



## **A statistical approach of the chromaticity. The sticheron *Σήμερον συνέχει τάφος* – *Today, a tomb holds Him* in the new and old notation**

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*Η περαιτέρω ανάπτυξη μεθόδων ανάλυσης της Βυζαντινής Μουσικής μέσω διακαλλιτεχνικών και διεπιστημονικών ανοιγμάτων, ειδικά με την αξιοποίηση πορισμάτων έρευνας στους τομείς των γνωσιακών επιστημών της μουσικής, μπορεί να φέρει στο φως πολλές άγνωστες ακόμα πτυχές αυτής της θαυμάσιας μουσικής.<sup>1</sup>*

### **1. Introduction**

The present study proposes an interdisciplinary approach (Musicology and Mathematics – Statistic) which has to do with the analysis to the Byzantine Music through the research in manuscripts with new and old notation<sup>2</sup>.

More specifically, we use a mathematically-statistically<sup>3</sup> informed approach to investigate chromaticity in the *sticheron Σήμερον συνέχει*

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<sup>1</sup> *A further development of analytical methods of Byzantine Music through interarts and interdisciplinary approaches, especially through the use of research findings in the fields of cognitive science of music will enlighten many unknown aspects of this wonderful music;* Μαρία Αλεξάνδρου, “Παρατηρήσεις για την ανάλυση, υφή και μεταισθητική της Βυζαντινής Μουσικής. Ο ύμνος *Σιγησάτω πάσα σαρξ βροτεία*” (Maria Alexandru, “Remarks on the analysis, musical texture and meta-aesthetics of Byzantine Chant. The Hymn *Let all mortal flesh keep silence*”), in International Musicological Conference “*Crossroads | Greece as an intercultural pole of musical thought and creativity*”, School of Music Studies of the Aristotle University of Thessaloniki and International Musicological Society (IMS), Regional Association for the Study of Music on the Balkans, 6-10 of June 2011, Θεσσαλονίκη, at the conclusions of this article – unit 4. Proceedings to be published; I would like to thank Professor Alexandru for her support and encouragement.

<sup>2</sup> By new notation we mean the so called New Method or New System in use since 1814, the year of the Reform of the Three Teachers. Old notation is every kind of notation before 1814, in our case especially the middle-Byzantine one. Cf. Μαρία Αλεξάνδρου, *Ιστορία της Βυζαντινής και Μεταβυζαντινής Μουσικής* (Maria Alexandru, *History of Byzantine and post-Byzantine music*), vol. 2, Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης, Τμήμα Μουσικών Σπουδών, 2007-2008, pp. 7-8.

<sup>3</sup> “*Statistics is the science of learning from data, and of measuring, controlling, and communicating uncertainty; and it thereby provides the navigation essential for controlling the course of scientific and societal advances.*” From the American

τάφος – *Today, a tomb holds Him*<sup>4</sup> which is chanted as the first idiomelon of the Lauds of Mattins of Holy Saturday and it is in the second (B') mode with finalis *Di*<sup>5</sup>.

In the present study, the sticheron which belongs to the repertory of the *Old Sticherarion*, is examined:

i) In new notation from the manuscript *Sancti Sepulcri 715* (MPT 715<sup>6</sup>), which is written by Chourmouzius Chartofylaxin the early 19<sup>th</sup> century<sup>7</sup> and includes the slow exegeseis – transcriptions – interpretations of the aforementioned Teacher for the old sticheraric style.

ii) In old notation from the highly important manuscript Dionysiou 564 (D 564), which is written by Grigorios Mpunis Alyatis<sup>8</sup> in

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Statistical Association webpage: <http://www.amstat.org/careers/whatisstatistics.cfm> (11/05/2012).

<sup>4</sup> *The Lenten Triodion*, transl. by Mother Mary and Archimandrite Kallistos Ware, Faber and Faber, London, 1978, p. 652.

<sup>5</sup> *Τριώδιον (Triodion)*, Αποστολική Διακονία της Εκκλησίας της Ελλάδος, Αθήνα, 1960, p. 417. For the theoretical finalis of the eight modes in the new notation: Maria Alexandru, *Εξηγήσεις και μεταγραφές της βυζαντινής μουσικής. Σύντομη εισαγωγή στον προβληματισμό τους* (Maria Alexandru, *Exegeseis and transcriptions of byzantine music. Brief introduction to the musicological issue*), University Studio Press, Θεσσαλονίκη, 2010, p. 65. See also Δημήτριος Παναγιωτόπουλος, *Θεωρία και Πράξεις της Βυζαντινής Εκκλησιαστικής Μουσικής* (Dimitrios Panagiotopoulos, *Theory and practice of Byzantine Ecclesiastical Music*), Αδελφότης Θεολόγων "ὁ Σωτήρ", Αθήνα, 1997, pp. 181-183.

<sup>6</sup> The abbreviation MPT comes from the Greek name: Metochion Panagiu Taphou.

<sup>7</sup> For the new analytical notation and specially for Chourmouzius Chartofylax see: Χουρμούζιος Χαρτοφύλαξ, *Εισαγωγή εἰς τὸ Θεωρητικὸν καὶ πρακτικὸν τῆς Εκκλησιαστικῆς Μουσικῆς* (Chourmouzius Chartofylax, *Introduction to the theory and practice of ecclesiastic music*), critical edition by Εμμανουήλ Γιαννόπουλος, University Studio Press, Θεσσαλονίκη, 2002, pp. 9-16. See also Γεώργιος Παπαδόπουλος, *Ἱστορικὴ ἐπισκόπησις τῆς βυζαντινῆς ἐκκλησιαστικῆς μουσικῆς ἀπὸ τῶν Ἀποστολικῶν χρόνων μέχρι τῶν καθ' ἡμᾶς* (Georgios Papadopoulos, *Historical review of the byzantine ecclesiastical music from Apostolic times until today*), 1<sup>st</sup> repr., Τέρτιος, Κατερίνη, 2002, pp. 198-200. About the ergography of Chourmouzius: Μανόλης Χατζηγιακουμῆς, *Μουσικὰ χειρόγραφα Τουρκοκρατίας* pp. 1453-1832 (Manolis Chatzigiakoumis, *Musical manuscripts of the Tourkokratia*), vol. I, Ἀδελφοὶ Ρόδη, Αθήνα, 1975, pp. 389-391. About the dating of the MPT 715: Chourmouzius Chartofylax.: Χατζηγιακουμῆς, *Μουσικὰ Χειρόγραφα*, p. 390. See also Γρηγόριος Στάθης, *Τιμὴ πρὸς τὸν διδάσκαλον. Ἐκφραση ἀγάπης στὸ πρόσωπο τοῦ καθηγητοῦ Γρηγορίου Θ. Στάθη. Αφιέρωμα στὰ ἐξηντάχρονα τῆς ἡλικίας καὶ στὰ τριαντάχρονα τῆς ἐπιστημονικῆς καὶ καλλιτεχνικῆς προσφορᾶς του* (Gregorios Stathis, *Honour to the Teacher. Expression of love for the Teacher Gregorios Stathis. To his sixtieth birthday and thirty years of his scientific and artistic contribution*), Ανατολὴς το Περιήχημα, Αθήνα, 2001, p. 706.

<sup>8</sup> Alyatis was possibly the Precentor of St. Sophia in Constantinople in 1453, the year of the Fall of the City. For a detailed ergobiography: Maria Alexandru, "Gregorios Mpunis Alyatis: An Open Bioergographic Index Card and an analysis of the pentikostarion Τὴν

1445 A.D. This manuscript is neumated with fully developed Middle-Byzantine notation.<sup>9</sup>

The aim of the study is to investigate whether some notes of the chromatic scale have a “closer relation” with:

- i) the ison and the neumes which augment the duration of the phonetic signs<sup>10</sup>,
- ii) the syllables and the kola<sup>11</sup> of the hymnographic text.

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λάμπιν τοῦ προσώπου σου”, in *Psaltike, Neue Studien zur Byzantinischen Musik: Festschrift für Gerda Wolfram*, ed. Nina Maria Wanek, Praesens, Vienna, 2011, p. 18. See also Κωνσταντίνος Καραγκούννης, *Ἡ παράδοση καὶ ἐξήγηση τοῦ μέλους τῶν χειρουβικῶν τῆς βυζαντινῆς καὶ μεταβυζαντινῆς μελοποιίας* (Konstantinos Karagunis, *The tradition and exegesis of the melos of the cherubic hymn of the Byzantine and post-byzantine melopoieia*), IBM – Μελέται, Γρ. Στάθης, Αθήνα, 2003, p. 270.

About a detailed description and the dating of the manuscript: Γρηγόριος Στάθης, *Τὰ χειρόγραφα βυζαντινῆς μουσικῆς, Ἅγιον Ὄρος, Κατάλογος περιγραφικὸς* (Gregorios Stathis, *The manuscripts of byzantine chant, Holy Mountain, Descriptive catalogue*), vol. 2, Ἴδρυμα Βυζαντινῆς Μουσικολογίας and Γρηγόριος Στάθης, Αθήνα, 1976, pp. 688-689.

<sup>9</sup> For the stages and the development of the old notation see: Αλεξάνδρου, *Ἱστορία*, pp. 7-8.

<sup>10</sup> In the new notation these signs are the so called *prosthetika chronika simeia* (additive duration marks): the *klasma*, the *apli* with its derivatives (*dipli* [double], *tripli* [triple] e.t.c.) and the *argon*. All signs add duration to the note on which they have been put. Παναγιωτόπουλος, *Θεωρία*, pp. 66-67 and 78. The pauses in the new notation could be considered as *prosthetika chronika simeia* but they will not be included in our measurements because they are not related with any note. In the old notation the duration marks are called *argiai* and they are four: *kratima*, *dipli*, *dyo apostrophoi*, and *tsakisma*. However, in this paper we will not examine the *tsakisma* because it represents only the half length (*ἡμισον ἀργία*) according to the Protheory of the Papadike. Cf. Maria Alexandru, *Studie über die 'grossen Zeichen' der byzantinischen musikalischen Notation unter besonderer Berücksichtigung der Periode vom Ende des 12. bis Anfang des 19. Jahrhunderts*, Dissertation, vol. 2, University of Copenhagen, 2000, p. 17. Moreover it seems that *tsakisma*'s functionality has to do both with the embellishment and only a small increasing of the duration of the note on which it stands.

