Flux JPA at LNF

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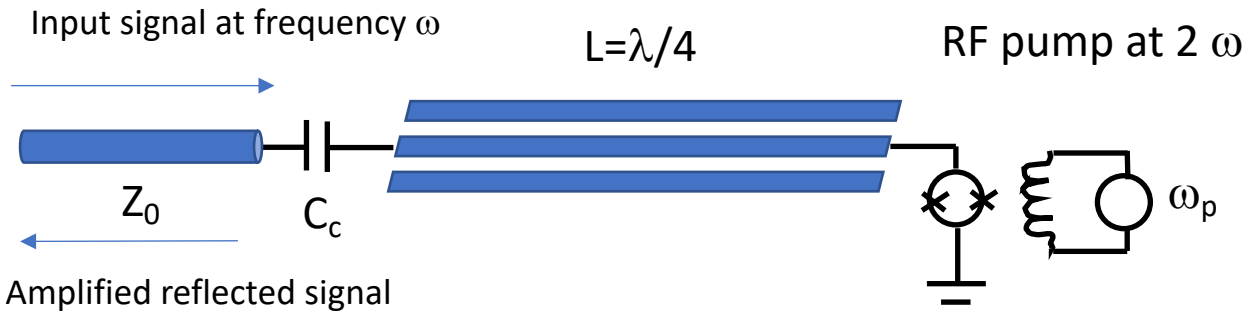
