

Current ARC Performance Capabilities

October 2020

ARC Laser IPT



LLNL-PRES-816308

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC



ARC current performance capabilities

ARC Beamlet	Current Capabilities			
Number	4			
Pulse duration	1 ps	10 ps	30 ps	38 ps
Energy	0.25 kJ	0.6 kJ	0.9 kJ	1 kJ
Focal spot (~ 30 ps, ~ 1 kJ)	10-30% of energy at $\geq 1e17$ W/cm ² ≥ 30 -50% in 150 μ m spot			
Alignment accuracy ⁽¹⁾ rms (X_{ARC} , Y_{ARC})	(63, 38) μ m			
Pointing range from TCC (ARC)	($\pm 50, \pm 50, +10/-45$) mm			
Beamlet-to-beamlet pointing	<1.26 mm in x,y, 2 mm in focus (beam coordinates)			
Pre-pulse contrast	80 dB ($t < -1$ ns), 60-70 dB ($t \approx -1$ ns), 70 dB ($t < -200$ ps)			
Timing Accuracy ARC to ARC	10 ps rms (any beamlet wrt any other beamlet)			
Timing Accuracy ARC to NIF	30 ps rms (any beamlet wrt NIF)			
Delay relative to NIF ⁽¹⁾	Up to 70 ns (any beamlet wrt NIF)			
Delay of B beamlet wrt A beamlet	Up to 30 ns (B after A) ⁽³⁾			
Delay of B354 wrt B353	Up to 3.6 ns (B353 after B354) ⁽³⁾			

(1) Based on 7 pointing shots with TCC pointing

(2) Without affecting 35B (i.e. drop Q35B)

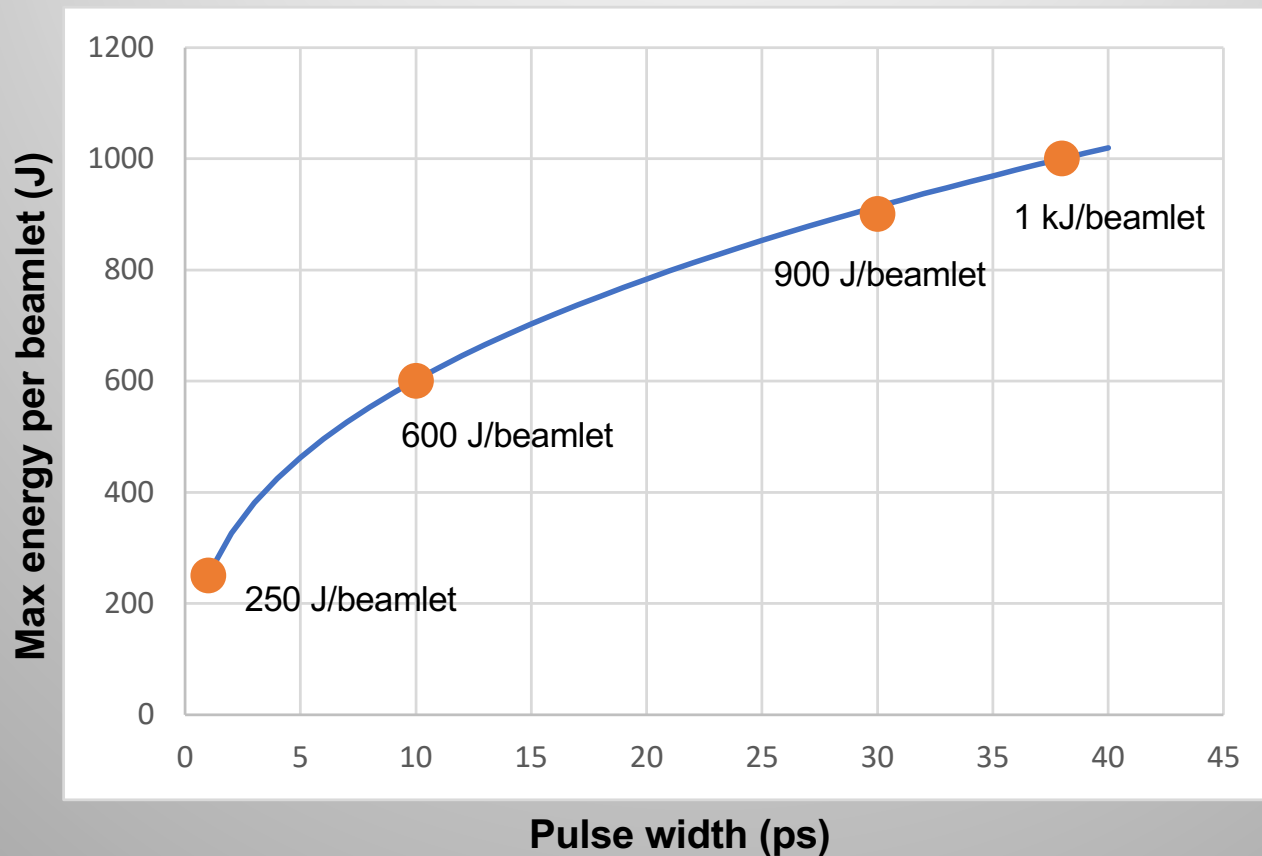
(3) Without requiring platform development to extend current capability



