**Data S1**

# DCTN2 inhibited cellular senescence through targeting TRIM21 mediated MST2 ubiquitination and activation in hepatocellular carcinoma

Yanbo Wang [1,2, †], Yaomei He [4, †], Qin Yu [7, †], Ningrui Wang [6, †], Qiaoling Ruan [2], Haiyan Wang [2], Hanqing Zhao [2], Yonglin Zhang [2], Yang Ke [8], Caie Tang [2], Liqi Lang [2], Yuxia Tang [2], Lixia Liu [2], Hao Zhang [2], Shan Yan [2, *], Aimin Wang [1, 5, *], Qiushuo Shen [2, *], Ceshi Chen [2, 3 *]

[†] These authors contributed equally to this work.

[*] Correspondence to: Ceshi Chen: chenc@kmmu.edu.cn

Qiushuo Shen: shenqiushuo@kmmu.edu.cn

Aimin Wang: wam@qdu.edu.cn

Shan Yan: yanshan@kmmu.edu.cn

**This file includes:**

Figures S1 to S7

Tables S1 to S3

## Supplementary Figures

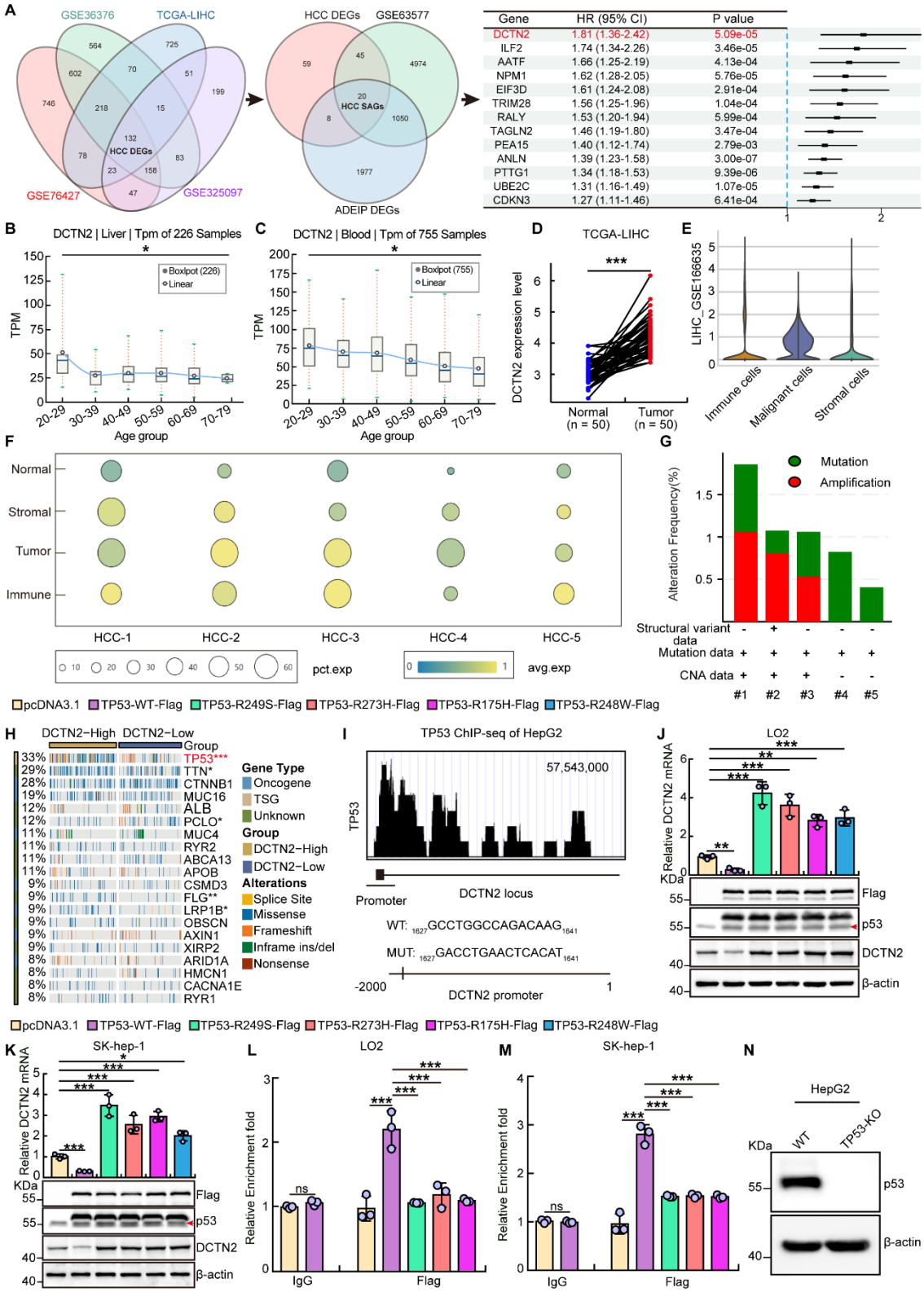



**Figure S1. Senescence-related gene DCTN2 was up-regulated by TP53 mutation in HCC. (A)**

Identification of 20 core HCC senescence-associated genes via Venn diagram intersection of multi-dataset DEGs including GSE76427 (|LogFC| > 0.58, $P$ < 1E-10), GSE36376 (|LogFC| > 0.58, $P$ < 1E-10), GSE325097 (|LogFC| > 1, $P$ < 0.05), TCGA-LIHC GSE63577 ($P$ < 0.05) and ADEIP DEGs ($P$ < 0.05), accompanying with Cox proportional hazards model analysis for these 20 genes in TCGA-LIHC dataset. **(B-C)** The mean *DCTN2* transcripts per million across six age groups were retrieved from the ADEIP database for both 226 liver samples and 755 blood samples derived from healthy individuals. **(D)** Expression levels of DCTN2 in paired normal and tumor tissues extracted from the TCGA-LIHC dataset. **(E)** Distribution of DCTN2 expression across distinct cell types (immune cells, malignant cells and stromal cells) in the single-cell RNA sequencing (scRNA-seq) analysis from GSE166635 dataset, visualized as a violin plot. **(F)** Cell-type-specific spatial expression of DCTN2 from five HCC samples, visualized across four cellular compartments. Dot size = proportion of expressing cells; color = average expression intensity. **(G)** Alteration frequency of DCTN2 (mutation and amplification) in diverse hepatocellular carcinoma cohorts from online cBioPortal repository, indicating CNA, mutation, and structural variant data availability. The datasets were denoted as #5: HCC (CLCA, Nature 2024), #4: HCC (INSERM, Nat Genet 2015), #3: HCC (TCGA GDC, 2025), #2: LIHC (TCGA, PanCancer Atlas), #1: LIHC (TCGA, Firehose Legacy). **(H)** Waterfall plot showed the mutation distribution of the top 20 most frequently mutated genes in TCGA-LIHC cohort from CAMOIP database, grouped by DCTN2 expression status. **(I)** The DCTN2 promoter contained a predicted TP53 binding site identified by ChIP-seq. Data were obtained from the ENCODE project. **(J-K)** The relative expression levels of DCTN2 were detected via RT-qPCR (top) and immunoblotting (bottom) in LO2 (J) and SK-hep-1 (K) cells transfected with pcDNA3.1, TP53-WT-Flag, TP53-R249S-Flag, TP53-R175H-Flag, TP53-R248W-Flag, and TP53-R273H-Flag. The red arrow marked

the endogenous p53 protein band. **(L-M)** CUT&Tag and qPCR assays showed the enrichment of Flag-tagged TP53 and mutants at the DCTN2 promoter in LO2 (L) and SK-hep-1 (M) cells, with IgG serving as a negative control. **(N)** Immunoblotting was applied to assess TP53 knockout efficacy in HepG2 cells. Bars indicate mean ± SD. ns, no significant difference. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

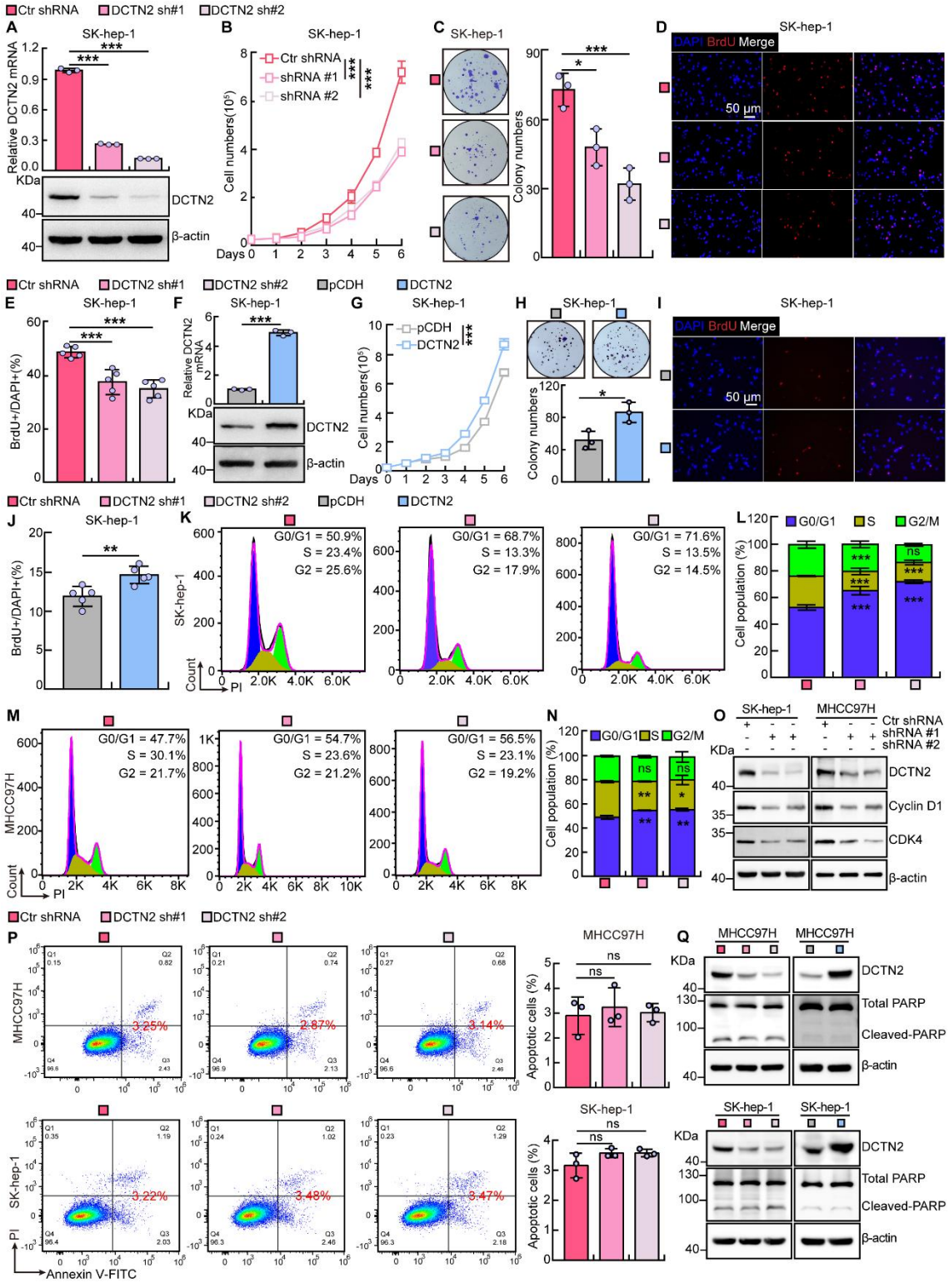



**Figure S2. DCTN2 promoted tumor cell growth.** (**A**) Establishment of DCTN2 knockdown in SK-hep-1 cells, verified by RT-qPCR (top) and immunoblot (bottom). (**B**) The indicated cell growth was examined

