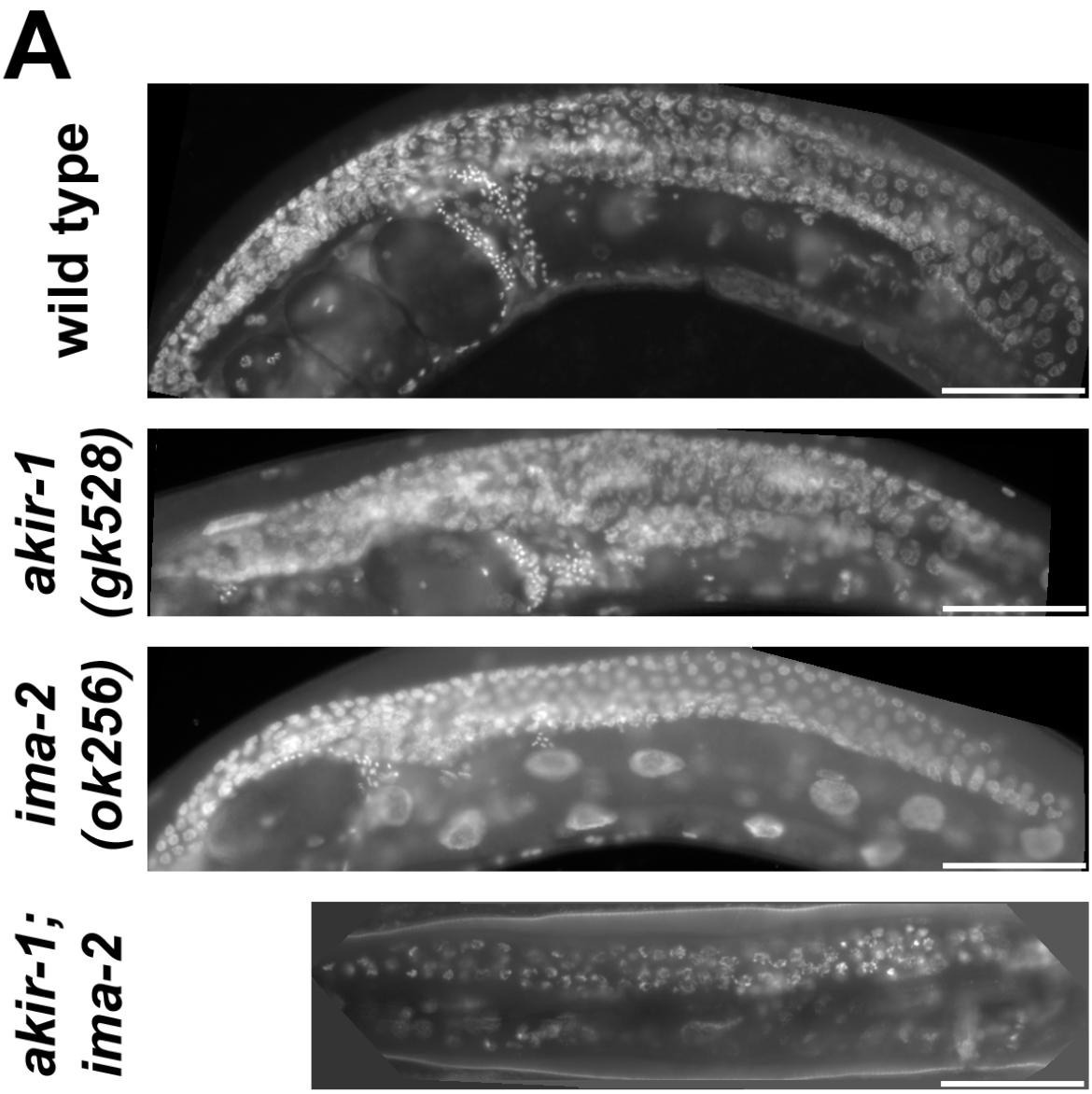

Figure S1: Loss of AKIR-1 and IMA-2 leads to reduction in gonad size

A) Whole worm fixation and DAPI staining in wild type, *akir-1(gk528)*, *ima-2(ok256),* and *akir-1(gk528)*; *ima-2(ok256)*. Images are projections of about half a worm containing one gonadal arm. scale bars are 50μm.

