

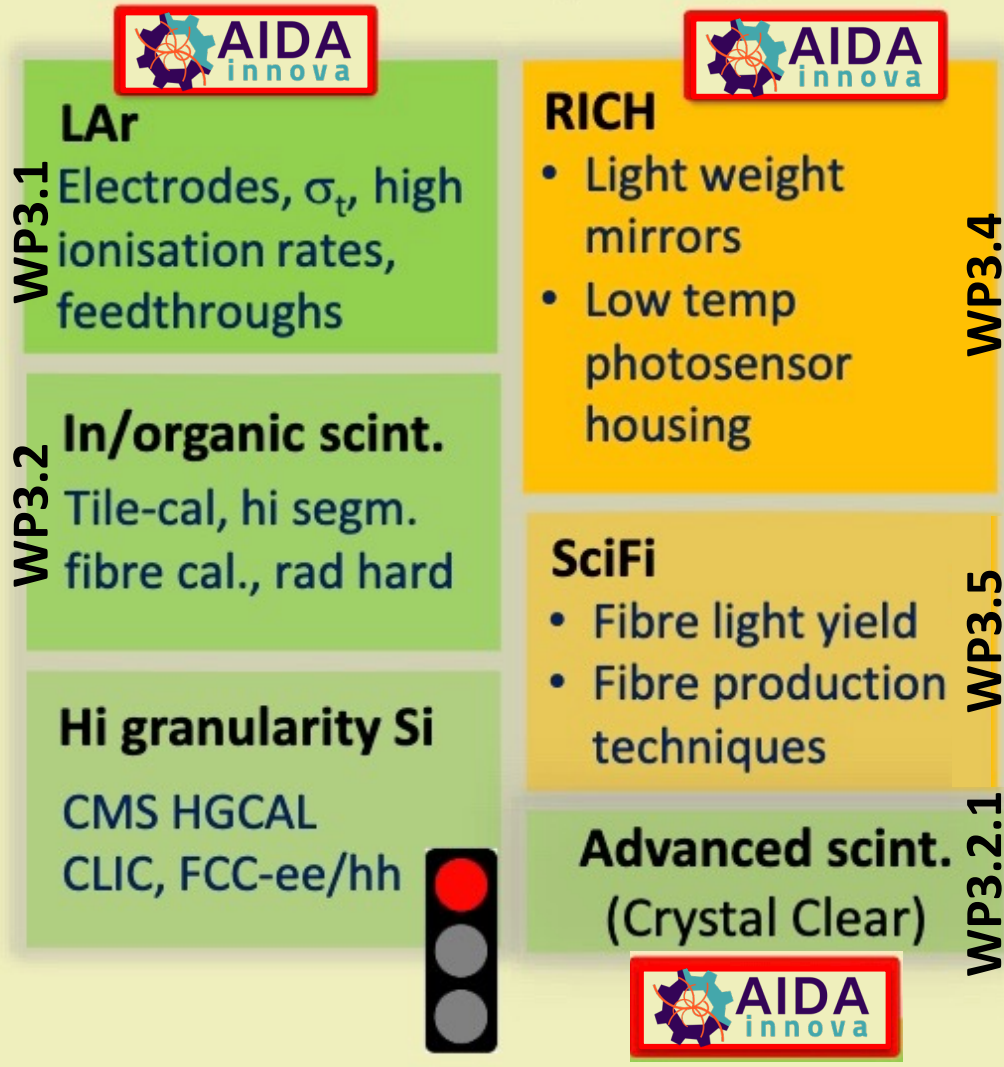


# EP R&D WP3 – Summary

M. Aleksa for EP R&D WP3

# Sub-Workpackages

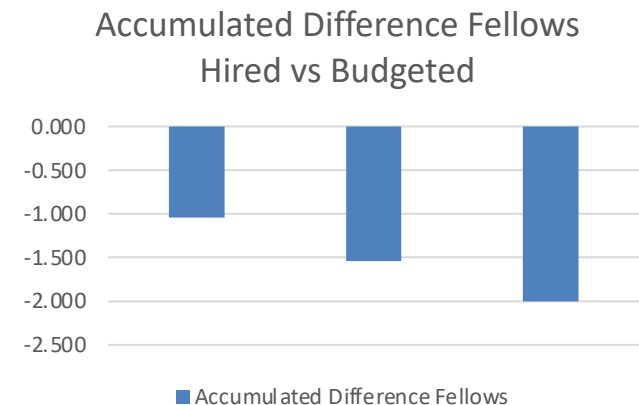
