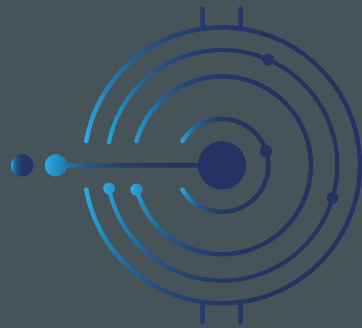


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# WP4 - TWJPA TEST AND CHARACTERIZATION

C GATTI



# DARTWARS

Detector Array Readout with Traveling Wave Amplifiers

General Meeting 1/12/2021

# WP4 MILESTONES AND DELIVERABLES

## WP Main Goal

INFN-LNF and IBS-CAPP: application to axion searches in two different frequency ranges: 8-12 GHz and 1-4 GHz, respectively.

INFN-LE: readout of transmon qubits coupled to magnetostatic modes in Yttrium Iron Garnet (YIG) single crystals in strong-coupling regime.

		2021			2022			2023		
WP4	TWJPA Test and Characterization									
T4.1	Set up of the experimental instrumentations		D4.1							
T4.2	Characterization of the produced TWJPAs						D4.2			D4.2
T4.3	Read out with microwave cavities and qubit with TWJPAs									D4.3

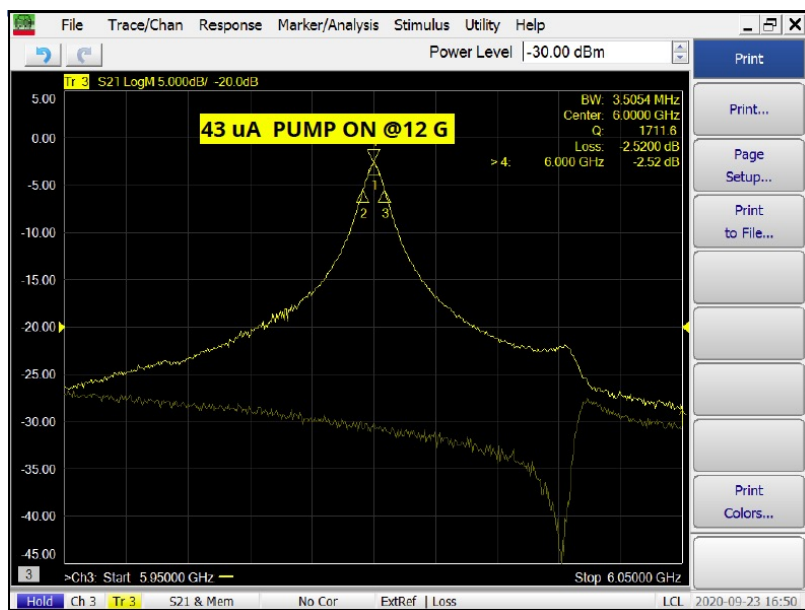
Task 4.1: Set up of the experimental instrumentations (M1-M6)

Task 4.2: Experimental characterization of the performances of produced TWJPAs (M12-30);

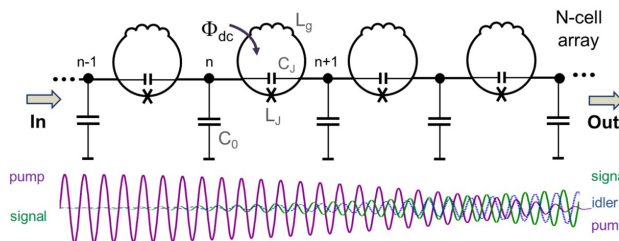
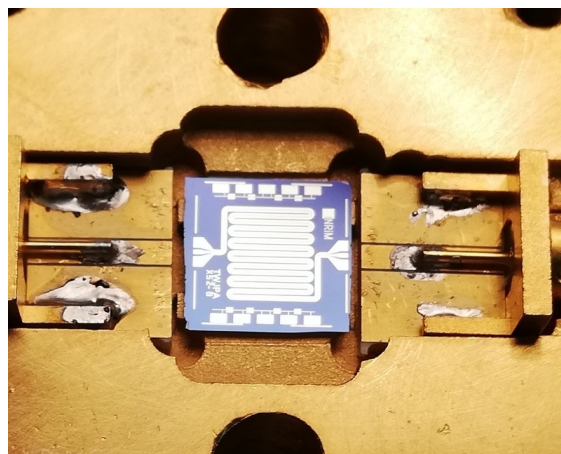
Task 4.3: Test of produced TWJPAs and read out demonstration with detectors (M24-36);

