

# JEFFREY M. BERGTHORSON

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## CV SUMMARY STATEMENT

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My research program targets the strategically-important area of the combustion of alternative fuels for transportation and power-generation applications. Previous research expertise in the areas of combustion [J4, J8], laser diagnostics [J2, J3], and laminar & turbulent fluid mechanics [J1, J5–7] is being leveraged to support a broad research program, combining advanced experimentation and modeling, that has already developed strong linkages with the aerospace and automotive industries. A key contribution from my research program at McGill is the discovery of important trends and similarities in the ignition properties of a range of biofuels that can be linked to the chemical structure of the fuel molecules [J9–12, J14–16]. These trends and similarities in ignition properties are allowing my research group to develop reduced-order combustion models for biofuel/petrofuel blends that can be used in industrial gas-turbine engine modeling by our collaborators at Pratt & Whitney Canada and Rolls-Royce Canada [J23]. Work on the modeling of stagnation flames [J13] has enabled new research directions targeting the pollutant emissions from biofuel/petro-fuel blends [J21,RC7] and the combustion of alternative gaseous fuels at high pressures and low temperatures using plasma-assisted combustion. Our work on the combustion of flames in small channels [J17–18] has led to a new research thrust into the design and optimization of burners for low-calorific (diluted) biofuel sources for power generation applications using Stirling engines. These projects focus on developing new technologies that make use of lower value, diluted, low-calorific fuels, such as raw (non-upgraded) biogas and syngas (producer gas) from biomass feedstocks. In addition to our research on the combustion of alternative gaseous and liquid fuels, we have established a new laboratory and research program funded by a NSERC CRD and a U.S. DTRA grant on the combustion of solid metal particles [J20] that has important applications to novel automotive fuel technologies, high-speed propulsion systems and industrial safety analysis. We envision a completely carbon-free transportation energy system where reactive metal powders are used as renewable energy carriers as a feasible alternative to the much-hyped, but never realized, hydrogen economy.

I have published 22 papers in the top journals in my field, 1 book chapter and 42 conference papers. I have supervised or co-supervised a total of 7 Ph.D. students, 11 M.Eng. students, 3 postdoctoral scholars, 12 undergraduate honours theses, and 14 undergraduate summer researchers (47 total advisees). One Ph.D. student and five M.Eng. students have graduated under my supervision. My graduating students have gone on to become faculty members, graduate students at prestigious institutions, and engineers in important Canadian, and international, industries. I have also demonstrated a strong record of securing research funding, having raised \$2.9M<sup>1</sup> to date for my research group out of \$45M in funded proposals that I have contributed to.

I have proven myself to be a competent course instructor who is appreciated by both the undergraduate and graduate students at McGill. I have been awarded the “Professor of the Year” by the McGill Association of Mechanical Engineers (undergraduate student society) in both 2008 and 2009, and have also received the MELS<sup>2</sup> Chantier II Fellowship for Excellence in Research and Teaching, a 5-year “Chair” for exceptional teachers/researchers in engineering and business.

In addition to my strong research and teaching records, I have also been extremely active in important initiatives within the Department of Mechanical Engineering and the Faculty of Engineering at

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<sup>1</sup>Direct research funding exclusive of overhead.

<sup>2</sup>Ministère de l'Éducation, du Loisir et du Sport de Québec

McGill. My service and leadership on the critically-important KIP<sup>3</sup> renovation have been essential to the success of this project. As the Chair of the Mechanical Engineering Teaching Laboratories Committee, I have overseen a complete overhaul of our undergraduate laboratory space (funded by the KIP renovation), as well as secured the funds necessary to upgrade the necessary teaching equipment ( $\approx$ \$1M). I am now chairing the *ad hoc* committee set up to finalize the priority spending list to make optimal use of this funding. As the Chair of the Faculty Safety Committee, I have overseen an initiative to develop a coherent faculty-wide safety policy that will greatly improve our ability to track the safety training that each undergraduate and graduate student receives as part of their research and course work. I have been an ambassador for the university, and its research networks, in international workshops and took part in Premier J. Charest's "Mission to India" as part of the green aviation delegation. I have also played a leadership role in several major national funding proposals, culminating in our recently-approved Networks of Centres of Excellence on Bio-fuels, where I acted as a Theme Leader for the combustion/utilization theme. My most-important international scholarly community, the Combustion Institute, has recognized my efforts in helping to organize the International Symposium on Combustion at McGill University (1200 attendees), and has asked me to be a member of the Site Selection Committee where I have been serving for the past two years. My expertise in this field has been recognized through an invitation to join the Editorial Board of the highest-impact review journal in our field, *Progress in Energy & Combustion Science*, as well as being a reviewer for many high-impact combustion and energy journals.

## RESEARCH INTERESTS

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### **Combustion properties of biofuel/petrofuel blends**

- $\text{NO}_x$  emission measurements in gaseous and liquid biofuel, as well as surrogate petro-fuel, flames.
- High-temperature ignition and flame propagation behaviour of biofuels and petro-fuels.
- Turbulent mixing and combustion experiments for gas-turbine-engine model validation.
- Stagnation flame experiments for combustion model validation.
- Surrogate fuel modeling for jet/biojet mixtures.

### **Combustion properties of low-calorific fuels**

- Propagation and pollutant formation in diluted lean-premixed flames at high pressure.

### **Novel combustors for low-calorific fuels**

- High-pressure, plasma-assisted fuel reformation and combustion for gas-turbine engines.
- Development, and experimental validation, of design tools for heat-recirculating combustors.
- Development of heat-recirculating combustors for Stirling engine generators.

