Proposal for a setup for microscopic gas parameters measurement @ Bari

R. Radogna, *A. Colaleo, M. Maggi, P. Verwilligen, A. Pellecchia*

Uniba and INFN-BARI
22 April 2021

Expression of Interest

**Many activities ongoing on gas detectors @ Bari**
Our Interest:
- F-based alternatives for MPGD
- Microscopic studies for Fast timing MPGD
- Macroscopic behaviour of MPGD with new mixtures

A new proposal for the measurement of microscopic drift and ionization properties and macroscopic behaviour in MPGD
- in **environmental friendly gas mixtures** suitable for the operation of **gaseous detectors** at current and future colliders
- to provide **new data to be compared to simulations**
- in a **wide range of the electron energy**

Fast Timing MPGD

- Primary Ionization
- Secondary Ionization (due to δ-electrons)
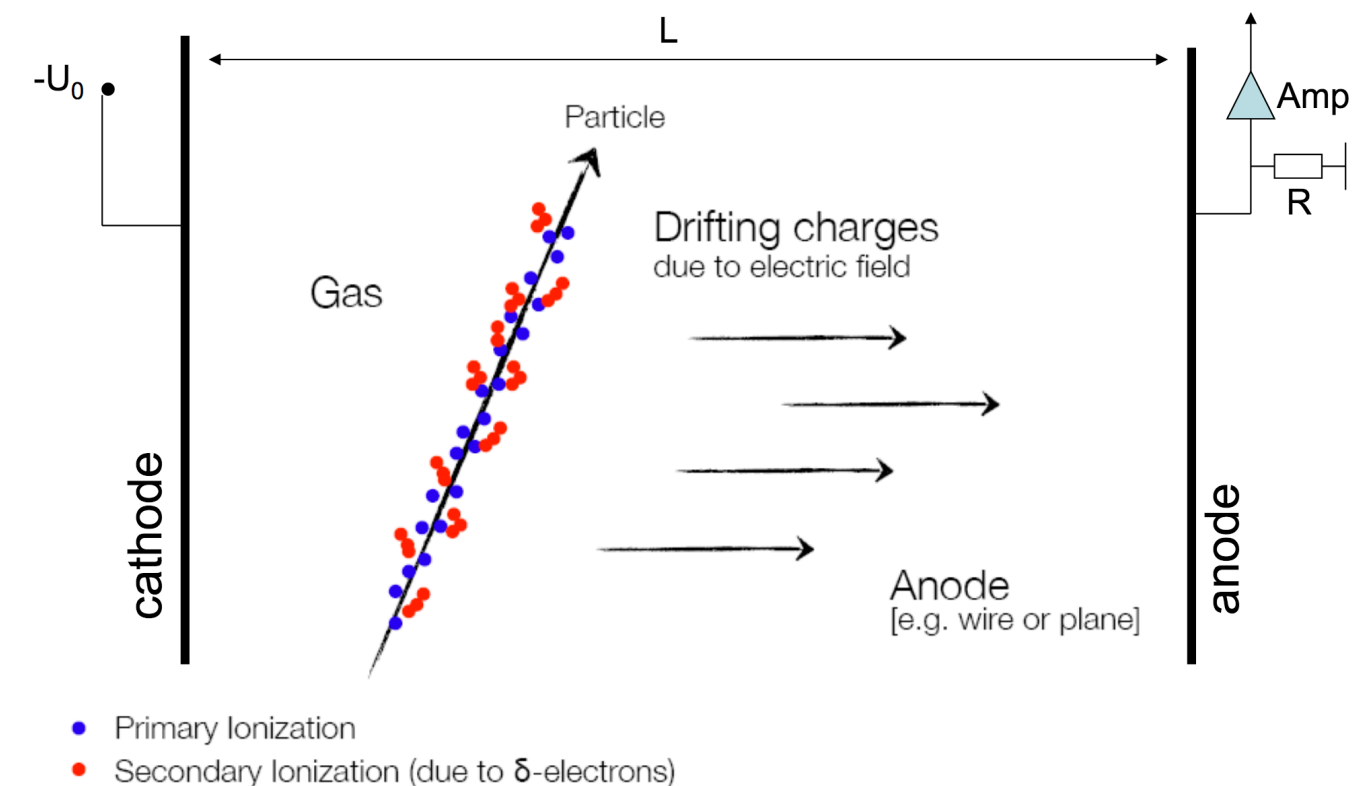
For Future Colliders
- to instrument **large areas**, gas detector technology will remain unchallenged
- **high rate capability** is needed
- **Fast Timing** will enable to identify the correct interaction in high-Pile-Up environment (as many as 200 collisions will overlap with the interesting event)

Operation
- **rate capability** governed through the evacuation velocity of ions
- **time resolution** σ_t depends on **ionization mean free path** and the **drift velocity** λ/v_d

Proposed Activity for Microscopic behaviour

Objectives

Experimental determination of electron ionization and drift parameters in gas mixtures for the operation of current and future gaseous detectors.

