LUCEDA PHOTONICS

Design challenges of hybrid PICs

Pierre Wahl
Luceda Photonics

take control of your photonics design flow

We want to make photonic IC designers enjoy the same power as electronic IC designers.

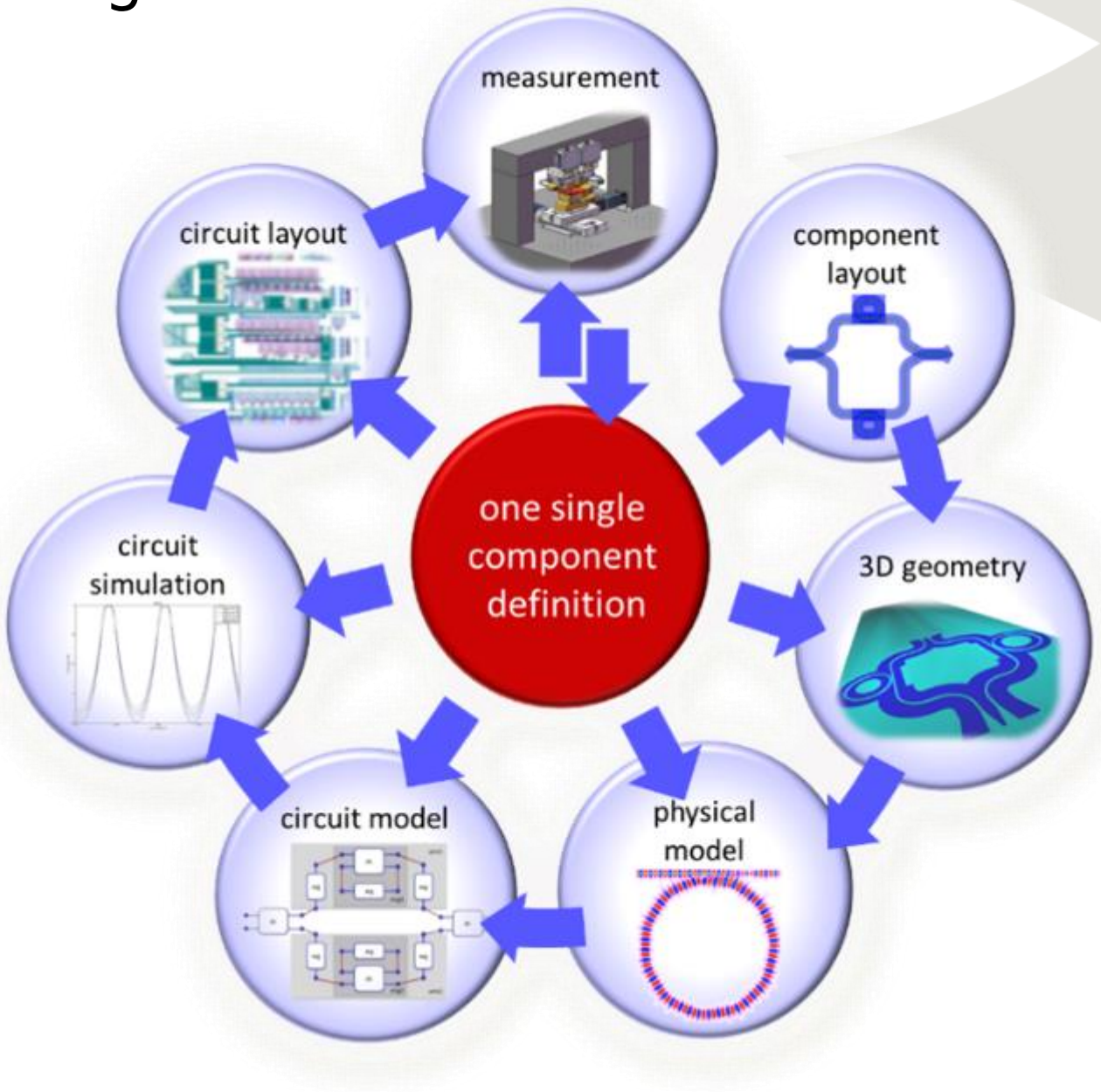
We supported the tape-out of over 400 designs within 10 years

IPKISS is validated over > 400 designs

Fast growing customer base, including 2 Fortune-500 companies

The IPKISS design framework for design automation

- From a single environment
- Component & circuit layout
- Physical & circuit simulation
- Characterization & testing
- Python powered
- Validated on >400 designs
- Native platform for IMEC & IHP PDK



