Supplementary figures and tables



Figure S1. Data processing workflow of the CR from the X. laevis oocyte NPC.



Figure S2. Data processing workflow of the NR from the X. laevis oocyte NPC.



Figure S3. Assessments of cryo-EM maps of the CR subunit. (**A**, **B**, **C**) Map display, local resolution estimation, FSC, 3D-FSC and directional FSC of the CR subunit region, CR core region and CR Nup358 region. (**D**) Map model overlay of the CR subunit, and map versus model FSC estimation.



Figure S4. Assessments of cryo-EM maps of the NR subunit. (**A**, **B**, **C**) Map display, local resolution estimation, FSC, 3D-FSC and directional FSC of the NR subunit region, NR core region and NR Nup133 region. (**D**) Map model overlay of the NR asymmetric unit, and map versus model FSC estimation.















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Figure S5. Model building quality and secondary structure assignment of the CR subunit. (A-J) Model building quality of Nup85, Seh1, Nup43, Nup160, Nup37, Sec13, Nup96, Nup107, Nup133, Nup205, Nup93, Nup358 and Nup214 complexes.



Nup160





Figure S6. Model building quality and secondary structure assignment of the NR asymmetric unit. (A-G) Model building quality of Nup85, Seh1, Nup43, ELYS, Nup160, Sec13, Nup96, Nup133, Nup107, Nup205 and Nup93.



Figure S7. Comparisons of the refined structure and predicted structure by AlphaFold2 (AF) of CR Nups from the *X. laevis* NPC.



Figure S8. Comparisons of the refined structure and predicted structure by AlphaFold2 (AF) of NR Nups from the *X. laevis* NPC.



Figure S9. Structural comparations of Y-complexes in NR & CR from X. laevis NPC.



Figure S10. CR and NR models of *X. laevis* NPC fitted in human NPC map (EMD-3103).



Figure S11. Nup205, instead of Nup188, is located in NR and CR. (A) Model comparison of Nup205 and Nup188 onto local densities in NR subunit. Major differences are enlarged and displayed in detail. (B) Model comparison of Nup205 and Nup188 onto local densities in CR subunit. The cryo-EM density maps are shown as a black mesh.



Figure S12. Comparisons of bridge-like densities in the NPC NR for different species.

Α
 Nup85_X.laevis
 TT
 BI
 B2
 B3
 nl
 cl
 NUDS5.X.laevis GKSRKADLVOVSRNYRSYRRACMEEMHTJSESTRE...TAOKYISOTSILSAMELSKNLCEILFIESAPAGELLILLERVRHVCEVDNI NUDS5_Human GKSRKSQLVRVSNNYRSVIRACMEEMHOVAIAAKDPANGGOSSQNSILSAMELIWNLCEILFIEVAPAGELLHLEWVRLHVCEVDSL NUP85_X. Laevis VODVLRSERFELENEK FWD GVEG VLOGRNINEAROL DAKEAST SASARSWGRVLDDDLKK MENUL HTGGTOTLTEFELKKOHN FEGER NUP85_Ruman SADVLGSENFEKHDSFWN LVTTLVLOGRNIDEARON USKEADASPASAGICRINGDDMRTEPILESFENTOTLTEELKKOHN HEEGERVLO
 all
 all</th Nup85_X.laevis NGTPSSNVHMBAVCRVLLGDEVLLGBEVLLBKRDLMTTWYHFLVSRLLFKHDTVKPTDLHFYAQSSLDWFLAGDSCPEPLDNTLLAAFEFDIHQV Nup85_Human DSTFATSFHUBSLLKINLGDBALLEOKELLSNWYHFLVHRLLYSNPTVKPTDLHYYAQSSLDWFLGESSPEPLDNTLLAAFEFDIHQV NUPS5_X.laevis IKEFSIMSSNMHFVAHLTDLLDHC2UFCAHNYFGANMRFLLLEVASGLFAHFSUMSLCQUQVDYFDYCPNLCREYMKLEWERTPLEVEKKA NUPS5_Ruman IKECSIALSNMHFVAHLTDLLDHC2UFCAHNYFGANMRFLLLEVASGLFAHFSLWQLQVDYFDYCPNLCREYMLEWERTPLEVEKKA
 A 50
 A 50
 A 50
 A 50
 S 20
 NUP85_X.laevis YREFHRMYSCEOFSEAASLLISLMTSRIAPREFWERLLDALPLLEQKQVIFSAEQTYELMRCLEDRAARALESTSPDEIGKODSSIDNT Nup85_Ruman YREFHRMYSCERFADIAASLLISLMTSRIAPREFWERLLDALPLLEQKQVIFSAEQTYELMRCLEDLTSRIPVHSESDTEGLODDDIETT Nup85_X.laevis KVEMLRLALARNLARAIVTEGALOE. Nup85 Human KVEMLRLSLARNLARAIIREGSTEGS

В

 Sehl_X.laevis
 B1
 B2
 B3
 B4
 B5
 B1
 B6

 1
 10
 20
 30
 40
 50
 60
 70
 80

 Sehl_X.laevis
 MFVARSIAADHKDLIHDVSPDFHGRRMATCSSDQSVKVWDKSENGNWHCTASWKTHSGSVWRVTWAHPEFGQVLASCSFDRTAA
 Sehl_Human
 MFVARSIAADHKDLIHDVSFDFHGRRMATCSSDQSVKVWDKSESGDWHCTASWKTHSGSVWRVTWAHPEFGQVLASCSFDRTAA
 β12 150 160 VMNLSOWSLOPEISCKL β13 DVMNLSQWSLQHEISCK DVMNLSQWSLQHEISCK β19 Sehl_X.laevis β_{190} TT β_{15} β_{16} TT β_{17} β_{17} β_{18} β20 250 270 Sehl X.laevis AVGSDDSSPNIMGKVOIFEYNENTRKYAKAETLMEVEDPVHDIAFAPNLGRSFHILAFATKDVRIFTMKFFIRKELESSGGVTKFEIHIVAQ Sehl X.laevis AVGSDDSSPNIMGKVOIFEYNENTRKYAKAETLMEVEDPVHDIAFAPNLGRSFHILAFATKDVRIFTMKPERSEGSGVTKFEIHIVAQ $\begin{array}{c} \textbf{Seh1_Human} \\ \textbf{Seh1_X.laevis} & \textbf{TT} \underbrace{\beta 21}_{280} & \textbf{TT} \underbrace{\beta 22}_{300} & \textbf{TT} \underbrace{\beta 23}_{310} & \textbf{TT} \underbrace{\beta 24}_{320} & \textbf{330}_{340} & \textbf{350}_{350} & \textbf{360}_{350} & \textbf{360}_{350$ $\begin{array}{c} \text{Nup43_X.laevis} & \rightarrow \text{TT} & \begin{array}{c} \beta 8 & \beta 9 & \beta 10 \\ 100 & 110 & 120 & 130 & 140 & \text{TT} \\ 100 & 110 & 120 & 130 & 140 & \text{TT} \\ 100 & 110 & 120 & 130 & 140 & \text{TT} \\ 100 & 110 & 120 & 130 & 140 & \text{TT} \\ 100 & 120 & 130 & 140 & \text{TT} \\ 100 & 120 & 130 & 140 & \text{TT} \\ 100 & 120 & 130 & 140 & \text{TT} \\ 100 & 120 & 130 & 140 & \text{TT} \\ 100 & 120 & 100 & \text{TT} \\ 100 & 120 & 100 & \text{TT} \\ 100 & 100 & 100 & 100 & \text{TT} \\ 100 & 100 & 100 & 100 & \text{TT} \\ 100 & 100 & 100 & 100 & \text{TT} \\ 100 & 100 & 100 & 100 & \text{TT} \\ 100 & 100 & 100 & 100 & \text{TT} \\ 100 & 100 & 100 & 100 & \text{TT} \\ 100$ TT 150 160 IVSVGEDGRINCFRAESRDVLRTI IVTVGEDGRINLFRADHKEAVRTI $\begin{array}{c} \text{Nup43_X.laevis} & \begin{array}{c} \beta 17 \\ 180 \\ \text{Nup43_X.laevis} \end{array} & \begin{array}{c} \beta 17 \\ 180 \\ \text{PLRT} \\ \text{Fill UVNS UGOLKE DI LSUGGENE FOILSULAUX CONSTRUCTION OF UNDER STATEMENT OF ST$ $\begin{array}{c} \text{Nup43_X.laevis} \\ \text{Nup43_X.laevis} \\ \text{Nup43_X.laevis} \\ \text{Nup43_X.laevis} \\ \text{Nup43_X.laevis} \\ \text{HPSNPEHLFTCSEDGSLWHWDASADSEK..PTELIGGRSTPNESSIAPPNAMOSLACATISTOPTEGOLETTELPSSTLSVNEDDVINTUPATION STATE AND ALS ADDIE AND ALS ADDIE$ β28 Nup43_X. laevis TT _____360 _____370 Nup43_X.laevis CONLVCGTDAEAIYVTRRLFS Nup43_Human CPCLVCGTDAEAIYVTRHLFS

