

# JEAN-CHRISTOPHE BLANCON

## *Ph.D. physics*

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Materials science  
Semiconductor physics  
Light-matter interaction  
Excitons in low dimensions  
Dynamics of carriers & structure  
Optoelectronics, Photonics  
Single photon emitters  
1D & 2D nano-materials  
Structure-property interplay

## SUMMARY OF QUALIFICATIONS

- Competent and reliable professional, committed to top quality and meticulous work.
- Versatile and multi-skilled person, with great capacity to adapt to new R&D problems.
- Resourceful in identifying, analysing and solving complex problems in a timely manner.
- Capacity to work in fast-paced, intense, challenging environment, and to handle multi-tasks.
- Responsible, efficient, and self-motivated.
- Demonstrated capacity to mentor, manage and guide undergraduate and graduate students.
- Skilled at designing experiments to solve scientific problems.
- Successful at obtaining beamtime at synchrotron facilities (BNL, ALS) and DOE facilities.
- Aptitude to conceive and write scientific projects, and apply for multi-year research funding (3 years, > 100k\$ /year grants for DOD, DOE, internal funding).

## EDUCATIONAL BACKGROUND

- Ph.D.** 2013 **Physics**, Université Claude Bernard Lyon 1, France.  
**M.Sc.** 2010 **Optics & Photonics**, Karlsruhe Institute of Technology, Germany.  
**M.Sc.** 2010 **Physics**, École Normale Supérieure de Lyon, France.  
**B.Sc.** 2007 **Physics**, École Normale Supérieure de Lyon, France.

## RESEARCH EXPERIENCES

- Since **Senior Research Scientist, Rice University, USA.**  
2018 Physics and structure-property interplay in 2D semiconductors from the nanoscale to the macroscale for applications as exciton platform, photo- and spin-transistors, single-photon emitters, ferromagnets, photovoltaics, LEDs, hydrogen production.
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- 2017- **Research Scientist, Los Alamos National Laboratory, USA.**  
2018 Spectro-electronic approaches to unravelling intrinsic (nano-)material properties and roles of interfaces towards the rational design of novel optoelectronic devices.
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- 2014- **Research associate, Los Alamos National Laboratory, USA.**  
2017 Effects of spatial degrees of freedom on exciton dissociation mechanisms and charge dynamics investigated by correlated transport and optical probes.  
*Advisors: Prof. A. D. Mohite & Dr. J. J. Crochet.*

- 2010-2013 **Ph.D. thesis, Institut Lumière Matière, Université de Lyon, France.**  
Absolute optical absorption and electronic properties of individual carbon nanotubes.  
*Advisors: Prof. A. San Miguel, Dr. F. Vallee, Dr. A. Ayari & Prof. N. Del Fatti.*
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- 2010 **Master thesis, Karlsruhe Institute of Technology, Germany.**  
Few-photon-quantum transport in low-dimensional systems.  
*Advisors: Prof. K. Busch & Dr. P. Longo.*
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- 2009 **Internship, Forschungszentrum Karlsruhe, Germany.**  
Interferometric displacement sensor for accurate magnetic field measurements.  
*Advisor: Dr. M. Hagelstein.*
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- 2008 **Internship, LPMCN, Université de Lyon, France.**  
Characterization of new types of Clathrates under extreme conditions.  
*Advisors: Prof. A. San Miguel & Prof. D. Machon.*
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- 2007 **Internship, CELIA, Université de Bordeaux 1, France.**  
Characterization of fs laser pulses by FROG and interferometric-FROG methods.  
*Advisor: Prof. Eric Cormier.*



## TEACHING & MANAGING EXPERIENCES

- **Teaching assistant for undergraduate students at Université Claude Bernard Lyon 1, France.** Tutorials (87 hrs) and lab courses (84 hrs) to first year undergraduate students with major in “physics” or “Life and earth sciences”. Size of classes varied between 20 and 35 students. I was involved in the preparation of lab courses, tutorials, and end-of-semester exams. I was also responsible to evaluate my own students.
- **Mentoring of 4 undergraduate/ master students, 10 graduate students, 2 postdocs.**
- **Lab manager at Rice University (since 2018): Design/plan/setup/manage research lab space of newly appointed associate professor (Prof. Aditya Mohite),** including wet chemistry and synthesis lab, optical-electronic spectroscopy, and optoelectronic device characterization.
- **Safety coordinator officer (since 2018)** of entire floor lab spaces (regrouping the labs of five PIs) at Rice University.



