SUPPLEMENTAL INFORMATION

Ensemble cryo-electron microscopy reveals conformational states of the nsp13 helicase on the SARS-CoV-2 helicase replication-transcription complex

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Supplemental information includes 2 tables and 2 videos.

Supplementary Table 1. Cryo-EM datasets of the nsp13-RTC.

Structural class	Dataset 1 [1]			Dataset 2		
	particles (%)	nominal resolution (Å)[1]		particles (%)	map	nominal resolution (Å)[1]
$nsp13_1$-RTC	17,345 (20%)	4.0		85,187 (20%)	2	3.2
$nsp13_2$-RTC	58,942 (67%)	3.5		315,120 (72%)	3	2.9
$(nsp13_2$-RTC$)_2$	11,771 (13%)	7.9		35,392 (8%)	4	3.3
total particles	88,058			435,699		

[1]Gold-standard FSC calculated by RELION [2].

Supplementary Table 2. Comparison of nsp13$_2$-BTC and nsp13$_2$-RTC classes.

BTC-class[a]	particles	resolution (Å)	rms_cur[b]	rmsd (Å) against nsp13$_2$-RTC class			
				nsp13$_T$-apo	nsp13$_T$-engaged	nsp13$_T$-swiveled	1B-open
class1	22,132 (9.4%)	4.1	all	5.955	3.715	9.071	8.372
			nsp13$_T$+nsp13$_F$	8.748	5.421	13.349	12.306
			nsp13$_T$	7.8	1.493	13.282	10.941
class2	31,364 (13%)	4.0					
class3	35,082 (15%)	3.9	all	6.689	5.801	8.325	3.156
			nsp13$_T$+nsp13$_F$	9.888	8.551	12.307	4.614
			nsp13$_T$	13.211	11.201	16.101	1.716
class4	146,569 (62%)	3.6	all	4.626	0.685	7.099	6.246
			nsp13$_T$+nsp13$_F$	6.784	0.963	10.466	9.167
			nsp13$_T$	8.776	0.303	13.057	10.854

[a]Extended Data Fig. 8.

[b]After superimposition via the α-carbons of nsp12, the nsp13$_2$-BTC components listed in this column were compared with the same components of the nsp13$_2$-RTC class using the PyMOL rms_cur command.

Supplemental Videos

Supplementary Video 1. Opening of nsp13$_T$-RecA domains in nsp13$_T$-apo vs nsp13$_T$-engaged states. Related to Fig. 4. The video compares the disposition of the nsp13$_T$ RecA domains in the nsp13$_T$-engaged vs. the nsp13$_T$-apo state. In the nsp13$_T$-engaged state, the RecA domains are closed onto the substrate RNA and bound to ADP-AlF$_3$, a non-hydrolyzable ATP analog. In the nsp13$_T$-apo state, the RecA2 domain is rotated open by ~21°, resulting in a translation of the separation between the RecA1 and RecA2 centers-of-gravity by 3.4 Å. The video shows how this conformational change is related to an inchworming model for nsp13$_T$ translocation, and illustrated how nsp13$_T$ translocation drives backtracking of the RTC.

Supplementary Video 2. Structural overview of the nsp13$_2$-RTC and the nsp13$_T$-engaged, nsp13$_T$-open, and nsp13$_T$-swiveled states. Related to Figs. 2, 3, 5, and 7. The video highlights the nsp13$_T$ conformational changes between the nsp13$_T$-engaged, nsp13$_T$-swiveled, and nsp13$_T$-open states.

References

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