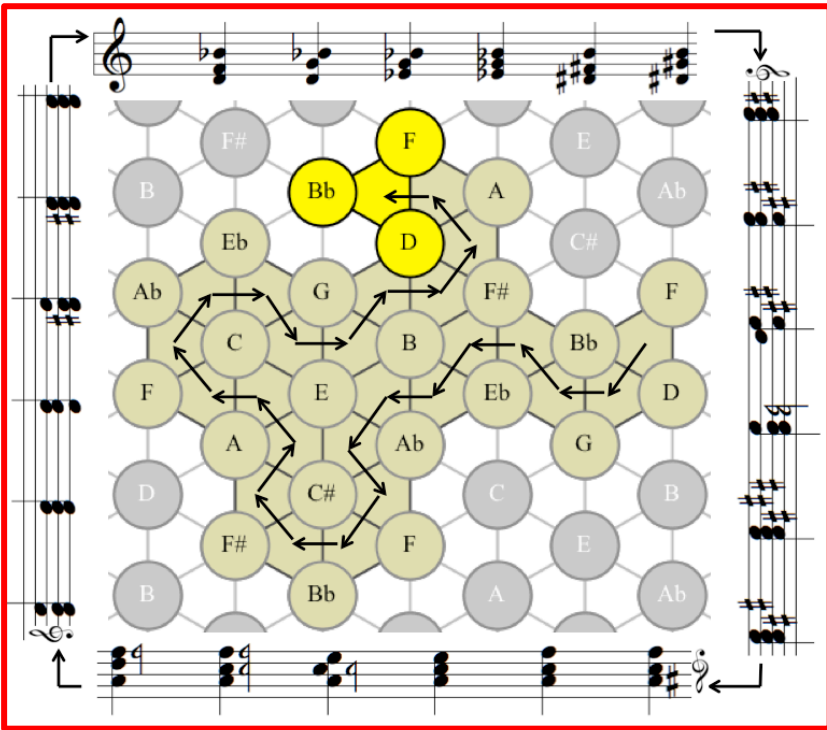
Le catalogue complet des 124 cycles hamiltoniens

List of 124 Hamiltonian Cycles (Bigo/Andreatta, February 2016)