## LAB & RESEARCH ACHIEVEMENTS

- **Conceived/optimized/calibrated several state-of-the-art microscopy capabilities allying optical spectroscopy and electronic characterization techniques:** linear and transient absorption/photoemission, single-(nano)object spectroscopy, Raman, fs-spectroscopy, time resolved single photon counting, Hanbury Brown & Twiss experiment, Hong-Ou-Mandel interferometer, modulation spectroscopy for single molecule detection, photocurrent, field effect transistor, external and internal quantum efficiency, hyperspectral imaging.
- **Pioneered work in understanding the fundamental physics of semiconducting quantum-well layered (2D) perovskites** and the mechanisms enabling high-performance optoelectronics.
- **Performed the first direct measurements of the absolute optical absorption** of free-standing individual carbon nanotubes & elucidated environment effects on optical properties.

- **Investigated/understood the fundamental photo-physics and transport properties** of large-grain hybrid perovskites and mono-layer transition metal dichalcogenides.
- **Understood the effect of external stimuli** (e.g. sunlight in thin films integrated in solar cells, magnetic field, and temperature) **on the physics and structure** of 2D and 3D halide perovskites, and 2D heterostructures.
- **Probed the ultrafast structural and electronic responses of 2D halide perovskite crystals** using ultra-fast electron diffraction, transient absorption and photoluminescence. Understood the intra-band relaxation processes and electron-phonon coupling as a function of the 2D perovskite structure and composition.
- **Designed synthesis protocol to improve the phase purity of 2D halide perovskite crystals and thin films.** Developed a physical understanding of the film formation and crystal nucleation processes using in-situ structural and optical spectroscopy/microscopy probes.

### SELECTED SCIENTIFIC PUBLICATIONS

35 publications, citations ~6000, h-index 22 (source: Google Scholar)

#### *Heterostructures, interfaces and surfaces*

- Giant Enhancement of Photoluminescence Emission in WS<sub>2</sub>-2D Perovskite Heterostructures, **Nano Lett.** 19, 4852-4860 (2019).
- Scaling-up phase selection, **Nat. Mater.** 17, p. 1058 (2018).
- Extremely efficient internal exciton dissociation through edge states in layered 2D perovskites, **Science** 355, 1288-1292 (2017).
- Spatially resolved photo-excited charge carrier dynamics in phase-engineered monolayer MoS<sub>2</sub>, **ACS Nano** 9 (1), 840–849 (2015).

#### *Photophysics of semiconductors (3D, 2D, and 1D systems)*

- Scaling law of excitons in 2D perovskite quantum wells, **Nat. Commun.** 9:2254 (2018)
- Light-induced lattice expansion leads to high-efficiency and stable perovskite solar cells, **Science**, 360, 67-70 (2018).
- Direct measurement of the absolute absorption spectrum of individual semiconducting single-wall carbon nanotubes, **Nat. Commun.** 4:2542 (2013).
- The effects of electronic impurities and electron–hole recombination dynamics on large-grain hybrid perovskite photovoltaic efficiencies, **Adv. Func. Mater.** 26, 4283-4292 (2016).

#### *Physics of optoelectronic devices and energy transformation*

- Halide perovskite high-k field-effect transistors with dynamically reconfigurable ambipolarity, **ACS Mater. Lett.** 1, 633-640 (2019).
- High-efficiency two-dimensional Ruddlesden–Popper perovskite solar cells, **Nature** 536, 312-316 (2016).
- Light-activated photocurrent degradation and self-healing in perovskite solar cells, **Nature Commun.** 7:11574 (2016).
- High-efficiency solution-processed perovskite solar cells with millimeter-scale grains, **Science** 347, 522-525 (2015).

