SPACE STATIONS CONSTRUCTION BY MATHEMATICA: INTERACTIVE PROGRAMS TO USE THE DOUBLE ROLE OF THE GOLDEN RHOMBOHEDRA MODULES (THE CRYSTALLOGRAPHY OF A SPACE STATION).

Kabai, S. [1]***, Bérczi, Sz.*** [2] [1]UNICONSTANT, H-4150 Püspökladány, Honvéd u. 3. Hungary, [2]Eötvös University, Faculty of Science, Department of G. Physics, Cosmic Materials Space Research Group, H-1117 Budapest, Pázmány Péter s. 1/a. Hungary, (unico@mail.matav.hu, bercziszani@ludens.elte.hu)

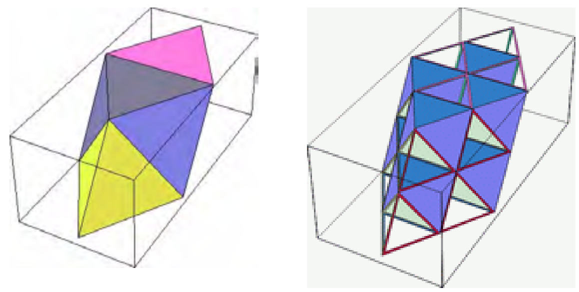
Abstract In our new course we prepared an interactive Mathematica program to study crystallography and technology of constructing a space station in a free space. This crystallography based on the characteristics of the golden rhombohedra units: such modular units could be used both for regular crystallographic and for the quasi-crystalline filling (tiling) of the 3D space.

Introduction Later generations of space stations will be far from the Earth, (i.e. in the Lagrange-points of the Earth-Moon, or the Sun-Earth system). There we should like to preserve as much terrestrial initial condition for orientation, as possible. In our earlier course [1] we defined space station architecture with three functionally different belts (regions): from centre: core (house), "front-garden" and antenna region. Such spherical main architecture (with Earth-like celestial orientation) can be constructed by a quasi-crystalline tiling (golden rhombohedron modular units can fit into a stellated rhombic triacontahedron). Extensions of the main body need the crystallographic characteristics of the golden rhombohedron.

Benefits of golden rhombohedron modules: The golden rhombohedron is a polyhedron covered with 6 congruent golden rhombuses. In golden rhombus the golden section of the diagonals results in a possibility to construct those structures which also contain this ratio in their structural generators. Both icosahedron and pentagonal dodecahedron has the icosahedral symmetry and spatial fitting of 20 pieces of golden rhombohedra may produce a stellated rhombic triacontahedron (SRT), a basic structure in the world of the quasicrystals, too. (Fig. 1.)

Fig. l. The golden rhombohedron (A) and the design of its fitting into architecture to build up a SRT, if fitting are to icosahedron (B) or the fitting is to RT (C) inner basis.

Renormalisation: The final modules of golden rhombohedra can be built from smaller modular units. For example we show new units made from 8 golden rhombohedra forming a larger golden rhombohedral unit. This new unit is replaced in the earlier structure (it is called renormalisation of the original structure) (Fig. 2.)



Equivalent embedded structures At this point we can use the following characteristics of the structures: units of golden rhombohedron can be substituted in its spatial relations, if we it is built up from dodecahedral units (Fig. 3.)

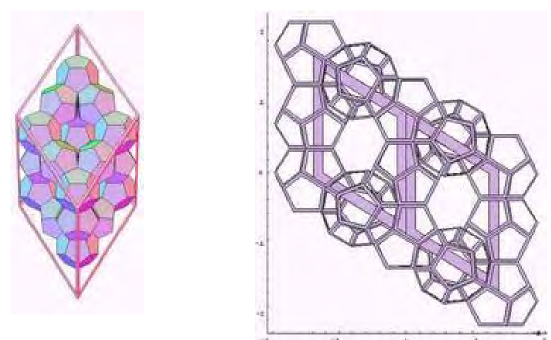


Fig.1. A.