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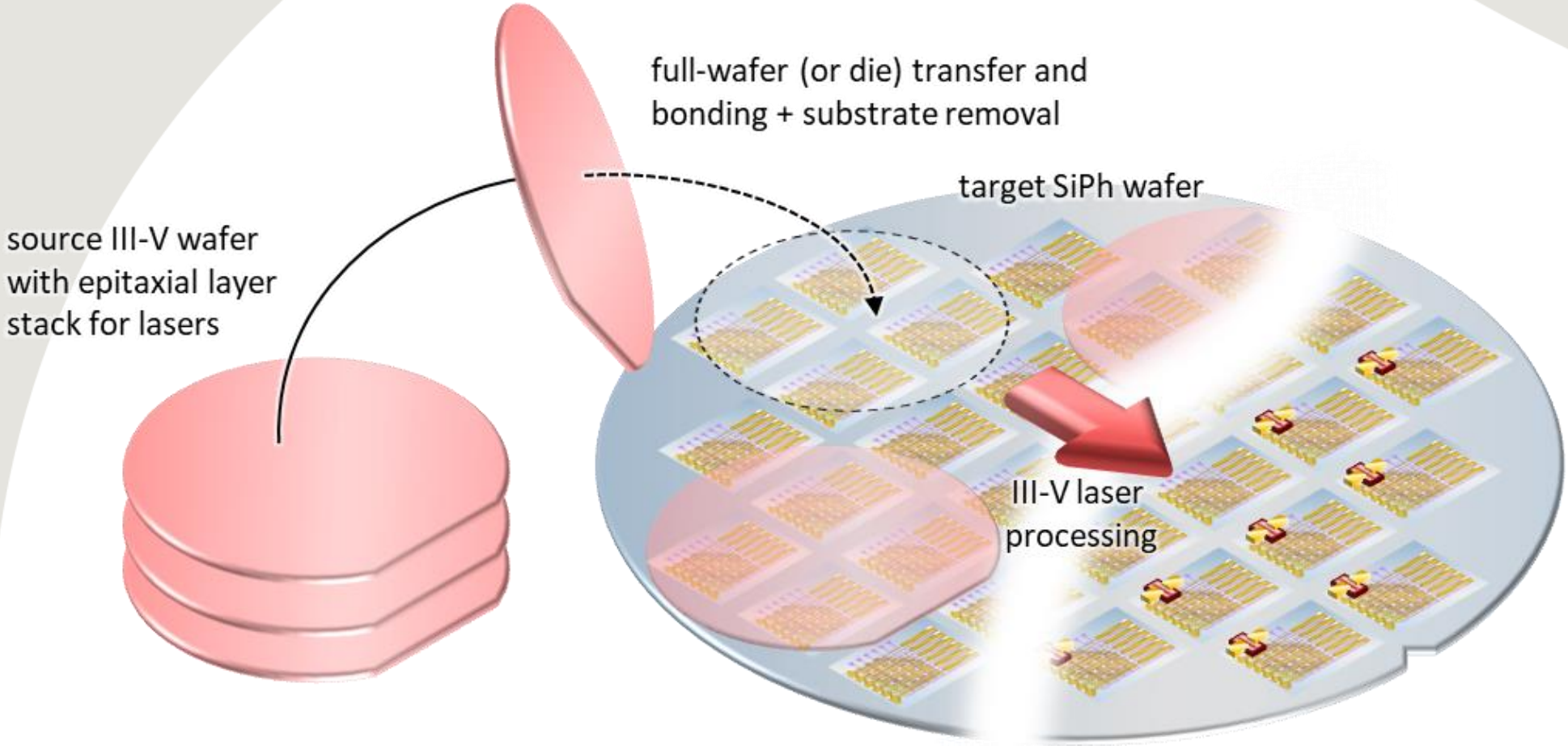
