



Разработка холловских двигателей в США и Западной Европе

BHT-200

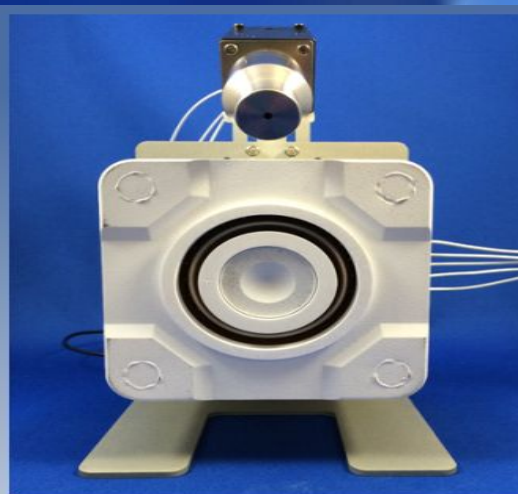


BHT-200 Hall Effect Thruster

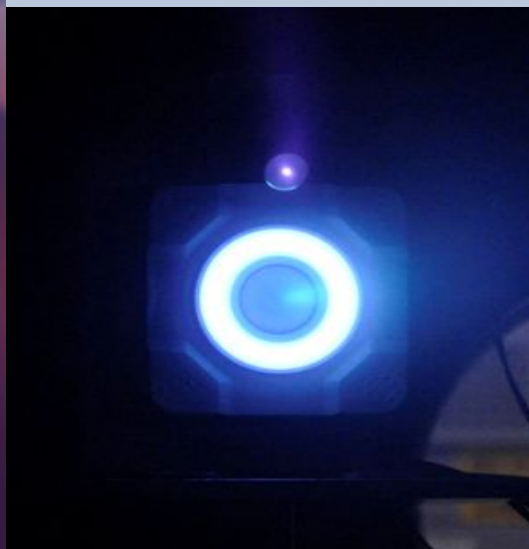
BHT-200 System Technical Specifications

Nominal Discharge Power	200W
Nominal Voltage	250 VDC
Thrust	13 mN
Specific Impulse	1,375 seconds
Propellant	xenon, iodine, krypton
Cathode	BHC-1500
Cathode Location	External
Thruster Mass	1 kg
Cathode Mass	0.2 kg

BHT-600



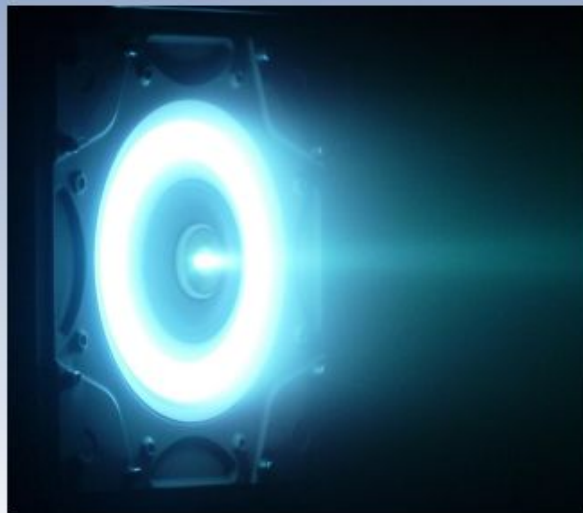
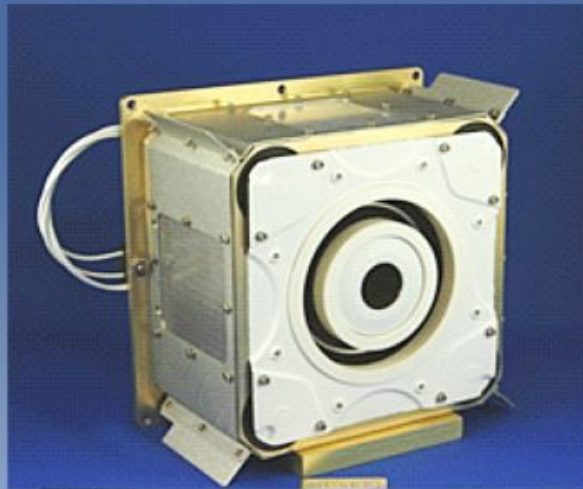
BHT-600 Hall Effect Thruster



BHT-600 System Technical Specifications

Throttle Range	200W - 800W
Nominal Discharge Power	600W
Thrust	39 mN
Specific Impulse	1,500 seconds
Propellant	xenon, iodine, krypton
Cathode	BHC-1500
Cathode Location	External
Thruster Mass	2.6 kg

