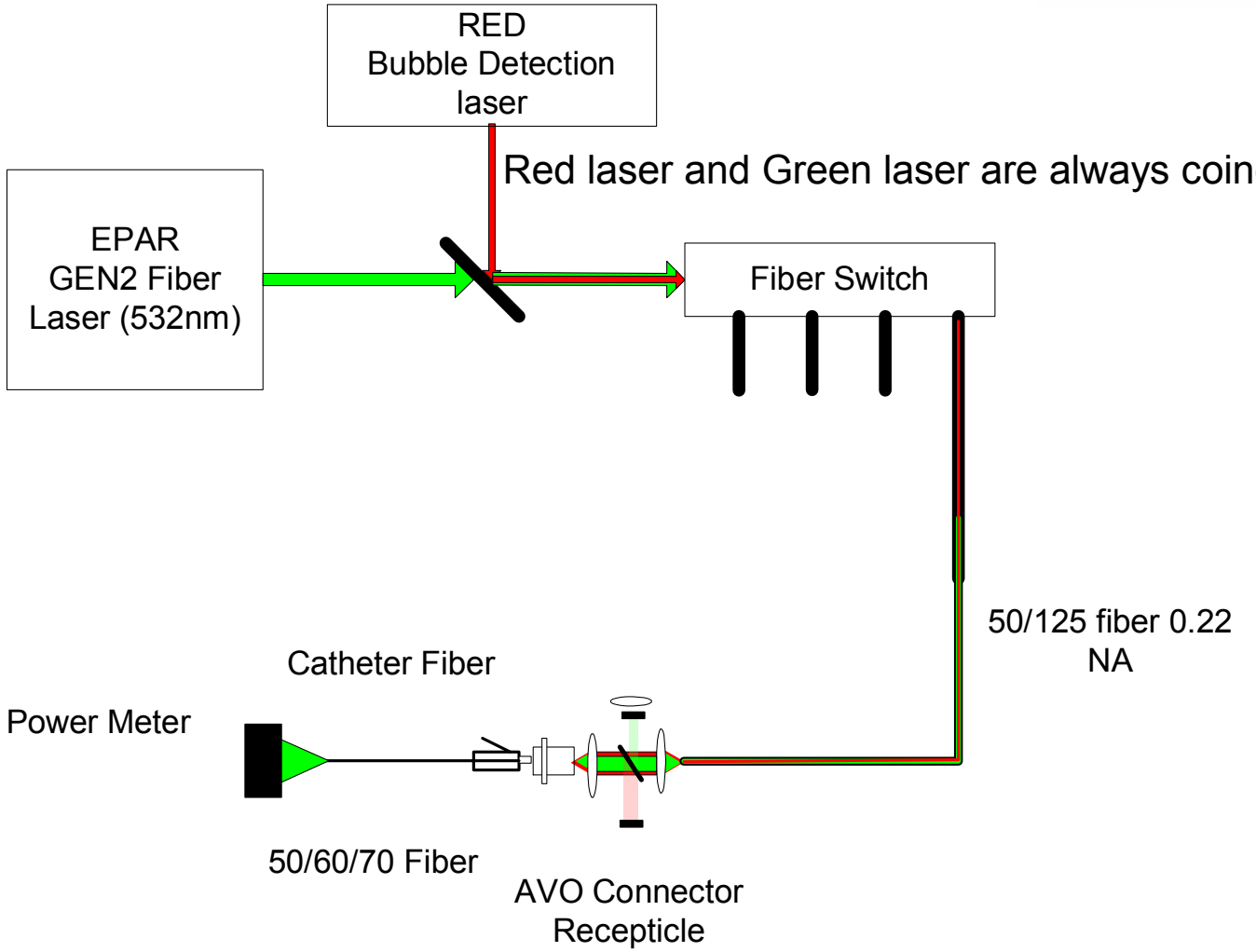
RED LASER FEEDBACK
Damage Detection and Bubble Signature

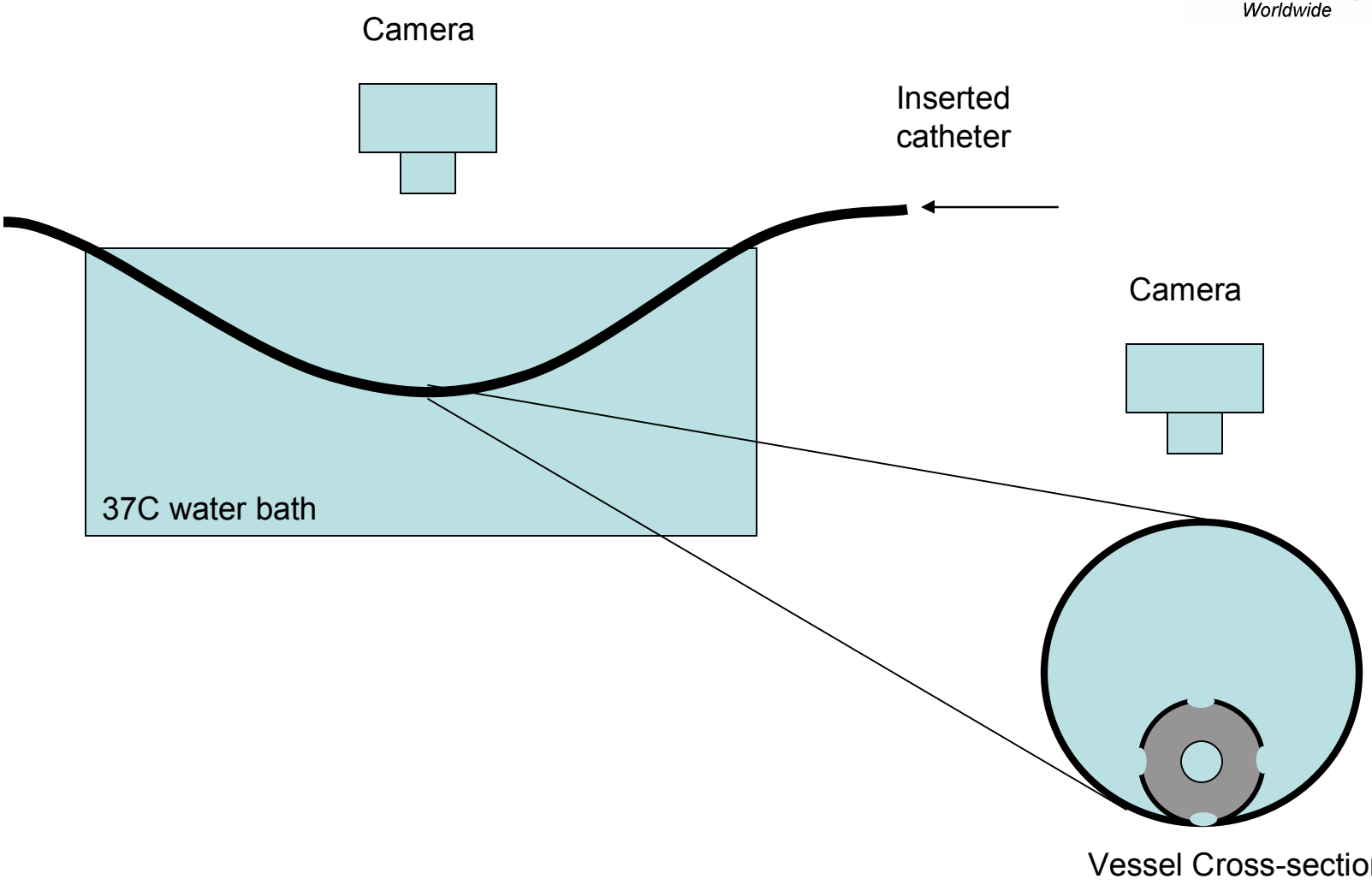
EPAR Laser System Configuration (controlled)

