This PFRC README.txt file was generated on 2023-08-04 by S.A. Cohen

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GENERAL INFORMATION

Title of Dataset: Data from the Princeton Field Reversal Configuration (PFRC) Experiment

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Description:
The data includes Excel, HDF5, TXT, TRC and MCA files for the experiments conducted using PFRC between 2014 and 2023. Data includes raw, intermediate and post processed data from the interferometer, fast camera, visible spectroscopy, SDD X-ray diagnostics, RF power characteristics, pressure gauges, probes, gas puff characteristics, axial boundary potentials, and residual gas analyzer (RGA). There is a lot of data in these files that are PDF documents made by scanning screenshots of Lecroy Digital Storage Oscilloscopes displays used to accumulate and analyze the data, Runsheet based on the diagnostics that displays the experimental parameters and the file numbers.

Date of data collection: 20140424-20230801

Geographic location of data collection: Princeton, NJ, Mercer County, USA

Funding sources or sponsorship that supported the collection of the data:
DOE Contract Numbers: DE-AC02-09CH11466, DE-AC02-76CH03073

SHARING/ACCESS INFORMATION

Recommended citation for the data:
Cohen, Samuel A., Swanson, Charles, Jandovitz, Peter, Vinoth, Sangeeta, David, Liam, & Berlinger, Bruce. (2024). Data from the Princeton Field Reversal Configuration (PFRC) Experiment [Dataset]. Princeton Plasma Physics Laboratory, Princeton University. 10.34770/8ecv-zm19

Citation for and links to publications that cite or use the data:
https://w3.pppl.gov/ppst/pages/pfrc_papers.html

DATA & FILE OVERVIEW

File list: The files are contained in folders, each identified by date in the format YYYYMMDD. The files in each folder have titles that represent the type of data stored in them. Most data is in the form of screenshots from Digital Storage Oscilloscopes (DSOs). (See description of these screenshots at the end of this README.)

METHODOLOGICAL INFORMATION

Description of methods used for collection/generation of data: The data was collected by DSOs connected to the various diagnostics on the PFRC device.

Software- or Instrument-specific information needed to interpret the data, including software and hardware version numbers: The DSO are all manufactured by LeCroy.

Environmental/experimental conditions are described in files named *date-Runsheet.pdf*

The primary people involved with sample collection, processing, analysis and/or submission have been: S.A. Cohen, C.P.S. Swanson, P. Jandovitz, S. Vinoth, L. David, B. Berlinger

