



## Project News

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Piet Verwilligen

FTM-Next 2020

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FTM-Next Meeting 28-02-2020

# Goals FTM-Next

- **Reduce production time of Polyimide foils with thin DLC coating**
- Develop procedure for DLC deposition with **reproducible resistivity** through **Pulsed Laser Deposition** process & increase DLC strength
- Use small PLD produced DLC samples to instrument a small size FTM prototype with reduced noise design and **demonstrate FTM principle with small-size prototype**
- Pioneer **new Flexible Copper Clad Laminates** (FCCLs) and pioneer etching of  $125\ \mu\text{m}$  FCCLs to allow reaching higher gas gains
- Asses **electrostatic stability**  $250\ \mu\text{m}$  gaps  $\Rightarrow$  scale to larger area
- Continue **Fast Electronics** development for smal signals (1.6 fC)

# Consuntivi 2019

## Milestones 2019:

- ★ **MS-1:** [06/19] Design of small size FTM that can hold DLC samples WP 2  
↪ **100% done**
- ★ **MS-2:** [12/19] Development of a Procedure for reproducible DLC deposition  
↪ **100% done**
- ★ **MS-3:** [12/19] Test FTM-v4 extended up to 12 layers for Efficiency Meas.  
↪ **50% changed to:** *Test Efficiency of FTMv4 prototype with single-layer*
- ★ **MS-4:** [06/19] Submission of improved FATIC-v2 to foundry  
↪ **0% due to problems with CADENCE license; postponed to next year**  
↪ **100% done** changed to: *Identification of the improvements for the FATIC chip*

# Consuntivi 2019

## Financial Requests & Assignments 2019

Chapter	WP	Motivation	Req. k€	S.J. k€	Ass. k€	S.J. k€
<b>Bari</b>			<b>27</b>	<b>30</b>	<b>21</b>	<b>30</b>
MIS	1	Etching sessions at CERN	7		4	
CON	1	<b>Prototype Constr. Mat.</b> , Polyimide, Etching Sessions	10		8	
CON	4	Front-End chip FATIC-v2 submission		30		30
INV	1	2 × Large Bandwidth Current Pre-Amp CIVIDEC (40 dB)	5		4	
L-SW	1	Licenze COMSOL (€ 3k) ed ANSYS (€ 2k)	5		5	
<b>Lecce</b>			<b>7</b>		<b>6</b>	
MIS	2	Meeting Attendance & Publication Fees	2		1	
CON	2	Reagents, C tape, Cu grids, Au target, Laser Gas (He,Ne)	5		5	
<b>Pavia</b>			<b>8</b>		<b>7.5</b>	
MIS	3	Electrostatic Stability Setup Design at CERN	2		2	
CON	3	Lab consumables for testing FTM	1		0.5	
INV	3	CAEN A1561H 12 ch High Resolution (50 pA) HV PS	5		5	
<b>2019</b>		<i>Total inserted in DB Preventivi</i>	<b>42</b>	<b>30</b>	<b>34.5</b>	<b>30</b>

# Conferences & Publications 2019

## ● Conferences 2019:

- MPGD 2019 (May 2019) P.Verwilligen - Diamond-Like Carbon for the Fast Timing
- EPS-HEP 2019 (July 2019) C.Roskas - Progress in the development of Fast Timing Micro-Pattern Gaseous Detector
- COLA 2019 (Sep 2019) M.Cesaria - Controlled Uniformity, Structure and Electrical Properties of PLD-deposited DLC resistive films for Fast Timing Micropattern Gas Detectors
- IPRD 2019 (Oct 2019) A.Pellecchia - A UV laser test bench for micro-pattern gaseous detectors
- IEEE NSS-MIC (Nov 2019) I.Vai - Fast Timing Micropattern gaseous detector: working principle and latest progresses in the detector development