# TWJPA TEST DURING FIRST YEAR

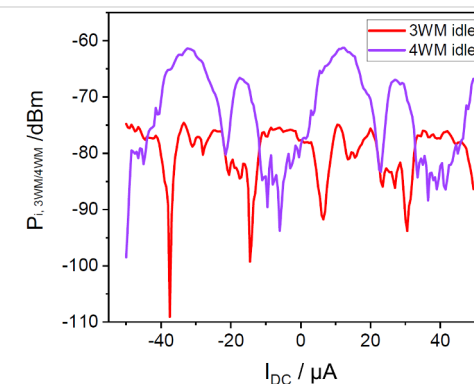
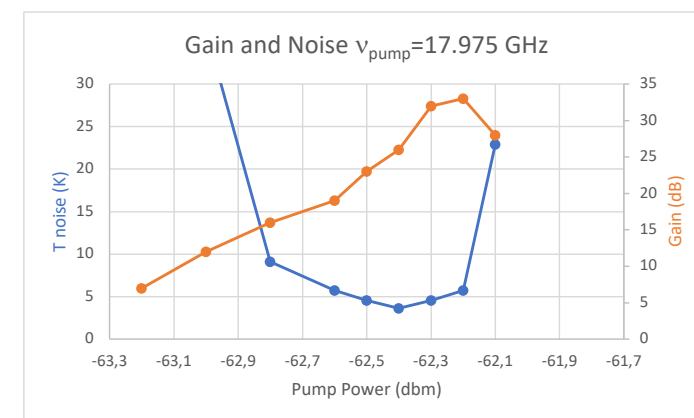
First TWJPA samples characterized at LNF and IBS-CAPP at end of 2020. Parametric amplification observed only for single frequencies at 3, 6 and 9 GHz (!?). Modulation of 4/3 wave-mixing behaviour observed.



Measurements at IBS-CAPP (Çağlar Kutlu)



