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Mon-Af-Or6-01 [Invited]: SuperCIC: enhancing winding current density for high-field windings of tokamaks

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The design for a new approach to cable-in-conduit (SuperCIC) for use in the high-field windings of tokamaks. Two layers of high-field superconductor wires are cabled onto a thin-wall perforated center tube. An overwrap is applied and the cable is inserted as a loose fit into a sheath tube. The sheath tube is drawn down onto the cable to compress the wires onto the center tube and immobilize them. The SuperCIC is then co-wound with a high-strength armor extrusion, which is kerf-cut so that the co-winding onto a coil mandrel can be made without deformation within the armor or the CIC. Windings can be layer-wound so that the wires used in the SuperCIC for each successive layer are appropriate to the magnetic field seen by that layer (NbTi, Nb₃Sn, Bi-2212). Demountable splices interconnect layers and can be configured as a split-shell toroid that accommodates assembly onto an intact plasma chamber. Optimized simulations show that a tokamak with field at plasma of 12 T could be made with winding current density ~ 150 A/mm², sufficient for optimizing the fusion power density in a compact spherical tokamak.

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