

JENNIFER3 WP4

JENNIFER3 Kickoff meeting

January 27-28 IFAE Barcellona

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UNIVERSITÀ DEGLI STUDI
DI PERUGIA



JENNIFER3 Activity Structure

WP	Title	Lead beneficiary	Person months	Proposed coordinator
WP1	Search for new phenomena in the Belle II data	OEAW	128	C. Schwanda
WP2	Near detectors for neutrino physics at T2K and Hyper-Kamiokande	CNRS	40	C. Giganti
WP3	Far detectors for neutrino physics at T2K and Hyper-Kamiokande	KCL (partner)	55	F. Di Lodovico
WP4	Advanced Particle detector technologies	INFN	40	C. Cecchi
WP5	Information Technology and machine learning applications	DESY	27	S. Lange
WP6	Outreach and Communication	JSI	0	R. Pestotnik
WP7	Management of the project	INFN	0	A. Passeri

WP4: Advanced Particle detector technologies

Tasks

Task 4.1 Monolithic silicon trackers

J.Baudot (CNRS), G.Rizzo (INFN), C.Marinas (CSIC), F.Bernlochner (DESY), K.Nakamura (KEK)

Task 4.2 Photodetection devices for particle detectors.

R.Pestotnik (JSI), C.Cecchi (INFN), S.Bolognesi (CEA)

Task 4.3 Innovative detectors for particle beam monitoring

P.Bambade (CNRS), A.Martens (CNRS), R.Giordano (INFN)

Task 4.4 Future neutrino imaging detectors

E.Radicioni (INFN), F.Bernlochner (DESY)

Deliverables

D4.1 – Report on prototype ladder with CMOS sensors - month 48

D4.2 – Joint report on photodetectors R&D - month 48

D4.3 – Report on luminometer and polarimeter design for SuperKEKB - month 48

D4.4 – Report on potentiality of imaging detectors for neutrino physics - month 36

Task 4.1 Monolithic silicon trackers [CNRS, DESY, INFN, CSIC, KEK]

The development of a new vertex detector based on Monolithic Active Pixel Sensors (MAPS) in CMOS technology for Belle II upgrade. With spatial resolution, below 15 μm , material budget around 0.2% X/X_0 per layer for the inner radii and 0.8% X/X_0 per layer for the outermost radii. Hit rate of the order of 120 MHz/cm², a total ionising dose of 100 Mrad and a NIEL fluence (non-ionizing energy losses) of 5×10^{14} neq/cm²

Characterize the prototype sensor OBELIX-1 under various irradiation and temperature conditions also with beam test campaigns in the KEK facility. Design and validate the next sensor, OBELIX-2, considering OBELIX-1 test results, finalized for the construction of the next vertex detector (VTX). Finalize the design of the VTX detection module and ladder structures. Prototype these structures with the OBELIX-1 sensor and develop the assembly procedure. Design the mechanical and electrical services required for the VTX and develop prototypes for each part.

Participants' roles: all institutes participate to all activities with the following leading roles: sensor design (CNRS); sensor testing and validation (INFN, DESY, KEK); detection module structure (INFN for outer layers, CSIC for inner layers); services electrical and mechanical (HEPHY, DESY, INFN, KEK).

Number of person months: 22

Task 4.2 Photodetection devices for particle detectors [JSI, INFN, CEA, KEK, CAEN, ETZH]

Study of Silicon Photomultipliers (SiPM) in single-photon regime in highly irradiated areas of Belle II Particle identification devices (expected fluence more than 10^{12} n/cm²).

- **The use of SiPM in a multiphoton regime for the light readout of crystal electromagnetic calorimeters**
- **ASICs for photodetectors:**
 - **FASTIC+ low power, low noise amplifier, shaper, and discriminator with a 25 ps TDC**
 - **HKROC digitizer (JINST 18 (2023) 01, C01035) for measurement of the charge deposited in the sensors and its Time-of-Arrival (ToA)**

Study of silicon photomultipliers as single photon counters in neutron irradiated areas. Test of SiPM for crystal calorimeter readout in high pile-up conditions. Characterization of ASICs designed for photosensors readout. Studies of Digital SiPMs and Spad Arrays with integrated electronics coupled with scintillating fibers and water-based scintillators.

Participants' roles: JSI and KEK study SiPM as single photon counters, INFN for crystal calorimeters, CEA, JSI, KEK, and CAEN for ASICs. INFN and ETHZ for DSiPM and Spad Arrays studies.

Number of person months: 12

Task 4.3 Innovative detectors for particle beam monitoring [CNRS, INFN, KEK]

- **Luminosity monitor detectors (diamonds) for high lumi SuperKEKB and polarimeter**
- **FPGA based background monitor (Single Event Upsets)**

Development of an optimized luminosity device and electronics with 1% precision for SuperKEKB at design luminosity. Design and prototype a Compton polarimeter for electron and positron beams at SuperKEKB. Test solid-state radiation detectors for the Belle II experiment. Training of junior scientists and students at the interface between accelerator, detector, and particle physics.

Number of person months: 3

Task 4.4 Future neutrino imaging detectors [INFN, UGE, IFAE, DESY]

- **High Pressure TPCs for imaging neutrino detectors**
- **Emulsions for FASER ν**

Characterize the capability of fine track sampling in a range of gas mixtures at high pressure and study the related physics potential in the context of the J-Parc neutrino beam and its infrastructure. Develop emulsion analysis techniques in high-track density events.

Number of person months: 7

Agenda of WP4 for this meeting

Introduction to WP4

Claudia Cecchi

IFAE

09:00 - 09:10

Task 4.1 Monolithic Silicon Trackers

jerome Baudot

IFAE

09:10 - 09:30

Task 4.2 Photodetection devices for particle detectors

Rok Pestotnik



IFAE

09:30 - 09:50

Task 4.3 Innovative detectors for particle beam monitoring (C. Cecchi on behalf of task 4.3 people)

Claudia Cecchi

IFAE

09:50 - 10:10

Task 4.4 Future neutrino imaging detectors

Florian Bernlochner

IFAE

10:10 - 10:30