D

Nup160_X.tropicalis Nupl60_X.tropicalis β_1 β_2 β_4 β_5 β_6 β_7 β_8 β_7 β_8 β_7 β_8 β_7 β_8 β_9 $\beta_$ Nup160_X.tropicalis Nup160_Human YSESAGEY YVESGKUSSTRNRFIHWISSOTLELWESSDINLINNAVRIKILNCSTLPGOVHICETONNII UTLINOVVHRL Nup160_Human YSESAGEY YVESGKUSSTRNRFIHWISSOTLELMESSDINLINNARIKISONCSULPGOVYUSETONRVIILMITNOVVHRL $\begin{array}{c} \begin{array}{c} \eta_1 & \eta_1 & \eta_1 & \eta_2 &$ $\begin{array}{c} \mu_{1} \mu_{2} \mu_{1} \mu_{2} \mu_{1} \mu_{2} \mu_{2$ α2 20000 330 $\begin{array}{c} \mu_{1} \mu_{2} \mu_{2} \mu_{3} \mu_{1} \mu_{1} \mu_{2} \mu_{3} \mu_{3$ Nup160_X.tropicalis KHINFERNOAGHNNEVFÜNPLPLDDLATGDEGEPERATECLERAGGRETIAALGAATOILERGSGEVÜDLSMEELKKEVTITVER Nup160_Human NYINFEHNVAGONNEVFMOPLPLEEIVERDEGEREMYLOSLFTPGOFTNEALGAALOIFCEGTERNLDLSMSELKKEVTIAVENE Nup160_X.tropicalis VI (DOVDGASDIVSLI)CLINE ADVITEDMAY OMSSACCHPOSPEVAEOILEDE ANDIDNIMENTONKLODINNE AASFLUO Nup160_Human TISDVDIARDVICLIKCLILEBSVIVDVSVIMEMSGYNLOSPEKAEOILEDMITIDVENVMEDIGSKLOEINNE HAIGLER Nup160_X.tropicalis NMOYET NMOMEOS.....OHNVRLNIST LYGSVITSSSVCOATIYKISA REFUTCRDLLILGHLL RLGDMAIVG COLLHSCOFT Nup160_Human EMDYETEVEMEKGFNPAOPLNIRMNLTOLYGSNTAGYIVCRGVHKIASTRFLICRDLLILGCALMRLGDAVINGTCOLFQAOODL α15 α16 Nup160_X.tropicalis 0000000000000000 0000000000 770 780 790 800 810 Nup160_X.tropicalis PRAACLLLSYVETPROSCIACAVENDLLESNLOHLSVLELSDSO.WERRETSGIOTIVELFPEDVERHEPOVFARLFIGSGSS Nup160_Human HETAPLLLSYYETRWGSECLATDVPHDTLESNLOHLSVLELTDSGALMANREVSSPOTIVELFPERMARKHI...ISHLSSOPKAP
 alg
 alg</th Nup160_X.tropicalis QVHRSLNWADIHERITSYLLOLLWPSNPNFCERECIMENCOVTOLGEVERLUPWCQVNVGSCHEMLACVVAGERERIA.DCFSC Nup160_Human LSQTCLNWFEMITAITSYLLOLLWPSNPGCLPHECLMCNCQVVQLGEVECLUPHPWCQVNVGSCHEMLCFCVLVAGERERIA.DCFSC
 Nupl60_X.tropicalis
 a24
 a25
 a26
 a27
 a28

 940
 950
 960
 970
 980
 990
 1000
 1000
 Nup160_X.tropicalis AASEVEREPLEXLTRVEECESU.SPRLOYNARVLRLLEDVGLPELVTOLASIAISA DOURSOAALATRFFKHRLDVGCHNSOAY Nup160_Ruman AASEVEREPLERLTRSEBGEIVSTPRLOYYDKVLRLLEVIGLPELVTOLASIAIEACDDWRSOATLRTCTFKHHLDICHNSOAY
 η8
 α46
 α47

 Nup160_X.tropicalis
 2020
 1380
 1380
 1400
 1410
 1420
 1430
 Nup160_X.tropicalis GKCHOYFGIQAPLSATSOEVA FPYSAIDHERLALGENSANSHNAALSOKULDEFOREKKATDDYKKIV@KYVA Nup160_Human GKCHOYFGIESPLSATARMVULPYSSIDOLQALGENSANSHNAALSOKULDKEEVOOKVDKATKBLLYRRIL...

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Nup37_X.laevis	β1 	β2	β3	30	β4	β5 50 50	β 60	70	β7 80 TT	TT 90
Nup37_X.laevis Nup37_Human	MKQDSASN MKQDASRN	ATYTVDCE AAYTVDCE	DYVHVVEFNE	FDSGEAGSL FENGDSGNL	LAYGGISY IAYGGNNY	VVIASCRFQEED VVIGTCTFQEED	STVEGIEFKT Advegioykt	LKTFHHGER LRTFHHGVR	VVAIAWSPETI VDGIAWSPETI	RCDALL RLDSLP
Nup37_X.laevis	β8		110	β10	β11	β12 140	T - β13	β14	β15	180
Nup37_X.laevis Nup37_Human	PLLRFATA PVIKFCTS	AG <mark>DKKIRI</mark> AADMKIRL	FTSDFQDKNE FTSDLQDKNE	EYKVIEGHSG EYKVLEGHTD	YINDLVFC FINGLVFD	SP <mark>EGTDIASV</mark> GDI PK <mark>EGQEIASV</mark> SDI	DHTCRIWDLD DHTCRIWNLE	GKQIAMFIL GVQTAHFVL	RSPGMSVAWHI HSPGMSVCWHI	PEGAFK PEETFK
Nup37_X.laevis	β16 TT	β17 90	β18 200	β19 210	220	β20 β21 2 3 0	-TT -	β22 2 5 0 TTT	β23 260 TT	β24
Nup37_X.laevis Nup37_Human	LMVAEKTG LMVAEKNG	TIRFYDL TIRFYDL	THQAILSLES	SV <mark>QVPLMSA</mark> D SEQVPLMSAH	WCVRNTLR WCLKNTFK	IGAVAGNDWIIW VGAVAGNDWLIW	EMP <mark>RSSYPO</mark> D DIT <mark>RSSYPO</mark> N	NKPAHADRA KRPVHMDRA	RMFRWSKCNEI CLFRWSTISEI	NVFATT NLFATT
Nup37_X.laevis	TTT	β25 80	β26	β27	β28	β29 320				
Nup37_X.laevis Nup37_Human	GYPGKM <mark>k</mark> s Gypgkm <mark>a</mark> s	OIAIHHLA OFOIHHLG	HPQPILIGT/ HPQPILMGS	PVGSGLSWH AVGSGLSWH	RRLPLCVV RTLPLCVI	GGYRKLFFWLTE GGDHKLLFWVTE	7 7			