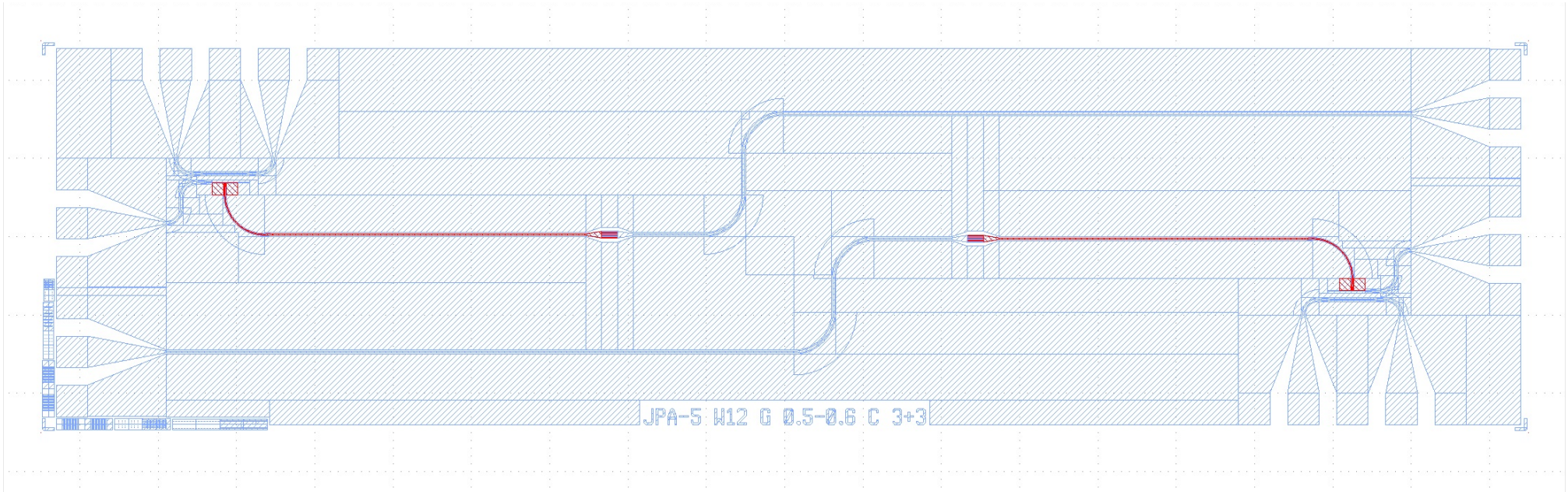
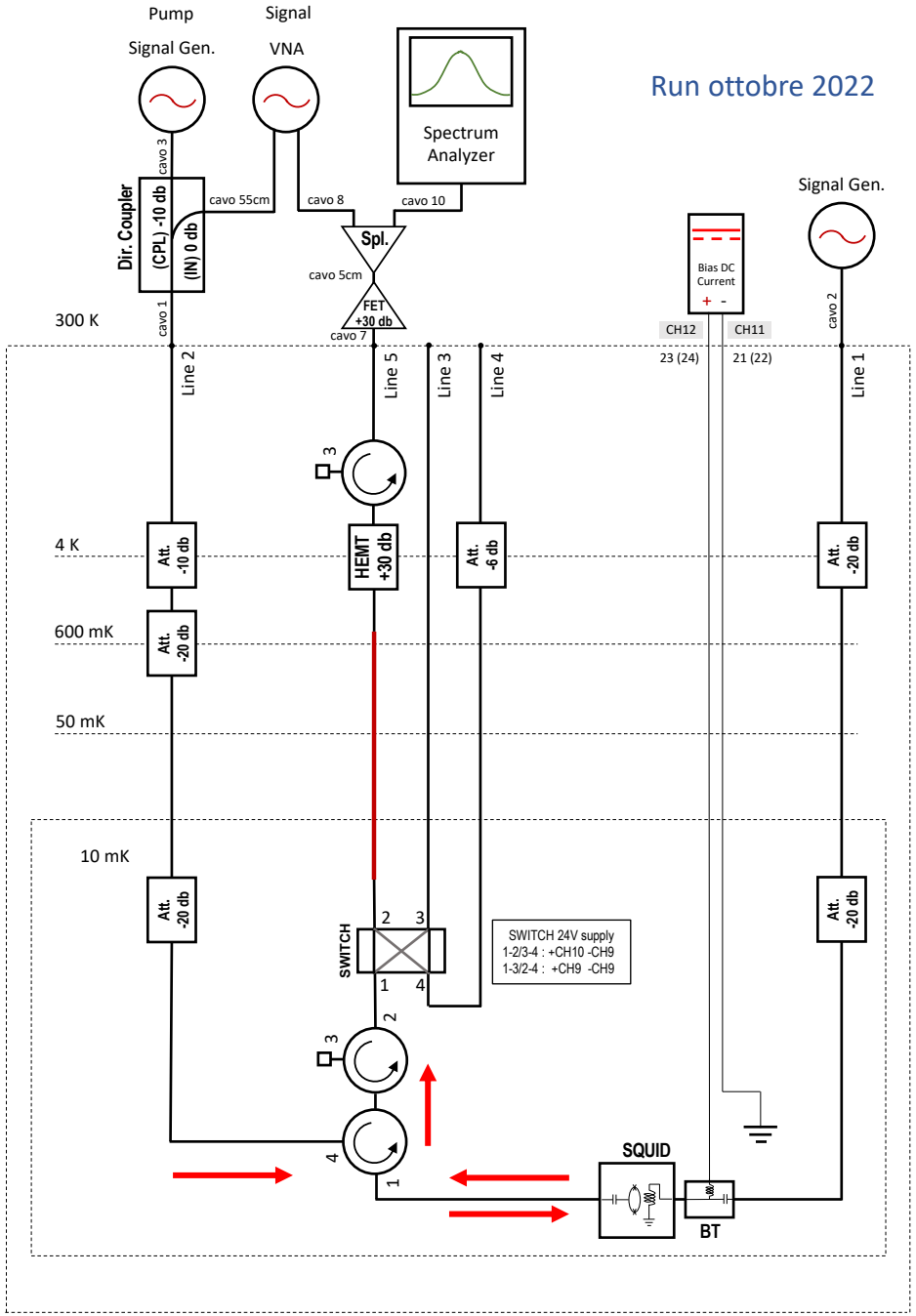
Qub-IT