### **Metal powders as zero-emission, renewable energy carriers**

- Combustion studies of reactive-metal powders for potential use as renewable energy carriers.
- Fundamental flame properties of mixtures of gaseous (methane) and solid metal-particle (Al, Fe) fuels studied in a stabilized dust-flame apparatus and flame-quenching setup.
- Metal-water reactions for hydrogen production.
- Development of power-generation devices burning reactive-metal renewable energy carriers.

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<sup>3</sup>Federal Government funded Knowledge Infrastructure Program

## EDUCATION

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- 2000–2005                      California Institute of Technology                      Pasadena, CA  
**Ph.D. in Aeronautics**  
 ■ Dissertation title: “Experiments and Modeling of Impinging Jets and Premixed Hydrocarbon Stagnation Flames”, Advisor: P. Dimotakis  
 ■ Subject Minor in Physical Chemistry
- 1999–2000                      California Institute of Technology                      Pasadena, CA  
**M.Sc. in Aeronautics**
- 1995–1999                      University of Manitoba                      Winnipeg, MB  
**B.Sc. in Mechanical Engineering** with Distinction

## HONOURS

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- NSERC Discovery Grant Accelerator award (2012–2015)
- Quebec “Ministère de l’Éducation, du Loisir et du Sport” Chantier II Fellowship for Excellence in Research and Teaching (2008–2013).
- Professor of the Year, awarded by the McGill Association of Mechanical Engineers (2008, 2009).
- William F. Ballhaus Prize for outstanding doctoral dissertation in Aeronautics (2005).
- Charles D. Babcock Award for achievements in teaching — Experimental Methods (2003).
- University of Manitoba Program Medal for highest standing in Mechanical Engineering graduating class (1999).

## PROFESSIONAL EXPERIENCE

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- 2012–present                  McGill University, Department of Mechanical Engineering                  Montreal, QC  
**Associate Professor**  
 ■ Research interests are in the broad area of alternative fuel combustion chemistry and novel combustion systems.  
 ■ Combustion of biofuel blends for aircraft engines and power generation is of specific interest.
- 2006–2012                  McGill University, Department of Mechanical Engineering                  Montreal, QC  
**Assistant Professor**  
 ■ Research targeted validation of combustion models for alternative fuels against shock tube ignition and laminar flame experiments.
- 2005–2006                      California Institute of Technology                      Pasadena, CA  
**Postdoctoral Scholar**  
 ■ Performed experimental research on compressible turbulent mixing applicable to high-speed propulsion technologies such as supersonic combustion ramjet engines.
- 2000–2005                      California Institute of Technology                      Pasadena, CA  
**Graduate Research Assistant**  
 ■ Performed combustion research on strained premixed flames of small hydrocarbons using laser diagnostic techniques for combustion model validation.
- 1997–1999                      Boeing Canada Technology                      Winnipeg, MB  
**Manufacturing Engineering Analyst**  
 ■ Acted as team leader of a Quality Improvement Team and developed manufacturing plans for 737 and 747 aircraft assemblies (three 4-month summer internships).

## TEACHING EXPERIENCE

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Mech 578 – Advanced Thermodynamics	2006 – 2011
Mech 240 – Thermodynamics I	2008 – 2012
Mech 261/262 – Statistics and Measurement Laboratory	2008 – 2012

## SUPERVISORY EXPERIENCE

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	Currently		Completed	
	Supervised	Co-supervised	Supervised	Co-supervised
Postdoctoral scholars	–	1	2	–
Ph.D. students	4	2	1	–
M.Eng. students	4	1	6	–
Undergraduate Honours Thesis students	–	–	11	1
Undergraduate summer researchers	–	–	8	6
<b>Totals</b>		<b>12</b>		<b>35</b>

## PROFESSIONAL ACTIVITIES AND AFFILIATIONS

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### Editorial Boards

- *Progress in Energy and Combustion Science*, Elsevier (5-year impact factor: 13.1) — Member of Editorial Board (2012–present)

### Professional Committee Membership

*The Combustion Institute*:<sup>4</sup>

- International Symposium Site Selection Committee — Member (2010–present)
- International Symposium Local Organizing Committee — Member (2006–2008)

### Professional Organization Licenses and Membership

- Licensed Professional Engineer, Professional Engineers of Ontario, No. 100128547
- The Combustion Institute
- American Institute of Aeronautics and Astronautics
- Society of Automotive Engineers
- American Society of Mechanical Engineers

### Select Peer Reviewing Activities

*Journal Articles*

- *Progress in Energy and Combustion Science*
- *Combustion and Flame*
- *Journal of Fluid Mechanics*
- *Proceedings of the Combustion Institute*
- *Combustion Science and Technology*
- *Energy and Fuels*
- *AIAA Journal*
- *International Journal of Hydrogen Energy*
- *Journal of Physical Chemistry*
- *Experimental Thermal and Fluid Sciences*

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<sup>4</sup>The Combustion Institute is the most important scientific organization in my field of research.

