



Science and  
Technology  
Facilities Council

# UK Electronics & Integration Workshop

ECFA TF7 Report

Rob Halsall

# ECFA TF7

**ECFA Detector R&D Roadmap Symposium of Task Force 7 Electronics and On-detector Processing**

Thursday 25 Mar 2021, 09:00 → 18:00 Europe/Zurich

Dave Newbold (STFC Rutherford Appleton Laboratory (GB)), Francois Vasey (CERN)

**Description** Details about the ECFA Detector R&D Roadmap can be found on: <https://indico.cern.ch/event/1001692/>

You are invited to register for the symposium at: [Registration Link](#)

Please click the link below to join the webinar:  
[cern.zoom.us/j/65350431679?pwd=cFNZROlSU3hyRHh3dzRIU1VFhGtQT09](https://cern.zoom.us/j/65350431679?pwd=cFNZROlSU3hyRHh3dzRIU1VFhGtQT09)

Webinar ID 653 5043 1679

Zoom instructions can be found [below](#). (If needed use passcode: 2021)

If the maximum number of participants is reached a live webcast will be streamed via: [http://indico.cern.ch/event/1001692/](#)

Please read the privacy notifications attached:

Webcast: ☒ There is a live webcast for this event

**09:00 → 09:20 Introduction and welcome**  
Speakers: Francois Vasey (CERN), Philip Patrick Allport (University of Birmingham (UK))  
ECFA TF7\_Question..., ECFA TF7\_Question..., ECFA TF7 Symposium...

**09:20 → 09:35 Part A Introduction: ASICs and front-end electronics**  
Covering scope and summary of inputs  
Speaker: Valerio Re (Universita and INFN (IT))  
Replies\_1\_Question..., TF7\_ASICs\_Introdu..., TF7\_ASICs\_Introdu...

**09:35 → 10:05 Keynote talk: Future trends, challenges and opportunities in ASICs for HEP: a birds-eye view**  
Speaker: Angelo Rivetti (INFN - National Institute for Nuclear Physics)  
ECFA\_ASIC\_Rivetti...

**10:05 → 10:15 Topical invited talk: Moving to leading-edge technology nodes**  
Speaker: Federico Faccio (INFN)

**ECFA R&D Task Force 7: Electronics and Processing**

**Request for community input to the TF7 R&D roadmap**

The TF7 remit includes on-detector (front-end) electronics (ASICs, services and integration), off-detector hardware, firmware and software (TDAQ) and all elements required to integrate these elements into an overall detector system.

This document outlines some specific questions to stimulate input from the community, with the intention of identifying:

- Key needs for R&D in electronics and data processing, driven by proposed projects to realize future facilities in a timely fashion
- Ideas on how to better organise R&D, collaboration and production efforts in order to maximise efficiency and minimise turnaround time and costs
- R&D developments already under way, foreseen, or considered by the community

The TF7 remit covers a broad and diverse set of topics, encompassing many potential R&D developments, and the work of many groups with specialised interests and skills. We therefore do not ask for a complete set of inputs from any individual or group. Please provide information to whichever questions you feel relevant to your work and expertise. The Task Force will then attempt to synthesise a complete view for further consideration by the community. Please also indicate any further points or considerations that are not captured by the questions below.

Please send responses to: [Questionnaire-TF7-ECFA-DeRDRMap@cern.ch](mailto:Questionnaire-TF7-ECFA-DeRDRMap@cern.ch) by 28 Feb 2021 if possible.

**I. On-Detector ASICs**

1. What are the most important new functionalities and performance improvements required of front-end ASICs?
2. Which technologies should we target for future ASIC developments, bearing in mind both cost issues and performance requirements?
3. How many different technologies should be targeted, taking into account the different requirements of tracking, calorimetry, timing detectors, etc?
4. What new design and verification approaches are required to address the complexity of larger and higher-performance devices?
5. How can more intelligence and data processing capacity be integrated into the front end, and how can the additional complexity be best managed?
6. How can interconnection density be improved? What is the scope for high levels of integration (e.g. 3D interconnect)?
7. How should the ASIC development community organise itself for maximum efficiency? How can expertise and IP best be shared between us?
8. How can testing and validation of complex ASICs be best facilitated / organised?

