CIARÁN DUNNE

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Profile

Formal methods researcher in INRIA's Deducteam group. I build tools for translating between proof assistants, SMT solvers, and other automated reasoning systems. I am also interested in the mathematical foundations of these systems, particularly approaches that combine set-theoretic and type-theoretic techniques.

Recently, I have become interested in "agentic theorem proving"; leading me to develop an editor extension and MCP server that allows models to work autonomously within the LambdaPi proof assistant.

Proof assistants Isabelle/HOL, HOL Light, Lean, Rocq, Agda · **SMT** cvc5, SMT-LIB, Eunoia
Industrial Atelier-B, TLA+ · **Languages** OCaml, Standard ML, Haskell, Python

Experience

2024–present **Postdoctoral Researcher — ENS Paris-Saclay / Télécom SudParis**

Two projects on proof-system interoperability in Deducteam:

- **`eo2lp`** *(Amazon Research Award)*: OCaml tool for exporting cvc5 proofs to LambdaPi. The translation targets *Eunoia*—a logical framework encoding cvc5's proof calculus—enabling formalisation of cvc5's inference rules and proof certificates within LambdaPi. Verified 1,000+ proof scripts across SMT-LIB fragments. [code · paper]
- **`pp2lp`** *(ANR ICSPA, with CLEARSY)*: Supported for exporting proofs from Atelier B's Predicate Prover to LambdaPi for independent proof-checking, and a LambdaPi tactic that allows using PP as an external prover for first-order logic. We also provide machine-checked proofs of correctness for PP's inference rules with respect to classical logic. The work was supported by industrial partner CLEARSY. [note]

I also contribute to LambdaPi itself: improved the LSP server, built an MCP server exposing proof-checking to AI agents, and authored an extension for the Zed code editor.

2023 **EPSRC Doctoral Prize Fellow — Heriot-Watt University**

Short postdoc building on PhD work: formal semantics for generalised set theories via transfinite iterators, connecting them with Isabelle/HOL's (co)inductive datatypes.

2019–2023 **PhD Researcher — Heriot-Watt University**

Development and formalization of *generalised set theories*: an approach to foundations aimed at exploring the trade-offs between set-theoretic and type-theoretic foundations. Built an Isabelle/HOL framework with custom Standard ML tooling, and machine-checked proofs of GST consistency. Three publications at CICM (2020–2022).

2015–2019 **BSc Mathematics & Computer Science (1st class) — Heriot-Watt University**

2017 **Summer Research Project — London Mathematical Society**

Publications

Dunne, Burel. 2025. *Automatically Translating Proof Systems for SMT Solvers to the λΠ-calculus.* paper · code
Dunne. 2023. *Towards a Set-Theoretic Foundation of Mathematics Closer to Mathematical Practice.* thesis
Dunne, Wells. 2022. *Isabelle/HOL/GST: A Formal Proof Environment for Generalized Set Theories.* paper · code
Dunne, Wells, Kamareddine. 2021. *Generating Custom Set Theories with Non-Set Structured Objects.* paper
Dunne, Wells, Kamareddine. 2020. *Adding an Abstraction Barrier to ZF Set Theory.* paper · formalization

References

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