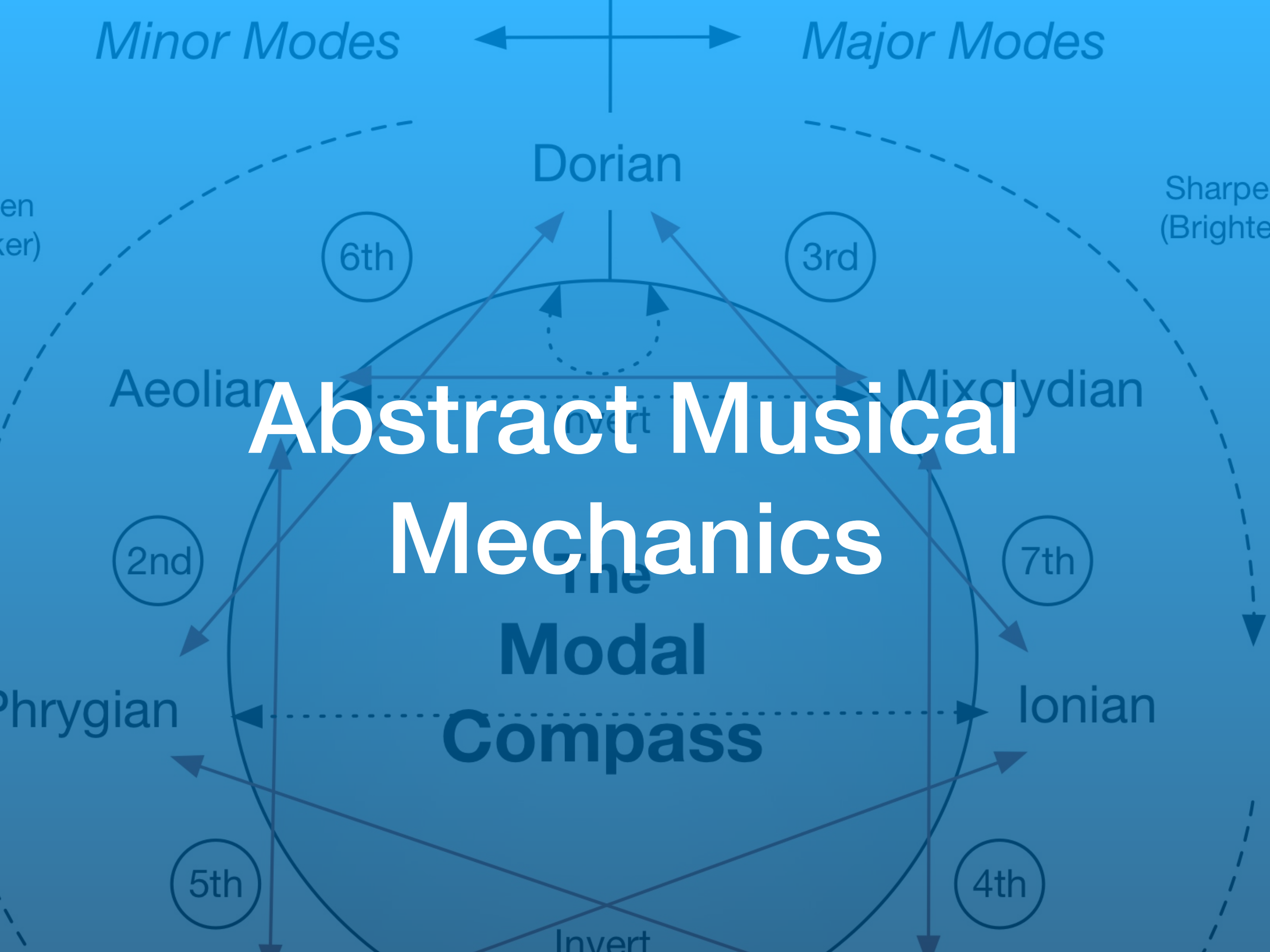
Sound Asleep

Royal Society of Medicine

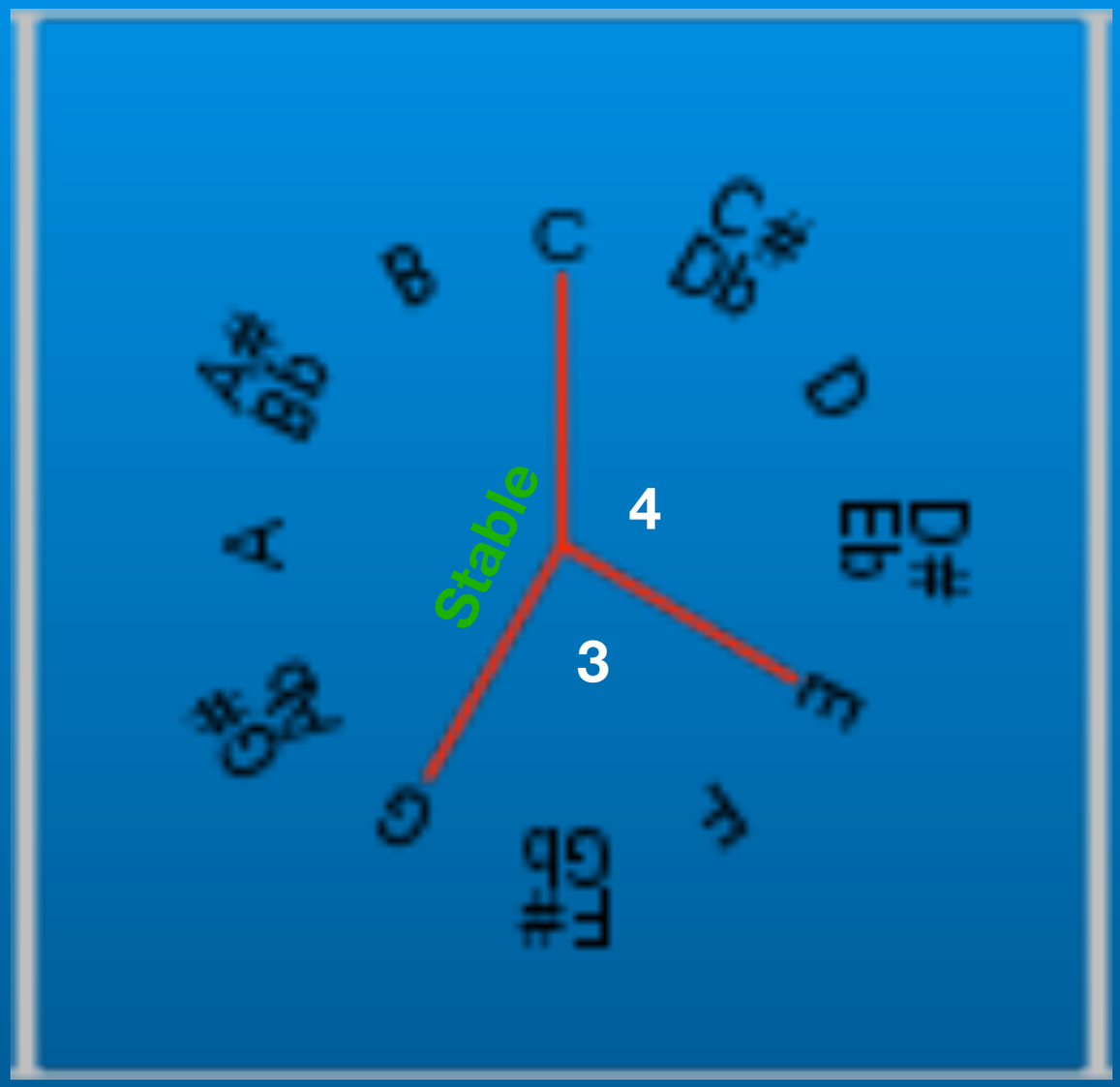
Dr Milton Mermikides University of Surrey

