

Head Talk Series
An Overview of
Department of Space Engineering and Rocketry
(Program: Aerospace Engineering)



Birla Institute of Technology Mesra, Ranchi
August 03rd, 2022

The Department Welcomes

Members of the BIT Community

Contents

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 - Many Firsts...
 - Vision and Mission
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Background

A Perspective

- **Established in 1964...**
 - Initially offered post-graduate diploma
 - Two-year post-graduate degree program started in 1968
- **Degree: M.Tech in Aerospace Engineering**
 - **Specializations:** Aerodynamics and Rocket Propulsion

Department is supported by FIST and UGC-SAP

Many Firsts..

- First academic department in the country to flight test solid propellant rockets of different calibre
- **1969:** First institution to test solid-gas and solid-liquid hybrid engines in the country
- **1974:** Developed and flight tested rockets for weather modification and cloud seeding

Our Vision

- To effectively integrate teaching, research and innovation for significant contribution towards national aerospace programs and related activities

Our Mission

- To impart quality education and advanced research training leading to postgraduate and doctoral degree
- To generate modern infrastructure and conducive research atmosphere for carrying out innovative sponsored research projects
- To nurture spirit of excellence and professional leadership in students and faculty members through exposure to leading academic/research organizations and external experts
- To create attractive opportunities for sustained interaction and collaboration with academia and industry

Departmental Information

Courses We Offer

- **Both programs are structured according to CBCS**
 - **First semester:** Common to both programs
 - Courses specific to program are offered in subsequent semesters
- **Upcoming modifications**
 - **Updated course structure:** curriculum, new courses
 - **Changes as per AICTE norms:**
 - MTech in Aerospace Engineering with specialization in Aerodynamics or Rocket Propulsion

Faculty and Staff

- **Faculty details (Sept. 2021 onwards)**

Sl. No.	Name of Faculty	Designation	Specialization
1.	Dr. D. P. Mishra	Professor & In-Charge HOD	Heat Power Engineering, Fluid Mechanics, CFD
2.	Dr. Sudip Das	Professor	Aerodynamics
3.	Dr. Priyank Kumar	Asst. Professor	Aerodynamics
4.	Dr. Partha Mondal	Asst. Professor	Computational Fluid Dynamics
5.	Dr. Rajiv Kumar	Asst. Professor	Rocket Propulsion
6.	Dr. Shelly Biswas	Asst. Professor	Combustion and Rocket Propulsion
7.	Dr. Swarup Y. Jejurkar	Asst. Professor	Micropropulsion

- **Summary**

- Total number of faculty: 6
- Assistant Professors: 5; Professors: 1 (1 : 0 : 5)
- All faculty members hold PhD degree
- Lab in-charge is rotated every 3 years
- Two Adjunct Professors: Prof. R. S. Pant and Padmashri R. M. Vasagam

We are supported by our technical and administrative staff

Visit faculty homepages for more information!

Faculty Contributions

R&D projects in the last five years

Project Title	Proposed Amount (Rs in lakhs)	Funding Agency	Project Investigator	Project Period
Open Cavity studies at Supersonic Speed	24.46	RESPON D ISRO	Dr. Sudip Das Dr. Priyank Kumar	2016-2019
Effect of protrusion on regression rate and combustion instability at varying L/D of hybrid rocket motor	31.196	ECR, SERB, DST	Dr. Rajiv Kumar	2016-2019
Steady and Unsteady Flow investigation on Slender body at High Angles of Attack	26.832	ARDB, DRDO	Dr. Priyank Kumar Dr. Sudip Das	2018-2021

Faculty Contributions (Aerodynamics)

Ongoing R&D Projects

Project Title	Proposed Amount (Rs in lakhs)	Funding Agency	Project Investigator	Project Period
Aerodynamic characterization of reusable launch vehicles at low speeds	22.39	RESPOND ISRO	Dr. Priyank Kumar Dr. Sudip Das	2020-23
Supersonic Flow Studies over spike blunt body with different nose bluntness ratio	22.3	ARDB	Dr. Sudip Das Dr. Priyank Kumar	2020-22
Establishment of AICTE – IDEA Lab at BIT Mesra	106.81	AICTE	Dr. Priyank Kumar	2021-23
Scheme for Promoting Interests, Creativity and Ethics among Students (SPICES)	2.00	AICTE	Dr. Priyank Kumar	2021-22

Faculty Contributions (Rocket Propulsion)