*Grant Applications*

- NSERC: Discovery and Collaborative Research & Development Grants
- U.S. Department of Defense Strategic Environmental R&D Program
- American Chemical Society, Petroleum Research Fund

**Chairing of Conference Sessions**

- 34<sup>th</sup> International Symposium on Combustion (2012)
- 9<sup>th</sup> International Symposium on Special Topics in Chemical Propulsion (2012)
- Spring Technical Meeting of the Combustion Institute, Canadian Section (2009–2012)
- U.S. National Meeting of the Combustion Institute (2011)
- International Colloquium on the Dynamics of Explosive and Reactive Systems (2007)

**UNIVERSITY SERVICE**

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**Academic Board Membership**

- McGill Institute for Sustainability in Engineering and Design Academic Advisory Board — Member (2011–present)

**Membership in McGill Institutes and Networks**

- McGill Network for Innovation in Biofuels and Bioproducts (2008–present)
- McGill Institute for Aerospace Engineering (2010–present)
- McGill Institute for Sustainability in Engineering and Design (2010–present)

**Select Academic Committee Service**

- Ad hoc Committee for Undergraduate Teaching Laboratory Renewal — Chair (2012–present)
- Knowledge Infrastructure Program Renovation Committee — Chair (2011–present) and Member (2009–2011)
- Engineering Faculty Safety Committee — Chair (2007–present)
- University Laboratory Safety Committee — Member (2007–present)
- Mechanical Engineering Teaching Laboratories Committee — Chair (2008–present)
- Environmental Engineering Committee — Member (2009–present)
- Mechanical Engineering Department Chair Search Committee — Member (2008/09 & 2011)
- Mechanical Engineering Faculty Search Committee — Member (2009/10 & 2010/11)
- Mechanical Engineering Departmental Safety Committee — Member (2006–2009)

## SUMMARY OF RESEARCH CONTRIBUTIONS

Contribution type	Number of Publications
Book Chapters	1
Submitted Journal Articles	1
Published & Accepted Journal Articles	23
Refereed Conference Papers	7
Conference Papers with Refereed Abstracts	35
Total	68

## BOOK CHAPTERS

- [B1] JM Bergthorson<sup>5</sup>, L Kunst, DB Levin, PBE McVetty, DL Smith, and JK Vessey. “Biodiesel — An integrated approach for a highly efficient biofuel”. In: *Comprehensive Biotechnology, Second Edition*. Ed. by M Moo-Young. Vol. 4. Oxford, UK: Elsevier, 2011, pp. 87–99.

## JOURNAL ARTICLES

- [J24] Y Yavor<sup>‡</sup>, S Goroshin, JM Bergthorson, D Frost, R Stowe, and S Ringuette. “Aluminum-Water Reaction Kinetics at Temperatures up to 150°C”. *International Journal of Energetic Materials and Chemical Propulsion*<sup>6</sup> (submitted).
- [J23] SD Salusbury<sup>†</sup> and JM Bergthorson. “Experiments in diluted premixed turbulent stagnation flames for gas-turbine engine applications”. *International Journal of Energetic Materials and Chemical Propulsion*<sup>6</sup> (accepted).
- [J22] P Versailles<sup>†</sup> and JM Bergthorson. “Optimized laminar axisymmetrical nozzle design using a numerically-validated Thwaites method”. *Journal of Fluids Engineering* (accepted). DOI: 10.1115/1.4007155.
- [J21] GA Chung<sup>†</sup>, B Akih-Kumgeh<sup>‡</sup>, GMG Watson<sup>†</sup>, and JM Bergthorson. “NO<sub>x</sub> formation and flame velocity profiles of *iso*- and *n*- isomers of butane and butanol”. *Proceedings of the Combustion Institute* 34 (2012). URL: <http://dx.doi.org/10.1016/j.proci.2012.06.114>.
- [J20] M Soo<sup>†</sup>, P Julien<sup>†</sup>, S Goroshin, JM Bergthorson, and D Frost. “Stabilized flames in hybrid aluminum-methane-air mixtures”. *Proceedings of the Combustion Institute* 34 (2012). URL: <http://dx.doi.org/10.1016/j.proci.2012.05.044>.
- [J19] R Eaton<sup>§</sup>, B Zhang, JM Bergthorson, and HD Ng. “Measurement and chemical kinetic model predictions of detonation cell size in methanol-oxygen mixtures”. *Shock Waves* 22 (2012), pp. 173–178.
- [J18] GP Gauthier<sup>†</sup>, GMG Watson<sup>†</sup>, and JM Bergthorson. “An evaluation of numerical models for temperature-stabilized CH<sub>4</sub>/Air flames in a small channel”. *Combustion Science & Technology* 184 (2012), pp. 850–868.
- [J17] GMG Watson<sup>†</sup> and JM Bergthorson. “The effect of chemical energy release on heat transfer from flames in small channels”. *Combustion & Flame* 159 (2012), pp. 1239–1252.

<sup>5</sup>This review article covers oilseed crop genetics, production of plant oils, conversion to biodiesel, and use in engines. I contributed the combustion/engines section.

