DMAG internal workshop meeting on the 20th of August 2025

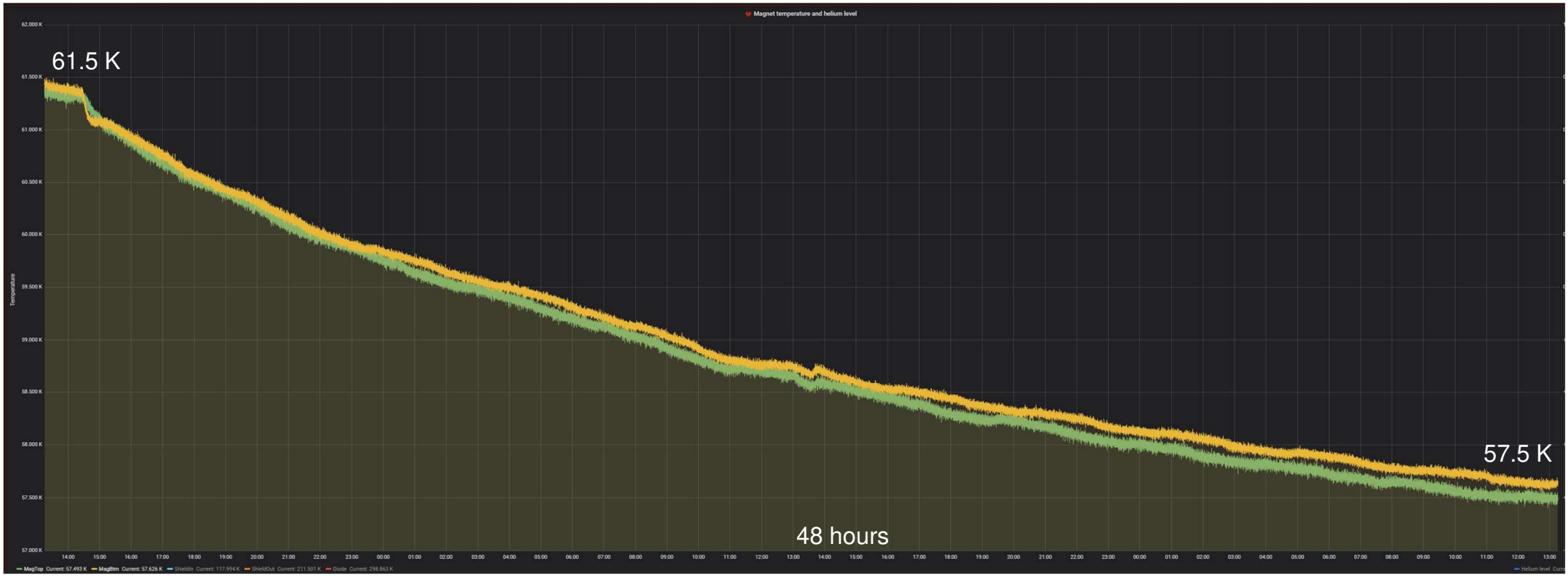
B.I. Ivanov and the amazing 12TB team

12 TB schedule

Main stages:

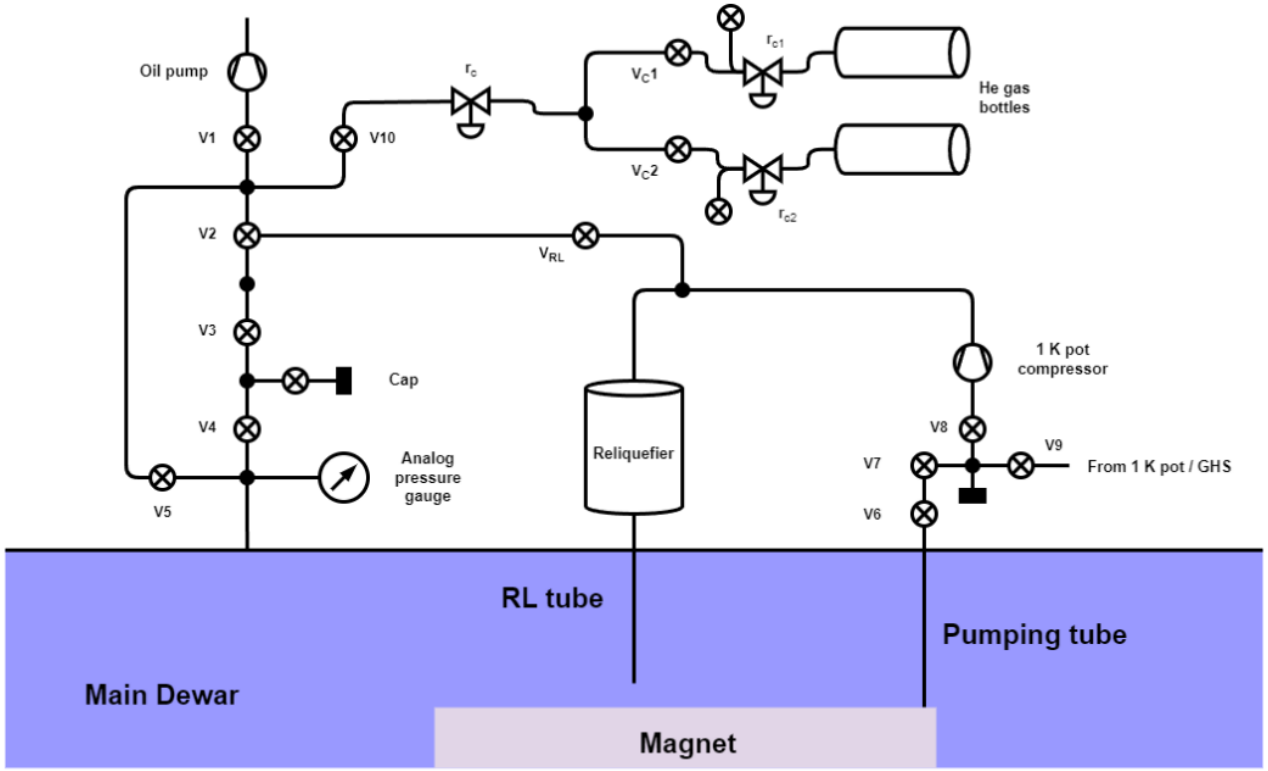
1. Cooling down the superconducting magnet to 4K;
2. Assembling the readout chain with cavity and JPA LEO-II assembly;
3. Preparation and insertion of the dilution refrigerator;
4. 4K readout chain tests (HEMT, cavity);
5. Running the dilution refrigerator obtaining base temperature;
6. 30 mK receiver chain, cavity tests;
7. Ramping up the magnet;
8. Start scanning.