Ongoing R&D Projects

Project Title	Proposed Amount (Rs. In lakhs)	Funding Agency	Project Investigator	Project Period
Development of catalyst system for stable combustion of HAN green propellants	30.207	ARDB, DRDO	Dr. Shelly Biswas Dr. Rajiv Kumar	2021-Ongoing
Use of multi-location swirl injection as a performance enhancer for the hybrid rocket system	39.7786	CRG, SERB, DST	Dr. Rajiv Kumar Dr. Shelly Biswas	2021-Ongoing

Faculty Contributions

- Faculty Research Publications

Sr. No.	Name	Publications		
		Journal	Conf.	Books / Chapters
1	D. P. Mishra	31	12	3 / 4
2	Sudip Das	20	71	0
3	Priyank Kumar	18	54	0
4	Rajiv Kumar	18	31	0 / 1
5	Partha Mondal	5	17	0
6	Shelly Biswas	13	7	0 / 1
7	Swarup Y. Jejurkar	15	7	0

Visit faculty homepages for more information!

Faculty Contributions

- Guidance for PhD (For entire tenure)**

Name of Faculty	Designation	Guidance on PhD
Dr. D. P. Mishra	Professor & In-charge HOD	3 + 2 (ongoing)
Dr. Sudip Das	Professor	3 (Ongoing)
Dr. Priyank Kumar	Assistant Professor	1+2 (Ongoing)
Dr. Partha Mondal	Assistant Professor	1 (Ongoing)
Dr. Rajiv Kumar	Assistant Professor	2
Dr. Shelly Biswas	Assistant Professor	1 (Ongoing)
Dr. Swarup Y. Jejurkar	Assistant Professor	1 (Ongoing)