<sup>‡</sup> Postdoctoral scholar supervised by J.M. Bergthorson

<sup>§</sup> Undergraduate student supervised by J.M. Bergthorson

<sup>†</sup> Graduate student supervised by J.M. Bergthorson

- [J16] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Experimental and modeling study of trends in the high-temperature ignition of methyl and ethyl esters”. *Energy & Fuels* 25 (2011), pp. 4345–4356.
- [J15] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Ignition of C3 oxygenated hydrocarbons and chemical kinetic modeling of propanal oxidation”. *Combustion & Flame* 158 (2011), pp. 1877–1889.
- [J14] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Structure-reactivity trends of C1–C4 alkanolic acid methyl esters”. *Combustion & Flame* 158 (2011), pp. 1037–1048.
- [J13] JM Bergthorson, **SD Salusbury**<sup>†</sup>, and PE Dimotakis. “Experiments and modelling of premixed laminar stagnation flame hydrodynamics”. *Journal of Fluid Mechanics* 681 (2011), pp. 340–369.
- [J12] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Comparative study of methyl butanoate and *n*-heptane high temperature autoignition”. *Energy & Fuels* 24 (2010), pp. 2439–2448.
- [J11] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Shock tube study of methyl formate ignition”. *Energy & Fuels* 24 (2010), pp. 396–403.
- [J10] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Tailoring ethanol high temperature ignition by means of chemical additives and water content”. *SAE International Journal of Fuels & Lubricants*<sup>‡</sup> 3 (2010), pp. 598–609.
- [J9] **KE Noorani**<sup>†</sup>, **B Akih-Kumgeh**<sup>†</sup>, and JM Bergthorson. “Comparative high temperature shock tube ignition of C1–C4 primary alcohols”. *Energy & Fuels* 24 (2010), pp. 5834–5843.
- [J8] LJ Benezech, JM Bergthorson, and PE Dimotakis. “Premixed laminar C<sub>3</sub>H<sub>8</sub>- and C<sub>3</sub>H<sub>6</sub>-air stagnation flames: experiments and simulations with detailed kinetic models”. *Proceedings of the Combustion Institute* 32 (2009), pp. 1301–1309.
- [J7] JM Bergthorson, MB Johnson, AM Bonanos, MD Slessor, WJ Su, and PE Dimotakis. “Molecular mixing and flowfield measurements in a recirculating shear flow. Part I: Subsonic flow”. *Flow, Turbulence & Combustion* 83 (2009), pp. 269–292.
- [J6] AM Bonanos, JM Bergthorson, and PE Dimotakis. “Molecular mixing and flowfield measurements in a recirculating shear flow. Part II: Supersonic flow”. *Flow, Turbulence & Combustion* 83 (2009), pp. 251–268.
- [J5] AM Bonanos, JM Bergthorson, and PE Dimotakis. “Mixing measurements in a supersonic expansion-ramp combustor”. *Flow, Turbulence & Combustion* 80 (2008), pp. 489–506.
- [J4] JM Bergthorson and PE Dimotakis. “Premixed laminar C<sub>1</sub>–C<sub>2</sub> stagnation flames: experiments and simulations with detailed thermochemistry models”. *Proceedings of the Combustion Institute* 31 (2007), pp. 1139–1147.
- [J3] JM Bergthorson and PE Dimotakis. “Particle velocimetry in high-gradient/high-curvature flows”. *Experiments in Fluids* 41 (2006), pp. 255–263.
- [J2] JM Bergthorson, DG Goodwin, and PE Dimotakis. “Particle streak velocimetry and CH laser-induced fluorescence diagnostics in strained, premixed, methane-air flames”. *Proceedings of the Combustion Institute* 30 (2005), pp. 1637–1644.
- [J1] JM Bergthorson, K Sone, TW Mattner, PE Dimotakis, DG Goodwin, and DI Meiron. “Impinging laminar jets at moderate Reynolds numbers and separation distances”. *Physical Review E* 72.6 (2005),

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<sup>‡</sup> SAE paper 2010-01-2113 was selected for publication in the SAE International Journal of Fuels and Lubricants.

## REFEREED CONFERENCE PAPERS

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- [RC7] **BM Denman**<sup>†</sup>, **JD Munzar**<sup>†</sup>, and JM Bergthorson. “An experimental and numerical study of the laminar flame speed of jet fuel surrogate blends”. In: *Proceedings of the ASME Turbo Expo 2012*. ASME paper GT2012-69917. Copenhagen, Denmark, 2012.
- [RC6] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Methyl and ethyl esters as biodiesel surrogates: observations on trends in ignition behavior”. In: *Proceedings of the 23<sup>rd</sup> International Colloquium on the Dynamics of Explosions and Reactive Systems*. Irvine, CA, 2011.
- [RC5] **GMG Watson**<sup>†</sup> and JM Bergthorson. “The effect of mixture composition on stabilized flames in a meso-scale channel with a wall temperature gradient”. In: *Proceedings of the 23<sup>rd</sup> International Colloquium on the Dynamics of Explosions and Reactive Systems*. Irvine, CA, 2011.
- [RC4] **GP Gauthier**<sup>†</sup>, **GMG Watson**<sup>†</sup>, and JM Bergthorson. “Numerical investigation of pre-mixed flames stabilized in a narrow duct with a wall temperature gradient”. In: *Proceedings of the 23<sup>rd</sup> International Colloquium on the Dynamics of Explosions and Reactive Systems*. Irvine, CA, 2011.
- [RC3] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Tailoring ethanol high temperature ignition by means of chemical additives and water content”. In: *SAE Technical Meeting on Powertrains, Fuels and Lubricants*. SAE paper 2010-01-2113<sup>d</sup>. San Diego, CA, 2010.
- [RC2] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Autoignition of methyl butanoate as a biodiesel surrogate”. In: *Proceedings of the 22<sup>nd</sup> International Colloquium on the Dynamics of Explosions and Reactive Systems*. Minsk, Belarus, 2009.
- [RC1] JM Bergthorson, MB Johnson, AM Bonanos, and PE Dimotakis. “Measurements of molecular mixing in an expansion-ramp combustor”. In: *Proceedings of the 21<sup>st</sup> International Colloquium on the Dynamics of Explosions and Reactive Systems*. 63. Poitiers, France, 2007.