Cooling down the superconducting magnet to 4K



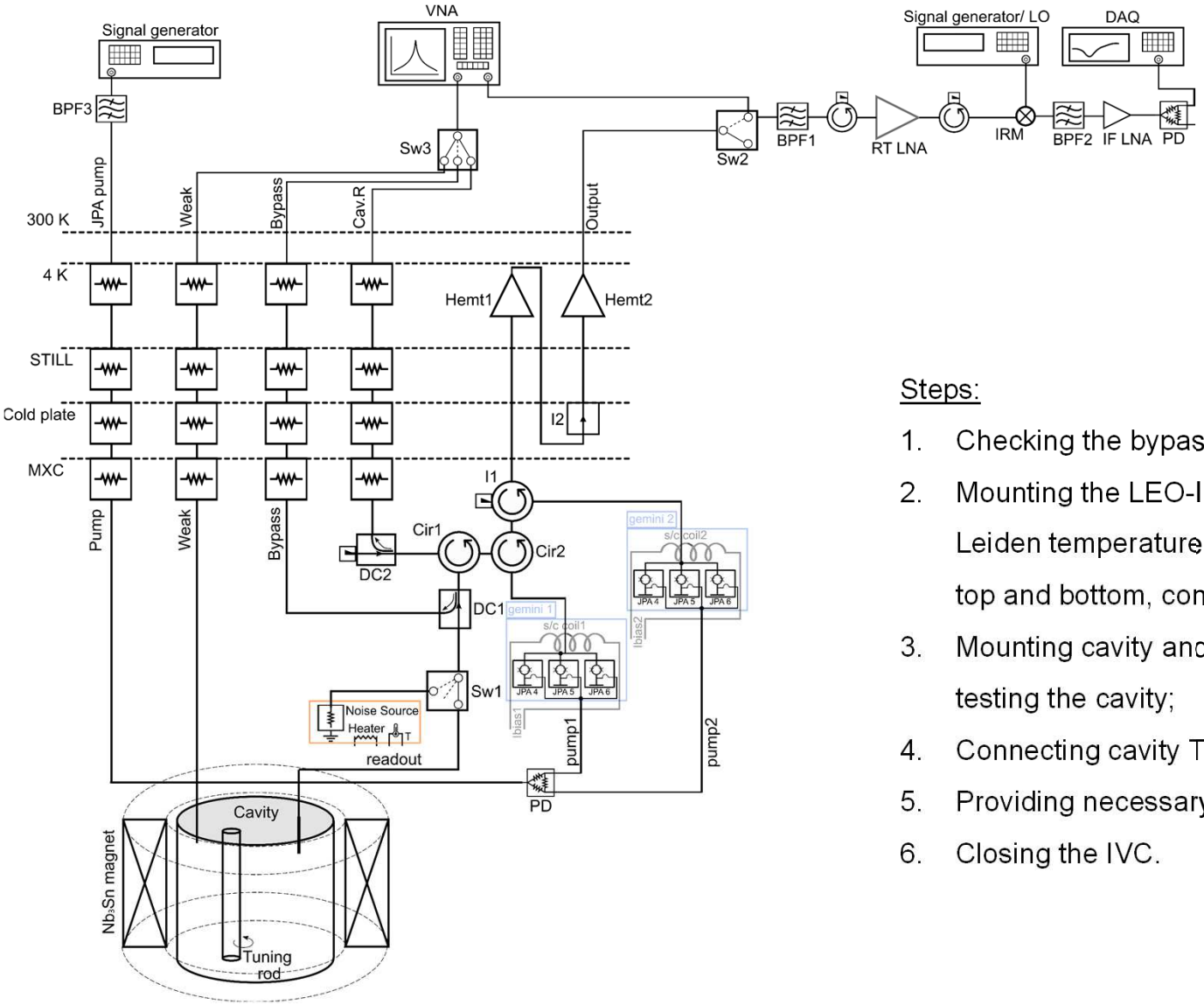
Magnet cooling speed: 2 K per day. 10 K estimation time in 24 days

Cooling down the superconducting magnet to 4K. He manifold diagram



From Heejun:
additional sliding seal test on the August 22nd. If that test goes smoothly, he will decide on a cooling schedule.

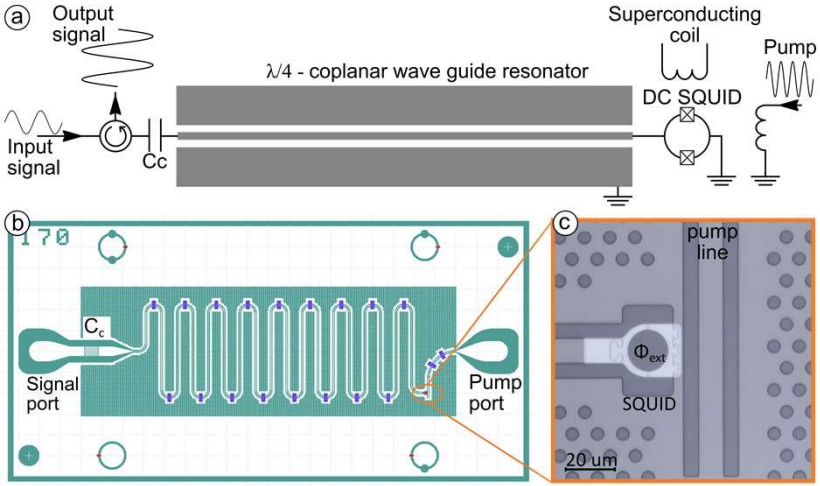
Assembling the readout chain with cavity and JPA LEO-II assembly

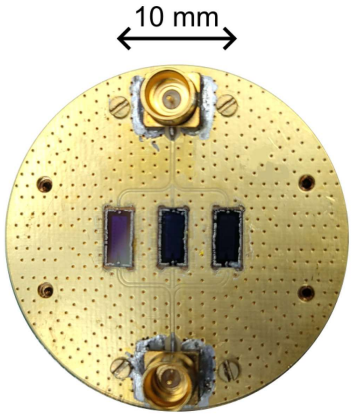


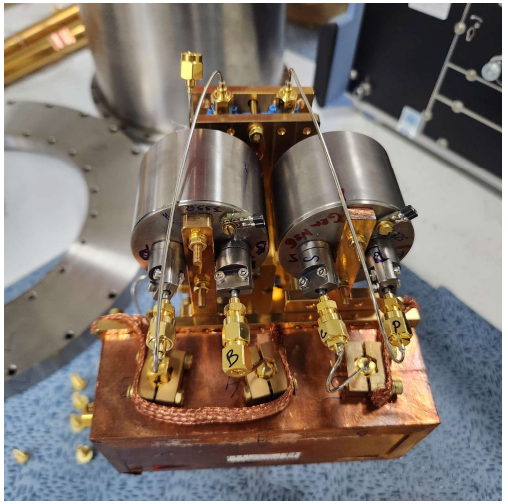
Steps:

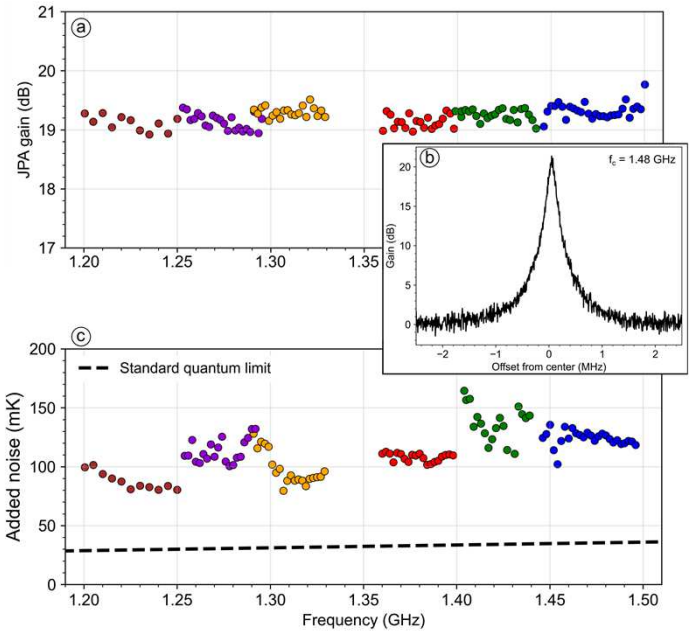
1. Checking the bypass, weak, cavity reflection, output (HEMT) lines;
2. Mounting the LEO-II assembly, connecting all the RF cables, connecting Leiden temperature sensors, connecting Lakeshore T sensors except cavity top and bottom, connecting RF-switch, connecting piezo lines;
3. Mounting cavity and connecting the cavity top and bottom T sensors, testing the cavity;
4. Connecting cavity T-sensors, checking all the thermometers;
5. Providing necessary thermalization of the system;
6. Closing the IVC.

