6 T CABLE-IN-CONDUIT DIPOLES TO DOUBLE THE ENERGY OF THE JLEIC ION RING

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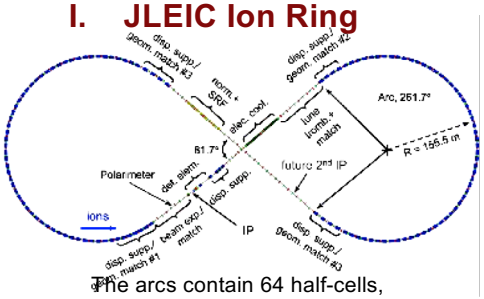
Abstract: *The proposed electron-ion collider JLEIC would make high-luminosity collisions of polarized ions and polarized electrons with electron energy up to 12 GeV and ion energy up to 40 GeV/u. Both the luminosity and the collision energy could be increased by doubling the dipole field in the ion ring from 3 T to 6 T, and the enhanced performance would access the full range of parameters for the physics objectives of the project.*

A large-aperture 6 T dipole is being developed for this purpose. It utilizes a 2-layer CIC winding to produce homogeneous field in a 10cm x 6cm aperture over the operating field range from 0.5 T to 6 T.

I. JLEIC Ion Ring



The arcs contain 64 half-cells,
Each half-cell contains two 4 m long dipoles.
100 GeV ion energy ⇒ 3 T dipole field.
200 GeV ion energy ⇒ 6 T dipole field.

II. Cable-in-Conduit technology

CIC for 6 T dipole:

23 kA 2--layer CIC
15+21 wires NbTi/Cu 1.2 mm dia.
perforated 316LN center tube
0.7 mm CuNi sheath tube
6 cm bend radius

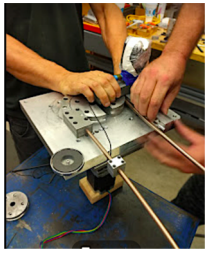
Long-length fabrication of CIC

1. Perforated center tube (SCHe flow).
2. Cable wires onto center tube, SS tape over-wrap. Repeat step 2 for layer 2.
3. Pull cable through sheath tube as loose fit.
5. Draw sheath tube onto cable to compress wires against center tube.
6. Finished 140 m segment of 13 kA CIC for one JLEIC dipole.

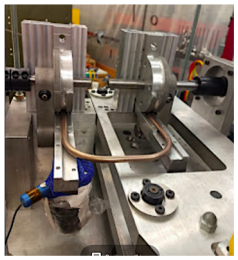
ATC manufactures 140 m lengths of CIC – product for sale!

II. CIC Coil Technology

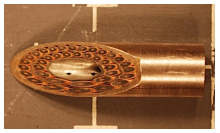
Robotic bend tools form the flared ends:

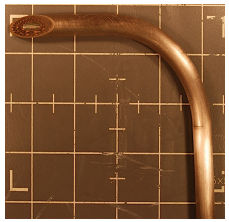


180° U-bend

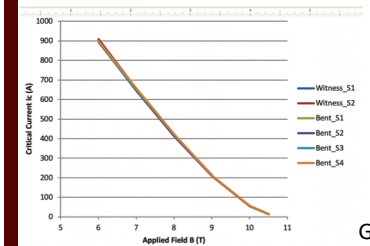


90° flare of U-bend

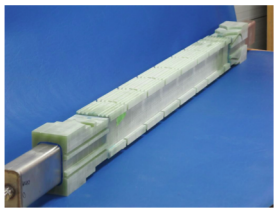




Samples of 2-layer CIC were formed into U-bends and into several dipole winding turns.

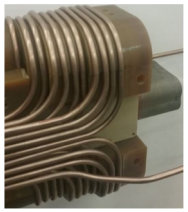


Measure I_C of extracted strands from CIC in flared ends of winding: ***no degradation***.



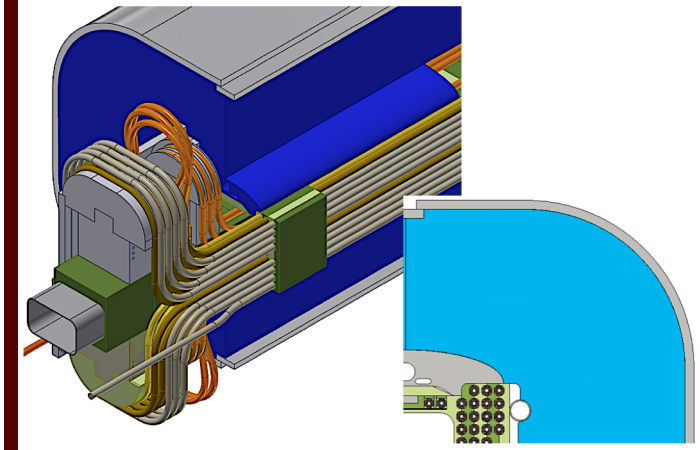
G-11 Structural beam with machined channels for CIC turns

CMM measurements of CIC locations in 3-layer dipole winding confirm that x/y ***precision is consistent with collider field homogeneity.***



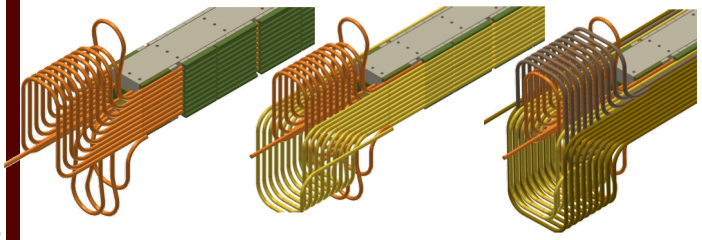
Completed 24-turn CIC winding

III. 6 T Superferric CIC dipole



6 T operating field, 10x6 cm^2 aperture
b_n < 1 unit for all multipoles over field range 0.1-6 T.
37 turns, 23 kA coil current

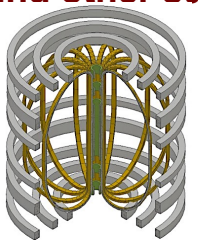
Winding the coil for the 6 T dipole



Layer 1 Layer 2 Layer 3

V. CIC using other superconductors

Nb_3Sn, Bi-2212:



MgB_2: