

**DRD3 WG1/WP1**

**Project Proposal Preparation**

Fine-Pitch CMOS Sensors with Precision Timing  
for Lepton Collider Experiments

M. Backhaus

T. Bergauer

A. Besson

M. Bomben

D. Dannheim

M. Deveaux

J. Dingfelder

A. Macchiolo

**S. Spannagel**

P. Svihra

1<sup>st</sup> DRD3 Week

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# ECFA Detector R&D Roadmap

*Technology developments needed for detectors at  $e^+ e^-$  Higgs-EW-Top factories in all possible accelerator manifestations including instantaneous luminosities at 91.2 GeV of up to  $5 \times 10^{36} \text{ cm}^{-2} \text{ s}^{-1}$  and energies up to the TeV range*

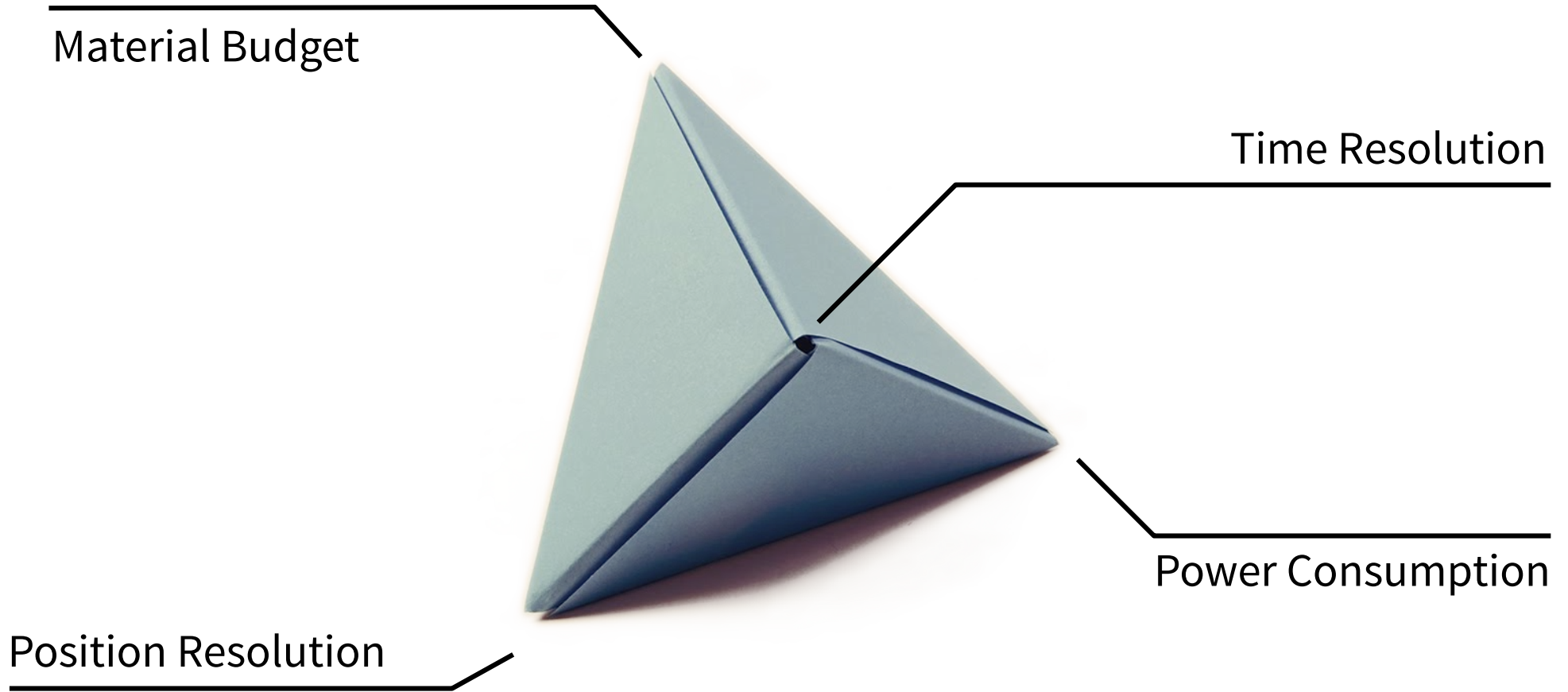
**DRDT 3.1** - Achieve full integration of sensing and microelectronics in monolithic CMOS pixel sensors.