## ● Publications 2019:

- Development of the FTM technology for TOF-PET - R. Radogna, P. Verwilligen, M. Maggi. 2019. 2 pp. Published in Nucl.Instrum.Meth. A936 (2019) 449-450 - DOI: 10.1016/j.nima.2018.11.036
- Simulation of a Fast Timing Micro-Pattern Gaseous Detector for TOF-PET and future accelerators Raffaella Radogna, Piet Verwilligen, Marcello Maggi (INFN, Bari). 2019. 8 pp. Published in EPJ Web Conf. 214 (2019) 02033 - DOI: 10.1051/epjconf/201921402033
- FATIC: an ASIC for Fast Timing Micro-Pattern Gas Detectors F. Licciulli, G.De Robertis, A. Ranieri, P. Verwilligen (INFN, Bari). 2019. 6 pp. - DOI: 10.1109/IWASI.2019.8791274

## ● Publications 2020:

- A UV laser test bench for micro-pattern gaseous detectors - Antonello Pellecchia, Antonio Ranieri, Piet Verwilligen - arXiv:2002.08661 [physics.ins-det]
- Fast Timing Micropattern Gaseous Detector (FTM) simulations for future colliders and medical applications - Y. Maghrbi, P. Verwilligen, M. Maggi. 2020. - Nucl.Instrum.Meth. A954 (2020) 161666
- Diamond-Like Carbon for the Fast Timing MPGD - P.Verwilligen et al. - arXiv:1907.13559 [physics.ins-det]
- [Proceedings for EPS-HEP 2019?](#)
- [Proceedings for COLA 2019?](#)
- [Proceedings for IEEE 2019?](#)

# Preventivi 2020

## Milestones 2020:

- ★ **MS-1:** [06/20] Test FTM w/ Laser & Cosmics: Signal, Gain & Eff
- ★ **MS-2:** [12/20] new FCCL (Cu-Cr-DLC) with DLC of desired resistivity
- ★ **MS-3:** [03/20] Final design FATIC-v2 ready for submission to foundry
- ★ **MS-4:** [06/20] Deposit  $100 \text{ M}\Omega/\square$  with Cr-Cu cover + Etching Test
- ★ **MS-5:** [12/20] Test FTM at BTF: Measurement of Time Resolution

**Project Team** ..... [slide 12](#)

**Project Organization** ..... [slide 9](#)

**Financial Requests** ..... [slide 4](#)

# Preventivi 2020

## Financial Requests & Assignments 2020

Chapter	WP	Motivation	Req. k€	S.J. k€	Ass. k€	S.J. k€
<b>Bari</b>			<b>40</b>	<b>30</b>	<b>11</b>	<b>37</b>
MIS	1	Test Beam (BTF-LNF)	5			4
CON	1	<b>Prototype Constr. Mat.</b> , Polyimide, Etching Sessions	5		3	
CON	4	Front-End chip FATIC-v2 submission		30		30
CON	4	FATIC Test Board & New FE Boards	3			3
CON	1	Laser Optics	1		1	
CON	1	Scintillators & Mechanics Test-Beam	2.5		1	
CON	5	Pyrolytic Carbon, Conductive glue	2		1	
INV	1	Motorized Vertical Stage ( <i>anticipated 2019</i> )	3.5		3.5	
INV	1	Fast Timing MCP-PMT ( <i>anticipated 2019</i> )	8		10.5	
L-SW	1	Licenze COMSOL (€ 7.5k) ed ANSYS (€ 2.5k)	10.0		5	
<b>Lecce</b>			<b>7</b>		<b>6</b>	
MIS	2	Open Access Publication	2			2
CON	2	Reagents, C tape, Cu grids, Au target, Laser Gas (He,Ne)	5		4	
<b>Pavia</b>			<b>4</b>		<b>4</b>	
MIS	3	Etching Sessions CERN	2		2	
CON	3	HV cables	2		2	
<b>2020</b>		<i>To be inserted in DB Preventivi 2020</i>	<b>51</b>	<b>30</b>	<b>33</b>	<b>39</b>