Creative Technologies Worldwide

.



In-Vitro Configuration Geometry



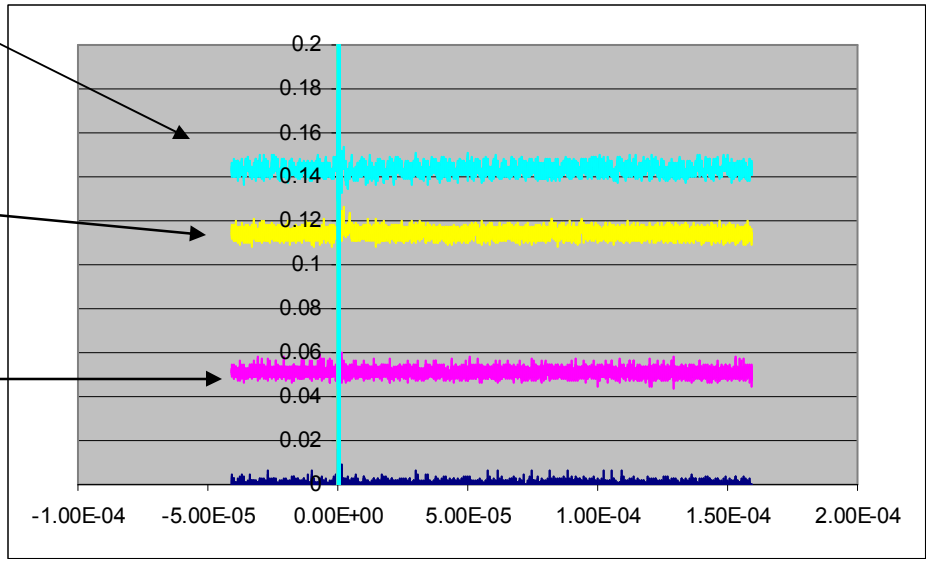
Three Components of Red Laser Feedback

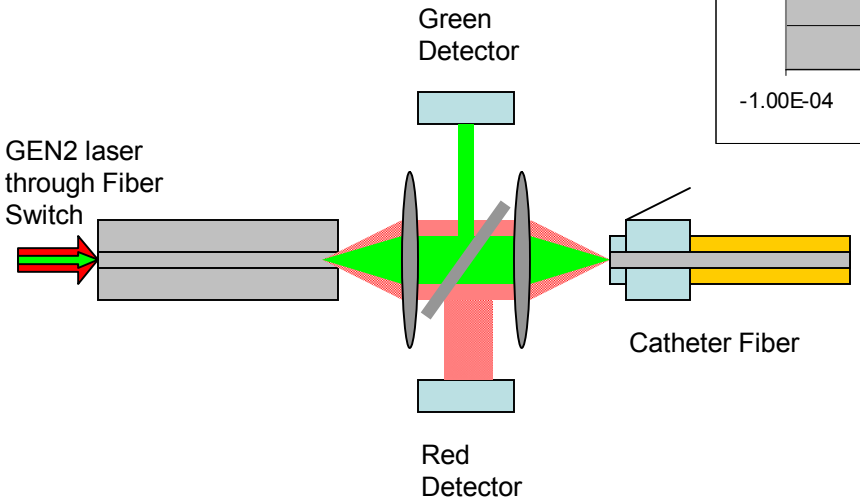
Creative Technologies Worldwide

Reflection from LC connector catheter Fiber proximal face and distal face

Reflection from catheter Fiber distal face

CCR basal internal reflection





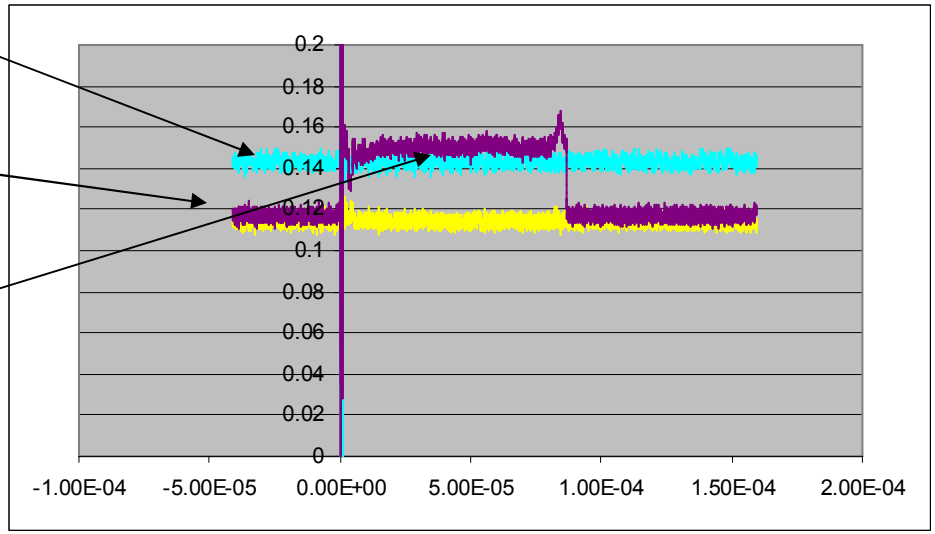
Three Components of Red Laser Feedback (Bubble Feedback)

