

MICE cavity test progress at the MTA, Fermilab

David C. Speirs

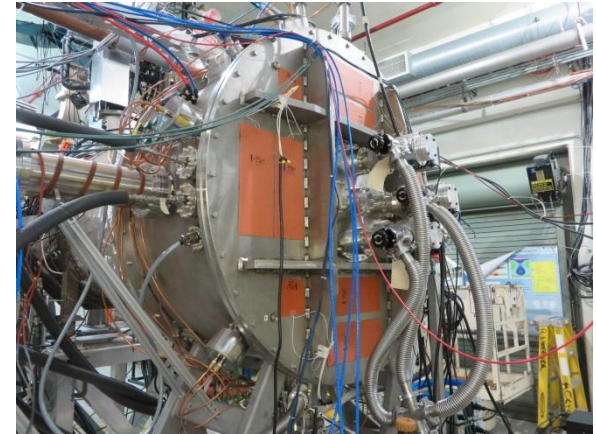
Department of Physics, University of Strathclyde, Glasgow, U.K.

On behalf of the staff and students at the MTA, Fermilab, U.S.A.

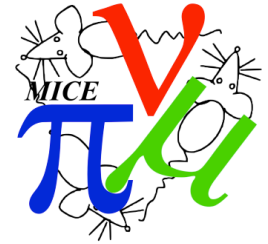
Background



- ▶ The first production MICE RF cavity is currently undergoing tests within the Muon Test Area (MTA) at Fermilab U.S.A.
- ▶ Cavity tests currently have no magnetic field and are without Beryllium windows. Drive frequency is following cavity prior to commissioning of tuner-actuator system
- ▶ Getter pump is currently being assisted by turbo molecular pumps to aid in evacuation of the cavity and vessel (will need removal prior to tests with external magnetic field).
- ▶ Plan to replace turbos with larger getter pump.
- ▶ Vacuum pressures typically 7×10^{-8} mBar in the cavity and 9×10^{-8} mBar in the vacuum vessel.
- ▶ During recent visit and associated shifts, a peak operating gradient of ~ 12 MV/m was typically measured with very few cavity spark events.
- ▶ Some modulator maintenance issues led to periodic shut downs, but these have now been rectified.



Shifts on the MTA



- ▶ Since early September, the overall up-time has been 53% – this comes in spite of many outages (electricity, water, network) during the accelerator / linac shutdown period.
- ▶ Shift coverage while the cavity has been powered is 83% – this has been possible due to high level of commitment from MTA staff supported by UK colleagues (plus Tianhuan from LBNL).

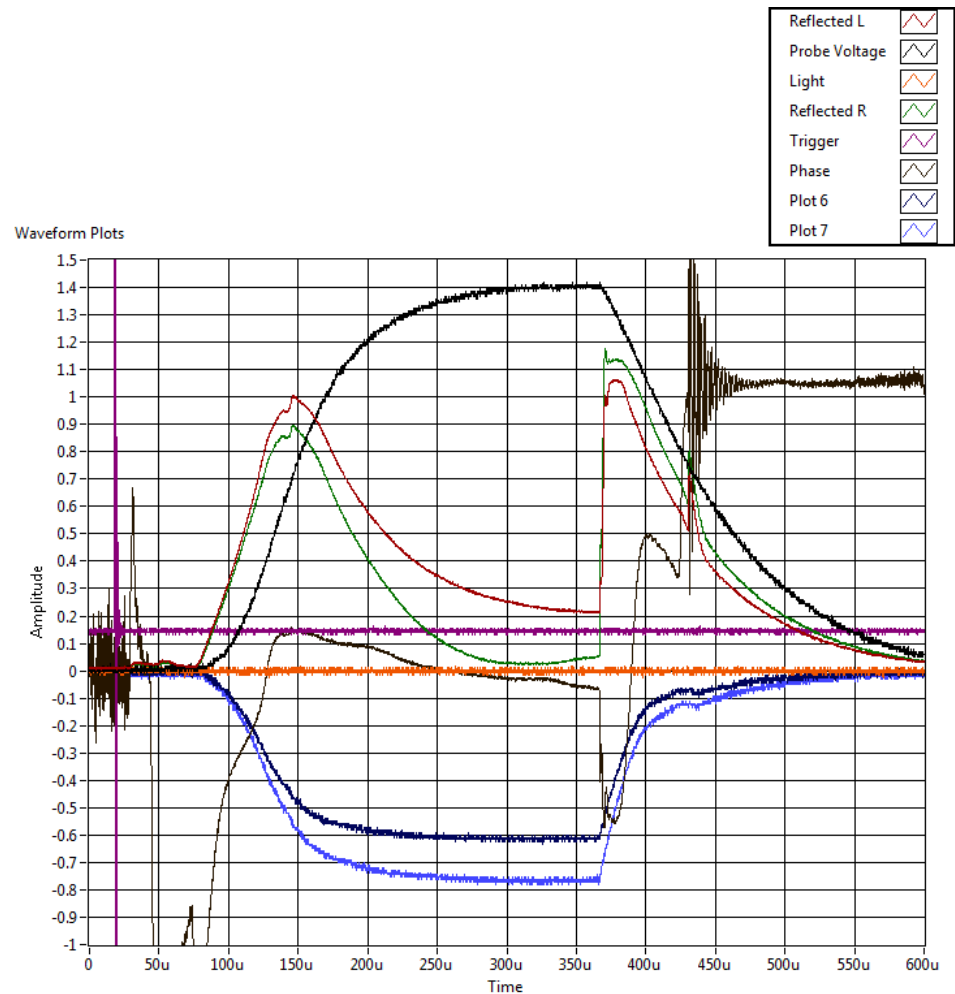
Date		00:00-04:00	04:00-08:00	08:00-12:00	12:00-16:00	16:00-20:00	20:00-24:00	Date	
R F	Mon Oct 13	ML	YT	AK	DS	MP	PL	Oct 13	Mon
	Tue Oct 14	ML	TS	AK	DS	YT	PL	Oct 14	Tue
	Wed Oct 15	ML	YT	AK	DB	BF	PL	Oct 15	Wed
	Thu Oct 16	x	x	MP	AK	DB	+	Oct 16	Thu
	Fri Oct 17	x	x	x	x	x	x	Oct 17	Fri
	Sat Oct 18	x	x	x	x	x	x	Oct 18	Sat
	Sun Oct 19	x	x	x	x	x	x	Oct 19	Sun
Date		00:00-04:00	04:00-08:00	08:00-12:00	12:00-16:00	16:00-20:00	20:00-24:00	Date	

