

Preparations for CPP

February 23, 2022

GlueX Collaboration Meeting

Would be nice to have a picture here of the final delivery of MWPCs.

Andrew Schick

With: Alex Austrigesilo, Albert Fabrizi, David Hornidge, Mark Ito, Nikhil Kalra,
Ilya Larin, David Lawrence, Rory Miskimen, Elton Smith,
Simon Taylor, Beni Zihlmann

Running Conditions

Configuration	Nominal GlueX I	Charged Pion Polarizability	Neutral Pion Polarizability
Electron Beam Energy	11.6 GeV	11.6 GeV	11.6 GeV
Coherent Peak Energy	8.4-9.0 GeV	5.5-6 GeV	5.5-6 GeV
Current	150 nA	27 nA	27 nA
Radiator thickness	50 μ m diamond	50 μ m diamond	50 μ m diamond
Collimator aperture	5 mm	3.4 mm	3.4 mm
Peak polarization	35%	73%	73%
Tagging ratio	0.6	0.56	0.56
Flux 5.5-6.0 GeV	-	11 MHz	11 MHz
Flux 8.4-9.0 GeV	20 MHz	-	-
Flux 0.3-11.3 GeV	367 MHz	56 MHz	56 MHz
Target Position	65 cm	1 cm	1 cm
Target, length	LH2, 30 cm	²⁰⁸ Pb, 0.03 cm	²⁰⁸ Pb, 0.03 cm
Start Counter and DIRC	Nominal	Removed	Removed
Tagger microscope	Nominal for Peak at 9 GeV	Moved for Peak at 6 GeV	Moved for Peak at 6 GeV
Muon Detector	None	Installed behind FCAL	Not needed
Trigger	FCAL/BCAL (40 kHz)	TOF (30 kHz)	FCAL/BCAL (10 kHz)

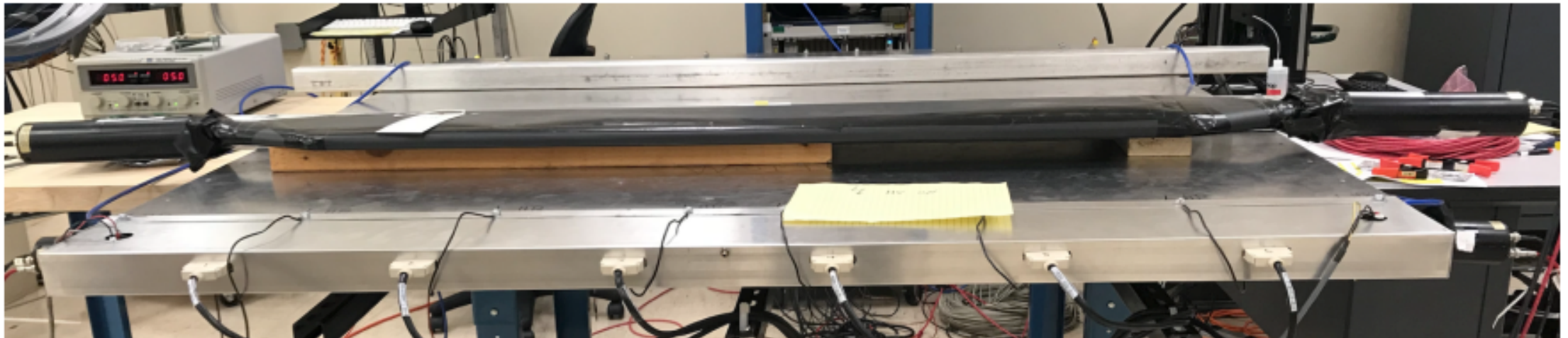
New Equipment and Installations

This Talk:
Concentrate on items in Blue

- Muon detector (UMass and Hall D Mechanical)
 - Modifications to forward platform
 - Modifications to FCAL dark room to allow installation
 - MWPC fabrication
 - Assembly of muon detector with MWPCs and iron shielding
 - MWPC testing in EEL; move to Hall D
 - Electronics and DAQ modifications for MWPCs
- Move tagger microscope to cover 6 GeV coherent peak
- Diamond radiator update
- Target and modifications to target area to use solid Pb target
- Development of TOF trigger
 - TOF design requirement document completed
 - Production trigger would include an 'OR' of the FCAL/BCAL trigger for NPP and the new TOF trigger for CPP + random, PS and LED calibration triggers

