Automatic Scoring up of Parts in Mensural Notation

Martha E. Thomae, Julie E. Cumming, Ichiro Fujinaga

Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT)

McGill University

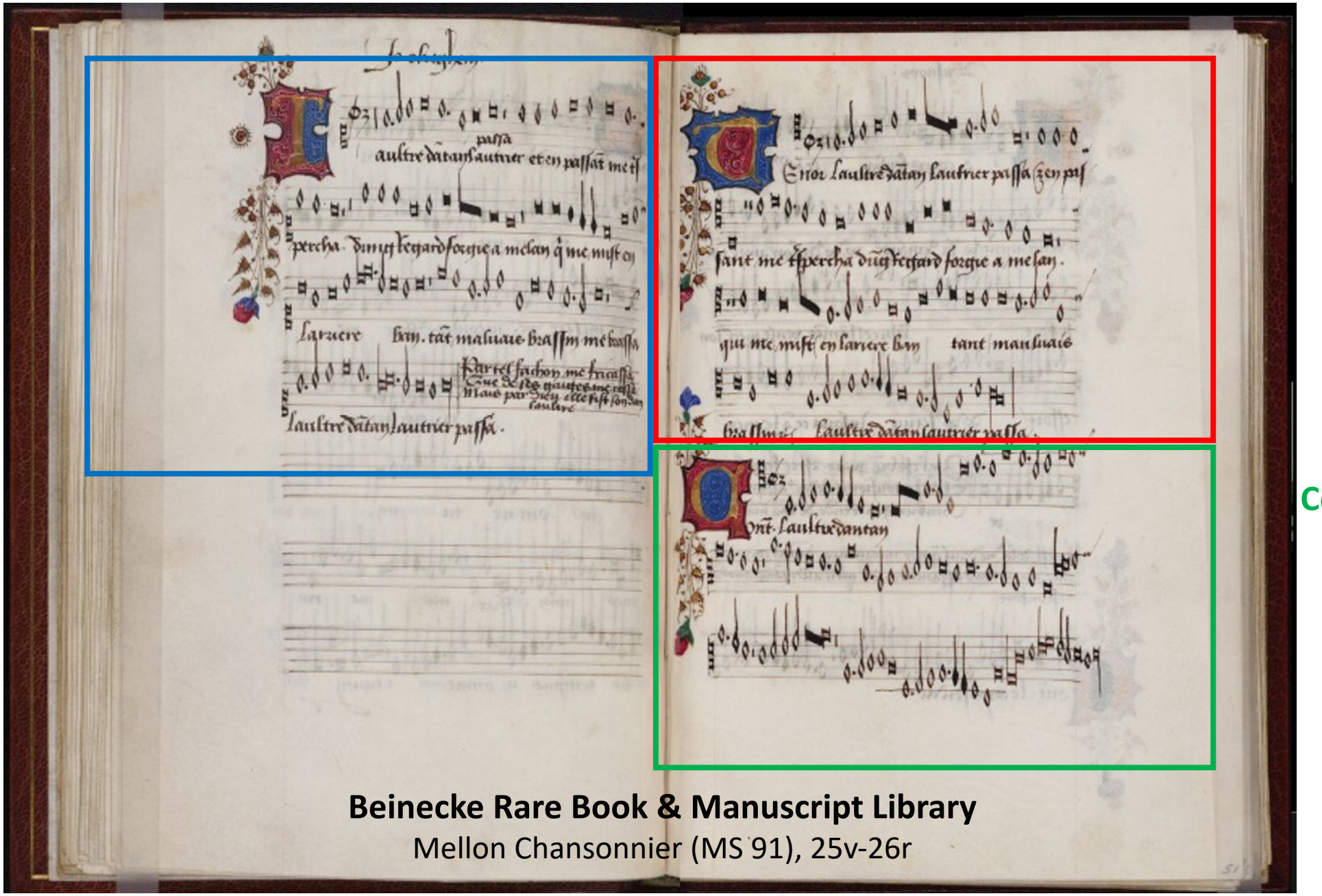
Medieval and Renaissance Music Conference