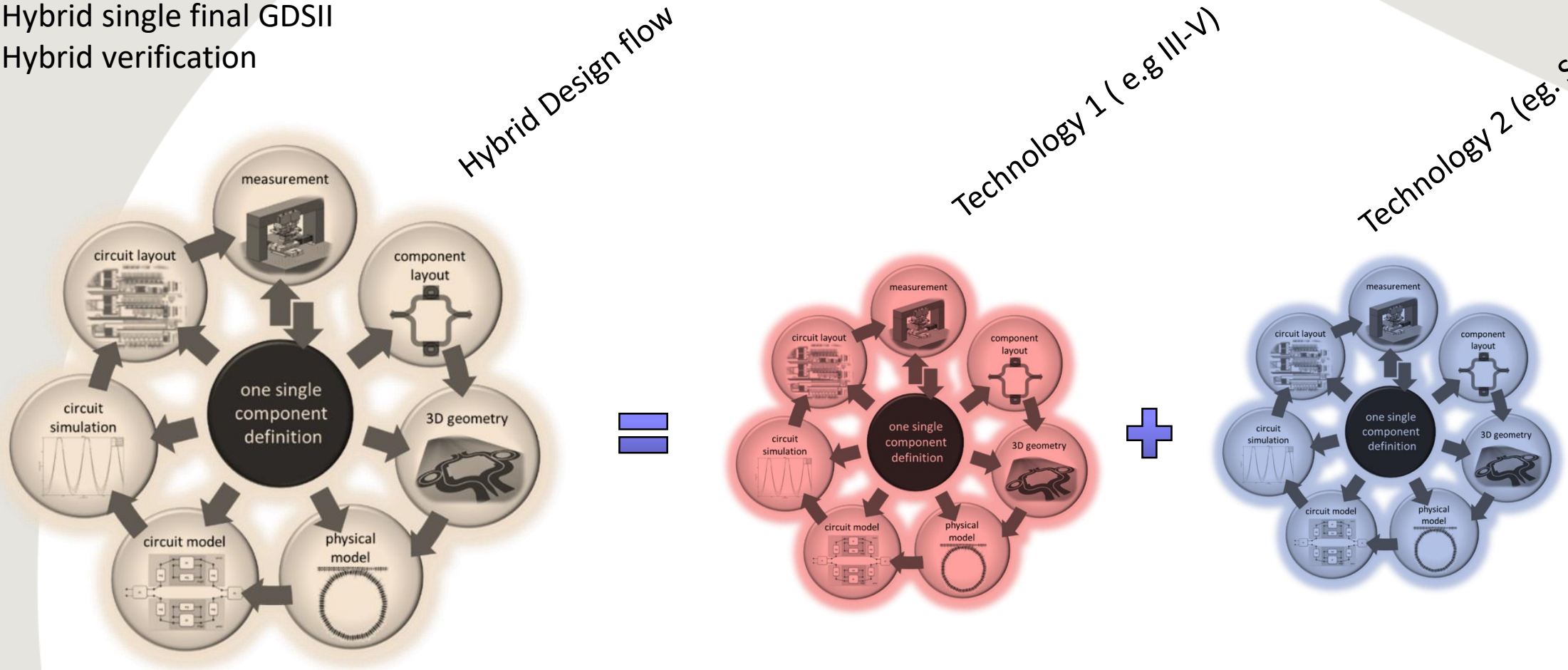
Hybrid PICs combine several technologies, foundries and material systems



