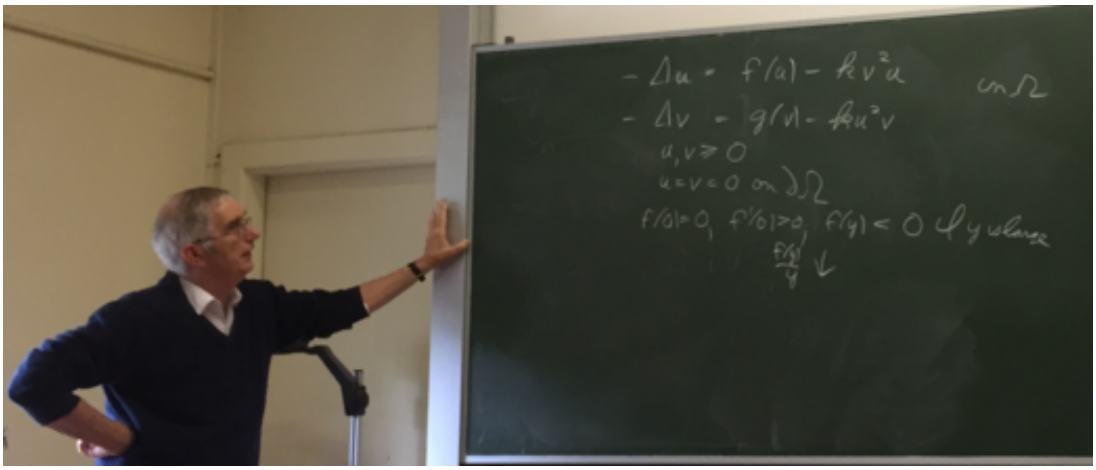
# International conference on nonlinear partial differential equations

## A celebration of Professor Norman Dancer's 70th birthday

University of New England, Armidale, Australia
November 20-25, 2016



**Sponsors**

**Organisers:** Florica Cîrstea (USyd), Daniel Daners (USyd, Co-Chair), Yihong Du (UNE, Co-Chair), Daniel Hauer (USyd), Aron Murphy (UNE), Shusen Yan (UNE), Mrs Kate Daly (UNE, Admin)

## Timetable Overview

All talks are in Lecture Theatre 1, McClymont Building.

| | Sun 20th | Mon 21st | Tue 22nd | Wed 23rd | Thu 24th | Fri 25th |
|---|---|---|---|---|---|---|
| 07:30–08:30 | | *Breakfast* | | | | |
| 08:45–08:55 | | Opening | | | | |
| 09:00–09:40 | | N Trudinger | A Pistoia | F Hamel | Y Lou | XJ Wang |
| 09:45–10:25 | | M Tacy | E Crooks | XJ Hu | SB Chen | JK Liu |
| 10:30–11:00 | | *Morning Tea* | | | | |
| 11:00–11:40 | | ZT Zhang | J Droniou | J López-Gómez | ZM Guo | T ter Elst |
| 11:45–12:25 | | ML Zhou | WW Ding | | J Ching | L Tzou |
| 12:30–14:00 | | *Lunch* | | | *Lunch* | |
| 14:00–14:40 | | CF Gui | M Grossi | *Lunch at* | M Chipot | |
| 14:45–15:25 | | QR Li | J Vétois | *UNE Smart Farm* | KL Wang | |
| 15:30–16:00 | | *Afternoon Tea* | | *and* | *Afternoon Tea* | |
| 16:00–16:40 | | J McCoy | F Robert | *Excursion* | G Sweers | |
| 16:45–17:25 | | N Shah | TY Chang | | | |
| 18:30–20:00 | *Reception* | *Dinner* | | *Conference Dinner* | *Dinner* | |

# Contents



# 1 General Information

## 1.1 Internet

The best way to access the Internet is to use the wireless network ***eduroam*** (see https://www.eduroam.org/about/connect-yourself/) which allows you login with the credentials of your home institution.

## 1.2 Social Program

| | | |
|---|---|---|
| Sun 20th 18:30–20:30 | Reception: Tea room of the Mathematics Building (C26), including informal dinner. | |
| Wed 23rd afternoon | Excursion and conference dinner: | |
| | 12:15 | pick up from UNE campus for UNE Smart Farm |
| | 12:30–1:30 | staying at Smart Farm for lunch and presentation |
| | 13:30 | leave Smart Farm for Wollomonbi National Park |
| | 14:10–16:30 | staying at the National park for walks etc. |
| | 16:30 | leave the National Park for UNE |
| | 18:30 | pick up from UNE for conference dinner at the Wicklow in town |
| | 21:30 | pick up from Wicklow for UNE. |
| Thu 24th 12:30–14:00 | Women's luncheon for all (Booloominbah building on campus) | |
| | 12:45 | Introduction |
| | 12:50 | Speech of Prof Annabelle Duncan, UNE VC and CEO |
| | 13:00 | Speech of Prof Angela Pistoia, Univ of Rome |
| | 13:10–13:55 | Lunch |

### Meals Provided on Campus

For those eligible, all the breakfasts and dinners (except conference dinner) will be provided at the Booloominbah Restaurant on Campus.

## 2 List of Talks

All talks are in Lecture Theatre 1, McClymont Building.