Blue Jay Way

Abstract Musical Mechanics

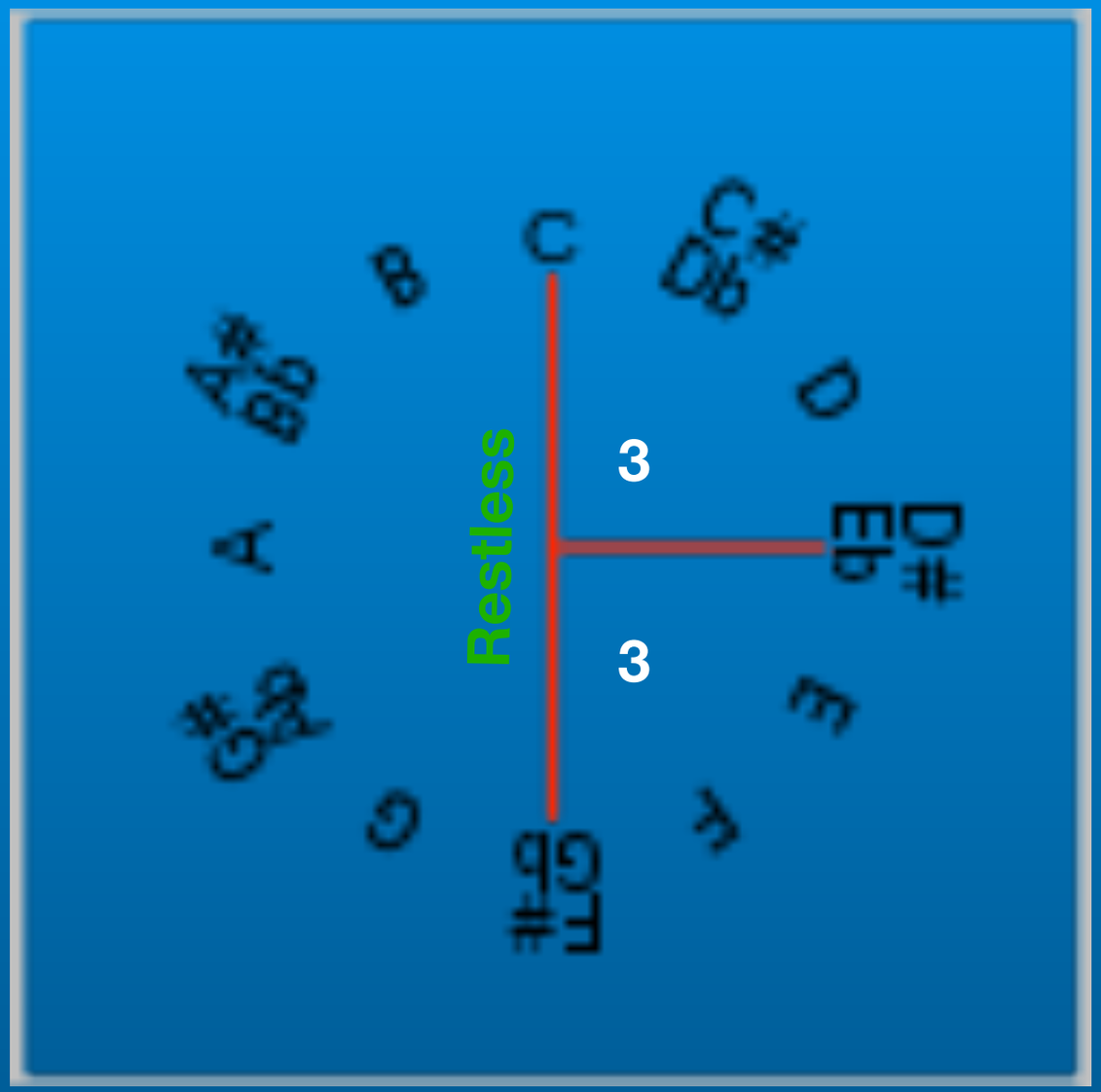


Major



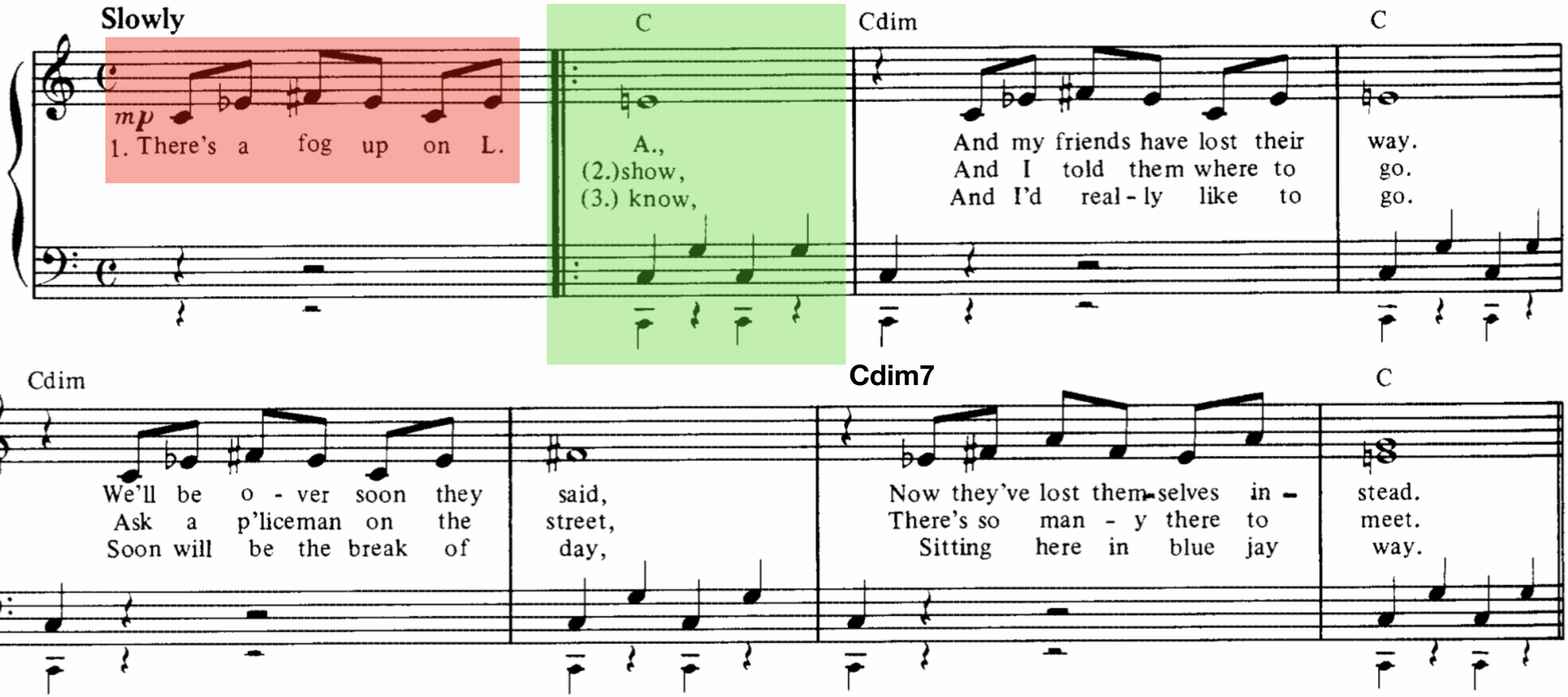
Simple Harmonic Ratios
Consonant

Diminished

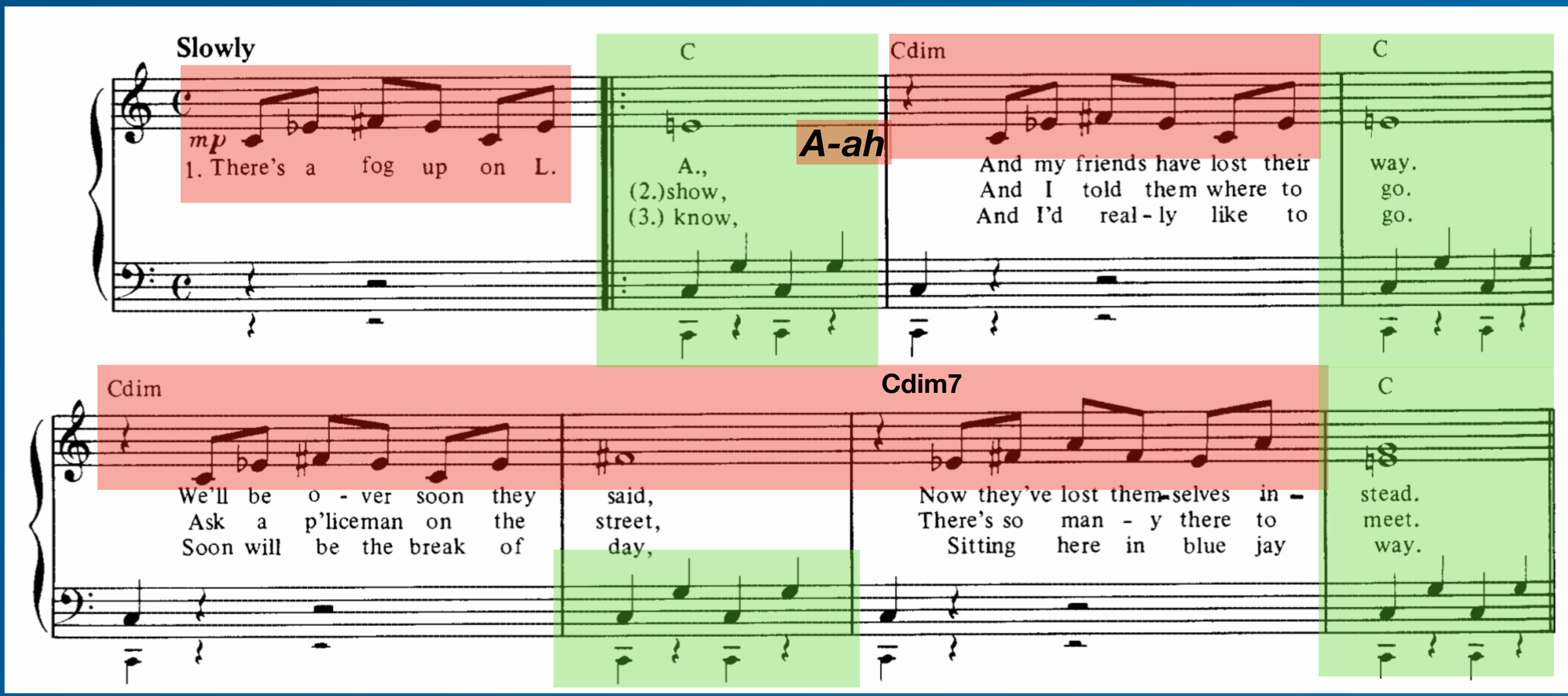


More complex Harmonic Ratios
Dissonant

Blue Jay Way analysis



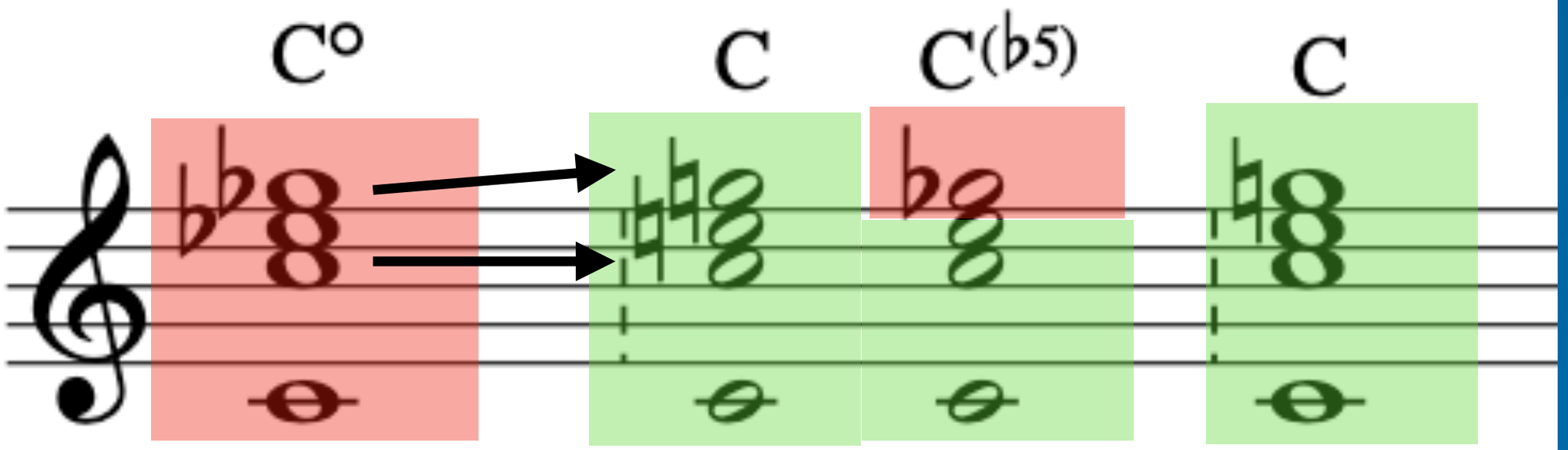
Blue Jay Way's strange cadence



Dissonance

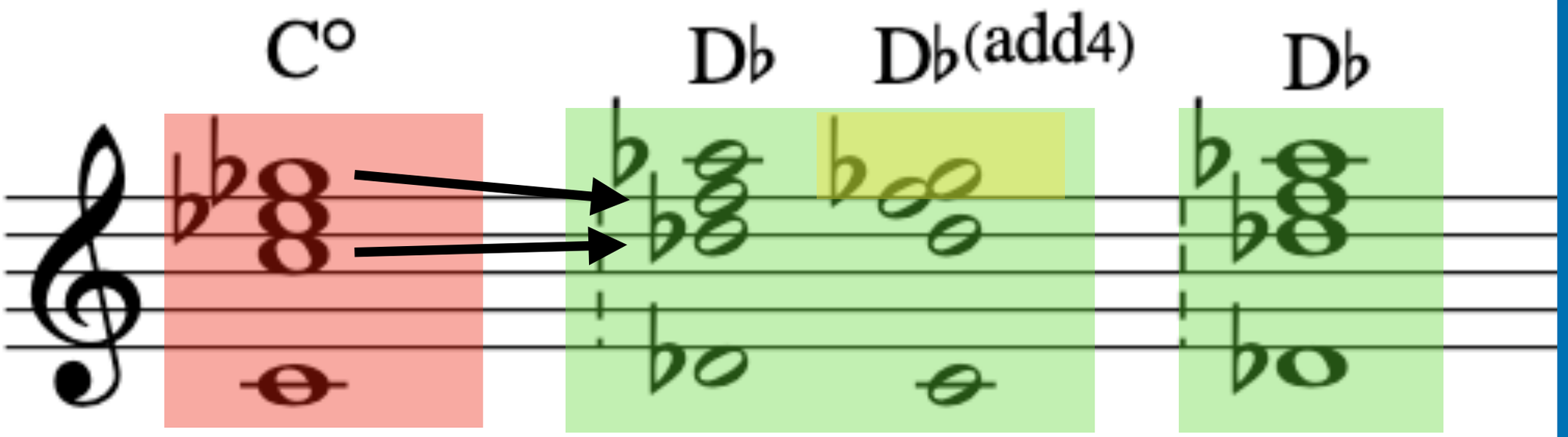
Consonance

Blue Jay Way Harmonic Reduction - Dissonance resolved in place

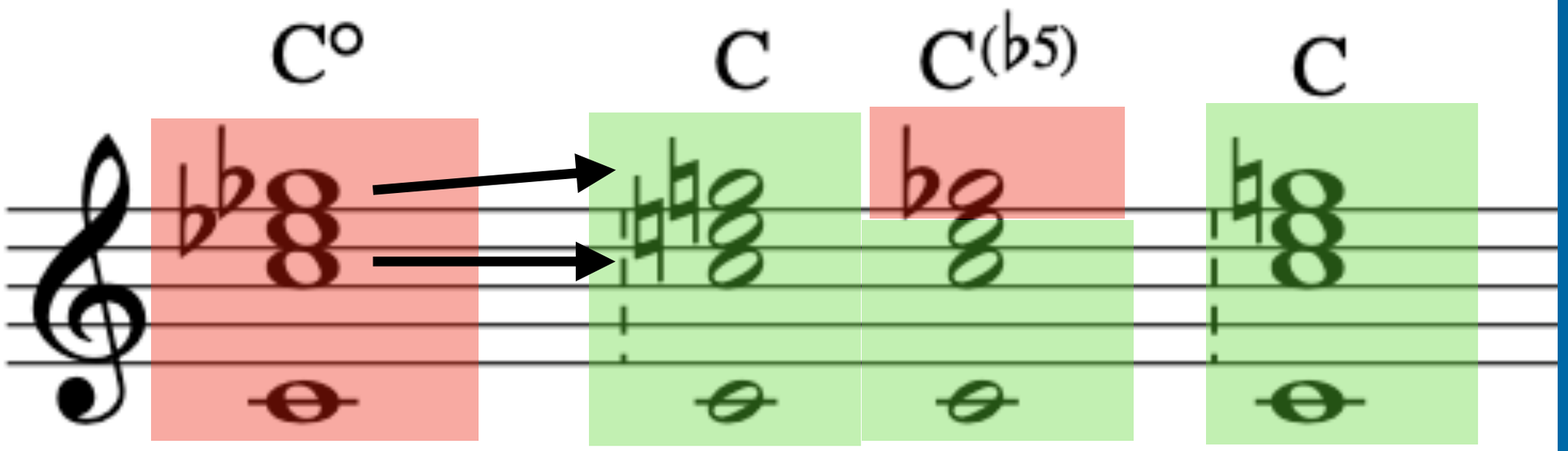


There's a fog up on.... LA
And my friends have lost their... way

Blue Jay Way Sanitised Version - Dissonance resolved 'away'

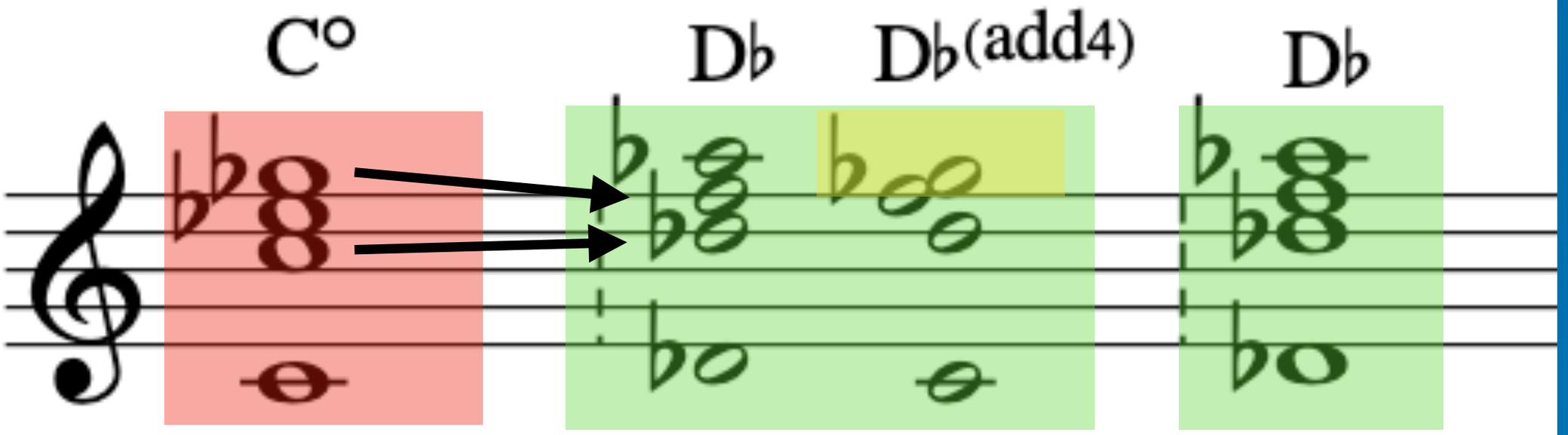


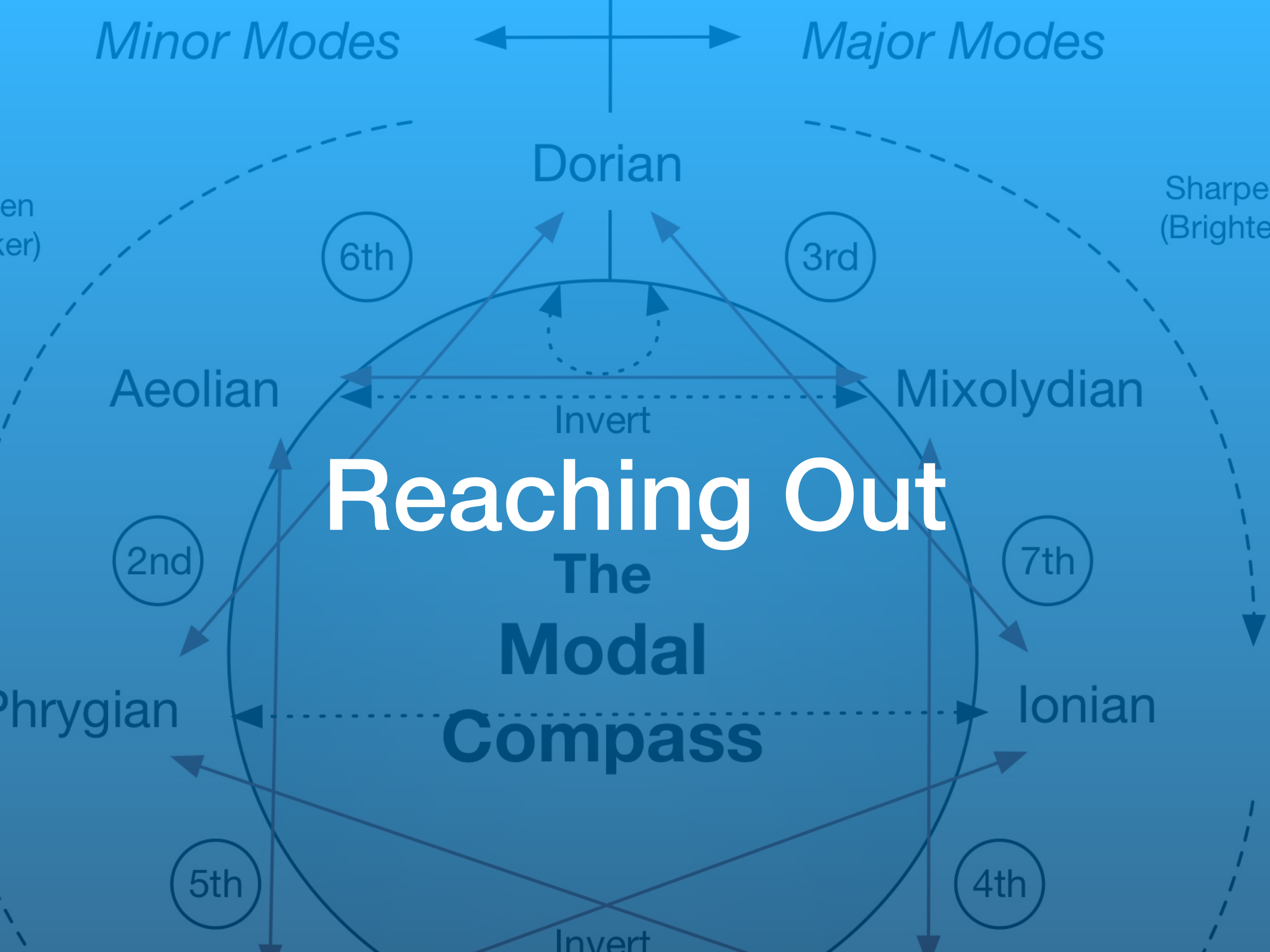
Blue Jay Way Harmonic Reduction - Dissonance resolved ‘in place’



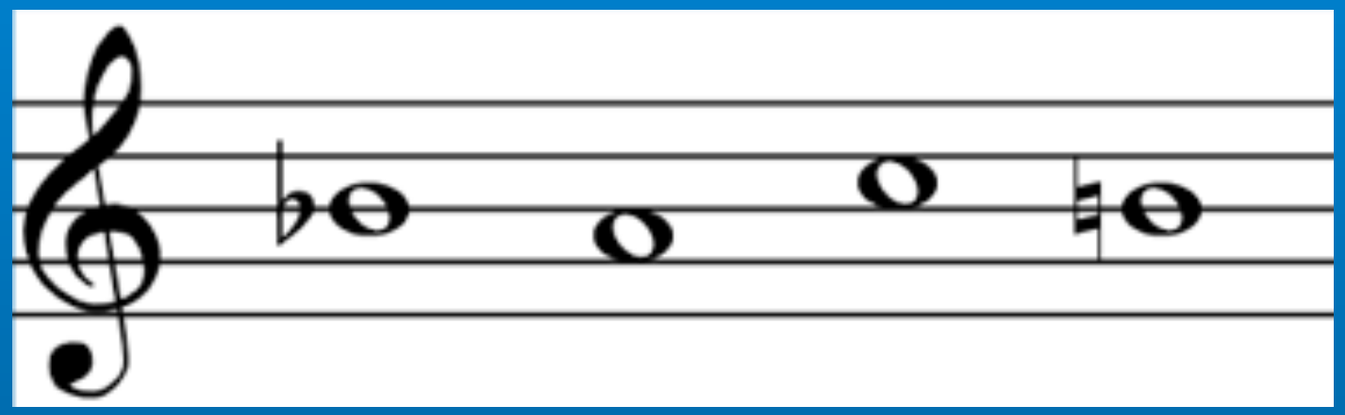
There’s a fog up on…. LA
And my friends have lost their… way

Blue Jay Way Sanitised Version - Dissonance resolved ‘away’

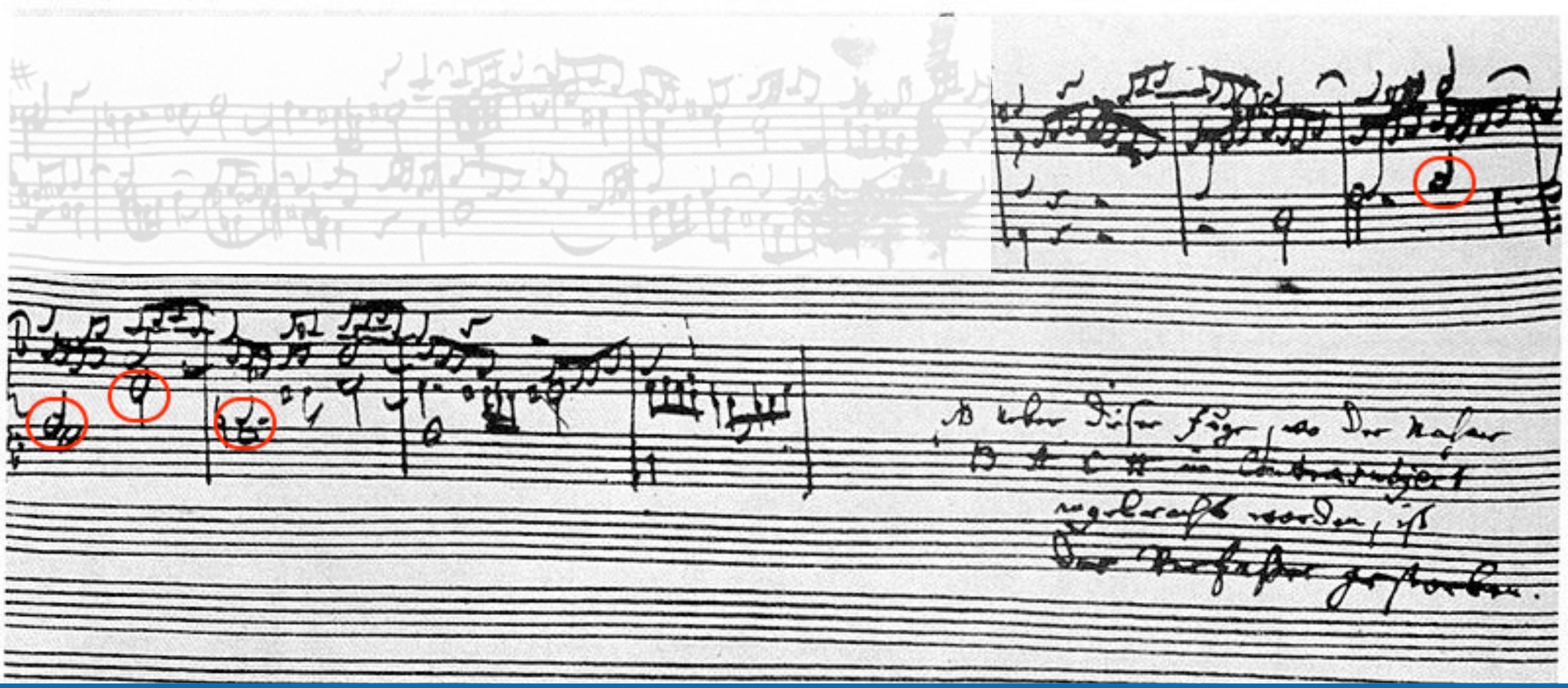




Reaching Out



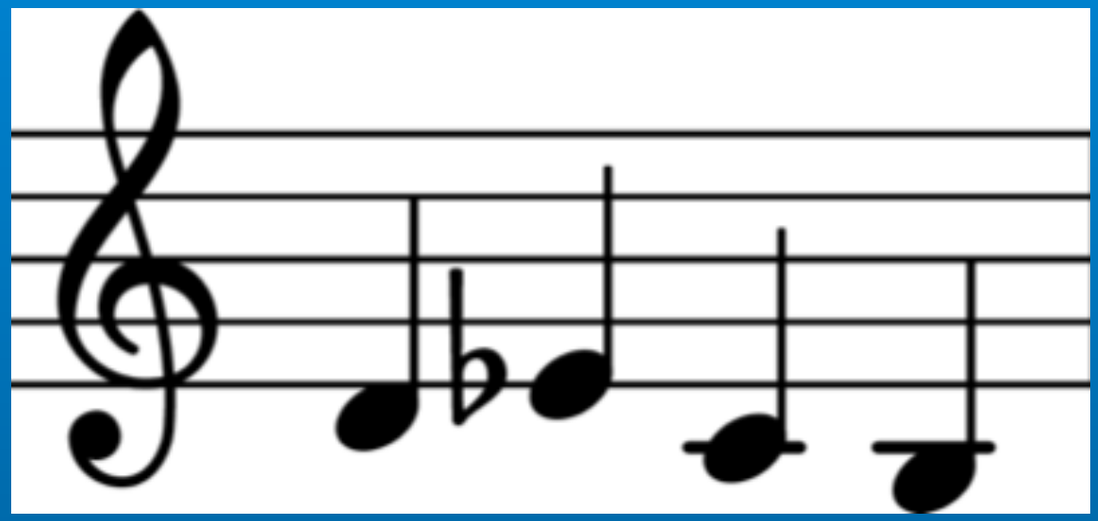
B A C H



The unfinished *Contrapunctus XIV* C.P.E. Bach's note reads "*At the point where the composer introduces the name BACH in the countersubject to this fugue, the composer died.*"