F

Nup96_X.tropicalis	1 10		20	3.0	4.0	5.0			7.0	80
Nup96_X.tropicalis Nup96_Human	SKYGLODSDE	EDDQLN.SA EEEEHPSKI	EA <mark>KKLKTAP</mark> ST <mark>KKLKTAP</mark>	VPPQGKQPP LPPASQTTP	LOOATLPG LOMA.LNG	KVT PPP KPA PPP QSC	SPAVDQL SPEVEQL	RVMELDSD RVVELDSD	MADITOD	QD <mark>LDSVAE</mark> EQ PV <mark>LDTMLE</mark> .E
Nup96_X.tropicalis	90	100	110	120		130	140	150		160
Nup96_X.tropicalis Nup96_Human	DIS <mark>EEQEPL</mark> S SMPEDQEPVS	SAS <mark>SHIASSI</mark> SAS <mark>T</mark> HIASSI	GINPHALQV GINPH <mark>VLQ</mark> I	MKASLLLEE MKASLLTDE	EDGEIM EDVDMALD	SRFSSFPS RFSRLPSK	MDPYPDVF ADTSQEIC	SPRLFPSS SPRLPISA	HAK <mark>R</mark> SHSSKT <mark>R</mark>	PSSI <mark>GLLQSK</mark> SLVG <mark>GLLQSK</mark>
Nup96_X.tropicalis	170	180	1	90	200	210	220	230		240
Nup96_X.tropicalis Nup96_Human	FSAPSMSRLS FTSGAFLSPS	ET <mark>VO</mark> GSHS VSVOECRTE	RAASLMNIP	PAAP <mark>WSVP</mark> A STSS <mark>WSVP</mark> P	PLAPSFIM PLTSVFTM	PG <mark>PAPD</mark> TH PS <mark>PAPE</mark> VPI	RTVGTRRC KTVGTRRC	QE <mark>LVP</mark> L <mark>EK</mark> LG <mark>LVP</mark> R <mark>EK</mark>	SVT <mark>hgrg</mark> SVT <mark>ygkg</mark>	T <mark>LMIDM</mark> G <mark>LFM</mark> K <mark>LLMDM</mark> ALFM
Nup96_X.tropicalis	250 ^{β1}	2 6 0	η1 200 270	280	290	300	β3	. ọ	00000 320	αl 2000000000 330
Nup96_X.tropicalis Nup96_Human	GRSFRVGWGE GRSFRVGWGE	NWTLVHNG NWTLANSGE	KLSERLNAE QLNGSHELE	EDRDMDTID NHQI <mark>ADSME</mark>	YGFLPKPT: FGFLPNPV	SAKSLTESP A <mark>vk</mark> pltesp	FKVHVEKI	SLEQKT SLRQRKPD	KDLQSYL EDMKL <mark>Y</mark> Q	LPLEIELKNS T <mark>PLEL</mark> K <mark>LK</mark> HS
Nup96_X.tropicalis	340	350	α2 2000000000 360	37	<u></u>	α3 200000000 380	390	400 e	41	α4 000000000000000000000000000000000000
Nup96_X.tropicalis Nup96_Human	TVDKSGP <mark>CP</mark> TVHVDEL <mark>CP</mark> I	HFR <mark>PN</mark> P GV TA LIV <mark>PN</mark> L <mark>GV</mark> AV	IHDYAGWVR IHDYADWVK	NF <mark>SSEAAE</mark> V EASGDLPE.	EAVVKQWG AQIVKHWS	LTWTLCES LTWTLCEAL	WGOLKEL WGHLKEL	ASLDEPNE SOLNEPRE	YVKNLER YIQILER	RKAFSHWLAQ RRAFSRWLSC
Nup96_X.tropicalis	20 20 4	200 00 30 4	α5 100000000 140	<u>0000000</u> 450	460	α7 22222 TT 470	480	α8 000000000 4 9	0 0	۵۹ <u>دودودوو</u> 500
Nup96_X.tropicalis Nup96_Human	TAQERIEEEV TATPQIEEEV	SLYGPERHI SLTQKNSP	EAVFSYLTG EAVFSYLTG	GRISDACRL K <mark>RISEAC</mark> SL	AQ <mark>K</mark> SGDHR AQ <mark>Q</mark> SGDHR	LSLLLSOMV Lalllsofv	GSQ <mark>EVRDI</mark> GSQ <mark>SVREI</mark>	ITLQLVDW LTMQLVDW	NK <mark>LQV</mark> DH HQ LQAD S	YIQEERLRVF FIQDERLRIF
Nup96_X.tropicalis	<u> β4</u> 510	TT β5	<u> </u>	α10 000000 540	TT 000 550	α11 20000000 560		7 Q	580	α12 00000 590
Nup96_X.tropicalis Nup96_Human	CLLS <mark>GTPVW</mark> F ALLAGKPVW(RS <mark>SDNRSIN</mark> 21 <mark>SEKKOIN</mark>	CSQLDWKRT CSQLDWKRS	LGIHLWYML LAIHLWYLL	PPTATVAQ PPTASISR	ALHMYEOAF ALSMYEEAF	QEQEGGEF QNTSDSDF	YACYPLPP YACSPLPS	YLEDC <mark>G</mark> F YLEGS <mark>G</mark> C	SFGDDPSAKF VIA <mark>EE</mark> QNS
Nup96_X.tropicalis	600	α13 0000000 610	η2 200 620	η3 20 630	α14 0000000 6	20000 40	650 650	α15 00000000 660	670	α16 0000000 680
Nup96_X.tropicalis Nup96_Human	ISLQ <mark>RDVC</mark> VE QTPL <mark>RDVC</mark> FE	ILLKLYS <mark>E</mark> R ILLKLYS <mark>D</mark> R	YDLCQLLDP YDLNQLLEP	SSATPDPLD RSITADPLD	YRLSWHMW YRLSWHLW	VLOALNYT VLRALNYT	HLSGHRQC HLSAQCE	MLHASYAA VLOASYAG	QLENVGL QLESEGL	WEWAIFVLLH WEWAIFVLLH
Nup96_X.tropicalis	0 000000 0 6 9	217 2000000000 70	00 2000 7	α18 00000000 10	720	α19 200000000 730	00 0000 740	α20 0000000 750	α21	α22 0000 0000 760
Nup96_X.tropicalis Nup96_Human	IQDPHVREA IDNSGIREK	VRELLNRHC VRELLTRHC	VVHDSPESL QLLETPESW	AKENFLIQR AKETFLTQK	LCLPAOWI LRVPAKWI	HK <mark>akavr</mark> sr He <mark>akavr</mark> ah	RDG <mark>DKH</mark> KE MES <mark>DKH</mark> LE	ALYLLKSH ALCLFKAE	QWNQCHK HWNRCHK	LVTRHLAADA LIIRHLASDA
Nup96_X.tropicalis	000 00000 770	23 2000000 9 780	α24 200000 0 790	800 800	α25 00000000 810	820	<u>00000000</u> 83	α26 000000000 0	00 840	<u>20000000</u> 850
Nup96_X.tropicalis Nup96_Human	VINENYRYL IINENYDYL	GFLGELAR GFLEDLAP	EHCKHIQDW ERSSLIQDW	ETAGKVYLD ETSGLVYLD	YISVIEML YIRVIEML	NQIRQDECS RHIQQVDCS	GGELEKLE GNDLEQLE	TKVMSLCK IKVTSLCS	WVELIQC RIEQIQC	YSAK <mark>G</mark> RLAQS YSAK <mark>DRLAQ</mark> S
Nup96_X.tropicalis	α27 202020200 860	87 <u>0</u>	тт вво	000	α28 00000 9	000000	α29 00000000 910	920 920		
Nup96_X.tropicalis Nup96_Human	EMAKRVANII DMAKRVANLI	RVVLSLQOF RVVLSLHH	PESMSDSSS PDRTSDSTP	EP.RVPLRL DPORVPLRL	LAPHIGRLI LAPHIGRLI	PMPEDYA <mark>LE</mark> PMPEDYAMD	ELR <mark>G</mark> LTQS ELR <mark>S</mark> LTQS	YLRELICG YLRELAVG	SL SL	

G

Sec13_X.laevis	1 10	β1 20 TT	β2	β3 40	β4 5 0	β5	<u>β6</u>	→TT
Sec13_X.laevis Sec13_Human	MVSVINTVDT MVSVINTVDT	SHEDMIHDAQMDYYG SHEDMIHDAQMDYYG	IRLATCSSDI TRLATCSSDI	RSVKIFDV <mark>K</mark> NG RSVKIFDV <mark>R</mark> NG	GQILIADLRG GQILIADLRG	HDGPVWQVAWA HEGPVWQVAWA	HPMYGNILAS HPMYGNILAS	CSYDRKVIIW <mark>K</mark> EEN CSYDRKVIIW <mark>R</mark> EEN
Sec13_X.laevis	T	β9	β10 120	β11	β12	-TTβ13	160	TT 170 180
Sec13_X.laevis Sec13_Human	GTWEKTYEYT GTWEKSHEHA	GHDSSVNSVCWAPHD GHDSSVNSVCWAPHD	FGLVLACGS YGLILACGS	SDGAISILTFT SDGAISLLTYT	GDGPWEVKKI GEGOWEVKKI	SNAHTIGCNAV NAHTIGCNAV	SWAPSVIPGS SWAPAVVPGS	LVDOPSSOKPNYIK LIDHPSGOKPNYIK
Sec13_X.laevis	β14	β15 .►TT 200	210	β17 220 TT	β18 230	TTβ19	β20 2 5 0	β21 260
Sec13_X.laevis Sec13_Human	RFVSGGCDNL RFASGGCDNL	VKIWRE EDGQWKED IKLWKEEEDGQWKEE	QKLEAHSDW QKLEAHSDW	VRDVAWAPSIG VRDVAWAPSIG	LPTSTIASCS LPTSTIASCS	QDGRVYIWTSD QDGRVFIWTCD	DAATNCWTPK DASSNTWSPK	LLHKFNDVVWHVSW LLHKFNDVVWHVSW
Sec13_X.laevis	70 ^{TT} β22 28	β23	β24 300	310	320			
Sec13_X.laevis Sec13_Human	SITANILAVS SITANILAVS	GGDNKVTLWKESVDG GGDNKVTLWKESVDG	QWACISDVNI QWVCISDVNI	KGQGAVST.VT KGQGS <mark>VS</mark> ASVT	EGQL <mark>NDQ</mark> EGQQNEQ			

