# SUPPLEMENTARY INFORMATION

## Combining proximity labeling and crosslinking mass spectrometry for proteomic dissection of nuclear envelope interactome.

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**Table S2.** Crosslinking peptide searches of the 14 nuclear envelope proteins.

**Table S3.** Protein IDs and spectral counts of the BASU-LAP1 PL-MS and PL/XL-MS experiments using non-crosslinked peptide searching. (xlsx file)

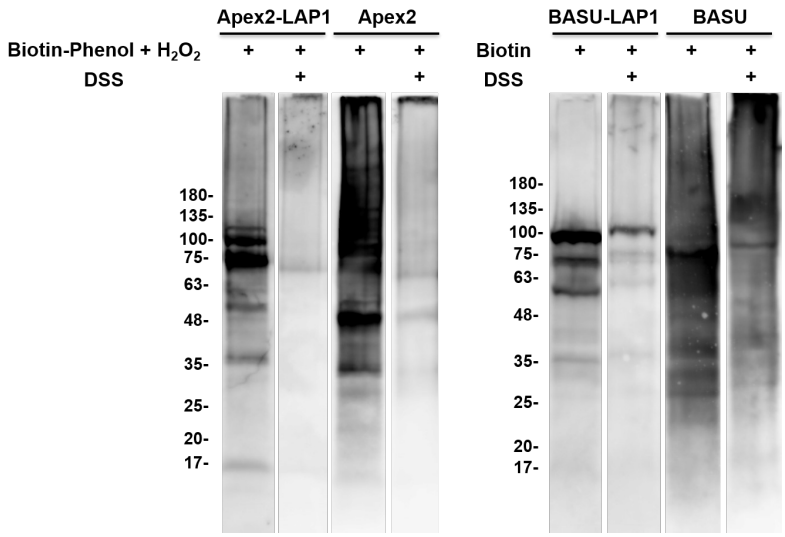


**Fig. S1.** Western blot showed DSS crosslinking prior to cell lysis led to protein aggregation. Proximity labeling was performed in four stable cell lines expressing APEX2-LAP1, APEX2, BSAU-LAP1, and BASU, respectively. Each sample was either not treated or treated with DSS before cell lysis. The samples were analyzed by western blot detected by streptavidin-HRP.

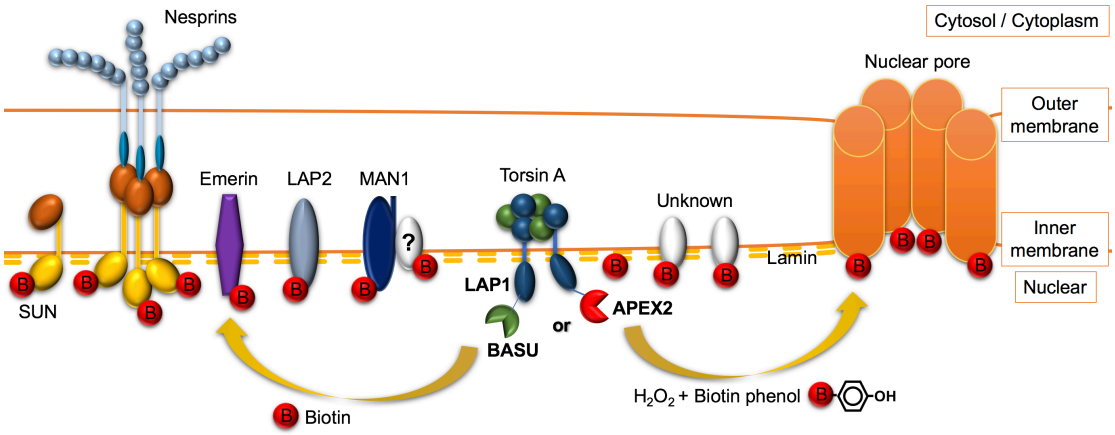


**Fig. S2.** Illustration of BASU-LAP1 and APEX2-LAP1 proximity labeling at the nuclear envelope. A biotin ligase (BASU) or heme peroxidase (APEX2) is fused at the N-terminus of LAP1, a known inner nuclear membrane protein, to study the protein-protein interactions at the nuclear envelope by proximity labeling. The proximity labeling was performed by adding biotin for BASU or biotin phenol and $H_2O_2$ for APEX2 in cell culture. The labeling radius is about 10 nm for both enzymes. After labeling, the biotinylated proteins are enriched by streptavidin beads.