Date		00:00-04:00	04:00-08:00	08:00-12:00	12:00-16:00	16:00-20:00	20:00-24:00	Date	
R F	Mon Oct 20	x	x	x	x	x	x	Oct 20	Mon
	Tue Oct 21	x	x	x	x	x	x	Oct 21	Tue
	Wed Oct 22	x	x	YT	AM	ML	ML	Oct 22	Wed
	Thu Oct 23	YT	+	PL	DB	ML	+	Oct 23	Thu
	Fri Oct 24	YT	+	PL	DB	BF	+	Oct 24	Fri
	Sat Oct 25	YT	YT	+	ML	+	MB	Oct 25	Sat
	Sun Oct 26	+	YT	YT	ML	+	+	Oct 26	Sun
Date		00:00-04:00	04:00-08:00	08:00-12:00	12:00-16:00	16:00-20:00	20:00-24:00	Date	

Results



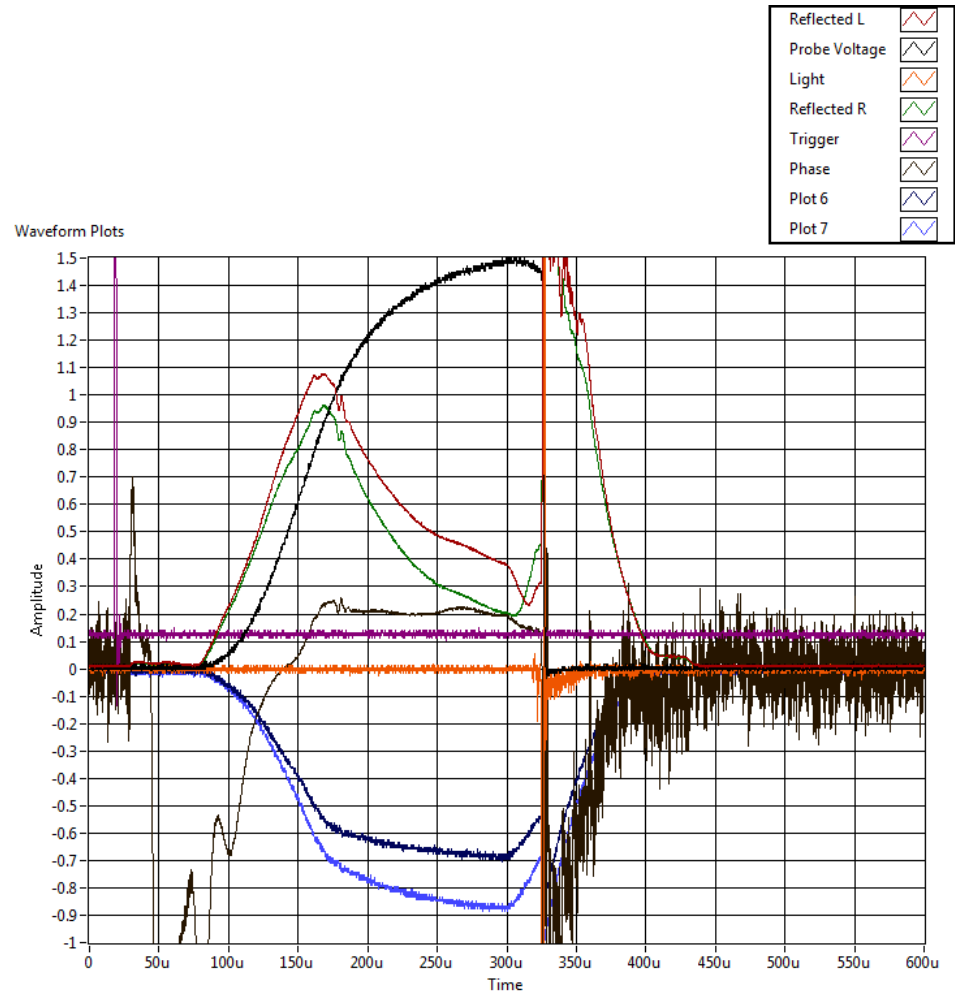
- ▶ As of 27/10/14, over 2 Million pulses have been obtained at $>12\text{MV/m}$ for 5Hz rep rate.
- ▶ Pulse duration is about $250\mu\text{s}$
- ▶ 7 cavity breakdown events have been observed at this power level (although none have been observed for over a million pulses).
- ▶ Rep rate dropped to 2.5Hz and drive raised to 13MV/m . The modulator requiring adjustment and repair, but is now recommissioned.



