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Ultrastructure of the Gas Vesicle Protein Shell

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Gas Vesicles (GVs) are hollow, gas-filled protein nanostructures expressed in certain types of cyanobacteria, heterotrophic bacteria, and Archaea [1]. Production of GVs reduces cytoplasm density, allowing cell flotation, and consequently maintaining optimal access to light and nutrients. The unique physical properties of GVs allowed to utilize them as genetically encodable ultrasound and MRI contrast agents, enabling deep tissue imaging of cells such as microbes and tumors with high spatial and temporal resolution [2–4]. Although bioengineering of GVs is rapidly progressing, it is hindered by our limited knowledge about their basic structure and assembly. Here we employed cryo-electron tomography to investigate continuity and subunit arrangement within the proteinaceous shell of GVs. Our results reveal that GVs are formed by a helical strand of GvpA subunits which changes polarity in the central section of the GV cylinder. We hypothesize that this is a consequence of the GVs elongation mechanism where individual subunits of GvpA are added in opposite direction from a single elongation center. Furthermore, a high-resolution sub-tomogram average of the section of the GV shell revealed that minor structural protein, GvpC binds parallel to the GvpA subunits, following the same helical pattern.

References:

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