Maynooth, 06 July 2018

Superius

Tenor

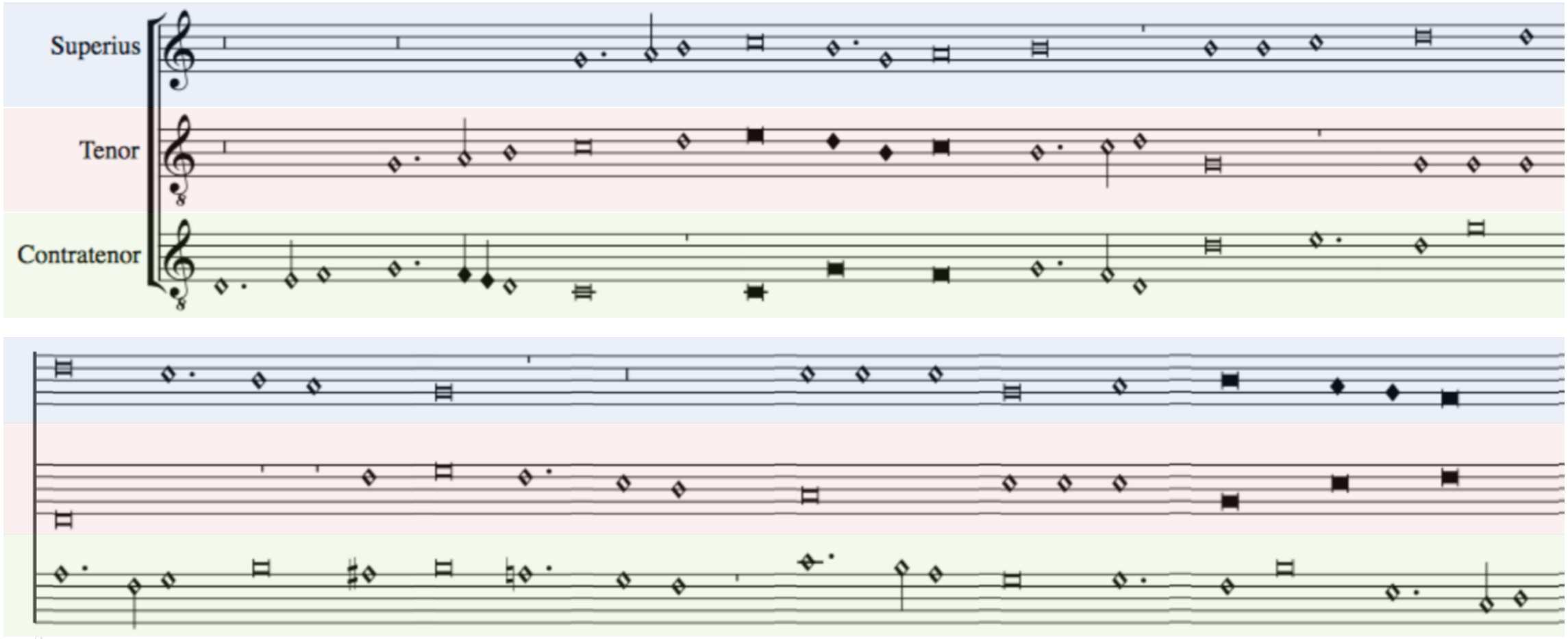
Contratenor



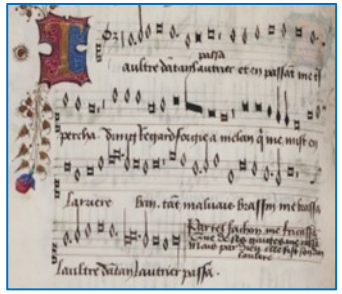
Beinecke Rare Book & Manuscript Library

Mellon Chansonnier (MS 91), 25v-26r

Scoring up

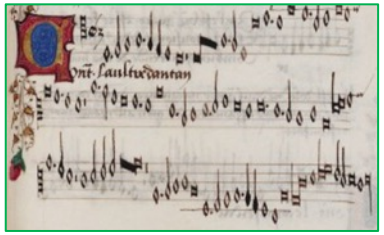


Scoring-up Tool



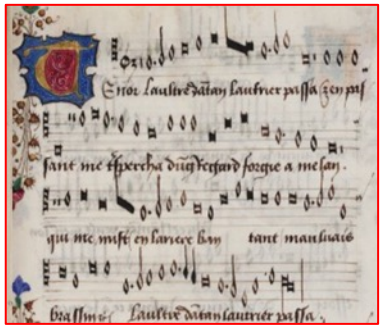
File 1

Superius part



File 2

Contratenor part



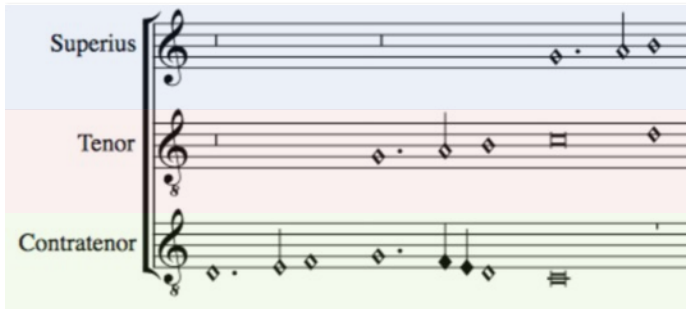
File 3

Tenor part

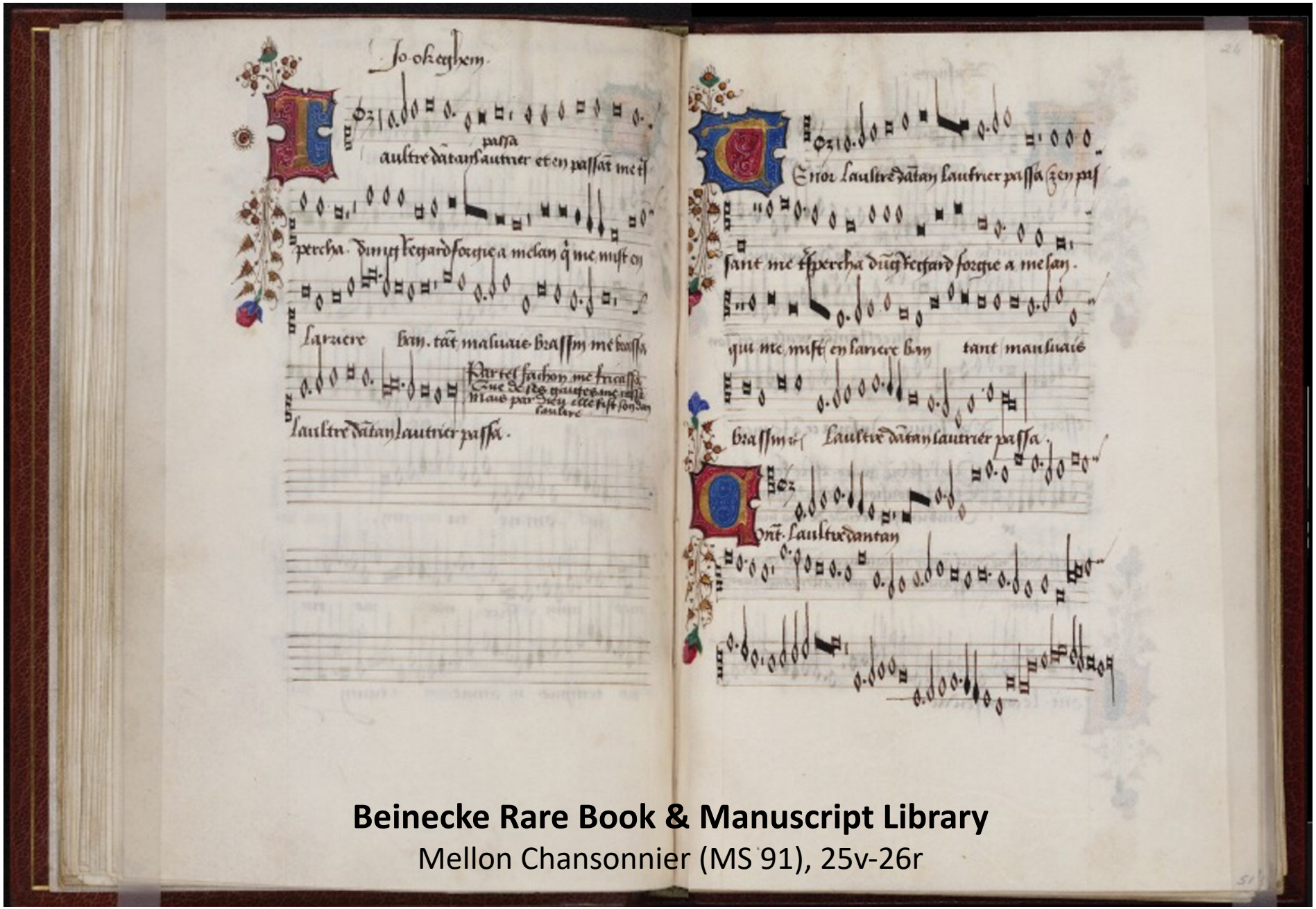
Scoring-up Tool

Output File

SCORE



Mensural Notation 101



Beinecke Rare Book & Manuscript Library
Mellon Chansonnier (MS 91), 25v-26r

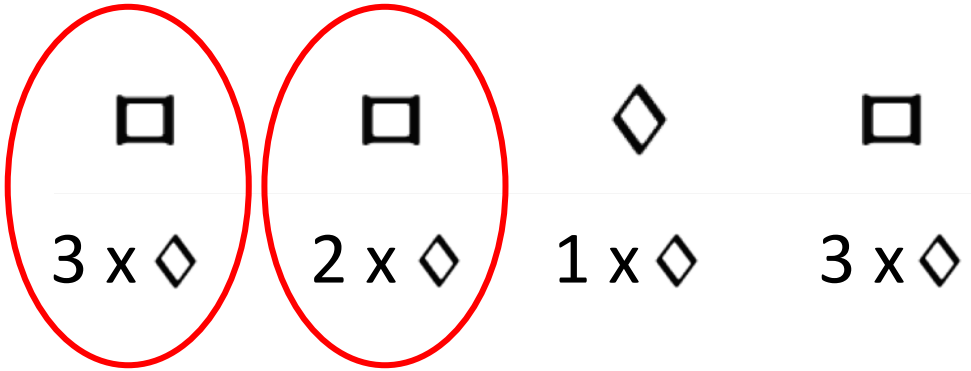
Mensural Notation

- There is a clear hierarchy in the note duration

longest

shortest

Notes		Values	
Name	Shape	Perfect	Imperfect
Maxima			
Long			
Breve			
Semibreve			



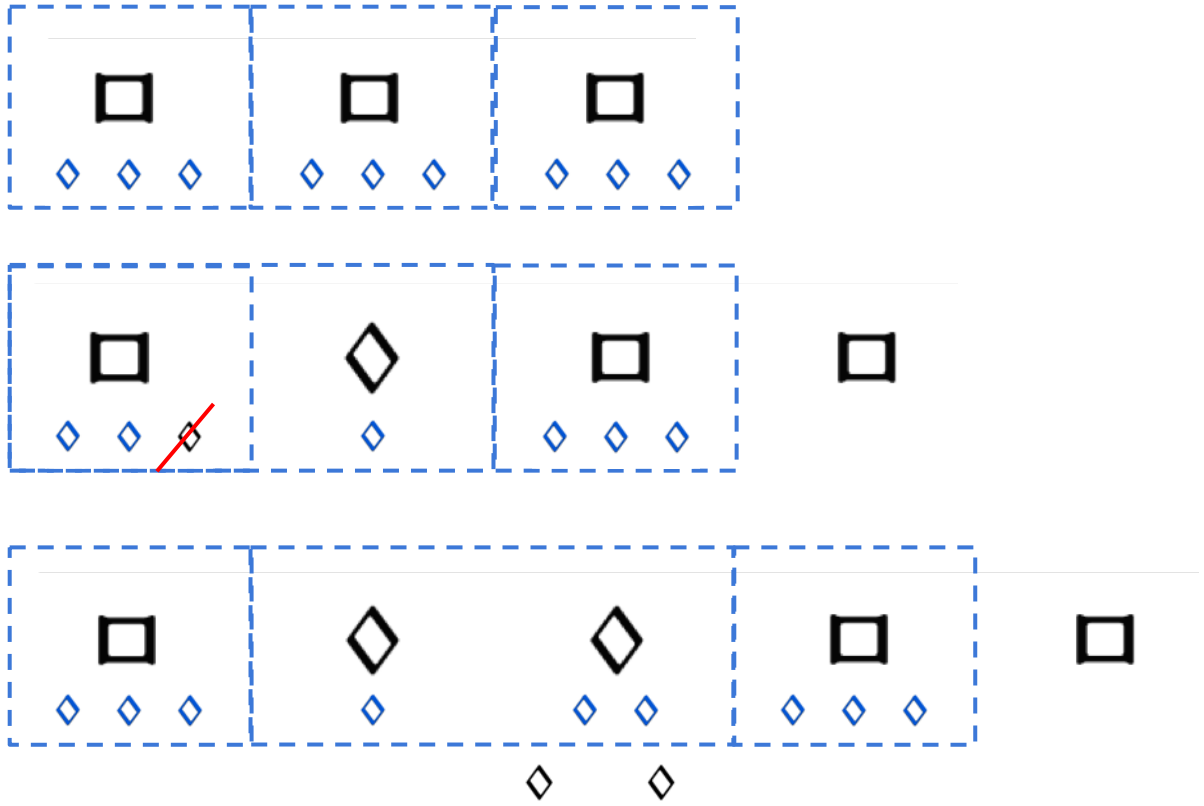
Mensuration

Establishes the relation between the note values (“perfect” or “imperfect”)

In **perfect mensurations**, the **duration** of the individual note symbols is not absolute, but rather depends on context

Examples of Context Changing the Note's Duration

Mensuration: Breve = 3 → Breves are perfect by default



Principles of Imperfection and Alteration

Imperfection
Perfect → Imperfect

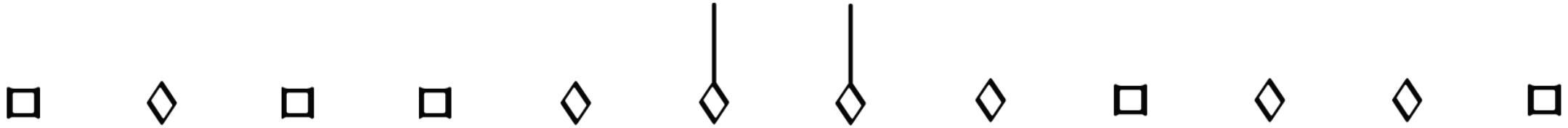
Alteration

Franco of Cologne
Ars Cantus Mensurabilis (ca. 1280)

The Scoring-up Tool

Algorithm

Mensuration: Breve = 3 → Breves are perfect by default



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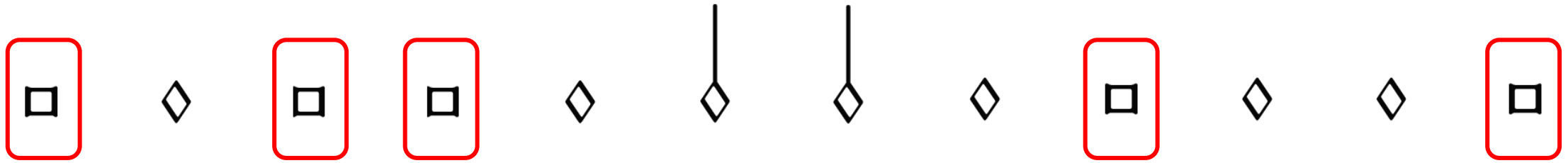

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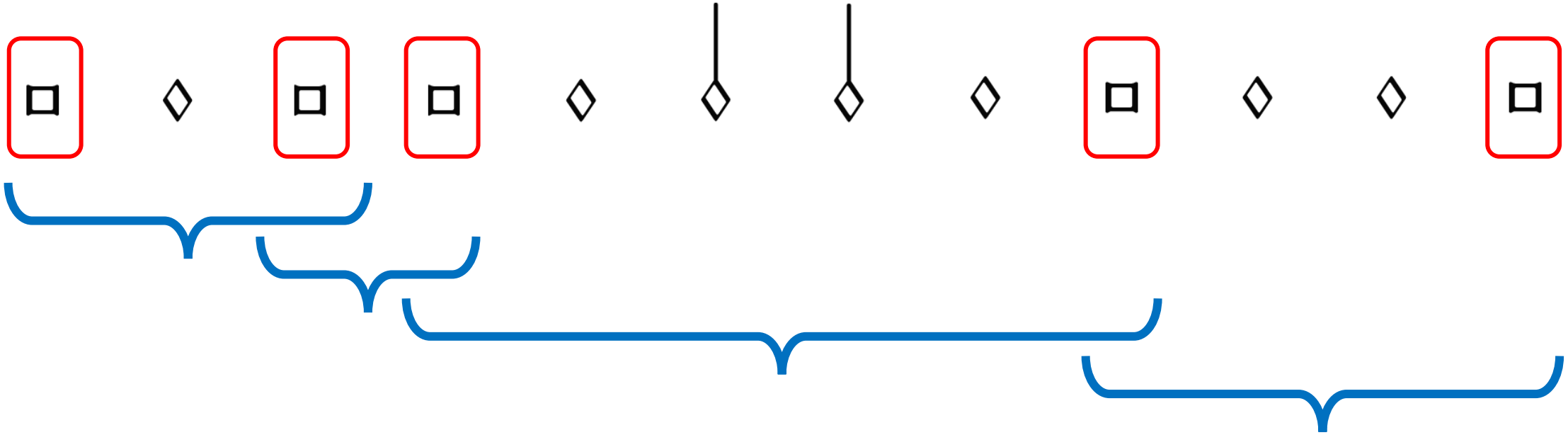
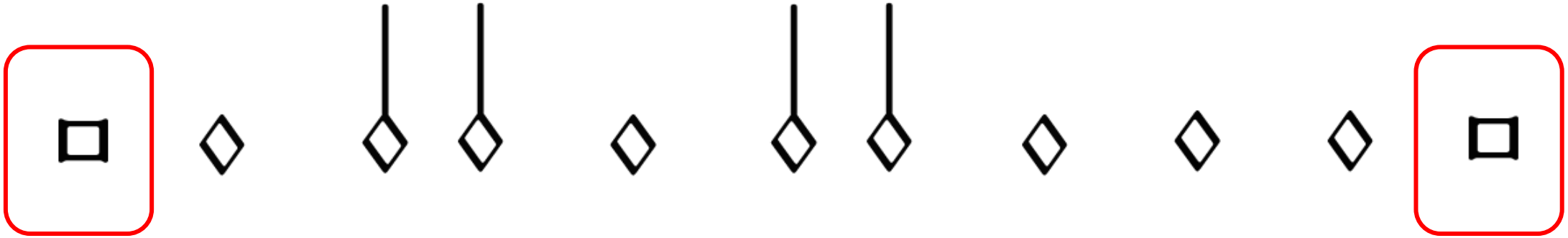


Example: (sequence bounded by breves)



Example in *perfect tempus and minor prolatio*

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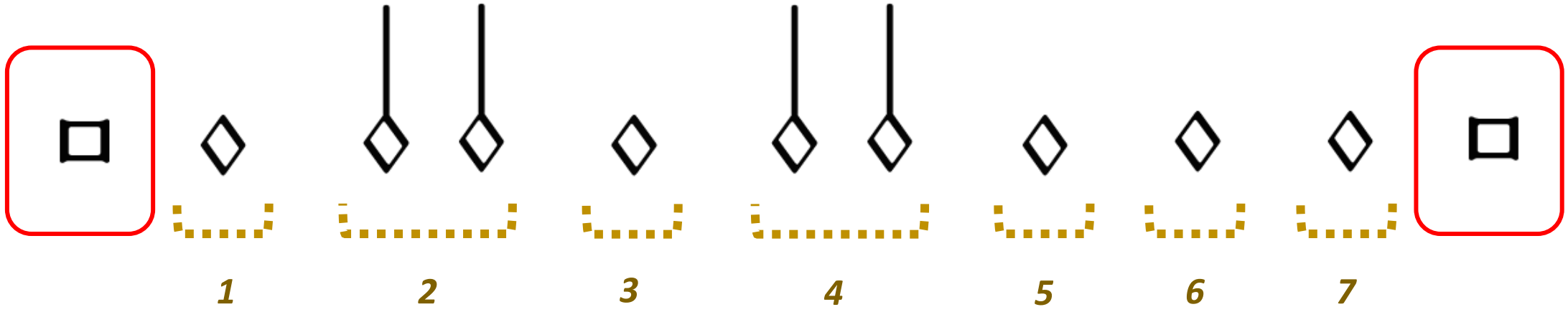

7 semibreves

Example in *perfect tempus and minor prolatio*

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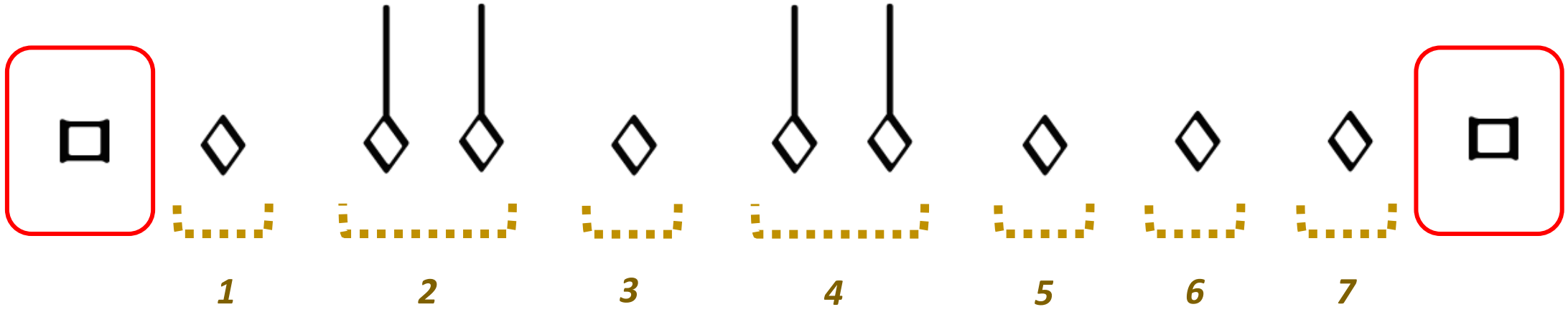

7 semibreves = Two groups of 3 semibreves + 1

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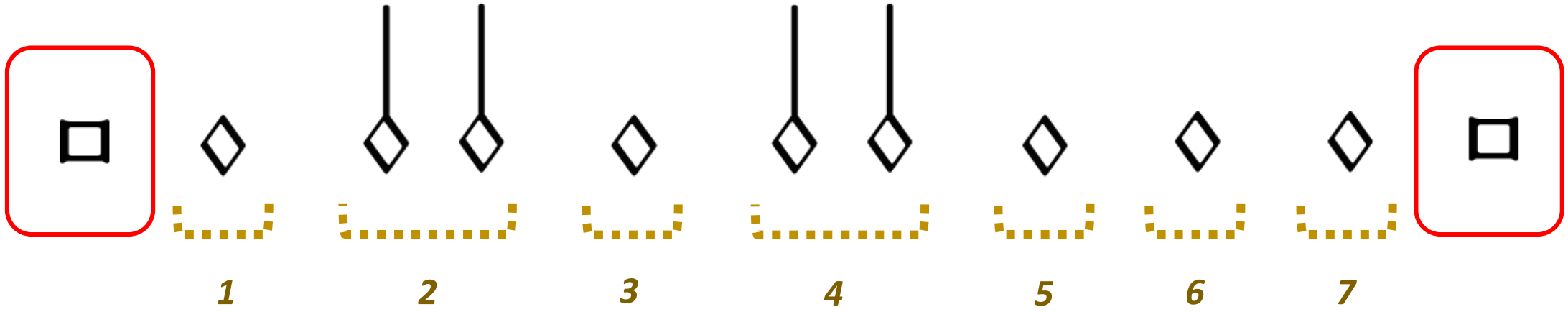