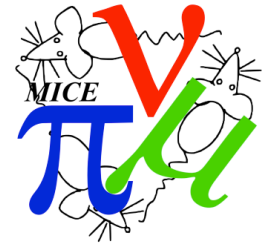
Results



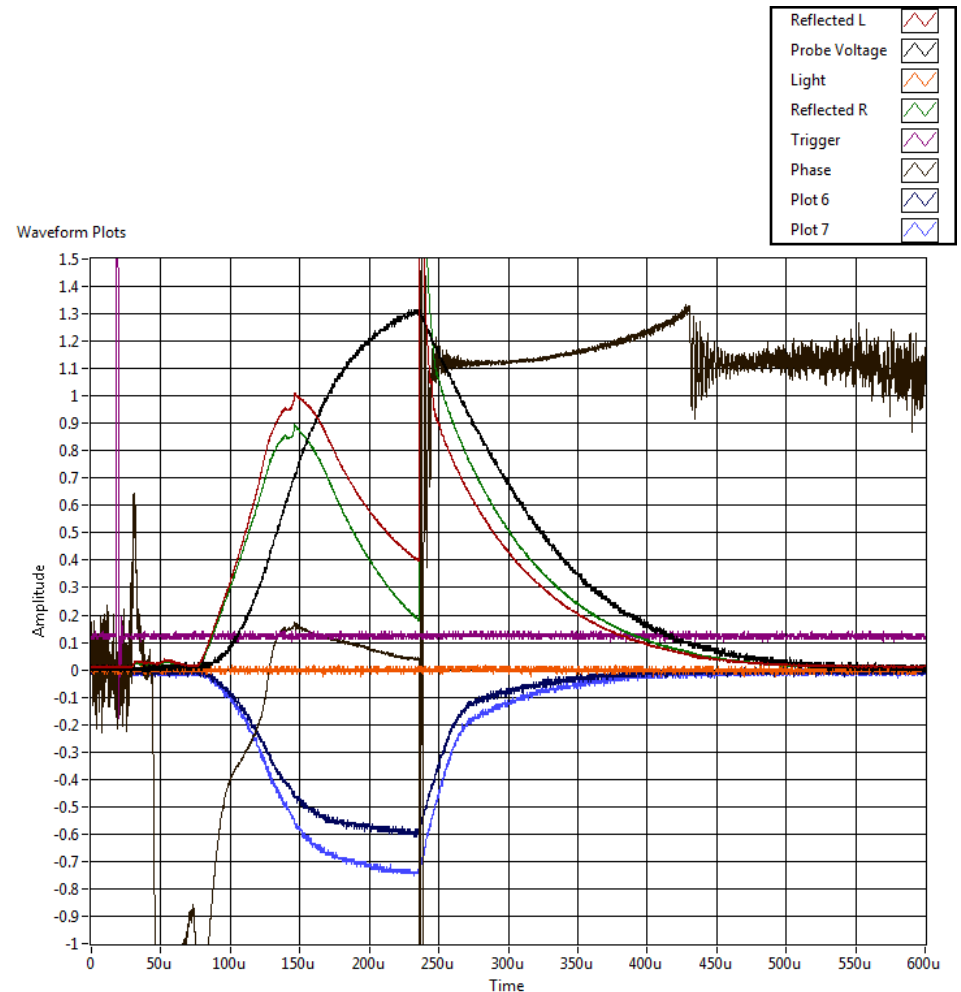
- ▶ Sparks in cavity identified by coincident breakdown in cavity voltage and observed light signal from the cavity.
- ▶ Initially, sparks were observed when the vacuum pressure in the cavity rose above operational specification.
- ▶ Subsequently, breakdown events were identified for elevated drive voltage / gradients of $> 12\text{MV/m}$.



