

COMPARISON and INTEGRATION of APPROACHES to DECIPHERING of ANCIENT RUSSIAN HYMNALS

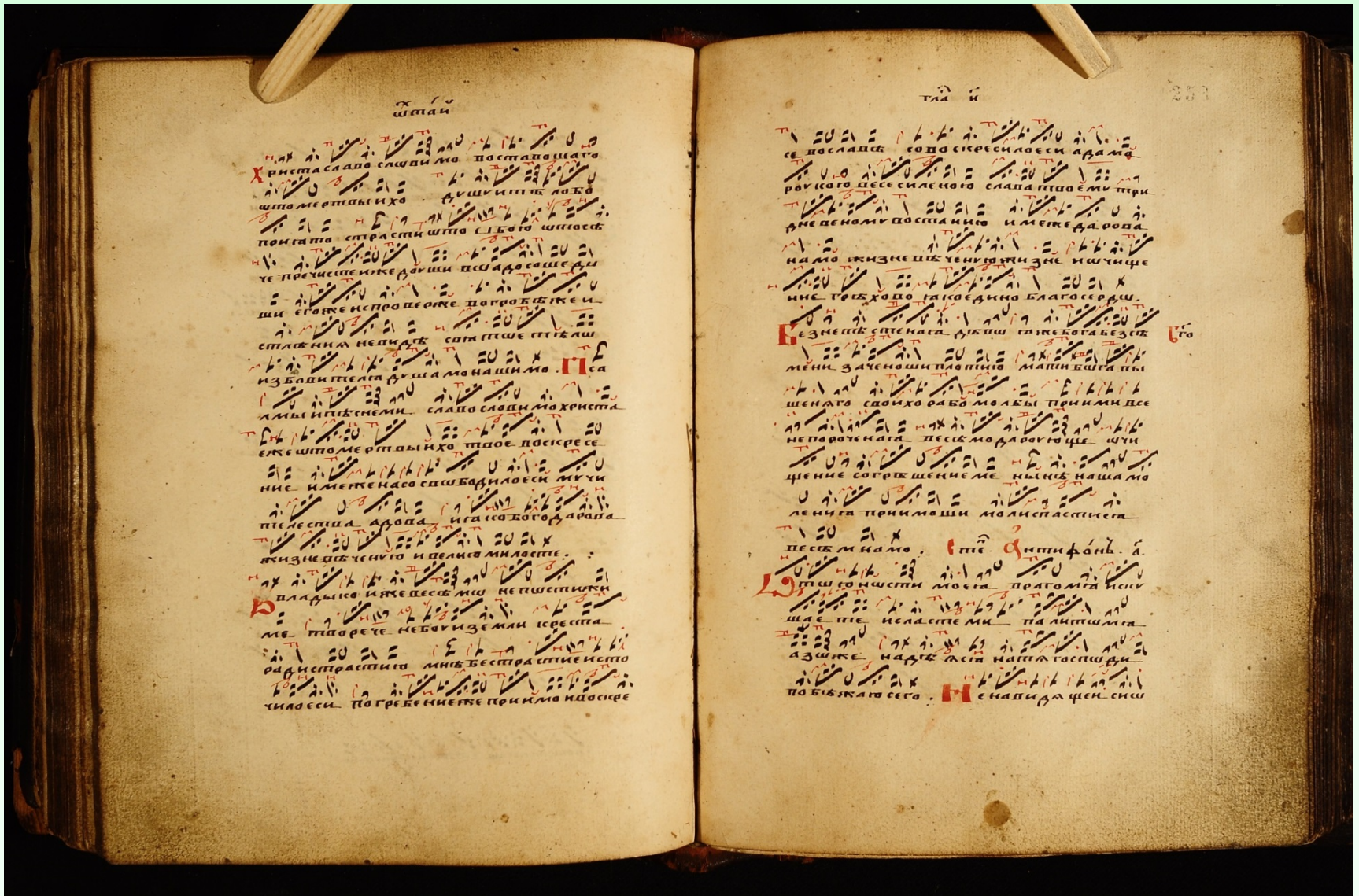
