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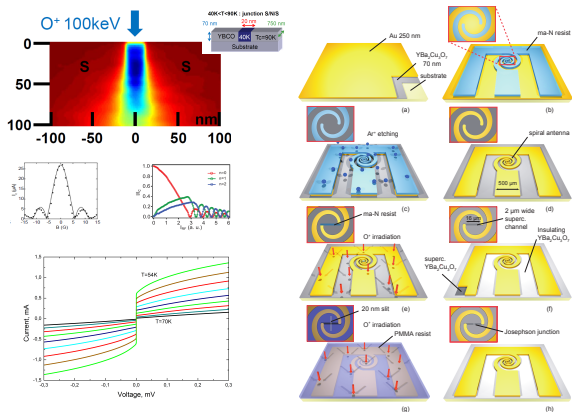
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Terahertz heterodyne detection based on ion-irradiated high-Tc Josephson junctions and arrays

A. Sharafiev¹, M. Malnou¹, C. Feuillet-Palma¹, C. Ulysse², P. Febvre³, J. Lesueur¹, N. Bergeal¹

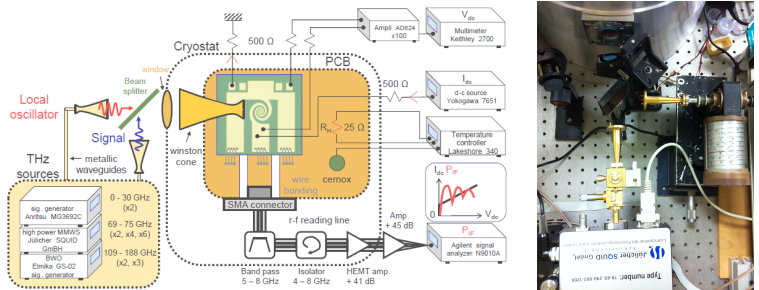
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Ion-irradiated junctions and manufacturing process



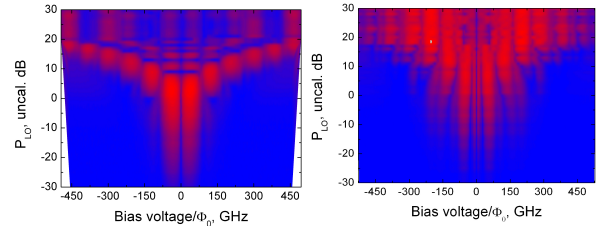
Good Josephson properties + **variable R_N**

Mixing experiment

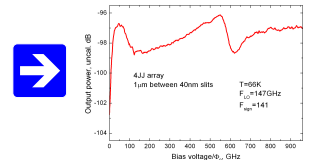


4JJ array mixing properties

$F_{LO}=20\text{GHz}$, $F_{\text{sign}}=14\text{GHz}$
 $T=66\text{K}$ $T=60\text{K}$



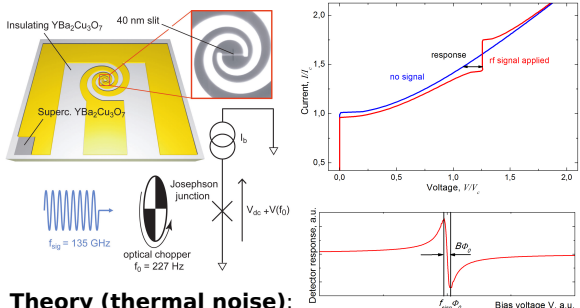
$F_{LO}=147\text{GHz}$
 $F_{\text{sign}}=141\text{GHz}$
 $T=66\text{K}$



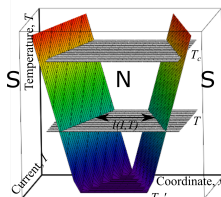
Main conclusion:
 if T is close to T_J parameters spread is less
 → **giant Shapiro steps**

Generation linewidth

Detector response technique

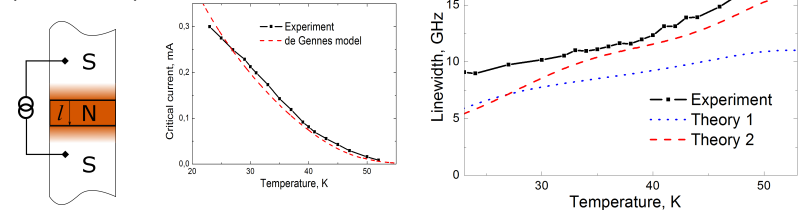


Linewidth is determined by:
thermal noise
 +
1/f-noise



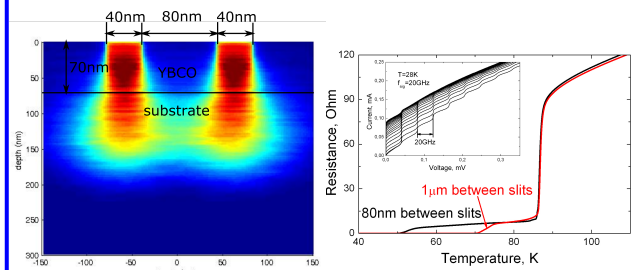
Theory (thermal noise):

1. variable normal part (Katz)
2. nonlinear noise power transformation (Likharev-Semenov)
3. proximity effect I_c(T) dependence (de Gennes)



Main conclusion:
 thermal noise is the main contribution to the linewidth

"Multislit" junctions



Main conclusion: all samples with closely spaced slits worked as one junction

Conclusion

1. Thermal noise gives the main contribution to the Josephson generation linewidth of ion-irradiated junctions
2. Giant Shapiro steps (and therefore effective mixing) are achievable in the hundred-GHz band when temperature is high and spread of parameters is lower.
3. Closely spaced slits form a single junction with low T_J.