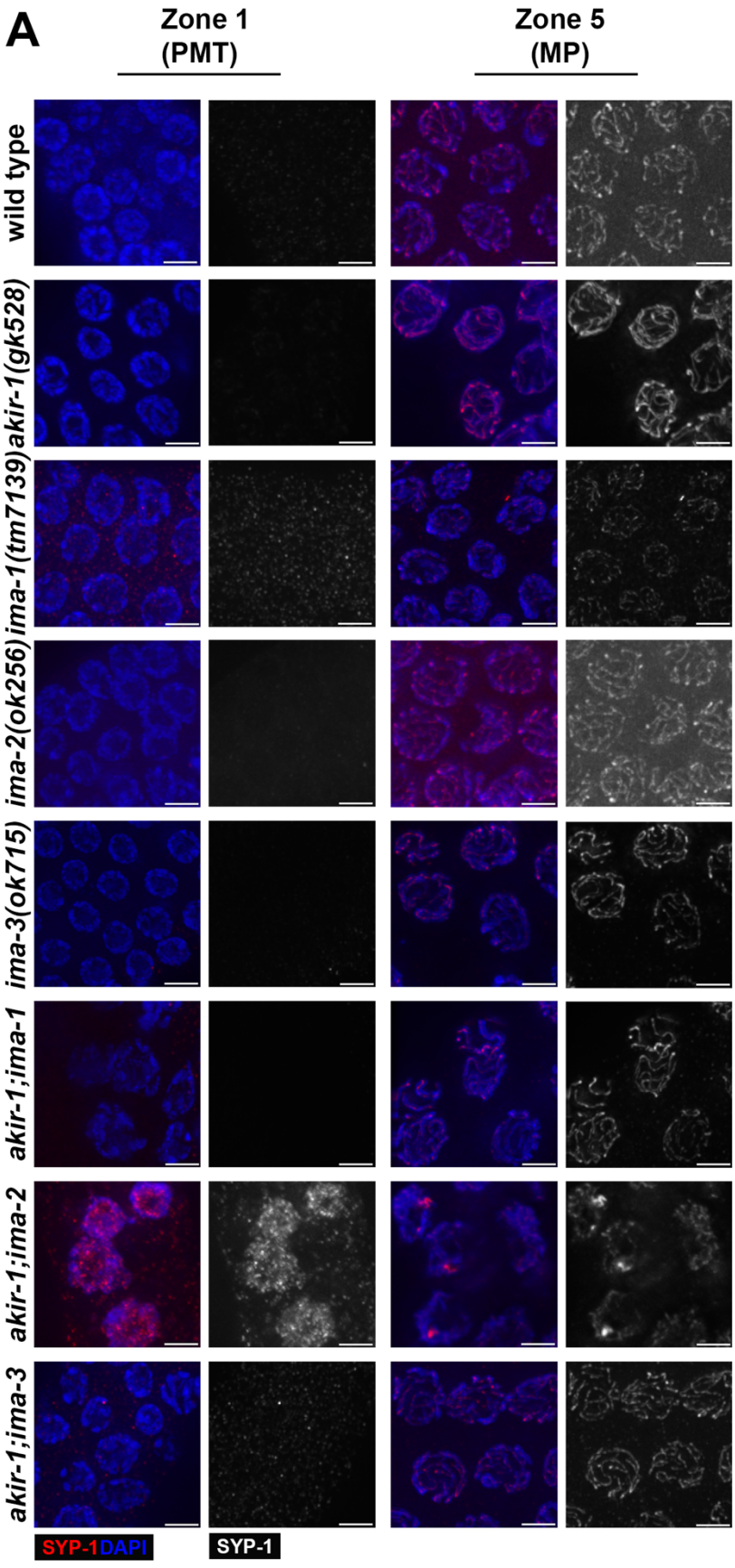
A
Zone 1
(PMT)
Zone 5
(MP)
wild type
akir-1(gk528)
ima-1(tm7139)
ima-2(ok256)
ima-3(ok715)
akir-1;ima-1
akir-1;ima-2
akir-1;ima-3
SYP-1DAPI
SYP-1

Figure S2: Loss of AKIR-1 and either IMA-1 or IMA-3 does not affect import or loading of SYP proteins

A) Immunolocalization of SYP-1 in wild type, *akir-1(gk528)*, *ima-1(tm7139), ima-2(ok256), ima-3(ok715)*, and *akir-1;importin* double mutants for germline nuclei in mitotic proliferation and middle prophase. The only mutant exhibiting aberrant loading of SYP proteins are *akir-1;ima-2*. Blue is DAPI stained chromatin, red is SYP-1, and black and white is SYP-1 without chromatin in the background, scale bars are 3μm.