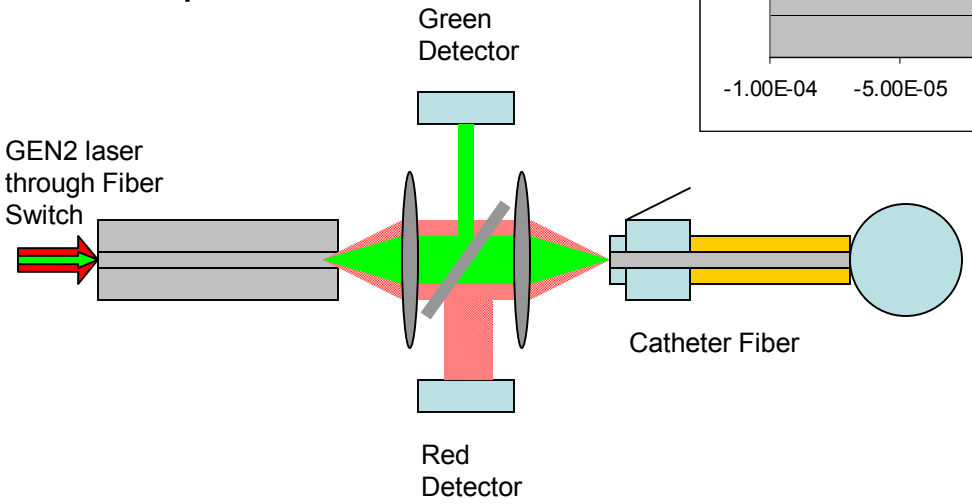
Creative Technologies Worldwide

Reflection from LC connector catheter Fiber proximal face

Reflection from catheter Fiber distal face

Reflection from internal Bubble/liquid interface

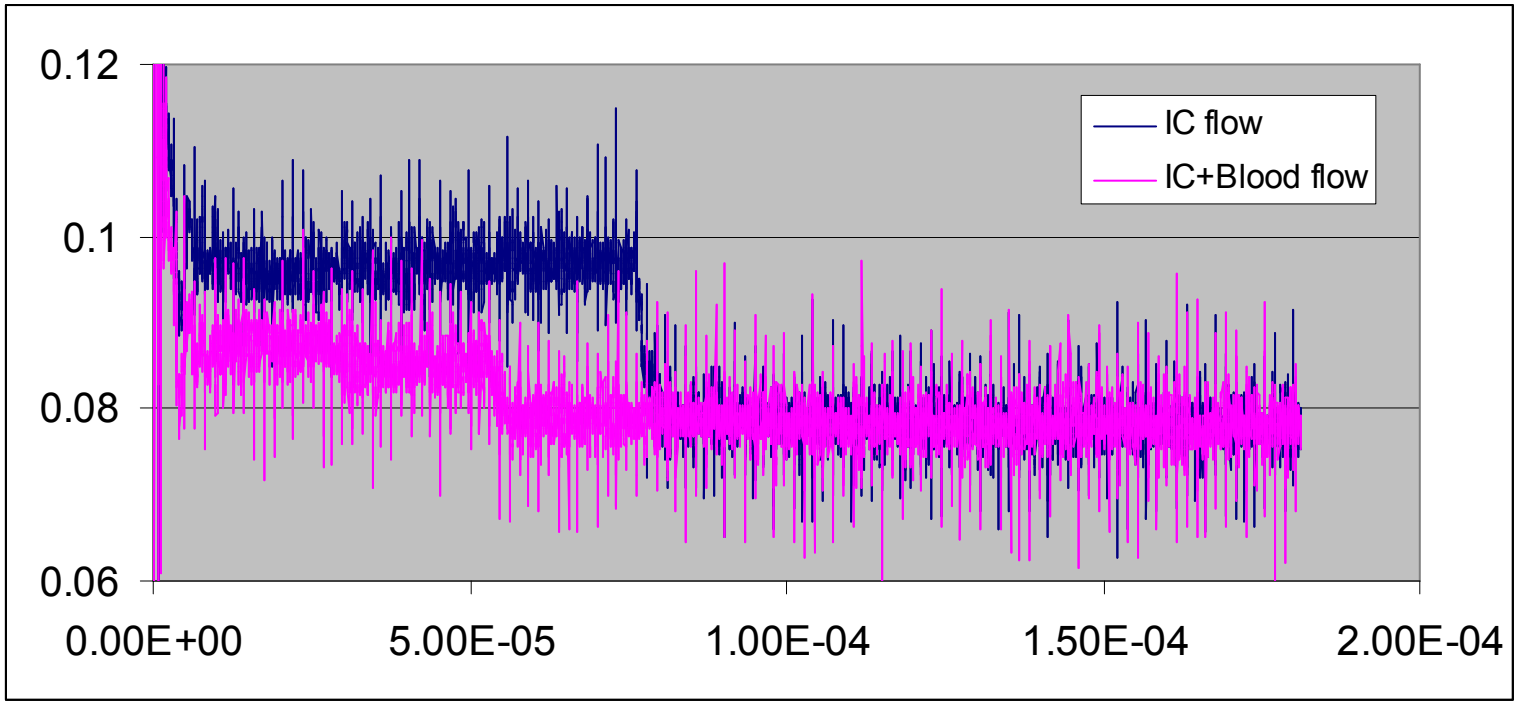