The lecture theatre has a computer and digital projector, a document projector and white boards.

| | |
|---|---|
| *Chang, Ting-Ying* | On singular solutions of weighted divergence operators |
| *Chen, Shibing* | Some regularity result in optimal transportation |
| *Ching, Joshua* | Nonlinear elliptic partial differential equations with a gradient term |
| *Chipot, Michel* | Asymptotic issues in cylinders |
| *Crooks, Elaine* | Invasion speeds in a competition-diffusion model with mutation |
| *Ding, Weiwei* | Spreading in space-time periodic media governed by a monostable equation with free boundaries |
| *Droniou, Jérôme* | Analysis of a degenerate elliptic-parabolic system with measure source terms |
| *Grossi, Massimo* | On some systems with critical growth |
| *Gui, Changfeng* | The sphere covering inequality and its application to a Trudinger-Moser type inequality and mean field equations |
| *Guo, Zongming* | On some weighted elliptic equations |
| *Hamel, François* | One-dimensional symmetry for the Euler equations and related semilinear elliptic equations |
| *Hu, Xijun* | An index theory for unbounded motions of Hamiltonian systems and its applications |
| *Li, Qirui* | A flow towards the Aleksandrov and dual Minkowski problems |
| *Liu, Jiakun* | Schauder estimates for stochastic partial differential equations |
| *Lou, Yuan* | Evolution of diffusion in a mutation-selection model |
| *López-Gómez, Julián* | On the existence of nodal solutions for a class of degenerate boundary value problems |
| *McCoy, James* | Curvature flow in symmetric spaces |
| *Pistoia, Angela* | On the existence of solutions to weakly coupled elliptic system with critical growth |
| *Robert, Frédéric* | The Hardy-Schrödinger operator with interior singularity: mass and blow-up analysis |
| *Shah, Nirav* | Lower order regularity in the critical dimension. |
| *Sweers, Guido* | Fourth order elliptic problems and corners |
| *Tacy, Melissa* | $L^p$ estimates for eigenfunctions on manifolds with boundary |
| *ter Elst, Tom* | Hölder estimates for second-order operators with mixed boundary conditions |
| *Trudinger, Neil* | From optimal transportation to conformal gemetry |
| *Tzou, Leo* | Inverse Scattering on Surfaces |
| *Vétois, Jérôme* | Blowing-up solutions for critical elliptic equations in low dimensions |
| *Wang, Kelei* | The structure of finite Morse index solutions of phase transition models in the plane |
| *Wang, Xu-Jia* | The $p$-Minkowski problem |
| *Zhang, Zhitao* | Existence, uniqueness, and bifurcation of solutions for Schrödinger systems |
| *Zhou, Maolin* | Propagation speed of nonlinear porous medium equation |

# 3 Abstracts

## On singular solutions of weighted divergence operators

*Ting-Ying Chang* (*University of Sydney, Australia*)

**Abstract.** We study the behaviour of solutions with isolated singularities to weighted-divergence operators of the form

$$-\operatorname{div}(A(|x|)|\nabla u|^{p-2}\nabla u) = 0 \quad \text{in } B^* := B_1 \setminus \{0\}, \tag{1}$$

where $B_1$ denotes the unit ball centred at 0 in $\mathbb{R}^N$ with $N \geq 2$. We impose $A$ to be a positive $C^1(0,1]$-function such that

$$\lim_{t\to 0^+} \frac{tA'(t)}{A(t)} = \vartheta \text{ for some } \vartheta \in \mathbb{R}.$$

We are able to classify the solutions to (1) for the entire range of $p$ by adapting the rescaling method from Kichenassamy and Véron's study of isolated singularities of $p$-harmonic functions. The adapted method relies on the construction of a suitable "fundamental solution" depending on the range of $p$. We show that all possible singularities at 0 for a positive solution of (1) are either removable (and $u$ can be extended as a continuous solution in the entire ball $B_1$), weak, or $u$ can be extended as a continuous function in $B_1$. We note there exists no solutions with strong singularities to (1), a case which only arises when absorption terms are present on the right-hand side of (1).

## Some regularity result in optimal transportation

*Shibing Chen* (*Australian National University, Australia*)

**Abstract.** We prove that, in the optimal transportation problem with general costs and positive continuous densities, the potential function is always of class $W^{2,p}_{loc}$ for any $p \geq 1$ outside of a closed singular set of measure zero. We also establish global $W^{2,p}$ estimates when the cost is a small perturbation of the quadratic cost. The latter result is new even when the cost is exactly the quadratic cost.

## Nonlinear elliptic partial differential equations with a gradient term

*Joshua Ching* (*University of Sydney, Australia*)

**Abstract.** Let $N \geq 2$ be the dimension. Let $\Omega \subseteq \mathbb{R}^N$ be a domain containing the origin 0. We consider non-negative $C^1(\Omega \setminus \{0\})$ solutions to the following elliptic equation in dimension $N$:

$$\operatorname{div}(|x|^\sigma |\nabla u|^{p-2}\nabla u) = |x|^{-\tau} u^q |\nabla u|^m \quad \text{in } \Omega \setminus \{0\},$$

where we impose appropriate conditions on the parameters $m, q, p, \sigma, \tau$.

Our aim is to study several features of these solutions. In the model case where $p = 2$ and $\sigma = \tau = 0$, we provide a sharp classification result of the asymptotic behaviour of these solutions near the origin. We also provide corresponding existence results in which we emphasise the more difficult case of $m \in (0,1)$ where new phenomena arise.

