Stanford

Tanmoy Chattopadhyay

Physical Science Research Scientist

Kavli Institute for Particle Astrophysics and Cosmology

Curriculum Vitae available Online

Bio

BIO

I am working on the development of advanced X-ray CCDs and their readout electronics for Advanced X-ray Imaging Satellite (AXIS) which is a NASA X-ray probe mission.

I am involved in the development of novel X-ray detector technologies (e.g. Single electron Sensitive Read Out / SiSeRO) which can provide order of magnitude faster readout speeds and sub-electron noise sensitivity simultaneously. Such detectors will be key to the development of sensitive spectro-imagers for the next generation flagship astronomy missions, e.g. Lynx in X-rays or Habitable Worlds, Spec-S5 in visible wavelength.

I am interested in the hard X-ray polarimetric studies of X-ray sources. With the advent of hard X-ray mirrors (e.g. NuSTAR), it is now possible to conceive hard X-ray polarimeters at the focal plane of hard X-ray telescopes. I have been working on the performance study and development of one such instrument which consisted of a central plastic scatterer (viewed by a PMT) surrounded by an array of CsI(Tl) scintillators (read out by Si photo-multipliers). We are also exploring the feasibility of replacing the plastic scatterer by a fast Silicon imager (a fast X-ray CCD / SiSeRO matrix / X-ray HCD) to enable simultaneous X-ray spectroscopy, imaging, timing and polarimetry.

I am involved in the X-ray spectro-polarimetric studies with CdZnTe Imager (CZTI) onboard Indian astronomy mission – AstroSat for various bright X-ray sources. We verified polarimetric capabilities of CZTI by measuring polarization of Crab pulsar and nebula. Currently, I am leading the spectro-polarimetry studies of Gamma-ray Bursts and Cygnus X-1, a high mass black hole X-ray binary using AstroSat-CZTI data.

Google scholar link - https://scholar.google.com/citations?user=xD-mOikAAAAJ&hl=en

ACADEMIC APPOINTMENTS

- Physical Science Research Scientist, Kavli Institute for Particle Astrophysics and Cosmology

ADMINISTRATIVE APPOINTMENTS

- Staff Scientist, Stanford University, (2021- present)
- Postdoctoral Scholar, Stanford University, (2019-2021)
- Postdoctoral Scholar, Pennsylvania State University, (2016-2019)
- Postdoctoral Scholar, Physical Research Laboratory, (2016-2016)

HONORS AND AWARDS

- Justice Oak Award, Astronomical Society of India (2018)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Full Member, International Society for Optics and Photonics (SPIE) (2025 - present)
- Full Member, Astronomical society of India (ASI) (2023 - present)
- Full Member, American Astronomical Society (AAS) (2022 - present)

PROFESSIONAL EDUCATION

- PhD, Physical Research Laboratory , Astrophysics (2016)
- M.Sc., BHU (India) , Physics (2010)
- B.Sc., Burdwan University (India) , Physics (2008)

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

In order to cope up with the large photon flux at the focal plane of the next generation large area telescopes (e.g. X-ray mission concepts like Lynx), the focal plane detectors need to be extremely fast (order of magnitude faster compared to the Chandra CCDs) and low noise to avail <1 keV measurements along with small pixel sizes in order to fully utilize the high angular resolution of the next generation X-ray mirrors. One approach towards achieving these goals is to use active pixel sensors. As part of the collaboration between the Penn State University and the Teledyne Imaging Sensors to develop Silicon based X-ray Hybrid CMOS detectors (an active pixel sensor), I was involved in characterizing these X- ray HCDs with Cryogenic SIDECAR ASICs. The other approach is to build upon the success of Chandra by developing faster and low noise X-ray CCDs and readout electronics. As a part of the collaboration between the Stanford University, MIT and MIT Lincoln Laboratory, I have been working on the development of fast low noise readout electronics and characterization of these new generation X-ray CCDs. While the X-ray CCDs are based on traditional source follower voltage readout, an alternate option utilizing current readout from these detectors (like in DEPFETs) can provide faster readout along with extremely low noise yield. I am currently working on one such novel technology called Single electron sensitive readout (SiSeRO) manufactured in collaboration with MITLL. Moreover, SiSeROs are supposed to provide sub-electron read noise by utilizing the so-called repetitive non-destructive readout (RNDR) of the charge packets. We are currently working on the readout circuitry to enable this feature and developing a suitable set up to test these aspects. If successful, it might also be possible to develop a matrix of these current readout amplifiers to develop a SiSeRO active pixel sensor.