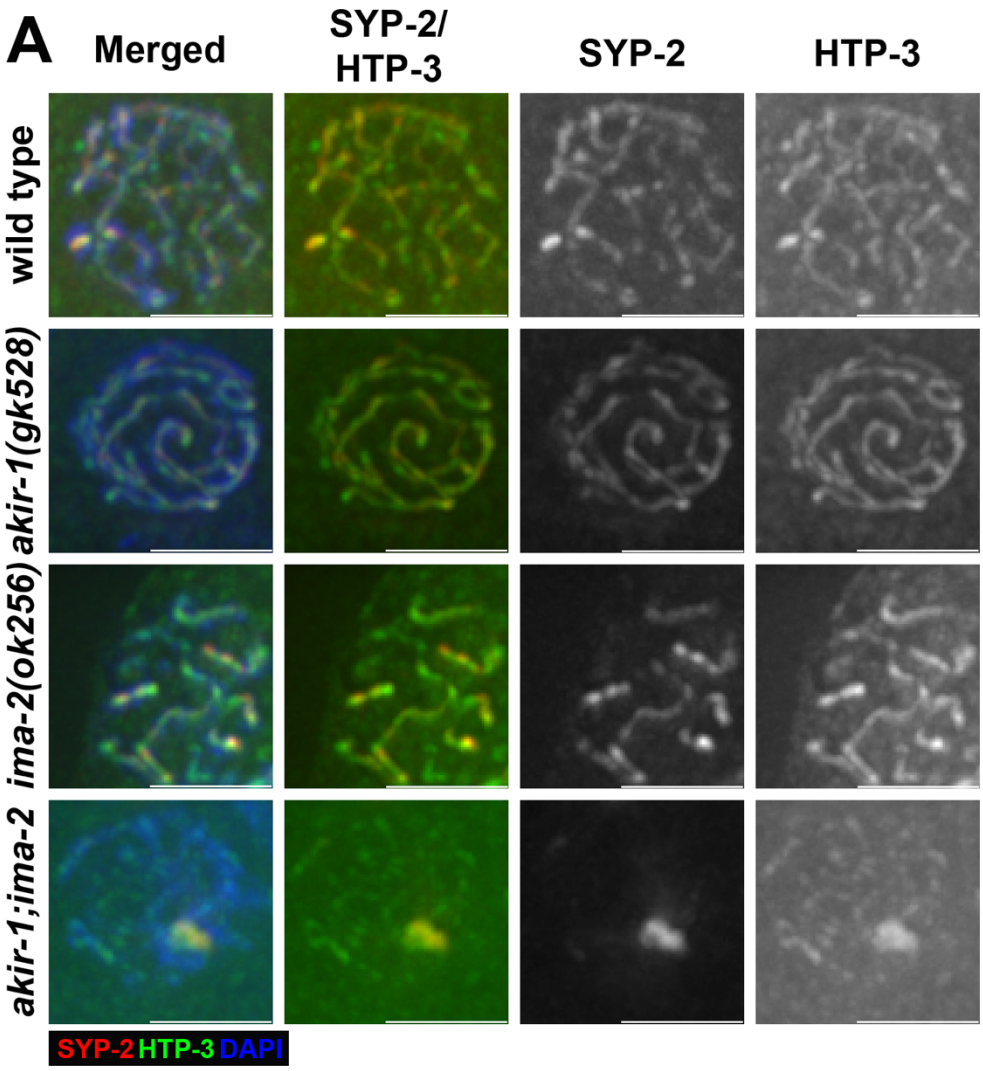

Figure S3: Co-localization of central region and axial element proteins

A) Immunolocalization of the colocalization of the SC central region protein SYP-2 and the axial element protein HTP-3. Blue is DAPI stained chromatin, red is SYP-2, and green is HTP-3. The MERGE panel contail all three channels, while SYP-2/HTP-3 does not contain DAPI. Black and white panels contain the localization pattern only for the antibody that is indicated at the top of the panel. Scale bars are 3μm.