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Example in *perfect tempus and minor prolatio*

Number N of semibreves between the boundaries	Number P of perfect groups of semibreves	General Interpretation	Alternative Interpretation
N = 3P + 1	P >= 0	Imperfection (by following)	Imperfection (by preceding)
N = 3P + 2	P = 0	Alteration	Imperfection (by following) & Imperfection (by preceding)
	P > 0	Imperfection (by following) & Imperfection (by preceding)	Alteration
N = 3P	P = 0	-	-
	P = 1		Imperfection (by following) & Alteration
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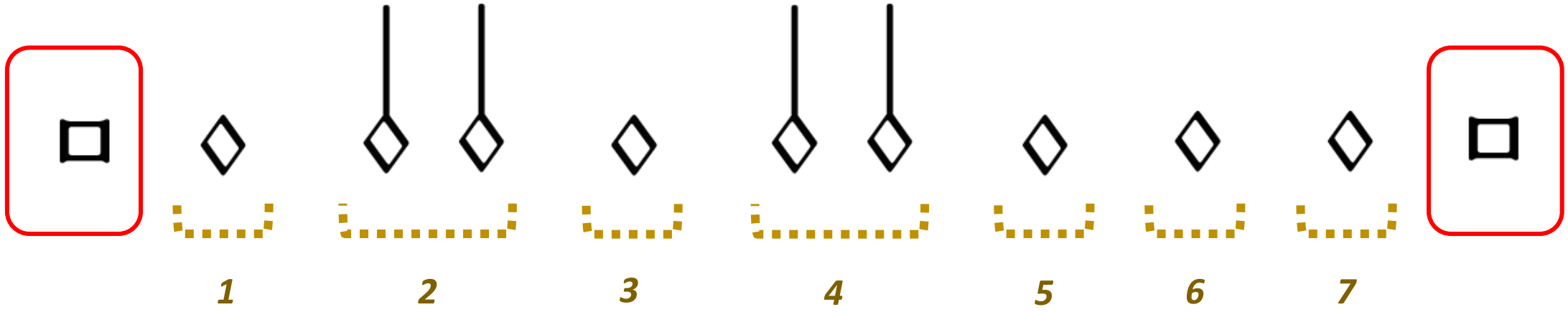

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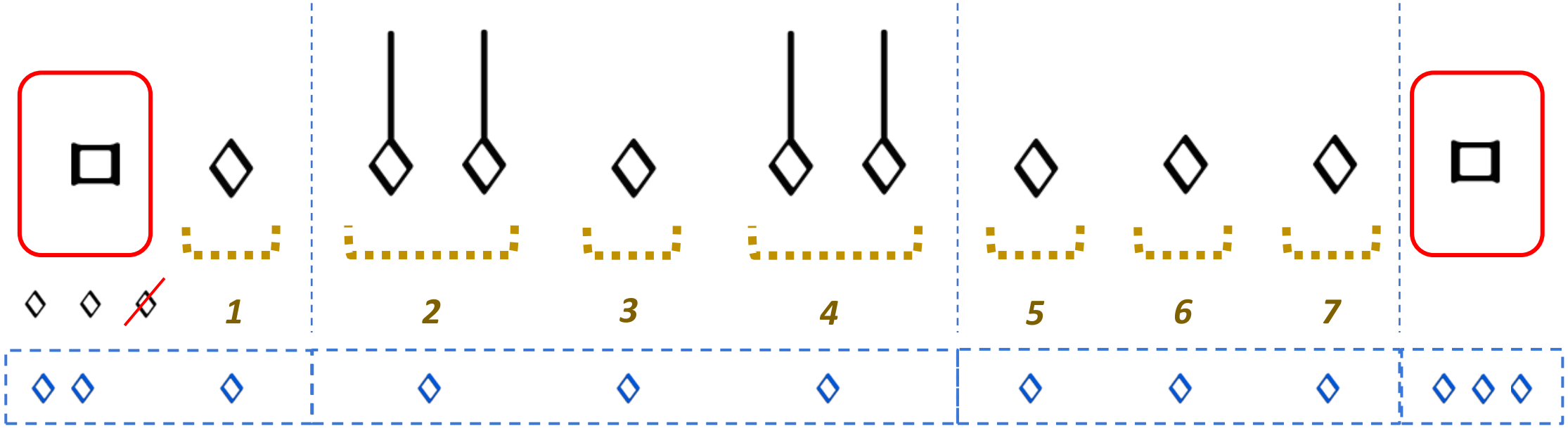

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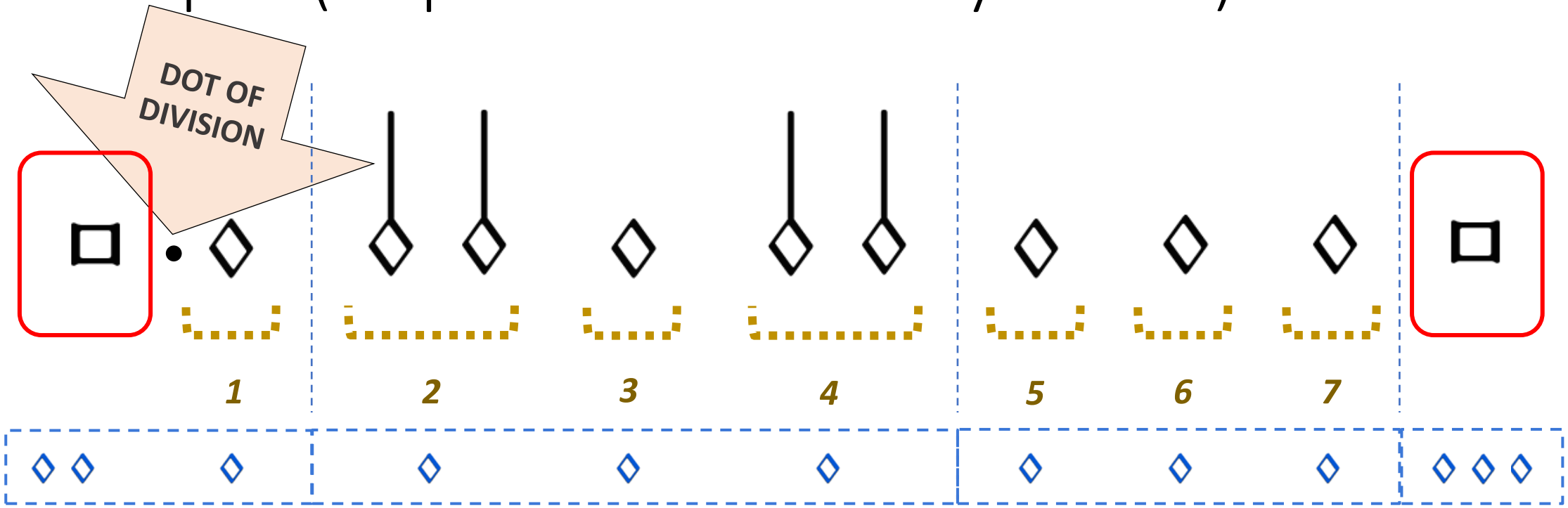

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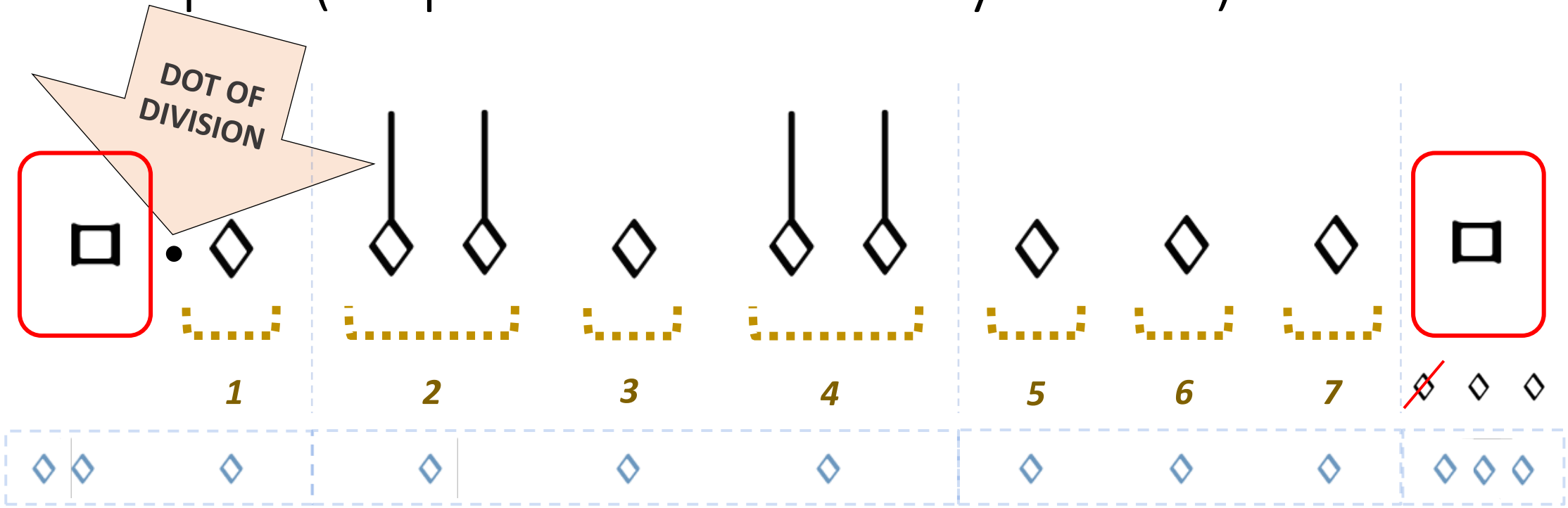

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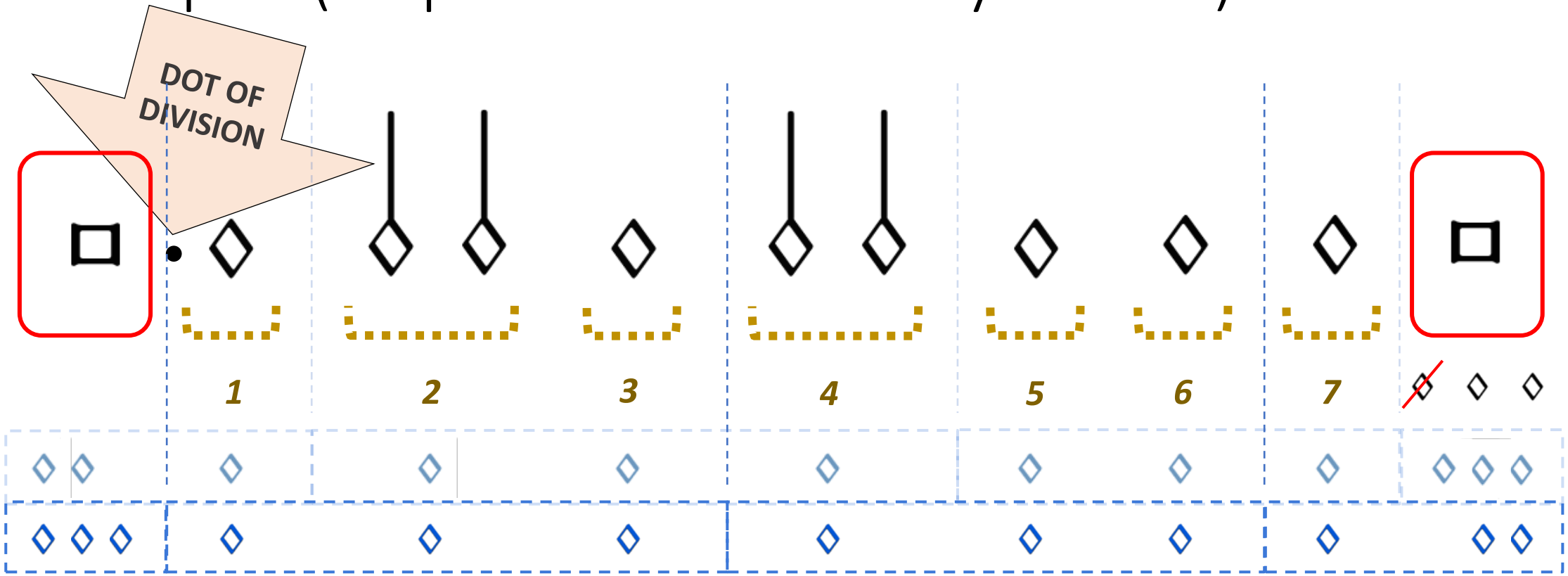
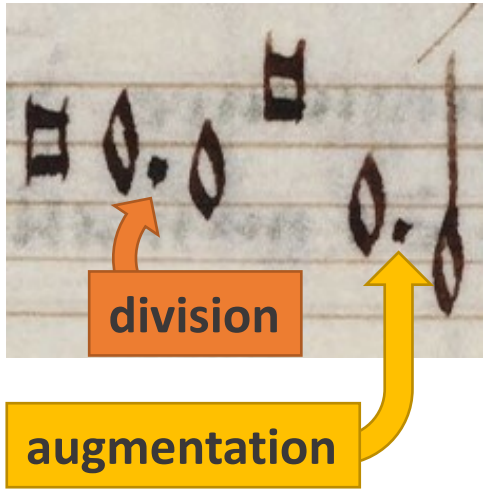


7 semibreves = Two groups of 3 semibreves + 1

Example in *perfect tempus and minor prolatio*

Scoring-up Tool

- Deals with the context-dependent nature of mensural notation
  - By implementing the “principles of imperfection and alteration”
- Deals with other non-context-related features:
  - Dots of augmentation → **When?** Distinguish between “dots of division” and “dots of augmentation”
  - Coloration