JPA LEO-II assembly









Flux sweep test at 170 mK:

JPA1 range 1.23 GHz - 1.25 GHz,

JPA2 range 1.258 GHz - 1.291 GHz,

JPA3 range 1.31 GHz - 1.357 GHz,

JPA4 range 1.348 GHz - 1.398 GHz,

JPA5 range 1.43 GHz - 1.45 GHz,

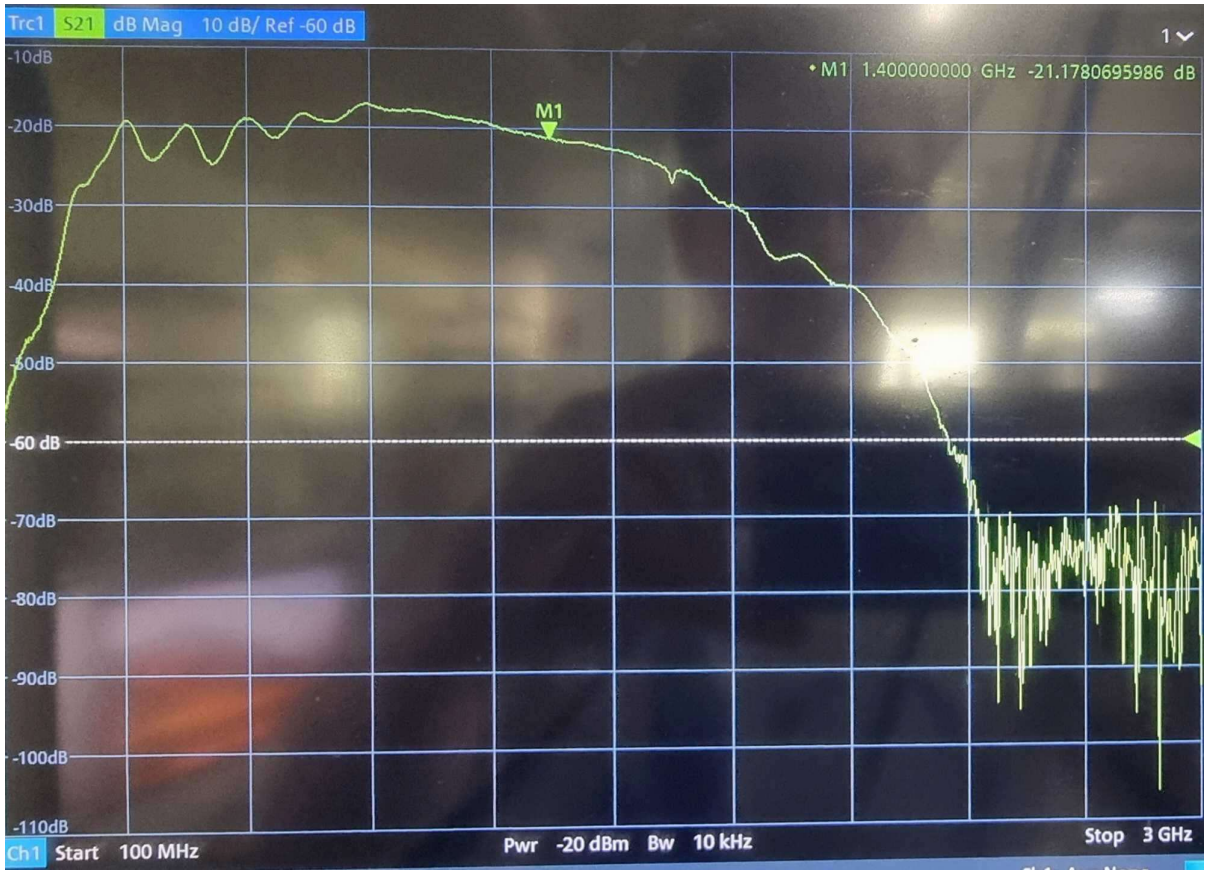
JPA6 range 1.45 GHz - 1.5 GHz.

77K HEMT test

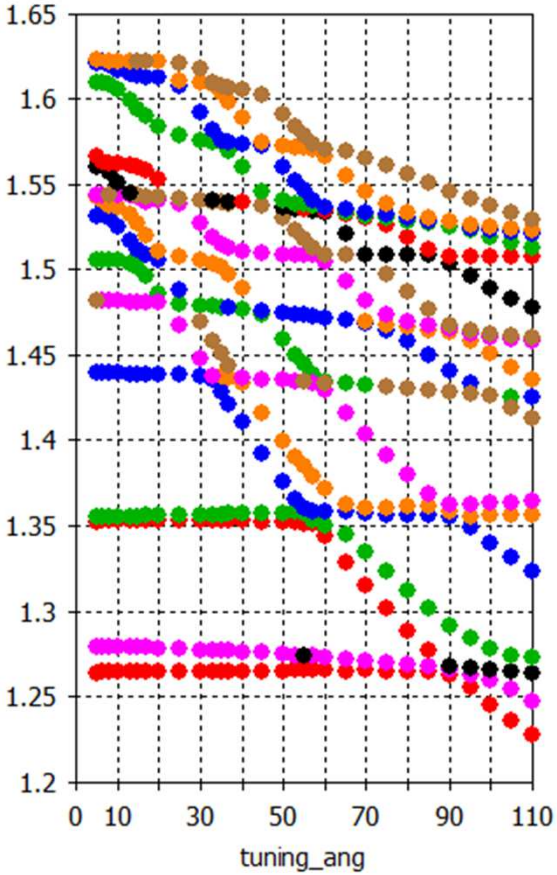
The Hemts gain curve is checked.