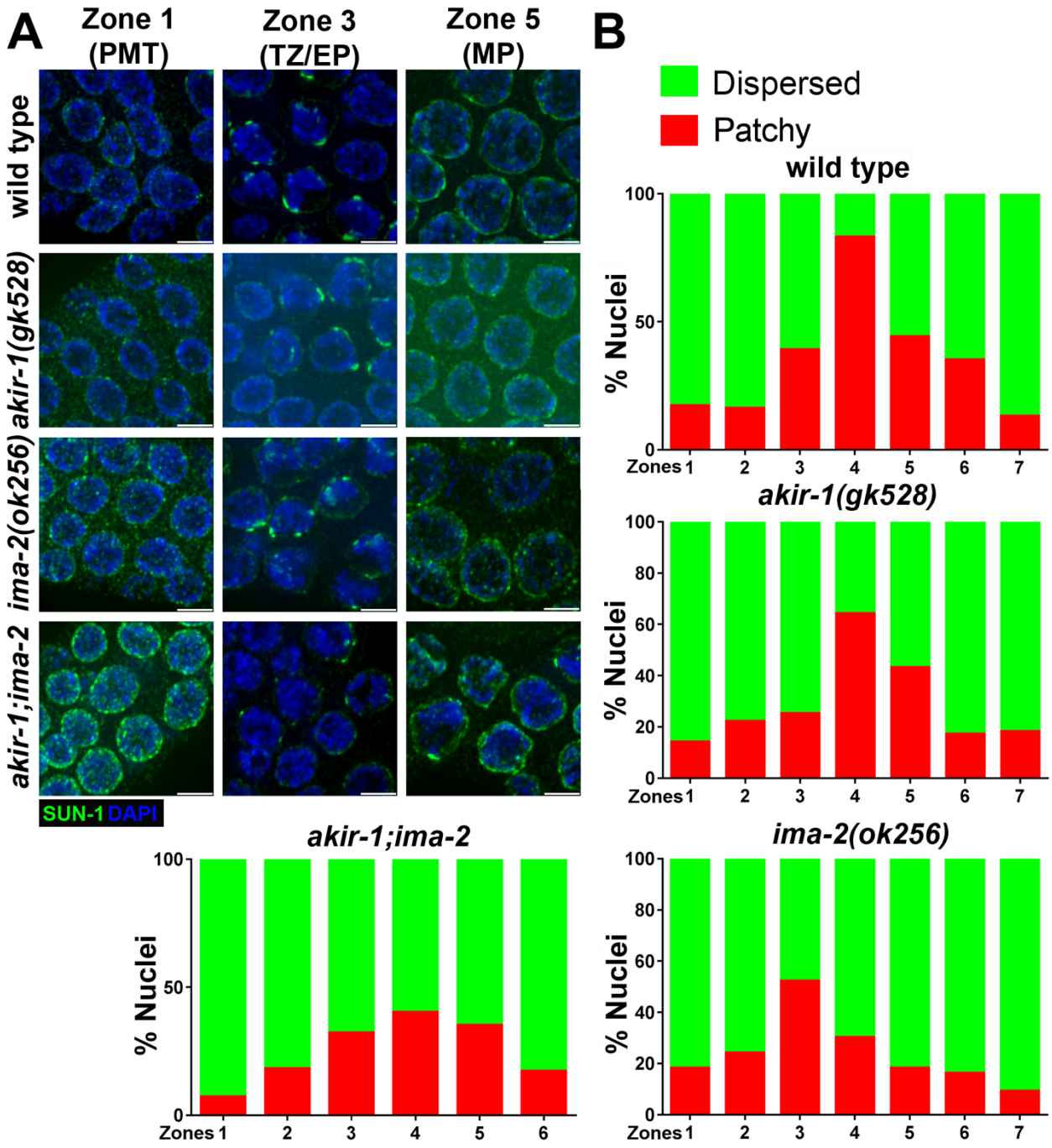

Figure S4: Loss of AKIR-1 and IMA-2 does not impact SUN-1 nuclear envelope localization

A) Immunolocalization of the SUN/KASH protein SUN-1 for nuclear envelope localization in all genotypes. Wild type SUN-1 is dispersed around the nuclear envelope (even localization around DAPI) in mitotic nuclei, patchy SUN-1 (regions that are more intense than others) is seen in early

prophase, and dispersed SUN-1 is found in middle prophase. *akir-1(gk528), ima-2(ok256)*, and the double mutant *akir-1(gk528);ima-2(ok256)* SUN-1 follows the same pattern as wild type (n=3 gonads), scale bars are 3μm. B) Quantification of SUN-1 localization as either dispersed (green) or patchy (red). All genotypes display the same phenotypes with some variation in timing of patchy localization. For n values see table S1.

