Expression of Interest – CEA Saclay

Please indicate the name of the contact person for this submission:
F. Bossù

Please indicate all institutions collectively involved in this submission of interest:
CEA Saclay

Please indicate the items of interest for potential equipment cooperation:
Main area of interest:

- MPGD for particle tracking
- Front end electronics for tracking detectors
- Reconstruction software for tracking detectors
- Micromegas timing layers (Picosec) for TOF or sampling calorimeters
- PARTONS software for DVCS and DVMP phenomenology and MC event generator

More details in the following slides

Expression of Interest - CEA Saclay

Opportunities for engagement of other groups

In these areas, we welcome the collaboration of other groups:

- Large areas MPGD construction and integration
  - CEA Saclay participate in eRD6 and we have ongoing discussions with Yale
- Development of ASICs
- PARTONS software
  - Collaboration with Warsaw NCBJ already in place

Discussions underway to potentially make a common EoI from both French research institutions: CNRS/IN2P3 & CEA-Saclay

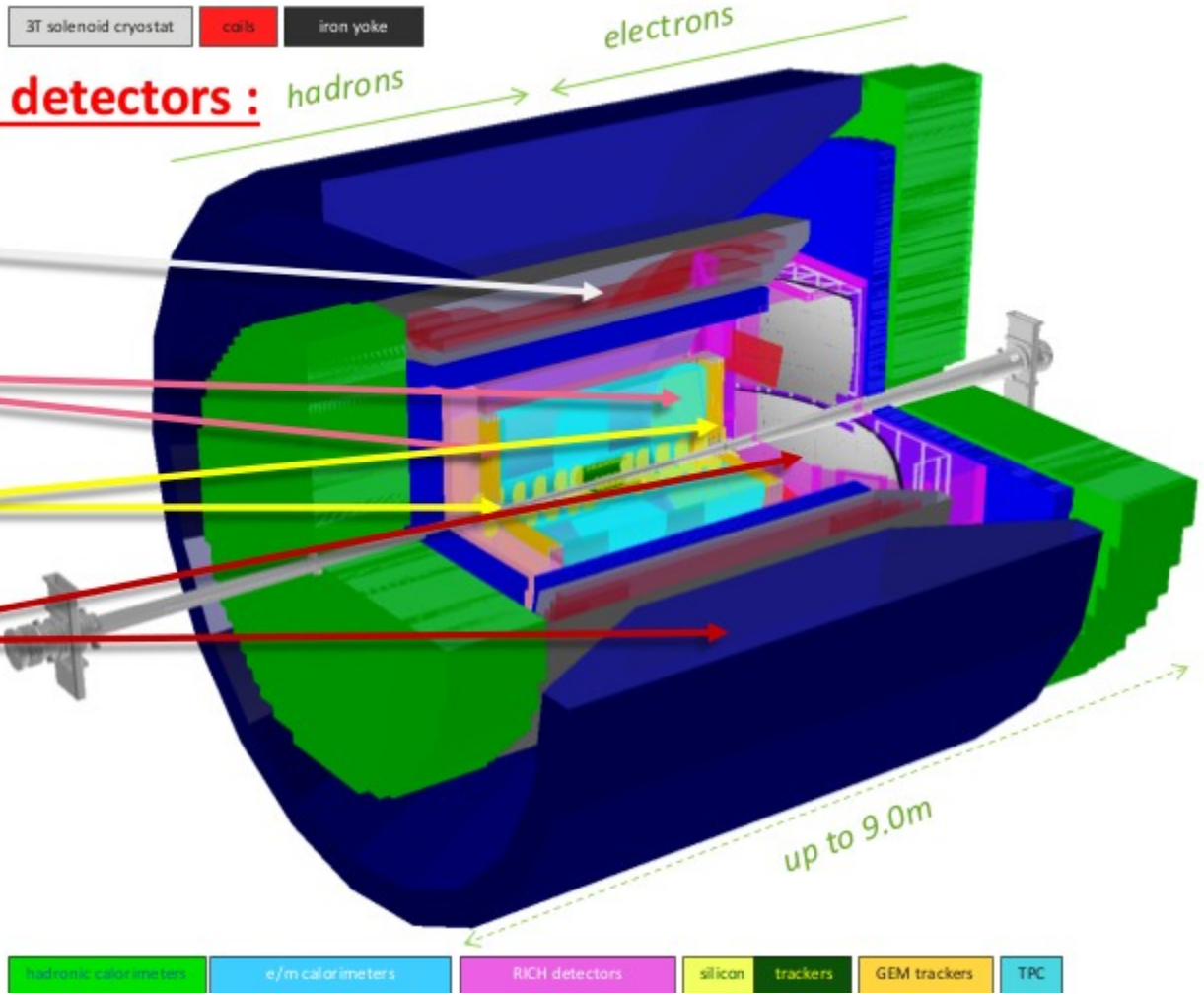
Additional information you think may be useful for the community to know about your expression of interest.

