NASCENT FOLDING OF PROTEINS ACROSS THE THREE DOMAINS OF LIFE

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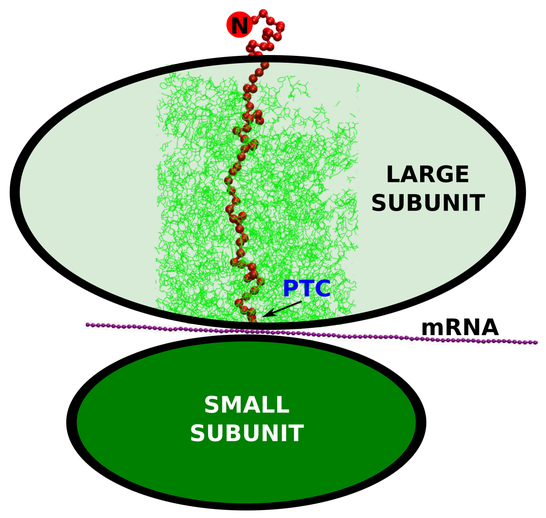
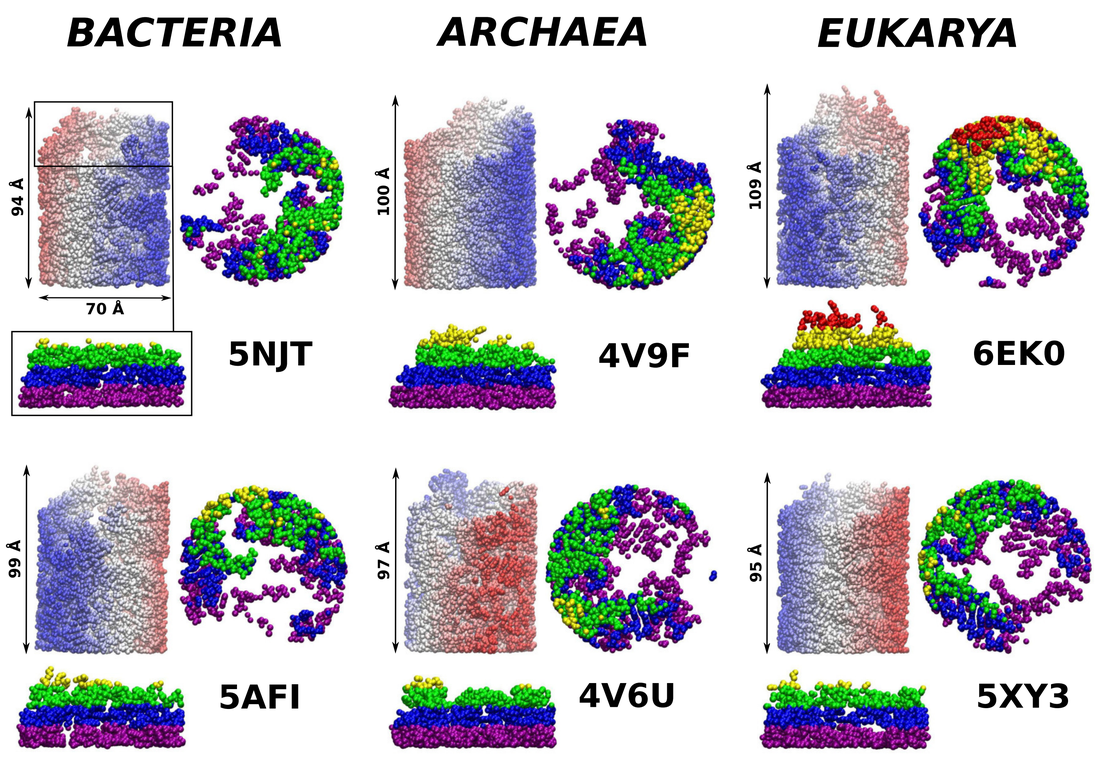
ABSTRACT

We study the nascent behavior of three model coarse- grained proteins in six rigid all-atom structures representing ribosomes that come from three domains of life. The synthesis of the proteins is implemented as a growth process [1]. The geometry of the exit tunnel is quantified and shown to differ between the domains of life: both in volume and the size of constriction sites [2]. This results in different characteristic times of capture within the tunnel and various probabilities of the escape. One of the proteins studied is the bacterial YibK which is knotted in its native state [3]. A fraction of the trajectories results in knotting and the probability of doing so is largest for the bacterial ribosomes. Relaxing the condition of the rigidness of the ribosomes should result in a better avoidance of trapping and better proper folding.