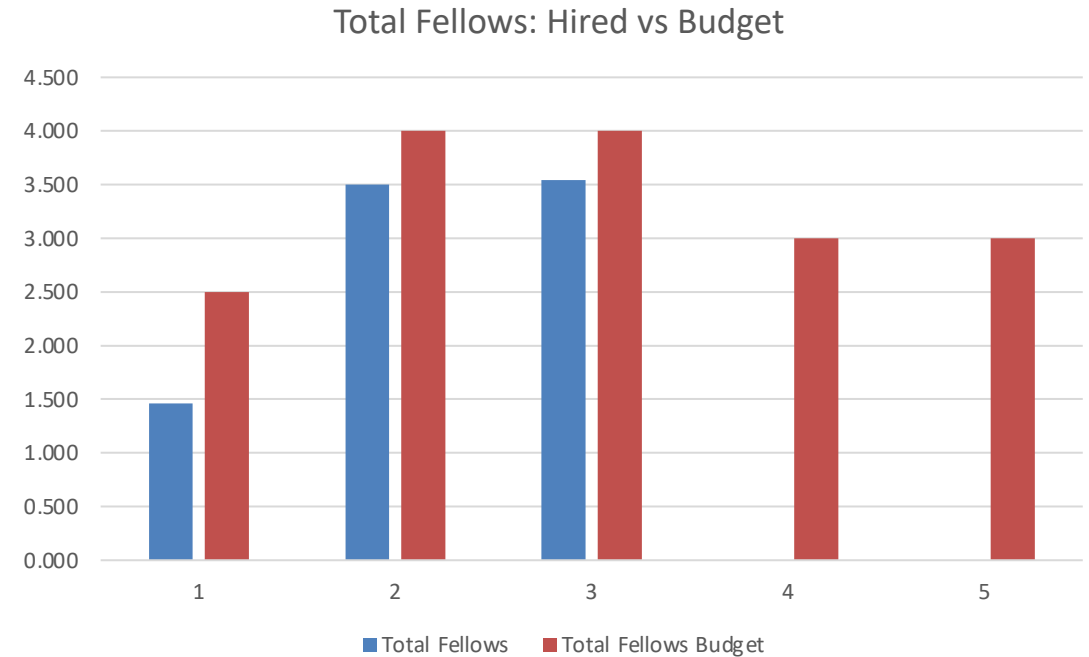
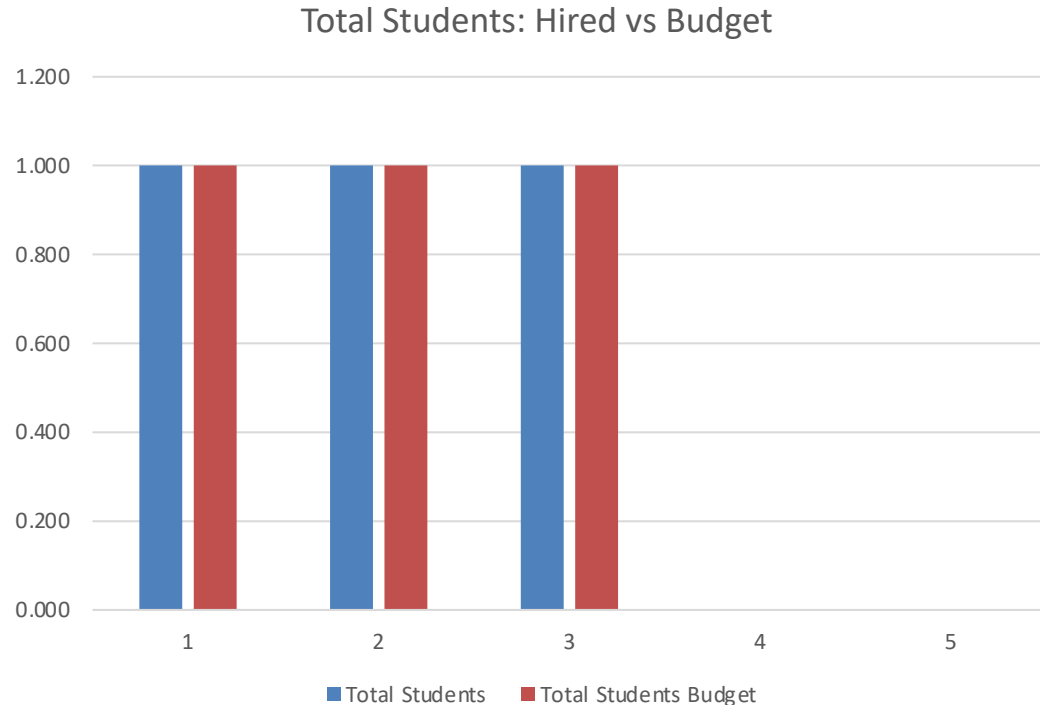
## WP3: Calorimetry + Light based



