updated 2022.05.20 *send updates to: klopf@hzdr.de*	Wavelength (um)		Frequency (THz)		Avg. Power (W)		Peak Power max (kW)	Micpulse Energy (µJ)		Pulsewidth min (ps)	Bandwidth ΔλΔ (%)	Peak Field (MV/cm)	Optimal Lasing Wavelength (um)	Repetition Rate		User Operations/Facilities			undulator and optical cavity				e- Beam emittance		l average (mA)	l macropulse (mA)	Types of Measurement Capabilities	Other Notes of Interest	First Lasing	Location	website / source	updated 2022.05.20 *send updates to: klopf@hzdr.de*
	min	max	min	max	typical	max		typical	max					Micropulse	Macropulse	User Ops	Operational	High Field Magnets	Period (mm)	# of periods	K (range)	cavity type	Energy (MeV)	bunch charge (pC)							
FELIX-1	25	140	2	12	0.4	0.8	10^4	5	25	1 - 20	0.3 - 2 (rms)	close to diffraction limited		25 MHz / 1 GHz	10 Hz	16/5	YES	≤ 35 T (static)	65		0.4 - 2.0	free space	15 - 25				200 @ 1GHz	(i) gas-phase (bio-) molecular, cluster and ion (action) spectroscopy (ii) nonlinear, time resolved spectroscopy in the condensed phase at low temperature and /or high magnetic field	three beamlines can be operated simultaneously (FELIX-1 or FELIX-2 and FLARE and FELICE)	1991	Nijmegen, The Netherlands	http://www.ru.nl/felix/	**FELIX-1**
FELIX-2	3	45	6.7	100	0.7	1.5	10^5	10	50	0.25 - 10	0.2 - 3 (rms)	close to diffraction limited		25 MHz / 1 GHz	10 Hz	16/5	YES	≤ 35 T (static)	65		0.4 - 1.9	free space	25 - 45				200 @ 1GHz	(i) gas-phase (bio-) molecular, cluster and ion (action) spectroscopy (ii) nonlinear, time resolved spectroscopy in the condensed phase at low temperature and /or high magnetic field	three beamlines can be operated simultaneously (FELIX-1 or FELIX-2 and FLARE and FELICE)	1992	Nijmegen, The Netherlands	http://www.ru.nl/felix/	**FELIX-2**
FLARE	100	1700	0.2	3	0.2	2	100	1	5	20 - 300	0.3 - 1 (rms)	close to diffraction limited		60 MHz / 3 GHz	10 Hz	16/5	YES	≤ 35 T (static)	110		0.5 - 3.4	waveguide	11 - 17				600 @ 3GHz	nonlinear, time resolved spectroscopy in the condensed phase at low temperature and /or high magnetic field	three beamlines can be operated simultaneously (FELIX-1 or FELIX-2 and FLARE and FELICE)	2011	Nijmegen, The Netherlands	http://www.ru.nl/felix/	**FLARE**
FELICE	5	100	3	60	intra-	cavity	2 x 10^6	200	1000	0.3 - 15	0.3 - 3 (rms)	close to diffraction limited		16 MHz / 1 GHz	10 Hz	16/5	YES		60		0.4 - 1.7	free space	18 - 45				200 @ 1GHz	gas-phase (bio-) molecular, cluster and ion (action) spectroscopy	three beamlines can be operated simultaneously (FELIX-1 or FELIX-2 and FLARE and FELICE)	2007	Nijmegen, The Netherlands	http://www.ru.nl/felix/	**FELICE**
ENEA Frascati (mmW FEL)	2000	3500	0.086	0.15	0.01	0.05	5	0.15		60	0.6 - 8	0.01	2600	3 GHz	4 µs macropulse 10 Hz		YES		25	8	1	waveguide	2.3	90	60 mm mrad		300	studies of biological effects on cells and model membranes, reflective near-field imaging/microscopy	Electron-transparent mirrors (gold coated tungsten wire grids) allow for a compact optical resonator	1991	Frascati, Italy	http://www.frascati.enea.it/fis/lac/fel/fel2.htm	**ENEA Frascati (mmW FEL)**
ENEA Frascati (FEL-CATS)	400	800	0.4	0.7	0.02	0.04	20	0.3		15	10	close to diffraction limited	780	3 GHz	5 µs macropulse 1 Hz		NO		25	16	0,5 - 1,4	N/A	2.5	75			250		single-pass super-radiant FEL allows for a very compact source (2m overall length)	2003	Frascati, Italy	http://www.frascati.enea.it/fis/lac/fel/fel2.htm	**ENEA Frascati (FEL-CATS)**
