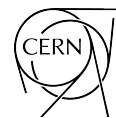


Test Beam July 2021

G. Rigoletti



EP-DT
Detector Technologies



Outline

- Data acquisition overview
- Results for EP-DT chamber
 - STD
 - ECO2

Data acquisition

Several runs taken:

- 1 Run = 1 Folder
- Failed run discarded
- Available runs here:
<https://cernbox.cern.ch/index.php/s/YCSoDfl6H8JRRiM>

Gas mixture	Gamma so	Folder	Comments
STD	Off	ECOGASSourceOffBeamOnSTD	First run. Max efficiency at 95% due to geometrical acceptance of triggers
STD		46 ECOGASABS213(46)BeamOnSTD	
STD		10 ECOGASABS211(10)BeamOnSTD	
STD		4.6 ECOGASABS113(4.6)BeamOnSTD	
ECO2	Off	ECOGASSourceOffBeamOnECO2	First run. Changed around 13 gas volumes
ECO2		220 ECOGASABS312(220)BeamOnECO2	Lower irradiation tested due to already high currents with ECO2 and higher irradiation filters from downstream
ECO2		69 ECOGASABS223(69)BeamOnECO2	
ECO2		46 ECOGASABS213(46)BeamOnECO2	
ECO2	Off	ECOGASSourceOffBeamOnECO2_2	Repeated run for better statistics
ECO2		46 ECOGASABS213(46)BeamOnECO2_2	Repeated run for better stats. To check if downstream the filter is different from the other same run
ECO2		10 ECOGASABS211(10)BeamOnECO2	Max irradiation tested. Currents ~ 500 uA
ECO2	Off	ECOGASSourceOffBeamOnECO2_3	Third run for better stats
ECO2		33 ECOGASABS222(33)BeamOnECO2Pions	Run with pions on RD51. Nothing should change on our side but just to be sure I indicated it was taken in this conditions. Rate data taken separately during no beam period.
ECO2		69 ECOGASABS223(69)BeamOnECO2Pions	Same as previous run

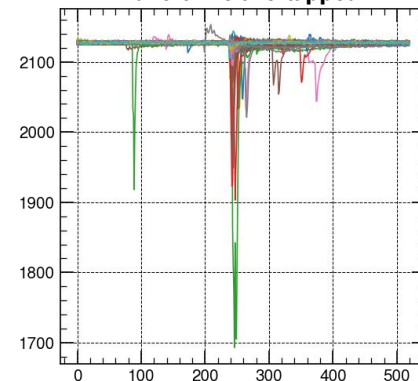
Data acquisition: details

Jupyter notebooks explaining data layout here:

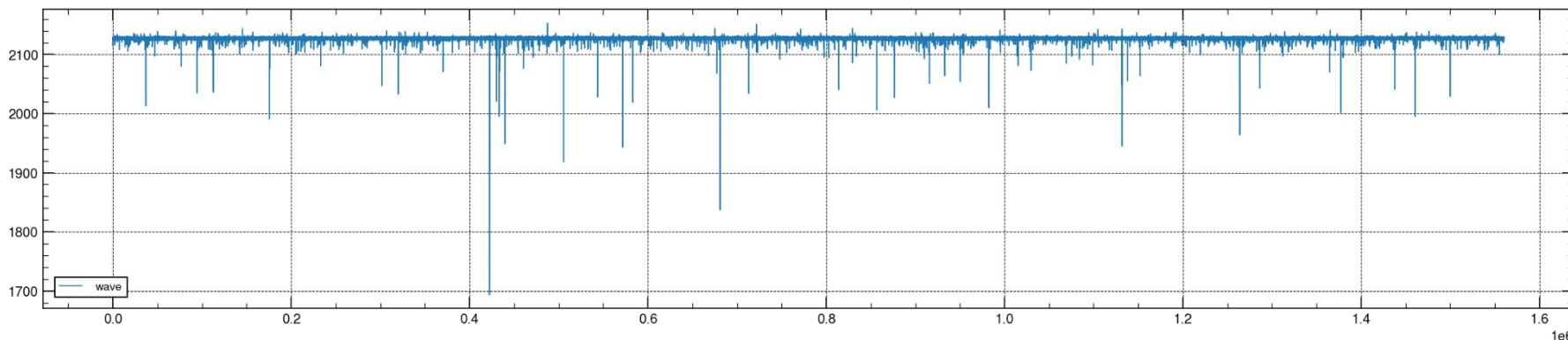
<https://cernbox.cern.ch/index.php/s/Hi7BzqPHt1PaNG8>