<sup>11</sup> The *kolon* could be defined as the basic musical and poetical unit of a setting. It ends with a cadence. Cf. Maria Alexandru, “Αναλυτικές προσεγγίσεις και ιχνηλασία του κάλλους στη βυζαντινή μουσική. Ο Ευχαριστήριος Ὕμνος Σὲ ὁμνοῦμεν”, (Maria Alexandru, “Analytic approach and a quest for the discovery of beauty of byzantine music. The Thanksgiving Hymn, *We pray You*), in *Symposium Μουσική Θεωρία και ἀνάλυση – Μεθοδολογία και Πράξη (Music Theory and analysis – Methodology and Practice)*, Proceedings of the Symposium, 29.09.-1.10. 2006, ed. Kostas Tsougras and A.U.Th. - School of Music Studies, Θέρμη - Θεσσαλονίκη, 2006, p. 320. See also Ομάδα Παλαιογραφίας Βυζαντινῆς Μουσικῆς ἀπὸ το Τμήμα Μουσικῶν Σπουδῶν του Αριστοτελείου Πανεπιστημίου Θεσσαλονίκης, “Χρυσέοις ἔπεσι, ἓνα στιχηρὸ εἰς τιμὴ τοῦ Ἁγίου Ἰωάννου τοῦ Χρυσοστόμου στη διαχρονικὴ του εξέλιξη: Παλαιογραφικὲς & αναλυτικὲς ἀναζητήσεις” (Study Group of Palaeography of Byzantine Music, “*Chryseois epesti-In golden words*” – a *sticheron* in honor of St. John Chrysostom in its diachronic musical development), ed. M. Alexandru, in *Proceedings of the 1<sup>st</sup>*

Moreover, we want to examine whether and how some notes have a greater total duration in comparison with other notes in the same scale and to visualize the “profile<sup>12</sup>” of the second mode according to the acoustic result of the sticheron *Σήμερα συνεχει τάφος*.

The conclusions emerge through a parallel research which focuses on the modulations which occur in the sticheron both in new and old notation. It has to be noticed that the notes in the old notation show us the metrophonic structure of the melody<sup>13</sup>.

## **2. The sticheron *Σήμερα συνεχει τάφος* in new notation. The interpretation of Chourmouzos Chartofylax in MPT 715**

In new notation we examined statistically:

❖ In which note and how often we have the *ison* and the additive duration marks<sup>14</sup>.

❖ Which are the first notes of every *kolon* and inside the *kolon*, of every new syllable of the hymnographic text.

❖ Which is the total duration of each note in the whole *sticheron*.

❖ Which is the “profile” of the B’ mode according to the distribution of the duration of the tones of the chant we examine.

The reason we include the *ison* and the additive duration marks in our measurements, is that the first sign causes repetition while the second group of signs causes extension of the note, in other words, both signs lead to melodic strengthening of the respective notes. Similarly, we

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*International Conference of the American Society of Byzantine Music and Hymnology*, September 10-15<sup>th</sup> 2007, Αθήνα, p. 357 (337-485). Published on the internet: <http://www.asbmh.pitt.edu/page9/page10/page11/page11.html> and <http://www.asbmh.pitt.edu/page12/Alexandru.pdf>

At the beginning of this study the plan included only the measurements for the first note for every syllable. After the suggestion of Professor Alexandru the first note of the *kolon* has also been taken in consideration.

<sup>12</sup> This was the second suggestion of Professor Alexandru.

<sup>13</sup> Metrophonic structure of a piece is what is written down with the intervals signs (*ison* and *emphona*) of the middle-Byzantine. Μαρία Αλεξάνδρου, *Παλαιογραφία Βυζαντινής Μουσικής* (Maria Alexandru, *Palaeography of Byzantine Music*), Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης, notes of the courses entitled: Μετροφωνία – Παραλλαγή – Μέλος και άλλες έννοιες κλειδί στη Θεωρία της Ψαλτικής Τέχνης (*Metrophonia – Parallagi – Melos* and other key terms in the Theory of the Chanting Art), academic year 2012-2013. The notes we read in metrophonic structure (old notation) are called notes of the metrophonic structure or structural notes. On the other hand, dominating notes (new notation) are the notes, on which the cadences (perfect, imperfect, final) of the *melos* occur. Additionally, these notes appear more frequently and the melody focuses on them, while neighbour notes usually tend to be attracted by them. See: Παναγιωτόπουλος, *Θεωρία*, pp. 126-127.

<sup>14</sup> The so called *prosthetika chronika simeia* (*klasma, apli* and *argon*). See footnote 16 in the introduction.

examine the first note of every new syllable and the *kolon*. The relation between words and music in Byzantine Chant is very strong<sup>15</sup> and additionally, it seems that the first note of each syllable and the incipit of each *kolon* are of major importance in the perception's and memory's area<sup>16</sup>. Furthermore, we examine the total duration for each note in order to: a) find out which notes sound longer in this *sticheron* and b) shape the "profile" of the second mode with finalis Di.

In Fig. 1 is the *sticheron* from manuscript MPT 715<sup>17</sup>. The additional colored circles show the *phthorai* which indicate modulation. Blue circles show the *phthorai* for the soft chromatic scale, red circles the *phthorai* for the intense chromatic scale and green circles the *phthorai* for the soft diatonic scale. Table 1 includes the hymnographic text with structural, metrical and modal analysis<sup>18</sup> of the *sticheron*. In the first, second and third column the periods, verses and *kola* are noticed respectively. In the fourth column the full hymnographic text is colored in order to show the use of the soft chromatic scale with blue color, the intense chromatic scale with red color and the diatonic scale with green color. Sometimes, a change of scale occurs inside a syllable. In such cases the syllable is underlined. The color of the letters shows the scale at the beginning of the syllable and the color of the line shows the following scale. There is no syllable with more than one modulation in this *sticheron*. At the last column there is the total number of syllables for each *kolon*.

In Table 2 we have the statistic measurements we aforementioned and in Graphs 1a till 6 we have the visualization of these measurements. It is necessary to notice some parameters of the measurements. When the intense chromatic scale or the diatonic scale is used, then the

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<sup>15</sup> Egon Wellesz, *Byzantinische Musik. Ein Vortrag*, ed. Gerda Wolfram, Verlag der Osterreichischen Akademie der Wissenschaften, Vienna, 2000, p. 17 & cover page. Cf.: Αλεξάνδρου, *Σιγησάτω πάσα σὰρξ βροτεία*.

<sup>16</sup> Sven Blankenberger & Katrin Bittrich, "The Impact of Trace Decay, Interference, and Confusion in a Tonal Memory Span Task", in *12<sup>th</sup> International Conference for Music Perception and Cognition and 8<sup>th</sup> Conference of the European Society for the Cognitive Sciences of Music. Proceedings of the joint Conference, 23-28.07.2012*, ed. Emilios Cambouropoulos, Costas Tsougras, Panayotis Mavromatis, Konstantinos Pasiadis, A.U.Th. – School of Music Studies, Θεσσαλονίκη, 2012, p. 109 and hand out of the presentation. In the proceedings only the abstract of this paper is included exclusively in p.109. In this research, the impact of different mechanisms of forgetting in short term memory for tonal and verbal stimuli is examined. In the main results, included in the hand out, it was mentioned that the first verbal and tonal stimuli had the greatest percentage of correct immediate and delayed recall.

<sup>17</sup> For this manuscript see the unit 1. Introduction.

<sup>18</sup> This multilevel analysis is based on the researches of the Study group of Palaeography from Aristotle University of Thessaloniki.: Ομάδα Παλαιογραφίας, "Χρυσέοις έπεισι".

measurements are based on the notes of the *pseudoparallagi*<sup>19</sup>. Moreover, the effect of the *phthorai* is measured from the sign on which they stand. For instance, almost at the beginning of the second line of the *sticheron*, on the syllable *σνν-* of the word *σννέχει*, there is a *phthora* for the intense chromatic scale (see Fig. 1). This *ison* is counted in the intense chromatic scale.

Furthermore, in two cases there are two *isa* with *gorgon*<sup>20</sup>. The duration of each *ison* pair lasts one *protos chronos* (one quaver in a hypothetical transcription on staff) and for this reason each pair is counted as one *ison*.

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<sup>19</sup> By *Pseudoparallagi* we mean the change of the names of the notes according to a *phthora* which indicates a modulation in another mode or/and scale.

<sup>20</sup> 1) Seventh line of the *sticheron* on the syllable *-θος* of the word *λιθος*. 2) Fifteenth line on the syllable *-ξα* of the word *δόξα*.

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**Figure 1.** The *sticheron* *ἡμερον συνεχει τάρφος* in manuscript MPT 715 (f. 193v-r). Blue circles show the *phthorai* for the soft chromatic scale, red circles the *phthorai* for the intense chromatic scale and green circles the *phthorai* for the diatonic scale.

Structural, metrical and modal analysis				
Period	Verse	Kolon	Text with indications of the modulations between soft and intense chromatic scale and diatonic scale	Nr. of syllables
I	A	1	Σήμερον <b>συνέχει τάφος</b> ,	8
		2	τόν <b>συνέχοντα παλάμη</b> τὴν Κτίσιν	11
	B	3	<b>καλύπτει λίθος</b>	5
		4	τόν <b>καλύψαντα</b> ἀρετῆ τοὺς οὐρανοὺς	12
	C	5	ὑπνοῖ ἡ ζωή	5
		6	καὶ Ἰδης <b>τρέμει</b>	5
	D	7	καὶ Ἀδάμ <b>τῶν δεσμῶν ἀπολύεται</b>	11
II	E	8	<b>Δόξα τῇ σῇ οἰκονομίᾳ</b>	9
		9	δι' ἧς <b>τελέσας πάντα</b>	7
	F	10	<b>σαββατισμὸν αἰώνιον</b>	8
	G	11	<b>ἔδωρήσω ἡμῖν</b> ὡς Θεός	9
	H	12	<b>τὴν παναγίαν</b>	5
		13	ἐκ νεκρῶν σου <b>Ἀνάστασιν</b>	8

**Table 1.** Structural, metrical and modal analysis of the *sticheron* *Σήμερον συνέχει τάφος* with indications of the oscillations between **soft** and **intense** chromatic scale and **diatonic** scale in MPT 715 f. 193r-v<sup>21</sup>.

