

Genome Editing Publications Using Nucleofector® Technology

Authors	Citation	Nucleofector® Platform	Cell Types	Substrates
CRISPR				
Afolabi LO et al.	Immunology 158(2):63-69 (2019)	4D-Nucleofector® System	Human NK cells	protein (Cas9 RNP)
Agudelo D et al.	Nat Methods 14(6):615-620 (2017)	4D-Nucleofector® System	K562, U2OS, HEK293, human CD34	plasmid, protein (Cas9 RNP)
Akidil E et al.	Plos Path 17(4): e1009117 (2021)	4D-Nucleofector® System	Human B cells	protein (Cas9 RNP)
Albanese M et al.	Nat Methods 19(1):81-89 (2021)	4D-Nucleofector® System	Human T cells	protein (Cas9 RNP)
Bak RO et al.	Nat Prot 13(2):358-376 (2018)	4D-Nucleofector® System	Human T cells, human CD34	protein (Cas9 RNP)
Basar R et al.	Blood Adv 4(14):3357-3367 (2020)	4D-Nucleofector® System; 96-well and LV-Unit	Human T cells, HEK293	protein (Cas9 RNP)
Blaeschke F et al.	Cell Res 186(19):4216-4234.e33 (2023)	4D-Nucleofector® System; 96-well Unit	Human T cells	protein (Cas9 RNP), HDR
Bexte T et al.	Oncoimmunology 11(1):2081415 (2022)	4D-Nucleofector® System	NK, T cells, MM1S	n.d.
Borot F et al.	PNAS 116(24):11978-11987 (2019)	4D-Nucleofector® System	Human CD34	protein (Cas9 RNP)
Bothmer A et al.	CRISPR J 3(3):177-187 (2020)	4D-Nucleofector® System	Human T cells	protein (Cas9 RNP)
Bothmer A et al.	Nat Commun 8:13905 (2017)	4D-Nucleofector® System	U2OS	plasmid
Brownigg LM et al.	Cytotherapy 22: S382 (2020)	4D-Nucleofector® System; LV-Unit	CAR T cells	plasmid
Bressan R et al.	Development 144(4):635-648 (2017)	4D-Nucleofector® System	Human neural stem cell line	plasmid, protein (Cas9 RNP)
Byrne SM et al.	Curr Prot Stem Cell Biol 35:5A.8: -1-5A.8.22 (2015)	4D-Nucleofector® System	Human iPSC	plasmid
Byrne SM et al.	Nucleic Acids Res 43(3): e21 (2015)	4D-Nucleofector® System	Human iPSC	plasmid
Carusillo A et al.	Nucleic Acids Res 51(9): 4660-4673 (2023)	4D-Nucleofector® System	Jurkat, K562, human CD34 and T cells	mRNA, RNP, ssODN
Chan KF et al.	Biotechnol J 11(3):399-414 (2016)	4D-Nucleofector® System	CHO suspension	plasmid
Chavez A et al.	Nat Meth 12(4): 326-328 (2015)	4D-Nucleofector® System	Human iPSC	plasmid
Dalvai M et al.	Cell Rep 13(3):621-633 (2015)	4D-Nucleofector® System	K562	plasmid
Damhofer H et al.	STAR Protoc 2(2): 100575 (2021)	4D-Nucleofector® System	THP-1, mES, OCI-AML3, mouse CD34	protein (Cas9 RNP), HDR
Dever DP et al.	Nature 539(7629):384-389 (2016)	4D-Nucleofector® System; LV-Unit	Human CD34	protein (Cas9 RNP)
Dever DP et al.	iScience 15:524-535 (2019)	4D-Nucleofector® System	Human NSCs	plasmid (Cas9, TALEN), mRNA (Cas9)
Dewari PS et al.	Elife 7:e35069 (2018)	4D-Nucleofector® System; 96-well Unit	Human/mouse ESC, mouse NSC line, human glioblastoma	protein (Cas9 RNP), HDR
DeWitt MA et al.	Sci Transl Med 8(360):360ra134 (2016)	4D-Nucleofector® System	CD34, K562	protein (Cas9 RNP), HDR
Dickson A et al.	SLAS Discov 2:29-35 (2023)	384-well HT Nucleofector® System	SAEC	protein (Cas9 RNP)
Doudna JA, Charpentier E	Science 346(6213):1258096 (2014) - Review	n.d.	n.d.	n.d.