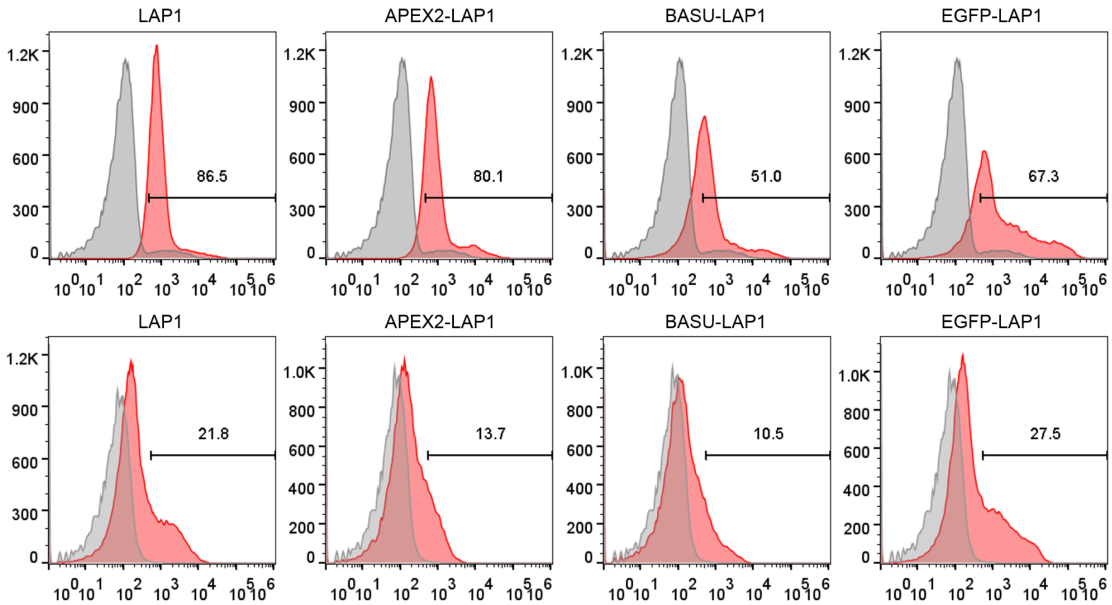


**Fig. S3.** Flow cytometry experiments showed gradual loss of ectopic expression after lentiviral transduction. Four stable cell lines (LAP1, APEX2-LAP1, BASU-LAP1, and EGFP-LAP1) were analyzed for their ectopic protein expression levels by anti-Myc staining. The upper row shows the cell lines with early passage numbers within 2-3 weeks of lentiviral transduction, whereas the bottom row shows the cell lines with older passage numbers within 4-5 weeks of lentiviral transduction.

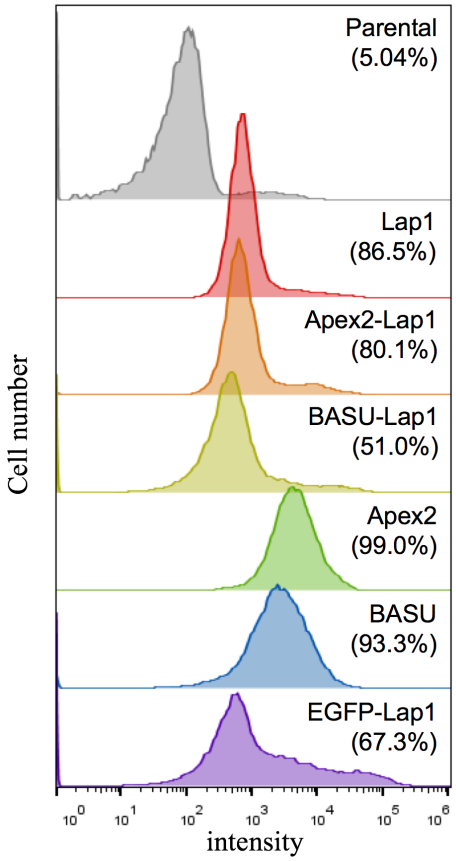


**Fig. S4.** Flow cytometry experiments showed good and comparable expression between APEX2 and BASU cell lines. The ectopic expression levels of LAP1, APEX2-LAP1, BASU-LAP1, APEX2, BASU, and EGFP-LAP1, were measured in the cognate stable cell lines, respectively. All the expressions were measured by immunostaining of Myc-tag.

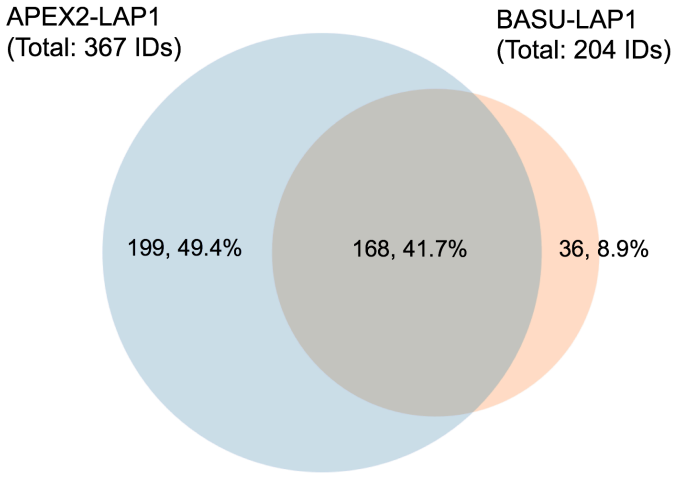


**Fig. S5.** The comparison of identified proteins in APEX2-LAP1 and BASU-LAP1 PL-MS experiments. The APEX2-LAP1 PL-MS identified more protein IDs than BASU-LAP1 (367 vs 204). Among the 199 IDs that were only observed in the APEX2-LAP1 experiment, 87 IDs are categorized as non-nuclear-envelope nuclear proteins by Unitprot classification. In contrast, 17 out of 36 IDs that were only observed in the BASU-LAP1 experiment are non-nuclear-envelope nuclear proteins.