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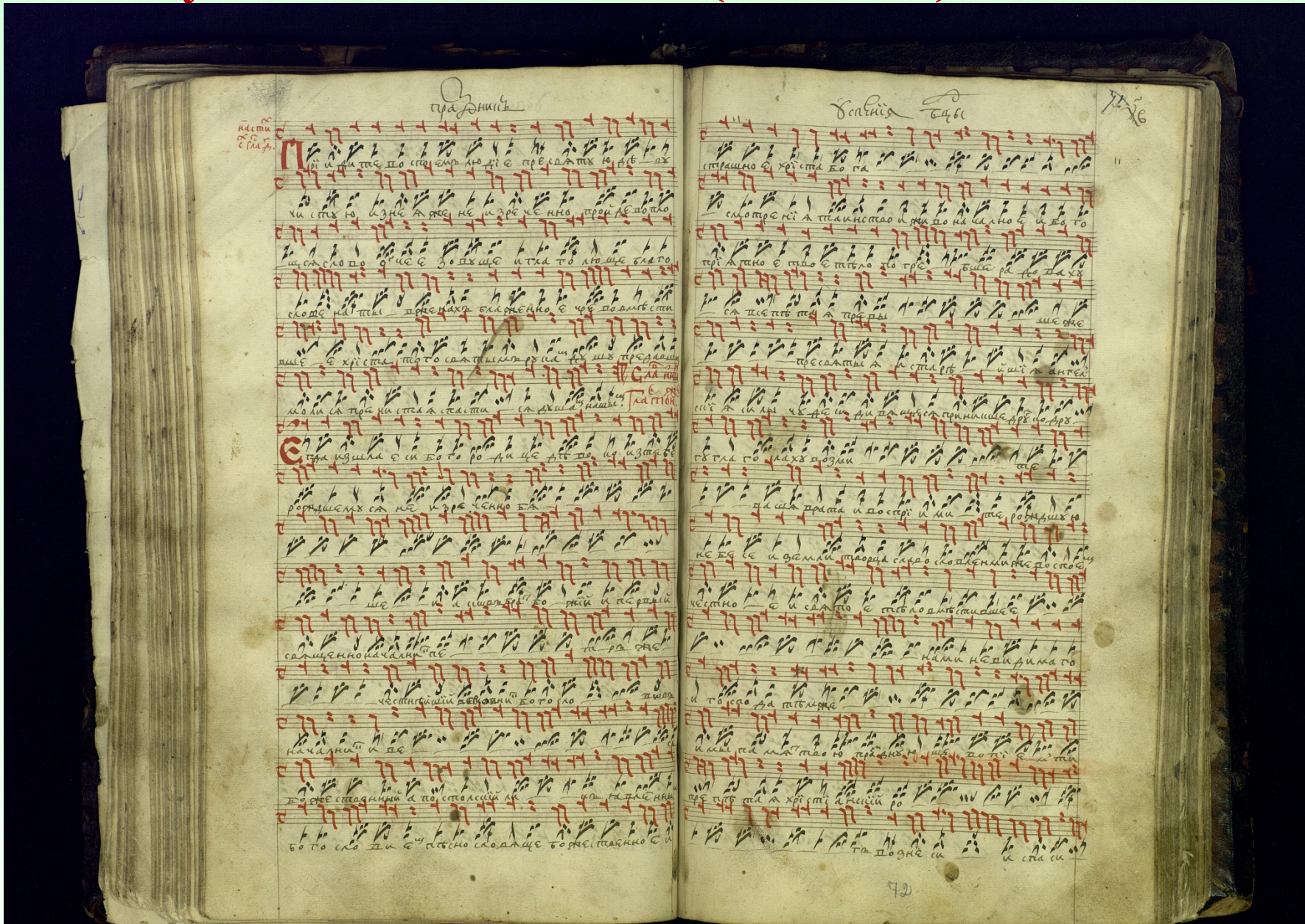
Example from the manuscript