Muon chamber update

- As of last November, all 8 muon chambers have been delivered to JLAB (6 to be installed, 2 back ups)
- HV and LV testing in EEL with cosmic rays, ([GlueX-doc-5373](#))
- *No wires broken in move from UMass → EEL → Hall D. All detectors work!*



Chambers installed in hall D

First 4 chambers and absorbers

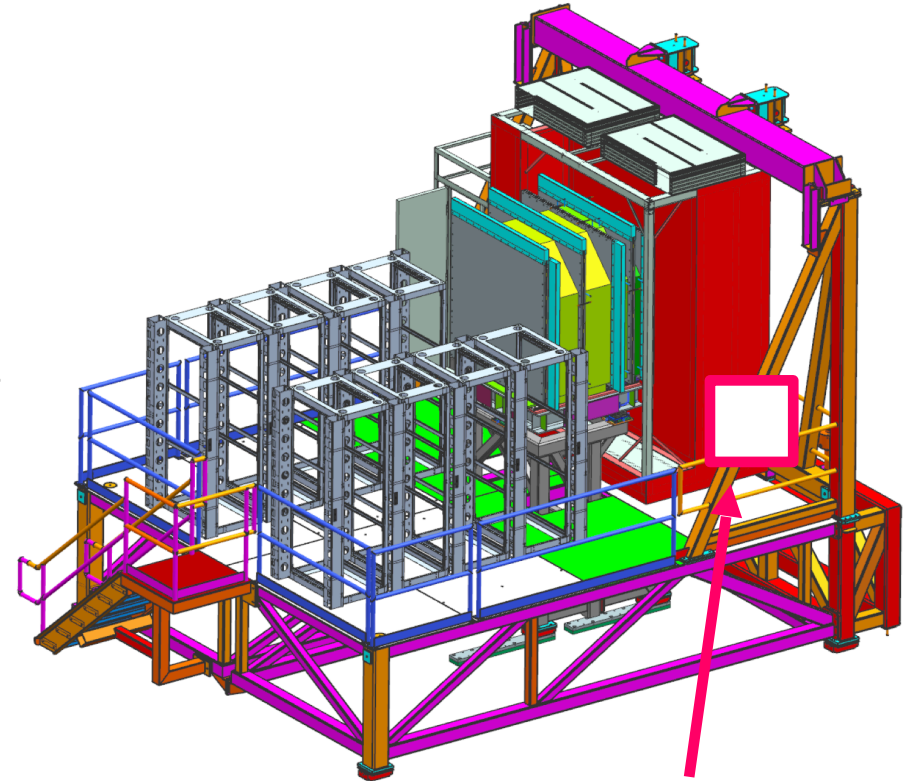


Last absorber with last two chambers



Electronics

- **Responsibility: Jlab Electronics (Fernando and Chris)**
- **Signal cables (new cables)**
 - Six MWPCs, 144 wires/MWPC, 864 wires total
 - 6 cables/MWPC, 24 wires/cable, 36 cables total + spares
- **Move crate from upstream platform to FCAL platform**
 - Locate a full rack on the north side of the muon detector
- **1 FADC signal crate (borrowed from CDC)**
 - 864 FADC-125 channels
 - 12 FADC-125 modules, 72 channels/module
- **CAEN HV crate (additional card in Ccal crate)**
 - Need special transition connector (Chris)
 - 1 SHV cable/MWPC, 6 HV channels total