BHT-1500



BHT-1500 Hall Effect Thruster

BHT-1500 System Technical Specifications

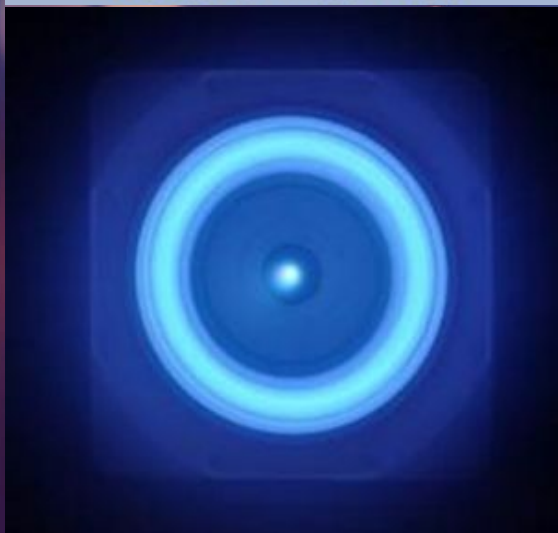
Propellant	xenon, iodine, krypton
Cathode	BHC-2500
Cathode Location	Internal Center Mounted
Thruster Mass	6.8 kg
Cathode Mass	0.3 kg

Power (W)	High Thrust Mode		High I_{sp} Mode	
	Thrust (mN)	Total I_{sp} (s)	Thrust (mN)	Total I_{sp} (s)
1,000	68	1,615	58	1,860
1,500	101	1,710	87	1,895
1,800	120	1,740	103	1,940
2,000	134	1,700	118	1,915
2,400	158	1,735	143	2,045
2,700	179	1,865	154	2,035

BHT-8000



BHT-8000 Hall Effect Thruster



BHT-8000 System Technical Specifications

Throttle Range	4kW - 10kW	
Nominal Discharge Power	8kW	
Nominal Voltage	400V	800V
Thrust	449mN	325mN
Specific Impulse	2,210 s	3,060 s
Propellant	xenon, iodine, krypton	
Cathode	BHC-5000	
Cathode Location	Internal Center Mounted	
Thruster Mass	25 kg	
Cathode Mass	0.4 kg	

Катоды-компенсаторы



Cathode Designation	BHC-1500	BHC-2500	BHC-5000	BHC-10000
Emitter Tube Diameter	3.2 mm	6.4 mm	12.7 mm	25.4 mm
Emission Current	0 - 3 A	0 - 25 A	0 - 70 A	0 - 200 A
Emitter Type	Barium (6:1:2) impregnated porous tungsten emitter			
Notes	Igniter included Lab and Flight electronics available			



BHC-10000

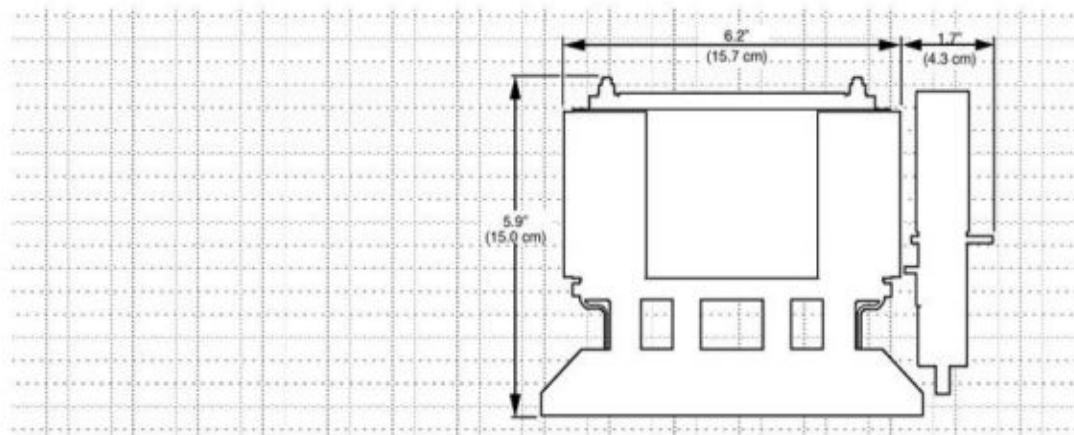
Current: 120 A

Discharge Voltage: 19.5V

Flow Rate: 33 sccm (Xenon)

BPT-2000

BPT-2000 Hall Effect Thruster



Design Characteristics

- Propellant Xenon
- Mass (Thruster & Cathode) <5.2 kg
- Envelope Dimensions 15 x 17 x 22 cm
- Nominal Input Power 2200 Watt
- Operational Power Range 1200 – 2700 Watt
- Nominal Voltage 350 Volt
- Operational Voltage Range 250 – 400 Volt