Refer to the following slides for more details

WHERE CEA-SACLAY CAN CONTRIBUTE

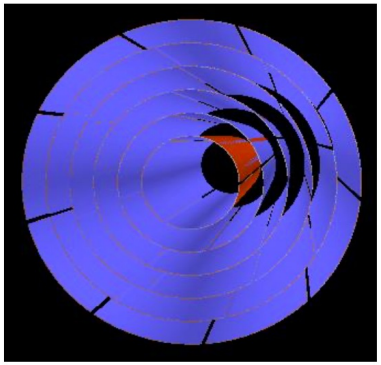
IRFU's expertise in tracking detectors :

- Barrel detectors
- TPC Readout
- Forward Detectors
- Timing Detectors

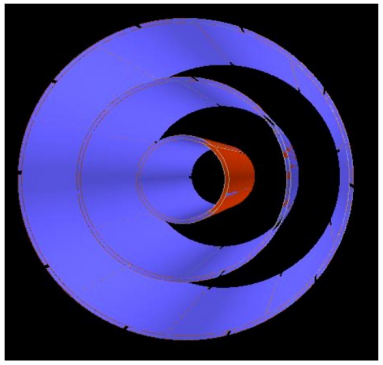


CENTRAL REGION

Micromegas based tracker

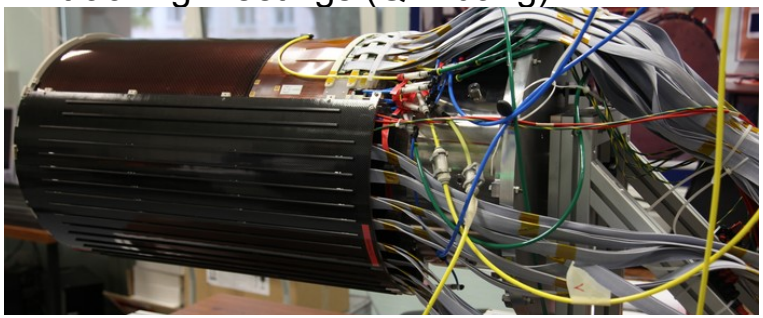


6 equidistant layers

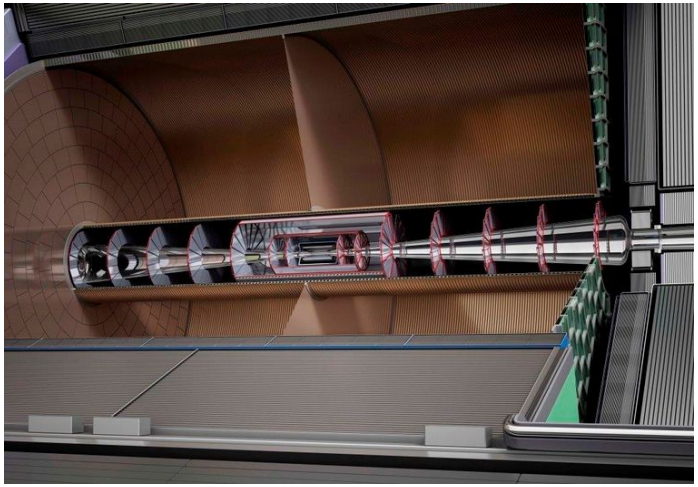


6 layers arranged as 3×2

- Compact design and low material budget: about 0.3%X0 per layer
- Good resolutions: spatial ~100µm, time ~40 ns
- Curved MM technology already used in CLAS12 and ASACUSA
- Ongoing R&D on readout patterns (M.Revolle)
- Preliminary geometries discussed within YR tracking meetings (Q. Huang)