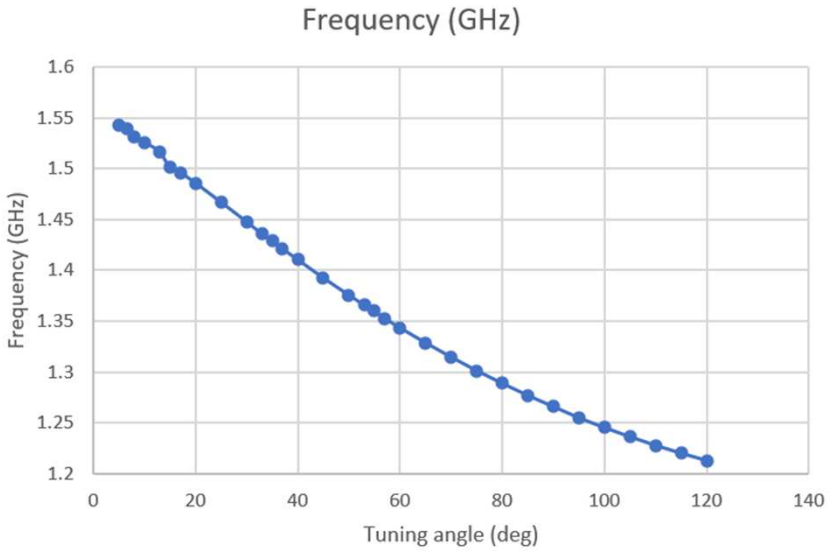
V1 = 1.15 V, I1= 21 mA. V2 = 1.26 V, I2 = 21.32 mA.

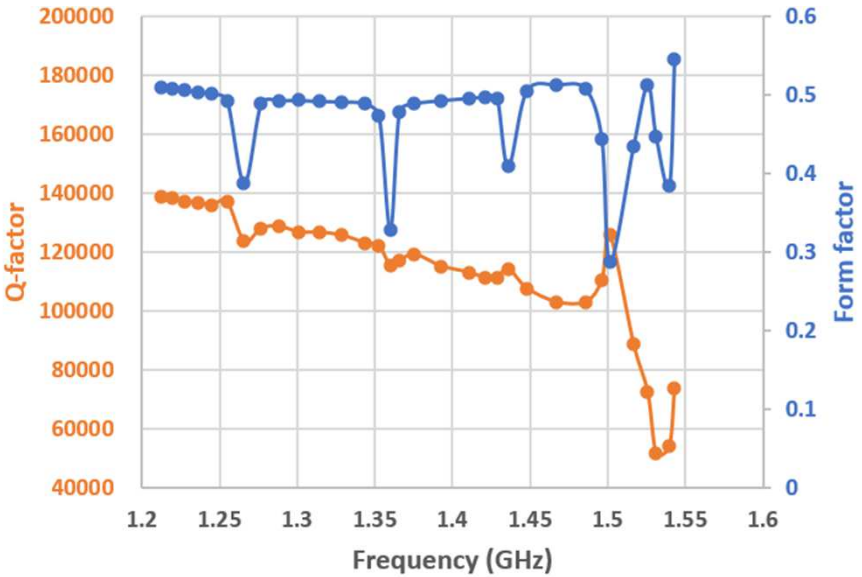
Vna Pin = -20 dBm, linear gain mode



Cavity


1.65
1.6
1.55
1.5
1.45
1.4
1.35
1.3
1.25
1.2
0 10 30 50 70 90 110
tuning_ang

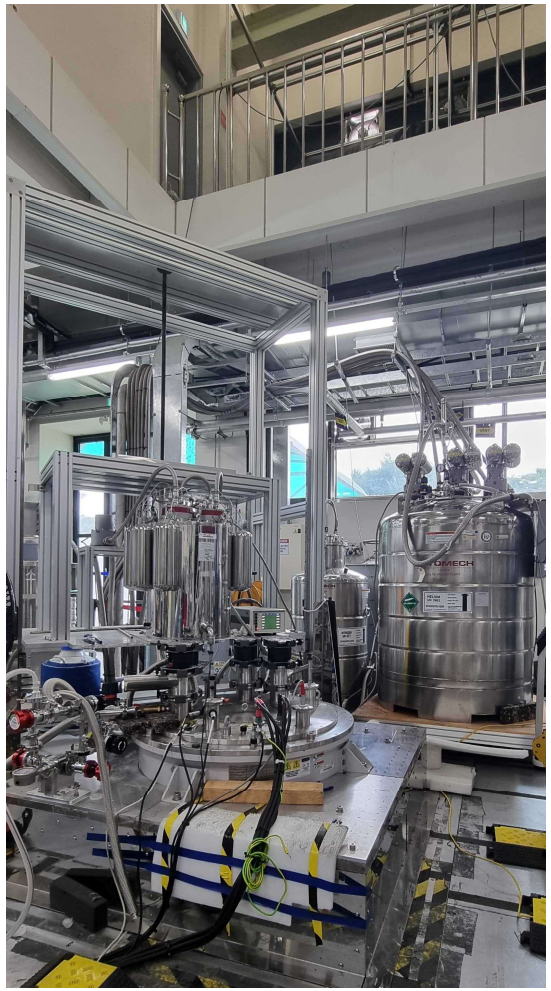

Frequency (GHz)
1.6
1.55
1.5
1.45
1.4
1.35
1.3
1.25
1.2
0 20 40 60 80 100 120 140
Tuning angle (deg)


200000
180000
160000
140000
120000
100000
80000
60000
40000
Q-factor
0.6
0.5
0.4
0.3
0.2
0.1
0
Form factor
1.2 1.25 1.3 1.35 1.4 1.45 1.5 1.55 1.6
Frequency (GHz)

Preparation and insertion of the dilution refrigerator

Steps:

1. Setting the pressure of 1K pot;
2. Performing internal and external leak checking;
3. Inserting the exchange gas to the IVC;
4. Moving the DR to the insertion point;
5. Inserting the DR;
6. Connecting of the 1K pot line over the compressor splitter;
7. Connecting the condensing and STILL lines, starting pumping them, cleaning the cold traps.



1K pot tests

Test 1:

Performing internal leak test (observation of the possible leak between 1K pot lines and IVC):

1. Connect and run leak detector (Adixen), run the IVC turbo pump at the top of the cryostat (S5). The measurement scheme is: Leak Detector (LD) --> A2 valve -> IVC turbo pump -> A0 valve -> IVC. The leak rate background LR_BG = 1.2 e-9 mbarl/s. P_IVC = 5 e-5 mbar.
2. Apply He flow from external He gas cylinder with pressure P = 1,7 bar. No change in leak rate. **The 1K pot line is tight inside of the IVC.**

Test 2:

Pumping test

While having He gas inside of the main Dewar with P_RL = 1.5 psi.

Testing the 1K pot operation while pumping the 1 K pot with S4 GHS pump. P2 (the pressure we use for monitoring while 1K pot is used) went down to 7 mbar. Close the needle valve --> no pressure change, open needle valve --> no pressure change. **The test is not efficient!**

Test 3:

Test with pumping the 1K pot down to 7 mbar and stop pumping and watch increasing the pressure at the P2 pressure gauge:

Needle valve is closed. The pressure increased to 100 mbar within ~2 minute.

1. Needle valve is opened. The pressure increased to 100 mbar within ~ 1 minute.

First result was that the 1K pot is operates in a normal mode, next step is to log the pressure depending on time.

