

Cold compressors: challenges and perspectives

- : State of the art of the technology early 90'es

CC for Fermi Lab.



Rotor shaft

Journal bearing



Thrust bearing



Dynamic gas bearing

Specification

	Nominal
Flow-rate [g/s]	60
Suction pressure [kPa]	51
Discharge pressure [kPa]	142
Suction temperature [K]	3.56
Impeller diameter	33 mm
Motor	Induction motor 1.4 kW / 80,000rpm
Bearing	Foil-type dynamic gas bearing



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CC for CEBAF, 1993-1998

(Air Liquide)



240 g/s from 0.029 b to 1.157 b

Cold compressors: challenges and perspectives

- : Challenges for the LHC

Design strategy

- High efficiency

- High reliability

- Easy to handling
& maintenance

Challenges

- High performance 3D impeller
& Low heat inleaks.

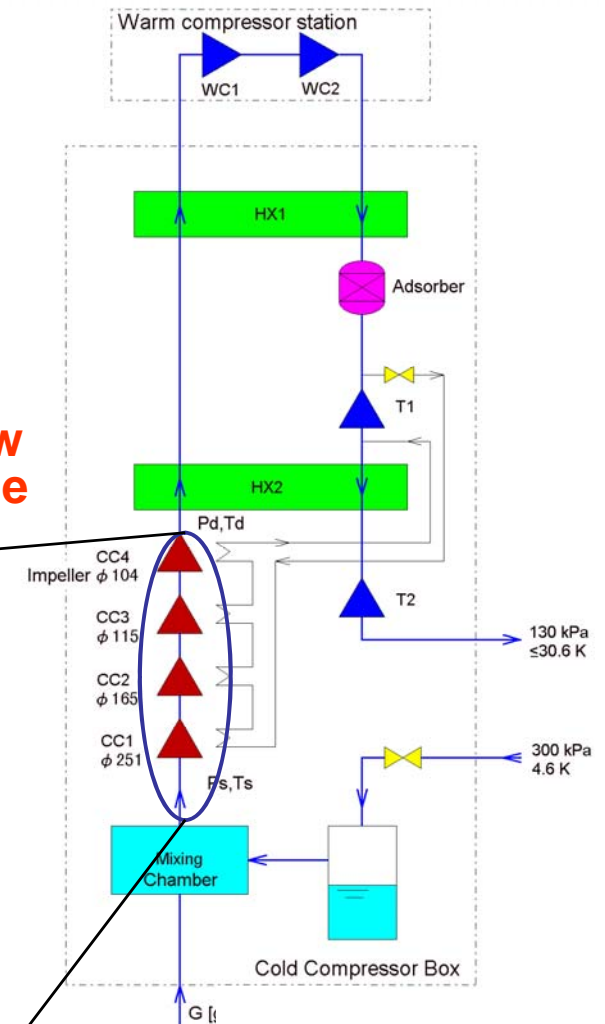
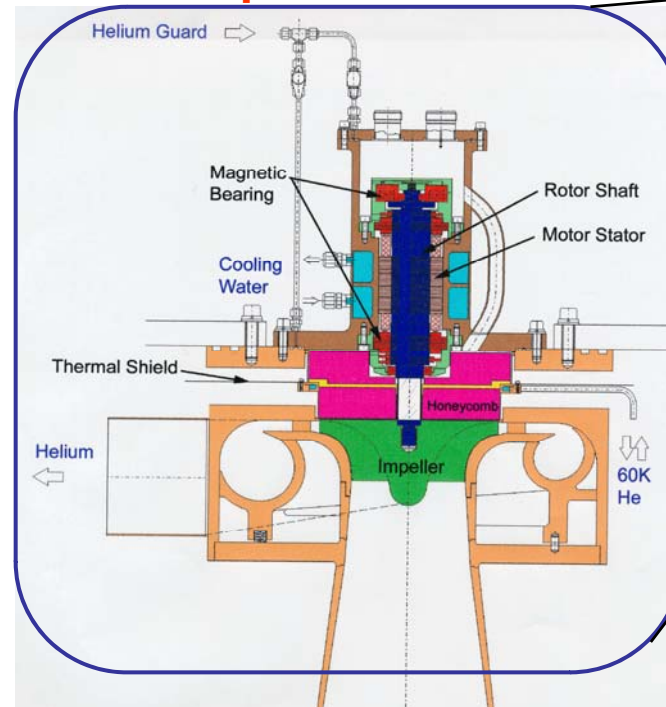
- Oil-free machine
Adoption of magnetic bearing