No. of PhD Thesis Awarded in 2021: 1

No. of PhD Thesis Submitted in 2021: 1

No. of PhD Students: 5

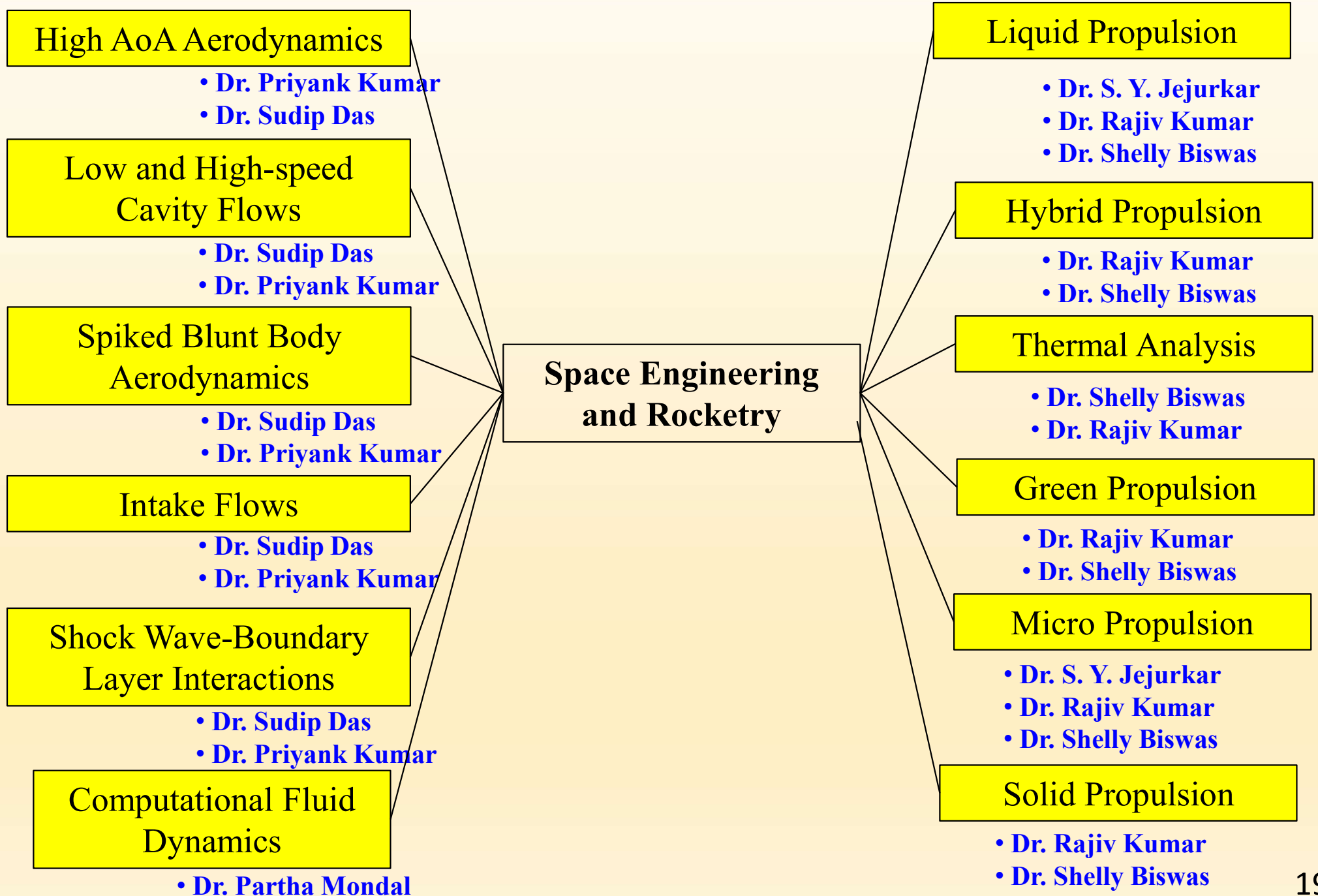
Facilities

**Visit our homepage for more
information!**

Educational Facilities

- **Classrooms: 2**
 - Sitting capacity: 20 + 20
 - Equipped with dedicated ICT facilities
- **Seminar Halls: 2**
 - Sitting capacity: 45 + 45
 - Equipped with dedicated projection facilities
 - Seminar Hall I is air-conditioned
 - Seminar Hall II – Facility for Aerospace Society
- **Departmental Library**
 - Thesis repository
 - 3 Terminals for online access to subscribed library resources
 - Furniture: Tables and chairs
- **Study Room: 1**
 - Sitting capacity: 6
 - Furniture: study tables and chairs
 - High-speed internet connections: 5
- **Faculty Rooms: 7**
 - Furniture: office table + chairs + storage cabinet
 - Dedicated personal computers
- **Amenities**
 - Washrooms: 3 (M), 1 (F)
 - High-speed internet + Wi-Fi connections
 - Uninterrupted power supply

Thrust Areas for Research



Research Facilities

Name of Laboratory	Equipment
<p style="text-align: center;">Aerodynamics Laboratory (Faculty In-charge: Dr. Priyank Kumar)</p>	Supersonic wind tunnel
	Subsonic wind tunnel
	Smoke cum wind tunnel
	Digital oscilloscope
	Schlieren system
	High-speed data acquisition system
	2-channel hot wire anemometer
	Pressure transducers
	Unsteady KULITE pressure
	Transducers with necessary hardware
	1/3/5 and 6-component strain gage balance
	Pressure scanner
Signal conditioner	

Research Facilities

Name of Laboratory	Equipment
Aerodynamics Laboratory (Faculty In-charge: Dr. Priyank Kumar)	Air dryer
	Single channel CTA system
	Smoke generator
	Dead weight calibrator
	Reciprocating air compressor
	Air reservoir
	Digital SLR camera
	Honeywell pressure sensor 24 PVEF6D
	Data acquisition system 6036E
	Basler cameras for schlieren

Recently installed Shock tube and hypersonic tunnel

Research Facilities

Name of Laboratory	Facilities
CFD Laboratory (Faculty In-charge: Dr. Partha Mondal)	10 PCs (Software: ANSYS 17.0 and MATLAB)

Research Facilities

Name of Laboratory	Equipment
Propellant Technology Laboratory (Faculty In-charge: Dr. Shelly Biswas)	Double Planetary Mixer
	High Speed Dispenser
	Sigma Blade Mixer
	Sieve Shakers
	Vacuum Casting Unit
	Ovens (normal and vacuum)
	Muffle Furnace
	Sensitivity Tester
	Pulverizer
	Igniter Testing Unit
	Dehumidifier
	Electronic analytical semi microbalance
	Environmental chamber
	Double distillation plant
Rotary Evaporator	

Research Facilities

Name of Laboratory	Equipment
Solid Rocket Propulsion Laboratory (Faculty In-charge: Dr. Rajiv Kumar)	Static rocket motor test facility
	Auto-console firing unit
	Pressure transducers
	Computer aided data acquisition system
	Pressure gages, thrust gages, etc.
	Data acquisition and analysis system
	For solid rocket tests
	Digital SLR camera

Research Facilities

Combustion Laboratory (Faculty In-charge: Dr. Rajiv Kumar)	Flame propagation and stability tester
	Stereo-microscope
	High-pressure Crawford bomb setup
	Sub-atmospheric burning rate set up
	Strand burner setup
	Flammability tester
	Optical pyrometer
	Nozzle Testing Setup