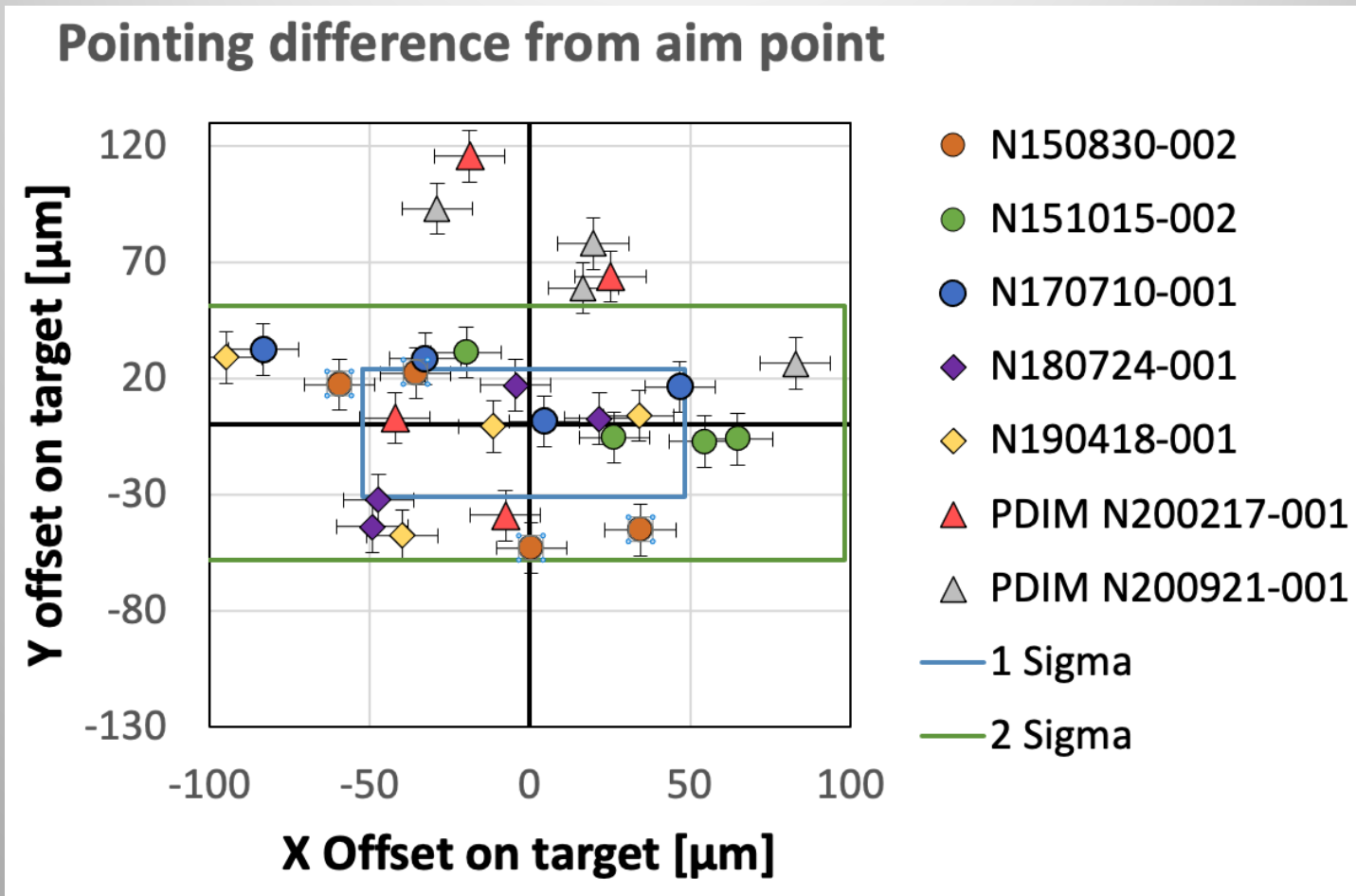
Max allowed energy vs pulse width for current optic ROE

