THE KINEMATICS OF REGULAR STRUCTURES

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ABSTRACT. Three kinds of movements, providing stability of Universal Sky Net (USN), are listed. The series of peculiar kinematical parameters, connected with the USN structure are also given.

Key words: Galaxy, structure, kinematics.

There are many regular structures in all Universe scales.

The order in the Universe is supported by the regular motions and the chaotic motions play not the main role.

The regularities can be described, using Universal Sky Net (USN). This USN one can build by the method of fractal branching in the triedr vertex of 0-order ξ, η, ζ or by its rotation around the vertexes (poles) for angles multiple π/4 and π/6 (Shatsova, Anisimova).

$$\mathrm{tg}b = \mathrm{ctg}\Omega_p \sec b_p \sin(l - l_p) + \mathrm{tg}b_p \cos(l - l_p),$$

here $P(l_p, b_p)$ – the Pole coordinates, Ω_p – its meridians positional angles.

l_p, b_p, Ω_p: $k\pi/n$, here k and n – integer small numbers: 2,4,6…

The USN is the system of ladder's rail, passing through the whole Universe.

This ladder is hierarchical and contains of stairs:

- Solar system
- The Galaxy
- Clusters of galaxies
- Supergalaxies
- Metagalaxy

The chaotic motions are not compatible to the USN stability. This stability puts the limits on the kinematics.

Here are the valid motions:

- the expansion of Universe saves the shape and orientation of main structures, that is its similarity to itself and non-dimensionality
- the rotation of structures in USN planes will preserve these planes (the rotation in MW plane of our Galaxy or in Λ plane of Supergalaxy Virgo)
- the cosmic objects' streams along the USN axis and in its meridian planes. The streams may be really progressive (moving stellar clusters), or vortical, having small deviations from progressive or rotating ones in limits of sky belts where meridians pass.

To make sure on compatibility of known stellar streams and USN we used both the data obtained by different authors and our own.

The members of known stellar streams are scattered all over the sky, but the coordinates of its radiants are measured and have precision of several degrees. Δ – the angle distance of radiants from the nearest USN meridian.

$$\sin\Delta = \sin B \times \cos b^* - \cos B \times \sin b^* \times \sin(L - l^*)$$

here l^* & b^* - the parameters of meridian in the equation

$$tgb = tgb^* \times \sin(l - l^*)$$

Table 1. The coordinates of USN meridians

№	l*	b*	meridian
II	203	-12	Γ
III	230	-20	Z
IV	199	-2	MW
V	219	-25	⊥VD
VI	204	-22	GB
VII	11	-34	VD
VIII	209	-9	Γ
IX	242	6	⊥Γ

We investigated:

- 20 Eggen groups,
- About 10 groups, selected by Agekyan and Orlov and processed by Ninckovich and Popovich

The radiants fit into the meridian belts (width <3°, Table 2). More often they are the meridians of Z and η poles.

The totality of Z-meridians was selected by Dolidze in 1980. This part of USN may be named "Dolidze net".

The projection of velocity ellipsoid to the celestial sphere determined for the stars $V<9^m$ over SAO catalogue is given in Fig. 1. The vectors of deviation from velocity ellipsoid are shown in the areas. They form the stream parallel to E and Loop I.

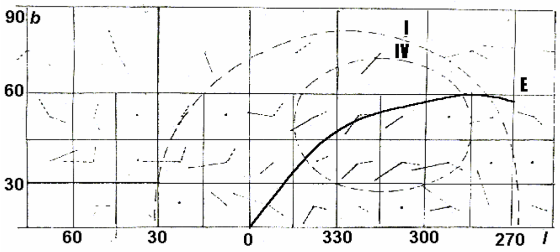

Figure 1. The vectors of deviation from velocity ellipsoid in projection to the celestial for the stars $V<9^m$

Table 2. The radiants of moving clusters and Eggen groups and its distances from the nearest USN meridian

	Group	L	B	V(km/s)	Belt	Δ
t=1	Uma	4	-32	15	⊥MW, VD	1.4
	Sirius	8	-32	15	⊥MW, VD	1.0
	α Per	215	17	16	⊥F	1.5
	Sun I	180	57	19	MC, S	-2.6
t=2	Sco-Cen	227	-14	26	⊥Γ Z`	3.0
	Sun II	0	-90	27	Π`	0
	Pleiad	254	-30	30	Γ	-1.9
t=3	Hyades	203	-4	44	MW, Γ	4.5
	Wolf630	305	-24	44	Γ	2.9
t=4	HR1614	267	16	60	⊥VD	0.2
t=5	ξ Her	224	-14	69	VD	1.3
	γ Leo	357	-6	76	Γ	0.4
	ε Ind	208	-1	84	MW, VD	-1.0, -4.1
t=7	η Cep	251	-4	103	MW, ⊥VD	-4, -1.9
	61 Cyg	210	-3	106	MW, VD	-3, 0.2
	σ Pup	232	-3	111	MW, ⊥Γ	-3, 2.5
t=8	Arctur	250	-3	124	⊥VD,MC, MW	-0.5, -1.83
t=9	Gr1830	320	0	303	S, MW	-1.0, 0
	Kapteyn	270	2	289	MW, Λ	2, 6.7
	Untilted	297	1	357	GB, MW	1, 1.1

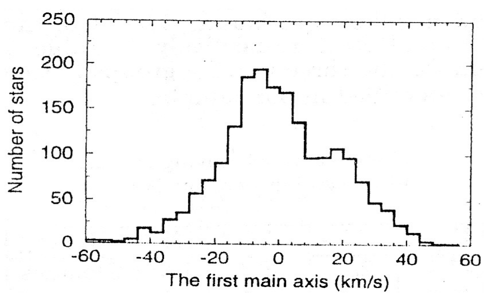

Figure 2.The histogram for the main axis of velocity ellipsoid (Chen, Torra, Figueras, Asiain).