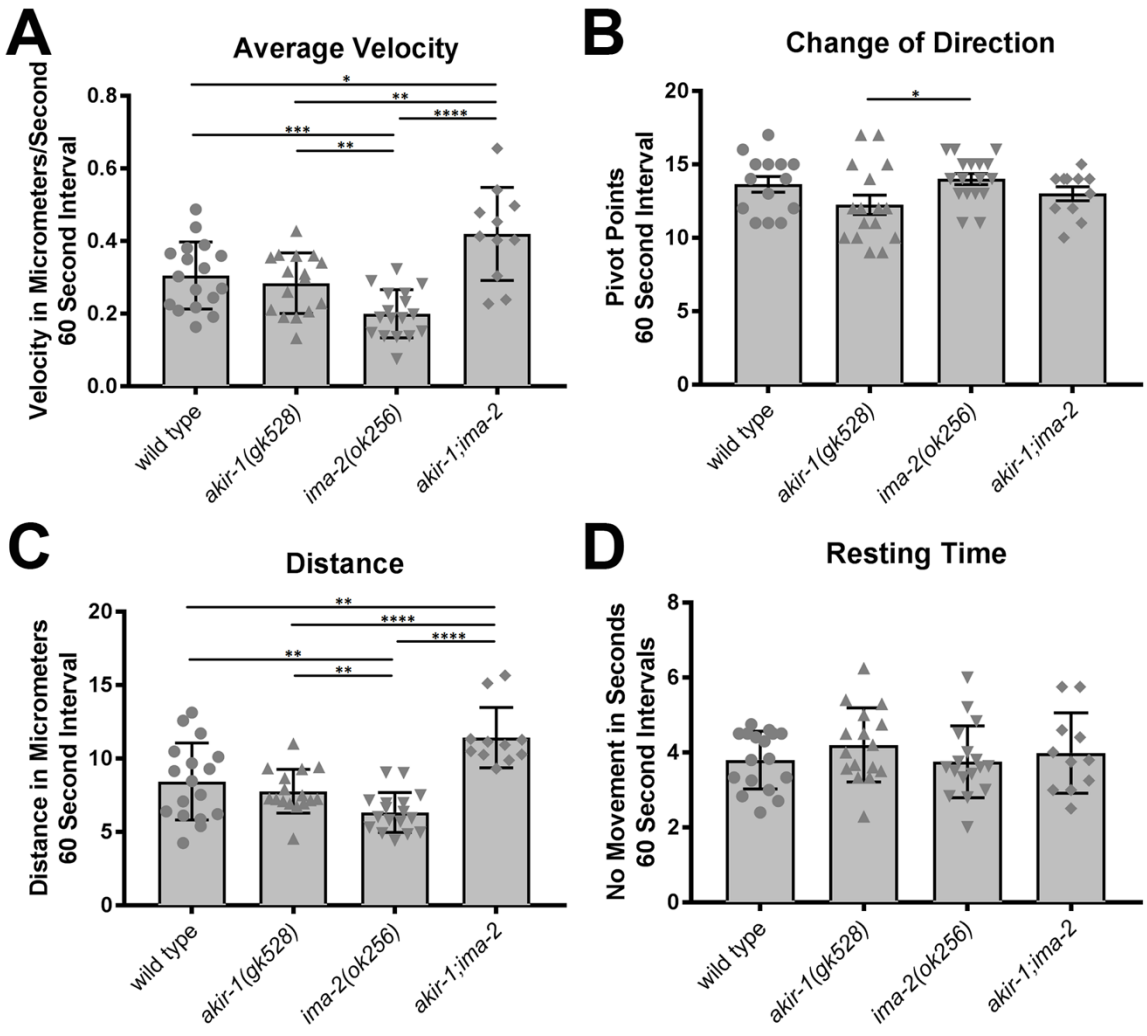

Figure S5: SUN/KASH complex nuclear envelope movement

A) Average velocity (distance/interval), number of direction changes, distance travelled, and total periods of no movement during the interval of the SUN/KASH complex. Measured by live imaging GFP tagged ZYG-12 in wild type (n=14), *akir-1(gk528)* (n=16), *ima-2(ok256)* (n=17), and *akir-1;ima-2* (n=11) animals, significance is indicated by asterisks ($p \leq 0.05$ [$0.05 \leq$ * ≥ 0.01, $0.01 <$ ** ≥ 0.001, $0.001 <$ *** ≥ 0.0001, $0.0001 <$ ****] MW u-test).

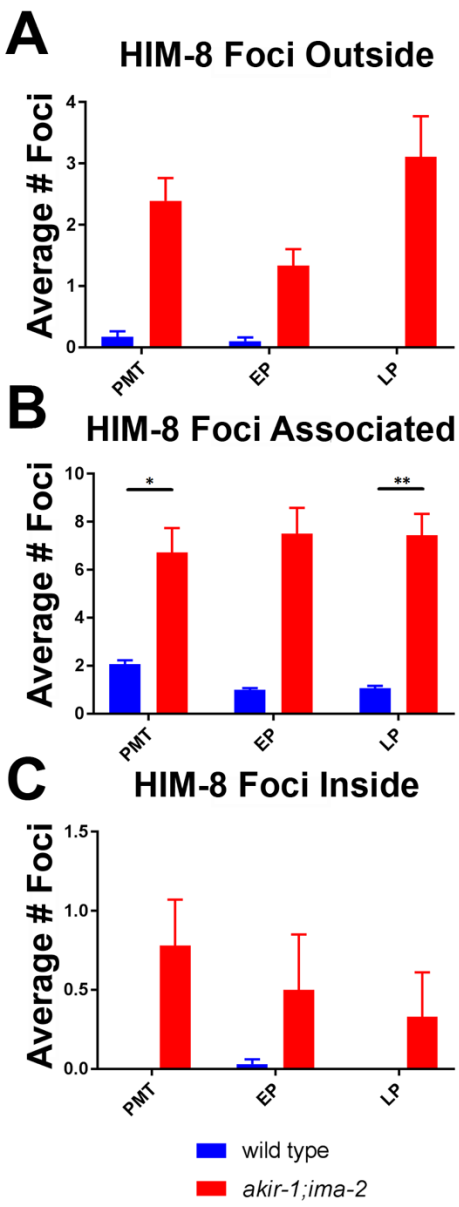

Figure S6: HIM-8 foci associate with ZYG-12 at the nuclear envelope

A) Quantification of HIM-8 foci immunolocalization in the cytoplasm of wild type and *akir-1;ima-2* in the germline during mitotic proliferation, early- and late-pachytene. B) Quantification of HIM-8 foci associated with ZYG-12 on the inner nuclear membrane. C) Quantification of HIM-8 foci inside the nucleus, and not associated with ZYG-12, significance indicated by asterisks ($p \leq 0.05$, [$0.05 \leq * \geq 0.01$, $0.01 < ** \geq 0.001$] MW u-test).