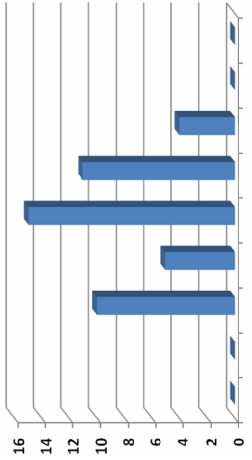
<sup>21</sup> Based on the multilevel analysis of: Ομάδα Παλαιογραφίας, "Χρυσέοις ἐπέσι".



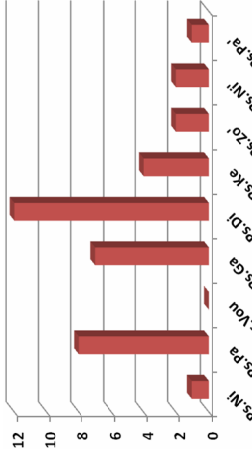
## 2.1. Table for measurements and Graphs

Manuscript MPT 715, f. 193r-v														
Object	Mode - Scale	Measurements - Percentag	Notes Measurements Percentage (%)										Graph	
			Ni	Pa	Vou	Ga	Di	Ke	Zo'	Ni'	Pa'	Vou'		Ga'
Ison	B'	Notes	-	-	<b>10</b>	<b>5</b>	<b>15</b>	<b>11</b>	<b>4</b>	-	-	-	-	1a
		Number	-	-	22,2	11,1	33,3	24,4	8,9	-	-	-	-	
	Percentage %	-	-	-	-	-	-	-	-	-	-	-		
	Notes Pseudopar.	Ps.Ni	Ps.Pa	Ps.Vou	Ps.Ga	Ps.Di	Ps.Ke	Ps.Zo'	Ps.Ni'	Ps.Pa'	Ps.Vou'	Ps.Ga'		
	Pl.B'	Number	<b>1</b>	<b>8</b>	-	<b>7</b>	<b>12</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	-	1b
		Percentage %	2,6	21,1	-	18,4	31,6	10,5	5,3	5,3	2,6	2,6	-	
Diat. scale	Number	-	-	-	-	<b>1</b>	<b>2</b>	-	<b>1</b>	-	-	-	1c	
	Percentage %	-	-	-	-	25,0	50,0	-	25,0	-	-	-		
Additive duration marks	B'	Notes	Ni	Pa	Vou	Ga	Di	Ke	Zo'	Ni'	Pa'	Vou'	Ga'	
		Number	-	-	<b>23</b>	<b>14</b>	<b>37</b>	<b>18</b>	<b>1</b>	<b>1</b>	-	-	-	2a
	Percentage %	-	-	24,5	14,9	39,4	19,1	1,1	1,1	-	-	-		
	Notes Pseudopar.	Ps.Ni	Ps.Pa	Ps.Vou	Ps.Ga	Ps.Di	Ps.Ke	Ps.Zo'	Ps.Ni'	Ps.Pa'	Ps.Vou'	Ps.Ga'		
	Pl.B'	Number	<b>3</b>	<b>21</b>	<b>16</b>	<b>12</b>	<b>24</b>	<b>13</b>	<b>11</b>	<b>3</b>	<b>4</b>	<b>1</b>	<b>1</b>	2b
		Percentage %	2,8	19,3	14,7	11,0	22,0	11,9	10,1	2,8	3,7	0,9	0,9	
Diat. scale	Number	-	-	-	-	-	-	<b>3</b>	<b>2</b>	<b>2</b>	-	-	2c	
	Percentage %	-	-	-	-	-	-	42,9	28,6	28,6	-	-		
New syllable	B'	Notes	Ni	Pa	Vou	Ga	Di	Ke	Zo'	Ni'	Pa'	Vou'	Ga'	
		Number	-	-	<b>18</b>	<b>8</b>	<b>16</b>	<b>5</b>	-	-	-	-	-	3a
	Percentage %	-	-	38,3	17,0	34,0	10,6	-	-	-	-	-		
	Notes Pseudopar.	Ps.Ni	Ps.Pa	Ps.Vou	Ps.Ga	Ps.Di	Ps.Ke	Ps.Zo'	Ps.Ni'	Ps.Pa'	Ps.Vou'	Ps.Ga'		
	Pl.B'	Number	<b>2</b>	<b>11</b>	<b>5</b>	<b>8</b>	<b>18</b>	<b>4</b>	<b>3</b>	<b>1</b>	-	-	-	3b
		Percentage %	3,9	21,6	9,8	15,7	35,3	7,8	5,9	2,0	-	-	-	
Diat. scale	Number	-	-	-	-	<b>1</b>	-	<b>1</b>	<b>2</b>	-	-	-	3c	
	Percentage %	-	-	-	-	25,0	-	25,0	50,0	-	-	-		
New kola	B'	Notes	Ni	Pa	Vou	Ga	Di	Ke	Zo'	Ni'	Pa'	Vou'	Ga'	
		Number	-	-	<b>4</b>	-	<b>3</b>	-	-	-	-	-	-	4a
	Percentage %	-	-	57,1	-	42,9	-	-	-	-	-	-		
	Notes Pseudopar.	Ps.Ni	Ps.Pa	Ps.Vou	Ps.Ga	Ps.Di	Ps.Ke	Ps.Zo'	Ps.Ni'	Ps.Pa'	Ps.Vou'	Ps.Ga'		
	Pl.B'	Number	<b>1</b>	<b>1</b>	<b>1</b>	-	<b>1</b>	<b>1</b>	-	-	-	-	-	4b
		Percentage %	20,0	20,0	20,0	-	20,0	20,0	-	-	-	-	-	
Diat. scale	Number	-	-	-	-	-	-	-	<b>1</b>	-	-	-	4c	
	Percentage %	-	-	-	-	-	-	-	100,0	-	-	-		
Total duration	B'	Notes	Ni	Pa	Vou	Ga	Di	Ke	Zo'	Ni'	Pa'	Vou'	Ga'	
		Number	<b>4</b>	<b>14</b>	<b>116</b>	<b>139</b>	<b>231</b>	<b>171</b>	<b>66</b>	<b>13</b>	-	-	-	5a
	Percentage %	0,5	1,9	15,4	18,4	30,6	22,7	8,8	1,7	-	-	-		
	Notes Pseudopar.	Ps.Ni	Ps.Pa	Ps.Vou	Ps.Ga	Ps.Di	Ps.Ke	Ps.Zo'	Ps.Ni'	Ps.Pa'	Ps.Vou'	Ps.Ga'		
	Pl.B'	Number	<b>32</b>	<b>122</b>	<b>127</b>	<b>151</b>	<b>179</b>	<b>87</b>	<b>65</b>	<b>39</b>	<b>25</b>	<b>9</b>	<b>3</b>	5b
		Percentage %	3,8	14,5	15,1	18,0	21,3	10,4	7,7	4,6	3,0	1,1	0,4	
Diat. scale	Number	-	-	-	<b>2</b>	<b>9</b>	<b>21</b>	<b>13</b>	<b>13</b>	-	-	-	5c	
	Percentage %	-	-	-	3,4	15,5	36,2	22,4	22,4	-	-	-		

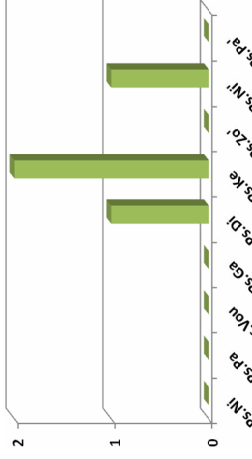
**Table 2.** Measurements for the *ison*, additive duration marks, new syllables, new *kola* and the total duration which is counted in quavers i.e. half *chronoi protoi*. (Pl.B': Plag of the second mode.)



**Graph 1a.** The notes with ison in the parts where the soft chromatic scale is used.

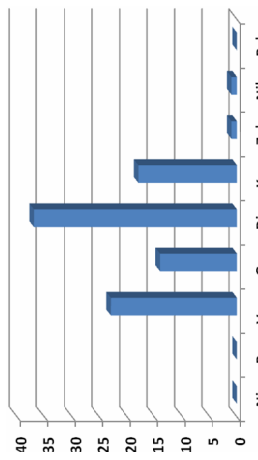


**Graph 1b.** The notes (*pseudoparallagi*) with ison in the parts where the intense chromatic scale is used.

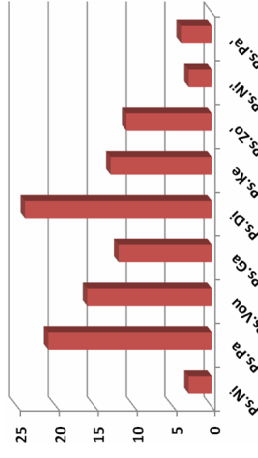


**Graph 1c.** The notes (*pseudoparallagi*) with ison in the parts where the diatonic scale is used.

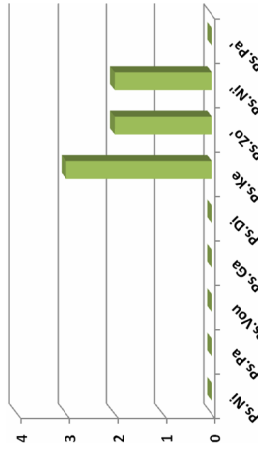
**Graphs 1a-c.** The notes (horizontal axis) and the number of (vertical axis) *isa* for each note in the *sticheron Σήμερον συνεχέχει τάφος* from the manuscript MPT 715, f. 193r-v.



**Graph 2a.** The notes with additive duration marks in the parts where the soft chromatic scale is used.

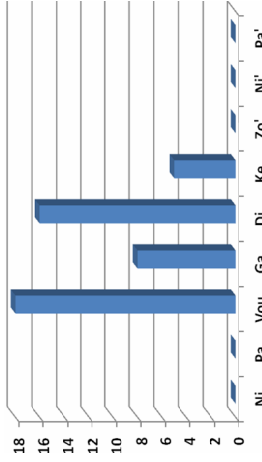


**Graph 2b.** The notes (*pseudoparallagi*) with additive duration marks in the parts where the intense chromatic scale is used.