Another of 100s of examples through the ages…

Dimitri Schostakovich



D Eb(S) C H

Extending the concept

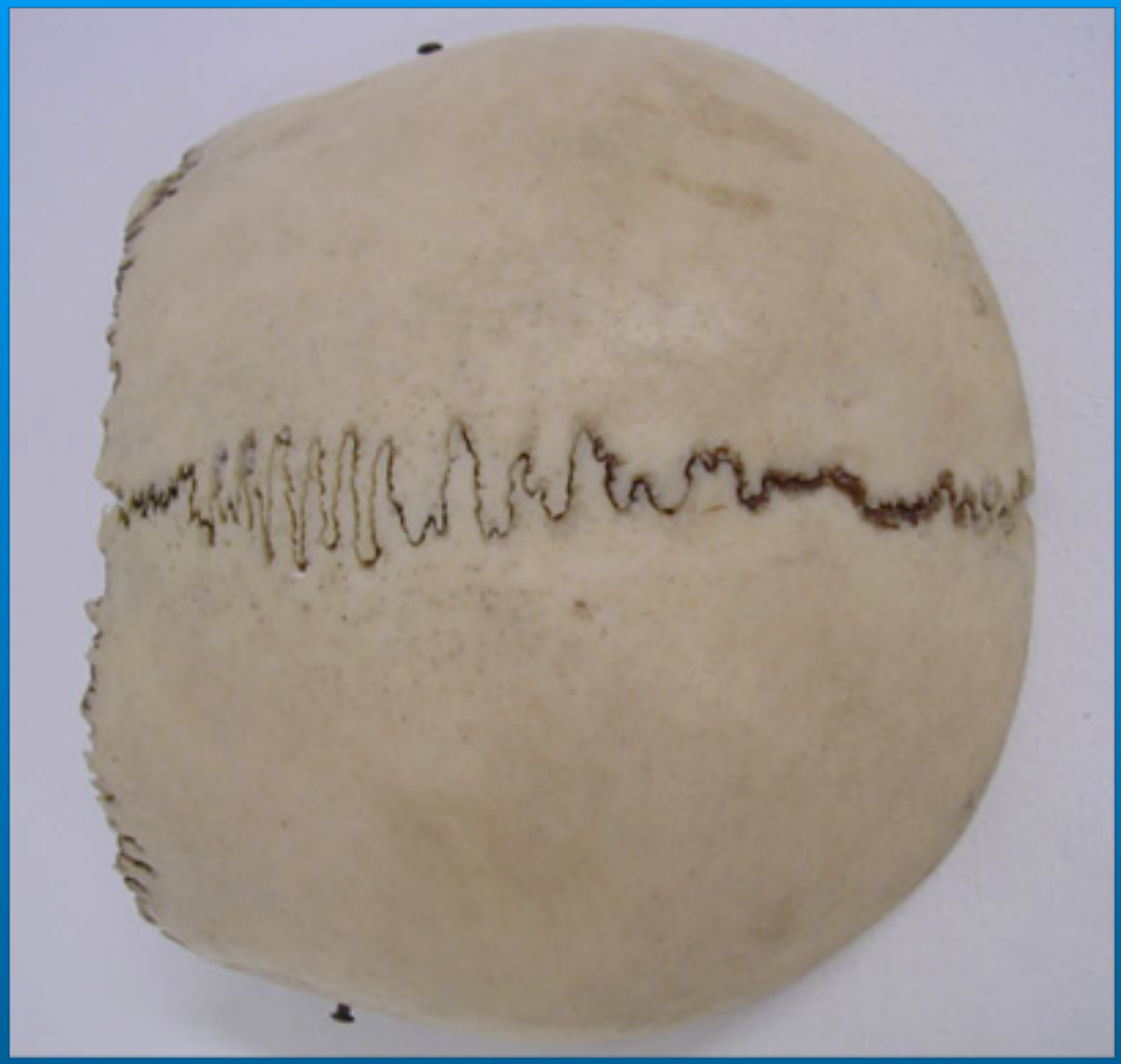
Villa-Lobos
(1887-1959)

VILLA-LOBOS: **NEW YORK SKY LINE MELODY** - GRÁFICO DERIVADO DA VERSÃO DE 1957. (C. KATER, 1982)

New York Skyline Melody (1939)

The coronal suture of the skull [has] a certain similarity to the closely wound line […]of a phonograph […] Suppose, one played a trick on this needle and caused it to retrace a path not made by the graphic translation of a sound, but self-sufficing and existing in nature […] what would happen? …

Ur-Geräusch (Rilke 1919)



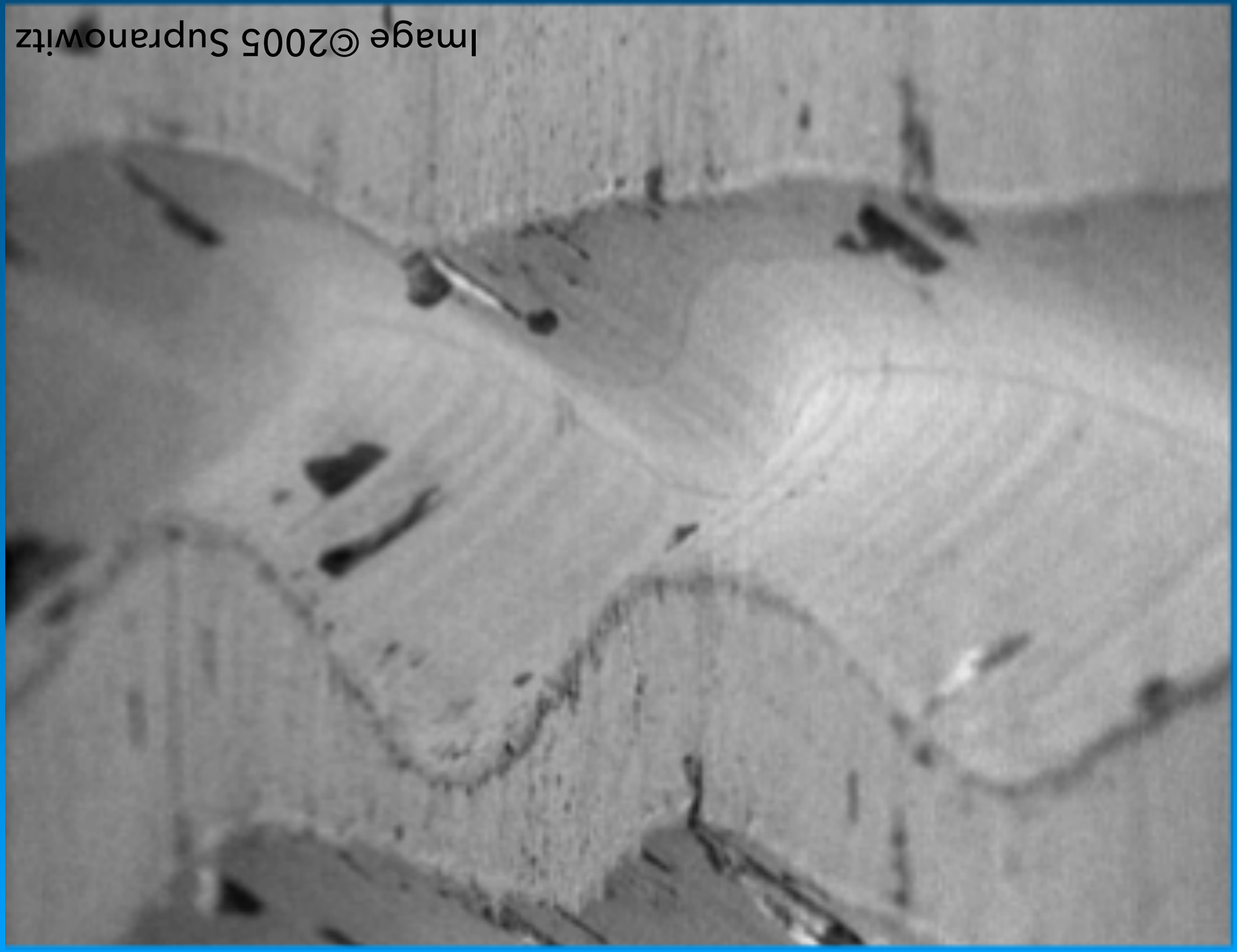
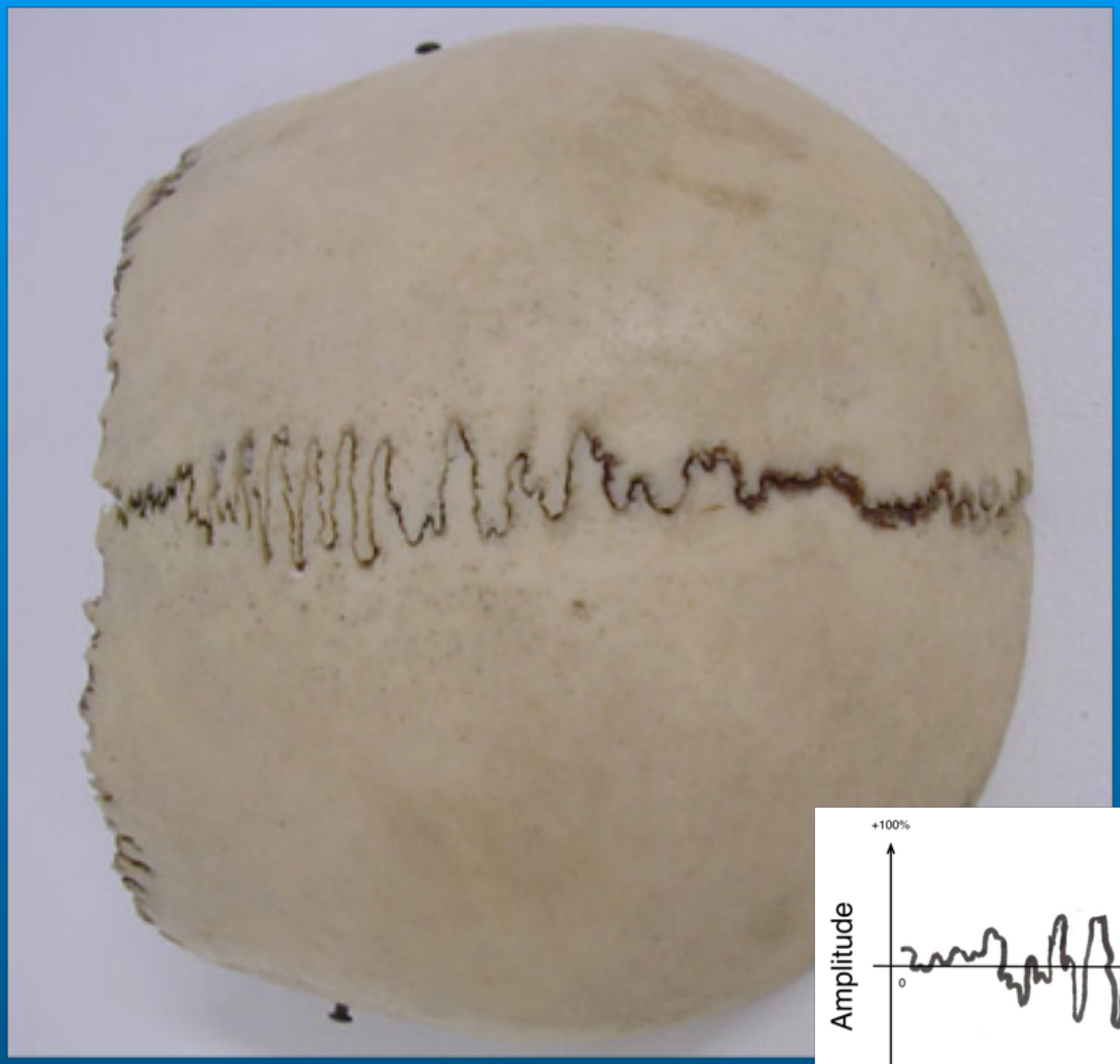
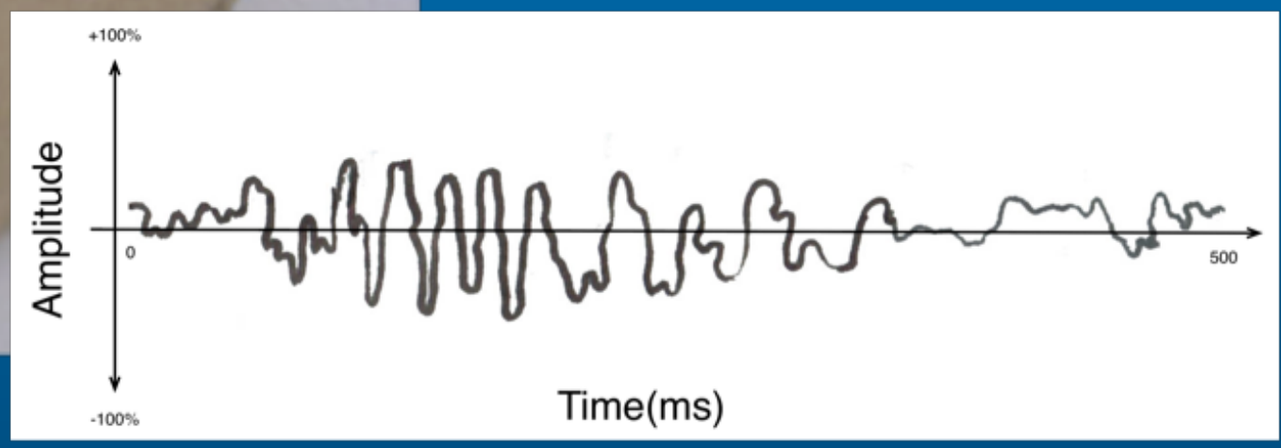


Image ©2005 Supranowitz

Primal Sound (2004)





MUSIC IN THE BLOOD

BloodLines (2004, 2013)

DATE	WBC	RBC	HB	HCT	MCV	MCH	MCHC	RDW	Platelets	Neutrophl	Lymphocy	Monocy	Eosinop	Basophi
22/11/04	340.0	5.74	10.0	0.343	59.7	17.4	29.1	17.0	31					
23/11/04	332.0	5.29	10.5	0.317	59.9	19.6	33.1	16.8	39					
24/11/04		4.74	8.3	0.280	59.2	17.5	29.5	16.5	35	14.4	311.0	19.5	0.4	0.2
24/11/04	345.0	4.66	8.5	0.280	59.9	18.3	30.8	16.8	73					
24/11/04	370.0	4.90	7.3	0.300	61.1	19.1	29.3	16.2	72					
25/11/04	242.0	4.42	8.2	0.266	60.1	18.6	31.0	16.0	72	12.4	212.0	17.5	0.3	0.2
25/11/04	81.4	4.63	9.1	0.276	59.5	19.7	33.1	15.8	50	8.6	68.6	4.0	0.2	0.0
26/11/04	17.9	4.10	8.5	0.252	60.2	20.3	33.8	15.0	32	4.4	12.7	0.7	0.0	0.0
26/11/04	16.3	4.18	8.3	0.249	59.5	19.9	33.5	15.4	32	4.4	11.3	0.5	0.0	0.0
27/11/04	6.6	3.72	7.7	0.225	60.5	20.7	34.3	15.3	18	2.5	3.9	0.2	0.0	0.0
28/11/04	5.6	3.79	7.7	0.226	59.6	20.3	34.0	15.1	17	1.8	3.7	0.1	0.0	0.0
28/11/04	5.7	3.84	7.8	0.228	59.4	20.4	34.3	15.1	16	1.7	3.8	0.1	0.0	0.0
29/11/04	4.0	3.23	6.6	0.197	61.1	20.6	33.7	15.4	13	1.1	2.9	0.1	0.0	0.0
30/11/04	5.3	4.14	9.3	0.263	63.5	22.5	35.4	20.2	36	1.9	3.3	0.1	0.0	0.0
01/12/04	5.4	3.90	8.7	0.250	64.2	22.3	34.7	20.1	30	1.6	3.6	0.1	0.0	0.0
02/12/04	5.2	4.40	9.8	0.280	63.6	22.4	35.2	20.7	43	2.1	2.8	0.3	0.0	0.0
02/12/04	5.5	4.21	9.3	0.270	64.1	22.2	34.6	20.7	37	2.9	2.3	0.3	0.0	0.0
03/12/04	2.5	3.73	8.3	0.239	64.2	22.3	34.8	20.8	51	2.0	0.5	0.0	0.0	0.0
04/12/04	3.2	3.25	7.1	0.211	65.0	21.9	33.6	20.8	66	1.5	1.6	0.1	0.0	0.0
05/12/04	2.8	3.59	8.7	0.246	68.5	24.1	35.2	22.6	113	1.4	1.4	0.0	0.0	0.0
06/12/04	4.0	3.04	9.4	0.271	70.5	24.9	34.8	22.0	220	2.7	2.1	0.0	0.0	0.0
07/12/04	3.0	3.44	8.3	0.247	71.7	24.8	33.5	23.0	240	1.1	1.9	0.0	0.0	0.0
08/12/04	2.1	3.31	8.2	0.235	71.1	24.9	35.0	23.0	281	0.6	1.4	0.1	0.0	0.0
09/12/04	2.0	3.40	8.6	0.240	71.4	25.1	35.2	23.3	270	0.0	0.9	0.2	0.0	0.0
10/12/04	3.2	4.38	10.7	0.324	74.1	24.6	33.2	23.1	289	2.1	0.9	0.2	0.0	0.0
11/12/04	2.8	4.09	10.0	0.305	74.7	24.5	32.8	23.1	292	1.7	0.9	0.1	0.0	0.0
12/12/04	1.6	4.16	10.2	0.315	75.6	24.4	32.9	23.0	280	0.6	1.0	0.0	0.0	0.0
13/12/04	2.1	4.46	10.8	0.333	74.6	24.2	32.5	23.0	315	0.3	1.7	0.0	0.0	0.0
15/12/04	11.7	4.29	10.6	0.317	73.9	24.7	33.4	23.2	316	11.3	0.4	0.0	0.0	0.0
16/12/04	17.7	4.17	10.2	0.318	76.1	24.4	32.1	23.3	288	15.7	1.8	0.2	0.0	0.0
17/12/04	5.0	4.24	10.5	0.318	75.1	24.9	33.1	23.0	296	3.2	1.5	0.2	0.0	0.0
18/12/04	4.3	4.40	10.9	0.329	74.9	24.8	33.1	22.9	328	1.8	2.2	0.3	0.0	0.0
19/12/04	2.1	3.86	9.8	0.288	74.7	25.5	34.2	22.7	221	0.6	1.4	0.1	0.0	0.0
20/12/04	2.0	3.65	9.0	0.275	75.3	24.7	32.7	22.7	210	0.7	1.3	0.0	0.0	0.0
21/12/04	2.9	3.91	9.6	0.294	75.3	24.7	32.8	22.9	241	0.9	1.9	0.0	0.0	0.0
22/12/04	3.4	3.94	9.8	0.294	74.6	24.8	33.3	22.9	281	1.4	1.9	0.1	0.0	0.0
23/12/04	2.9	3.55	9.1	0.266	75.1	25.5	34.0	22.9	225					
24/12/04	3.7	4.20	10.3	0.308	73.4	24.5	33.4	23.4	249	1.5	2.0	0.2	0.0	0.0
25/12/04	3.2	4.02	9.9	0.302	75.2	24.8	32.9	23.7	282	2.0	1.1	0.1	0.0	0.0
26/12/04	2.5	3.70	9.5	0.286	75.6	25.8	33.3	22.6	190	1.9	0.6	0.0	0.0	0.0
27/12/04	1.8	3.83	9.6	0.292	76.1	25.0	32.9	22.3	145	1.4	0.4	0.0	0.0	0.0
28/12/04	0.8	3.47	8.7	0.263	75.9	25.0	33.0	21.9	119	0.5	0.3	0.0	0.0	0.0
30/12/04	0.7	3.17	8.1	0.255	80.5	25.6	31.8	21.9	83	0.3	0.4	0.0	0.0	0.0
31/12/04	0.3	3.39	9.0	0.264	78.0	26.5	33.9	18.9	51	0.0	0.3	0.0	0.0	0.0
01/01/05	0.3	3.45	9.0	0.279	81.1	26.2	32.3	19.2	32	0.0	0.3	0.0	0.0	0.0
01/01/05	0.3	3.62	9.5	0.284	78.6	26.3	33.5	19.0	25	0.0	0.3	0.0	0.0	0.0