Status

- Flight Prototype Unit Fabricated and Tested

Performance at 2.2 kW

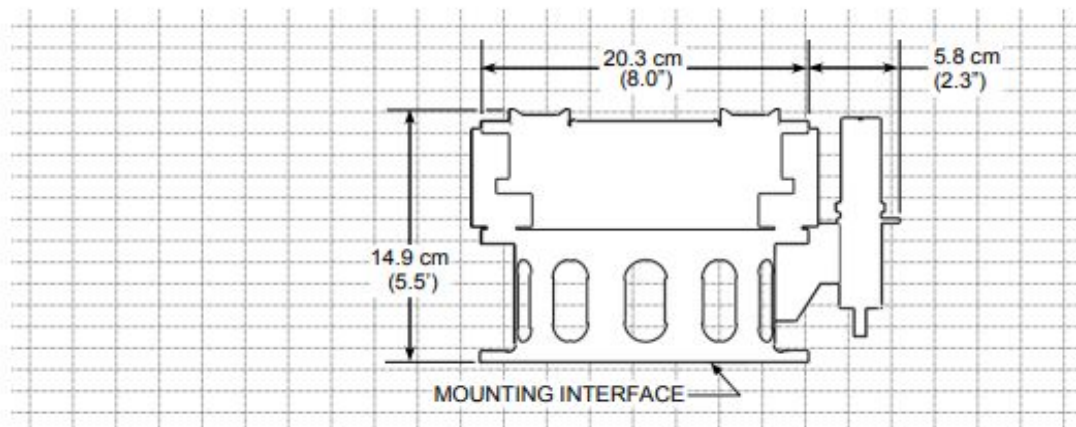
- Thrust 123 mN
- Specific Impulse* 1765 sec
- Efficiency* 48%
- Life (Continuous)** >6000 hr
- Total Impulse >2.6 x 10⁶ N-sec
- Nominal Flowrate 7.1 mg/sec
- On/Off Cycles 6000 cycles

* Corrected for facility pressure effects

** Based on accel life tests and analysis

BPT-4000

DUAL MODE BPT-4000 HALL THRUSTER



Design Characteristics

- Propellant Xenon
- Mass (Thruster & Cathode) <12.3 kg
- Envelope 14 x 25 x 28 cm
- Input Power 1000 to 4500 Watt
- Input Voltage 200 or 400 Volt

Status (as of Feb. 2006)

- Qualification Complete
- >6,700 hours Demonstrated, Additional Life Testing Planned
- >6,300 Cycles Demonstrated, Additional Life Testing Planned

Performance

	2.0 kW	3.0 kW	4.5 kW
■ Thrust (300 Volts).....	132 mN	195 mN	290 mN
■ Thrust(400 Volts).....	117 mN	170 mN	254 mN
■ Specific Impulse (300 V)	1676 sec	1700 sec	1790 sec
■ Specific Impulse (400 V)	1858 sec	1920 sec	2020 sec
■ Life Capability	>10,000 hr		
■ Total Impulse	>5.5 x 10 ⁶ N-sec		
■ On/Off Cycles	6,700 Cycles		