Location of new rack

Electronics

- **Low voltage to power MWPC electronics**
 - Require two pairs +/-5 V inputs to each chamber ($2 \times 2 \times 6 = 24$ inputs)
 - MWPC chambers draw 1 A from each +5 and -5 V supply.
 - Need cable adaptor for connections to MWPC (Chris).
- **Gas system (Hall D Mechanical)**
 - The MWPCs will have their own gas system, premixed 90-10 Ar:CO₂
- **Slow controls (Hovanes)**
 - HV CAEN control
 - LV control of MPODs
 - Gas system
- **DAQ modifications needed to read crate in new configuration (Sergei and Sasha)**
 - There are spare optical cables on the forward platform
 - All systems will be used except for DIRC, Ccal, and Start Counter

Tagger

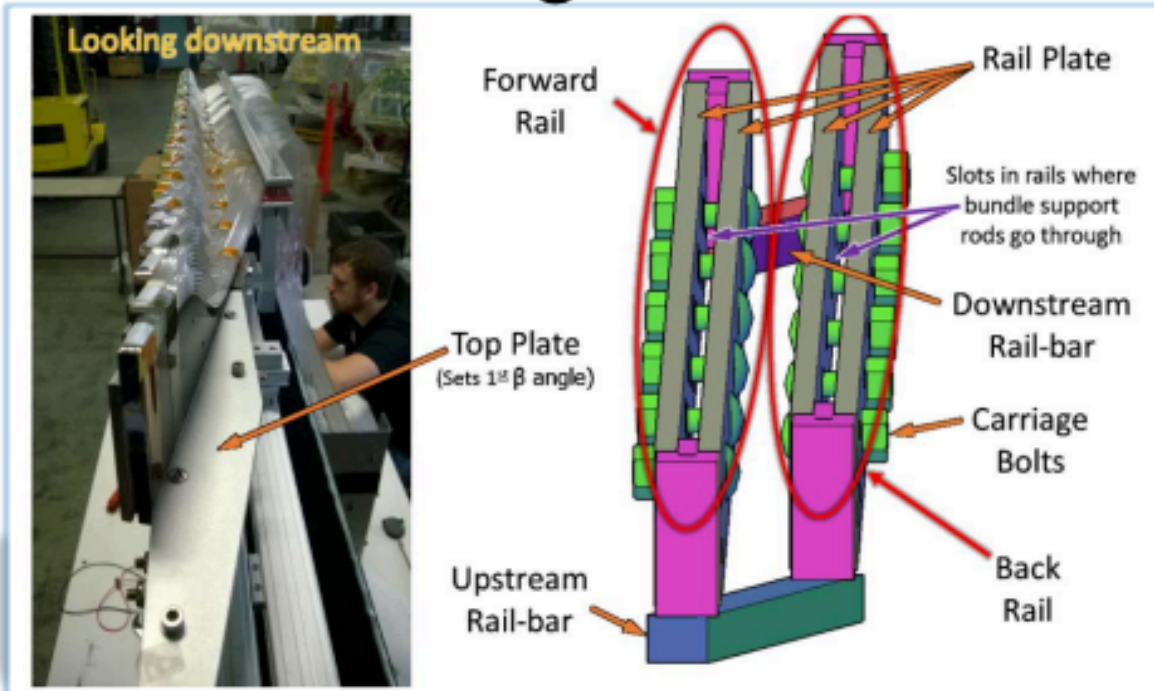
- Tagger microscope was successfully moved this January to cover 4.7 GeV - 6.2 GeV. Talk by James McIntyre, Daniel Prather, and Richard Jones ([GlueX-doc-5420-v1](#)).
- The hodoscope counters need to be reinstalled in the new microscope region



Diamond Radiator

- current 50um diamond JD70-105, used since fall 2018, is now at the end of lifetime due to radiation damage
- new 50um diamonds JD70-103, 106, 107, 109 are now mounted inside the goniometer, available for use for CPP
- while far from perfect, any one of these would be usable for CPP
- detailed rocking curve data were taken at CLS in 2019 on all 4 of these diamonds, and have been processed into images on storage at UConn
- UConn plans to integrate fits to harp scan data with visualization of the X-ray data to provide an online means to search for good beam spots
- tool will output coherent intensity and polarization profiles for a given beam spot shape and location on the surface of a given diamond radiator
- work in progress, demonstration model expected in 6-8 week time frame (April).
- will be presented at photon beam meeting