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Nup107_X.laevis									
Nup107_X.laevis Nup107_Human	MDMLS MDRSGFG <mark>EI</mark> SS	TU VVREAEVSRAA VIREAEVTRTA	RROSSNRKN RKOSAQKRVLL	PADESWSNAT QASQDENFGNT	PTRGPSSRTTC PRNQVIPR	GOTLFROHMTP PSSFROPFTP	QTWNSSRPPDV TSRSLLROPDI	SAILGTVGRSP SCILGTG <mark>GK</mark> SP	
Nup107_X.laevis	80 90	100	110	000000 120	αl 00000000 130	000000000	α2 00000000000 150	160	
Nup107_X.laevis Nup107_Human	RLLOTPGRLAN RLTOSSGFFGN	LSMMSNPDDSVW LSMVTNLDDSNW	TTT <mark>FS</mark> PG <mark>RTG</mark> M AAA <mark>FS</mark> SQ <mark>RSGL</mark> 1	YTTLDSPSFTED FTNTEPHSITED	ITLSAVMLOER VTISAVMLREI	DPGEAATMSM DPGEAASMSM	YP DFL K <mark>SFL</mark> EH FS DFL Q SFL KH	IP <mark>SSAVFELIE</mark> Q IS <mark>SSTVFDLVE</mark> E	
Nup107_X.laevis	α3 00000000000 170 180	0000000 TT 0 190	20002000000	α4 20000000000 210	220	230	240 240	5 200000 20000 250	
Nup107_X.laevis Nup107_Human	YEATCNTQITL YENICGSOVNI	LKKIVKRVTPG LSKIVSRATPGL	QKFSKTASILW QKFSKTASMLW	LLQQEMVTWRL LLQQEMVTWRL	AALYRDRIQSA ASLYRDRIQSA	LEEENMFEIA LEEESVFAVT	AP <mark>NASEKTIV</mark> D Av <mark>nasektvv</mark> e	KLFQRDTLVRQ ALFQRDSLVRQ	
Nup107_X.laevis	α6 00000000000 260 2	α7 20000 <u>00000</u> 280 280	٥ 2 9 0	α8 000000000 300	310	<u>00000</u> 320	<u>0000000</u> 330	α10 20000000000 340	
Nup107_X.laevis Nup107_Human	SQLVVDWLESI SQLVVDWLESI	KDEV <mark>GD</mark> FSDNI KDE <mark>IGE</mark> FSDNI	E <mark>yyaksvywen</mark> E <mark>fyaksvywen</mark>	TLHTLKORSMLS TLHTLKOROLTS	.LGSSRPLVSE YVGSVRPLVTE	LDPDAPIRQK LDPDAPIRQK	LPLDDLDRED MPLDDLDRED	RLLKYLFTLI VRLLKYLFTLI	
Nup107_X.laevis	α11 00 0000000 350	α12 200 00000 360 3	0 70 38	o 390	α13 0000000 400	410	α14 0000000000 42 0	α15 2000 43 0	
Nup107_X.laevis Nup107_Human	RAGMTDEAQRL RAGMT <mark>E</mark> EAQRL	CKRCGQAWRAAT CKRCGQAWRAAT	LEGWKLYHDAN LEGWKLYHD <mark>P</mark> N	INGGTELQAVEG VNGGTELEPVEG	NPYRCVWKTCO NPYRRIWKISO	WRMAEDE <mark>O</mark> FN WRMAEDE <mark>L</mark> FN	KYERAIYATLS Ryeraiya <mark>a</mark> ls	GNLKQLLPVCE GNLKQLLPVCD	
Nup107_X.laevis	<u>0000000000000000000000000000000000000</u>	α16 2000000000000 45 9	00 TT 460 4	α17 <u>0000</u> 70 480	α18 00000000 490	α19 <u>00000000</u> 500	α20 0000000000 510	α21 <u>00000000</u> 520	
Nup107_X.laevis Nup107_Human	SWEDTVWAHFK TwedtvwayfR	/MVDSLVEQEI /MVDSLVEQEI Q	A <mark>SIISFNE</mark> AN <mark>E</mark> T <mark>SVAT</mark> LDETEE	LPREYL <mark>E</mark> ANWTL LPREYLG <mark>ANWT</mark> L	DSVFEELQATI EKVFEELQATI	KKRVLEEN <mark>R</mark> E KKRVLEEN <mark>O</mark> E	HYHIIQKFVII HYHIVQKFLII	ADVDGLMDEFS GDIDGLMDEFS	
Nup107_X.laevis	530	α22 20000000000 540	00000 Q	α23 000000000000 560 57	0000 000	α24 0000000 00 590	α25 0000000000 600	α 2000000 610	26
Nup107_X.laevis Nup107_Human	EWLSNGKNLLL KWLSKS <mark>RN</mark> NLP	GHLLRFMTHL <mark>I</mark> L GHLLRFMTHL <mark>I</mark> L	FFRTLGLQAKE FFRTLGLQTKE	EVS <mark>VEVLKTYIQ</mark> EVS <mark>IEVLKTYIQ</mark>	RLINEKQIELI LLIREKHINLI	AFYVSHLPQE AFYTCHLPQD	LAISQYAVELE LAVAQYALELE	NITDPDORORC SVTEFEORHHC	
Nup107_X.laevis	0000000 620	α27 200000000000 630	0 640	650 <u>6</u>	α28 α2 000000 000 60 67	9 20 2020 70 68	α30 00000000000 0 690	α31 200 <u>200000</u> 700	
Nup107_X.laevis Nup107_Human	LELAKEAGLDV LELAKEADLDV	SITKTVVENTR TITKTVVENIR	KKDAGEFAHHD KKDN <mark>GEF</mark> SHHD	APALDSGTSEE APALDTGTTEE	DRAKIDVIDWI DRLKIDVIDWI	VFDPAQRAEA VFDPAQRAEA	LKOSNAIMRKF LKOGNAIMRKF	LASKKHEAAKE LASKKHEAAKE	
Nup107_X.laevis	2020 <u>200</u> 710	α32 20000000 720	<u>0000000</u> 730	α33 200000000000 740	750	760 7	70 78	00000000000000000000000000000000000000	
Nup107_X.laevis Nup107_Human	VFAKIPQDSIA VFVKIPQDSIA	EIYSQWEEQAMD EIYNOCEEQGME	SALPAEDDNAI SPLPAEDDNAI	REHLCIRAYLES REHLCIRAYLE	HE <mark>AFNEWFKH</mark> HETFNEWFKH	NSPPQKPTLV NSVPQKPALI	GOASFTEKVAH Poptftekvah	EHKEKKYEMDF	
Nup107_X.laevis	α34 00000000000 800	810	TT TT 820	830	α35 00000000000 840	850	α3 2 222220 860 8	6 200000 370	
Nup107_X.laevis Nup107_Human	GIWKGHLDALT GIWKGHLDALT	DVKEKIYNVLL DVKEKMYNVLL	FVDGGWMVDVR FVDGGWMVDVR	EDTEEDPERSHQ EDAKEDHERTHQ	MVLLR.LCLPM MVLLRKLCLPM	MCFLLHTVLH LCFLLHTILH	NTKQYKDCLRI STGQYQECLQI	ADIVSSENOKL ADMVSSERHKL	
Nup107_X.laevis 8	80 00000 80 890	α37 20000000000 900	<u>910</u>						
Nup107_X.laevis Nup107 Human	YTVFSKTEMRN YLVFSKEELRK	LLQKLRESSLML LLQKLRESSLML	LDLOLDPLGYE LDOGLDPLGYE	IQS					