Applications

- investigating new gas mixtures GHG-free
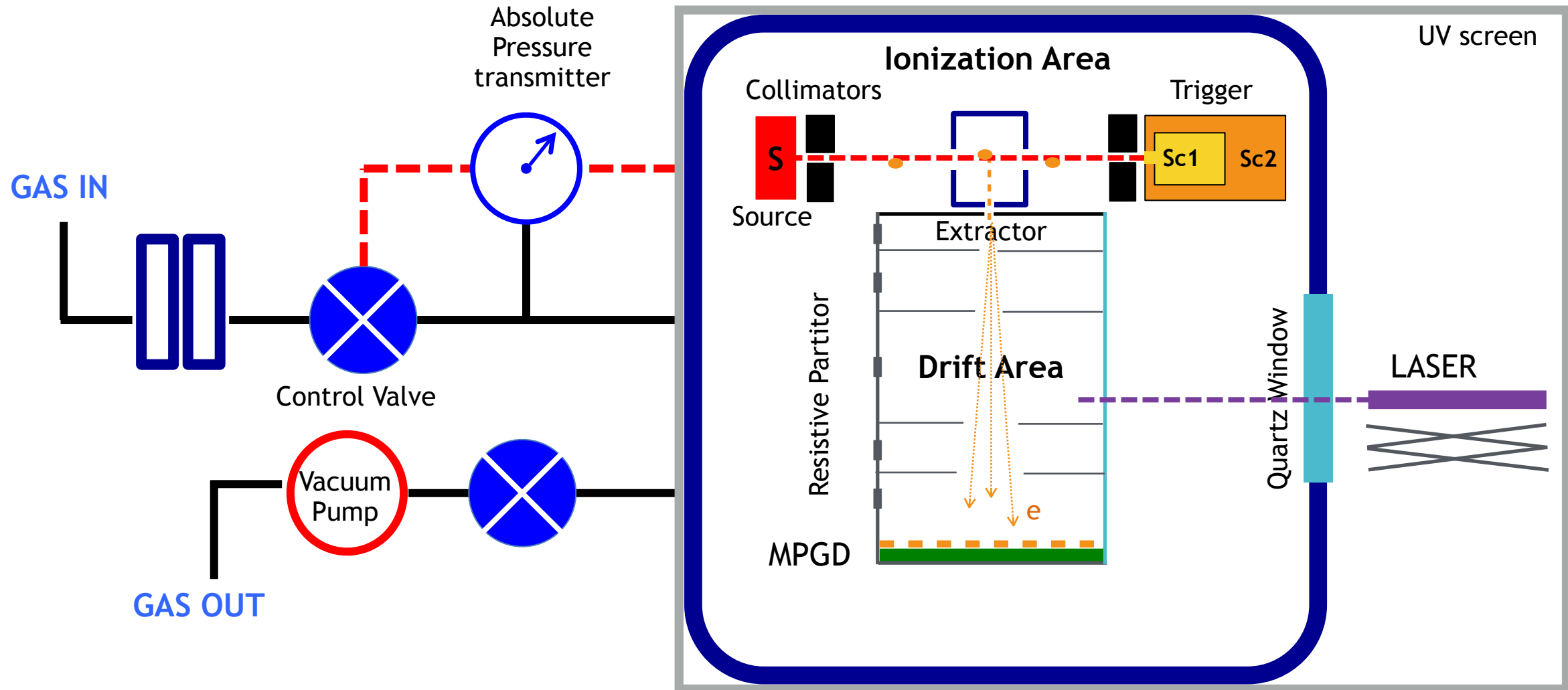- new data for MC simulations in a wide energy range

Measurements

- **M1** - **drift velocity** and **diffusion coefficients**
- **M2** - ionization **mean free path** λ
- **M3** - ionization **cluster size**

Work Packages:

- **WP1** - **Experimental set-up** design and assembling. M1-2-3 for Ar/CO2
- **WP2** - M1-2-3 using **new gas** mixtures
- **WP3** - Computer **Simulations**

Experimental Set-up

Set-up

- **electron gun** mounted in a collimator defining a narrow beam.
- **trigger** system (Sc1 AND !Sc2) and electron energy measurement Sc1.
- MPGD detector (GEM) will be considered at the **anode.**
- guard electrodes connected to a resistor chain for the **electric field.**
- apparatus enclosed in a vessel filled with the **gas** under investigation.
- **pressure to control** primary ionization density and detection efficiency.

Experimental Method
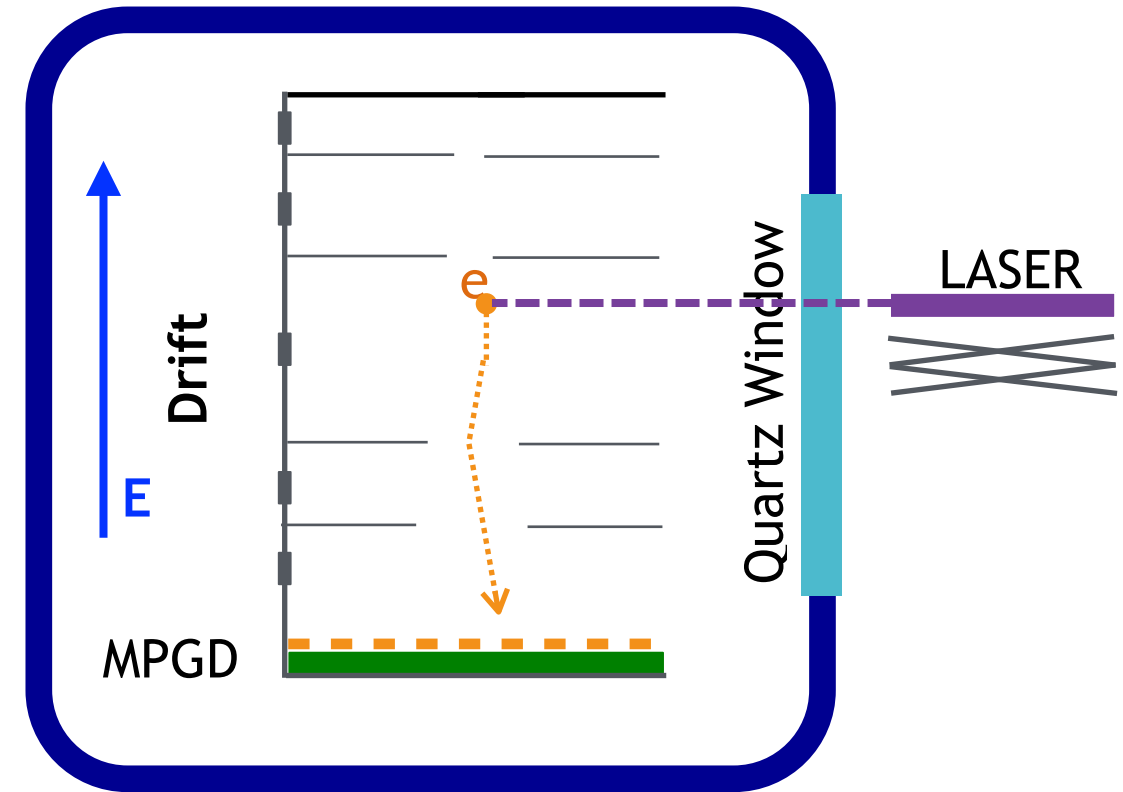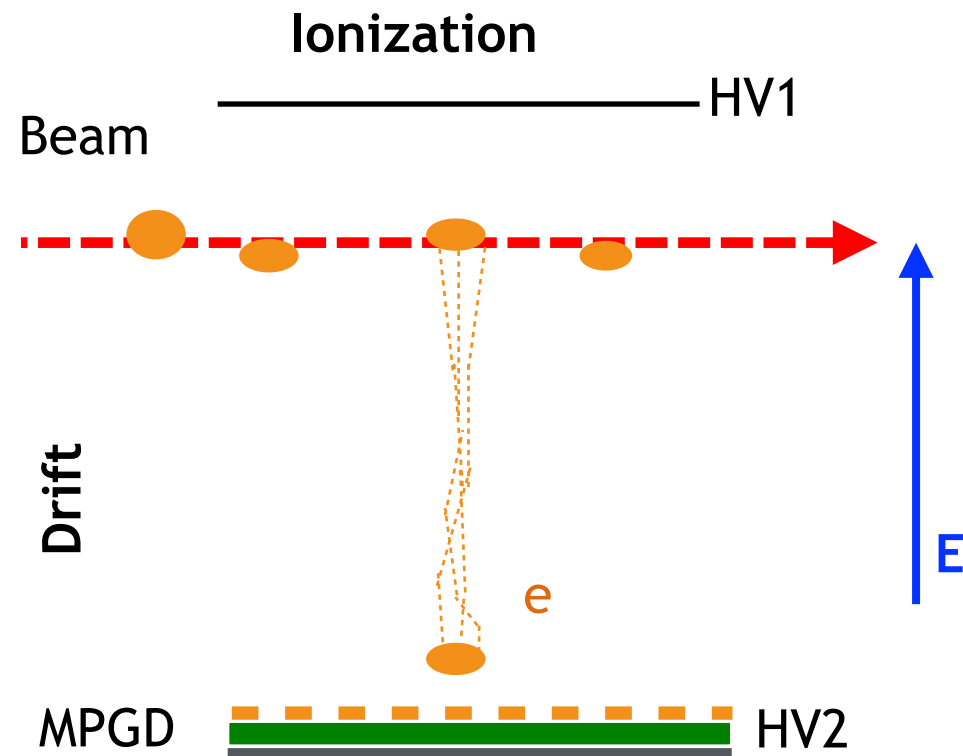
Measurement-1 (M1):

