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Table showing nomenclature for differentiation of three classes of chlorophyll fluorescence parameters obtained by LIFT/FRRF from those obtained in the saturating pulse of PAM

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Abstract

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Parameter	Definition	Summary of LIFT fluorescence parameters
Q_A flash	LIFT excitation protocol designed to reduce Q_A and to observe the kinetics of electron transport from Q_A to PQ pool and from PQ pool to PSI	Saturating sequence (SQ_A) of 180 flashlets at 50% duty cycle (average excitation power ~6300 µmol photons m^{-2} s^{-1}; 1 µs pulses of 470 nm light applied at 2 µs intervals) followed by relaxation sequence (RQ_A) of 90 flashlets at exponentially-increasing time intervals
PQ flash	LIFT excitation protocol designed to fully reduce PQ pool, but programmed to fire at predetermined intervals during continual Q_A flash operation.	Saturating sequence (SPQ) of up to 6000 flashlets at 20 µs intervals, followed by relaxation phase (RPQ) of 90 flashlets. Functionally analogous to the saturating pulse of PAM
Double flash	LIFT Q_A flash as above followed by a PQ flash as above	Used to 'internally calibrate' Q_A flash parameters against PAM-analogous PQ flash
Ft	Fluorescence transient observed in response to any of the above LIFT/FRRF flash protocols	Fluorescence signal digitised at 10^7 samples s^{-1}, integrated over the length of each flashlet.
F_oQ_A	Intrinsic *continuously monitored* fluorescence with fully oxidised Q_A in the dark	Fast repetition rate (FRR) excitation pulses fit to Q_A Ft to pre-flash conditions in the dark
F_mQ_A	Maximum *continuously monitored* fluorescence under ambient levels of Q_A and PQ pool reduction.	FRR fit to Q_A Ft under ambient levels of Q_A and PQ pool reduction in the dark
F_vQ_A	Variable fluorescence *continuously monitored* in the dark (proportional to reducible Q_A)	$= F_mQ_A - F_oQ_A$
$F'Q_A$	As F_oQ_A but in actinic light	As above but in actinic light
F'_mQ_A	As F_mQ_A but in actinic light	As above but in actinic light
F'_vQ_A	As F_vQ_A but in actinic light	$= F'_mQ_A - F'Q_A$
F_oPQ	*Spot measurement* of intrinsic fluorescence with fully reduced PQ pool in the dark	FRR fit of PQ Ft to pre-flash conditions in the dark (c.f. F_oPAM)
F_mPQ	*Spot measurement* of maximum fluorescence with fully reduced PQ in the dark	FRR fit of PQ Ft with full reduction of PQ pool (c.f. F_mPAM)
F_vPQ	*Spot measurement* of variable fluorescence with fully reduced PQ in the dark	$= F_mPQ - F_oPQ$ (c.f. F_vPAM)

$F'PQ$	As F_oPQ but in actinic light	As above but in actinic light (c.f. $F'PAM$)
F'_mPQ	As F_mPQ but in actinic light	As above but in (c.f. F'_m PAM))
F_mWL	*Spot measurement* of maximum fluorescence with fully reduced PQ in the dark	FRR fit to Q_A Ft with fully reduced PQ pool in a strong WL pulse in the dark (c.f. F_mPAM)
F_vWL	*Spot measurement* of variable fluorescence with fully reduced PQ in the dark	$= F_mWL – F_oQ_A$ (c.f. F_vPAM)
F'_mWL	As F_mWL but in actinic light	As above but in actinic light (c.f. F'_mPAM)
F'_vWL	As F_vWL but in actinic light	$= F'_mWL – F'_oQ_A$ (c.f. F'_vPAM)
F_oPAM	Intrinsic fluorescence from PAM in the dark	(c.f. F_oPQ)
F_mPAM	Maximum fluorescence from PAM in the dark in a saturating WL pulse to fully reduced PQ	(c.f. F_mWL or F_mPQ)
F_vPAM	Variable fluorescence in the dark from PAM	(c.f. F_vWL or F_vPQ)
$F'PAM$	As F_oPAM but in actinic light	(c.f. $F'PQ$)
F'_mPAM	As F_mPAM but in actinic light	(c.f. F'_mWL or F_mPQ)
F'_vPAM	As F_vPAM but in actinic light	(c.f. F'_vWL or F_vPQ)
$\phi_{PSII}Q_A$	Maximum photochemical efficiency of open PSII centres *continuously monitored* in the dark with ambient levels of Q_A reduction	$= (F_mQ_A – F_oQ_A)/F_mQ_A$
$\phi'_{PSII}Q_A$	As above but in actinic light	$= (F'_mQ_A – F'Q_A)/F'_mQ_A$
$\phi_{PSII}PQ$	Maximum photochemical efficiency of open PSII centres in the dark from *spot measurements* with the PQ flash	$= F_vPQ/F_mPQ$ (c.f. F_vPAM/F_mPAM)
$\phi'_{PSII}PQ$	As above in actinic light	$= F'_vPQ/F'_mPQ$ (c.f. F'_vPAM/F'_mPAM)
$\phi_{PSII}WL$	Maximum photochemical efficiency of open PSII centres *continuously monitored* in the dark with the Q_A flash	$= F_vWL/F_mWL$ (c.f. F_vPAM/F_mPAM)
$\phi'_{PSII}WL$	As above in actinic light	$= F'_vWL/F'_mWL$ (c.f. F'_vPAM/F'_mPAM)
$\phi_{PSII}PAM$	Maximum photochemical efficiency of open PSII centres in the dark from *spot measurements* in a PAM saturating pulse	$= F_vPAM/F_mPAM$ (c.f. F_vPQ/F_mPQ)
$\phi'_{PSII}PAM$	As above in actinic light	$= F'_vPAM/F'_mPAM$ (c.f. F_vPQ/F_mPQ)

σ_{PSII}	*Continuously monitored* functional absorption cross-section of PSII in the dark	Numerical fit of FRR model to Q_A flash Ft
σ'_{PSII}	As above but in actinic light	As above
a_{PSII}	*Continuously monitored* optical absorption cross-section of PSII (antenna size) in the dark	$= \sigma_{PSII}/\phi_{PSII}$
a'_{PSII}	As above but in actinic light	$= \sigma'_{PSII}/\phi_{PSII}$
τ_1	*Continuously monitored* time constant of electron transport from Q_A to PQ pool	Numerical fit of Q_A flash Ft to FRR model, roughly corresponding to first phase of RQ_A fluorescence relaxation kinetics
τ_2	*Continuously monitored* time constant of electron transport from PQ pool to PSI	Numerical fit of Q_A flash Ft to FRR model, roughly corresponding to second phase of RQ_A fluorescence relaxation kinetics
E_k	*Continuously monitored* half saturation PFD for ETR	FRR model simulation of an instantaneous light response curve