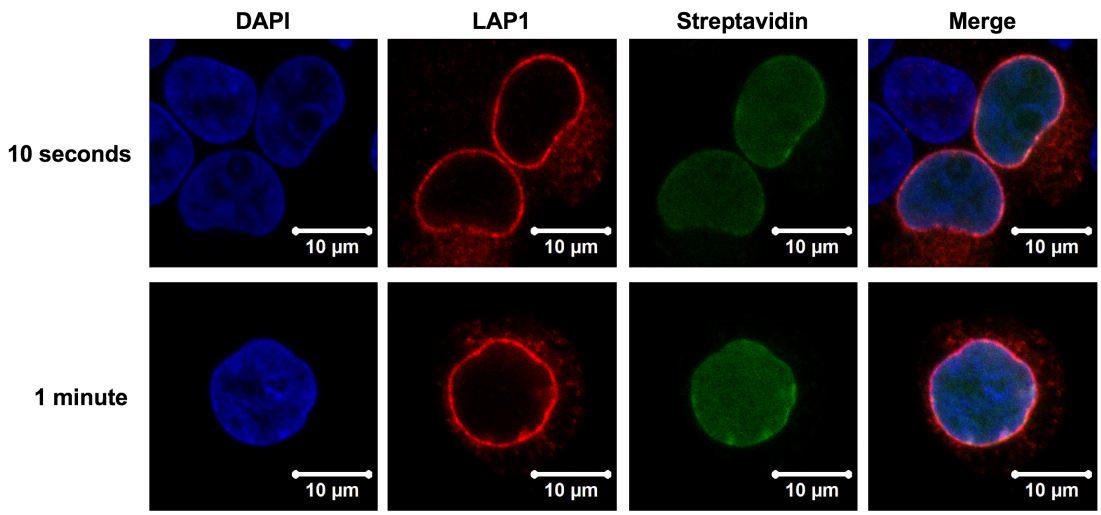


**Fig. S6.** APEX2-LAP1 proximity labeling was not restrained at the nuclear envelope but diffusive in the nucleus. The proximity labeling was performed for 10 seconds or 1 minute in the APEX2-LAP1 cell line. Both conditions showed strong biotinylation over the whole nucleus although APEX2-LAP1 was localized at the INM.

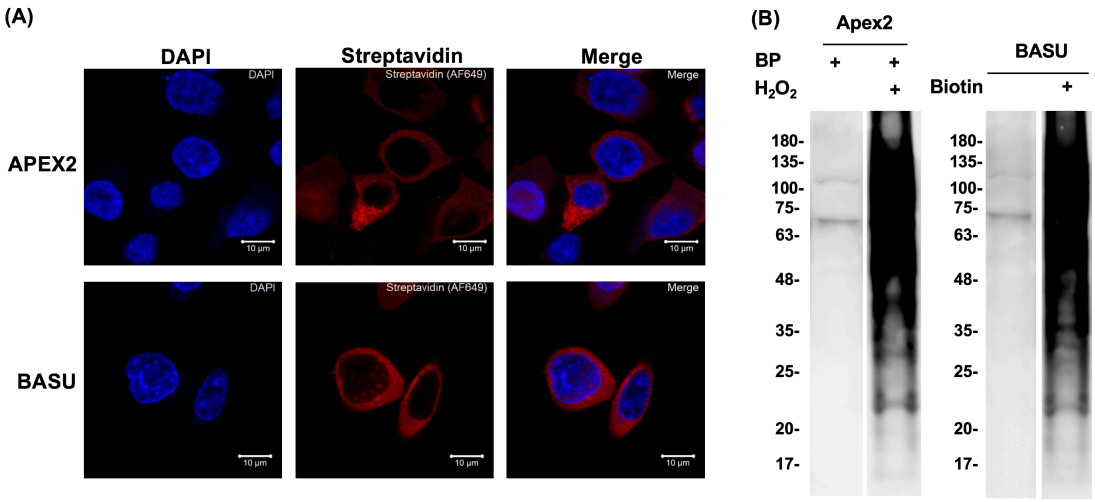


**Fig. S7.** Cytosolic APEX2 and BASU showed comparable levels of proximity labeling to a wide range of cytoplasmic proteins. Proximity labeling was performed in APEX2-only and BASU-only stable cells for 1 min and 18 hr, respectively. (A) Immunofluorescence experiments showed that the proximity labeling was spread in the cytosol for both APEX2 and BASU cells. (B) SA-HRP western blots revealed a comparable level of biotinylation between the APEX2 and BASU cells across molecular weights.