- Waveforms stored into .txt files
- 1 wave file = multiple waveforms (~3000 triggers recorded)

waveforms overlapped



wave.txt file content

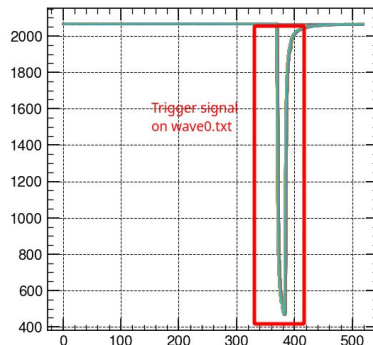


Data acquisition: details

- wave0.txt = trigger signal
- wave1-7.txt = 2.4 cm strips connected

When the source was ON:

- MIX0/ folder = trigger signals waveforms
- Rate/ folder = single, auto trigger long acquisition of gamma background signals



Run folder structure

	Rate	Auto trigger signals	Date modified: 19/07/2021 18:48
	results		Date modified: 19/07/2021 18:30
	acquisition_data_report		Date modified: 19/07/2021 18:48 Size: 41.9 KB
	currents	Recorded currents in .csv	Date modified: 19/07/2021 18:48 Size: 623 bytes
	currents		Type: PNG File Dimensions: 1012 x 1082 Size: 74.9 KB
	currents.xlsx	Recorded currents in .xlsx	Date modified: 26/07/2021 16:26 Size: 8.57 KB
	olefin_analysis.pkl		Date modified: 27/07/2021 09:56 Size: 33.5 MB Type: PKL File
	olefin_config	.yaml file with more metadata about run	Date modified: 19/07/2021 20:28 Size: 1.53 KB Type: Yaml Source File
	parameters	.txt file mapping between MIX0 folders and HV values	Date modified: 19/07/2021 18:30 Size: 439 bytes Type: DAT File