1. C-Cm-Ab-Abm-E-Em-G-Gm-Eb-Ebm-B-Bm-D-Dm-Bb-Bbm-F#-F#m-A-C#m-C#-Fm-F-Am--PLPLPRPLPLPRPLPLPLPLPL
2. C-Cm-Ab-Abm-E-Em-G-Gm-Eb-Ebm-B-Bm-D-F#m-F#-Bbm-Bb-Dm-F-Fm-C#-C#m-A-Am--PLPLPRPLPLPLPLPLPLPLPL
3. C-Cm-Ab-Abm-E-Em-G-Gm-B-Bm-Eb-Ebm-Bb-Bbm-F#-F#m-D-Dm-F-Fm-C#-C#m-A-Am--PLPLPRPLPLPLPLPLPLPLPL
4. C-Cm-Ab-Abm-E-C#m-C#-Fm-F-Am-A-F#m-F#-Bbm-Bb-Dm-D-Bm-B-Ebm-Eb-Gm-G-Em--PLPLRPLPLRPLPLRPLPLPL
5. 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
6. C-Cm-Ab-Abm-B-Bm-G-Gm-Eb-Ebm-F#-F#m-D-Dm-Bb-Bbm-C#-Fm-F-Am-A-C#m-E-Em--PLRPLPLRPLPLRPLPLRPL
7. C-Cm-Ab-Abm-B-Bm-G-Gm-Eb-Ebm-F#-Bbm-Bb-Dm-D-F#m-A-Am-F-Fm-C#-C#m-E-Em--PLRPLPLRPLPLRPLPLRPL
8. C-Cm-Ab-Abm-B-Bm-G-Em-E-C#m-A-F#m-D-Dm-Bb-Gm-Eb-Ebm-F#-Bbm-C#-Fm-F-Am--PLRPLRPLRPLRPLRPLRPLR
9. C-Cm-Ab-Abm-B-Ebm-Eb-Gm-G-Bm-D-Dm-Bb-Bbm-F#-F#m-A-Am-F-Fm-C#-C#m-E-Em--PLRPLPLRPLPLRPLPLRPL
10. C-Cm-Ab-Abm-B-Ebm-Eb-Gm-Bb-Dm-D-Bm-G-Em-E-C#m-A-F#m-F#-Bbm-C#-Fm-F-Am--PLRPLRPLRPLRPLRPLRPLR
11. C-Cm-Ab-Abm-B-Ebm-Eb-Gm-Bb-Dm-F-Fm-C#-Bbm-F#-F#m-D-Bm-G-Em-E-C#m-A-Am--PLRPLRPLRPLRPLRPLRPLR
12. C-Cm-Ab-Fm-F-Am-A-C#m-C#-Bbm-Bb-Dm-D-F#m-F#-Ebm-Eb-Gm-G-Bm-B-Abm-E-Em--PLRPLPLRPLPLRPLPLRPL
13. C-Cm-Ab-Fm-F-Am-A-F#m-F#-Bbm-C#-C#m-E-Abm-B-Ebm-Eb-Gm-Bb-Dm-D-Bm-G-Em--PLRPLRPLRPLRPLRPLRPLR
14. C-Cm-Ab-Fm-F-Am-A-F#m-D-Dm-Bb-Gm-Eb-Ebm-F#-Bbm-C#-C#m-E-Abm-B-Bm-G-Em--PLRPLRPLRPLRPLRPLRPLR
15. C-Cm-Ab-Fm-F-Dm-Bb-Gm-Eb-Ebm-B-Abm-E-Em-G-Bm-D-F#m-F#-Bbm-C#-C#m-A-Am--PLRPLRPLRPLRPLRPLRPLR
16. 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
17. C-Cm-Ab-Fm-C#-C#m-A-F#m-F#-Bbm-Bb-Gm-Eb-Ebm-B-Abm-E-Em-G-Bm-D-Dm-F-Am--PLRLPLRPLRPLRPLRPLR
18. C-Cm-Ab-Fm-C#-C#m-A-F#m-D-Bm-B-Abm-E-Em-G-Gm-Eb-Ebm-F#-Bbm-Bb-Dm-F-Am--PLRLPLRPLRPLRPLRPLR
19. C-Cm-Ab-Fm-C#-C#m-E-Abm-B-Bm-D-F#m-A-Am-F-Dm-Bb-Bbm-F#-Ebm-Eb-Gm-G-Em--PLRLRPLRPLRPLRPLRPLR
20. C-Cm-Ab-Fm-C#-C#m-E-Abm-B-Ebm-Eb-Gm-Bb-Bbm-F#-F#m-A-Am-F-Dm-D-Bm-G-Em--PLRLRPLRPLRPLRPLRPLR
21. C-Cm-Ab-Fm-C#-Bbm-Bb-Dm-F-Am-A-C#m-E-Abm-B-Bm-D-F#m-F#-Ebm-Eb-Gm-G-Em--PLRLRPLRPLRPLRPLRPLR
22. C-Cm-Ab-Fm-C#-Bbm-Bb-Gm-Eb-Ebm-F#-F#m-D-Dm-F-Am-A-C#m-E-Abm-B-Bm-G-Em--PLRLRPLRPLRPLRPLRPLR
23. C-Cm-Eb-Ebm-B-Bm-G-Gm-Bb-Bbm-F#-F#m-D-Dm-F-Am-A-C#m-C#-Fm-Ab-Abm-E-Em--PRPLPLRPLPLRPLPLRPL
24. C-Cm-Eb-Ebm-B-Bm-G-Gm-Bb-Dm-D-F#m-F#-Bbm-C#-C#m-A-Am-F-Fm-Ab-Abm-E-Em--PRPLPLRPLPLRPLPLRPL
25. C-Cm-Eb-Ebm-B-Bm-D-F#m-F#-Bbm-C#-Fm-Ab-Abm-E-C#m-A-Am-F-Dm-Bb-Gm-G-Em--PRPLRPLRPLRPLRPLRPL
26. C-Cm-Eb-Ebm-B-Abm-Ab-Fm-C#-Bbm-F#-F#m-D-Bm-G-Gm-Bb-Dm-F-Am-A-C#m-E-Em--PRPLRPLRPLRPLRPLRPLR
27. 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--PRPRPRPLR
28. 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--PRPLRPR
29. 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--PRPLRRL
30. C-Cm-Eb-Gm-G-Bm-B-Ebm-F#-F#m-D-Dm-Bb-Bbm-C#-C#m-A-Am-F-Fm-Ab-Abm-E-Em--PRLPLRPLRPLRPLRPLRPL
31. C-Cm-Eb-Gm-G-Bm-D-F#m-F#-Ebm-B-Abm-Ab-Fm-C#-Bbm-Bb-Dm-F-Am-A-C#m-E-Em--PRLPLRPLRPLRPLRPLRPL
32. C-Cm-Eb-Gm-G-Bm-D-F#m-A-Am-F-Dm-Bb-Bbm-F#-Ebm-B-Abm-Ab-Fm-C#-C#m-E-Em--PRLPLRPLRPLRPLRPLRPL
33. C-Cm-Eb-Gm-G-Em-E-Abm-Ab-Fm-C#-C#m-A-F#m-D-Bm-B-Ebm-F#-Bbm-Bb-Dm-F-Am--PRLRPLRPLRPLRPLRPLR
34. C-Cm-Eb-Gm-Bb-Bbm-F#-Ebm-B-Bm-G-Em-E-Abm-Ab-Fm-C#-C#m-A-F#m-D-Dm-F-Am--PRLRPLRPLRPLRPLRPLR
35. 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
36. C-Cm-Eb-Gm-Bb-Bbm-C#-Fm-Ab-Abm-E-C#m-A-Am-F-Dm-D-F#m-F#-Ebm-B-Bm-G-Em--PRLRPLRPLRPLRPLRPLR
37. 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
38. C-Cm-Eb-Gm-Bb-Dm-D-F#m-A-Am-F-Fm-Ab-Abm-E-C#m-C#-Bbm-F#-Ebm-B-Bm-G-Em--PRLRPLRPLRPLRPLRPLR
39. C-Cm-Eb-Gm-Bb-Dm-D-F#m-A-C#m-C#-Bbm-F#-Ebm-B-Bm-G-Em-E-Abm-Ab-Fm-F-Am--PRLRPLRPLRPLRPLRPLR
40. 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--PRLRRLPR
41. C-Em-E-Abm-Ab-Cm-Eb-Ebm-B-Bm-G-Gm-Bb-Bbm-F#-F#m-D-Dm-F-Fm-C#-C#m-A-Am--LPLRPLRPLRPLRPLRPLR
42. 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--LPLRL
43. C-Em-E-Abm-Ab-Fm-F-Am-A-C#m-C#-Bbm-Bb-Dm-D-F#m-F#-Ebm-B-Bm-G-Gm-Eb-Cm--LPLRPLRPLRPLRPLRPLR
44. C-Em-E-Abm-Ab-Fm-F-Am-A-C#m-C#-Bbm-F#-F#m-D-Dm-Bb-Gm-G-Bm-B-Ebm-Eb-Cm--LPLRPLRPLRPLRPLRPLR
45. C-Em-E-Abm-Ab-Fm-C#-C#m-A-Am-F-Dm-D-F#m-F#-Bbm-Bb-Gm-G-Bm-B-Ebm-Eb-Cm--LPLRPLRPLRPLRPLRPLR
46. C-Em-E-Abm-B-Bm-G-Gm-Eb-Ebm-F#-F#m-D-Dm-Bb-Bbm-C#-C#m-A-Am-F-Fm-Ab-Cm--LPLRPLRPLRPLRPLRPLR
47. C-Em-E-Abm-B-Bm-G-Gm-Bb-Bbm-F#-Ebm-Eb-Cm-Ab-Fm-C#-C#m-A-F#m-D-Dm-F-Am--LPLRPLRPLRPLRPLRPLR
48. C-Em-E-Abm-B-Bm-G-Gm-Bb-Dm-D-F#m-A-C#m-C#-Bbm-F#-Ebm-Eb-Cm-Ab-Fm-F-Am--LPLRPLRPLRPLRPLRPLR
49. 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
50. C-Em-E-Abm-B-Ebm-Eb-Cm-Ab-Fm-F-Dm-Bb-Gm-G-Bm-D-F#m-F#-Bbm-C#-C#m-A-Am--LPLRPLRPLRPLRPLRPLR
51. C-Em-E-Abm-B-Ebm-Eb-Cm-Ab-Fm-C#-C#m-A-F#m-F#-Bbm-Bb-Gm-G-Bm-D-Dm-F-Am--LPLRPLRPLRPLRPLRPLR
52. C-Em-E-Abm-B-Ebm-F#-F#m-D-Bm-G-Gm-Eb-Cm-Ab-Fm-F-Dm-Bb-Bbm-C#-C#m-A-Am--LPLRPLRPLRPLRPLRPLR
53. C-Em-E-Abm-B-Ebm-F#-F#m-A-C#m-C#-Bbm-Bb-Dm-D-Bm-G-Gm-Eb-Cm-Ab-Fm-F-Am--LPLRPLRPLRPLRPLRPLR