Evgin L et al.	Nat Commun 11(1):3187 (2020)	4D-Nucleofector® System	CAR T cells	protein (Cas9 RNP)
Freund EC et al.	J Exp Med 217(7):e20191692 (2020)	4D-Nucleofector® System	Human/mouse Monocytes, Macrophages or DCs	protein (Cas9 RNP)
Fu Y et al.	Nat Biotech 32(3):279-284 (2014)	4D-Nucleofector® System	U2OS	plasmid
Fu Y et al.	Nat Biotech 31(9):822-826 (2013)	4D-Nucleofector® System	U2OS, K562	plasmid
Gaj T et al.	Nucleic Acids Res 45(11):e98 (2017)	4D-Nucleofector® System	HEK293T, U2OS-GFP, C6, human fibroblasts	protein (Cas9 RNP)
George AF et al.	Hum Reprod 35(3):617-640 (2020)	4D-Nucleofector® System; 96-well Unit	Endometrial stromal fibroblasts	protein (Cas9 RNP)
Ghorbal M et al.	Nat Biotechnol 32:819-821 (2014)	4D-Nucleofector® System	Plasmodium falciparum	plasmid (linearized)
Gianni D et al.	Exp Opin Drug Discov 9: 127-136 (2022)	384-well HT Nucleofector® System	n.d.	n.d.
Giuffrida L et al.	Nat Commun 12(1):3236 (2021)	4D-Nucleofector® System	Human CAR T cells	protein (Cas9 RNP)
Goodwin M et al.	Sci Adv. 6(19):eaaz0571 (2020)	4D-Nucleofector® System	K562, Human CD34	protein (Cas9 RNP)
Gordon DE et al.	Science (2020)	384-well HT Nucleofector® System	Caco2	protein (Cas9 RNP)
Grobarczyk B et al.	Stem Cell Rev and Rep 11:774-787 (2015)	4D-Nucleofector® System	Human iPSC	plasmid
Han T et al.	Science 356(6336):eaal3755 (2017)	4D-Nucleofector® System	HCT116	plasmid
Han T et al.	Nat Chem Biol 12(7):511-515 (2016)	4D-Nucleofector® System	HCT116, HeLa	plasmid
Hartweg H et al.	J Exp Med 216(6):1301-1310 (2019)	4D-Nucleofector® System	Human/mouse B cells	protein (Cas9 RNP)
Hiatt J et al.	Cell Rep 35(6):109105 (2021)	4D-Nucleofector® System; 96-well Unit	Human CD14	protein (Cas9 RNP)
Hill RJ et al.	J Biol Chem 291(46):24280-24292 (2016)	4D-Nucleofector® System	Plasmodium falciparum	plasmid
Hong SG et al.	Mol Ther 25(1):44-53 (2017)	4D-Nucleofector® System	Rhesus iPSC	plasmid
Hultquist JF et al.	Cell Reports 17:1438-1452 (2016)	4D-Nucleofector® System; 96-well Unit	Human T cells	protein (Cas9 RNP)
Hultquist JF et al.	Nat Prot 14(1):1-27 (2019)	4D-Nucleofector® System; 96-well Unit	Human T cells	protein (Cas9 RNP)
Jacobs EZ et al.	Sci Rep 7(1):16650 (2017)	4D-Nucleofector® System	Human ES, HEK293T	plasmid
Jedrzeczyk DJ et al.	Biosci Rep 12(1): 12193 (2022)	4D-Nucleofector® System; 96-well Unit	Jurkat	protein (Cas12a RNP), HDR
Jiang S et al.	Curr Protoc Mol Biol 121:31.12.1-31.12.23 (2018)	4D-Nucleofector® System	LCL	protein (Cas9 RNP)
Jian-Fei H et al.	Front Immunol 13:958960 (2022)	4D-Nucleofector® System	CAR T cells	protein (Cas9 RNP)
Jost M et al.	Elife 10:e65856 (2021)	4D-Nucleofector® System; 96-well Unit	Human DC	protein (Cas9 RNP)