Data analysis

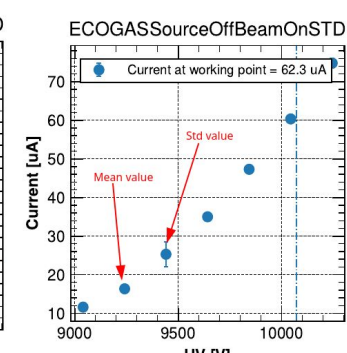
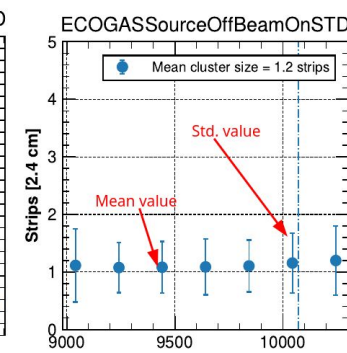
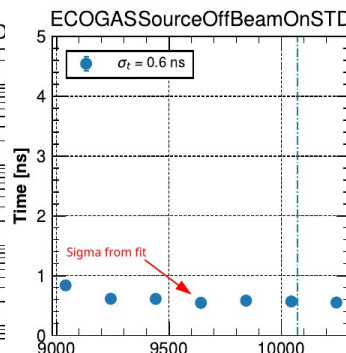
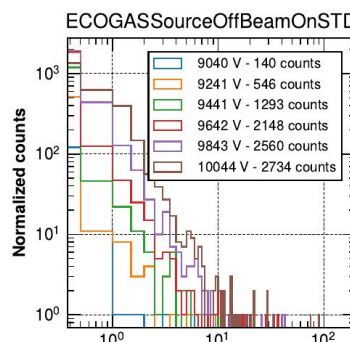
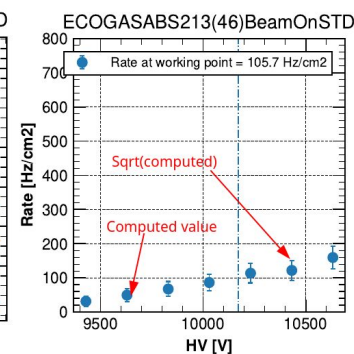
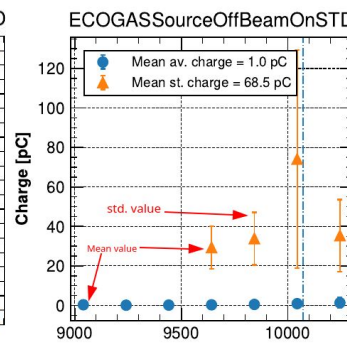
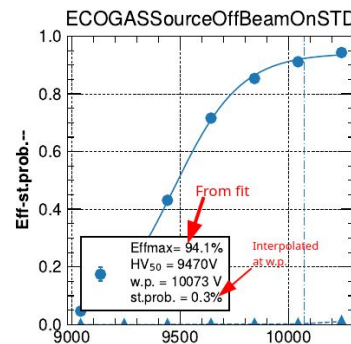
Parameters computed for each run:

- Efficiency
- Streamer probability
- Mean avalanche charge
- Mean streamer charge
- Cluster size
- Time resolution
- Currents (without beam)

Each parameter is computed also at working point

W.P. = Knee + 150 V

Knee = HV(95% Eff.Max)



Preliminary results

Folder with plots:

<https://cernbox.cern.ch/index.php/s/JLuBlrxYJZUu3CL>

Single pdf with all runs:

<https://cernbox.cern.ch/index.php/s/sNtTMNMGHixdXbV>

Excel file with computed values:

<https://cernbox.cern.ch/index.php/s/NqMHV1fILH2KB3z>

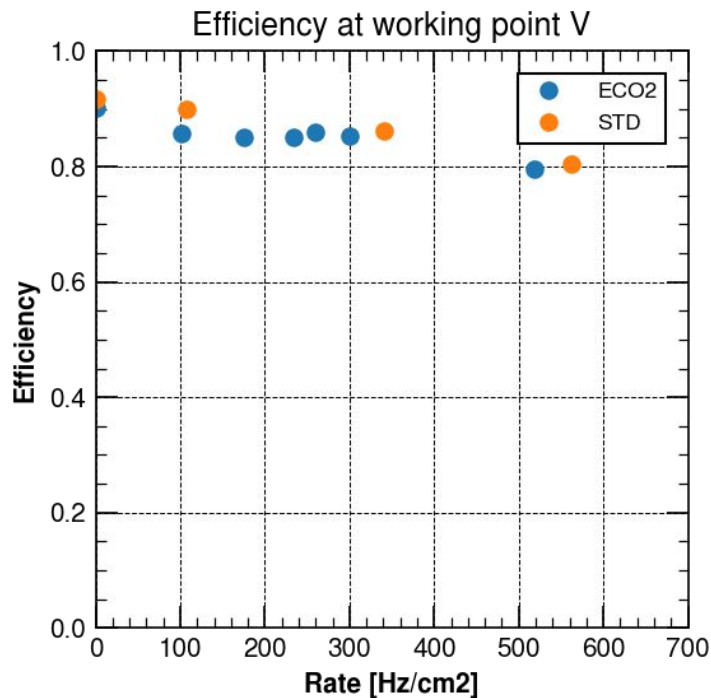
Summary results:

- Foremost parameter computed, taken at working point for different background rates:
 - Efficiency, w.p., avalanche charge, cluster size, currents, streamer probability



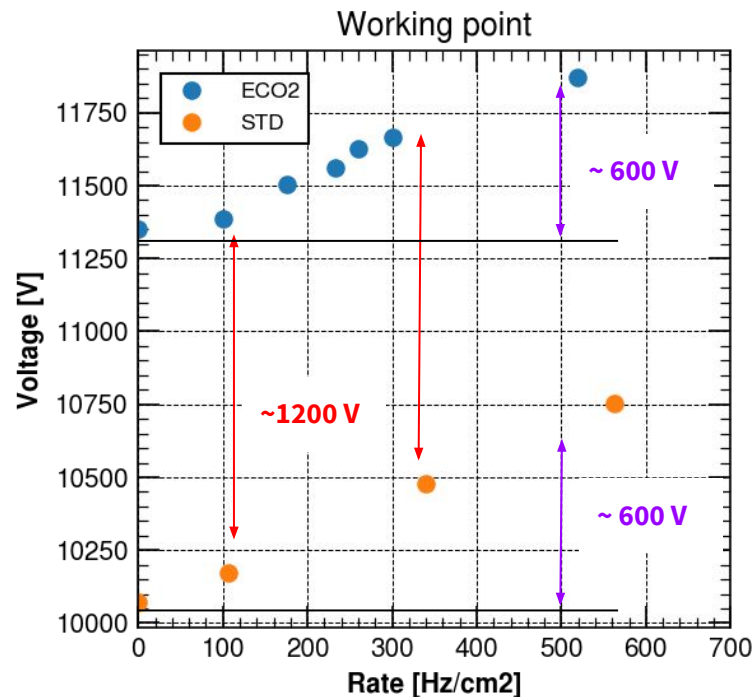
Preliminary results: efficiency at w.p.

- Both mixture have a similar efficiency drop with higher gamma background
- Efficiency drop $\sim 12\%$ / 500 Hz/cm²



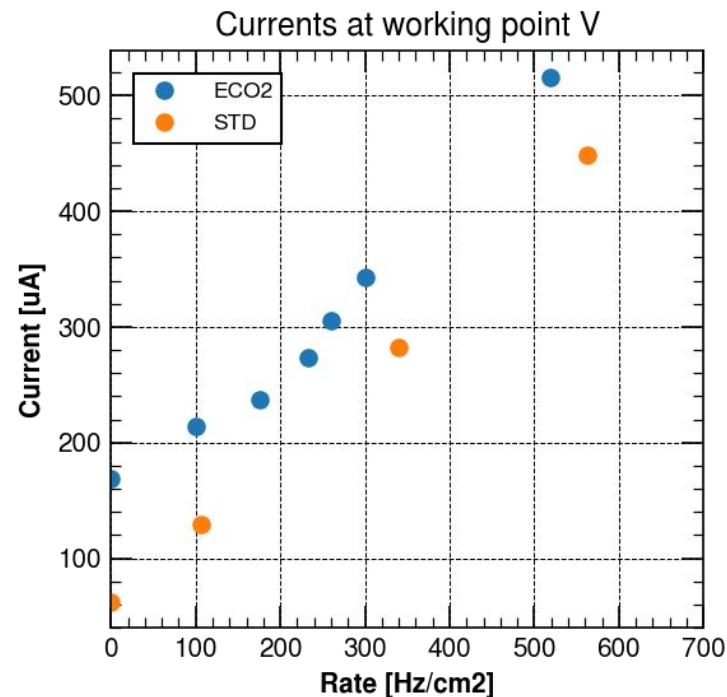
Preliminary results: working point

- Delta w.p ~ 1100-1200 V
- Similar to laboratory results (9.8-10 kV for STD mixture and 11-11.2 kV for ECO2)
- From 0 to 500 Hz/cm² the two mixtures share similar voltage drop ~ 600 V