Le catalogue complet des 124 cycles hamiltoniens

- 108. C-Am-F-Fm-C#-Bbm-F#-F#m-A-C#m-E-Abm-Ab-Cm-Eb-Ebm-B-Bm-D-Dm-Bb-Gm-G-Em-RLPLRLRPLRPLRPLRPLRPL
- 109. C-Am-F-Fm-C#-Bbm-F#-F#m-Eb-Ebm-Cm-Eb-Gm-Bb-Dm-D-F#m-A-C#m-E-Em-G-Bm-B-Abm-Ab-Cm-RLPLRLRPLRPLRPLRPLRPL
- 110. C-Am-F-Fm-C#-Bbm-F#-F#m-Eb-Ebm-Cm-Eb-Gm-Bb-Dm-D-F#m-A-C#m-E-Em-RLPLRLRPLRPLRPLRPLRPL
- 111. C-Am-F-Fm-Ab-Abm-E-Em-G-Bm-B-Ebm-F#-Bbm-C#-C#m-A-F#m-D-Dm-Bb-Gm-Eb-Cm-RLRPLRPLRPLRPLRPLRPL
- 112. C-Am-F-Fm-Ab-Cm-Eb-Ebm-F#-Bbm-C#-C#m-A-F#m-D-Dm-Bb-Gm-G-Bm-B-Abm-E-Em-RLRPLRPLRPLRPLRPLRPL
- 113. C-Am-F-Fm-Ab-Cm-Eb-Gm-G-Bm-D-Dm-Bb-Bbm-C#-C#m-A-F#m-F#-Ebm-B-Abm-E-Em-RLRPLRPLRPLRPLRPLRPL
- 114. C-Am-F-Dm-D-F#m-A-C#m-C#-Fm-Ab-Abm-E-Em-G-Bm-B-Ebm-F#-Bbm-Bb-Gm-Eb-Cm-RLRPLRPLRPLRPLRPLRPL
- 115. C-Am-F-Dm-D-F#m-A-C#m-C#-Fm-Ab-Cm-Eb-Ebm-F#-Bbm-Bb-Gm-G-Bm-B-Abm-E-Em-RLRPLRPLRPLRPLRPLRPL
- 116. 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-RLRPRRP
- 117. 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-RLRPRRP
- 118. C-Am-F-Dm-D-Bm-G-Gm-Bb-Bbm-F#-F#m-A-C#m-C#-Fm-Ab-Cm-Eb-Ebm-B-Abm-E-Em-RLRPLRPLRPLRPLRPLRPL
- 119. C-Am-F-Dm-D-Bm-G-Em-E-Abm-B-Ebm-Eb-Gm-Bb-Bbm-F#-F#m-A-C#m-C#-Fm-Ab-Cm-RLRPLRPLRPLRPLRPLRPL
- 120. 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
- 121. C-Am-F-Dm-Bb-Bbm-F#-F#m-Eb-Ebm-Gm-G-Em-E-Abm-B-Bm-D-F#m-A-C#m-C#-Fm-Ab-Cm-RLRPLRPLRPLRPLRPLRPL
- 122. C-Am-F-Dm-Bb-Bbm-F#-F#m-Ebm-B-Bm-D-F#m-A-C#m-C#-Fm-Ab-Abm-E-Em-G-Gm-Eb-Cm-RLRPLRPLRPLRPLRPLRPL
- 123. 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-RLRPRRP
- 124. 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



Aprile (d'après Gabriele D'Annunzio)



Aprile

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

Lyrics: Gabriele d'Annunzio
Music and Vocals: Moreno Andreatta
Hypersphere and Ideograms: Gilles Baroin
Original "Chicken Wire" graph: J.Douthett, P.Steinbach

<http://www.mathemusic.net>

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

↓ ↑

mi_m → Sol → si_m → Ré → ré_m → **Sib** → sol_m → Mib → mib_m → Si → sol#_m → Mi

↑ ↓

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

↑ ↓

la_m ← Fa ← ré_m ← Ré ← si_m ← Sol ← sol_m ← **Sib** ← sib_m ← Fa# ← fa#_m ← La

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

↓ ↑

do#_m → La → fa#_m → Ré → ré_m → **Sib** → sol_m → Sol → si_m → Si → sol#_m → Sol#

↑ ↓

La fenêtre est entr'ouverte, sur le jardin.
Une heure passe, lente, somnolente.
Et elle, d'abord attentive, finit par s'endormir.
À cette voix qui là-bas se lamente,
Qui se lamente au fond de ce jardin.

Cycle hamiltonien #1

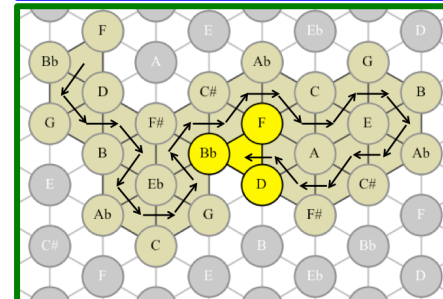
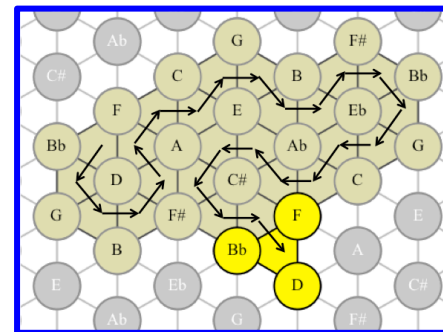
Ce n'est qu'une voix d'eau sur la pierre,
Et combien de fois, combien de fois entendue !
Cet amour et cette heure s'abîment dans cette vie
Comme s'abîment dans l'onde sans fin
Le cadavre et la pierre liés ensemble.

Cycle hamiltonien #2

Elle détend son angoisse dans le sommeil.
Mais l'angoisse est forte, et le sommeil est si léger !
(La lumière d'avril ressemble presque à une neige
qui serait tiède.)
Et certes elle doit souffrir,
Vaguement souffrir, aussi dans le sommeil.

Cycle hamiltonien #3

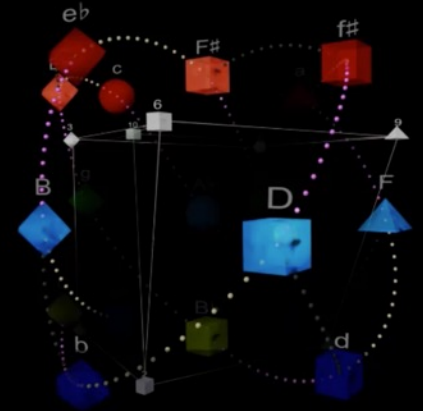
The musical score is presented on a grand staff with treble and bass clefs. The notes are arranged in a sequence that corresponds to the Hamiltonian cycles described in the adjacent text boxes. A path of notes is highlighted in yellow, representing the cycles.



Aprile

Hamiltonian Song

Mathemusical
2D & 4D Visualizations



G. D'Annunzio
(1863-1938)

Composition, Performance: Moreno Andreatta
Hyperspheres & Animations: Gilles Baroin
Spinnen-Tonnetz: Hugò Seress & G.B
Lyrics by Gabriele D'Annunzio
www.MatheMusic.net

« Ah ! » : une ballade semi-hamiltonienne en compagnie de Jacques Roubaud

4/4 C |

2/4 C | 4/4 Em E | C#m |
Ah ! quel silence Dans la rue de Valence !

A F#m | D |
Mais quel vacarme Dans la rue de Parme !