СОУДЕБЪ ГЛУБИНА ДЕЛИКА . ЕДИНОСЛАВНО
НО ШПЕЦУ ИСЫНУ СОСЛУЖЕБЕНОВЪ . Х
С ПЕПЕ . ГЛА . И . АНТИ . А .
С ПЛОЮНОСТИ МОЕА . ДРАГОМНА ИС
КУЩАЕТЕ И СЛАСТЕМИ ПАЛИТОМНА .
А ВОЖЕНА ДЬ АСА НА ППАТОСПОДИ .
И ЛОВ БЖАЮ СЕГО . Х **Н**ЕНАДИДЦЕН
СИШНА . ААБУДУПТЕОУБО ПРЕЖЕ ПОСПО
РЖЕНИИ НА ПО ПРАДА . СОСЪ ЧЕПЪБО
ХРИСТОСЪ ПЫНА ИХО . УСТЬ ЧЕНИЕМЕМУ
ИСО . Х **С** ПНАТЫМЪ ДУХОМЕ ЕРЖЕЖИ
ПИ ПЕСЬ ГЛА . СЪТЪ ПО ШПСОПЪ ПТА
БОГОДЕЛИКО . СО ШПЕЦЕМЕ БО ПОЕМЪ Е

Example of hymnal with a marks (pometas)



Dvoeyznamennik: neumes (znamena) and notes



The coding of hymnals from a dvoeyznamennik

- Coding of neume:
 - 1: stepennya pometa; 2-5: neume code; 6: indicating pometa
- Example of correspondence between notes and pometas

Г	Н	Ц	Г	Н	·	Ж	П	В	Ж	П	Ъ
простое согласие			мрачное согласие			светлое согласие			тресветлое согласие		
G	A	H	c	d	e	f	g	a	b	C	D

Duration of notes: 1 2 2. 4 4. 8

- Old Slavonic text of verses

Example of the coding

(m0401-c2Bo)(v0121-e2нми)(r0121-e2зе)(r0111-e2мле)(r0211-e4d4и)

(r1941-c4d4e2не)(p1011-d1бо)(v0901-c4e4и)(p0302-d4c4вну)(-0501Td2e2ши)

(*1021-f1)(-0511-d4e4гла)

Old-Russian neume notation - 'kryuki' (hooks)

Examples of neume writing



– 'kryuk' (hook) (e_2);



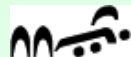
– palka ($e_2, f_2, e_4f_4, d_4c_4\dots$);



– chashka (d_4c_4)



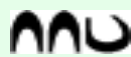
– strela prostaya: f_1 ($e_1\dots$)



– strela povodnaya s oblachkom I ottyazhkoj: $d_4e_4f_2.d_4$



– golubchik borzyi : c_4d_4 ($d_4e_4, e_4f_4\dots$)



– khamila: $H_4H_4A_2$



– zmiitsa so stat'ioi: $d_4e_4d_4.c_8H_4$

Examples of interpretation:










– *столица с очком*: назад отшибнуть гортанью, вскочить и опуститься на голубчик или на скамейцу: e_4d_4 ($d_4c_4\dots$)








– *сложитие*: покудрить гортанью: $f_8e_8f_4, g_4f_4\dots$

Sets of neumes ...

-  – *крюк* ($e_2, H_4 \dots$)
-  – *оттяжка* ($d_2, d_1 \dots$)
-  – *крюк с подчашием* ($e_2 d_2, e_2 . d_2 \searrow$)

-  – *крюк мрачный* ($e_2, d_4 \dots$)
-  – *крюк мрачный с оттяжкой* (f_2, e_2)
-  – *крюк мрачный с подчашием* ($e_2 d_2 \searrow$)
-  – *крюк мрачный с оттяжкой и подчашием* ($g_2 f_2 \searrow$)

-  – *крюк светлый* ($g_2, g_4, g_4 b_4 \nearrow \dots$)
-  – *крюк светлый с подверткой* ($f_4 e_4 \searrow$)
-  – *крюк с сорочьей ножкой* (C_2, C_4)

-  – *крюк тресветлый* (b_2)
-  – *крюк тресветлый с подчашием* ($b_2 a_2 \searrow$)

Initial data

Learning material: Octoechos (Oktoikhs) XVII– XVIII sc.

RNB, St.–Petersburg, Solovetskoe collection, 619/647, 618/644 and QI188.

8 parts (echos - glas)

Number of hymnals in various ichoses

619/647 and 618/644: 25 – 29;









QI188: 17 – 19.

Length of hymnals : 32 – 314 (on average 80-100) neumes.

Checking material: Hirmologion (Irmologii) from Odoevskyi collection
(M., PGB, Ф.210, №18).

