

# DART WARS: Detector Array Readout with Traveling Wave Amplifiers

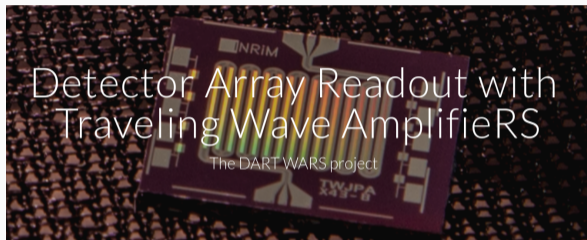
First meeting

Andrea Giachero

University & INFN of Milano-Bicocca



- Collaboration mailing list: [dartwars@lists.infn.it](mailto:dartwars@lists.infn.it)
- Project web page: [dartwars.unimib.it](http://dartwars.unimib.it)
- Wiki page: [wiki.infn.it/progetti/dartwars/home](http://wiki.infn.it/progetti/dartwars/home)  
All the collaborators with an INFN AAI account can read, create and edit pages.  
Those without an INFN AAI credential have received an email with instructions to obtain it few days ago.
- Indico page: [agenda.infn.it/category/1473/](http://agenda.infn.it/category/1473/)
- Google Drive: [bit.ly/33y0ODS](https://bit.ly/33y0ODS)
- Other? Zulip, Slack, Discourse, Mattermost



DARTWARS is a project funded by the National Scientific Committee 5 (CNS5) - All Rights Reserved.

*Thanks to Emanuele for the background picture*

The management and coordination of DART WARS will be carried out by the Project Management Board (PMB), composed of the Project Coordinator (RN), the Unit Coordinators (RL) and the leaders of all WPs.

First Name	Second Name	Unit	Role
Emanuele	Enrico	INRiM/TIFPA	WP2 leader and INRiM contact
Elena	Ferri	MIB	RL INFN-MIB
Claudio	Gatti	LNf	WP4 leader
Andrea	Giachero	MIB	WP5 leader and RN
Carlo	Ligi	LNf	RL INFN-LNf
Benno	Margesin	TIFPA	RL INFN-TIFPA and FBK contact
Giuseppe	Maruccio	LE	RL INFN-LE
Sergio	Pagano	SA	WP1 leader and RL INFN-SA
Andrea	Vinante	TIFPA	WP3 leader

Mailing list: [dartwars-pmb@lists.infn.it](mailto:dartwars-pmb@lists.infn.it)

WPs	WP Leader	Description
WP1	Sergio Pagano (SA)	Design and Simulation
WP2	Emanuele Enrico (INRiM)	Devices fabrication
WP3	Andrea Vinante (TIFPA)	DTWKI Test and Characterization
WP4	Claudio Gatti (LNF)	TWJPA Test and Characterization
WP5	Andrea Giachero (MIB)	Management

The technical goal is to achieve:

- Gain value around **20 dB**, comparable to HEMT;
- Large bandwidth: **4 GHz**, comparable to HEMT;
- High saturation power, **around -50 dBm**;
- Quantum limited or nearly quantum limited noise:  $T_N < 600 \text{ mK}$ .

## Broadband quantum limited noise amplification and its implication in particle physics

Possible target journal: Progress in Nuclear and Particle Physics (IF: 13.421)

[www.sciencedirect.com/journal/progress-in-particle-and-nuclear-physics](http://www.sciencedirect.com/journal/progress-in-particle-and-nuclear-physics)

### (Tentative) Outline

- State of the art (Giachero/Enrico)
- Application with TESs
  - Neutrino mass measurement (MIB)
  - Low threshold measurement: Dark Matter,  $CE\nu S$ , neutrino from supernovae (MIB+external support from MPG)
  - SIMP-like detectors for axions (TIFPA?)
- Application with MKIDs
  - Dark Matter and  $0\nu DBD$  (external support from A. Cruciani (Roma1))
  - CMB?
- Application with RF cavities
  - QUAX-like detectors for axions (LNF)
  - Others?
- Qubit-magnon hybrid quantum system in microwave cavities (LE?)
- Other?
- Any suggestions are welcome.

Unit	MISS [k€]		CON [k€]		INV [k€]		LIC-SW [k€]		APP [k€]		PERS [k€]		Total [k€]	
	REQ	ALLOC	REQ	ALLOC	REQ	ALLOC	REQ	ALLOC	REQ	ALLOC	REQ	ALLOC	REQ	ALLOC
LE	4	1	26	15	33	25sj							63	16+25sj
LNF	4	4	35	7+20sj	18	15sj							57	11+35sj
MIB	4	2	8	4	35	25sj							47	6+25sj
SA	4	4	23	17			5	5	50	10	30	29	112	55.5+10sj
TIFPA	5	2.5	20	4+15.sj	76	19+21.sj							101	25.5+36sj
<b>Total</b>	<b>21.0</b>	<b>13.5</b>	<b>112</b>	<b>47+35sj</b>	<b>162</b>	<b>19+86sj</b>	<b>5</b>	<b>5</b>	<b>50</b>	<b>10.0</b>	<b>30.0</b>	<b>30.0</b>	<b>380</b>	<b>114+131sj</b>
<b>Total</b>	<b>21.0</b>	<b>13.5</b>	<b>112</b>	<b>82</b>	<b>162</b>	<b>105</b>	<b>5</b>	<b>5</b>	<b>50</b>	<b>10.0</b>	<b>30.0</b>	<b>30.0</b>	<b>380</b>	<b>245</b>

