Perspectives on Parabolic Points in Holomorphic Dynamics
March 29 – April 3.

MEALS

*Breakfast (Buffet): 7:00–9:30 am, Sally Borden Building, Monday–Friday
*Lunch (Buffet): 11:30 am–1:30 pm, Sally Borden Building, Monday–Friday
*Dinner (Buffet): 5:30–7:30 pm, Sally Borden Building, Sunday–Thursday
Coffee Breaks: As per daily schedule, in the foyer of the TransCanada Pipeline Pavilion (TCPL)
*Please remember to scan your meal card at the host/hostess station in the dining room for each meal.

MEETING ROOMS

All lectures will be held in the lecture theater in the TransCanada Pipelines Pavilion (TCPL). An LCD projector, a laptop, a document camera, and blackboards are available for presentations.

SCHEDULE

Sunday
16:00 Check-in begins (Front Desk - Professional Development Centre - open 24 hours)
17:30–19:30 Buffet Dinner, Sally Borden Building
20:00 Informal gathering in 2nd floor lounge, Corbett Hall (if desired)
Beckers and a small assortment of snacks are available on a cash honor system.

Monday
7:00–8:45 Breakfast
8:45–9:00 Introduction and Welcome by BIRS Station Manager, TCPL
9:00–10:00 Hubbard, Parabolic Implosion Intro lecture
Coffee Break, TCPL
10:30–11:30 Shishikura, Dynamical charts for irrationally indifferent fixed points and Denjoy odometer

11:30–13:00 Lunch
13:00–14:00 Guided Tour of The Banff Centre; meet in the 2nd floor lounge, Corbett Hall
14:00 Group Photo; meet in foyer of TCPL (photograph will be taken outdoors so a jacket might be required).
14:15–15:05 Bedford, Introduction to diffeomorphisms of $C^2$ with semi-parabolic fixed point I
Coffee Break, TCPL
15:35–16:25 Cheraghi,
Legs stretching
16:40–17:30 Uhre,
17:30–19:30 Dinner
19:45–20:30 Yampolsky, Beyond cylinder renormalization
Tuesday
7:00–9:00  Breakfast
9:00–10:00  Cheritat, Parabolic Implosion minicourse II
            Coffee Break, TCPL
10:30–11:30  Epstein, Geometric Limits in Holomorphic Dynamics I.
11:30–13:30  Lunch
14:00–14:50  Petersen, Double Parabolic Implosion.
            Coffee Break, TCPL
15:20–16:10  Dudko, Ecalle-Voronin invariants via resurgent theory.
            Legs stretching
16:30-17:20  Yampolsky, Fixed point of parabolic renormalization.
17:30–19:30  Dinner

Wednesday
7:00–9:00  Breakfast
9:00–10:00  Hubbard, Parabolic Implosion minicourse III
            Coffee Break, TCPL
10:20–11:10  Bedford, Introduction to diffeomorphisms of \(C^2\) with semi-parabolic fixed point II
            Legs stretching
11:20–12:10  Lomonaco,
11:30–13:30  Lunch
            Free Afternoon
17:30–19:30  Dinner
19:45–  Poster Session

Thursday
7:00–9:00  Breakfast
9:00–10:00  Cheritat, Parabolic Implosion minicourse VI
            Coffee Break, TCPL
10:30–11:30  Rousseau, Modulus of analytic classification of a generic germ of analytic family unfolding
            a parabolic point of co-dimension \(k\).
11:30–13:30  Lunch
14:00–14:50  Roesch, Cubic parabolic slice.
            Coffee Break, TCPL
15:20–16:10  Bouillot,
            Legs stretching
16:30-17:20  Epstein, Geometric Limits in Holomorphic Dynamics II.
17:30–19:30  Dinner