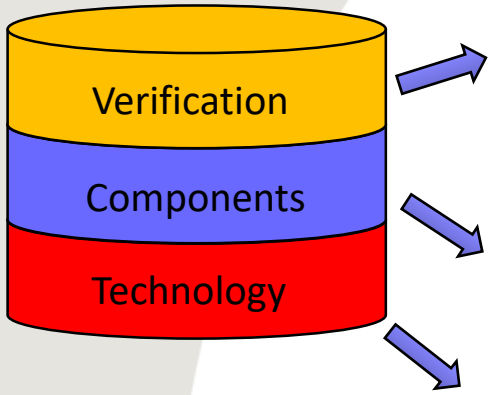
Source: Wim Bogearts - UGhent

Hybrid PICs require a hybrid automated design flow.

- Hybrid virtual PDKs
- Hybrid single final GDSII
- Hybrid verification



Single IPKISS PDK



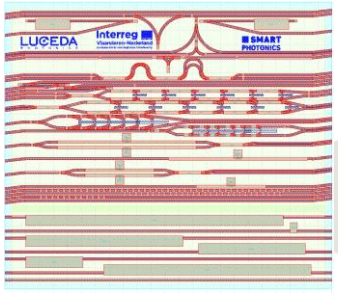
- DRC – Calibre deck
- Circuit simulation
- Layout aware verification

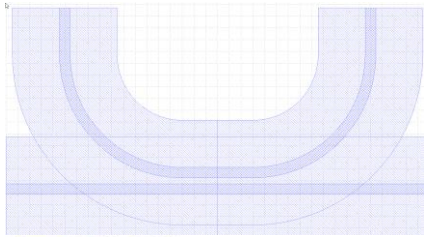
- Parametric cells
- Component models
- Waveguide templates
- Simulation recipes

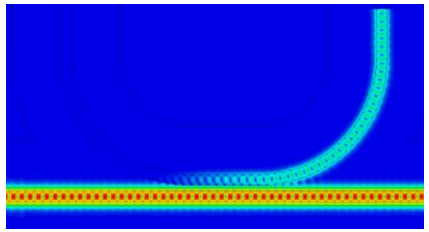
- GDSII Layers
- Virtual fabrication settings
- Design Rules
- Gridding

```
#ifdef $PDK_PATH
include $PDK_PATH/CALIBRE/DRC/layers.txt
#else
include layers.txt
#endif

#define HAVE_SHALL
#define HAVE_FULL
#define HAVE_CLROUT
#define HAVE_OPCLAD
```





