updated 2018.10.17	Wavelength (um)		Frequency (THz)		Avg. Power (W)		Peak Power	Micpulse Energy (µJ)		Pulsewidth	Bandwidth	Peak	Optimal Lasing	Repetition Rate		User Operations/Facilities			undulator and optical cavity				e- Beam										updated 2018.10.17
send updates to: klopf@hzdr.de	min	max	min	max	typical	max	max (kW)	typical	max	min (ps)	$\Delta\lambda/\lambda$ (%)	Field (MV/cm)	Wavelength (um)	Micropulse	Macropulse	User Ops	Operational	High Field Magnets	Period (mm)	# of periods	K (range)	cavity type	Energy (MeV)	bunch charge (pC)	emittance	I average (mA)	I macropulse (mA)	Types of Measurement Capabilities	Other Notes of Interest	First Lasing	Location	website / source	*send updates to: klopf@hzdr.de*
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, clustere 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-radiant 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		FEL driven by an Electrostatic accelerator		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		status unknown		30				30							circa 1993	Beijing, China	https://doi.org/10.7567/JJAPS.41S1.29	**BFEL (MIR)**
BFEL (FIR)	20	50	6	15										2.86 GHz	4 µs macropulse 3.125 Hz		status unknown		40				30							circa 2001	Beijing, China	https://doi.org/10.7567/JJAPS.41S1.29	**BFEL (FIR)**
ISIR FEL (Osaka U)	35	150	2	8.5	0.2	0.55		250	350	~ 2 - 20 (tentative)	8.5% (FWHM) - zero detuning 2.8% - 10um detuing at 70 um		70 - 80	27 MHz	4 - 5.5 us macropulse 10 Hz max.	YES	YES	NO	60		0.01 - 1.55 (rms)	concentric cavity	15				< 2400		FEL based on an L-band linac with a thrermionic cathode	1994	Osaka, Japan		**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(03)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**
CAEP THz FEL	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	**CAEP THz FEL**
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	2.5			120										59.9 - 476 MHz	5 - 10 µs macropulse 20 Hz		under construction		46	50	0.5 - 3.2		25 - 60					dedicated to research of fundamental energy chemistry			Hefei, China	http://iopscience.iop.org/article/10.1088/1674-1137/41/1/018102	**FELiChEM**
FELiChEM		200	1.5											59.9 - 476 MHz	5 - 10 µs macropulse 20 Hz		under construction		56	40		partial/full waveguide	15 - 25					dedicated to research of fundamental energy chemistry			Hefei, China	http://iopscience.iop.org/article/10.1088/1674-1137/41/1/018102	**FELiChEM**