National Aeronautics and
Space Administration

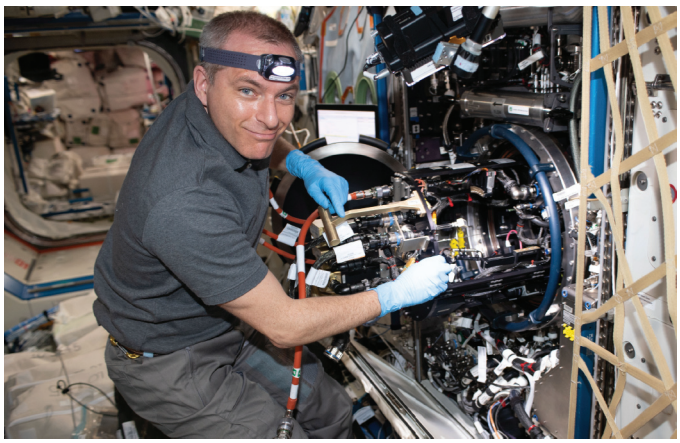
NASA GLENN RESEARCH CENTER

Advanced Combustion via Microgravity Experiments (ACME)

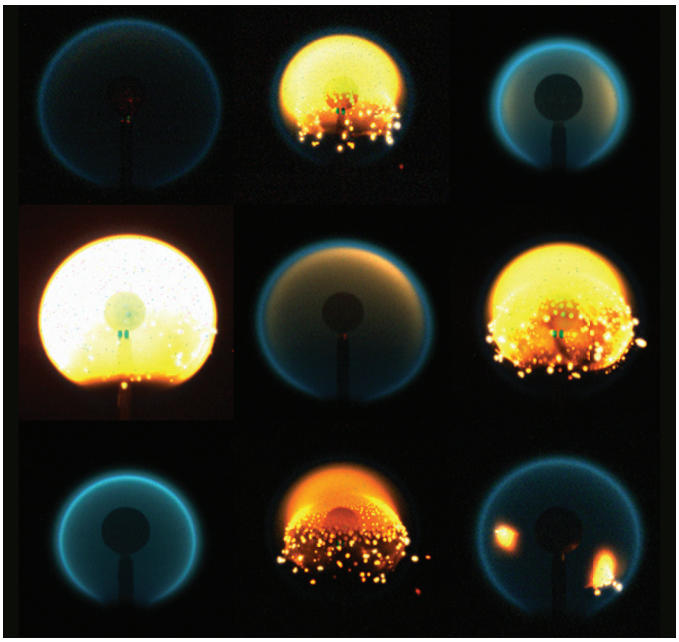
PURPOSE: ACME is focused on advanced combustion technology via fundamental microgravity research. The primary goal is to improve efficiency and reduce pollutant emission in practical terrestrial combustion. A secondary objective is fire prevention, especially for spacecraft.

U.S. astronaut Christina Koch preparing the ACME chamber insert for the Flame Design experiment.

RESEARCH: ACME includes six independent experiments investigating laminar and nonpremixed flames of gaseous fuels. The experiments are being conducted with a single set of modular hardware in the Combustion Integrated Rack (CIR) on the International Space Station (ISS). While the ISS astronauts set up the experimental hardware, the ACME tests are remotely commanded from the NASA Glenn Research Center.



Canadian astronaut David Saint-Jacques replacing the igniter tip on the ACME chamber insert.



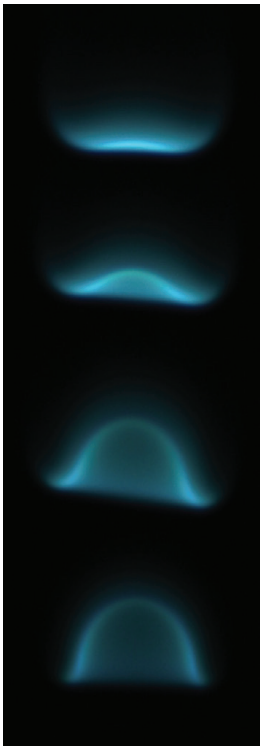
Example images from ACME's Flame Design experiment.

STATUS: ACME was set up by the ISS crew in September and October 2017 where thus far 21 astronauts from Canada, Germany, Italy, Japan, Russia, and the United States have supported the project's research. Over 800 flames have been ignited since November 2017 for five of the six ACME experiments. On-orbit testing has yet to begin for the CFIG experiment. In contrast, the planned testing for the E–FIELD Flames investigation has been completed. Testing is currently underway for the s–Flame experiment. ACME tests are expected to continue on the ISS through most, if not all, of 2020.