A key step in these proofs is to obtain gradient estimates. Dropping now the restrictions on $p, \sigma, \tau$ in the model case, we show that one can obtain gradient estimates which are independent of the domain using a technique of Bernstein's. We shall see that this can be done even when $q \neq 0$. Via these gradient estimates, we will show a Liouville-type result that extends a theorem of Farina and Serrin (2011). Time permitting, we outline how this is done in the model case, as well as explore how these techniques may be applied to the general case.

In this talk, we present results from Ching and Cîrstea (2015, Analysis & PDE), as well as further developments from my thesis

## Asymptotic issues in cylinders

*Michel Chipot* (*University of Zürich, Swizerland*)

**Abstract.** We would like to present some results on the asymptotic behaviour of different problems set in cylindrical domains of the type $\ell\omega_1 \times \omega_2$ when $\ell \to \infty$. For $i = 1, 2$, $\omega_i$ are two bounded open subsets in $\mathbb{R}^{d_i}$.

To fix the ideas on a simple example consider for instance $\omega_1 = \omega_2 = (-1, 1)$ and $u_\ell$ the solution to

$$-\Delta u_\ell = f \quad \text{in } \Omega_\ell := (-\ell, \ell) \times (-1, 1), \qquad u_\ell = 0 \quad \text{on } \partial\Omega_\ell.$$

It is more or less clear that, when $\ell \to \infty$, $u_\ell$ will converge toward $u_\infty$ solution to

$$-\Delta u_\infty = \quad \text{in } \Omega_\infty := (-\infty, \infty) \times (-1, 1), \qquad u_\infty = 0 \quad \text{on } \partial\Omega_\infty.$$

However this problem has infinitely many solutions since for every integer $k$

$$\exp(k\pi x_1) \sin(k\pi x_2)$$

is solution of the corresponding homogeneous problem. Our goal is to explain the selection process of the solution for different problems of this type when $\ell \to \infty$.

## Invasion speeds in a competition-diffusion model with mutation

*Elaine Crooks* (*Swansea University, United Kingdom*)

**Abstract.** We consider a reaction-diffusion system modelling the growth, dispersal and mutation of two phenotypes. This model was proposed by Elliott and Cornell (2012), who found evidence that for a class of dispersal and growth coefficients, the two phenotypes spread into the unstable extinction state at a single speed that is faster than either phenotype would spread in the absence of mutation. Under suitable smallness conditions on the effect of mutation and inter-morph competition, we prove that the spreading speed of the two phenotypes is determined by the linearisation about the extinction state, and then deduce both that the spreading speed is a non-increasing function of mutation, and the ratio at which the phenotypes occur at the leading edge in the small-mutation limit. This is joint work with Luca Börger and Aled Morris.

## Spreading in space-time periodic media governed by a monostable equation with free boundaries

*Weiwei Ding* (*University of New England, Australia*)

**Abstract.** This work is aimed at classifying the long-time behavior of the solution to a free boundary problem with monostable reaction term in space-time periodic media. Such a model may be used to describe the spreading of a new or invasive species with the free boundary representing the expanding front. In Part 1 of this work, we establish a theory on the existence and uniqueness of solutions to this free boundary problem with continuous initial functions, as well as some comparison results, and spreading-vanishing dichotomy. In Part 2, we develop the methods of Weinberger to prove the existence of asymptotic spreading speed when spreading happens, without knowing a priori the existence of the corresponding semi-wave solutions of the free boundary problem. This is a completely different approach from earlier works on the free boundary model, where the spreading speed is determined by firstly showing the existence of a corresponding semi-wave. This work is in collaboration with Prof. Yihong Du and Prof. Xiang Liang.

### Analysis of a degenerate elliptic-parabolic system with measure source terms

*Jérôme Droniou* (*Monash University, Australia*)

**Abstract.** Tertiary oil recovery consists of injecting a solvent through a well in an underground oil reservoir to create an oil-solvent mixture with a lower viscosity that will flow more easily through the reservoir towards a second well.

This process is modelled by a coupled system of an elliptic equation (on the pressure) and a parabolic equation (on the concentration). The diffusion matrix appearing in the parabolic equation depends on the solution to the pressure, and in practical situations vanishes when the gradient of the pressure vanishes. This parabolic equation therefore degenerates into a reaction equation, but in regions that cannot be controlled a priori since they depend on the solution to the elliptic equation. Another feature of the diffusion matrix is that it is potentially unbounded: it grows linearly with the pressure gradient.

The relative scales of the wellbores ($\sim$20cm) and the reservoir ($\sim$1-2km) justifies the modelling of the corresponding source terms by measures – Dirac point sources in 2D, measures on lines in 3D.

The setting of a bounded, non-degenerate diffusion matrix and measure source terms was tackled by Fabrie and Gallouët in 2000. The degenerate diffusion case was considered – with regular (function) source terms – by Amirat and Ziani in 2004. In this talk, we propose to study the full coupled model, with degenerate and unbounded diffusion matrix, and with measure source terms. The resolution of these various challenges requires more than simply a combination of the ideas of Fabrie-Gallouët and Amirat-Ziani; in particular, one needs new techniques based in particular on the Aubin-Simon theorem in a very weak space.