L Nup133_X.laevis NUPIS_ALABVIS 1 10 20 30 40 50 60 Nupis3_X.laevis ...MPPSPRAQCMCSARPFNRLTCGRKA....LCPCVTASSPSALVPRVCRRVFASGARSTPSRVYLLPAA Nupis3_Kumman MPPAAPSPRTPCTCSRRCPLAGLOPCSTPRTASRKCLPLGSAVSSPVLFPEVCRRVSBLSSRCFTTRMPPEMS[αl Nup133_X.laevis 00000000 110 TT-120 NUD133_X.laevis PVKVMEAL ENA SEDERMARCI HECGWANLACNDELIIWKISHSSSAKLWVCKEID PPLSDSEN SADI NUD133_Ruman PVKVMEAL ELA EVDOQUIUM BECGWACLWCKERLIIWKIALSPITKLSVCKERCIEPSDFHWSADI IGDPAAAOS<mark>VA</mark>LM/ SGEAHSTOAVAVM β9 → ^{β13} $\rightarrow \frac{\beta}{210}$ ►TT -Nup133_X.laevis 90 Nup133_X.laevis ATPECSSRYWENTLHEGYYIESYTERCS.SLCAPVTAVKENSFILSSEKNOLVRLTPEASCKMNORVLPCCCCM Nup133_Human ATRESIRYWFSLAGEDTYTEAFVESCGDKYYSLFAVVGCGSFILSSSGSOLIRLIPESSCKIHOHILPOCOCM β14 TT. T β16 β17 α2 α3 299 300 310 320 330 B19 Nup133_X.laevis 270 280 Nup133_X.laevis SPAVESTLCSVLWDKG.DCFYTLDSSINKWELDDTSESOVLNWDMSRULREYISDAIWCSESOVDIKACHNINYLSLN Nup133_Human SPSSDLTLSSVLWDRERSSFYSLTSSNISKWELDDSSEKHAYSWDINRALNEN TTDAIWCSESNYEATKECVNIRYLDLK β21 389 β23 β22 β25 Nup133_X.laevis 410 Nup133_X.laevis SAAWHPG Nup133_Human AAAWHSA COLYYTLYTVKDEGYN ISDEITVEVTOENPVFOARGMOLCOLYVPNFSSOACYLYTOEMI Llyysliniednocomsdavtvevtoynppfosedliicoltvpnfsnotaylymesav S29 549 549 559 660 Nup133_X.laevis ILCACENVOEFFE, SSWEDDELDLYNGISVDLDOYPASDPRWAESVPEEAAGFSNTSLI LHOLEDKWKAHSF WDFHQVCLFG Nup133_Human LCHACEVVDELFSSHSDLDESLDRAVIQISVDLWDDYPASDPRWAESVPEEAFGFSNTSLI LHOLEDKWKAHSFLWDFHQVCLFG Nup133_X.laevis RESTCOTECHUVATRLELSEBAEKLSAATVLKNHBAED VLVNSATOLALDERMCTVPONLTAADVVPREVSOMEIIFECLVDEREADL Nup133_Ruman RESTVINGTPWATRLLLCBHAEKLSAATVLKNHBERESDEVNHATLLALMEREVEIDENLTADVFPREVSOVOTTCECLLEBEVVV
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Κ $\begin{array}{c} \textbf{ELYS}.\textbf{X}.\textbf{laevis} & \begin{array}{c} \beta 1 \\ 1 \\ 0 \end{array} & \begin{array}{c} \beta 2 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \beta 2 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \beta 2 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \beta 2 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \beta 2 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \beta 2 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \beta 2 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \beta 2 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \beta 2 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \beta 2 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \beta 2 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \beta 2 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \end{array} & \begin{array}{c} \alpha 1 \\ 0 \end{array} & \begin{array}{c} \alpha 1 \end{array} & \begin{array}{c} \alpha$ $\begin{array}{c} \beta 8 \\ \hline \beta 8 \\ \hline 100 \\ \hline 110 \\ \hline 120 \\ \hline 120 \\ \hline 120 \\ \hline 120 \\ \hline 110 \\ \hline 120 \\ \hline 110 \\ \hline 120 \\ \hline 110 \\$ ELYS X.laevis -ELYS_X.laevis $\begin{array}{c} \underline{\beta}14 & \underline{\alpha}3 & \underline{\beta}15 & \underline{\beta}16 & \underline{\beta}17 & \underline{\beta}18 & \underline{\beta}19 & \underline{\beta}200000000 & \underline{2}10 & \underline{2}20 & \underline{2}30 & \underline{2}40 & \underline{2}50 & \underline{2}60 & \underline{2}70 \\ \underline{ELYS}.X.1aevis & \underline{\beta}A5 DLEVMSVIPTKIEFLIREARTERRELCLOLAPTCTTVSCLSVISTNOLAVCPSDCYFSLWMMTLERDVH001ECCRVPVCAVAPO & \underline{2}10 & \underline{2}20 & \underline{2}30 & \underline{2}10 & \underline{2}50 & \underline{2}60 & \underline{2}70 \\ \underline{ELYS}.X.1aevis & \underline{\beta}A5 DLEVMSVIPTKIEFLIREARTERRELCLOLAPTCTTVSCLSVISTNOLAVCPSDCYFSLWMMTLERDVH001ECCRVPVCAVAPO & \underline{1}001ECCRVPVCAVAPO & \underline{1}001ECCRVPVCAVAP$
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 ELYS_X.laevis
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 ELYS_Human
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 $\begin{array}{c} \texttt{ELYS},\texttt{Human} & \texttt{ELYS},\texttt{K},\texttt{Iaevis} & \texttt{B25} & \texttt{B26} & \texttt{B26}$ ELYS_X.laevis 460 470 480 490 500 510 520 520 540 ELYS_X.laevis SRGTPPSYPPPEQFYYPSTYNFDATCLINSGLTHFACTGFQXETLHFLKKSGSSLNEATPDGYNRCLAAGLDAPKFTDVQASSLSQEEQLQ ELYS_Ruman NgGVPSYPPPEQFEMPSTYNFDATCLLNSGVVHLTGTGFQXETLTFLKKSGFBLNEETPDGYNRCLMAGLLSPERVDVQFSSLSQEEQLG α14 20000 720 ELYS.X.1aevis FIACAMEVTOCCAVDITIKOSVETELITIYSVVLWEGKSCHDEGSSDETVOLTREFYNYCVICCYSDCRKELERIARGKUISSUNDGL ELYS.Ruman FASERELIDESNE VVEHLICCYXCVVLWESKSCHLERCIDSVCLSRICYNYFVICNYYTSRCEFELSRCKWNFDCLMIDGL ELYS X. Laevis INGEGERIO OLWERDDNGTGKYPPAN LHALDDWYLLENADENSKHAITIYFLLDINYSFPDREDSSIESFFAFFWPGSLIKLIGGFWLUD ELYS Human YSGLGERIEKLMKRDGGTGKYPPAS LHAWLDWYLLGGYTBAAKHSITIYLLDINYSFPNHTDDFIESFFTWFALSWGQVKLIGGFWLUD ELYS_X.1aevis HNDYDNSVDCTLNPASSRVFSWOHSDETENLUCHGDSROALRYHOVMKPVATTSKEVKHHWEVLLANRSFIEANNLCRLHSSRANVBELEK ELYS_Human HNDYDSSCHDLLFHPATAKPLSWOHSSEIOAFMSCGEHROALRYHOTMKPTUSSCNDVILHWEVVLFNRCMVBANNFLROHCRANNFEROEDNIN ELYS X. Laevis HMYEMCOEMCL BELKKI TETEFECS YIHKELOTT. GVONCEL LLVHHLORANY ISALCLNOSLNTNHENDCORRLRERSGARNATLOYG ELYS Human HMYEMCOEMCL WEDLIKKI FTDTECSCL VKFLOSSASVONHEFLLVHHLORANY WPALKLNOTLNINWNDEPPRLRERSJARNSTLDOYG α31 ELYS_X.laevis 000000 ELYS_X.laevis <u>00000000</u> 1000 1010 1020 1030 1040 1050 1060 1070 1080 ELYS_X.laevis KILPRVORTASERAKEYSMP.SLVBREVARPKELSTIAKGARPGSIITKANFIGNVLSKIKEVSTANEKREYSMVSEPT, .RPP ELYS_Human KILPRVHEKTAIERAKEYHISTSSVERLVSREVEDSAVEKOVYTGTVITESVFINNVLSKICEVWASKEPINSTLDFNSKIEEPSPIMYS

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 <td Nup205_X.laevis KANGGSSAENIGAAGGSPVSWDHPFHSLMLYHEHLREDLPNTDNTHORTHORELDGLTACLOLICTIDNSEARLALCEHAG Nup205_Ruman KVNGSSHUENIGAGGSPVSWBHFFHSLMLYHEHLREDLPSADSVOYRHLPSRGITGREDDGLTAFLOLISFTITTSENARLALCEHAG a29 a30 a31 a32 640 650 660 670 680 690 700 α28 Nup205_X.laevis 000000000 630 Nup205_X.laevis WMPVVVILGLLQCSIPPULKAELLKTLAAFGKSPEIAASLWQSLEYQILQTVRATGLRQGVGIEVELNEIESRCEEYPLTRAF Nup205_Kuman WTPVVVILGLLQCSIPPULKAELLKTLAAFGKSPEIAASLWQSLEYQILQTVRATGLRVELNEIESRCEEYPLTRAF Nup205_X.laevis TLVESSFPTNLGAGLRAPGFEPYLOFLRDTVFLRURTRAYRRAAEKWEVAEAVLEVFYKLLKDYEPGEDFVDOTVELQGEERTAFKP Nup205_Ruman TLVESSFPSNLGAGLRPPGFEPYLOFLRDEVFLRURTRAYRRAAEKWEVAEWVLEVFYKLLKDYEPGEDFVDOTVELQGEETTAYKPP Nup205_X.laevis GFSLMHHLLNESPMLELCLSLWEECVTOLDTYAPFPGKKHLEKAVAYGFWLLNLTLOXENRFMDLLRESHLSWIVTPLEOLLOGINPRS Nup205_Ruman GFSLMYHLLNESPMLELABSLEECVTOLDTYAPFPGKKHLEKAVOHCLALLNLTLOXENRFMDLLRESGLALIVGPLEOLLOGINPRT 970 Nup205_X.laevis 0LCACSDTSCPTMRYLRTSQDFLFSQLOHLDFSWESSEISAMNOMSWLMKTATTELSRTSLKRQRSHTQRLHLLLDDMPTKPYS.DGE Nup205_Klaman 0LCACSDTSCPTMRYLRTSQDFLFSQLOHLPFSWESSEISAMNOMSWLMKTATTELSRTSLNRQRSHTQRLHLLLDDMPTKPYS.DGE α53 Nup205_X.laevis 00000 1160 1170 α54 202020202 1180 1190 Nup205_X.laevis GGMEDESRSESCFLHFDTTSKVRRKIDRILDSIGFSNEIPEPLQLDFFDRSGIEQVIANCEHKNRRGQTVCNVKLLHRVLVAEVNALQ Nup205_Ruman GGMEDESRSESCFLHPDTATKVRRKIDNILDSIGFSNEIPEPLQLDFFDRSGIEQVIANCEHKNLRGQTVCNVKLLHRVLVAEVNALQ
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 MAAIGORPLIMEEINTILOYVERNKLLOCHAKRHALESWRQLVEIILTACPODLEPTEHROLITHOLOGHUKKLLODBAAQELMPT

