Technologies for mm and sub-mm waves sideband separating receivers

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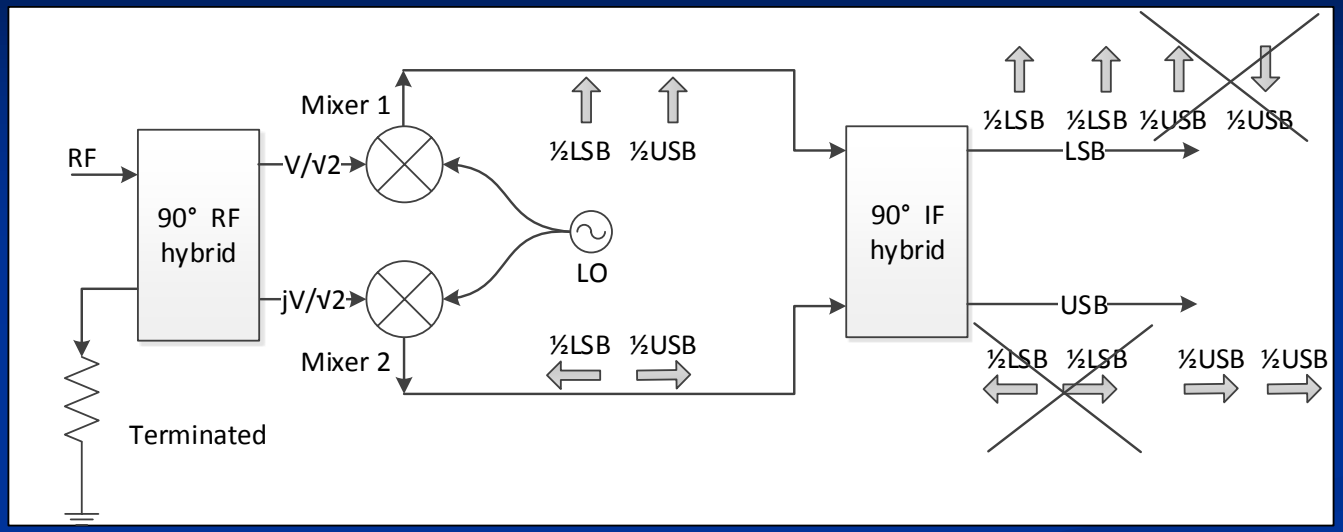
View south from Cerro Chajnantor. Photo S. Radford 1994 November

Outline

- 2SB SIS mixer receivers - introduction;
- SIS mixer improvements;
- Passive components of the 2SB mixer;
- LO sources;
- SEPIA.

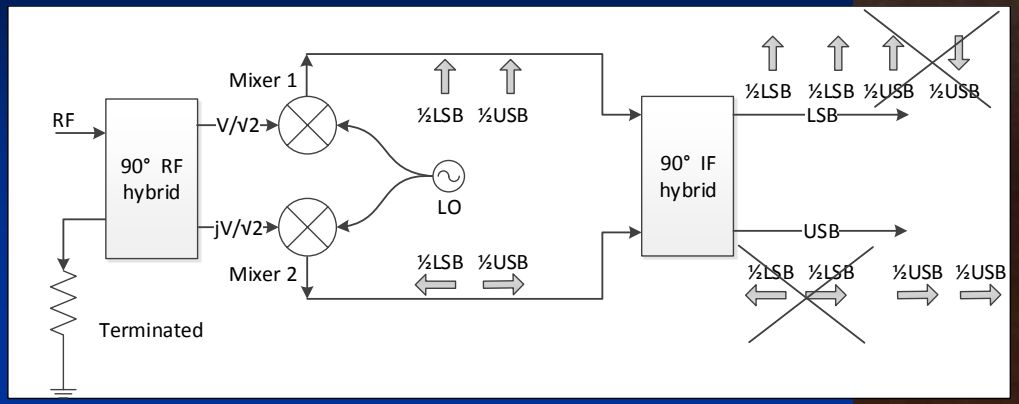
2SB Mixers - intro

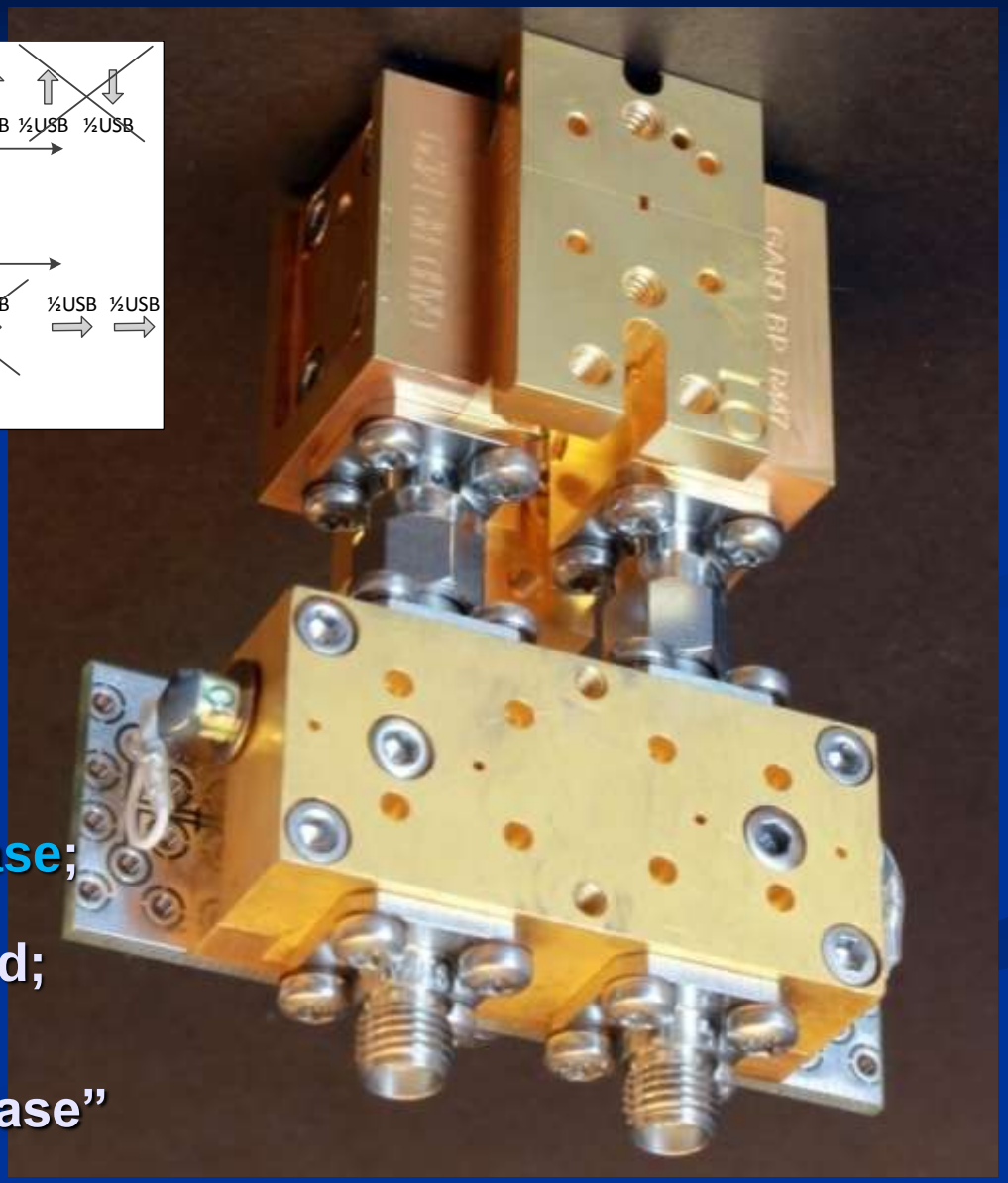


- Symmetry in amplitude and phase;
- RF hybrid, DSB mixers, IF hybrid;

ALMA Band 5 is used as "show-case"

2SB Mixers – ALMA Band 5





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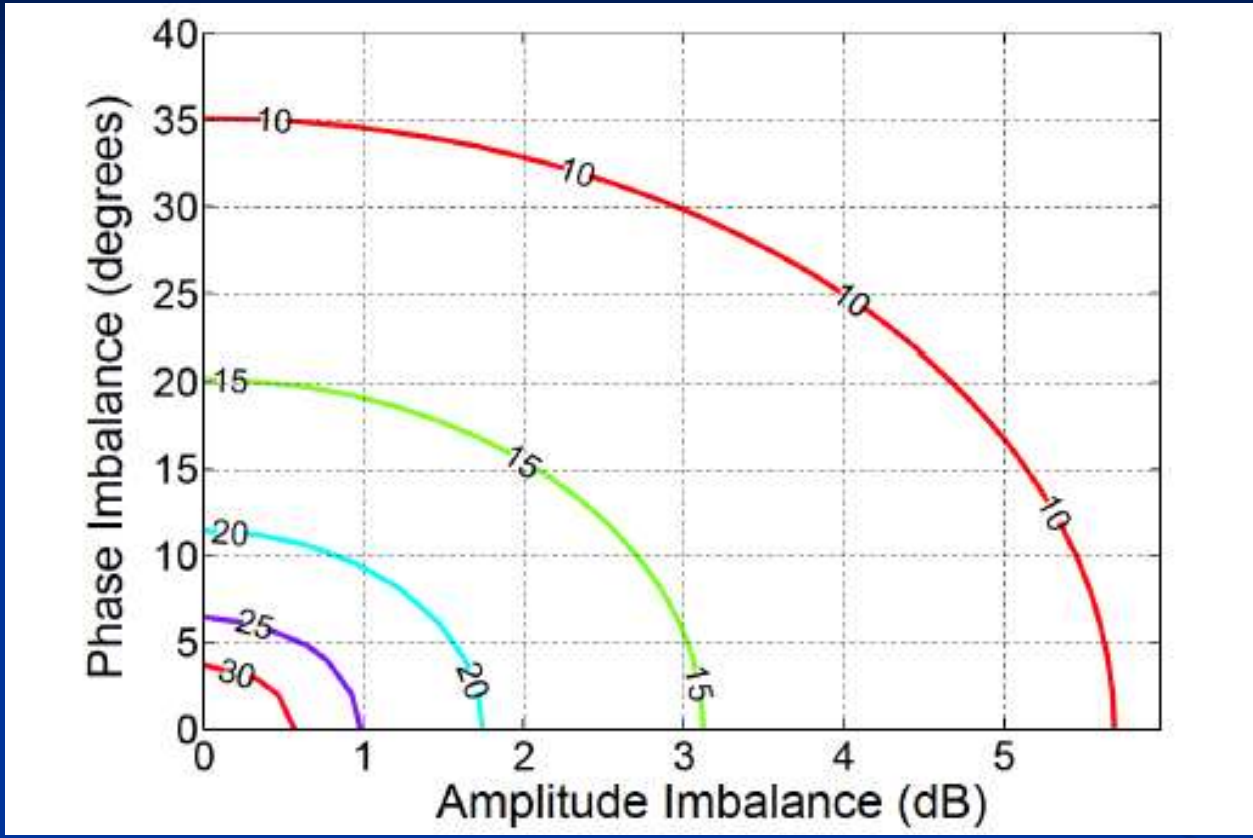

