INFN Istituto Nazionale di Fisica Nucleare

DART WARS
WP1

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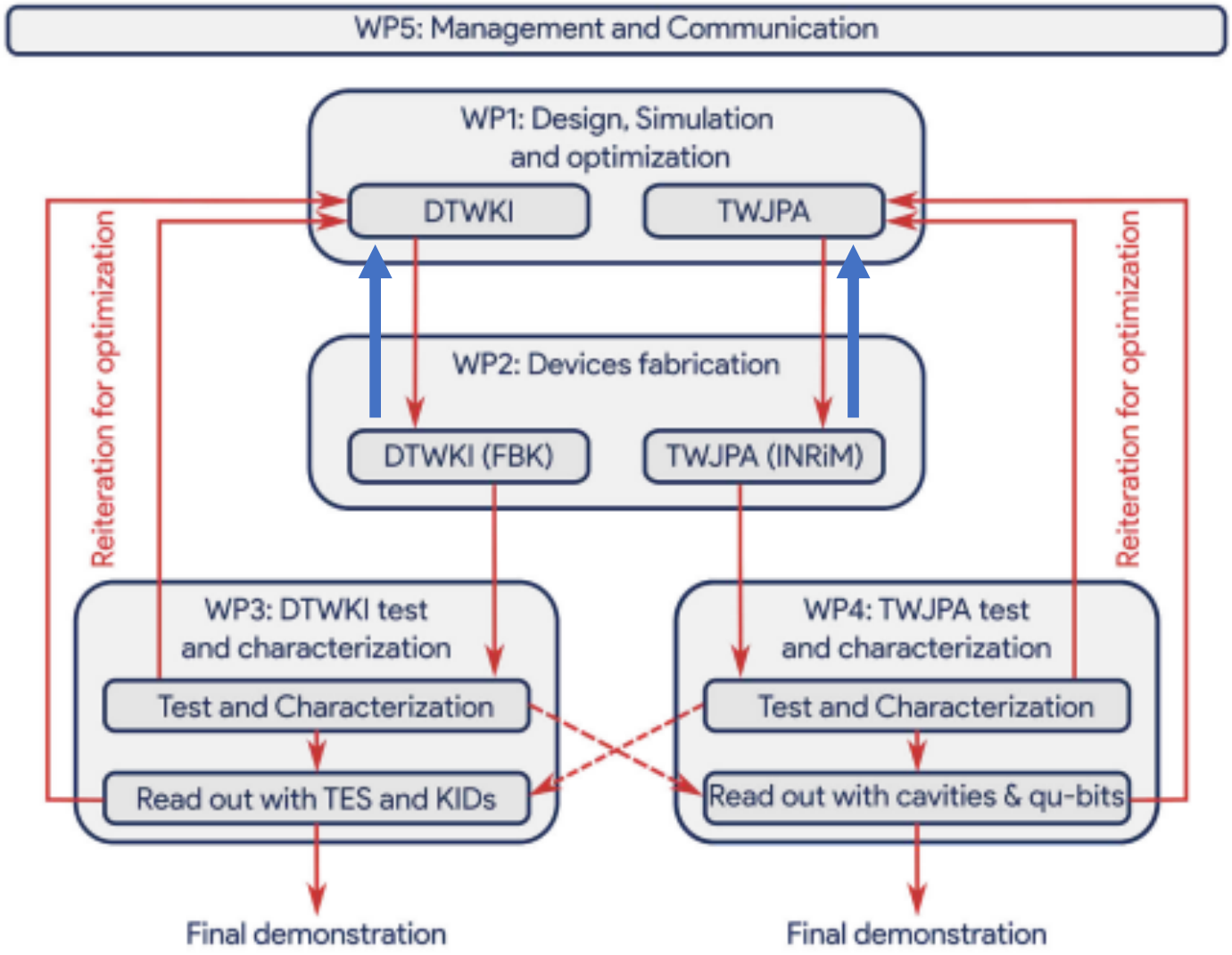


