

# Greetings from the Serpent developer team

11th International Serpent UGM

Garching, Germany, Aug. 29 – Sept 1, 2022

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Serpent is a continuous-energy Monte Carlo neutron and photon transport code:

- ▶ Developed at VTT since 2004
- ▶ Physics models for neutron, photon and coupled neutron/photon transport simulations
- ▶ Originally developed for reactor physics calculations
- ▶ OpenMP/MPI parallelization
- ▶ Support for various geometry types (CSG, mesh, CAD, etc...)
- ▶ Built-in routines for group constant generation, burnup calculation and variance reduction
- ▶ Multi-physics interface for external coupling
- ▶ User-friendly, adaptable, no external dependencies, no wrappers

*Serpent started out as a reactor physics code, but is currently used for a wide range of fission, fusion and other radiation and particle transport applications.*

Website: <https://serpent.vtt.fi/serpent/>

## Reactor physics as part of the Kraken framework:

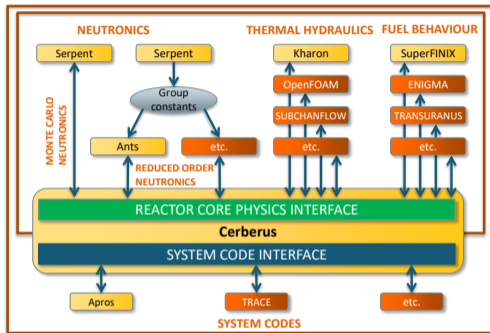
- ▶ Group constant generation for nodal neutronics code Ants
- ▶ Direct coupling as a high-fidelity solver

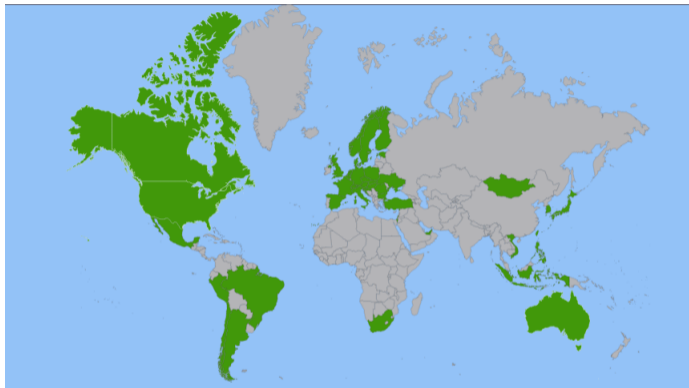
## Stand-alone applications:

- ▶ Criticality calculations
- ▶ Fuel cycle studies
- ▶ Fusion neutronics
- ▶ Radiation shielding and transport applications

## Future applications: medical physics?

Development at VTT: Jaakko Leppänen, Ville Valtavirta, Riku Tuominen, Ana Jambrina, ... + significant contribution from the Serpent user community.





User community in numbers:

- ▶ More than 1000 users, 250 organizations, 43 countries
- ▶ Statistics on users and publications no longer actively maintained

A few examples of new capabilities implemented during the past few years:

- ▶ New features for group constant generation
- ▶ Methods for sensitivity and uncertainty analysis
- ▶ Dynamic simulations
- ▶ Function expansion tallies
- ▶ Domain decomposition for large burnup calculation problems
- ▶ Automated routines for variance reduction
- ▶ New features for pebble bed reactor geometries
- ▶ Stochastic geometry model with Voronoi tessellation

New base version 2.2 was released in May 2022 (more about this tomorrow).

## Previous International Serpent User Group Meetings:

- 2011** Dresden, Germany – 2 days, 33 participants, 16 presentations
- 2012** Madrid, Spain – 3 days, 40 participants, 20 presentations
- 2013** Berkeley, USA – 3 days, 35 participants, 24 presentations
- 2014** Cambridge, UK – 3 days, 34 participants, 24 presentations
- 2015** Knoxville, USA – 3 + 1 days, 41 participants, 28 presentations
- 2016** Milan, Italy – 3 + 1 days, 40 participants, 26 presentations
- 2017** Gainesville, USA – 3 + 1 days, 28 participants, 28 presentations
- 2018** Espoo, Finland – 3 + 1 days, 39 participants, 26 presentations
- 2019** Atlanta, USA – 3 + 1 days, 35 participants, 25 presentations
- 2020** Virtual meeting organized by TUM – 3 + 1 days, 174 participants, 30 presentations
- 2021** No meeting (thanks, COVID!)

## This meeting:

- ▶ 3 + 1 days, 30 live participants + on-line, 20 technical presentations (so far)
- ▶ ~ 30 minutes reserved for presentation, questions and discussion, but the schedule is flexible
- ▶ Presentations collected at a website after the meeting (send pdf to [Jaakko.Leppanen@vtt.fi](mailto:Jaakko.Leppanen@vtt.fi))



Group photos from previous International Serpent User Group Meetings: Dresden, 2011; Madrid, 2012; Berkeley, 2013; Cambridge, 2014; Knoxville, 2015; Milan, 2016; Gainesville, 2017; Espoo, 2018; Atlanta 2019; Virtual meeting 2020.

Group photo for this meeting is on Wednesday before the reactor tour.

**Enjoy the 11th International Serpent User Group Meeting!**

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