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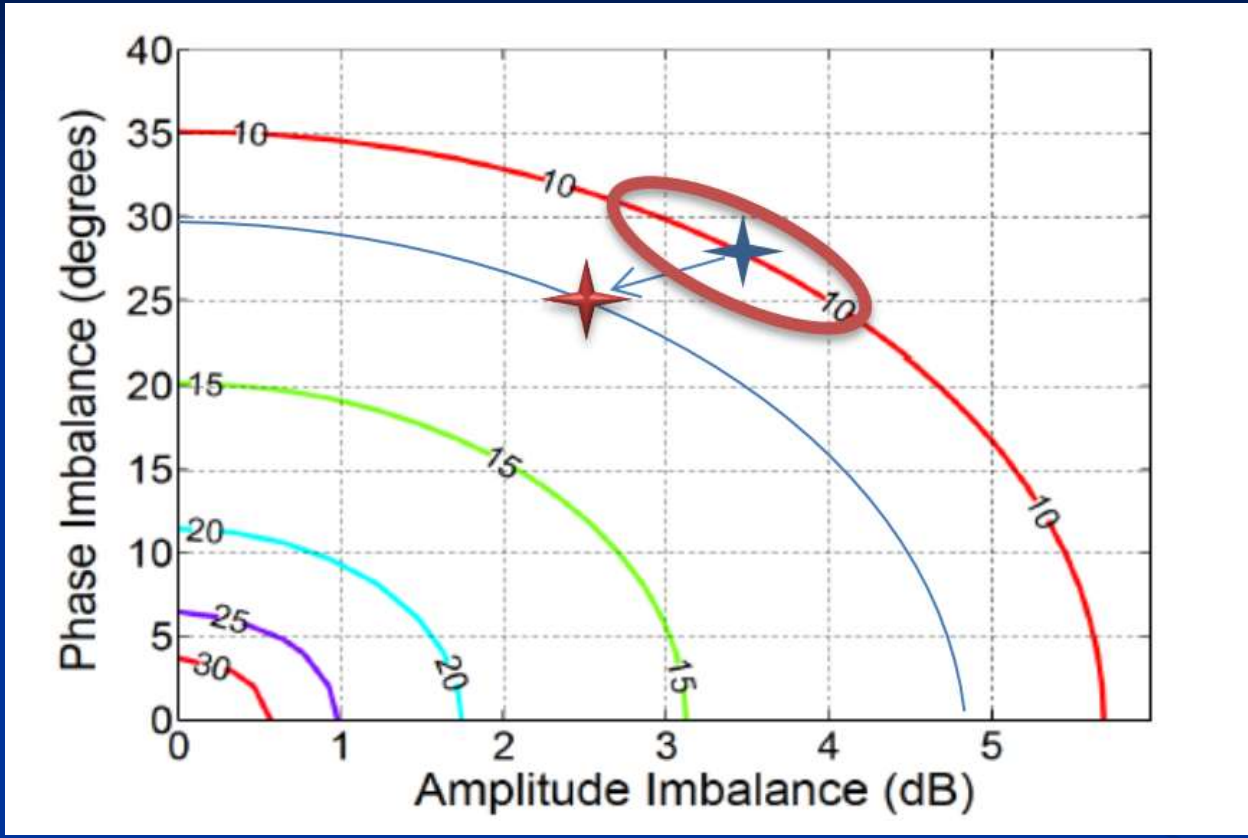

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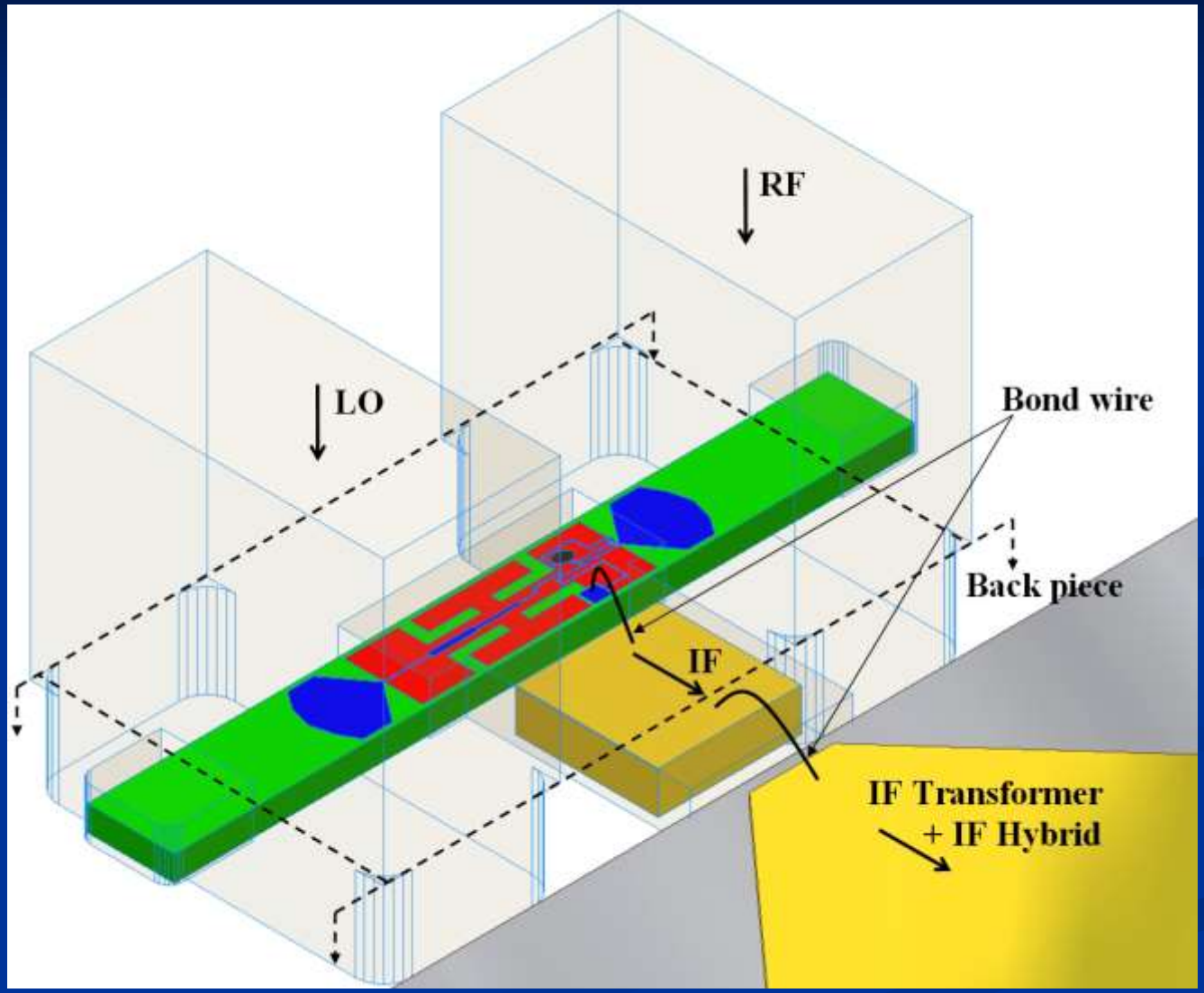
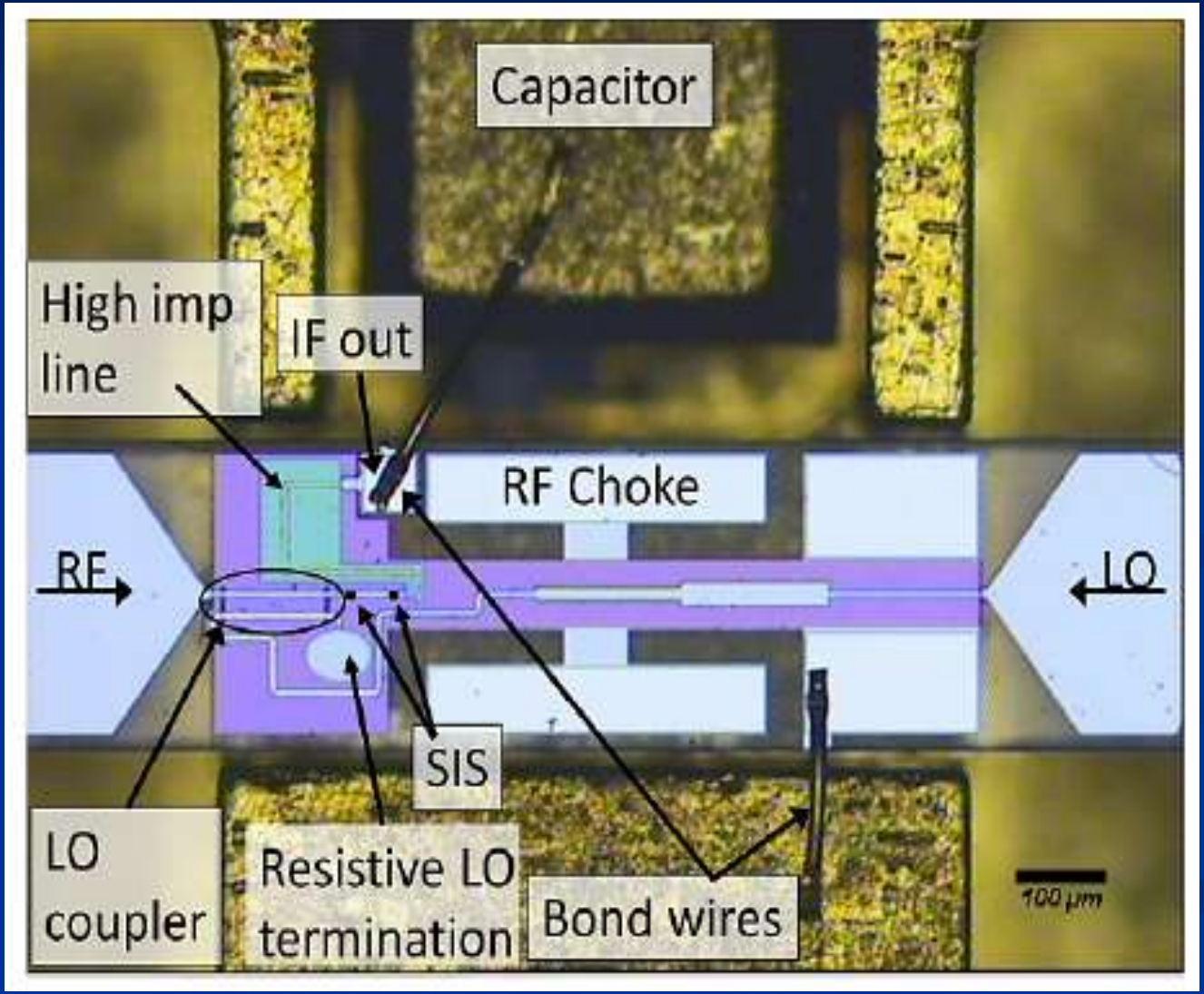
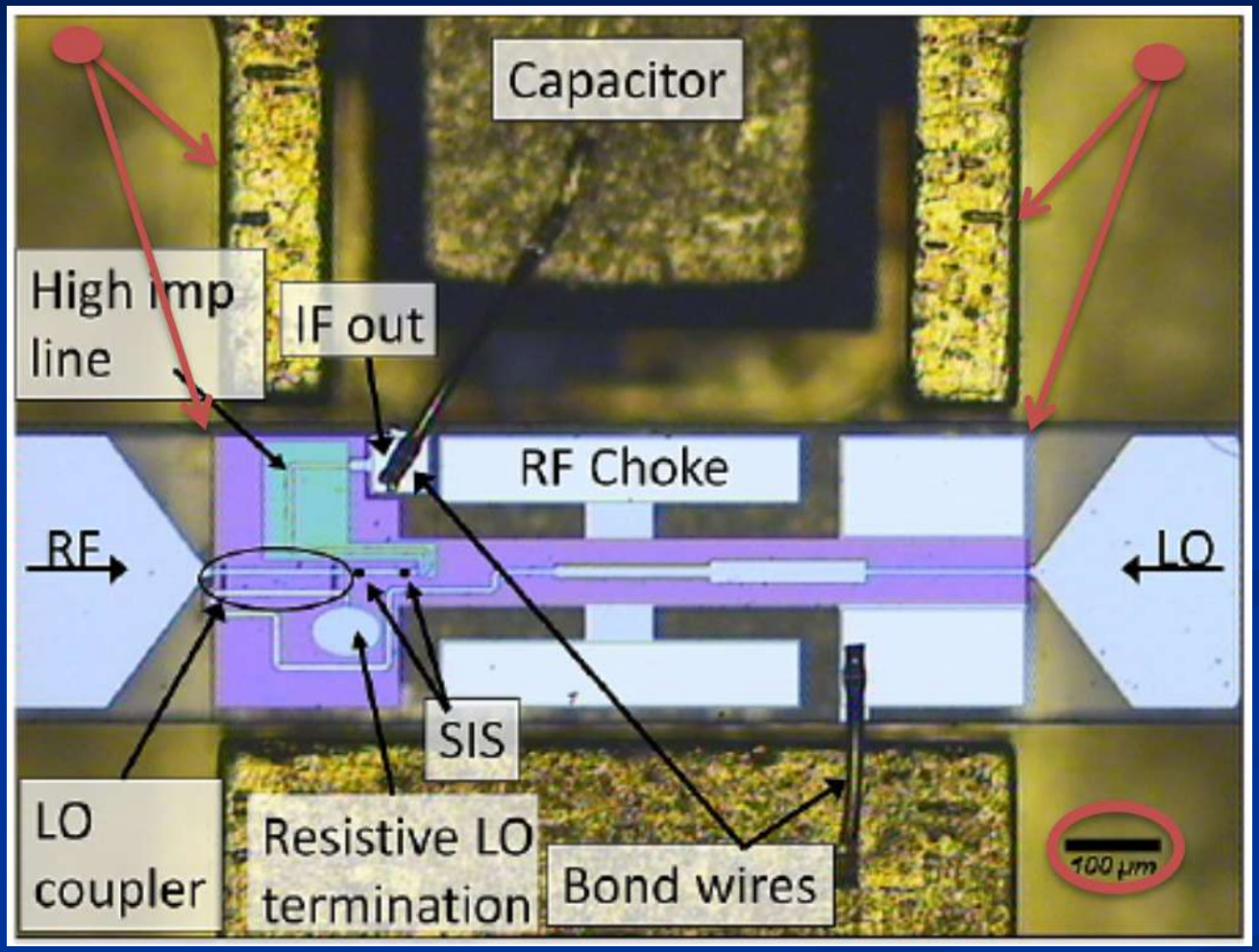
SIS DSB Mixers