2/4 Dm Bb | 4/4 Gm G | Bm |
Calme ah ! quel calme Dans la rue des Palmes

B Abm | Ab |
Quelle agitation Dans la rue Bran-cion

Cm | Eb |
Ah ! l'heure sereine Dans la rue de Seine !

Gm G | Bm |
Mais quelle inquiétude Boulevard de Dix-mude !

D Dm Bb Bbm | Db |
Ah ! quel trouble interne Avenue des ternes

Fm F | Am |
Quel repos intérieur Rue Gît-le-Cœur.

C Em | E | C#m A | F#m | D Dm | Bb | Gm G | Bm | B Abm Ab Cm
Ah ! etc.

| Eb | Gm G Bm D | Dm | Bb Bbm | Db | Fm F | Am |

2/4 C | 4/4 Em E | C#m |
Ah ! quel silence Dans la rue de Valence !

A F#m | D |
Mais quel vacarme Dans la rue de Parme !

2/4 Dm Bb | 4/4 Gm G | Bm |
Calme ah ! quel calme Dans la rue des Palmes

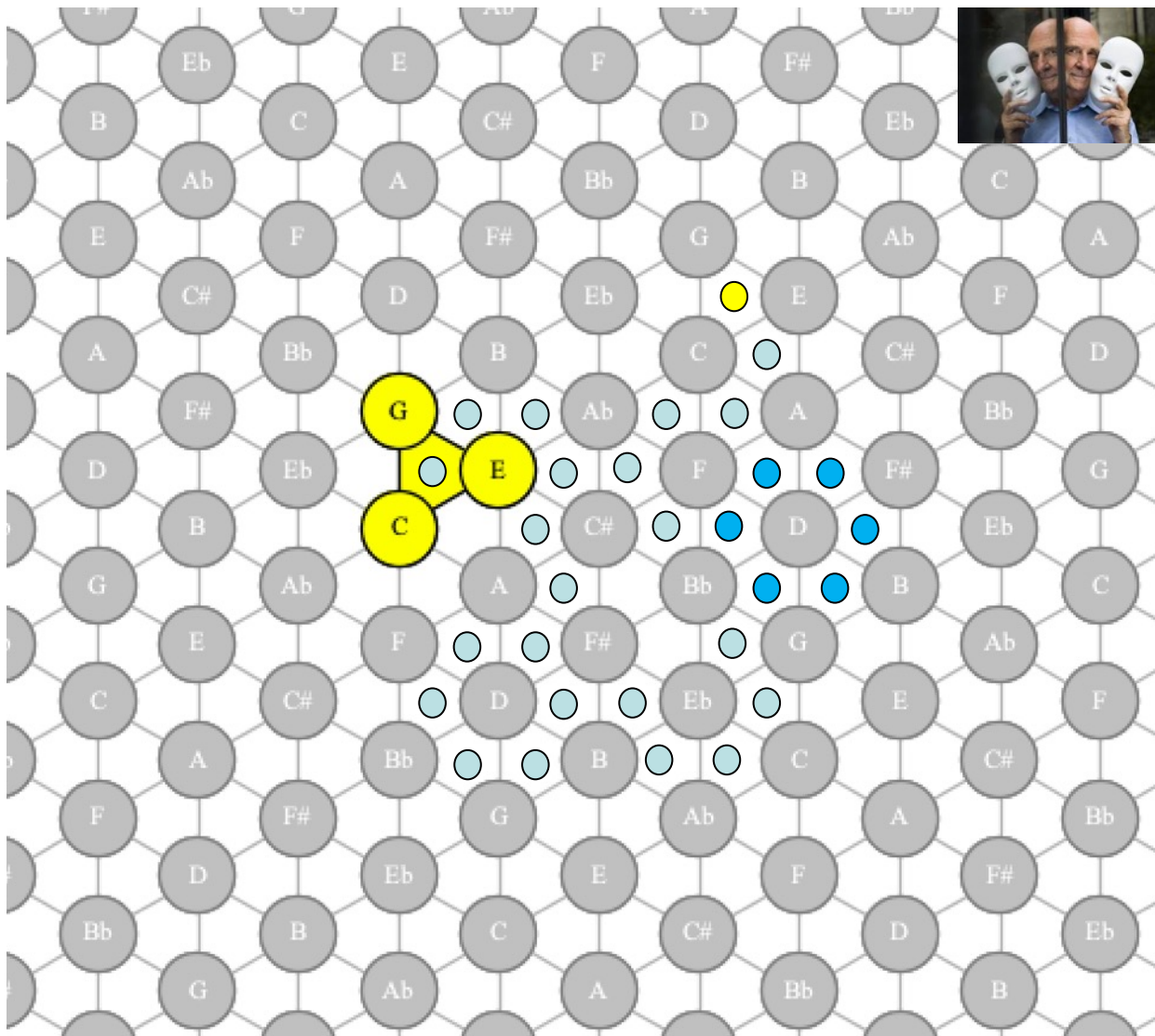
B Abm | Ab |
Quelle agitation Dans la rue Bran-cion

Cm | Eb |
Ah ! l'heure sereine Dans la rue de Seine !

Gm G | Bm |
Mais quelle inquiétude Boulevard de Dix-mude !

D Dm Bb Bbm | Db |
Ah ! quel trouble interne Avenue des ternes

Fm F | Am | C |
Quel repos intérieur Rue Gît-le-Cœur.



➔ http://repmus.ircam.fr/_media/moreno/ah_jacquesroubaudhamilton.mp3

The Gunner's Hamiltonian Dream (une expérience *oumupienne* autour de Pink-Floyd)

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 D Dm
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 E G#m
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.



Le rêve du canonnier

Flottant parmi les nuages

Des souvenirs se ruent à ma rencontre.

Dans l'espace entre les cieux

Et dans un recoin d'un lointain champ de bataille

J'ai fait un rêve,

J'ai fait un rêve.

