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M3Or4A-05 [Invited]: Update on Aircraft Electric Propulsion and Impact of Superconducting and Cryogenic Technology

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The aerospace industry is the last transportation industry to implement hybrid-electric technology for propulsion. Nearly exponential growth is occurring recently for electric aircraft propulsion, with reportedly more than 300 startup companies worldwide formed in the last 2-3 years, and supported by Airbus, Boeing, Embraer, Rolls Royce, Uber, Google, Intel, and others. A 6-9 passenger aircraft being developed by Eviation will fly 650 miles, which exceeds the range of more than 50% of 4.5 Billion flights worldwide. Electric propulsion is understood to enable new capabilities and advantages, such as reduction of energy use and operation costs 6-10x or more, alternate and lighter structural designs, and development of new industries such transport between regional/inter-city hubs by vertical-take-off-lift (VTOL). Electric propulsion will be especially important to countries or remote localities with limited access to carbon-based fuels, and where other transport methods such as auto or sea can be painfully slow and expensive.

This paper will summarize recent progress in this field, and present how superconducting/cryogenic is the only demonstrated technology available to overcome fundamental limitations of 'conventional' technologies from high heat loss and weight. The aerospace industry is especially sensitive to size-weight-and-power-loss (SWaP), and the development of cryogenic electric-power drivetrains is expected to provide significant advantages and system-level benefits. Electric drivetrain components to be reviewed include generators and motors, power transmission cables, power storage devices including Li-batteries and superconducting magnetic energy storage (SMES), power electronics including inverters, and critical supporting technologies. Properties of cryogenic systems and components will be compared to 'conventional' technology, and the effect of different cooling options may be considered.

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