## Measurements at LNF

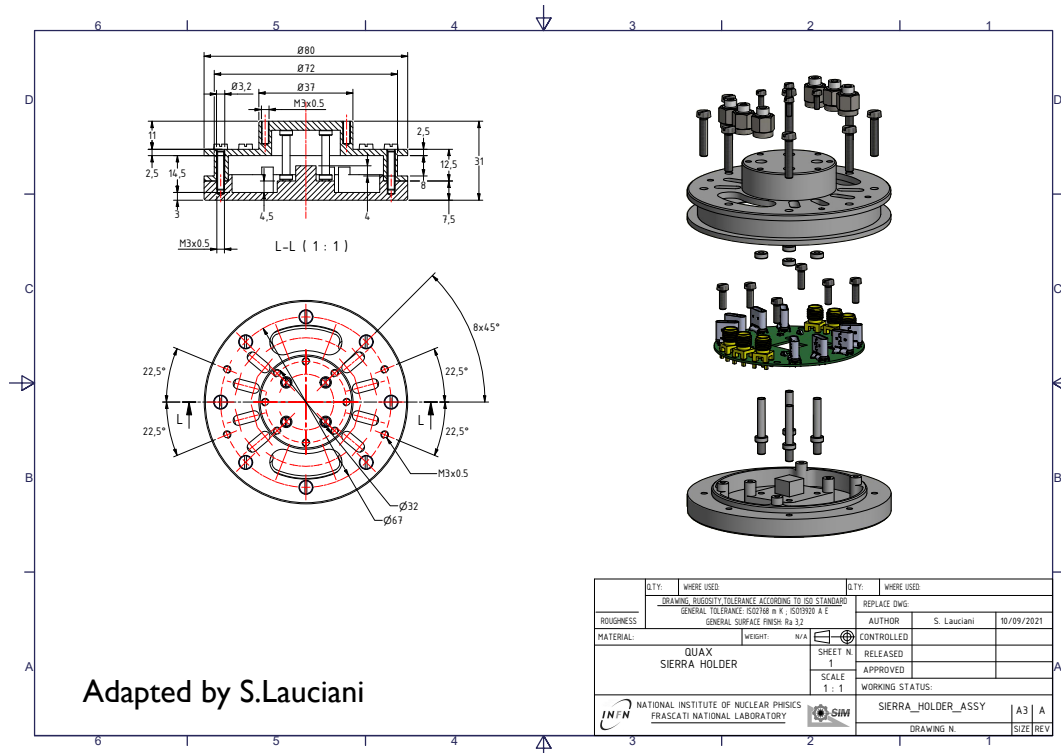




# D4.1 SETUP OF LABS

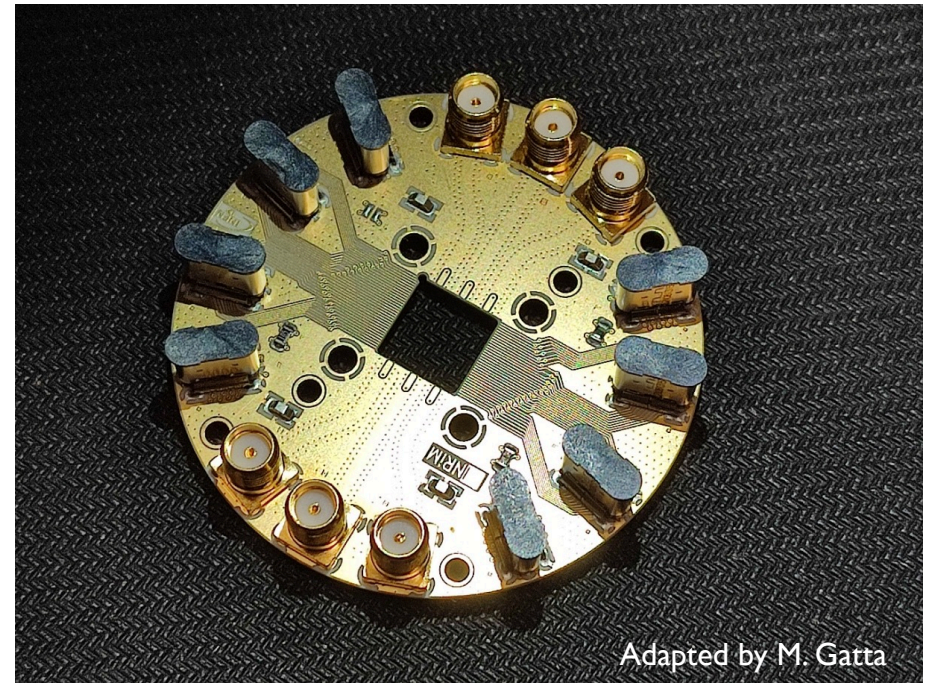
# LNF Lab: Sample holder

PCB and holder based on INRiM design



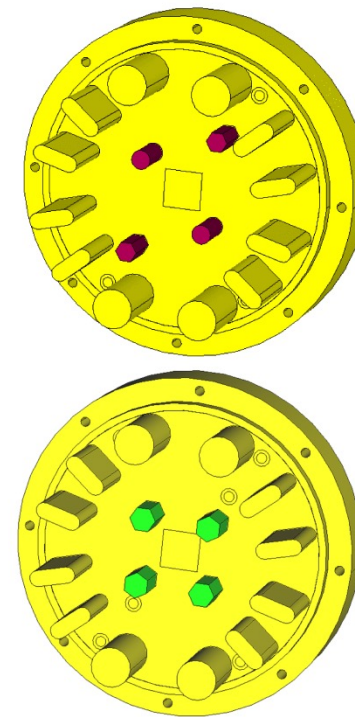
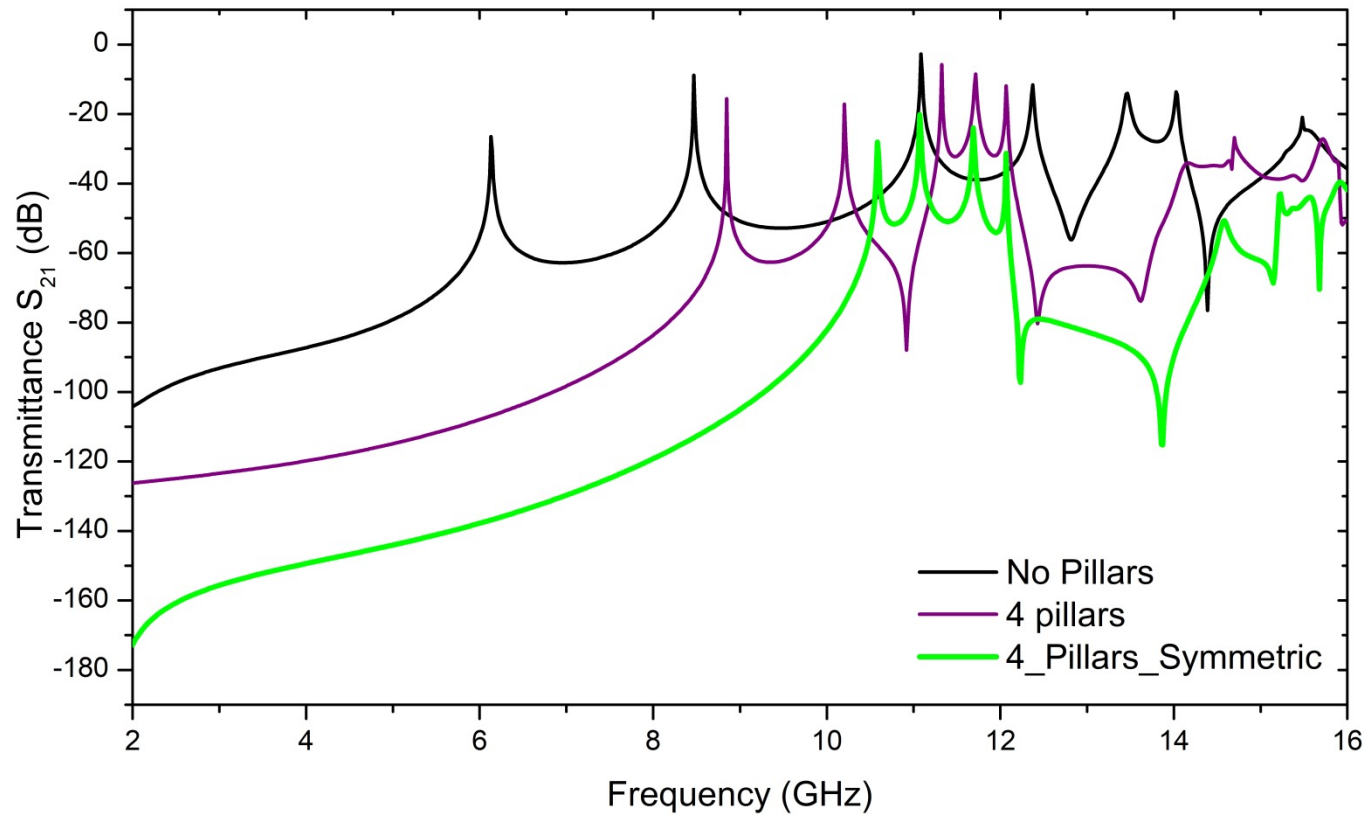