MM based TPC readout

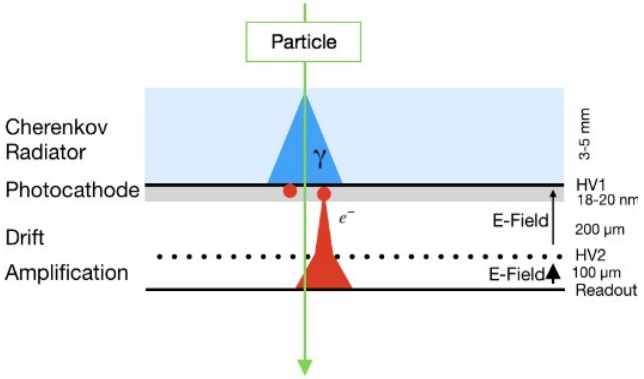


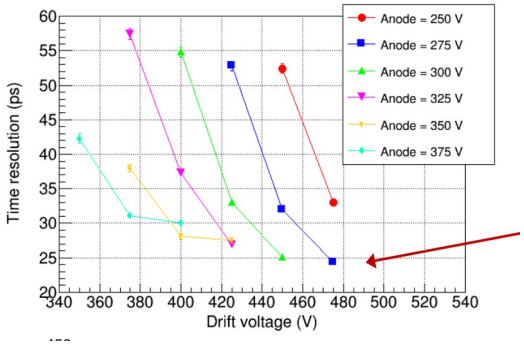
- EIC TPC will require good dE/dX resolution and minimum material budget in the endcaps
- MM provide similar performances as GEM, with less material
- IRFU's experience in TPCs for ILC, T2K, Minos, FCC
- Ongoing R&D for a very low IBF and with a good energy resolution (A. Glaenzer)

TIMING DETECTORS AND FORWARD REGIONS

Picosec: Micromegas for timing detectors

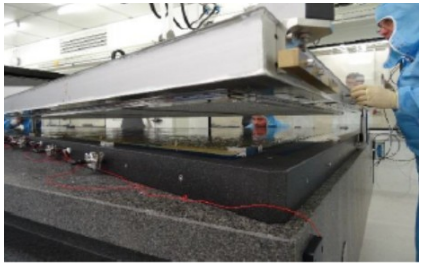
- Use light (Cerenkov radiation) instead of ionization: fast detectors
- Cheap and modular design
- Time resolution ~25 ps for MIPs





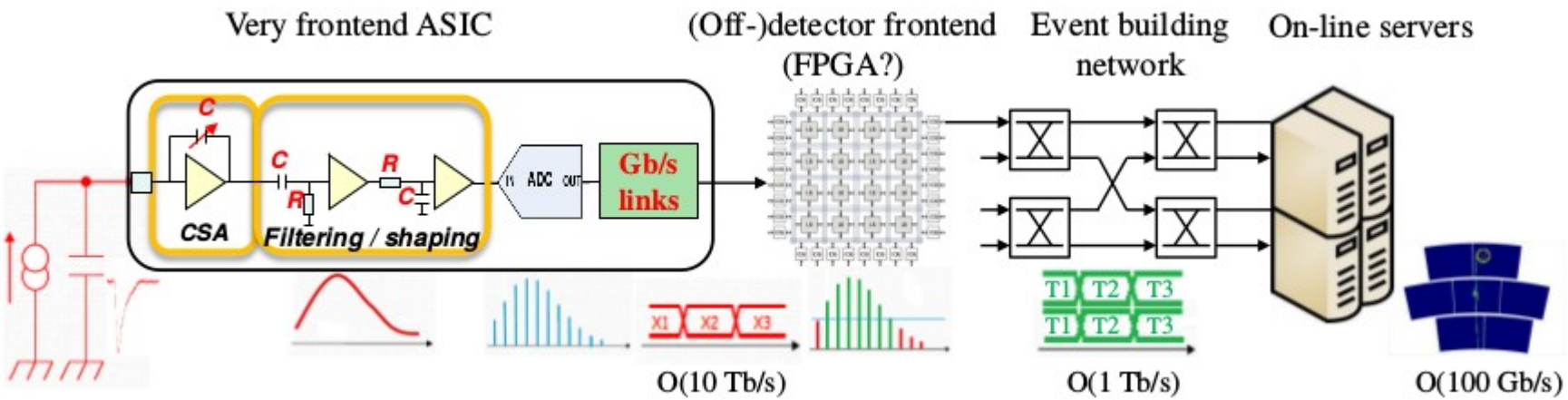
Forward tracking detectors

- Experience in high rate detectors (COMPASS, CLAS12, ATLAS)
- Very large detectors ATLAS NSW
- 1200m2 of resistive Micromegas
- 100μm mechanical precision
- Maximum rate of 15kHz/cm2
- 2M channels read by MMFE-8



