**Supplemental Movie 1.** Single-molecule imaging of HaloTag-EZH2, labeled with JF646, for diffusion analysis. The first 10 sec of one representative movie with imaging performed at 97.5 Hz. The upper left corner contains a time-stamp in seconds and the upper right corner shows a scale bar.

**Supplemental Movie 2.** Single-molecule imaging of HaloTag-SUZ12, labeled with JF646, for diffusion analysis. The first 10 sec of one representative movie with imaging performed at 97.5 Hz. The upper left corner contains a time-stamp in seconds and the upper right corner shows a scale bar.

**Supplemental Movie 3.** FRAP imaging of HaloTag-EZH2. Imaging was performed at 0.5 Hz. The lower right corner contains a time-stamp in minutes:seconds and the upper left corner shows a scale bar.

**Supplemental Movie 4.** Time-lapse imaging of untreated HaloTag-EZH2 cells, labeled with JF646, for lifetime analysis. Imaging was performed at 2 Hz. The lower right corner contains a time-stamp in minutes:seconds and the upper left corner shows a scale bar.

**Supplemental Movie 5.** Single-molecule imaging of HaloTag-EZH2, labeled with JF646, in cells expressing SUZ12(WT). The first 10 sec of one representative movie with imaging performed at 97.5 Hz. HaloTag-EZH2 cells were co-transfected with 3xFlag-SUZ12(WT), siRNA to the 3' UTR of SUZ12, and a nuclear BFP transfection marker. Transfected cells were identified using BFP fluorescence and then HaloTag-EZH2 was imaged.

**Supplemental Movie 6.** Single-molecule imaging of HaloTag-EZH2, labeled with JF646, in cells expressing SUZ12(PHF1+ABHmut). The first 10 sec of one representative movie with imaging performed at 97.5 Hz. HaloTag-EZH2 cells were co-transfected with 3xFlag-SUZ12(PHF1+ABHmut), siRNA to the 3' UTR of SUZ12, and a nuclear BFP transfection marker. Transfected cells were identified using BFP fluorescence and then HaloTag-EZH2 was imaged.

**Supplemental Movie 7.** Single-molecule imaging of HaloTag-EZH2, labeled with JF646, in cells expressing SUZ12(VEFS). The first 10 sec of one representative movie with imaging performed at 97.5 Hz. HaloTag-EZH2 cells were co-transfected with 3xFlag-SUZ12(VEFS), siRNA to the 3' UTR of SUZ12, and a nuclear BFP transfection marker. Transfected cells were identified using BFP fluorescence and then HaloTag-EZH2 was imaged.