Adapted by S.Lauciani

Sample holder now in fabrication at LNF workshop. Ready in 1-2 weeks.

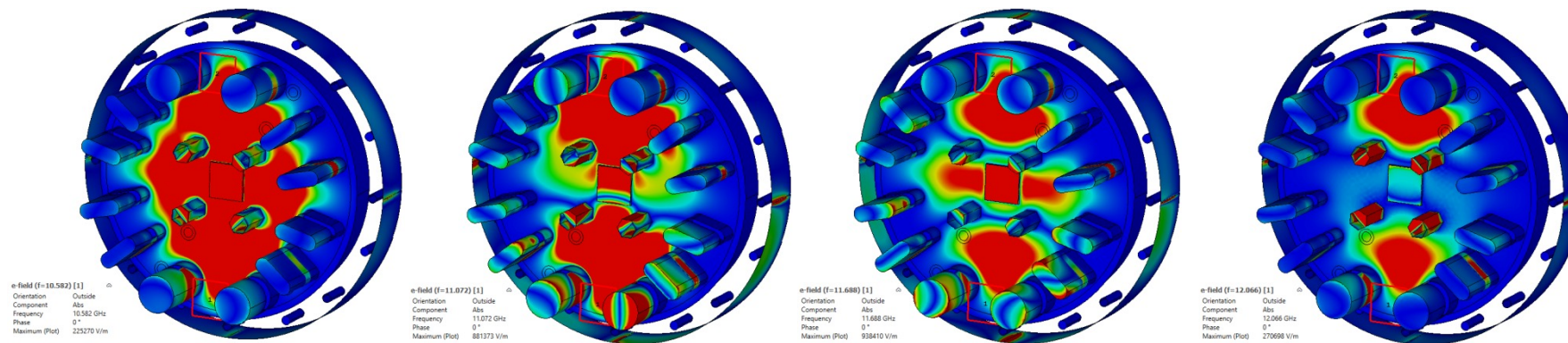


Adapted by M. Gatta

New PCB ready



Simulations from  
Nassim Chikhi  
From CNR-Spin  
Pzzuoli (within  
Supergalax  
collaboration)