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- Questionnaire
- 1 day workshop
- 15 Presentations
- ASICs & Front End Electronics
- Links Powering & Interconnects
- Off Detector Systems
- All talks/videos/Q&A/Survey Response/Wrap up on line

<https://indico.cern.ch/event/1001692/>

# ECFA TF7 Overview

	Introduction and welcome	Francois Vasey
<b>A</b>	<b>ASICs and front-end electronics</b>	<b>Valerio Re</b>
	Future trends, challenges and opportunities in ASICs for HEP	Angelo Rivetti
	Moving to leading-edge technology nodes	Federico Faccio
	3D integration	Christophe Wyon
	Perspectives on future development	Erik Heijne
	Comments and brief discussion	Christophe De La Taille
<b>B</b>	<b>Links powering and interconnects</b>	<b>Marc Weber</b>
	Front-End Power and Links - Trends and Expected Needs	Philippe Farthouat
	Future rad-hard optical links	Jan Troska
	Wireless link technologies on the detector	Richard Brenner
	Powering and data communications challenges at FCChh	Werner Riegler
	Comments and brief discussion	Francois Vasey
<b>C</b>	<b>Off-detector systems</b>	<b>Niko Neufeld</b>
	DAQ and Trigger Beyond HL-LHC	Dr Emilio Meschi
	Challenges of large software-oriented TDAQ systems	Dr Alessandro Thea
	Using COTS processing technologies effectively	Conor Fitzpatrick
	Moving intelligence onto the detector	Farah Fahim
	Comments and brief discussion	Dave Newbold
	Wrap-up and next steps	Dave Newbold

# Introduction



## TF7 Symposium, Electronics

Niko Neufeld, Dave Newbold, Valerio Re, Christophe de la Taille, Francois Vasey, Marc Weber

25 March 2021

ECFA Detector R&D Roadmap

- Results of the Questionnaire
- 23 responses
- Many at the national level
- ‘Few Predictions’
  
- “No UK National Response”

# ASICs & Front End Electronics

ECFA

European Committee for Future Accelerators

TF7

Electronics and On-Detector Processing

## Part I: ASICs and front-end electronics

Christophe de la Taille (CNRS/IN2P3)  
Valerio Re (INFN Pavia/Univ. Bergamo)

ECFA Detector R&D Roadmap Symposium of Task Force 7 Electronics and On-detector Processing, March 25, 2021

- Cost & complexity of following Industry down low nm path
- 3D IC & Silicon photonics
- Multi gigabit links
- System Architecture
- Methodology & Management
- Recruitment, Retention & Retirement
- Rad Hardness
- Building & retaining design teams long term
- Industrial Collaboration

A	ASICs and front-end electronics	Valerio Re
	Future trends, challenges and opportunities in ASICs for HEP	Angelo Rivetti
	Moving to leading-edge technology nodes	Federico Faccio
	3D integration	Christophe Wyon
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# Links powering and interconnects



## Feedback from the community – survey responses

Links, powering and packaging

Francois Vasey, Marc Weber

- Channels & bandwidth growth
- Optical Links - Can we keep up?
- 3D IC & Silicon photonics
- 256Gbit/s line rates?
- Direct attach to COTS networks?
- Trigger less v on detector reduction
- Powering
- Low voltage - high amps
- Rad Hard
- Magnetic field

B		
	Front-End Power and Links - Trends and Expected Needs	Philippe Farthouat
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	Comments and brief discussion	Francois Vasey

# Off Detector Systems



- FPGA at the Front End challenges
- Non FPGA processing
- Processing on/near detector
- 3000TB/s -> Data Centre
- FPGA/PCB Complexity
- Methodology & Management
- Standard Protocols
- COTS & Industry
- Design Re-use
- Power & cooling
- Radiation Tolerant

Off-detector systems	Niko Neufeld
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# Conclusions

## Goal of this Process

- The overarching goal for the future projects roadmap
  - “Make sure the detectors are not the show-stoppers”
    - And make sure that we can demonstrate that
  - What do we need to do *in the next five years* to make sure the correct decisions are taken at the next Strategy Update?
    - And to make sure we are on top of the technologies required to implement the outcome?
- The roadmap report
  - Summary of the information and views gathered during the process
  - Prioritised list of R&D topics for the coming years
  - Recommendations on how to implement the roadmap
- Timeline from this point on
  - Spontaneous inputs from the community are still very welcome
    - Either via the survey, or focussed comments via [Questionnaire-TF7-ECFA-DetRDRMap@cern.ch](mailto:Questionnaire-TF7-ECFA-DetRDRMap@cern.ch)
  - As we discuss priorities / organisation, will need to consult further
    - We are not experts on all relevant topics
    - Focussed further discussions or conversations are likely to be needed
  - The consultation ‘closes’ and report writing starts around 7th May
    - Of course this is just the start of the discussion...

TF7 Symposium, 25th March 2021

Dave.Newbold@stfc.ac.uk



Wrap-up and next steps

Dave Newbold

- Giant Challenges
- Overwhelming number of topics
- Management & Efficiency concerns
- Careers, training & engagement
- More and more complex technologies
- Not drivers for industry
- Opportunities for more co-operation
- Opportunities for Novel Solutions
- Broad Agreement on issues
- “The problem is choice ...”





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# Thank you

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