# Project Status 2020

## Work done 2019:

- LE** Deposition of Uniform DLC over  $\approx 2$  cm, 100 MOhm/ $\square$   
 $\hookrightarrow$  *Do we have a recipe yet of Resistivity as function of deposition pars?*
- LE** Electrical Characterisation of DLC samples
- BA** designed and constructed w/ DLC from USTC (China) (Spring)  
Test Beam conceptualized; Choice of MCP-PMT for  $t_0$  (Summer)  
FTM small prototype tested (Autumn)  
but having stability problems  $\rightarrow$  new design (Autumn/Winter)
- BA** DLC Workshop (Spring)  
AIDA proposal on DLC & multi-layer graphene (60kEUR - 4Y) (Autumn)
- BA** Initiated Ion-Beam deposition, resistivity control through  $H$ -doping, adhesion & etching tests
- PV** technical issues with testing of large prototype of MPGD-FaTimA



# Project Organization Update

WP	Task Description	2019				2020				2021			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	27	30	33	36
<b>WP1 Detector Architecture Design Simulation, Construction &amp; Test</b>										WP Leader: Bari			
Task 1.1	Design of Small size FTM		★										
Task 1.2	Prototype Construction												
Task 1.3	Laser Tests						★						
Task 1.4	Test Beam (DESY/PSI)												
Task 1.5	Laser, Cosmics, Beam Tests												
<b>WP2 Pulsed Laser Deposition of Diamond Like Carbon on PI Foils</b>										WP Leader: Lecce			
Task 2.1	PLD w/ Resistivity Control				★								
Task 2.2	Creation new FCCL Structs												★
Task 2.3	PLD w/ Resistivity Variation												
<b>WP3 Large Area &amp; High Gain R&amp;D</b>						WP Leader: Pavia							
Task 3.1	Eff with Large drift (50 $\mu\text{m}$ )				★								
Task 3.2	Refit FTM with 4 good foils												
Task 3.3	Etching Studies 125 $\mu\text{m}$												
<b>WP4 Fast Electronics Development</b>						WP Leader: Bari							
Task 4.1	Design & Prod of FATIC-v2		★				★						
Task 4.2	Lab Tests + Cosmic Tests												
<b>WP5 Ion Beam Deposition of Diamond Like Carbon on PI Foils</b>										WP Leader: Bari			
Task 5.1	a-C:H (100 M $\Omega$ /□) + Cr-Cu cover						★						
Task 5.2	Study $\rho_5$ as function of thickness												
Task 5.3	Deposit 10 cm $\times$ 10 cm												

# Some News

- **AIDAInnova:**

Submission to EU: 17/03/2020 — 10MEUR EU Budget — Funding Starts 2021

160 Eols submitted - 13 WPs — WP7 Gaseous Detectors: 8/38 Eols selected — 60kEUR

<https://agenda.infn.it/event/21203/contributions/107219/attachments/70753/88422/AIDAInnova-CSN1-18-02-2020.pdf>

[https://agenda.infn.it/event/21203/contributions/107219/attachments/70753/88440/AIDAInnova\\_NPastrone\\_CSN1\\_18feb20.pdf](https://agenda.infn.it/event/21203/contributions/107219/attachments/70753/88440/AIDAInnova_NPastrone_CSN1_18feb20.pdf)

- **RD-51 DLC workshop:**

<https://indico.cern.ch/event/872501/timetable/?view=standard>

- **Adhesion & Etching tests performed at CERN:**

- New Procedure for DLC Etching requires a well-adherent Cu - DLC layer
- Adhesion only if in same vacuum and using thin Ti or Cr layer (IBS tests)
- Rui would like to work with samples at least  $6 \times 6 \text{ cm}^2$