Wellcome Trust Radio 4 Aldeburgh Music Smithsonian Institute UCL Neuroscience

Surrey: Microbiology, Mathematics, Medicine, Programming, Sleep Research Rutherford Centre

Times Higher Education British Library Frank Moer Institute TedX Groningen Nordezoon Festival

CHEMISTRY

MATHE RINI

ROSM SORI

Milton Mermikides (University of Surrey)

Debra J. Skene (University of Surrey)

Renata Rhia (University of Edinburgh)

Vlad Vyazovskiy & Nanyi Cui (Oxford University)

Yurubi Rosales Suarez/ Professor Paul Krause (University of Surrey)

Anna Tanczos

University of Surrey

Research & Innovation Support

The Royal Society

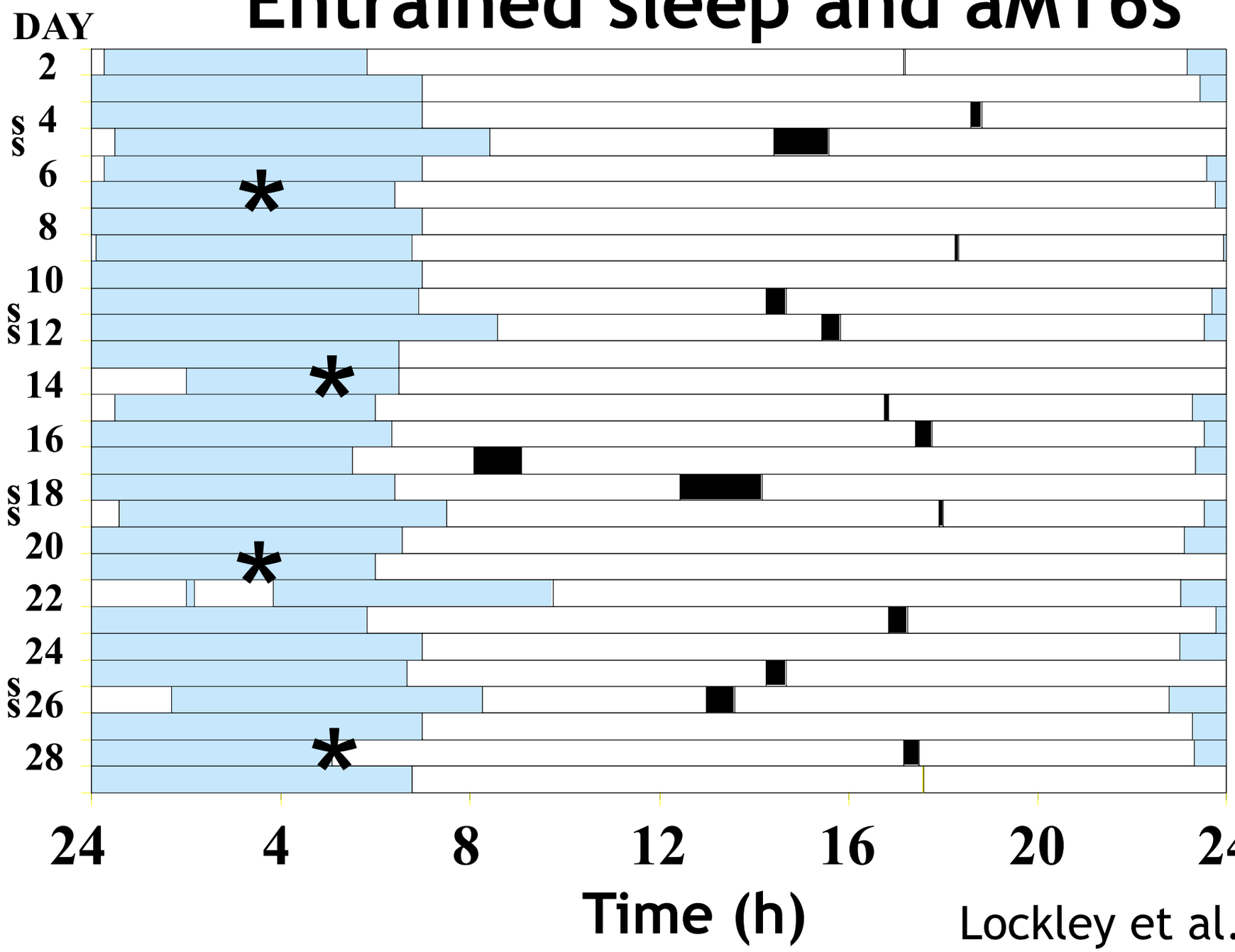
SOUND ASLEEP

MAKING SLEEP VISIBLE TO THE BLIND

Debra J. Skene (University of Surrey)

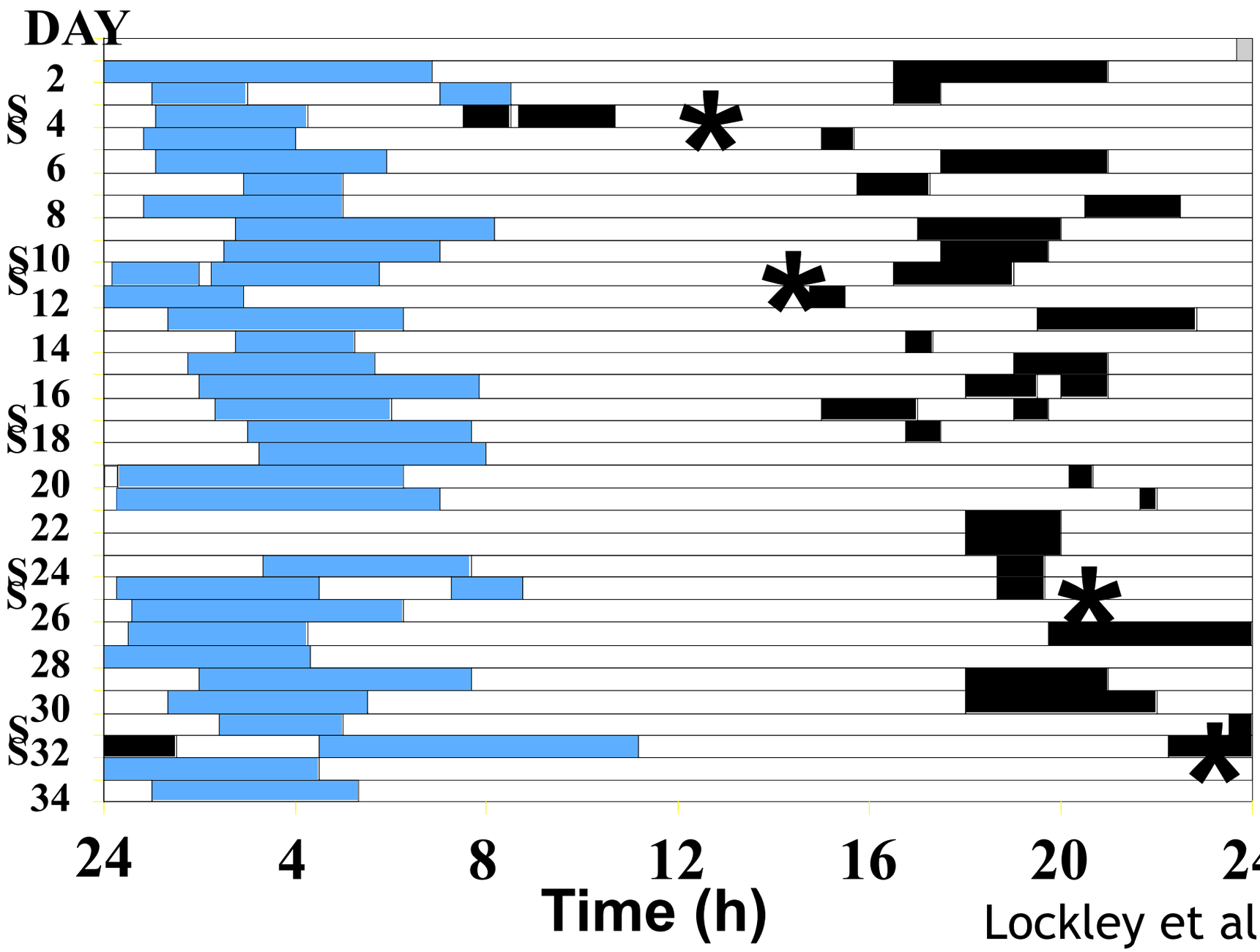
Milton Mermikides (University of Surrey)

Entrained sleep and aMT6s



Lockley et al., 1997

Abnormal circadian phase - poor sleep- daytime nap



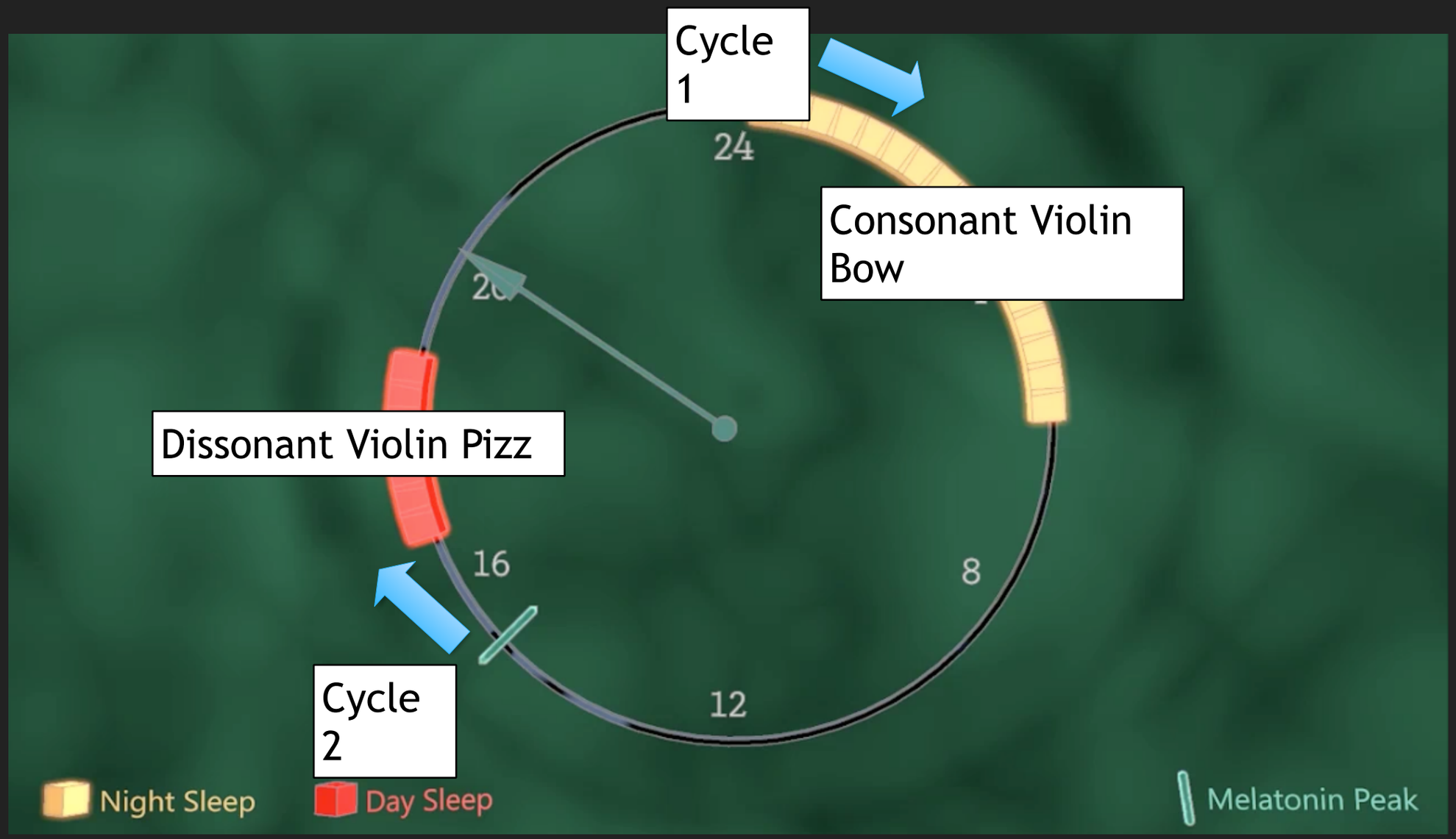
Lockley et al., 1997

MUSICAL ANALOGIES

24-Beat Cycle (Shona Mbira)

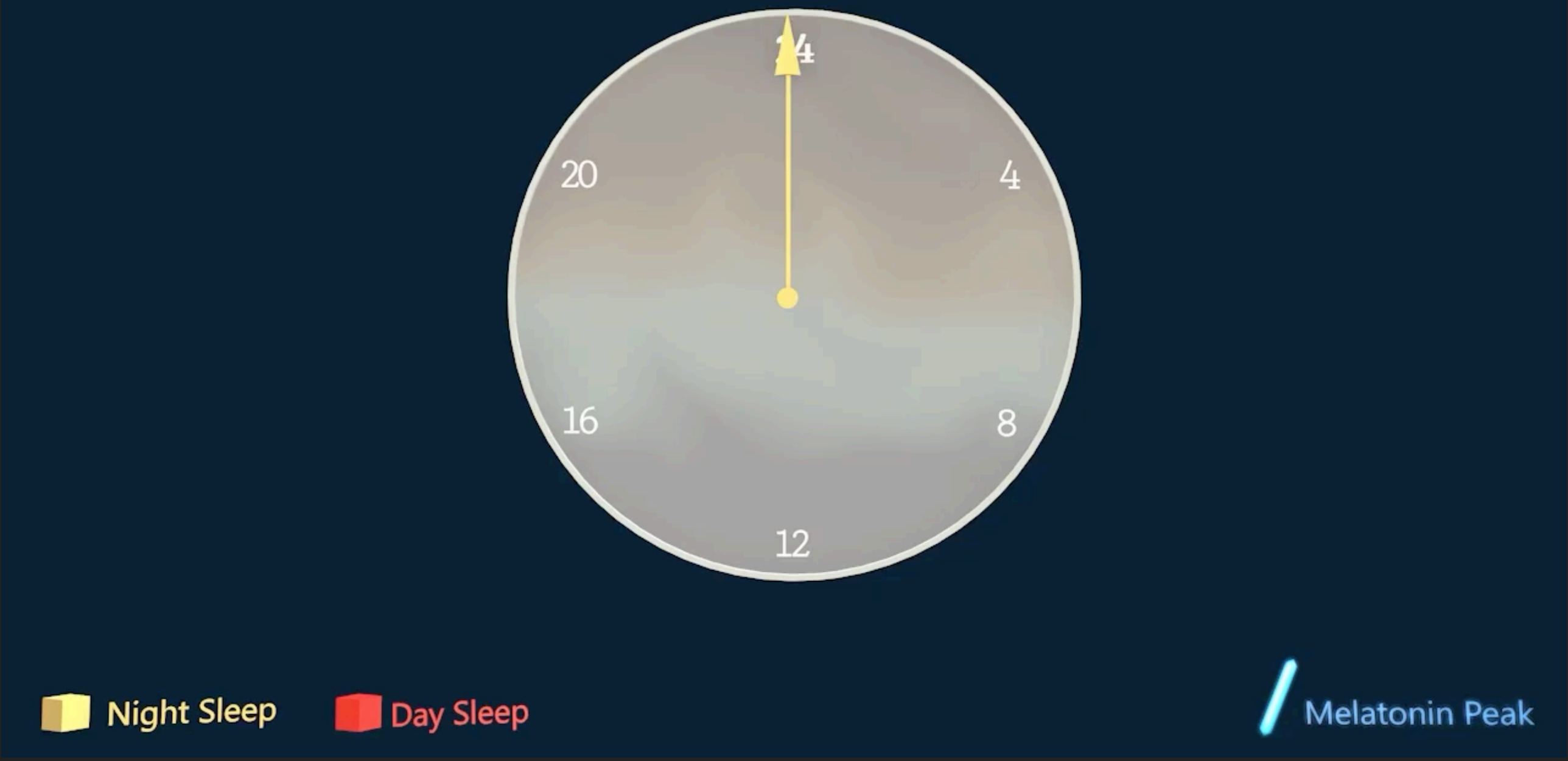
Displacement/Phase (West Africa, Steve Reich)