by daily counting. (**C**) DCTN2 knockdown reduced the colony formation ability of SK-hep-1 cells. (**D-E**) DCTN2 knockdown reduced BrdU positive staining cells determined by the BrdU incorporation assay in SK-hep-1 cells. (E) Quantification data for (D). Scale bar = 50 μm. (**F**) Establishment of DCTN2 overexpression in SK-hep-1 cells, verified by RT-qPCR (top) and immunoblot (bottom). (**G**) The indicated cell growth was examined by daily counting. (**H**) DCTN2 overexpression elevated the colony formation ability of SK-hep-1 cells. (**I-J**) In SK-hep-1 cells, BrdU incorporation assay showed DCTN2 overexpression increased BrdU-positive cells. (J) Quantification data for (I). Scale bar = 50 μm. (**K-N**) DCTN2 knockdown increased G0/G1 phase cell populations as examined by FACS analysis. (L, N) Quantitative data corresponding to (K, M) respectively. (**O**) Depletion of DCTN2 decreased CyclinD1 and CDK4 expression. (**P**) Annexin V/PI flow cytometry quantification of apoptotic MHCC97H and SK-hep-1 cells with DCTN2 knockdown. (**Q**) Immunoblotting for DCTN2, total/cleaved PARP in DCTN2 silenced HCC cells. Bars indicate mean ± SD. ns, no significant difference. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

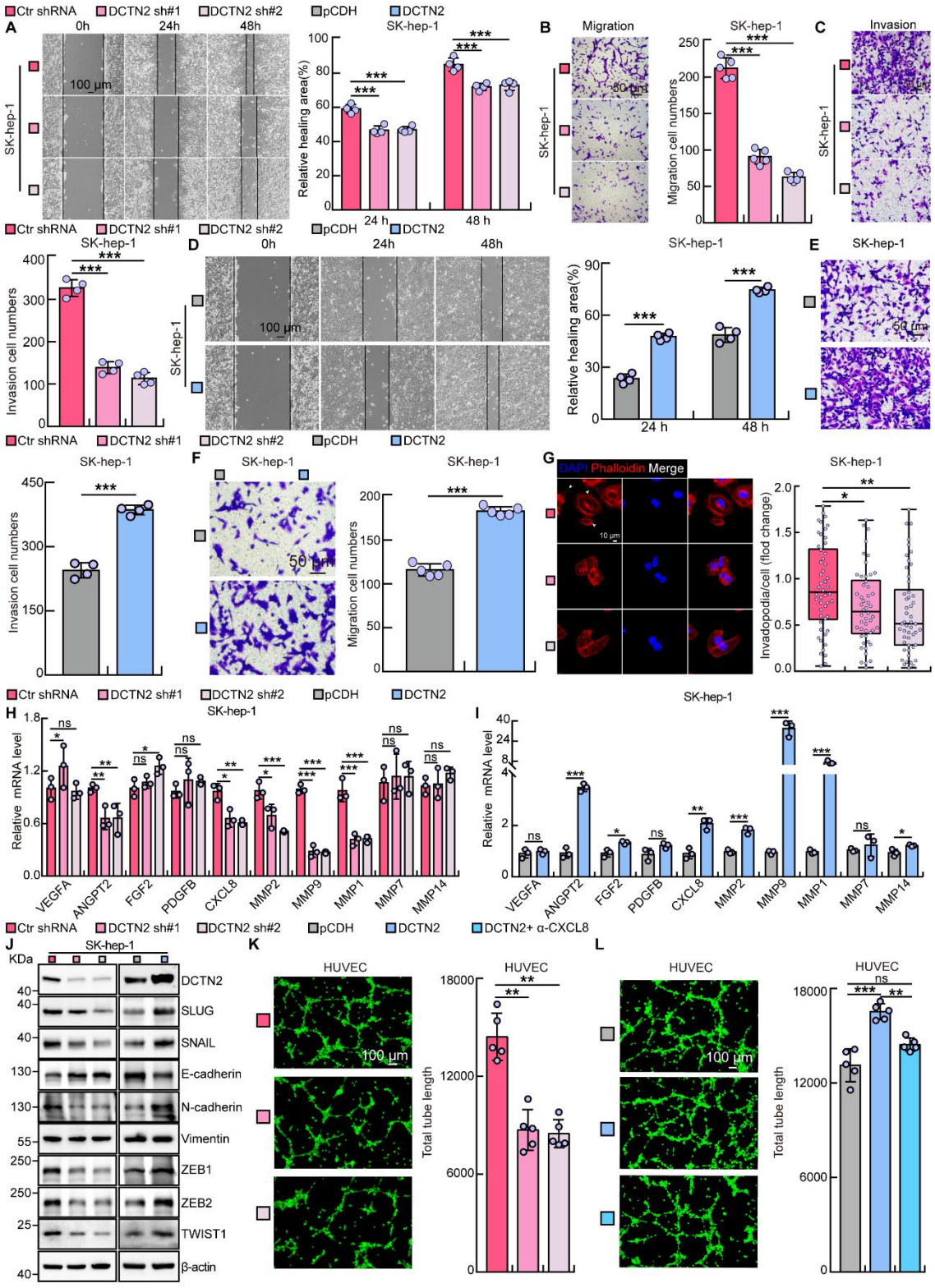



**Figure S3. Ablation of DCTN2 suppressed tumor cell migration. (A-C)** Wound healing (A), trans-well (C), and invasion (E) assays were conducted for evaluating how DCTN2 knockdown affected the migration

ability of SK-hep-1 cells, and quantification data were displayed in the panel on the right. Scale bars = 100 μm (A), 50 μm (B, C). **(D-F)** Wound healing (D), invasion (E), and trans-well (F) assays were used to detect the migratory ability of SK-hep-1 cells with DCTN2 overexpression. **(G)** The indicated cells underwent IF staining with phalloidin, and white head arrows highlighted structures that took on a pseudopodia-like appearance. Scale bar = 10 μm. (**H-I**) RT-qPCR quantification of pro-angiogenic mediators in SK-hep-1 cells with DCTN2 knockdown (H) or overexpression (I). (**J**) The protein expressions of SLUG, SNAIL, E-cadherin, N-cadherin, Vimentin, ZEB1, ZEB2 and TWIST1 in SK-hep-1 knockdown or overexpression cell extracts. **(K)** The capacity of primary HUVECs to form tubes was inhibited when treated with CM collected from SK-hep-1 cells with DCTN2 knockdown. Scale bar = 100 μm. (**L**) Ectopic DCTN2 overexpression promoted HUVEC angiogenesis, whereas neutralizing CXCL8 (3 μg/mL) partially abrogated this phenotype. Scale bar = 100 μm. Bars indicate mean ± SD. ns, no significant difference. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

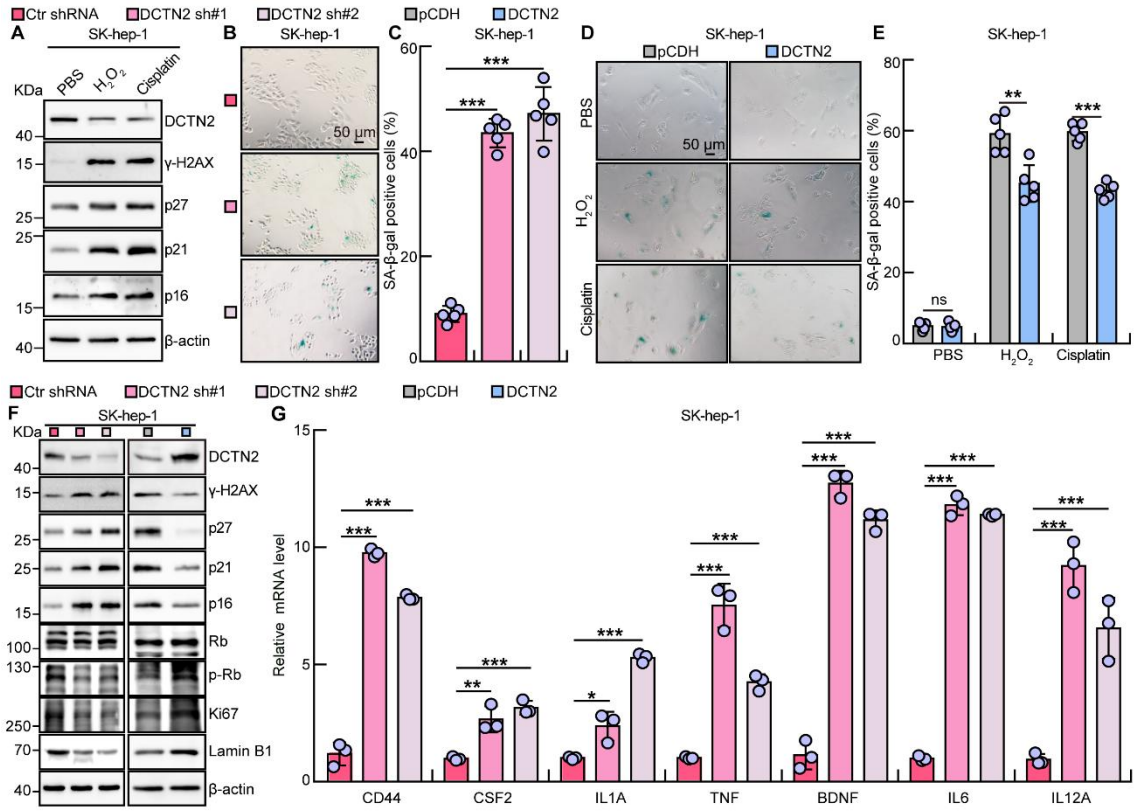



**Figure S4. Inhibition of DCTN2 enhanced cellular senescence. (A)** Western blot examined DCTN2, γ-H2AX, p27, p21 and p16 protein levels in $H_2O_2$ or cisplatin treated SK-hep-1 cells. **(B-E)** SA-β-gal activity changes in DCTN2-knockdown or overexpressing SK-hep-1 cells; (C) and (E) were the statistical graphs of (B) and (D), respectively. Scale bar = 50 μm. Data represented the percentage of SA-β-gal-positive cells ± SD. **(F)** Immunoblotting examined DCTN2, γ-H2AX, p27, p21, p16, Rb, p-Rb, Ki67 and Lamin B1 protein expression in SK-hep-1 cells with DCTN2 depletion or overexpression. (**G**) RT-qPCR examined the mRNA expression levels of SASP including CD44, CSF2, interleukin 1A, 6, 12A, TNF and BDNF in DCTN2-depleted SK-hep-1 cells. Bars indicate mean ± SD. ns, no significant difference. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