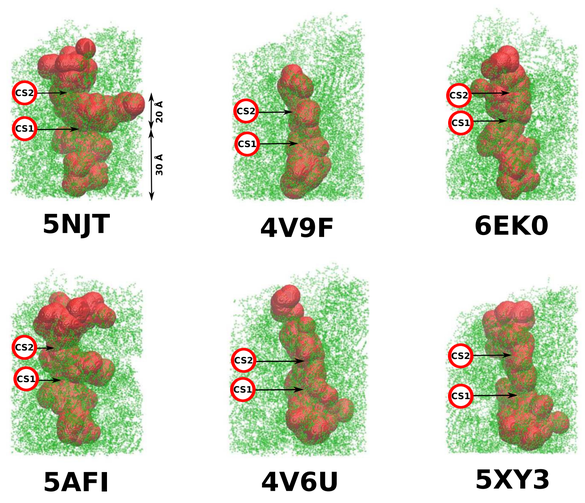
THE RIBOSOMAL SUBUNITS



THE RIBOSOMAL EXIT TUNNELS

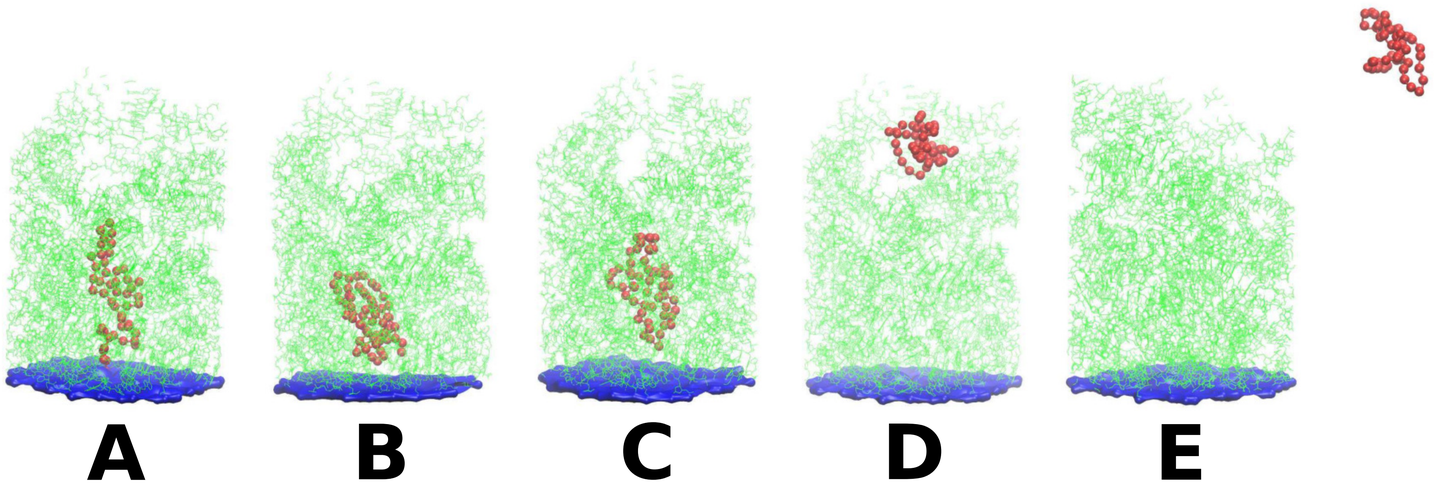


THE CONSTRICTION SITES

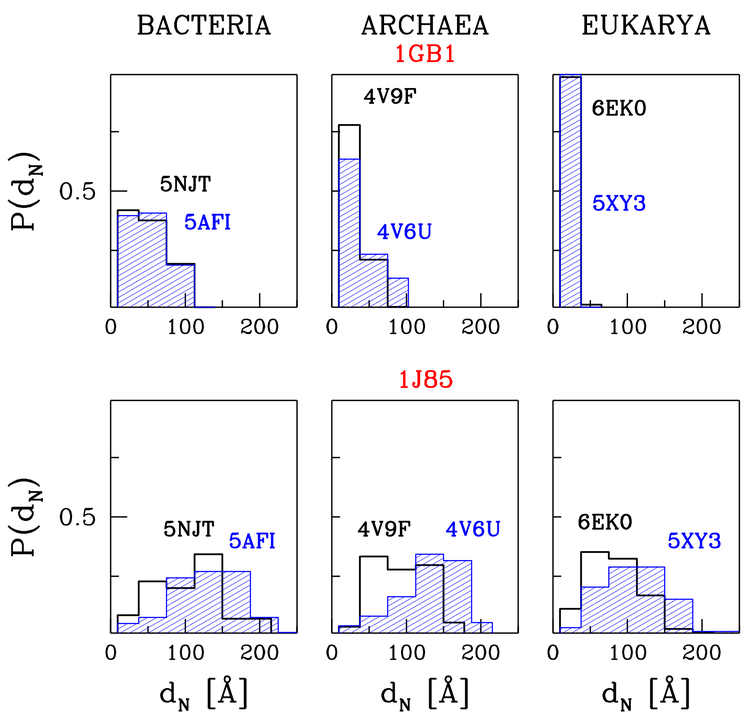


AN ILLUSTRATION OF THE STAGES OF THE FOLDING PROCESS

The protein is modeled within the structure-based approach. The contact interactions are selected by using the overlap criterion between the atoms of the residues as determined in the fully folded native state. Dynamically, the bottom of the cylinder is represented by a repulsive wall. This wall prevents making any backward steps. We incorporate the sequential growth at the PTC. Each of the amino acids emerges after the previous one created earlier. The direction of the amino acid motion is given by the repulsive potential accelerating the created bead toward the exit of the tunnel.



FOLDING RESULTS



CONCLUSIONS

- Our approach has demonstrated the existence of differences in the dynamical behavior of nascent proteins across the domains of life.
- The tight eukarya ribosomal exit tunnels impede the protein movement towards the exit.
- The wider constrictions sites found in the two other domains of life allow for proteins for an easier squeezing through away from the PTC.

ACKNOWLEDGEMENTS

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