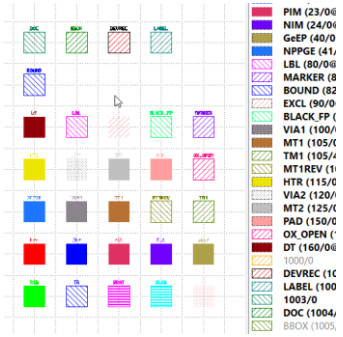


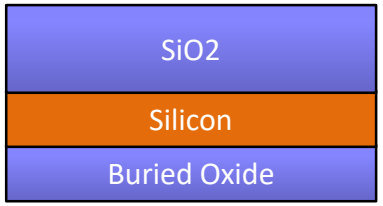
```
class MMI(i3.PCell):

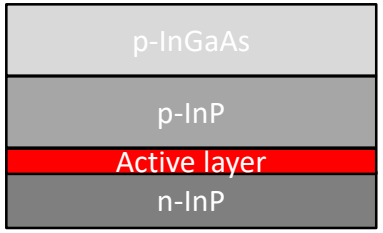
    """
    MMI with a variable number of inputs and outputs with variable width and length
    """
    n_inputs = i3.PositiveIntProperty(default=1, doc="Number of inputs")
    n_outputs = i3.PositiveIntProperty(default=2, doc="Number of outputs")
    trace_template = i3.TraceTemplateProperty(doc="Trace template at the ports")

    def _default_trace_template(self):
        return SiWireWaveguideTemplate(name=self.name + "tt")

    class Layout(i3.LayoutView):
```







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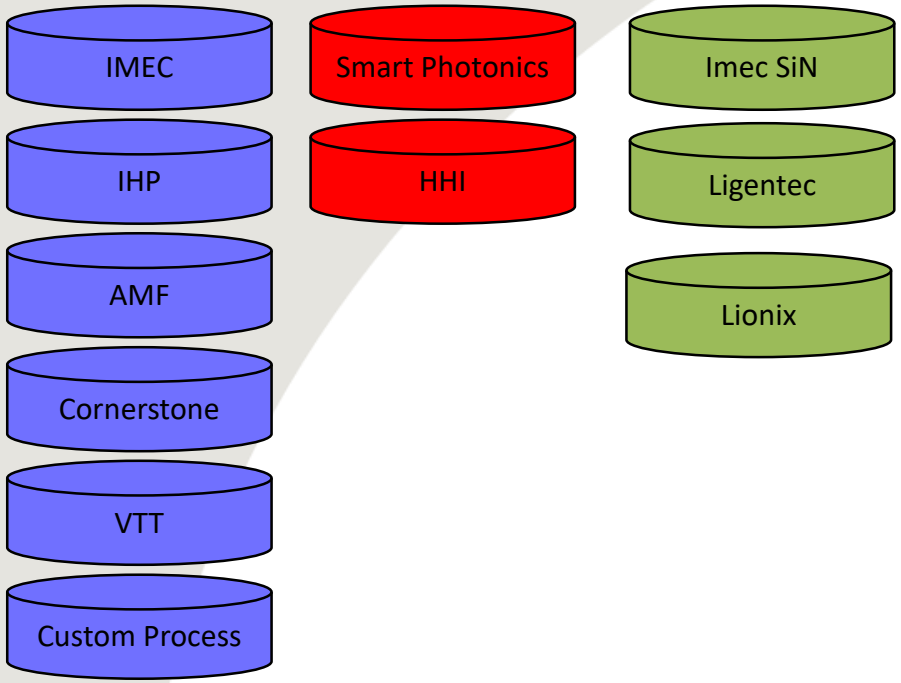
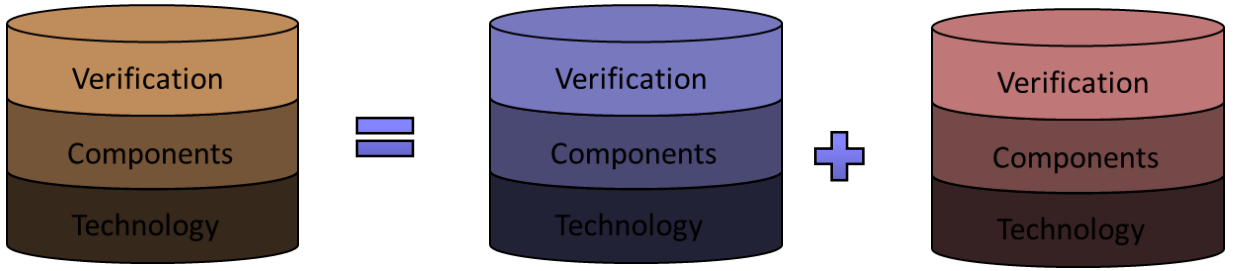
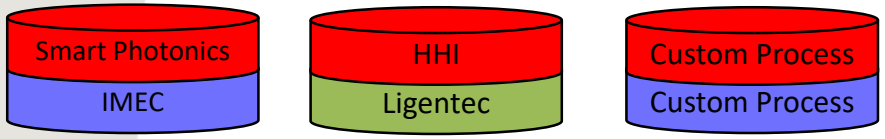
Hybrid PDKs: PDK is a design parameter