### INVITED SCIENTIFIC PRESENTATIONS

- 2020 EMRS Spring meeting, Strasbourg, France.
- 2018 34<sup>th</sup> International Conference on the Physics of Semiconductors, Montpellier, France.
- 2018 Excited States Processes in Electronic and Bio Nanomaterials, Santa Fe, NM, USA.
- 2017 SPIE Optics+Photonics, San Diego, CA, USA.
- 2016 French meeting for Perovskites, Rennes, France.
- 2016 Electronic and Structural Dynamics in Hybrid Perovskites: Theory Meets Experiment, Telluride, CO, USA. .
- 2015 CMOS Emerging Technologies Research, Vancouver, BC, Canada.
- 2015 Physical Sciences Symposia, Boston, MA, USA.

### GRANTS, FELLOWSHIPS, AND PRIZES

- **2018 IUPAP Young Scientist Prize (YSP) for Semiconductor Physics.**
- **Highly Cited Researcher in the field of Cross-Field 2019** (source: Web of Science)
- **LDRD grant 5M\$** (Los Alamos Nat. Lab.) | Co-Investigator | 2017-2020.
- **Beamline time granted after project reviews** at synchrotron facilities (Brokhaven National Lab, Argonne National Lab), ultrafast electron diffraction (SLAC, Stanford), high magnetic field facilities (Los Alamos National Lab).
- **Postdoc fellowship** from Los Alamos National Laboratory | 2014-2017.
- **Ph.D. fellowship** from École Normale Supérieure de Lyon | 2010-2013.
- **Undergraduate & Master degree excellence fellowship (Bourse normalien)** from École Normale Supérieure de Lyon | 2006-2010.

### PROFESSIONAL SERVICES & SKILLS

- **Reviewer for scientific journals:** physical review letters, nature reviews, nature communications, journal of the American chemical society, ACS Nano, science advances, advanced functional materials, physical review materials, advanced materials.
- **Reviewer for project funding:** ERC consolidator grant, MOST Israel.
- Windows, Linux, Unix | Igor, Origin, Matlab, C | Labview, Delphi7
- French (mother tongue) | English (proficient) | German (basics)



## FULL LIST OF SCIENTIFIC PUBLICATIONS

1. Christofilos, D., **Blancon, J.-C.**, Arvanitidis, J., Miguel, A. S., Ayari, A., Del Fatti, N. & Vallée, F. Optical Imaging and Absolute Absorption Cross Section Measurement of Individual Nano-objects on Opaque Substrates: Single-Wall Carbon Nanotubes on Silicon. *J. Phys. Chem. Lett.* **3**, 1176–1181 (2012).
2. **Blancon, J.-C.**, Ayari, A., Marty, L., Bendiab, N. & San-Miguel, A. Electronic transport in individual carbon nanotube bundles under pressure. *J. of Appl. Phys.* **114**, 143704 (2013).