*Developments of Monolithic Active Pixel Sensors (MAPS) should achieve very high spatial resolution and very low mass [...] To achieve low mass in vertex and tracking detectors, thin and large area sensors will be crucial.*

# ECFA DRD – Vertex Detectors



# Challenges for Vertex Detectors @ Lepton Colliders



# Project Goals & Scope

- Simulation, development and evaluation of MAPS
- Development in 65nm TPSCo CIS process
- Targeting the **vertex-detector requirements of future Lepton Colliders:**
  - **3  $\mu\text{m}$  single-point resolution**
  - down to 5 ns time resolution (depending on chosen Lepton-Collider technology)
  - average power consumption below 50 mW/cm<sup>2</sup>
  - thinning to 50  $\mu\text{m}$ , minimal inactive periphery area
  - sensor architecture scalable to a large-area detector system
- Development of new high-resolution sensors for beam telescopes as intermediate target  
Relaxed power-consumption (<500 mW/cm<sup>2</sup>) and timing requirements (100 ns)
- Staged approach allows further refinement of performance targets after next strategy update

# Milestones & Deliverables

Number	Deliverable/Milestone Title	WP project #	Lead	Type	Dissemination Level	Due Date
M1	Report on Demonstrators	4	DESY	Report	DRD3 report	Month 9 (Q1 2025)
D1 <b>MPR2</b>	Beam Telescope Demonstrator Matrix Submission <b>3 μm</b>	1, 2	IPHC	Prototype	Manual / Presentation	Month 24 (Q2 2026)
M2	Report on Demonstrator Matrix Characterization	3, 4	DESY	Report	Publication	Month 36 (Q2 2027)
D2 <b>MPR3</b>	Full Beam Telescope Sensor Submission	2, 3	IPHC	Prototype	Manual / Presentation	Month 48 (Q2 2028)
M3	Report on Beam Telescope Sensor Performance	3, 4	DESY	Report	Publication	Month 60 (Q2 2029)
D3 <b>ER</b>	LC Vertex Sensor Demonstrator Submission	1, 2	IPHC	Prototype	Manual / Presentation	Month 66 (Q4 2029)
M4	Report on LC Vertex Sensor Demonstrator Performance	3, 4	DESY	Report	Publication	Month 78 (Q4 2030)