 Nup205_Ruman
 MAAIGORPLIMEEINTILOYVERNKLLOCHAKRHALESWRQLVEIILTACPODLEDTEHROLITHOLOGHUKKLLODBAAQELMPT
 Nup205_X.laevis VAGAVFTLTAHLSQSWTBIKQPMTASGLGQSQTWGMLDGSBAAPEGTENISGGFASICDSSLHWILRNLEFILKTCGGPQRVRAHLY Nup205_Human VAGAVFTLTAHLSQAVLTEOKET.SYLGPAEAHYAFMLDSCTTSPPPENPLWGFASICDSSLYLTLKKLLEFILKTCGGPQRVRTHLY α62 Nup205_X.laevis 000000000 1430 1450 1440 Nup205_X.laevis GSL1YLQIAQRPDEPDTESAEKSMWERLTAPEDVFSKLQRENESIFESYGALMEVVCRDACDGHEIGRMLALALLORIVSV Nup205_Ruman GSL1YLQIAQRPDEPDTESAEKSMWERLTAPEDVFSKLQRENEAIESYGALMEVVCRDACDGHEIGRMLALALLORIVSV Nup205_X.laevis WLLYLSNSGYLKVLVDSLMEDDWIL BLDWPDPLLKALYI VESKMAFLTRVARSGQAI ELLRSGVIVRLAQCQVYDMRPETDPHGT Nup205_Ruman WLLYLSNSGYLKVLVDSLMEDDRTHQSLLTPQPPLLKALYI VESKMAFLTRVARSGQAI ELLRSGVIVRLAQCQVYDMRPETDPHGTF Nup205_X.laevis GMRBTPWETPHPVBRYRQILLPALOHCCILLTSSTAQHLQAACQVLQFVAHSDTIQAILRSGECSLGSLQELALLTGIISKAALPCIL Nup205_Ruman GMRBPPWETPHPVBRYRQILLPALQHCQVLLTSSMAQHLQAACQVLQFLISHSDTIQAILRCGDVSAGSLGELALLTGIISKAALPCIL Nup205_X.laevis NELDIGINGCSMMELOGHIGRFOROCLALLINGFGGSDRLRGLSLODDSSRLDGVSKKDDMELAMOOIGSNVMEYCGALWHONSPSFOOI Nup205_Human SELDYDUNEGSLMELOGHIGRFOROCLGLLSRFGGSDRLRGFKFODDNVEGDKVSKKDEIELAMOOIGANVMEYCGSLMHOSSPIFGHA Nup205_X.laevis Nup205_Ruman VCLFTPSLSETVNRDGPRODECKSTPSWELPSLGVTHLLKQSANNDFTYYDIHRQSVGKLQNVEQLPPDEIKELCQSVMPMGVDKIS η13 00000 **1950** 1879 1889 1890 1990 1910 1920 1930 1940 1950 MUP205_X.laevis nTQXYGLARRRLVXLFN QRXLLSLCSYISTCCLYISTCCLYTLUCHTSDSOD (TTGC) TROTTONTDPN DPROLPACETNLDFR QDF NUP205_Ruman nAQXY (MARRLVXLSTN) QRXLLSLCSYISTCCLYILTRHLSYYLLHCMPTDSOD (TARSTLEKSRE) 2005 ASSTNDDFR QG.LAIV
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 Nup205_X.lsevis
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 Nup205_X.laevis SQDUDTLLREGANSFGESLOKELLDISLYCKVRSRHSFIQALVRRIRCLLRVSR Nup205_Kuman SGHDLDADATMAFGESLOKELLDIEGLYSKVRSRYSFIQALVRRIRCLLRISR

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Nup93_X.laevis	200000000000000000000000000000000000000	2000000000000000	<u>000000000000</u>	0000000000 TT
Nup93_X.laevis Nup93_Human	MDGEGFGELLQQAEQLAAETEGVTELPH MDTEGFGELLQQAEQLAAETEGISELPH	VERNLQEIQQAGERLRSKTMTRT VERNLQEIQQAGERLRSETLTRT	SQESANVKASVLLGSRGLI SQETADVKASVLLGSRGLI	DISHISORLESLSAATTFEPL DISHISORLESLSAATTFEPL
Nup93_X.laevis	00000000000000000000000000000000000000	α5 000000000000000000000000000000000000	<u>00000000</u> 150 160	ọ 17ọ 18ọ
Nup93_X.laevis Nup93_Human	EPVKDTDIQGFLKNEKDNALLSAIEESR EPVKDTDIQGFLKNEKDNALLSAIEESR	KRTF <mark>V</mark> MAEEYHRESMLVEWEQVK KRTF <mark>G</mark> MAEEYHRESMLVEWEQVK	QR <mark>V</mark> LHTLLASGEDALDFT QR <mark>I</mark> LHTLLASGEDALDFT	DESET <mark>SYISES</mark> GAPGRSSLDN DESEPSYISDVG <mark>PPGRSSLDN</mark>
Nup93_X.laevis	α6 <u>000000000000000000000000000000000000</u>	α7 α8 000000 <u>000000000000</u> 10 220 230	α9 240 240 250	α10 00000000000000000000000000000000000
Nup93_X.laevis Nup93_Human	VEMAYARQMYMYNEKVVSGHLQPSLVDL IemayarqiyiynekivnghlqpNlvdl	CTEAAERLDDKNVSDLWVMVKQM CASVA.ELDDKSISDMWTMVKQM	TDVPLIPASDTLKSRCSG TDVLLTPATDALKNRSSVI	MOMAFVRQALNYLEQSYKNY Evrmefvrqalayleqsykny
Nup93_X.laevis	α11 α12 <u>0000000</u> <u>00000</u> 280 290 3	$\begin{array}{cccc} & & & & & & & & \\ \hline 0 0 0 & & & & & & \\ 0 0 & & & & & & \\ \end{array} \begin{array}{c} & & & & & & \\ & & & & & \\ \end{array} \begin{array}{c} & & & & & \\ & & & & & \\ & & & & & \\ \end{array} \begin{array}{c} & & & & & \\ & & & & \\ & & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & \\ & & & & \\ \end{array} \begin{array}{c} & & & & \\ & & & \\ & & & \\ \end{array} \end{array}{c} \begin{array}{c} & & & \\ & & & \\ \end{array} \end{array}{c} \end{array}{c} \begin{array}{c} & & & \\ & & & \\ \end{array} \end{array}{c} \end{array}{c} \end{array}{c} \begin{array}{c} & & & & \\ & & & \\ & & & \\ \end{array}{c} \end{array}{c} \end{array}{c} \end{array}{c} \end{array}{c} \end{array}{c} \end{array}{c} \end{array}{c}$	α13 α14 <u>00000000</u> <u>00000000</u> 330 340	α15 α16 <u>000000000000000000000000000000000000</u>
Nup93_X.laevis Nup93_Human	TLISVFANLOQAQLGGVPGTYNLVRSFL TLVTVF <mark>GNLHQAQLGGVPGTYO</mark> LVRSFL	NIRLPTPTPGLQDGETEGYPVWA NIKLPAPLPGLQDGEVEGHPVWA	LIYYCMRCGDLMAAQQVVI LIYYCMRCGDLLAASQVVI	NRAQHQLGDFKNCFQEYIHNK NRAQHQLGEFKIWFQEYMNSK
Nup93_X.laevis	α17 000000000000000 370 380 3	α18 0000000 90 400 410	α19 000000000 420 43	ηl α20 <u>200 00000000</u> 440 450
Nup93_X.laevis Nup93_Human	DRRLSP <mark>TTENKLRLHYRRAVRAS</mark> TDPYK DRRLSP <mark>ATENKLRLHYRRALR</mark> NNTDPYK	RAVYCIIGRCDVSDNHSEVADKT RAVYCIIGRCDVTDNCSEVADKT	EDYLWLKLSQVCFEDEAN EDYLWLKLNQVCFDDDGT	SSPQDRLTLPQFQKQLFEDYG SSPQDRLTLSQFQKQLLEDYG
Nup93_X.laevis	α21 α22 000000000 00000 469 479 4	η2 α23 000 000000000000000000 80 490 500	510 ^{β3} 510 520	$\mathbf{TT} \xrightarrow{\beta4} \underbrace{\alpha24}_{0000000000}_{530} 540$
Nup93_X.laevis Nup93_Human	ESHFAVNQQPYLYFQVLFLTAQFEAATA ESHFTVNQQPFLYFQVLFLTAQFEAAVA	FLFRLERTRCHAVHVALALFELK FLFRMER <mark>L</mark> RCHAVHVALVLFELK	LLLKS <mark>TGQSAQLLS</mark> EPG LLLKS <mark>SGQSAQLLS</mark> HEPG	SPOGVRRLNFIRLLMLYTRKF PPCLRRLNFVRLLMLYTRKF
Nup93_X.laevis	α25 η3 <u>000000000000000000000000000000000000</u>	α26 000000000 70 580 590	α27 00000 0000 600 610	α28 α29 000000000 0000000 0 620 630
Nup93_X.laevis Nup93_Human	EPTDPREALQYFYFLRNEKDNQGESMFL Estdprealqyfyflrdekdsqgenmfl	RCVSELVIESREFDM <mark>LLGKLEKD</mark> RCVSELVIESREFDM <mark>LLGKLEN</mark> D	GSRKPG <mark>AIDKFTR</mark> DTKTI GSRKPG <mark>VIDKFTS</mark> DTK <mark>P</mark> I	INKVASVAENKGLFEEAAKLY INKVASVAENKGLFEEAAKLY
Nup93_X.laevis	α30 <u>000</u> <u>00000000000000000000000000000000</u>	α31 000000000000000000000000000000000000	α32 <u>000000000000000000000000000000000000</u>	α33 000000 00000000 0 710 720
Nup93_X.laevis Nup93_Human	DLAKN <mark>PDKVLELTNKLLSPVVSQISAPQ DLAKNA</mark> DKVLELMNKLLSPVV <mark>PQISAPQ</mark>	SN <mark>RERLKNMALA</mark> IAERYKSQGVS SNKERLKNMALSIAERY <mark>RA</mark> QGIS.	AEKSINSTFYLLLDLITF ANKFVDSTFYLLLDLITF	FDEYHA <mark>GHIDLSFDVIERLKL</mark> FDEYHS <mark>GHIDRA</mark> FD <mark>IIERLKL</mark>
Nup93_X.laevis	η4 α34 202020202020 20202020 730 740 7	α35 000000000000000000000000000000000000	α36 000000000000000000000000000000000000	0000000000 00000 0 800 810
Nup93_X.laevis Nup93_Human	VPLSODSVEERVAAFRNFSDEIRHNLSE VPLNOESVEERVAAFRNFSDEIRHNLSE	ILLATMNILFTQYKRLKGSGPTT VLLATMNILFTQFKRLKGTSPSS	LG <mark>RPQRVQEDKDSVLRSQ</mark> SS <mark>RPQRVIEDR</mark> DSQLRSQ	ARALITFAGMIPYR <mark>M</mark> SGDTNA ART <mark>LITFAGMIPYRT</mark> SGDTNA
Nup93_X.laevis	α37 <u>000000000</u> 820			
Nup93_X.laevis Nup93_Human	RLVQMEVLMN RLVQMEVLMN			

