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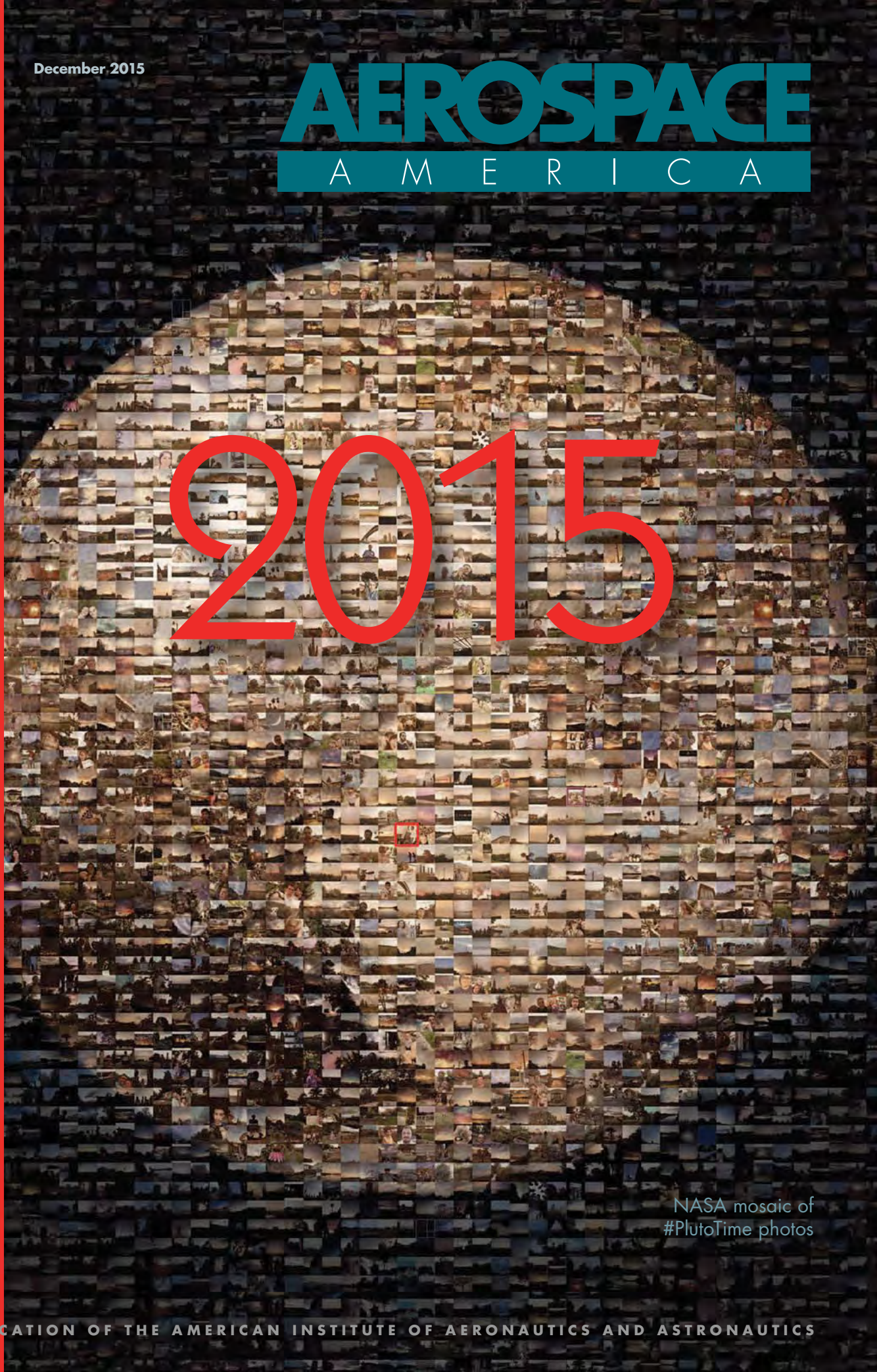

NASA mosaic of #PlutoTime photos

A PUBLICATION OF THE AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

Artist's concept of the spaceplane being designed for DARPA by Northrop Grumman, with help from its Scaled Composites company and Virgin Galactic.

Northrop Grumman

SpaceX reaffirms commitment to reusability

by Adam Dissel and Barry Hellman

*The **Reusable Launch Vehicles Program Committee** brings together experts to focus on leading-edge programs and developments in this area.*

Interest in reusable launch systems and spacecraft continues to sustain multiple commercial and governmental development efforts, many of which are scheduled to achieve significant milestones in the coming year.

DARPA has been actively working the **Experimental Spaceplane** (XS-1) program with the main objective to mature aircraft-like operations for a launch vehicle with a reusable first stage. There are three prime contractors working the program: Boeing, Masten Space Systems and Northrop Grumman. The program has completed a year-long preliminary design phase, and DARPA has decided to continue to mature the designs for another year before moving into the critical design, build and fly phases.

The launch vehicles are designed to put at least 3,000 pounds of payload into low-Earth orbit and support hypersonic testing. The program's flight testing will include flying the first stage 10 times over 10 consecutive days, launching at least a 900-pound payload into LEO.

Reaction Engines of Oxfordshire, U.K., continues to make progress on developing the pre-cooling heat exchanger and other components of the Synergetic Air Breathing Rocket Engine (SABRE). This engine has the potential to enable a horizontal takeoff hypersonic access to space launch system. Reaction Engines has been collaborating with the U.S. Air Force Research Laboratory and the U.K. Defence Science and Technology Laboratory to explore applications of the pre-cooler heat exchanger. SABRE was expected to be awarded 60 million pounds ($92 million) from the British government to move to the next phase of development. In October, Reaction Engines announced a 20 million pound ($30 million) investment from BAE Systems.

SpaceX has reaffirmed its commitment to reusability as an essential element of the company's vision for the future of spacelift. Following several attempts to recover its Falcon 9 first stage, SpaceX officials expect a successful recovery within the next year on the company's downrange drone ship. The Falcon Heavy configuration is planned to fly in 2016 and will eventually feature the ability to recover and reuse all three first stage cores.

Swiss Space Systems continues to make progress on the **Soar three-stage launch system**. Activities completed include wind tunnel testing in Europe, improved aerodynamics through coupled analysis and test, thermal protection optimization and analog software simulations on replica hardware. Soar development is expected to progress toward major program milestones in the coming year.

XCOR, based in Mojave, California, continues to make progress on its **Lynx suborbital spaceplane** and has completed a significant portion of the vehicle build. The Lynx Mark 1 is scheduled to begin flight testing in 2016.

Generation Orbit of Atlanta is proceeding with the development of the GO Launcher 1 suborbital vehicle that is air launched from a business-jet-class aircraft. The company has completed several captive flight tests with representative hardware and is planning to reach system preliminary design review in 2016. The **GO Launcher 1** is intended as a flight test platform and is capable of achieving a wide variety of test conditions.

Virgin Galactic concluded the investigation of the October 2014 flight test accident of the suborbital SpaceShipTwo and implemented changes to correct the premature activation of the vehicle's wing feather system. Construction on the next SpaceShipTwo airframe is advancing rapidly. Additionally, Virgin Galactic is continuing development of the LauncherOne small spacelift system.

In February, the European Space Agency flew the Intermediate eXperimental Vehicle. The IXV features a lifting-body design and a ceramic matrix composite thermal protection system. Launched by the Vega rocket into LEO, the IXV successfully demonstrated atmospheric entry from orbital velocity and descended under chutes to an ocean splashdown. The configuration and material technologies demonstrated are relevant to future reusable systems and ESA plans future IXV flights that will be recovered on land.