ARC is commissioned with discrete pulse lengths of 1, 10, 30, 38 ps

The max energy per beamlet scales at $(\text{pulsewidth})^{0.38}$

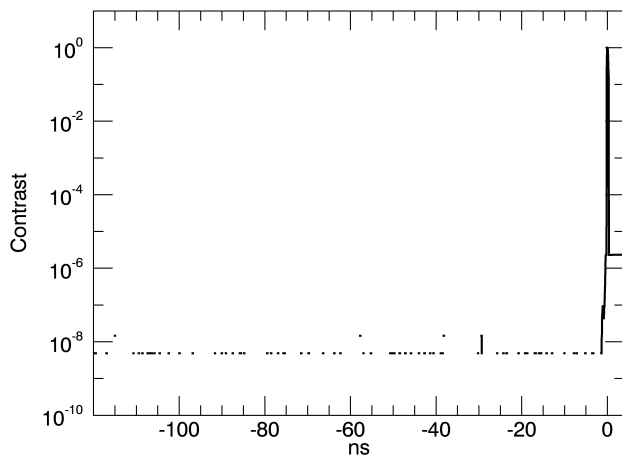


Pointing data from a total of 7 shots at TCC indicate
 $(X_{ARC}, Y_{ARC}) = (63, 38) \mu\text{m rms}$

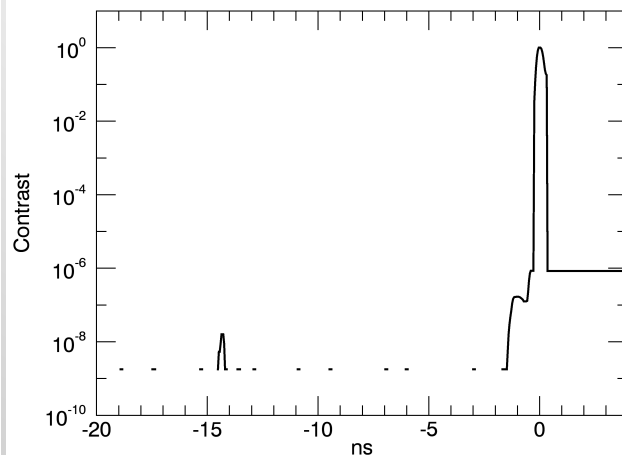


Pre pulse data for N160524 produced 80 dB contrast for $t < -1$ ns & 60-70 dB @ -1 ns