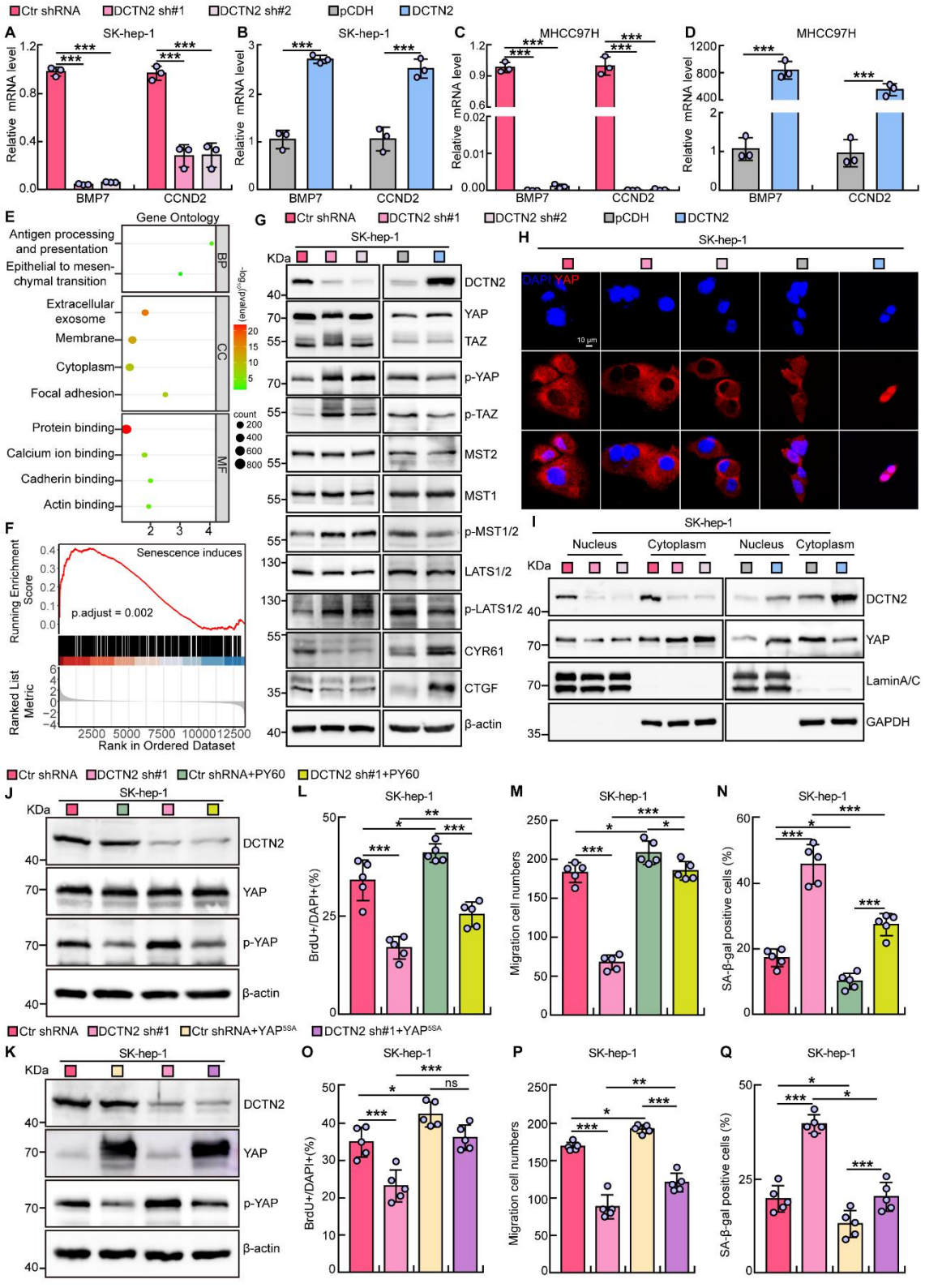



**Figure S5. DCTN2 restrained the Hippo signaling pathway. (A-D)** RT-qPCR was performed to validate BMP7 and CCND2, the downstream genes of DCTN2 identified from RNA-seq results. **(E)** GO enrichment

analysis of DEGs identified relevant pathways perturbed by DCTN2 depletion. **(F)** GSEA analysis from RNA-seq data indicated the involvement of DCTN2 in HCC cellular senescence. **(G)** Western blot was used to detect the protein levels of key Hippo signaling pathway components and its downstream target genes CYR61, CTGF in SK-hep-1 cells under DCTN2 overexpression or knockdown. **(H-I)** Immunofluorescence staining (H) and western blot of nucleus-cytoplasm fractionation (I) were utilized to determine the subcellular localization of YAP in SK-hep-1 cells. Scale bar = 10 μm. **(J-K)** Immunoblotting was employed to validate the protein levels of DCTN2, YAP and p-YAP in indicated SK-hep-1 cells. **(L-Q)** Treatment with PY60 or ectopic expression of $YAP^{5SA}$ was able to restore the phenotypes in DCTN2-deleted SK-hep-1 cells. Bars indicate mean ± SD. ns, no significant difference. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

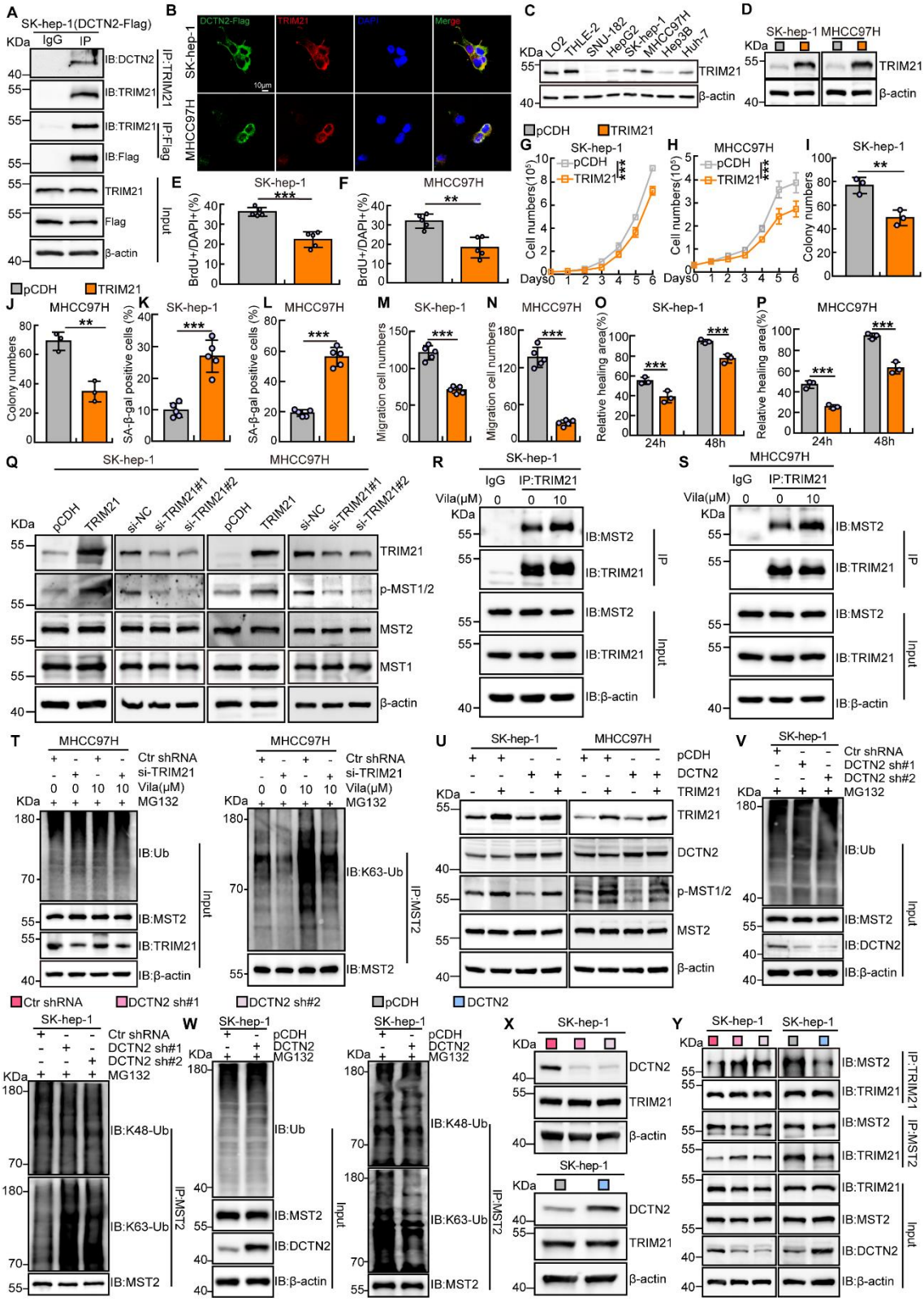


**Figure S6. TRIM21 suppressed HCC malignancy. (A)** Co-IP assay using Flag and TRIM21 antibodies in DCTN2-Flag overexpressing SK-hep-1 cells. IgG was used as a negative control. **(B)**

Immunofluorescence assay indicated the co-localization of DCTN2 with TRIM21 in SK-hep-1 and MHCC97H cells. **(C)** The relative expression level of TRIM21 in HCC cell lines including LO2, THLE-2, SNU-182, HepG2, SK-hep-1, MHCC97H, Hep3B and Huh7 examined by immunoblotting assay. **(D)** TRIM21-overexpressing SK-Hep-1 and MHCC97H cell lines were established and verified via western blot. **(E-J)** TRIM21 overexpression decreased SK-hep-1 and MHCC97H cells' proliferation abilities by BrdU incorporation (E, F), growth curve (G, H), and colony formation experiments (I, J). (**K-L**) β-gal staining quantification result of SK-hep-1 (K) and MHCC97H (L) cells with stable overexpression of DCTN2. **(M-P)** Forced expression of TRIM21 inhibited cell migration in trans-well assays (M, N) and wound healing (O, P). **(Q)** The protein expressions of TRIM21, p-MST1/2, MST2, and MST1 were detected by immunoblot with the indicated antibodies in SK-hep-1 and MHCC97H cell extracts. **(R-S)** Co-IP analysis demonstrating that vilazodone enhanced endogenous TRIM21-MST2 interaction in SK-hep-1 (R) and MHCC97H (S) HCC cells. Cells were exposed to 0 or 10 μM vilazodone. IgG served as negative control for immunoprecipitation. **(T)** Ubiquitination analysis of MST2 in MHCC97H cells with TRIM21 knockdown and vilazodone intervention. **(U)** Western blot analysis of TRIM21, DCTN2, p-MST1/2 and MST2 expression in SK-hep-1 and MHCC97H cells transfected with or without DCTN2-expressing plasmid and TRIM21-expressing plasmid. **(V-W)** DCTN2 mainly mediated K63-linked polyubiquitination of MST2. SK-hep-1 cells with DCTN2 knockdown (V) or overexpression (W) were subjected to anti-MST2 immunoprecipitation, followed by *in vivo* ubiquitination assay to detect K48- and K63-linked polyubiquitination of MST2 using chain-specific antibodies. **(X)** Western blot was used to assess TRIM21 expression in MHCC97H cells with DCTN2 silencing or overexpression. **(Y)** Co-IP assay was performed to investigate the interaction between DCTN2 and TRIM21 in SK-hep-1 cells with DCTN2 overexpression

or knockdown. Bars indicate mean ± SD. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