Table 3. The velocities of stars in the layer η (-5÷ -16pc) in interval |v| (107 – 117 km/s)

№	v_ξ	v_η	v_ζ	v
HIC	km s^{-1}			
70536	1	-107	-27	110
95223	-24	105	-11	108
95575	10	101	-32	107
948	-31	95	-44	109
78241	-44	96	-36	111
74537	-34	84	-73	116
70865	-40	80	-69	113
109461	65	- 94	-26	117
110035	26	107	-32	115
3170	26	103	-10	107
95447	8	108	-14	109
67487	-15	97	-55	112
103458	-92	-21	-56	110
98792	-53	-90	-24	107
91605	22	-105	-18	109
109601	19	-115	-12	117
mean	-18	28	-20	111
abs. mean	32	94	34	
dispersion	36	94	34	3.5

Several groups, having vortical movements, were selected from catalogues Gliese – Jahreiss и Hipparcos: almost the same large velocity components η and recurrently changing smaller ξ and ζ (in ecliptical system) $\xi_{n+1}=\zeta_n$.

There is also the movement of galaxies, having dispersion σ=61 ± 8 km/s. The equality of $|v_r|$ for opposite objects means approximate equality of residual velocities v_r of different signs for pairs or even for triplets of objects. It is similar to streams, having large distances between the members, up to Δr ≈ 1-2Mpc:

LMC and Dragon galaxy v_r = 271 and -281, peculiar $(v_r)_{pec}$=47 km/s, Δr ≈ 130kpc

Group of galaxies Andromeda (v_r ≈ 300 ± 70 km/s) and Antlia (300 – 360); Δr ≈ 2Mpc

If this is a stream, then it consists of large part of Local group' galaxies.

The large semi-axis of velocity ellipsoid is directed to the vertex. It was shown long ago, that the vertex must coincide with the centre of Galaxy in axis-symmetrical rotating galaxy. But the observations give the vertex deviation to the side of positive longitudes differently for various stellar groups up to 20°.

a)

b)

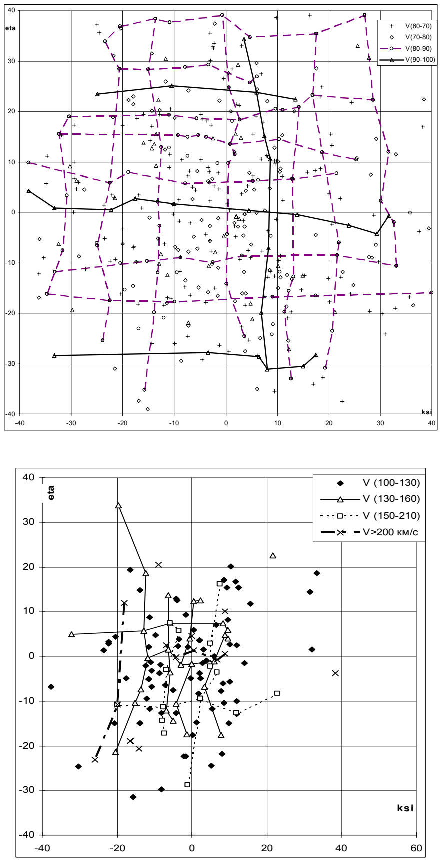

Figure 3. The stars from catalogues Gliese, Jahreys and Hipparcos in groups on velocity v (ξ, η) projection.

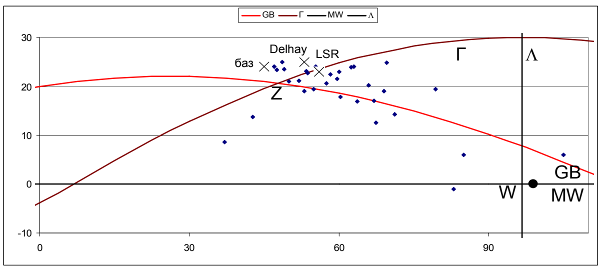

Figure 4. The ⊙ apexes of 32 groups of stars (over Bobylev; Delhay)

Table 4. The vertex longitudes (over Bobylev)

8±1	12±2	6±2	11±2	13±0	19	15	10
14	15	8	8	15	12	7	7

So, the vertex deviation is 7÷15°, that is beginning from η\` and further.

Beginning with Kempbell, the positive K-member or K-effect was found in the OB-stars radial velocity distribution. Usually it is explained by the expansion of the group of OB-stars from some centre v_r≈4km/s, for example, from the Local system centre. But this centre is not observed. Comeron thinks, that the expansion is not from the centre point, but from the line l=135-315°. Let's note, that l=137-317° is the node line of spurs belt S. On our opinion S is the equator of Local system, perpendicular to Z axis. And its spurs I-IV are the expanding shell structures, having the velocities 3-13km/s. Probably, the nature of expansion is the same for spurs and stars.

Conclusion

- The USN stability is compatible to the next kinds of motions:
  - the expansion of Universe
  - the rotation of structures in USN planes
  - the streams of cosmic objects along the USN axis and in its meridian planes.
- The peculiarities of the kinematic parameters show their connection with USN. So, the USN factor must be taken into account in stellar kinematics.
- The radiants of moving clusters and Eggen groups are in the belts of USN meridians.
- The vectors of deviations from the velocity ellipsoid form the stream along E
- The nearby stars form series parallel to the USN axis, having small dispersion σ(v) - Δv multiple v=11 ± 2 km/s.
- The ⊙ apexes are along USN axis
- The vertex deviation is 7 – 15° (η\` pole)

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