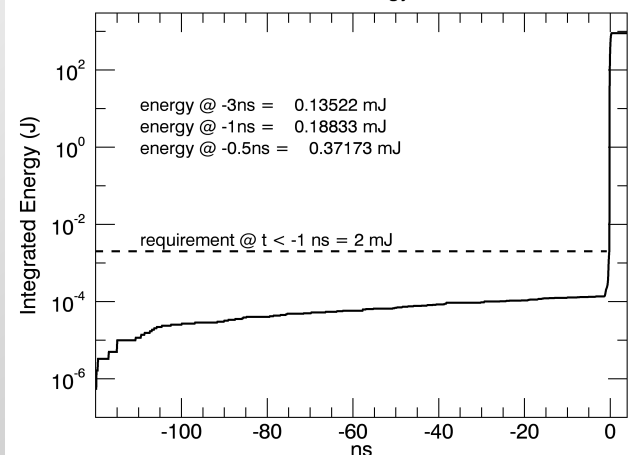
Shot N160524-003-999 Prepulse B354A rod strehl= 1.00



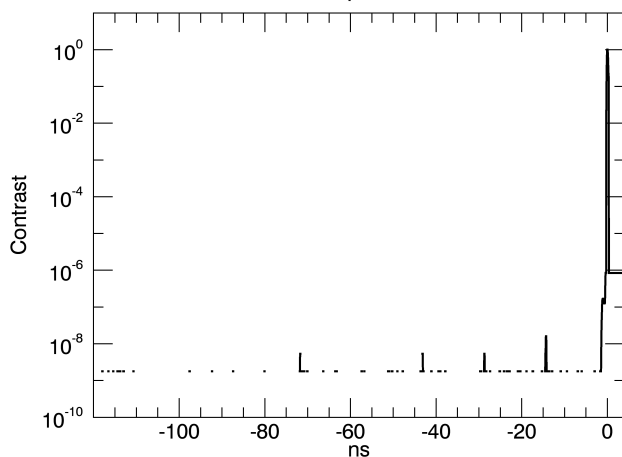
Shot N160524-003-999 Prepulse B354B rod strehl= 1.00



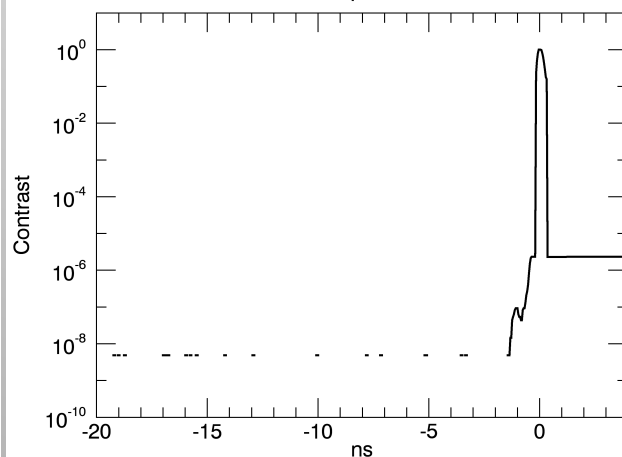
Shot N160524-003-999 Int. Energy B354A rod strehl= 1.00



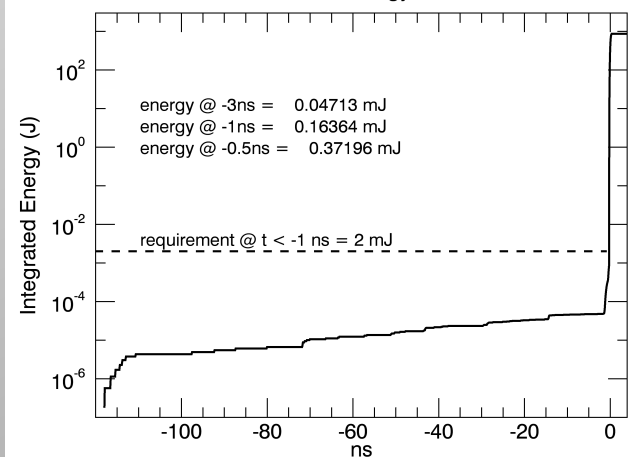
Shot N160524-003-999 Prepulse B354B rod strehl= 1.00