Friday
7:00–9:00  Breakfast
9:00–9:50  Mukherjee, Discontinuity of the straightening map in anti-holomorphic dynamics.
            Coffee Break, TCPL
10:10–11:00  Inou, Parabolic implosion in anti-holomorphic family.
            Legs stretching
11:10–12:00  Open Problems Session
            ** NB Checkout of rooms by 12 noon. **
12::15–13:30  Lunch
            Free Afternoon

** 5-day workshop participants are welcome to use BIRS facilities (BIRS Coffee Lounge, TCPL and Reading
Room) until 3 pm on Friday, although participants are still required to checkout of the guest rooms by 12
noon. **
ABSTRACTS
(in alphabetic order by speaker surname)

Speaker: Eric Bedford (SUNY StonyBrook)
Title: Introduction to diffeomorphisms of $C^2$ with semi-parabolic fixed point I, II
Abstract: We give an introduction to the work of Ueda which describes the local behavior of a 2-dimensional diffeomorphism at a semi-parabolic fixed point. This describes the semi-parabolic basin and gives the analogue of the repelling petal. As time permits, we discuss two sorts of perturbations of such maps. One of them is the perturbation for which the fixed point splits into a saddle/attractor pair. The other is in the direction of implosion, for which we will describe a paper with Smillie and Ueda: arXiv:1208.2577.

Speaker: Olivier Bouillot (Université Paris Est - Marne-la-Vallée)
Title: TBA
Abstract:

Speaker: Arnaud Cheritat (Université de Bordeaux)
Title: Implosion and Vector Fields.
Abstract: I will compare parabolic points and their perturbation to vector fields. This will be applied to:
- a normalization convention for Fatou coordinates for a parabolic point with several petals
- estimates on perturbed Fatou coordinates (parabolic implosion).

Speaker: Davoud Cheraghi (Kings College London)
Title: TBA
Abstract:

Speaker: Artem Dudko (SUNY StonyBrook)
Title: Ecalle-Voronin invariants via resurgent theory
Abstract: Given a holomorphic germ with a simple parabolic fixed point at the origin the Fatou coordinates have common asymptotic expansion. Using Ecalle’s alien operators I will show how to reconstruct Ecalle-Voronin analytic invariants from the formal Borel transform of this expansion and write each of the invariants as a convergent numerical series.

Speaker: Adam L. Epstein (University of Warwick)
Title: Geometric Limits in Holomorphic Dynamics I + II
Abstract: We present a formal definition of the notion of geometric limit of conformal dynamical systems, and outline a proof of a Structure Theorem for the geometric limits of algebraically convergent sequences of rational maps.

Speaker: John Hamal Hubbard (Cornell University)
Title: TBA
Abstract:

Speaker: Hiroyuki Inou (Kyoto University)
Title: Parabolic implosion in anti-holomorphic family.
Abstract: Some anti-holomorphic families can be considered as a real-analytic sub-family of a two or more
dimensional family of holomorphic dynamics with a special symmetric structure. In such a family, one and two-dimensional phenomena coexist. We study the family of quadratic (or unicritical) anti-holomorphic polynomials and how parabolic implosion in this family is related to some two-dimensional phenomena.

**Speaker:** Luna Lomonaco (University of Sao Paulo)
**Title:** TBA
**Abstract:**

**Speaker:** Sabyasachi Mukherjee (Jacobs University Bremen)
**Title:** Discontinuity of the straightening map in anti-holomorphic dynamics.
**Abstract:** It is well known by classical works of Douady and Hubbard that the ‘straightening map’ from a baby Mandelbrot set to the original one is a homeomorphism (which explains why the Mandelbrot set contains infinitely many small copies of itself). The corresponding situation for parameter spaces of higher degree polynomials is much more complicated; there exists a wider variety of parameter space configurations, and the corresponding straightening maps are typically not as well-behaved as in the unicritical case. Inou showed that the straightening map is typically discontinuous in the presence of critical orbit relations. Inou’s proof of discontinuity of the straightening map, however, makes essential use of two complex dimensional bifurcations, and can not be applied to one-parameter families. In this talk, we will consider the tricorn, the connectedness locus of quadratic anti-holomorphic polynomials $z^2 + c$. Our main goal is to demonstrate that every odd period hyperbolic component of the tricorn is the basis of a ‘baby tricorn’ (much like the Mandelbrot set), but the straightening map from any ‘baby tricorn’ to the original one is discontinuous. This is achieved by proving that all non-real ‘umbilical cords’ of the tricorn wiggle, which generalizes a theorem of Hubbard and Schleicher, and settles a conjecture of Hubbard, Milnor and Schleicher. Time permitting, we will outline some other stark topological/analytic differences between the Mandelbrot set and the tricorn.