TAGM Realignment & Move



[GlueX-doc-5420-v1](#)

- Removed 17th fiber bundle (closest to beam dump)
- Replaced carriage bolts and spacers
- Inspected & documented SiPMs
- Aligned fiber bundles for new position along the focal plane
- Installed new “net” to hold down optical fibers
- Repaired issues with electronics

Target

- Pb target from PrimeX experiment in hall B, in hand.
- What are it's specs? Picture?

TOF Trigger

- Sasha Somov recorded few runs in raw mode at the end of SRC run for the firmware testing
- Firmware was made by Hai Dong specifically for TOF trigger.
- Ilya looked for rates, and the rates were 25% higher compared to what we measured year ago during dedicated runs. We are looking forward to hearing from Sasha about it.

CPP software

1. Started holding weekly CPP software meetings to address needs prior to summer run
 - Thursdays at 12:30 pm on zoom, [listed on CPP meeting page](#)
2. Core updates
 - a. Tracking code has been updated to project to each plane of FMWPC
 - b. CTOF recon classes added to FMWPC library
 - c. FMWPC recon classes added to FMWPC library
 - d. FCAL single block hits added to REST (for MIPs)
 - e. ...cont on next

CPP software

2. Core updates (cont.)

e. hdview2 has FMWPC viewer added

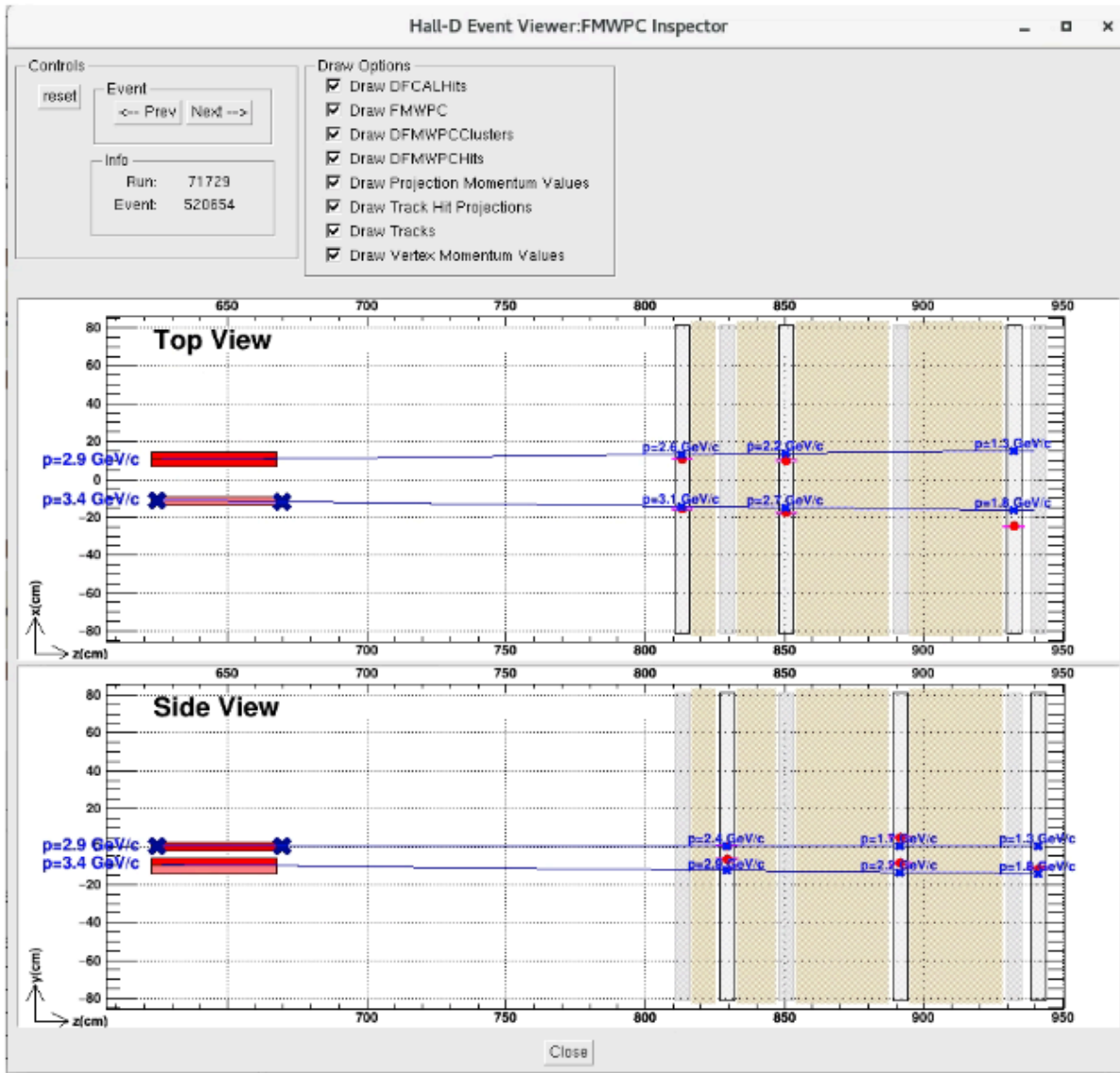
Source: ../output_files_mumu/hddm/cpp_mumu_20220121_071729_000_geant4_smeared.hddm