I am interested in the hard X-ray polarimetric studies of X-ray sources. With the advent of hard X-ray mirrors (e.g. NuSTAR), it is now possible to conceive hard X-ray polarimeters at the focal plane of hard X-ray telescopes. I have been working on the performance study and development of one such instrument which consisted of a central plastic scatterer (viewed by a PMT) surrounded by an array of CsI(Tl) scintillators (read out by Si photo-multipliers). We are also exploring the possibility of replacing the plastic scatterer by a fast Silicon imager (a fast X-ray CCD / SiSeRO matrix / X-ray HCD) to enable simultaneous X-ray spectroscopy, imaging, timing and polarimetry.

I am involved in the X-ray spectro-polarimetric studies with CdZnTe Imager (CZTI) onboard Indian astronomy mission – AstroSat for various bright X-ray sources. We verified polarimetric capabilities of CZTI by measuring polarization of Crab pulsar and nebula. Currently, I am leading the spectro-polarimetry studies of Gamma-ray Bursts and Cygnus X-1, a high mass black hole X-ray binary using AstroSat-CZTI data.

Publications

PUBLICATIONS

- **Development of a one-dimensional position sensitive detector for Compton X-ray polarimeters** *EXPERIMENTAL ASTRONOMY*
  Kumar, A., Vadawale, S. V., Mithun, N. S., Chattopadhyay, T., Goyal, S. K., Patel, A. R., Shanmugam, M.
  2026; 61 (3)

- **Spectropolarimetry of GRB 180427A: Evidence for Distinct Emission Sites with Varying Polarization** *ASTROPHYSICAL JOURNAL*
  Sonawane, R., Iyyani, S., Gupta, S., Chattopadhyay, T., Bhattacharya, D., Bhalerao, V. B., Vadawale, S. V., Dewangan, G. C.
  2025; 990 (2)