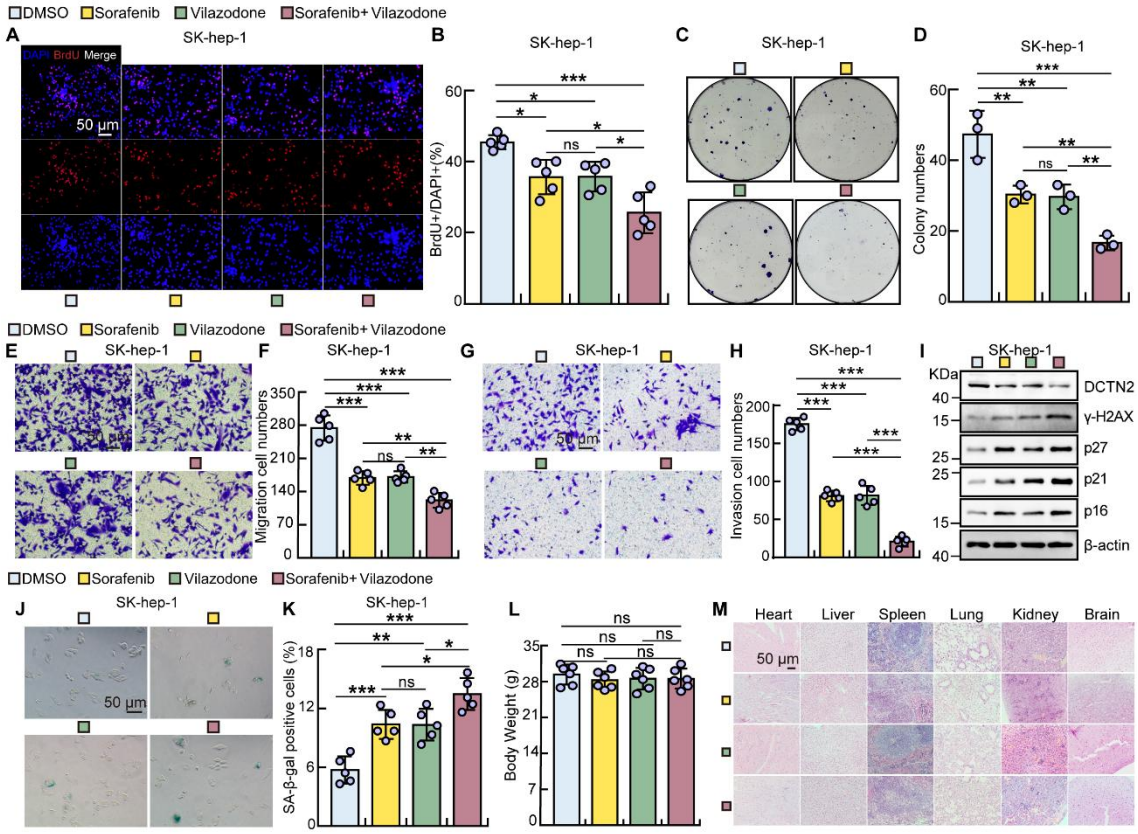



**Figure S7. The TRIM21 activator vilazodone exhibited an additive therapeutic effect in combination with sorafenib. (A-D)** The co-treatment with vilazodone and sorafenib led to an additive inhibition of SK-hep-1 cell proliferation, as evidenced by the BrdU incorporation assay (A) and colony formation assay (C). The statistical analyses for (A) and (C) were presented in (B) and (D), respectively. **(E-H)** The combination of vilazodone and sorafenib notably diminished the migration capacity of SK-hep-1 cells, as confirmed by trans-well assays (E) and invasion assays (G). The statistical data for (E) and (G) were presented in (F) and (H), respectively. **(I)** Western blot analysis was performed to assess the expression levels of DCTN2, γ-H2AX, p27, p21, and p16 proteins in SK-hep-1 cells treated with vilazodone and sorafenib. **(J-K)** The co-treatment with vilazodone and sorafenib resulted in an obvious induction of SK-hep-1 cell senescence, with

statistical data shown in (K) corresponding to (J). Scale bar = 50 μm. **(L)** There were no significant changes in the body weight of nude mice by treatment of SK-hep-1 with vilazodone in combination with sorafenib (n = 6 per group). **(M)** The heart, liver, spleen, lung, brain and kidney of nude mice were harvested, followed by H&E staining to assess potential drug toxicity. No noticeable morphological alterations were observed in the organs post-treatment with the drug. Scale bar = 50 μm. Bars indicate mean ± SD. ns, no significant difference. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

**Supplementary Tables**

**Table S1. Antibodies and oligos used in this study.**

| Antibody Name | Catalog number | Supplier | Species |
|---|---|---|---|
| p53 | sc-126 | Santa Cruz | Mouse |
| DCTN2 | A2200 | abclonal | Rabbit |
| p16 | 23200S | CST | Rabbit |
| β-actin | 3700S | CST | Mouse |
| p21 | 2947S | CST | Rabbit |
| p27 | 3686S | CST | Rabbit |
| Ki67 | RMA-0731 | MXB | Rabbit |
| p-MST2 | bs4634R | Bioss | Rabbit |
| p-MST1/2 | AP1564 | abclonal | Rabbit |
| CyclinD1 | 55506 | CST | Rabbit |
| CDK4 | 553048 | Biosciences | Mouse |
| γ-H2A.X | 7631S | CST | Rabbit |
| YAP/TAZ | 8418S | CST | Rabbit |
| p-YAP | 4911S | CST | Rabbit |
| p-TAZ | AF4315 | Affinity | Rabbit |
| MST1 | 22245-1-AP | proteintech | Rabbit |
| Snail | 13099-1-AP | proteintech | Rabbit |

| | | | |
|---|---|---|---|
| Slug | 12129-1-AP | proteintech | Rabbit |
| MST2 | A9036 | abclonal | Rabbit |
| MST2 | PA5-29320 | thermo | Mouse |
| LATS1/2 | DF7517 | Affinity | Rabbit |
| p-LATS1/2 | AF8163 | Affinity | Rabbit |
| K48-Ub | A3606 | abclonal | Rabbit |
| K63-Ub | A18164 | abclonal | Rabbit |
| CTGF | ER1802-69 | HUABIO | Rabbit |
| CYR61 | ER1905-70 | HUABIO | Rabbit |
| YAP | 14074S | CST | Rabbit |
| LaminA/C | 81042-1-RR | proteintech | Rabbit |
| GAPDH | 60004-1-Ig | proteintech | Mouse |
| Flag | 14793S | CST | Rabbit |
| Flag | F1804 | Sigma | Mouse |
| HA | SC-7392 | Santa Cruz | Mouse |
| HA | 3724S | CST | Rabbit |
| TRIM21 | 67136-1-Ig | proteintech | Mouse |
| TRIM21 | DF6717 | Affinity | Rabbit |
| Myc | 2278S | CST | Rabbit |
| Ub | 80992-1-RR | proteintech | Rabbit |

| | | | |
|---|---|---|---|
| RB | 10048-2-Ig | proteintech | Rabbit |
| N-cadherin | 22018-1-AP | proteintech | Rabbit |
| E-cadherin | 20874-1-AP | proteintech | Rabbit |
| Vimentin | 10366-1-AP | proteintech | Rabbit |
| PARP | 9532S | CST | Rabbit |
| ZEB2 | A5705 | abclonal | Rabbit |
| ZEB1 | EM1710-27 | HUABIO | Mouse |
| TWIST1 | 25465-1-AP | Proteintech | Rabbit |
| P-RB | 30376-1-AP | Proteintech | Rabbit |
| Ki-67 | 84192-4-RR | Proteintech | Rabbit |
| Lamin B1 | 13435S | CST | Rabbit |
| CXCL8 | MAB208 | R&D | Mouse |

| **Primer Name** | **Primer Sequences (5’-3’)** |
|---|---|
| Human β-actin_F | AAGTGTGACGTGGACATCCGC |
| Human β-actin_R | CCGGACTCGTCATACTCCTGCT |
| Human DCTN2_F | ATGGCGGACCCTAAATACGC |
| Human DCTN2_R | TCAGGTAGGTCGCTAGTTTCATA |
| Human p53_F | CAGCACATGACGGAGGTTGT |
| Human p53_R | TCATCCAAATACTCCACACGC |
| Ctr shRNA_F | GCACTACCAGAGCTAACTCAG |

| | |
|---|---|
| Ctr shRNA_R | CTGAGTTAGCTCTGGTAGTGC |
| Human DCTN2 shRNA #1_F | GCCTCTGTAGAAGATGCAGAT |
| Human DCTN2 shRNA #1_R | ATCTGCATCTTCTACAGAGGC |
| Human DCTN2 shRNA #2_F | CAACTGTTTCTGACCATTAAA |
| Human DCTN2 shRNA #2_R | TTTAATGGTCAGAAACAGTTG |
| Negative Control siRNA_F | UUCUCCGAACGUGUCACGUTT |
| Negative Control siRNA_R | ACGUGACACGUUCGGAGAATT |
| Human p53 siRNA #1_F | CGGCGCACAGAGGAAGAGAAU |
| Human p53 siRNA #1_R | AUUCUCUUCCUCUGUGCGCCG |
| Human p53 siRNA #2_F | GUCCAGAUGAAGCUCCCAGAA |
| Human p53 siRNA #2_R | UUCUGGGAGCUUCAUCUGGAC |
| Human TRIM21 siRNA #1_F | GACUUCACCUGUUCUGUGATT |
| Human TRIM21 siRNA #1_R | UCACAGAACAGGUGAAGUCTT |
| Human TRIM21 siRNA #2_F | CAGCACGCUUGACAAUGAUTT |
| Human TRIM21 siRNA #2_R | AUCAUUGUCAAGCGUGCUGTT |
| Human CD44_F | GCCGCTTTGCAGGTGTATT |
| Human CD44_R | TCCATCTGGGCCATTGTG |
| Human CSF2_F | CCCTGGGAGCATGTGAAT |
| Human CSF2_R | GCCCTTGAGCTTGGTGAG |
| Human IL1A_F | GGTTGAGTTTAAGCCAATCCA |