CLIO	5	150	2	60			100000		100	1 - 10	0.2 - 1			62.5 MHz	10 µs macropulse 25 Hz		YES		50				10 - 41				80		two-color lasing possible 5 - 40 µm	1992	Orsay, France	http://clio.lcp.u-psud.fr/spip.php?rubrique2	**CLIO**
NovoFEL-1	90	240	1.25	3.3	80	500	500	15	50	100	0.3-1		130	5.64/22.56 MHz	CW	12/4	YES	≤ 5 T (static)	120		0 - 1.1	free space	10.8-13.2			8/30		imaging, spectroscopy, one-pulse high-resolution spectroscopy, ellopsometry, pump-probe, low-temperature, holography, NMR, plasmonics, transformation of wave-beam front, biology study, nano- and microparticle study, continuous optical discharge, combustion and detonation, mass-spectroscopy, atmosphere study, material study	FEL driven by Energy Recovery Linac (ERL)	2003	Novosibirsk, Russia	http://ssrc.inp.nsk.su/CKP/NovoFEL3/	**NovoFEL-1**
NovoFEL-2	35	80	3.75	8.6	80	500	2000	10	60	50	1 - 2		50	7.52 MHz	CW	12/4	YES	≤ 5 T (static)	120		0 - 1.4	free space	20 - 24			8			FEL driven by two-turn ERL	2009	Novosibirsk, Russia	http://ssrc.inp.nsk.su/CKP/NovoFEL3/	**NovoFEL-2**
NovoFEL-3	5	15	20	60	10	100		3	30	10	1 - 2		8	3.76 MHz	CW	12/4	YES	≤ 5 T (static)	60		0.3 - 2.5	free space	40-44			4			FEL driven by four-turn ERL	2015	Novosibirsk, Russia	http://ssrc.inp.nsk.su/CKP/NovoFEL3/	**NovoFEL-3**
FELBE (U27)	4	21	14.2	75	5	20	1900	0.4	1.5	0.8	0.5 - 5	5	10	13 MHz	CW 1 - 25 Hz single-shot	24/7	replaced by U37	≤ 70 T (pulsed) ≤ 8 T (static)	27		0.3 - 0.7	free space	15 - 35	77		1.6	1.6	pump-probe, s-SNOM, low-temp, high field, low temperature, time-resolved spectroscopy, primarily solid-state material physics, low-dimensional materials and structures, correlated systems, plasmonics	2 undulator sections separated by a variable drift distance	2004	Dresden, Germany	https://www.hzdr.de/FELBE	**FELBE (U27)**
FELBE (U100)	18	250	1.2	16.5	10	65	5000	0.7	5	1	0.5 - 5	0.6	80	13 MHz	CW 1 - 25 Hz single-shot	24/7	YES	≤ 70 T (pulsed) ≤ 8 T (static)	100	38	0.5 - 2.8	partial parallel plate waveguide	15 - 35	77		1.6	1.6	pump-probe, s-SNOM, low-temp, high field, low temperature, time-resolved spectroscopy, primarily solid-state material physics, low-dimensional materials and structures, correlated systems, plasmonics		2006	Dresden, Germany	https://www.hzdr.de/FELBE	**FELBE (U100)**
FELBE (U37)	5	40	7.5	60	7	45	3750	0.5	3	0.8	0.5 - 5	10 (TBD)	10	13 MHz	CW 1 - 25 Hz single-shot	24/7	YES	≤ 70 T (pulsed) ≤ 8 T (static)	37	54	0.4 - 1.35	free space	15 - 35	77		1.6	1.6	pump-probe, s-SNOM, low-temp, high field, low temperature, time-resolved spectroscopy, primarily solid-state material physics, low-dimensional materials and structures, correlated systems, plasmonics		2017	Dresden, Germany	https://www.hzdr.de/FELBE	**FELBE (U37)**
ALICE	5	9	33.3	60			600		0.6	1	0.9 - 1.8			16.25 MHz	85 µs macropulse 10 Hz		YES						27.5					Dedicated for medical/biological studies	FEL driven by Energy Recovery Linac	2010	Daresbury, Great Britain	https://www.astec.stfc.ac.uk/Pages/ALICE-free-electron-laser.aspx	**ALICE**
TARLA-1														13 MHz		planned/under construction			25				10 - 40 (target)					commissioning planned for 20##		Ankara, Turkey	https://tarla.org.tr/	**TARLA-1**