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			α1						α2
Nup214_X.laevis	690	00000000 700	710	720	730	740	750	760	770
Nup214_X.laevis Nup214_Human	QPQ RSVALE PQAKSLQPAVAE	NQAKVTKESDS Koghowkdsdp	ILN <mark>GIREEIAH</mark> VMA <mark>GI</mark> G <mark>EEIA</mark> H	FQKELDDLK FQKEL <mark>EE</mark> LK	ARTSRACFOVG	SEEEKROLR TSEEMKMLR	TESDGLHSF TESDDLHTFI	LEIKETTE LEIKETTE	SLRGEFSA SLHGDISS
Nup214_X.laevis	780	790	α3 00000000 800	810	820	α4 000000000 830	840	850	860
Nup214_X.laevis Nup214_Human	MKIKN LEGFASI LKTTLLEGFAGV	DVQQR <mark>N</mark> KLKQ EAREQNERNR	DPKYLOLLYKK DSGYLHLLYKR	PLDPKSETQ PLDPKSEAQ	QEIRRLNQYV QEIRRLHQYV	KNAVQDVND KFAVQDVND	/LDLEWDQYI	EEKOKKKORI	IIIPERET LLVPERET
Nup214_X.laevis	00000000000000000000000000000000000000	x5 00000000000 880	00000 999	900	91		20 5	30	940
Nup214_X.laevis Nup214_Human	LFN <mark>SLAN</mark> HQEII) LFN <mark>TLAN</mark> NREII)	NQQR <mark>PKLEQLV</mark> NQQRKRLNHLV	EN <mark>LQK</mark> LRLYNQ DSLQOLRLYKQ	I <mark>S</mark> Q <mark>WNV</mark> PD. T <mark>S</mark> L <mark>WSL</mark> SSAV	<mark>SS</mark> T <mark>KSFD</mark> /PSQ <mark>SS</mark> I HSFD	V <mark>ELENM</mark> QKT S <mark>DLESL</mark> CNA	SQTAIDTQ LKTTIESH1	KPQA <mark>KLP</mark> KSLP <mark>KVP</mark>	KISPVKQS KLSPMKQA
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Num62 X laouis							0000000		

Nup62_X.laevis	310	320	330	340	350	360	370	380
Nup62_X.laevis Nup62_Human	TSTATSTGFG.MKT TTTSSSSTTGFALNLKP	ASSAVPTG APAGIPSN	TLATSTASLGVK TAA	APLAGTIV	QANAV <mark>G</mark> SA AA T VTAPP <mark>G</mark> PG <mark>AA</mark> A	GISTATAMTY GAAASSAMTY	AQLENLINKWSI AQLESLINKWSI	ELEDQE <mark>K</mark> HFLQ ELEDQERHFLQ
Nup62_X.laevis	<u>0000000000000000000000000000000000000</u>	αl 20000000 410	<u>420</u>	<u>430</u>	440	450	460	α2 200000000000 470
Nup62_X.laevis Nup62_Human	QATQVNAWDRTLMONGE QATQVNAWDRTLIENGE	ITTLHRE ITSLHRE	EKVKLDQKRLDQ EKVKLDQKRLDQ	ELDFILSO	QKELEDLL PLI QKELEDLLSPLI	EESVKEQSGT EELVKEQSGT	IYLQHADEERER IYLQHADEERER	TYKLAENIDAQ TYKLAENIDAQ
Nup62_X.laevis	<u>0000000000000000000000000000000000000</u>	500	<u>0000000000000000000000000000000000000</u>	<u>520</u>	α3 00000000000 530	<u>540</u>	<u> </u>	
Nup62_X.laevis Nup62_Human	LKRMAQDLK <mark>EV</mark> IEHLNTS LKRMAQDLKDIIEHLNTS	AGPGDASN GAPADTSD	PLQQICKILNAH PLQQICKILNAH	MDSLQWID	QNSALLQRKVE QNSALLQRKVE	VTKECESRR VTKVCEGRR	KEQERGES IAFD KEQERSER ITED	

 Nup88_X.laevis
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 Nup88_Human
 EEGEHIREMVKQINDIRNHVNF

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 NUD2558_X.1aevis MRRSKABIORYMEMAQMSASSPREKSKKGEUPARTYEAKEYELAKRSWELAKRSWEVECAKRSKEVECYERSIEL NUD258_Ruman MRRSKADVERYIASVOGSTPSPROKSMKGEVFALLYYEAKEYELAKRSWICIYINVOERDPKAHRFLGLUYELBENTOKAVECYERSUEL NUP358_X.laevis NPTQKDLTLEIAELICTLNIKDGRAEYWWERASKLFPGSEIYRLKEQLLSSQGBAGWNQLFDLIQAELFARBNDWYVNLKLVDLFLSN Nup358_Ruman NPTQKDLVLEIAELLCKNDUTDGRAEYWLERASKLFPGSERIYRLKEQLLSSQGBAGWNKLFDLIQSEHYVRPDDWHVNERLVEVYRST
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 all</th - 180 190 200 200 220 230 230 250 260 Nup358_X.laevis (RLEENVIHGLKPER, ALK TOTENCSCVVRVFKEYLASKOCK, NINMRMITKELLA, VANLMUKTSKKOVOKSKEADER DO AL Nup358_Ruman KELKAVARGHEA 28. NIALSSEANNSCVV0TLKEYLASIO (CLSOKEDWRATNTELLAYANLMULTLSTERCOV) (SBRELLOSDKEAD) Nup358_X.laevis SVKOSVSGTDASDISWTFYEMRGHYYMHAGTLLLKMAQ.SCEVQMRALIEPAALCYLLAWQVFKFRSKPWKGDDNGQCFDEFDAFDROS Nup358_Human SVKSLG...GNDELSKTFILMKCHEYMHAGSLLLKMQCHSSNVQMRALSELAALCYLLAFQVFRFKILLIKCE.AGQNLDEMMACDRIS
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 0 A40 Nup358_X.laevis KSGHULLNISEGKONFISET ETFANOCGOSTLLKTDEDMLSMODSEWGSDDISVENGVEDMSVEDMSVEDMSVEDMSVEDMSVEDMSVEDMSVE Nup358_Human OSGHULLNISEGKODDUKEIVETFANKSGOSALVDALDSSGSPKDTSILGSDDIGNLDVREPELEDIEN VDVGALRAHNGSLOHLTWLG
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 nup358_X.laevis
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 690
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 NUP358_X.laevis KSIPEPUDEPKHFHNKDIKOSEVKDLEDEACHAFATLDIVOGKTEDAHIAFESVKNVVAYHNLALIYORKAEBIENDCH AESOEBC Nup358_Ruman NSIPEPIDELFKHFHSVDIGASEUVEVEBAHIAFAILDAWNGNIEDAATAFESVKNVVAYHNLALIGHKAEBIENDABSPESOEBCK