| | |
|---|---|
| Human IL1A_R | TGCTGACCTAGGCTTGATGA |
| Human TNF_F | TCCAGGCGGTGCTTGTTC |
| Human TNF_R | GGCTACAGGCTTGTCACTCG |
| Human BDNF_F | CTCTTTCTGCTGGAGGAATACA |
| Human BDNF_R | CGCCGTTACCCACTCACT |
| Human IL6_F | GAAAGCAGCAAAGAGGCAC |
| Human IL6_R | GCTCTGGCTTGTTCCTCACTAC |
| Human IL12A_F | TGGCTACCCTGGTCCTCCT |
| HumanIL12A_R | GCCTCCACTGTGCTGGTTTTAT |
| Human BMP7_F | TCGGCACCCATGTTCATGC |
| Human BMP7_R | GAGGAAATGGCTATCTTGCAGG |
| Human CCND2_F | TTTGCCATGTACCCACCGTC |
| Human CCND2_R | AGGGCATCACAAGTGAGCG |
| DNA Spike in Primer F | GCCTTCTTCCCATTTCTGATCC |
| DNA Spike in Primer R | CACGAATCAGCGGTAAAGGT |
| hDCTN2 Cut&Tag qPCR primer_F | TCTGCTCAGCAACTGTCTGG |
| hDCTN2 Cut&Tag qPCR primer_R | TTCCCTTAAGATTCAAGGTAGGTT |
| Human VEGFA_F | AGGGCAGAATCATCACGAAGT |
| Human VEGFA_R | AGGGTCTCGATTGGATGGCA |
| Human ANGPT2_F | AACTTTCGGAAGAGCATGGAC |

| | |
|---|---|
| Human ANGPT2_R | CGAGTCATCGTATTCGAGCGG |
| Human FGF2_F | AGAAGAGCGACCCTCACATCA |
| Human FGF2_R | CGGTTAGCACACACTCCTTTG |
| Human PDGFB_F | CTCGATCCGCTCCTTTGATGA |
| Human PDGFB_R | CGTTGGTGCGGTCTATGAG |
| Human CXCL8_F | GACATACTCCAAACCTTTCCACC |
| Human CXCL8_R | AAACTTCTCCACAACCCTCTGC |
| Human MMP2_F | TACAGGATCATTGGCTACACACC |
| Human MMP2_R | GGTCACATCGCTCCAGACT |
| Human MMP9_F | TGTACCGCTATGGTTACACTCG |
| Human MMP9_R | GGCAGGGACAGTTGCTTCT |
| Human MMP1_F | AAAATTACACGCCAGATTTGCC |
| Human MMP1_R | GGTGTGACATTACTCCAGAGTTG |
| Human MMP7_F | GAGTGAGCTACAGTGGGAACA |
| Human MMP7_R | CTATGACGCGGGAGTTTAACAT |
| Human MMP14_F | GGCTACAGCAATATGGCTACC |
| Human MMP14_R | GATGGCCGCTGAGAGTGAC |

**Table S2. Bioinformatical databases used in this study.**

| Name | Link | Targets |
|---|---|---|
| ADEIP | https://gb.whu.edu.cn/ADEIP/ | To investigate DCTN2 expression pattern in 226 liver and 755 blood samples across six age groups of healthy individuals. |
| HCCDB V2 | http://lifeome.net/database/hccdb/home.html | To validate DCTN2 expression in the spatial transcriptomics data. |
| CAMOIP | http://www.zjyy-oncology.com:20002/ | To explore the correlation between DCTN2 expression and TP53 mutation status. |
| GSEA | https://www.gsea_msigdb.org/gsea/index.jsp | To examine the correlation between DCTN2 and cellular senescence process. |
| KEGG | https://www.genome.jp/kegg/catalog/org_list.html | To examine DCTN2 regulated Hippo signaling pathway. |
| GO | http://geneontology.org/ | To examine DCTN2 regulated Hippo signaling pathway. |
| Kaplan Meier Plotter | https://kmplot.com/analysis/index.php?p=background | To examine the correlation between DCTN2 and survival time of HCC patients. |
| ROC Plotter | https://www.rocplot.org/ | To examine the correlation between DCTN2 and prognosis of HCC patients. |

| | | |
|---|---|---|
| GEO | https://www.ncbi.nlm.nih.gov/geo/ | To examine the expression of DCTN2 in different GEO datasets. |
| cBioPortal | http://www.cbioportal.org/ | To examine the mutation and amplification status in HCC. |
| ENCODE | https://www.encodeproject.org/ | To examine whether the DCTN2 promoter contains a predicted TP53 binding site |

**Table S3. Clinicopathological characteristics of liver cancer patients in this study.**

| Patient characteristics | Clinical parameters | Cases | Low expression | High expression | *P* value |
|---|---|---|---|---|---|
| **Gender** | Male | 74 | 30 | 44 | |
| | Female | 16 | 9 | 7 | 0.251 |
| **Age (years)** | < 60 | 68 | 39 | 29 | |
| | ≥ 60 | 22 | 16 | 6 | 0.199 |
| **Clinical stage** | I/II | 58 | 23 | 35 | |
| | III/IV | 32 | 16 | 16 | 0.343 |
| **Tumor size (cm)** | < 5 | 44 | 21 | 23 | |
| | ≥ 5 | 46 | 18 | 28 | 0.411 |
| **Total bilirubin (μM)** | < 17 | 64 | 30 | 34 | |
| | ≥ 17 | 26 | 9 | 17 | 0.287 |
| **ALT (U/L)** | < 40 | 41 | 21 | 20 | |
| | ≥ 40 | 49 | 18 | 31 | 0.167 |
| **ALB (g/dL)** | < 40 | 22 | 7 | 15 | |
| | ≥ 40 | 68 | 32 | 36 | 0.210 |
| **AFP (μg/L)** | < 400 | 57 | 29 | 28 | |
| | ≥ 400 | 33 | 10 | 23 | 0.058 |
| **GGT (U/L)** | < 50 | 35 | 22 | 13 | |
| | ≥ 50 | 55 | 17 | 38 | **0.003** |

