Supplementary Figures

Figure S1. Mean size of myosin II clusters. (a) Atomic force microscopy (AFM) and (b-d) high-resolution cryo-transmission electron microscopy (cryo-TEM) imaging of myosin II motor filaments formed at variable KCl concentrations. Bipolar filaments (clusters) formed at low and intermediate KCl concentrations (a-c); individual myosin II molecules exist at 0.5M KCl (d). The white arrow-heads mark individual myosin aggregates; the black double-headed arrow mark the length ℓ of such an aggregate. Conditions: [M] = 4 μM and (a) 0.025, (b) 0.05, (c) 0.16, and (d) 0.5 M KCl. (e) Values of the mean cluster size and mean number of myosin II molecules per cluster N_{myo} as a function of KCl concentration. †Calculated values of ℓ and N_{myo} (see Materials and Methods). *The range of tail lengths of individual myosin molecules, extracted from cryo-TEM micrographs, is given.

Figure S2. Mesh size of actomyosin networks as a function of [KCl]. The mesh size of actin networks is depicted as a function of KCl concentration. The diagram is divided to three depending on the extent of network reorganization and coarse graining. At low KCl concentrations (up to 0.08M) the network undergoes disruption (in that case, the mesh size corresponds to its values just before disruption begins), at intermediate concentrations ($0.08 \leq$ [KCl] < 0.17M) a mechanically tensile network forms (the mesh size corresponds to the value measured at steady state), while at high KCl concentrations ($\geq$ 0.17M) active networks do not form. Conditions: 16 μM G-actin, [A]/[F]=7, and [A]/[M]=18, 1mM Mg-ATP, and 1mM $MgCl_2$. Values correspond to mean ± SD.

Figure S3. Mobility of myosin II motor clusters. (a) Probability distribution of the radius of gyration, R_g, of the motion of different motor clusters at [A]/[M]=150. We compare the motion of motors from three different regimes: large (blue), small (red) and intermediate (green) R_g. (b) Comparison of the MSD of motors in the different regimes. (c) Trajectories of motors in the different regimes. Conditions: 5 μM G-actin, [A]/[F]=18, [A]/[M]=150, 1mM Mg-ATP, and 1mM $MgCl_2$, and [KCl]=0.025M.

Figure S4. Mobility of myosin II motor clusters. (a) Probability distribution of the radius of gyration, R_g, of the motion of different motor clusters at [A]/[M]=10. We compare the motion of motors from three different regimes: large (blue), small (red) and intermediate (green) R_g. (b) Comparison of the MSD of motors in the different regimes. (c) Trajectories of motors in the different regimes. Conditions: 5 μM G-actin, [A]/[F]=18, [A]/[M]=10, 1mM Mg-ATP, and 1mM $MgCl_2$, and [KCl]=0.025M.

Supplementary Movies.

Supp Movie S1. Myosin assisted network self-organization at early formation stages. The sample was excited at 561 nm (myosin II – left) and 488 nm (actin – right) laser lights and the emission spectra were recorded simultaneously in two channels. At first we observe only individual motor clusters as the actin bundles are too fine to detect. Actin bundles start to be visible at later stages. The motors are embedded within the network and move in a correlated manner from the beginning. Conditions: 5 μM G-actin, [A]/[F]=18, [A]/[M]=150, 1mM Mg-ATP, and 1mM $MgCl_2$, and [KCl]=0.025M.

Supp Movie S2. Myosin assisted self-organization and contractility in actin networks. The sample was excited at 561 nm (myosin II – left) and 488 nm (actin – right) laser lights and the emission spectra were recorded simultaneously in two channels. At first we observe only individual motor clusters as the actin bundles are too fine to detect. About a minute later actin bundles start to be visible. The network continues to built-up for an additional 1.5 minutes, after which it undergoes rapid macroscopic contraction. Conditions: 5 μM G-actin, [A]/[F]=18, [A]/[M]=150, 1mM Mg-ATP, and 1mM $MgCl_2$, and [KCl]=0.025M.

Supp Movie S3. Myosin assisted self-organization and contractility in actin networks. Conditions as Supp movie S2; here myosin (green) and actin (red) channels are overlaid.

Supp Movie S4. Multi-step coarsening in actomyosin networks - disintegration, alignment and bundle sliding. Conditions: 8 μM G-actin, [A]/[F]=7, [A]/[M]=9, 1mM Mg-ATP, and 1mM $MgCl_2$, and [KCl]=0.025M.

Supp Movie S5. Bigger myosin clusters pull stronger. A large myosin aggregate marked by a white arrows pulls actomyosin bundles (actin - green and embedded motor clusters - red) resulting in actin and myosin accumulation at that spot. Generally, larger myosin aggregates pull smaller ones. Conditions: 5 μM G-actin, [A]/[F]=18, [A]/[M]=50, 1mM Mg-ATP, and 1mM $MgCl_2$, and [KCl]=0.025M.

Supp Movie S6. Actomyosin network disintegration mediated by myosin II. Pulling forces mediated by myosin II motors (‘attractor’) are sufficient to disrupt network structure. Continuous accumulation of actomyosin bundles towards the ‘attracting’ center lead to network coarse graining, eventually ending up in the formation of disconnected actin patches/asters. Buckling of bundles is also observed during the accumulation process. Conditions: 5 μM G-actin, [A]/[F] =18, [A]/[M]=20, 1mM Mg-ATP, and 1mM $MgCl_2$, and [KCl]=0.025M.

Supp Movie S7. Myosin II mediated actomyosin bundle wrapping and severing. The red arrow marks an actin bundle that is pulled and wrapped around an actomyosin patch. Although infrequent, myosin II motors can also lead to bundle severing (white arrow). Conditions: 5 μM G-actin [A]/[F] =18, [A]/[M]=20, 1mM Mg-ATP, and 1mM $MgCl_2$, and [KCl]=0.025M.

Supp Movie S8. Buckling of individual bundles occurs during network contraction. Conditions: 5 μM G-actin, [A]/[F]=18, [A]/[M]=900, 1mM Mg-ATP, and 1mM $MgCl_2$, and [KCl]=0.025M.

Supp Movie S9. Disintegration of actomyosin networks into aster-like patches. In this case network coarsening and disintegration occurs by continuous pulling and tearing of actomyosin bundles. Conditions: 16 μM G-actin, [A]/[F]=7, [A]/[M]=18, 1mM Mg-ATP, and 1mM $MgCl_2$, and [KCl]=0.025M.

Supp Movie S10. A pulling event. Myosin motors are imaged during the evolution of a network. One motor cluster is relatively confined (marked in magenta in Fig 5a) and pulls a second motor cluster towards it (marked in green in Fig5a). Conditions: 5 μM G-actin, [A]/[F]=18, [A]/[M]=150, 1mM Mg-ATP, and 1mM $MgCl_2$, and [KCl]=0.025M.