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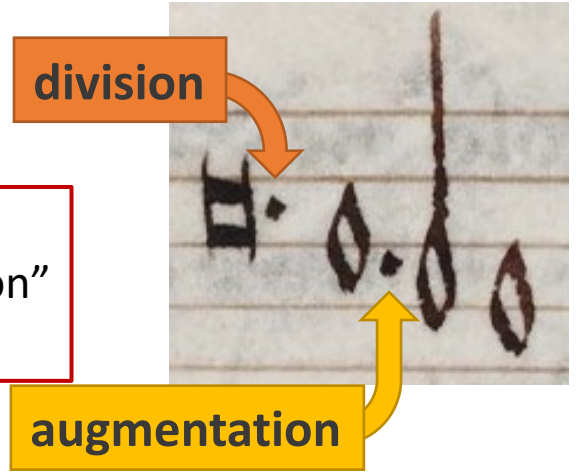

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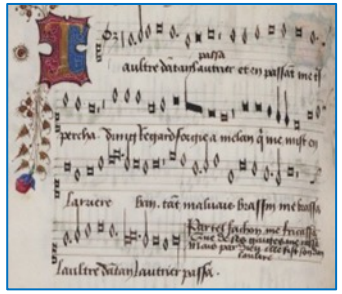
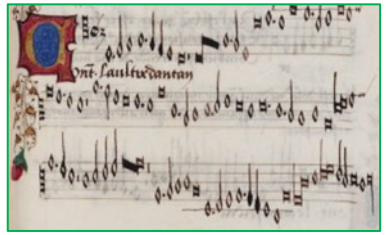
  - Dots of augmentation → **When?** Distinguish between “dots of division” and “dots of augmentation”
  - Coloration → **When does coloration affect the note value?**

Scoring-up Tool



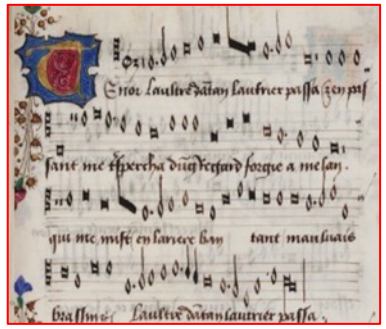
Mensural MEI file

Superius part



Mensural MEI file

Contratenor part



Mensural MEI file

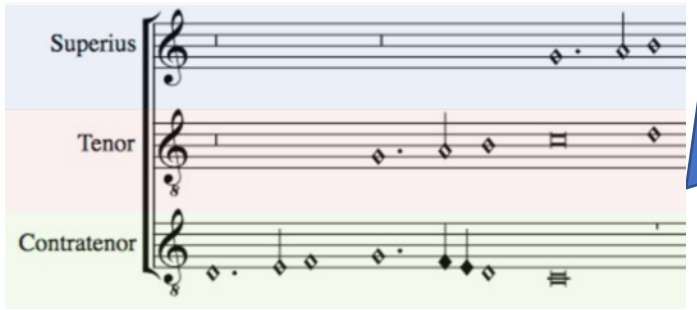
Tenor part

Scoring-up Tool

Mensural MEI file

SCORE

Verovio



Data used for the Experiment

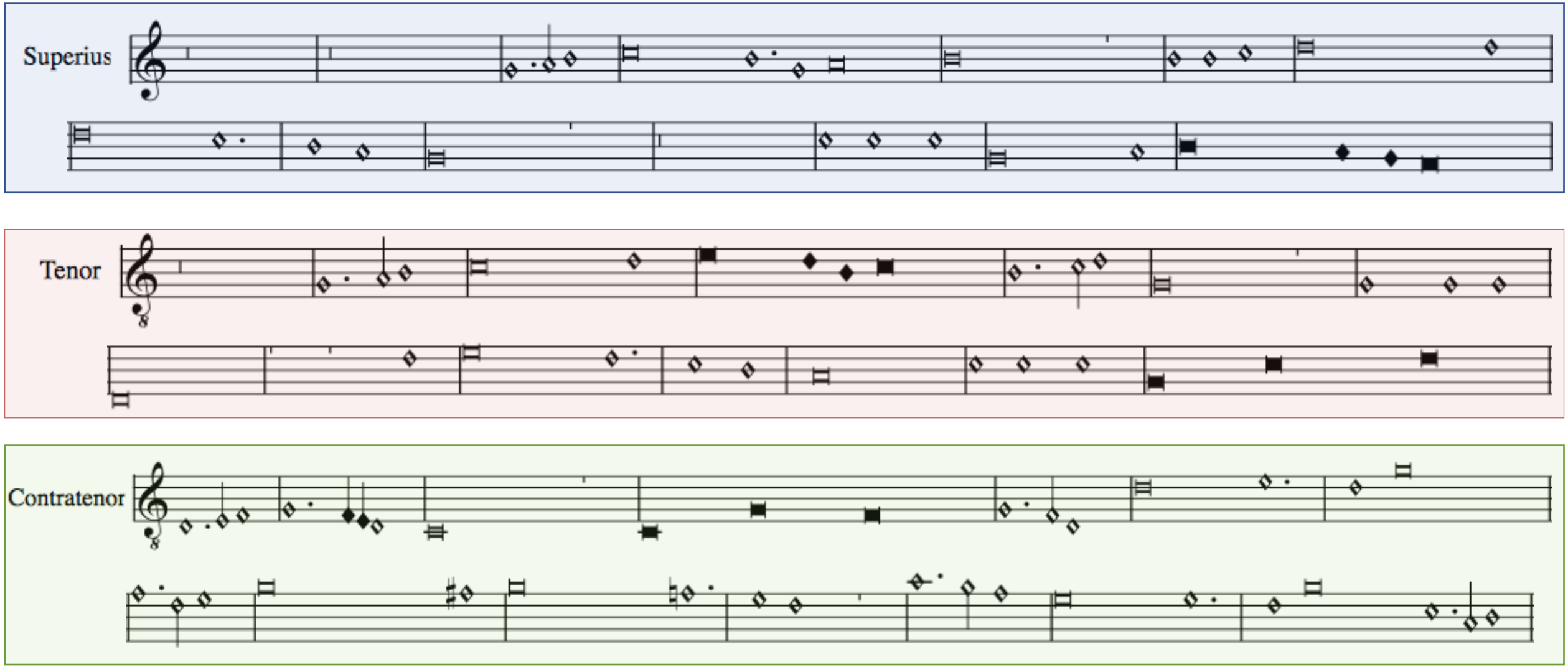
Pieces from the XIV and XV Centuries

Century	Project	Format	Composers and Sources	Number of Pieces
XIV	Measuring Polyphony Project (Karen Desmond http://measuringpolyphony.org)	Mensural MEI	Vitry, Machaut, Anonymous (Ivrea Codex)	8
XV	Josquin Research Project (Jesse Rodin, Craig Sapp, Clare Bokulich)	Modern transcriptions converted into Mensural MEI using: *SibMEI + Mensural MEI Translator*	Du Fay and Ockeghem (GB-Ob, Dijon, Mellon, Laborde, Wolfenbüttel)	Du Fay: 5 Ockeghem: 5

Results

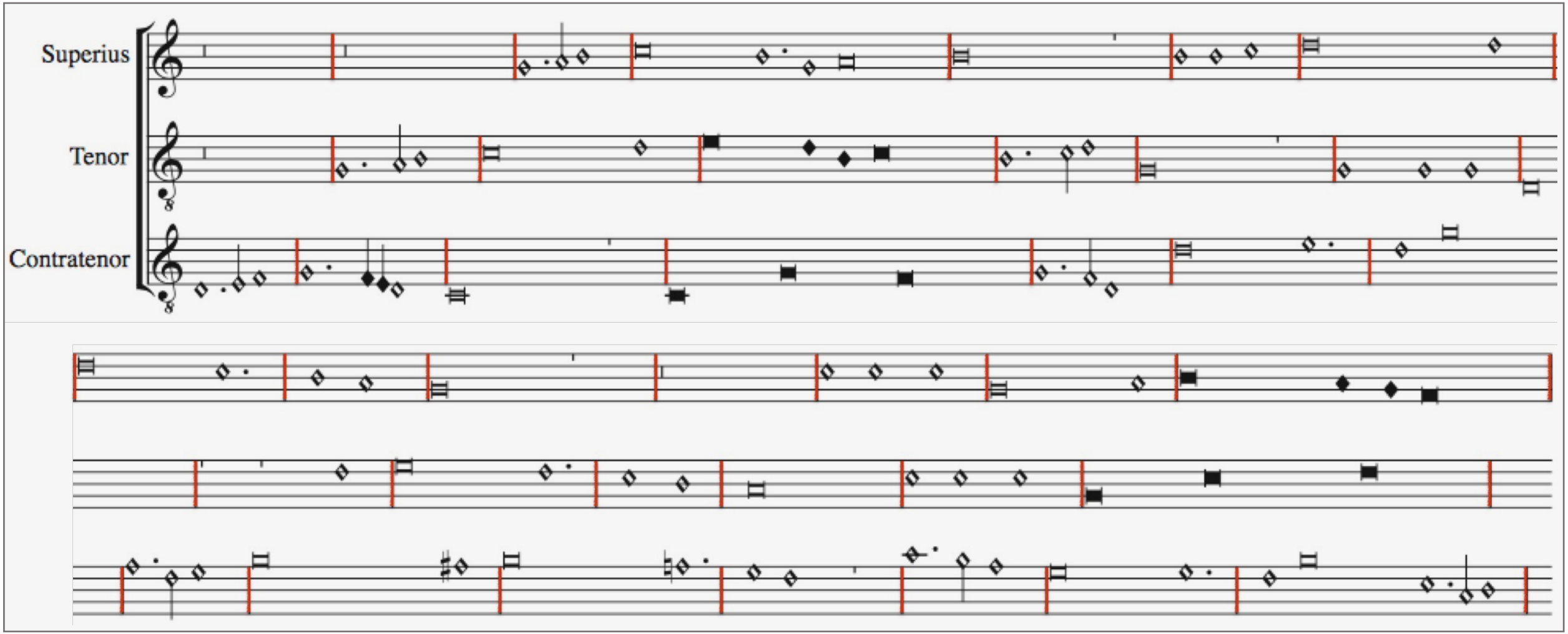
- Accuracy: 98%
- Only 55 mislabeled notes out of 2866 notes of ambiguous duration
- Most common source of error: absence of the dot of division

Example: Three Separate Parts

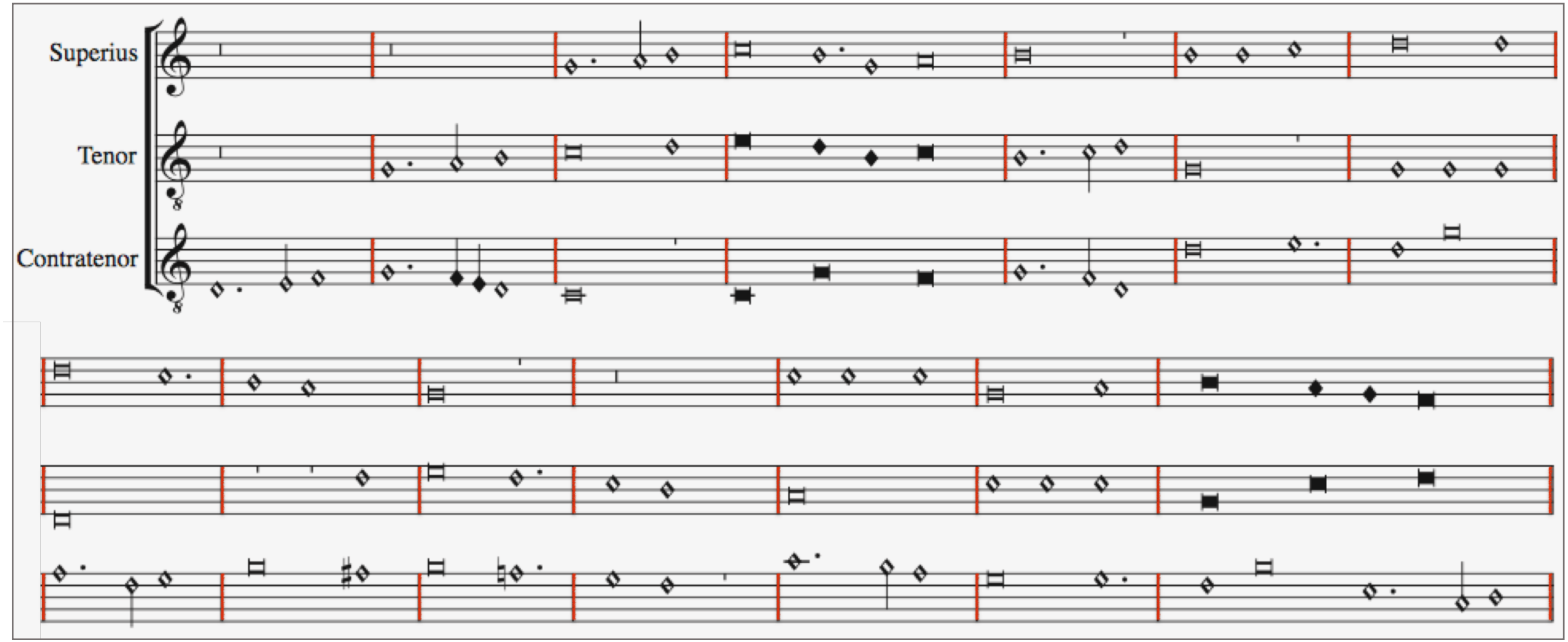


In Quasi-Score Format – Without Scoring-up Tool

(notes are not aligned)



In Score Format – With Scoring-up Tool
(modification values encoded)