TARLA-2														13 MHz		planned/under construction			90				10 - 40 (target)					commissioning planned for 20##		Ankara, Turkey	https://tarla.org.tr/	**TARLA-2**
FHI	2.9	50	6	103							≤ 1			1 GHz	1 - 15 µs macropulse 20 Hz		YES		40		0.5 - 1.6		18.5 - 43.5							2012	Berlin, Germany	http://fel.fhi-berlin.mpg.de/Main/HomePage	**FHI**
s-DALINAC	no up to date information available about current status																???													Darmstadt, Germany	http://www.ikp.tu-darmstadt.de/sdalinac_ikp/index_en.jsp	**s-DALINAC**
Israeli FEL (FIR/THz)	100	300	1	3											5 Hz		under construction						6					Super-raidiant THz FEL driven by an RF photoinjector	2018 (planned)	Ariel, Israel	http://www.ariel.ac.il/research/fel	**Israeli FEL (FIR/THz)**
Israeli FEL (mmW)	2725	3156	0.095	0.11						1-50E+06	1.30E-04			N/A	1 - 50 µs ??? Hz		???		44.4				1.35 - 1.45				700 - 3000			Ariel, Israel	http://www.ariel.ac.il/research/fel	**Israeli FEL (mmW)**
UCSB - FIR FEL	63	338	0.89	4.76			6			1.0E+06	0.007			N/A	1 - 20 µs 0 - 2 Hz single-shot	by request	YES	≤ 8 T (static) ≤ 12. 5T (static)	20		0.132	parallel plate waveguide	2.5 - 6				2000		FEL driven by a recirculating Electrostatic accelerator cavity dumping currently not available	1989	Santa Barbara, CA USA	http://www.mrl.ucsb.edu/terahertz-facility/instruments/ucsb-free-electron-laser-source	**UCSB - FIR FEL**
UCSB - mmW FEL	338	2500	0.12	0.89	0.001	0.003	100	500	3000	4.0E+04	0.025		500	N/A	1 - 6 µs 0 - 2 Hz single-shot	by request	YES	≤ 8 T (static) ≤ 12. 5T (static)	71.4		0.707	parallel plate waveguide	2 - 6				2000	FEL driven EPR (with seeding at 240 GHz)	FEL driven by a recirculating Electrostatic accelerator cavity dumping outcoupling available (30 ns pulsewidth / 9 ns rise time delivering 100 kW peak power)	1991	Santa Barbara, CA USA	http://sbfel3.ucsb.edu/	**UCSB - mmW FEL**
JLab IR FEL	0.9	14	21.4	333	1000	> 10k	250000		120	0.2	0.5 - 1			4.9 - 78 MHz	CW 1 - 50 Hz single-shot	-	NO	-				free space	80 - 150			≤ 10	≤ 10	Two FELs (IR and UV) driven by an Energy Recovery Linac + broadband high power coherent THz source (CSR)		1998	Newport News, VA USA	https://www.jlab.org/FEL/	**JLab IR FEL**
BFEL (MIR)	5	25	12	60										2.86 GHz	4 µs macropulse 3.125 Hz	No (decommissioned)			30				30							circa 1993	Beijing, China	https://doi.org/10.7567/JJAP.S.4151.29	**BFEL (MIR)**
BFEL (FIR)	20	50	6	15										2.86 GHz	4 µs macropulse 3.125 Hz	No (decommissioned)			40				30							circa 2001	Beijing, China	https://doi.org/10.7567/JJAP.S.4151.29	**BFEL (FIR)**
ISIR FEL (Osaka U)	35	150	2	8.5	0.095	0.28	10^4 - 10^5 (tentative)	180	260	~ 2 - 20 (tentative)	8.5% (FWHM) - zero detuning 2.8% - 10um detuing at 70 um		70 - 80	27 MHz 108 MHz	3 - 4 ms macropulse 10 Hz max.	YES	YES	NO	60	32	0.01 - 1.55 (rms)	concentric cavity	12 - 19	(27 MHz)1 nC (108 M	100 - 150 p rad•m (norm.)		110	FEL based on an L-band linac with a thermionic cathode		1994	Osaka, Japan	https://doi.org/10.1016/j.nima.2020.163582	**ISIR FEL (Osaka U)**
KAERI (mmW FEL)	3000	10000	0.03	0.1											30 µs macropulse	No (decommissioned)			33				0.4					FEL driven by an Electrostatic accelerator		1996	Yusong, Taejon, Korea	https://doi.org/10.1016/0168-9002(95)01502-7	**KAERI (mmW FEL)**
