
VALERIAN H. HALL-CHEN

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CURRENT WORK

Institute of High Performance Computing, A*STAR **Singapore**
Scientist 2021 – present

Group Manager, Plasma Physics & Energy 2023 – present

- Leading a team of 11 staff scientists and engineers, including several principal investigators.
- Covering topics from developing fusion energy to simulating urban environments.

Technical Lead, A*STAR Fusion Taskforce 2023 – present

- Developing an A*STAR-wide fusion energy research strategy. This effort ranges from plasma diagnostics to materials and manufacturing.
- Liaising with a range of external stakeholders, including Singaporean government agencies.

Principal Investigator 2021 – present

- Investigating radiofrequency and microwaves for burning plasmas with beam tracing, full-wave simulations, and AI.
- Focusing primarily on diagnostics, especially synthetic diagnostics for turbulence, but also extending to heating and current drive.

Fusion Consultant **Singapore**
Freelancer 2023 – present

Providing technical expertise on fusion energy, including to two Temasek-linked companies.

EDUCATION

University of Oxford

DPhil in Theoretical Physics (Plasma Physics and Controlled Fusion)

Oxford, UK

2016 – 2021

Thesis title Beam model of Doppler backscattering: theory and experiment.

Supervisors Felix Parra (Oxford) and Jon Hillesheim (UKAEA/CCFE).

Courses Kinetic Theory, Advanced Fluid Dynamics, Collisional Plasma Physics, Collisionless Plasma Physics.

Our model shed new light on the physics of Doppler backscattering, allowing the associated diagnostic data to be better interpreted. Together with collaborators from UCLA and UKAEA, we validated the model in various experiments. This model has recently been implemented as an OMFIT module, enabling its insights to be brought to more experiments globally. We are currently working on extending the model to other diagnostics, such as high-k and cross-polarisation scattering.

University of Cambridge

M.A. in Natural Sciences (Physics), Double First Class Honours

Cambridge, UK

2012 – 2015

Part IA Physics, Materials Science, Computer Science, Mathematical Methods.

Part IB Physics A, Physics B, Mathematical Methods.

Part II Experimental and Theoretical Physics.

CAREER HISTORY

Institute of Materials Research and Engineering, A*STAR

Specialist I

Singapore

2016 – 2016

Institute of High Performance Computing, A*STAR

Research Engineer

Singapore

2015 – 2016

Designed and fabricated various optical and photonic structures as a staff researcher at the Agency for Science, Technology, and Research (A*STAR). Co-supervised three high school student interns.

Republic of Singapore Air Force

Corporal

US and Singapore

2010 – 2012

Drafted into the military for two years. For the most part, I organised ground logistics at the Peace Prairie Detachment in Texas, a joint Chinook detachment run by the Republic of Singapore Air Force and the Texas Army National Guard. This typically involved checking inventories and ensuring that the right people signed appropriate forms on time.

RESEARCH INTERNSHIPS

California Institute of Technology

Summer Undergraduate Research Fellow

Pasadena, CA, US

Summer 2014

Harry Atwater; Department of Applied Physics and Materials Science

Performed FDTD simulations of photonic gyroid structures, fabricated them using 3D 2-photon lithography and various deposition techniques, and characterised them using FTIR and SEM.

Data Storage Institute, A*STAR

Research Intern

Singapore

Summer 2013

Kwaku Eason; Spintronics and Magnetism Group

Simulated magnetisation reversal of macrospins under conditions close to the Curie temperature. By systematically surveying stability and reliability, I evaluated the suitability of different materials for heat assisted magnetic recording devices.

Institute of Materials Research and Engineering, A*STAR

Research Intern

Singapore

Summer 2008 – 2010 and 2012, Winter 2008

Nikolai Yakovlev; Analysis and Characterisation Group

Developed in-house characterisation equipment and characterised magnetic thin films. Explained their behaviour by leveraging different models.

VOLUNTEERING, OUTREACH, AND TEACHING

IEEE Singapore Section, Nuclear and Plasma Science Chapter 2022 – present

- Organise technical seminars.

College Tutor, University of Oxford 2019 – 2020

- Taught five third-year students a physics module.
- Taught seven first-year students a mathematics module.