1K pot test

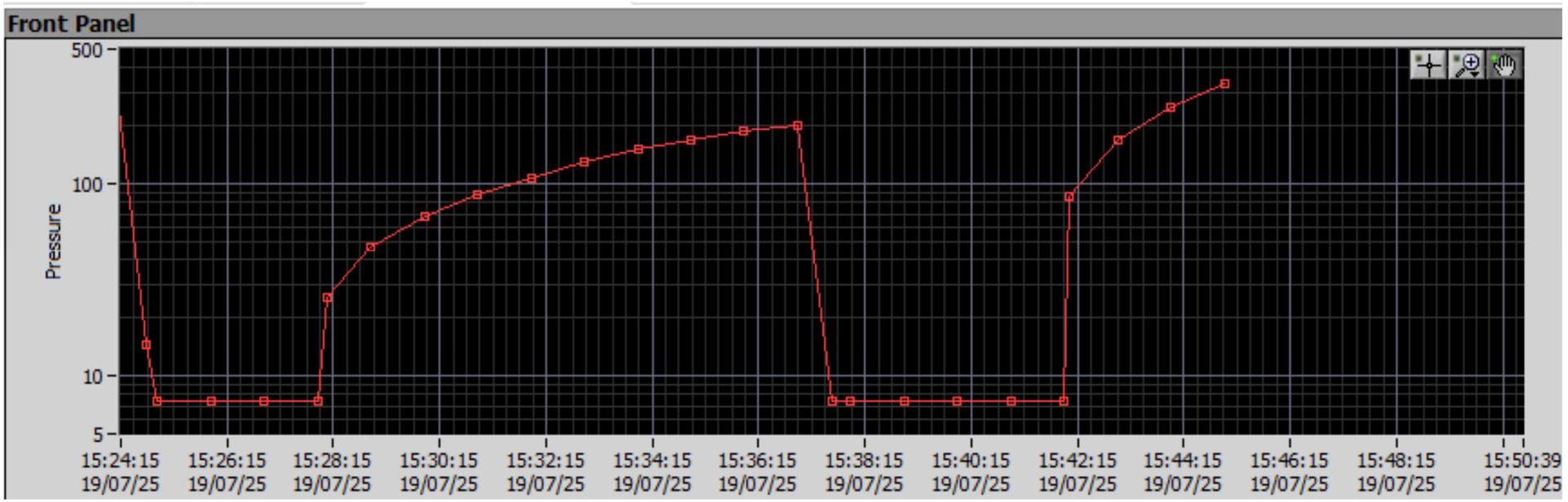
Test 3 (1 K pot flow, logging P2):

Measurement tools: 1. Use Gas Handling System (GHS), P2 pressure gauge, 2. Pressure gauge at the re-liquifier (RL), Needle valve (Closed and opened).

Measurement procedure:

P_RL = 1.5 bar (He gas pressure inside of the main Dewar), Needle Valve: CLOSED, pump the 1K pot to P_2 = 7 mbar, stop pumping at t1 = 15:28 and wait until P_2 = 200 mbar, t2 = 15:37.

1. P_RL = 1.5 bar, Needle Valve: OPENED, pump the 1K pot to P_2 = 7 mbar, stop pumping at t3 = 15:42 and wait until P_2 = 200 mbar, t4 = 15:44.



1K pot test

Test 4. Liquid N2 test:

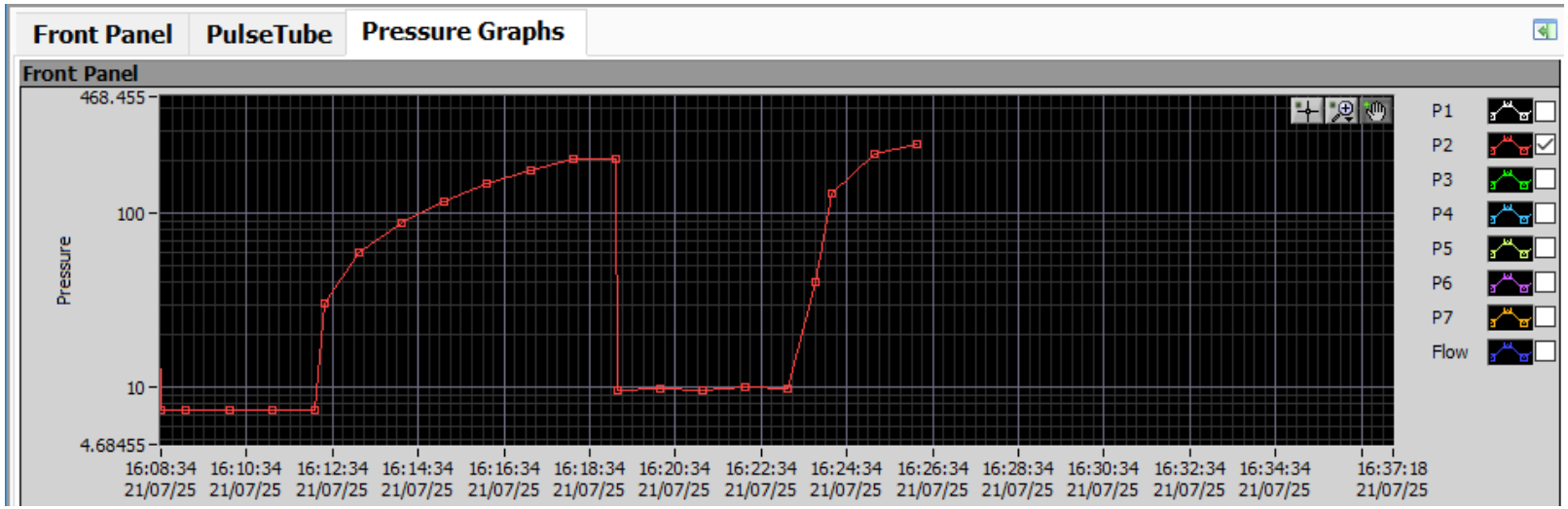
Testing 1K pot flow again with 60% of LN2 and P_RL = 1.9 psi.

Measurement tools: 1. Use Gas Handling System (GHS), P2 pressure gauge, 2. Pressure gauge at the re-liquifier (RL), Needle valve state (closed and opened).