Drift velocity and longitudinal diffusion coefficient (σ_L)
- arrival time distributions of single clusters or single electrons at the end of a variable drift distance;
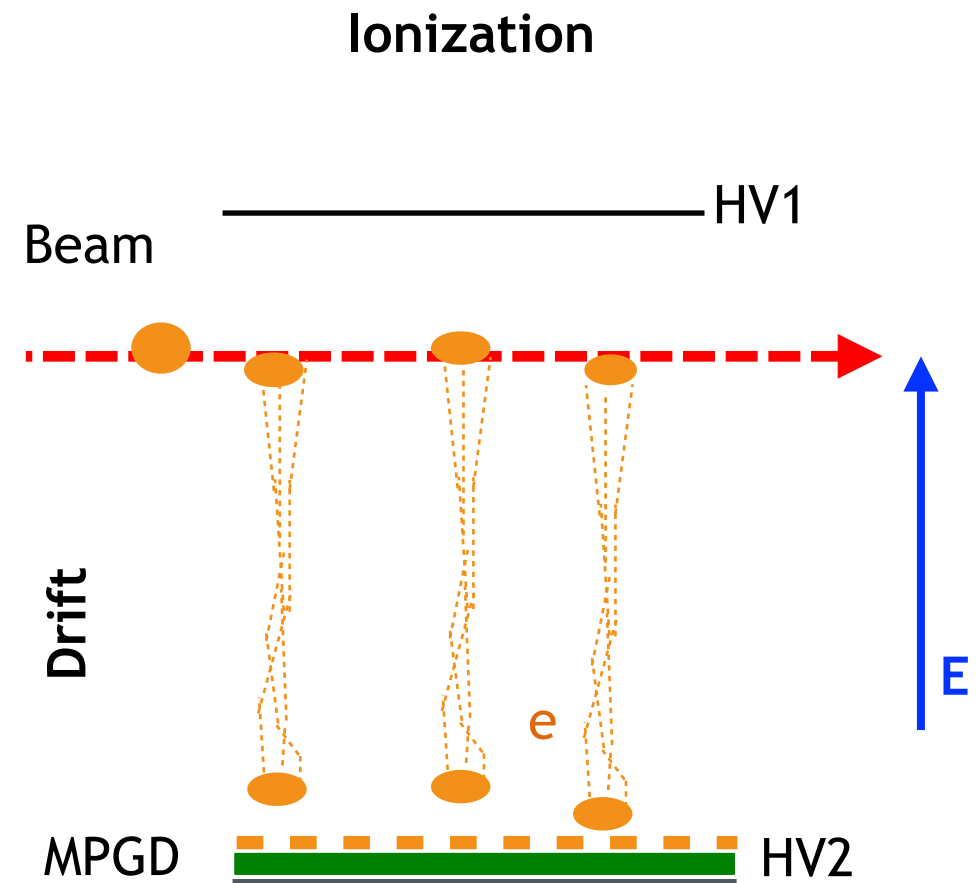
Transverse diffusion
- transverse spatial distribution of electrons arriving at the anode

Experimental Method

Measurement-2 (M2):