Diatonic/non-diatonic to represent comfort


Cycle 1
Consonant Violin Bow
Dissonant Violin Pizz
Cycle 2
24
20
16
8
12
Night Sleep
Day Sleep
Melatonin Peak

S12

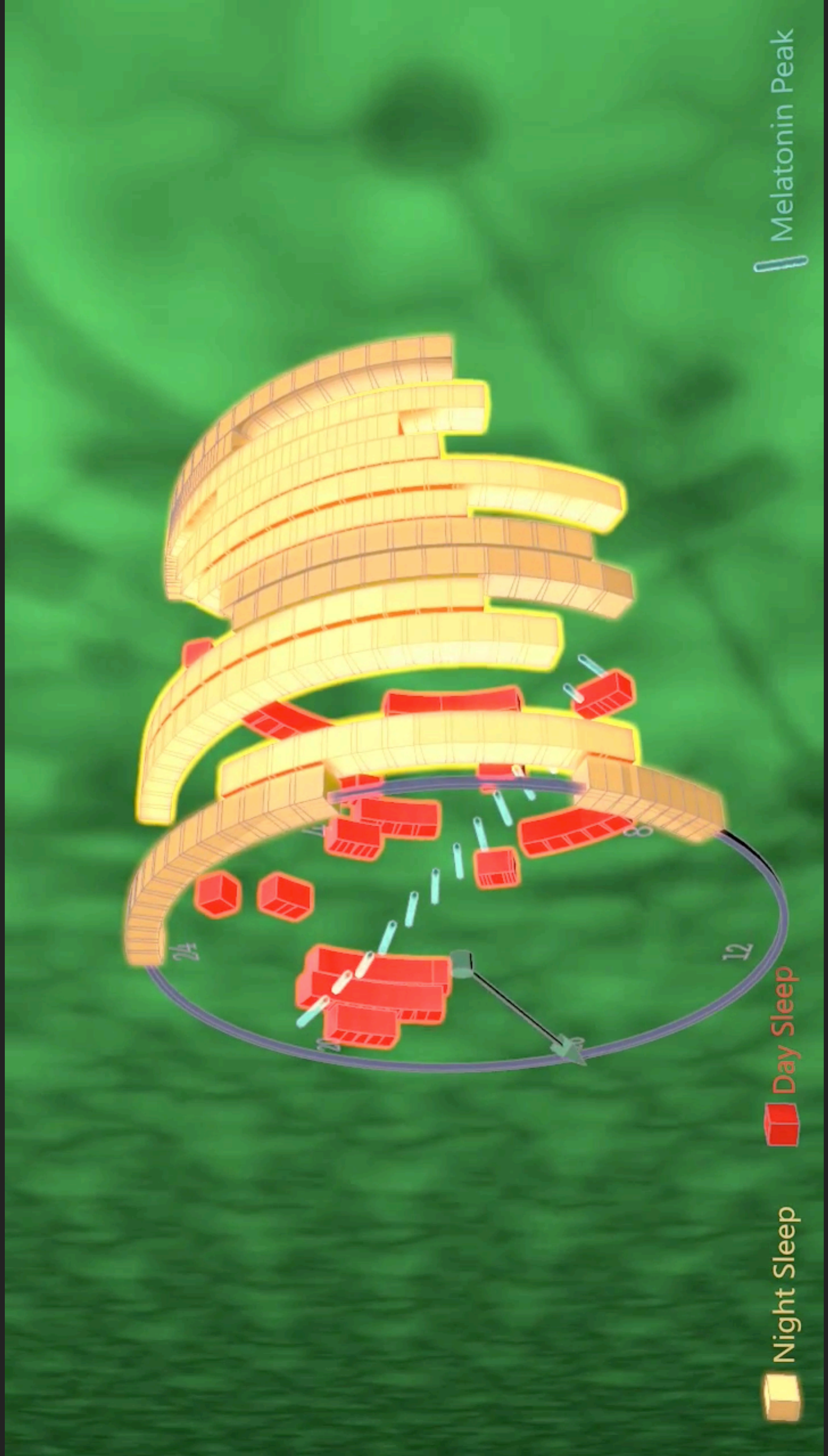
ENTRAINED SLEEP


20
4
16
8
12
Night Sleep
Day Sleep
Melatonin Peak

S23

NON 24 H SLEEP/WAKE DISORDER


4
20
4
16
8
12
Night Sleep
Day Sleep
Melatonin Peak

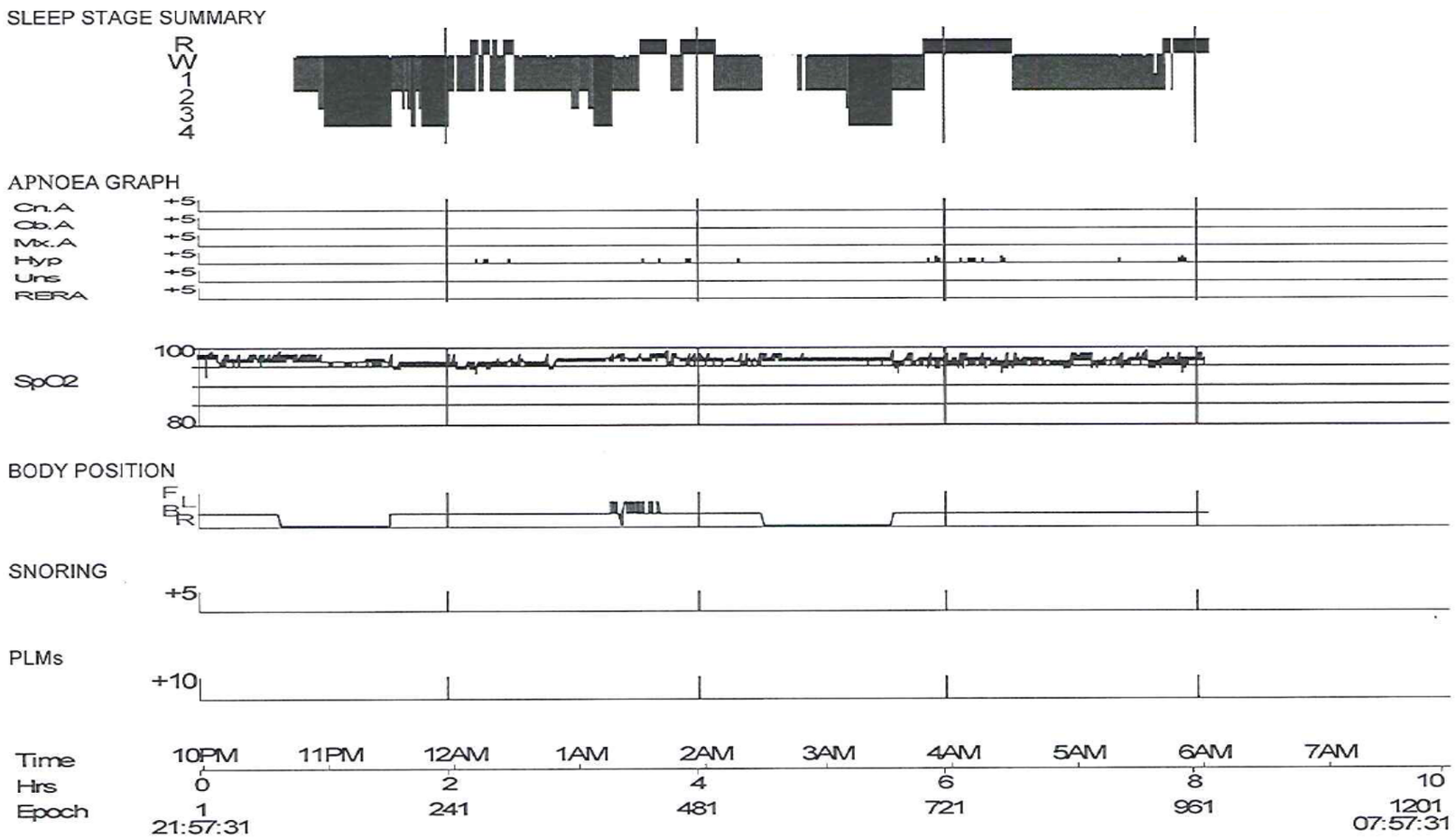

Melatonin Peak
24
12
12
8
Night Sleep
Day Sleep

PSG NOCTURNE:

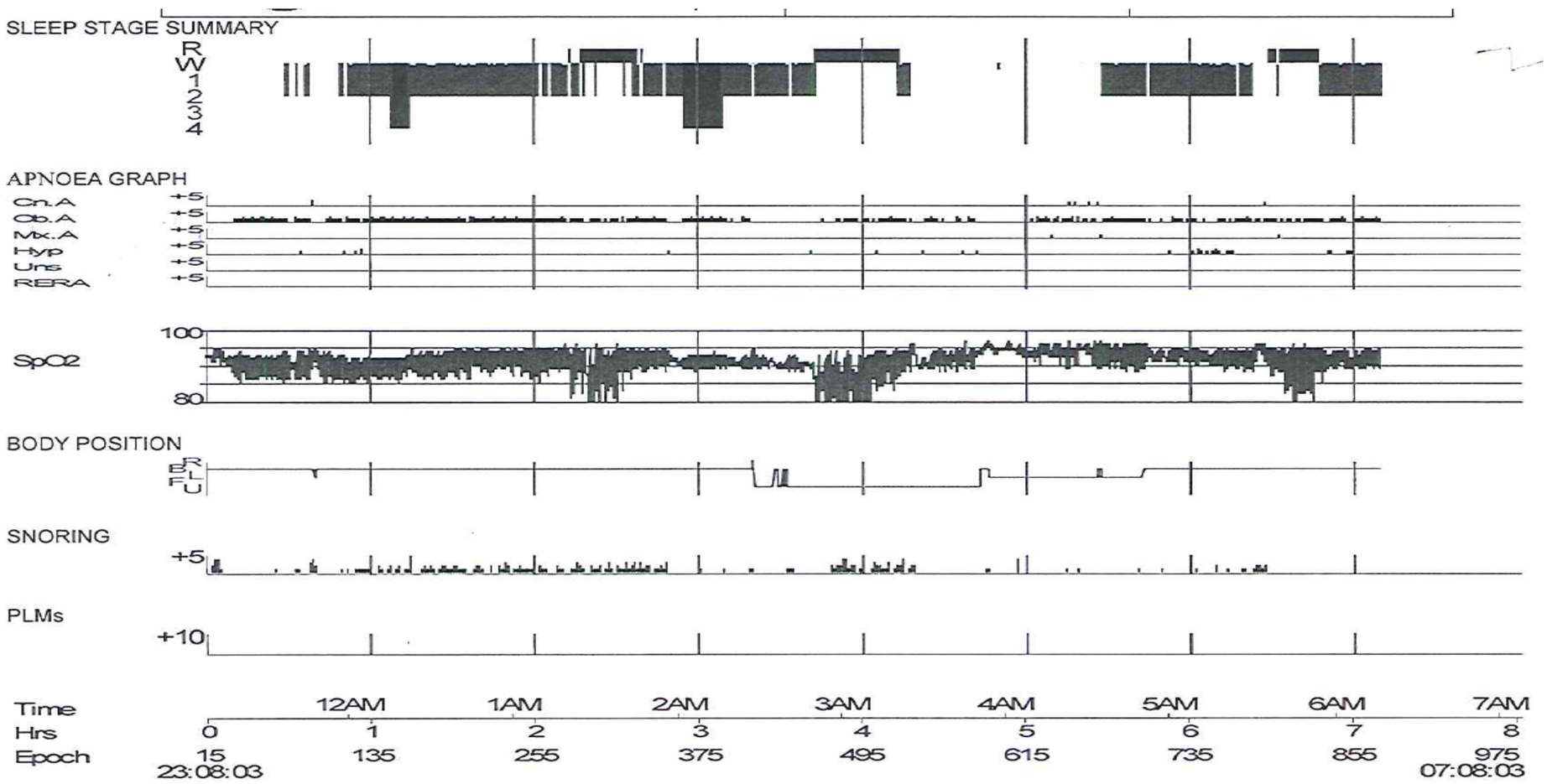
CONVERTING PSG DATA INTO MULTI-LAYERED COMPOSITIONS.

Renata L Riha (University of Edinburgh)

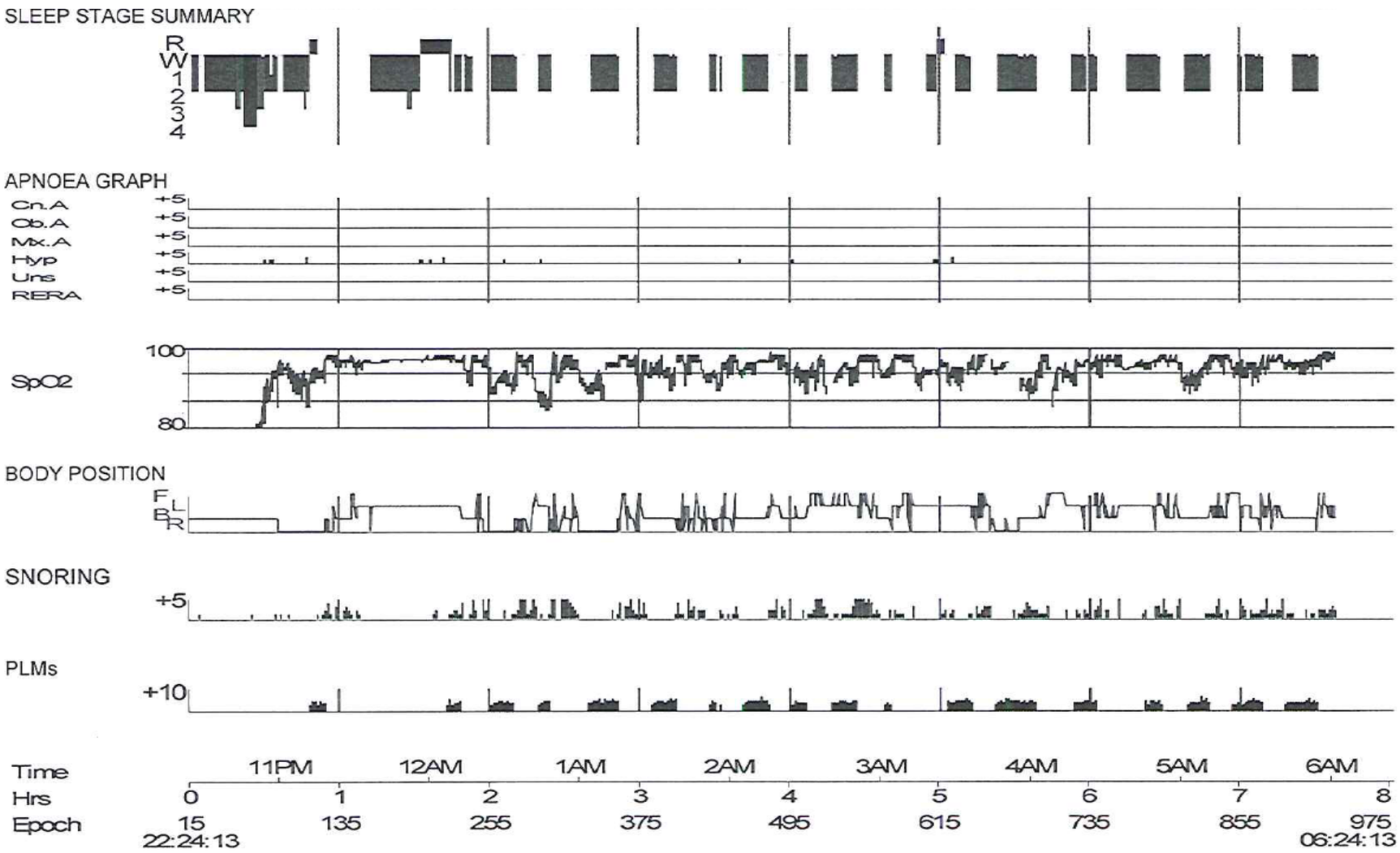
NORMAL PSG


SLEEP STAGE SUMMARY
R
W
1
2
3
4
APNOEA GRAPH
Cn.A
Ob.A
Mx.A
Hyp
Un6
RERA
+5
SpO2
100
80
BODY POSITION
F
L
R
SNORING
+5
PLMs
+10
Time
Hrs
Epoch
10PM
11PM
12AM
1AM
2AM
3AM
4AM
5AM
6AM
7AM
0
2
4
6
8
10
1
241
481
721
961
1201
21:57:31
07:57:31

SEVERE SLEEP APNOEA



RESTLESS LEG SYNDROME



PSG AS SCORE

1. Grande Cymbale Chinoise
Grosse Caisse (très grave)

2. Gong
Tam-tam clair
Tam-tam grave

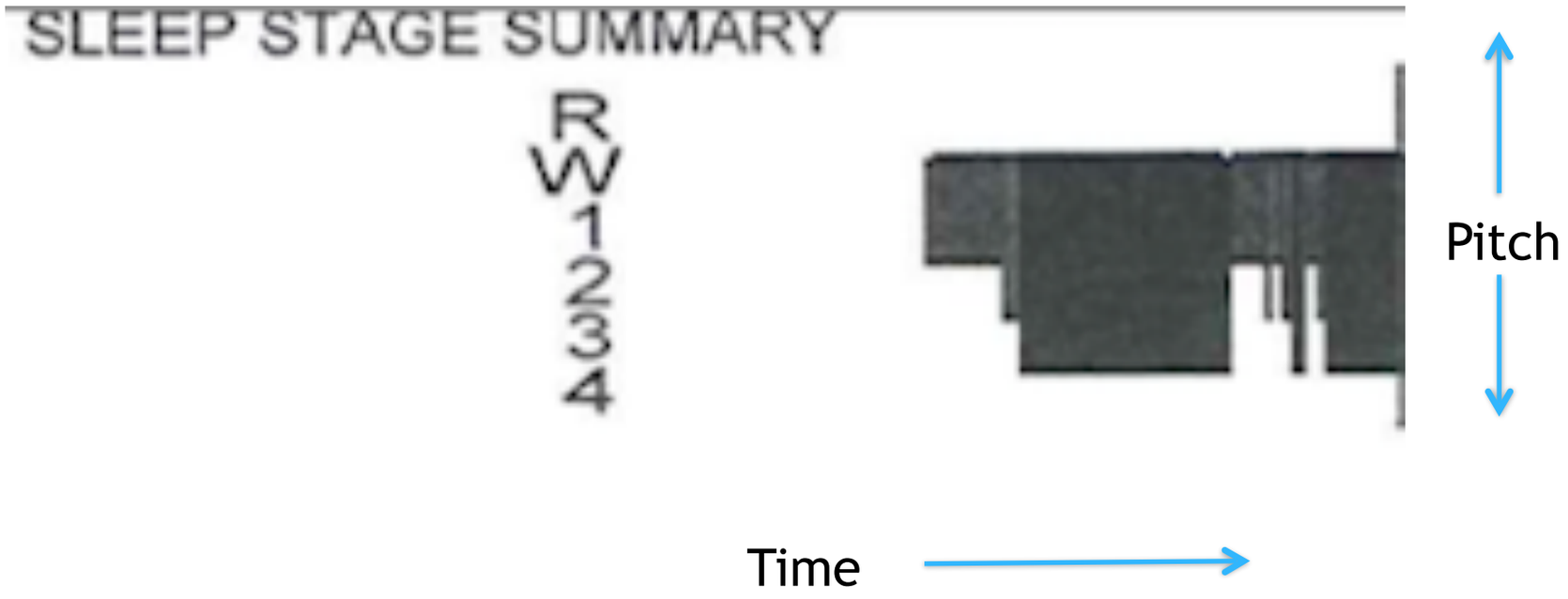
3. 2 Bongos (clair, grave)
Caisse Roulante
2 Grosses Caisses (moyenne, grave)