**Speaker:** Carsten Lunde Petersen (Roskilde University)
**Title:** Double Parabolic Implosion
In this talk I will discuss the parabolic bifurcation unfolding near the map $z + 1/z$ with a view towards the unfolding of a general parabolic bifurcation near a parabolic fixed point of multiplier 1 and degeneracy 2.
**Abstract:**

**Speaker:** Pascale Roesch (Université de Marseille)
**Title:** Cubic parabolic slice.
**Abstract:**

**Speaker:** Christiane Rousseau (Université de Montréal)
**Title:** Modulus of analytic classification of a generic germ of analytic family unfolding a parabolic point of co-dimension $k$.
**Abstract:** We present here a complete modulus of analytic classification for a germ of generic $k$-parameter family unfolding a parabolic point of co-dimension $k$. The modulus is an unfolding of the modulus of the parabolic point. It is described for generic values of the parameter. The first step is to show that the parameters are canonical. The generic values of the parameters where the fixed points are simple are covered with $C_k$ sectoral domains, where $C_k$ is the $k$-th Catalan number. Canonical changes of coordinates to the formal normal form are constructed on sectors in the variable space for parameters in each sectoral domain. The construction has a bounded limit for the other parameter values.

**Speaker:** Mitsuhiro Shishikura (Kyoto University)
**Title:** Dynamical charts for irrationally indifferent fixed points and Denjoy odometer
**Abstract:** We introduce the notion of dynamical charts for holomorphic functions with a irrationally indifferent fixed point. Dynamical charts will be constructed recursively corresponding to the steps of
near-parabolic renormalization. The combinatorics of the charts is governed by a symbolic dynamics called (modified) Denjoy odometer. As an application we describe the structure of hedgehogs.

**Speaker:** Eva Uhre (Roskilde Kathedralskole, Roskilde University)
**Title:** TBA

**Abstract:**

**Speaker:** Michael Yampolsky (University of Toronto)
**Title:** Fixed point of parabolic renormalization

**Abstract:** I will present a summary of our work with O. Lanford on the Inou-Shishikura fixed point of the parabolic renormalization operator. In particular, I will describe a renormalization-invariant class analytic maps with a maximal domain of analyticity to which the fixed point belongs, and a numerical computation scheme for the fixed point which is based on resurgent asymptotic series for the Fatou coordinate.

**Speaker:** Michael Yampolsky (University of Toronto)
**Title:** Beyond cylinder renormalization

**Abstract:** I introduced the cylinder renormalization operator in the early 2000s to prove hyperbolicity of renormalization of critical circle maps. It has since appeared in many related contexts, most notably, in Inou-Shishikuras work on almost parabolic germs. Parabolic renormalization can be naturally seen as its limiting case. Recently, D. Gaydashev and I have studied higher-dimensional generalizations of the above renormalization problems. In this context, we had to replace cylinder renormalization with a different approach. In one complex dimension, we obtained new proofs of renormalization hyperbolicity results for critical circle maps and Siegel disks – without using cylinder renormalization. In two dimensions, we obtained results on rotational attractors of dissipative maps. In particular, jointly with D. Gaydashev and R. Radu, we proved that for a highly dissipative Henon map a with semi-Siegel fixed point with the golden-mean rotation number, the boundary of the Siegel disk is a topological (in fact, quasi-) circle.