## CONFERENCE PAPERS WITH REFEREED ABSTRACTS

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- [C35] B Akih-Kumgeh\* and JM Bergthorson. “Combustion chemical kinetic mechanism reduction using an Alternate Species Elimination Method (ASEM)”. In: *Proceedings of the 2012 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Toronto, ON, 2012.
- [C34] **BM Denman**<sup>†</sup>, **JD Munzar**<sup>†</sup>, and JM Bergthorson. “Flame propagation of jet fuel surrogate components and blends”. In: *Proceedings of the 2012 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Toronto, ON, 2012.
- [C33] **GA Chung**<sup>†</sup>, **B Akih-Kumgeh**<sup>†</sup>, and JM Bergthorson. “NO<sub>x</sub> formation and flame velocity profiles of *iso*- and *n*- isomers of butane and butanol”. In: *Proceedings of the 2012 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Toronto, ON, 2012.
- [C32] **GMG Watson**<sup>†</sup>, **GP Gauthier**<sup>†</sup>, and JM Bergthorson. “The effect of flame-wall heat transfer on the propagation of flames in small heated channels”. In: *Proceedings of the 2012 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Toronto, ON, 2012.
- [C31] **J Palecka**<sup>§</sup>, S Goroshin, AJ Higgins, D Frost, JM Bergthorson, **P Julien**<sup>†</sup>, and **M Soo**<sup>†</sup>. “Quenching distance measurements in aluminum-methane-air laminar flames”. In: *Proceedings of the 2012 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Toronto, ON, 2012.



- [C30] **P Julien**<sup>†</sup>, **M Soo**<sup>†</sup>, S Goroshin, JM Bergthorson, and D Frost. “Aluminium Dust Combustion in Premixed Methane-Air Flames”. In: *Proceedings of the 2012 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Toronto, ON, 2012.
- [C29] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Methyl butanoate and *n*-heptane as surrogates for the high-temperature combustion of biodiesel/diesel blends”. In: *Proceedings of the 2011 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Winnipeg, MB, 2011.
- [C28] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Thermochemical kinetics: Implications in the development of detailed and reduced kinetic models”. In: *Proceedings of the 2011 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Winnipeg, MB, 2011.
- [C27] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Functional group and isomer effects on selected C3 oxygenated hydrocarbon combustion: Trends in ignition behavior”. In: *Proceedings of the 7th U.S. National Combustion Meeting*. Atlanta, GA, 2011.
- [C26] **B Akih-Kumgeh**<sup>†</sup>, **KE Noorani**<sup>†</sup>, and JM Bergthorson. “Trends and similarities in C1–C4 primary alcohol high-temperature ignition”. In: *Proceedings of the 7<sup>th</sup> Mediterranean Combustion Symposium*. Chia Laguna, Italy, 2011.
- [C25] **GMG Watson**<sup>†</sup>, **GP Gauthier**<sup>†</sup>, and JM Bergthorson. “An evaluation of numerical models for temperature-stabilized combustion in small tubes”. In: *Proceedings of the 7<sup>th</sup> Mediterranean Combustion Symposium*. Chia Laguna, Italy, 2011.
- [C24] **GMG Watson**<sup>†</sup> and JM Bergthorson. “An evaluation of numerical models for a flame stabilized in a small tube”. In: *Proceedings of the 2011 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Winnipeg, MB, 2011.
- [C23] **GMG Watson**<sup>†</sup> and JM Bergthorson. “The effect of chemical energy release on heat transfer from flames in small channels”. In: *Proceedings of the 7th U.S. National Combustion Meeting*. Atlanta, GA, 2011.
- [C22] **GP Gauthier**<sup>†</sup>, **GMG Watson**<sup>†</sup>, and JM Bergthorson. “Numerical investigation of premixed flames stabilized in a narrow duct”. In: *Proceedings of the 2011 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Winnipeg, MB, 2011.
- [C21] **GP Gauthier**<sup>†</sup>, **GMG Watson**<sup>†</sup>, and JM Bergthorson. “Numerical study of premixed flames stabilized in small tubes”. In: *Proceedings of the 7th U.S. National Combustion Meeting*. Atlanta, GA, 2011.
- [C20] **MH Hakka**<sup>‡</sup> and JM Bergthorson. “Premixed flame speed study of compounds of kerosene fuel”. In: *Proceedings of the 2011 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Winnipeg, MB, 2011.
- [C19] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Tailoring the ignition properties of ethanol by means of chemical additives”. In: *Proceedings of the 2010 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Ottawa, ON, 2010.
- [C18] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Ignition of alkyl esters and alkanes: trends, similarities and differences”. In: *Proceedings of the 2010 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Ottawa, ON, 2010.
- [C17] **C Jackson**<sup>§</sup>, **J Sidey**<sup>§</sup>, S Goroshin, and JM Bergthorson. “Particle size effects on the reaction of aluminum nano- and micron-sized particles with water”. In: *Proceedings of the 2010 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Ottawa, ON, 2010.