Chairperson, Deployed Committee, A*STAR Scholars' Network 2022 – present

Chairperson, A*STAR Scholars' Network 2015 – 2016

- Organised a wide range of events, from scholar networking sessions to panel discussions.
- Expanded the inclusivity, bringing more scholars from different scholarship types into the fold.

Co-chairperson, Cambridge University Physics Society 2014 – 2015

- Organised talks by esteemed academics, both internal and external.
 - Founded a YouTube channel to broadcast our talks.
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JOURNAL PUBLICATIONS

15. J Ruiz Ruiz, FI Parra, **VH Hall-Chen**, N Belrhali, C Giroud, JC Hillesheim,
Beam focusing and consequences for Doppler Backscattering measurements,
TBC, (in preparation).
14. Q Pratt, **VH Hall-Chen**, T Neiser, R Hong, J Damba, T. Rhodes, K Thome, S Haskey, T Cote,
T Carter,
**Doppler back-scattering measurements and modeling of density fluctuation wavenum-
ber spectra,**
Nuclear Fusion, (undergoing peer review).
13. **VH Hall-Chen**, FI Parra, JC Hillesheim, J Ruiz Ruiz, P Shi, NA Crocker, HS Chu, SJ Freethy,
LA Kogan, WA Peebles, QT Pratt, TL Rhodes, K Ronald, R Scannell, DC Speirs, S Storment, J
Trisno,
Effect of mismatch on Doppler backscattering in MAST plasmas,
Nuclear Fusion, (undergoing peer review).
<https://arxiv.org/abs/2211.17141>
12. TL Rhodes, CA Michael, P Shi, R Scannell, S Storment, Q Pratt, R Lantsov, I Fitzgerald, **VH
Hall-Chen**, N Crocker, WA Peebles,
**Design elements and first data from a new Doppler backscattering system on the
MAST-U spherical tokamak,**
Review of Scientific Instruments **93**(11), 113549 (2022)
11. J Damba, QT Pratt, **VH Hall-Chen**, R Hong, R Lantsov, R Ellis, TL Rhodes,
**Evaluation of the upgraded DIII-D Doppler backscattering system for high wavenum-
ber measurement and signal enhancement,**
Review of Scientific Instruments **93**(10), 103549 (2022)
10. **VH Hall-Chen**, J Damba, FI Parra, QT Pratt, TL Rhodes, NA Crocker, JC Hillesheim, R Hong,
CA Michael, WA Peebles, S Peng, CE Png, J Ruiz Ruiz,
**Validating and optimising mismatch tolerance of Doppler backscattering measure-
ments with the beam model,**
Review of Scientific Instruments **93**(10), 103536 (2022)
9. **VH Hall-Chen**, FI Parra, JC Hillesheim,
Beam model of Doppler backscattering,
Plasma Physics and Controlled Fusion **64**(9), 095002 (2022)
8. J Ruiz Ruiz, FI Parra, **VH Hall-Chen**, N Christen, M Barnes, J Candy, J Garcia, C Giroud, W
Guttenfelder, J Hillesheim, C Holland, N Howard, Y Ren, A White,
Interpreting radial correlation Doppler reflectometry using gyrokinetic simulations,
Plasma Physics and Controlled Fusion **64**(5), 055019 (2022).

7. Y Liu, H Wang, J Ho, RC Ng, RJ Ng, **VH Hall-Chen**, EH Koay, Z Dong, H Liu, CW Qiu, JR Greer, JKW Yang,
Structural color three-dimensional printing by shrinking photonic crystals,
Nature Communications **10**(1), 4340 (2019)
 6. JR Ong, HS Chu, **VH Chen**, AY Zhu, P Genevet,
Freestanding dielectric nanohole array metasurface for mid-infrared wavelength applications,
Optics Letters **42**(13), 2639–2642 (2017).
 5. **VH Chen**, JR Ong, CE Png,
Polarisation independent silicon-on-insulator slot waveguides,
Scientific Reports **6**(1), 37760 (2016).
 4. S Peng, R Zhang, **VH Chen**, ET Khabiboulline, P Braun, HA Atwater,
Three-dimensional single gyroid photonic crystals with a mid-infrared bandgap,
ACS Photonics **3**(6), 1131–1137 (2016).
 3. JR Ong, **VH Chen**,
Optimal geometry of nonlinear silicon slot waveguides accounting for the effect of waveguide losses,
Optics Express **23**(26), 33622–33633 (2015).
 2. NL Yakovlev, YY Tay, ZJ Tay, **HV Chen**,
Distribution of switching fields in thin films with uniaxial magnetic anisotropy,
Journal of Magnetism and Magnetic Materials **329**, 170–177 (2013).
 1. NL Yakovlev, **H Chen**, K Zhang,
Two-axis magnetisation analysis of epitaxial cobalt films,
Journal of Nanoscience and Nanotechnology **11**(3), 2575–2578 (2011).
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SELECTED CONFERENCES AND SEMINARS