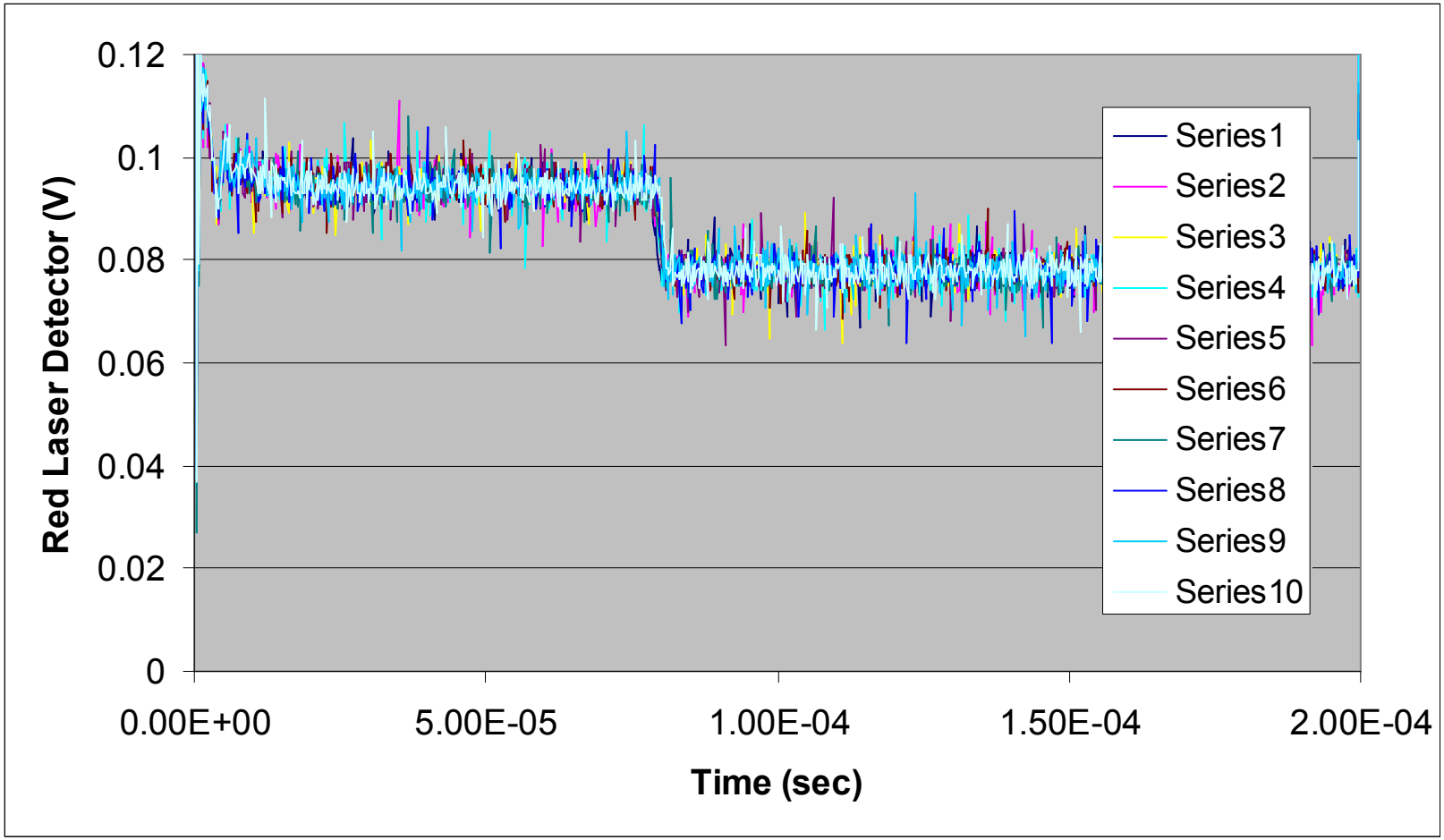
Vessel Blood Flow Shortens The Red Laser Bubble Feedback Response

Creative Technologies Worldwide

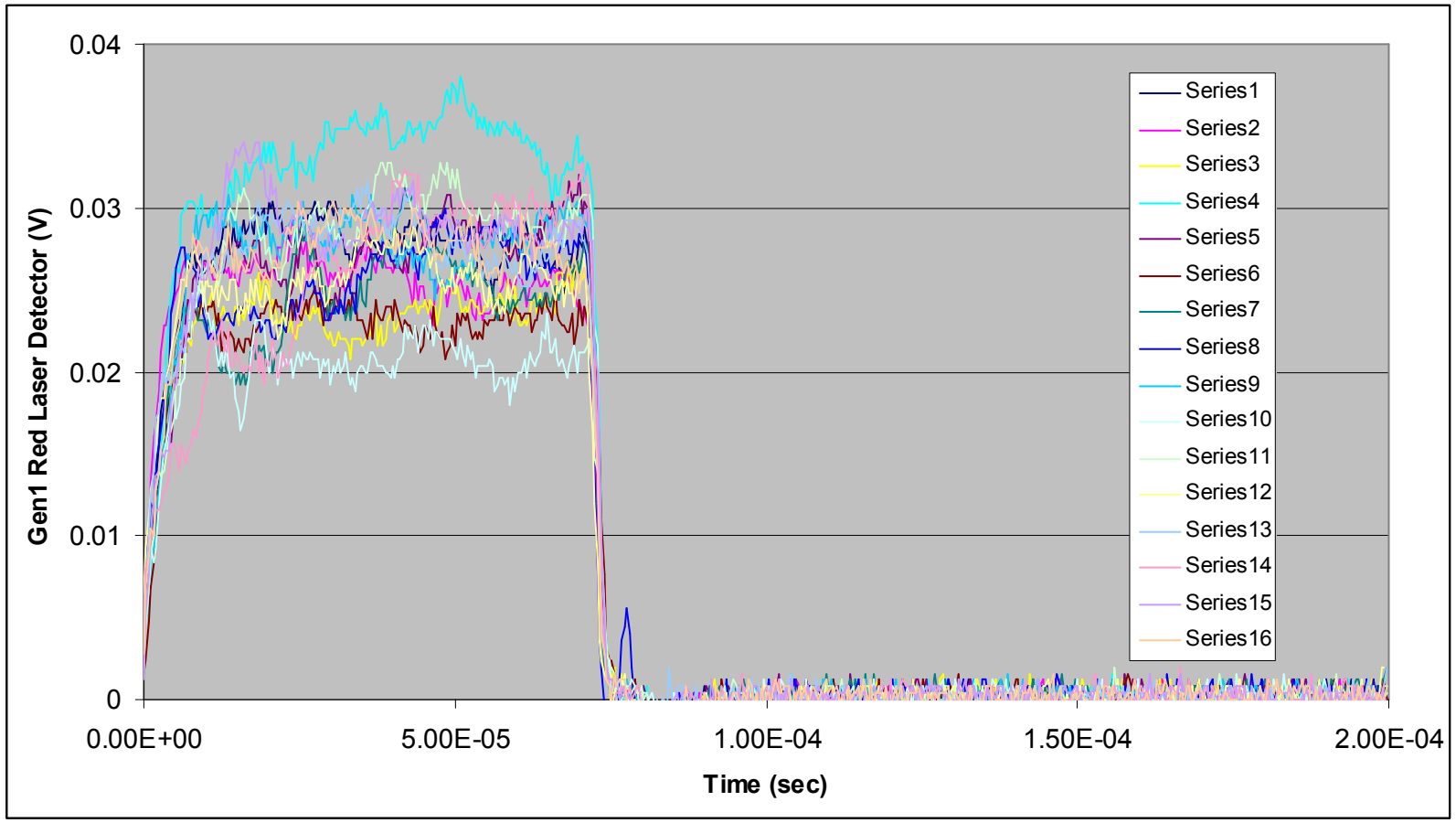
1. Catheter movement creates tip environmental disturbances that impact bubble development