- [C16] **GA Chung**<sup>†</sup>, **SD Salusbury**<sup>†</sup>, **BAS Fishbein**<sup>†</sup>, **MH Hakka**<sup>†</sup>, and JM Bergthorson. “Premixed butanol stagnation flame profile measurements”. In: *Proceedings of the 2010 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Ottawa, ON, 2010.
- [C15] **GMG Watson**<sup>†</sup> and JM Bergthorson. “Premixed flames stabilized in narrow channels: Effect of chemical heat release on interfacial flame/wall energy transfer”. In: *Proceedings of the 2010 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Ottawa, ON, 2010.
- [C14] **GP Gauthier**<sup>†</sup>, **GMG Watson**<sup>†</sup>, and JM Bergthorson. “Two-dimensional simulation of a premixed laminar flame in a heated channel”. In: *Proceedings of the 2010 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Ottawa, ON, 2010.
- [C13] JM Bergthorson and **SD Salusbury**<sup>†</sup>. “Stagnation flame hydrodynamics”. In: *Proceedings of the 2010 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Ottawa, ON, 2010.
- [C12] **KE Noorani**<sup>†</sup>, **B Akih-Kumgeh**<sup>†</sup>, and JM Bergthorson. “Shock tube ignition delay times of C1–C4 alcohols and iso-octane”. In: *Proceedings of the 2010 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Ottawa, ON, 2010.
- [C11] M Bakari, M Ngadi, and JM Bergthorson. “Energy analysis of biochemical conversion processes of biomass to bioethanol”. In: *Proceedings of the XVIIth World Congress of the International Commission of Agricultural Engineering*. 2010.
- [C10] **SD Salusbury**<sup>†</sup> and JM Bergthorson. “Premixed methane stagnation flames with oxygen enrichment”. In: *Proceedings of the 2010 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Ottawa, ON, 2010.
- [C9] **B Akih-Kumgeh**<sup>†</sup> and JM Bergthorson. “Shock tube ignition studies of methyl formate”. In: *Proceedings of the 2009 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Montreal, QC, 2009.
- [C8] **GMG Watson**<sup>†</sup> and JM Bergthorson. “Experiments and modeling of premixed flames stabilized in a narrow tube with a wall temperature gradient”. In: *Proceedings of the 2009 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Montreal, QC, 2009.
- [C7] JM Bergthorson, LJ Benezech, and PE Dimotakis. “Relative CH concentrations in C<sub>1</sub>–C<sub>3</sub> hydrocarbon stagnation flames”. In: *Proceedings of the 2008 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Toronto, ON, 2008.
- [C6] JM Bergthorson, AM Bonanos, MB Johnson, and PE Dimotakis. “Measurements of molecular mixing in high-speed flows using fast chemistry”. In: *Proceedings of the 2008 Spring Technical Meeting of the Combustion Institute/Canadian Section*. Toronto, ON, 2008.
- [C5] AM Bonanos, JM Bergthorson, and PE Dimotakis. “Molecular mixing and flowfield measurements in an expansion-ramp combustor: supersonic flow”. In: *Proceedings of the 43<sup>rd</sup> AIAA/ASME/SAE/ASEE Joint Propulsion Conference & Exhibit*. AIAA-2007-5417. 2007.
- [C4] JM Bergthorson and PE Dimotakis. “Stagnation flame experiments for combustion model validation”. In: *Proceedings of the 2007 Spring Technical Meeting of the Combustion Institute/Canadian Section*. C–7. Banff, AB, 2007.

- [C3] JM Bergthorson and PE Dimotakis. “Particle velocimetry in spatially varying flow fields”. In: *Proceedings of the Sixth International Symposium on Particle Image Velocimetry*. P048. Pasadena, CA, 2005.
- [C2] JM Bergthorson, DG Goodwin, and PE Dimotakis. “Experiments and modeling of impinging jets and premixed stagnation flames”. In: *Proceedings of the Fifteenth Australasian Fluid Mechanics Conference*. Ed. by M Behnia, W Lin, and G D McBain. AFMC00087. Sydney, Australia, 2004.
- [C1] JM Bergthorson and PE Dimotakis. “An experimental and numerical study of impinging jets and reacting stagnation flow”. In: *Proceedings of the Fall 2003 Meeting of the Western States Section of the Combustion Institute*. 03F-5. Los Angeles, CA, 2003.

## TECHNICAL REPORTS

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- [TR6] JM Bergthorson, M Ngadi, **SD Salusbury**<sup>†</sup>, **B Fishbein**<sup>†</sup>, M Bakari, and V Toepel. *IATA 2009 Report on Alternative Fuels — Chapter 1*. Tech. rep. by International Air Transport Association (IATA), 2009.
- [TR5] JM Bergthorson, M Ngadi, **SD Salusbury**<sup>†</sup>, **B Fishbein**<sup>†</sup>, M Bakari, and V Toepel. *2nd Generation Biomass Conversion Efficiency*. Tech. rep. submitted to International Air Transport Association (IATA), 2009.
- [TR4] JM Bergthorson, D Smith, M Ngadi, **SD Salusbury**<sup>†</sup>, **B Fishbein**<sup>†</sup>, S Subramanian, and V Toepel. *2nd Generation Biomass into Biojet Potential*. Tech. rep. submitted to International Air Transport Association (IATA), 2008.
- [TR3] JHS Lee, J Chao, and JM Bergthorson. *Measurement of the Laminar Burning Velocity of ethylene-propylene-air and ethylene-propylene-methane-ethane air*. Tech. rep. submitted to Baker Engineering and Risk Consultants, Inc., 2007.
- [TR2] LJ Benezech, JM Bergthorson, and PE Dimotakis. *Experimental investigation of planar strained methane-air and ethylene-air flames*. Tech. rep. GALCITFM:2006.002. Caltech, 2006. URL: <http://resolver.caltech.edu/CaltechGALCITFM:2006.002>.
- [TR1] JM Bergthorson, K Sone, TW Mattner, PE Dimotakis, DG Goodwin, and DI Meiron. *Experiments and modeling of impinging laminar jets at moderate separation distances*. Tech. rep. GALCITFM:2005.003. Caltech, 2005. URL: <http://resolver.caltech.edu/CaltechGALCITFM:2005.003>.

