Evolution of Busek's Colloid Thruster From SBIR to Flight

FY 98 | FY 01 | FY 04 | FY 07 | FY 10 | FY 13 | FY 16

SBIR

GRC SBIR Phase 1 NAS3-99014 12/98-6/99 $69.9K **TRL 3**

Neutralizer:
DOD SBIR Phase 2, F04611-98-C-0017 **TRL 3**
NASA SBIR Phase 2, NAS3-99166 **TRL 4**

GRC SBIR Phase 2 NAS3-00017, LEW-17511 11/99-10/01 $599K "Colloid Thrusters for Micro and Nano-Satellites" ***TRL 4***

AFRL SBIR Phase 2 (F04611-01-C-0048) 7/01-7/05 $750K "Micro Newton Thrust Stand". **TRL 4** enables direct validation of ST7 thruster technology

JPL SBIR Phase 1 (NNX08CD10P) 1/08-7/08 $70K "Colloid Thruster for Attitude Control Systems and Tip-off Control Appls.**TRL 3**

JPL SBIR Phase 2 - 12/08-12/10 "Colloid Thruster for Attitude Control Systems and Tip-off Control Appls. **TRL 4**

SPINOFF ACTIVITIES (as a result of SBIR awards)
- Worcester Polytechnic Institute – Diagnostics
- Yale work – Propellant technology
- MIT Collaborations – MEMS fabrication
- DOD – Higher thrust activities
- DARPA – Advanced studies

Space Act Agreements, Awards, Collaborations & Follow-On Activities

Feasibility study done by GSFC/JPL on colloid thruster work 8/99

(Subcontract 1222538), "New Millennium Program, Micro-Newton Thrusters

10/01-11/01 SBIR GRC Phase 2 hardware delivered to JPL for further testing

3/02 JPL announced Busek's colloid propulsion system chosen to fly on mission as part of the Disturbance Reduction System flight test

TRL 5

Early 08 milestone – 2 colloid thruster clusters passed their formal review and HRCR and delivered to JPL

Candidate for 2008-13 New Start Micro-Arcsecond X-Ray Imaging Mission (MAXIM) Pathfinder X-Ray Interferometer

MAXIM Mission >2014

2009-2012 Improvements for a more robust thruster system for LISA lifetime - $800K per year

2018 LISA Mission

Jun/Jul 09 expected delivery of thruster clusters to ESA

2010 New Millennium Space Technology 7's (ST7) Disturbance Reduction System (DRS) will fly onboard the European Space Agency's (ESA)/NASA Laser Interferometer Space Antenna (LISA) Pathfinder Mission - $18.8M plus $1.1M from JPL – Partnership with GSFC on software **TRL 6**

After Pathfinder launch **TRL 7**