Reference

- AIAA-2005-3682

HT100, HT400, HT5k



HT100

Power: 100-350 W

Thrust: 6-18 mN

Efficiency: 40%

Mass: < 450 g

Isp: 1000-1600 s

Permanent magnets



HT400

Power: 200-1000 W

Thrust: 20-50 mN

Efficiency: 50%

Mass: < 900 g

Isp: up to 1850 s

Permanent magnets



HT5k

Power: 2,5-7,5 kW

Thrust: 150-350 mN

Efficiency: > 55%

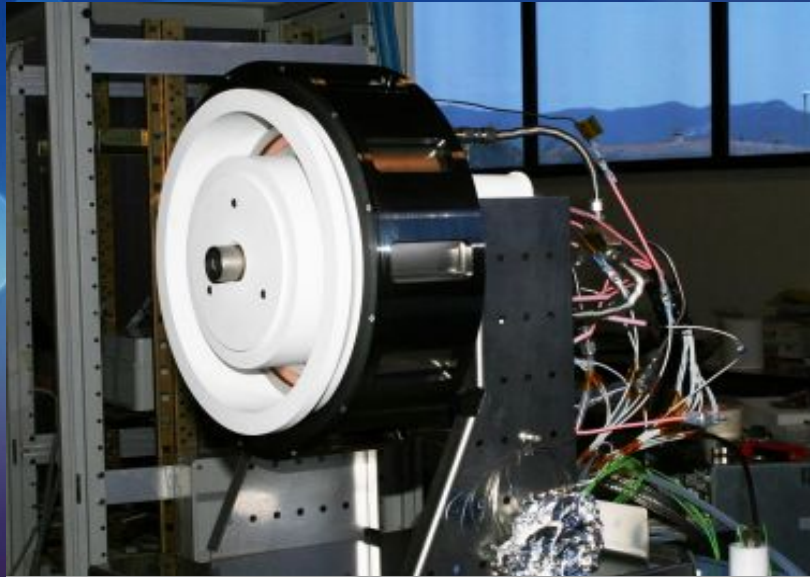
Mass: 12200 g

Isp: 1700-2800 s

Coils



HT20k

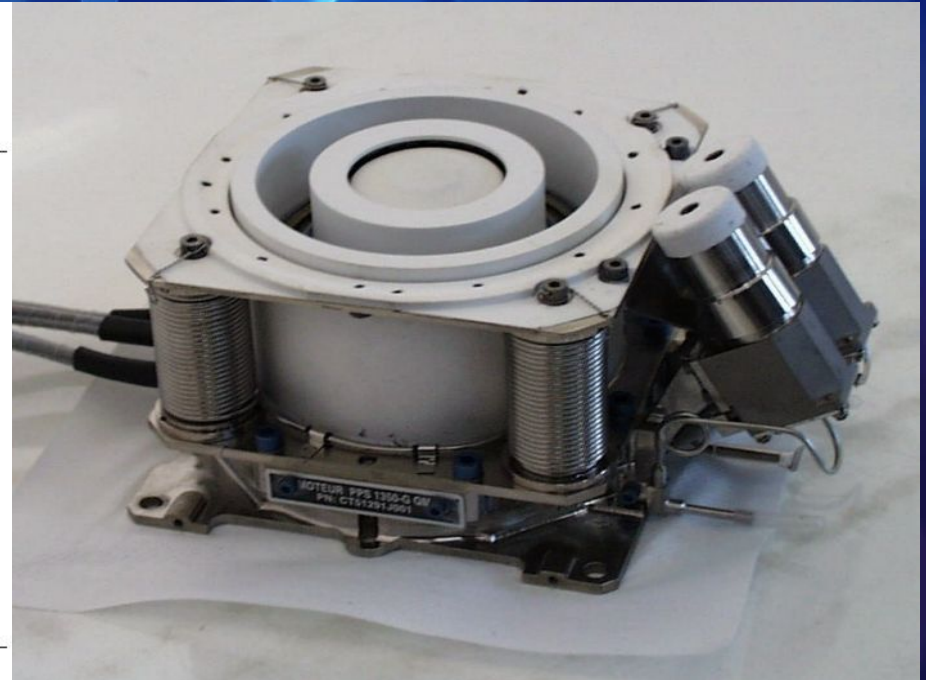
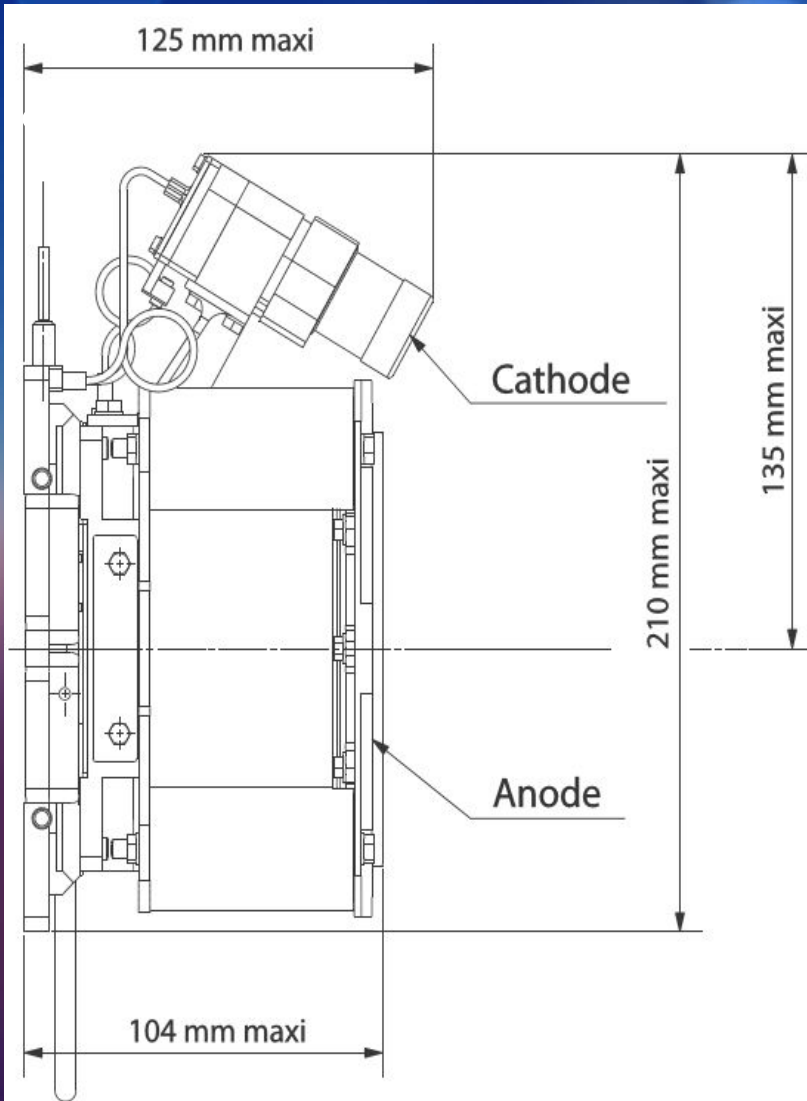


Thruster operating parameters and performance

Voltage [V]	300-1000
Power [kW]	10-20
Efficiency	Up to 72%
Thrust [mN]	300-1100
Specific Impulse [s]	2000-3800