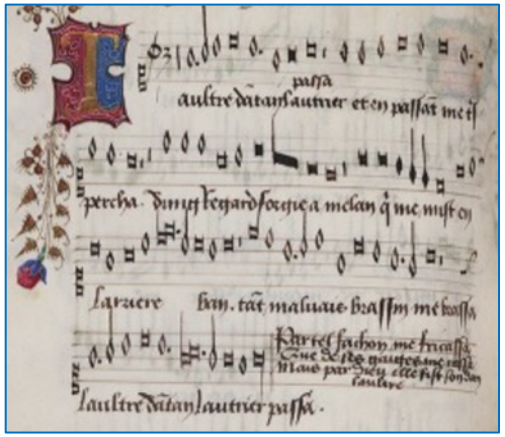
Conclusions

- Preserves the original note values
- The scoring-up tool presents the piece in score format
- Facilitates visualizing the vertical sonorities and studying the relation between the voices of a piece

Future work

Optical Music Recognition (OMR)

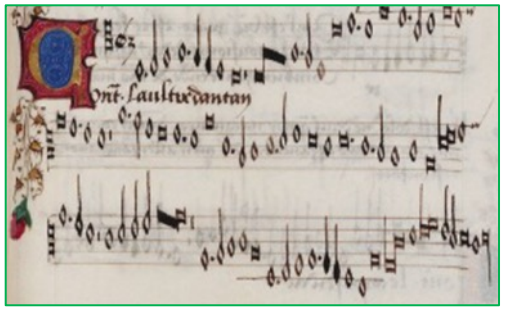
- Similar to Optical Character Recognition (OCR)



OMR

Mensural MEI file

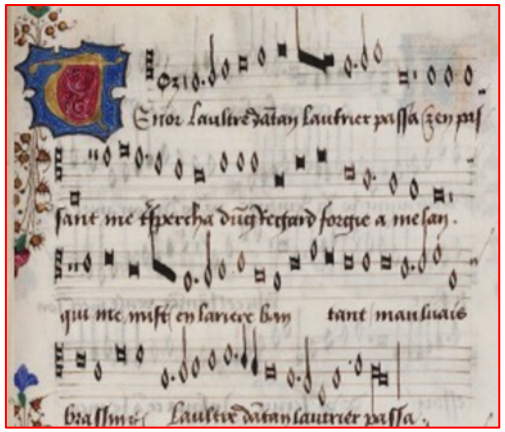
Superius part



OMR

Mensural MEI file

Contratenor part

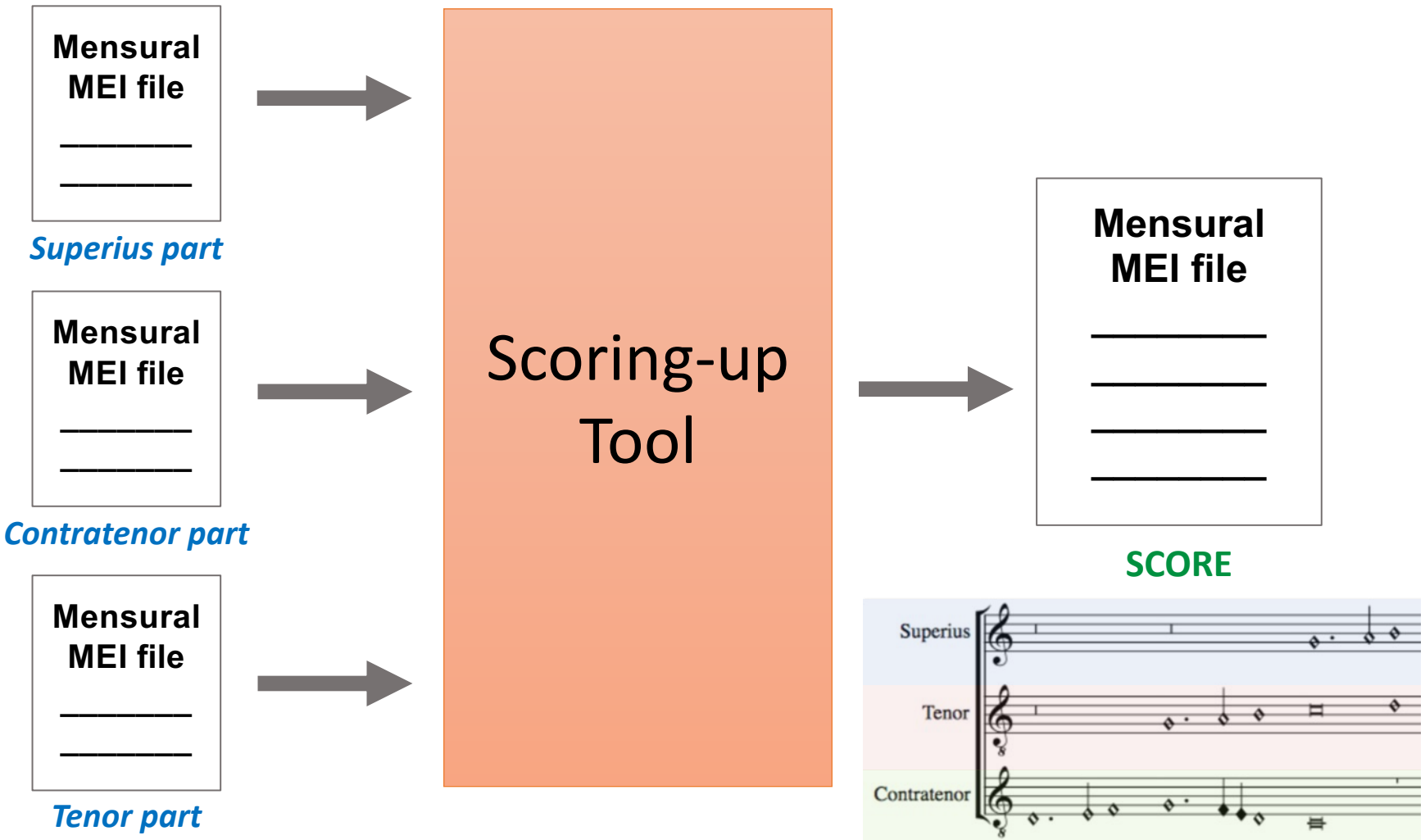


OMR

Mensural MEI file

Tenor part

Future work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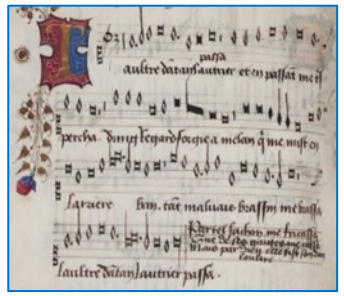
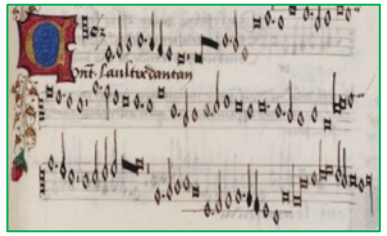


OMR

Mensural MEI file

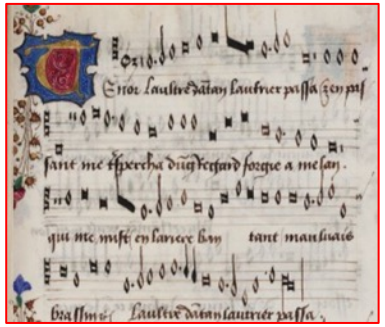
Superius part



OMR

Mensural MEI file

Contratenor part



OMR

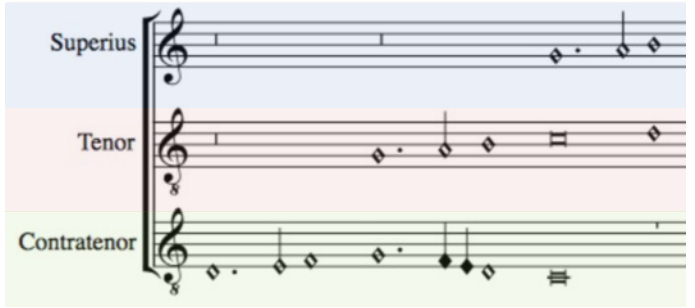
Mensural MEI file

Tenor part

Scoring-up Tool

Mensural MEI file

SCORE



Thank you!

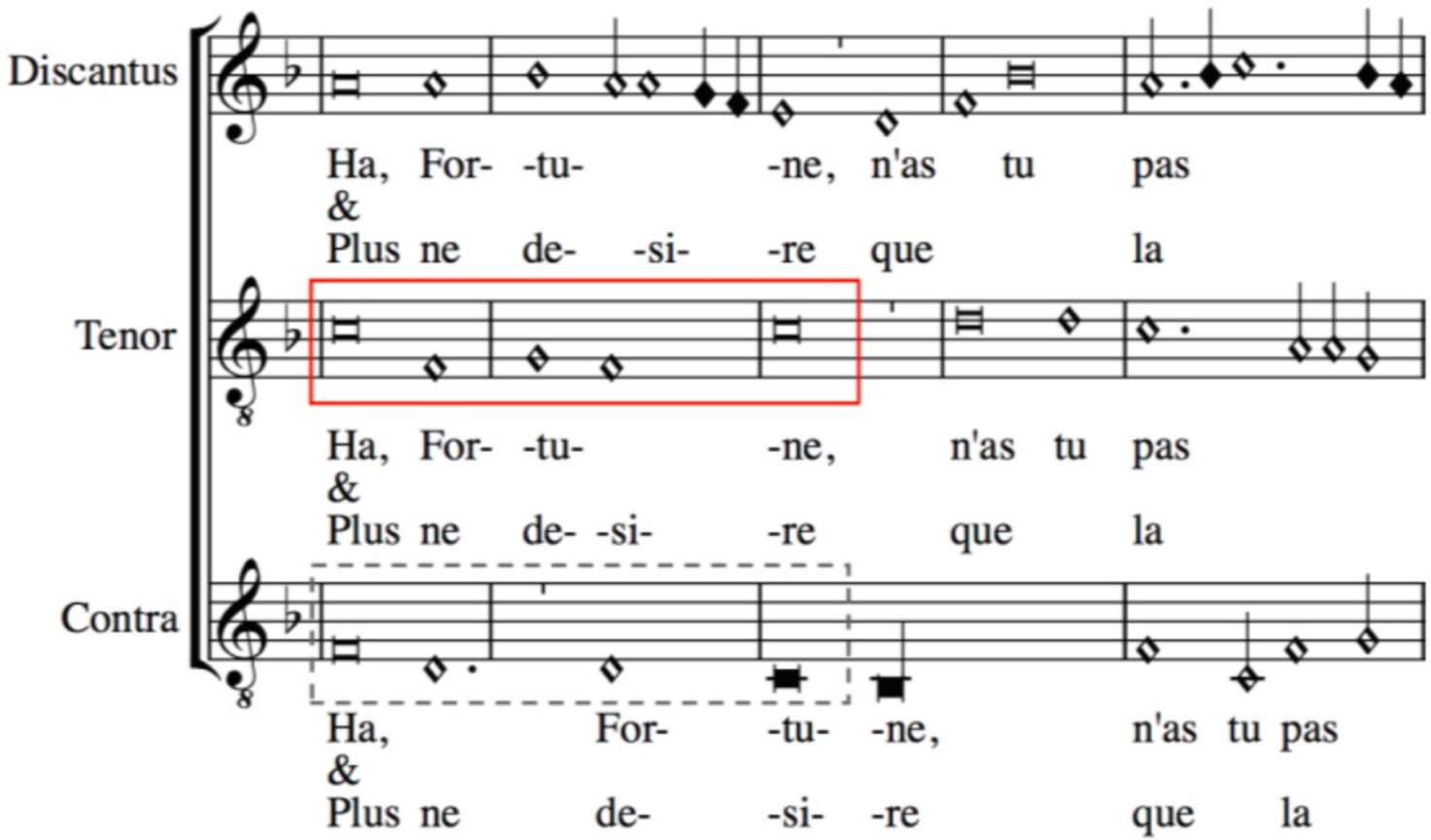
martha.thomaeelias@mail.mcgill.ca

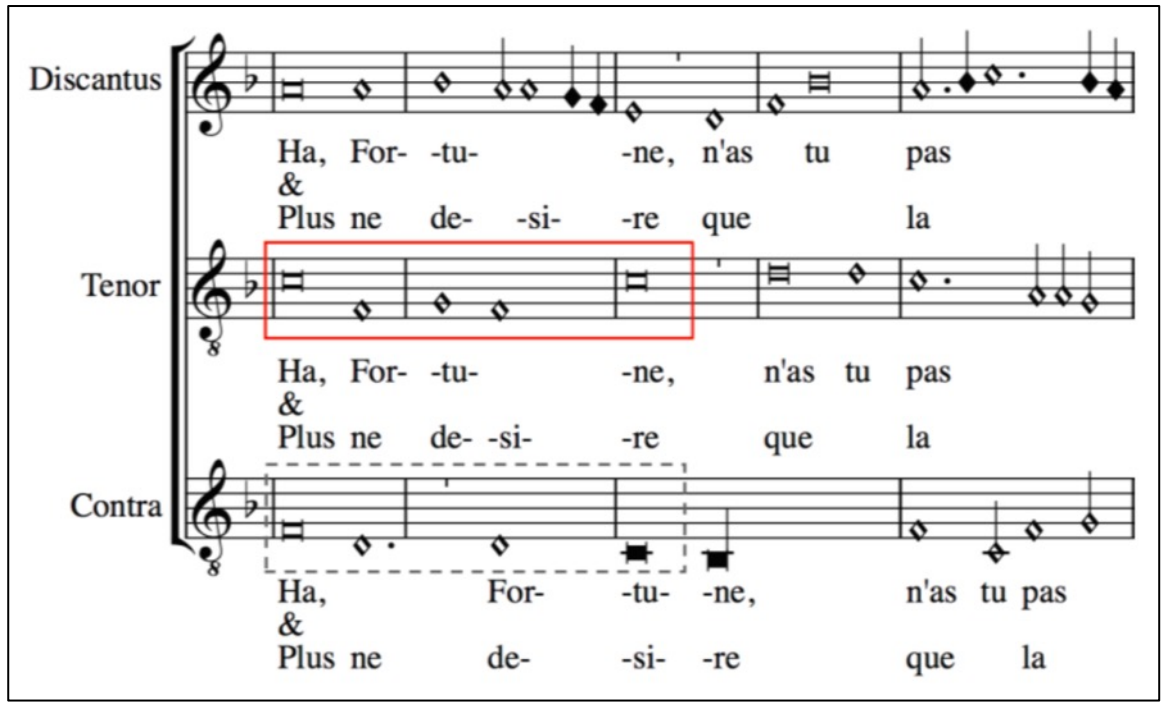
https://github.com/elvis-project/scoring-up