SIS DSB Mixers

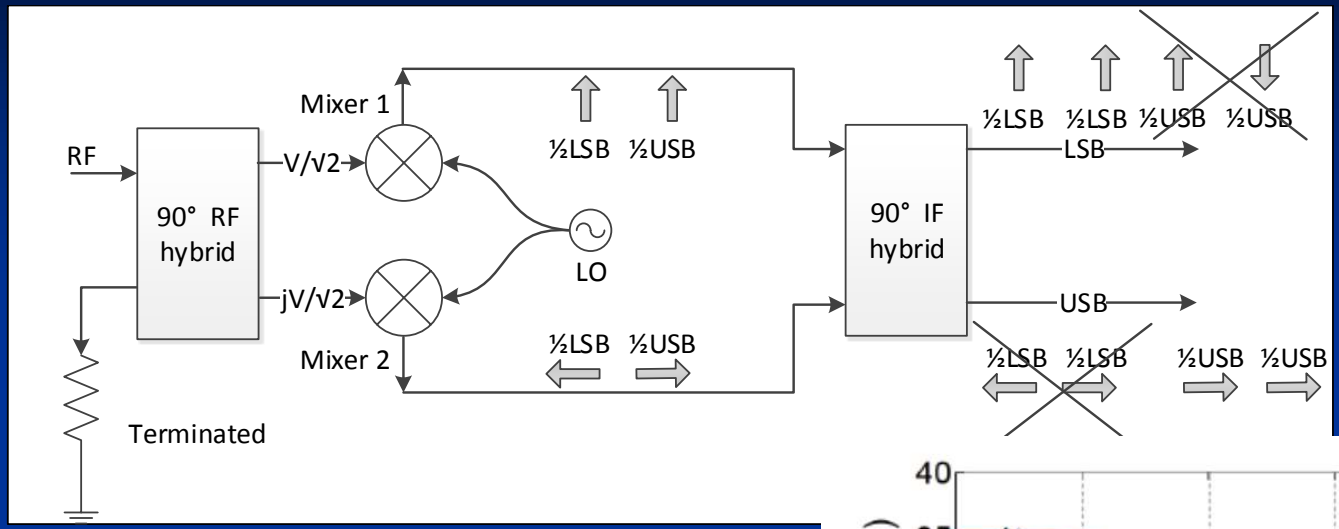


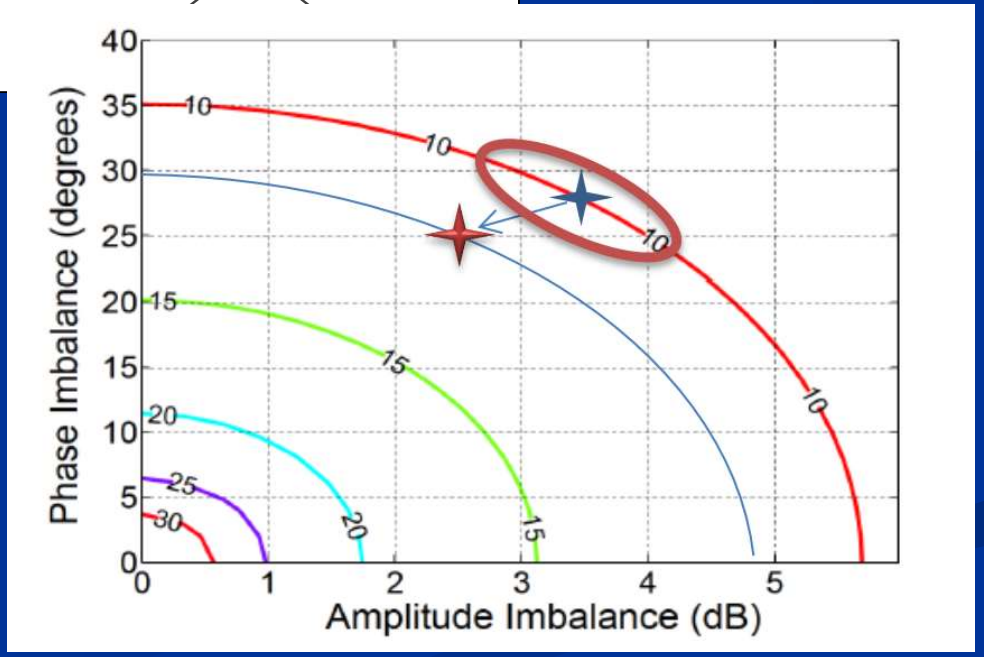
SIS DSB Mixers



15 um substrate offset gives 12.5 degree in phase;

SIS DSB Mixers - improvement





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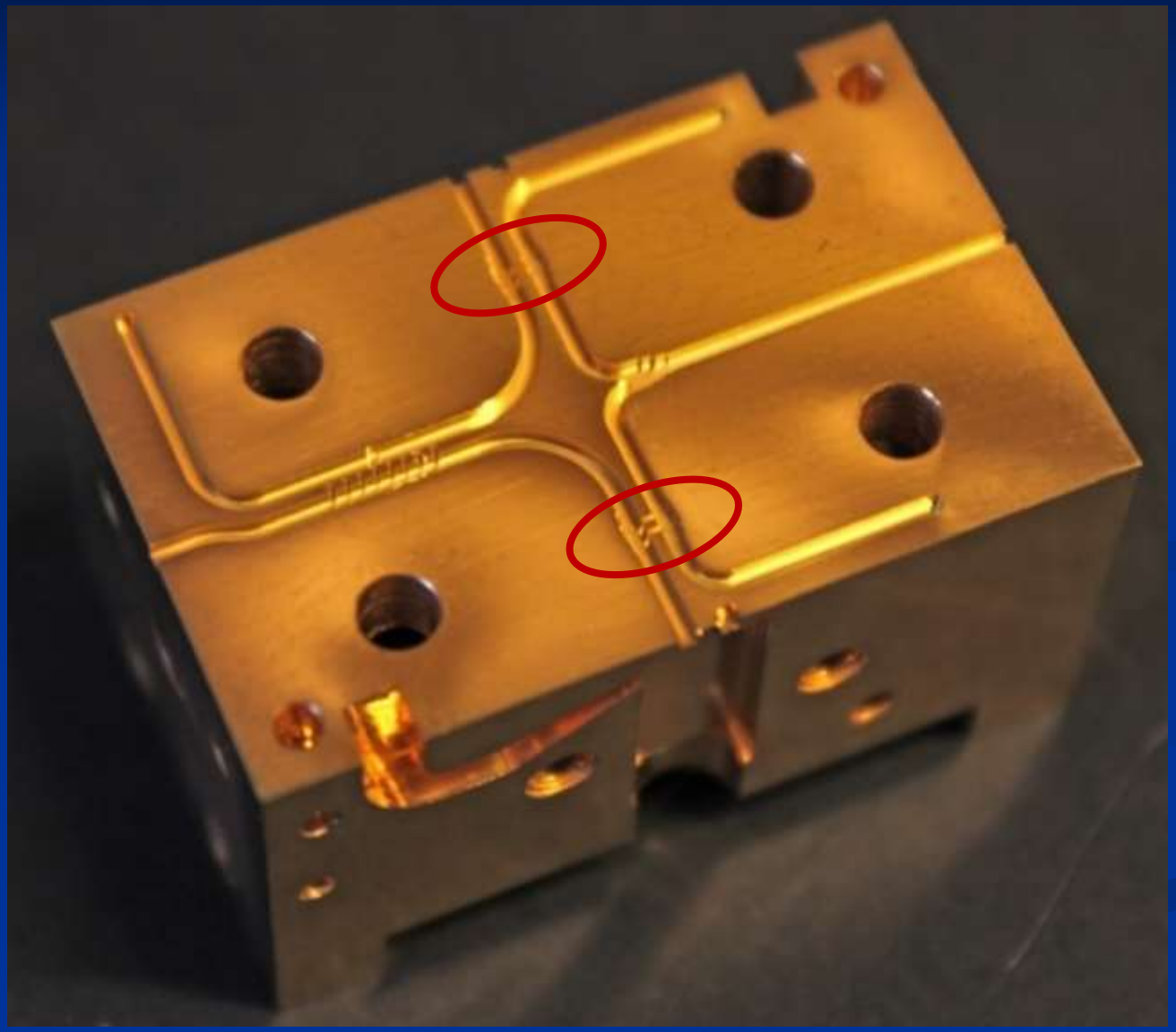