- **Time-resolved spectro-polarimetric analysis of extremely bright GRB 230307A: Possible evidence of evolution from photospheric to synchrotron dominated emission** *ASTRONOMY & ASTROPHYSICS*
  Gupta, S., Gupta, R., Chattopadhayay, T., Sahayanathan, S., Frederiks, D., Svinkin, D., Bhattacharya, D., Racusin, J., Vadawale, S., Bhalerao, V., Lysenko, A., Ridnaia, A., Tsvetkova, et al
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- **Investigating polarization characteristics of GRB 200503A and GRB 201009A** *JOURNAL OF ASTROPHYSICS AND ASTRONOMY*
  Saraogi, D., Bala, S., Joshi, J., Iyyani, S., Bhalerao, V., Aditya, J., Svinkin, D. S., Tsvetkova, A., Frederiks, D. D., Lysenko, A. L., Ridnaia, A. V., Kozyrev, A. S., Golovin, et al
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- **A Detailed Time-resolved and Energy-resolved Spectro-polarimetric Study of Bright Gamma-Ray Bursts Detected by AstroSat CZTI in Its First Year of Operation** *ASTROPHYSICAL JOURNAL*
  Gupta, R., Pandey, S. B., Gupta, S., Chattopadhayay, T., Bhattacharya, D., Bhalerao, V., Castro-Tirado, A. J., Valeev, A., Ror, A. K., Sharma, V., Racusin, J., Aryan, A., Iyyani, et al
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- **Localization of gamma-ray bursts using AstroSat Mass Model** *MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY*
  Saraogi, D., Aditya, J., Bhalerao, V., Bala, S., Balasubramanian, A., Mate, S., Chattopadhyay, T., Gupta, S., Prasad, V., Waratkar, G., Navaneeth, P. K., Gopalakrishnan, R., Bhattacharya, et al
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- **High Hard X-Ray Polarization in Cygnus X-1 Confined to the Intermediate Hard State: Evidence for a Variable Jet Component** *ASTROPHYSICAL JOURNAL LETTERS*
  Chattopadhyay, T., Kumar, A., Rao, A. R., Bhargava, Y., Vadawale, S. V., Ratheesh, A., Dewangan, G., Bhattacharya, D., Mithun, N. S., Bhalerao, V.
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- **X-ray speed reading with the MCRC: prototype success and next generation upgrades**
  Orel, P., Pan, A. Y., Herrmann, S. C., Chattopadhyay, T., Morris, G. R., Stueber, H., Allen, S. W., Wilkins, D. R., Prigozhin, G. Y., LaMarr, B. J., Foster, R. F., Malonis, A. C., Bautz, et al
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- **Continued developments in X-ray speed reading: fast, low noise readout for next-generation wide-field imagers**
  Herrmann, S. C., Orel, P., Chattopadhyay, T., Morris, G. R., Prigozhin, G. Y., Stueber, H. R., Allen, S. W., Bautz, M. W., Donlon, K., LaMarr, B. J., Leitz, C. W., Miller, E. D., Pan, et al
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- **Demonstrating sub-electron noise performance in Single electron Sensitive Readout (SiSeRO) devices**
  Chattopadhyay, T., Herrmann, S., Orel, P., Donlon, K., Allen, S. W., Bautz, M. W., Cantrall, B., Cooper, M., LaMarr, B., Leitz, C., Miller, E., Morris, R., Pan, et al
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- **The XOC X-ray Beamline: Probing Colder, Quieter, and Softer**
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- **Towards efficient machine-learning-based reduction of the cosmic-ray induced background in X-ray imaging detectors: increasing context awareness**
  Poliszczuk, A., Wilkins, D., Allen, S. W., Miller, E. D., Chattopadhyay, T., Schneider, B., Darve, J., Bautz, M., Falcone, A., Foster, R., Grant, C. E., Herrmann, S., Kraft, et al
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- **Fast, low-noise image sensor technology for strategic X-ray astrophysics missions**
  Bautz, M. W., Miller, E. D., Prigozhin, G. Y., LaMarr, B. J., Malonis, A., Foster, R., Grant, C. E., Schneider, B., Leitz, C., Donlon, K., Prigozhin, I., Lambert, R., Cooper, et al
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- **Extending the energy range of AstroSat-CZTI up to 380 keV with compton spectroscopy** *MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY*
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- **Hard X-Ray Polarization Catalog for a Five-year Sample of Gamma-Ray Bursts Using AstroSat CZT Imager** *ASTROPHYSICAL JOURNAL*
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- **Experimental verification of off-axis polarimetry with cadmium zinc telluride detectors of AstroSat-CZT Imager** *JOURNAL OF ASTRONOMICAL TELESCOPES INSTRUMENTS AND SYSTEMS*
  Vaishnava, C. S., Mithun, N. S., Vadawale, S. V., Aarthy, E., Patel, A. R., Adalja, H. L., Tiwari, N., Ladiya, T., Navale, N., Chattopadhyay, T., Rao, A. R., Bhalerao, V., Bhattacharya, et al
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- **Probing into emission mechanisms of GRB 190530A using time-resolved spectra and polarization studies: synchrotron origin?** *MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY*
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- **X-ray speed reading with the MCRC: a low noise CCD readout ASIC enabling readout speeds of 5 Mpixel/s/channel**
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  SPIE-INT SOC OPTICAL ENGINEERING.2022

- **Development and characterization of a fast and low noise readout for the next generation x-ray charge-coupled devices** *Journal of Astronomical Telescopes, Instruments, and Systems*

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- **First results on SiSeRO devices: a new x-ray detector for scientific instrumentation** *Journal of Astronomical Telescopes, Instruments, and Systems*
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- **Single electron Sensitive Readout (SiSeRO) X-ray detectors: Technological progress and characterization**
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- **Sub-MeV spectroscopy with AstroSat-CZT imager for gamma ray bursts** *JOURNAL OF ASTROPHYSICS AND ASTRONOMY*
  Chattopadhyay, T., Gupta, S., Sharma, V., Iyyani, S., Ratheesh, A., Mithun, N. S., Aarthy, E., Palit, S., Kumar, A., Vadawale, S. V., Rao, A. R., Bhalerao, V., Bhattacharya, et al
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- **The AstroSat mass model: Imaging and flux studies of off-axis sources with CZTI** *JOURNAL OF ASTROPHYSICS AND ASTRONOMY*
  Mate, S., Chattopadhyay, T., Bhalerao, V., Aarthy, E., Balasubramanian, A., Bhattacharya, D., Gupta, S., Kutty, K., Mithun, N. S., Palit, S., Rao, A. R., Saraogi, D., Vadawale, et al
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- **Hard X-ray polarimetry-an overview of the method, science drivers, and recent findings** *JOURNAL OF ASTROPHYSICS AND ASTRONOMY*
  Chattopadhyay, T.
  2021; 42 (2)