Preliminary results: currents

- The currents for ECO2 seem to be ~ 20% higher at ~ 300 Hz/cm²
- Currents > 500 μ A for the chamber when rate > 500 Hz/cm²
- Gap size = 70x100 cm²
- Current density for $I = 500 \mu\text{A} \rightarrow 0.071 \mu\text{A}/\text{cm}^2$

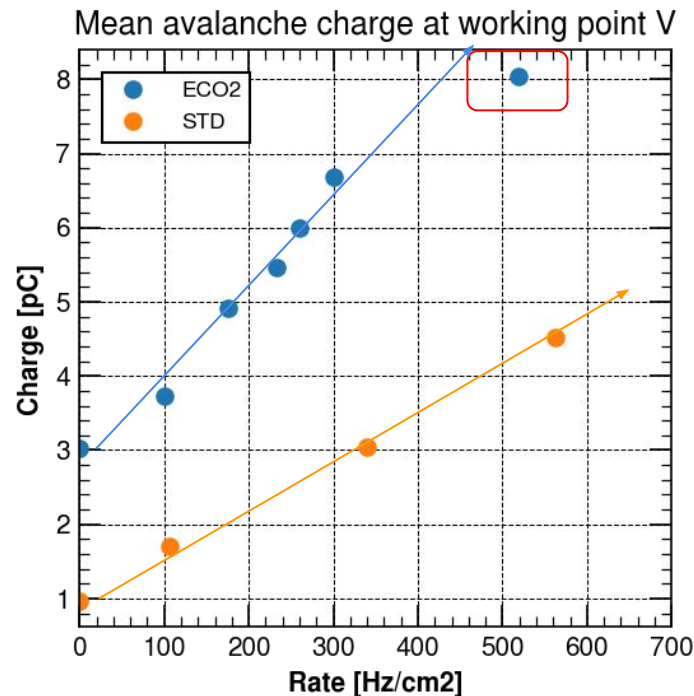


Preliminary results: avalanche charge

For the analysis

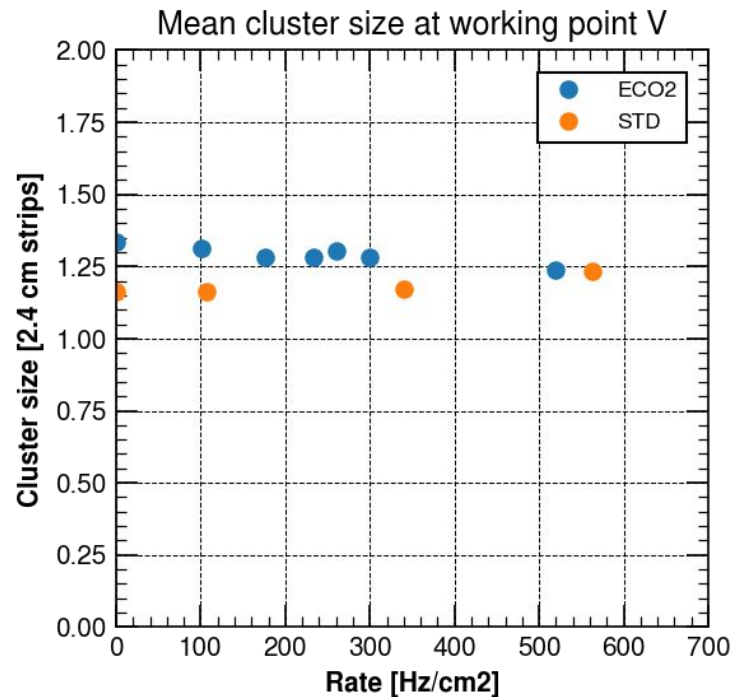
avalanche = $q \leq 10^8$ electrons

- Mean avalanche charge increases with rate
- For STD it increases of ~ 0.7 pC/100 Hz
- For ECO2 it increases of ~ 1 pC/100 Hz
- Last point in ECO2 might be out of trend due to saturation or working point estimation
- At 300 Hz/cm² we have ~ 3 pC for STD mix and ~ 6.5 pC for ECO2 (x2 times higher)