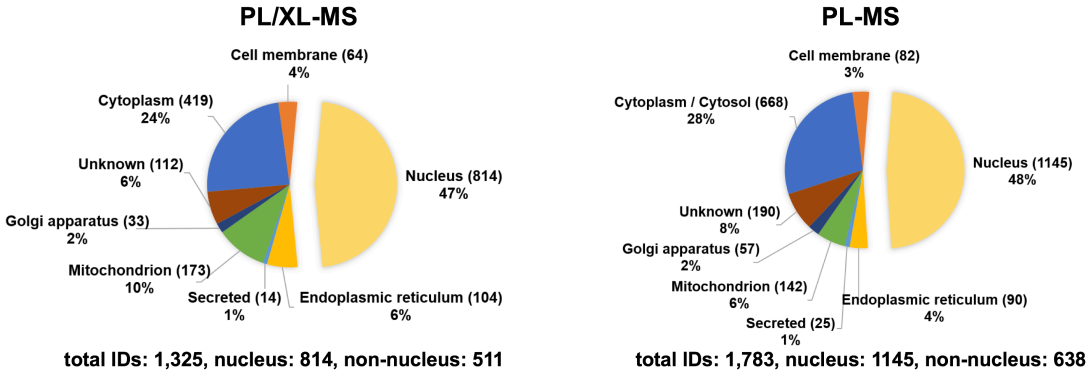


**Fig. S8.** Subcellular localization analyses of the PL/XL-MS and PL/MS experiments using BASU-LAP1 cells.

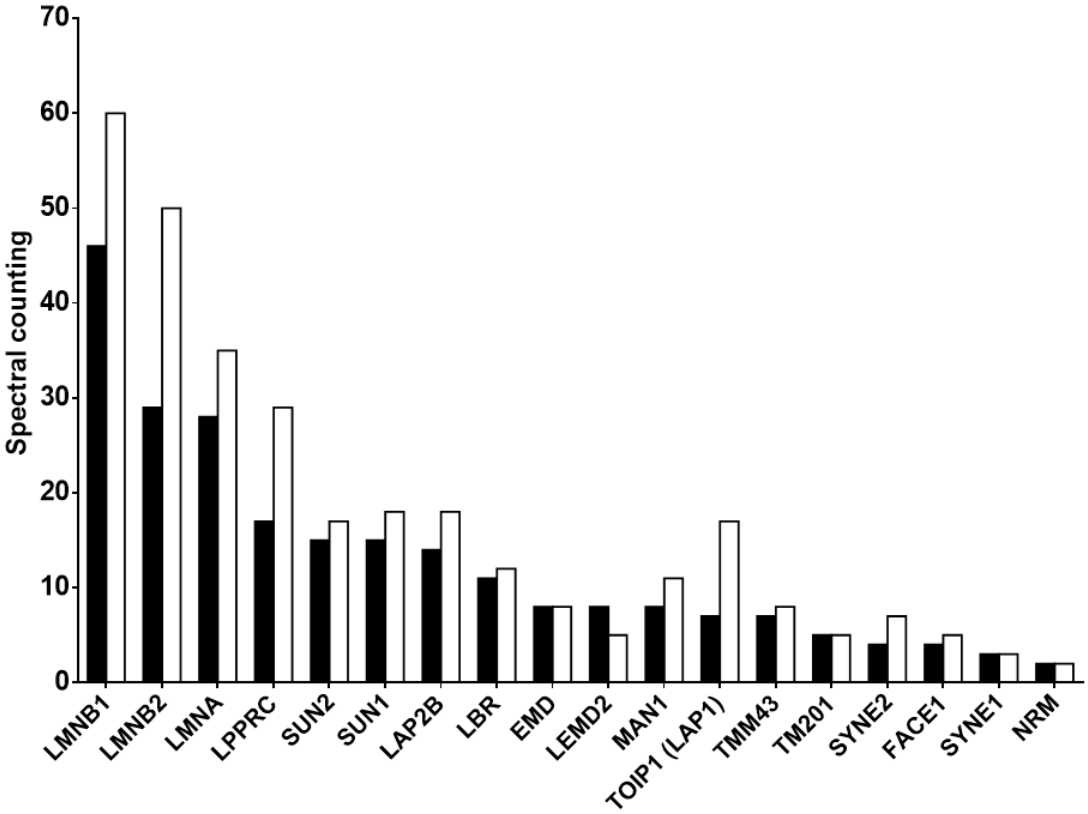


**Fig. S9.** Spectral counts of known INM and nuclear lamina proteins identified in the BASU-LAP1 PL/XL-MS experiment. Two biological replicates data were shown in black and white bars, respectively.

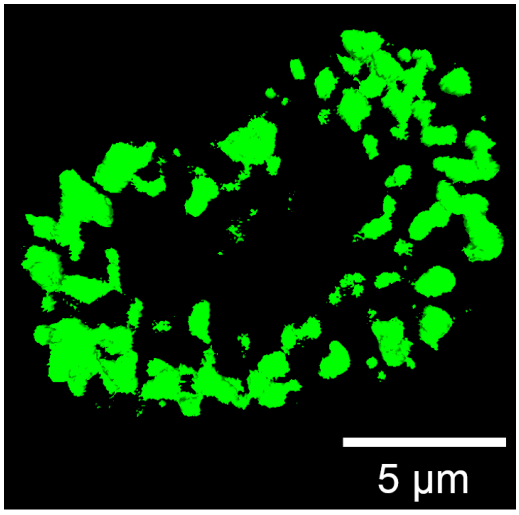


**Fig. S10.** Three-dimensional rendering of Matrin-3 immunofluorescence staining in HEK293T. Multiple z-stack images were acquired using a confocal microscope. 8 consecutive slides (0.5 μm each) in the midst of the nucleus were used to reconstruct the 3D rendering. The Matrin-3 was immunostained by an anti-Myc-tag antibody.

**Table S1.** List of the reagents used in this work.

| **Reagents and resource** | **Brand** | **Catalog** |
|---|---|---|
| **RIPA lysis buffer** | | |
| 10mM Tris-HCl (pH=8.0) | Amresco | 1185-53-1 |
| 1mM EDTA | Invitrogen | 15575-038 |
| 1% Triton-X100 | Merck Millipore | 9002-93-1 |
| 0.1% Sodium dodecyl sulfate | Merck Millipore | 1.13760.1000 |
| 140mM sodium chloride | Merck Millipore | 1.06404.5000 |
| 1mM PMSF | Merck Millipore | P7626 |
| **Reagents and resource** | **Brand** | **Catalog** |
| **6 × SDS-PAGE sample buffer** | | |
| 10% Sodium dodecyl sulfate | Merck Millipore | 1.13760.1000 |
| 1.25M Tris-HCl | Amresco | 1185-53-1 |
| 50% glycerol | Merck Millipore | 1.04057.2511 |
| 0.002% Bromophenol blue | Sigma | 34725-61-6 |
| **Reagents and resource** | **Brand** | **Catalog** |
| **PBST** | | |
| 0.1% Tween20 | Sigma | P1379 |
| PBS | Protech | BF203 |
| **Reagents and resource** | **Brand** | **Catalog** |
| **Flow cytometry and immunofluorescence blocking buffer** | | |
| 1% BSA | Sigma | B4287 |
| 22.52mg/ml glycine | J.T.Baker | 4059-06 |
| PBS | Protech | BF203 |
| **Reagents and resource** | **Brand** | **Catalog** |
| **Western blot** | | |
| BCA protein assay kit | Thermo-Fisher | 23225 |
| Bradford protein assay | Merck Millipore | 1.10306.0500 |
| GoPAGE$^{TM}$ TGN Precast Gel | SMOBIO | XR-LSB-GL4510 |
| PVDF membrane | Merck Millipore | IPVH00010 |
| HRP substrate | Merck Millipore | P90720 |
| **Western blot blocking buffer** | | |