3. **Blancon, J.-C.**, Paillet, M., Tran, H. N., Than, X. T., Guebrou, S. A., Ayari, A., Miguel, A. S., Phan, N.-M., Zahab, A.-A., Sauvajol, J.-L., Fatti, N. D. & Vallée, F. Direct measurement of the absolute absorption spectrum of individual semiconducting single-wall carbon nanotubes. *Nat. Commun.* **4**, 2542 (2013).
4. **Blancon, J.-C.**, Yamaguchi, H., Kappera, R., Lei, S., Najmaei, S., Mangum, B. D., Gupta, G., Ajayan, P. M., Lou, J., Chhowalla, M., Crochet, J. J. & Mohite, A. D. Spatially Resolved Photoexcited Charge-Carrier Dynamics in Phase-Engineered Monolayer MoS<sub>2</sub>. *ACS Nano* **9**, 840–849 (2015).
5. Nie, W., Tsai, H., **Blancon, J.-C.**, Asadpour, R., Neukirch, A. J., Gupta, G., Crochet, J. J., Chhowalla, M., Tretiak, S., Alam, M. A., Wang, H.-L. & Mohite, A. D. High-efficiency solution-processed perovskite solar cells with millimeter-scale grains. *Science* **347**, 522–525 (2015).
6. **Blancon, J.-C.**, Machon, D., Pischedda, V., Debord, R., Toulemonde, P., Floch, S. L., Pascarelli, S., Mélinon, P. & San-Miguel, A. Revisiting pressure-induced phase transition in silicon clathrates using Ge substitution. *Phys. Rev. B* **93**, (2016).
7. **Blancon, J.-C.**, Nie, W., Neukirch, A. J., Gupta, G., Tretiak, S., Cognet, L., Mohite, A. D. & Crochet, J. J. The Effects of Electronic Impurities and Electron–Hole Recombination Dynamics on Large-Grain Organic–Inorganic Perovskite Photovoltaic Efficiencies. *Adv. Funct. Mater.* **26**, 4283–4292 (2016).
8. Mallajosyula, A. T., Fernando, K., Bhatt, S., Singh, A., Alphenaar, B. W., **Blancon, J.-C.**, Nie, W., Gupta, G. & Mohite, A. D. Large-area hysteresis-free perovskite solar cells via temperature controlled doctor blading under ambient environment. *Appl. Mater. Today* **3**, 96–102 (2016).
9. Mohite, A. D., Nie, W., **Blancon, J. C.**, Tsai, H. & Gupta, G. Optoelectronic properties and photo-physics of large grain hybrid perovskites. in *2016 23rd International Workshop on Active-Matrix Flatpanel Displays and Devices (AM-FPD)* 49–51 (Institute of Electrical and Electronics Engineers (IEEE), 2016). doi:10.1109/am-fpd.2016.7543615
10. Neukirch, A. J., Nie, W., **Blancon, J.-C.**, Appavoo, K., Tsai, H., Sfeir, M. Y., Katan, C., Pedesseau, L., Even, J., Crochet, J. J., Gupta, G., Mohite, A. D. & Tretiak, S. Polaron Stabilization by Cooperative Lattice Distortion and Cation Rotations in Hybrid Perovskite Materials. *Nano Lett.* **16**, 3809–3816 (2016).
11. **Blancon, J.-C.**, Nie, W., Neukirch, A. J., Appavoo, K., Tsai, H., Chhowalla, M., Alam, M. A., Sfeir, M. Y., Katan, C., Even, J., Tretiak, S., Crochet, J. J., Gupta, G. & Mohite, A. D. Light-activated photocurrent degradation and self-healing in perovskite solar cells. *Nat.*

