



WP2 - Inner and central tracking with PID (Drift Chambers)



Nicola De Filippis
Politecnico and INFN Bari



3rd DRD1 collaboration meeting, December 9, 2024

Participating institutes

- Laboratoire de Physique des 2 Infinis Irène Joliot-Curie(IJCLab-IN2P3)
- INFN, Bari (INFN-BA)
- INFN, Lecce (INFN-LE)
- INFN, Rome (INFN-RM)
- US cluster (US):
 - - U. Mass Amherst, U. Michigan, Irvine, Tufts U., BNL, FIT, U. Florida, U. Wisconsin
- Nankai University (Nankai U.)
- Tsinghua University (Tsinghua U.)
- Institute of High Energy Physics, Chinese Academy of Sciences (IHEP-CAS)
- Wuhan University (Wuhan U.)
- Jilin University (Jilin U.)
- University of Science and Technology of China (USTC)
- Institute of Modern Physics, Chinese Academy of Sciences (IMP-CAS)
- Bose Institute (Bose)

Kickoff and subsequent WP2 meetings

WP2 - Drift Chambers

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Managers

drd1-wp2-leaders

October 2024

10 Oct WP2 -Drift Chambers meeting

July 2024

18 Jul WP2 -Drift Chambers meeting

May 2024

17 May WP2 -Drift Chambers meeting

April 2024

10 Apr WP2 -Drift Chambers meeting

March 2024

01 Mar WP2 -Drift Chambers meeting

- 5 WP2 meetings since March 2024
- active participation of the communities involved
- tasks, delivery and milestones well defined
- preliminary contact with founding agencies through the WP2 participating institutes (work in progress)

- Active participation to **DRD1 Gaseous Detectors School**, November 26 to December 6
 - Hands-on session on characterization of drift tubes

R & D Tasks for WP2

Task ID	Task	Performance Goal	ECFA DRD Theme
T1	Development of front-end ASIC for cluster counting	Design/construction/test of a prototype of the frontend ASIC for cluster counting (with High bandwidth, High gain, Low power consumption, Low mass)	1.1, 1.2, 1.3
T2	Development of a scalable multichannel DAQ board	Working prototype of a scalable multichannel DAQ board (with High sampling rate, Dead-timeless, DSP and filtering ability, Event time stamping, for Track triggering)	
T3	Mechanics: new wiring procedures and new endplate concepts	Conceptual designs of novel wiring procedures (feed-through-less wiring procedures) and full design of innovative concepts of more transparent endplate ($< 5\% X_0$).	
T4	Increase rate capability and granularity	Measurements of performance on prototypes of drift cells at different granularities (smaller cell size and shorter drift time) and with different field configurations (higher field-to-sense ratio).	
T5	Consolidation of new wire materials and wire metal coating	Evaluation of the electrostatic stability of wires with High yield strength, Low mass, low Z, High conductivity. Study of aging effects. Evaluation of existing or a sputtering facility for metal coating of carbon wires.	
T6	Study ageing phenomena for new wire types	Tests of prototypes built with new wire types at beams and irradiation facilities. Measurement of performance on total integrated charge and establish charge collection limits.	
T7	Optimization of gas mixing, recuperation, purification and recirculation systems	Measurement of the performance of hydrocarbon-free gas mixtures with High quenching power, Low-Z, High radiation length. Design of a recirculating system.	

STARTED

STARTED

ADVANCED

TO BE RESTARTED

STARTED

ADVANCED

NOT STARTED

R & D Tasks for WP2

Number	Title	Description	Start date	End date	Institutions
D2.1	Realization of a frontend/digitizer/DAQ	Realization of a scalable front-end/digitizer/DAQ electronics chain for cluster counting/timing	0	36M	CN-IHEP-CAS, CN-UTSINGHUA, CN-WHU, IT-INFN.BA, IT-INFN.LE, e ⁺ e ⁻ -US Cluster
M2.1.1	80% efficiency of the cluster counting/timing	At least 80% efficiency of the cluster counting/timing with resolution in dn/dx smaller than 30% for single hit	0	12M	
M2.1.2	Design of frontend ASIC for cluster counting	Design of the frontend ASIC optimized for cluster counting, inspection of different solutions to cope with the rate, the bandwidth the amount of information to handle	12M	24M	

R & D Tasks for WP2

D2.2	Performance of K-p separation	Performance of the K-p separation in the momentum range from 2 to 30 GeV/c	0	36M	CN-IHEP-CAS, CN-WHU, FR-CNRS-IN2P3/IJCLab, IT-INFN.BA, IT-INFN.LE, IT-INFN.RM1, e⁺e⁻ - US Cluster
M2.2.1	Supply and test of wire materials	Supply and test of wire materials and the anchoring of them (crimping, gluing, soldering)	0	12M	
M2.2.2	Design of full-length prototype	Completion of the mechanical design of the full-length drift chamber prototype, finalization of the FEM analysis	0	12M	
M2.2.3	Validation of the tension recovery scheme	Validation of the tension recovery scheme for the endplate, by exploiting the realization of the spokes, the stays, the spacers, the PCBs and the soldering procedure, feed-through-less wiring procedure	12M	24M	

