ThickGEM studies recommendations:

- Electron Transfer Properties
- Maximum Gain
- Rate Capability
- Uniformity
- Temporal Stability

All measurements should be performed with following parameters:

- Fixed gas Ar-CO2 70-30 (with monitored oxygen and water content),
- Fixed gaps (10 mm drift, 5 mm induction) → Anode readout (not bottom GEM electrode)
- Collimated source (1mm and 10 mm diameters) with fixed energy (Fe or Cu),
- Fixed rates (100 Hz for Pulse Height measurements and 10^4 for Current measurements),
- Fixed electronics shaping time (1 microsecond) for PH measurements.

ThickGEM should be treated in controlled way before being mounted into the gas container (for example baked for 24h at 60 degrees C). Gas should be flushed at least for 12h after ThickGEM mounting. Dark current should be continuously monitored. HV should be supplied by individual power supplies to each electrode with current limit set to 100 nA.

Electron Transfer

Measurement of the PH and Energy Resolution as a function of Drift (Induction) field for fixed Induction (Drift) field at different ThickGEM voltages, to define external fields for other measurements. Working fields should correspond to optimum electron collection into the hole and transfer to the anode, but below parallel plate amplification threshold. **Possible temporal instabilities should be taken into account by keeping HV on and irradiating detector prior to measurement (this remark holds also for Maximum Gain, Rate Capability and Uniformity measurements**).
First guess would be 1kV/cm for drift and 3.5 kV/cm for induction fields.

Maximum Gain

Measurement of the PH and Energy Resolution at fixed optimum external fields defined by previous measurement at different ThickGEM voltages (note that transfer properties will vary during this measurement). Measurement should be stopped at the point when several (3-5) consecutive discharges occurred, defined by HV power supply trip with current limit set to 100 nA. Possible external discharge problems should be eliminated by testing detector with pure nitrogen or CO2.

Rate Capability

Measurement of the PH (at fluxes below 5x10^4) and current (at fluxes above 10^4) at fixed drift, induction and ThickGEM fields defined in Electron Transfer Measurement and gas gain ~1000 as a function of X-rays rate. There should be an overlap between PH and current measurements to be able to combine them. Rate estimation at high rates is done with absorbers calibrated at fluxes below 10^4.

Uniformity

Measurement of the PH and Energy Resolution in several points covering whole active area at low rate and gas gain of ~1000.

Temporal Stability

Temporal Stability studies consist of 3 different measurements.
Every measurement should be performed in the fresh, non-irradiated point. After irradiation, **PH and Energy Resolution scan** should be done in steps of 1mm around irradiated area, to disentangle between global and local (correlated with irradiation spot) effects.

1. H.V. should be off at least for 12 h before measurement. At H.V. on, low rate irradiation is switch on every 15 min only for the time of PH and Energy Resolution measurement. Measurement is performed until plateau is reached.
2. H.V. should be off at least for 12 h before measurement. At H.V on detector is irradiated contentiously at low (high) rate. PH and Energy Resolution (current) is measured every 15 min until plateau is reached.
3. H.V. should be on for the time corresponding to plateau determined in measurement 1. Detector is irradiated contentiously at low (high) rate. PH and Energy Resolution (current) is measured every 15 min until plateau is reached.