Juchem KW et al.	Front Immunol 12:773445 (2022)	4D-Nucleofector® System	Jurkat, mouse and human monocytes	protein (Cas9 RNP)
Kararoudi N et al.	Cell Rep Methods 2(6):100236 (2022)	4D-Nucleofector® System	Human NK cells	protein (Cas9 RNP)

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Kath J et al.	Mol Ther Methods Clin Dev 25:311-330 (2022)	4D-Nucleofector® System; 96-well Unit	Jurkat, human T cells	protein (Cas9 RNP)
Kim S et al.	Genome Res 24:1012-1019 (2014)	4D-Nucleofector® System	K562, H9, BJ fibroblasts	RNP
Kararoudi N et al.	J Vis Exp (136):58237 (2018)	4D-Nucleofector® System	Human NK cells	protein (Cas9 RNP)
Kaufuss M et al.	Sci Rep 13(1):10555 (2023)	4D-Nucleofector® System	Human NK cells	protein (Cas9 RNP)
Kleistiver BP et al.	Nature 529(7587):490-495 (2016)	4D-Nucleofector® System	U2OS	plasmid
Kleistiver BP et al.	Nat Biotechnol 34(8):869-874 (2016)	4D-Nucleofector® System	U2OS	plasmid
Koehler KR et al.	Nat Biotechnol 35(6):583-589 (2017)	4D-Nucleofector® System	Human ESC	plasmid
Kouranova E et al.	Hum Gene Ther 27(6):464-475 (2016)	4D-Nucleofector® System; 96-well Unit	C6, Neuro2A	plasmid, mRNA
Kuppers DA et al.	PLoS ONE 18(6):1-15 (2023)	4D-Nucleofector® System	Human CD34	protein (Cas9 RNP)
Kurppa KJ et al.	Cancer Cell 37(1):104-122.e12 (2020)	4D-Nucleofector® System	H3122 and EBC-1	protein (Cas9 RNP)
Lambert M et al.	Meth Mol Biol 2121:213-239 (2020)	4D-Nucleofector® System	Human NK cells	protein (Cas9 RNP)
Lattanzi A et al.	Sci Transl Med 13(598):eabf2444 (2021)	4D-Nucleofector® System; LV-Unit	Human CD34	protein (Cas9 RNP)
Lee J et al.	Sci Rep 10(1):17753 (2020)	4D-Nucleofector® System	Raji, human T cells	protein (Cas9 RNP)
Li CZ et al.	JHEP Rep 4(4):100446 (2022)	4D-Nucleofector® System	Human PBMCs, human iPSCs	ssODN, plasmid
Lin S et al.	eLife 3:e04766 (2014)	4D-Nucleofector® System; 96-well Unit	HEK293T, human fibroblast, H9 human ESC	RNP
Lin-Shiao E et al.	Nucleic Acids Res 50(3):1256-1268 (2022)	4D-Nucleofector® System; 96-well Unit	K562, Tcell, HEK293T	plasmids
Liu X et al.	Cell Res 27(1):154-157 (2017)	4D-Nucleofector® System	CAR T cells	protein (Cas9 RNP)
Liu J et al.	Nat Prot 10(11):1842-1859 (2015)	4D-Nucleofector® System	H9 hESC	protein (Cas9 RNP)
Lynn RC et al.	Nature 576(7786):293-300 (2019)	4D-Nucleofector® System	HA-28z CAR T cells	protein (Cas9 RNP)
Madsen RR et al.	Wellcome Open Res 4:37 (2019)	4D-Nucleofector® System	Human iPSCs	protein (Cas9 RNP)
Maji B et al.	Cell Res 177(4): 1067-1079 (2019)	4D-Nucleofector® System	U2OS	plasmid
Marthaler AG et al.	Stem Cell Res 16(1):162-5 (2016)	4D-Nucleofector® System	Human iPSC	plasmid
Martufi M et al.	CRISPR J 2:31-40 (2019)	4D-Nucleofector® System	Human lung fibroblasts, human T cells	protein (Cas9 RNP)
Mithal A et al.	Nat Commun 11(1):215 (2020)	4D-Nucleofector® System	H9, human iPSCs	plasmid