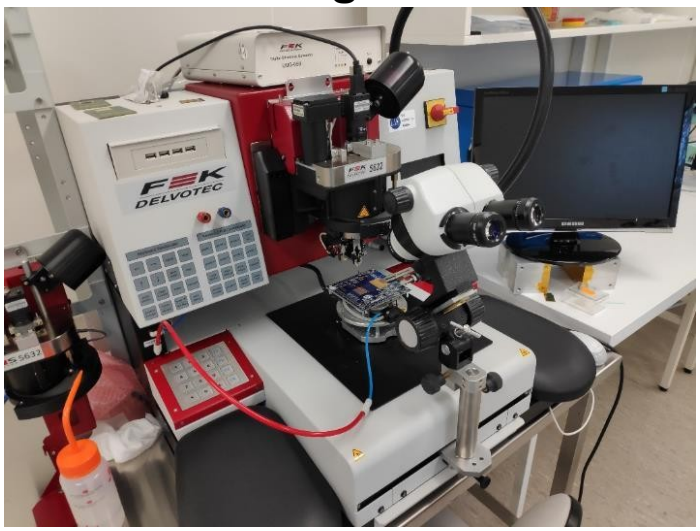
ELECTRONICS

- Substantial experience in the design of readout systems
  → Among major contributors to HEP experiments world-wide
  Gaseous TPC / trackers, active sensors, calorimeters, muon spectrometers
- Concentration of know-how
  → Analog / digital ASIC and electronics board design
  → Turnkey system developments with O(100k) channels
- Close access to advanced machinery for prototyping, production, validation
  → In-situ and within the scientific-industrial pole of the Plateau de Saclay
- Successful history of co-developments
  → ASICs, boards and trigger/DAQ systems

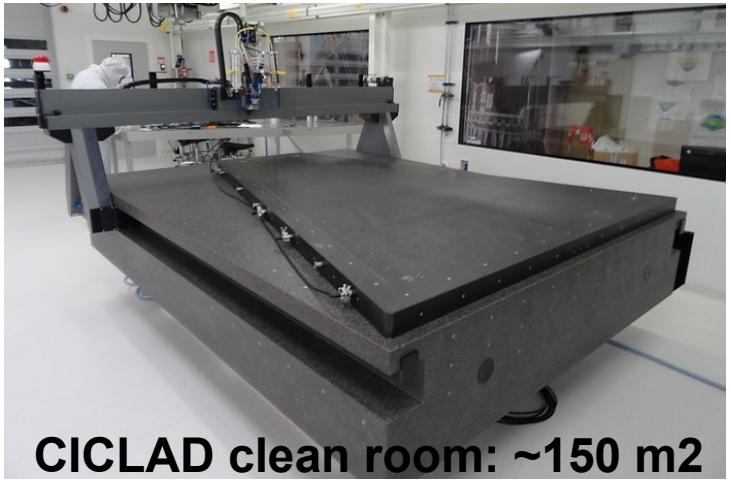


(SOME OF THE) ELECTRONICS AND DETECTOR FACILITIES

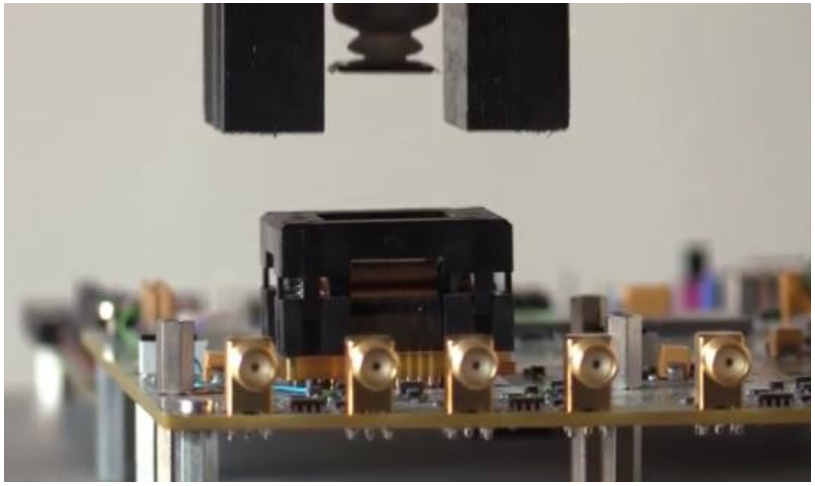
Wire-bonding machines



Large area clean rooms



Robotized test bench for ASIC



MPGD workshop

SUMMARY

- The EIC project is in the CEA/Irfu roadmap
- Involvement in YR report activities (physics, tracking and electronics), in LDRD programs and eRD6 recently joined
- Broad interest in many areas:
  - Tracking and timing detectors
  - ASICs and readout electronics
- Large facilities at Saclay for detectors production
- Interest in participation to whole systems development: detectors together with the readout electronics
- Open to collaborate in international consortia