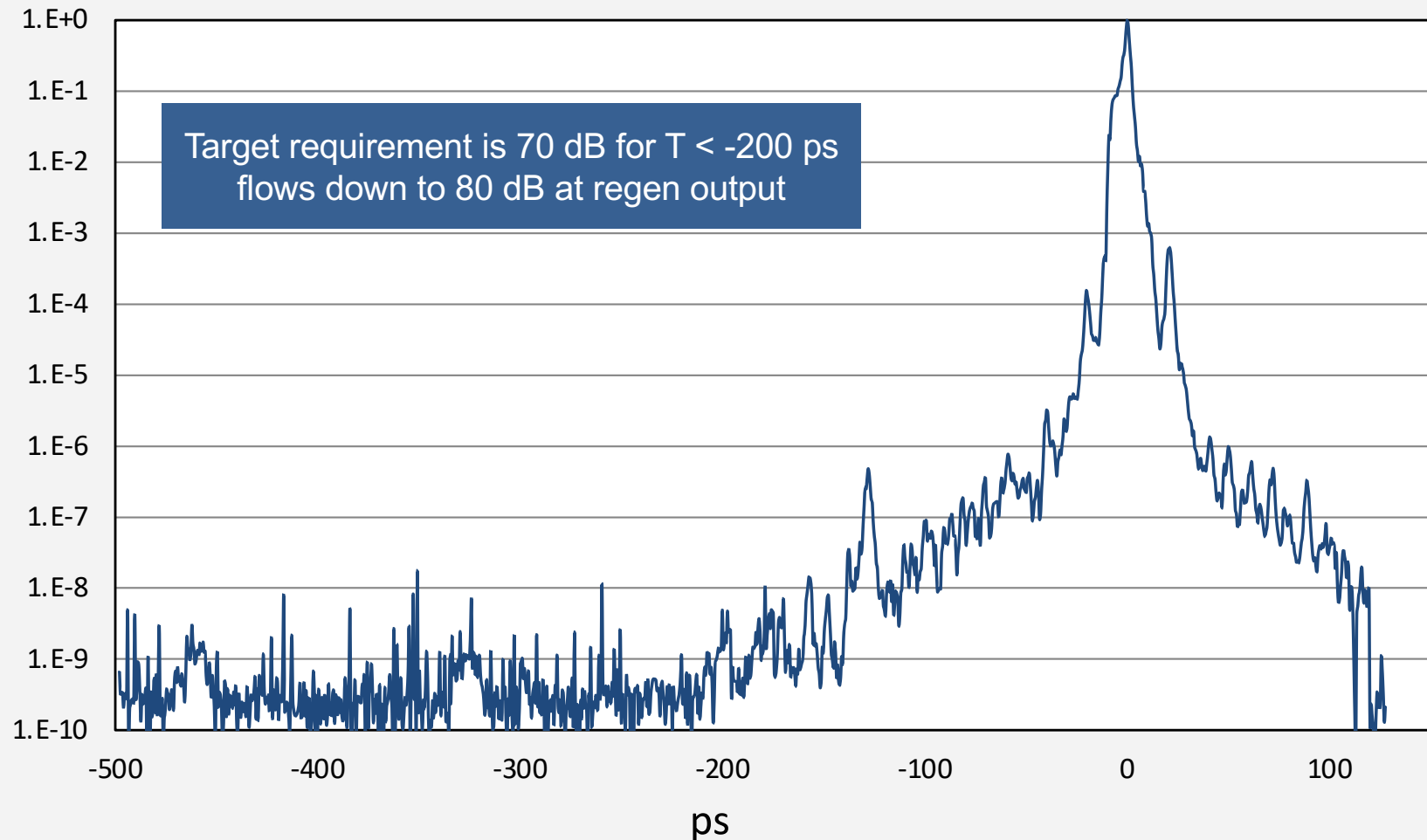
Shot N160524-003-999 Prepulse B354A rod strehl= 1.00



