



Figure S4. Low concentration of Mg^{2+} induce a large rotation of head in all directions.

a. Multi-body refinement of particles for 30S at 1 mM Mg^{2+} with masks (dash line) on head (gray) or body (blue) part. **b.** Maps were aligned based on the body and rotation of head related to body was measured (red arrow). **c, d.** Same as a, but showing the rotation of head in other two directions (red arrows). The progressive colors of map represent different maps from volume 1 (grey) to 10 (yellow) in multi-body refinement.