Science & Technology · GS - III

Explain how multi-wavelength astronomical observations help scientists understand energetic cosmic phenomena such as black-hole outbursts and galaxy-cluster collisions.

EXAM YEAR	PAPER	SUBJECT
DAILY PRACTICE 02/11/2026	GS - III	Science & Technology

MARKS	WORD LIMIT
10	~150 words

BECOME IAS
AI POWERED UPSC PREP

Answer Hint

Electromagnetic spectrum; X-ray astronomy; radio astronomy; black-hole activity; shockwaves; galaxy clusters; multi-wavelength data

Model Answer

Introduction

Modern astronomy uses observations across the electromagnetic spectrum to investigate objects and processes that cannot be fully understood through visible-light observations alone.

Role of Multi-Wavelength Astronomy

1. X-ray Observations

X-ray telescopes such as NASA’s Chandra X-ray Observatory detect emissions from extremely hot gas surrounding black holes and within galaxy clusters. These observations help scientists examine temperature, energy distribution and high-energy interactions.

2. Radio Observations

Radio telescopes can reveal extended structures produced by energetic particles and magnetic fields. Such structures may record past outbursts from active black holes.

3. Understanding Cosmic Interactions

When galaxy clusters collide, their hot gas can be compressed and disturbed, generating shockwaves. Comparing radio and X-ray data helps researchers investigate the relationship between these disturbances and pre-existing structures.

Significance

Multi-wavelength studies improve understanding of black-hole feedback, galaxy-cluster evolution and the distribution of energy in the universe. They also demonstrate how different astronomical instruments complement one another.

Conclusion

Combining observations across wavelengths provides a more complete picture of energetic cosmic events and strengthens our understanding of the physical processes governing the universe.

BECOME IAS
AI POWERED UPSC PREP