Au revoir Max

Au revoir maman

Après le service, quand tu marches lentement vers la voiture

Et l'argent dans ses cheveux luit dans l'air froid de novembre

Tu entends sonner le glas

Et touche la soie sur ton revers

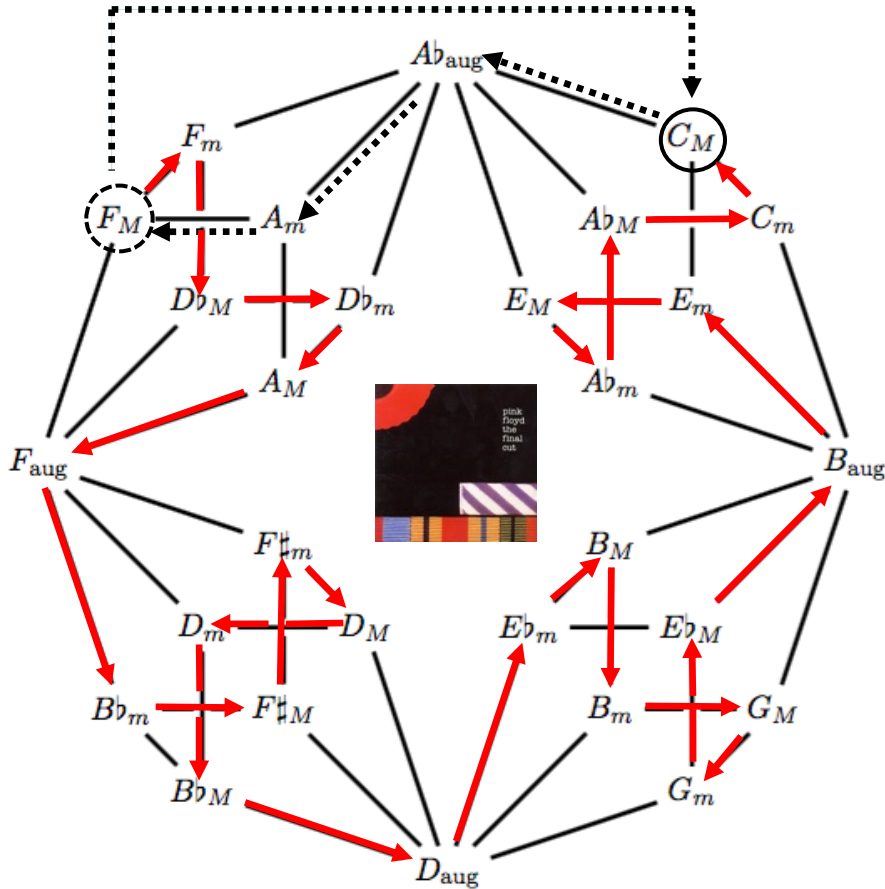
Et tandis que les larmes versées s'élèvent pour se fondre dans le confort du groupe

Tu prends sa frêle main

Et tu t'accroches au rêve.



The Gunner's Hamiltonian Dream (une expérience *oumupienne* autour de Pink-Floyd)



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C C+
 Floating down through the clouds
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 Memories come rushing up to meet me now.
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 In the space between the heavens
 C# C#m
 and in the corner of some foreign field
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 F# F#m D Dm
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 Bb
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 D+
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 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 E G#m
 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 three Hamiltonian Cycles ($C_M = C$, $C_m = C_m$, $C_{aug} = C+$)

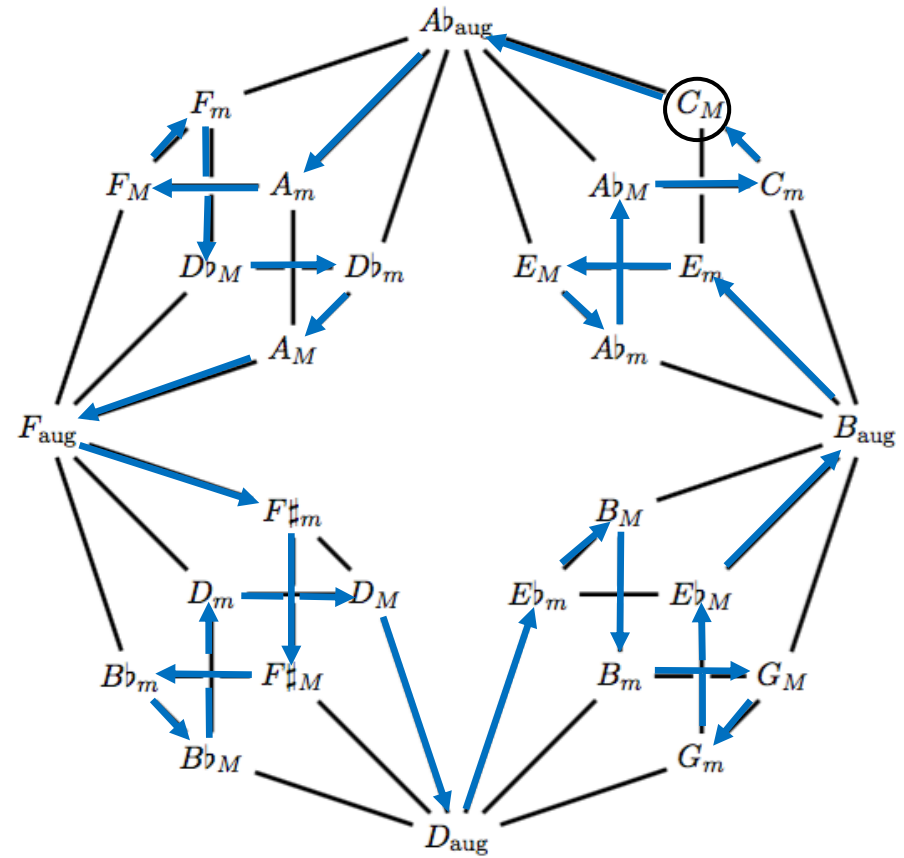
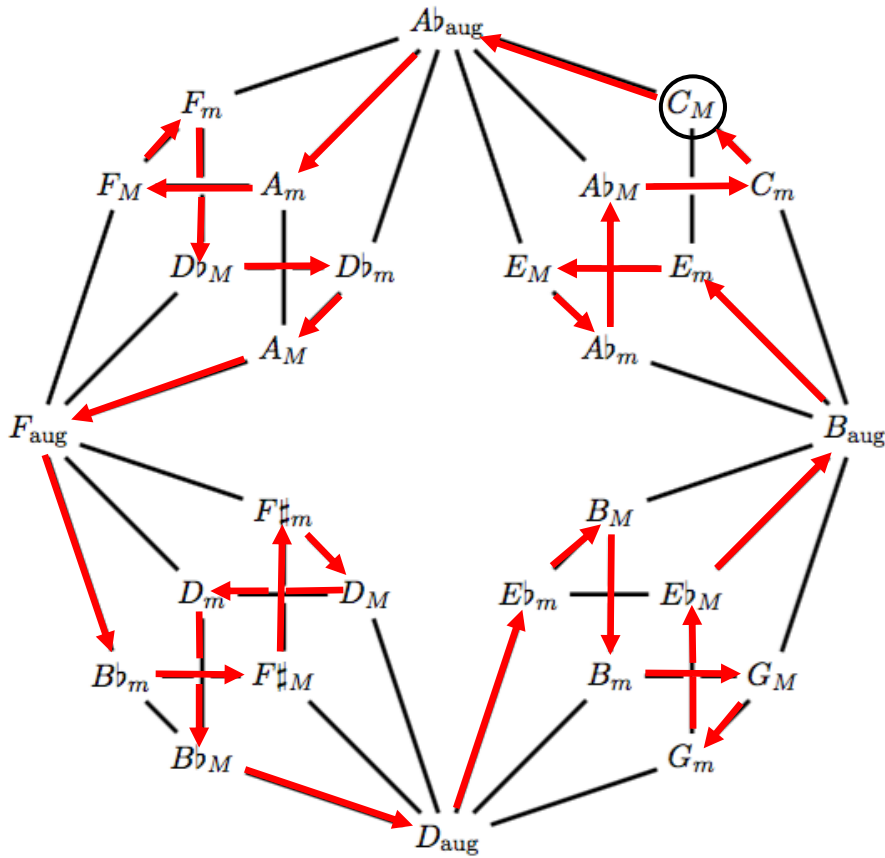
$C \rightarrow C+ \rightarrow Am \rightarrow F \rightarrow Fm \rightarrow C\# \rightarrow C\#m \rightarrow A \rightarrow F+ \rightarrow Bbm \rightarrow F\# \rightarrow F\#m \rightarrow D \rightarrow Dm \rightarrow Bb \rightarrow D+ \rightarrow Ebm \rightarrow B \rightarrow Bm \rightarrow$
 $\rightarrow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