PPS-1350



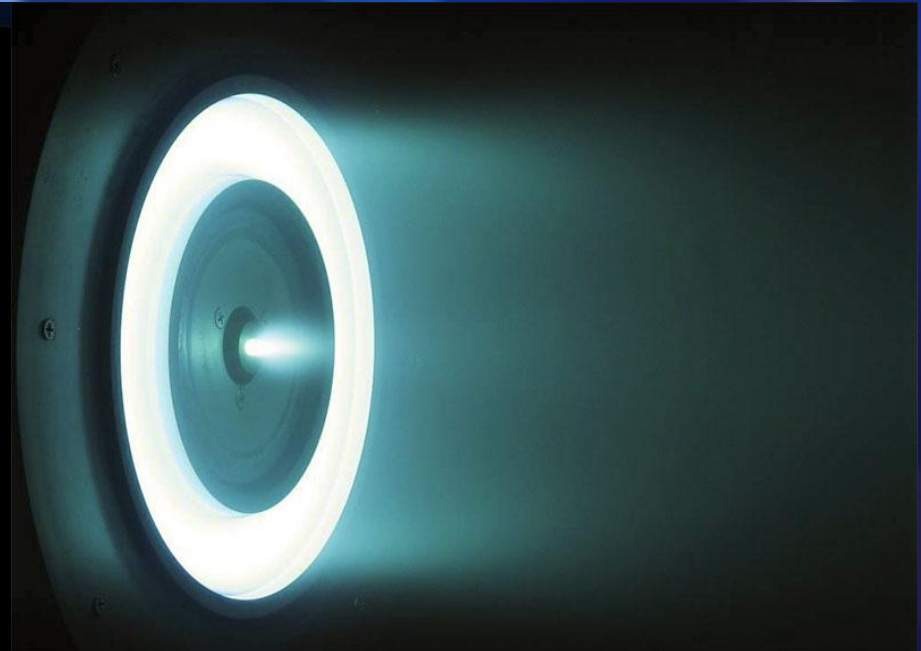
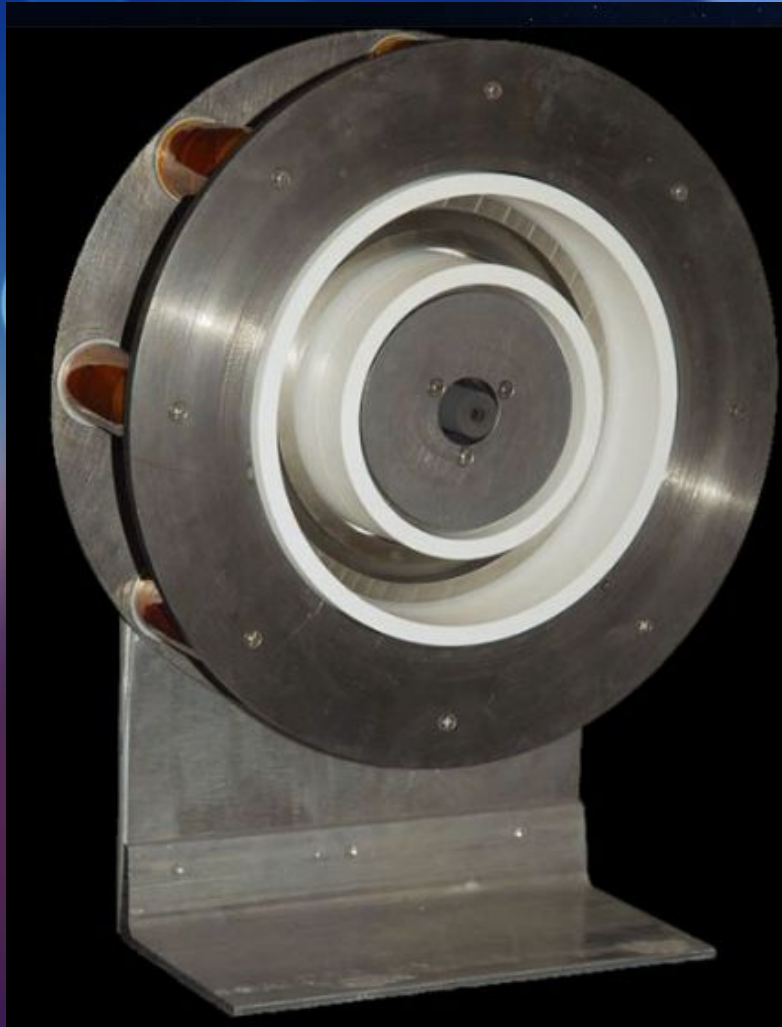
Power (nominal) (W)	1,500
Thrust (mN)	90
Specific impulse (s)	1,660
Total impulse delivered (N.s)	$3.4 \cdot 10^6$
Number of cycles	7,300
Discharge current (A)	4.28
Efficiency (%)	55
Supply voltage (V)	350
Xenon supply pressure (bar)	2.50 – 2.80
Mass (including 2 Xe flow control systems) (kg)	5.30