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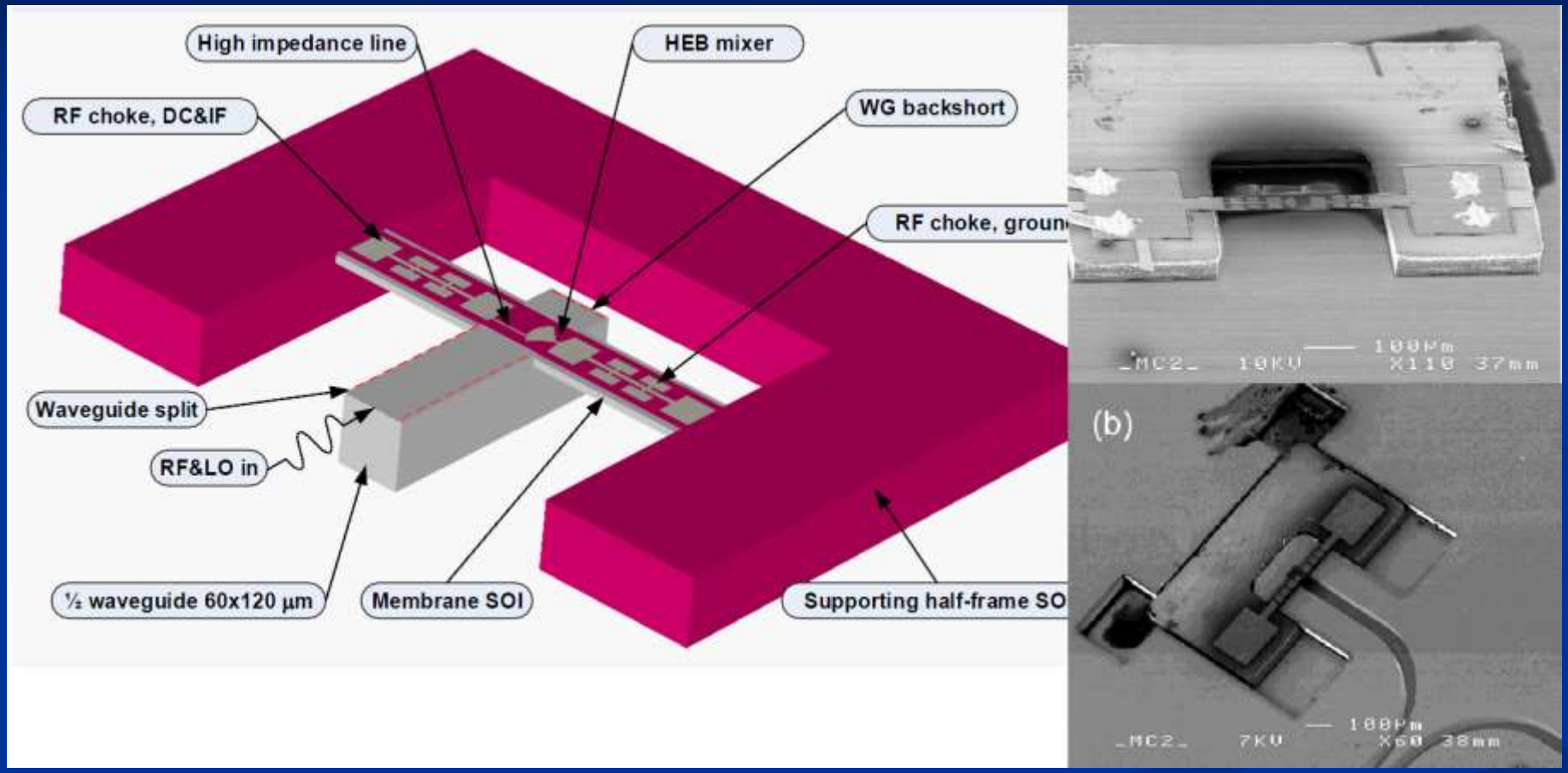
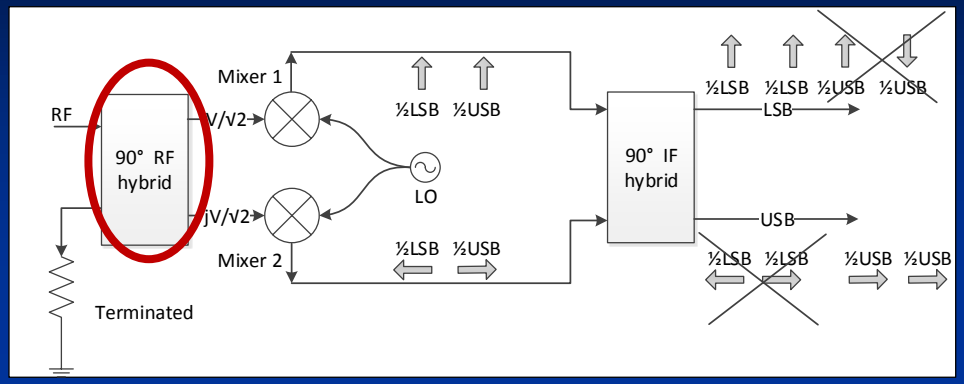
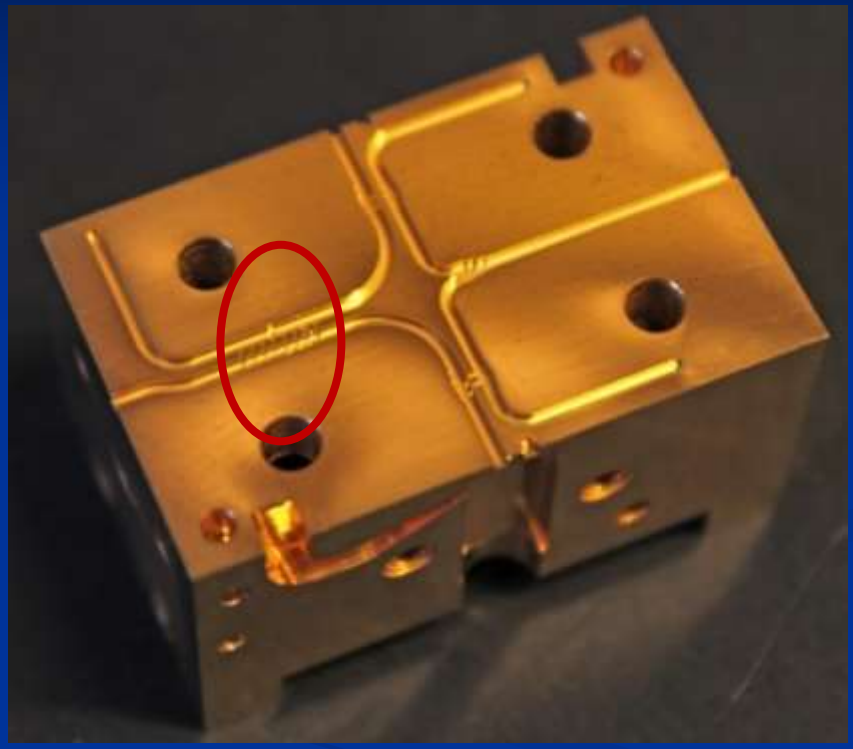
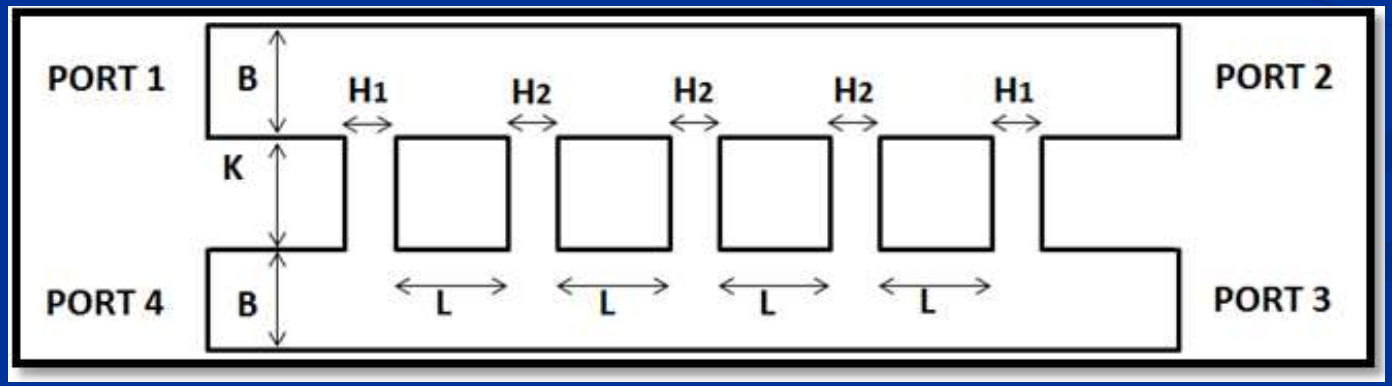