## SUPERVISED THESES

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- [ST6] **G Chung**<sup>†</sup>. “Planar laser-induced fluorescence of nitric oxide in isomeric butanol and butane stagnation flames”. M.Eng. thesis. McGill University, 2012.
- [ST5] **KE Noorani**<sup>†</sup>. “Comparative chemical kinetic and experimental study of methanol, ethanol, *n*-propanol and *n*-butanol auto-ignition delay times”. M.Eng. thesis. McGill University, 2012.
- [ST4] **B Akih-Kumgeh**<sup>†</sup>. “Shock tube studies and chemical kinetic modeling of oxygenated hydrocarbon ignition”. Ph.D. thesis. McGill University, 2011. URL: [http://digitool.Library.McGill.CA:80/R/-?func=dbin-jump-full&object\\_id=103701&silolibrary=GEN01](http://digitool.Library.McGill.CA:80/R/-?func=dbin-jump-full&object_id=103701&silolibrary=GEN01).
- [ST3] **BAS Fishbein**<sup>†</sup>. “Combustion of surrogate jet fuel components in premixed stagnation flames”. M.Eng. thesis. McGill University, 2011. URL: [http://digitool.Library.McGill.CA:80/R/-?func=dbin-jump-full&object\\_id=97224&silolibrary=GEN01](http://digitool.Library.McGill.CA:80/R/-?func=dbin-jump-full&object_id=97224&silolibrary=GEN01).

- [ST2] **RA Brackmann**<sup>†</sup>. “Improvement of an experimental setup for a stagnation flow burner and experimental laminar flame speed measurements for the components of a jet fuel surrogate”. Diplome Thesis\*. Universität Stuttgart, 2011.
- [ST1] **SD Salusbury**<sup>†</sup>. “Premixed methane stagnation flames with oxygen enrichment”. M.Eng. thesis. McGill University, 2010. URL: `{http://digitool.Library.McGill.CA:80/R/?func=dbin-jump-full&object_id=87008&current_base=GEN01}`.

## INVITED PRESENTATIONS

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- [IP5] JM Bergthorson. *Fuel combustion properties for gas turbine engines*. Clean Combustion and Alternative Fuels Research R&D Networking Event. Winnipeg, Manitoba, 2010.
- [IP4] JM Bergthorson. *Alternative fuel combustion properties for aircraft propulsion*. Inauguration of Benedek Integrated Laboratories in Environmental Engineering. McGill University, Montreal, Quebec, 2010.
- [IP3] JM Bergthorson. *The impact of biofuel properties on combustion in automotive and aircraft engines*. 2<sup>nd</sup> Green Crop Network Workshop. Montreal, Quebec, 2009.
- [IP2] JM Bergthorson. *Biofuel combustion properties for automotive and aircraft applications*. China-Canada-California Forum on Energy and the Environment: Climate Change, Agriculture, Biorefineries/Biofuels. Wuxi, China, 2008.
- [IP1] JM Bergthorson. *Experiments and Modeling of Impinging Jets and Premixed Hydrocarbon Stagnation Flames*. GALCIT Fluid Mechanics Seminar. California Institute of Technology, Pasadena, CA, 2005.

## DETAILS OF RESEARCH TRAINEE SUPERVISION

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Name	Dates Supervised or Co-supervised	Project Title	Current Position
<b>Senior Research Associate:</b>			
Samuel Goroshin	Collaborator <sup>11</sup> (2009–present)	Hybrid flames of gaseous and solid fuels & Metal-water reactions to produce hydrogen	Research Scientist, McGill
<b>Postdoctoral Scholars:</b>			
Hichem Hakka	Supervised (2010–2011)	Combustion properties of jet fuel surrogates	Postdoc <sup>12</sup> , U. Nancy & Shell
Benjamin Akih	Supervised (2011–2012)	Turbulent flamelet modeling for gas turbine engines	Assistant Professor, Syracuse University
Yinon Yavor	Co-supervised with D. Frost <sup>13</sup> (2011–present)	Metal-water reactions for hydrogen production for power and propulsion	Postdoc, McGill
<b>Ph.D. Students:</b>			
Benjamin Akih	Supervised (2007–2011)	Shock tube studies and chemical kinetic modeling of oxygenated hydrocarbon ignition	Assistant Professor, Syracuse University

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<sup>\*</sup>Performed Diploma thesis research at McGill University

<sup>11</sup>I am performing collaborative research with Dr. Goroshin, who also works closely with Profs. Frost and Higgins.

<sup>12</sup>Postdoctoral Scholar

<sup>13</sup>Prof. D. Frost, Department of Mechanical Engineering, McGill U.

Graeme Watson	Supervised (2007–present)	The influence of interfacial heat transfer on stable flame propagation in small channels	Ph.D. student, McGill
Sean Salusbury	Supervised (2009–present)	Turbulent flamelets of hydrogen-enriched natural gas	Ph.D. student, McGill
Farzam Fotovat	Co-Supervised with J. Chaouki <sup>14</sup> (2009–present)	Hydrodynamics of biomass gasification in fluidized beds	Ph.D. student, École Polytechnique
Philippe Versailles	Supervised (2011–present)	Plasma-assisted combustion at high pressure	Ph.D. student, McGill
George Gauthier	Supervised (2011–present)	Novel burners for combustion of low-calorific fuels	Ph.D. student, McGill
Philippe Julien	Co-supervised with D. Frost (2011–present)	Hybrid flames of gaseous and solid fuels	Ph.D. student, McGill

