Crystals Gaps and Cracks

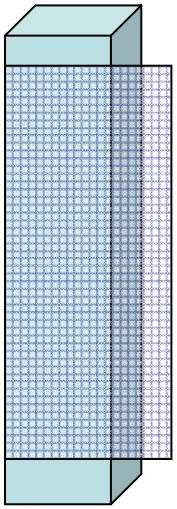
SuperB Endcap Modular units

PRELIMINARY

Corrado Gargiulo
INFN Roma1

MODULE

Carbon Fiber Reinforced Plastic

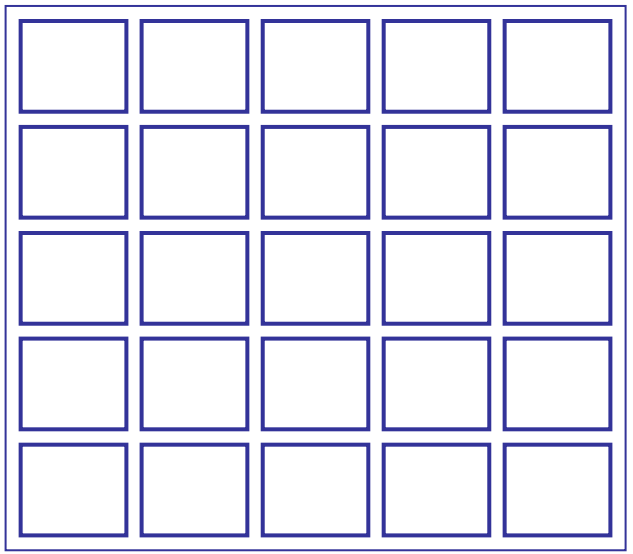


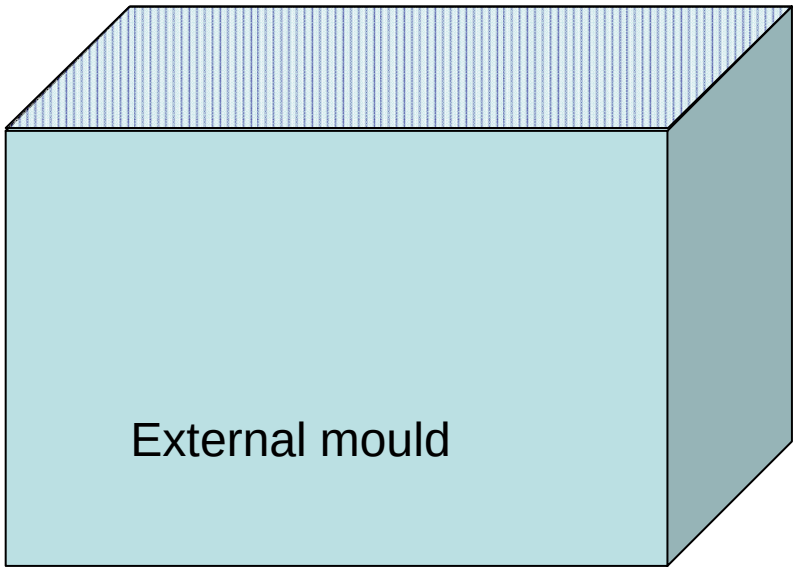
Internal mould

2 layers CFRP pre-preg

~0.2mm

Over wrapped on a
precise male mould



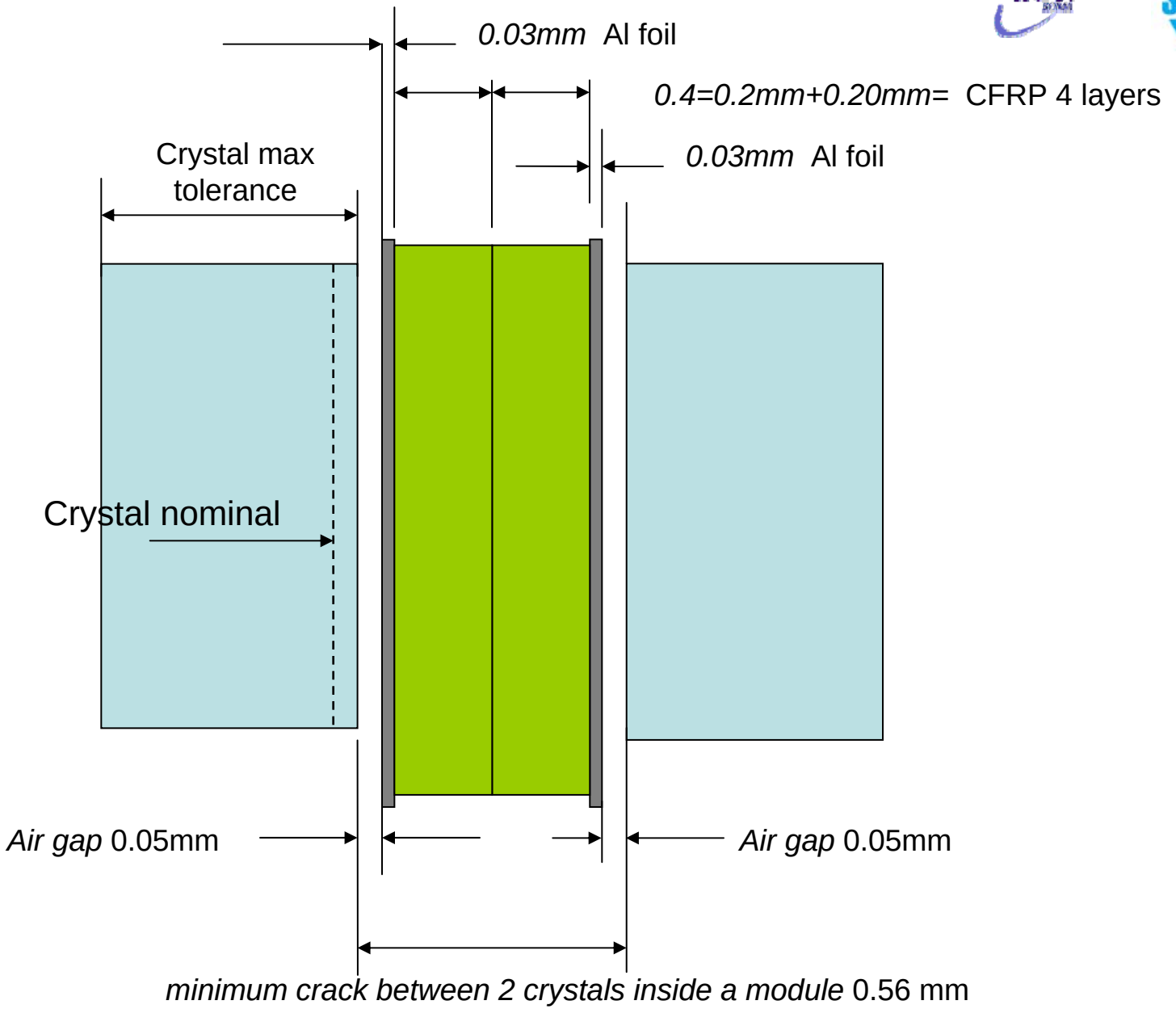


1 layers pre-preg

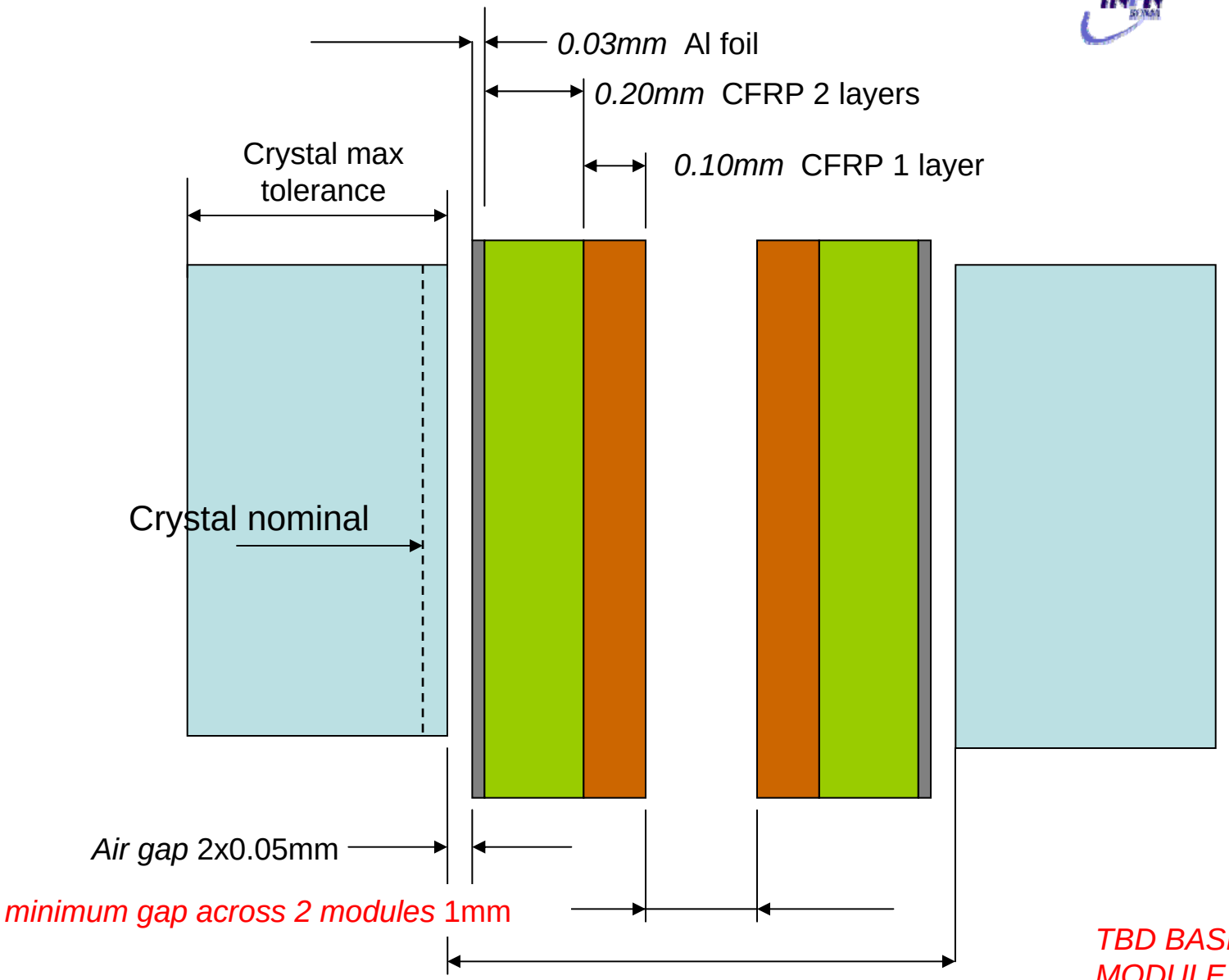
~0.1mm

1 Layer inside a
precise female mould

CRACK &GAP INSIDE A MODULE

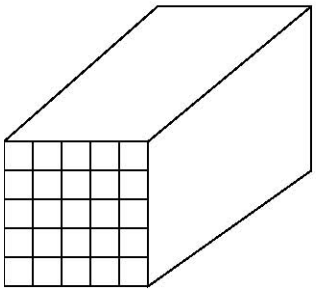


CRACK &GAP ACROSS TWO MODULES

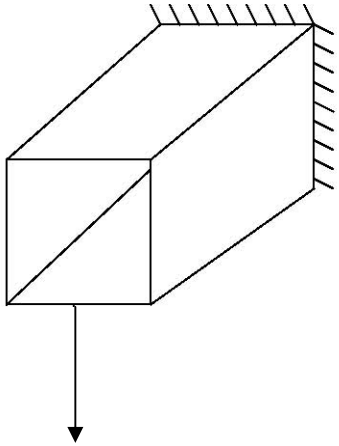


TBD BASED ON MODULE FIXATION DESIGN