- Commun.* **7**, 11574 (2016).
12. Pedesseau, L., Saponi, D., Traore, B., Robles, R., Fang, H.-H., Loi, M. A., Tsai, H., Nie, W., **Blancon, J.-C.**, Neukirch, A., Tretiak, S., Mohite, A. D., Katan, C., Even, J. & Kepenekian, M. Advances and Promises of Layered Halide Hybrid Perovskite Semiconductors. *ACS Nano* **10**, 9776–9786 (2016).
  13. Seo, M., Yamaguchi, H., Mohite, A. D., Boubanga-Tombet, S., **Blancon, J.-C.**, Najmaei, S., Ajayan, P. M., Lou, J., Taylor, A. J. & Prasankumar, R. P. Ultrafast Optical Microscopy of Single Monolayer Molybdenum Disulfide Flakes. *Sci. Rep.* **6**, 21601 (2016).
  14. Tran, H. N., **Blancon, J.-C.**, Huntzinger, J.-R., Arenal, R., Popov, V. N., Zahab, A. A., Ayari, A., San-Miguel, A., Vallée, F., Fatti, N. D., Sauvajol, J.-L. & Paillet, M. Excitonic optical transitions characterized by Raman excitation profiles in single-walled carbon nanotubes. *Phys. Rev. B* **94**, (2016).
  15. Tsai, H., Nie, W., **Blancon, J.-C.**, Stoumpos, C. C., Asadpour, R., Harutyunyan, B., Neukirch, A. J., Verduzco, R., Crochet, J. J., Tretiak, S., Pedesseau, L., Even, J., Alam, M. A., Gupta, G., Lou, J., Ajayan, P. M., Bedzyk, M. J., Kanatzidis, M. G. & Mohite, A. D. High-efficiency two-dimensional Ruddlesden–Popper perovskite solar cells. *Nature* **536**, 312–316 (2016).
  16. Appavoo, K., Nie, W., **Blancon, J.-C.**, Even, J., Mohite, A. D. & Sfeir, M. Y. Ultrafast optical snapshots of hybrid perovskites reveal the origin of multiband electronic transitions. *Phys. Rev. B* **96**, 195308 (2017).
  17. **Blancon, J.-C.**, Tsai, H., Nie, W., Stoumpos, C. C., Pedesseau, L., Katan, C., Kepenekian, M., Soe, C. M. M., Appavoo, K., Sfeir, M. Y., Tretiak, S., Ajayan, P. M., Kanatzidis, M. G., Even, J., Crochet, J. J. & Mohite, A. D. Extremely efficient internal exciton dissociation through edge states in layered 2D perovskites. *Science* **355**, 1288–1292 (2017).
  18. Soe, C. M. M., Nie, W., Stoumpos, C. C., Tsai, H., **Blancon, J.-C.**, Liu, F., Even, J., Marks, T. J., Mohite, A. D. & Kanatzidis, M. G. Understanding Film Formation Morphology and Orientation in High Member 2D Ruddlesden–Popper Perovskites for High-Efficiency Solar Cells. *Adv. Energy Mater.* **8**, 1700979 (2017).
  19. Stoumpos, C. C., Soe, C. M. M., Tsai, H., Nie, W., **Blancon, J.-C.**, Cao, D. H., Liu, F., Traoré, B., Katan, C., Even, J., Mohite, A. D. & Kanatzidis, M. G. High Members of the 2D Ruddlesden–Popper Halide Perovskites: Synthesis, Optical Properties, and Solar Cells of  $(\text{CH}_3(\text{CH}_2)_3\text{NH}_3)_2(\text{CH}_3\text{NH}_3)_4\text{Pb}_5\text{I}_{16}$ . *Chem* **2**, 427–440 (2017).
  20. Tran, H. N., **Blancon, J.-C.**, Arenal, R., Parret, R., Zahab, A. A., Ayari, A., Vallée, F., Del Fatti, N., Sauvajol, J.-L. & Paillet, M. Quantum interference effects on the intensity of the G modes in double-walled carbon nanotubes. *Phys. Rev. B* **95**, 205411 (2017).
  21. Tsai, H., Nie, W., Lin, Y.-H., **Blancon, J.-C.**, Tretiak, S., Even, J., Gupta, G., Ajayan, P. M. & Mohite, A. D. Effect of Precursor Solution Aging on the Crystallinity and Photovoltaic Performance of Perovskite Solar Cells. *Adv. Energy Mater.* **7**, 1602159 (2017).
  22. **Blancon, J.-C.**, Stier, A. V., Tsai, H., Nie, W., Stoumpos, C. C., Traoré, B., Pedesseau, L., Kepenekian, M., Katsutani, F., Noe, G. T., Kono, J., Tretiak, S., Crooker, S. A., Katan, C., Kanatzidis, M. G., Crochet, J. J., Even, J. & Mohite, A. D. Scaling law for excitons in 2D perovskite quantum wells. *Nat. Commun.* **9**, 2254 (2018).