Field maps for the 4 picks on the green curve

# Test setup @ UNISA (Salerno)



Heliox VL 300 mK insert with 12 DC lines and 2 MW lines (coax+flex lines)

Home made DC JJ I-V curve tracer

MW source Rohde&Schwarz 0.1-26GHz

Hp source 8-12 and 12-16 GHz

2 x chinese source 0.1-20 GHz

GPS disciplined 10MHz reference

HP spectrum analyzer HP8563E 26 GHz

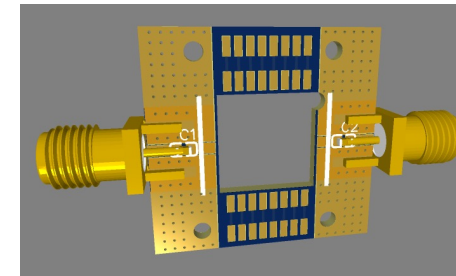
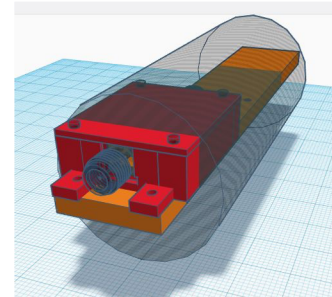
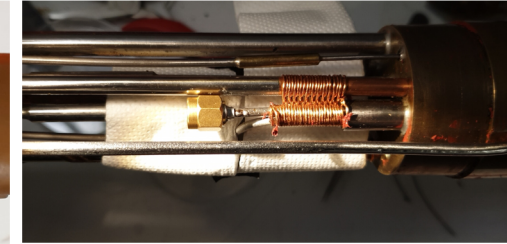
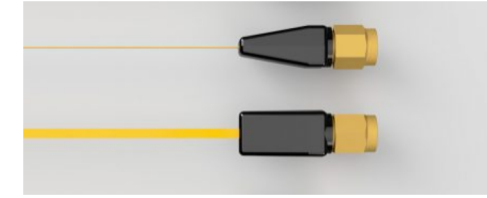
Cryogenic Low Noise Amplifier 0.3-14 GHz

Low noise amplifier room temp. 1-15 GHz

Low noise Isolator 4-12 GHz

Magnetic shielding (Cryoperm)

MW OFHC Cu/Au box with PCB



Status as by December 1<sup>st</sup>:

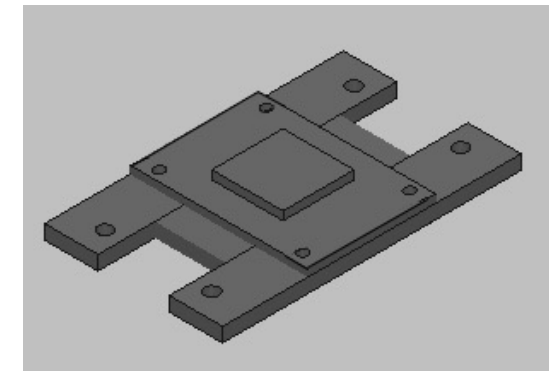
PCB in Europe at Customs since 2 weeks

MW box designed and commissioned to local INFN facility (2 weeks)

Au plating system (ordered)

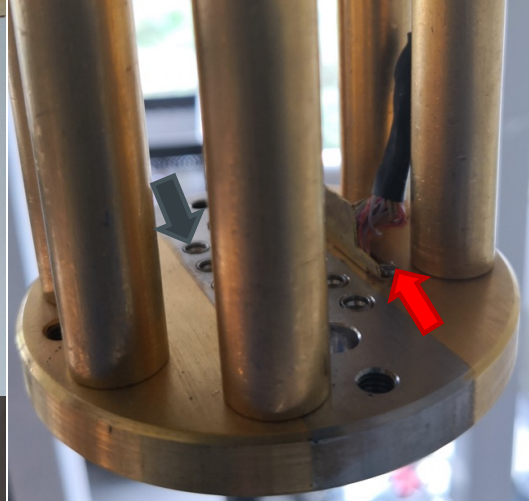
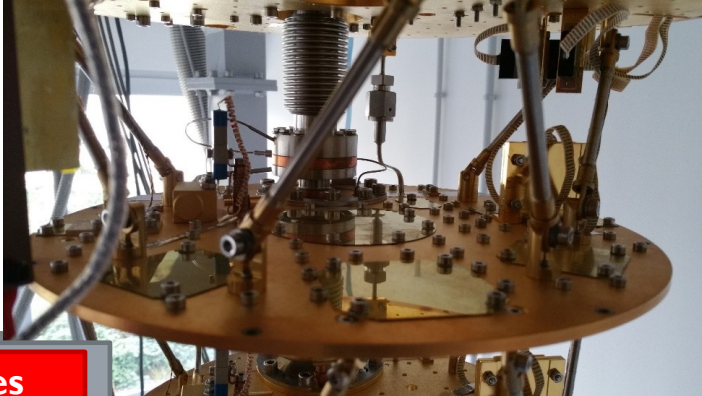
DC measurements OK (1 week setup) need to order LHe (1-2 weeks)