**M.Eng. Thesis Students:**

Sean Salusbury	Supervised (2007–2009)	Study of methane combustion over extended flammability range	Ph.D. student, McGill
Bryan Fishbein	Supervised (2008–2011)	Combustion of biofuel/jet-fuel blends for gas-turbine engine	Engineer, P&WC <sup>15</sup>
George Gauthier	Supervised (2010–2011)	Heat recirculating burners for efficient clean combustion	Fast-tracked to Ph.D., McGill
Robin Brakmann	Supervised <sup>16</sup> (2010–2010)	Improvement of an experimental setup . . . and experimental laminar flame speed measurements for . . . jet fuel . . .	Ph.D. student, Germany
Khalid Noorani	Supervised (2009–2011)	Ignition properties of bio-alcohols	Engineer, Minova South Africa
Gregory Chung	Supervised (2009–2012)	Experimental and modeling studies of butanol flames	Consulting Engineer, Navigant Consulting
Bradley Denman	Supervised (2010–present)	Nonpremixed flames of biojet and jet fuels	M.Eng. student, McGill
Michael Soo	Co-Supervised with D. Frost (2010–present)	Aluminum dust concentration effect on aluminum combustion in hydrocarbon Bunsen flames	M.Eng. student, McGill
Jeffrey Munzar	Supervised (2011–present)	NO pollutant formation in premixed flames for gas-turbine engine applications	M.Eng. student, <sup>17</sup> McGill
Sam Whiteley	Supervised (2012–present)	Experiments and modelling of hybrid flames of gaseous-metal fuels	M.Eng. student, McGill

**M.Eng. Non-Thesis Students:**

Ahmed Zia	Supervised (2012–present)	Premixed flames of biojet and jet fuels	M.Eng. student, McGill
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**Undergraduate Honours Thesis Students:**

Rachel Eaton	Supervised (2007–2008)	Analysis of methanol detonation sensitivity	Engineer, Shell Canada
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<sup>14</sup>Prof. J. Chaouki, Dept. of Chemical Engineering, École Polytechnique<sup>15</sup>Pratt & Whitney Canada<sup>16</sup>German Exchange Diplome student from Stuttgart University<sup>17</sup>Recipient of fast-track MEDA award

Andrew Barkman	Supervised (2007–2008)	Laser tracking velocimetry in heterogeneous combustion	unknown
Scott McCaig	Supervised (2007–2008)	Conversion of natural gas to syngas	Engineer, NI <sup>18</sup>
Khalid Noorani	Supervised (2008–2009)	Ignition of methyl esters for biodiesel combustion modeling	M.Eng. student, McGill
Gavin Friedman	Supervised (2008–2009)	Gas analysis for assessing fuel reformation efficiency. . .	Engineer, Los Alamos National Laboratory
Christopher Jackson	Supervised (2009–2010)	Particle size effects on reactivity of metal-water mixtures	M.Sc. student, McGill
Alqayam Mehgji <sup>19</sup>	Supervised (2009–2010)	Two dimensional flow effects on combustion in microchannels	unknown
Jennifer Sidey	Supervised (2010–2010)	Particle size effects on metal-water reactions	Ph.D. student, Cambridge U.
Jeffrey Munzar	Supervised (2010–2010)	Vaporization and ignition of biojet/jet-fuel droplets	M.Eng. student, <sup>20</sup> McGill
Gideon Balloch	Supervised (2010–2011)	Conjugate heat transfer modeling for flames in small channel	Undergraduate, McGill
Jan Palecka	Co-Supervised with D. Frost (2011–2012)	Quenching of hybrid flames of gaseous and metal fuels	Honours Thesis student, McGill
Gyu-Hyeong Lim	Supervised (2011–2012)	Non-intrusive temperature measurements for flames in small channels	Engineer, Bell Helicopter
<b>Undergraduate Summer Researchers:<sup>21</sup></b>			
Jamal Abdel Dayam	Co-Supervised (2008–2008)	Particle velocimetry in heterogeneous combustion	Engineer, Shell Canada
George Gauthier	Supervised (2009–2009)	Heat recirculating burner for stirling engine application	Ph.D. student, McGill
Gideon Balloch	Supervised (2009–2009)	Vapor pressure of mixtures of jet fuel with biojet	Undergraduate, McGill
Jeffrey Munzar	Supervised (2011–2011)	Iso-teniscope for jet/biojet fuel vapor-pressure measurements	M.Eng. student, McGill
Kyle Goyette	Supervised (2011–2011)	Temperature diagnostics for flames in small channels	Undergraduate, McGill
Rodrigo Jiménez Chávez	Supervised (2011–2011)	Vapor-pressure measurements of jet and biojet fuel mixtures	Undergraduate, McGill
Sarah McElman	Supervised (2011–2011)	Metal-water reactions for hydrogen production	Undergraduate, Johns Hopkins U.
Matthew Barbacki	Co-Supervised with D. Frost (2011–2011)	Reactor design for metal-water reactions	Undergraduate, McGill

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<sup>18</sup>National Instruments

<sup>19</sup>Visiting undergraduate student from U. of Birmingham, U.K.

<sup>20</sup>Recipient of fast-track MEDA award

<sup>21</sup>Note that multiple of the Undergraduate Honours Thesis students also completed summer research internships, but these students are not listed again to avoid duplication.

Alexander Coderre-Chabot	Co-Supervised with D. Frost (2011–2011)	Hybrid flame burner	Undergraduate, McGill
Alex Wright	Co-Supervised with D. Frost (2012–2012)	Stabilized hybrid flames of gaseous-metal fuels	Undergraduate, McGill
Jean-Frédéric Ruel	Co-Supervised with D. Frost (2012–2012)	Spherically-propagating hybrid flames of gaseous-metal fuels	M.Eng. student, McGill
Maxime Julien	Co-Supervised with D. Frost (2012–2012)	Metallic dust dispersion system	Undergraduate, École Polytechnique
Sam Whiteley	Supervised (2012–2012)	Modelling of hybrid flames of gaseous-metal fuels	M.Eng. student, McGill
Rodrigo Jiménez Chávez	Supervised (2012–2012)	Vapor-pressure measurements of jet and biojet fuel mixtures	Undergraduate, McGill