



INTERNATIONAL
CENTRE for
THEORETICAL
SCIENCES

TATA INSTITUTE OF FUNDAMENTAL RESEARCH

SOLVING
PROBLEMS
OF THIS CENTURY
THROUGH BIG DATA
AND COMPUTING
- A NEW DATA AND
COMPUTATIONAL
SCIENCE INITIATIVE
AT ICTS-TIFR

ICTS

envisages growing an institute along the lines of the Flatiron Institute (of the Simons Foundation) to address multiple fundamental questions through the computational lens.

The seed for this ambitious goal will be a special **ICTS Data and Computational Science** Initiative which will build on the intellectual and physical infrastructure already in place. This will be a chance for India to take a leadership role playing to its strengths in mathematical and physical sciences, yet making a deep impact on society.



1 ADDRESSING KEY PROBLEMS THROUGH COMPUTATION

High performance computing, big data, and artificial intelligence play a transformative role in understanding fundamental questions across disciplines. We share two examples where Indian scientists can have an outsized impact.

The Indian Monsoon and Climate Studies: A Novel Approach

- The standard climate models do not work for India
- ICTS has initiated a multidisciplinary research program of ICTS to:
 - Decipher the mechanisms responsible for the monsoon;
 - Build much better models using ML techniques
- Build large-scale high-performance computing (HPC) models to:
 - Predict how cloud turbulence impacts greenhouse energy budgets;
 - Model coupling of the Indian ocean and atmospheric systems

Black Holes and Extreme Gravity: A New Window into the Universe

- One of the biggest sources of data is going to be from astronomy. ICTS has played a major role in the epochal discovery of Gravitational Waves (GW).
- Current and future GW observations require sophisticated computational techniques involving:
 - Big-data analytics (including ML) and high-throughput computing
 - Modeling of astrophysical phenomena through large-scale simulations solving Einstein's equations



2 WHAT WILL THIS INITIATIVE SUPPORT?

Upgradation of Computing Clusters

- An *upgrade* of the available dedicated computing clusters with more CPUs and GPUs, and the associated *human resources* to manage it.

Special International Workshops and Collaborations

- *Focused programs & workshops* on topics at the intersection of computer science with physics and mathematics fostered by in-house researchers and the Visiting Chair Professors in the key thrust areas
- *Collaborative exchanges* with a focus on emerging hardware, technologies, and algorithms with the close involvement of industry.

Visiting Chair Professorships

- Host some of the *world's top experts* in computer and data science to interface with our researchers and engage in problems ranging from extreme astrophysics to oceanography, the Indian monsoon and climate change, quantitative biology and quantum matter

Internships and Graduate Program

- An *active internship program* in collaboration with industry for two-way know-how transfer.
- A *graduate training program* for graduate students across India to train them in data and computer science

3 REQUEST FOR SUPPORT

The current computing facility at ICTS includes four HPC clusters with a total of ~6000 CPU cores. The research problems that we plan to address in the next ten years will require additional computing resources of ~**16000** modern CPU cores and ~**200** general-purpose GPUs.

	Research Program			
	Monsoon and Climate Studies	Black Holes & Extreme Gravity	Complex Systems	Total Equipment
CPU cores (GPUs)	7200 (80 GPUs)	4800 (60 GPUs)	4000 (60 GPUs)	16000
Physical memory	24 TB	20 TB	16 TB	60 TB
Storage	1800 TB	1200 TB	1000 TB	4000 TB
Expected Cost	1.5 million USD	1 million USD	1 million USD	3.5 M USD
Building cost				1 M USD
Human Resource Development cost (5 years)*				1 M USD
Total				5.5 M USD

*Human Resource Development Cost Breakdown (200,000 USD per year) -
 100,000 USD: Visiting Chair Professorships
 20,000 USD: Internships and Training
 30,000 USD: Workshops
 50,000 USD: Human Resources

4 DONOR RECOGNITION AND NAMING OPPORTUNITIES

As a donor, you will become a 'Friend of ICTS' and will receive our newsletters, invitations to our events, campus visits and interactions with our extended research community which includes eminent scientists and laureates from across the world.

- 1) Support the *entire initiative* with a contribution of **USD 5.5 million**. (Such support will include naming rights for a period of 10 years. The donor will be part of a special advisory committee that will meet twice a year to provide inputs and review progress.)
- 2) Fund the *Monsoon and Climate Studies program* with a contribution of **USD 1.5 million**.
- 3) Fund the *Black Holes and Extreme Gravity program* with a contribution of **USD 1 million**.
- 4) Fund the *Complex Systems Program* with a contribution of **USD 1 million**. (Supporting each of the above three program initiatives includes naming rights for 10 years and half yearly meetings with the head of the program)
- 5) Support *Named Visiting Chair Professorships* with a contribution of **USD 500,000**.
- 6) Fund *Named Internship or Training programs* with a contribution of **USD 100,000**.
- 7) Fund the *Rooftop Solar Power Plant* to meet the energy requirements of the computing centre with a contribution of **100,000 USD**
- 8) Fund *individual workshops* with a contribution of **USD 30,000**.
- 9) Support a *Visiting Program* for a year for **USD 20,000**.
- 10) Support a *Graduate Training Program* for a year for **USD 10,000**.
- 11) Support *individual interns* with a contribution of **USD 5,000**.

Your gift is eligible for tax benefits in India and the US.

- We welcome your valuable partnership in supporting this initiative and furthering our goals.
- Your contributions, small or large, will be appropriately acknowledged.
- Anyone giving over and above USD 1K will also be acknowledged with a plaque at our computing centre.



Call to Action

Join us in building a high-quality data and computational science initiative that will serve India for several decades to come. Such foundational support will go a long way in creating an ecosystem of high-quality research and thought leadership for the country.

We look forward to discussing how we may engage your support in this exciting initiative.

Contact Us

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