Research Facilities

Liquid Rocket Test Facility (Faculty In-charge: Dr. Swarup Y Jejurkar)	Static rocket motor test facility
	Pressure Transducer
	Electro-pneumatic actuators
	Fuel tank with piping connections
	Oxidizer Tank with piping connection
	Data acquisition system

Hybrid Rocket Test Facility (Faculty In-charge: Dr. Rajiv Kumar)	Static rocket motor test facility
	Signal conditioner
	Electro-pneumatic actuators
	Load Cell
	Pressure transducers
	Data acquisition system

Research Facilities

Instrument Laboratory (Faculty In-charge: Dr. Shelly Biswas)	Simultaneous thermal analyzer (DSC + TGA +DTG)
	UV-Vis spectrophotometer
	Bomb calorimeter
	Brookfield viscometer
	Electronic analytical semi microbalances
	Dedicated acquisition terminals
	10 kVA UPS system, battery rack

Research Facilities

Aerodynamics Laboratory



Reservoir

Subsonic Wind Tunnels

(600mm x 600mm, 30 m/sec)
(150mm x 300mm, 10 m/sec)

**Also useful for
building
aerodynamics!**



Research Facilities

Aerodynamics Laboratory



Supersonic Wind Tunnel
(100mm x 150mm, Mach 1.5 to 3.5)



Supersonic Wind Tunnel
(50mm x 100mm, Mach 1.2 to 2.5)



Anechoic Jet Facility



(Faculty In-charge: Dr. Priyank Kumar) 29

Research Facilities

Aerodynamics Laboratory



Supersonic Wind Tunnel



Jet Facility



Calibration Rig Facility

Research Facilities

Aerodynamics Laboratory



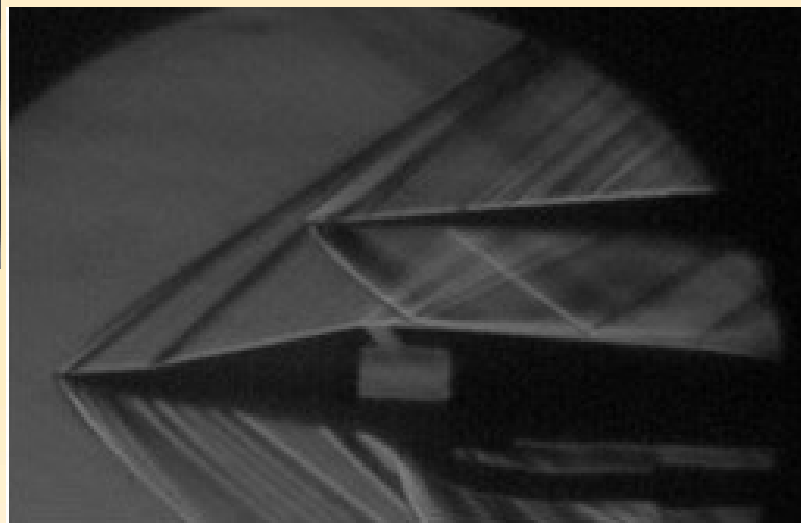
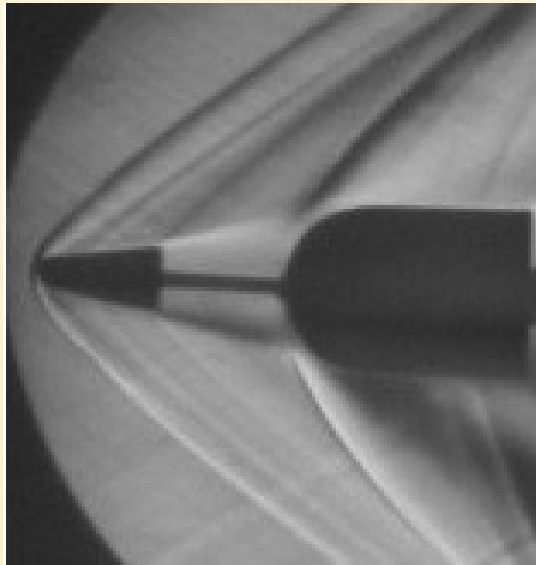
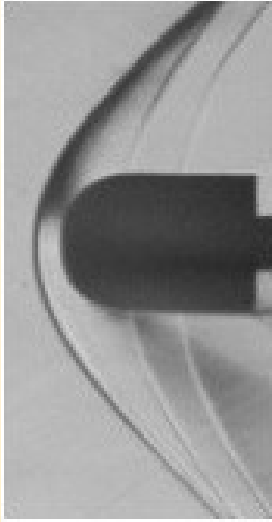
Subsonic Facility