Ionization mean free path λ
- the full collection of clusters along the electron path will be detected, and thus the **ionization mean free path** from the distance among two consecutive clusters.
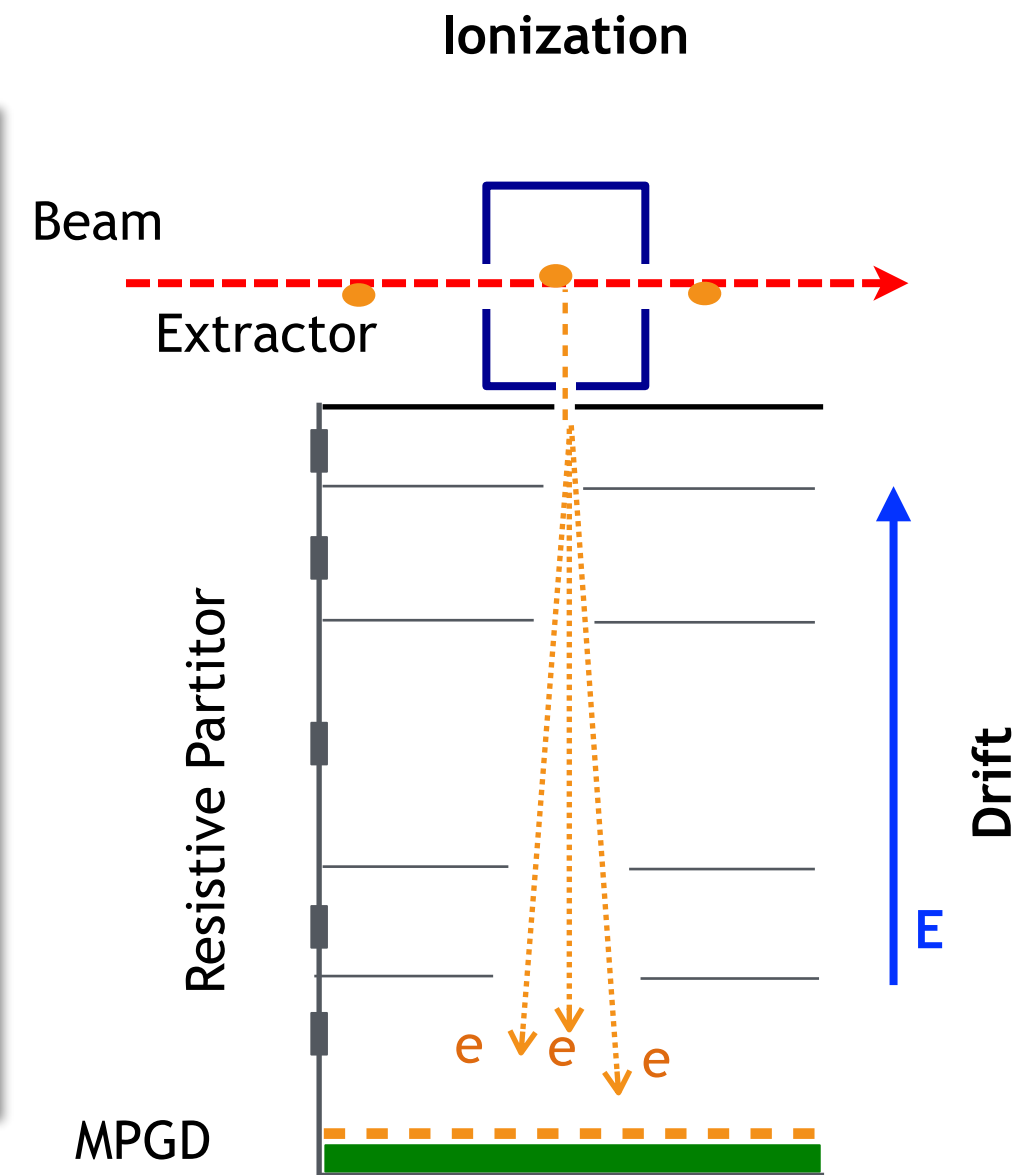
Ionization

Beam

HV1

Drift

MPGD

HV2

e

E

Measurement-3 (M3):

Cluster size
- one single cluster will be isolated
- setting a long drift region, the **electrons in the cluster** will be separated from each other by diffusion
- the electrons will be counted separately.

Summary and Impact

- A drastic **reduction of GHG emission** is compelling to fight the global warming
- The need for **eco-gas** is especially true **for fast gaseous detectors**
- Systematic study of **microscopic properties** of gas mixtures for MPGD
- Macroscopic behaviour of **MPGD** with new mixtures
- Effort to provide new data for **simulations**

Thank you
for your attention