Gen2 EPAR Red Laser Bubble Feedback Signals



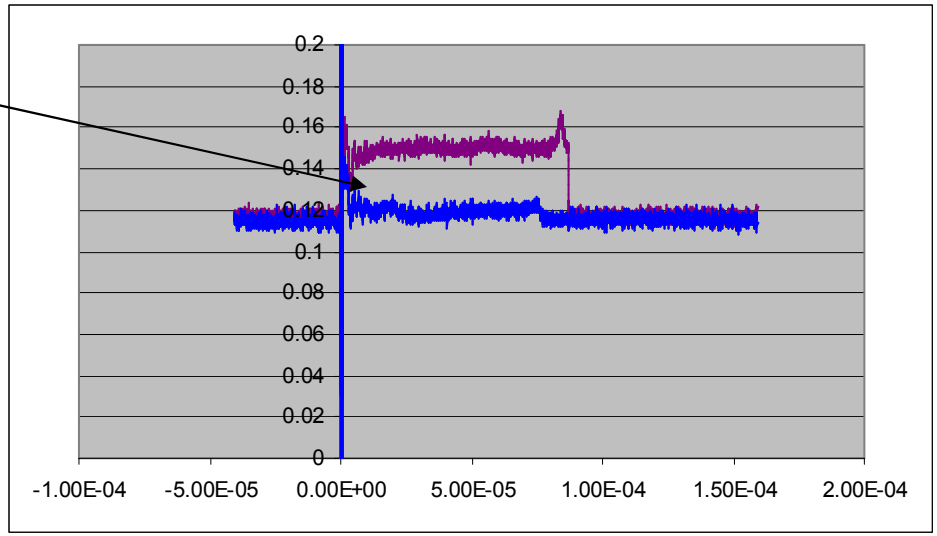
Gen1 EPAR Red Laser Bubble Feedback Signal Variability

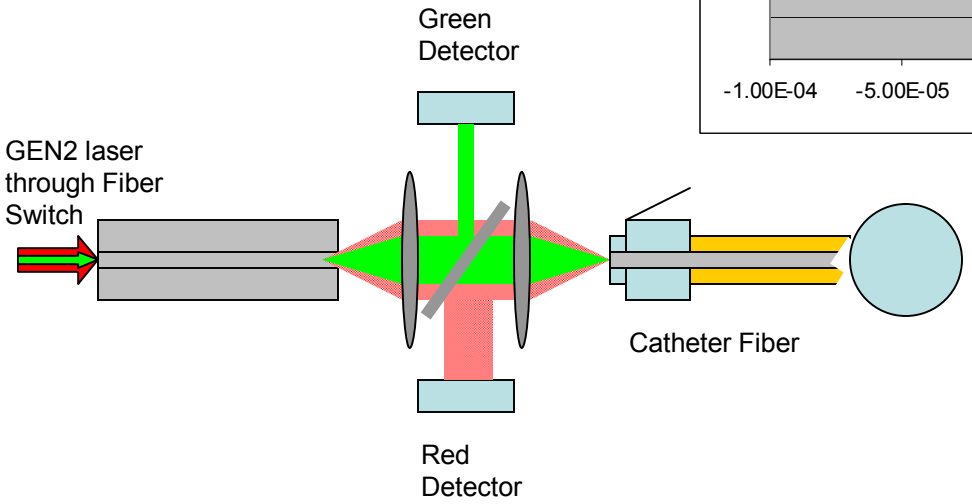


Gen2 Red Laser Feedback
(Bubble feedback with distal fiber damage)