KAERI (FIR FEL)	100	200	1.5	3	0.0005	0.002	2	0.01	0.02	1.0E+01	0.3	0.01	110	2.8 GHz	3 µs macropulse 20 Hz	by request	YES		25		1 - 1.6	parallel plate waveguide	5 - 6.5			0.004	40 - 50	FEL driven by a microtron		1999	Yusong, Taejon, Korea	https://doi.org/10.1016/S0168-9002(01)01533-9	**KAERI (FIR FEL)**
KAERI (IR FEL)	300	600	0.5	1	0.1	0.2	5	0.1	0.2	40	1			2.8 GHz	3 µs macropulse 200 Hz	under construction			25		1.8 - 2.7	hybrid waveguide	5			0.05	60	FEL driven by an Energy Recovery Linac			Yusong, Taejon, Korea	https://accelconf.web.cern.ch/accelconf/a01/PDF/TUBM03.pdf	**KAERI (IR FEL)**
FEL-TUS (MIR)	5	14	21.4	60					6	1	~ 1			2.9 GHz	2 µs macropulse 5 Hz		YES		32				≤ 40							2000	Tokyo, Japan	http://www.rs.noda.tus.ac.jp/fel-tus/English/E-Top.html	**FEL-TUS (MIR)**
FEL-TUS (FIR)	25	147	2	12			5000			~ 20				108 MHz	8 µs macropulse 30 Hz	status unknown			60		0.01 - 1.54		12.5 - 20.5					the current status of the FIR FEL is unkown		2010	Tokyo, Japan	http://www.rs.noda.tus.ac.jp/fel-tus/English/E-Top.html	**FEL-TUS (FIR)**
LEBRA NIR FEL	1.16	6.13	49	258						~ 0.2			2		20 µs macropulse 12.5 Hz		YES (2011)		48		≤ 1.35		30 - 125				200			2001	Tokyo, Japan	https://accelconf.web.cern.ch/accelconf/f07/PAPERS/MOPPH046.PDF	**LEBRA NIR FEL**
JAERI-ERL FEL	24 µm demonstrated 1999, spectral range unknown										0.37 (1999)			10.4 MHz	CW ??? pulsed mode	No (decommissioned)			33				17					FEL driven by an Energy Recovery Linac		2002	Tokai, Japan	https://doi.org/10.1016/S0168-9002(01)00849-0	**JAERI-ERL FEL**
KU-FEL	3.6	23	13	83.3				0.5	2 13	0.7	3			2.86 GHz 29.75 MHz	2 µs macropulse 1 - 2 Hz	YES	YES		33		≤ 1.35		19 - 40				100	Two types of e- guns: thermionic (upper value) photocathode (lower value)		2008	Kyoto, Japan	https://doi.org/10.1016/j.phpro.2016.11.009	**KU-FEL**
CTFEL	100	300	1	3										54.17 MHz	CW (planned) 5 Hz		YES		38			full waveguide	6 - 8					SRF linac driven FEL		2017	Chengdu, China	http://dx.doi.org/10.1109/IRMMW-THz.2015.7327884	**CTFEL**
Osaka FEL (NIR)	1	6	50	300		3	15000			~ 5 ps				22.3 MHz	24 µs macropulse 10 Hz		YES		3.8		0.5 - 1.4		≤ 75				27				Osaka, Japan	http://www.fel.eng.osaka-u.ac.jp/	**Osaka FEL (NIR)**
Osaka FEL (MIR)	5	22	13.6	60		1	5000			~ 5 ps				22.3 MHz	24 µs macropulse 10 Hz		YES		3.4		0.5 - 1.5		≤ 30				27				Osaka, Japan	http://www.fel.eng.osaka-u.ac.jp/	**Osaka FEL (MIR)**
Osaka FEL (FIR 1)	20	60	5	15		1	5000			~ 5 ps				22.3 MHz	24 µs macropulse 10 Hz		YES		9		1 - 2.7		≤ 30				27				Osaka, Japan	http://www.fel.eng.osaka-u.ac.jp/	**Osaka FEL (FIR 1)**
Osaka FEL (FIR 2)	50	100	3	6		1	5000			~ 5 ps				89.3 MHz	10 µs macropulse 10 Hz		YES		8		1 - 2.3		≤ 20					RF photo-gun e- source			Osaka, Japan	http://www.fel.eng.osaka-u.ac.jp/	**Osaka FEL (FIR 2)**
FELiChEM	2	50	6	150	0.9	3	60000	50	200	2-5	0.1-3		10	238, 119, 59.5, 29.75 MHz	1 - 10 µs macropulse 1 10Hz	YES	YES		46	50	0.5 - 2.5	partial waveguide	30 - 60	1 nC				dedicated to research of fundamental energy chemistry		2019	Hefei, China	http://iopscience.iop.org/article/10.1088/1674-1137/41/1/018102	**FELiChEM**
FELiChEM	20	200	1.5	15	0.1	1	30000	20	170	~5ps	0.3-3		80	238, 119, 59.5, 29.75 MHz	1 - 10 µs macropulse 1 10Hz	YES	YES		56	40	0.5 - 2.4	partial waveguide	12-30	1 nC				dedicated to research of fundamental energy chemistry		2021	Hefei, China	http://iopscience.iop.org/article/10.1088/1674-1137/41/1/018102	**FELiChEM**

https://www.hzdr.de/FEL_table