Results



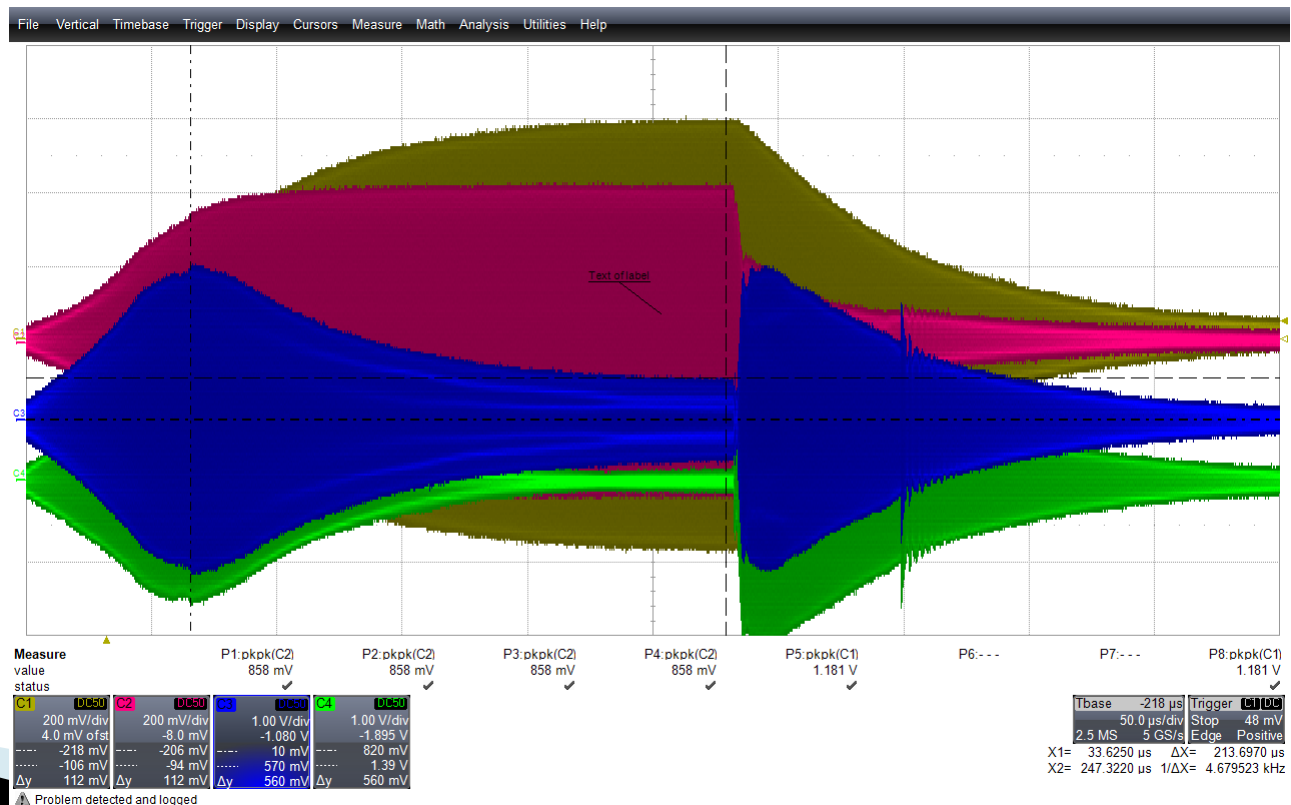
- ▶ Modulator breakdown events were logged, but easy to differentiate from cavity breakdown events.
- ▶ Adjustments made to the modulator have now resulted in greater stability at elevated drive powers.
- ▶ Gradients greater than 13MV/m are now attainable.



Results



- ▶ Unrectified RF signal data has now been transferred to Strathclyde for the drive, probe and reflected components.
- ▶ This should be very useful in development of the undersampling based phase-timing diagnostic- realistic data with the same spectral content as the MICE cavity signals, with digitiser resolution and stability.



Moving forward



- ▶ The team at Fermilab are now preparing for the next phase of testing, with cavity downtime scheduled and breaking of vacuum in mid-November.
- ▶ A thorough cavity inspection will be conducted with installation of the Beryllium windows.
- ▶ Modification will be made to the vacuum system (removal of turbo pumps) and the cavity vessel will be moved against the solenoid for B-field running similar to Step 3Pi/2 (or whatever we decide to call the terminal experimental configuration).