PPS-5000



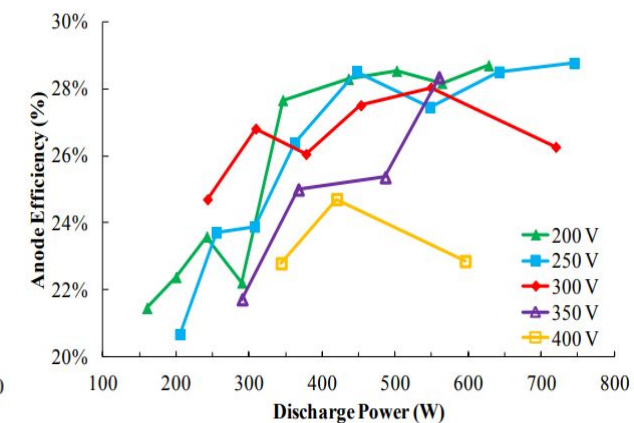
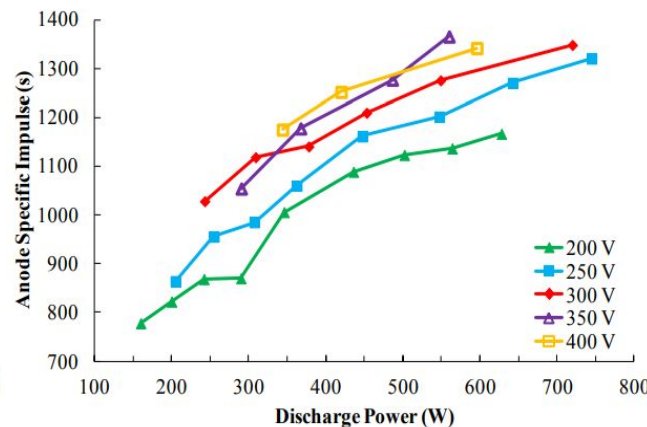
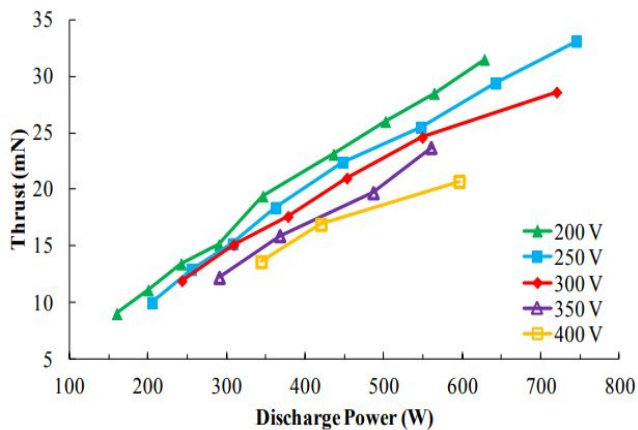
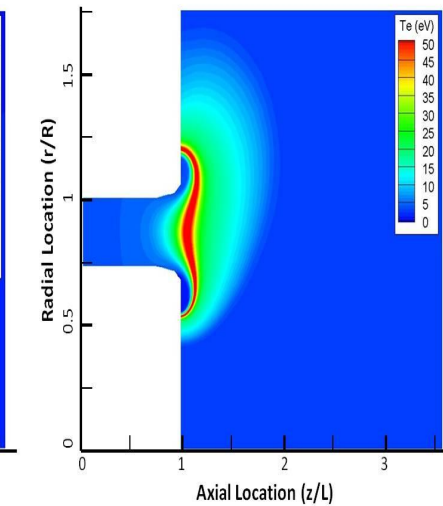
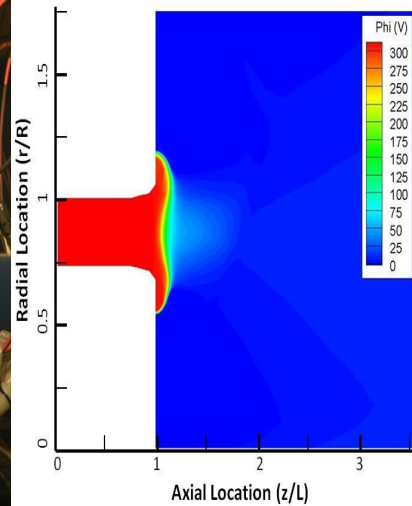
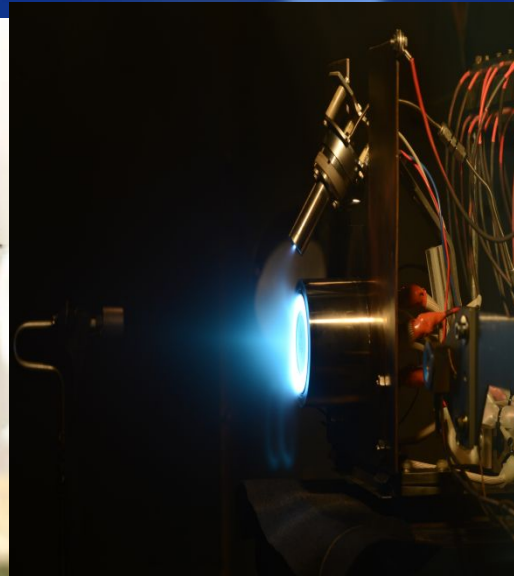
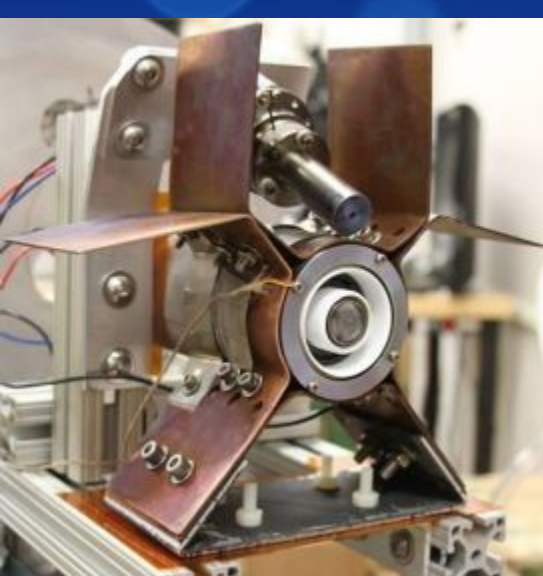
Thruster	Country	Power	Thrust	Specific impulse	Efficiency
PPS-5000	France	5 kW	135 mN	2300 s	50%