Modarri SR et al.	Gene Ther 28(1-2):105-113 (2020)	4D-Nucleofector® System	Human CD34	protein (Cas9 RNP)
Mohr M et al.	ACS Nano 12(2): 375-389 (2023)	4D-Nucleofector® System; 96-well Unit	Jurkat, human T cells	protein (Cas12a RNP), HDR
Mueller KP et al.	BioResearch Open Access 1:1 (2021)	4D-Nucleofector® System; LV-Unit	Human T cells	protein (Cas9 RNP)
Nazlamova L et al.	Hum Genet 140(4):593-607 (2020)	4D-Nucleofector® System	hTERT RPE-1	protein (Cas9 RNP)
Ng MSF et al.	Sci Immunol 4(41):eaav5947 (2019)	4D-Nucleofector® System	Naive T cells	protein (Cas9 RNP)
Nguyen DN et al.	Nat Biotechnol 38(1):44-49 (2019)	4D-Nucleofector® System; 96-well Unit	Human CD34, iPS-derived CD34, human T cells	protein (Cas9 RNP)
Ni W et al.	PLoS ONE 9(9): e106718 (2014)	n.d.	Goat fetal fibroblasts	plasmid
Niu X et al.	J Biol Chem 291(32):16576-16585 (2016)	4D-Nucleofector® System	Human iPSC	plasmid, ssODN
Nuessing S et al.	J Immunol 204(8):2308-2315 (2020)	4D-Nucleofector® System	Mouse T cells	protein (Cas9 RNP)
Nuñez JK et al.	Cell 184(9):2503-2519.e17 (2021)	4D-Nucleofector® System; 96-well Unit	HeLa, U2OS	plasmids
Nyberg WA et al.	Cell 186(2):446-460 (2023)	4D-Nucleofector® System; 96-well Unit	Human and mouse T cells	protein (Cas9 RNP)
Ode Z et al.	Cancers (Basel) 12(6):1704 (2020)	4D-Nucleofector® System	Human T cells	protein (Cas9 RNP)
Ottaviano G et al.	Sci Transl Med 14 eabq3010 (2022)	4D-Nucleofector® System; LV-Unit	CAR T cell	mRNA
Pantazis CB et al.	Cell Stem Cell 29(12): 1685-1702.e22 (2022)	4D-Nucleofector® System	Human iPSC	plasmid, RNPs, ssODN
Park RJ et al.	Nat Genet 49(2):193-203 (2017)	4D-Nucleofector® System	Human T cells	protein (Cas9 RNP)
Pavel-Dinu M et al.	Nat Commun 10(1):1634 (2019)	4D-Nucleofector® System	Human CD34, human T cells, U-2OS	plasmid, protein (Cas9 RNP)
Pesch T et al.	Front Immunol 10:2630 (2019)	4D-Nucleofector® System	Mouse B cells, hybridoma cell line	protein (Cas9 RNP)
Pires C et al.	Stem Cell Res 17(2):285-288 (2016)	4D-Nucleofector® System	Human iPSC	plasmid, ssODN
Pogson M et al.	Nat Commun 7:12535 (2016)	4D-Nucleofector® System	Hybridoma cell lines	plasmid
Poon A et al.	Stem Cell Res 17(3):466-469 (2016)	4D-Nucleofector® System	Human iPSC	plasmid
Rathbone T et al.	CRISPR J 5(3):397-409 (2022)	4D-Nucleofector® System	Mouse and human hepatocytes, HEK293H, HEPA 1-6, NIH/3T3	plasmid, mRNA
Ran FA et al.	Cell 154:1380-1389 (2013)	4D-Nucleofector® System	HUES62	plasmid, PCR cassette
Ran FA et al.*	Nat Prot 8(11):2281-2308 (2013)	4D-Nucleofector® System	HUES9, HEK293	plasmid, PCR cassette
Richardson CD et al.	Nat Biotechnol 34(3):339-344 (2016)	4D-Nucleofector® System	HEK293	protein (Cas9 RNP)