| | | |
|---|---|---|
| 5% BSA | Sigma | B4287 |
| 0.1% Tween20 | Sigma | P1379 |
| PBS | Protech | BF203 |
| **SDS running buffer** | | |
| SDS running buffer | Omics Bio | IB3371 |
| **Western transfer buffer** | | |
| Western transfer buffer | Omics Bio | IB3351 |
| **Sucrose buffer** | | |
| 320mM sucrose | J.T. Baker | 409704 |
| 3mM calcium chloride | Merck | 1.02382.1000 |
| 2mM magnesium acetate | Merck | 1.05819.0250 |
| 0.1mM EDTA | Invitrogen | 15575-038 |
| 10mM DTT | Merck | 1.11474.0005 |
| 0.5mM PMSF | Sigma | P7626 |
| **Nuclei lysis buffer** | | |
| 50mM HEPES | Sigma | H4034 |
| 3mM magnesium chloride | Sigma | M8266 |
| 300mM sodium chloride | Merck Millipore | 1.06404.5000 |
| 1mM DTT | Merck | 1.11474.0005 |
| 0.1mM PMSF | Merck Millipore | P7626 |
| 0.1mg/ml DNase I | Cyrusbioscience | 101.9003.98.9 |
| **Reagents and resource** | **Brand** | **Catalog** |
| **Cell culture** | | |
| Dulbecco's modified Eagle's medium | Gibco | 12100-046 |
| 10% fetal bovine serum | Gibco | 10437-028 |
| sodium bicarbonate | Sigma | S5761 |
| polyethyleneimine (linear, MW25000) | Polyscience | 23966-1 |
| Opti-MEM | Gibco | 31985-070 |
| polybrene | Merck Millipore | TR-1003-G |
| puromycin | Invivogen | ant-pr-1 |
| **Versene buffer** | | |
| 0.5 mM EDTA | Invitrogen | 15575-038 |
| Cell culture PBS | Corning | 46-013-CM |
| **Reagents and resource** | **Brand** | **Catalog** |

| **RNA extraction and reverse-transcription PCR** | | |
|---|---|---|
| RNeasy mini kit | Qiagen | 74106 |
| 70% ethanol | Merck Millipore | 1.00983.2500 |
| SuperScript® III First-strand synthesis system | Invitrogen | 18080-051 |
| **Plasmid Construct** | | |
| APEX2 plasmid | Addgene | #49386 |
| BASU plasmid | Addgene | #107250 |
| Phusion polymerase | New England BioLabs | M0530 |
| 1% agarose | Amresco | 0710 |
| GenepHlow™ Gel/PCR kit | Geneaid | DFH300 |
| Stbl | NEB | C3040 |
| mini-prep extraction kit | Geneaid | PDH301 |
| **Reagents and resource** | **Brand** | **Catalog** |
| **PL/XL-MS** | | |
| low-binding eppendorf | Eppendorf | 0030 120-086 |
| streptavidin magnetic beads | Promega | Z5481 |
| disuccinimidyl suberate | Cayman | 13008 |
| 2M urea | Amresco | 0378 |
| ammonium bicarbonate | Sigma | 9830 |
| tris(2-carboxyethyl)phosphine | Sigma | C4706 |
| iodoacetamide | Sigma | I1149 |
| trypsin | Promega | V511A |
| 10% Trifluoroacetic Acid | Merck | 1.08262.1000 |
| **Reagents and resource** | **Brand** | **Catalog** |
| **Antibodies** | | |
| Anti-myc-AF647 | Cell signalling | 2233S |
| Anti-streptavidin-HRP | Rockland | S000-03 |
| Anti-streptavidin-FITC | Rockland | S000-02 |
| Anti-HA-AF488 | Biolegend | 901509 |
| Anti-HA-AF647 | Biolegend | 682404 |

**Table S2.** Crosslinking peptide searches of the 14 nuclear envelope proteins. The left column lists the IDs collected from BioGRID, which defines the library for the crosslinking peptide search. The right column lists the IDs observed in the crosslinking data. The number of crosslinked peptides and normalized spectrum abundance factor (NSAF) are shown in left and right, respectively, in parenthesis.

**LMNB1 (P20700)**

| BioGRID | | | | | | Experiment |
|---|---|---|---|---|---|---|
| 124 | | | | | | 12 |
| Q5SSJ5 | P02545 | Q13561 | Q14781 | P21796 | Q9NS73 | P20700(25, 0.0952) |
| P35222 | P50402 | O75935 | Q8NDX5 | P38398 | O43149 | P35227(2, 0.0096) |
| P02751 | P05771 | Q15003 | P19793 | P46937 | O00629 | P09651(1, 0.0047) |
| P08559 | P08670 | Q9H040 | P36894 | Q01538 | P27694 | Q9HCE5(1, 0.0043) |
| P00441 | Q13813 | P14859 | Q9H8T0 | Q14872 | P35244 | P42167(1, 0.0043) |
| P52272 | P20700 | Q8IXM2 | P61081 | Q9H492 | Q15393 | Q9H040(1, 0.0042) |
| P04899 | P42166 | Q14999 | Q8NFZ5 | Q9GZQ8 | Q13247 | Q5SSJ5(1, 0.0039) |
| P19320 | P42167 | O75147 | P43699 | Q9BXW4 | O75928 | P27694(1, 0.0037) |
| P31040 | Q9GZM8 | Q9H0W5 | Q12873 | O95166 | Q03252 | Q03252(1, 0.0037) |
| P56537 | O43918 | O75530 | Q14839 | P13569 | Q86UK7 | Q9H4L7(1, 0.0028) |
| P49736 | P51532 | P63000 | P78317 | Q14680 | P01106 | P13569(1, 0.0022) |
| P06493 | P17735 | Q13418 | P49427 | P07550 | P50750 | Q13813(1, 0.0015) |
| P36957 | P0CG48 | P61221 | Q92731 | P18848 | Q9HCE5 | |
| P13612 | Q8N0X7 | P11142 | Q01196 | Q14161 | Q69YN4 | |
| Q12906 | Q13315 | P04629 | Q5XPI4 | Q9H221 | P17252 | |
| P33993 | O95229 | P78362 | O95714 | P27348 | P35227 | |
| Q9NY93 | Q9H4L7 | P52294 | Q9HC62 | Q9P2P5 | P01133 | |
| Q7KZN9 | Q15717 | P48681 | O95994 | O60260 | Q9H0U3 | |
| Q06609 | P09651 | Q5T3F8 | O94761 | Q9NZ32 | Q14146 | |
| P01011 | O43567 | Q92542 | Q96C86 | P61163 | P42025 | |
| Q9NR30 | Q9NRD1 | P52597 | Q13127 | | | |