Full column height

≥ 2cm<sup>2</sup> sensor

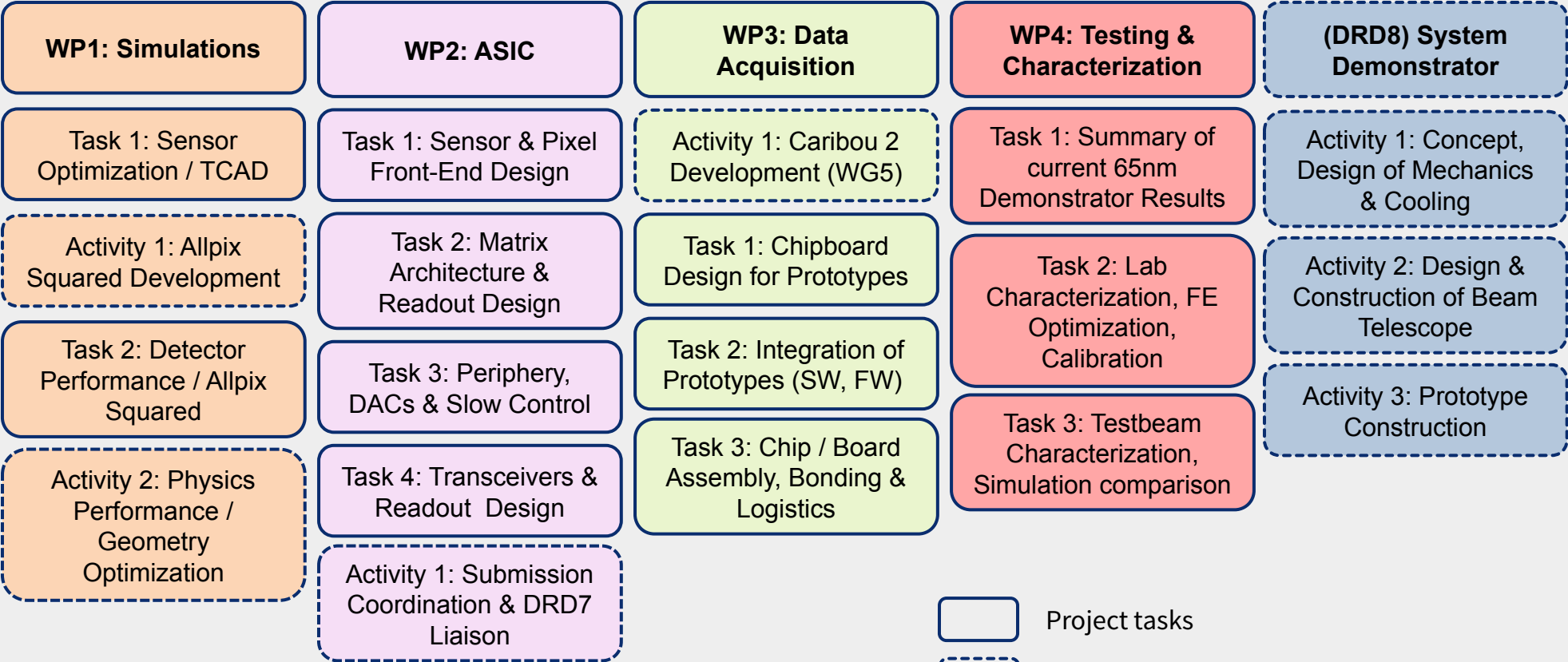
# Collaborative Work



This project will explore **synergies** with other proposed & running **projects utilizing TPSCo 65nm**

This project will collaborate with several other DRD3 WGs as well as other DRDs:

- WG4: Monte Carlo as well as TCAD Simulations, simulation development
- WG5: Further development of Caribou DAQ system
- DRD7:
  - Support for access to technology, design / testing tools (WG7, Tools and technologies)
  - ASIC design, validation, submission support (WG6, Complex imaging ASICs and technologies)
  - IP blocks developed within project are made available to community in context of WG6
- DRD8: Possible collaboration on lightweight detector mechanics and cooling systems, including the possible construction of a demonstrator prototype

# Fine-Pitch CMOS Sensors with Precision Timing for LC Experiments



 Project tasks  
 Additional activities / collab. with other projects



# Participating Institutes

Institute	Contact	Main areas of contribution
APC Paris	M. Bomben	Simulations, testing
Bonn University	J. Dingfelder	ASIC design, testing
CERN	D. Dannheim	Testing, DAQ, ASIC design support (through DRD7)
DESY	S. Spannagel	ASIC design, testing, DAQ, simulations
ETH Zurich	M. Backhaus	ASIC design, testing
FNSPE Prague	P. Svihra	ASIC design, DAQ, testing
GSI	M. Deveaux	Simulations, testing
HEPHY Vienna	T. Bergauer	DAQ, testing, ASIC design
IPHC Strasbourg	A. Besson	ASIC design, testing
Zurich University	A. Macchiolo	Testing, DAQ, simulations

Some of the resources are still to be confirmed by the institutes.

The project is **open to further collaborators** who wish to contribute to any of the areas or work packages.

# Summary

- Proposing project for developing a LC vertex detector MAPS
  - Tackling vertex-detector requirements of future Lepton Colliders
  - Comprises simulation, development and evaluation of MAPS in the TPSCo 65nm process
  - Beam telescope chip as intermediate goal
- Proposal draft well advanced, goals, milestones & project structure mostly clear
- Currently 10 institutes participating  
Newcomers welcome to join, contact us!
- Continuing more detailed (resource-) planning over summer to finalize proposal