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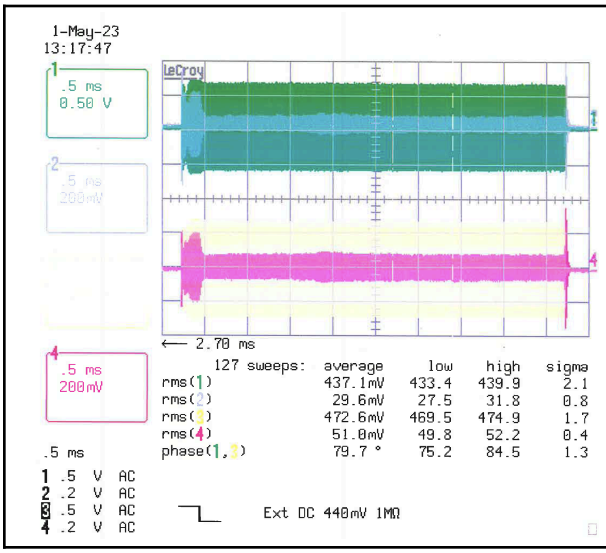
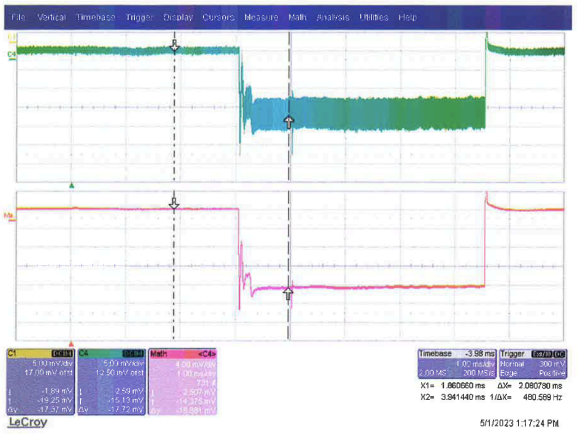
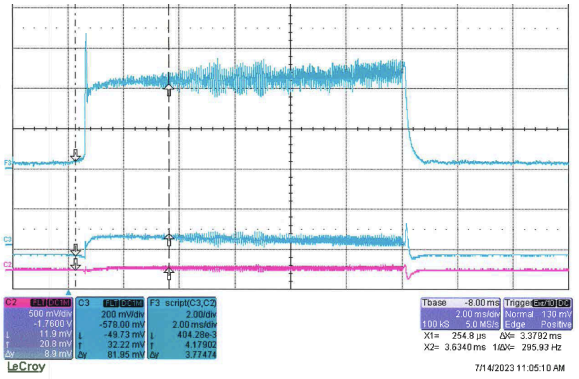
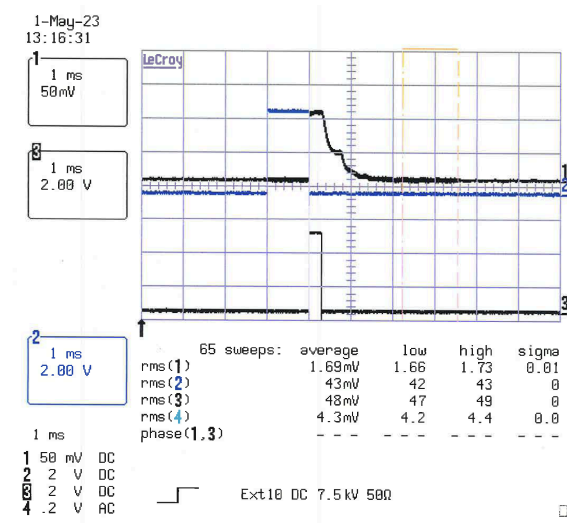
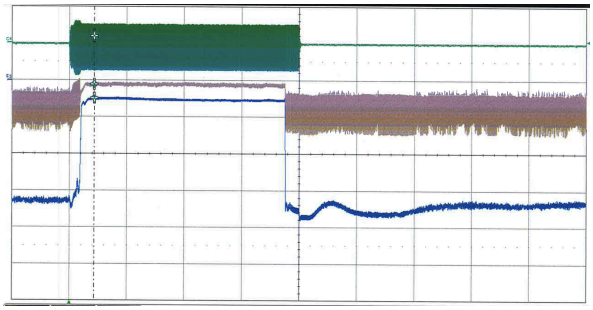
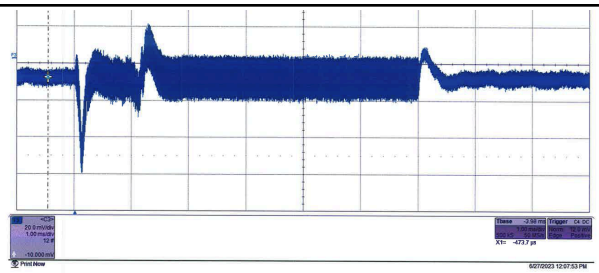
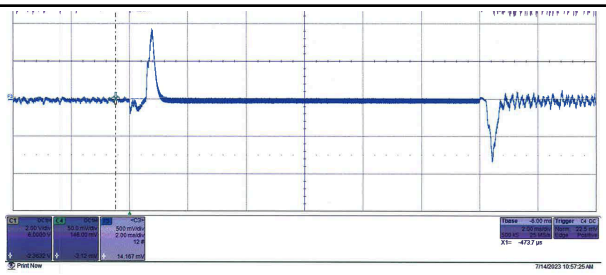
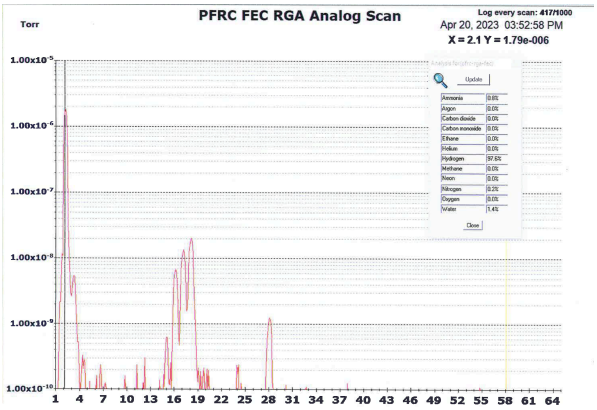
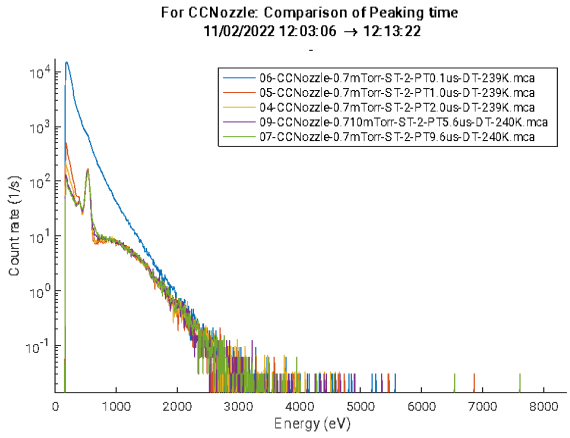
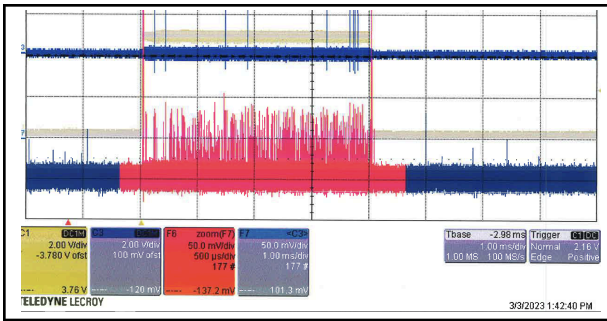
DATA-SPECIFIC INFORMATION

