# Magnetic Shield Materials

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Permeability measurement

•At room temperature, liquid nitrogen and helium

temperatures

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- •Effects of strain

•Summary

## Ambient field:



Earth's magnetic field

•ls not uniform in the tunnel.

•Is not the only source of ambient field in the tunnel.

The STF tunnel, for example.

## Ambient field:



#### Ambient field: not uniform, changes directions, signs...



#### Ambient field: the earth magnetic field is not the only source.



## Ambient field:

For cERL

Make sure that the ambient magnetic field is not too large. The magnetization of the vacuum vessel is not an issue, since it is not iron.



Permeability measurement: the catalog data are the champion data!



cryogenic temperatures) is measured.

100

CF gives the highest  $\mu_{max}$ . AU and CF are made of the same high-Ni alloy. AU & BU are prepared by one manufacturer while CF is by another.

H(A/m)

10

Х

X

0.1

 $10^{4}$ 





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## Effects of mechanical strain



The degree of strain is evaluated by parameter  $\varepsilon$ , defined as  $\varepsilon = \Delta t/2R$ , where  $\Delta t$ and R are the thickness of the sample and the radius of the curvature of the template blocks, respectively. Permeability of two types of materials P and R measured at the room temperature.





By using the permeability data obtained from samples AU and CF, calculations were carried out for the magnetic shield designed for the cERL superconducting accelerating cavities.
On the basis of the calculations and studies described here, CF was chosen.
As for the shape, square was chosen mainly due to the alignment requirement.
We will try to avoid adding any mechanical strain when assembling the shield.
And of course attention will be paid to the process of heat treatment for each part.
Further detailed design work for the magnetic shield of the cERL is underway.
Survey of the ambient magnetic field in the cERL tunnel is recommended!

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(1)Permeability measurements of various materials

•Permeability of sample rings ("AU","BU" and "CF") made of high Ni-content alloys is measured.

•Sample type "CF" gives the highest permeability at LHe temperature, though "AU" and "CF" are made of the same 100 high-Ni alloy.

Do not assume that you always get the catalog performance.

(2)Effetcs of the heat-treatmentCooling rate is important.

(3)Effects of mechanical strainSignificant decrease in permeability due to deformation is observed.