- **Detector Tests & Test-beam prep**

- Slides of Antonello



## Backup:

- Anagrafica

# Anagrafica

Sez.	Name	Pos.	Time	Gender	CSN	Task
<b>Bari</b>						<b>1.8 FTE</b>
BA	<b>Verwilligen Piet (PI)</b>	Ric.	30%	M	CSN-I	<b>Sim, Design &amp; Test</b>
BA	Colaleo Anna	P.R.	10%	F	CSN-I	FTM Test
BA	Maggi Marcello	P.R.	10%	M	CSN-I	FTM Test
BA	Venditti Rosamaria	A.d.R.	10%	F	CSN-I	FTM Test
BA	<b>Ranieri Antonio</b>	D.R.	30%	M	CSN-I	<b>FATIC v2 Test</b>
BA	Licciulli Francesco	A.T.	20%	M	CSN-I	FATIC v2 Design & Test
BA	<b>Valentini Antonio</b>	P.A.	20%	M	CSN-V	<b>Ion Beam Deposition</b>
BA	Teresa Ligonzo	Ric.	30%	F	CSN-V	Ion Beam Deposition
BA	Grazia Cicala	P.R.	20%	F	CSN-V	Ion Beam Deposition
<b>Lecce</b>						<b>1.2 FTE</b>
LE	<b>Serra Antonio (RL)</b>	P.A.	30%	M	CSN-V	<b>DLC Characterization</b>
LE	Calcagnile Lucio	P.O.	10%	M	CSN-V	DLC Characterization
LE	Manno Daniele Erminia	P.A.	20%	F	CSN-V	DLC Characterization
LE	Quarta Gianluca	Ric.	10%	M	CSN-V	DLC Characterization
LE	<b>Caricato Anna Paola</b>	P.A.	10%	F	CSN-V	<b>DLC Deposition</b>
LE	Di Giulio Massimo	P.A.	20%	M	CSN-V	DLC Deposition
LE	Martino Maurizio	P.A.	20%	M	CSN-V	DLC Deposition
<b>Pavia</b>						<b>1.0 FTE</b>
PV	<b>Vai Ilaria (RL)</b>	R.T.D.a	30%	F	CSN-I	<b>Large FTM &amp; Beam Test</b>
PV	Riccardi Cristina	P.A.	10%	F	CSN-I	Large FTM Test
PV	Salvini Paola	Ric.	20%	F	CSN-I	Large FTM Test
PV	Vitulo Paolo	P.A.	20%	M	CSN-I	Large FTM & Beam Test
PV	Ressegotti Martina	A.d.R	20%	M	CSN-I	Large FTM & Beam Test

# Overview of MCP-PMT offers & specs

**Table:** Full MCP-PMT offers, for vacuum devices with input window; photocathode (PC) made of Multi-Alkali (MA) or Bi-Alkali (BA); dual-stage MCP (Gain  $10^3$ – $10^6$  for 2.4–3.6 kV typically) and anode with connector or pins. Photonis detectors can reach a max gain of  $10^5$  at 2800 V max.

Producer id	Price kEUR	$\varnothing/\ell$ (mm)	# r/o	C <sub>anode</sub> pF	channel $\varnothing$ (um)	tts (ps)	$t_{rise}$ (ps)	Window (mm)	PC (QE% – $\lambda$ )	Geom eff (%)
HAMAMATSU <i>R3809U-50</i>	11.9	○ 11	1	3	6	25	160	Quartz 3.2	MA (> 25%) 200-400 nm	100
HAMAMATSU <i>R10754-07-M16</i>	8.3	□ 23	16	0.8	10	33	180	Quartz 1.5	MA (> 25%) 200-400 nm	61
PHOTONIS <i>PP2365D</i>	10.1	○ 18	1	1-10	6	40	800	Quartz 5.0	BA (> 30%) 250-400 nm	100
PHOTONIS <i>XP58012</i>	8.8	□ 53	64	0.1	25	37	600	Saffier 1.27	BA ( $\geq$ 20%) 150-460 nm	81