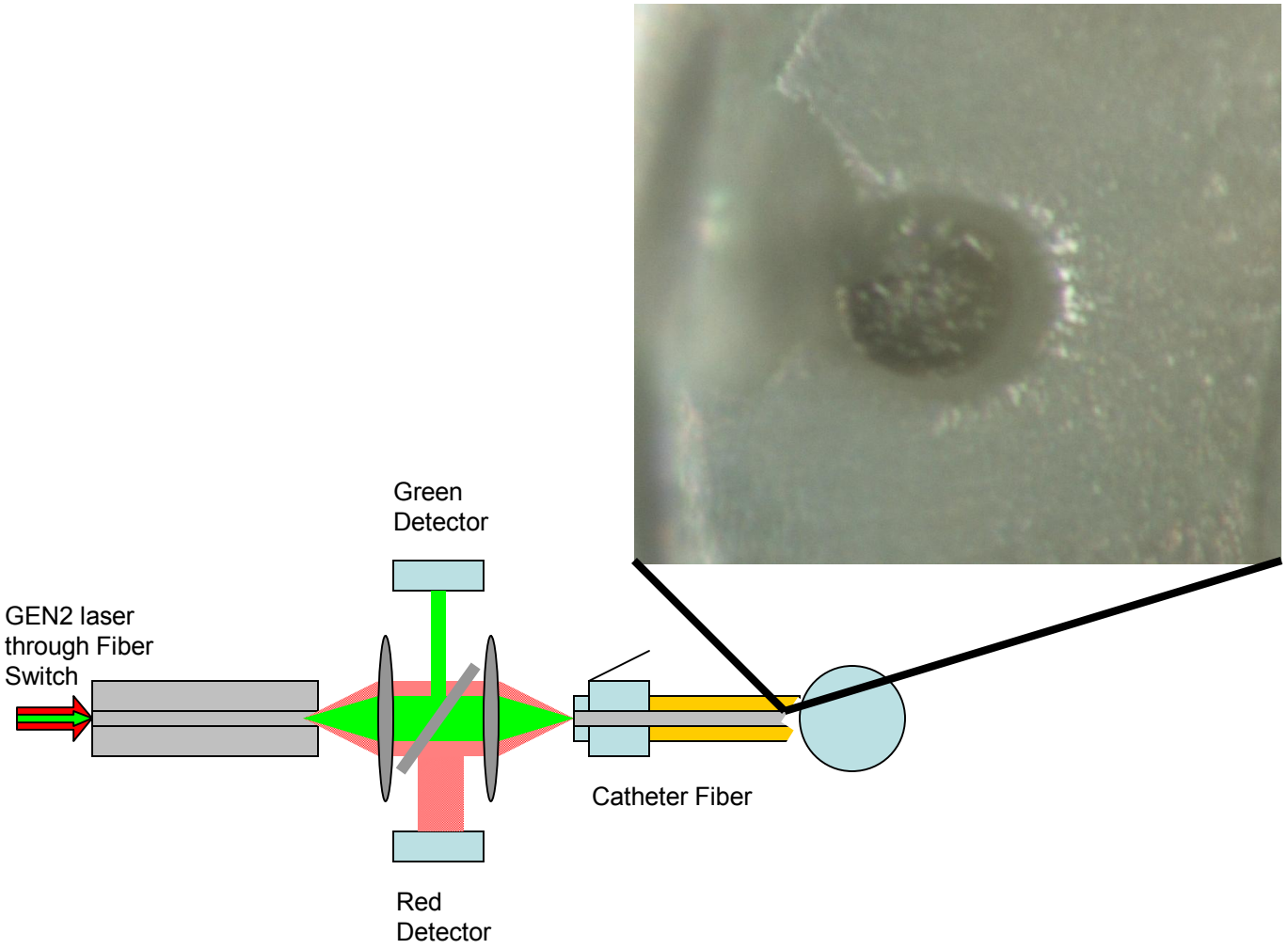
Creative Technologies Worldwide

Dc level and bubble pulse
Amplitude reduced

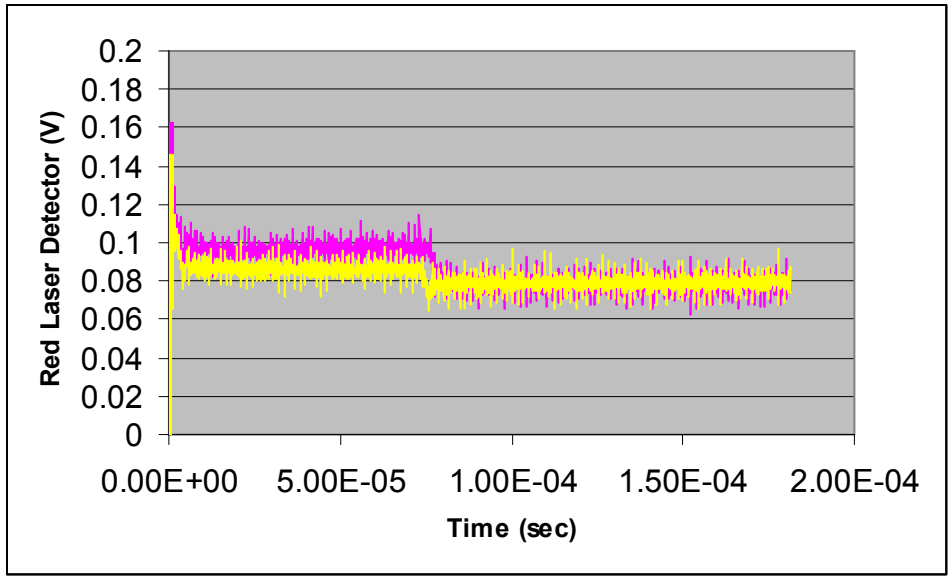


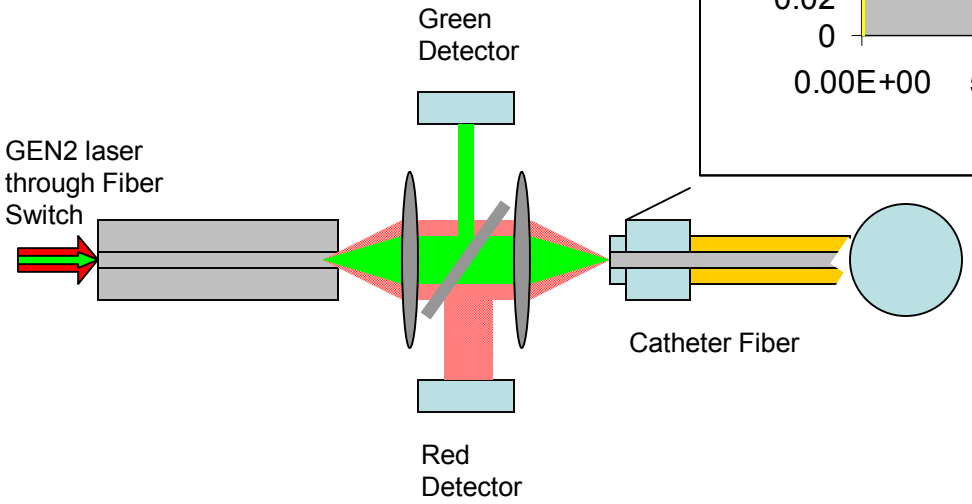


Gen2 Red Laser Feedback
(Bubble feedback with distal fiber damage)