C jj = 0.4 pF
Ic jj = 0.45 μA
f jj = 9.24 GHz

f0 bare res. = 11.35 GHz

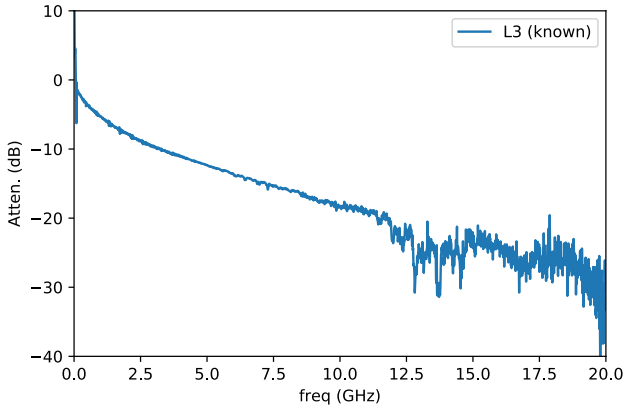


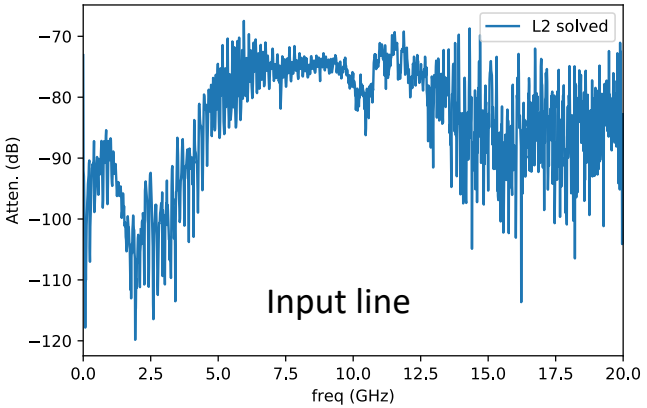


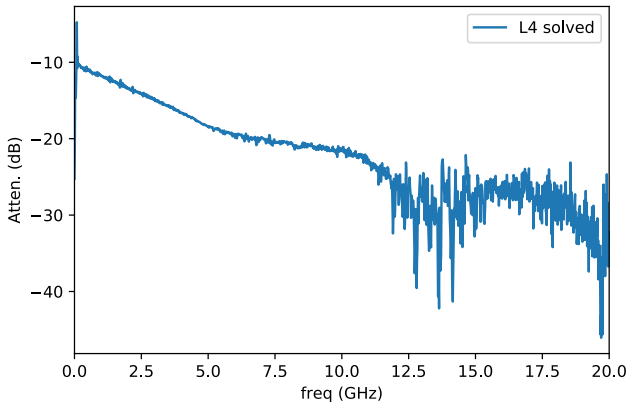
Run ottobre 2022

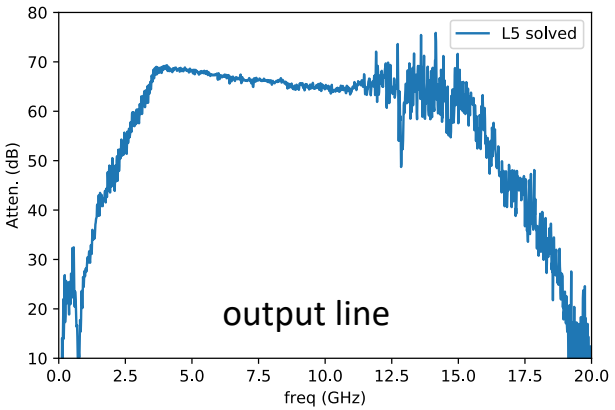
$$S25 = L2 + L5$$
$$S23 = L2 + L3$$
$$S45 = L4 + L5$$
$$S34 = L3 + L4$$

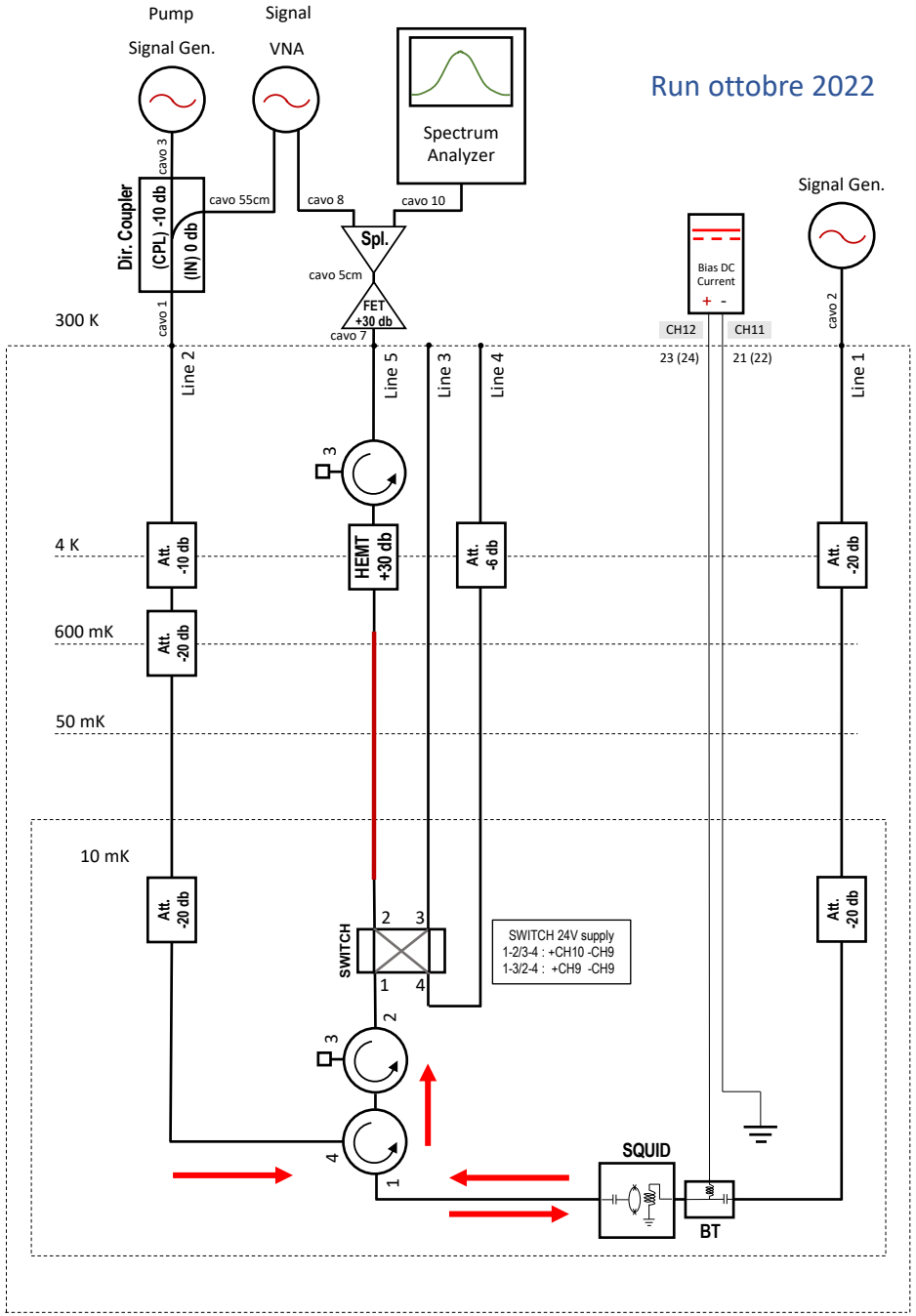
where $L3$ is known from previous measurements