Hypersonic Facility

Research Facilities

Aerodynamics Laboratory



Schlieren Set up

Research Facilities

Aerodynamics Laboratory



**Water Table for Flow
Visualization**



Research Facilities

Propellant Technology and Processing Laboratory



**Fume Hood –Liquid Propellant
Ignition Delay Testing**



Chemical Pulverizer



Dehumidifier



Igniter Ignition Delay Testing Unit



**Vacuum
Casting
Unit**

Research Facilities

Propellant Processing Facility



Double Planetary Mixer



High Speed Dispenser



Sigma Blade Mixer

(Faculty In-charge: Dr. Shelly Biswas)

Research Facilities

- **Rocket Propulsion (Liquid Rocket Test Facility)**



Control and Data Acquisition Station



Pressure-fed Fuel Tank



Liquid Rocket Static Fire Test Set up



Rocket Motors



Pressure-fed oxidizer Tank

Research Facilities

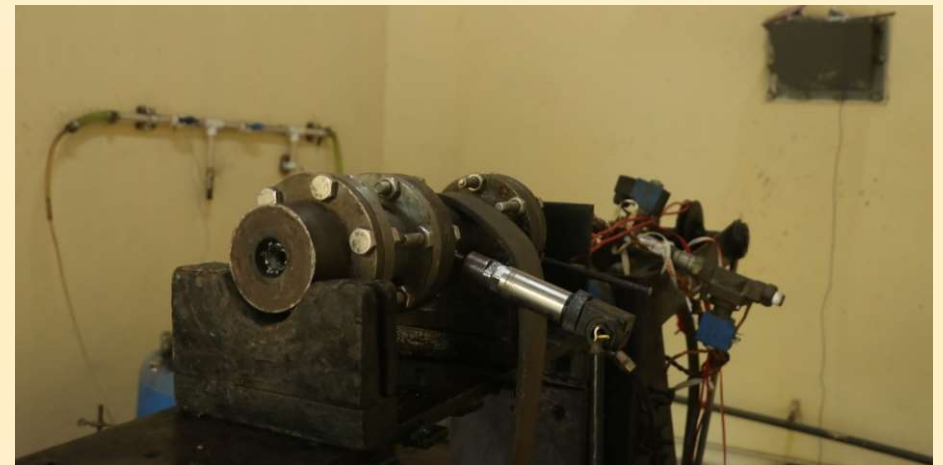
Solid and Hybrid Test Facility



Control Room and Data Acquisition Facility



Exhaust from a Static Fire Test of Solid Propellant



**Hybrid Rocket Static Fire Test Stand
(Faculty In-charge: Dr. Rajiv Kumar)**

Research Facilities

Instrument Laboratory



Simultaneous Thermal Analyzer

**Propellant characterization
using STA, Parr Bomb
calorimeter, Brookfield
viscometer**



Research Facilities



PVC-AP Composite Solid Propellant
(Thrust = 750 N at 60 bar)



Launchers



Kerosene-Gaseous Oxygen
(Thrust = 100 N)



Wax-Gaseous Oxygen Hybrid Propellant
(Thrust = 50 N at 7 bar)

Our New Initiatives

Initiatives for Continuous Improvement

Facility	Improvement	Remarks
Experimental Aerodynamics Laboratory	Experimentation under supersonic flow conditions Hypersonic facility is being developed	Available both for PG students, PhD students and faculty members for research
Water tunnel experiments	Hands-on experience of flow in a water tunnel	
Computing	Software for Optimization, system analysis, and signal processing (MatLab, LabVIEW, ANSYS, in-house CFD code development)	