### On some systems with critical growth

*Massimo Grossi* (*Università di Roma "La Sapienza", Italy*)

**Abstract.** None provided

### The sphere covering inequality and its application to a Trudinger-Moser type inequality and mean field equations

*Changfeng Gui* (*University of Texas at San Antonio, USA*)

**Abstract.** In this talk, I will introduce a new geometric inequality: the Sphere Covering Inequality. The inequality states that the total area of two distinct surfaces with Gaussian curvature less than 1, which are also conformal to the Euclidean unit disk with the same conformal factor on the boundary, must be at least $4\pi$. In other words, the areas of these surfaces must cover the whole unit sphere after a proper rearrangement. We apply the Sphere Covering Inequality to show the best constant of a Trudinger-Moser type inequality conjectured by A. Chang and P. Yang. Other applications of this inequality include the classification of certain Onsager vortices on the sphere, the radially symmetry of solutions to Gaussian curvature equation on the plane, classification of solutions for mean field equations on flat tori and the standard sphere, etc. The resolution of several open problems in these areas will be presented. The work is jointly done with Amir Moradifam from UC Riverside.

### On some weighted elliptic equations

*Zongming Guo* (*Henan Normal University, China*)

**Abstract.** I will present some results for a class of weighted elliptic equations, which include embeddings of weighted Sobolev spaces, Liouville type results, regularity of solutions to the related Dirichlet problems and classification of solutions via Morse index and the applications.

## One-dimensional symmetry for the Euler equations and related semilinear elliptic equations

*François Hamel* (*University of Aix Marseille, France*)

**Abstract.** In this talk, I will discuss one-dimensional symmetry properties for the solutions of some problems in dimension 2 and in higher dimensions. We will see that, in a two-dimensional strip, a steady flow of an ideal incompressible fluid with no stationary point and tangential boundary conditions is a shear flow. The same conclusion holds for a bounded steady flow in a half-plane. The proofs are based on the study of the geometric properties of the streamlines of the flow and on one-dimensional symmetry results for the solutions of some semilinear elliptic equations. Some related one-dimensional symmetry results will also be discussed in N-dimensional slabs in any dimension N. The talk is based on some joint works with N. Nadirashvili.

## An index theory for unbounded motions of Hamiltonian systems and its applications

*Xijun Hu* (*Shandong University, China*)

**Abstract.** Index theory revealed its prominent role in the study of periodic orbits of Hamiltonian systems and its dynamical consequences are enormous. Although the index theory in the periodic case is well-established, very few results are known in the case of homoclinic orbits of Hamiltonian systems and, as far as we know, no results at all, in the case of heteroclinics and halfclinics (i.e. parametrised by a half-line) orbits. Motivated by the importance played by these motions, we develop a new index theory and we prove at once a general spectral formula for heteroclinics, homoclinics and halfclinic trajectories. We will introduce the applications in $N$-body problem, FitzHugh-Nagumo systems and Bifurcations theory.

This lecture is based on joint works with ChaoNien Chen, Alessandro Portaluri and Yuwei Ou.

## A flow towards the Aleksandrov and dual Minkowski problems

*Qirui Li* (*Australian National University, Australia*)

**Abstract.** In this talk we will discuss a Gauss curvature type flow which deforms convex hypersurfaces in $\mathbb{R}^{n+1}$ to the solutions of the Aleksandrov and dual $q$-Minkowski problem with $q \leq 0$. For $q > 0$, counterexample is given for the convergence of the flow. This is a joint work with Weimin Sheng and Xujia Wang.

## Schauder estimates for stochastic partial differential equations

*Jiakun Liu* (*University of Wollongong, Australia*)

**Abstract.** Considering stochastic partial differential equations of parabolic type with random coefficients in vector valued Holder spaces, we establish a sharp Schauder theory. The existence and ubiqueness of solutions to the Cauchy problem is also obtained. This ia a joint work with Kai Du. More recently the theory is extended to systems jointly with Fu Zhang.

## Evolution of diffusion in a mutation-selection model

*Yuan Lou* (*Renmin University of China/Ohio State University, USA*)

**Abstract.** We consider an integro-PDE model for a population structured by the spatial variables and a trait variable which is the diffusion rate. Competition for resource is local in spatial variables, but nonlocal in the trait variable. We focus on the asymptotic profile of positive steady state solutions. Our result shows that in the limit of small mutation rate, the solution remains regular in the spatial variables and yet concentrates in the trait variable and forms a Dirac mass supported at the lowest diffusion rate. Hastings and Dockery et al. showed that for two competing species in

spatially heterogeneous but temporally constant environment, the slower diffuser always prevails, if all other things are held equal. Our result suggests that their findings may well hold for arbitrarily many or even a continuum of traits. This is a joint work with King-Yeung Lam, Ohio State University.

### On the existence of nodal solutions for a class of degenerate boundary value problems

*Julián López-Gómez* (*Universidad Complutense de Madrid, Spain*)

**Abstract.** We characterize the existence of nodal solutions in a class of degenerate one-dimensional boundary value problems. This problem is rather intrincate as the solution set might contain an arbitrarily large number of components according to the size of the vanishing region of the weight function in front of the nonlinearity, which makes the mathematical analysis highly nontrivial. All the results are joint work with M. Molina-Meyer and P.H. Rabinowitz.

### Curvature flow in symmetric spaces

*James McCoy* (*University of Wollongong, Australia*)

**Abstract.** I'll discuss some recent work on fully nonlinear contraction of convex hypersurfaces to round points in the sphere and some other ambient spaces.