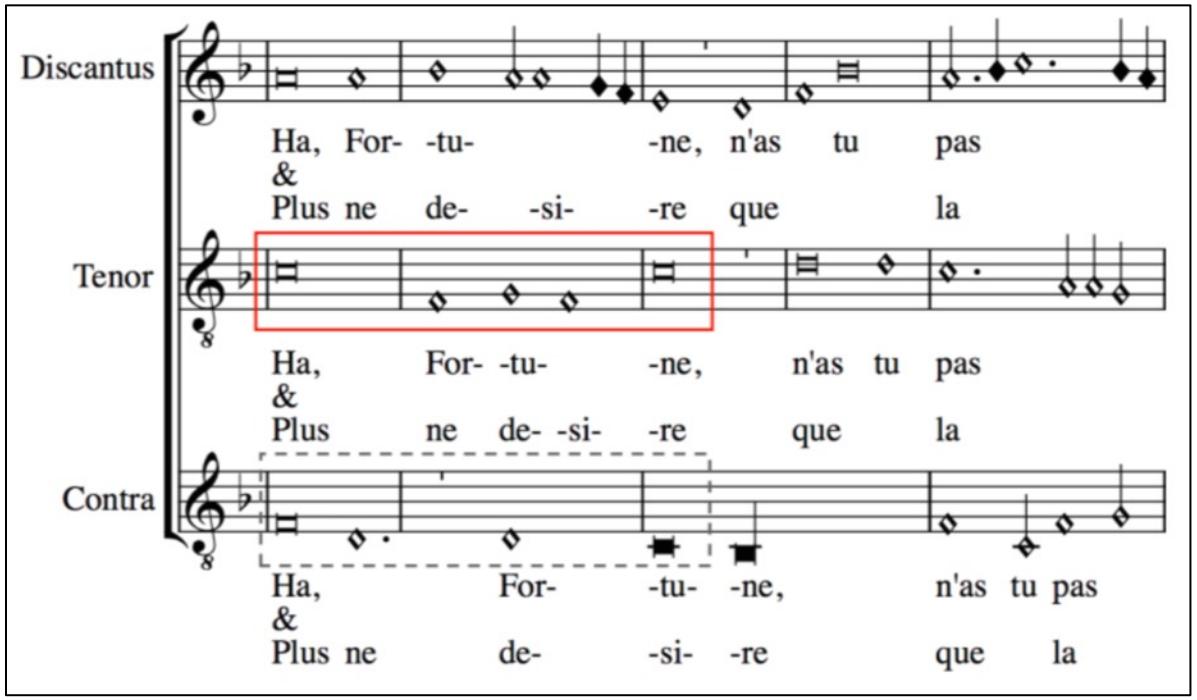
Sources of Error

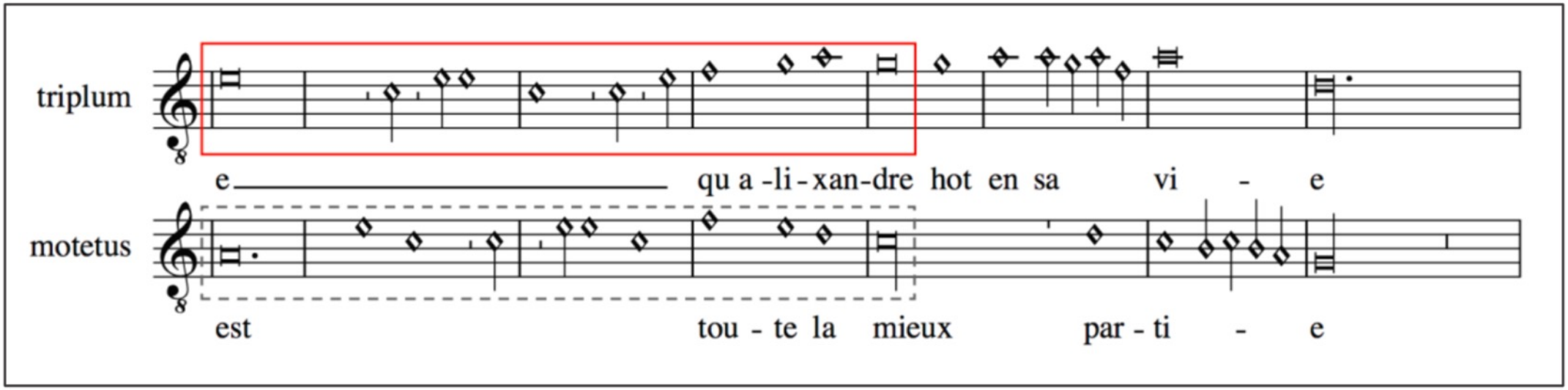
Types of Error		Instances	Mislabeled Notes
Errors in the sources	Absence of a dot of division	11	25
	Others	1	1
Errors in the experiment	Placement of the dot of division	4	7
	Last note	7	7
	Missing information regarding the staff-line in which a rest lies	2	4
	Others	1	2
Errors due to situations out of the scope of the principles of imperfection and alteration		5	9
			55

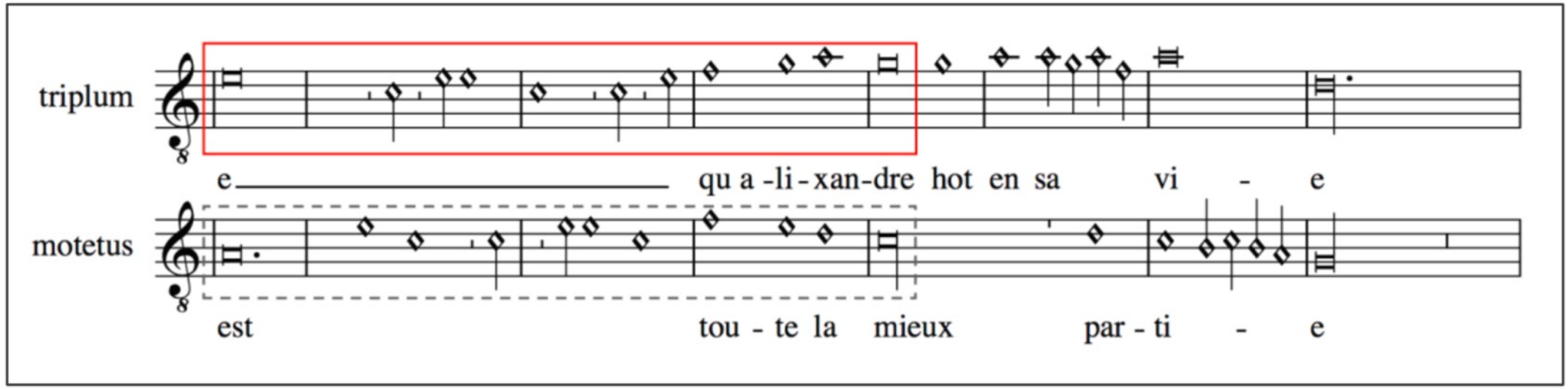
Absence of a dot of division

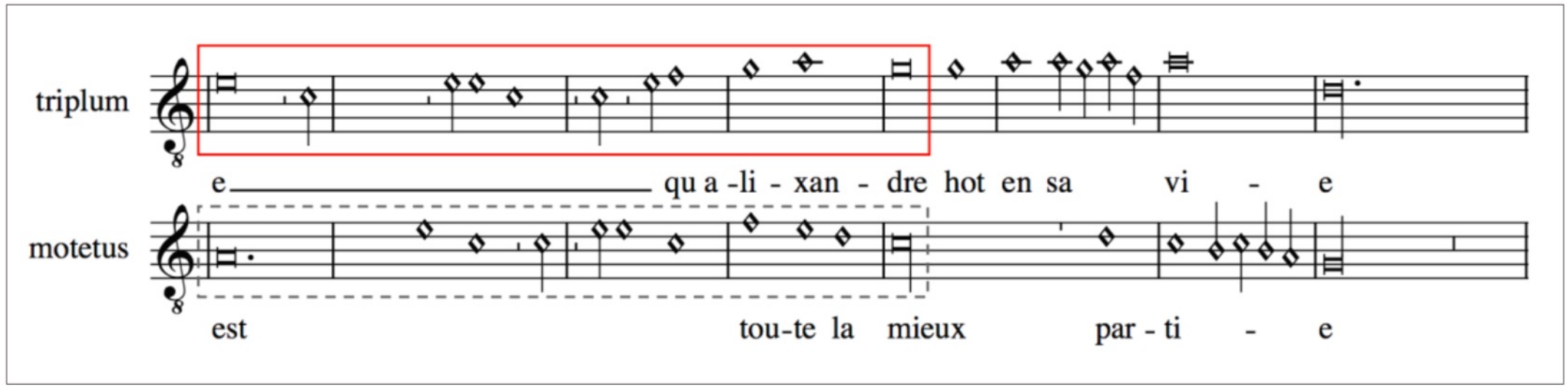

Discantus
Ha, For- -tu- -ne, n'as tu pas
&
Plus ne de- -si- -re que la
Tenor
Ha, For- -tu- -ne, n'as tu pas
&
Plus ne de- -si- -re que la
Contra
Ha, For- -tu- -ne, n'as tu pas
&
Plus ne de- -si- -re que la


Discantus
Ha, For- -tu- -ne, n'as tu pas
&
Plus ne de- -si- -re que la
Tenor
Ha, For- -tu- -ne, n'as tu pas
&
Plus ne de- -si- -re que la
Contra
Ha, For- -tu- -ne, n'as tu pas
&
Plus ne de- -si- -re que la


Discantus
Ha, For- -tu- -ne, n'as tu pas
&
Plus ne de- -si- -re que la
Tenor
Ha, For- -tu- -ne, n'as tu pas
&
Plus ne de- -si- -re que la
Contra
Ha, For- -tu- -ne, n'as tu pas
&
Plus ne de- -si- -re que la


triplum
e
qu a -li- xan-dre hot en sa
vi - e
motetus
est
tou - te la
mieux
par - ti - e


triplum
e qu a -li - xan-dre hot en sa vi - e
motetus
est tou - te la mieux par - ti - e


triplum
e qu a -li - xan - dre hot en sa vi - e
motetus
est tou-te la mieux par - ti - e

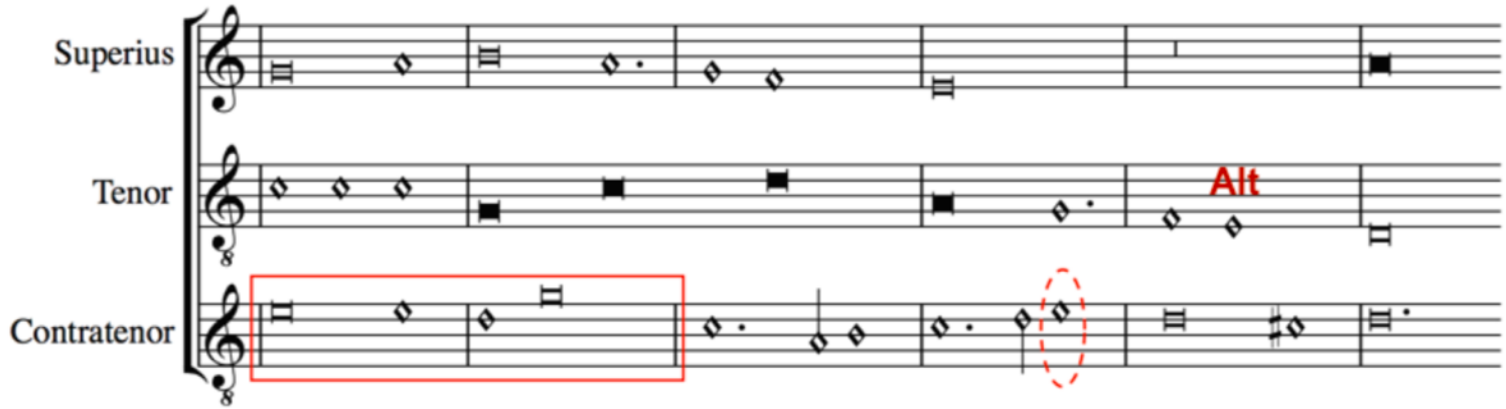


Figure 4-6: Ground truth interpretation of Ock3009 (contra voice) as found in Dijon based on a modern transcription.