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

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



The Gunner's Hamiltonian Dream (une expérience *oumupienne* autour de Pink-Floyd)



Les trois cycles hamiltoniens ($C_M = C$, $C_m = C_m$, $C_{aug} = C+$)

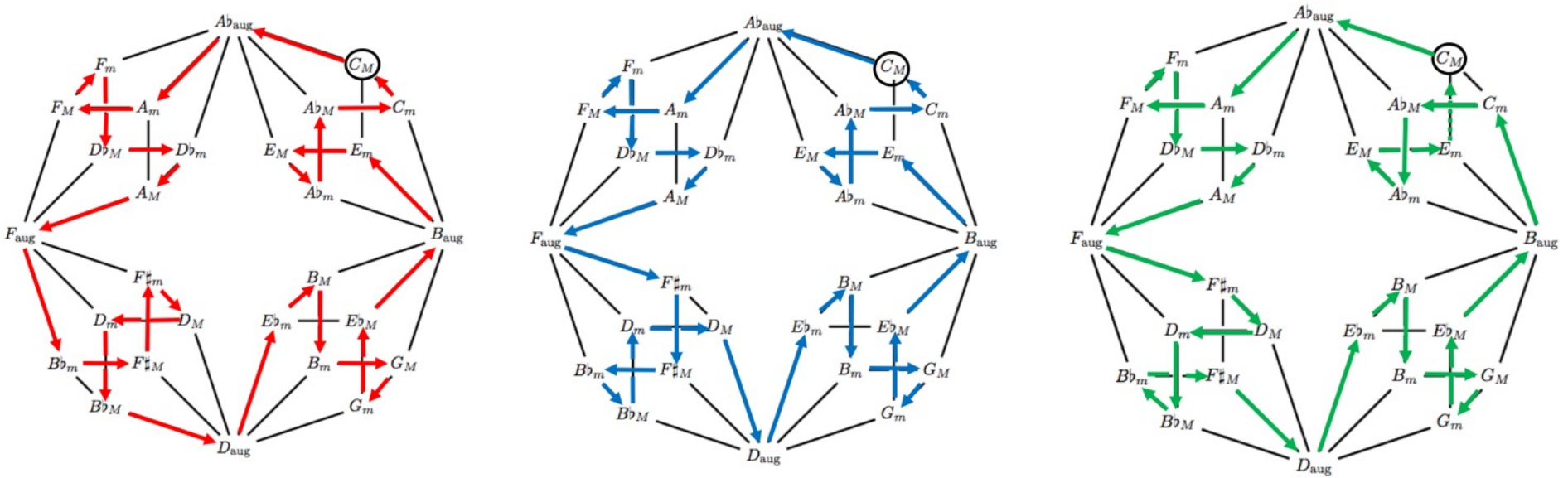
$C \rightarrow C+ \rightarrow Am \rightarrow F \rightarrow Fm \rightarrow C\# \rightarrow C\#m \rightarrow A \rightarrow F+ \rightarrow Bbm \rightarrow F\# \rightarrow F\#m \rightarrow D \rightarrow Dm \rightarrow Bb \rightarrow D+ \rightarrow Ebm \rightarrow B \rightarrow Bm \rightarrow$
 $\rightarrow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

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

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



The Gunner's Hamiltonian Dream (an *oumoupien* experiment on a song by Pink-Floyd)



Les trois cycles hamiltoniens ($C_M = C$, $C_m = C_m$, $C_{aug} = C+$)

$C \rightarrow C+ \rightarrow A_m \rightarrow F \rightarrow F_m \rightarrow C\# \rightarrow C\#_m \rightarrow A \rightarrow F+ \rightarrow B\flat_m \rightarrow F\# \rightarrow F\#_m \rightarrow D \rightarrow D_m \rightarrow B\flat \rightarrow D+ \rightarrow E\flat_m \rightarrow B \rightarrow B_m \rightarrow G \rightarrow G_m \rightarrow E\flat \rightarrow G+ \rightarrow E_m \rightarrow E \rightarrow G\#_m \rightarrow G\# \rightarrow C_m \rightarrow C$

$C \rightarrow C+ \rightarrow A_m \rightarrow F \rightarrow F_m \rightarrow C\# \rightarrow C\#_m \rightarrow A \rightarrow F+ \rightarrow F\#_m \rightarrow F\# \rightarrow B\flat_m \rightarrow B\flat \rightarrow D_m \rightarrow D \rightarrow D+ \rightarrow E\flat_m \rightarrow B \rightarrow B_m \rightarrow G \rightarrow G_m \rightarrow E\flat \rightarrow G+ \rightarrow E_m \rightarrow E \rightarrow G\#_m \rightarrow G\# \rightarrow C_m \rightarrow C$

$C \rightarrow C+ \rightarrow A_m \rightarrow F \rightarrow F_m \rightarrow C\# \rightarrow C\#_m \rightarrow A \rightarrow F+ \rightarrow F\#_m \rightarrow D \rightarrow D_m \rightarrow B\flat \rightarrow B\flat_m \rightarrow F\# \rightarrow D+ \rightarrow E\flat_m \rightarrow B \rightarrow B_m \rightarrow G \rightarrow G_m \rightarrow E\flat \rightarrow G+ \rightarrow C_m \rightarrow G\# \rightarrow G\#_m \rightarrow E \rightarrow E_m \rightarrow C$