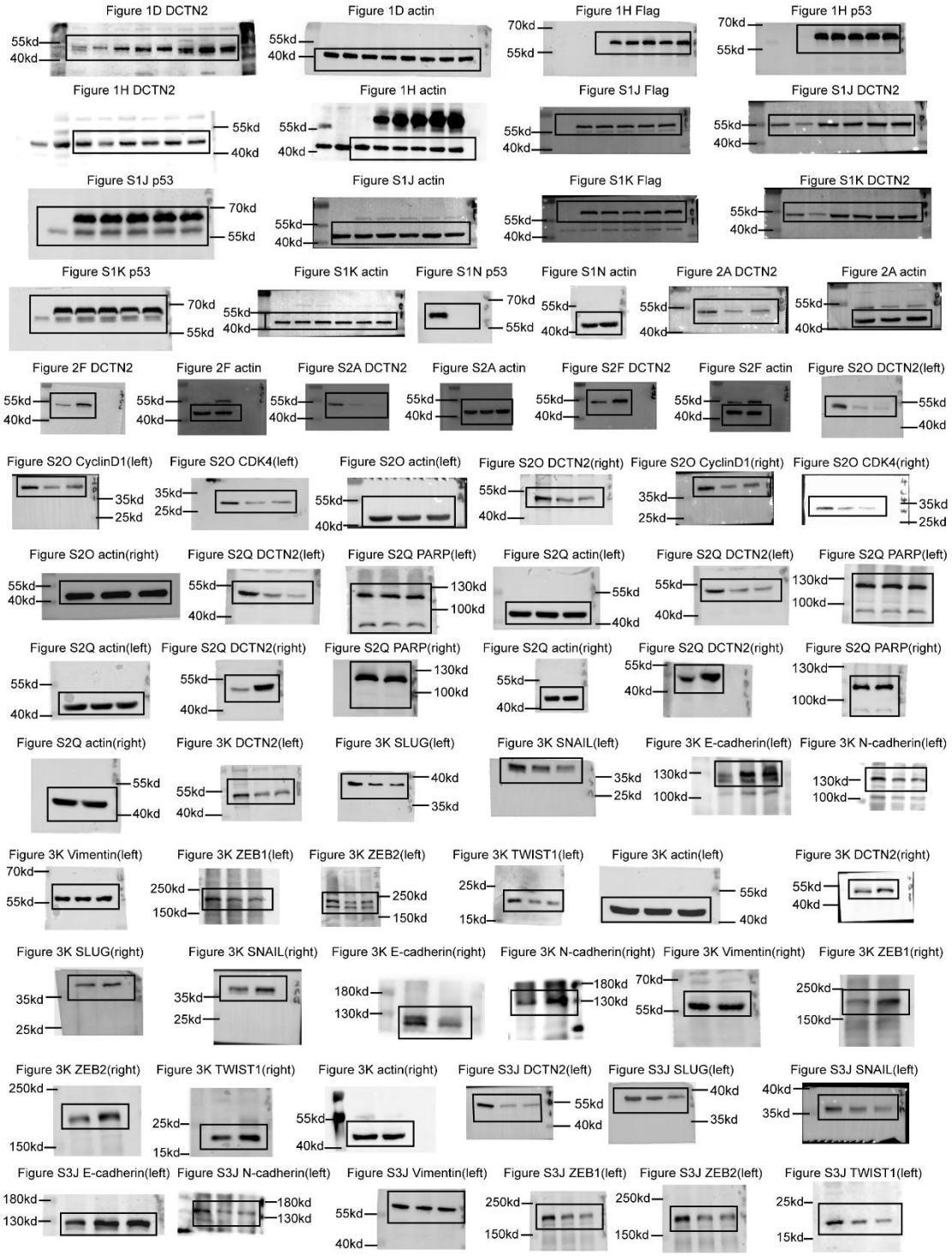
ALT: Alanine Aminotransferase

ALB: Albumin

AFP: Alpha-fetoprotein

GGT: γ-glutamyl transpeptidase

# Data S3. Full gels/blots images used in this study



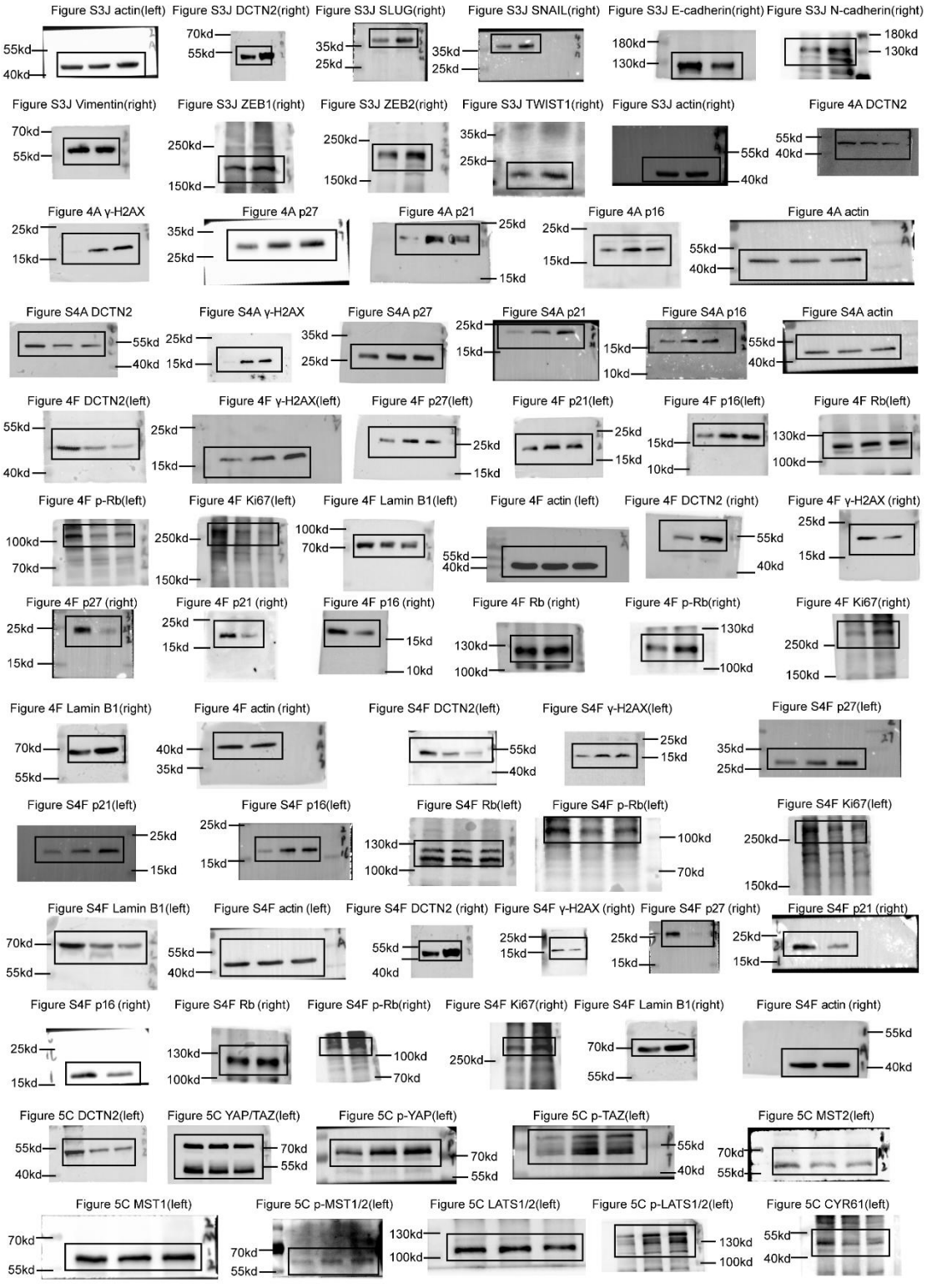


Figure S3J actin(left)
55kd
40kd
Figure S3J DCTN2(right)
70kd
55kd
Figure S3J SLUG(right)
35kd
25kd
Figure S3J SNAIL(right)
35kd
25kd
Figure S3J E-cadherin(right)
180kd
130kd
Figure S3J N-cadherin(right)
180kd
130kd
Figure S3J Vimentin(right)
70kd
55kd
Figure S3J ZEB1(right)
250kd
150kd
Figure S3J ZEB2(right)
250kd
150kd
Figure S3J TWIST1(right)
35kd
25kd
Figure S3J actin(right)
55kd
40kd
Figure 4A DCTN2
55kd
40kd
Figure 4A γ-H2AX
25kd
15kd
Figure 4A p27
35kd
25kd
Figure 4A p21
25kd
15kd
Figure 4A p16
25kd
15kd
Figure 4A actin
55kd
40kd
Figure S4A DCTN2
55kd
40kd
Figure S4A γ-H2AX
25kd
15kd
Figure S4A p27
35kd
25kd
Figure S4A p21
25kd
15kd
Figure S4A p16
15kd
10kd
Figure S4A actin
55kd
40kd
Figure 4F DCTN2(left)
55kd
40kd
Figure 4F γ-H2AX(left)
25kd
15kd
Figure 4F p27(left)
25kd
15kd
Figure 4F p21(left)
25kd
15kd
Figure 4F p16(left)
15kd
10kd
Figure 4F Rb(left)
130kd
100kd
Figure 4F p-Rb(left)
100kd
70kd
Figure 4F Ki67(left)
250kd
150kd
Figure 4F Lamin B1(left)
100kd
70kd
Figure 4F actin (left)
55kd
40kd
Figure 4F DCTN2 (right)
55kd
40kd
Figure 4F γ-H2AX (right)
25kd
15kd
Figure 4F p27 (right)
25kd
15kd
Figure 4F p21 (right)
25kd
15kd
Figure 4F p16 (right)
15kd
10kd
Figure 4F Rb (right)
130kd
100kd
Figure 4F p-Rb(right)
130kd
100kd
Figure 4F Ki67(right)
250kd
150kd
Figure 4F Lamin B1(right)
70kd
55kd
Figure 4F actin (right)
40kd
35kd
Figure S4F DCTN2(left)
55kd
40kd
Figure S4F γ-H2AX(left)
25kd
15kd
Figure S4F p27(left)
35kd
25kd
Figure S4F p21(left)
25kd
15kd
Figure S4F p16(left)
25kd
15kd
Figure S4F Rb(left)
130kd
100kd
Figure S4F p-Rb(left)
100kd
70kd
Figure S4F Ki67(left)
250kd
150kd
Figure S4F Lamin B1(left)
70kd
55kd
Figure S4F actin (left)
55kd
40kd
Figure S4F DCTN2 (right)
55kd
40kd
Figure S4F γ-H2AX (right)
25kd
15kd
Figure S4F p27 (right)
25kd
15kd
Figure S4F p21 (right)
25kd
15kd
Figure S4F p16 (right)
25kd
15kd
Figure S4F Rb (right)
130kd
100kd
Figure S4F p-Rb(right)
100kd
70kd
Figure S4F Ki67(right)
250kd
Figure S4F Lamin B1(right)
70kd
55kd
Figure S4F actin (right)
55kd
40kd
Figure 5C DCTN2(left)
55kd
40kd
Figure 5C YAP/TAZ(left)
70kd
55kd
Figure 5C p-YAP(left)
70kd
55kd
Figure 5C p-TAZ(left)
55kd
40kd
Figure 5C MST2(left)
70kd
55kd
Figure 5C MST1(left)
70kd
55kd
Figure 5C p-MST1/2(left)
70kd
55kd
Figure 5C LATS1/2(left)
130kd
100kd
Figure 5C p-LATS1/2(left)
130kd
100kd
Figure 5C CYR61(left)
55kd
40kd