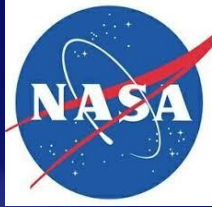
H6



Thruster parameter	Value
Thrust (mN)	401
Discharge (or anode current) (A)	20
Discharge voltage (V)	300
Anode mass flow rate (mg/s)	20.98
Cathode mass flow rate (mg/s)	1.47
Specific Impulse	1950

MaSMI-60





HIVHAC



Characteristic	HIVHAC
Input Power, kW	0.3-3.9
Specific Impulse, sec	860-2700
Thrust, mN	20-207
Efficiency	0.32-0.62
Propellant Throughput, kg	>300
Operating Voltage, V	200-700

NASA-173



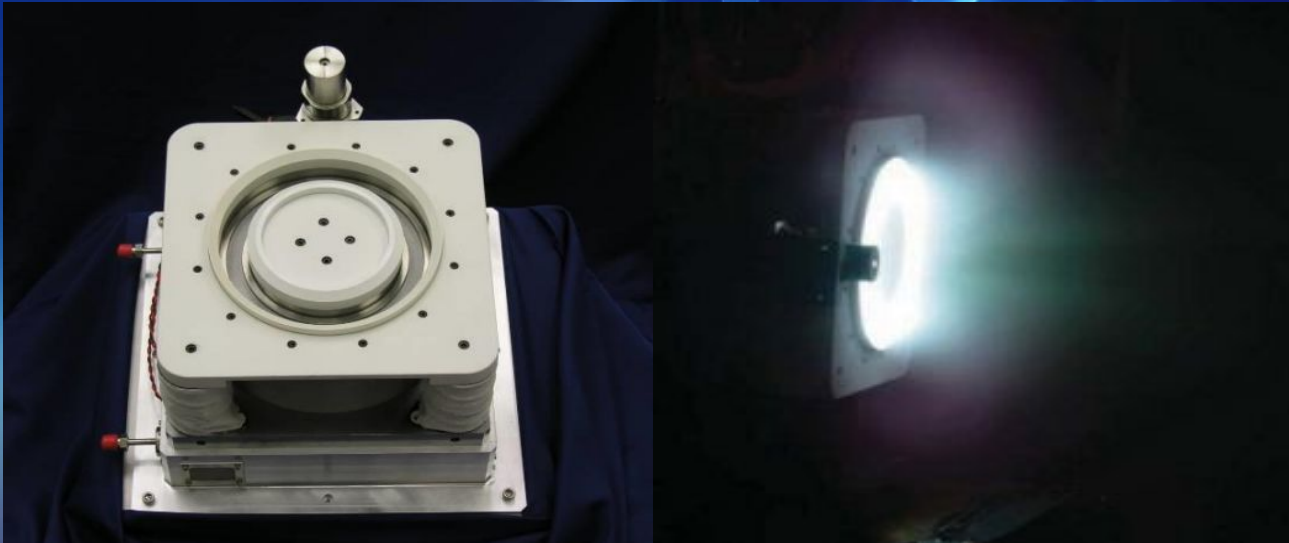
NASA-173MV2

- **NASA-173MV2 HALL THRUSTER**
 - MAGNETIC CIRCUIT OPTIMIZED FOR HIGH-ISP
 - DESIGNED FOR XENON
- **XENON CONDITIONS**
 - 800 V, 9.84 A
 - 10 MG/S ANODE, 1 MG/S CATHODE
 - THRUST 324 mN
 - ANODE ISP 3310 s (TOTAL ISP = 3000 s)
 - ANODE EFFICIENCY 66.7% (TOTAL EFFICIENCY = 59.6%)
- **KRYPTON CONDITIONS**
 - 800 V, 8.27 A
 - 6.4 MG/S ANODE, 0.64 MG/S CATHODE
 - THRUST 215 mN
 - ANODE ISP 3410 s (TOTAL ISP = 3100 s)
 - ANODE EFFICIENCY 54.7% (TOTAL EFFICIENCY = 48.8%)