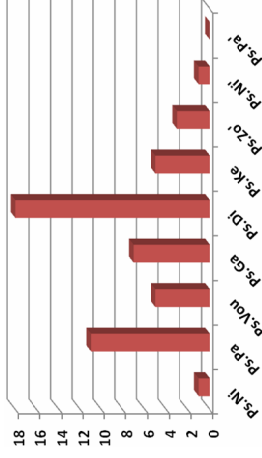


**Graph 2c.** The notes (*pseudoparallagi*) with additive duration marks in the parts where the diatonic scale is used.

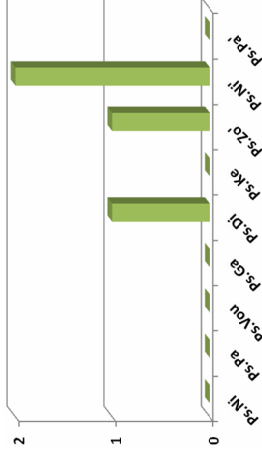
**Graphs 2a-c.** The notes (horizontal axis) and the number (vertical axis) of additive duration marks for each note in the *sticheron Σήμερον συνεχέχει τάφος* from the manuscript MPT 715, f. 193r-v.



**Graph 3a.** The first notes of the new syllables in the parts where the soft chromatic scale is used.



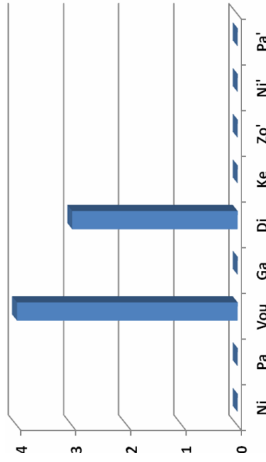
**Graph 3b.** The first notes (*pseudoparallagi*) of the new syllables in the parts where the intense chromatic scale is used.



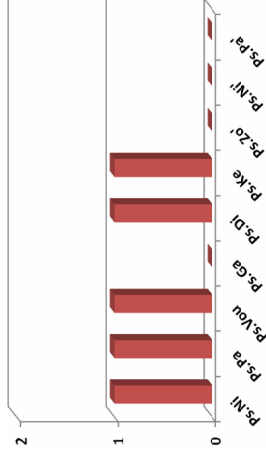
**Graph 3c.** The first notes (*pseudoparallagi*) of the new syllables in the parts where the diatonic scale is used.

**Graphs 3a-c.** The first notes (horizontal axis) and the number (vertical axis) of their appearance on a new syllable in the *sticheron Σήμερον συνέχει τόφος* in manuscript MPT 715, f. 193r-v.

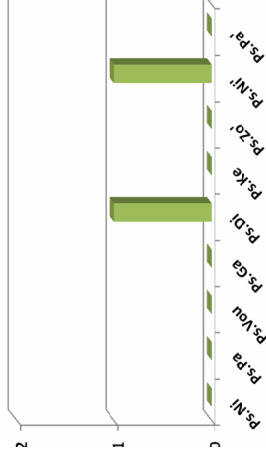
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**Graph 4a.** The first notes of the new *kola* in the parts where the soft chromatic scale is used.

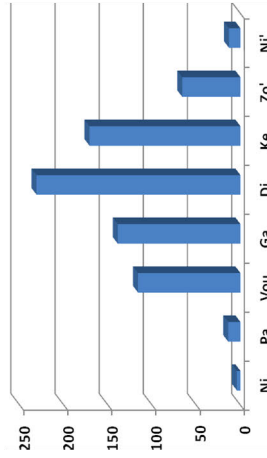


**Graph 4b.** The first notes (*pseudoparallagi*) of the new *kola* in the parts where the intense chromatic scale is used.

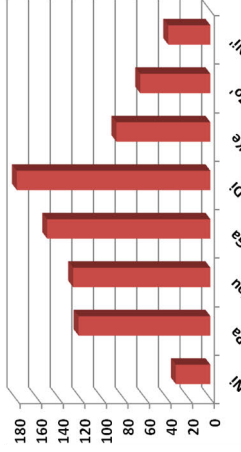


**Graph 4c.** The first notes (*pseudoparallagi*) of the new *kola* in the parts where the diatonic scale is used.

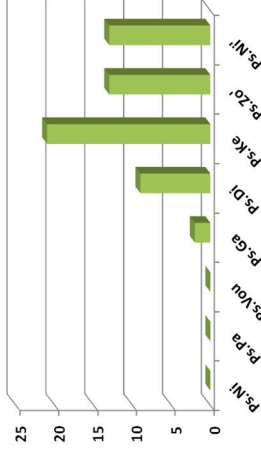
**Graphs 4a-c.** The first notes (horizontal axis) and the number (vertical axis) of their appearance on a new kola in the *sticheron Σήμερον συνέχει τόφος* in manuscript MPT 715, f. 193r-v.



**Graph 5a.** The overall duration of each note in the parts where the soft chromatic scale is used.

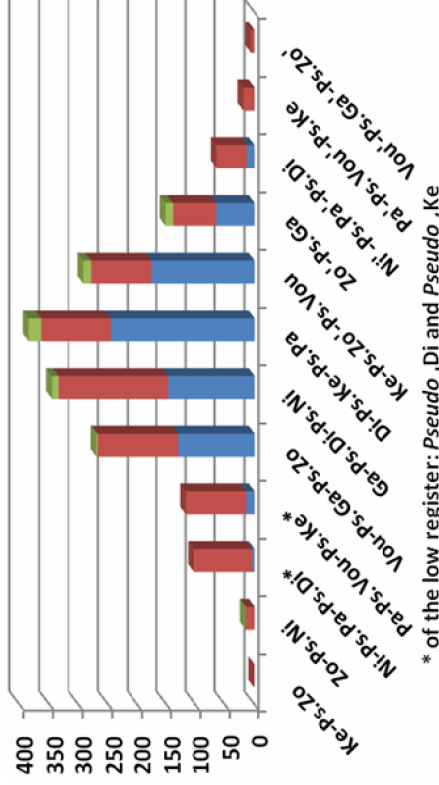


**Graph 5b.** The overall duration of each note (*pseudoparallagi*) in the parts where the intense chromatic scale is used.



**Graph 5c.** The overall duration of each note (*pseudoparallagi*) in the parts where the diatonic scale is used.

**Graphs 5a-c.** The notes (horizontal axis) and their overall duration (vertical axis) in the *sticheron Σήμερον συνέχει τάφος* in manuscript MPT 715, f. 193r-v.



\* of the low register: *Pseudo* ,Di and *Pseudo* ,Ke

**Graph 6.** The “profile” (distribution of the duration of the tones) of the second mode with finalis Di in the *sticheron Σήμερον συνέχει τάφος* in manuscript MPT 715, f. 193r-v. The inner modal oscillations in B’, pl.B’ mode and diatonic scale of the *sticheron* are included. Duration is counted in quavers i.e. half *chronoi protoi*.

## 2.2. Observing the measurements' results and the graphs 1a till 6

Observing the Graphs 1a-c for the *ison*, we can see that when the melody uses the soft chromatic scale, the notes with *ison* are more usually the notes Vou, Di and Ke (overall percentage of the dominating notes<sup>22</sup> of the B' mode Vou and Di<sup>23</sup>: 55,5%). On the other hand, when the melody uses the intense chromatic scale, the notes are more usually Pa and Di (overall percentage of the dominating notes of the plagal of the second mode [pl.B'] Pa and Di<sup>24</sup>: 53,7%). It should be noticed that in this *sticheron* there is no *ison* on note Pa in the soft chromatic scale, while there is no *ison* on note Vou of the *pseudoparallagi* in the intense chromatic scale. There are also small parts of short duration where the diatonic scale is used. For this reason we will not examine them in this paper. A future study will focus on the diatonic genre with more than two *stichera*.

Graphs 2a-c and Table 2 show us similar things with Graphs 1a-1c. Dominating notes are strengthened with additive duration marks more than the other notes. Vou and Di for the soft chromatic scale have an overall percentage: 63,8%. Pa and Di (*pseudoparallagi*) in the intense chromatic scale have an overall percentage: 41,3%, bigger than any other pair of notes.

In Graphs 3a-c and Table 2 we see a very strong relation between the dominating notes and the first note of the syllables of the hymnographic text. Specifically, the first note for each new syllable is more usually in the soft chromatic scale one of the dominating notes Vou or Di (overall percentage 72,3%), while in the intense chromatic scale syllables begin with the dominating notes Pa and Di (*pseudoparallagi*) in overall percentage 56,9%.

In Graphs 4a-c and Table 2 a difference between soft and intense chromatic scale is obvious. In the soft chromatic scale new *kola* begin exclusively with the dominating notes Vou and Di (percentage 100%) while in the intense chromatic scale new *kola* begin equally with notes of the *pseudoparallagi* Ni, Pa, Vou, Ga, Di (Pa and Di 40,0%).

Graphs 5a-c are differentiated from the previous graphs. While both in the soft and intense chromatic scale the note Di<sup>25</sup> has the biggest

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<sup>22</sup> Dominating notes are the notes, on which the cadences (perfect, imperfect, final) of the *melos* occur. Additionally, these notes appear more frequently and the melody focuses on them, while neighbour notes usually tend to be attracted by them. See: Παναγιωτόπουλος, *Θεωρία*, pp. 126-127.

<sup>23</sup> *Θεωρητικὸν μέγα τῆς μουσικῆς Χρυσάνθου τοῦ ἐκ Μαδύτων* (*Great Theoritikon of Music by Chrysanthos ek Madyton*), critical edition by Γεώργιος Κωνσταντίνου, *Ἱερά Μεγίστη Μονή Βατοπαδίου*, 2007, pp. 412-413.

<sup>24</sup> *Θεωρητικὸν μέγα*, pp. 420-421.

<sup>25</sup> For the intense chromatic scale: Di of the *pseudoparallagi*.

overall duration, notes Vou and Pa respectively are the fourth notes in overall duration. In the soft chromatic scale the second and the third note are Ke and Ga (Di 14,0%, Ke 10,4%, Ga 8,4% and Vou 7,0%). In the intense chromatic scale the second and the third note of the *pseudoparallagi* are Ga and Vou, followed by Pa on the fourth place (Di 10,8%, Ga 9,1%, Vou 7,7% and Pa 7,4%).

