

## **Description of Additional Supplementary Files**

File Name: Supplementary Movie 1

Description: H3-H4 assembly DNA curtain assay, Abo1+ATP DNA curtain assay of Cy5-labeled H3-H4 deposition onto DNA in the presence of both Abo1 and ATP.

File Name: Supplementary Movie 2

Description: H3-H4 assembly DNA curtain assay, -Abo1+ATP DNA curtain assay of Cy5-labeled H3-H4 deposition onto DNA in the absence of Abo1 and presence of ATP.

File Name: Supplementary Movie 3

Description: H3-H4 assembly DNA curtain assay with CAF-1 DNA curtain assay of Cy5-labeled H3-H4 deposition onto DNA in the presence of CAF-1.

File Name: Supplementary Movie 4

Description: H3-H4 assembly DNA curtain assay with CAF-1, incubated with Abo1. DNA curtain assay of CAF-1 deposited Cy5-labeled H3-H4 DNA molecules subsequently incubated with Abo1.

File Name: Supplementary Movie 5

Description: Example HS-AFM Video of Abo1 in the presence of ATP. Example HSAFM movie of Abo1 displaying dynamic symmetry breaking events in the presence of ATP.

File Name: Supplementary Movie 6

Description: Example HS-AFM Video 2 of Abo1 in the presence of ATP. Example HS-AFM movie of Abo1 displaying dynamic symmetry breaking events in the presence of ATP.

File Name: Supplementary Movie 7

Description: Example HS-AFM Video of Abo1 Walker B mutant in the presence of ATP. Example HS-AFM movie of Walker B Abo1 displaying single symmetry breaking events in the presence of ATP.

File Name: Supplementary Data 1

Description: Excel file of all intra- and intermolecular crosslinks in an Abo1-H3H4 sample as identified by crosslinking mass spectrometry.