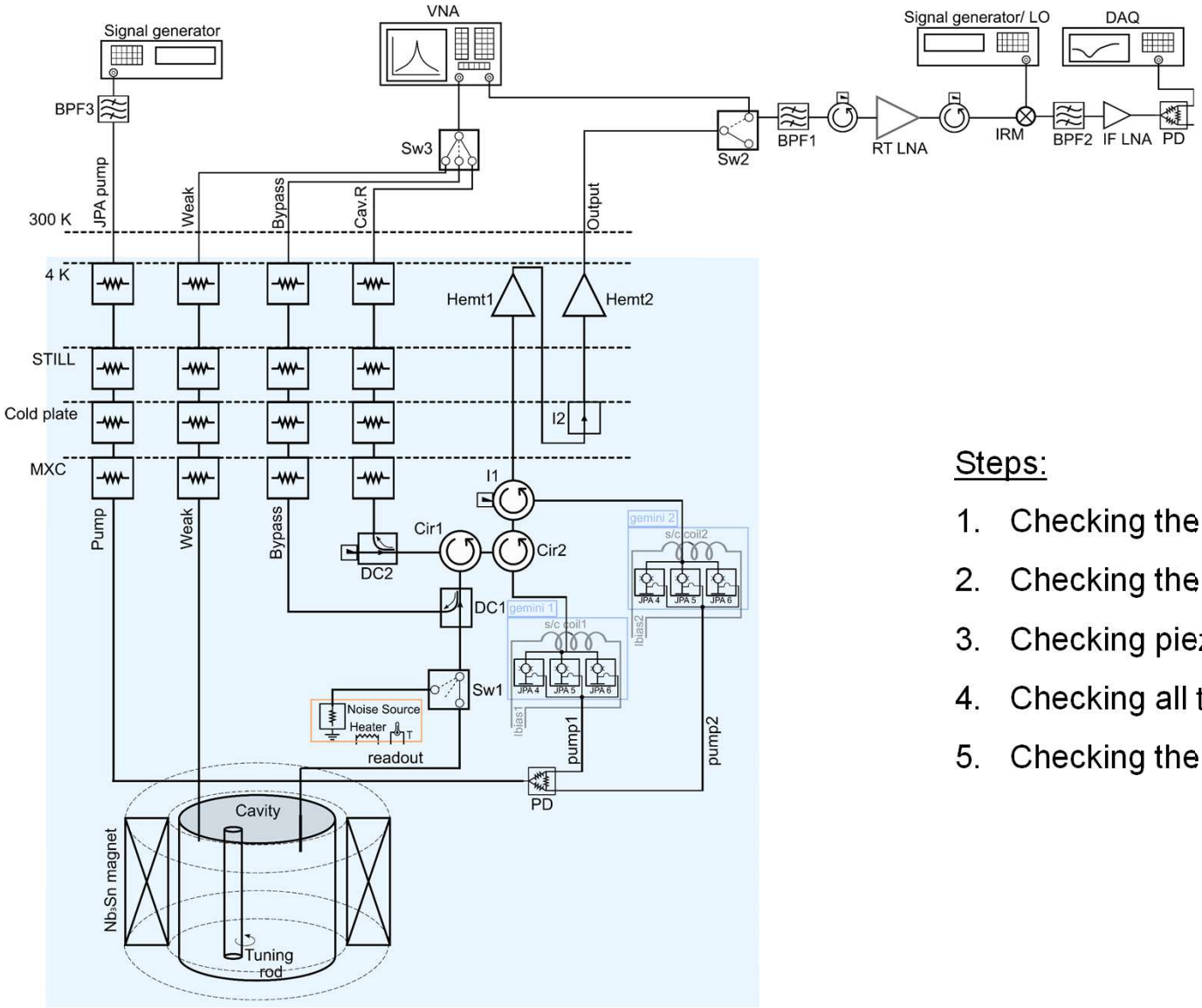
Measurement procedure:

P_RL = 1.9 bar, Needle Valve: CLOSED, pump the 1K pot to P_2 = 7 mbar, stop pumping at t1 = 16:12 and wait until P_2 = 200 mbar, t = 16:18.

P_RL = 1.9 bar, Needle Valve: OPENED, pump the 1K pot to P_2 = 7 mbar, stop pumping at t2 = 16:22 and wait until P_2 = 200 mbar, t = 16:25.



4K readout chain tests (HEMT, cavity)



Steps:

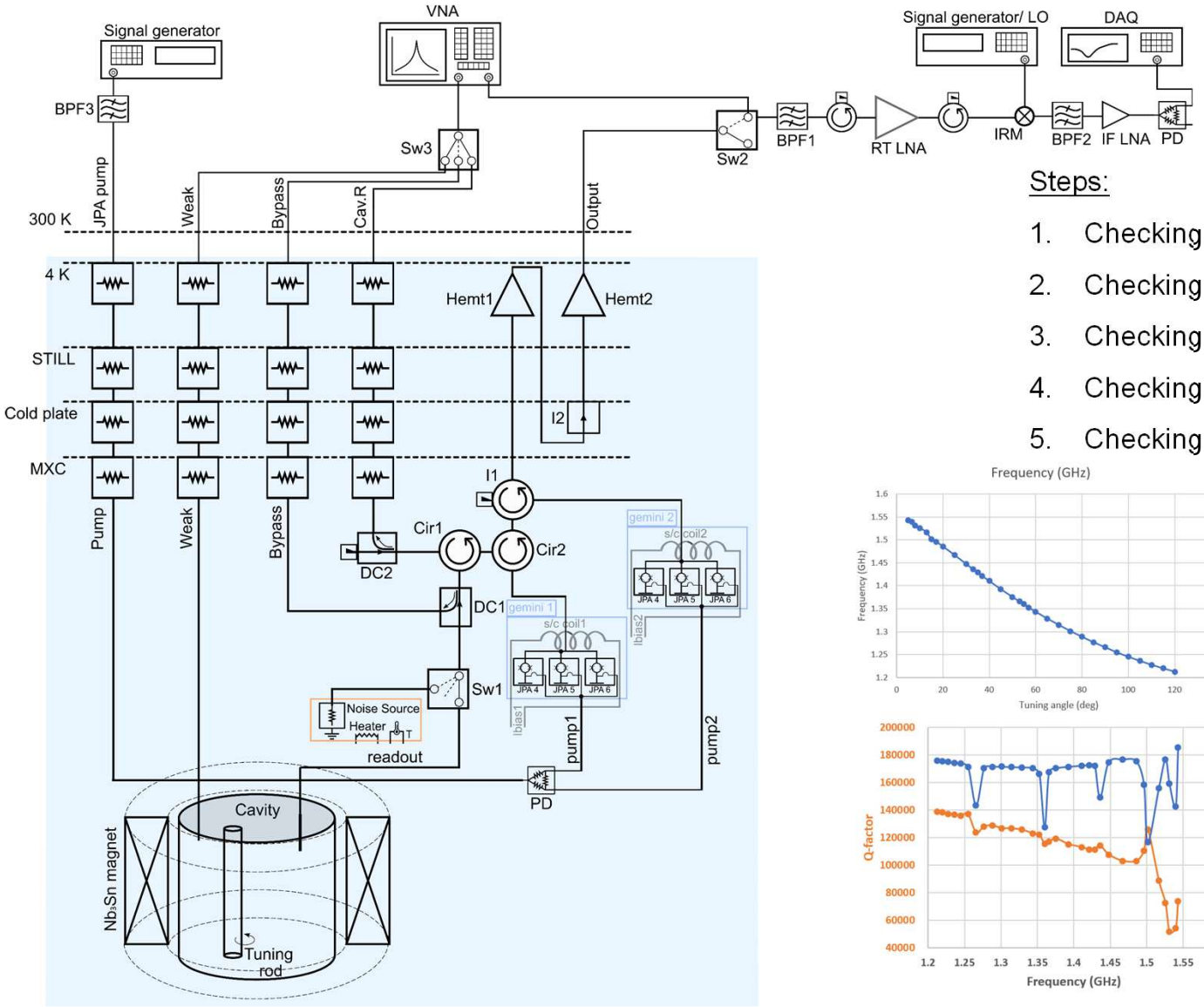
1. Checking the bypass, weak, cavity-R, ports;
2. Checking the cavity main parameters;
3. Checking piezo rotator and linear piezo;
4. Checking all the T-sensors calibrated to 4K;
5. Checking the JPA flux bias coils, RF-switch;

Running the dilution refrigerator obtaining base temperature

Steps:

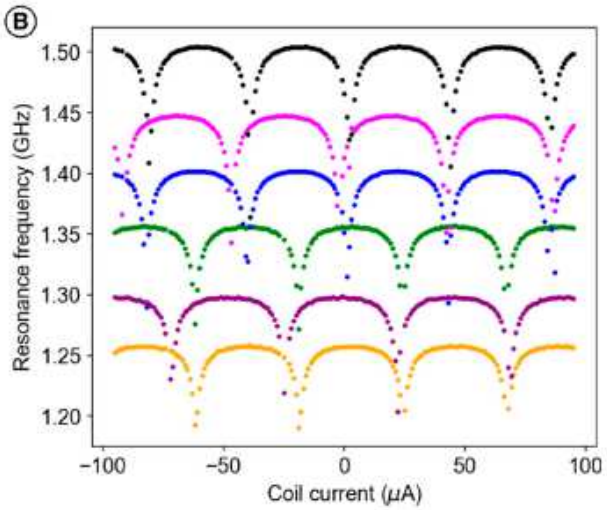
1. Filling up the main Dewar to min. 80 %;
2. Pumping the exchange gas;
3. Running the 1K pot;
4. Start condensing;
5. Obtaining base temperature, optimizing the mixture flow and base temperature.

