

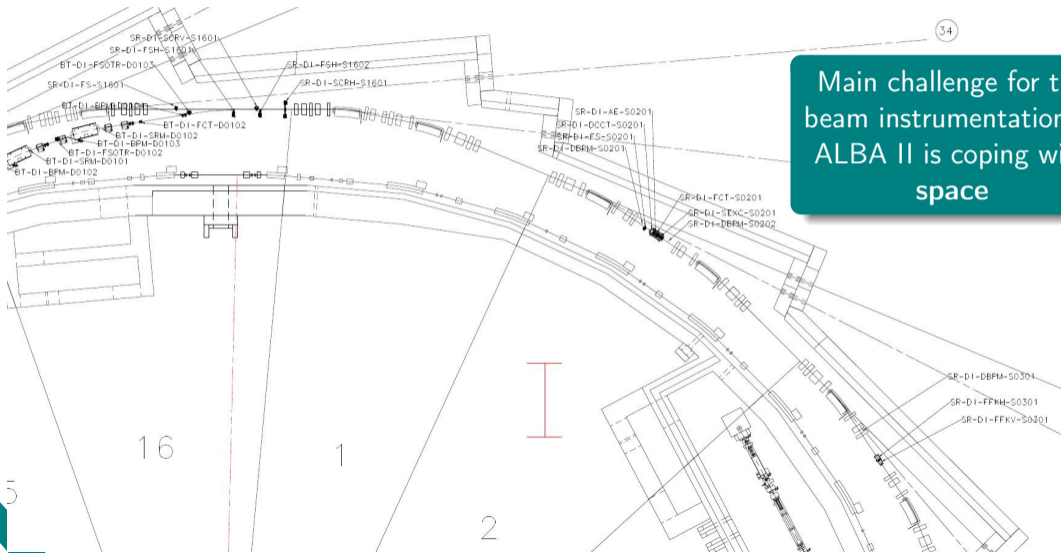


## BPMs design for ALBA II

L. Torino

Diagnostics Experts for European Light Sources

10/06/2024



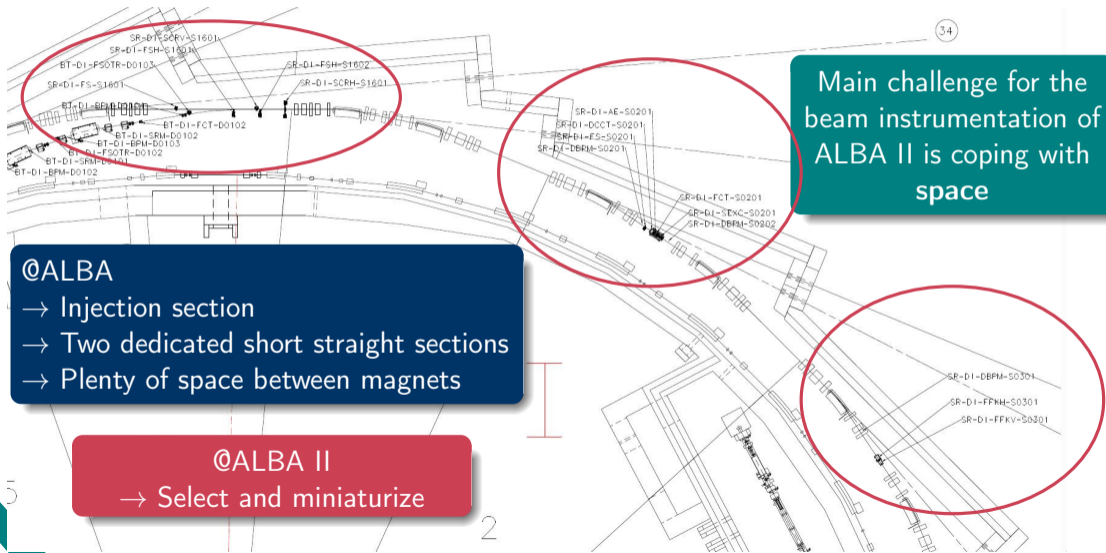
Main challenge for the beam instrumentation of ALBA II is coping with space



**@ALBA**

- Injection section
- Two dedicated short straight sections
- Plenty of space between magnets

**Main challenge for the beam instrumentation of ALBA II is coping with space**



34

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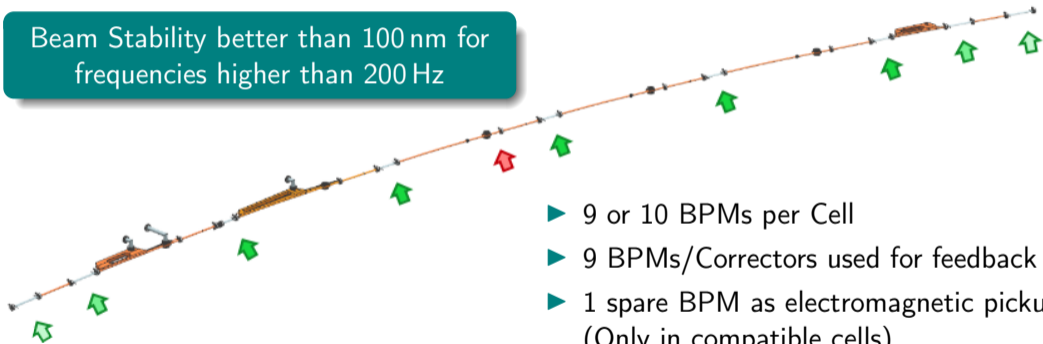
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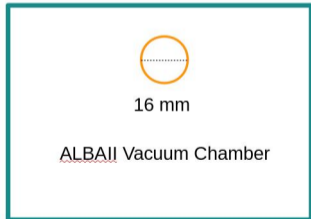
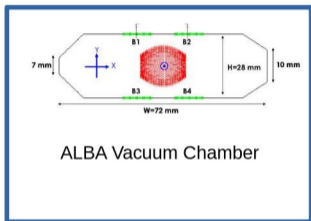
@ALBA II

- Select and miniaturize

Beam Stability better than 100 nm for frequencies higher than 200 Hz

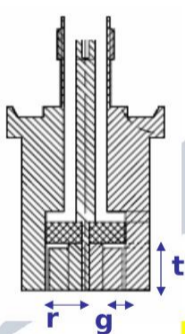


- ▶ 9 or 10 BPMs per Cell
- ▶ 9 BPMs/Correctors used for feedback
- ▶ 1 spare BPM as electromagnetic pickup (Only in compatible cells)



	ALBA	ALBA II
<b>V.C. Shape</b>	Flat	Round
<b>V.C. Dimensions</b>	Height: 28mm Width: 72mm	Diameter: 16mm
<b>V.C. Material</b>	Stainless Steel	Copper
<b>Thickness</b>	3mm	1mm
<b>BPM Radius</b>	3.5mm	2-3mm
<b>Gap</b>	300um	200-300um
<b>Thickness</b>	4mm	2-4mm

ALBA BPMs are already quite compact



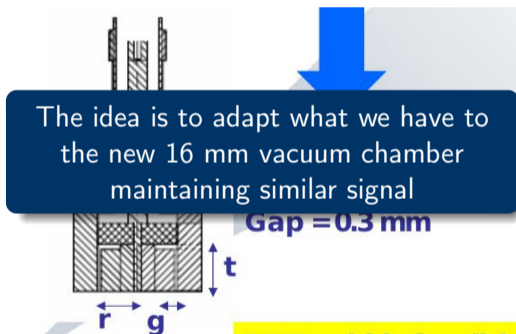
Radius = 3.5 mm  
Thickness = 4 mm  
Gap = 0.3 mm