Figure 4: DART-WARS working packages diagram

Working Package Number:	1	**Start Date or Starting Event**			Project start	
WP Package Title:	Design, Optimization and Simulation					
Participant short name:	LNF	LE	MIB	SA		
Person/month per participant	6	6	10	32		
WP Leader	Sergio Pagano (SA)					

Objectives: the goal of this WP is to improve the current parametric amplifiers design with new layouts and simulations

Description of work

For both amplifier solutions the designs will match a gain of >20 dB over different bandwidths: C-band (4-8 GHz, TESs and MKIDs), and X-band (8-12 GHz, for microwave cavities and qubit, L+S band (1-4 GHz for the cavities designed at the IBS-CAPP (Korea). Numerical simulation for the amplifier behavior will exploit the experience of the Unisa group in parallel GPU computing.

Tasks Description

T1.1: Development of theoretical models for describing the TWPAs behavior (M1-M9);
T1.2: Simulation and design of the TWPAs, considering new and innovative solution (M1-M24, M28-M32);
T1.3: Analysis of experimental results in terms of device model and results of simulations (M10-36)

Milestones

MI1.1: Design of TWJPA and DTWKI operating in different bands (M10)
MI1.2: Improved design of TWJPA and DTWKI operating in in different bands (M24)
MI1.3: Second improved design of TWJPA and DTWKI operating in different bands (if needed) (M32)

Role of participants

- INFN-SA and the WP2 leader will coordinate and supervise the design and simulation for theTWJPA amplifiers;
- INFN-MIB and the WP2 leader will coordinate and supervise the design and simulation for the DTWKI amplifiers;
- Results from simulation and experimental measurements will be analyzed by INFN-SA and INFN-MIB with the coordination of the WP2 leader.

Deliverables

D1.1: Optimized models and code for simulation of DTWKI/TWJPA (M12)
D1.2: Design of first generation of DTWKI/TWJPA operating in different bands (M10)
D1.3: Design of improved DTWKI/TWJPA after feedback from testing and field runs (M22/M30)
D1.4: Report on performances obtained and expected improvements (M12/M24/M36)

WP/ Task	Description	Year 1			
		Q1	Q2	Q3	Q4
WP1	Design and Simulation				
T1.1	Development of the TWPA theoretical model			D1.1	
T1.2	Simulation and design of the TWPA				D1.2 M1.1
T1.3	Analysis of simulation/experimental results				D1.4

Modeling and simulation of TWJPA
Torino + Salerno
SW: home made for JJ + PathWave RF Synthesis (Genesys) ??

Modeling and simulation of DTWKI
Milano + Trento
SW: Sonnet

Testing of TWJPA chips
Salerno

The Salerno Team

Sergio Pagano PO

JJ modeling, low T measurements

Carlo Barone RTDB

Low T measurements, noise meaurements

Giovanni Carapella RTI

JJ modeling, Low T measurements, MW+JJ interaction

Giovanni Filatrella PA Unisannio

JJ and JJ array modeling and simulation

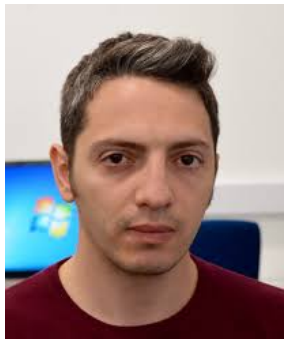
With the help of

Ing. Costantino Mauro, PhD in physics

Low T measurements, noise measurements

Dr. Guerino Avallone, (PhD in physics Q1 2021)

Low T measurements, electronics setup



Modeling and simulation activity

Strong collaboration with WP2 for design and modeling of TWJPA

Design simulation with MW simulation SW (to be acquired)

Development of code and Simulation of TWJPA with high speed parallel GPU
Already developed code for single JJ with noise