Preliminary results: cluster size

- Cluster size seems to be similar between the two gas mixtures

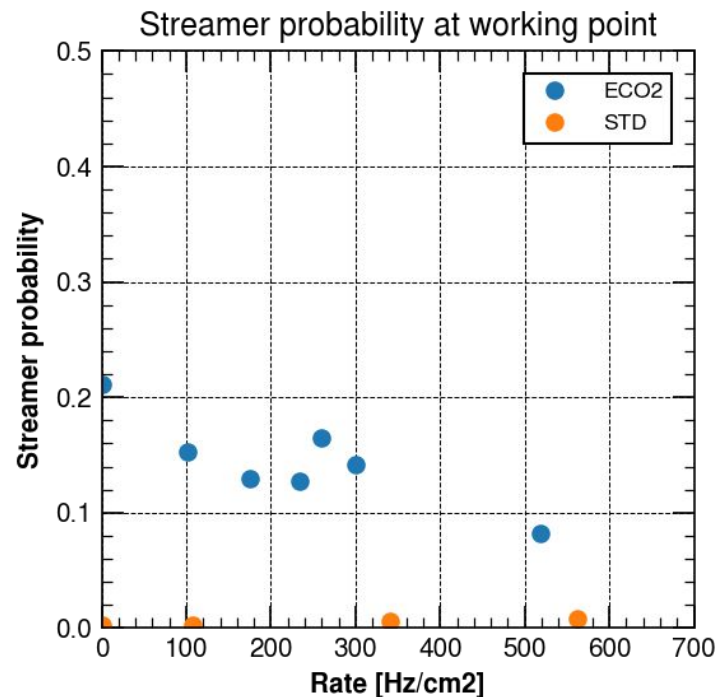
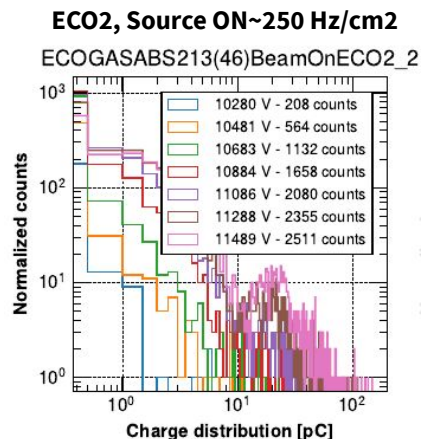
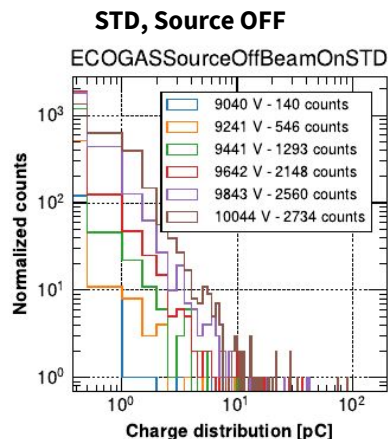


Preliminary results: st. prob.

For the analysis:

Streamer = $q \geq 10^8$ electrons

- Streamer probability at source off ~ 20 %
 - Compatible with EP-DT laboratory results
- Double population visible on charge distribution in the region 10-100 pX



Considerations

- Rate capability seems okay for ECO2
- Working point close to 12 kV for ECO2 at 500 Hz/cm² → might be too high
- Currents higher for ECO2 → to understand implications
- To be checked: currents stability at working point and high gamma background