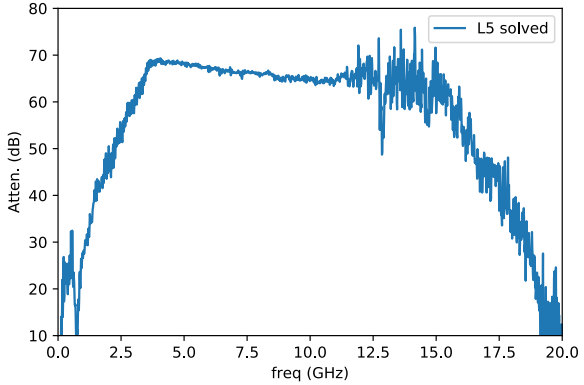




Run ottobre 2022

HEMT line gain calibration:

$$Gain = (64.5 \pm 2.0)\ \text{dB}$$

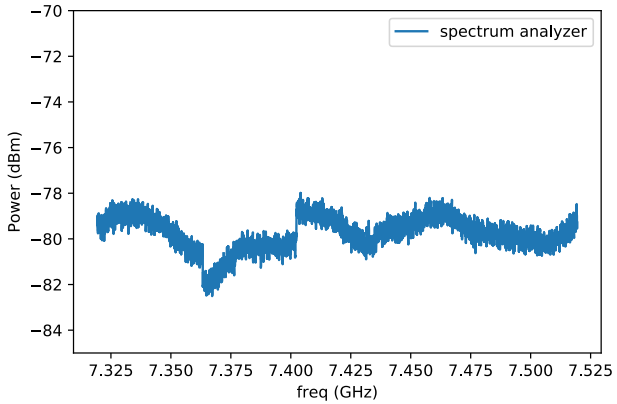


From spectrum analyzer:

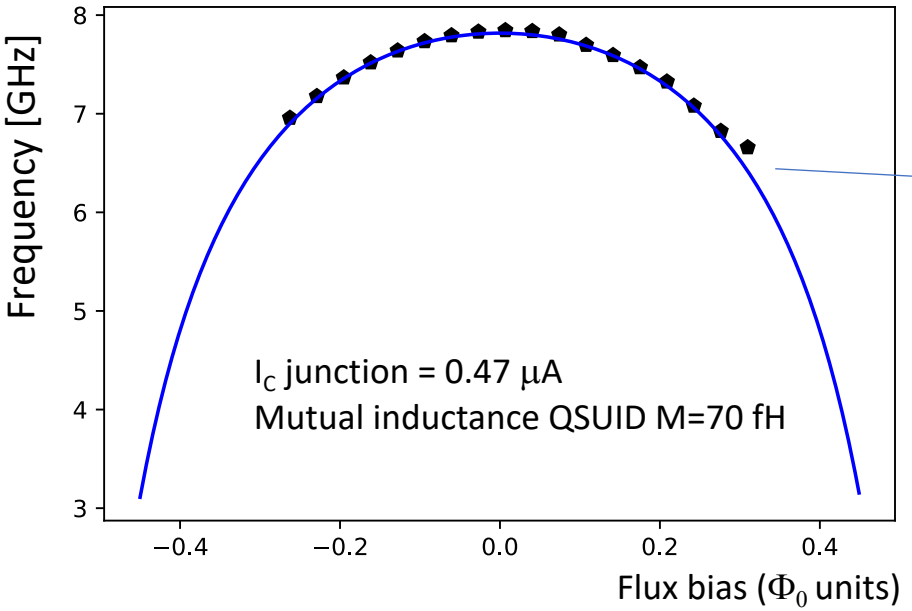
$$T_n^{HEMT} = \frac{P_n}{k_B\ \Delta\nu\ G} = (3.3\ {}^{1.9}_{1.2}\pm)\ K$$