Roth TL et al.	Nature 559(7714):405-409 (2018)	4D-Nucleofector® System; 96-well Unit	Human T cells	protein (Cas9 RNP), HDR
Roth TL et al.	Cell 181(3):728-744.e21 (2020)	4D-Nucleofector® System; 96-well Unit	Human T cells	protein (Cas9 RNP), HDR
Ruan GX et al.	Mol Ther 25(2): 331-341 (2017)	4D-Nucleofector® System	293FT	plasmid
Rupp LJ et al.	Sci Reports 7(1):737 (2017)	4D-Nucleofector® System	Human T cells	protein (Cas9 RNP)
Sauter EJ et al.	Meth Mol Biol 1942:101-121 (2019)	4D-Nucleofector® System	iPSC lines or patient-derived iPSCs	plasmid (PB or Cas9)
Schimmel J et al.	Cell Rep 42(2): 112019 (2023)	4D-Nucleofector® System	Human iPSC	protein (Cas9 RNP), ssODN
Schiroli G et al.	Sci Transl Med. 9(411):eaan0820 (2017)	4D-Nucleofector® System; LV-Unit	Human CD34	protein (Cas9 RNP)
Schober K et al.	Nat Biomed Eng 3(12):974-984 (2019)	4D-Nucleofector® System; 96-well Unit	Human T cells	protein (Cas9 RNP)

Authors	Citation	Nucleofector [®] Platform	Cell Types	Substrates
Schubert MS et al.	Sci Rep 11(1): 19482 (2021)	4D-Nucleofector [®] System; 96-well Unit	HEK293, HeLa, Jurkat, HAP-1, K562	protein (Cas9 RNP), HDR
Schumann K et al.	Nat Immunol 21(11):1456-1466 (2020)	4D-Nucleofector [®] System; 96-well Unit	Human Treg	protein (Cas9 RNP)
Shan Y et al.	ACS Chem Biol 17(4):918-929 (2022)	384-well HT Nucleofector [®] System	Human hepatic stellate cells	protein (Cas9 RNP)
Seki A and Rutz S	J Exp Med 215(3):985-997 (2018)	4D-Nucleofector [®] System; 96-well Unit	Mouse T cells, human T cells	protein (Cas9 RNP)
Smith BW et al.	Stem Cells Int 2016:2574152 (Epub 2016 Apr 11)	4D-Nucleofector [®] System	Human iPSC	plasmid
Srikanth P et al.	Cell Reports 12(9):1414-29 (2015)	4D-Nucleofector [®] System	Human iPSC	plasmid
Strecker J et al.	Nat Commun 10(1):212 (2019)	4D-Nucleofector [®] System	Human T cells	protein (Cas12b RNP)
Sun D et al.	Elife 10:e67886 (2021)	4D-Nucleofector [®] System	Human foetal lung and intestinal organoids	protein (Cas9 RNP)
Tang N et al.	JCI Insight 5(4):e133977 (2020)	4D-Nucleofector [®] System	HepG2, CAR T cells	protein (Cas9 RNP)
Tanudjojo B et al.	Nat Commun 12(1):3817 (2021)	4D-Nucleofector [®] System	Human iPSC	protein (Cas9 RNP)
Ting PY et al.	Nat Methods 15(11):941-946 (2018)	4D-Nucleofector [®] System	Human T cells, human CD34, CT-26	protein (Cas9 RNP)
Tsuchida CA et al.	Cell Press 03.22: 533709 (2023)	4D-Nucleofector [®] System; 96-well Unit	Human T cells	protein (Cas9 RNP)
Valleya HC et al.	J Cyst Fibros 18(4):476-483, (2018)	4D-Nucleofector [®] System	6HBE14o-cells	RNP, ssODN
Vakuskas CA et al.	Nat Med 24(8):1216-1224 (2018)	4D-Nucleofector [®] System	Human T cells, human CD34	protein (Cas9 RNP)
Van Agtmaal EL et al.	Mol Ther 25(1): 24-43 (2017)	4D-Nucleofector [®] System	Human immortalized myoblasts	plasmid