In Graph 6 we have the “profile” of the second mode for this *sticheron*. It seems that there is an axis of symmetry in this Graph formed by the notes Di-19,5% and Ga-21,8% (Ke and Di / Pa and Ni of the *pseudoparallagi* in the pl.B’ respectively). The notes higher than Di (Ke-16,5% and Zo’-8,6%) have a reduced overall duration in a similar way with the notes lower than Ga (Vou-15,3% and Pa-6,6%).

Concerning the above, we conclude that dominating notes of each mode-scale are melurgically strengthened with *ison* and additive duration marks (*prosthetika chronika simeia*) and are directly connected with the beginning of the microstructural (syllable) and mesostructural<sup>26</sup> (*kola*) parts of the musical-poetical text. However, as we see in Graphs 5a-c, they don’t have always the greatest overall duration. In short, dominating notes are strengthened qualitatively but not always quantitatively.

In this point we have to notice that we have already examined the *sticheron* in the new notation where almost every sign indicates a specific note and the B’ mode and the pl.B’ mode have a different scale with different intervals. In the old notation these two parameters were significantly differentiated. Firstly, in the old notation, the scale for the B’ and the pl.B’ mode is the same<sup>27</sup> and secondly, the old notation is treated as stenographical by the Three Teachers, thus being subjected to slow *exegesis*. This means that every sign indicates one or more than two notes or a whole musical phrase according to the musical context<sup>28</sup>. Thus, an important question arises: Which will be the results of the measurements if we examine the same *sticheron* in the middle-Byzantine notation?

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<sup>26</sup> For the categorization of the musical poetical text in microstructural, mesostructural and macrostructural level see: Σωτήρης Δεσπότης, *Ερμηνευτικές προσεγγίσεις στο μουσικό ύλικό της ελληνικής ψαλτικής τέχνης* (Sotirios Despotis, *Approaches to the interpretation of the music material of the Greek Chanting Art*), in Γρηγόριος ο Παλαμάς (pp. 417-428), γ. 90, fasc. 818, Θεσσαλονίκη, 2007, p. 421.

<sup>27</sup> See Fig. 2.

<sup>28</sup> Maria Alexandru, Kostas Tsougras, “On the Methodology of Structural Analysis in Byzantine and Classical Western Music – A Comparison”, in *Proceedings of the Fourth Conference on Interdisciplinary Musicology [CIMo8]*, ed. E. Cambouroπούλου, R. Parncutt, M. Solomos, D. Stefanou, C. Tsougras, A.U.Th. – School of Music Studies, Thessaloniki, 3-6 July 2008, p. 1.

### 3. The *sticheron Σήμερον συνέχει τάφος* in middle-Byzantine notation from the manuscript Dionysiou 564

Now we will examine the *sticheron Σήμερον συνέχει τάφος* in the old notation from the manuscript Dionysiou 564 (D 564) which is written by Gregorios Mpunis Alyatis in the year 1445<sup>29</sup>. As it is mentioned at the beginning of this paper, the highly important manuscript is neumated with fully developed Middle-byzantine notation. In Fig. 3 we see the *sticheron* with additional transnotation according to former researches<sup>30</sup>. As it is expected, there are no *phthorai* in the old manuscript despite the fact that in the interpretation by Chourmouzius we see eighteen *phthorai* for soft and intense chromatic and diatonic scale. Thus, an additional important question arises: Why did Chourmouzius Chartofylax made the modulations that we see in MPT 715? An obvious answer is that Chourmouzius knew the modulations from the oral tradition. However in this paper, we examine whether, except of the oral tradition, there are some embodied and hidden elements in the old notation which could reveal to us these modulations or generally some properties of the second mode and the chromatic genre.

We make the same measurements according to the modulations or rather modal oscillations in the interpretation by Chourmouzius Chartofylax. See Fig. 1 with the interpretation and the *phthorai* in MPT 715, Fig. 3 with the transnotation in D 564 according to the modulations in Chourmouzius' *exegesis* and Table 1 with the analysis in the hymnographic text. In Fig. 3 the letters of the transnotation indicate the modulations in the *exegesis*. Thus, the blue letters indicate soft chromatic scale in the interpretation, while red and green letters indicate intense chromatic and diatonic scale respectively. There are some syllables with two scales in their melody, for instance the syllable *-θος* of the word *λίθος*<sup>31</sup> with soft and intense chromatic scale. In such cases the color of the transnotation letter in Fig. 3 refers to the first scale. It is also important to be noticed that the transnotation letters for each syllable are without space. Moreover, the illegible place from this folio of D 564

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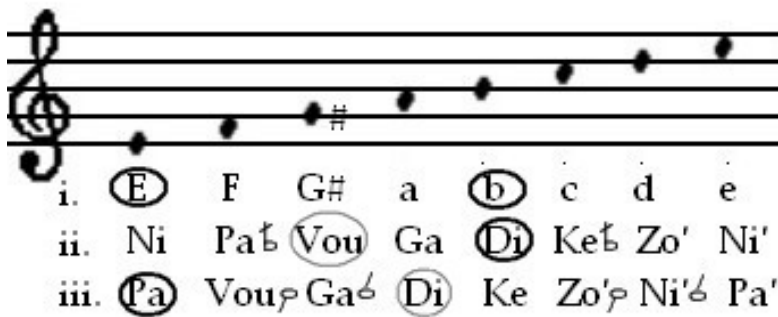
<sup>29</sup> For detailed information of the manuscript see unit 1. Introduction.

<sup>30</sup> Αλεξάνδρου, *Ἐξηγήσεις*, pp. 24-33, 76-77, 96. See also Jørgen Raasted, *Intonation Formulas and Modal Signatures in Byzantine Musical Manuscripts*. Monumenta Musicae Byzantinae: Subsidia 7, Munksgaard, Copenhagen, 1966. Cf. Ομάδα Παλαιογραφίας, "*Χρυσέοις ἔπει*", p. 370. For transnotations of the old notation on staff see also: Christian Troelsgård, *Byzantine Neumes: A New Introduction to the Middle Byzantine Musical Notation*, Monumenta Musicae Byzantinae: Subsidia 9, Museum Tusulanum Press, Copenhagen, 2011.

<sup>31</sup> See Fig. 1, lines 6-8.

has been supplemented according to a comparative study of many other manuscripts from the same period.

In Fig. 2 we see the scale of the second mode. Each note has three names. The first name is according to the old theoretical scale of the B' mode E, F, G#, a, b, c, d, e<sup>32</sup> and finalis (E). The second name is for the B' mode according to the New Method with the contemporary names Ni, Pa, Vou, Ga, Di, Ke, Zo', Ni', Pa' with finalis Di and dominating note Vou. The third name is for the pl.B' mode in the New Method with the finalis Pa and the dominating note Di<sup>33</sup>.



**Fig. 2.:**<sup>34</sup>

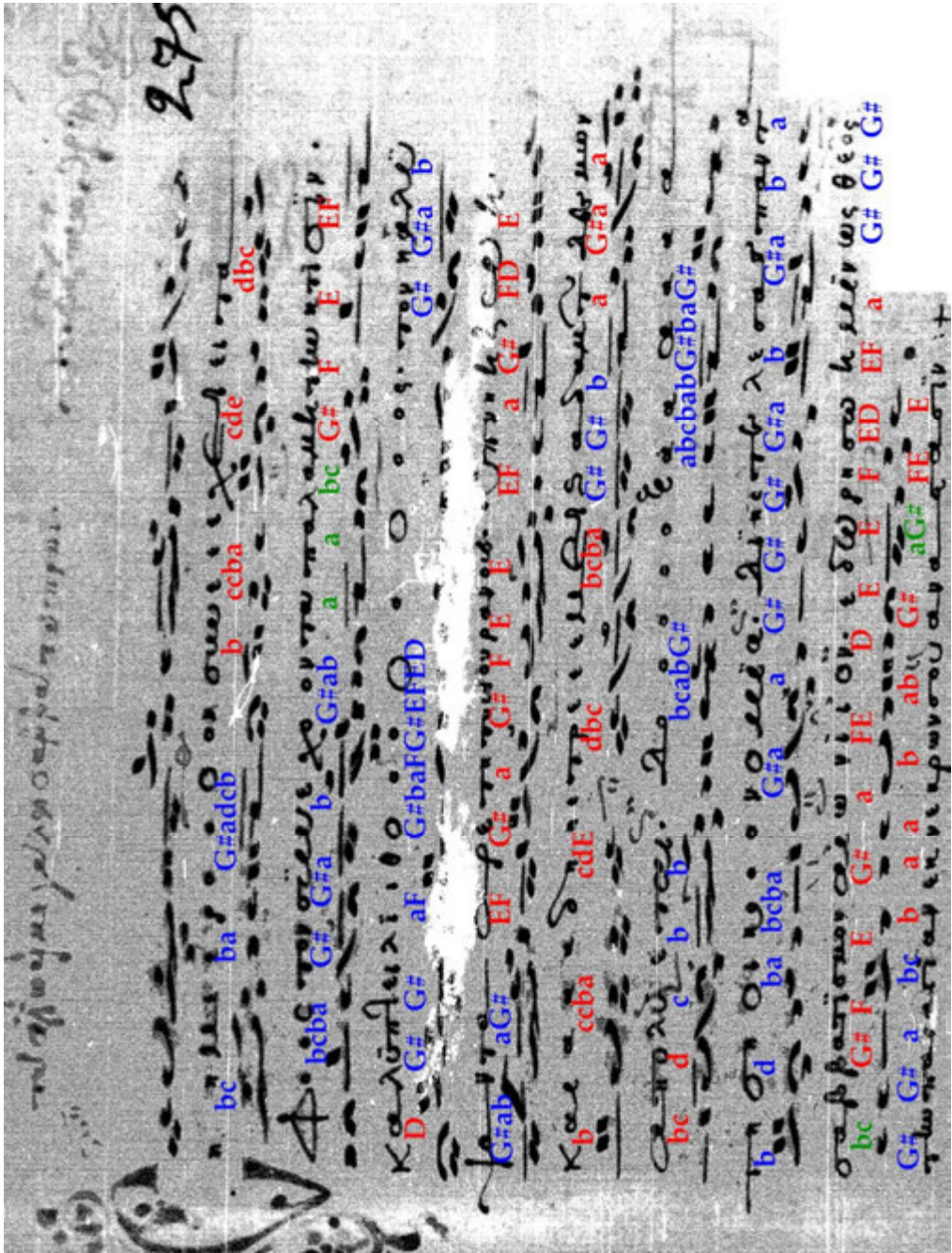
- i. The old theoretical scale of the second (B') and the plagal of the second (Pl.B') mode. Finales E and b.
- ii. The new theoretical scale of the B' mode. Finalis Di. Dominating notes Vou and Di.
- iii. The new theoretical scale of the pl.B' mode. Finalis Pa. Dominating notes Pa and Di.