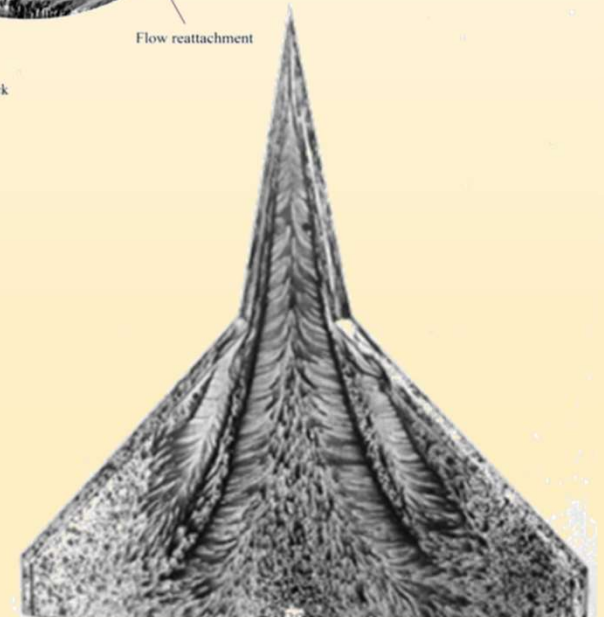
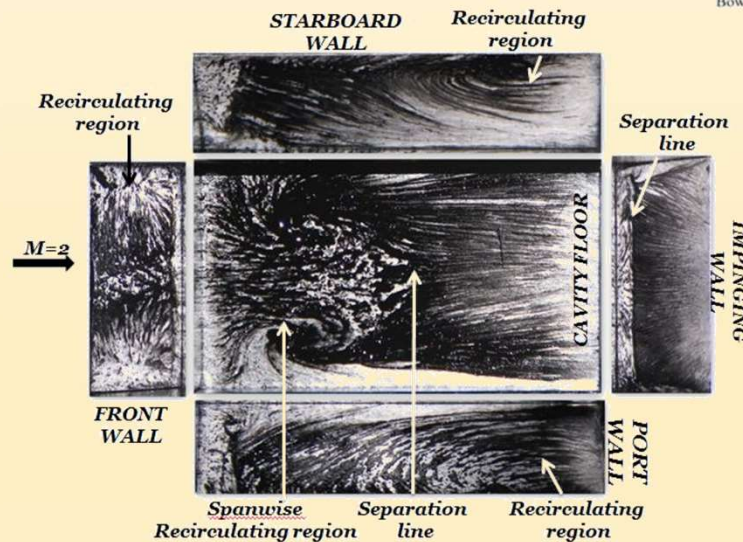
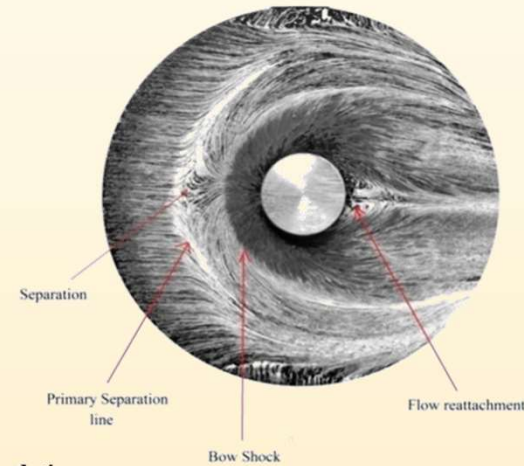
Initiatives for Continuous Improvement

Facility	Improvement	Remarks
Experimental Aerodynamics Laboratory	Supersonic free jet facility	Available PG students, PhD students and faculty for research

Facility	Improvement	Remarks
Experimental Aerodynamics Laboratory	Acoustics characterization	Available PG students, PhD students and faculty for research

Initiatives for Continuous Improvement (Aerodynamics)

- Flow Visualization Facility



Initiatives for Continuous Improvement (Aerodynamics)