- **WP3.1: Noble-Liquid Calorimetry (talk by M. Aleksa)**
  - 1 fellow since 2020: Read-out electrodes, electronics, performance
  - 1 summer student 2021
  - 1 PhD student (Gentner programme) starting in fall 2022
  - 1 fellow (shared with cryolab) March 2020 – March 2022: Feedthroughs
  - 1 fellow (shared with FCC) starting in fall 2022: Absorbers, test-module design
  - International collaboration ~6 institutes, supported by AIDAInnova
- **WP3.2: Scintillator-Based Calorimetry (talk by M. Salomoni)**
  - 1 fellow since 2020: SPACAL R&D
  - 1 student since 2019: WP3.2.1: Crystal Clear
  - 1 stagiarr since Jan. 2022: SPACAL R&D
  - 1 fellow (shared with ATLAS) starting 2022: FCC HCAL R&D – Sci/Pb/Steel TileCal
  - 1 student (based at CERN, but paid by LIP): FCC HCAL R&D
  - International collaboration (LHCb, Crystal Clear), synergy with AidaInnova and quantum initiative
- **WP3.4: RICH (talk by F. Keizer)**
  - 1 fellow (shared with LHCb) since 2021: LHCb RICH Upgrade R&D
  - Supported by AIDAInnova
- **WP3.5: Scintillating Fibre Tracker (also covered in talk by F. Keizer)**

# EP R&D Fellows & Students Budget

## Students and fellows on EP R&D budget:



- We used 2 fellow years less, than budgeted!
- Due to start dates other than Jan. of the respective year or holes between two contracts
- Could we re-inject these 2 fellow years?

# WP3.1 R&D on Noble Liquid Calorimeter

## R&D Activities

- Design, optimization, production and tests of prototype read-out electrodes
- Performance studies to define geometry and materials for FCC-ee experiment
  - Absorber material, active material, granularity, optimising resolution, particle identification, particle flow
- Absorber design, mechanical design of test module
- At a later stage production of test module (start ~2024-2025)
- Preparation of testbeam, identification of test cryostat

## EP R&D Resources

- 1.5 fellows (1 fellow + 50% of a fellow shared with FCC)
- For the moment continue within foreseen budget (65kCHF/year), funding for test module needs to be discussed

## Milestones

Q4/2019	Design and spice-simulation of multi-layer electrodes (A)
Q4/2019	Design of possible high signal density FT flange with O(100) connections (D)
Q2/2022	Design of small-size test module for testbeam measurements (A)
Q2/2021	Testbeam measurements LArPulse if needed on top of Protvino testbeam (C)
Q3/2023	Testbeam measurements (A)

- Milestones 1 and 2 have been reached (with some delay)
- Milestone 3 (Q2/2022) not yet reached, this is the subject of the program for a new fellow starting Q3/2022
- Milestone 4 was reached