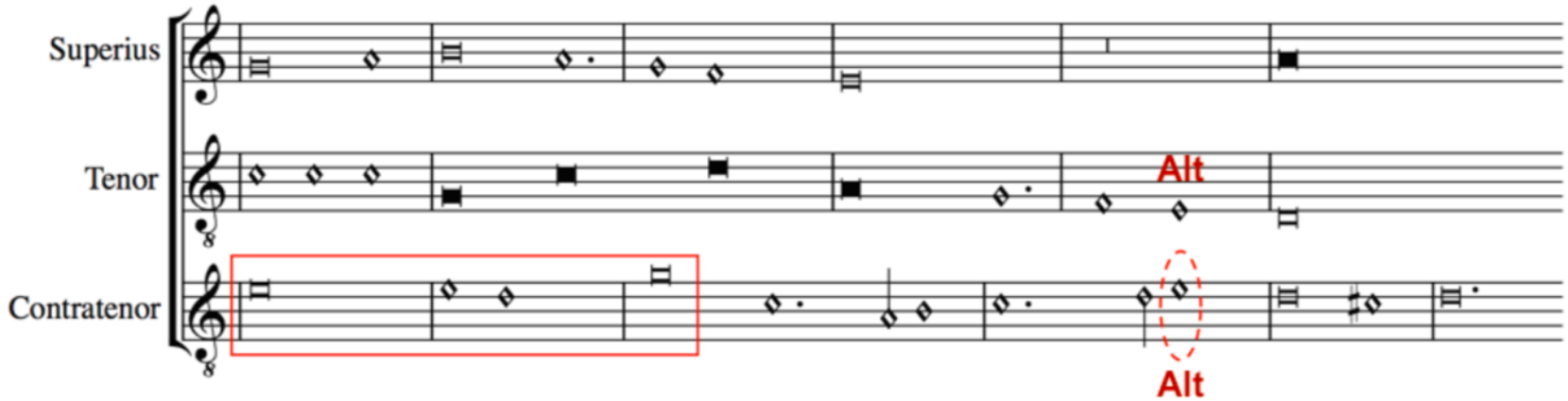


Figure 4-7: Incorrect interpretation from scoring-up tool of Ock3009 (contra voice) as found in Dijon.

Placement of the dot of division

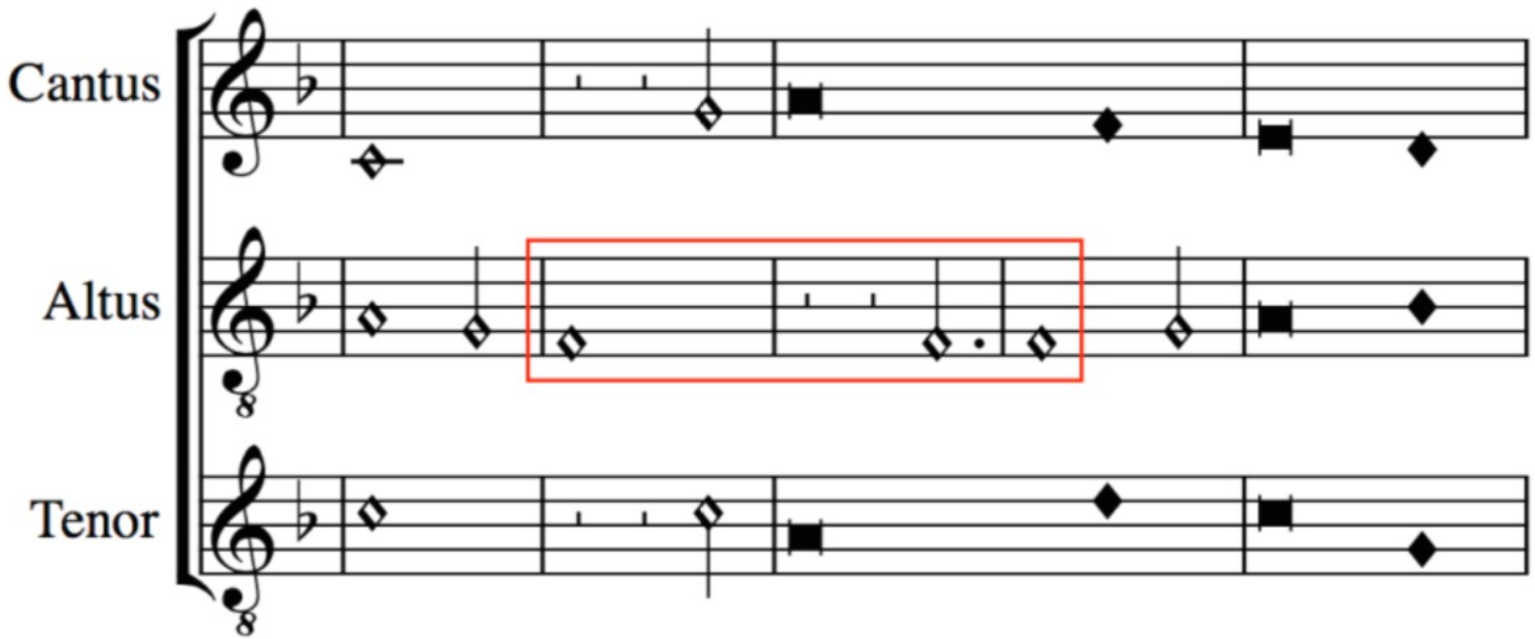


Figure 4-16: Ground truth interpretation of Duf16002 (altus) based on a modern transcription.

Last note

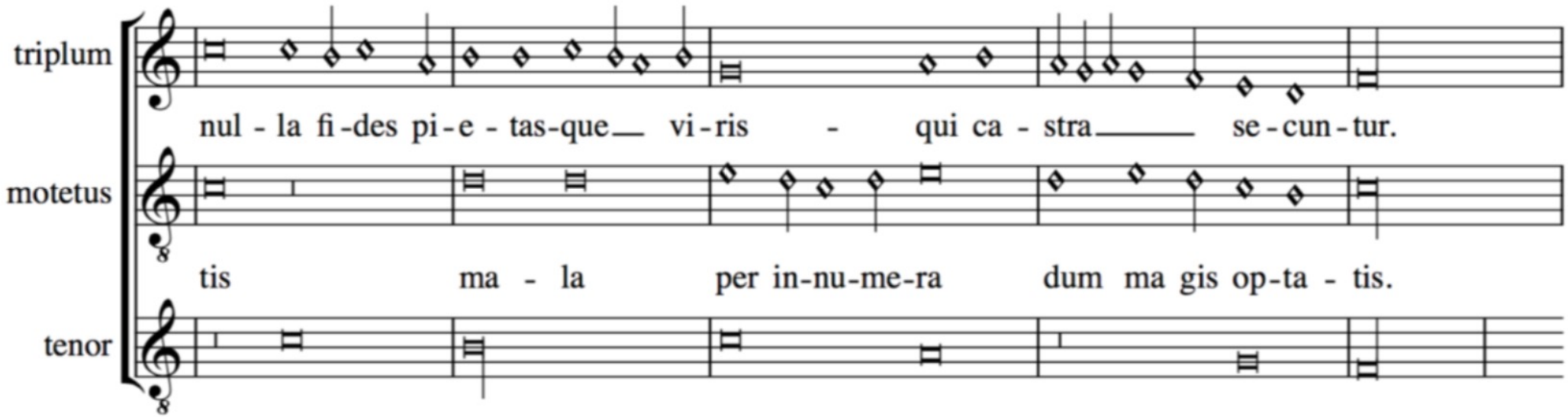
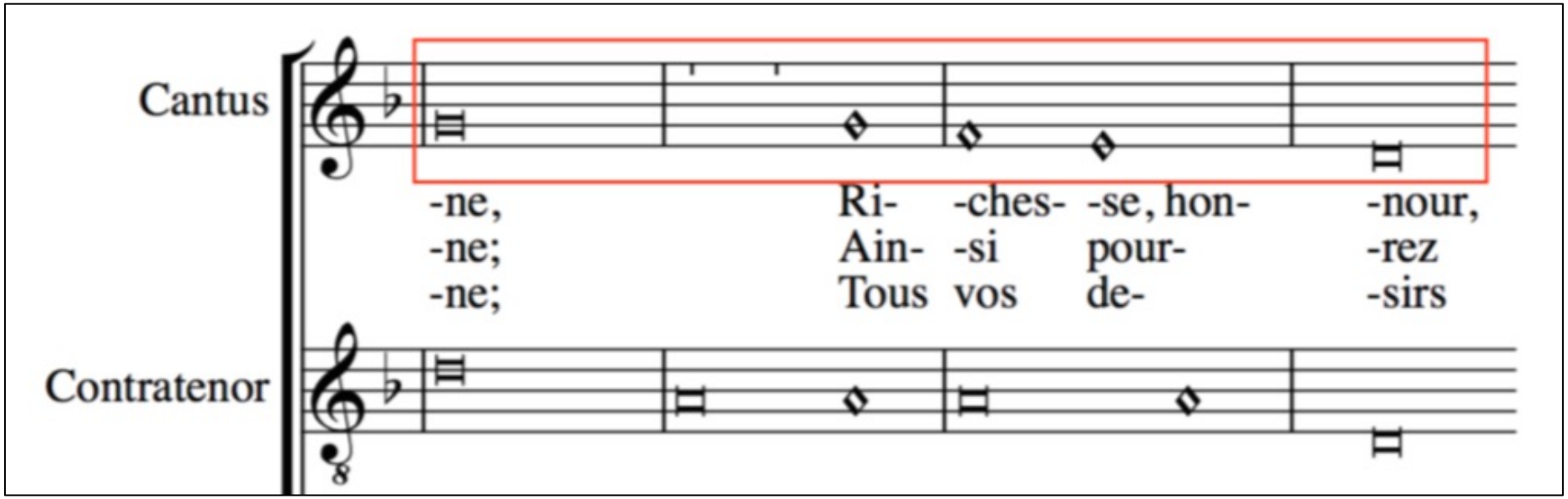
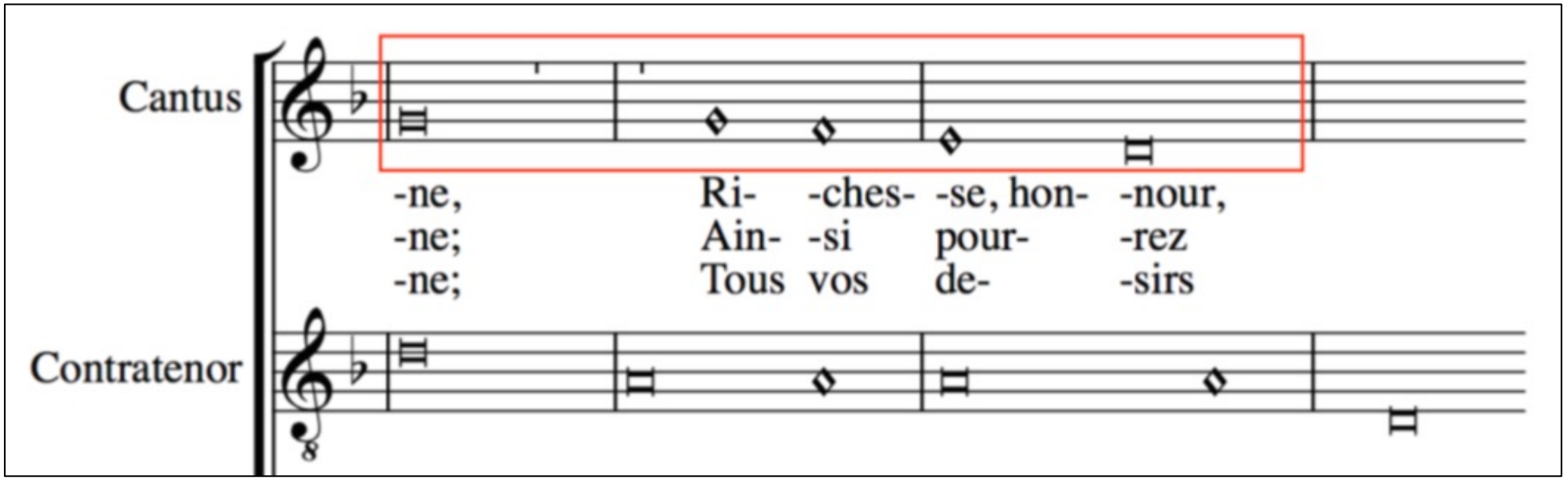


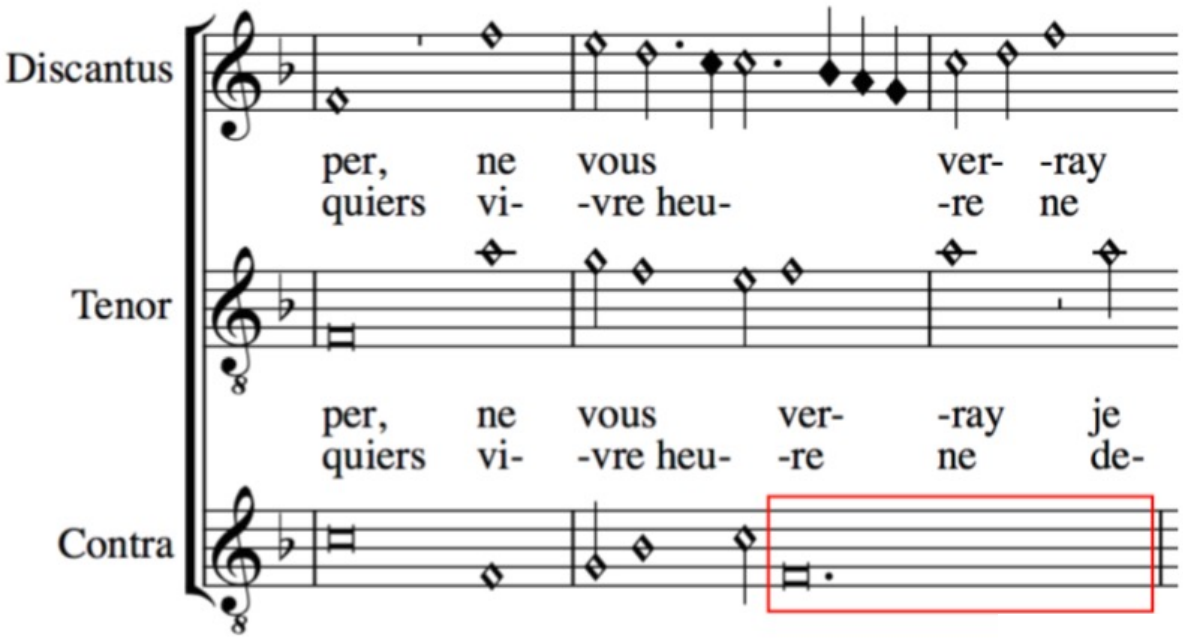
Figure 4-19: Interpretation from scoring-up tool of lv001's ending. Even though the last note of all voices is reached at the same time, the tenor ends sooner than other voices given that the last notes are interpreted according to the mensuration (perfect modus in triplum and motetus, and imperfect modus in the tenor).