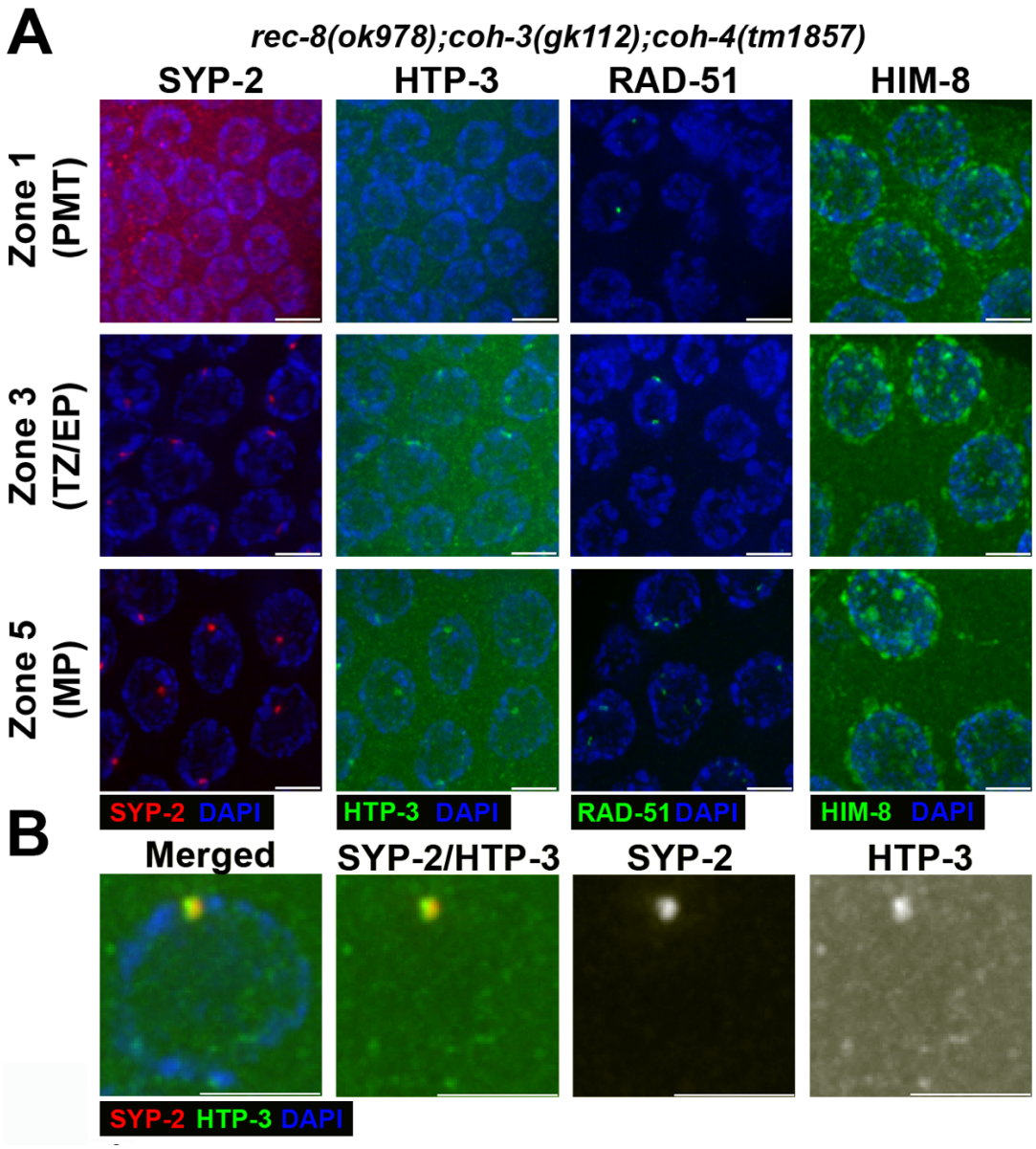

Figure S7: Loss of REC-8, COH-3, and COH-4 phenocopies *akir-1;ima-2* double mutant HIM-8 localization

A) Immunolocalization of RAD-51, SYP-1, HTP-3, and HIM-8 in *rec-8;coh-3;coh-4* cohesin deletion triple mutants showing localization patterns for each of the proteins, and indicating similar import and loading defects of the pairing center protein HIM-8, scale bars are 3μm. B) Coimmunostain of SYP-2 and HTP-3 showing co-localization of the central region and axial element proteins in the absence of cohesin complex subunits, scale bars are 3μm.