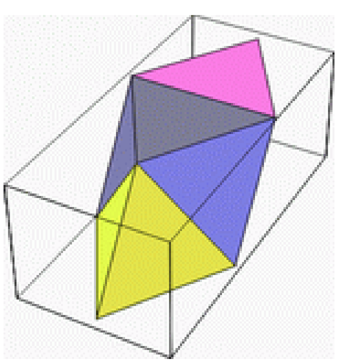


Fig. 1. B.

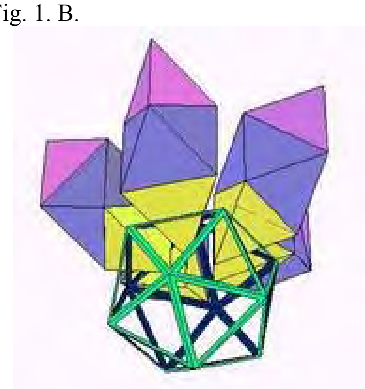
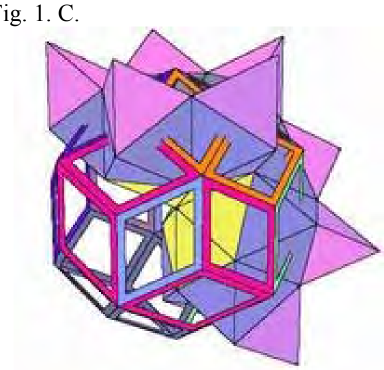


Fig. 1. C.



Truncated golden rhombohedral units: The surface of the SRT is determined by the outer vertices of the golden rhombohedra. 20 truncated units (Fig. 4.) give the Fullerene surface of the main architecture.

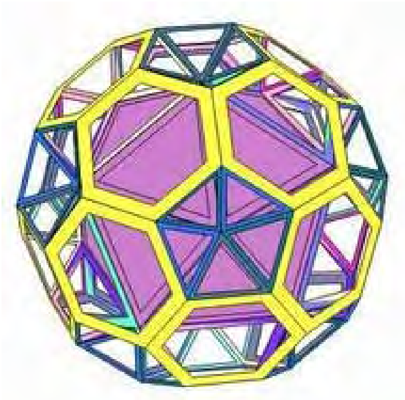


Fig. 4. Stellated Rhombic Triacontahedral (SRT) structures can be constructed also from other polyhedral fitting to the golden section system of the icosahedral symmetry. Fullerene surface [truncated icosahedra of (5,6,6)] of SRT constructed from the truncated golden rhombohedral unit.

Quasicrystalline nodes, extending crystallographic arms: Till now we used the quasicrystal building ability of the golden rhombohedron. But the golden rhombohedron can also be used in a classical crystallographic way to build up higher units with translational symmetry. This is used for cylindrical elongated arm space station units (Fig. 5.).

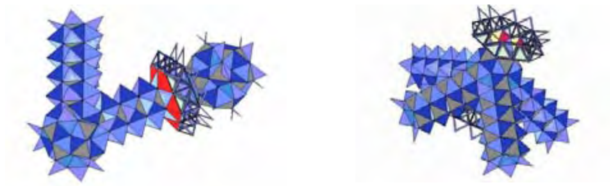


Fig. 5. Both quasicrystalline regions (nodes, spheres) and crystalline regions ("arms") are parts of larger space station architecture. Here folded units were used to show the arrangement of the two types of regions.

Summary: Using golden rhombohedral units we followed in a course the space station structure construction. Both crystallographic (with translational symmetry) truss structure and the stellated rhombic triacontahedral space station node were formed. We showed all the steps in graphics by Mathematica programs making visual models of not only the designed forms, but motions and simulations (i.e. docking) in the vicinity of the great polyhedral representations of the constructed units.

References: [1] Kabai, S., Miyazaki, K., Bérczi Sz. (2002): *LPSC XXXIII*, #1041, LPI, Houston (CD-ROM); [2] Szilassi L., Karsai J., Pataki T., Kabai S., Bérczi Sz. (2001): *LPSC XXXII*, #1184, LPI, Houston (CD-ROM); [3] Kabai, S., Bérczi Sz. (2001): *HyperSpace*, **10**. No. 2. 8.;