Van Overbeck M et al.	Mol Cell 63:633-646 (2016)	4D-Nucleofector [®] System	HEK293, HCT116, K562	protein (Cas9 RNP)
Van Zeebroeck L et al.	Front Immunol 12:655122 (2021)	4D-Nucleofector [®] System	Human Tregs	protein (Cas9 RNP)
Vazquez-Lombardi R et al.	Immunity 55: 1953-1966 (2022)	4D-Nucleofector [®] System; LV-Unit	Jurkat (modified)	RNP, HDR
Vavassori V et al.	EMBO Mol Med 13(3):e13545 (2021)	4D-Nucleofector [®] System	Human CD34	protein (Cas9 RNP)
Walter M et al.	eLife 5: e11418 (2016)	4D-Nucleofector [®] System	J1 ES cells	plasmid
Wang C et al.	Nat Cell Biol 24(2):268-278 (2022)	4D-Nucleofector [®] System	H9	plasmid
Witkowski MT et al.	Nat Commun 10: 1424-1432 (2022)	4D-Nucleofector [®] System; 96-well Unit	HUVEC, Human T cells	protein (Cas9 RNP)
Xu L et al.	Mol Ther Methods Clin Dev 30: P317-331 (2023)	4D-Nucleofector [®] System	Human CD34	protein (Cas9 RNP)
Wang R et al.	Cell 184(1):106-119 e14 (2021)	4D-Nucleofector [®] System; 96-well Unit	A549-ACE2 and Huh7.5.1-ACE2/	protein (Cas9 RNP)
Wang Y et al.	Sci Rep 11(1):1399 (2021)	4D-Nucleofector [®] System	4T1	protein (Cas9 RNP)
Wiebking Y et al.	Haematologica 106(3):847-858 (2021)	4D-Nucleofector [®] System	Human T cells	protein (Cas9 RNP)
Wienert B et al.	Nat Commun 11(1):2109 (2020)	4D-Nucleofector [®] System	K562-BFP, CD3+ T cell, mouse glial cells, HEK293, HDLECs, HeLa, iPSC, HSF; HSPCs	protein (Cas9 RNP)
Wienert B et al.	Nat Protoc 15(5):1775-1799 (2020)	4D-Nucleofector [®] System	K562, B16-F10	protein (Cas9 RNP)
Wohlfahrt T et al.	Nature 566(7744):344-349 (2019)	4D-Nucleofector [®] System	Human fibroblasts	plasmid
Xiang X et al.	EMBO Mol Med 8(9):992-1004 (2016)	4D-Nucleofector [®] System	Murine microglia cell line N9	plasmid
Yang L et al.	Nat Commun 5:5507 (2014)	4D-Nucleofector [®] System	Human iPSC	plasmid
Yang L et al.	Nucleic Acids Res 41:9049-9061 (2013)	4D-Nucleofector [®] System	Human iPSC	plasmid
Young CS et al.	Cell Stem Cell 18(4): 533-40 (2016)	4D-Nucleofector [®] System	Human iPSC	plasmid
Zhang Y et al.	Stem Cell Research 17(1):151-153 (2016)	4D-Nucleofector [®] System	Human iPSC	plasmid
Zhang Y et al.	Sci Adv 12;3(4): e1602814 (2017)	4D-Nucleofector [®] System	Human iPSC	plasmid
Zhang Y et al.	Front Med 11(4):554-562. (2017)	4D-Nucleofector [®] System	Human T cells	protein (Cas9 RNP)
Prime or base editing				
Anzalone AV et al.	Nature 576(7785):149-157 (2019)	4D-Nucleofector [®] System	K562, HeLa, U2OS	plasmid
Chen L et al.	Nat Commun 12(1): 1384 (2021)	4D-Nucleofector [®] System	H9, eHAP cells	plasmid
Chiesa R et al.	N Engl J Med 389(10):899-910 (2023)	4D-Nucleofector [™] System; LV-Unit	Human T cells	mRNA, RNP
Choi J et al.	Nature 608(7921):98-107 (2022)	4D-Nucleofector [®] System	MEF, MES	plasmid