RF measurements (testing BW of transmission lines, waiting for LNF delivery) (1 month)

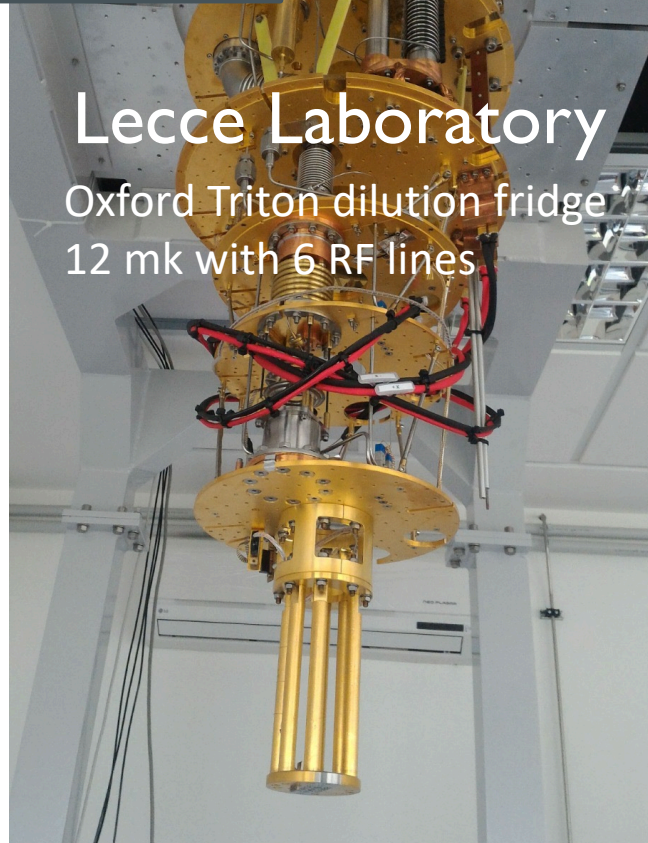




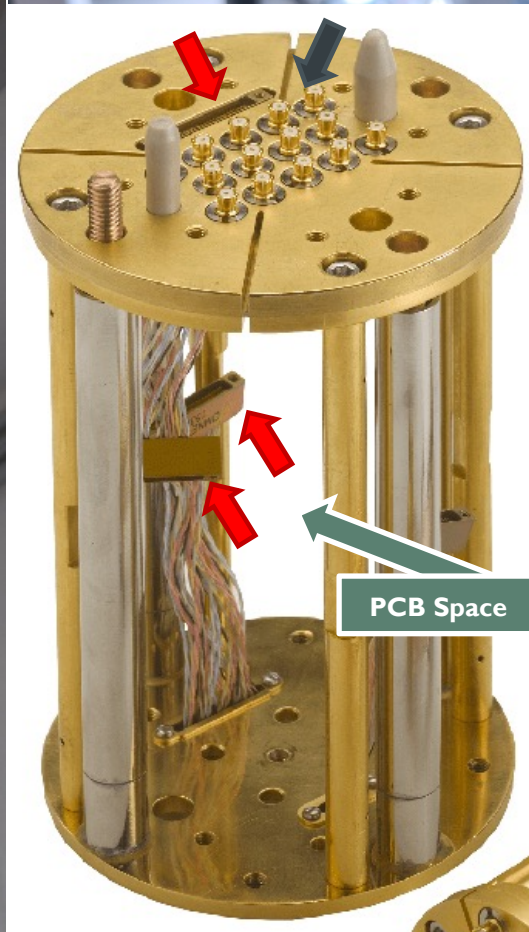
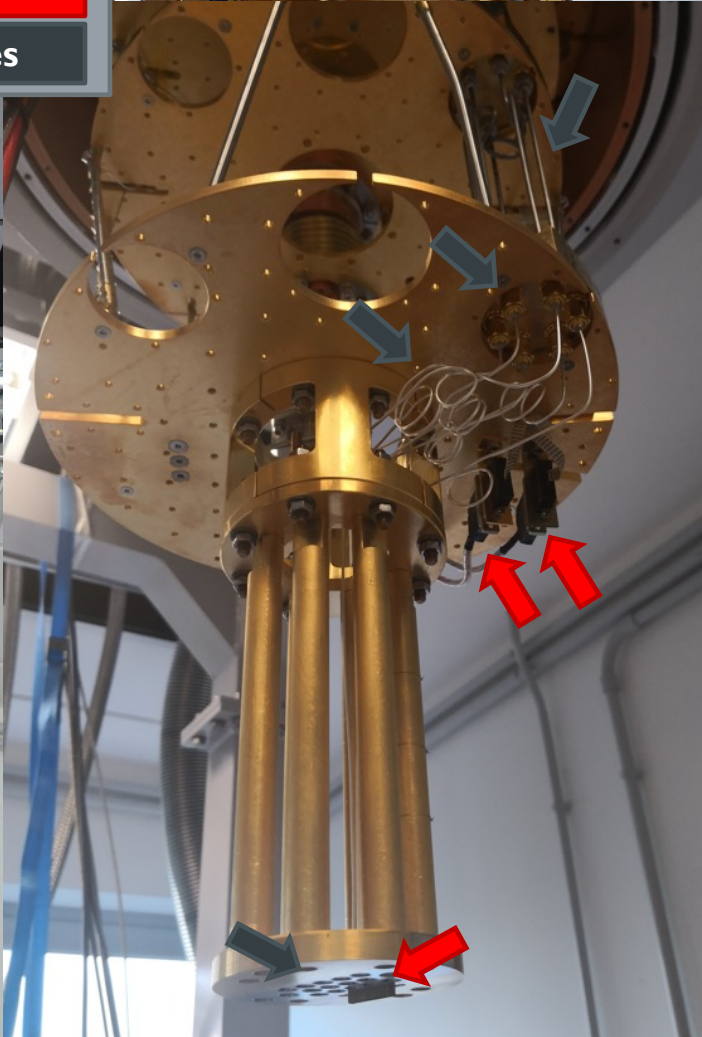
DC lines  
RF lines



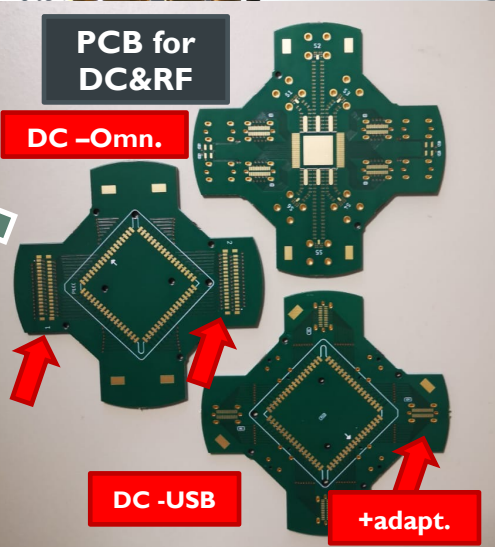