NVIDIA TITAN RTX SPECIFICATIONS

Architecture	NVIDIA Turing
Frame Buffer	24 GB GDDR6
Boost Clock	1770 MHz
Tensor Cores	576
CUDA Cores	4608

Testing activity

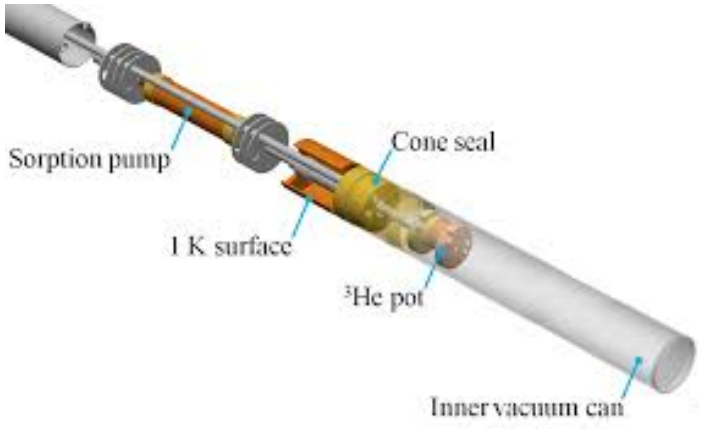
Setup of existing 300mK cryostat to mount TWJPA

Setup of electronics chain for characterization of TWJPA
Design of appropriate chip holder with optimized MW performances

Preliminary characterization of produced TWJPA

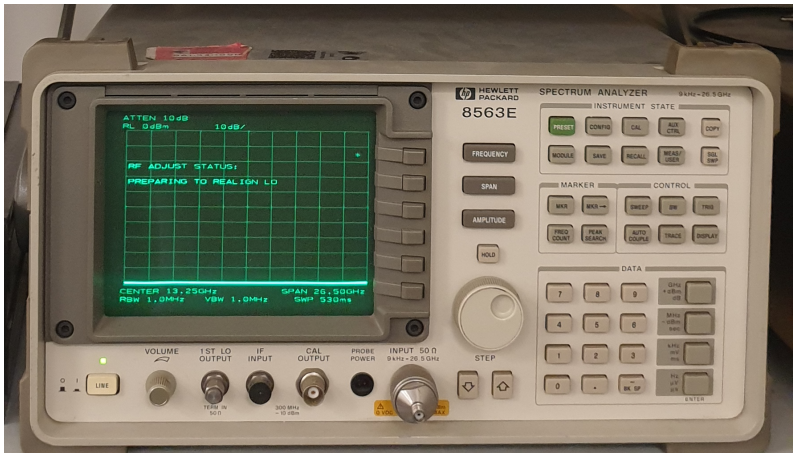
3He refrigeratore Oxford Heliox
Base temperature <300mK Hold time 4-8 h