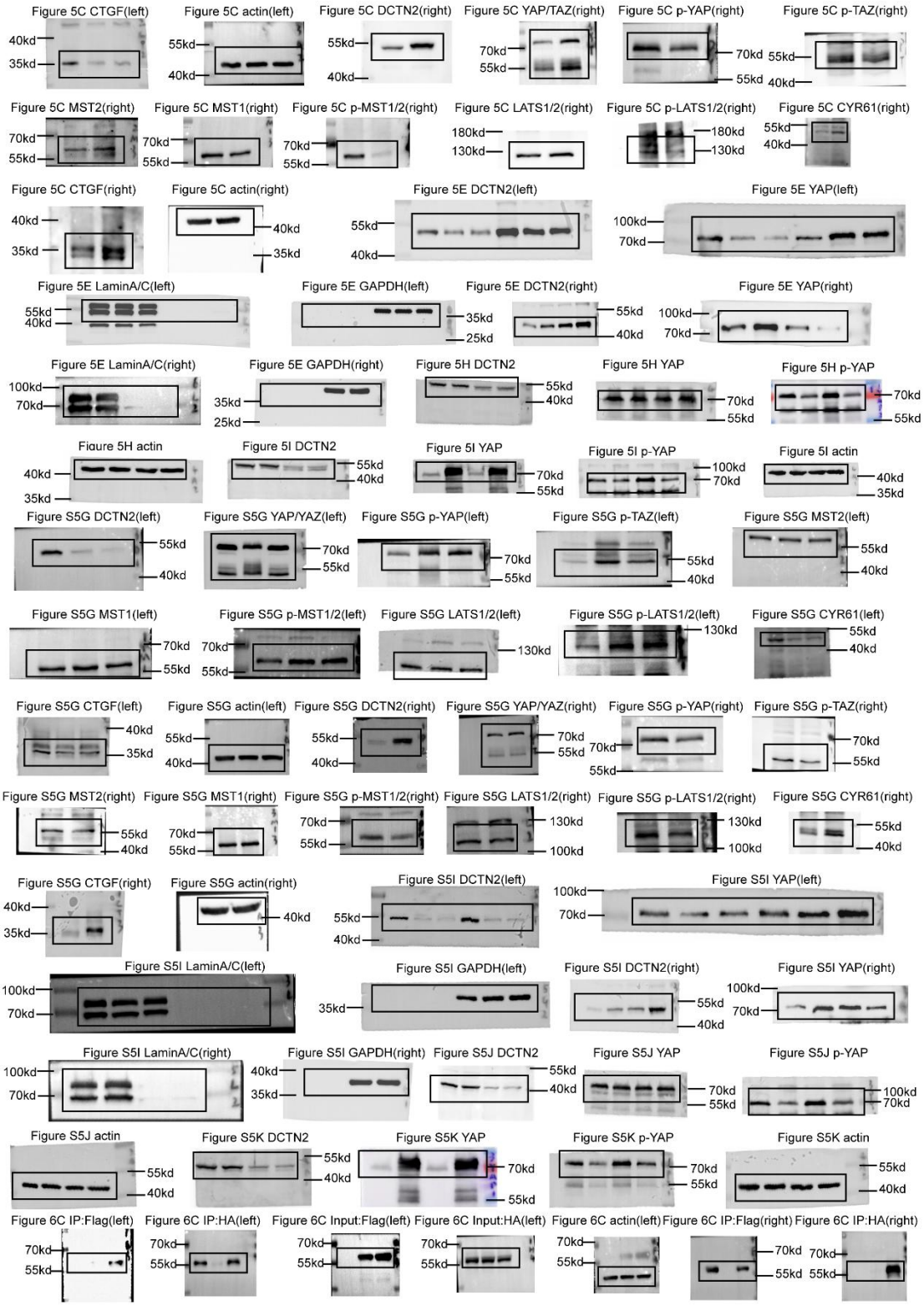


Figure 5C CTGF(left)
40kd
35kd
Figure 5C actin(left)
55kd
40kd
Figure 5C DCTN2(right)
55kd
40kd
Figure 5C YAP/TAZ(right)
70kd
55kd
Figure 5C p-YAP(right)
70kd
55kd
Figure 5C p-TAZ(right)
55kd
40kd
Figure 5C MST2(right)
70kd
55kd
Figure 5C MST1(right)
70kd
55kd
Figure 5C p-MST1/2(right)
70kd
55kd
Figure 5C LATS1/2(right)
180kd
130kd
Figure 5C p-LATS1/2(right)
180kd
130kd
Figure 5C CYR61(right)
55kd
40kd
Figure 5C CTGF(right)
40kd
35kd
Figure 5C actin(right)
40kd
35kd
Figure 5E DCTN2(left)
55kd
40kd
Figure 5E YAP(left)
100kd
70kd
Figure 5E LaminA/C(left)
55kd
40kd
Figure 5E GAPDH(left)
35kd
25kd
Figure 5E DCTN2(right)
55kd
40kd
Figure 5E YAP(right)
100kd
70kd
Figure 5E LaminA/C(right)
100kd
70kd
Figure 5E GAPDH(right)
35kd
25kd
Figure 5H DCTN2
55kd
40kd
Figure 5H YAP
70kd
55kd
Figure 5H p-YAP
70kd
55kd
Figure 5H actin
40kd
35kd
Figure 5I DCTN2
55kd
40kd
Figure 5I YAP
70kd
55kd
Figure 5I p-YAP
100kd
70kd
Figure 5I actin
40kd
35kd
Figure S5G DCTN2(left)
55kd
40kd
Figure S5G YAP/YAZ(left)
70kd
55kd
Figure S5G p-YAP(left)
70kd
55kd
Figure S5G p-TAZ(left)
55kd
40kd
Figure S5G MST2(left)
55kd
40kd
Figure S5G MST1(left)
70kd
55kd
Figure S5G p-MST1/2(left)
70kd
55kd
Figure S5G LATS1/2(left)
130kd
Figure S5G p-LATS1/2(left)
130kd
Figure S5G CYR61(left)
55kd
40kd
Figure S5G CTGF(left)
40kd
35kd
Figure S5G actin(left)
55kd
40kd
Figure S5G DCTN2(right)
55kd
40kd
Figure S5G YAP/YAZ(right)
70kd
55kd
Figure S5G p-YAP(right)
70kd
55kd
Figure S5G p-TAZ(right)
70kd
55kd
Figure S5G MST2(right)
55kd
40kd
Figure S5G MST1(right)
70kd
55kd
Figure S5G p-MST1/2(right)
70kd
55kd
Figure S5G LATS1/2(right)
130kd
100kd
Figure S5G p-LATS1/2(right)
130kd
100kd
Figure S5G CYR61(right)
55kd
40kd
Figure S5G CTGF(right)
40kd
35kd
Figure S5G actin(right)
40kd
Figure S5I DCTN2(left)
55kd
40kd
Figure S5I YAP(left)
100kd
70kd
Figure S5I LaminA/C(left)
100kd
70kd
Figure S5I GAPDH(left)
35kd
Figure S5I DCTN2(right)
55kd
40kd
Figure S5I YAP(right)
100kd
70kd
Figure S5I LaminA/C(right)
100kd
70kd
Figure S5I GAPDH(right)
40kd
35kd
Figure S5J DCTN2
55kd
40kd
Figure S5J YAP
70kd
55kd
Figure S5J p-YAP
100kd
70kd
Figure S5J actin
55kd
40kd
Figure S5K DCTN2
55kd
40kd
Figure S5K YAP
70kd
55kd
Figure S5K p-YAP
70kd
55kd
Figure S5K actin
55kd
40kd
Figure 6C IP:Flag(left)
70kd
55kd
Figure 6C IP:HA(left)
70kd
55kd
Figure 6C Input:Flag(left)
70kd
55kd
Figure 6C Input:HA(left)
70kd
55kd
Figure 6C actin(left)
70kd
55kd
Figure 6C IP:Flag(right)
70kd
55kd
Figure 6C IP:HA(right)
70kd
55kd

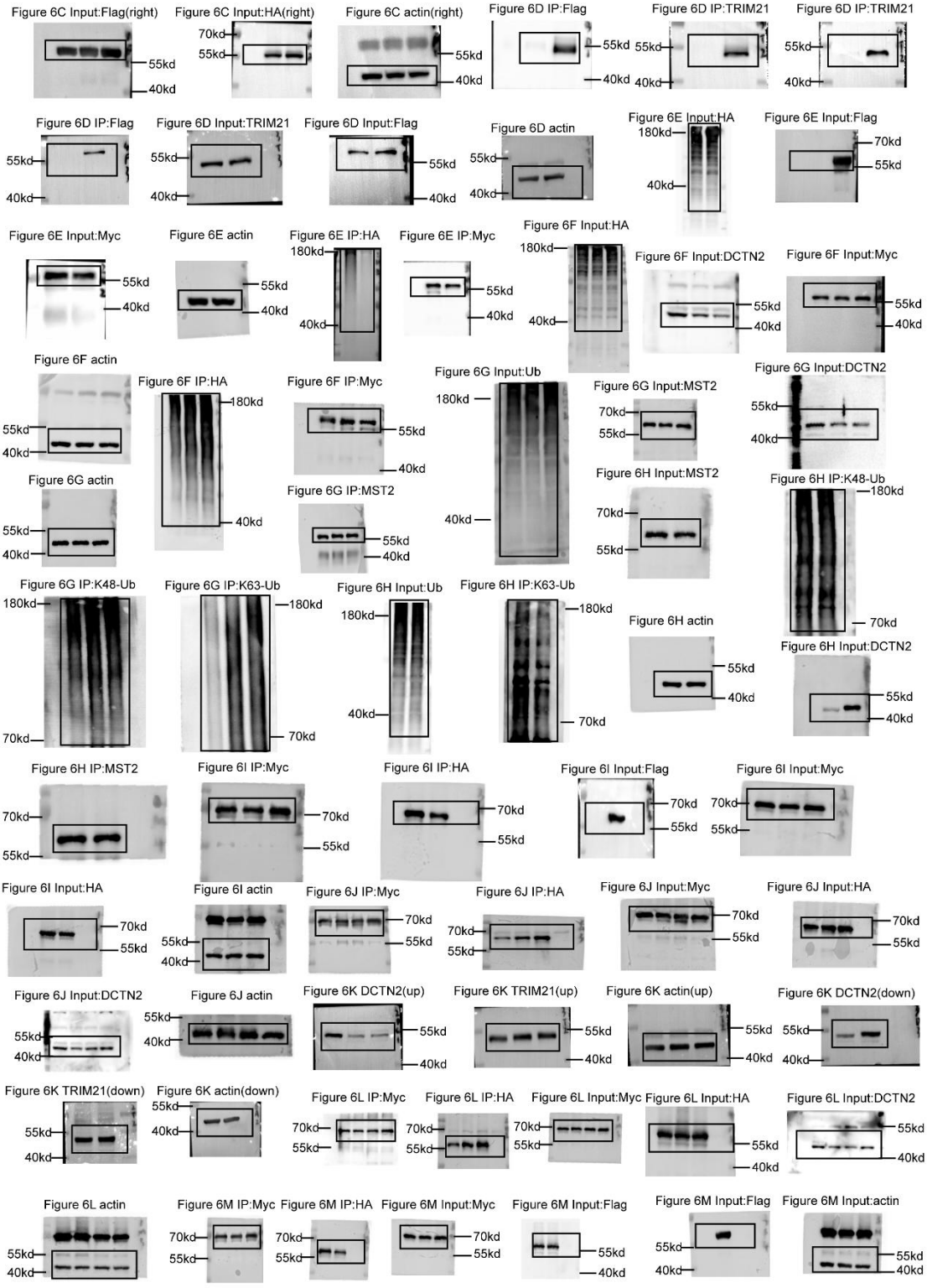


Figure 6C Input:Flag(right)
55kd
40kd
Figure 6C Input:HA(right)
70kd
55kd
Figure 6C actin(right)
55kd
40kd
Figure 6D IP:Flag
55kd
40kd
Figure 6D IP:TRIM21
55kd
40kd
Figure 6D IP:TRIM21
55kd
40kd
Figure 6D IP:Flag
55kd
40kd
Figure 6D Input:TRIM21
55kd
40kd
Figure 6D Input:Flag
55kd
40kd
Figure 6D actin
55kd
40kd
Figure 6E Input:HA
180kd
40kd
Figure 6E Input:Flag
70kd
55kd
Figure 6E Input:Myc
55kd
40kd
Figure 6E actin
55kd
40kd
Figure 6E IP:HA
180kd
40kd
Figure 6E IP:Myc
55kd
40kd
Figure 6F Input:HA
180kd
40kd
Figure 6F Input:DCTN2
55kd
40kd
Figure 6F Input:Myc
55kd
40kd
Figure 6F actin
55kd
40kd
Figure 6F IP:HA
180kd
40kd
Figure 6F IP:Myc
55kd
40kd
Figure 6G Input:Ub
180kd
40kd
Figure 6G Input:MST2
70kd
55kd
Figure 6G Input:DCTN2
55kd
40kd
Figure 6G actin
55kd
40kd
Figure 6G IP:MST2
55kd
40kd
Figure 6H Input:MST2
70kd
55kd
Figure 6H IP:K48-Ub
180kd
70kd
Figure 6G IP:K48-Ub
180kd
70kd
Figure 6G IP:K63-Ub
180kd
70kd
Figure 6H Input:Ub
180kd
40kd
Figure 6H IP:K63-Ub
180kd
70kd
Figure 6H actin
55kd
40kd
Figure 6H Input:DCTN2
55kd
40kd
Figure 6H IP:MST2
70kd
55kd
Figure 6I IP:Myc
70kd
55kd
Figure 6I IP:HA
70kd
55kd
Figure 6I Input:Flag
70kd
55kd
Figure 6I Input:Myc
70kd
55kd
Figure 6I Input:HA
70kd
55kd
Figure 6I actin
55kd
40kd
Figure 6J IP:Myc
70kd
55kd
Figure 6J IP:HA
70kd
55kd
Figure 6J Input:Myc
70kd
55kd
Figure 6J Input:HA
70kd
55kd
Figure 6J Input:DCTN2
55kd
40kd
Figure 6J actin
55kd
40kd
Figure 6K DCTN2(up)
55kd
40kd
Figure 6K TRIM21(up)
55kd
40kd
Figure 6K actin(up)
55kd
40kd
Figure 6K DCTN2(down)
55kd
40kd
Figure 6K TRIM21(down)
55kd
40kd
Figure 6K actin(down)
55kd
40kd
Figure 6L IP:Myc
70kd
55kd
Figure 6L IP:HA
70kd
55kd
Figure 6L Input:Myc
70kd
55kd
Figure 6L Input:HA
55kd
40kd
Figure 6L Input:DCTN2
55kd
40kd
Figure 6L actin
55kd
40kd
Figure 6M IP:Myc
70kd
55kd
Figure 6M IP:HA
70kd
55kd
Figure 6M Input:Myc
70kd
55kd
Figure 6M Input:Flag
55kd
40kd
Figure 6M Input:Flag
55kd
40kd
Figure 6M Input:actin
55kd
40kd

Figure 6N IP:MST2(left)

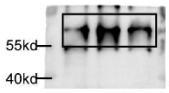



Figure 6N IP:TRIM21(left)

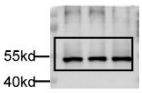



Figure 6N IP:MST2(left)

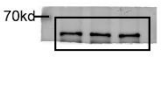



Figure 6N IP:MST2(left)

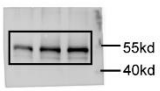



Figure 6N Input:TRIM21(left)

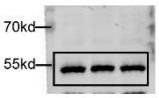



Figure 6N Input:MST2(left)

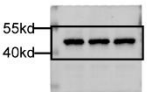



Figure 6N Input:DCTN2(left)

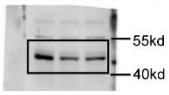



Figure 6N IP:MST2(right)

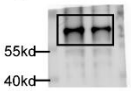



Figure 6N IP:TRIM21(right)

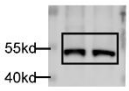



Figure 6N IP:MST2(right)

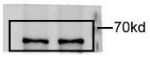



Figure 6N IP:TRIM21(right)

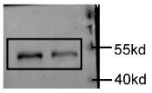



Figure 6N Input:DCTN2(right)