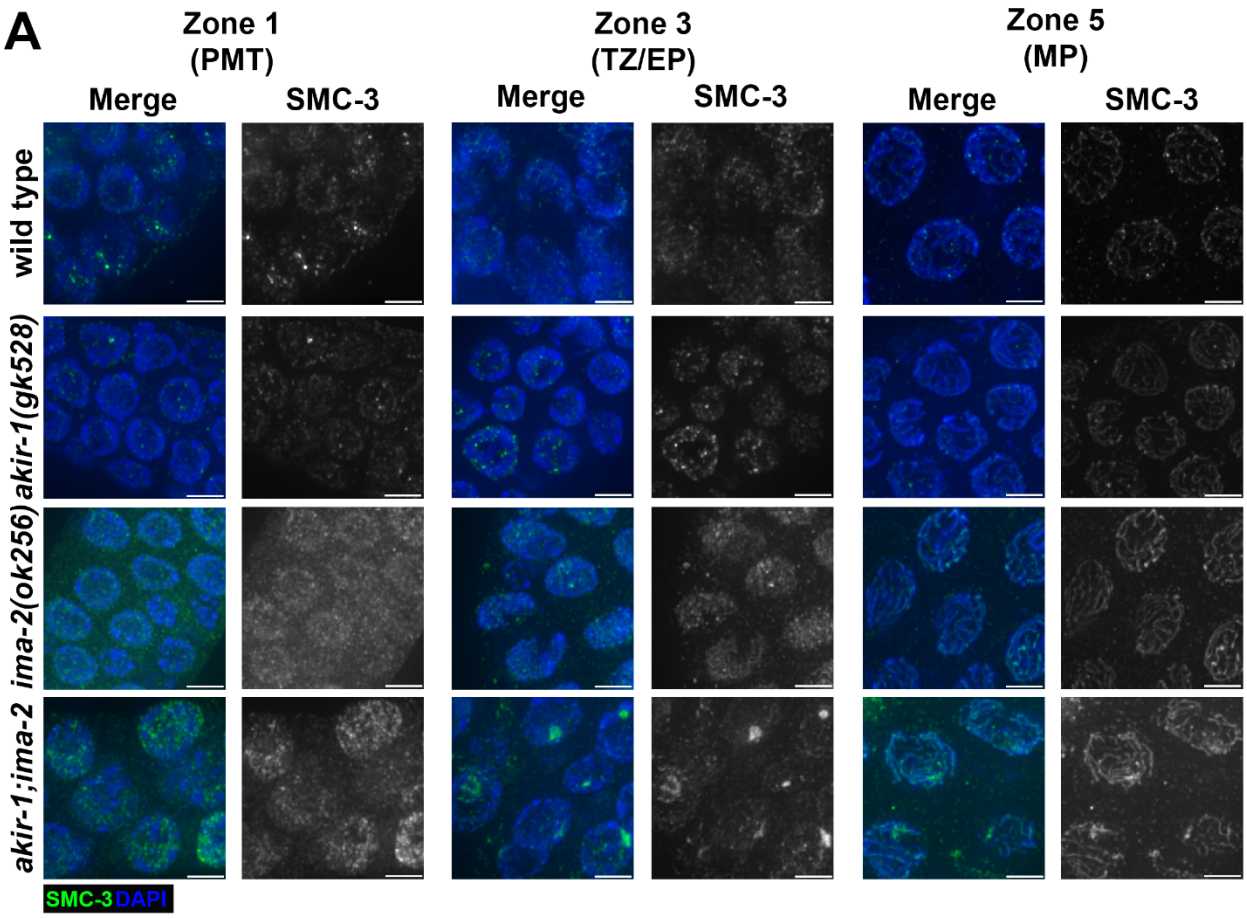

Figure S8: Loss of AKIR-1 and IMA-2 causes SMC-3 aggregate formation

A) Immunolocalization of the cohesin subunit SMC-3 for the genotypes indicated. Antibody only channel for each zone is presented on the right of the combined DABI/antibody channel. Scale bars are 3μm.

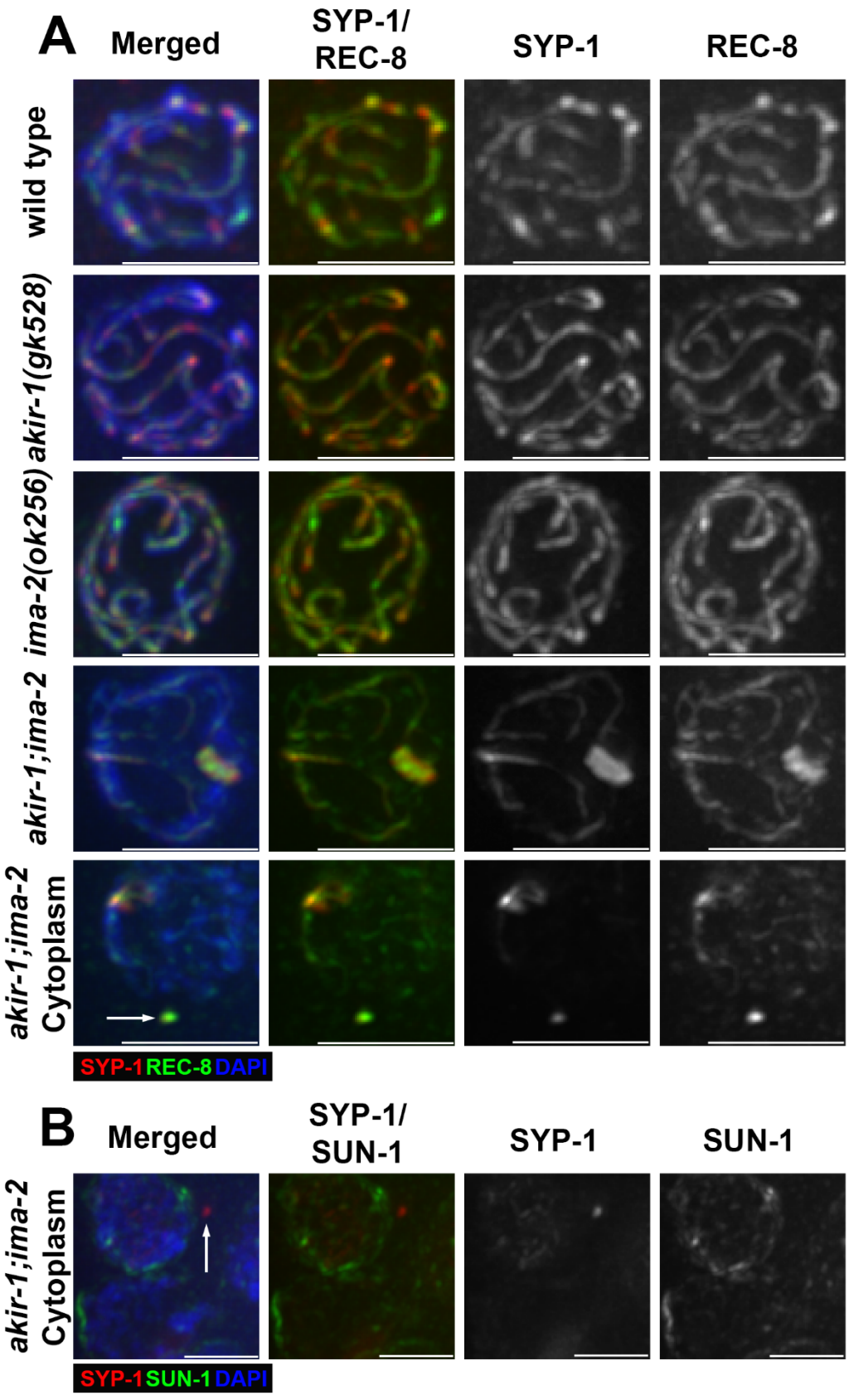
A
Merged
SYP-1/ REC-8
SYP-1
REC-8
wild type
akir-1(gk528)
ima-2(ok256)
akir-1;ima-2
akir-1;ima-2 Cytoplasm
SYP-1 REC-8 DAPI
B
Merged
SYP-1/ SUN-1
SYP-1
SUN-1
akir-1;ima-2 Cytoplasm
SYP-1 SUN-1 DAPI