### On the existence of solutions to weakly coupled elliptic system with critical growth

*Angela Pistoia* (*Università di Roma "La Sapienza", Italy*)

**Abstract.** We consider a critical weakly coupled elliptic systems in a domain $D$ in $\mathbb{R}^N$ with $N = 3, 4$. We prove the existence of positive solutions which blow-up around one or more points in $D$ provided some conditions are satisfied.

The results have been obtained in collaboration with Nicola Soave and Hugo Tavares.

### The Hardy-Schrödinger operator with interior singularity: mass and blow-up analysis

*Frédéric Robert* (*Université de Lorraine, France*)

**Abstract.** We consider the remaining unsettled cases in the problem of existence of positive solutions for the Dirichlet value problem $L_\gamma u - \lambda u = \frac{u^{2^*(s)-1}}{|x|^s}$ on a smooth bounded domain $\Omega$ in $\mathbb{R}^n$ ($n \geq 3$) having the singularity 0 in its interior. Here $\gamma < \frac{(n-2)^2}{4}$, $0 \leq s < 2$, $2^*(s) := \frac{2(n-s)}{n-2}$ and $0 \leq \lambda < \lambda_1(L_\gamma)$, the latter being the first eigenvalue of the Hardy-Schrödinger operator $L_\gamma := -\Delta - \frac{\gamma}{|x|^2}$. The higher dimensional case (i.e., when $\gamma \leq \frac{(n-2)^2}{4} - 1$) has been settled sometime ago. In this paper we deal with the case when $\frac{(n-2)^2}{4} - 1 < \gamma < \frac{(n-2)^2}{4}$. If either $s > 0$ or $\{s = 0 \text{ and } \gamma > 0\}$, we show that a solution is guaranteed by the positivity of the "Hardy-singular internal mass" of $\Omega$, a notion that we introduce herein. On the other hand, the classical positive mass theorem is needed for when $s = 0$, $\gamma \leq 0$ and $n = 3$, which in this case is the critical dimension. This is joint work with Nassif Ghoussoub (UBC, Vancouver).

### Lower order regularity in the critical dimension.

*Nirav Shah* (*The University of Queensland, Australia*)

**Abstract.** In this talk we will consider bounded, weak solutions to the following vector-valued Euler-Lagrange system:

$$-\operatorname{div}\big(A(x,u)Du\big) = g \quad \text{in } \Omega \tag{2}$$

for $\Omega$ a bounded open domain in $\mathbb{R}^2$. Under quite mild assumptions on the principal part, $A(x,u)Du$, and inhomogeneous part, $g$, we will show that every bounded weak solution of (2) is Hölder continuous. Since the dimension of $\Omega$ is 2 we are in the critical setting, and hence, cannot use the Sobolev embedding theorem to deduce Hölder continuity. This result resolves a conjecture by Beck and Frehse (2013).

### Fourth order elliptic problems and corners

*Guido Sweers* (*University of Cologne, Germany*)

**Abstract.** When moving from second to fourth order elliptic boundary value problems, a main difficulty that appears, is the loss of the maximum principle. Without the related order preserving property it is less clear how a source term will influence a solution. In order to see the difference between second and fourth order problems, domains with corners emphasize possible unexpected effects. In my talk I hope to survey some of those special effects.

### $L^p$ estimates for eigenfunctions on manifolds with boundary

*Melissa Tacy* (*Australian National University, Australia*)

**Abstract.** Measuring the $L^p$ mass of an eigenfunction allows us to determine its concentration properties. On a manifold without boundary such estimates follow from short time properties of the wave or semiclassical Schrödinger propagators. However the presence of a boundary opens the possibility for multiple reflections even in short time. This will lead to greater concentration of the eigenfunction (displayed by higher $L^p$ norms). It is known, for example, that the whispering gallery modes show this higher concentration. In this talk I will introduce a method of studying the boundary $L^p$ problem semiclassically by considering an exact solution to the boundary problem and an approximate solution to the ambient Helmholtz equation.

### Hölder estimates for second-order operators with mixed boundary conditions

*Tom ter Elst* (*University of Auckland, New Zealand*)

**Abstract.** We investigate linear elliptic, second-order boundary value problems with mixed boundary conditions on domains with a rough boundary. Assuming only boundedness/ellipticity on the coefficient function and very mild conditions on the geometry of the domain, including a very weak compatibility condition between the Dirichlet boundary part and its complement, we prove Hölder continuity of the solution. Moreover, Gaussian Hölder estimates for the corresponding heat kernel are derived.

This is joint work with Joachim Rehberg.

### From optimal transportation to conformal gemetry

*Neil Trudinger* (*Australian National University and University of Wollongong, Australia*)

**Abstract.** The original Yamabe problem concerning conformal deformation of Riemannian metrics on compact manifolds to those with constant scalar curvature opened up a vast area of critical growth problems in semilinear elliptic equations. In this talk we will consider extensions to nonlinear curvatures and manifolds with boundary and indicate how curvature notions in optimal transportation can be applied to the estimation of second derivatives. As a result we obtain estimates that were previously only known for prescribed boundary mean curvature and umblilic boundaries.

### Inverse Scattering on Surfaces

*Leo Tzou* (*University of Sydney, Australia*)

**Abstract.** On a surface with Euclidean ends we recover the magnetic Schrödinger operator, up to gauge equivalence, by wave scattering. This problem turns out to be intimately related to the topology of the surface and we see how classical index theorems such Riemann-Roch can play a significant role in understanding this relationship.