# WP3.2 R&D on TileCal Detector

## News

- Changes in person-power: Ana Henriques moved on, Henric Wilkens starting on the task. Michaela Mlynarikova started as FELL (April 2022, 50% EP R&D, 50% TileCal Data Preparation)

## R&D Activities

- In light of European strategy update, starting performance studies of Tile hadronic calorimeter for FCC-ee detector concept.
- Original plan to partially instrument a spare Tilecal module dropped, as it will not allow to test finer granularity. We will study the production of a new absorber stack (0.8x0.8x2m) which allow the smaller to be fully instrumented.
- Work on the SiPM + scintillating Tile initiated by Coralie Neubüser, will be resumed. New readout will be ordered.
- Long term plan: production of the absorber stack, and test beam. Test different scintillators (recycled Tilecal tiles, PEN, PET) in collaboration with LIP.

## EP R&D Resources

- 50% of a fellow (other 50% paid by ATLAS)
- 10kCHF/year until end 2024

# WP3.2 R&D on SPACAL Calorimeter

## R&D Activities

- Improve GAGG timing further to suppress slow component and speed up the fastest one with keeping existing excellent radiation hardness
- Improve and optimize the crystal fibre production
  - Larger ingot
  - Investigate new fiber production techniques (e.g. micro-pulling),
- Investigate new plastic scintillating fibres (timing and radiation hardness improvement)
- R&D on photodetectors
  - Need good linearity and timing
  - Optimise geometry to fit the SPACAL cell dimension
- R&D on optical coupling between fibre cell and photodetector

## EP R&D Resources

- 1 fellow foreseen (1 additional PhD student would be good)
- At the moment 60kCHF/year foreseen (requesting more money for next years)

# WP3.2.1 R&D on Scintillator Based Calorimeters

## R&D Activities

- Investigation, optimisation, characterization of scintillating and timing properties of various scintillators for future fast timing and calorimeter detectors:
  - Crossluminescence materials
  - Scintillator based on Nanomaterials
  - Cerenkov/scintillator Materials (potential for dual readout calorimetry)
- Optimisation photodetection readout (coupling for UV emission, separation Cherenkov and Scintillation)

## EP R&D Resources

- 1 PhD student currently foreseen (a fellow would be very welcome)
- For the moment continue within foreseen budget 40kCHF/year

# WP3.4 R&D on RICH Detector

## R&D Activities

- Intense activities also connected to LS3 LHCb RICH enhancements and to Upg. II
- New optoelectronic chain with time capability ( $O \sim 25\text{ps}$ )
- Development of new FastRICH Chip (EP-ESE-MIC)
- Studies on rate capabilities, data formats and system optimization
- R&D on cryogenic operation of photosensor (SiPM) just started (help from TE-CRG-CL)
- Low-mass optics and mechanics (mirrors, supports, high precision mechanical structures) (in coll. with EP-DT-EF)
- Low environmental impact radiator gases

## EP R&D Resources

- 1 fellow (66% EP R&D)
- At the moment 10kCHF ... (requesting more money for next years?)
- EP/LHCb R&D resources