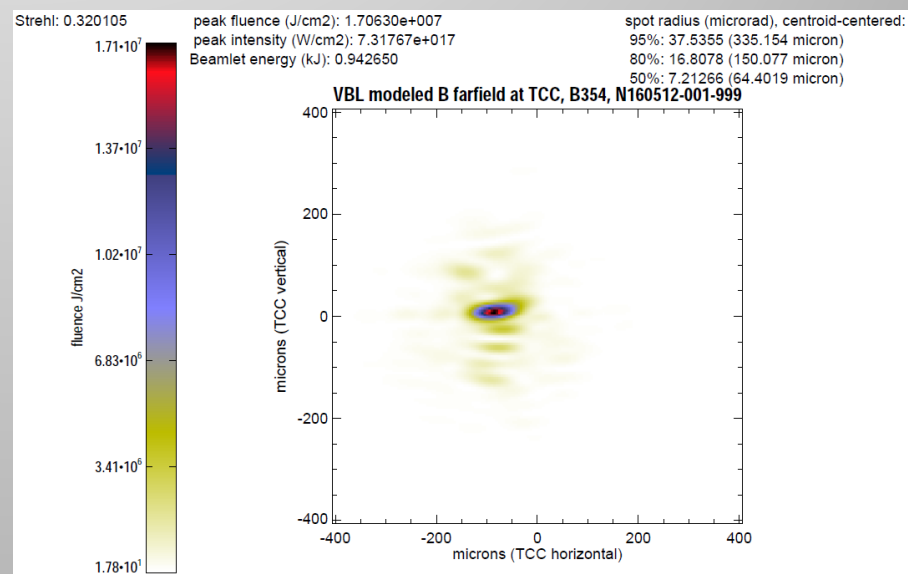
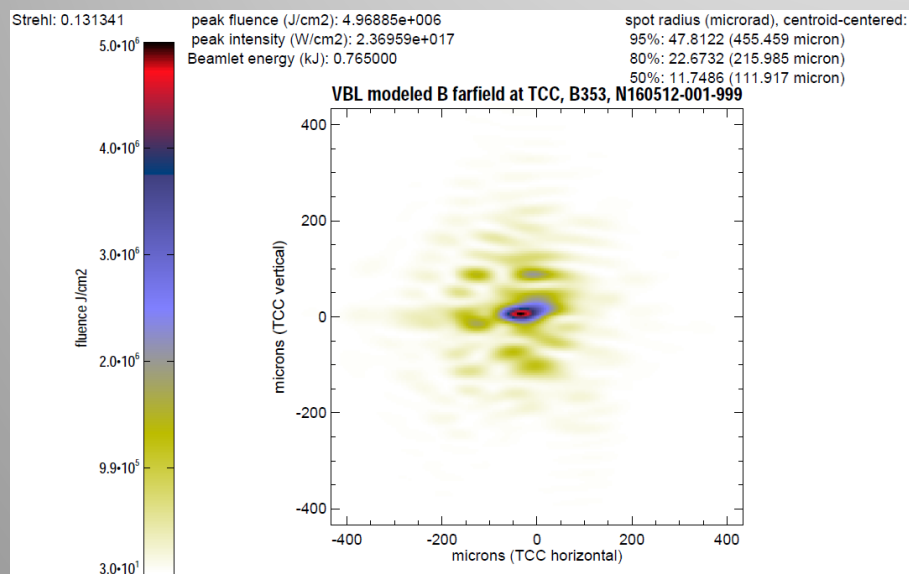
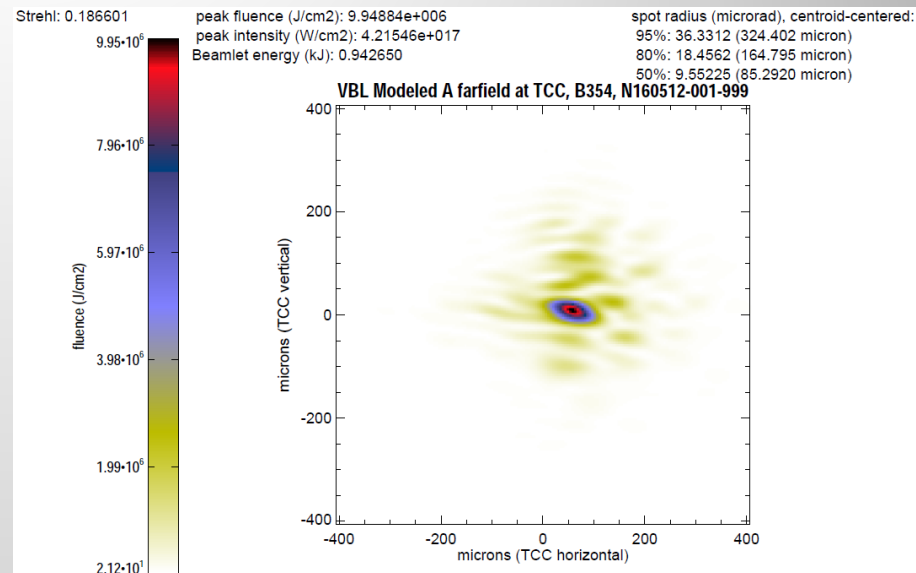