Figure S9: Co-localization of central region and cohesin complex proteins

A) Immunolocalization for of the SC central region protein SYP-1 and the cohesion REC-8. Blue is DAPI stained DNA, red is SYP-1, and green is REC-8. The white column under SYP-1 is SYP-1 without DNA in the background, and REC-8 without DNA in the background. The white arrow indicates a cytoplasmic aggregate of REC-8 and SYP-1. B) cytoplasmic aggregates are not enclosed within SUN-1 and thus are cytoplasmic. The white arrow indicates a cytoplasmic aggregate of SYP-1 outside the nuclear envelope as indicated by SUN-1 localization, scale bars are 3μm.

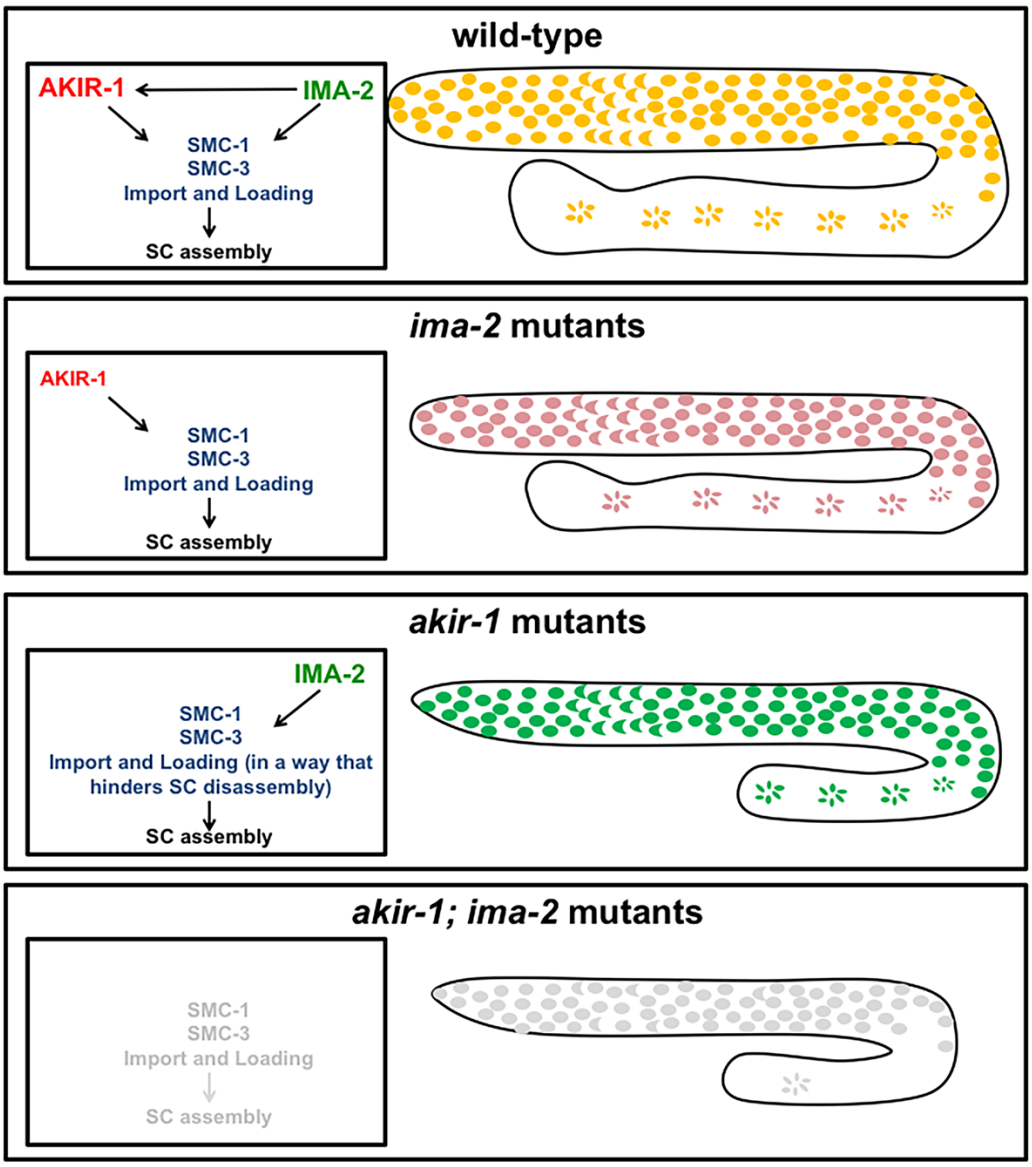

Figure S10: Model

Left- a suggested pathway in wild type and in each mutant examined. Right- expression region of AKIR-1 and IMA-2. Green is IMA-2 expression, red is AKIR-1 expression, yellow- both, gray- none. Expression of the IMA-2 and AKIR-1 proteins is found mainly in the nuclei, however, for simplicity the whole germline region is colored. Grey color in the pathway model indicates that the pathway is partially active.