10. **VH Hall-Chen**, FI Parra, JC Hillsheim, J Ruiz Ruiz, NA Crocker, J Damba, HS Chu, SJ Freethy, LA Kogan, CA Michael, WA Peebles, QT Pratt, TL Rhodes, K Ronald, R Scannell, P Shi, DC Speirs, S Storment, J Trisno,
Interpreting Doppler backscattering with beam tracing and reciprocity: theory and experiment.
Invited talk, 24th Topical Conference on High-Temperature Plasma Diagnostics (2022).
9. J Ruiz Ruiz, FI Parra, **VH Hall-Chen**, M. Barnes, N. Christen, JC Hillesheim,
Interpreting Radial Correlation Doppler Reflectometry with a realistic turbulence spectrum and a beam tracing model.
Contributed talk, US-EU Joint Transport Taskforce Workshop (2022).

8. **VH Hall-Chen**,
Challenges in Fusion Energy.
Colloquium, NUS Physics Department (2021).
7. DC Speirs, A Phelps, K Ronald, **VH Hall-Chen**, A Field, RGL Vann,
High-k mm-wave scattering diagnostic for measuring poloidal wavenumber electron-scale turbulence on MAST-U.
Poster presentation, 48th IEEE International Conference on Plasma Science (2021).
6. **VH Hall-Chen**, FI Parra, JC Hillesheim,
Interpreting Doppler backscattering with beam tracing and reciprocity in tokamak geometry.
Poster presentation, 23rd Topical Conference on High-Temperature Plasma Diagnostics (2020).
5. **VH Hall-Chen**, FI Parra, JC Hillesheim,
Interpreting Doppler backscattering with beam tracing and reciprocity in tokamak geometry.
Poster presentation, 62nd Annual Meeting of the APS Division of Plasma Physics (2020).
4. **VH Hall-Chen**, FI Parra, JC Hillesheim,
Modelling the effects of misaligning the probe beam and magnetic field in Doppler backscattering measurements.
Oral presentation, 14th International Reflectometry Workshop (2019).
3. **VH Chen**, FI Parra, JC Hillesheim,
Effects of misaligning the probe beam and magnetic field in Doppler backscattering measurements.
Poster presentation, 45th European Physical Society Conference on Plasma Physics (2018).
2. **VH Chen**, FI Parra, JC Hillesheim,
Doppler backscattering measurements of fusion plasmas.
Technical seminar, IEEE Nuclear and Plasma Sciences Society (Singapore Chapter) (2017).
1. **H Chen**, YY Tay, ZJ Tay, YJ Nguoi, NL Yakovlev,
Magnetic and optical properties of cobalt thin films with uniaxial anisotropy.
Poster presentation, International Conference for Young Researchers on Advanced Materials (2012).

BOOK CHAPTERS

1. L Wu, **VH Chen**, P Bai, S Sun,
Localized polaritons of multi-particle systems,
in Nanophotonics and Plasmonics: An Integrated View, 69–99, CRC Press (2017)
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HONOURS AND AWARDS

Expert panels

- Invited to join the ITER diagnostics topical group as a globally-recognised expert (pending).

Scholarships and fellowships

- A*STAR National Science Scholarship (PhD) (2016).
- A*STAR National Science Scholarship (BS) (2010).

Awards for examination results

- Carter Prize, University of Cambridge (2015).
- Caldwell Scholarship, University of Cambridge (2013).

Awards for science competitions

- Lee Kuan Yew Award for Mathematics and Science (2010).
 - Gold Award, Singapore Science and Engineering Fair (2009).
 - Commendation, A*STAR Talent Search (2009).
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