Cromer MK et al.	Nat Commun 13(1): 4724 (2022)	4D-Nucleofector [®] System	Human CD34	RNP
Georgiadis C et al.	Leukemia 35(12):3466-3481 (2021)	4D-Nucleofector [®] System; LV-Unit	Human T cells	mRNA
Glaser V et al.	Genome Biol 24(1):89 (2023)	4D-Nucleofector [®] System	Human T cells	mRNA, RNP, HDR
Kluesner MG et al.	Nat Commun 12(1):2437 (2021)	4D-Nucleofector [®] System	Human T cells, K562	plasmid, mRNA
Koblan LW et al.	Nat Biotechnol 39(11):1414-1425 (2021)	4D-Nucleofector [®] System	HAP1, U2OS, K562, HeLa	plasmid
Kurt IC et al.	Nat Biotechnol 39(1):41-46 (2021)	4D-Nucleofector [®] System	K562, HeLa, U2OS	plasmid
Lam DK et al.	Nat Biotechnol 41(5):686-697 (2023)	4D-Nucleofector [®] System; 96-well Unit	Human T cells	mRNA, RNP
Liao J et al.	Nat Commun 14(1): 207 (2023)	4D-Nucleofector [®] System	Human CD34	mRNA, RNP
Mok BY et al.	Nature 583(7817):631-637 (2020)	4D-Nucleofector [®] System	U2OS, human primary fibroblast	plasmid, mRNA
Nelson JW et al.	Nat Biotechnol 40(3):402-410 (2022)	4D-Nucleofector [®] System	HEK293T, HeLa, U2OS, K562	mRNA, plasmid
Petri K et al.	Nat Biotechnol 40(2):189-193 (2022)	4D-Nucleofector [®] System	HEK293T, human T cells	protein (Cas9 RNP)
Siegner SM et al.	Nat Commun 13(1):6900 (2022)	4D-Nucleofector [®] System	LCL, human CD34	mRNA, RNP
Stadelmann C et al.	Mol Ther Nucleic Acids 28:47-57 (2022)	4D-Nucleofector [®] System	Mucle stem cells	plasmid and mRNA
Tong Y et al.	Nat Commun 12(1): 5206 (2021)	4D-Nucleofector [®] System; 96-well Unit	Bacteria	plasmid
Wellhausen N et al.	Sci Transl Med 15(714):ead11145 (2023)	4D-Nucleofector [®] System	Human CD34, monocytes and T cells	mRNA, RNP

Authors	Citation	Nucleofector® Platform	Cell Types	Substrates
Woodruff R et al.	Mol Ther Methods Clin Dev 31:10123 (2023)	4D-Nucleofector® System; LV-Unit	Human T cells	circRNA
Wu Y et al.	STAR Protoc 4(4):102583 (2023)	4D-Nucleofector® System	Human iPSC	plasmid
TALEN®				
Byrne SM et al.	Nucleic Acids Res 43(3):e21 (2015)	4D-Nucleofector® System	Human iPSC	plasmid
Cerbini T et al.	PLoS ONE 10(1): e0116032 (2015)	4D-Nucleofector® System	Human iPSC, human NSC	plasmid
Chan KF et al.	Biotechnol J 11(3):399-414 (2016)	4D-Nucleofector® System	CHO suspension	plasmid
Dalvai M et al.	Cell Rep 13(3):621-633 (2015)	4D-Nucleofector® System	K562	plasmid
Dever DP et al.	iScience 15:524-535 (2019)	4D-Nucleofector® System	Human NSCs	plasmid (Cas9, TALEN), mRNA (Cas9)
Gogolok S et al.	Sci Reports 6:33209 (2016)	4D-Nucleofector® System	Mouse NSC	plasmid
Luo Y et al.	Stem Cells Transl Med 3(7):821-35 (2014)	4D-Nucleofector® System	Human iPSC	plasmid
Reyon D et al.	Nat Biotech 30:460-465 (2012)	4D-Nucleofector® System	U2OS, K562	plasmid
Spisak S et al.	Nat Med 21(11):1357-1363 (2015)	4D-Nucleofector® System	22Rv1, LNCaP	plasmid