The main data in these files are PDF documents made by scanning screenshots of Lecroy DSO displays used to accumulate and analyze the data. These are in files named “date”-scope-#. Examples are shown below. The appearance of each screenshot indicates what data it displays. Additionally, there are PDF documents identified as “Date-Runsheet.pdf” that provide machine parameters, such as fill gas species, fill gas pressure, current in the magnetic field coils, RF power, both for the capacitively coupled system (P_{cap} = 87*$V^{1.79}$ W) and for the RMF system (for each antenna set, $2P_{RMF}$ = 430*V^2 kW), duration of the discharge, frequency of the RMF system, RMF pulse repetition rate, and time when data was taken. A blank runsheet is at the end of this README.

	PDF of Lecroy DSO showing forward and reverse RMF powers for the two antenna sets. Top: N/S antenna set. Bottom T/B antenna set. Bottom table – values averaged over 127 discharges. Example for N/S forward power. $_{N/S}P_{RMF}$ = 430*V^2 kW/2 = $.437^2$ 430 = 41 kW. The reflected N/S power is a small fraction of the forward power, $(29.6/437.1)^2$ = 0.46%

	PDF of Lecroy DSO showing absorbed RMF power from the two antenna sets. Top traces - Yellow (c1): N/S antenna set. Green (c4): T/B antenna set. Bottom trace (Ma) –T/B power, averaged over 731 pulses. 1 kW/mV. Example for T/B absorbed power. $P_{a,T/B}$ = 16 mV x 1 kW/mV = 16 kW
	PDF of Lecroy DSO showing interferometer data. Blue upper trace (F3) = single shot; n ~ 1.34 x 10^{12}/cc/V. Lower traces: raw interferometer data. Example. Line-averaged n_e seen ~ 5 Volts ~ 6.5 x 10^{12}/cc, assuming 8-cm-radius plasma. Other measurements show the radius to be smaller, ca., 5 cm, which yields a higher density, 1.04 x 10^{13}/cc. FFTs of density data are sometimes made.
	PDF of Lecroy DSO showing Gas puff data: Top traces. Blue - trigger signal to pulsed gas valve. (Trigger at negative slope.) Black – measured voltage at the gas valve. Bottom trace – voltage pulse provided to gas valve/10. Example: 46 volts seen in lower trace. Concerning the odd shaped black upper signal – the exponential decay is due to the capacitance of the coax cable connecting the pulse gas valve to the pulser.
	PDF of Lecroy DSO showing Cup voltage, V_{cup}, vs time. Capacitive discharges lower the paddle potential, here to ~ - 700 eV. Application of RMF causes the cup potential to rise towards or exceeding 0 volts. HV probe /1000. The Green trace is pickup of the RMF; the Brown is a single