### Blowing-up solutions for critical elliptic equations in low dimensions

*Jérôme Vétois* (*McGill University, Canada*)

**Abstract.** I will discuss the question of existence of blowing-up, single-peak and multi-peak solutions for smooth perturbations of a critical elliptic equation on a closed manifold. I will present new existence results obtained with Frédéric Robert and Pierre-Damien Thizy in the case of low-dimensional manifolds.

### The structure of finite Morse index solutions of phase transition models in the plane

*Kelei Wang* (*Wuhan University, China*)

**Abstract.** The stability and finite Morse index condition plays an important role in the classfication of entire solutions of various elliptic equations. For the Allen-Cahn equation, it is conjectured that fintie Morse index solutions have finitely many ends. In this talk I will report some tools developed for the proof of this conjecture on some related phase transition models.

### The $p$-Minkowski problem

*Xu-Jia Wang* (*Australian National University, Australia*)

**Abstract.** The $p$-Minkowski problem is an extension of the classical Minkowski problem. It concerns the existence, uniqueness, and regularity of closed convex hypersurfaces with prescribed Gauss curvature. The Minkowski problem has been studied by many people in the last century and has been completely resolved.

To study the $p$-Minkowski problem, one is led to a Monge-Ampère equation on the unit sphere, which is related to the Blaschke-Santalo inequality. The existence, uniqueness, and regularity of solutions depend on the parameter $p$. For example for one range of $p$ we have the uniqueness of solutions and for another range of $p$ we may have infinitely many solutions. As one will see, the $p$-Minkowski problem shares many similar properties as the semilinear elliptic equations on the sphere. In this talk we will review the development in the study of the $p$-Minkowski problem and discuss some recent works on the problem.

### Existence, uniqueness, and bifurcation of solutions for Schrödinger systems

*Zhitao Zhang* (*Chinese Academy of Sciences, China*)

**Abstract.** We are concerned with the important system of nonlinear Schrödinger equations with linear and (or) nonlinear couplings which arises from Bose-Einstein condensates, we prove phase segregation results of the limit competition case, we use variational methods to prove the existence of ground state and bound state solutions of the systems, and use bifurcation theory to get structure of positive solutions. We give some partial symmetry results of positive solutions by Morse index and obtain existence and uniqueness of positive solution via synchronized solution techniques.

## Propagation speed of nonlinear porous medium equation

*Maolin Zhou* (*University of New England, Australia*)

**Abstract.** In this talk, we consider the porous medium equation (PME) coupled with KPP type of reaction term. In PME, there is a free boundary given compactly supported initial datum. We will show a sharp estimate on the speed of the free boundary in radially symmetry setting in higher dimensions.

# 4 List of Participants

Invited speakers are marked with *

*Chang, Ting-Ying* (University of Sydney, Australia)
*Chen, Shibing* (Australian National University, Australia)
*Ching, Joshua* (University of Sydney, Australia)
*Chipot, Michel** (University of Zürich, Swizerland)
*Crooks, Elaine** (Swansea University, United Kingdom)
*Cîrstea, Florica* (University of Sydney, Australia)
*Dancer, Norman* (University of Sydney, Australia)
*Daners, Daniel* (University of Sydney, Australia)
*Ding, Weiwei* (University of New England, Australia)
*Droniou, Jérôme** (Monash University, Australia)
*Du, Yihong* (University of New England, Australia)
*Grossi, Massimo** (Università di Roma "La Sapienza", Italy)
*Gui, Changfeng** (University of Texas at San Antonio, USA)
*Guo, Zongming** (Henan Normal University, China)
*Hamel, François** (University of Aix Marseille, France)
*Hauer, Daniel* (University of Sydney, Australia)
*Hu, Xijun** (Shandong University, China)
*Li, Qirui* (Australian National University, Australia)
*Liu, Jiakun** (University of Wollongong, Australia)
*Lou, Yuan** (Renmin University of China/Ohio State University, USA)
*López-Gómez, Julián** (Universidad Complutense de Madrid, Spain)
*McCoy, James** (University of Wollongong, Australia)
*Pistoia, Angela** (Università di Roma "La Sapienza", Italy)
*Robert, Frédéric** (Université de Lorraine, France)
*Shah, Nirav* (The University of Queensland, Australia)
*Sweers, Guido** (University of Cologne, Germany)
*Tacy, Melissa** (Australian National University, Australia)
*ter Elst, Tom** (University of Auckland, New Zealand)
*Trudinger, Neil** (Australian National University and University of Wollongong, Australia)
*Tzou, Leo** (University of Sydney, Australia)
*Vétois, Jérôme** (McGill University, Canada)
*Wang, Kelei** (Wuhan University, China)
*Wang, Xu-Jia** (Australian National University, Australia)
*Zhang, Zhitao** (Chinese Academy of Sciences, China)
*Zhang, Zhou* (University of Sydney, Australia)
*Zhou, Maolin* (University of New England, Australia)

# 5 General information

## 5.1 Emergency Assistance

| | |
|---|---|
| ***Safety*** | Security officers patrol campus 24/7. For assistance call 6773 2099 any time. |
| ***Emergency*** | In emergency situations always call '**000**' — Police, Ambulance & Fire<br>Then call Safety & Security on 6773 2099 to provide assistance until emergency services arrive. |
| ***Police*** | Other than emergency 02 6771 0699 |
| ***Fire Station*** | Other than emergency 02 6771 5076 |

## 5.2 Address

Mary White College, Trevenna Road University of New England, Armidale, NSW, 2351
www.une.edu.au/campus-life/une-accommodation/colleges/mary-white