Cb	2.7 pF
Sx	0.080 mm <sup>-1</sup>
Sy	0.075 mm <sup>-1</sup>
Power Dissipated	0.76 W (per block)
Intrinsic Resolution	0.56 μm (10mA @ 100kHz)

**PMB said is feasible → Prototype needed**

4th MAC meeting 21-22 March 2006

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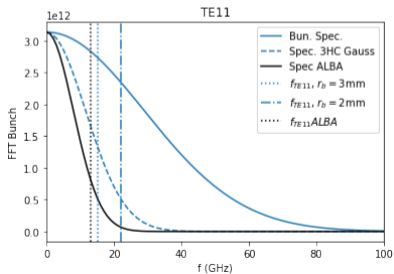
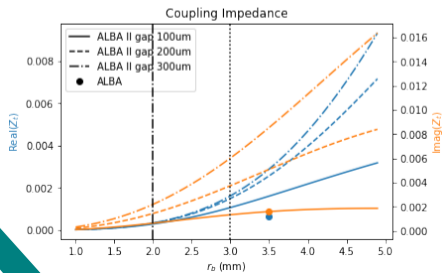
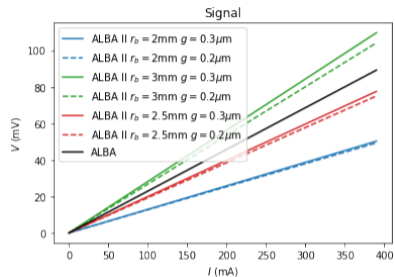
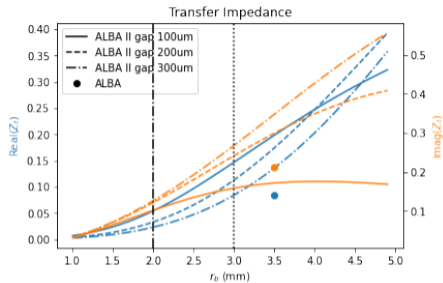
The BPM design was conceived as a **miniaturization** of ALBA Booster BPMs keeping ALBA Storage Ring BPMs characteristics

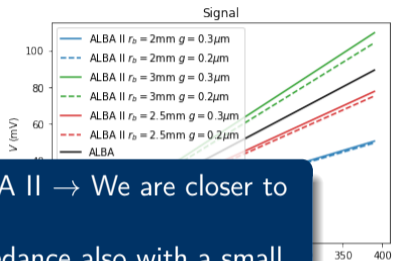
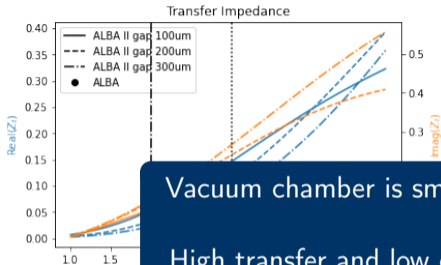
Analytical studies and CST simulation were performed:

- ▶ Maximize transfer impedance
- ▶ Minimize longitudinal coupling impedance
- ▶ TE11 Modes out of the bunch spectrum
- ▶ Optimize resolution

Vacuum chamber is smaller for ALBA II →  
We are closer to the beam  
High transfer and low coupling also with a  
small BPM radius (good for TE11)

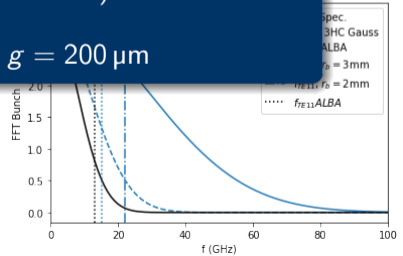
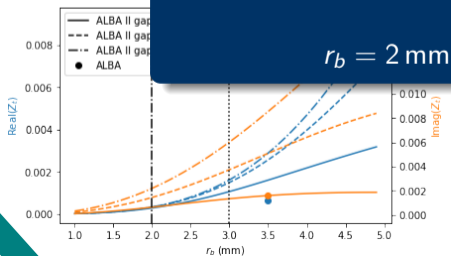
$$r_b = 2 \text{ mm} \quad g = 200 \text{ } \mu\text{m}$$