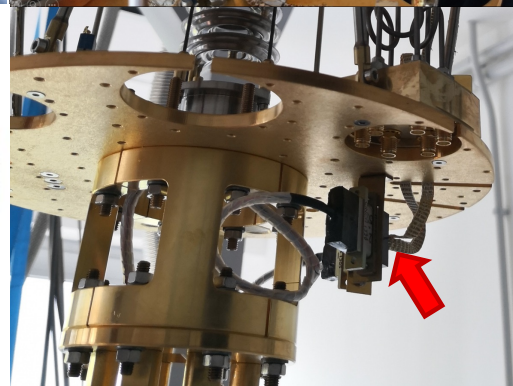
Cryo-amplifier  
Purchased. It  
will be shipped  
soon



Lecce Laboratory  
Oxford Triton dilution fridge  
12 mk with 6 RF lines



PCB Space

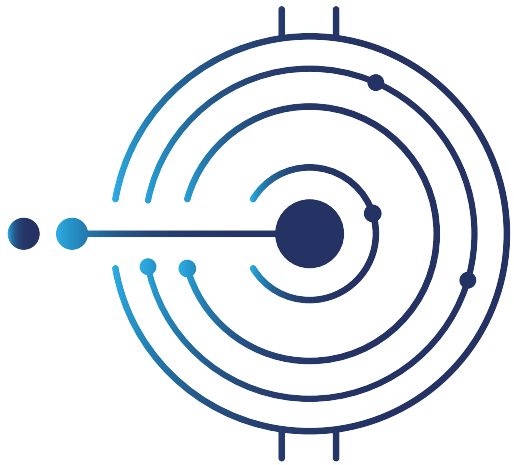


PCB for  
DC&RF  
DC -Omn.  
DC -USB  
+adapt.