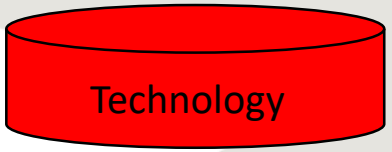

```
from isipp50g import technology as TECH1
from custom_inp import TECH2
TECH = combine_tech(TECH1, TECH2)
```



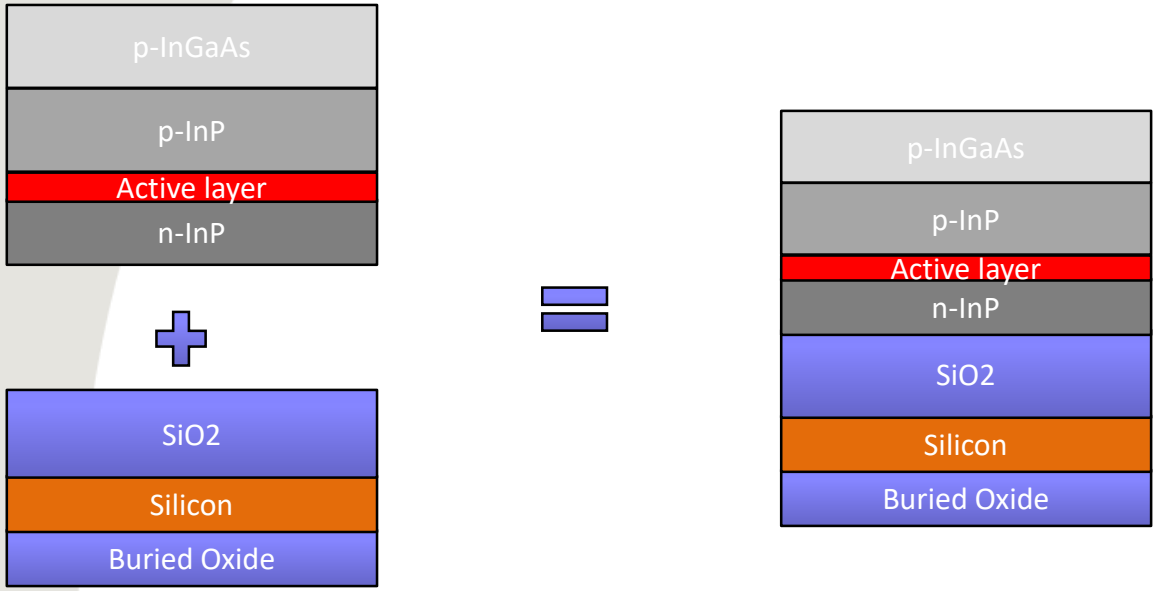


Virtual hybrid PDK

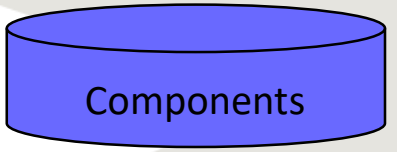
Virtual hybrid technology



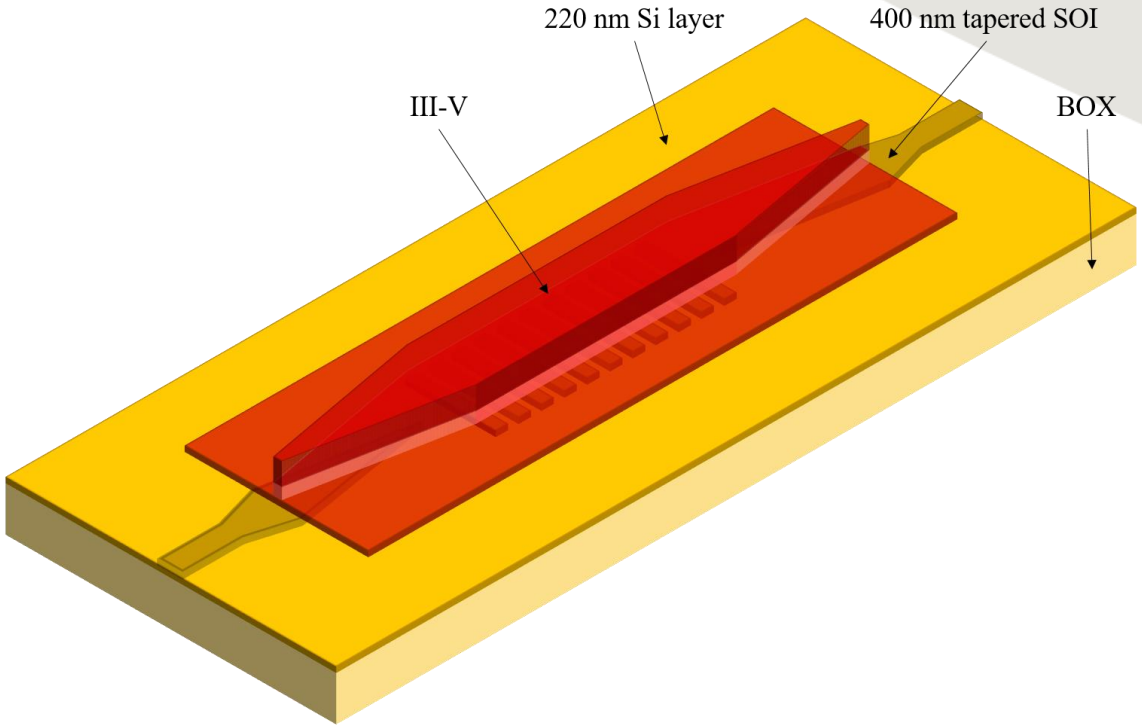
- Virtual technology is created that contains all layers as if it was a single process
- Additional layers are added (eg. Keep out layers)
- Material Stacks are added on top of each other (assumes planarization)

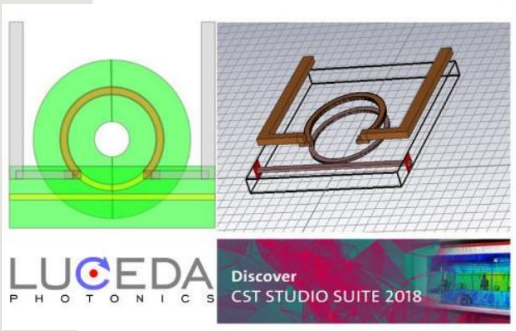


Components



- All existing components remain available in the virtual TECH.
- Possibility of creating **hybrid** components that address both technologies as a single component
- Simulation recipes take advantage of the full virtual layer stack.
- Allowing separation to have “technology agnostic” components.
- Allowing the automation of model extraction using Multiphysics simulations





Verification by DRC


```
#ifdef $PDK_PATH
include $PDK_PATH/CALIBRE/DRC/layers.txt
#else
include layers.txt
#endif

#define HAVE_SHALL
#define HAVE_FULL
#define HAVE_CLROUT
#define HAVE_OPCLAD
```