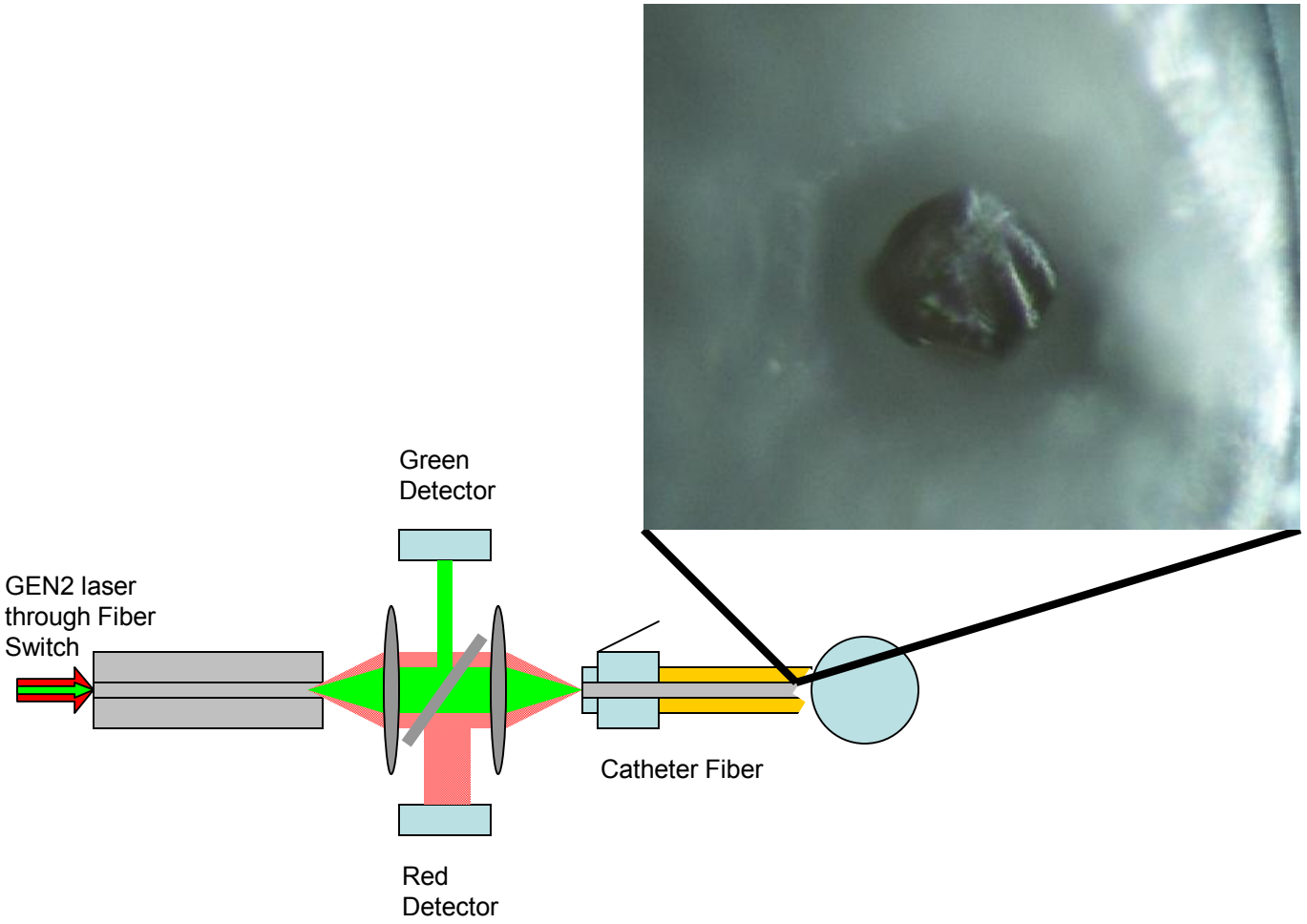


Gen2 Red Laser Feedback
(Bubble feedback with distal fiber damage)





Gen2 Red Laser Feedback
(Bubble feedback with distal fiber damage)

