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Atomic structures of shrimp nodaviruses reveals capsid assembly and viral infection

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Penaeus vannamei (*P. vannamei*) and *Macrobrachium rosenbergii* (*M. rosenbergii*) are cultured prawns of economic importance for 90% of the shrimp aquaculture industry. Shrimp nodaviruses, including *P. vannamei* (PvNV) and *M. rosenbergii* nodaviruses (MrNV), cause the white-tail disease of shrimps in the larvae stage with high mortality rates. Each viral capsid plays its essential role in the assembly, initial attachment and host specificity during infection. The first cryo-EM and crystal structures of *T*=3 and *T*=1 PvNV-like particles and protrusion domains of PvNV and MrNV in various forms were determined at high resolution. The two major strains of shrimp nodaviruses are homodimeric capsomeres with complete *T*=3 architectures formed by a single capsid protein (CP). A CP of PvNV shows five major domains: (i) the P-domain with a new jelly-roll structure forming cuboid-like spikes; (ii) the jelly-roll S-domain stabilized by two Ca^{2+} ions; (iii) the flexible linker region between the S- and P-domains influencing the dimeric-spike arrangement; (iv) the basic *N*-terminal arginine-rich motif (N-ARM) interacting with RNA; (v) the N-arm interacting with nucleotides throughout the inner surface. The N-ARM controls *T*=3 and *T*=1 assemblies. These results provide structural templates to guide the exploration of shrimp nodavirus and other virions, and define potential molecular determinants for the design of medical therapeutics and vaccines.

NSRRC operates two synchrotron rings— The Taiwan Light Source (TLS) of 1.5 GeV and the new Taiwan Photon Source (TPS) of a low-emittance 3 GeV. The TPS provides great opportunities for advanced research on the various fields of life sciences. The current status and the future plan of biological-related facilities at TPS and TLS of NSRRC will also be briefly introduced.