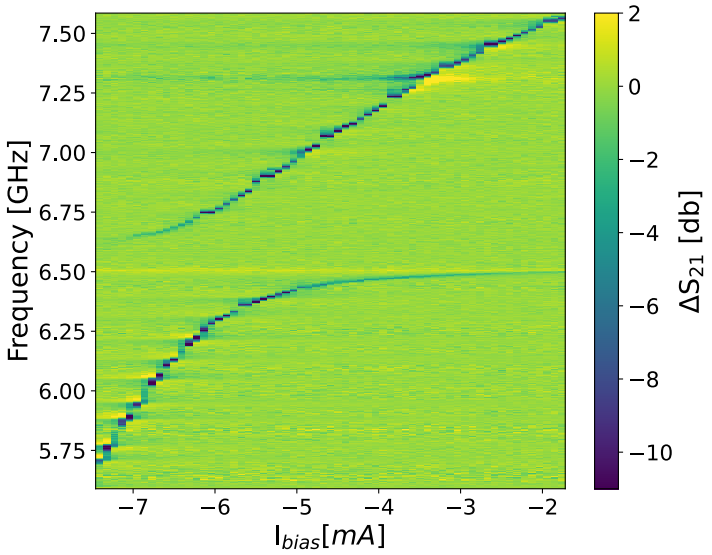
$\Delta\nu$ = RBW = 100 kHz

~3K from Low Noise Factory datasheet



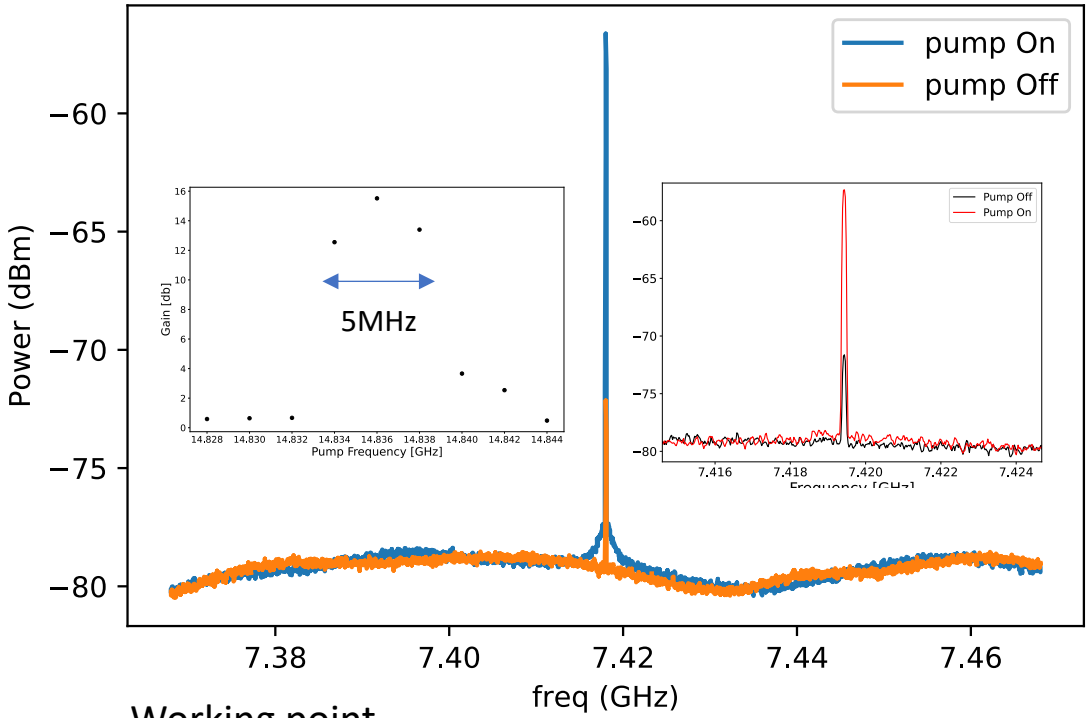
Tunability





Hybridization with spurious mode

Degenerate JPA Gain and Noise



Working point

f_{signal}=7.418 GHz

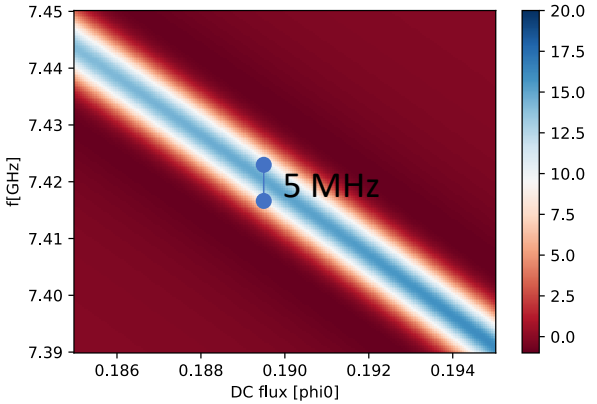
$f_{pump}=2f_{signal}$