Nup188_X.laevis Nup188_X.laevis VELLOTYLOYDYRGTOESVKVDPODEROSOALWLKMADYYYEERISLLRCVLYTLNYFO Nup188_Human VollocyLoedyrgtrosvktvLoderosoalilkiadyyyeertcilrcvLHLLTYFO η3 2020 20000000 250 260 Nup188_X.laevis BSHCREEAPTWETHGNEWTERQVSRWFVQRLREQAMLLEIIFLYEACFARGPSDLLALTKIFKEQGFGCRLAMHLVBPSMDFIV Nup188_Ruman BEBYKIEAPTWETHGNLWTERQVSRWFVQCLREQSMLLEIIFLYEAFSDLLULTKWFKEQGFGSRCINRHLVDFIMDFV
 Nup188_X.laevis
 al2
 al3
 n4
 al4

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 290
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 α15 0000000000000 320 330 α16 000000000000 00 NUP188_X.laevis YFSHLFELEALDMDTHMTCSLSDKIECHPESSEEQVCKEMDSILVHLCDVPHHCPVLLAWALLRETLNEDKVTSAVRKMCSTATQLHLF NUP188_Human YFSALLUVECMDIESEHKCALDDRRELHCEAQDGLICODMDCLMLFFGDHPHHAPVLLAWALLRHTLNEETSSVVRKMCCTATQLMWE α21 Nup188_X.laevis OVITRM_DOST_BSCEMNCTTSTACUCWTFHATWISTEEQVSOGOODUVERACCUFAADNLPD-LEXMM Nup188_Ruman OVITRM_DOST_ASGONDCTTSTACUCWTFLATWISTEELHTLGNOODIIERAGEWLADPSLEELHTKGT
 α22
 α23

 Nup188_X.laevis
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 470
 Nup188_X.laevis SPLLKLFTALVS.KSSAKKVYSFLDRMSSYTEHYRHKPHDTLSHDPT Nup188_Human SPLLOLLRALVSGKSTAKKVYSFLDKMSFYNELYKHKPHDVISHEDGT LW<mark>KRQTPKLLYALG</mark>LGQTNL LW<mark>R</mark>RQTPKLLY<mark>P</mark>LG.GQTNL
 a24 a25 η_6 a26 a27

 Nup188_X.laevis
 η_6 α_{20} η_{20} η_{20} \eta_{20}
 \eta_{20}
 \eta_{20}</th Nup188_X.laevis EYSYSCWTLFTCEIEMLHVVSTADVIHOCORVKFIID Nup188_Human EYSYSSWTLFTCEIEMLLHVVSTADVIOHCORVKFIID TTVMNPPMDFLSS TTVISPPVDVIAS 650 660 670 680 690 α29 Nup188_X.laevis 0 00000000 630 640 η7 α32 Nup188_X.laevis ATRLPAKVWTDLRHTGFLPFBANPVSG.HLISTEGMNAGGYGSUF.GIEQSQGEYSVTL Nup188_Ruman ARNPAKVWTDLRHTGFLPFWAHPVSSLSOMISAEGNAGGYGNDLMNSEQPQGEYSVTL η8 α33 Nup188_X.laevis <u>00</u> <u>200</u> <u>000000000000000000</u> 710 720 730 740 α34 α35 α36 <u>0000000000</u> <u>000000000</u> <u>000000000</u> <u>780</u> 780 Nup188_X.1aevis LEMLENYHENYRYNSHGYREOLGCITSLIHAILNLGPREER.GSAPNLRSHCTSLINTEAG Nup188_Human LEMLPSYHENYRYNSHGYREOLGCLITELIHAILNLGHETDLHSSHTBSLOFLCICSLAYTEAG Nup188_X.laevis GTEC..OCOMLMOTIKLAFSITNNVIRLKPPSSGVSPLEHAL Nup188_Human GAECOGCOLLIKTVKLAFSVTNNVIRLKPPSNVVSPLEOAL NUD188_X.1aevis Nud188_Human CLGNDAAAIRDAFLSRIRDNEDMOITKIMILEPLTVAVETOPGLIELFLNLERKDIREGSKETSLGENSCHOVVLKLIDSGODPESSNGA Nup188_X.laevis PLHRSATAFLHALWQDRRDSAMTVLRTKPNFWENLTSPLFCTLACPSESELSILSILETCAFIMKIICLEIYYAWEGSLGSLKKILKKE Nup188_Ruman PLHRAATAFLHALWQDRRDSAMTVLRTKPNFWENLTSPLFCTLSPSETSEPSILSILSILCALIWKIICLEIYYAWEGSLOSLKDILKKE Nup188_X.laevis SEBERFTYWSNYYHSLUCCVAETEG.TCNSLTEYOCLESAWRMFLIVATHNADW Nup188_Human SIEKRFAYWSGYVKSLAVHVAETEGSSCTSLLEYOULVSAWRMLLIIATHADH HHLTNPE<mark>VRQKLFKDILGGTOALLVVPRSVACMHL</mark> HHLTDSV<mark>VR</mark>RQLFLDVLDGTKALLLVPASVNCLRL
 ad5
 ad6
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 ad5</th α62 α63 α64 α65 Nup188_X.laevis 0000000000 0000000 00000 1330 1340 1350 1360 1370 202020 Nup188_X.laevis DFVGVHQERTLQCLSAVRTVQSLCLEEADHTVGFLQLSNFTKEWHFHLPQLTKDVQVNLCVLCQACTSLLHSRKMLQHYLQKKNGBC Nup188_Human DFVGVHQERTLQCLNAVRTVQSLCLEEADHTVGFLQLSNFMKEWHFHLPQLMHDHQVNLCVLCQACTSLLHSRKMLQHYLQKKNGBC
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Figure S13. Sequence alignments of Nups in CR and NR from *X. laevis* (or *X. tropicalis*) and human NPCs.

Data acquisition								
Microscope		Titan k	Titan Krios G2					
Voltage (kV)		300	300					
Detector		Gatan	K2					
Energy filter		Gatan	GIF Quantum, 20 eV					
Mode		Super	Super resolution					
Pixel size (Å)		2.24						
Stage tilting angle		30°/4	5°/ 60°/ 0°(side-view)					
Exposure per tilt (e/Å	\ ²)	60 / 80	0/ 100/ 100 (or 120)					
Number of images		8745						
Defocus range (µm)		-1 ~ -4	ŀ					
Software		Serial	EM					
Reconstruction in C	CR							
Software		RELIC	RELION-3.0/CryoSPARC					
Data set	CR core regi	on	CR subunit region	CR Nup358 region				
Final number of	354460		354460	678866				
particles	001100		001100					
Symmetry	C1		C1	C1				
Final resolution (Å)	8.0		8.7	8.9				
Map pixel size (Å)	2.24		2.24	2.24				
Map sharpening	-591		-763	-850				
B-factor (Ų)	001		100	-000				
Reconstruction in N	NR							
Software		F	RELION-3.0/CryoSPAF	RC				
Data set	NR core regi	on	NR subunit region	NR Nup133 region				
Final number of	417490		417490	298318				
particles				200010				
Symmetry	C1		C1	C1				
Final resolution (Å)	7.8		8.1	8.6				
Map pixel size (Å)	2.24		2.24	2.24				
Map sharpening B-factor (Ų)	-433		-541	-612				

 Table S1 Statistics of cryo-SPA data collection and image processing.

Supplementary Movies.

Movie S1. Overall structure of outer rings from the X. laevis NPC.

Movie S2. Model-map fitting quality of CR Nups from the *X. laevis* NPC.

Movie S4. Model-map fitting quality of NR Nups from the X. laevis NPC.

Movie S4. Structural comparison of Nup93 between the refined model and the model predicted by AlphaFold2.

Supplementary Scripts.

Script S1. The modified block-based reconstruction script for symmetry expanding of CR and NR asymmetric units.