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Cosmic particle acceleration by shocks and turbulence in merging galaxy clusters

Hoang, D.N.

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Curriculum Vitae

I was born on June 3, 1981 in Vietnam. When I was at high school, I realized that I was interested in doing a career in scientific research.

In 2003, I received my bachelor degree in chemistry from the University of Science - HoChiMinh City (US-HCMC). After graduation, I worked as a teaching assistant for laboratory courses on physical/computational chemistry at US-HCMC. I very much enjoyed doing chemistry experiments in the laboratory.

However, I was then more interested in physics and astronomy. In 2008, I decided to learn more about physics by attending a master program in physics at Stockholm University where I did my graduation thesis on theoretical quantum physics with my supervisor Prof. Hoshang Heydari. The thesis was about “geometrically controlled evolution of four-qubit states”.

After a short period of time working at International University - HoChiMinh City (VNU-HCMC-IU), I went to the Institute of Astronomy & Astrophysics, Academia Sinica (ASIAA) in Taiwan to learn about radio astronomy in 2012. At ASIAA, I joined the YTLA (Yuan-Tseh Lee Array, formerly AMiBA) group of Prof. Paul Ho. YTLA is a radio interferometer operating at 86 – 102 GHz and is built to observe the cosmic microwave background (CMB) radiation and the Sunyaev-Zel’dovich effect in galaxy clusters. In combination with radio observations at low frequency, the aim of my project was to search for the spatial correlation between the non-thermal (i.e. relativistic electrons, magnetic field) and thermal components in the intra-cluster medium (ICM).

In 2014, I was offered a PhD position in the group of Prof. Huub Röttgering at Leiden Observatory, Netherlands. My research focused on the particle acceleration mechanisms by large-scale shocks and turbulence in merging clusters of galaxies. To study the non-thermal components (i.e. relativistic electrons, magnetic field) in the ICM of merging galaxy clusters, I mainly used multi-frequency radio observations that were performed with the Low

Frequency Array (LOFAR), Karl G. Jansky Very Large Array (JVLA), Giant Metrewave Radio Telescope (GMRT), and Westerbork Synthesis Radio Telescope (WSRT). In addition, I also used X-ray data that were observed with X-ray satellites (i.e. Chandra, Suzaku). The results of my PhD research projects are presented in this thesis and are also published in international journals (i.e. Monthly Notices of the Royal Astronomical Society, *Astronomy & Astrophysics*). During my PhD study, I also attended/presented my research results at conferences in Beijing (China), Hamburg, Munich (Germany), Bologna (Italy), Assen, Dwingeloo, Leiden, Noordwijkerhout (Netherlands), Manchester (UK), California (US), and HoChiMinh (Vietnam).

After finishing my PhD study, I will move to Hamburg Observatory for a postdoctoral position in radio astronomy.

List of publications

First-author publications

1. Hoang, D. N. et al. Deep LOFAR observations of the merging galaxy cluster CIZA J2242.8+5301. 2017, MNRAS, 471, 1107 (Chapter 2)
2. Hoang, D. N. et al. Radio observations of the double-relic galaxy cluster Abell 1240. 2018, MNRAS, 478, 2218 (Chapter 3)
3. Hoang, D. N. et al. Radio observations of the merging galaxy cluster Abell 520. 2019, A&A, 622, A20 (Chapter 4)
4. Hoang, D. N. et al. Characterizing the radio emission from the binary galaxy cluster merger Abell 2146. 2019, A&A, 622, A21 (Chapter 5)

Co-author publications

1. Shimwell, T. W. et al. (including Hoang, D. N.) The LOFAR Two-metre Sky Survey – II. First Data Release. 2019, A&A, 622, A1
2. Mandal, S. et al. (including Hoang, D. N.) Ultra steep spectrum emission in the merging galaxy cluster Abell 1914. 2019, A&A, 622, A22
3. Di Gennaro, G. et al. (including Hoang, D. N.) Deep Very Large Array observations of the merging cluster CIZA J2242.8+5301: Continuum and spectral imaging. 2018, ApJ, 865, 24
4. Botteon, A. et al. (including Hoang, D. N.) The spectacular cluster chain Abell 781 as observed with LOFAR, GMRT and XMM-Newton. 2019, ApJ, 622, A19

5. Botteon, A. et al. (including Hoang, D. N.) LOFAR discovery of a double radio halo system in Abell 1758 and radio/X-ray study of the cluster pair. 2018, MNRAS, 478, 885
6. Donnert, J. M. F. et al. (including Hoang, D.) Magnetic field Evolution in Giant Radio Relics using the example of CIZA J2242.8+530. 2016, MNRAS, 462, 204
7. Kai-Yang, L. et al. (including Hoang, D. N.) AMiBA: Cluster Sunyaev-Zel'dovich Effect Observations with the Expanded 13-element Array. 2016, ApJ, 830, 91
8. Shimwell, T. W. et al. (including Hoang, D. N.) The LOFAR Two-metre Sky Survey I. Survey description and preliminary data release. 2016, A&A, 598, A04
9. Shimwell, T. W. et al. (including Hoang, D. N.) A plethora of diffuse steep spectrum objects in Abell 204. 2015, MNRAS, 459, 277

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This thesis is dedicated to my family, my father, my father-in-law, my mother, my mother-in-law, my brothers, my brother-in-law, my sisters, my sisters-in-law, and my beloved wife. Thank you very much for loving me unconditionally, always being supportive and believing in me. I always feel warm in my heart when thinking of you. Last but not least, lovely thanks to my wife, Ly, for always being by my side and being the best soulmate of mine in the Universe.