## 5.3 Transport and maps

Armidale Taxi — 131 008
Edwards Coaches — http://www.edwardscoaches.com.au/timetables.html
Interactive Campus Map — https://my.une.edu.au/map/
Armidale Street Maps — http://www.armidale.nsw.gov.au/tourism/maps/armidale-city-map

## 5.4 Restaurants

### Take Away Food

(All of the outlets below deliver to the UNE campus)

***Domino's Pizza*** – 02 6774 8388
4/4-10 Queen Elizabeth Drive, Armidale, https://www.dominos.com.au/menu

***Pizza Capers*** – 02 6772 9335
146 Marsh Street, Armidale, https://www.pizzacapers.com.au/

***PJ Thai*** – 0432 499 664
130 Marsh Street, Armidale, https://www.menulog.com.au/pj-thai

***Red Rooster*** – 02 6771 5111
146 Marsh Street, Armidale, http://www.redrooster.com.au/menu/

***Mun Hing Restaurant*** – Chinese Food – 02 6772 4432
236 Beardy Street, Armidale

### Other off campus options – Dine In

***The Royal Hotel*** – 02 67721444 107 Beardy Street, Armidale
***Whitebull Hotel*** – 02 6772 3833 117 March Street, Armidale
***The Grand Hotel*** – 02 6772 3149 251 Rusden Street, Armidale
***The New England Hotel Newie Brasserie*** – 02 6711 1186 196 Beardy Street, Armidale
***Red Grapevine Restaurant & Bar*** – 02 6772 2822 113 Jessie Street, Armidale
***The Coughing Gherkin*** – 02 6771 4008 1/117 Beardy Street, Armidale

For other options check out TripAdvisor
https://www.tripadvisor.com.au/Restaurants-g255315-Armidale_New_South_Wales.html

# Armidale City Centre Map


M = Motel
H = Hotel (Pub)
R = Roundabout
F = Fuel
C = Chemist
I = Internet
P = Parking

1 = Folk Museum
2 = Library (with free internet)
3 = Armidale Outdoors
4 = Hanna's Arcade
5 = Pet Shop

| | |
|---|---|
| ANZ: | East Mall |
| CBA: | Cnr Dangar Street and Cinders Lane |
| Greater Building Society: | 101 Faulkner Street |
| NAB | Cnr Dangar Street and The Mall |
| Newcastle Permanent: | Cnr Dangar Street and Cinders Lane |
| New England Mutual: | Cnr Dangar and Rusden Streets |
| Westpac: | Cnr East Mall and Faulkner Street |
| St George Bank: | 155 Beardy Street Mall |