Srikanth P et al.	Cell Reports 12(9):1414-29 (2015)	4D-Nucleofector® System	Human iPSC	plasmid
Yang L et al.	Nucleic Acids Res 41:9049-9061 (2013)	4D-Nucleofector® System	Human iPSC	plasmid
Zhu F et al.	Nucleic Acids Res 42(5):e34 (2014)	4D-Nucleofector® System	Human iPSC, H9 human ESC	plasmid
ZFN				
Genovese P et al.	Nature 510:235ff (2014)	4D-Nucleofector® System	Human CD34	RNA
Kouranova E et al.	Hum Gene Ther 27(6):464-475 (2016)	4D-Nucleofector® System; 96-well Unit	C6, Neuro2A	plasmid, mRNA
Sivalingam J et al.	Mol Ther 24(3):607-619 (2016)	4D-Nucleofector® System	K562, fibroblasts, stromal cells, CLECs	plasmid, mRNA
Wang J et al.	Genome Res 22:1316-1326 (2012)	4D-Nucleofector® System; 96-well Unit	K562	plasmid
Transposon/Transposase - Sleeping Beauty® (SB) or PiggyBac® (PB), e.g. for CAR-T				
Caruso HG et al.	J Immunother 39(5):205-217 (2016)	4D-Nucleofector® System	Human T cells	plasmid (SB), mRNA
Chavez A et al.	Nat Methods 12(4): 326-328 (2015)	4D-Nucleofector® System	Human iPSCs	plasmid (PB)
Cheng C et al.	J Med Genet Vol 56(1), 10-17 (2019)	4D-Nucleofector® System	Human T cells	plasmid (SB minicircle)
Doherty JE et al.	Hum Gene Ther 23(3):311-320 (2012)	4D-Nucleofector® System	Human T cells	plasmid (PB, SB)
Guo Y et al.	Cancer Res 76(4):773-786 (2016)	4D-Nucleofector® System	Ba/F3	plasmid (SB)
Hamada M et al.	EBioMedicine 34:18-26 (2018)	4D-Nucleofector® System	Human T cells	plasmid (PB)
Holstein M et al.	Mol Ther 26(4):1137-1153 (2018)	4D-Nucleofector® System	Human CD34	plasmid (SB minicircle) or mRNA (SB)
Magnani CF et al.	Oncotarget 7(32):51581-51597 (2016)	4D-Nucleofector® System	Human T cells, unstim (PBMCs)	plasmid (SB)
Mezzadra R et al.	Mol Ther Nucleic Acids 5:e298 (2016)	4D-Nucleofector® System	Jurkat, human T cells, unstim (PBMCs)	plasmid (SB, CRISPR)
Miskey C et al.	Nat Biotechnol 37(12):1502-1512 (2019)	4D-Nucleofector® System	Human T cells	plasmid (SB minicircle)
Monjezi R et al.	Leukemia 31(1):186-194 (2017)	4D-Nucleofector® System	Human T cells	plasmid/mRNA/minicircle (SB)
Prommersberger S et al.	Gene Ther 28(9):560-571 (2021)	4D-Nucleofector® System	Human T cells	plasmid
Querques I et al.	Nat Biotechnol 37(12):1502-1512 (2019)	4D-Nucleofector® System	Human CD34	protein (SB)
Sauter EJ et al.	Meth Mol Biol 1942:101-121 (2019)	4D-Nucleofector® System	iPSC lines or patient-derived iPSCs	plasmid (PB or Cas9)
Sjeklocha LM et al.	PLoS ONE 8(11):e80403 (2013)	4D-Nucleofector® System	Human CD34	plasmid (SB)
Wong DP et al.	Nat Commun 13(1):217 (2022)	4D-Nucleofector® System	DRG, human T cells, HEK293T, Jeko-1	mRNA, plasmid

*Provides a comprehensive protocol for use of the 4D-Nucleofector® System with CRISPR/Cas9

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