Checking the system at base temperature

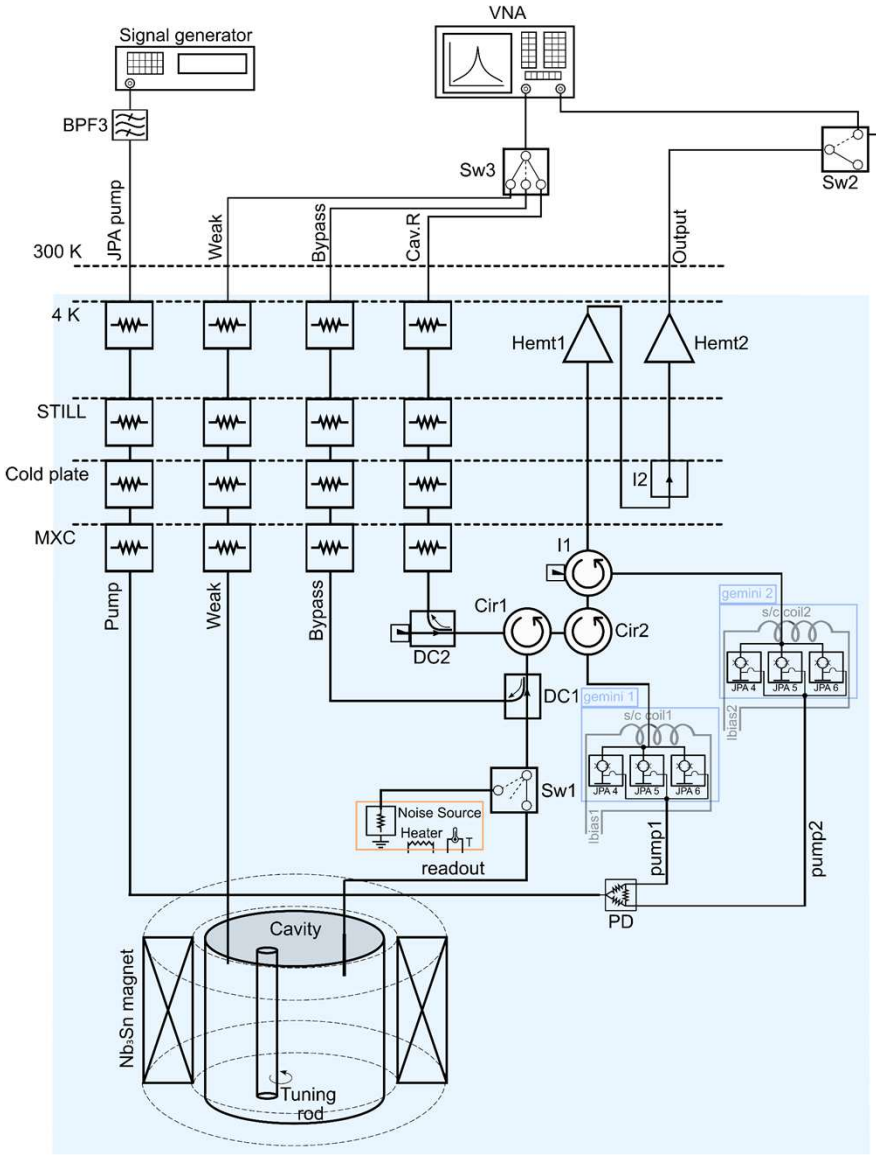


Steps:

1. Checking the bypass, weak, and cavity-R ports;
2. Checking the cavity main parameters;
3. Checking piezo rotator and linear piezo;
4. Checking the T-sensors;
5. Checking the flux-sweep of JPAs