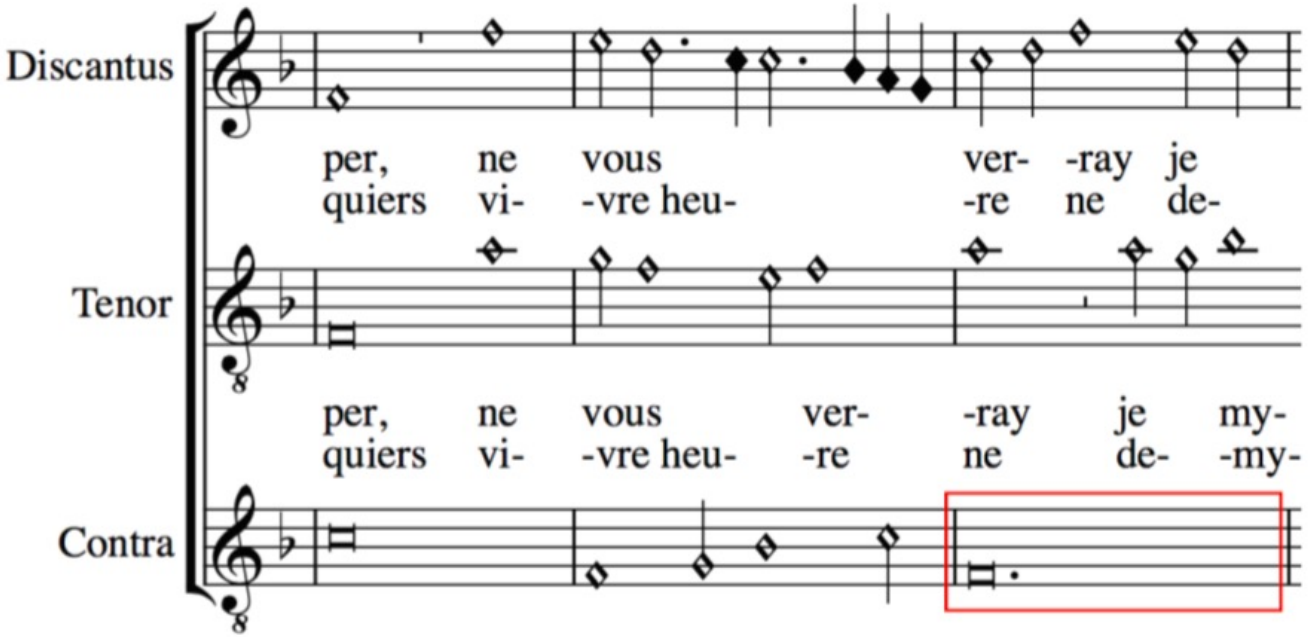
Missing information regarding the staff-line in which a rest lies


Cantus
-ne,
-ne;
-ne;
Ri-
Ain-
Tous
-ches-
-si
vos
-se, hon-
pour-
de-
-nour,
-rez
-sirs
Contratenor


Cantus
-ne,
-ne;
-ne;
Ri-
Ain-
Tous
-ches-
-si
vos
-se, hon-
pour-
de-
-nour,
-rez
-sirs
Contratenor

Errors due to situations out of the scope of the principles of imperfection and alteration


Discantus
per, ne vous ver- -ray
quiers vi- -vre heu- -re ne
Tenor
per, ne vous ver- -ray je
quiers vi- -vre heu- -re ne de-
Contra


Discantus
per, ne vous ver- -ray je
quiers vi- -vre heu- -re ne de-
Tenor
per, ne vous ver- -ray je my-
quiers vi- -vre heu- -re ne de- -my-
Contra

Other errors (sources)

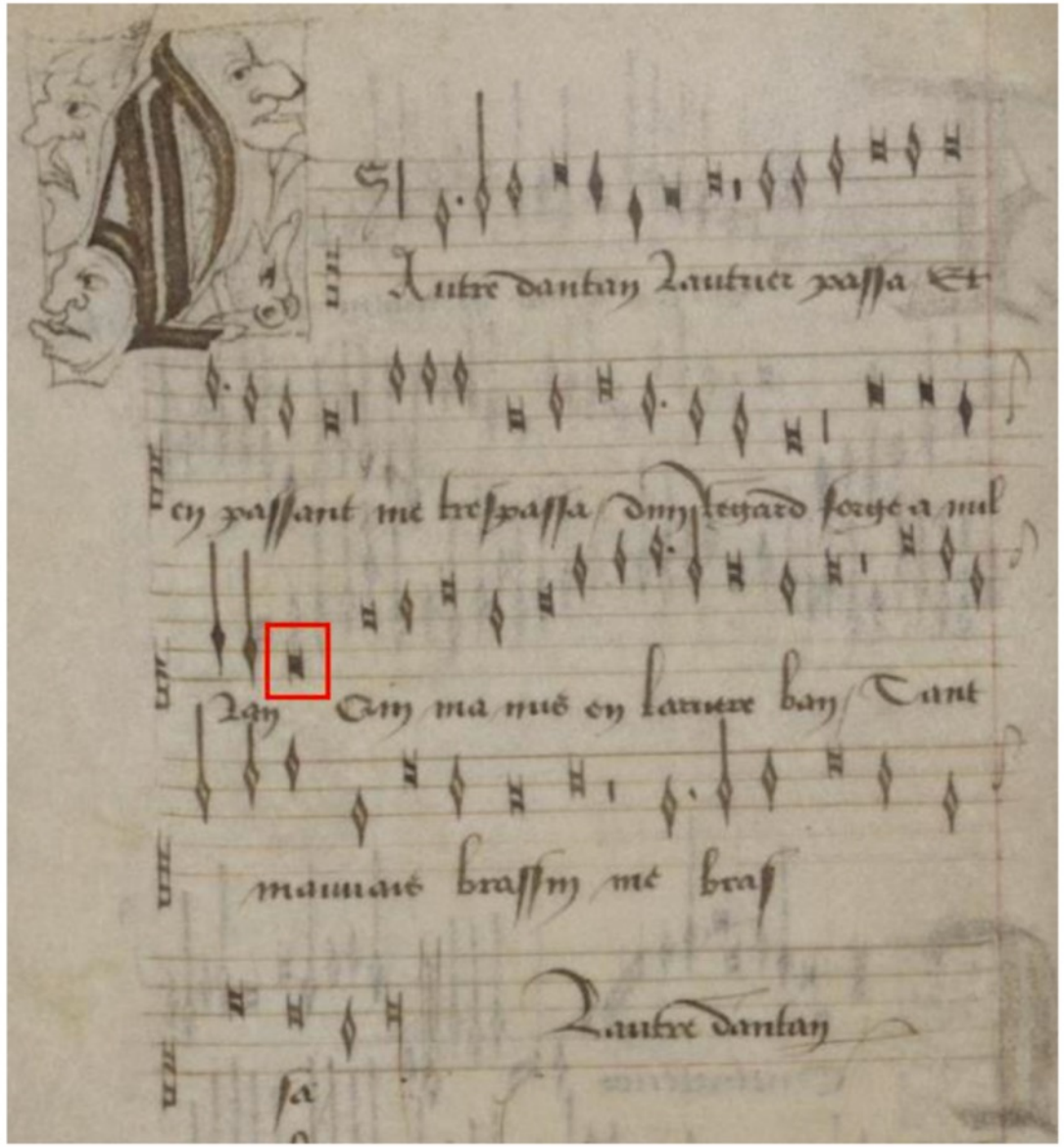


Figure 4-10: Tenor voice in Ock3009 according to Dijon.

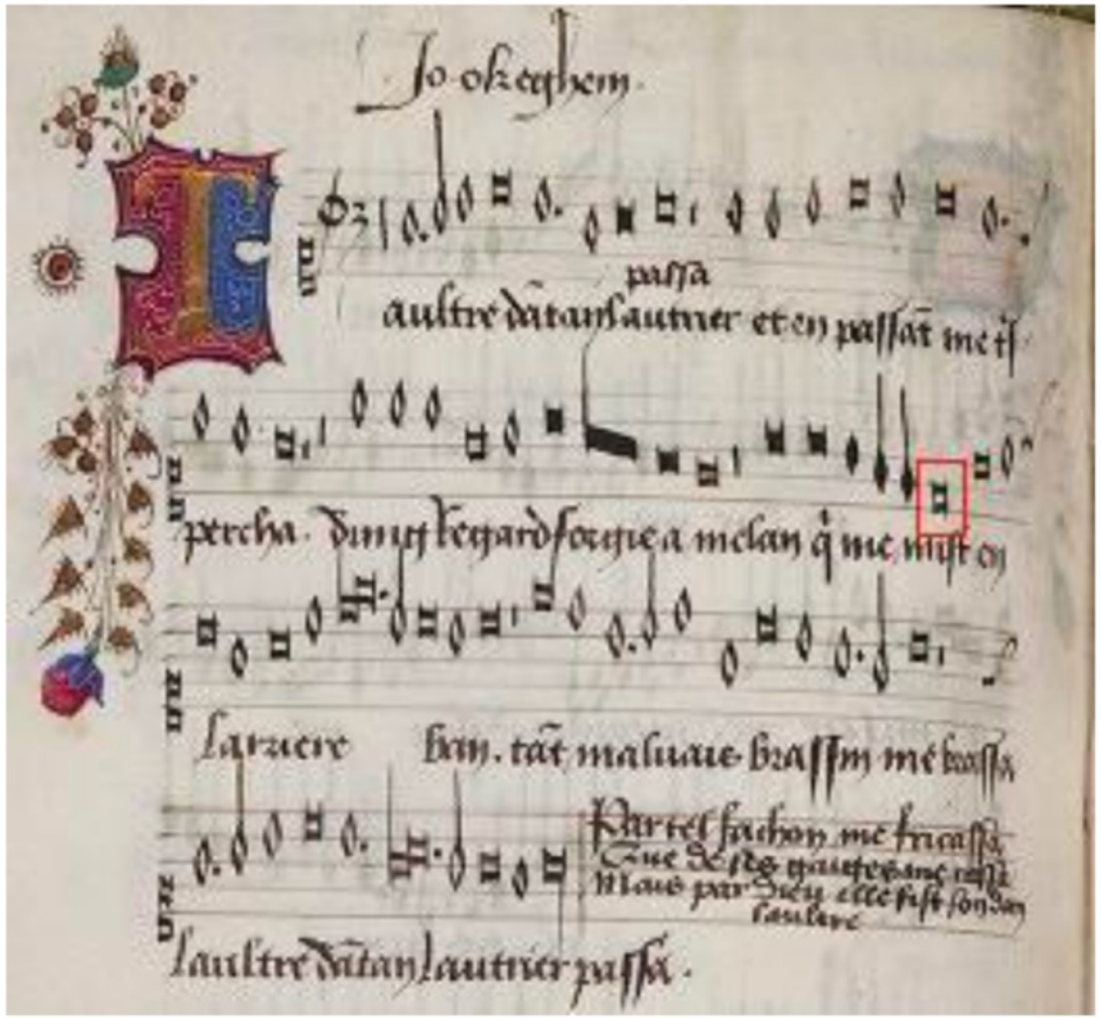


Figure 4-11: Tenor voice in Ock3009 according to Mellon.

Other errors (experiment)

Incompleteness of hemiola group coloration

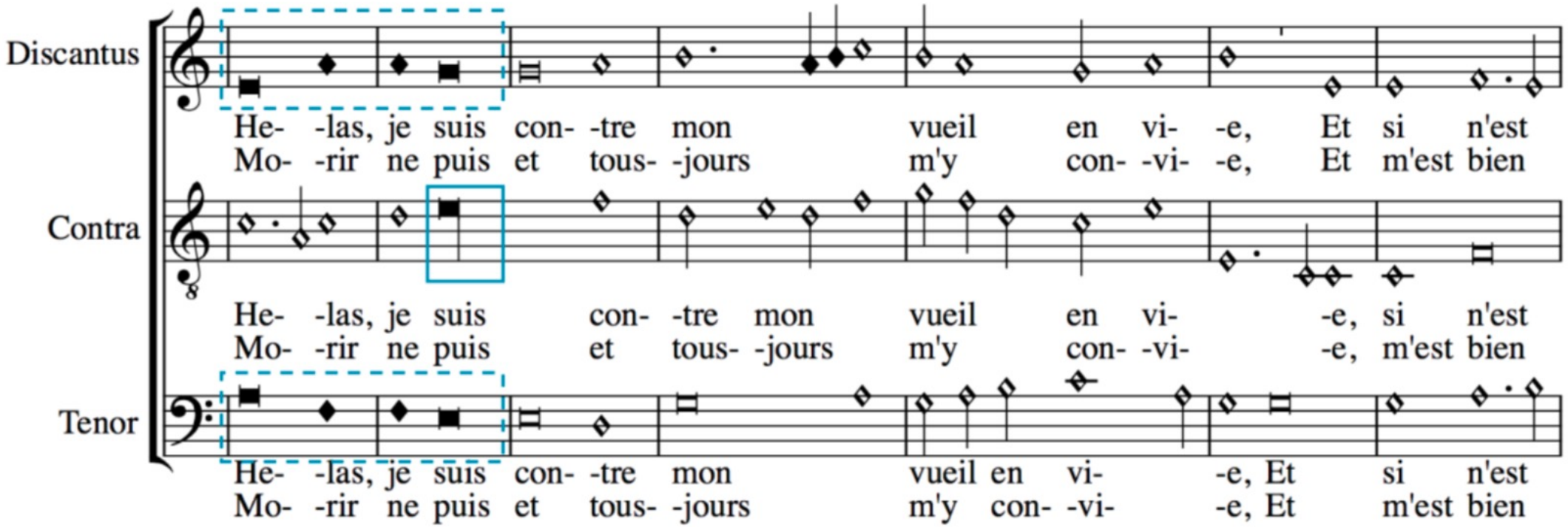


Figure 4-18: Ground truth interpretation of Ock3016 based on a modern transcription.