- **Flow Visualization and Instrumentation**



Schlieren Set up

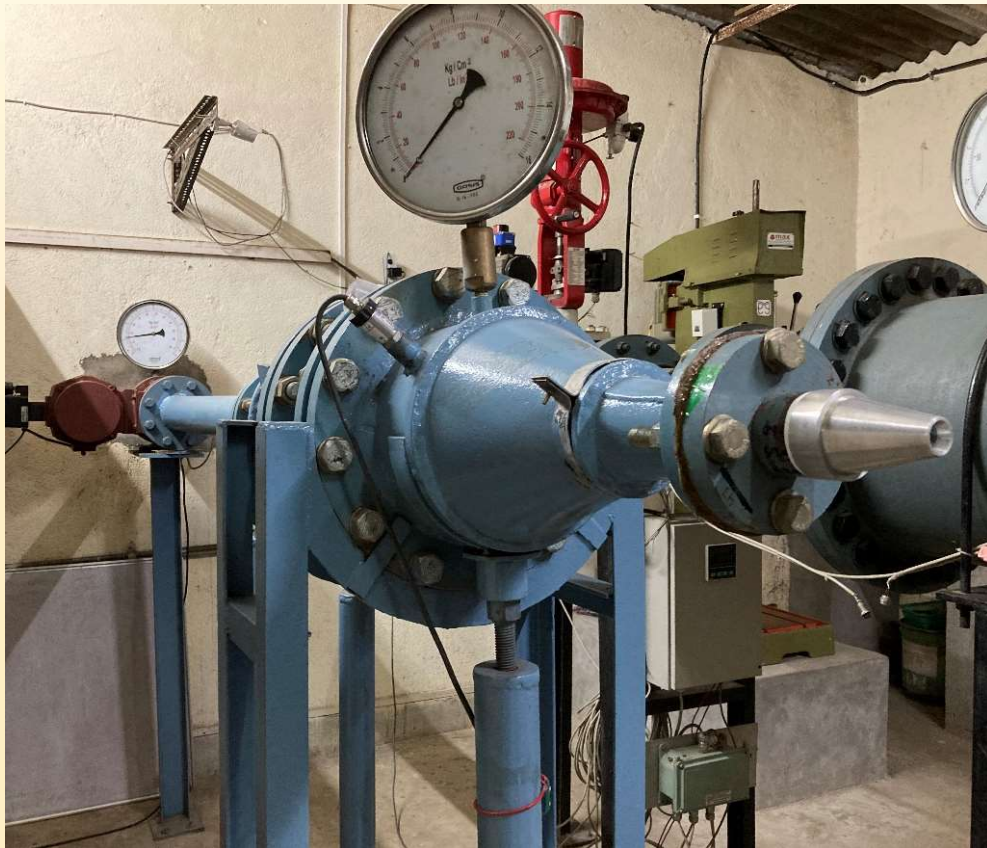


Motorized Traverse

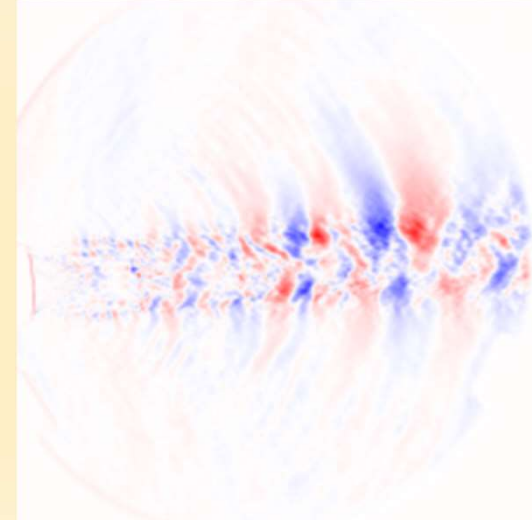
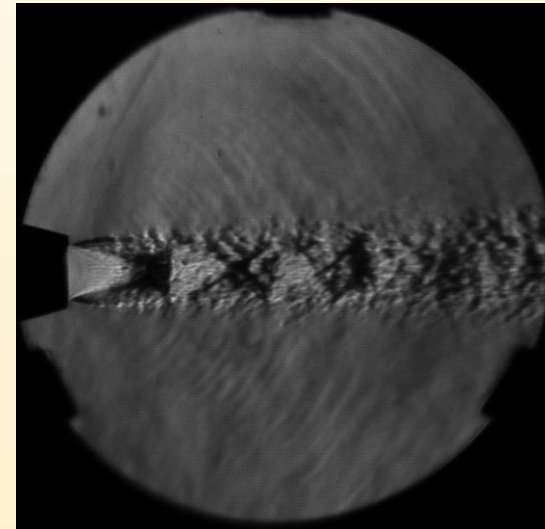
Initiatives for Continuous Improvement (Aerodynamics)

New facility!