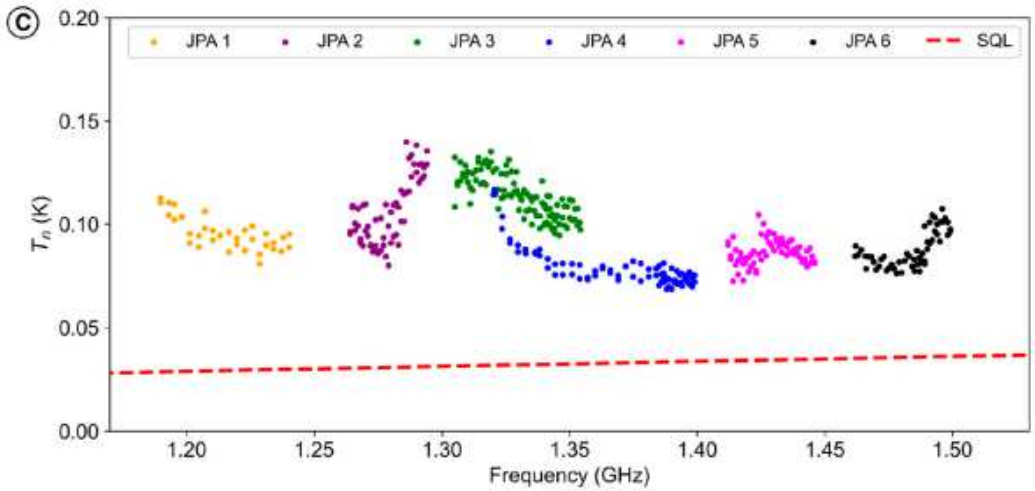


Checking the system at base temperature



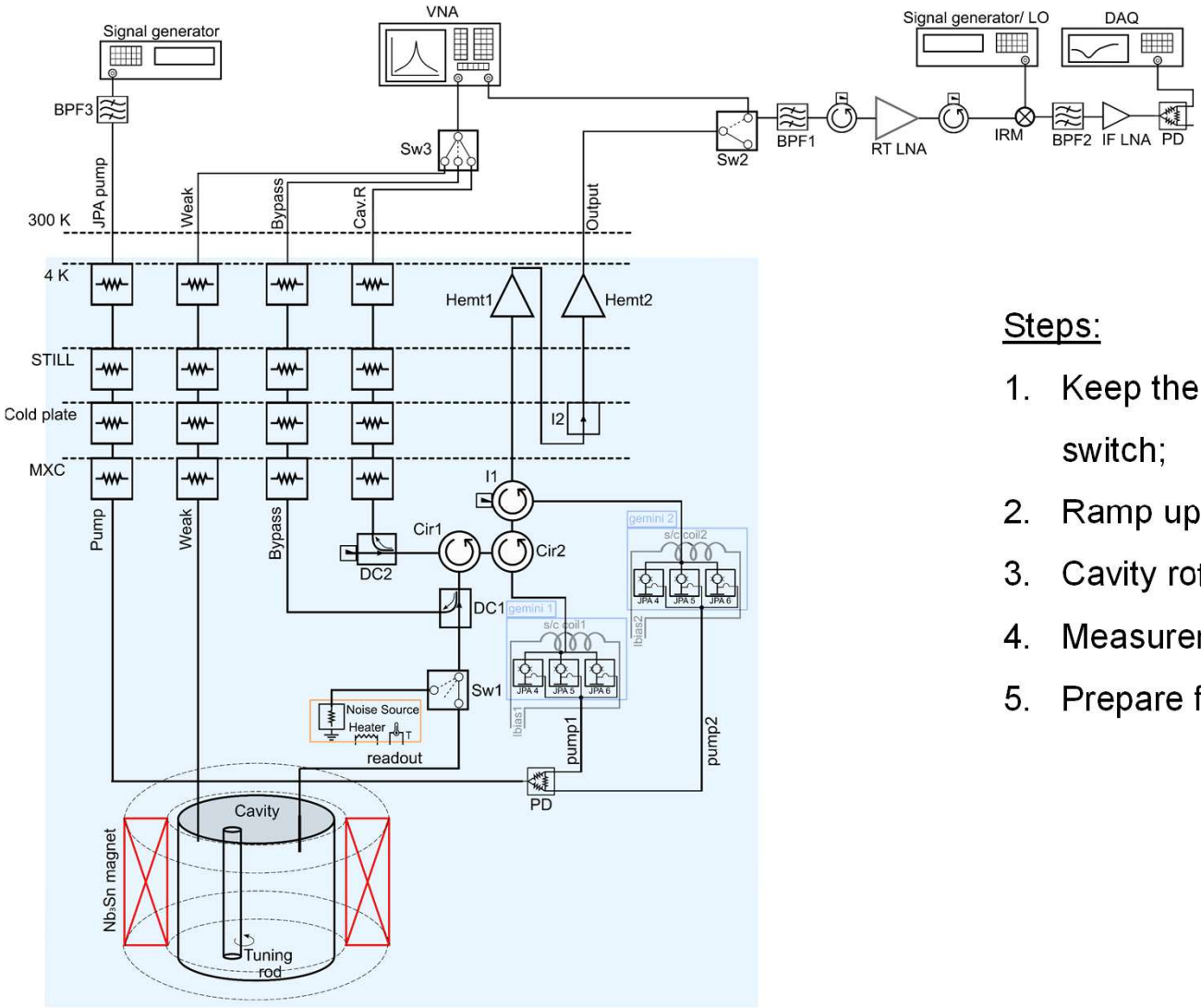
Steps:

1. HEMT noise measurements;
2. JPA detailed flux-sweep curve and paramap;
3. JPA noise measurements;
4. System noise measurements;



S.V. Uchaikin at all, 10.3389/fphy.2024.1437680

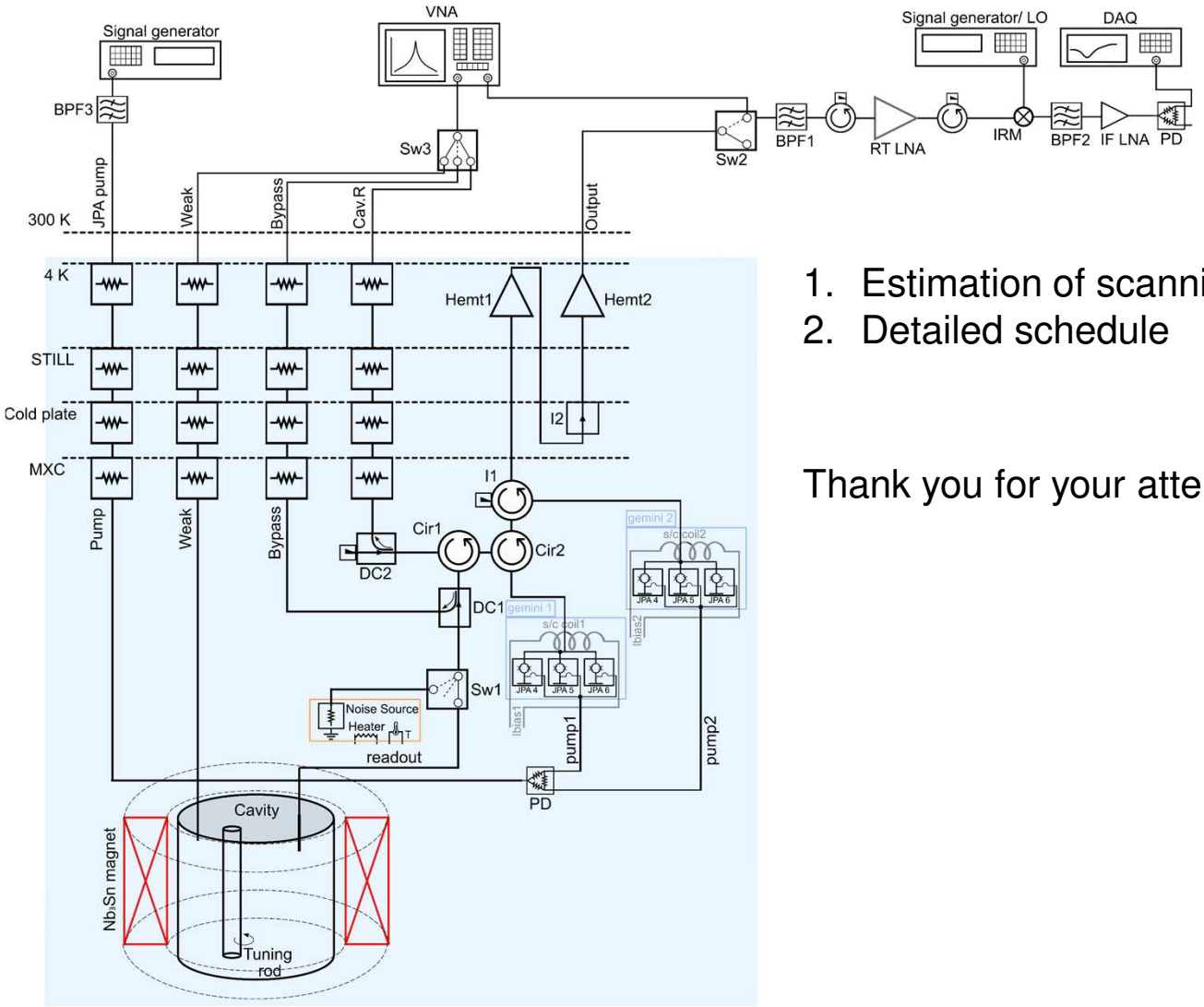
Ramping up the magnet



<u>Steps:</u>

1. Keep the DR in normal circulation and turn on the heat switch;
2. Ramp up the magnet to 12T and go to persistent mode;
3. Cavity rotator test;
4. Measurement of the receiver chain;
5. Prepare for scanning.

Need to do…



1. Estimation of scanning rate
2. Detailed schedule

Thank you for your attention