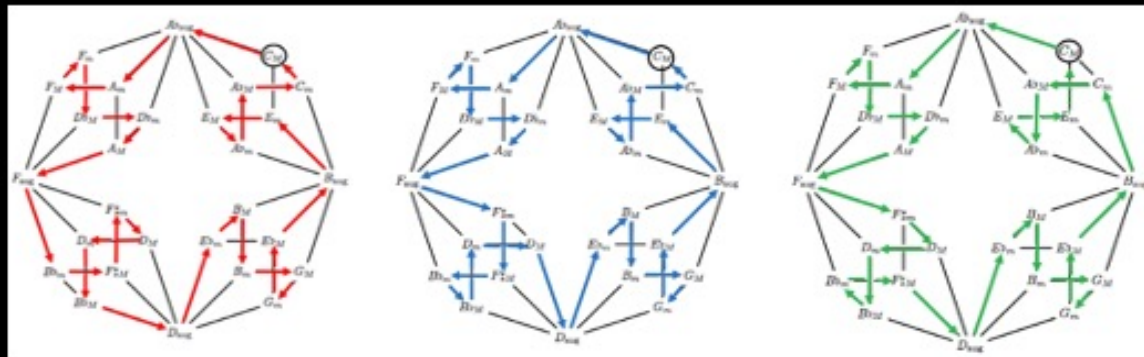
HamilFloyd

The Gunner's
Hamiltonian Dream

Moreno Andreatta
Gilles Baroin 2022



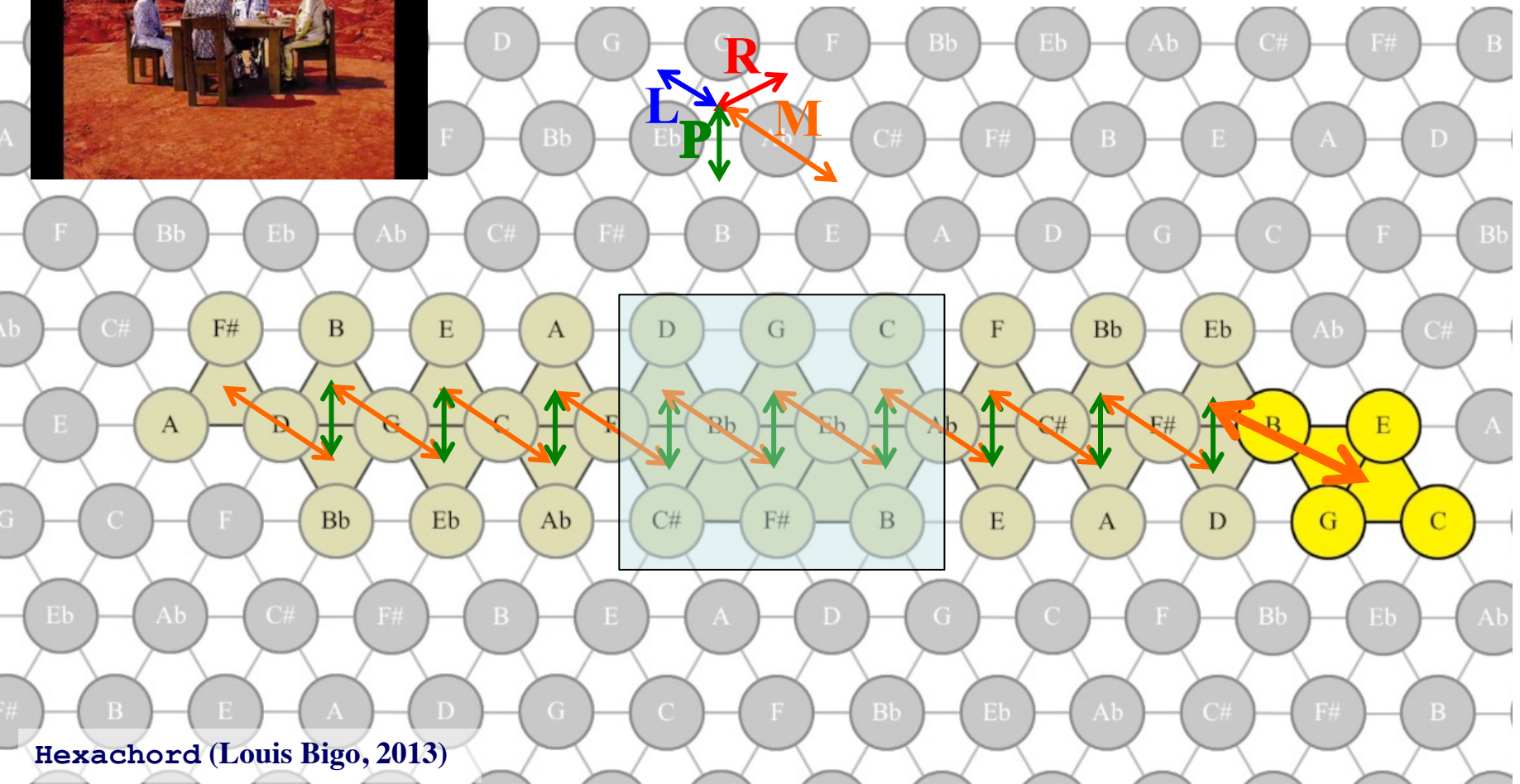
→ https://www.youtube.com/watch?v=nz5TYob02B4&ab_channel=MatheMusic4D



Symétries et procédés algorithmiques chez *Muse*



“Take a bow” (*Black Holes and Revelations*, 2006)

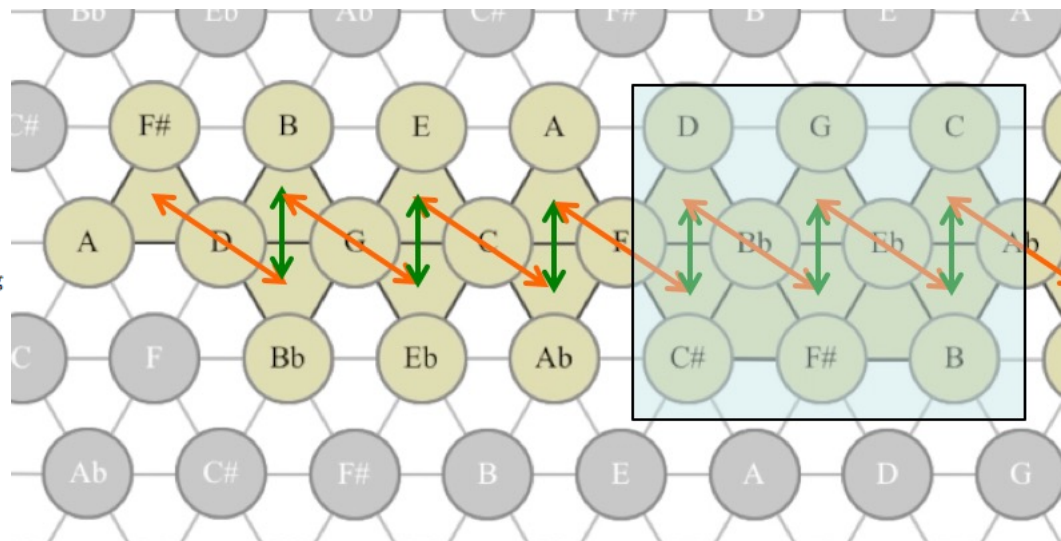
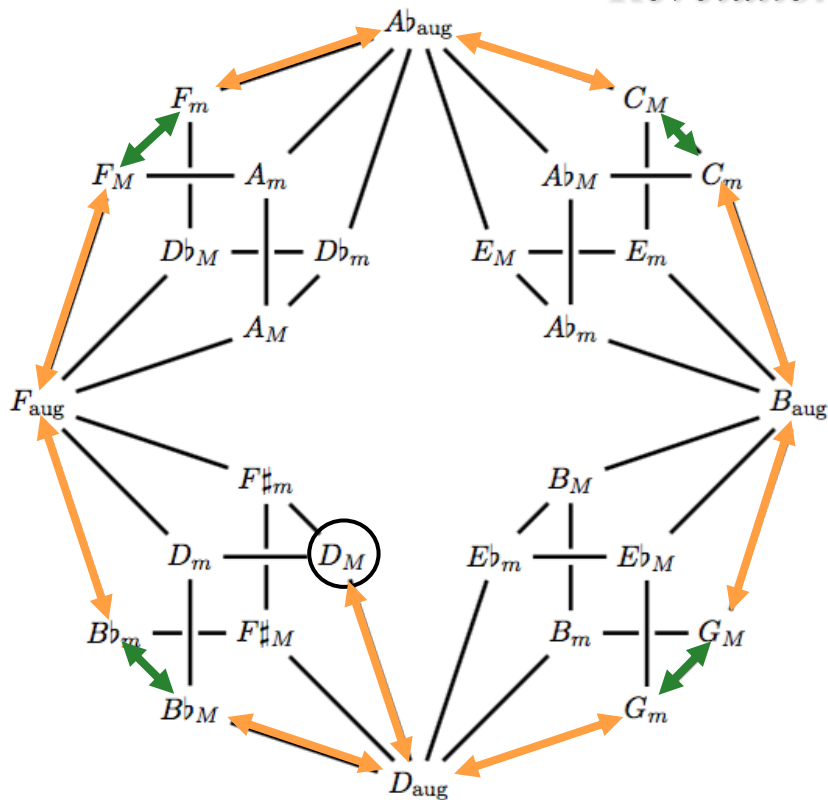