The screenshot displays the hdview2 software interface. At the top, there are control panels for View Controls, Event Controls, Info, and Inspectors. The Inspectors panel has a red arrow pointing to the 'FMWPC Inspector' button, with the text 'Open w/ this button' next to it. The main area contains four detector views: 'top view (looking down from above detector)', 'side view from beam right (south)', 'BCAL view from downstream looking upstream', and 'FCAL view from downstream looking upstream'. To the right of these views are color selection panels for BCAL and FCAL, and checkboxes for Track Draw Options and Hit Draw Options. At the bottom, there are two tables: 'Track Info Thrown' and 'Reconstructed'. The 'Reconstructed' table is populated with track data.

Track Info Thrown							Reconstructed										
trk:	type:	p:	theta:	phi:	z:		trk:	type:	p:	theta:	phi:	z:	chisq/Ndof:	Ndof:	FOM:	cand:	
1	Electron	12	0.0002365	4.147	-2400		1	e+	2.848	2.119	28.77	-0.7445	1.62	35	0.0116242	1	
2	Muon+	2.609	2.109	0.5345	1.012		2	pi+	2.844	2.119	28.79	-0.7418	1.62	35	0.0116042	1	
3	Muon-	5.85	1.395	3.504	1.012		3	K+	2.843	2.119	28.8	-0.762	1.632	35	0.0104948	1	
4	Lead	0.05099	82.56	0.02927	1.012		4	proton+	2.839	2.118	28.85	-0.8211	1.673	35	0.00752428	1	
							5	e-	5.927	1.38	-158.8	4.861	0.7956	31	0.782551	2	
							6	pi-	5.914	1.38	-158.8	4.875	0.7974	31	0.780161	2	
							7	K-	5.917	1.38	-158.8	4.868	0.7962	31	0.781741	2	
							8	proton-	5.91	1.38	-158.8	4.861	0.7978	31	0.779629	2	

CDD software

2.



```
setenv JANA_CALIB_CONTEXT "variation=mc_cpp"
```

```
setenv JANA_GEOMETRY_URL ccdb:///GEOMETRY/cpp_HDDS.xml
```

```
hdview2 -PRUNNUMBER=71729 \  
cpp_mumu_20220121_071729_006_geant4_smeared.hddm
```