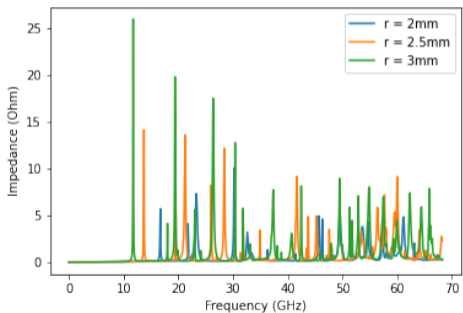


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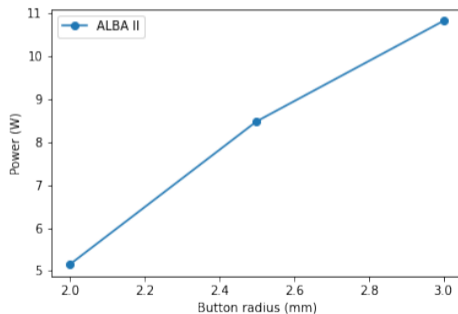
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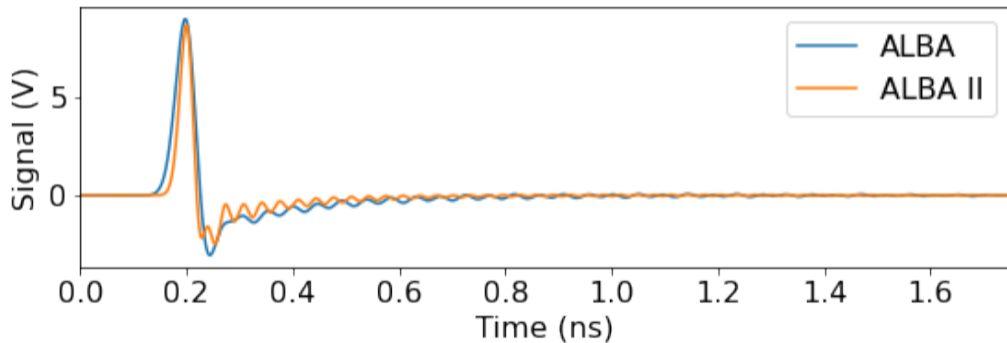


## Longitudinal Impedance



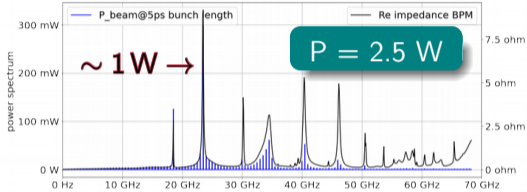
## Dissipated Power (Bun. Len = 5.5 ps)





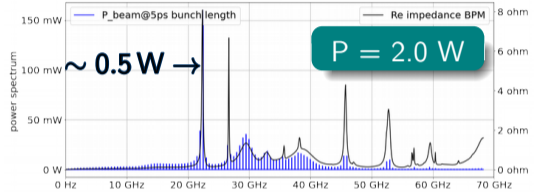
## Alumina

$r = 2\text{mm}$



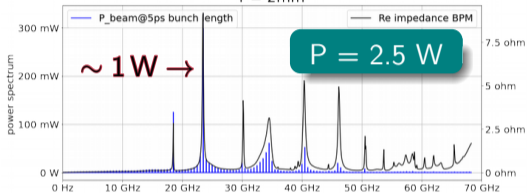
## Borosilicate Glass

$r = 2\text{mm}$



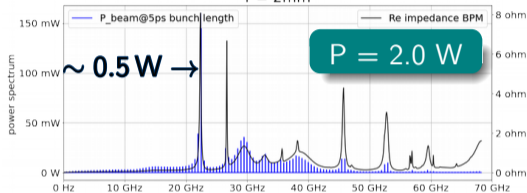
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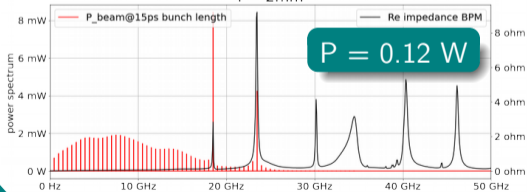