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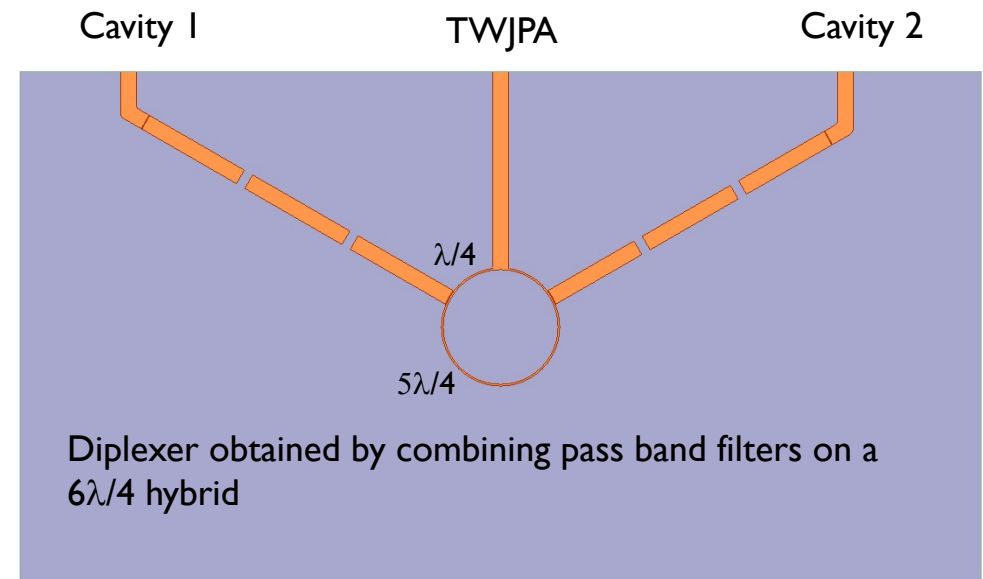
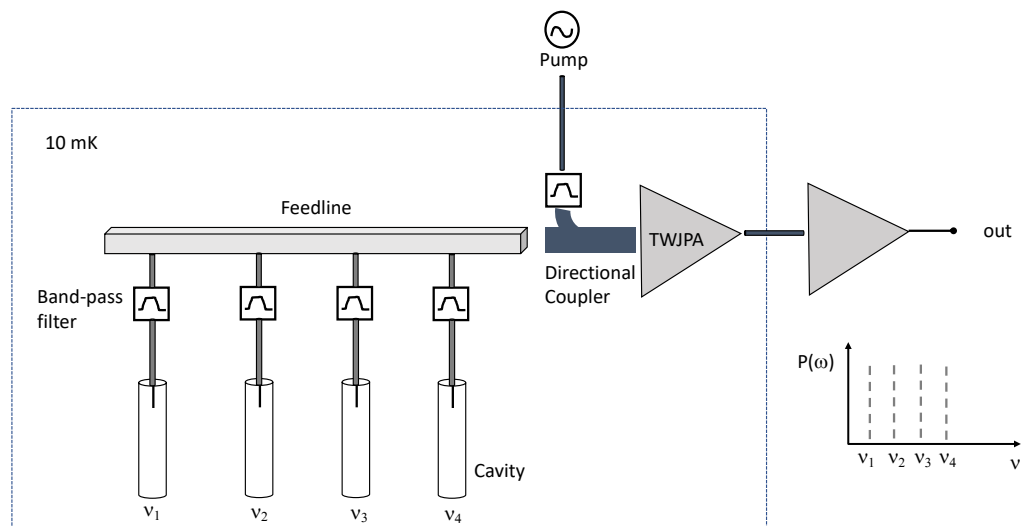
## D4.3 DETECTOR ARRAY READOUT



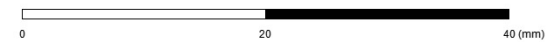
DARTWARS

Detector Array Readout with Traveling Wave Amplifiers

# DIPLEXER DESIGN FOR COMBINED CAVITY READOUT



Simone Tocci



# CONCLUSION

- First TWJPA production tested
- All the labs are ready for DC tests of JJ
- Waiting for delivery of amplifiers/MW components to finalize RF setup
- Design of array readout ongoing