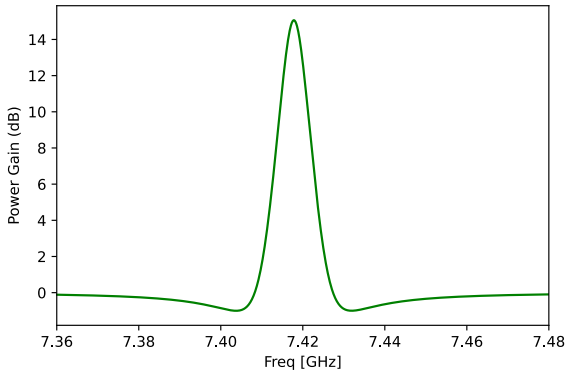
P_{signal}= -135 dbm

P_{pump}= -45 dbm

Φ=0.19 Φ_0

Theoretical expectation





Measured Gain

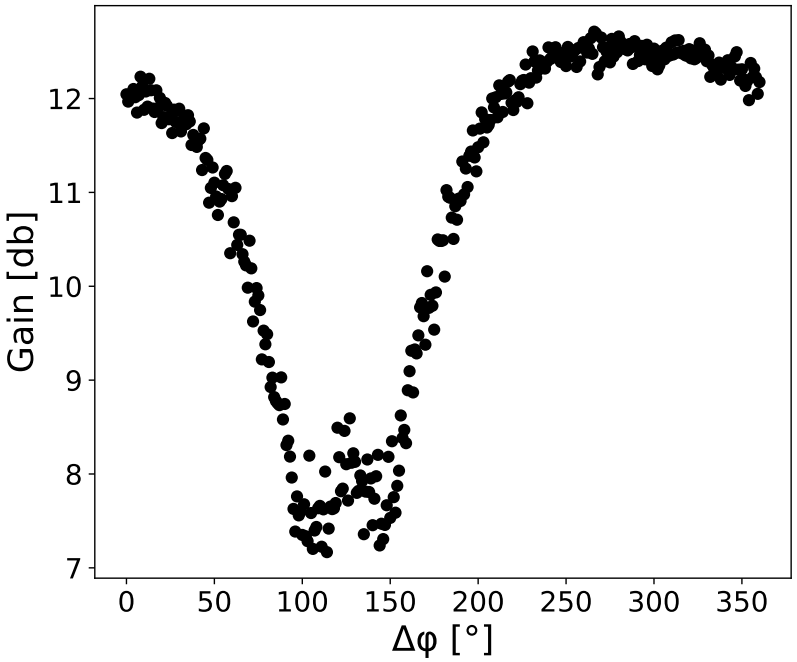
$G_{JPA} = 15.5$ dB

Measured Noise

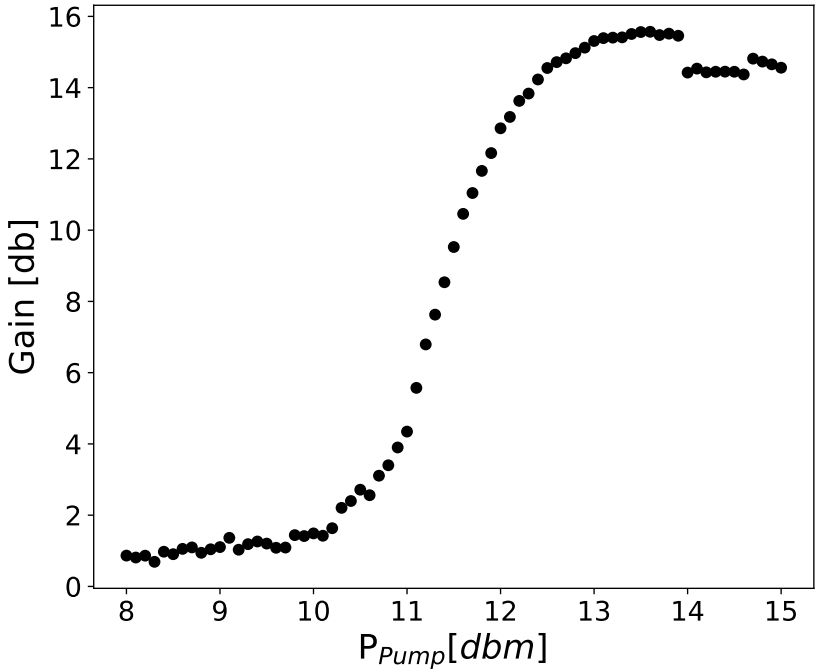
$$T_n^{JPA} = \frac{P_n}{k_B\,\Delta\nu\,(G5 + G_{JPA})} = \left(0.130\ {}^{0.075}_{0.049}\right) K$$