**LBR (Q14739)**

| BioGRID | Experiment |
|---|---|
| 75 | 12 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Q13185 | P22087 | Q4G0J3 | P49459 | Q07021 | O75530 | P68431(8, 0.0475) |
| P45973 | P68431 | P49427 | O43242 | Q13257 | Q9NQ29 | P62805(3, 0.0186) |
| P61981 | P11279 | O94992 | Q8IZL9 | Q9NX55 | P04629 | O43493(2, 0.0085) |
| Q9ULX6 | P62753 | Q7L2J0 | Q86UK7 | P12830 | P78362 | Q9ULX6(2, 0.0071) |
| Q14739 | Q71U36 | O95863 | Q9H6Z9 | Q9UM11 | Q96GX1 | Q9NX55(1, 0.0060) |
| P51608 | O43493 | Q9NZC7 | Q13635 | Q7RTS1 | Q6NUS6 | Q9NQ29(1, 0.0045) |
| P17735 | P62805 | O94761 | O14579 | O75596 | Q86UK5 | P32121(1, 0.0044) |
| P32121 | Q15013 | P01106 | P48729 | P36957 | Q86X19 | P51608(1, 0.0041) |
| P15923 | Q8NAF0 | P50750 | P56524 | P08559 | Q9P0N5 | Q14739(1, 0.0036) |
| Q9HCS4 | Q9Y3Y2 | P27824 | P78317 | Q13283 | Q9Y3E0 | Q00839(1, 0.0031) |
| P62136 | Q8NE63 | O43143 | Q12905 | Q9UK17 | Q00839 | P12830(1, 0.0030) |
| P62140 | Q14999 | P02545 | O43390 | Q08211 | P38919 | Q14999(1, 0.0019) |
| P36873 | O75147 | P49761 | | | | |

**MAN1 (Q9Y2U8)**

| BioGRID | | | | | | Experiment |
|---|---|---|---|---|---|---|
| 61 | | | | | | 5 |
| P84022 | Q92731 | Q8IV01 | Q01860 | P04629 | Q9NQ25 | P68431(9, 0.0383) |
| Q15796 | P01116 | P16070 | O95476 | Q12769 | Q8WVE6 | P62807(6, 0.0258) |
| Q9UKY7 | O15155 | Q9Y5G3 | O75106 | Q8NFH5 | Q8N6K0 | Q9Y3E5(2, 0.0082) |
| P33316 | P27824 | Q14392 | A2RU67 | P62807 | Q8N205 | Q8NFH5(1, 0.0036) |
| O15198 | P68431 | Q9UN71 | P08473 | Q9BPU9 | Q96IQ7 | Q8IV01(1, 0.0033) |
| Q15797 | P20339 | Q14258 | Q9H8X2 | Q96GX1 | O94766 | |
| P02545 | O43493 | Q13283 | Q8WWF5 | Q6NUS6 | Q16586 | |
| Q9ULZ3 | Q9Y3E5 | Q9H6Z9 | Q9UKU6 | Q86X19 | Q96G27 | |
| O43291 | Q69YN4 | P57078 | P11279 | Q9P0N5 | Q92633 | |
| Q9Y5M8 | Q9Y2U8 | P78317 | Q9HBB8 | Q9H9S0 | Q8WXA8 | |
| Q02297 | | | | | | |

**TOIP1 (LAP1) (Q5JTV8)**

| BioGRID | | | | | | Experiment |
|---|---|---|---|---|---|---|
| 60 | | | | | | 3 |
| P02545 | Q9UHQ1 | P11279 | Q2MV58 | P00533 | Q9Y581 | P62807(3, 0.0189) |
| P17735 | Q9UBW8 | O43493 | Q86X19 | Q9NS85 | P55809 | Q13620(1, 0.0030) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Q5JTV8 | Q969N2 | Q69YN4 | Q9P0N5 | Q13635 | Q96FQ6 | Q5UIP0(1, 0.0015) |
| Q13257 | Q9NX63 | Q04637 | Q5HYA8 | P04629 | Q9NQR4 | |
| P62136 | Q8N565 | P35813 | P36894 | Q16666 | P49821 | |
| Q15717 | Q8TEX9 | P10599 | Q9H6Z9 | P62807 | P52272 | |
| Q9NYB0 | Q9H792 | O94782 | Q16659 | Q96GX1 | Q9UKX7 | |
| Q15554 | Q8N4Q1 | Q9UHL9 | Q13620 | Q6NUS6 | Q96IR7 | |
| O14656 | Q96M94 | Q8WVD3 | Q92731 | Q86UK5 | P36873 | |
| Q5UIP0 | Q15013 | P27824 | O95831 | Q96Q45 | Q9H0W5 | |