RF hybrid - improvement







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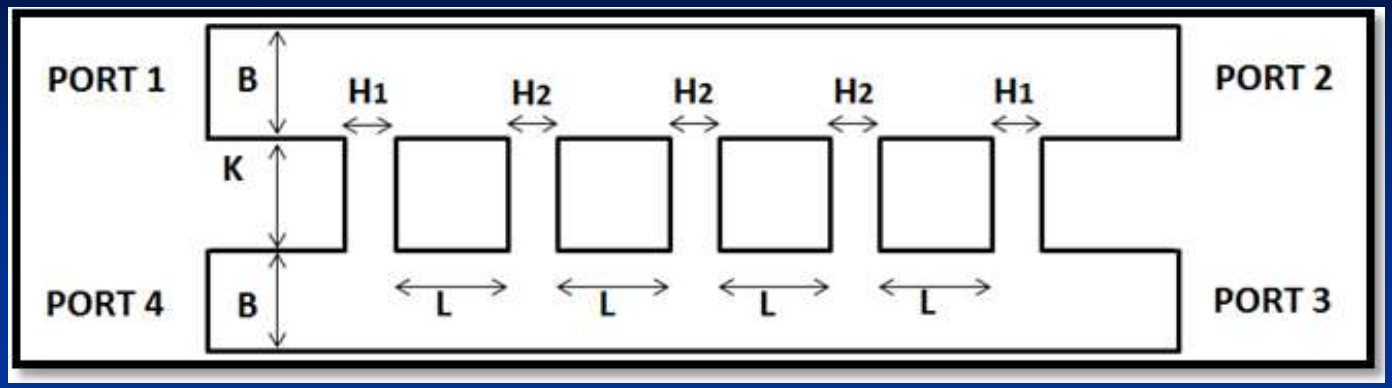

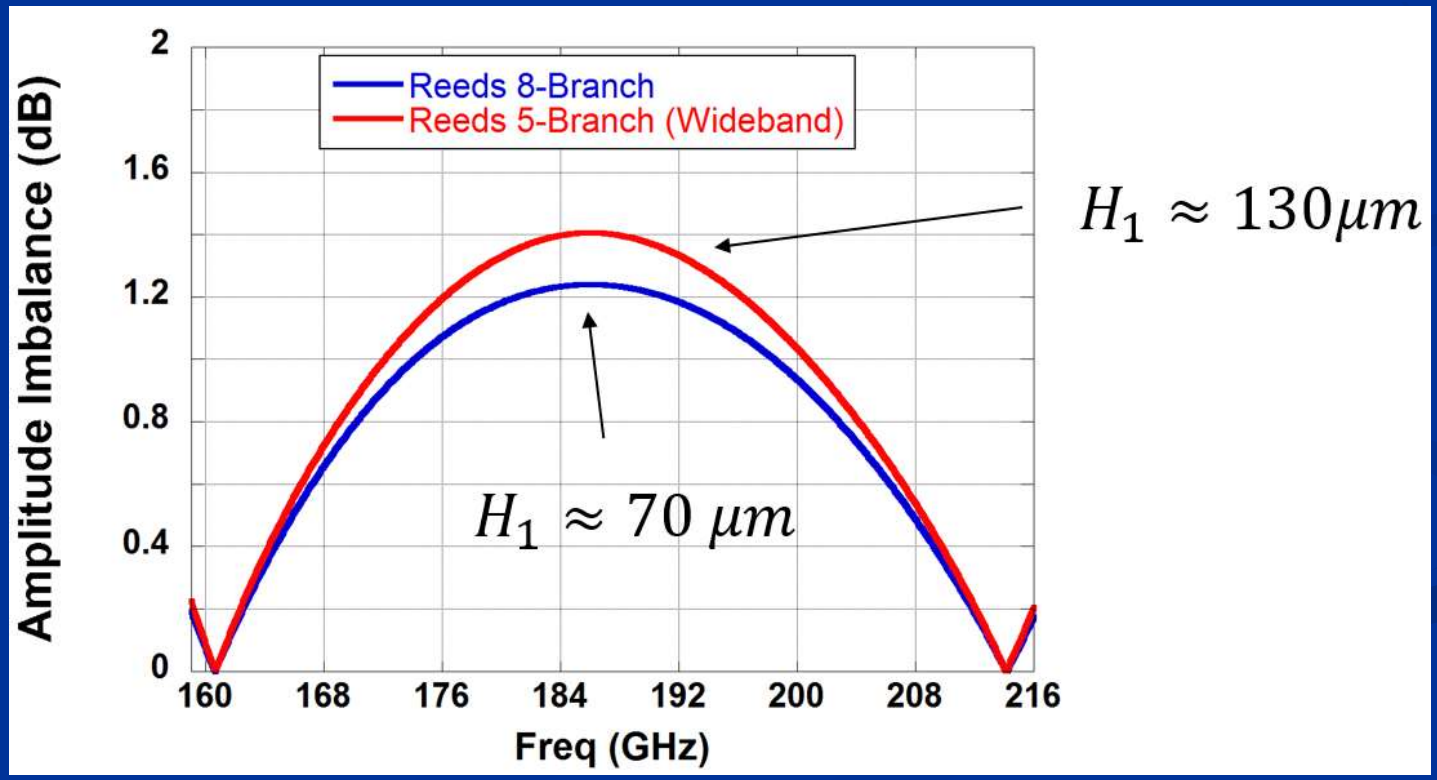

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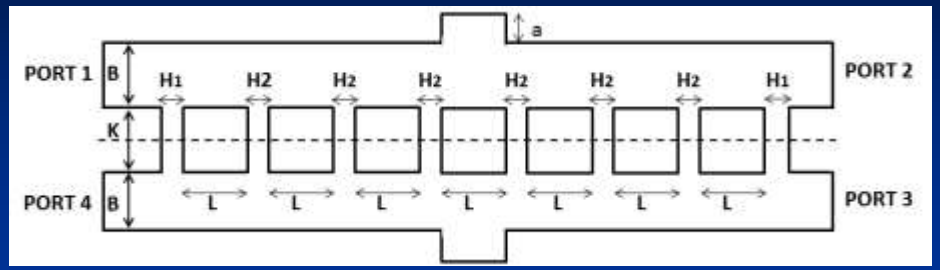
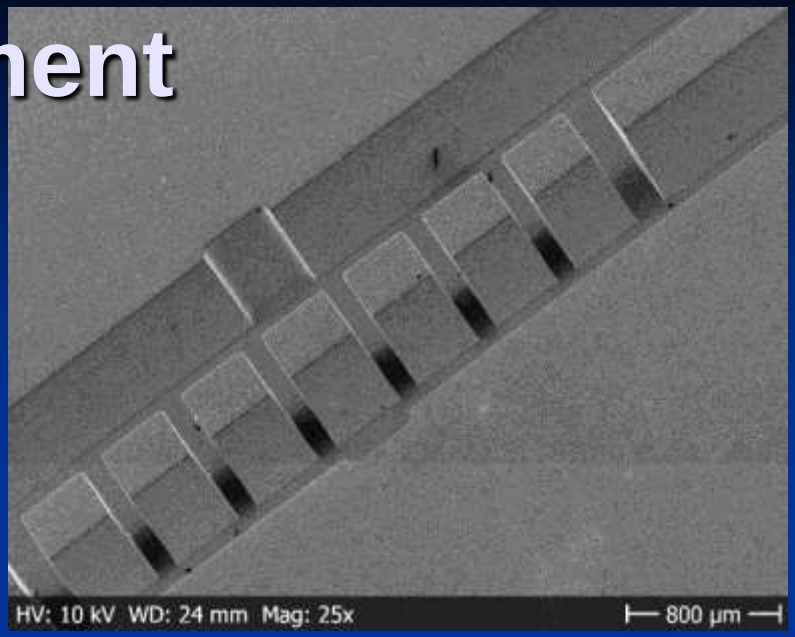
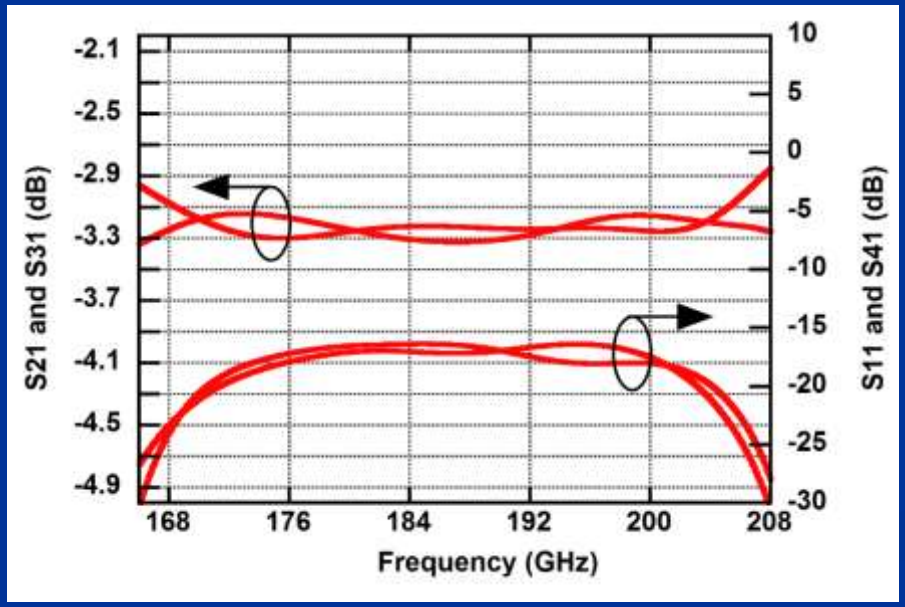
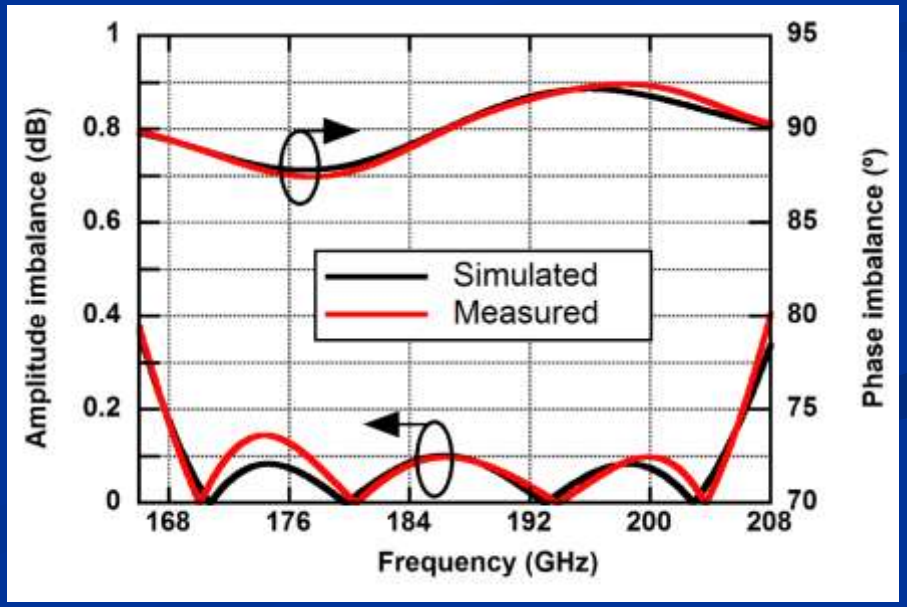
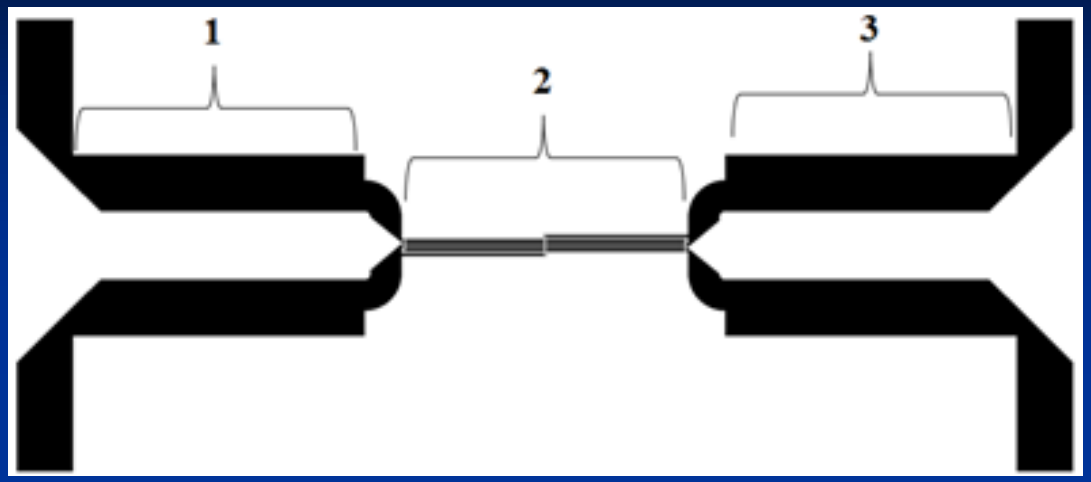