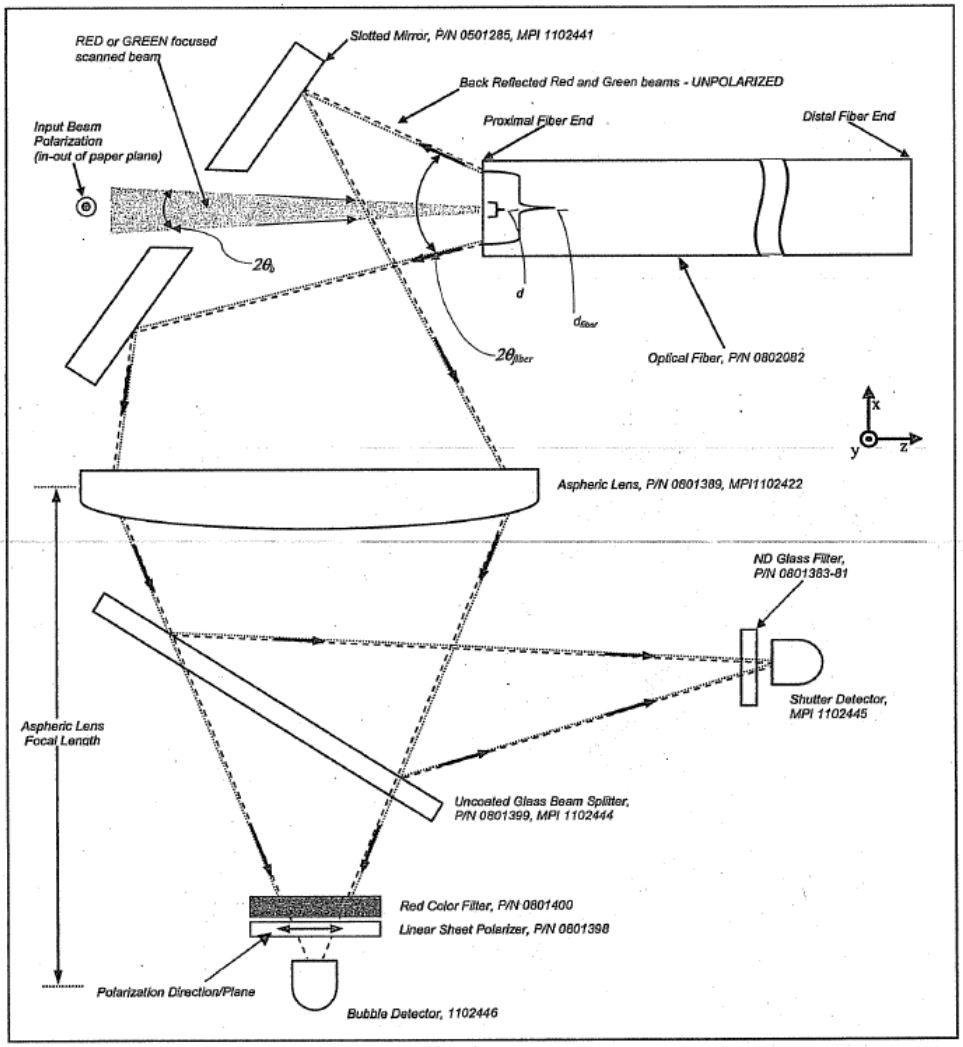


Conclusions

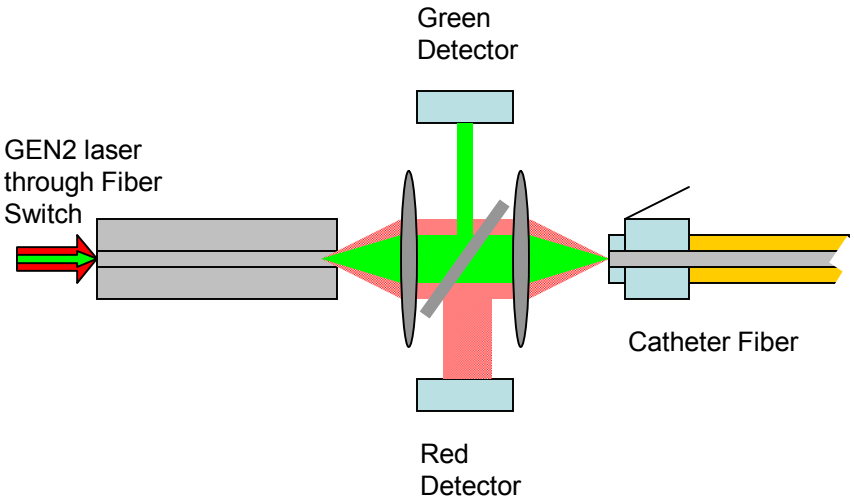
1. Very little damage to the fiber face is detectable by comparison to the predamage total reflection red feedback threshold allowing for auto fiber reflection correction.
2. The Gen2 red laser feedback signal is clean and independent of fiber movement polarization.
3. The bubble shape/size responds to blood flow and needs to be characterized

Gen1 Red Laser Feedback polarization dependence

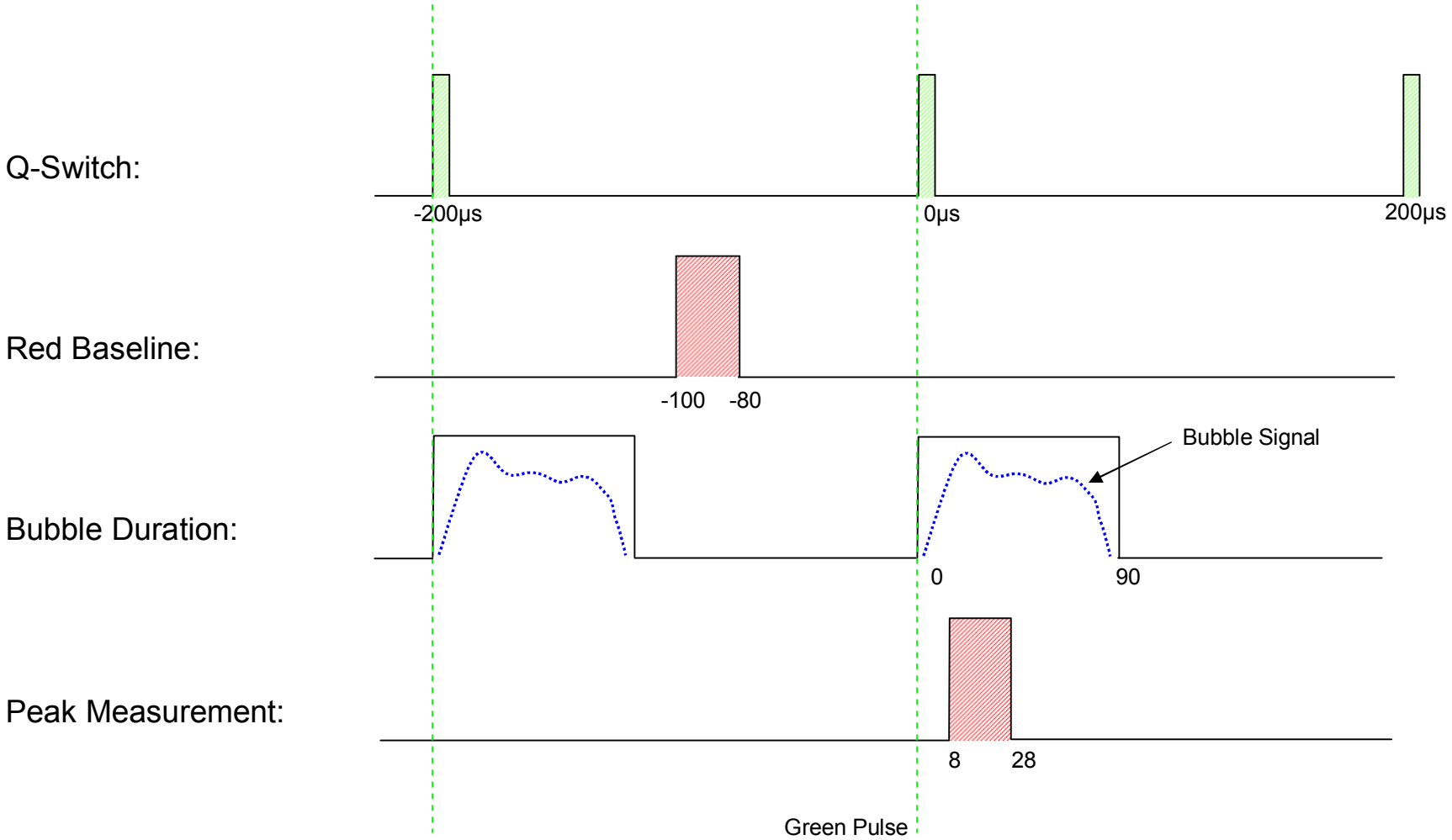
Creative Technologies Worldwide



Gen2 Red Laser Feedback polarization independence



Bubble Timing



Gen I Hardware Design

Elements:

1) *Pre-Amp*: The photodiode used is a PIN type. The preamplifier is a trans-impedance amplifier.
2) *DC Level*: S1 opens from 100us to 120us, quiescent level held on C2.
3) *Peak Detection: From 8us to 28us, S2 is closed capturing the peak level on C3*
4) *Width Comparator*: U3 measures the FWHM by timing the fall to ½ the peak voltage.
5) *Amplitude Comparator*: Peak value compared to menu chosen threshold (clinical = 0.35V)