=

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#define HAVE_CLROUT
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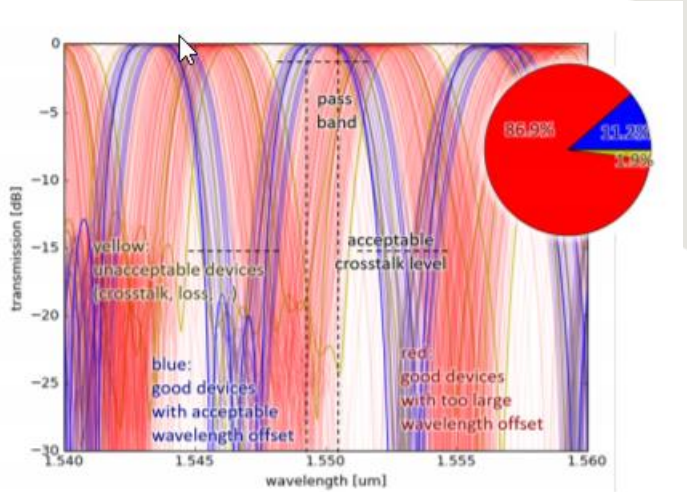
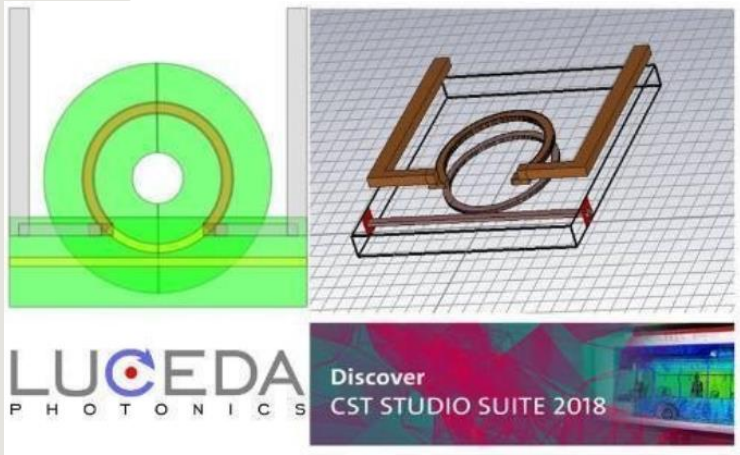
```

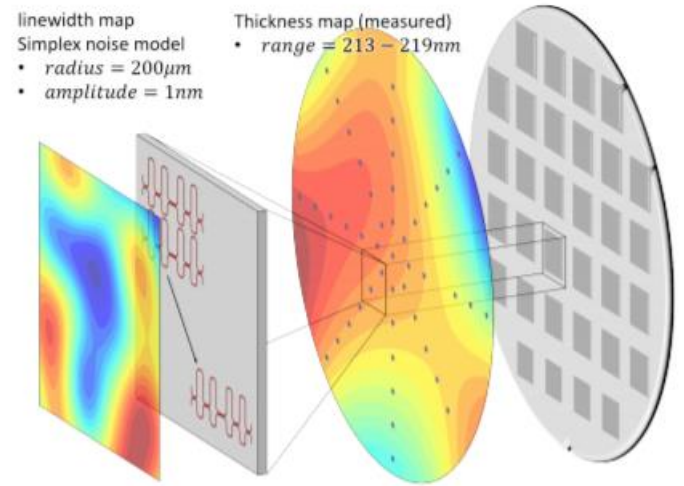
- Design rules are executed with a combined DRC deck on a single GDSII
- Additional rules can be added.
  - Keep out distances
  - Minimum overlap
  - …

Verification by circuit simulation

- Strong link between layout and circuit simulation.
- Strong automation of component model generation
- Incorporate “location dependent” parameters into the simulation
  - Location dependent temperature (laser – SOA)
  - Location dependent process variation (varying thicknesses)



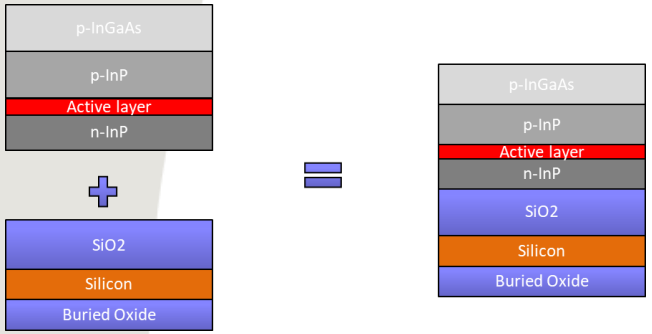


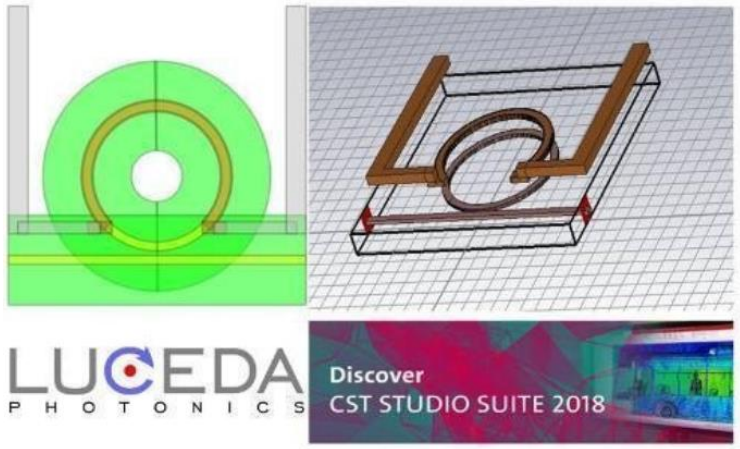


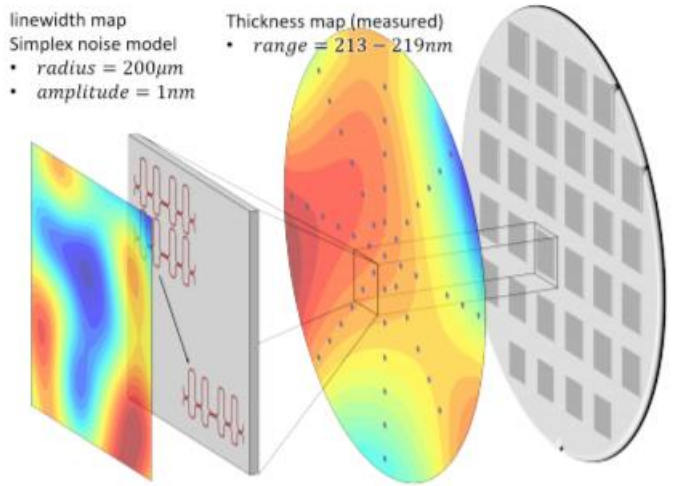