**TMM43 (Q9BTV4)**

| BioGRID | | | | | | Experiment |
|---|---|---|---|---|---|---|
| 59 | | | | | | 4 |
| Q9BTV4 | P78317 | Q9Y6E2 | Q9Y3E0 | Q9H497 | Q96D09 | Q16666(1, 0.0038) |
| Q9UP95 | Q92731 | Q16799 | Q8N4V1 | Q7L1Q6 | Q8IUQ4 | Q92973(1, 0.0034) |
| P82675 | Q9BWT7 | Q9GZM5 | P36894 | O60664 | Q8NBM4 | Q86UK7(1, 0.0034) |
| O75844 | Q69YN4 | P02647 | Q07021 | P04629 | Q96CS3 | Q69YN4(1, 0.0020) |
| P60842 | P37268 | Q969Z0 | Q86UP2 | Q16666 | Q53R12 | |
| Q9NUL7 | P36543 | O75170 | P51148 | Q96GX1 | P62079 | |
| Q07955 | Q13620 | Q16849 | Q15363 | Q6NUS6 | P57103 | |
| Q8IVS2 | Q96HH9 | P02545 | Q9BVC6 | P51149 | Q6P5W5 | |
| P13569 | O95999 | Q86UK7 | Q92973 | P62491 | Q9NQC3 | |
| Q96T76 | P00533 | Q8IUR7 | Q8TCT7 | Q9P0L0 | | |

**LMNB2 (Q03252)**

| BioGRID | | | | | | Experiment |
|---|---|---|---|---|---|---|
| 58 | | | | | | 11 |
| P42166 | Q9H8T0 | P36957 | P23258 | P61221 | P02545 | Q03252(5, 0.0360) |
| P42167 | P78317 | P31040 | Q7LBC6 | Q9NX07 | Q96D09 | P21796(2, 0.0315) |
| O75531 | Q92731 | P00441 | Q8WVC0 | P49356 | Q14999 | P42166(2, 0.0129) |
| O95425 | Q5XPI4 | P21796 | P55318 | Q06945 | O75147 | P04629(2, 0.0112) |
| Q15717 | O94761 | Q14258 | Q99853 | Q03252 | Q9H0W5 | O94761(2, 0.0074) |
| Q9NRC8 | Q96C86 | P20700 | Q9H2C0 | P63172 | Q15022 | Q7LBC6(2, 0.0051) |
| P55072 | P01106 | P13569 | Q12952 | P04629 | O75530 | O95714(2, 0.0016) |
| Q504Q3 | Q69YN4 | Q86UK7 | P35226 | Q9H9E1 | Q99496 | P42167(1, 0.0098) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Q96MN2 | P28482 | Q8NDX5 | Q9NX55 | O14593 | O95714 | P20700(1, 0.0076) |
| Q9HBH5 | P27361 | P61081 | Q7KZN9 | | | P02545(1, 0.0067) |
| | | | | | | O75147(1, 0.0024) |

**SUN2 (Q9UH99)**

| BioGRID | | | | | | Experiment |
|---|---|---|---|---|---|---|
| 55 | | | | | | 1 |
| P51148 | P42336 | O14579 | Q9H9Q2 | P45983 | P20339 | Q07157 (1, 0.0024) |
| O14964 | Q16851 | P78317 | Q8N6G5 | Q13131 | P61020 | |
| Q9Y2K6 | Q8TBX8 | Q92731 | P56539 | Q6AZY7 | P60866 | |
| Q9Y297 | P78356 | O95863 | Q8WWF5 | Q2TAP0 | Q8IXM6 | |
| Q9UKB1 | P50579 | Q15910 | Q53F39 | P04629 | Q12888 | |
| Q9H9G7 | A5A3E0 | Q15022 | Q9UKA2 | Q16666 | P02545 | |
| Q8NF91 | P48426 | O94761 | Q9Y5E2 | Q6NUS6 | P16219 | |
| Q8WXH0 | Q07157 | Q69YN4 | Q14258 | Q9Y3E0 | Q9BTZ2 | |
| Q8N6M6 | Q96FZ7 | Q9NWM8 | P46937 | O95476 | Q86UK7 | |
| Q9UH99 | | | | | | |

**SYNE2 (Q8WXH0)**

| BioGRID | | | | Experiment | |
|---|---|---|---|---|---|
| 51 | | | | 24 | |
| P68032 | Q9P0L0 | Q8TBP0 | O75147 | Q8WXH0(13, 0.0042) | Q14197(1, 0.0217) |
| Q5VYV7 | P49286 | Q13616 | Q5SW79 | Q9Y6Q1(8, 0.0557) | P28482(1, 0.0124) |
| P54274 | Q14258 | Q96CF2 | P52888 | Q7Z569(6, 0.0452) | Q5VYV7(1, 0.0109) |
| Q15554 | Q9Y5J3 | Q9NXV2 | P32121 | Q5SW79(5, 0.0141) | Q92731(1, 0.0084) |
| P0DP23 | Q9NWT6 | Q9H2C0 | P26447 | Q15554(3, 0.0247) | Q9NXB0(1, 0.0080) |
| Q13387 | Q15029 | O00499 | P00441 | Q96CF2(2, 0.0383) | Q14258(1, 0.0071) |
| Q9NRC8 | Q92731 | Q5HYA8 | O00267 | Q9P0L0(2, 0.0358) | P0CG48(1, 0.0065) |
| Q8WXH0 | Q69YN4 | O95476 | O43172 | Q9NRC8(2, 0.0223) | O94901(1, 0.0055) |
| Q9UH99 | O94901 | Q9Y6Q1 | Q14149 | Q8TBP0(2, 0.0116) | P29590(1, 0.0051) |
| P27361 | Q9NXB0 | O95292 | Q5TBB1 | Q14149(2, 0.0095) | Q15029(1, 0.0046) |
| P28482 | Q6UWU4 | Q96DB2 | Q14197 | P26447(1, 0.0442) | Q5HYA8(1, 0.0045) |
| Q14999 | Q7Z569 | Q16543 | P0CG48 | Q9Y6M9(1, 0.0249) | O00267(1, 0.0041) |
| P29590 | Q9Y6M9 | P31040 | | | |