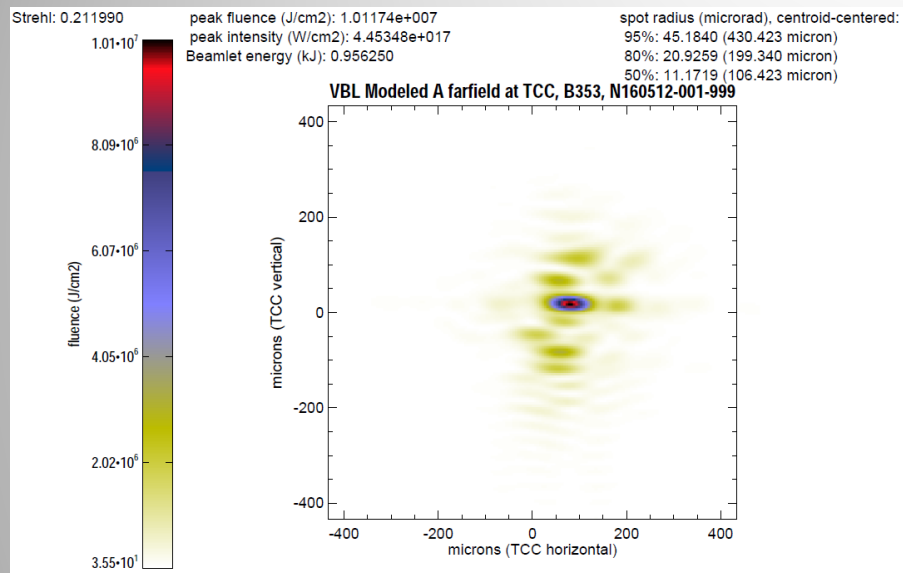
Shot N160524-003-999 Int. Energy B354B rod strehl= 1.00