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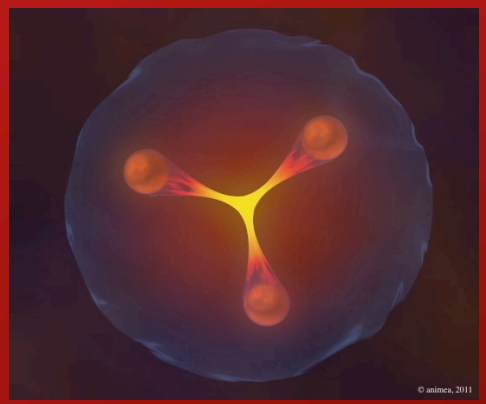
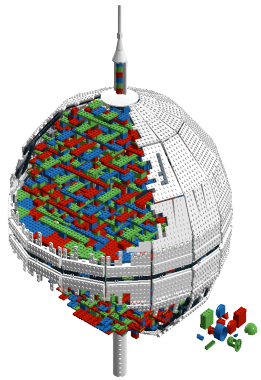
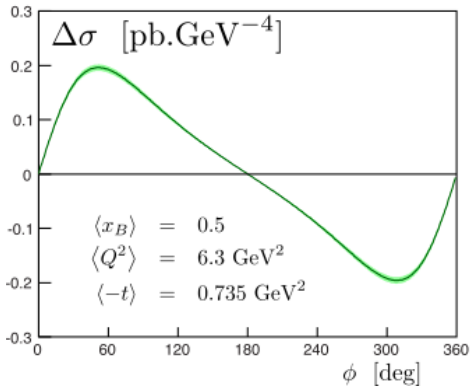
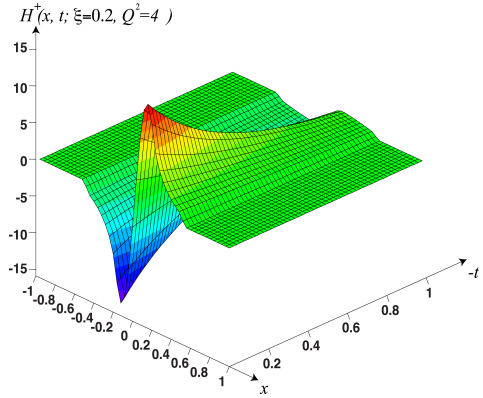


3D hadron structure with the PARTONS framework







EIC EoI on Software | Hervé MOUTARDE

université PARIS-SACLAY

Sep. 3, 2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

About PARTONS.

Short status and prospect.

- Collection of tools to **systematically relate** models to **experimental data** in **multi-channel** analysis and fits.
- An **homogeneous framework** for 3D hadron structure studies: initially designed for GPDs and exclusive processes, will be extended soon to TMDs.
- Recently interfaced to `APFEL++` and `LHAPDF`, about to be interfaced to `NangaParbat`.
- Recently interfaced to the **MC event generator** `MILOU` within EIC YR studies on exclusive processes.
- Plans to **further develop/interface to generic tools** for MC event generator for GPDs and TMDs.
- **Open source release** `http://partons.cea.fr`, also available on `GitLab`.

Meeting software needs.

Useful each time an observable should be predicted.

- Requirements.
  - Now: **input for event generation** with various assumptions (pQCD, nonperturbative models, etc.).
  - At completion: **high-level physics analysis** of new measurements for a first discussion.
- Technologies and techniques.
  - Future EIC software tools would benefit from a natural **interface to a framework computing theoretical predictions** (*e.g.* to input an event generator).
  - *Let's avoid reinventing the wheel!*
- Resources.
  - **On-going collaboration** between CEA (Saclay), NCBJ (Warsaw), BNL and SBU on the interface to `MILOU`.
  - Scope of joint developments (including number of people involved) could be extended if interest from EIC Coll.

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