## ~ Armidale Guided Heritage Tour ~

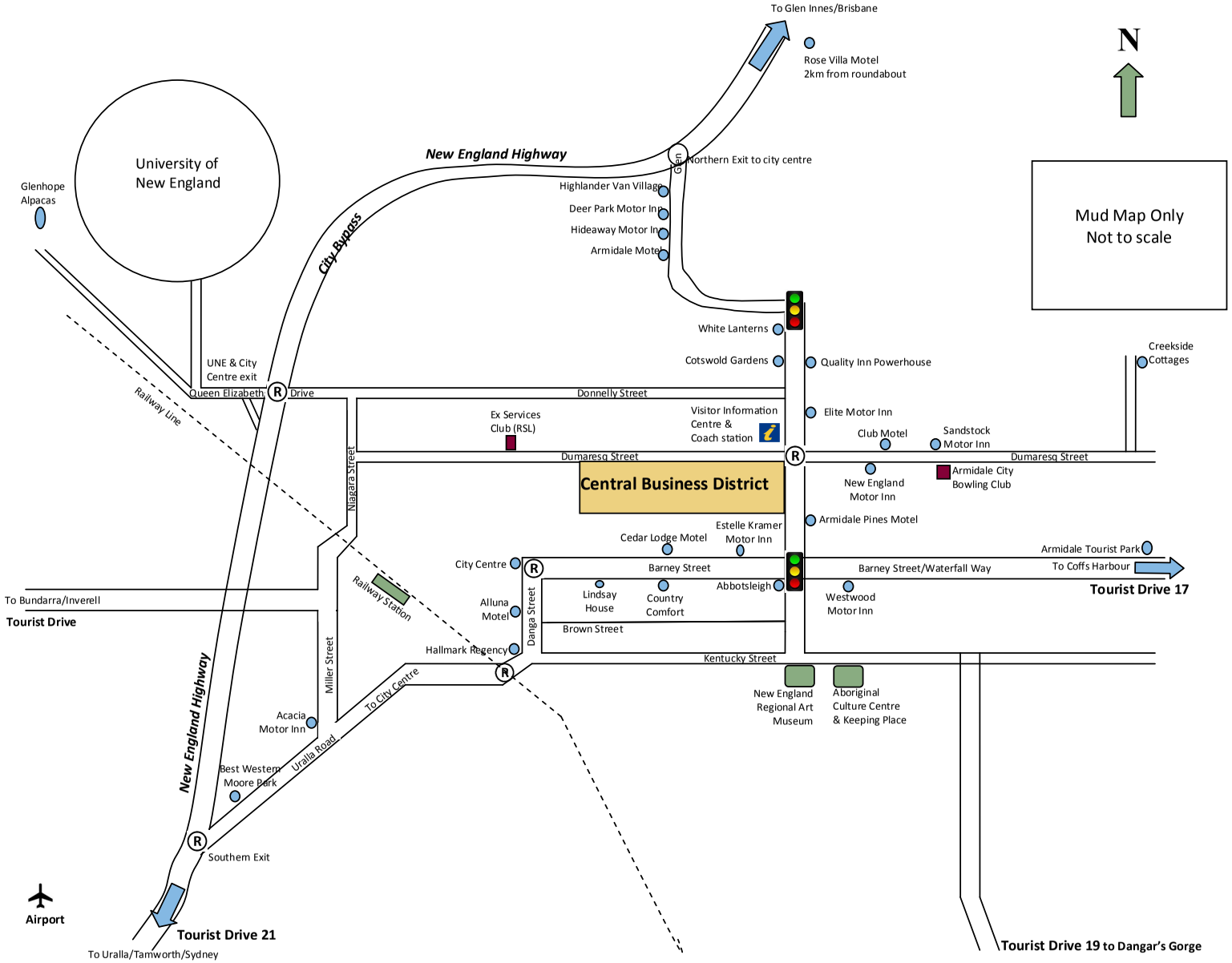
Minibus Tour, 2-2.5 hours

Leaves at 10.00am, 7 days a week, from the Armidale Visitor Information Centre

**Donation welcome**

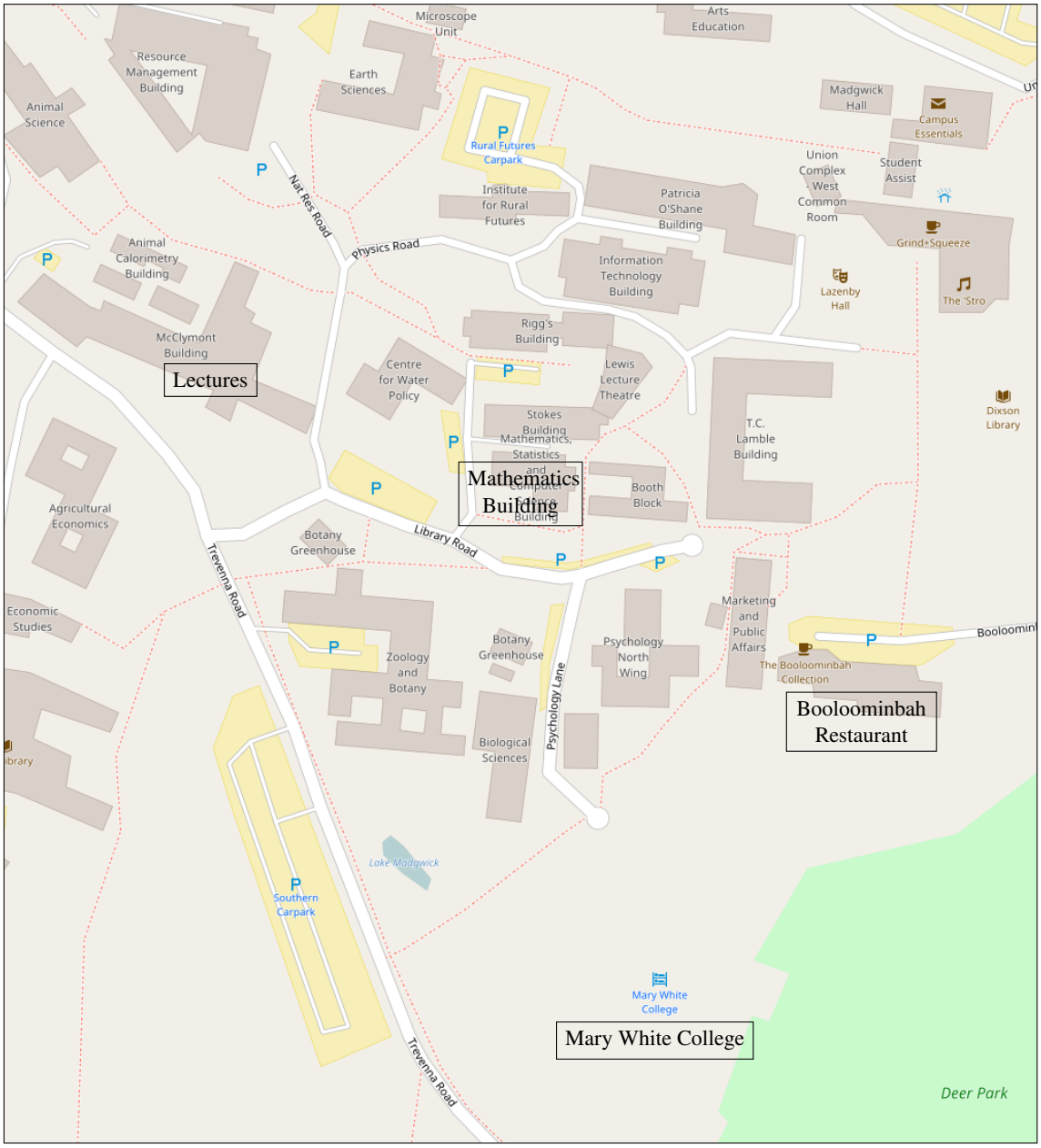
For bookings phone: 02 6770 3888

# Armidale Accommodation Map



## 5.5 Campus map

The map shows the part of the University of England campus showing relevant locations for the conference.




Map from openstreetmap.org