High Contrast Front End output meets prepulse contrast requirement of 80 dB for $t < -200$ ps



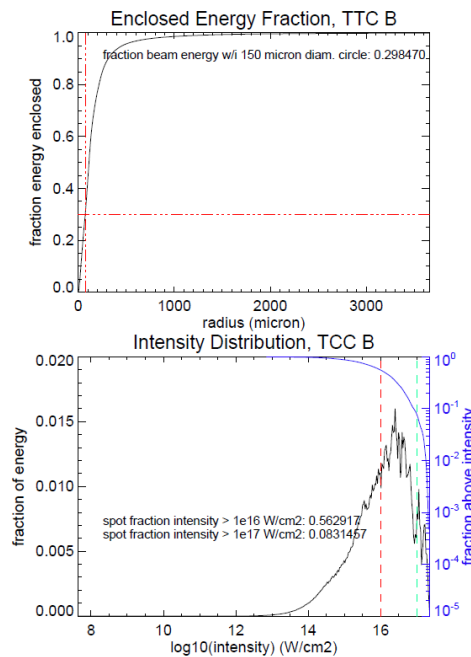
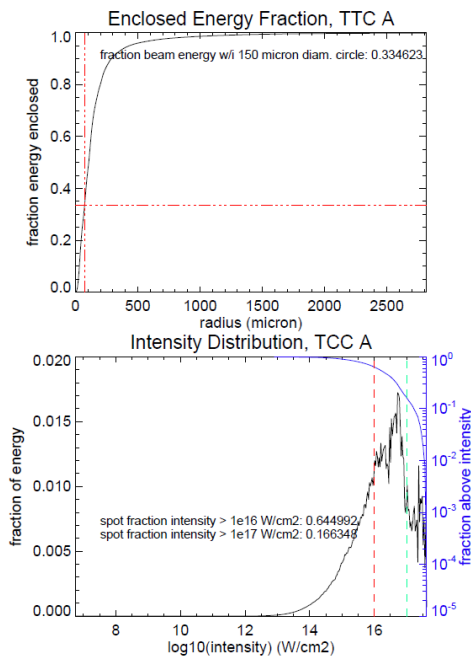
Calculated ARC beamlet far fields using VBL & measured wavefront data for N160512-001-999



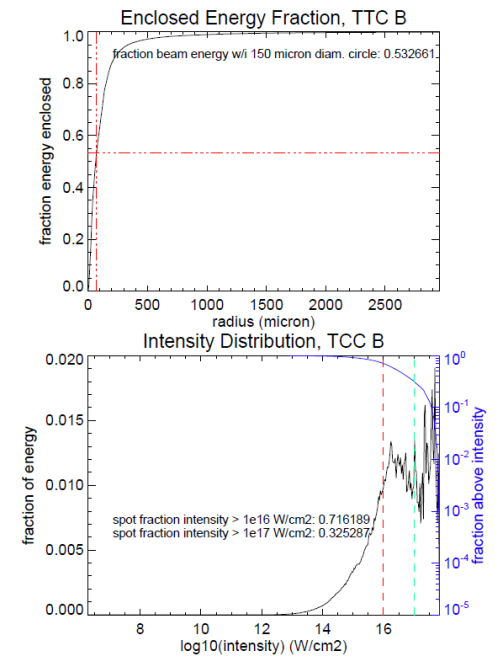
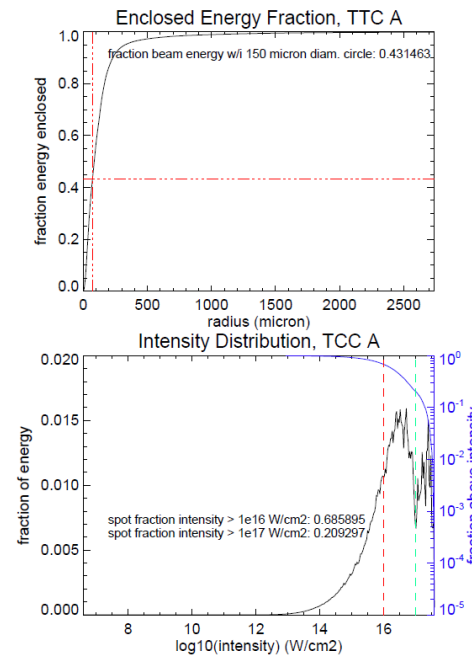
VBL FF calculations estimate 30-50% of the energy in 150 μm diameter & 10-30% energy $> 10^{17} \text{ W/cm}^2$

B353

B354



vbl_farfields.pro, rev1.0, Wed Jul 13 14:56:54



vbl_farfields.pro, rev1.0, Wed Jul 13 14:53:18