- 135 k€ cut from the original requests (~ 36%) ⇒ very big cut;
- 131 k€ over the total of 245 k€ are sub-judice (~ 47%)

CON/ALLOC @ LNF includes 15 k€ for production at INRiM;

CON/ALLOC @ TIFPA includes 15 k€ for production at FBK;

Unit	Rich. [k€]	Note Alla Richiesta	Commento
LE	25	Signal Generator, 250 kHz to 20 GHz	SJ alla presentazione dell'offerta. Si invita a coordinare l'acquisto con le altre sedi.
LNF	20	Fabbricazione devices presso INRiM	SJ alla presentazione dell'offerta.
LNF	15	Signal Generator, 250 kHz to 13 GHz	SJ alla presentazione dell'offerta. Si invita a coordinare l'acquisto con le altre sedi.
LE	25	Signal Generator, 250 kHz to 20 GHz	SJ alla presentazione dell'offerta. Si invita a coordinare l'acquisto con le altre sedi.
SA	10	Signal Generator, 250 kHz to 20 GHz	SJ al reperimento della restante cifra (circa 40 k€) da altri canali.
TIFPA	15	Fabbricazione devices presso INRiM	SJ alla presentazione dell'offerta.
TIFPA	21	Vector Network Analyzer 9 kHz - 18 GHz	SJ alla presentazione dell'offerta.
<b>Totale</b>	<b>131</b>		

- The VNA for TIFPA was totally cut;
- The next INFN CSN5 is (probably) scheduled in February, 2021;
- We need the quotations as soon as possible;

**Requirements:** up to 20 GHz and phase noise lower than -120 dBc/Hz @ 10 GHz

Art.	Descrizione Prodotto	Prezzo Unitario	Qta	Totale EUR	
1	<a href="#">E8257D</a> PSG Analog Signal Generator, Keysight Care Assured 3 years E8257D-520 Frequency Range from 250 KHz to 20 GHz	34.124,00	1	34.124,00	
	E8257D-UNX Ultra-low Phase Noi <b>(non necessario)</b>	8.036,00	1	8.036,00	
	E8257D-1E1 Step Attenuator <b>(non necessario)</b>	4.078,00	1	4.078,00	
	E8257D-1EU High Output Power <b>(non necessario)</b>	7.181,00	1	7.181,00	
				Totale listino	53.419,00
				Totale sconto	-7.419,00
				<b>Importo Totale</b>	<b>EUR 46.000,00</b>



## SMA100B Signal Generator

Pos.	Modello Descrizione / Tempi di consegna (sett)	Part Number	Qtà pz.	Prezzo unità EUR	Prezzo Totale EUR
2.1	<p><b>SMAB-B1H</b> OCXO with high performance, frequency option (R&amp;S®SMAB-B1xx) required, not installable post factory (hardware option)</p> <p>Garanzia: 12 mesi</p>	1420.8188.02	1	1.465,00	<b>1.465,00</b>
2.2	<p><b>SMAB-B709</b> Low phase noise Frequency option (R&amp;S®SMAB-B1xx) req., not installable post factory (hardware option)</p> <p>Garanzia: 12 mesi</p>	1420.9849.02	1	4.935,00	<b>4.935,00</b>
<b>Prezzo netto totale</b>				<b>EUR</b>	<b>24.500,00</b>

ROHDE & SCHWARZ



con IVA ~ 30 k€

**Keysight: Totalmente fuori budget!!! Rohde-Schwarz: Spesa Affrontabile**

- 14th Workshop on Low Temperature Electronics (WOLTE14), to be held in Matera, Italy, April 12–15, 2021;
- 15th European Conference on Applied Superconductivity (EUCAS2021), to be held in Moscow, Russia, September 5-10, 2021;
- 19th International Workshop on Low Temperature Detectors (LTD19), to be held in Boulder, Colorado, US, ???-??, 2021
- Others?

- M1** Kick-start meeting and report with project master and communication plans; **31-03-2021**
- M2** Public and Private project website on-line **31-03-2021**
- M3** First Design of TWJPA and DTWKI, operating in different bands, and submission to the foundries; **31-12-2021**
- M4** MIB: Setup and test of the experimental apparatus for the device characterization.  
Demonstration of optimal conditions for quantum-limited measurements; **31-12-2021**
- M5** LE: Setup and test of the experimental apparatus for the device characterization.  
Demonstration of optimal conditions for quantum-limited measurements; **31-12-2021**
- M6** LNF: Setup and test of the experimental apparatus for the device characterization.  
Demonstration of optimal conditions for quantum-limited measurements; **31-12-2021**
- M7** Setup and test of the experimental apparatus for the device characterization.  
Demonstration of optimal conditions for testing the operation of developed device **31-12-2021**
- M8** TIFPA: Setup and test of the experimental apparatus for the device characterization.  
Demonstration of optimal conditions for quantum-limited measurements; **31-12-2021**