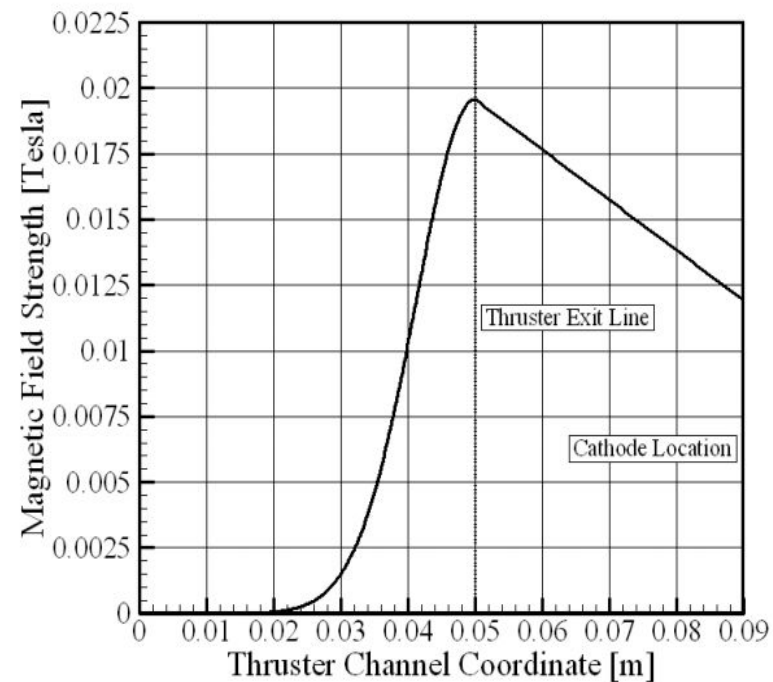
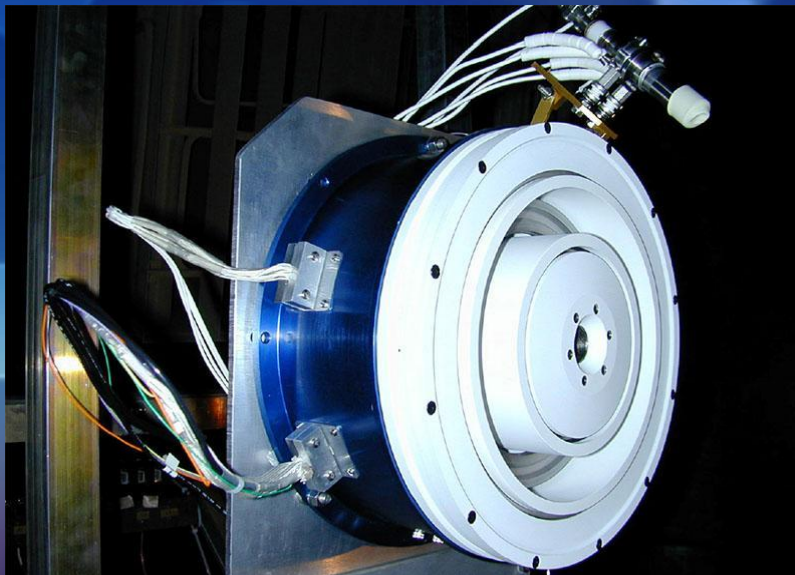
	Voltage [V]	Discharge Power [kW]	Thrust [N]	Anodic Efficiency	Anodic Specific Impulse [s]	Outer Diameter [mm]
NASA 300M	200-600	10-20	Up to 1.13	0.57-0.73	1709-3154	300
NASA 400M	200-600	4-47	0.27-2.1	0.46-0.72	1741-3245	400
NASA 457M	300-650	9-72	0.37-2.9	0.46-0.65	1741-3245	457

XR-12



Discharge Power (kW)	Anode Flow Rate (mg/s)	Cathode Flow Rate (mg/s)	Discharge Current (A)	Discharge Voltage (V)	Thrust (mN)	Specific Impulse (s)
4.5	11.5	0.80	11.2	399	257	2129
4.6	11.5	0.80	11.3	410	260	2157
4.5	11.0	0.80	10.8	418	251	2167
4.5	10.7	0.80	10.5	428	246	2181
4.5	10.0	0.70	10.1	445	232	2208
11.9	36.5	3.70	39.6	301	785	1992
11.9	37.0	3.70	39.6	301	796	1994
11.8	36.0	3.60	42.1	280	777	2002
11.6	36.0	3.60	41.3	281	773	1990
11.9	37.5	3.80	42.5	280	807	1994
11.9	38.0	3.80	43.9	270	804	1962
12.1	38.5	3.90	44.8	270	815	1961

T-220



Parameters	Experimental Results Thrust Error = ± 1 %	Numerical Results
T [mN]	<u>512</u>	<u>507</u>
$I_{sp,tot}$ [sec]	<u>2356</u>	<u>2348</u>
η_{tot} [%]	<u>57</u>	<u>56</u>
I_d [A]	<u>20</u>	<u>20</u>
P_{tot} [kW]	<u>10.39</u>	<u>10.46</u>

Спасибо за просмотр!
(надеюсь вы еще не уснули)