Various interpretations of a hook



R1 = 	473	525	442	506	443	334	321	612
	408	508	422	484	408	319	298	600
	d - 1	e - 3	c - 1	d - 4	f - 52	c - 2	c - 1	c - 2
	e - 26	f - 103	f - 33	e - 6	f - 177	d - 11	d - 2	e - 2
	f - 70	g - 191	g - 112	f - 100	g - 233	e - 28	e - 71	f - 189
	g - 211	a - 206	a - 234	g - 317	a - 116	f - 34	f - 34	g - 260
	a - 100	b - 5	b - 17	a - 57	b - 3	g - 90	g - 171	a - 142
			C - 25		C - 2	a - 11	a - 19	b - 5
					D - 2			
					C - 16			
R2 =  I1 (R2) = 2+ I2 (R2) = 1-	53	2			16	1		
	g - 53	f - 2			C - 16	f - 1		
R3 = 	11	14	17	11	13	10	17	8
				d - 1			d - 1	d - 2
R4 = 	1		3	9	5	4	4	3
						d - 2		
R5 =  I (R5) = 1-		1						
		a - 1						
R6 = 				g - 2			g - 2	
R7 = 					a - 1			
R8 =  I (R8) = 2-								1
								g - 1

Popevki of Mettallov V.M. (~ 500 popevok)

d2e4f4g1	Подъем малый
c4d4f4e4d4c2d2e1	Рымза
e4f4g4a4a4g2.	Дербица малая
g4a4g4f4e4f4g4a4a4g2.	Дербица большая
g4f4g4a4g4f4e4f4g4a4a4g2.	Дербица полная
c4d4e2c4e4d2c1d1	Мережа нижняя
f4e4f4g4a2g4f4g2f2e2d2f1	Завивец возводной
e4d4e4f4g2f2e4d4f2e2d4c4d4e4f2e1	Лацега большая
c4H4c4d4e2d2c4H4A4H4c4d4c2.H4c4d4e4d4c2d1	Храбрица полная с пауком великим

Гласы	1	2	3	4	5	6	7	8
М.	0.33	0.19	0.17	0.23	0.18	0.21	0.32	0.15
Zn.	0.26	0.12	0.22	0.16	0.06	0.12	0.42	0.06
+	0.89	0.66	0.83	0.87	1	0.85	0.83	0.77

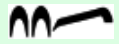
«М.» – covering of Irmologii by Metallov's popevkas

«Zn.» – covering of Irmologii by neume popevkas, reconstructed through comparison Metallov's popevkas and dvojeznamennic Oktoikh

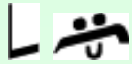
«+» – true covering of Irmologii by neume popevkas

Interglas invariants (*II*) и quasi-invariants (*QII*)

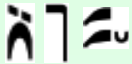
Invariants – neume chains that are interpreted unambiguously.



стрела громная / A1 / $F = 69$



стопица + подчашие светлое / e2 f4 / $F = 62$



голубчик борзый + палка + статья простая с подверткой /

/ e4f4 g2 e4f4e4d4 / $F = 27$

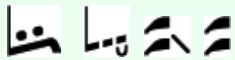


2 стопицы + подчашие светлое + запятая + палка + статья простая

/ e2 e2 f4e4 d2 e2 d1 / $F = 20$

Maximum length of *II* - 11

The chain of neumes is defined as *QII* if $F \geq 3$ and $F_{\max} / F > 1/2$



крюк светлый + переводка с подверткой + статья закрытая малая + статья

g2 e4f4d4 e1 d1 / $F = 23$,

a2 e4f4d4 e1 d1 / $F = 1$.