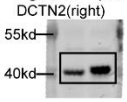



Figure 6N Input:actin(right)

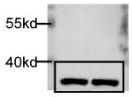



Figure S6A IP:DCTN2

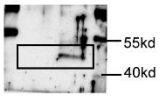



Figure S6A IP:TRIM21

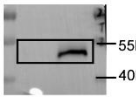



Figure S6A IP:TRIM21

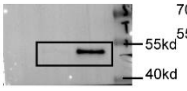



Figure S6A IP:Flag


Figure S6A Input:TRIM21

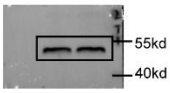



Figure 6N Input:TRIM21(right)

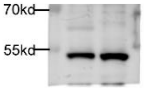



Figure S6A actin

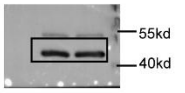



Figure S6C TRIM21

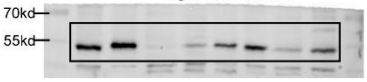



Figure S6C actin

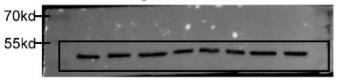



Figure S6A Input:Flag

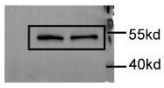



Figure S6D actin(left)

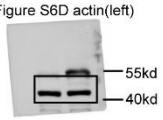



Figure S6D TRIM21(right)

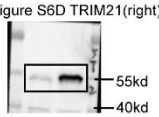



Figure S6D actin(right)

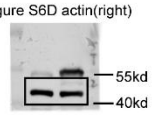



Figure S6Q TRIM21-1

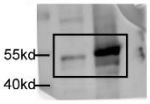



Figure S6Q TRIM21-2

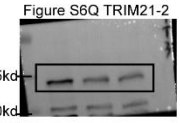



Figure S6D TRIM21(left)

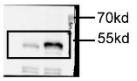



Figure S6Q TRIM21-4

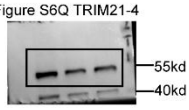



Figure S6Q p-MST1/2-1

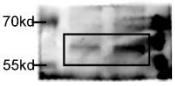



Figure S6Q p-MST1/2-2

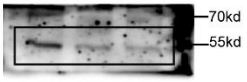



Figure S6Q p-MST1/2-3

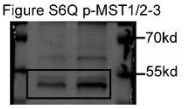



Figure S6Q TRIM21-3

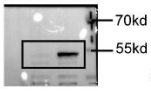



Figure S6Q p-MST1/2-4

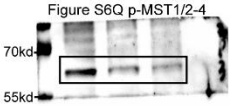



Figure S6Q MST2-1

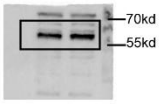



Figure S6Q MST2-2

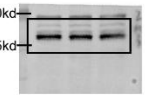



Figure S6Q MST2-3

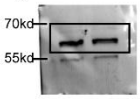



Figure S6Q MST2-4

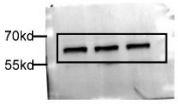



Figure S6Q MST1-1

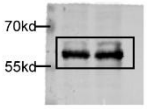



Figure S6Q MST1-2




Figure S6Q MST1-3




Figure S6Q MST1-4




Figure S6Q actin-1




Figure S6Q actin-2




Figure S6Q actin-3




Figure S6Q actin-4




Figure S6R IP:MST2




Figure S6R IP:TRIM21




Figure S6R Input:MST2




Figure S6S IP:MST2




Figure S6R Input:TRIM21




Figure S6R Input:actin




Figure S6S IP:TRIM21




Figure S6S Input:MST2




Figure S6S Input:TRIM21




Figure S6S Input:actin




Figure S6U MST2(left)




Figure S6U actin(left)




Figure S6U TRIM21(right)




Figure S6U DCTN2(right)




Figure S6U p-MST1/2(right)




Figure S6Y Input:DCTN2(left)




Figure S6Y actin(left)




Figure S6Y IP:MST2(right)




Figure S6Y IP:TRIM21(right)




Figure S6Y IP:MST2(right)

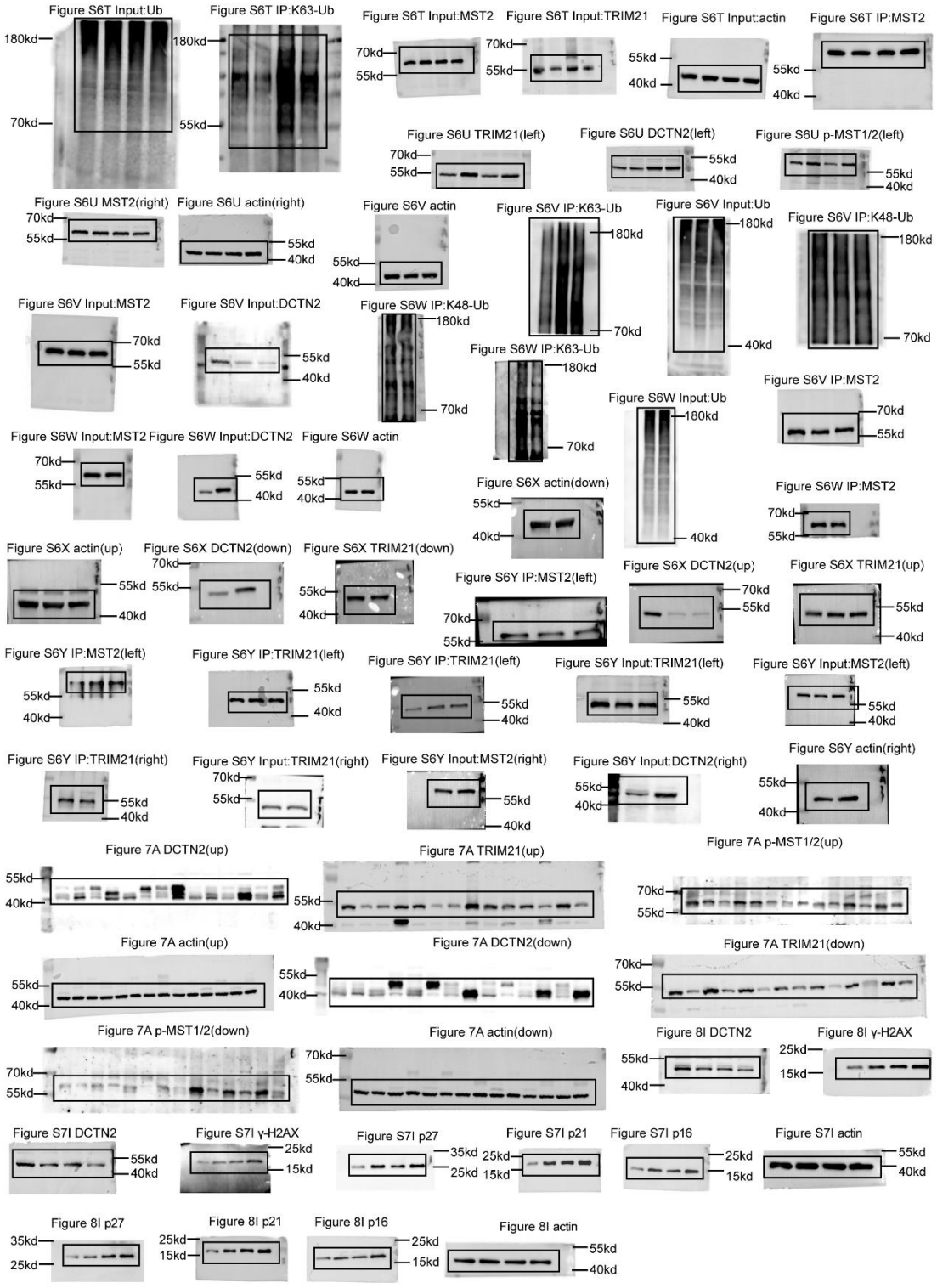


Figure S6T Input:Ub
180kd
70kd
Figure S6T IP:K63-Ub
180kd
55kd
Figure S6T Input:MST2
70kd
55kd
Figure S6T Input:TRIM21
70kd
55kd
Figure S6T Input:actin
55kd
40kd
Figure S6T IP:MST2
55kd
40kd
Figure S6U TRIM21(left)
70kd
55kd
Figure S6U DCTN2(left)
55kd
40kd
Figure S6U p-MST1/2(left)
55kd
40kd
Figure S6U MST2(right)
70kd
55kd
Figure S6U actin(right)
55kd
40kd
Figure S6V actin
55kd
40kd
Figure S6V IP:K63-Ub
180kd
70kd
Figure S6V Input:Ub
180kd
40kd
Figure S6V IP:K48-Ub
180kd
70kd
Figure S6V Input:MST2
70kd
55kd
Figure S6V Input:DCTN2
55kd
40kd
Figure S6W IP:K48-Ub
180kd
70kd
Figure S6W IP:K63-Ub
180kd
70kd
Figure S6W Input:Ub
180kd
40kd
Figure S6V IP:MST2
70kd
55kd
Figure S6W Input:MST2
70kd
55kd
Figure S6W Input:DCTN2
55kd
40kd
Figure S6W actin
55kd
40kd
Figure S6X actin(down)
55kd
40kd
Figure S6W IP:MST2
70kd
55kd
Figure S6X actin(up)
55kd
40kd
Figure S6X DCTN2(down)
70kd
55kd
Figure S6X TRIM21(down)
55kd
40kd
Figure S6Y IP:MST2(left)
70kd
55kd
Figure S6X DCTN2(up)
70kd
55kd
Figure S6X TRIM21(up)
55kd
40kd
Figure S6Y IP:MST2(left)
55kd
40kd
Figure S6Y IP:TRIM21(left)
55kd
40kd
Figure S6Y IP:TRIM21(left)
55kd
40kd
Figure S6Y Input:TRIM21(left)
55kd
40kd
Figure S6Y Input:MST2(left)
55kd
40kd
Figure S6Y IP:TRIM21(right)
55kd
40kd
Figure S6Y Input:TRIM21(right)
70kd
55kd
Figure S6Y Input:MST2(right)
55kd
40kd
Figure S6Y Input:DCTN2(right)
55kd
40kd
Figure S6Y actin(right)
55kd
40kd
Figure 7A DCTN2(up)
55kd
40kd
Figure 7A TRIM21(up)
55kd
40kd
Figure 7A p-MST1/2(up)
70kd
55kd
Figure 7A actin(up)
55kd
40kd
Figure 7A DCTN2(down)
55kd
40kd
Figure 7A TRIM21(down)
70kd
55kd
Figure 7A p-MST1/2(down)
70kd
55kd
Figure 7A actin(down)
70kd
55kd
Figure 8I DCTN2
55kd
40kd
Figure 8I γ-H2AX
25kd
15kd
Figure S7I DCTN2
55kd
40kd
Figure S7I γ-H2AX
25kd
15kd
Figure S7I p27
35kd
25kd
Figure S7I p21
25kd
15kd
Figure S7I p16
25kd
15kd
Figure S7I actin
55kd
40kd
Figure 8I p27
35kd
25kd
Figure 8I p21
25kd
15kd
Figure 8I p16
25kd
15kd
Figure 8I actin
55kd
40kd