Open
w/
this
button

CPP software

2. Core updates (cont.)

- e. hdview2 has FMWPC viewer added
- f. FMWPC_online plugin updated with some occupancy monitoring histograms and associated macros

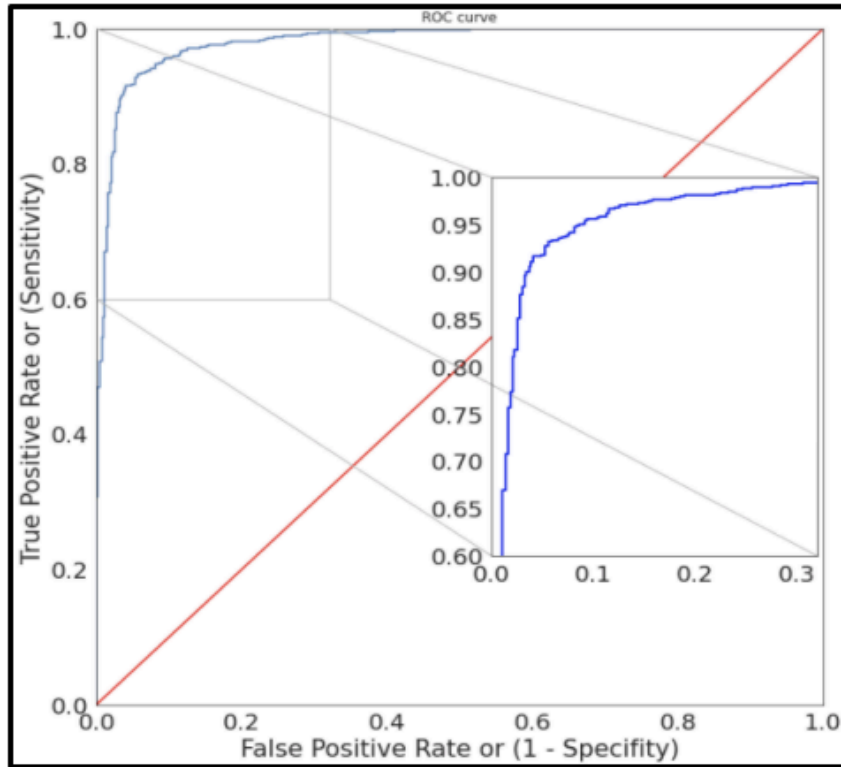
3. CPP geometry updated in HDDS/CCDB

4. Working on information flow to implement electron/pi/mu classification within framework (need kinfit tracks)

5. CPPMVATree plugin added to halld_recon on CPP branch

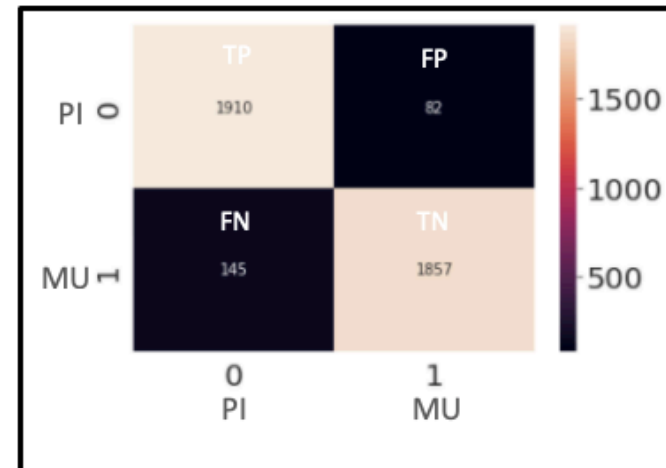
MVA for μ/π

Roc curve



Classification report

classification_report				
	precision	recall	f1-score	support
0.0	0.96	0.93	0.94	2055
1.0	0.93	0.96	0.94	1939
accuracy			0.94	3994
macro avg	0.94	0.94	0.94	3994
weighted avg	0.94	0.94	0.94	3994



Confusion_Matrix

David Lawrence, Malachi Schram, Nikhil Kalra