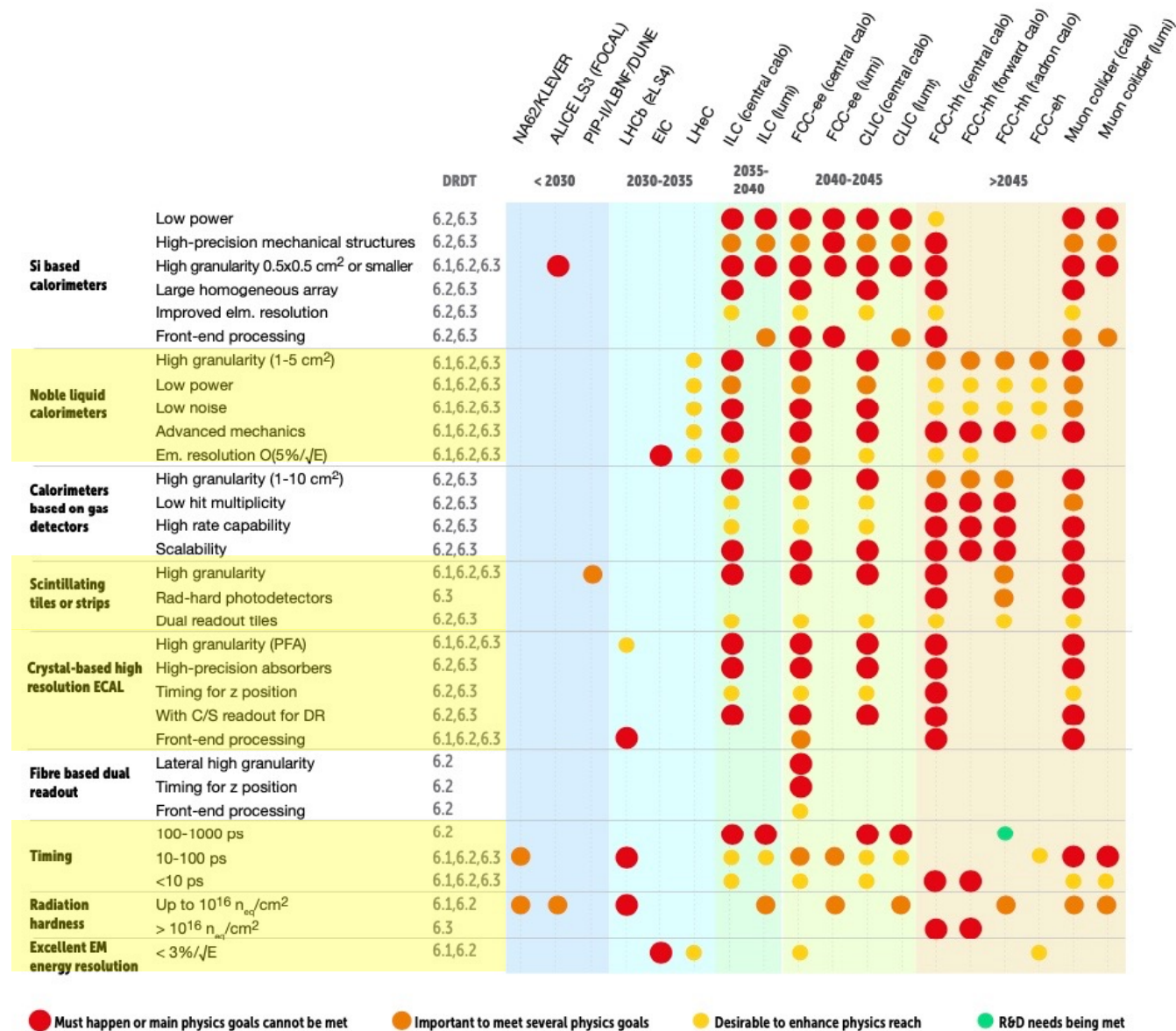
## Milestones

- Followed well, all foreseen experimental set-ups have been produced and will be further developed in parallel with our test beams campaigns, laboratory and simulation activities