4. Tambour militaire
Caisse roulante

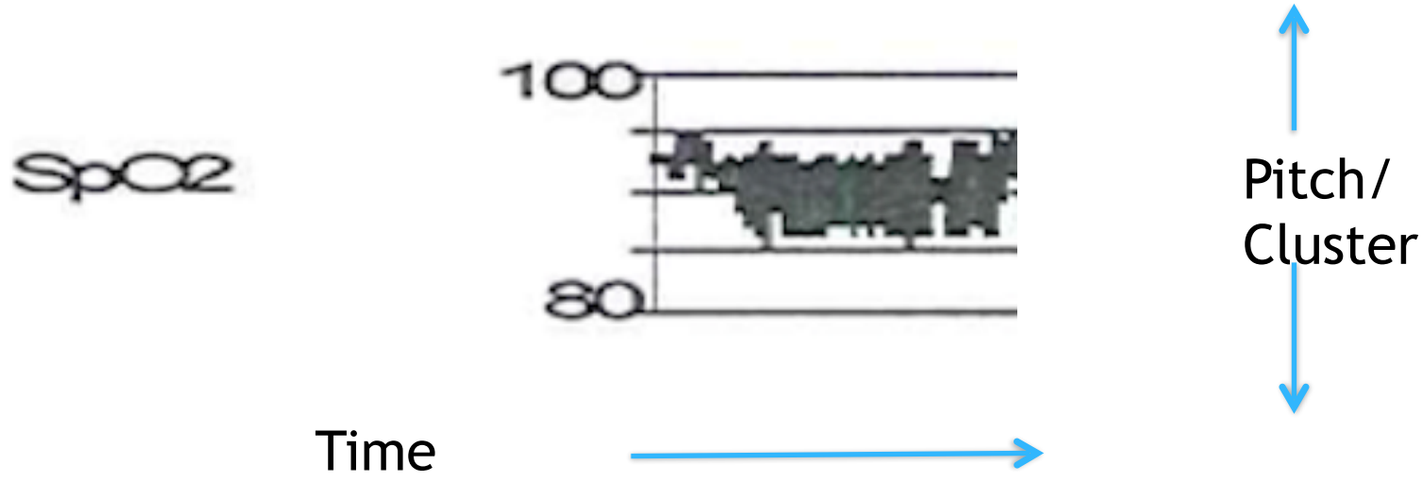
5. Sirène claire
Tambour à corde

6. Sirène grave
Fouet
Gélin

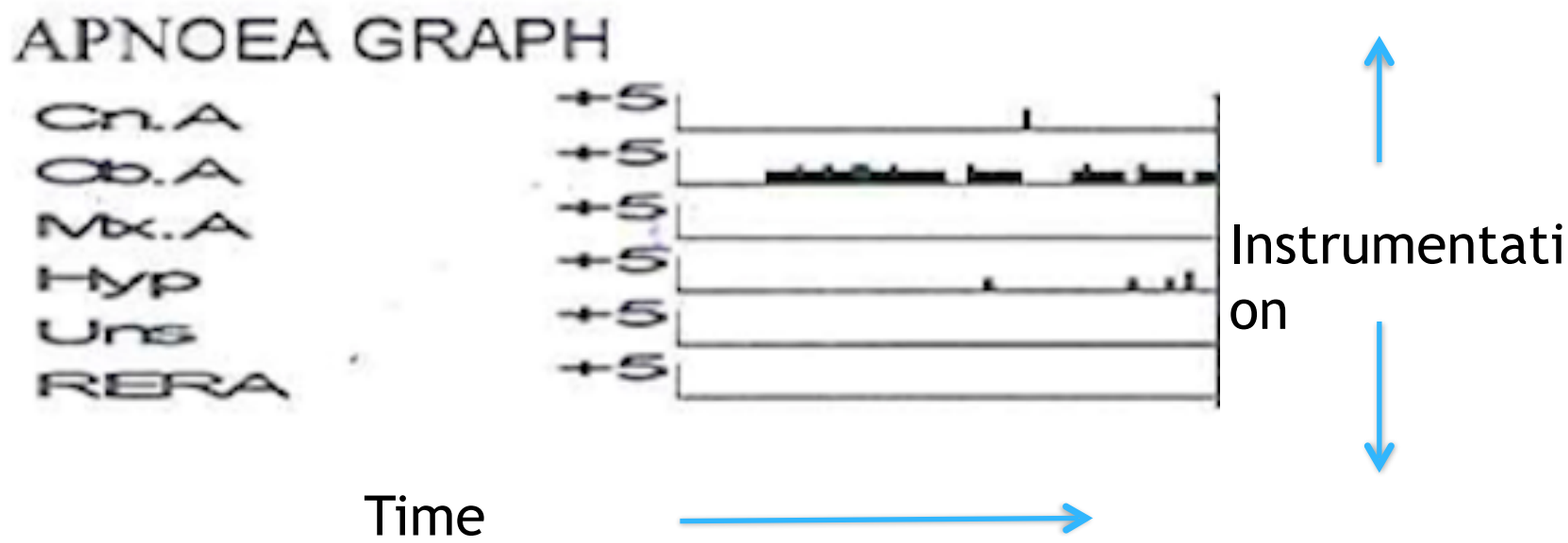
SLEEP FLUTE MELODY



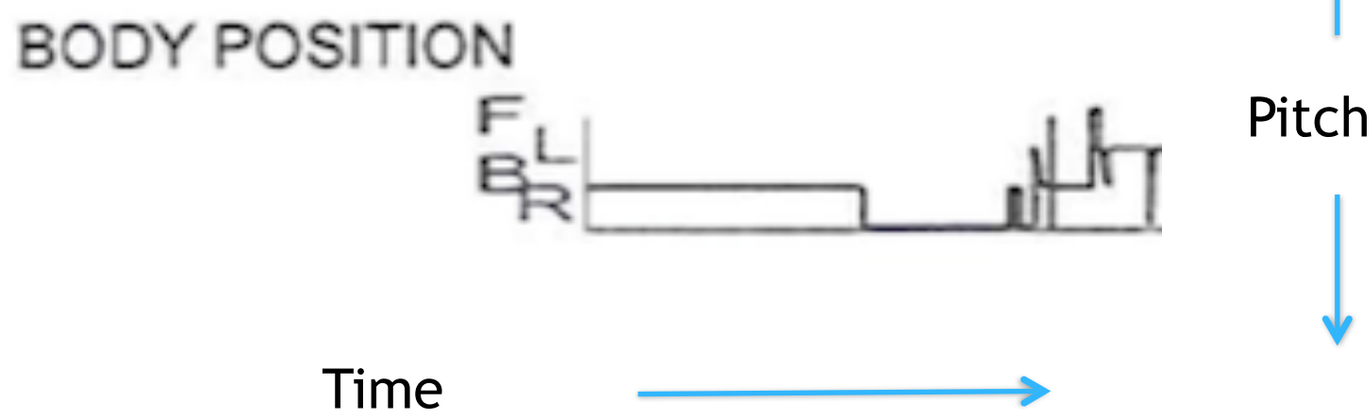
SPO2 TEXTURE/HARMONY



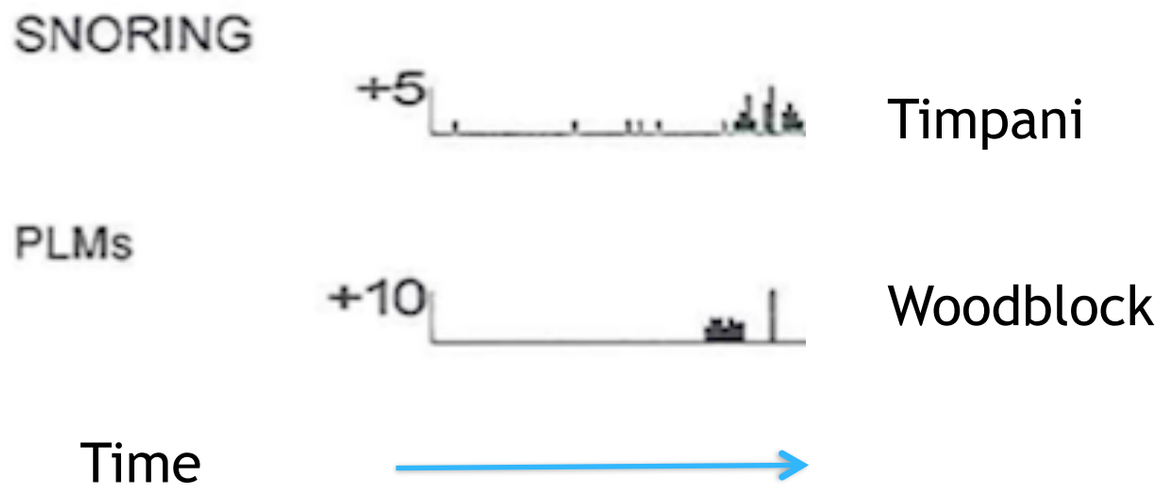
APNOEA PERCUSSION/PIZZICATO



BODY POSITION BASS-LINE



SNORING AND PLM TIMPANI/WOODBLOCK

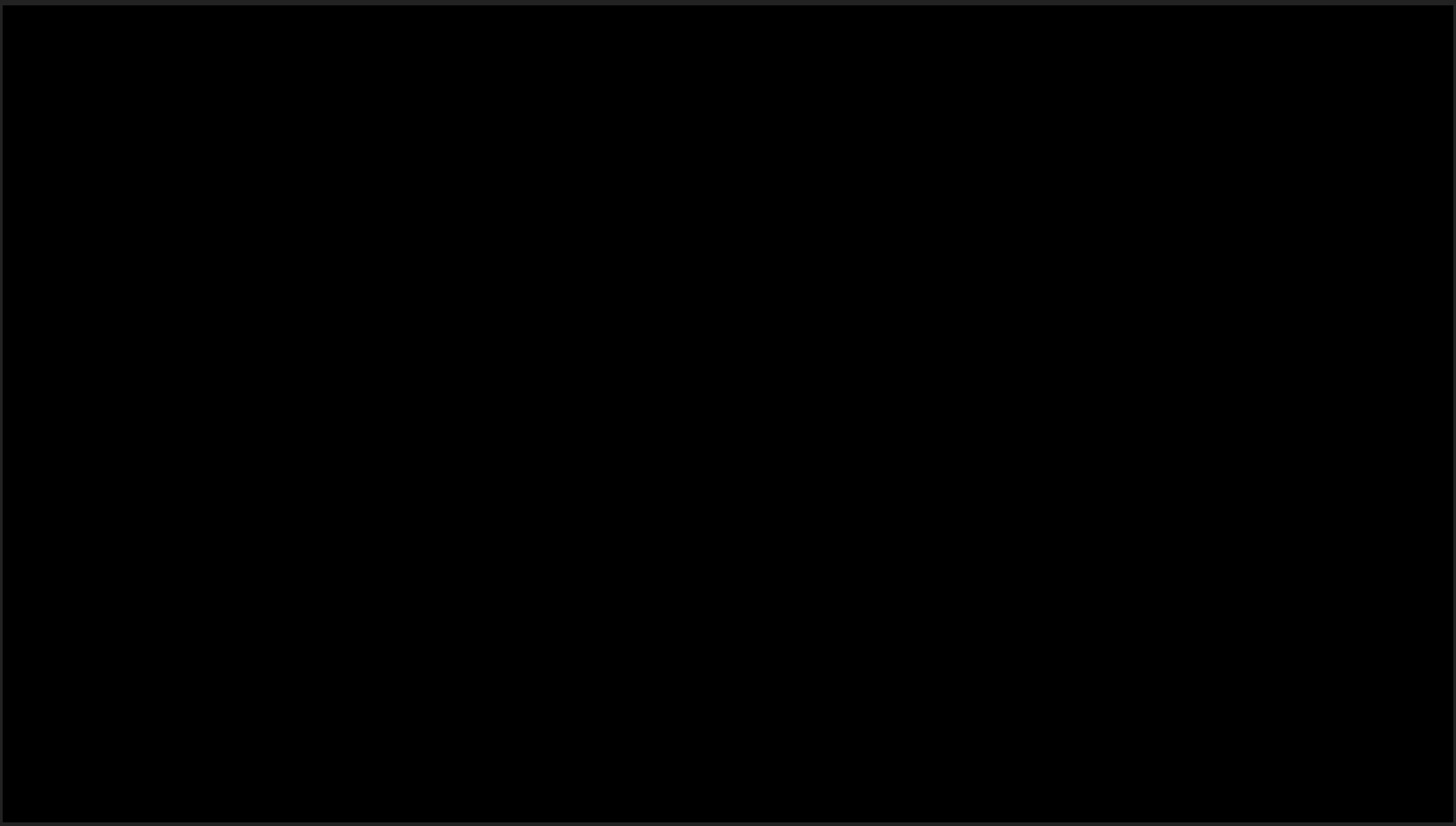


S9

NORMAL SLEEP

S11

APNOEA



S21

RESTLESS LEG SYNDROME

THE INNER SOUND OF SLEEP

TRANSLATING EEG DATA TO THE AUDIO SPECTRUM

Vladyslav Vyazovskiy (University of Oxford)

Milton Mermikides (University of Surrey)

