Supplementary Movie 1: Orbital Mapping of [Eu(pcam)$_3$X]$^{2+}$ and [Eu(pcam)$_3$]$^{3+}$. This movie reveals different energetic positions, and the shapes of unoccupied orbitals of [Eu(pcam)$_3$X]$^{2+}$ and [Eu(pcam)$_3$]$^{3+}$. It is created from 8000 dI/dV spectroscopic maps acquired over a pair of [Eu(pcam)$_3$X]$^{2+}$ - [Eu(pcam)$_3$]$^{3+}$ complexes at ±2000 mV range with 1 mV interval between the consecutive frames.

Supplementary Movie 2: Clockwise Rotation. This movie shows controlled clockwise rotation of an [Eu(pcam)$_3$X]$^+$ complex on Au(111) surface when a negative electric field is applied from the STM tip.

Supplementary Movie 3: Anticlockwise Rotation. This movie shows controlled anticlockwise rotation of an [Eu(pcam)$_3$X]$^+$ complex on Au(111) surface when a negative electric field is applied from the STM tip.