- **Supersonic Free Jet Facility**



Open Free jet setup

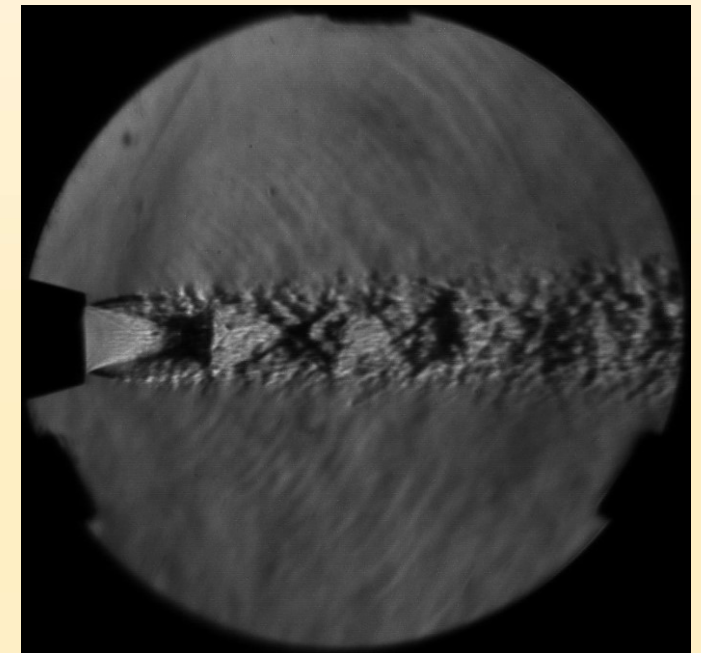
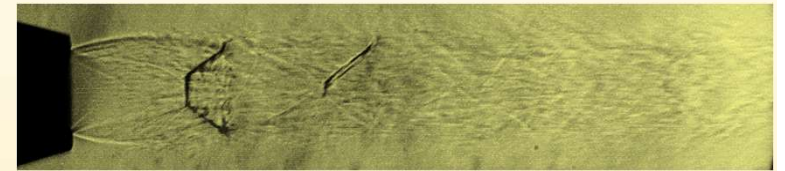


False color schlieren of an expanding supersonic free jet

Initiatives for Continuous Improvement (Aerodynamics)

- **Acoustics**

New facility!



Acoustic Jet

Anechoic chamber instrumented to investigate acoustics of free jet

Initiatives for Continuous Improvement (Aerodynamics)

Upcoming facility!

- **Hypersonic wind tunnel facility**
 - **Wind tunnel for aerodynamic characterization at hypersonic speeds**



Shock Tube



Hypersonic Tunnel

Initiatives for Continuous Improvement (Rocket Propulsion)

Facility	Improvement	Remarks
High pressure oxidizer line, Thrust Chamber assembly	Modernization of the solid-liquid and solid-gas hybrid system	Available both for PG students, PhD students and faculty members for research
Pressure transducers, digital pressure gauges and thermal sensor for pressure line and combustion chamber	Modernization of the solid-liquid and solid-gas hybrid system	
Impact IS-12 IR pyrometer for temperature profiling of flames	Modernization of combustion laboratory	

Initiatives for Continuous Improvement (Rocket Propulsion)

Facility	Improvement	Remarks
Rotary evaporator	For development of green propellants	Available both for PG students, PhD students and faculty members for research
Open cup drop test setup	For testing of catalyst system for green propellants	
Establishment of N ₂ O and H ₂ O ₂ based hybrid rocket motors	Modernization hybrid to cater the needs of advanced systems	
Nozzle Test Setup	Characterization of nozzle and study of flow fields	
Establishment of Tribid Rockets	Modernization hybrid to cater the needs of advanced systems	

Initiatives for Continuous Improvement (Rocket Propulsion)

Facility Creation	Improvement	Remarks
Data Acquisition System	For acquiring data for temperature, pressure and thrust from the test firing of the hybrid, liquid and solid rocket system	Available both for PG students, PhD students and faculty members for research
Computing	Software for optimization, system analysis, and signal processing (MatLab, LabVIEW, ANSYS)	

Initiatives for Continuous Improvement

- **Modernization of Solid and Hybrid Test Facility**



Control Room and Data Acquisition Facility

Initiatives for Continuous Improvement (Rocket Propulsion)

- Work on Green propellants



Rotary Evaporator



Concentration of Hydrogen peroxide using Rotary Evaporator

Notable Alumni



Shri E V S Namboodiry
Chairman, Cryogenic Project
Deputy Director, Liquid
Propulsion Systems Centre
ISRO (1999)



Dr. D. Narayan
Scientist 'G'
Group Director
Aeronautical Development
Agency (ADA)



Padma Shri M. C. Dathan
Former Director, Satish Dhawan
Space Centre (2008)
Former Director, Vikram
Sarabhai Space Centre (2014)



Shri Rajeev Sharma
Chief Solutions Officer, Ness
Digital Engineering
N Y, USA (2017)
Former Dy. Project Director
'AGNI', DRDL



Shri A. K. Chakrabarty
Director
Defence Research & Development
Laboratory (2012)



Prof. Ujjwal K. Saha
Professor, Department of
Mechanical Engineering
Indian Institute of Technology
Guwahati



Shri Sibnath Some
Director
Defence Research and Development
Laboratory (2014)



Shri S.L.N. Desikan
Scientist 'F',
EAD, Aero
Vikram Sarabhai Space Centre
(VSSC)

Thank
You