WAVES

Pitch Domain

Gamma	32-100Hz
Beta	14-60Hz
Alpha	8-12Hz to 30-50Hz
Theta	4-8Hz
Delta	0.5-3Hz

WAVES

Gamma 32-100Hz

Beta 14-60Hz

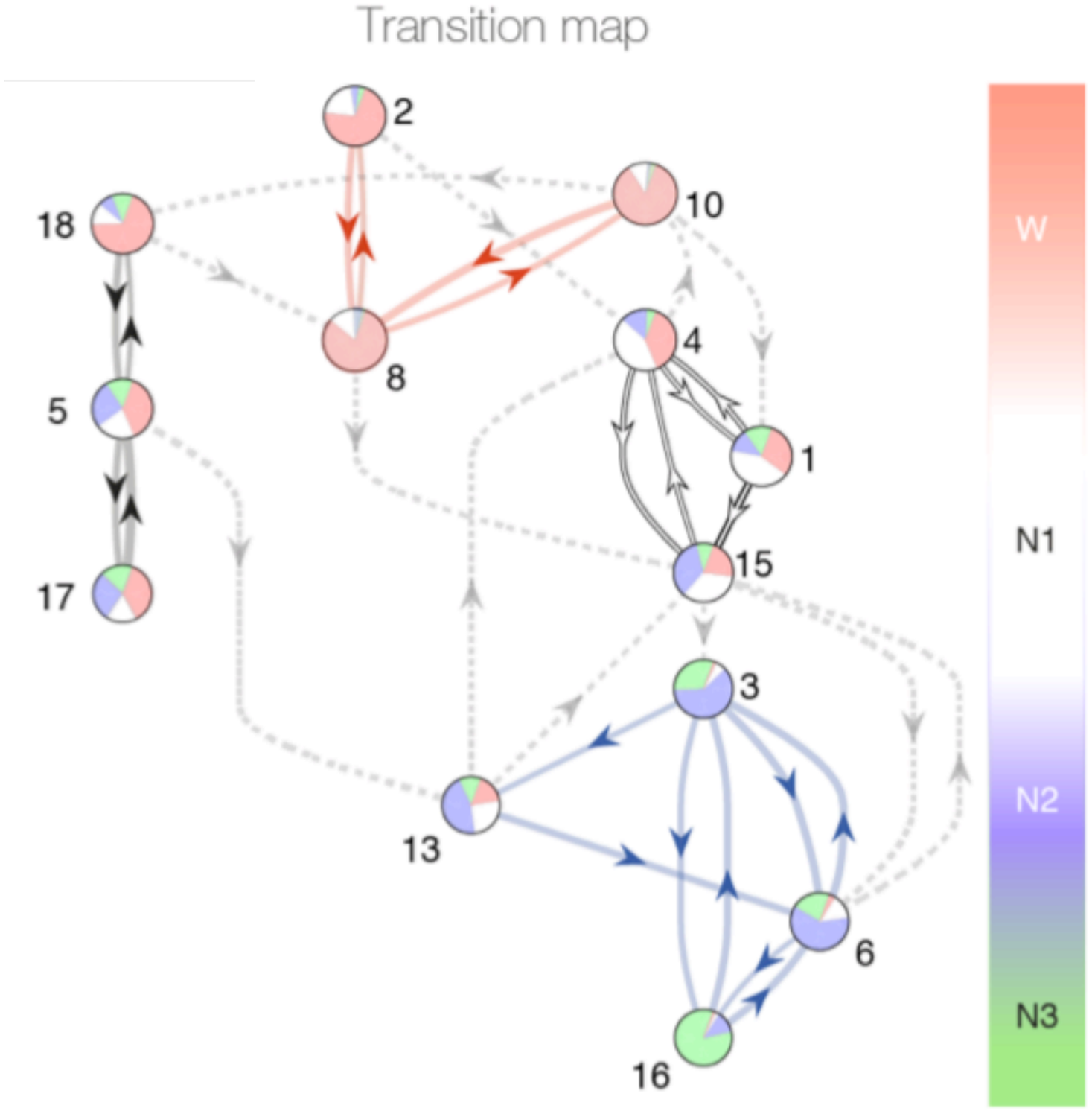
Alpha 8-12Hz to 30-50Hz

Theta 4-8Hz

Delta 0.5-3Hz

Rhythmic Domain

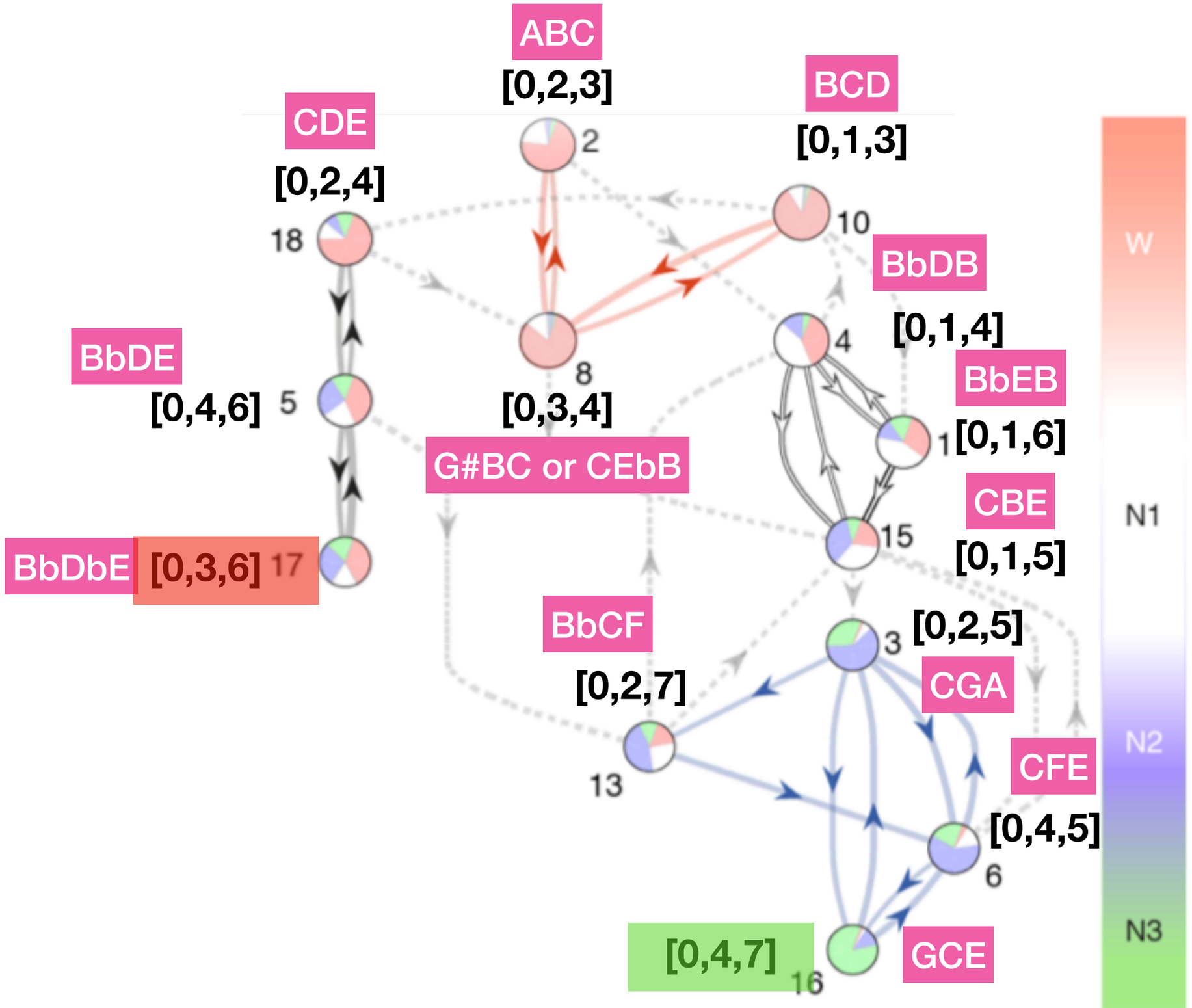
Network as Consonance/Dissonance Vectors


Transition map
2
10
18
8
4
5
1
15
17
3
13
6
16
W
N1
N2
N3

	0	1	2	3	4	5	6	7	8
3-1									
3-2a									
3-2b									
3-3a									
3-3b									
3-4a									
3-4b									
3-5a									
3-5b									
3-6									
3-7a									
3-7b									
3-8a									
3-8b									
3-9									
3-10									
3-11a									
3-11b									
3-12									

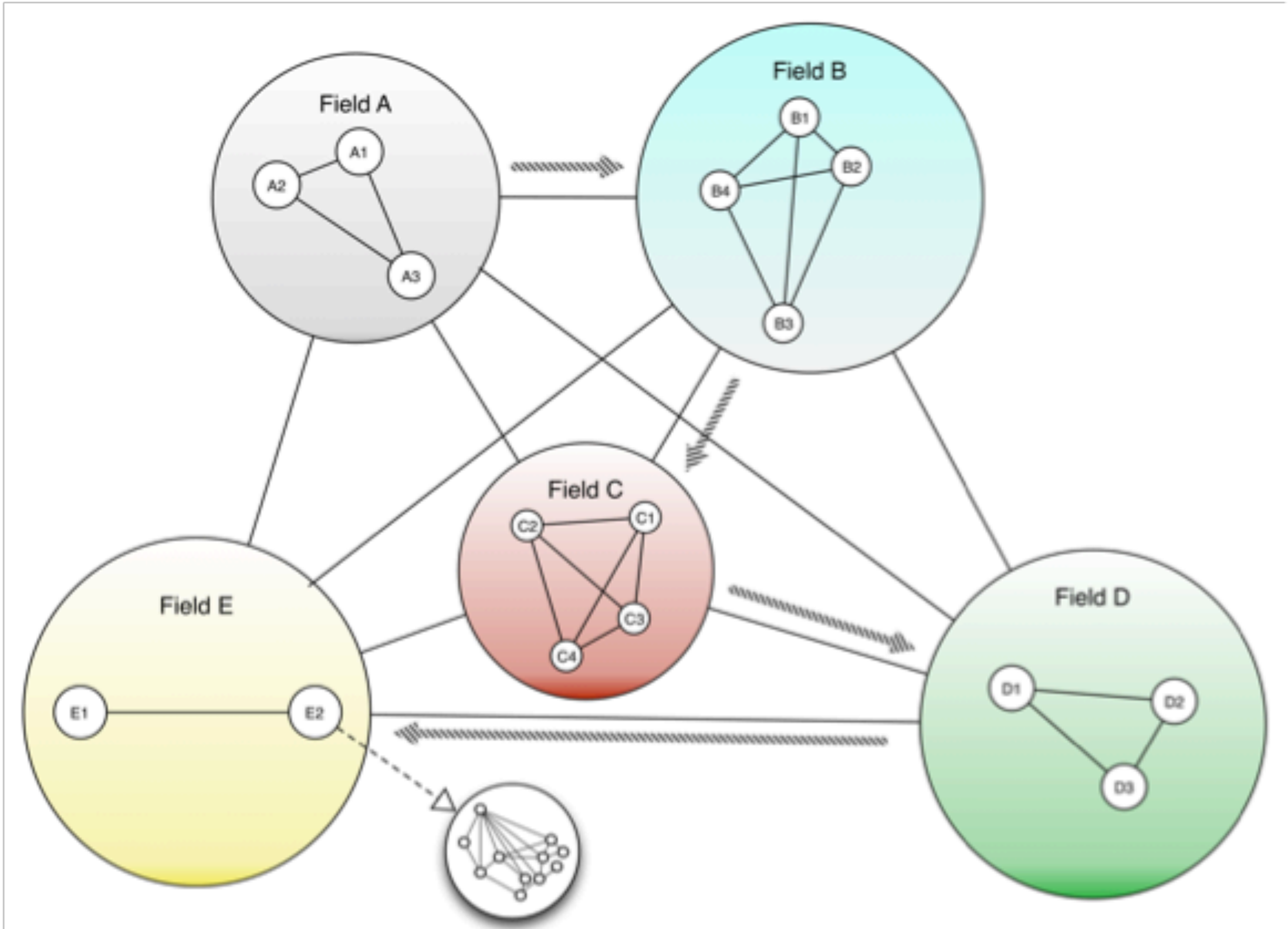
1	**3-1**	`[0,1,2]`	`<2,1,0,0,0,0>`	Cluster
2	**3-2A**	`[0,1,3]`	`<1,1,1,0,0,0>`	Soft Cluster A (Phrygian)
3	3-2B	`[0,2,3]`		Soft Cluster B (Aeolian)
4	**3-3A**	`[0,1,4]`	`<1,0,1,1,0,0>`	Hijaz A
5	3-3B	`[0,3,4]`		Hijaz B: Twilight
6	**3-4A**	`[0,1,5]`	`<1,0,0,1,1,0>`	Desert
7	3-4B	`[0,4,5]`		Sun
8	**3-5A**	`[0,1,6]`	`<1,0,0,0,1,1>`	Viennese A
9	3-5B	`[0,5,6]`		Viennese B
10	**3-6**	`[0,2,4]`	`<0,2,0,1,0,0>`	Whole Tone Cluster
11	**3-7A**	`[0,2,5]`	`<0,1,1,0,1,0>`	Blues trichord A (Soul)
12	3-7B	`[0,3,5]`		Blues trichord B (Trane)
13	**3-8A**	`[0,2,6]`	`<0,1,0,1,0,1>`	Italian 6th A
14	3-8B	`[0,4,6]`		Lydian
15	**3-9**	`[0,2,7]`	`<0,1,0,0,2,0>`	Sus chord
16	**3-10**	`[0,3,6]`	`<0,0,2,0,0,1>`	dim. chord
17	**3-11A**	`[0,3,7]`	`<0,0,1,1,1,0>`	minor chord
18	3-11B	`[0,4,7]`		major chord
19	**3-12**	`[0,4,8]`	`<0,0,0,3,0,0>`	Aug. chord

Trichord Interval Vectors



Trichord category and Interval Components

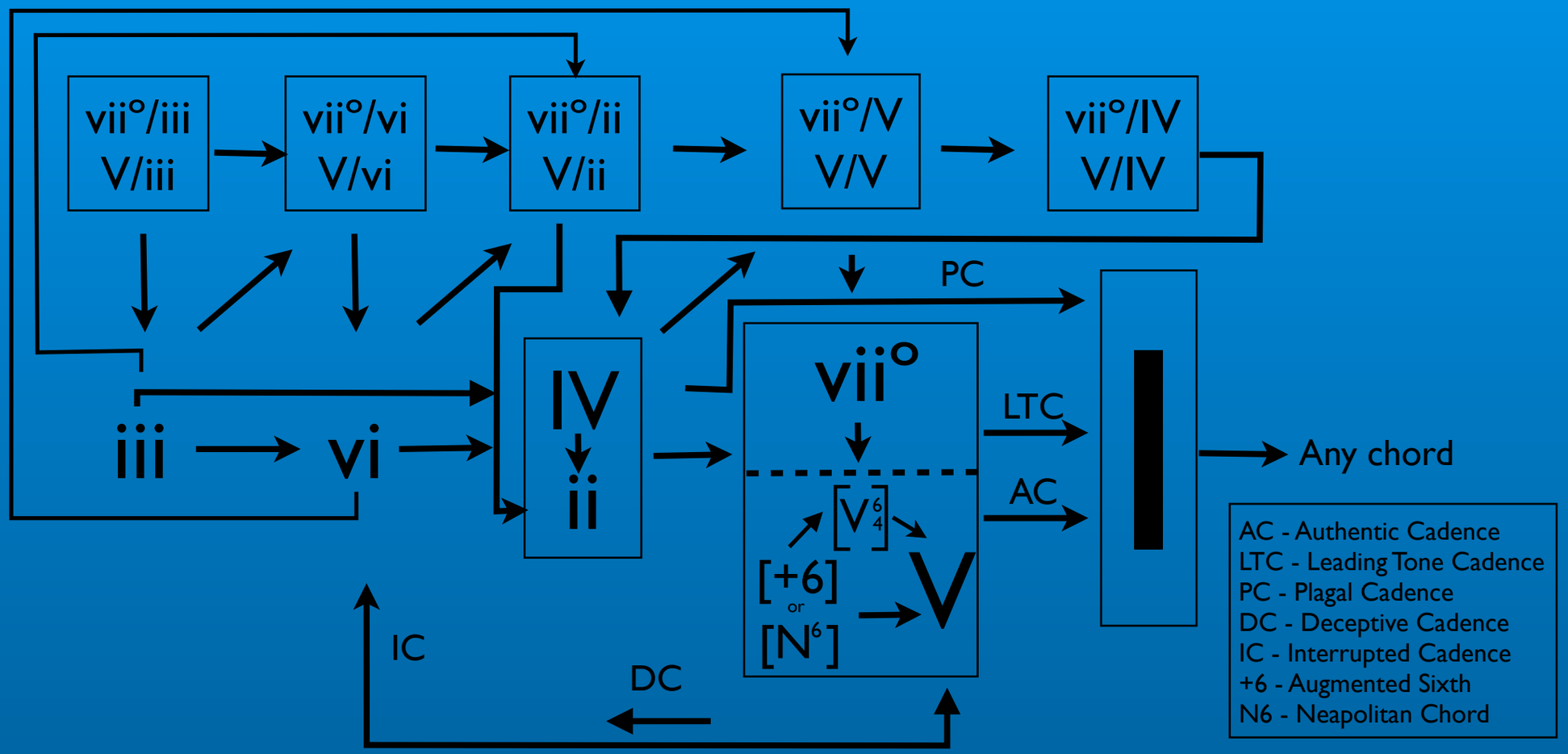
Network as Musical Proximity



Multi-level hierarchical units

Network as Harmonic Function

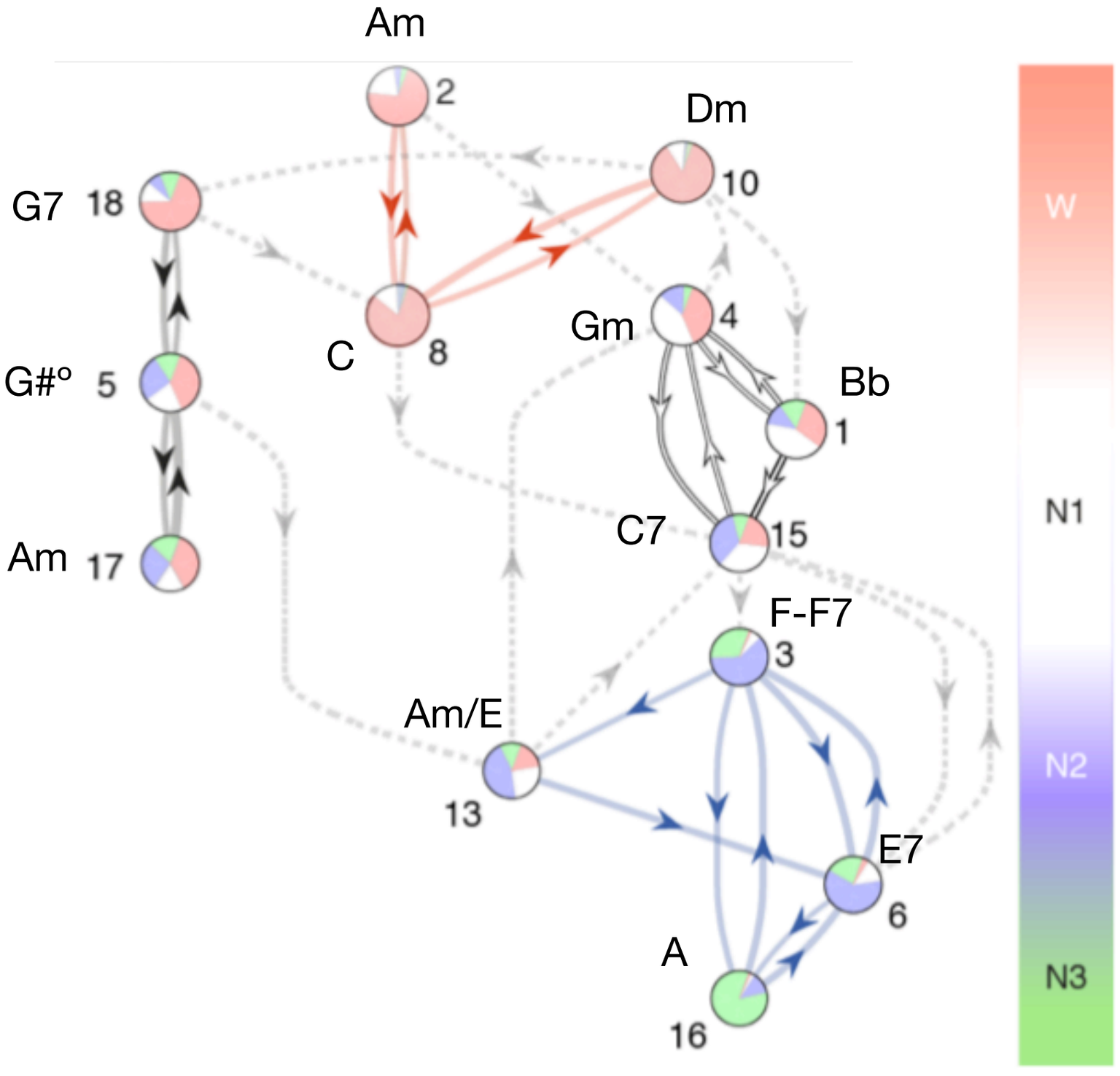
Tonal Harmony Flow Chart...
for Common Progressions in a Major Key