- **Exploring sub-MeV sensitivity of AstroSat-CZTI for ON-axis bright sources** *JOURNAL OF ASTROPHYSICS AND ASTRONOMY*
  Kumar, A., Chattopadhyay, T., Vadawale, S. V., Rao, A. R., Gupta, S., Mithun, N. S., Bhalerao, V., Bhattacharya, D.
  2021; 42 (2)

- **Identifying charged particle background events in X-ray imaging detectors with novel machine learning algorithms**
  Wilkins, D. R., Allen, S. W., Miller, E. D., Bautz, M., Chattopadhyay, T., Fort, S., Grant, C. E., Herrmann, S., Kraft, R., Morris, R. G., Nulsen, P.
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  SPIE-INT SOC OPTICAL ENGINEERING.2021

- **Progress toward fast, low-noise, low-power digital CCDs for Lynx and other high-energy astrophysics missions**
  Bautz, M., Burke, B., Cooper, M., Craig, D., Donlon, K., Foster, R., Grant, C. E., LaMarr, B., Leitz, C., Malonis, A., Miller, E., Prigozhin, G., Thayer, et al
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  SPIE-INT SOC OPTICAL ENGINEERING.2021

- **Spectropolarimetric analysis of prompt emission of GRB 160325A: jet with evolving environment of internal shocks** *MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY*
  Sharma, V., Iyyani, S., Bhattacharya, D., Chattopadhyay, T., Vadawale, S. V., Bhalerao, V. B.
  2020; 493 (4): 5218–32

- **Tiny-box: a tool for the versatile development and characterization of low noise fast x-ray imaging detectors** *X-Ray, Optical, and Infrared Detectors for Astronomy*
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- **MCRC V1: development of integrated readout electronics for next generation X-ray CCD detectors for future satellite observatories** *X-Ray, Optical, and Infrared Detectors for Astronomy*
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- **AstroSat-CZTI Detection of Variable Prompt Emission Polarization in GRB 171010A** *ASTROPHYSICAL JOURNAL*
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- **Prompt emission polarimetry of Gamma ray bursts with ASTROSAT CZT-imager** *The Astrophysical Journal*
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- **Flight Camera Package Design, Calibration, and Performance for the Water Recovery X-ray Rocket Mission**
  Wages, M., Hull, S. V., Falcone, A. D., Anderson, T. B., McQuaide, M., Bray, E., Chattopadhyay, T., Burrows, D. N., Buntic, L., McEntaffer, R. L., Miles, D. M., Tutt, J. H., Schultz, et al
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  SPIE-INT SOC OPTICAL ENGINEERING.2019

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  Burrows, D. N., Allen, S., Bautz, M., Bulbul, E., Chattopadhyay, T., Erdley, J., Falcone, A. D., Grant, C. E., Herrmann, S., Hornschemeier, A., Kelly, D., Kennea, J., Kraft, et al
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  SPIE-INT SOC OPTICAL ENGINEERING.2019

- **Development of position sensitive detector module using scintillator and Si photomultiplier for hard x-ray imaging and spectroscopy** *JOURNAL OF ASTRONOMICAL TELESCOPES INSTRUMENTS AND SYSTEMS*
  Goyal, S. K., Naik, A. P., Mithun, N. P. S., Vadawale, S. V., Nagrani, N., Madhvi, S., Tiwari, N. K., Ladiya, T., Patel, A. R., Adalja, H. K., Chattopadhyay, T., Shanmugam, M., Auknoor, et al
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- **Violation of Synchrotron Line of Death by the Highly Polarized GRB 160802A** *ASTROPHYSICAL JOURNAL*
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- **X-ray Hybrid CMOS Detectors: Recent Development and Characterization Progress**
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- **Design & development of position sensitive detector for hard X-ray using SiPM and new generation scintillators**
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