23. Kepenekian, M., Traore, B., **Blancon, J.-C.**, Pedesseau, L., Tsai, H., Nie, W., Stoumpos, C. C., Kanatzidis, M. G., Even, J., Mohite, A. D., Tretiak, S. & Katan, C. Concept of Lattice Mismatch and Emergence of Surface States in Two-dimensional Hybrid Perovskite Quantum Wells. *Nano Lett.* **18**, 5603–5609 (2018).
24. Mohite, A. D. & **Blancon, J.-C.** Scaling-up phase selection. *Nat. Mater.* **17**, 1058–1059 (2018).
25. Nie, W., Tsai, H., **Blancon, J.-C.**, Liu, F., Stoumpos, C. C., Traore, B., Kepenekian, M., Durand, O., Katan, C., Tretiak, S., Crochet, J., Ajayan, P. M., Kanatzidis, M., Even, J. & Mohite, A. D. Critical Role of Interface and Crystallinity on the Performance and Photostability of Perovskite Solar Cell on Nickel Oxide. *Adv. Mater.* **30**, 1703879 (2018).
26. Traore, B., Pedesseau, L., Assam, L., Che, X., **Blancon, J.-C.**, Tsai, H., Nie, W., Stoumpos, C. C., Kanatzidis, M. G., Tretiak, S., Mohite, A. D., Even, J., Kepenekian, M. & Katan, C. Composite Nature of Layered Hybrid Perovskites: Assessment on Quantum and Dielectric Confinements and Band Alignment. *ACS Nano* **12**, 3321–3332 (2018).
27. Tsai, H., Asadpour, R., **Blancon, J.-C.**, Stoumpos, C. C., Even, J., Ajayan, P. M., Kanatzidis, M. G., Alam, M. A., Mohite, A. D. & Nie, W. Design principles for electronic charge transport in solution-processed vertically stacked 2D perovskite quantum wells. *Nat. Commun.* **9**, (2018).
28. Tsai, H., Asadpour, R., **Blancon, J.-C.**, Stoumpos, C. C., Durand, O., Strzalka, J. W., Chen, B., Verduzco, R., Ajayan, P. M., Tretiak, S., Even, J., Alam, M. A., Kanatzidis, M. G., Nie, W. & Mohite, A. D. Light-induced lattice expansion leads to high-efficiency perovskite solar cells. *Science* **360**, 67–70 (2018).
29. Tsai, H., Nie, W., **Blancon, J.-C.**, Stoumpos, C. C., Soe, C. M. M., Yoo, J., Crochet, J., Tretiak, S., Even, J., Sadhanala, A., Azzellino, G., Brenes, R., Ajayan, P. M., Bulović, V., Stranks, S. D., Friend, R. H., Kanatzidis, M. G. & Mohite, A. D. Stable Light-Emitting Diodes Using Phase-Pure Ruddlesden–Popper Layered Perovskites. *Adv. Mater* **30**, 1704217 (2018).
30. Soe, C. M. M., Nagabhushana, G. P., Shivaramaiah, R., Tsai, H., Nie, W., **Blancon, J.-C.**, Melkonyan, F., Cao, D. H., Traoré, B., Pedesseau, L., Kepenekian, M., Katan, C., Even, J., Marks, T. J., Navrotsky, A., Mohite, A. D., Stoumpos, C. C. & Kanatzidis, M. G. Structural and thermodynamic limits of layer thickness in 2D halide perovskites. *PNAS* **116**, 58–66 (2019).
31. Hoffman, J. M., Che, X., Sidhik, S., Li, X., Hadar, I., **Blancon, J.-C.**, Yamaguchi, Y., Kepenekian, M., Katan, C., Even, J., Stoumpos, C. C., Mohite, A., & Kanatzidis, M. From 2D to 1D electronic dimensionality in halide perovskites with stepped and flat layers using propylammonium as a spacer. *J. Am. Chem. Soc.* **141** (27), 10661-10676 (2019).
32. **Blancon, J.-C.**, Yang, A., Jiang, W., Zhang, H., Wong, J., Yan, E., Lin, Y.-R., Crochet, J., Kanatzidis, M., Jariwala, D., Low, T., Mohite, A. D., Atwater, H. A. Giant enhancement of photoluminescence emission in WS<sub>2</sub>-two-dimensional perovskite heterostructures. *Nano Lett.* **19** (8), 4852-4860 (2019).
33. Devesa Canicoba, N., Zagni, N., Liu, F., McCuistian, G., Fernando, K., Bellezza, H., Traoré, B., Rogel, R., Tsai, H., Le Brizoual, L., Nie, W., Crochet, J. J., Tretiak, S., Katan, C., Even,

- J., Kanatzidis, M. G., Alphenaar, B. W., **Blancon, J.-C.**, Alam, M. A., Mohite, A. D., Halide Perovskite high-k field effect transistors with dynamically reconfigurable ambipolarity. *ACS Mater. Lett.* **1** (6), 633-640 (2019).
34. Traore, B., Pedesseau, L., **Blancon, J.-C.**, Tretiak, S., Mohite, A. D., Even, J., Katan, C. & Kepenekian, M. Importance of vacancies and doping in the hole-transporting nickel oxide interface with halide perovskites. *ACS Appl. Mater. Interfaces* **12** (5), 6633-6640 (2020).
35. Price, C. C., **Blancon, J.-C.**, Mohite, A. D. & Shenoy, V. B. Interfacial electromechanics predicts phase behavior of 2d hybrid halide perovskites. *ACS Nano* **14** (3), 3353-3364 (2020).