Bogaerts, Wim, Umar Khan, and Yufei Xing. "Layout-Aware Yield Prediction of Photonic Circuits

Conclusion

- Luceda provides very flexible and integrated design flow
- Virtual hybrid PDKs
  - Virtual technology
  - Hybrid component design
  - Hybrid verification strategies

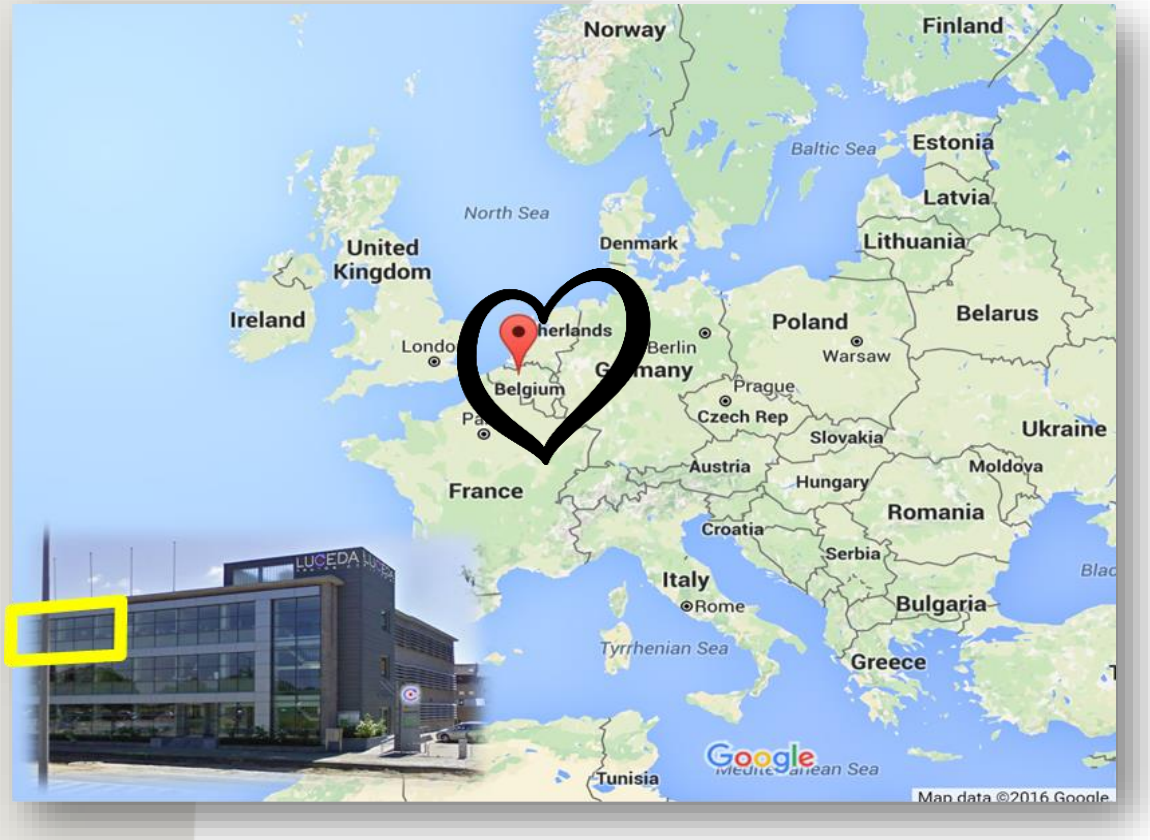






Luceda Photonics – We are hiring

Located in Dendermonde – Belgium PIC Region: Gent, Leuven, Aachen, Eindhoven



Work with several Fortune 500 companies & advanced startups on trailblazing PIC Design

You are

- ✓ An expert in computer programming
- ✓ A Pre- and post sales integrated photonics application expert

You are

- ✓ Excited to work in an international team
- ✓ Eager to interact with others

Come talk to us, send us an email: hr@lucedaphotonics.com

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