<sup>32</sup> Μαρία Αλεξάνδρου, *Παλαιογραφία Βυζαντινής Μουσικής* (Maria Alexandru, *Palaeography of Byzantine Music*), vol. 3, Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης, academic year 2009-2010, p. 34, 37.

<sup>33</sup> *Θεωρητικόν μέγα*, pp. 412-413. See also: 1) Αλεξάνδρου, *Ἐξηγήσεις*, pp. 65-66. 2) Κωνσταντίνος Φλώρος, *Ἡ ἑλληνικὴ παράδοση στις μουσικὲς γραφές του μεσαίωνα. Εἰσαγωγή στη νευματικὴ επιστήμη* (Constantinos Floros, *The Greek tradition in musical notations of the Middle Ages. Introduction to Neumatic Science*), transl. Κώστας Κακαβελάκης, Ζήτη, Θεσσαλονίκη, 1998, p. 157.

<sup>34</sup> See the previous footnote.





**Fig. 3.** The *sticheron* *Σήμερον συνέχει τάφος* of the manuscript D 564, f. 275r. The structural notes are colored according to the modal oscillations between **soft** and **intense** chromatic scale and **diatonic** scale in the slow *exegesis* by Chourmouziou Chartofylax (MPT 715, f.193r-v).

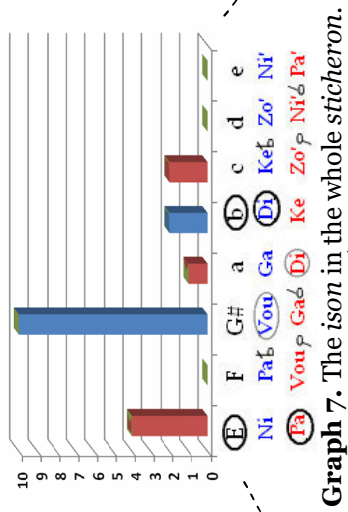
### 3.1. Table for measurements and Graphs

The above considerations could be summarized in **Table 3** and visualized in **Graphs 7a-12d**.

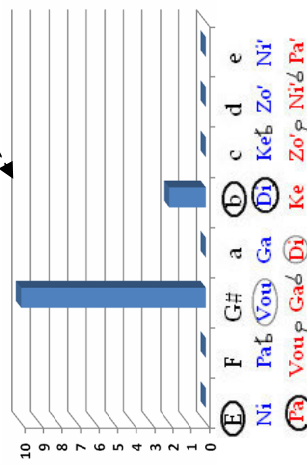
Manuscript Dionysiou 564, f. 275r												
Sign	Mode – Scale	Measurements – Percentage	Notes of the metrophonic structure: Old and New theoretical finalis							Graph		
			D	E	F	G#	a	b	c		d	e
			Zo	Ni	Pa	Vou	Ga	Di	Ke		Zo'	Nt'
Ison	B'	Number	-	-	-	10	-	2	-	-	-	7a
		Percentage %	-	-	-	83,3	-	16,7	-	-	-	
	Pl.B'	Number	-	2	-	-	1	-	2	-	-	7b
		Percentage %	-	40,0	-	-	20,0	-	40,0	-	-	
	Diaton. Scale	Number	-	-	-	-	-	-	-	-	-	7c
		Percentage %	-	-	-	-	-	-	-	-	-	
Dipli	B'	Number	-	-	-	3	1	4	-	-	-	8a
		Percentage %	-	-	-	37,5	12,5	50,0	-	-	-	
	Pl.B'	Number	-	3	-	-	2	1	2	-	-	8b
		Percentage %	-	37,5	-	-	25,0	12,5	25,0	-	-	
	Diaton. Scale	Number	-	-	-	-	-	-	-	-	-	8c
		Percentage %	-	-	-	-	-	-	-	-	-	
Dyo apostrophoi	B'	Number	-	-	-	2	1	1	-	-	-	9a
		Percentage %	-	-	-	50,0	25,0	25,0	-	-	-	
	Pl.B'	Number	1	2	-	-	1	-	-	-	-	9b
		Percentage %	25,0	50,0	-	-	25,0	-	-	-	-	
	Diaton. Scale	Number	-	-	-	-	-	-	-	-	-	9c
		Percentage %	-	-	-	-	-	-	-	-	-	
Kratima	B'	Number	-	-	-	1	-	4	1	-	-	10a
		Percentage %	-	-	-	16,7	-	66,6	16,7	-	-	
	Pl.B'	Number	-	-	-	-	1	-	2	1	-	10b
		Percentage %	-	-	-	-	100	-	-	-	-	
	Diaton. Scale	Number	-	-	-	-	-	-	-	-	-	10c
		Percentage %	-	-	-	-	-	-	-	-	-	
New syllable	B'	Number	1	-	-	22	8	16	1	1	-	11a
		Percentage %	2,0	-	-	44,9	16,3	32,7	2,0	2,0	-	
	Pl.B'	Number	1	13	7	8	9	6	4	3	-	11b
		Percentage %	2,0	25,5	13,7	15,7	17,6	11,8	7,8	5,9	-	
	Diaton. Scale	Number	-	-	-	2	1	-	-	-	-	11c
		Percentage %	-	-	-	66,7	33,3	-	-	-	-	
New kola	B'	Number	-	-	-	5	-	2	-	-	-	12a
		Percentage %	-	-	-	71,4	-	28,6	-	-	-	
	Pl.B'	Number	1	2	-	-	1	1	-	-	-	12b
		Percentage %	20,0	40,0	-	-	20,0	20,0	-	-	-	
	Diaton. Scale	Number	-	-	-	-	-	1	-	-	-	12c
		Percentage %	-	-	-	-	-	100	-	-	-	

**Table 3.** Measurements for the *ison*, *dipli*, *dyo apostrophoi*, *kratima*, new syllables, and new *kola*. Old and new theoretical finalis<sup>35</sup>.

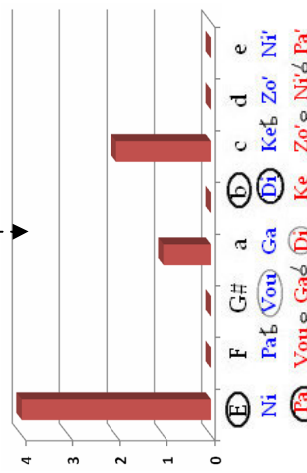
<sup>35</sup> See Fig. 2.



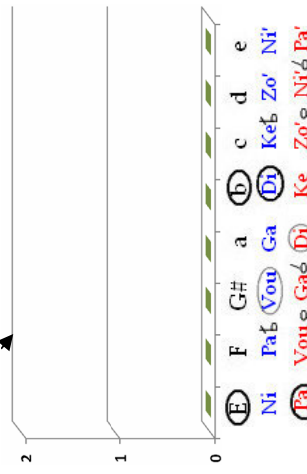
**Graph 7.** The ison in the whole *sticheron*.



**Graph 7a.** The ison in the parts where the soft chromatic scale is used in the *exegesis*.

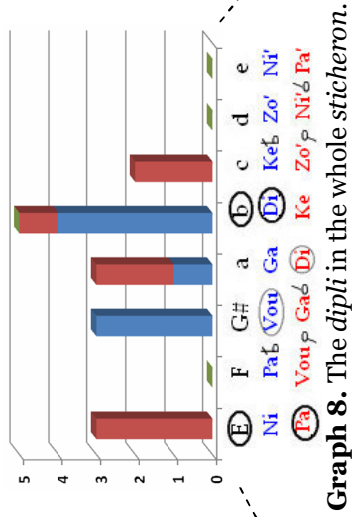


**Graph 7b.** The ison in the parts where the intense chromatic scale is used in the *exegesis*.

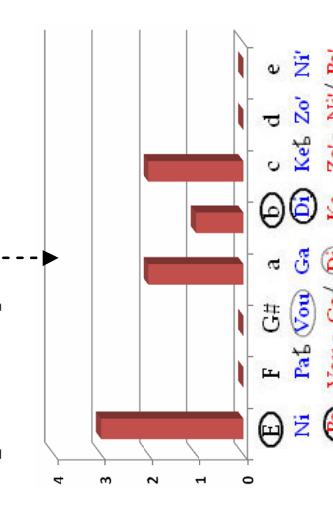


**Graph 7c.** The ison in the parts where the diatonic scale is used in the *exegesis*.

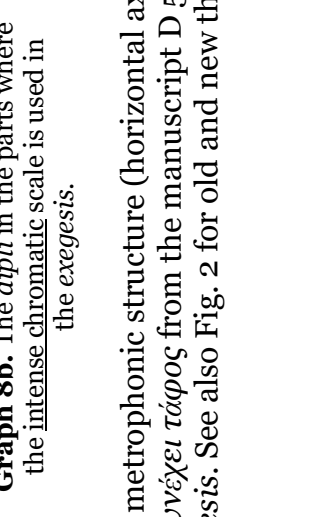
**Graphs 7-7(a-c).** The notes of the metrophonic structure (horizontal axis) and the number (vertical axis) of the *isa* in the *sticheron* *Σήμερον συνεχεται ταφος* from the manuscript D 564, f. 275r. Colors indicate the modal oscillations in Chourmouziotis' *exegesis*. See also Fig. 2 for old and new theoretical scale of B' and pl.B' mode.



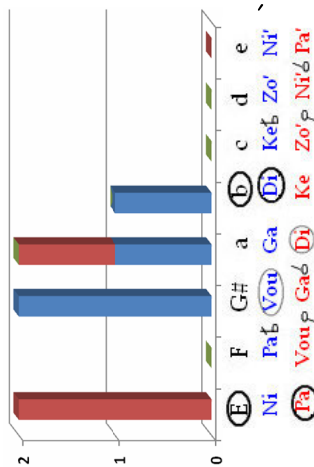
**Graph 8.** The *dipli* in the whole *sticheron*.



