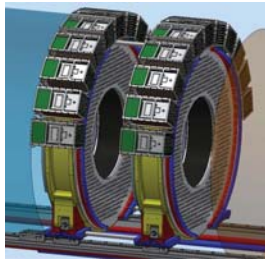


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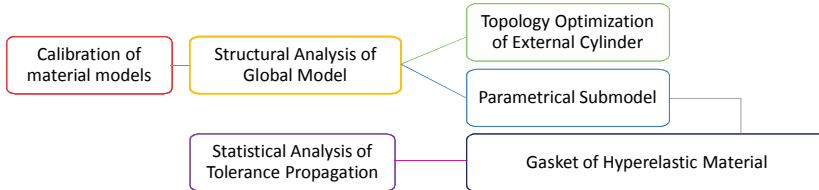
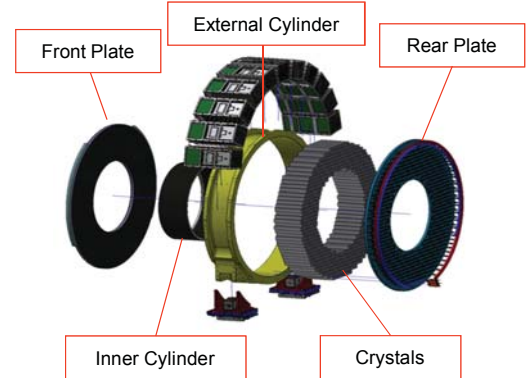
Introduction



The **calorimeter** is part of the **MU2E particle detector** that will be used at FermiLab in Chicago to observe **muon-to-electron conversion** and to clarify how particles created at the beginning of the universe broke down into stable lighter particles.

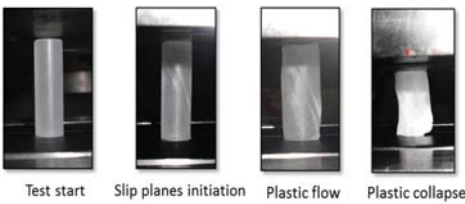
Targets

- ❖ Optimizing the **structural performance**;
- ❖ Developing a more realistic FEM model with particular attention to the inorganic scintillator **crystals**;
- ❖ Studying the **assembly** of the crystals to avoid interferences;
- ❖ Ensuring the perfect coupling between the crystals and the external structure.



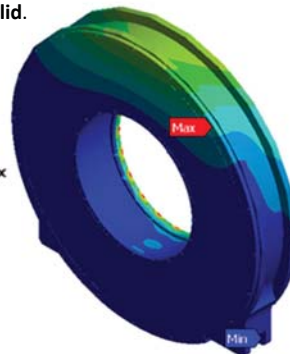
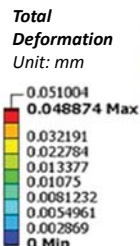
Crystals Material Model

Experimental results of **uniaxial compression tests** on the barium fluoride crystal has been used to calibrate the material model.



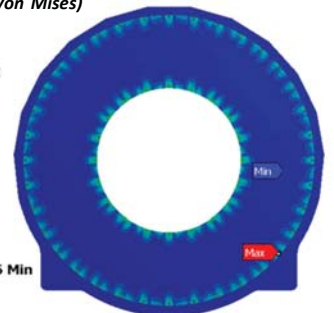
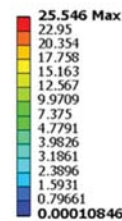
From the Global Model to Submodel

Because of the apparatus complexity, the global model has some simplifications like the simulation of all the crystals as a **single cylindrical solid**.



Equivalent (Von Mises) Stress

Unit: MPa



Shape Optimization of the External Cylinder

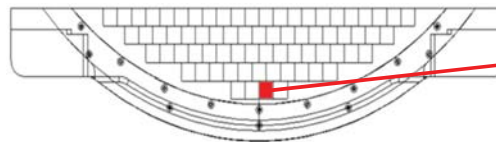


Simplified starting geometry

Topology optimization result with 30% mass reduction

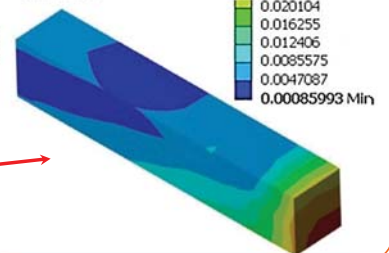
Final shape

The **parametrical sub-model** of the inferior part of the structure allows to change easily crystals dimensions and to optimize the layout.

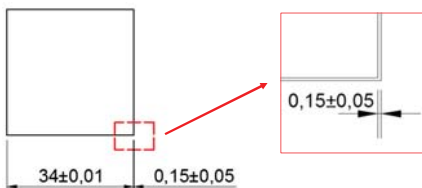


Equivalent (Von Mises) Stress

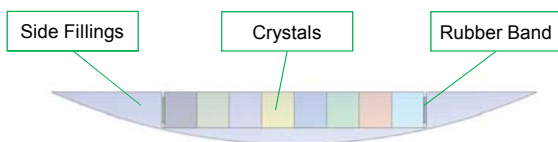
Unit: MPa



Tolerance Propagation and Assembly Methodology



The rubber band can be extended during the positioning of the crystals and released at the end of the process without damaging them.

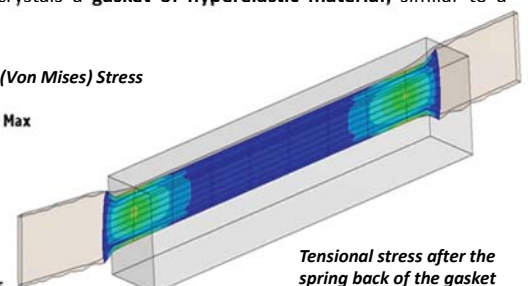
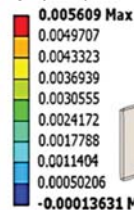


Every crystal is wrapped into a thin layer of PTEF. Propagation of deviations were evaluated for every row of crystals in order to calculate the **maximum space occupied by crystals** and, consequently, to design an aluminum side filling at the end of each row.

To fill the gap between side fillings and crystals a **gasket of hyperelastic material**, similar to a rubber band, has been considered.

Equivalent (Von Mises) Stress

Unit: MPa



Tensional stress after the spring back of the gasket