These triads (particularly V & vii°)may be freely extended to 7th chords

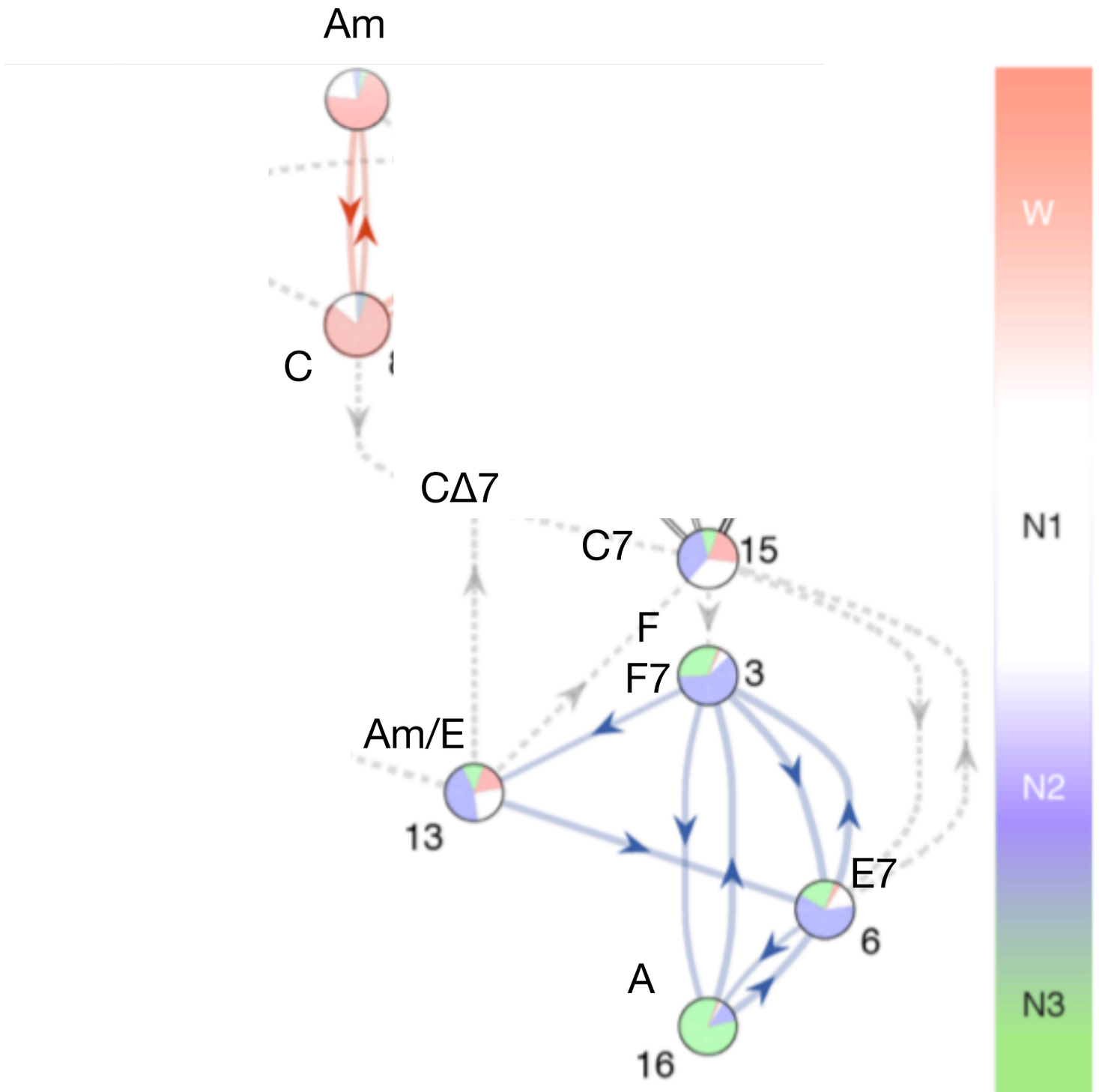
@miltonline

Tonal Devices



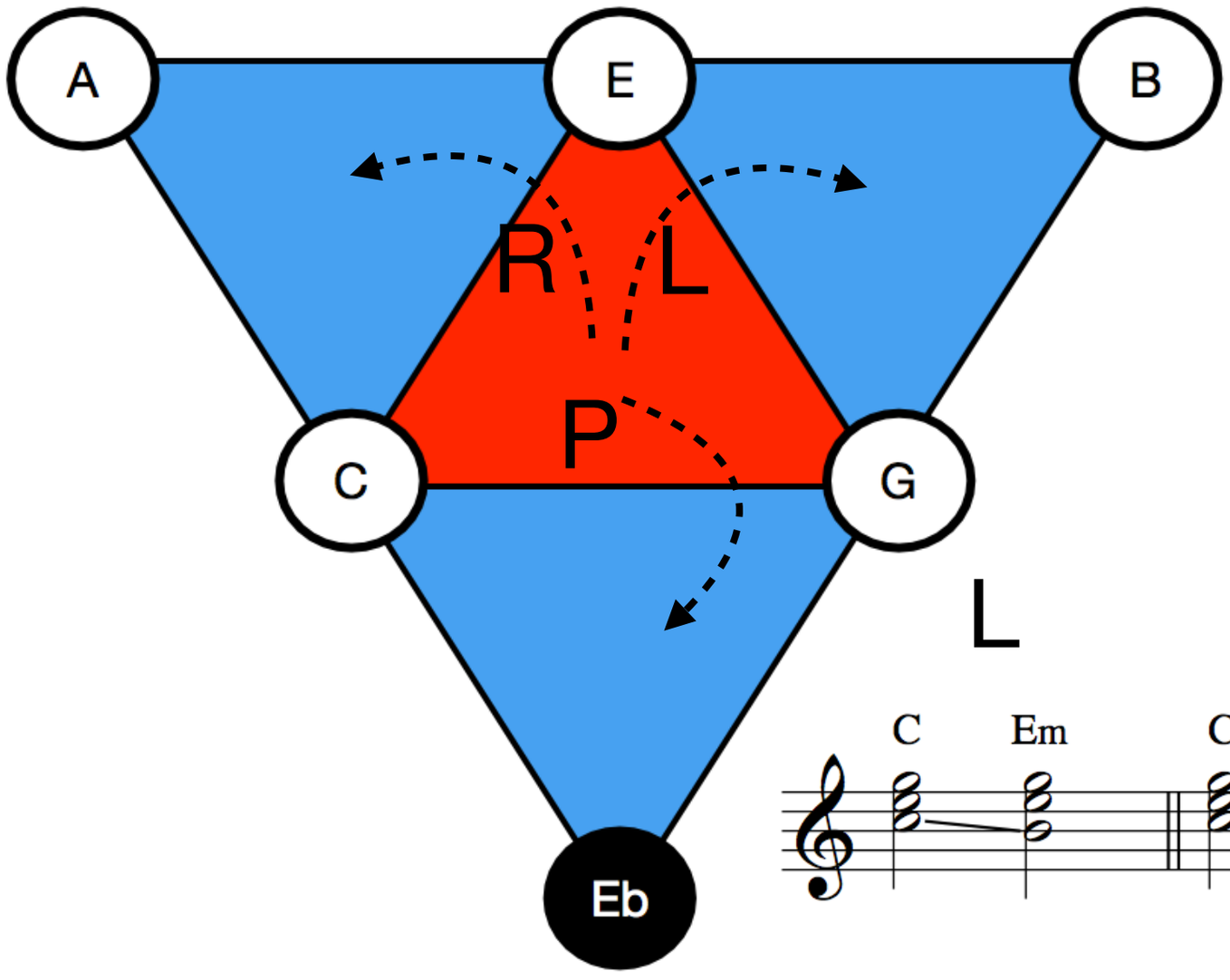
Harmonic Tonal Devices: key areas/directionality

Tonal Devices

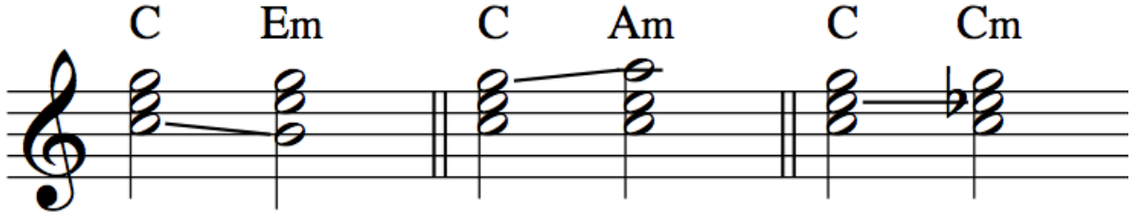


Harmonic Tonal Devices: key areas/directionality

Network as Harmonic Transformation



L R P



R

L

S

Eb Bb F C

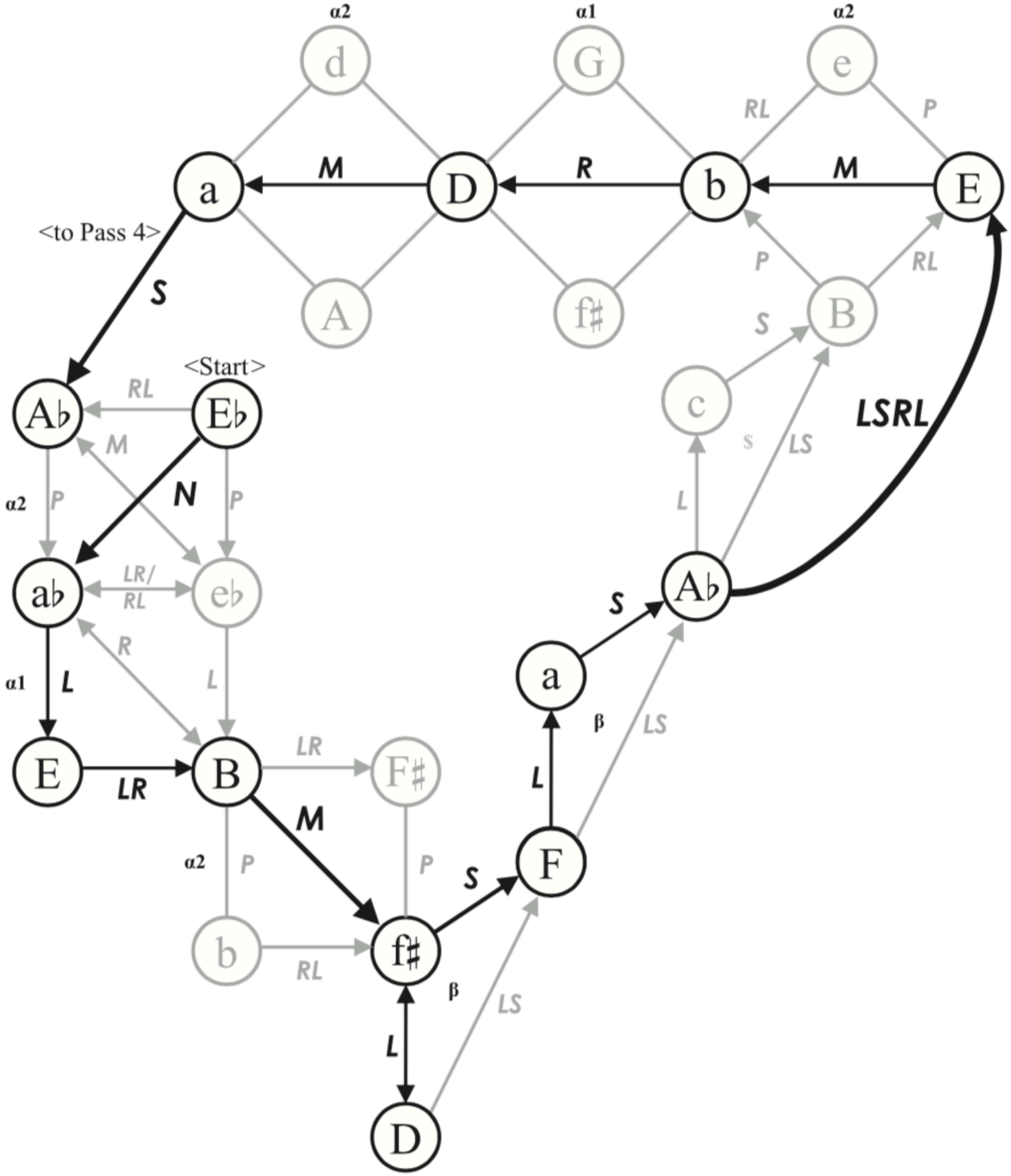
B F# C# G# D#

G D A E B

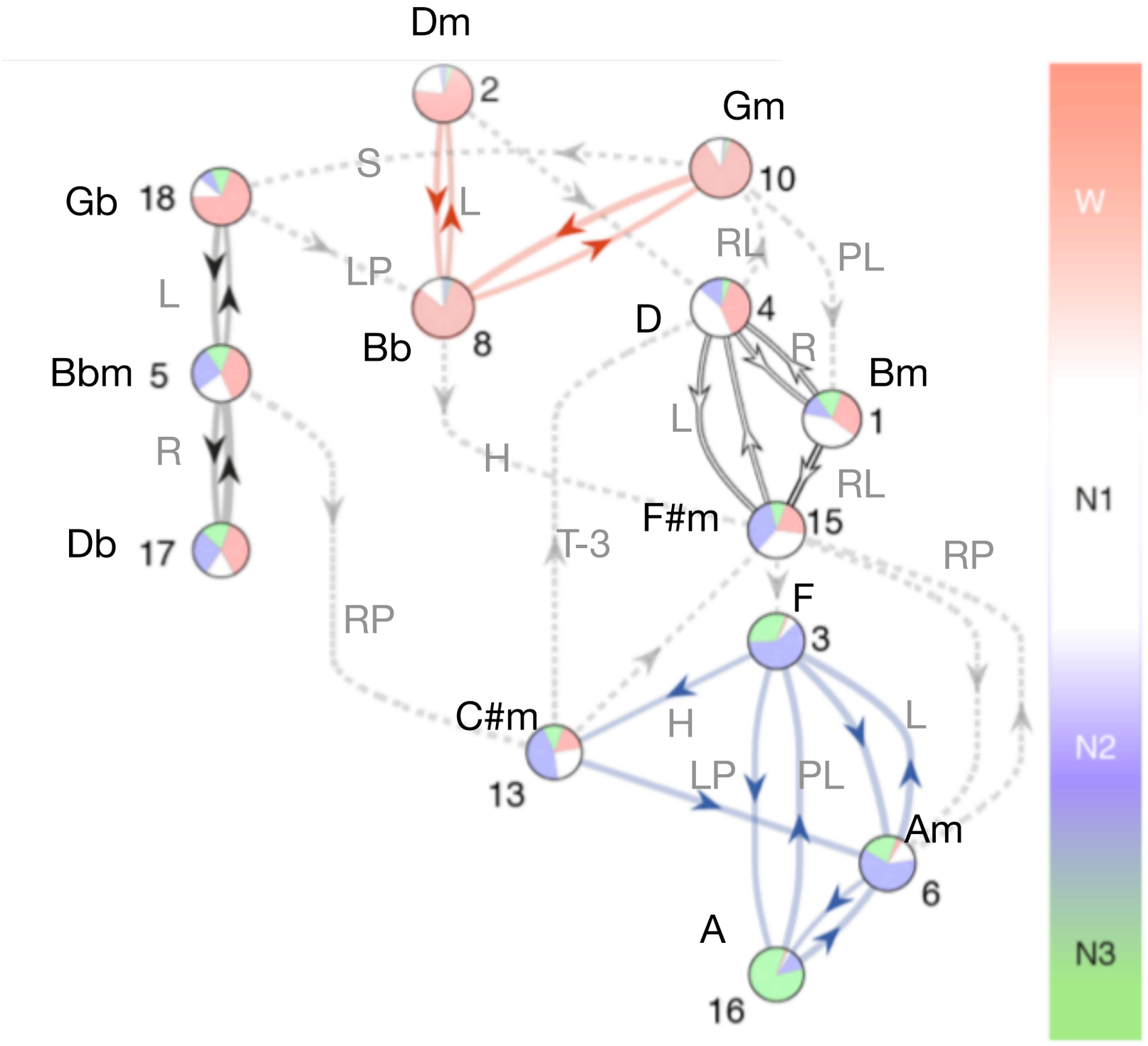
Eb Bb F C G D

B Gb Db Ab Eb Bb

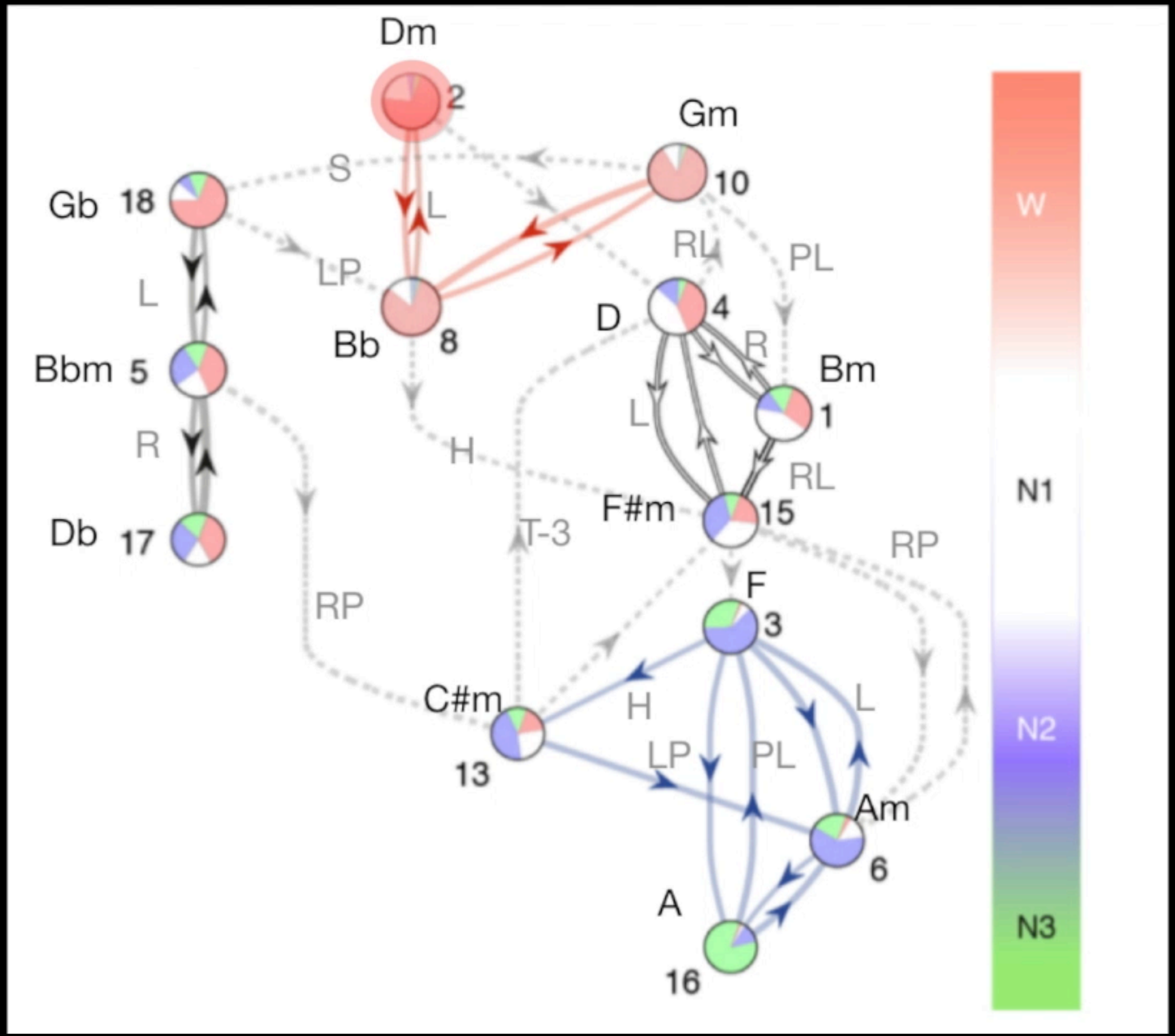
D A E B F# C#


α2
α1
α2
d
G
e
RL
P
a
M
D
R
b
M
E
<to Pass 4>
S
P
RL
A
f♯
S
B
<Start>
c
LSRL
RL
A♭
E♭
M
s
LS
α2
P
N
P
L
ab
LR/
RL
eb
S
A♭
R
α1
L
L
a
β
LS
E
LR
B
LR
F♯
L
LR
M
α2
P
P
S
F
b
RL
f♯
β
LS
L
D

Neo-Riemannian Transformational Network



Pathways denote
Number of common tones/intervallic proximity


Dm
2
Gm
10
Gb
18
S
L
LP
L
Bb
8
RL
PL
D
4
R
Bm
1
Bbm
5
R
H
L
RL
F#m
15
Db
17
T-3
RP
RP
F
3
C#m
13
H
L
LP
PL
Am
6
A
16
W
N1
N2
N3

CODA

Thanks