	shot measurement of V_{cup}; the dark Blue is the average of ~ 100 shots.
	PDF of Lecroy DSO showing Tantalum paddle voltage, V_{Ta}, vs time. Capacitive discharges lower the paddle potential slightly, here to ~ - 8 eV. Application of RMF causes spikes in the paddle potential, sometimes + and , sometimes -.
	PDF of Lecroy DSO showing Voltage on paddle in FEC/1000, averaged over 12 discharges. RMF begins at caret (2 divisions) and ends at 8 divisions. The + going signal at 2.4 divisions is ~ 1.8 div x 0.5 V/div x 100 = 0.9 kV.
	PDF of Lecroy DSO showing RGA spectrum in FEC. Partial pressure vs AMU. The hydrogen pressure in the CC is about 100x higher.
	PDF of Lecroy DSO showing SDD measured X-ray spectra, 5 peaking times.

	PDF of Lecroy DSO showing X-ray arrivals vs time. Each red spike corresponds to a detected X-ray.

There are additional data taken with the Fast Camera. These data are in HDF5 format. Some Interferometer data are also in HDF5 format.

The Excel sheets are the post processing of the SDD X-ray spectrum or Spectroscopy. The .txt files are visible spectroscopic data and parameter files.

The data files go back to April 2014. During this period four different RMF frequencies were used on the PFRC. (The RMF frequency at which we operated is noted on each Runsheet. The table below serves as a shorthand.) Daily tuning of the RMF system might change the operating frequency by ~ 0.2%.

Apprx RMF frequency (MHz)	Start date (MM-DD-YYYY)	End date (MM-DD-YYYY)
8.0	01-01-2011	05-13-2019
6.0	05-20-2019	11-11-2019
4.3	12-05-2019	11-01-2022
1.8	11-05-2022	---

Sample Runsheet

			Date:															
			Run description:	**FRC/RMF$_o$**														
	Base pressures:	SEC IG (T)																
		CC IG (T)																
		FEC IG (T)																
	SEC Slow Baratron (T)																	
	CC Slow Baratron (T)																	
	RMF	frequency & phase																
	Magnet configuration & PS			4x8 + 8x4 coils; BB PS & 2 Magna powers inside 8; eight BN-covered FCs									Recentered 4-turn MC coil					
		RMF system		SRS -> duty factor limiters -> AR100LM9 -> 8KD -> 200 kW home made									antennas: 2-turn; cable: RG-226, 60" long					
		Time																
	Magnapower	L-2 Coils I (A)																
	Big Blue	L-2 Coils I (A)																
		Nozzle coils I (A)																
		SEC IG (T)																
	SEC Slow Baratron (T)																	
		CC IG (T)																
	CC slow Baratron (T)																	
		FEC IG (T)																
		FEC FB (T)																
	Ta paddle voltage																	
		Main valve																
		Navigator valve																
		End turbo valve																
	Gases/feed location/sccm																	
		PV-10 (V)																
		Pulse	A $t_o/\Delta t$															
			B $t_o/\Delta t$															
	CC Pressure (mT)		P_b															
	(Fast Baratron)		P_a															
	170 GHz	dia (mV)/IM freq																
	Glassman	High Voltage (kV)																
	RMFo system	main SRS																
		Pulse width (ms)																
	Time between pulses (s)																	
	Frequency: Center(MHz)/Span(KHz)																	
			Phase °															
			P_a															
			$P_{f\ (kW)}$															
	ϕ_M or % reflected																	
	Vf																	
	Vr																	
		Helicon Pf/Pr																
		Helicon (SRS/mod)																
		Comments/changes:		for $\Delta\phi = \pi/2$, n_e =2.1e12 cm-3 for 16-cm dia plasma													sheet __ of __	