- Cartridge type

Problems: it is indispensable to achieve a low heat inleaks structure more than before for the design of the cold compressor.



CC cartridge



Mode	Instal	Low intensity	
Ps kPa	1.40	1.46	1.47
Ts K	3.96	3.95	4.20
Pd kPa	62.2	42.2	33.2
Td K	27.35	21.83	20.77
G g/s	125.7	84.69	63.89

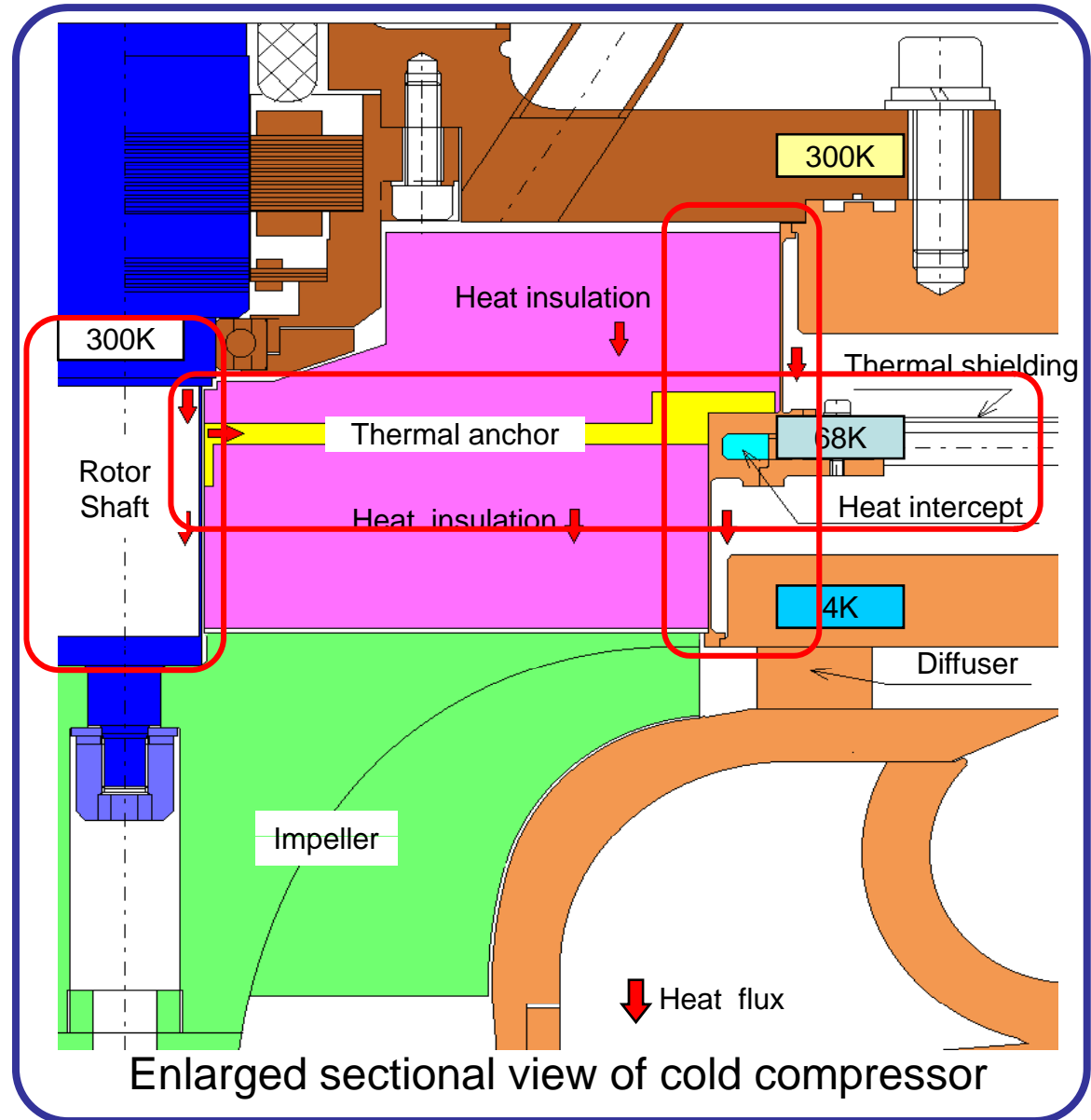
1.8K refrigeration unit

Cold compressors: challenges and perspectives

- : Solutions proposed

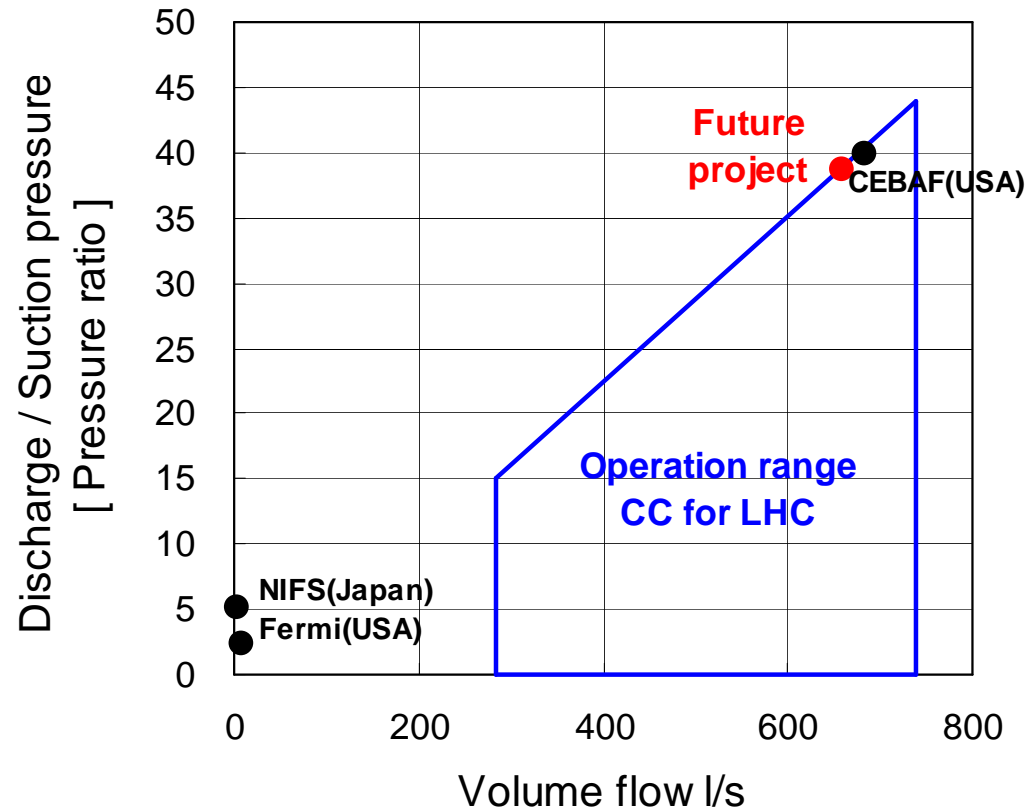
Low heat inleaks structure:

- Adoption of the heat intercept with thermal anchor.
- Adoption of thin tube casing and rotor shaft.



Cold compressors: challenges and perspectives

- : Limits and perspectives



-The LHC project is challenging specification in comparison with the previous project

-ILC project will be able to design because useful of this LHC project experience

-Some development might be needed depending on operation requirement.