**FACE1 (O75844)**

| BioGRID | | | | | | Experiment |
|---|---|---|---|---|---|---|
| 46 | | | | | | 1 |
| P08473 | P21796 | Q9BTV4 | O95994 | P29084 | Q02223 | P61026(1, 0.0066) |
| Q15717 | Q9BUJ2 | P0C7P4 | Q69YN4 | O00624 | Q8WTR4 | |
| O75844 | Q8IYS2 | P57105 | P39656 | Q86WS5 | Q08AM6 | |
| P08174 | P18031 | P51148 | P60903 | P22732 | P14324 | |
| O95817 | Q9NQ50 | Q10471 | O14880 | Q9BVJ7 | Q13503 | |
| Q6P1K2 | P61026 | P52597 | Q9UI12 | Q6PEY0 | O15263 | |
| Q9BY78 | Q00610 | P82675 | P17568 | P78317 | Q99679 | |
| P04798 | Q96GX1 | Q6NUS6 | P54219 | | | |

**LEMD2 (Q8NC56)**

| BioGRID | | | | | | Experiment |
|---|---|---|---|---|---|---|
| 41 | | | | | | 1 |
| Q96B97 | Q16322 | Q4KMQ2 | Q8WTR4 | O60506 | Q16586 | P30825 (1, 0.0039) |
| Q9UGI6 | P04004 | P46098 | Q12797 | O00567 | Q05901 | |
| P62079 | Q504Y0 | P48960 | P32297 | Q86UP2 | Q9UGM1 | |
| Q8N205 | P43699 | O43505 | O00322 | Q15363 | Q16666 | |
| Q99871 | P78317 | P22460 | P30825 | P35240 | P27635 | |
| Q6P5W5 | P02545 | P08473 | Q9C0K1 | P23634 | Q99523 | |
| P80370 | Q8NC56 | Q03721 | Q96HU1 | Q01814 | | |

**SYNE1 (Q8NF91)**

| BioGRID | | | | Experiment | |
|---|---|---|---|---|---|
| 38 | | | | 26 | |
| Q69YN4 | Q15910 | O60239 | Q9NRI5 | P25054(6, 0.0023) | Q5VYK3(2, 0.0008) |
| Q8NF91 | Q9BYT8 | P35226 | Q9NWB7 | Q8NF91(6, 0.0015) | Q8NFH5(1, 0.0005) |
| P25054 | Q9GZM8 | P04629 | O94901 | Q99459(5, 0.0023) | Q99496(1, 0.0005) |
| Q16666 | Q9Y570 | Q96EV8 | Q9UK80 | Q15554(4, 0.0019) | Q9GZM8(1, 0.0005) |
| Q5VYK3 | O95994 | Q14134 | P50402 | Q5TZA2(4, 0.0017) | Q96EV8(1, 0.0005) |
| Q8NFH5 | Q96MT8 | Q9NXR1 | Q9UKE5 | P35226(2, 0.0010) | Q9UK80(1, 0.0005) |
| P02545 | Q9UH99 | P57740 | Q99496 | Q14134(2, 0.0010) | P33993(1, 0.0005) |

| | | | | | |
|---|---|---|---|---|---|
| P33993 | Q5TZA2 | Q15554 | Q99459 | O14829(2, 0.0009) | Q9BYT8(1, 0.0005) |
| O75147 | O14829 | Q9UHP3 | Q15022 | P02545(2, 0.0009) | Q96MT8(1, 0.0005) |
| P49736 | O15146 | | | Q15910(2, 0.0009) | Q15022(1, 0.0005) |
| | | | | Q16666(2, 0.0009) | O94901(1, 0.0005) |
| | | | | Q9NRI5(2, 0.0009) | P49736(1, 0.0005) |
| | | | | O15146(2, 0.0009) | Q69YN4(1, 0.0004) |

**SUN1 (O94901)**

| BioGRID | | | | | | Experiment |
|---|---|---|---|---|---|---|
| 29 | | | | | | 5 |
| Q8NF91 | Q13283 | Q8WWF5 | O95476 | Q6AZY7 | Q5QGZ9 | Q16666(2, 0.0056) |
| Q8WXH0 | P78317 | Q8N6G5 | P16444 | Q16666 | Q9Y6I9 | Q8NF91(2, 0.0009) |
| Q9NRD1 | Q8TCN5 | Q9BQ31 | Q9Y6Q1 | Q6NUS6 | Q401N2 | Q13283(1, 0.0035) |
| O75147 | A2RUC4 | Q9NVF7 | Q86UE6 | Q9P0N5 | Q8WXA8 | P33176(1, 0.0025) |
| O94901 | Q15654 | Q14258 | Q53F39 | P33176 | | Q8WXH0(1, 0.0006) |

**TM201 (Q5SNT2)**

| BioGRID | | | | | | Experiment |
|---|---|---|---|---|---|---|
| 17 | | | | | | 3 |
| P02545 | P01106 | P57078 | O15482 | Q8NFH5 | P20036 | P02545(2, 0.0067) |
| Q9NRD1 | P55072 | P78317 | P0CG48 | Q8N3V7 | Q99675 | Q9H6Z9(1, 0.0049) |
| Q8NBM4 | Q5SNT2 | Q92731 | Q9H6Z9 | P61020 | | P01106(1, 0.0040) |

**NRM (Q8IXM6)**

| BioGRID | | | | | | Experiment |
|---|---|---|---|---|---|---|
| 11 | | | | | | 1 |
| Q9NRD1 | Q9UBG3 | Q96BA8 | P78317 | Q01814 | P23634 | Q9NRD1(1, 0.0080) |
| Q8IXM6 | Q96DA0 | Q8IWR1 | Q9UH99 | Q9Y278 | | |