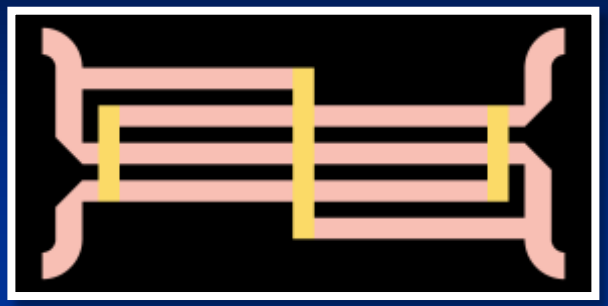


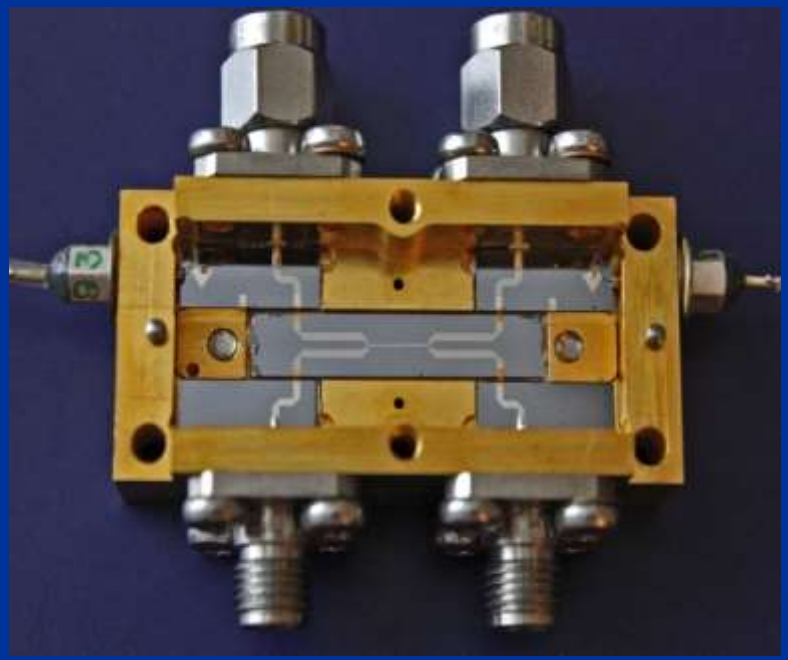


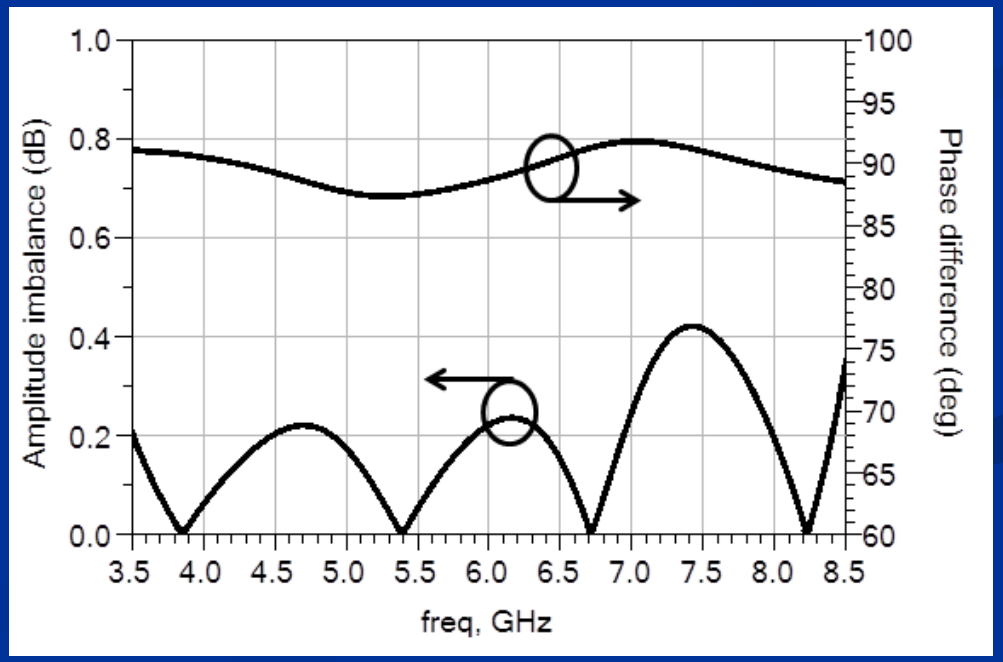


IF hybrid - improvement

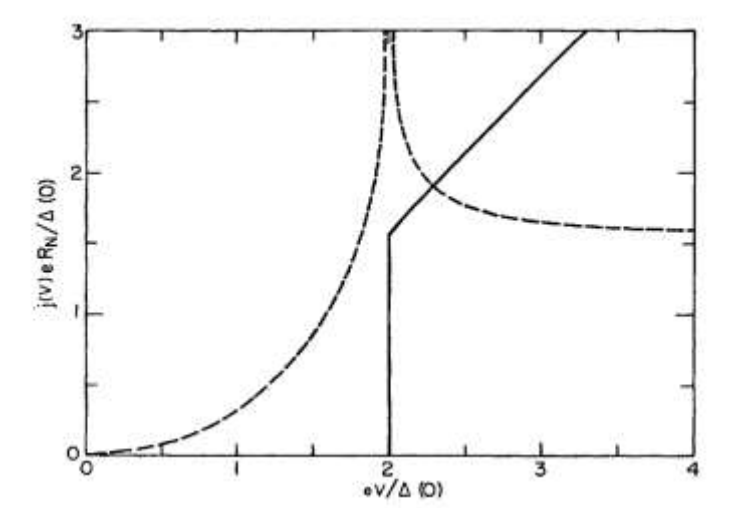


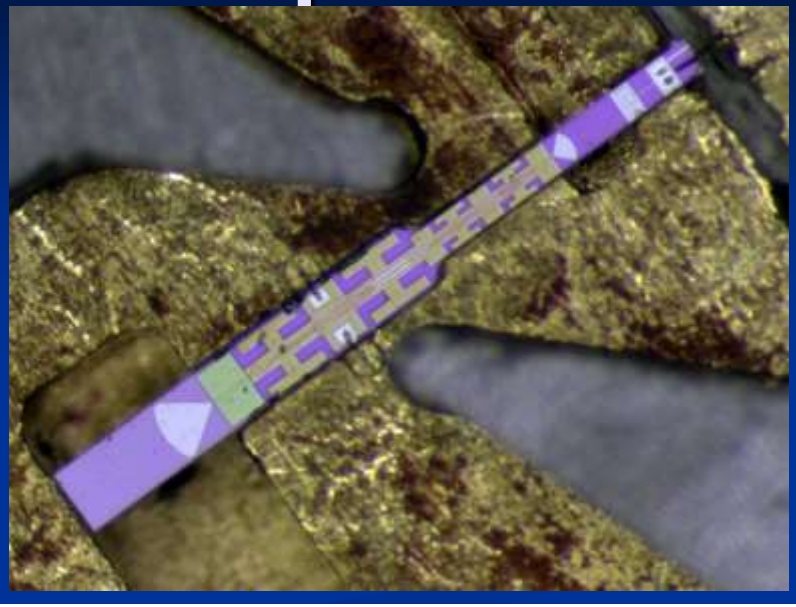


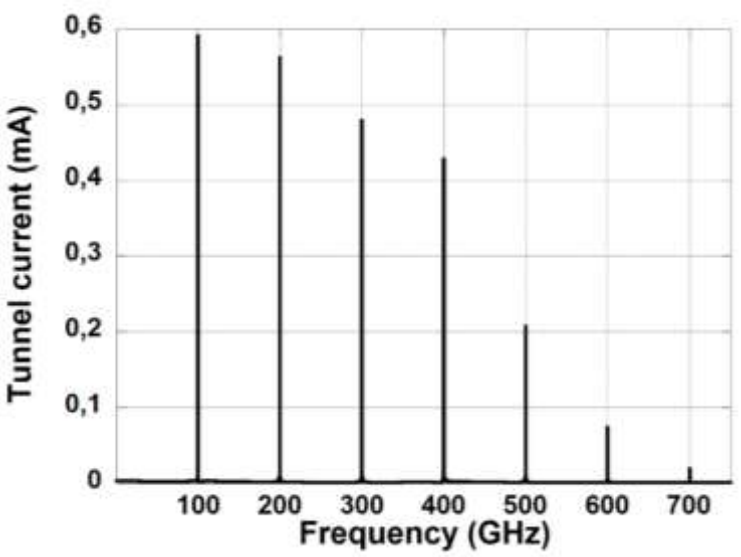


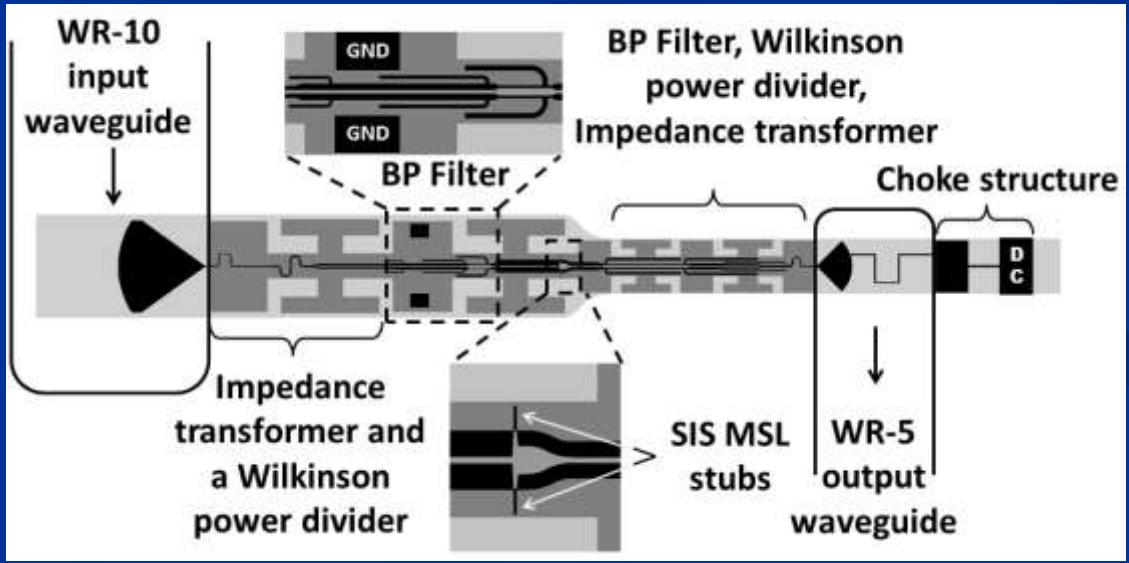


Local Oscillator – SIS multiplier









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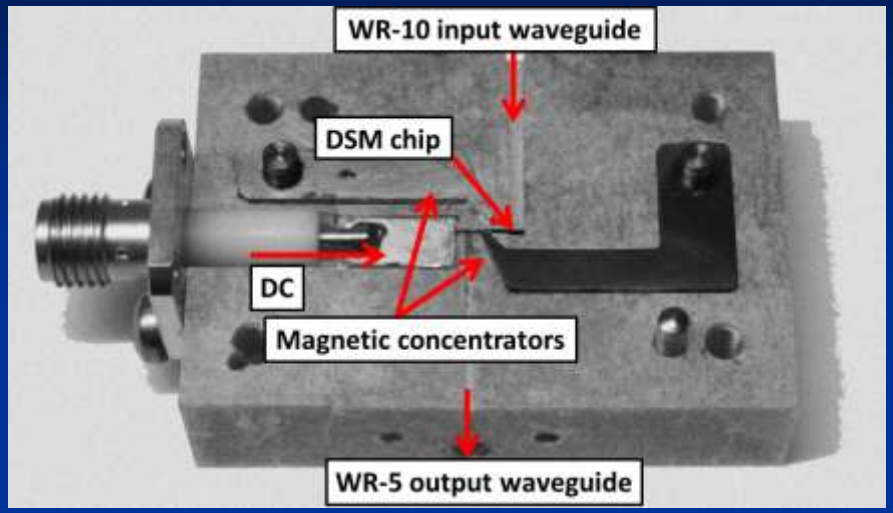
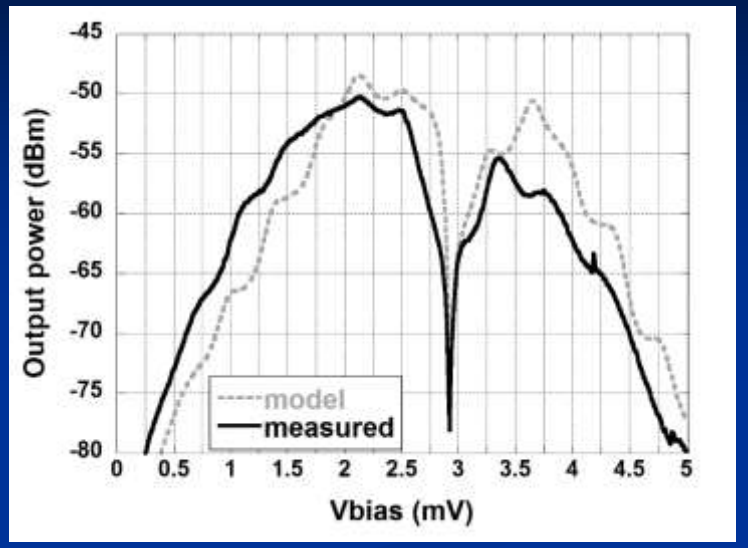
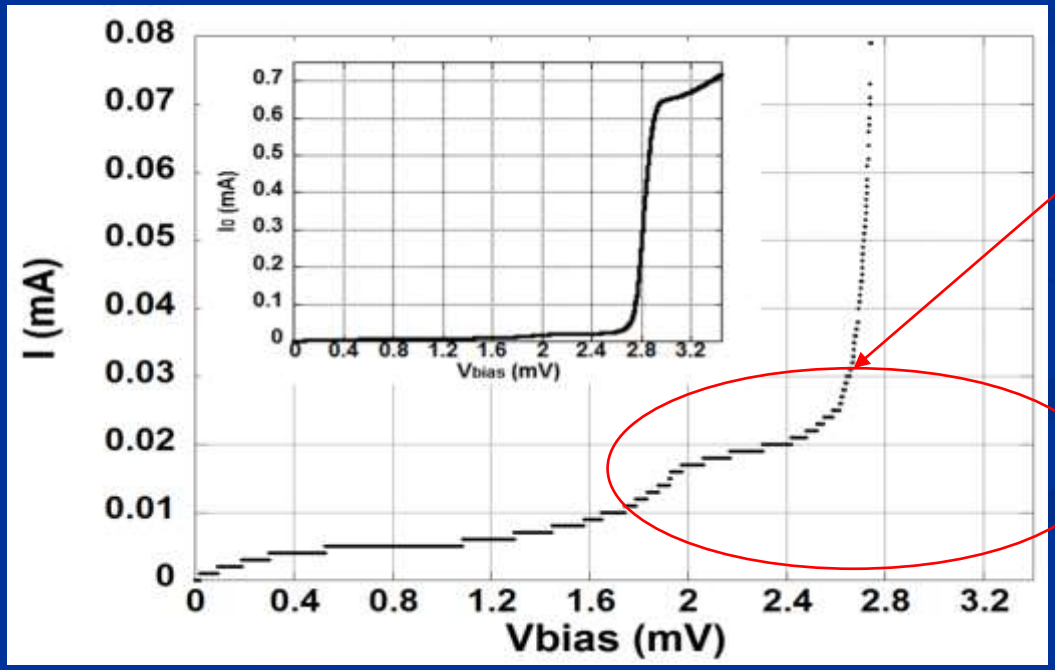