Expected quantum noise $\frac{1}{2}h\nu/k_B \implies T_{SQL} = 0.178\ K$

ΔPhase dependence



Pump power dependence

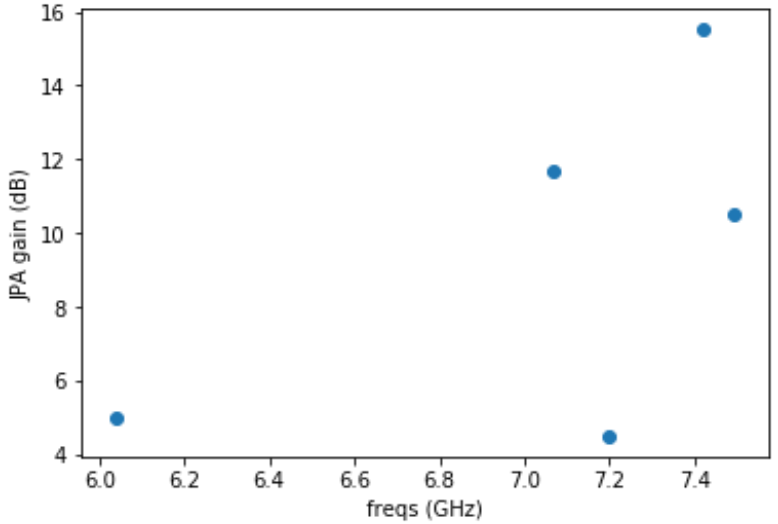


f_{signal}=7.418 GHz

$f_{pump}=2f_{signal}$

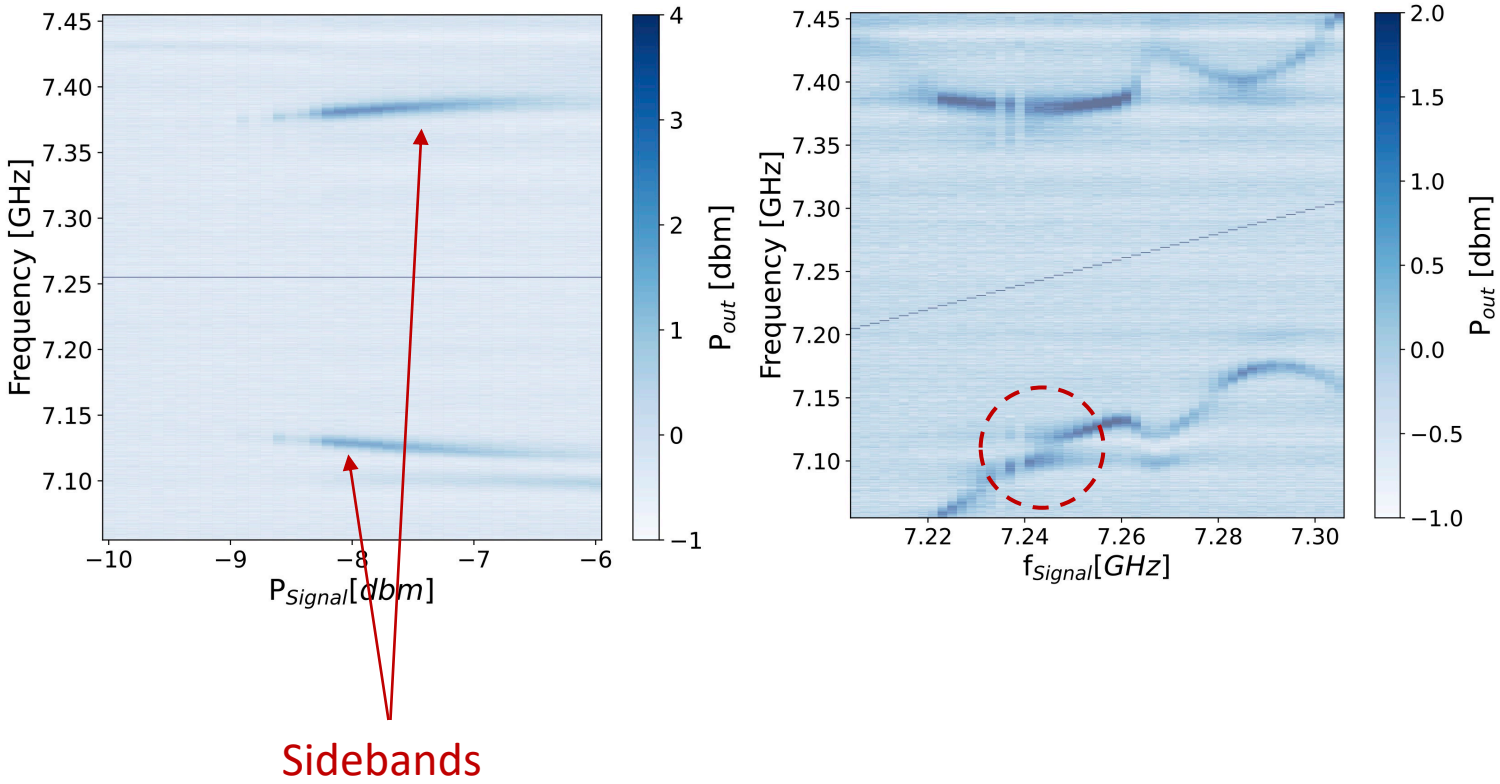
Other frequencies (degenerate regime)

freq (GHz)	P pump (dBm)	Gain JPA (dB)
6.04	10.3	5
7.07	9.8	11.7
7.2	16.8	4.5
7.418	13	15.5
7.4908	11.8	10.5

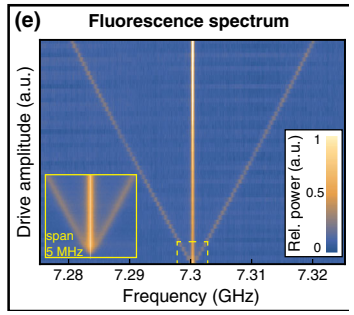


Resonance fluorescence with subnatural linewidth??

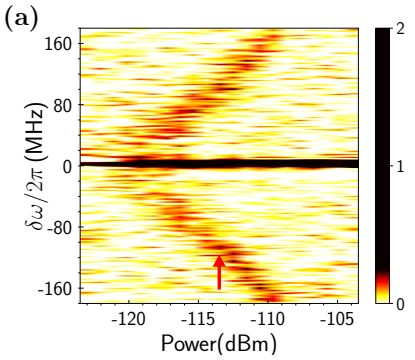
Signal only, pump OFF



Sidebands



10.1103/PhysRevX.6.031004



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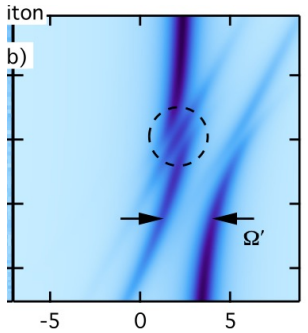

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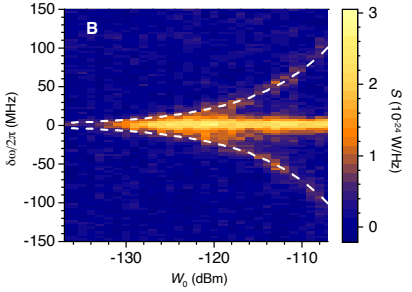

10.1126/science.1181918