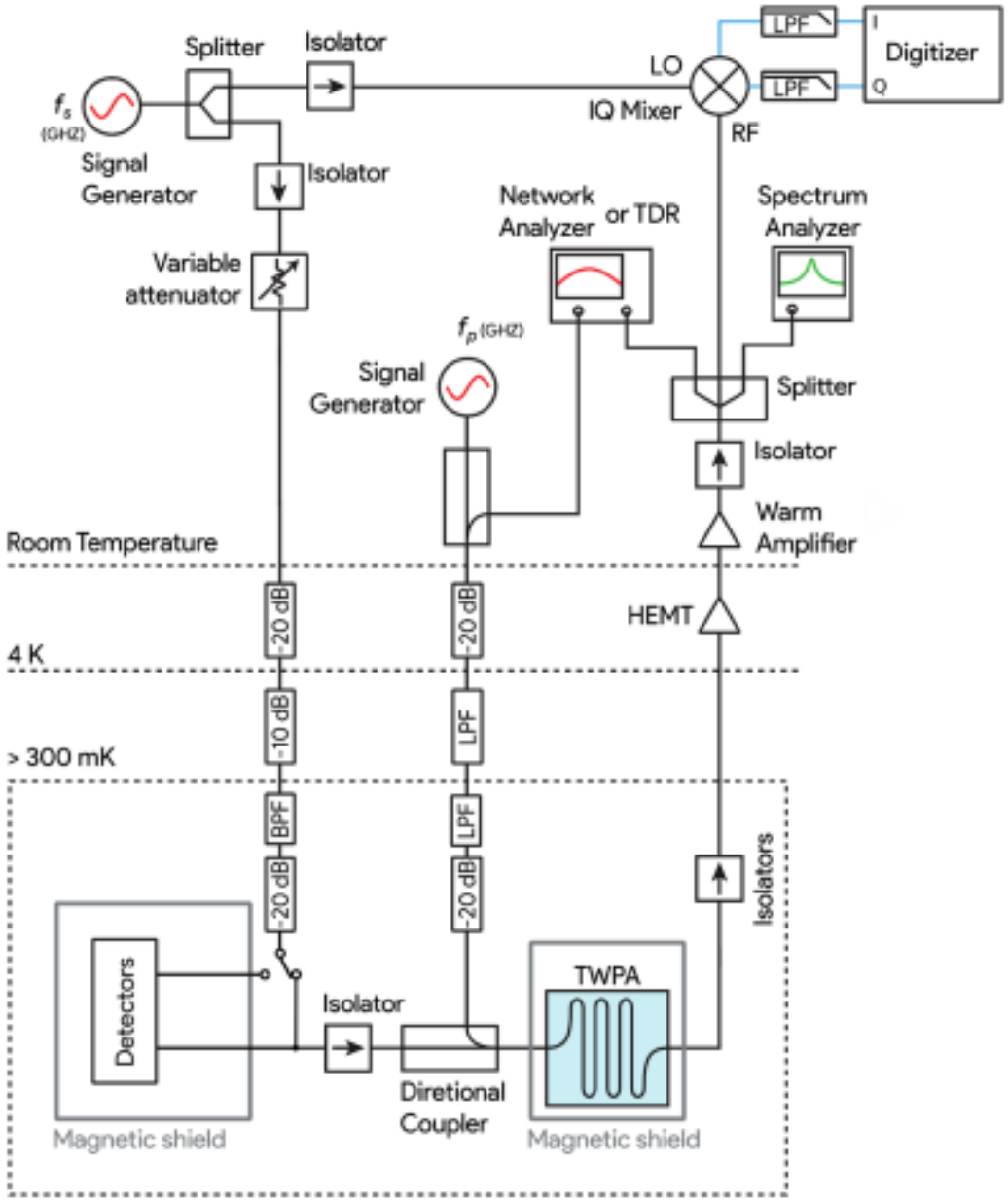
Equipped with two microwave lines but expandable
Used so far for low freq measurements
Need cold stage microwave setup



Other equipment available:

- MW generator 0-20GHz
- MW generator 8-12 GHz
- Spectrum analyzer 0-26 GHz
- Variors RT and Cold MW amplifiers




Splitter
Isolator
LPF
I
Digitizer
LO
Q
LPF
IQ Mixer
RF
f_s (GHz)
Signal Generator
Isolator
Network Analyzer
or TDR
Spectrum Analyzer
Variable attenuator
f_p (GHz)
Signal Generator
Splitter
Isolator
Warm Amplifier
Room Temperature
HEMT
20 dB
20 dB
4 K
10 dB
LPF
> 300 mK
BPF
LPF
20 dB
20 dB
Isolators
Detectors
TWPA
Isolator
Diretional Coupler
Magnetic shield
Magnetic shield

Initial activity (start of 2021)

- Purchasing of microwave components for cryostat setup
- Design and realization of chip holder
- Acquisition of wire bonder

- Definition and acquisition of MW simulation SW

- Call for a 1 year post doc position

- Modeling of TWJPA (with help of INRIM) and initial simulations