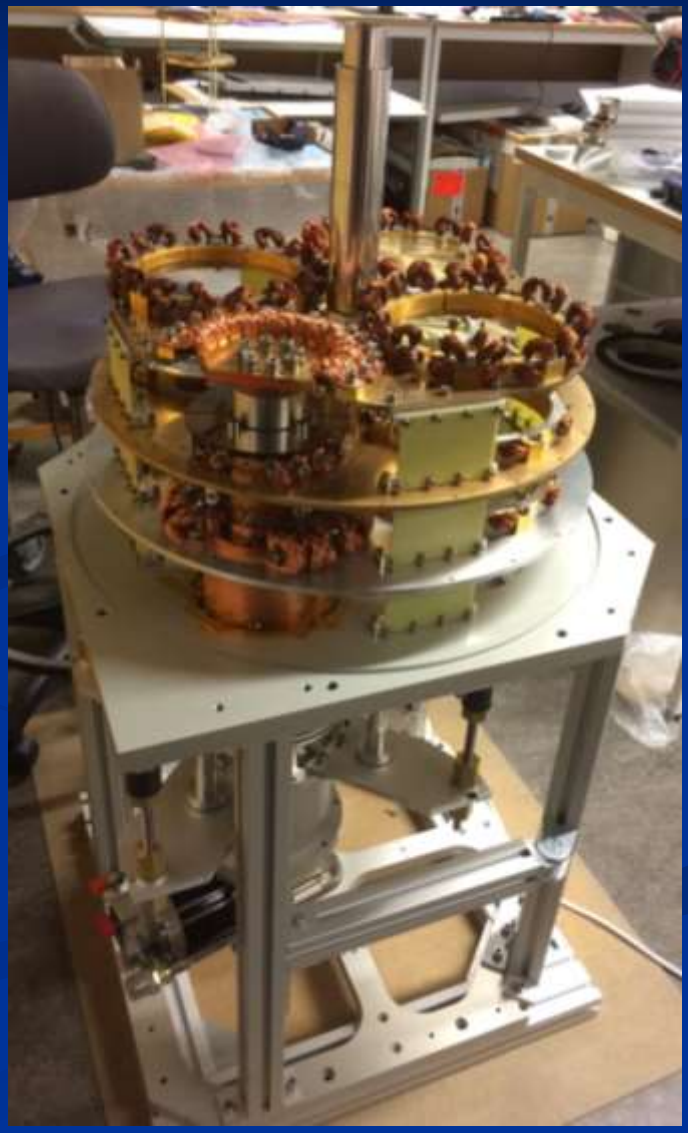
Pumped SIS mixer

Swedish ESO PI instrument for APEX

SEPIA

- February 2015: installed at APEX with ALMA Band 5 preproduction receiver.
- February 2016: ALMA Band 9 (NOVA, NL) technically commissioned after integration into SEPIA. Collaborative effort by APEX partners: ESO and GARD/OSO; details in the MoU.
- Planned in 2017: 2SB version of ALMA Band 9 from NOVA;
- Planned for 2018: GARD designed and built APEX B2 cartridge (=ALMA B7) receiver with IF 4-12 GHz;
- Future upgrade of ALMA B5 to IF 4-12 GHz;