The covering of Irmologii by II and QII

Glas	1	2	3	4	5	6	7	8
+	0.686	0.595	0.623	0.637	0.636	0.502	0.791	0.487
?	0.263	0.276	0.296	0.277	0.301	0.339	0.174	0.347
-	0.052	0.129	0.08	0.086	0.063	0.159	0.035	0.167

Algorithms of deciphering

1. Zero option: the alphabets for each of 8 ichoses from 3 Oktoikhs are constructed. For each neume from Irmologii we choose its note interpretation with maximal frequency from constructed alphabet
2. Deciphering by dictionaries of 3-gramms
3. Deciphering by dictionaries of II and QII
 - Threshold by frequency in Oktoikhs – 3
 - Threshold by frequency in Oktoikhs– 2
4. Combination of approaches 3 and 1. If there is no invariants then use the maximal value from alphabet.
5. Combination of approaches 3 and 2.
6. Invariants + Metallov's popevki + 1
7. Invariants + Metallov's popevki + 2
8. Invariants + Metallov's popevki + popevki from Diachie Oko + 1
9. Invariants + Metallov's popevki + popevki from Diachie Oko + 2

Results of deciphering

	Glas	1	2	3	4	5	6	7	8
	Approach								
1	Alphabet	0.538	0.436	0.476	0.475	0.503	0.418	0.541	0.433
2	3-gramm	0.657	0.572	0.586	0.552	0.558	0.517	0.712	0.499
3	II /QII (thresh 3)	0.686	0.595	0.623	0.637	0.636	0.502	0.791	0.487
4	II /QII (thresh 2)	0.704	0.603	0.663	0.647	0.642	0.522	0.809	0.534
5	3 + 1	0.702	0.625	0.649	0.666	0.648	0.549	0.799	0.517
6	3 + 2	0.701	0.632	0.654	0.667	0.652	0.557	0.802	0.528
7	3 + popevki M. + 1	0.720	0.636	0.650	0.674	0.650	0.567	0.838	0.511
8	7 + popevki D.o.	0.706	0.641	0.653	0.673	0.650	0.551	0.799	0.517
9	II/QII (3)+M.+D.o. +3-gr.	0.720	0.648	0.652	0.671	0.656	0.572	0.835	0.523
10	II/QII (2)+M.+D.o. +3-gr.	0.732	0.652	0.686	0.675	0.659	0.579	0.843	0.528

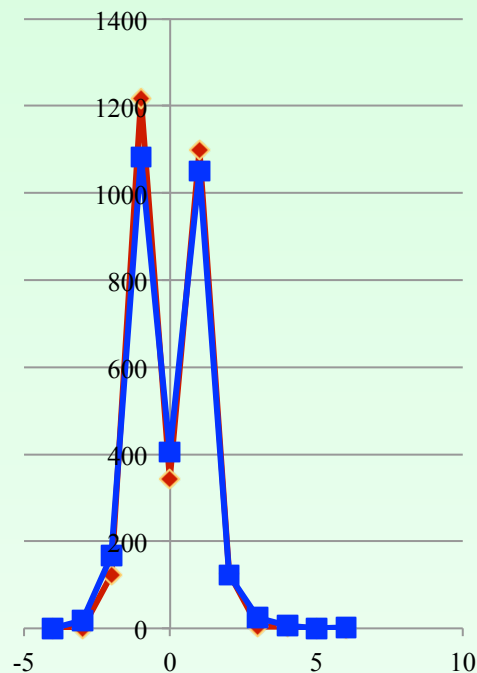
Reconstruction of rhythmic structure

glas	1	2	3	4	5	6	7	8
alphabet	0.941	0.920	0.938	0.964	0.944	0.916	0.946	0.871
3-gramms	0.949	0.936	0.940	0.952	0.937	0.925	0.965	0.896
II/QII (3)+popevki+3-gr.	0.962	0.966	0.954	0.972	0.962	0.945	0.980	0.910
II/QII (2)+popevki+3-gr.	0.969	0.968	0.956	0.973	0.963	0.949	0.981	0.916

What is possible to add to the decision rules?

Intervals between adjacent notes

I	$F(I)$	$F_D(I)$
-4	0	1
-3	1	19
-2	122	167
-1	1218	1082
0	342	406
1	1099	1051
2	126	122
3	4	25
4	5	6
6	1	2



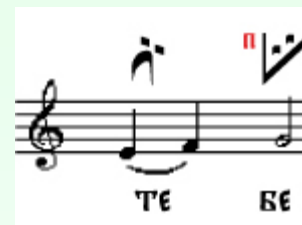
«Knowledge» :



- golubchik borzyi



Bring upwards to the next neume.



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APPROACHES to DECIPHERING of
ANCIENT RUSSIAN HYMNALS**

Thank you for attention!