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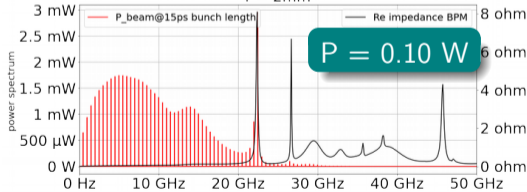
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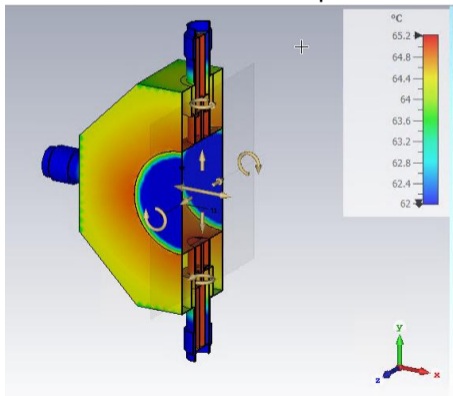


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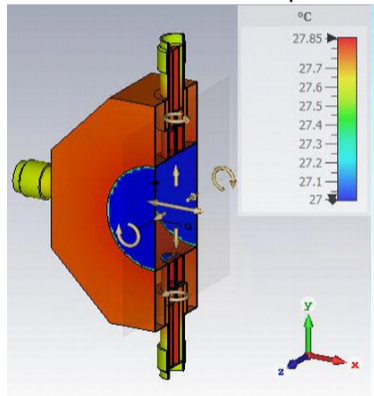


## Borosilicate Glass, $I = 250$ mA

Bunch. Len = 5 ps



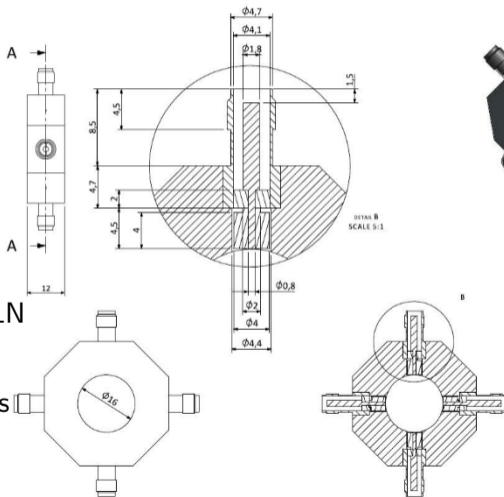
Bunch. Len = 15 ps





## ALBA II BPMs characteristics:

- ▶ Chamber diameter: 16 mm
- ▶ Button diameter: 4 mm
- ▶ Gap: 200  $\mu\text{m}$
- ▶ Insulator diameter: 4.4 mm
- ▶ No "skirt"
- ▶ Block thickness: 12 mm
- ▶ Block Material: Stainless Steel 316LN
- ▶ Button Material: Molybdenum
- ▶ Insulator Material: Borosilicate Glass



5 companies were contacted:

- ▶ Kyocera
- ▶ BC-Tech
- ▶ Solcera
- ▶ Alettra
- ▶ MDC Precision

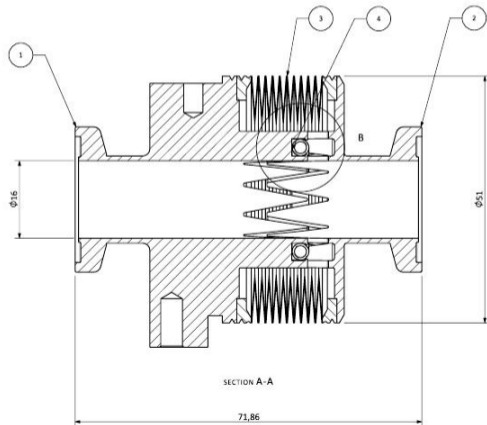
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- ▶ **BC-Tech** ✓ → Different Material
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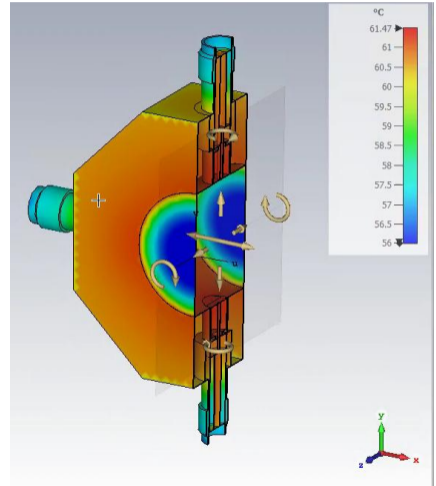
Buttons will be produced by one company and sent to the producer of the vacuum chamber to be welded



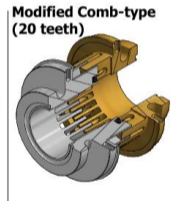
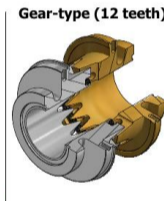
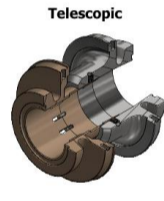
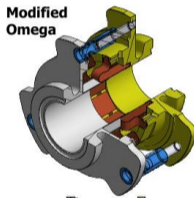
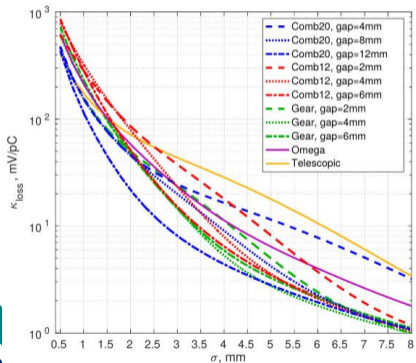
Based on experience with PETRA IV and SLS 2.0  
BC-Tech proposes:

- ▶ Case Material: Stainless Steel 316L
- ▶ Button Material: Hastelloy + gold plating
- ▶ Insulator Material: Borosilicate Glass

Doubt on magnetic  
characteristics of Hastelloy...



A gear type bellow, gap 4 mm has been selected.  
 Only BPMs in the arc will have 1 bellow per side to absorb thermal dilatation



CST and impedance simulations  
 TBD

\*H. O. C. Duarte , IPAC2019, Melbourne, Australia 2019 MOPGW001

We will produce:

- ▶ 2 simple BPMs Block with BPMs and NEG coating
  - ▶ One by BC-Tech the other by Kyocera
- ▶ 1 chamber with bellow without BPMs and no NEG for mechanical tests
- ▶ 1 chamber with bellow with BPMs (2 from Kyocera and 2 from BC-Tech) and NEG coating to be **installed in ALBA** (Summer 2026)

- ▶ First BPM button and chamber design is ready
- ▶ Button radius = 2 mm
- ▶ Gap = 200  $\mu\text{m}$
- ▶ Optimization of material maintaining a simple shape

To be done:

- ▶ Simulation of BPM block + bellow
- ▶ Understand effects of NEG coating
- ▶ Prepare a test-bench for BPM block and buttons testing
- ▶ Understand effect of non-Gaussian beam generated by 3<sup>rd</sup> harmonic RF

Many thanks to:  
O. Traver (BPMs draft)  
M. El Ajjouri (Soleil, CST  
simulations)  
G. Kube (DESY,  
Borosilicate Glass  
discussion)  
Diagnostics Community