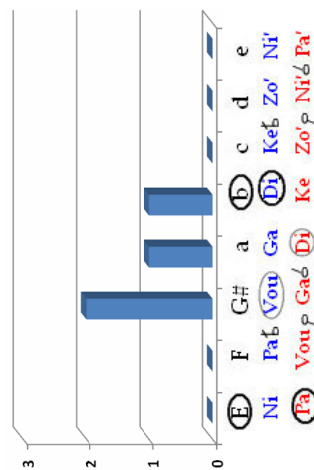
**Graph 8c.** The *dipli* in the parts where the diatonic scale is used in the *exegesis*.



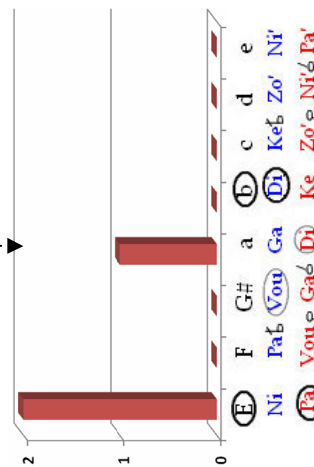
**Graphs 8-8(a-c).** The notes of the metrophonic structure (horizontal axis) and the number (vertical axis) of the *diples* in the *sticheron* Σήμερον συνέχει τάφος from the manuscript D 564, f. 275r. Colors indicate the modal oscillations in Chourmouziou's *exegesis*. See also Fig. 2 for old and new theoretical scale of B' and pl.B' mode.



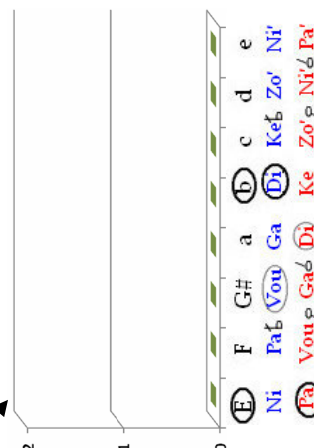
**Graph 9a.** The *dyo apostrophoi* in the whole *sticheron*.



**Graph 9b.** The *dyo apostrophoi* in the parts where the soft chromatic scale is used in the *exegesis*.

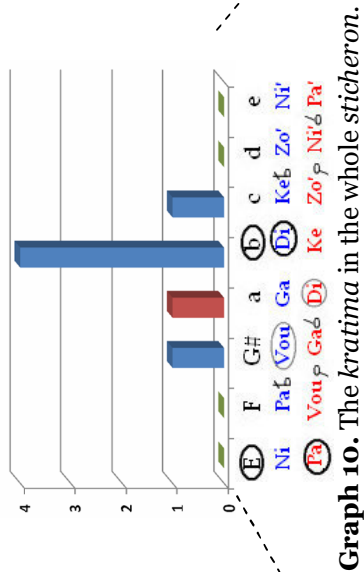


**Graph 9c.** The *dyo apostrophoi* in the parts where the intense chromatic scale is used in the *exegesis*.

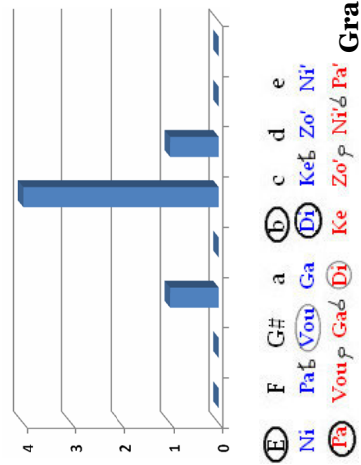


**Graph 9d.** The *dyo apostrophoi* in the parts where the daitonic scale is used in the *exegesis*.

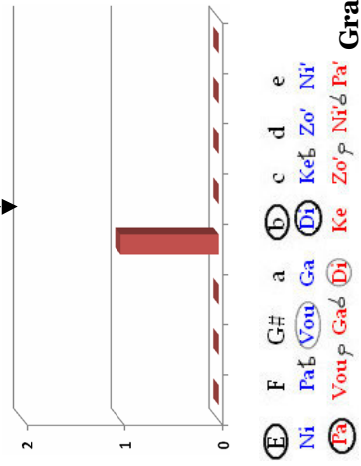
**Graphs 9-9(a-c).** The notes of the metrophonic structure (horizontal axis) and the number (vertical axis) of the *dyo apostrophoi* in the *sticheron* Συμμερον συνεχεται τάρφος from the manuscript D 564, f. 275r. Colors indicate the modal oscillations in Chourmouziou's *exegesis*. See also Fig. 2 for old and new theoretical scale of B' and pl.B' mode.



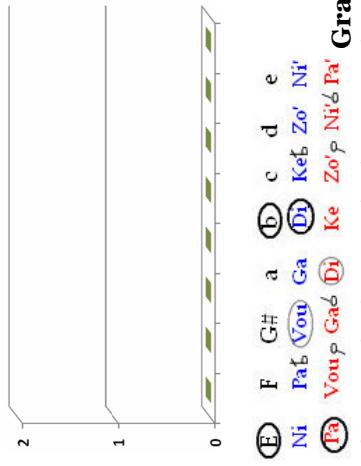
**Graph 10.** The *kratima* in the whole *sticheron*.