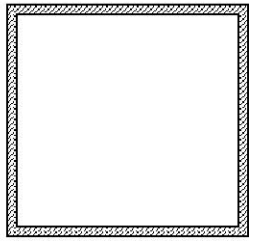
PRELIMINARY HAND CALCULATION



alveolar



crystals weight



Equivalent alveolar

Assumption:
-all alveolar internal walls collapsed in the outer walls
-alveolar loaded with the crystal weight at the free end

Crystal weight 3.4 kg, CRYSTAL OVERALL DIMENSIONS (50x50x300) mm^3

The outer skins are 0.3mm and the inner skins 0.4mm, so the total is 2×0.3 + 4×0.4 = 2.2mm, giving a wall thickness in the equivalent box of 1.1mm.

Normal σ and Shear stress τ

$$\sigma = \frac{M\,y}{I} \qquad \sigma = \frac{250\times.125}{1.13E-5} = 2.8\ \text{MPa} \qquad \tau = \frac{F}{A} = \frac{3.4\times25\times9.81}{0.25\times0.0022} = 1.5\ \text{MPa}$$

Low numbers compared to typical CFRP strength

where

$$M = F\times l \qquad M = 3.4\times25\times9.81\times0.3 = 250\ \text{Nm} \qquad I = \frac{(bd^3)_{outer} - (bd^3)_{inner}}{12} = \frac{.25^4 - .2478^4}{12} = (3.90625 - 3.77055)\times10^{-3}/12 = 1.13\times10^{-5}\,\text{m}^4$$

The only purpose of this hand calculation is to give an estimate of the order of magnitude of the expected overall stresses. The real stress concentration will be at the connection of the alveolar with the stiff back plate by which it will be supported. This local effect will be larger then what predicted and will be evaluated by finite element analysis according to final geometries and materials choice