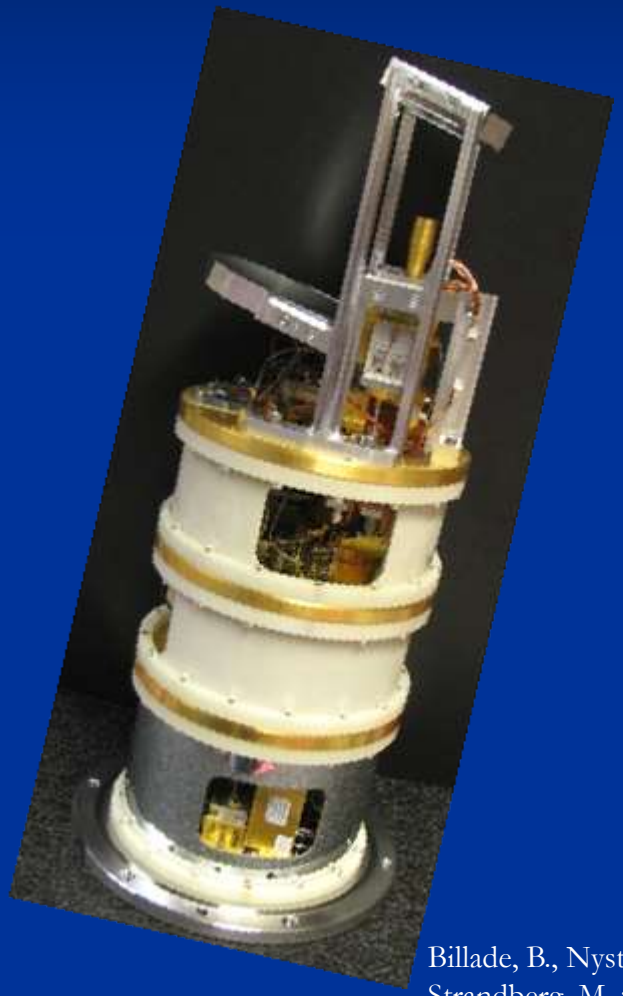
SEPIA Cryostat

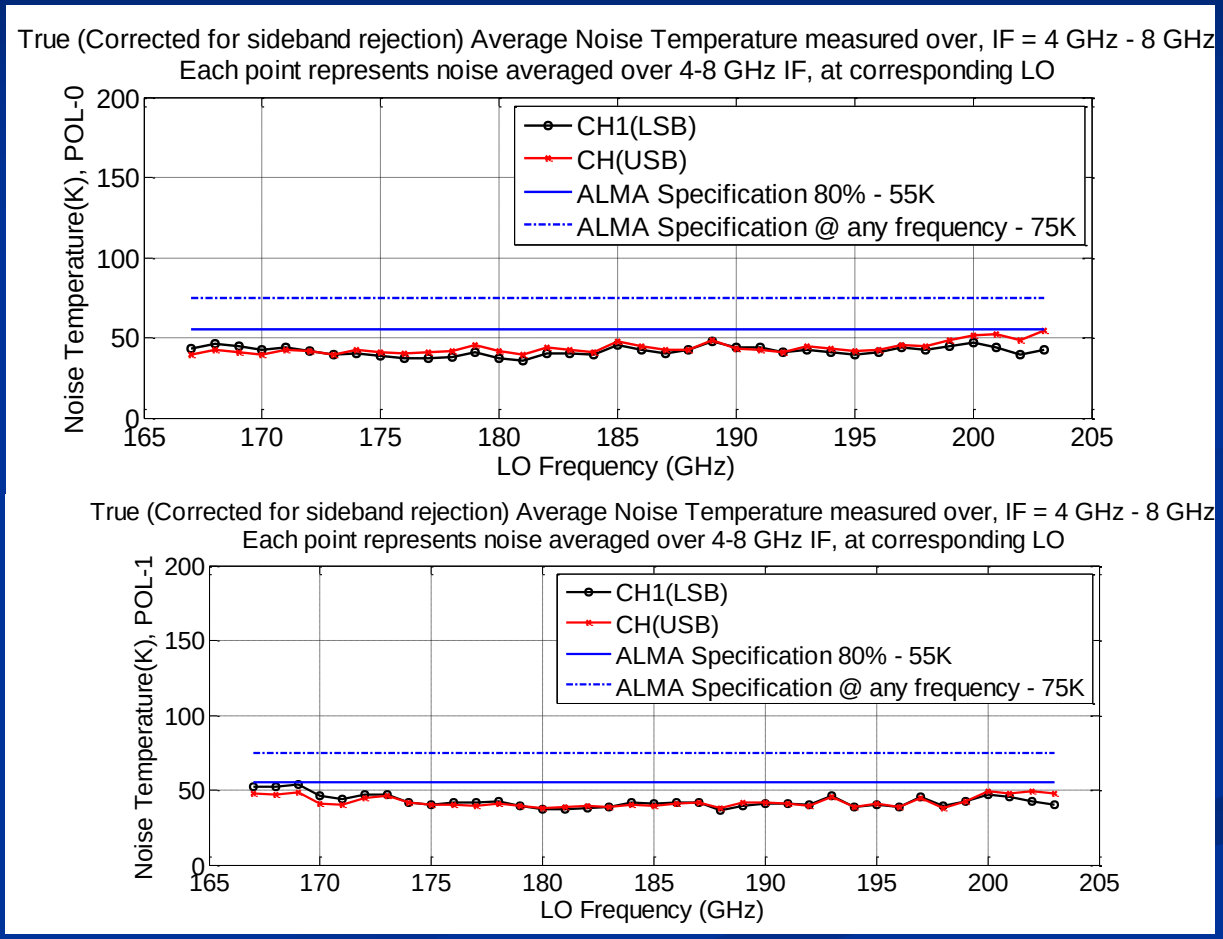


SEPIA Cryostat

SEPIA Receiver

SEPIA First Light Receiver





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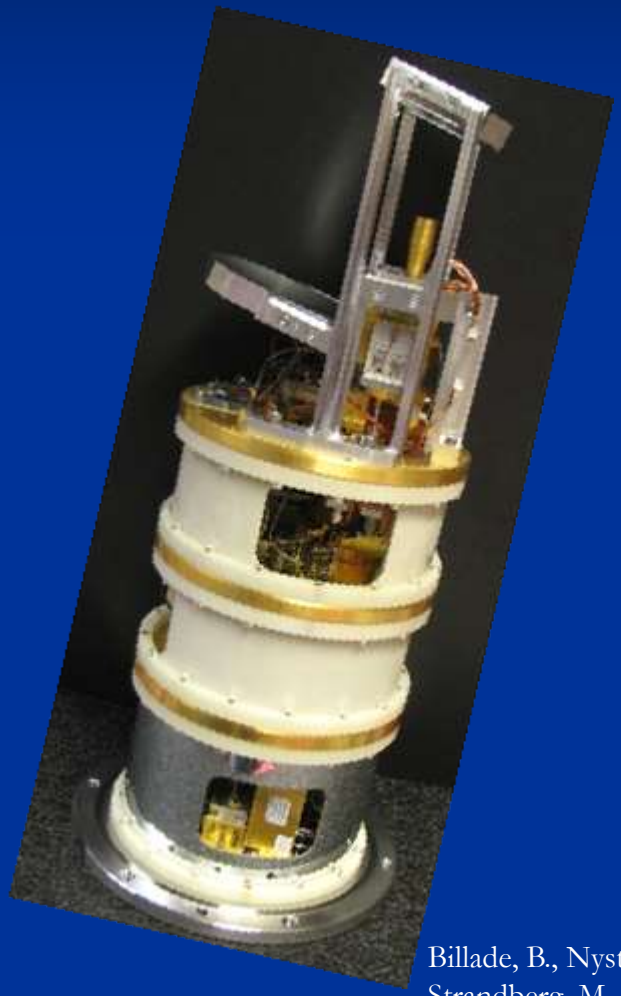
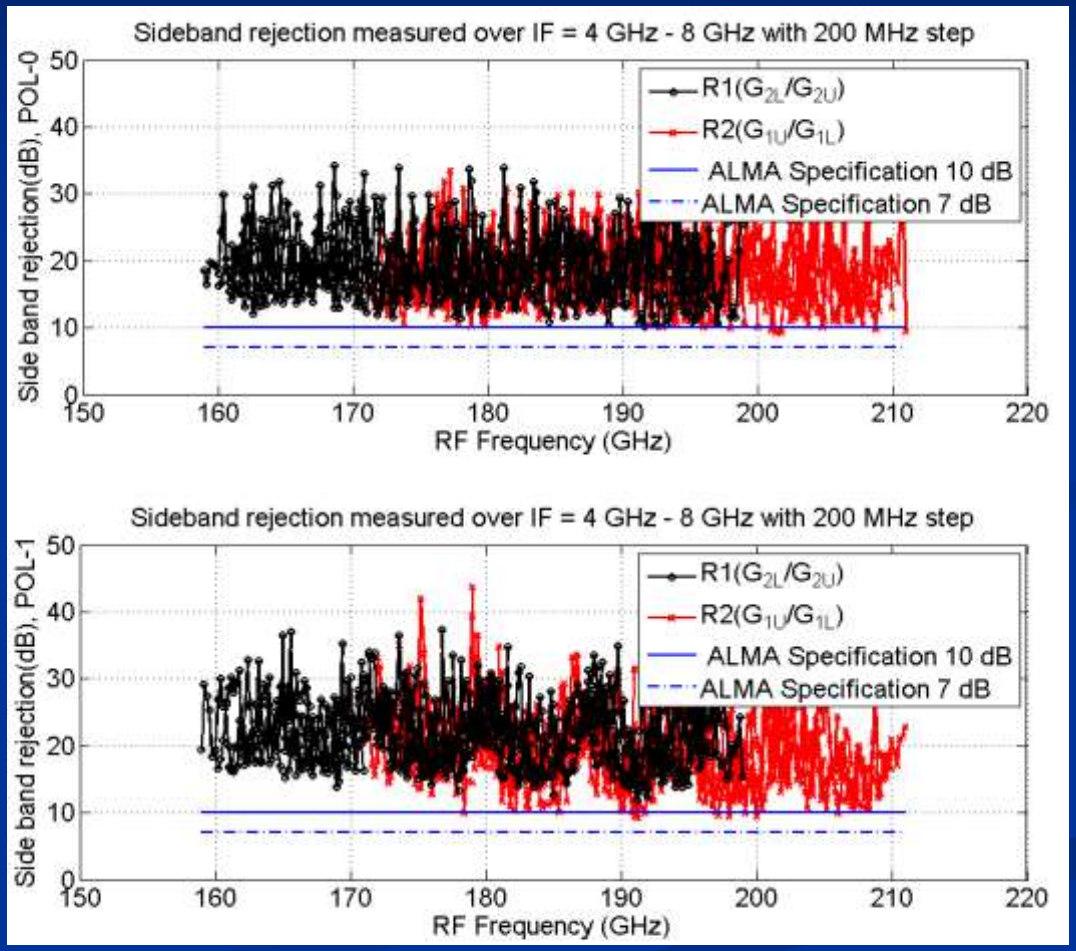
SEPIA First Light Receiver





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SEPIA: Flexible and Scalable Receiver Platform

Acknowledgements

GARD/OSO/Chalmers University
Rashid, H., Billade, B., Nystrom, O. ; Meledin, D. ; Sundin, E. ; Lapkin, I. ; Fredrixon, M.; Desmaris, V. ;; Strandberg, M. ; Ferm, S.-E. ; Pavolotsky, A. ; Olberg M.; Aghdam P.; Ermakov A.; de Beck E.; Bergman P.; Olofsson H.; Shafiee S.; Conway J.

ESO
De Breuck C.; Immer K.; Yagoubov P.

APEX
Big thanks to everybody of the Engineering staff and Astronomers for support and help! Special thanks to Thomas Klein as well !