

WP3 Organization

- Six projects in WP3 - Optimization of Straw Tracker Technologies
- Organizational structure with Project Leaders has been set up

Project	Title	Project Leader
WP3-FCC (A)	Straw chamber and drift tube technologies for applications at FCC-ee/hh	Oliver Kortner Junjie Zhu (US)
WP3-HAD (B)	Straw chamber technologies for hadron physics applications	Peter Wintz
WP3-DM (C)	Large area straw detector for Dark Sector applications	Daniel Bick
WP3-NEU (D)	Straw chamber technologies for neutrino physics applications	Roberto Petti
WP3-MPT (E)	Optimization of straw materials and production technologies	Temur Enik
WP3-RO (F)	Optimization of electronic readout	Katerina Kuznetsova

WP3 - Institutes

Deliverable	Institution	Investment (kCHF)	Person Power* (FTE)
D1	MPP Munich	xxx	xxx
	FZJ-GSI-RUB	xxx	xxx
	IFIN-HH	xxx	xxx
	JU Krakow	xxx	xxx
	FZJ (ZEA)	xxx	xxx
	CERN	xxx	xxx
	UHH	xxx	xxx
	GTU Georgia	xxx	xxx
	IIT Guwahati	xxx	xxx
	IIT Kanpur	xxx	xxx
	NISER	xxx	xxx
	Panjab	xxx	xxx
	INP	xxx	xxx
	U South Carolina*	xxx	xxx
	Duke Univ.*	xxx	xxx
	INFN Torino	xxx	xxx
	US Cluster	xxx	xxx
	U of Michigan		
	Harvard University		
	U of Mass, Amherst		
Tufts University			
U of California Irvine			
Michigan State University			

WP3 – MoU Annex

6.4.3 Work Package 3 – Optimization of Straw Tracker Technologies

The following text represents the Work Package Annex that will be part of the DRD1 MoU once the Work Package has been approved scientifically and resource-wise but the Scientific Coordination Board, the Resource Coordination Board and the Collaboration Board.

6.4.3.1 Description

The project aims to optimize straw chamber and drift tube detector technologies for a broad range of future applications from high-energy physics (HEP) and hadron physics at future accelerators (e.g. FCC-ee, CEPC, FCC-hh, FAIR) to Dark sector, rare event searches and neutrino physics experiments. The work package includes the application-specific development of straw tube and detector designs, materials, production techniques, electronic readout with ASIC design, and prototype or demonstrator setups with test measurements.

The goals are the optimization of straw and drift tube designs with thin tube walls, low radiation length, smaller diameter tubes for higher rate capabilities and fast timing, long straw lengths up to 4m for large detector areas, robust operation, operation of thin-wall straws with large detector area in vacuum, long-term high performance and detector longevity. Furthermore, the development of cost-effective production techniques and quality assurance for series production of tens of thousands of straws and enhancing the track measurement information, e.g. 4D-tracking with PID will be investigated.

The Work Package consists of the following R&D tasks:

Task ID	Task	Performance Goal	ECFA DRD Theme
T1	Optimize straw materials and straw production technologies	Development of thin straw film tube walls (20-30µm and below) with robust metallization, low cross-talk and resistance to ageing effects.	I.1, I.2, I.3
T2	Develop and improve application-specific straw tube designs	- Small diameter straws (5mm) with fast timing (<100ns). - Ultra-thin straws with tube walls < 20µm (X/X ₀ < 0.02%). - Ultra-long straws with thin walls (~30µm) and 4m length.	
T3	Optimize the detector mechanical system	Development of self-supporting straw modules and/or control of material relaxation with precise straw position alignment.	
T4	Optimize the front-end electronics (ASIC) and read-out system	Leading- and trailing-edge time readout and/or charge readout down to sub-ns precision.	
T5	Enhance the tracker measurement information	3D/4D tracking with high resolution, PID via the particle-specific dE/dx information. The goals are spatial straw resolutions of 150µm or better, time t ₀ extraction with O(ns) resolution and dE/dx resolution better than 10%.	
T6	Enhance the detector longevity	Ageing resistance of O(1 C/cm) for thin-wall straws.	
T7	Optimize the online/offline software	Develop SW and methods for straw tube and electronics simulations, straw calibration, pattern recognition, tracking, PID and tracker alignment.	

6.4.3.2 Start and End Date, Deliverables and Time Scale

The Work Package starts on **January 1st, 2024** and ends on **December 31st, 2026**. Overall^a Work Package Milestones and Deliverables and time scales are indicated in the table below.