STCF specific

D2.3	STCF-MDC prototype	Smaller cell size (5mm ~9mm) drift chamber prototype is under construction, and will be completed in the spring of 2025	0	24M	CN-USTC, CN-IMP-CAS
D2.4	Ageing phenomena test of STCF-MDC prototype	Ageing phenomena test using a β source(10mCi), and record the data (gain, energy resolution...) using DAQ every day.	0	24M	CN-USTC, CN-IMP-CAS

International collaboration

INFN Bari + Lecce involved in all the tasks

NEW: INFN Pisa joining with MEG DCH experts (not yet in DRD1 WP2)

INFN Perugia joining for tracking studies

G. Iakovidis group from BNL (US): wire procurement

NEW: A. Jung group from Purdue U. (US) (not yet in DRD1 WP2):

- coating / manufacturing facility at composite center Purdue would allow manufacturing all kinds of materials
- existing supported R&D on US side
 - composite R&D for thicker high TC / electric C CFs
 - reconstruction / tracking for FCC folded GEANT work of implementing CF into sim
 - prototype of CF and reference of tungsten being constructed in lab

G. Charles group from IJCLAB (France)

- any test with wire material, choice for the prototype chosen but new ones could be tested. Produce characterization of strength, maybe with a micrometric motor. Test different kind of wires
- test also of anchoring the wire (crimp, gluing, soldering)
- activity on mechanical design and realization of prototypes

China:

- well established collaboration with IHEP for NN-based cluster counting algorithm
- NEW deliverables: USTC and IMP-CAS strongly committed towards the STCF

Backup

R & D Tasks for WP2

T1: Development of front-end ASIC for cluster counting

- Performance goal:
 - High bandwidth and gain pre-amplifiers
 - Low power
 - Low mass
- Main developments covered:
 - achieve efficient cluster counting and cluster timing performances
- Deliverables next 3y:
 - full design/construction/test of a prototype of the frontend ASIC for cluster counting

T2: Development of a scalable multichannel DAQ board

- Performance goal:
 - High sampling rate
 - Dead-time-less
 - Event time stamping
 - Track triggering
- Main developments covered:
 - FPGA based architecture
 - ML algorithms-based firmware
- Deliverables next 3y:
 - working prototype of a scalable multichannel DAQ board

R & D Tasks for WP2

T3: Mechanics: new wiring procedures and new endplate concepts

- Performance goal:
 - feed-through-less wiring procedures
 - more transparent endplates ($< 5\% X_0$)
 - transverse geometry
- Main developments covered:
 - Separate the wire support function from the gas containment function
- Deliverables next 3y:
 - conceptual designs of novel wiring procedures
 - full design of innovative concepts of endplate

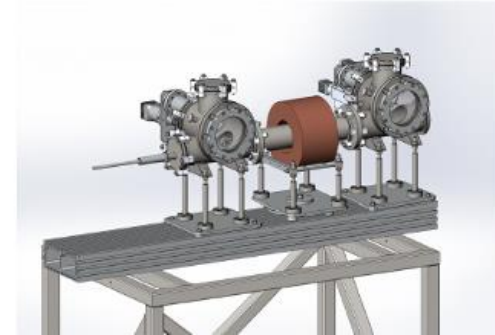
T4: Increase rate capability and granularity

- Performance goal:
 - smaller cell size and shorter drift time
 - higher field-to-sense ratio
- Main developments covered:
 - higher field-to-sense ratio allows to increase the number of field wires, decreasing the wire contribution to multiple scattering
- Deliverables next 3y:
 - measurements of performance on prototypes of drift cells at different granularities and with different field configurations

R & D Tasks for WP2

T5: Consolidation of new wire materials and wire metal coating

- Performance goal:
 - Electrostatic stability
 - High YTS (wire material yield strength)
 - Low mass, low Z
 - High conductivity
- Main developments covered:
 - Develop contacts with companies producing new wires
 - List companies
 - Metal coating of carbon wires
- Deliverables next 3y:
 - construction of a magnetron sputtering facility for metal coating of carbon wires



T6: Study ageing phenomena for new wire types

- Performance goal:
 - Establish charge collection limits for carbon wires as field and sense wires
- Main developments covered:
 - Build prototypes of drift chamber with new wires as field and sense wires
- Deliverables next 3y:
 - Tests of prototypes built with new wire types at beams and irradiation facilities
 - Measurement of performance on total integrated charge

R & D Tasks for WP2

T7: Optimization of gas mixing, recuperation, purification and recirculation systems

- Performance goal:
 - Non-flammable gas
 - High quenching power
 - Low-Z
 - High radiation length
 - High primary ions
- Main developments covered:
 - ATEX and safety requirements
 - cost of gas
 - Hydrocarbon-free mixtures
- Deliverables next 3y:
 - Performance of hydrocarbon-free gas mixtures
 - full design of a recirculating system