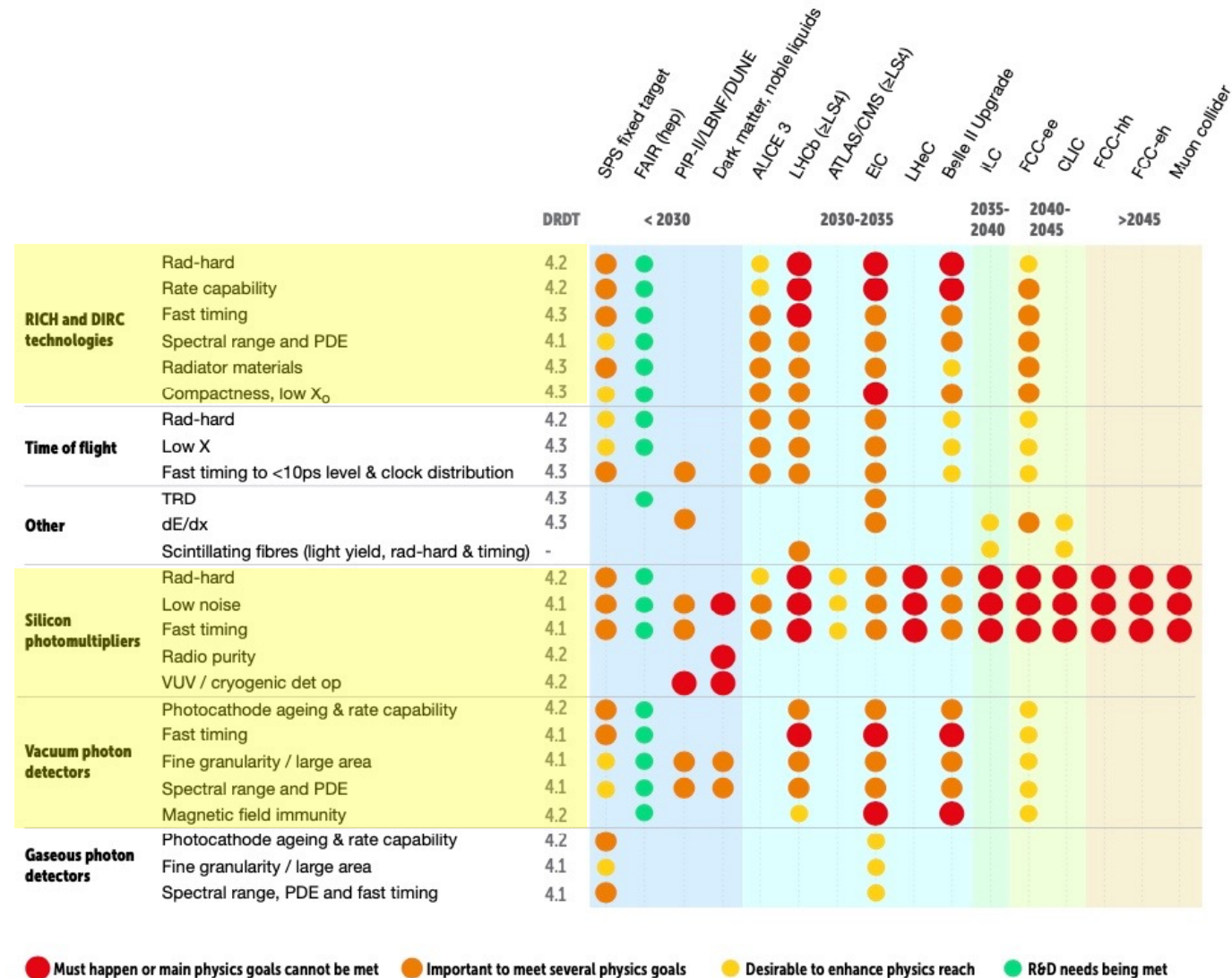
# WP3.1, WP3.2, WP3.2.1 – ECFA Roadmap

- **WP3.1** fully in line with all R&D goals on
  - Noble-liquid calorimeters
  - Radiation hardness
  - Timing (10 – 100ps)
- **WP3.2** and **WP3.2.1** fully in line with R&D goals on
  - Scintillating tiles or strips
  - Crystal-based high resolution ECAL
  - Radiation hardness
  - Timing
  - Excellent EM energy resolution



# WP3.4 – ECFA Roadmap

- **WP3.4** fully in line with all R&D goals on
- **RICH Technologies:**
  - New green-gas radiators
  - Low  $X_0$  mechanics and optics
  - Rad-hard, rate and time capabilities
  - Green-enhanced photo-sensors
  - Timing (10 – 100ps)
- **SiPMs and Vacuum Photo-Detectors**
  - Cryogenic detector operation for low noise and rad. Hard. (SiPMs)
  - Green-enhanced photo-sensors
  - Timing
  - High PDE
  - Rad. hardness and ageing
- **New RICH Dets Designs and Concepts**



# BACK-UP