Milestones and Deliverables	Title	Description	Start Date	End Date
M1.1	Work plan consolidation	Finalise work package objectives and decide final straw designs including simulation studies. Setting up laboratories, production and test facilities. Tendering and procurement of materials. [T1-T7]	0	12M
M2.1	Prototype design and construction	Optimization of straw materials, designs and production technologies for low radiation length, thin-wall tubes, small diameter tubes, long tubes and straws with enhanced longevity. [T1-T3, T6]	12M	24M
M2.2	Optimization of the prototype mechanical system	Low material budget and high mechanical precision. Development of the alignment method. [T3, T5, T7]	12M	24M
M2.3	Optimization of front-end electronic and ASIC design	Based on existing ASICs and simulation studies for fast timing, signal leading and trailing edge time readout with high resolution and charge measurement for PID. [T4, T5]	12M	24M
D1.1	Prototype tests and results	Performance of prototype designs and measurement Resolutions (3D-space <150 µm, time t ₀ of O(1 ns), dE/dx < 10%). [T1-T7]	24M	36M
D1.2	Evaluation of WP tasks	Evaluation of work package tasks with review of further enhancement and new potential. [T1-T7]	30M	36M

6.4.3.3 Participating Institutions

Table 1: Project A

Country	Collaborating Institution	Town	Contact	Deliverables
Germany	Max-Planck-Institut für Physik		O. Kortner	
USA	U of Michigan		J. Zhu	
USA	Harvard University		J. Huth	
USA	U of Mass, Amherst		V. Martinez Outschoon	
USA	Tufts University		H. Beauchemin	
USA	U of California Irvine		A. Taffard	
USA	Michigan State University		R. Schwienhorst	

^a Details of Tasks, Milestones and Deliverables can be requested from the Collaboration Management (Co-Spokespersons and Work Packages Leader).

Table 2: Project B

Country	Collaborating Institution	Town	Contact	Deliverables
Germany	Forschungszentrum Jülich (FZJ)	Jülich	P. Wintz	D1.1, D1.2
Germany	Gesellschaft für Schwerionenforschung (GSI)	Darmstadt	J. Taylor	D1.1
Germany	Ruhr-Universität Bochum (RUB)	Bochum	P. Wintz	D1.1
Poland	Jagiellonian University (JUK)	Krakow	J. Smyrski	
Romania	Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering (IFIN-HH)	Bucharest	M. Bragadireanu	

6.4.3.4 Work Package Funding Agencies (WP-FA)

Table 3: Project A

Country	Funding Agency	Representative	Institutions represented ^b
Germany	Max-Planck Society	TBC	Max-Planck-Institut für Physik
USA	DOE	TBC	U of Michigan
USA	DOE	TBC	Harvard University
USA	DOE	TBC	U of Mass, Amherst
USA	DOE	TBC	Tufts University
USA	DOE	TBC	U of California Irvine
USA	NSF	TBC	Michigan State University

Table 4: Project B

Country	Funding Agency	Representative	Institutions represented ^c
Germany	Helmholtz Association	TBC	GSI, RUB
Poland	TBD	TBD	JUK
Romania	Institute of Atomic Physics	TBC	IFIN-HH

^b Only if different from Funding Agency
^c Only if different from Funding Agency

WP3 Status

Project A (WP3-FCC)

- Further US groups joined the project
- Straw Tracker 2024 Workshop, Michigan University, Oct 14-15, 2024
 - Overview talks about world-wide straw and drift chamber technologies, experiences and perspectives
- Project coordination ongoing (last meeting Dec 2nd, 2024)
- Project report by Jianming Qian (MSU) in WG1 session today

• Project B (WP3-HAD)

- Group structure established (5 institutes)
- New straw laboratories set up
- Application for additional new funding for one group
- Finetuning of timelines to be done

WP3 Status

- Project D (WP3-Neu)
 - Group structure established
 - Discussion and coordination of timelines ongoing

Project E (WP3-MPT)

- Groups: Univ Hamburg (Daniel Bick) and INP Almaty (Nurzhan Saduyev)
- Aim: building one straw module
- Straws currently under production (4m length, US-welding technology)
- Further meetings for project organization needed

Project F (WP3-RO)

- Groups: INP Almaty (Nurzhan Saduyev), ZEA2-FZ Jülich (Andre Zambanini), INFN Torino (Maxim Alekseev)
- Project coordination meetings ongoing (organized by Katerina Kuznetsova)
- Adjustment of common interests and timelines, e.g. ASIC prototype expect available in 2025

WP3 – WP/WG Interplay

Contributions to WG

- WG1: reports about straw technology
- WG5: common-interest readout development (ASIC) in discussion, not yet decided
- WG7: current straw setup in test beam facility, further use to be discussed (contact: K. Kuznetsova)
- WG8: dissemination - lab exercise (hands-on) of thin-wall straw technology and lecture in DRD1 detector school

More connections to WGs expected (gas simulation, cluster counting, ..)

Interplay WP2 (drift chamber) - WP3 (straws)

- Exchange of technologies and experiences, e.g. Straw Tracker 2024 workshop

WP3 Endorsement

- Applications for (additional) funding done, outcome in next couple months
- Laboratories have been set up (e.g. in new groups)
- Further coordination of common project interests and timelines needed

- Inquiry about endorsement date done
- Feedback from all project leaders
- CM2025/1 too early
- Aim for two endorsement timemarks, CM 2025/2 (June) and CM 2025/3