**ph 10a.** The *kratima* in the parts where the soft chromatic scale is used in the *exegesis*.

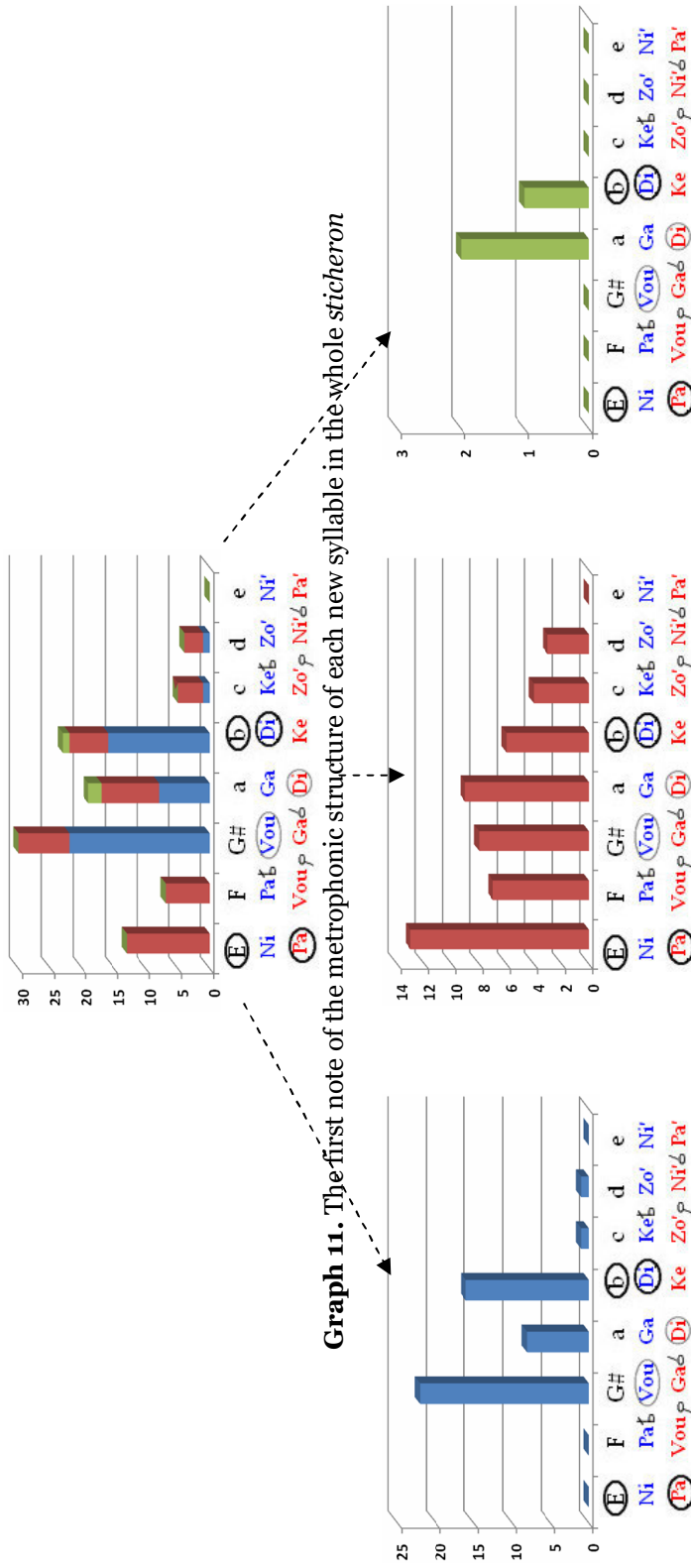


**ph 10b.** The *kratima* in the parts where the intense chromatic scale is used in the *exegesis*.



**ph 10c.** The *kratima* in the parts where the diatonic scale is used in the *exegesis*.

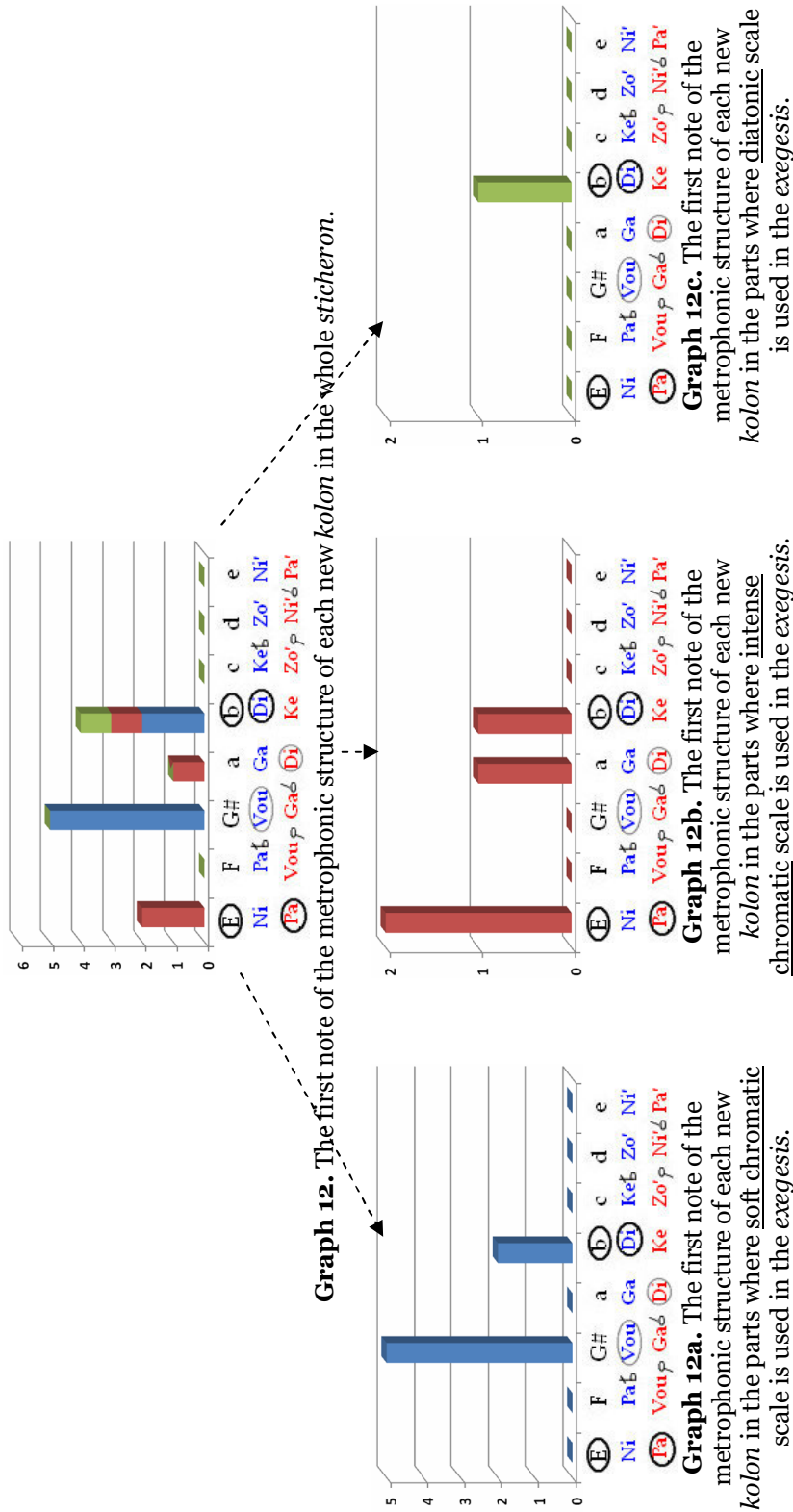
**Graph 10-10(a-c).** The notes of the metrophonic structure (horizontal axis) and the number (vertical axis) of the *kratima* in the *sticheron* *συνέχει τάφος* from the manuscript. Colors indicate the modal oscillations in Chourmouziou's *exegesis*. See also Fig. 2 for old and new theoretical scale of B' and pl.B' mode.



**Graph 11.** The first note of the metrophonic structure of each new syllable in the whole sticheron

**Graph 11c.** The first note of the metrophonic structure of each new syllable in the parts where diatonic scale is used in the exegesis.

**Graphs 11-11(c).** The first note of the metrophonic structure (horizontal axis) and the number (vertical axis) of the appearances in a new syllable in the *sticheron* Συμπερον *συνέχει τάφος* from the manuscript D 564, f. 275r. Colors indicate the modal oscillations in Chourmouziot' *exegesis*. See also Fig. 2 for old and new theoretical scale of B' and pl.B' mode.



**Graphs 12-12(a-c).** The first note of the metrophonic structure (horizontal axis) and the number (vertical axis) of the appearances in a new *kolon* (vertical axis) in the *sticheron* *συνέχει τάφος* from the manuscript D 564, f. 275r. Colors indicate the modal oscillations in Chourmouziotis' *exegesis*. See also Fig. 2 for old and new theoretical scale of B' and pl.B' mode.



### 3.2. Observing the measurements and the Graphs 7(a-c) till 12(a-c)

In Fig. 3, Table 3 and Graphs 7a-7d we see that the *ison* in the blue notes of the metrophonic structure<sup>36</sup> (soft chromatic scale) occurs only on G# and b / Vou and Di. More specifically, ten of the twelve *isa* are on the structural note G# / Vou. On the other hand, in the red Graph 7b we see that *isa* are on the structural notes E, a and c / Ni, Ga and Ke. This is important because the structural notes E and a, define a tetrachord which indicates the tetrachord Pa-Di in the New Method. Thus, the structural notes E, a and c / Ni, Ga and Ke correspond to Pa-Di-Zob. We will not comment the graphs for the diatonic parts due to their small percentage in this *sticheron*.

Graphs 8-8(a-c), 9-9(a-c), 10-10(a-c), 11-11(a-c) and 12-12(a-c) have a similar form with Graphs 7-7(a-c). Structural notes G# and b / Vou and Di in parts which have been interpreted in the soft chromatic scale are connected with the *dipli*, *dyo apostrophoi*, *kratima* and the beginning of the new syllables and *kola*. Respectively, in Graphs 8b, 9b, 11b and 12b, structural notes E and a / Ni and Ga are more than any other note connected with these measurements' objects.

## 4. Conclusions

❖ According to the measurements of this study in the *sticheron Σήμερον συνέχει τάφος*, some conclusions for the chromaticity and the dominating notes in the old sticheraric genre arise.

❖ In the new notation dominating notes are melurgically-compositionally strengthened with the usual repetition via *ison* (Graphs 1-1[a-c]) and with the usual extension of their duration through additive duration marks (Graphs 2-2[a-c]).

❖ Dominating notes (Δεσπίζοντες φθόγγοι) have a direct relation with the microstructural (syllables) and mesostructural (*kola*) verbal units of the hymnographic text, since they usually function as their first note.

❖ Dominating notes are differentiated as far as their overall duration is concerned. One of the two dominating notes has the greatest overall duration (Di in the B' and Ps.Di in pl.B' mode), while the other

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<sup>36</sup> As we mentioned in 1. Introduction. Notes of the metrophonic structure or structural notes are the notes we read in metrophonic structure (old notation). However, dominating notes (in the new notation) are the notes, on which the cadences (perfect, imperfect, final) of the *melos* occur. Additionally, these notes appear more frequently and the melody focuses on them, while neighbour notes usually tend to be attracted by them. See: Παναγιωτόπουλος, *Θεωρία*, pp. 126-127.

dominating notes have the fourth overall duration (Vou in the B' and Ps.Pa in pl.B' mode).

❖ To sum up the above, dominating notes are strengthened qualitatively but not necessarily quantitatively.

In new and old notation,

❖ The parts of the *exegesis* where Chourmouzos uses the soft chromatic scale correspond to the parts of the D 564 where the metrophonic structure focuses on notes G# and b / Vou and Di; In the same way, the parts of the interpretation where Chourmouzos uses the intense chromatic scale correspond to the parts of the D 564 where the metrophonic structure focuses on notes E and a / Ni and Ga. This means that in the second mode the metrophonic structure indicates the modal oscillations we see in the slow *exegesis*.

❖ It is about an indirect way of suggesting-showing the modulations since those are not explicitly noted (with *phthorai*) in the musical manuscript. These modulations or better modal oscillations will be easily noticed-recognized by an expert in old notation and oral tradition like the Three Teachers.

❖ It seems that there was no need for *phthorai* in middle-Byzantine notation in such cases. The notes of the metrophonic structure had greater «melurgical-compositional importance» than in new notation and sometimes, under specific circumstances, an individual note, which was strengthened for example with one or two contiguous *isa*, indicated a modulation in another mode<sup>37</sup>. With the passing of centuries the old notation becomes more and more *exegetical-analytical*. Thus, the same «melurgical-compositional idea» is shared-described in more notes than before and the «melurgical-compositional importance» of each note is decreased. This made more difficult for the musician to estimate-recognize the importance of the metrophonic structure notes which could lead to modulation. A need for an easier and direct sign for modulation arose, the *phthora*.

❖ The same measurements have been already done for other signs (e.g. *tsakisma*, *bareia* e.t.c.) and possibly will be presented in the future. It seems that such a palaeographical and statistical approach can reveal elements for the functionality of these signs in the old notation.

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<sup>37</sup> Such a case can be observed on the words *ως Θεός* in D 564 (end of the eighth line), in comparison with the interpretation in MPT 715.

**A statistical approach of the chromaticity.  
The sticheron *Σήμερον συνέχει τάφος* – *Today, a tomb holds Him* in the new and old notation**

**ABSTRACT**

The present study proposes an interdisciplinary approach (Musicology and Mathematics – Statistic) which has to do with the analysis to the Byzantine Music through the research in manuscripts with new and old notation. More specifically, we use a mathematically-statistically informed approach to investigate chromaticity in the *sticheron Σήμερον συνέχει τάφος* – *Today, a tomb holds Him* which is chanted as the first idiomelon of the Lauds of Mattins of Holy Saturday and it is in the second (B') mode with finalis *Di*.

According to the measurements of this study in the *sticheron Σήμερον συνέχει τάφος*, some conclusions for the chromaticity and the dominating notes in the old sticheraric genre arise; In the new notation dominating notes are melurgally-compositionally strengthened with the usual repetition via *ison* (Graphs 1-1[a-c]) and with the usual extension of their duration through additive duration marks (Graphs 2-2[a-c]); Dominating notes (Δεσπίζοντες φθόγγοι) have a direct relation with the microstructural (syllables) and mesostructural (*kola*) verbal units of the hymnographic text, since they usually function as their first note.

In new and old notation, the parts of the *exegesis* where Chourmouzios uses the soft chromatic scale correspond to the parts of the D 564 where the metrophonic structure focuses on notes G# and b / Vou and Di. In the same way, the parts of the interpretation where Chourmouzios uses the intense chromatic scale correspond to the parts of the D 564 where the metrophonic structure focuses on notes E and a / Ni and Ga. This means that in the second mode the metrophonic structure indicates the modal oscillations we see in the slow *exegesis*; It is about an indirect way of suggesting-showing the modulations since those are not explicitly noted (with *phthorai*) in the musical manuscript. These modulations or better modal oscillations will be easily noticed-recognized by an expert in old notation and oral tradition like the Three Teachers.

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