Hexachord (Louis Bigo, 2013)

→
axe temporel

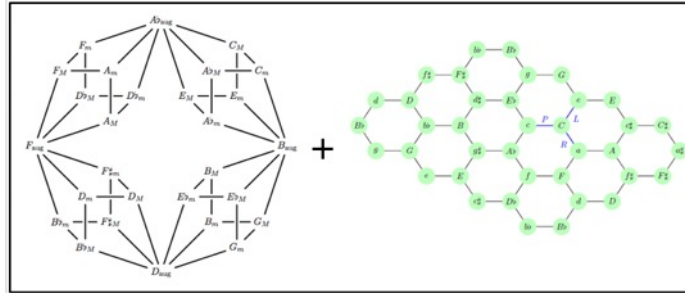
Autres espaces de représentations pour les progressions harmoniques

“Take a bow” (*Black Holes and Revelations*, 2006)

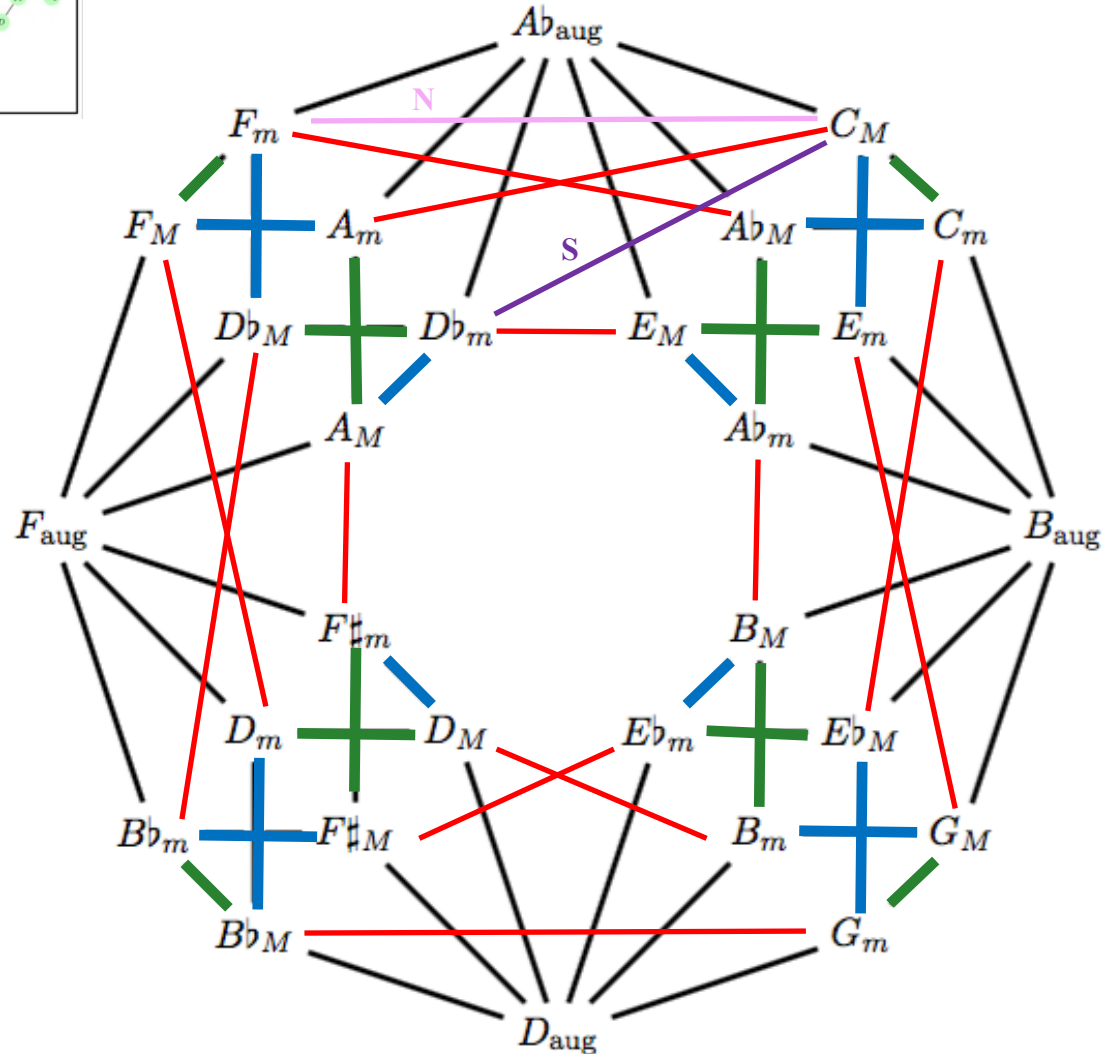
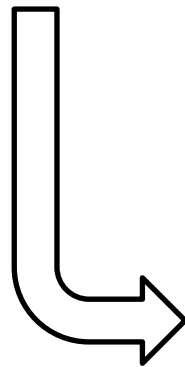


J. Douthett, P. Steinbach, Parsimonious Graphs: A Study in Parsimony, Contextual Transformation, and Modes of Limited Transposition, *Journal of Music Theory*, 42/2, 1998.

Cube-Dance et Tonnetz : à vous de jouer !



→ <http://repmus.ircam.fr/media/moreno/cube-dance-tonnetz.pdf>
 → https://alexpof.github.io/interactive_mathmusic/Pmn_graphs/pmn_graphs.html



LPR = SLIDE

RLP = NEBENVERWANDT

PRL = X