U.S. astronaut Joe Acaba and Russian cosmonaut Alexander Misurkin exchanging a CIR oxidizer bottle.

EXPERIMENTS:

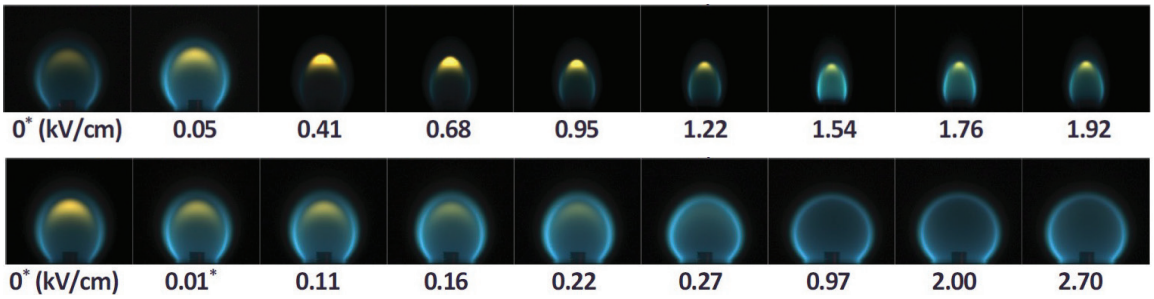
Burning Rate Emulator (BRE) is led by Prof. Jim Quintiere (University of Maryland), where collaborating researchers are from Russia's Peter the Great St. Petersburg Polytechnic University. A dramatic image of a flame shortly after ignition can be seen to the right, after which the nominally hemispherical flame became non-sooty.



Cool Flames Investigation with Gases (CFIG) is led by Prof. Peter Sunderland (University of Maryland), where the collaborators are from Washington University in St. Louis and the University of California San Diego.

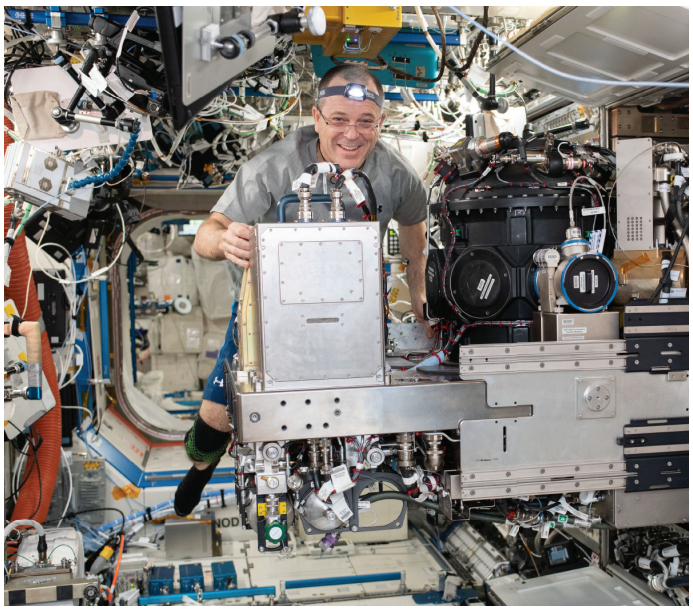
Coflow Laminar Diffusion (CLD) Flame is led by Prof. Marshall Long (Yale University), where the Russian collaborators are from the Far Eastern Federal University. Example images of a flame detached and lifted from the coflow burner can be seen on the left.

Electric-Field Effects on Laminar Diffusion (E-FIELD) Flames is led by Prof. Derek Dunn-Rankin (University of California Irvine), where the Russian collaborators are from the Far Eastern Federal University. Example flame images from a test with ACME's coflow burner can be seen below as a function of the electric field strength, where the copper electrode mesh above the burner is negatively and positively charged in the top and bottom rows, respectively.



Flame Design is led by Prof. Rich Axelbaum (Washington University in St. Louis), where there are collaborators from the University of Maryland and the N.N. Semenov Institute of Chemical Physics of the Russian Academy of Sciences. Example flame images can be seen on the other side of this information sheet.

Structure and Response of Spherical Diffusion Flames (s-Flame) is led by Profs. C.K. Law (Princeton University) and Stephen Tse (Rutgers University), where the Russian collaborators are from the P.N. Lebedev Physical Institute of the Russian Academy of Sciences.



U.S. astronaut Ricky Arnold conducting CIR maintenance tasks.

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