Some thoughts on writing a successful ERC proposal

Wim Bogaerts

ERC Consolidator Grant – Info Session
23 October 2017

GHENT UNIVERSITY

imec
embracing a better life

European Research Council

MY ERC CONSOLIDATOR GRANT: PhotonICSWARM

Photonic Integrated Circuits using

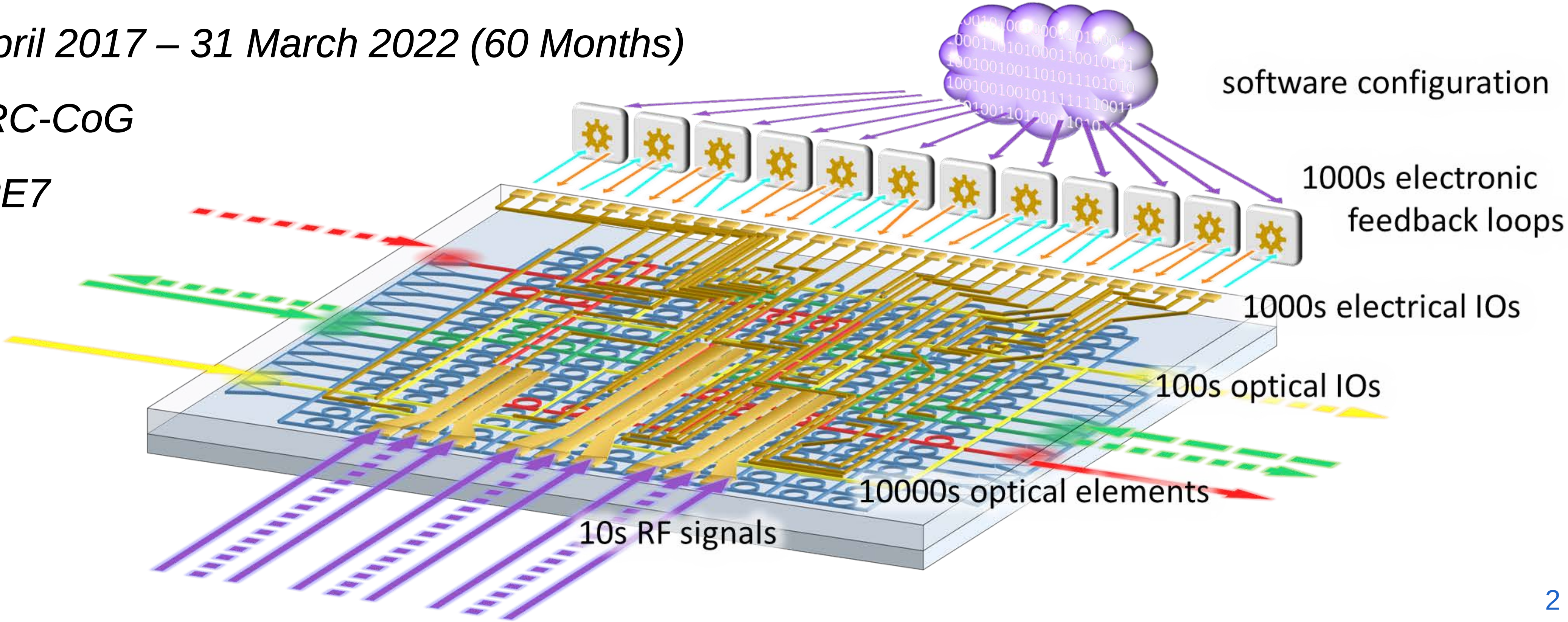
Scattered Waveguide elements in an Adaptive, Reconfigurable Mesh.

Host Institute: Ghent University (Universiteit Gent)

Duration: 1 April 2017 – 31 March 2022 (60 Months)

Call: 2016-ERC-CoG

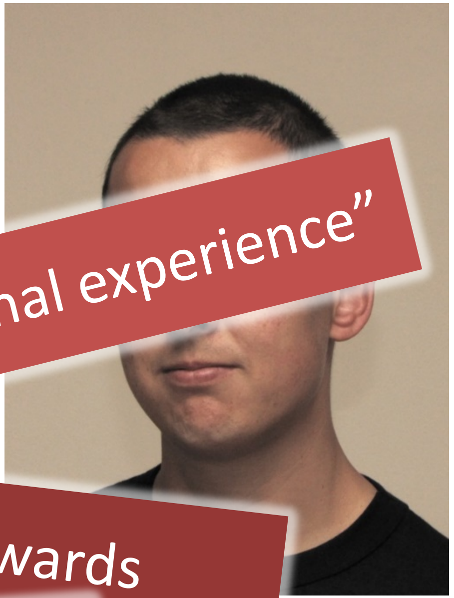
Committee: PE7



GHENT UNIVERSITY imec

My Personal Background

- M.Sc. Engineering - Applied Physics (Burgerlijk Natuurkundig Ir.)
  1998 – Ghent University
- Ph.D. EE. Engineering (Photonics)
  2004 – Ghent University, imec
- FWO Postdoctoral researcher
  2004 – 2010 – Ghent University, imec
- Tenure track lecturer in 2010
- Senior Lecturer in 2011
- Black belt in LEAN in 2013
- Spin-off company *Luceda Photonics* in 2014
  (remained part-time at UGent)
- Returned full-time to Ghent University in 2016



No "international experience"

No prizes and awards

No formal project coordination

Not a member of prestigious review boards

No personal *Nature* papers

an 2016):
- 115 journal papers
- 15 as first author
- 20 as last author
- vited
- omotor
- 5 bo
- H-index: 38

GHENT UNIVERSITY imec

A Nice Track Record Helps, but it is not Everything…

~3000 candidates

All smart people with good creds

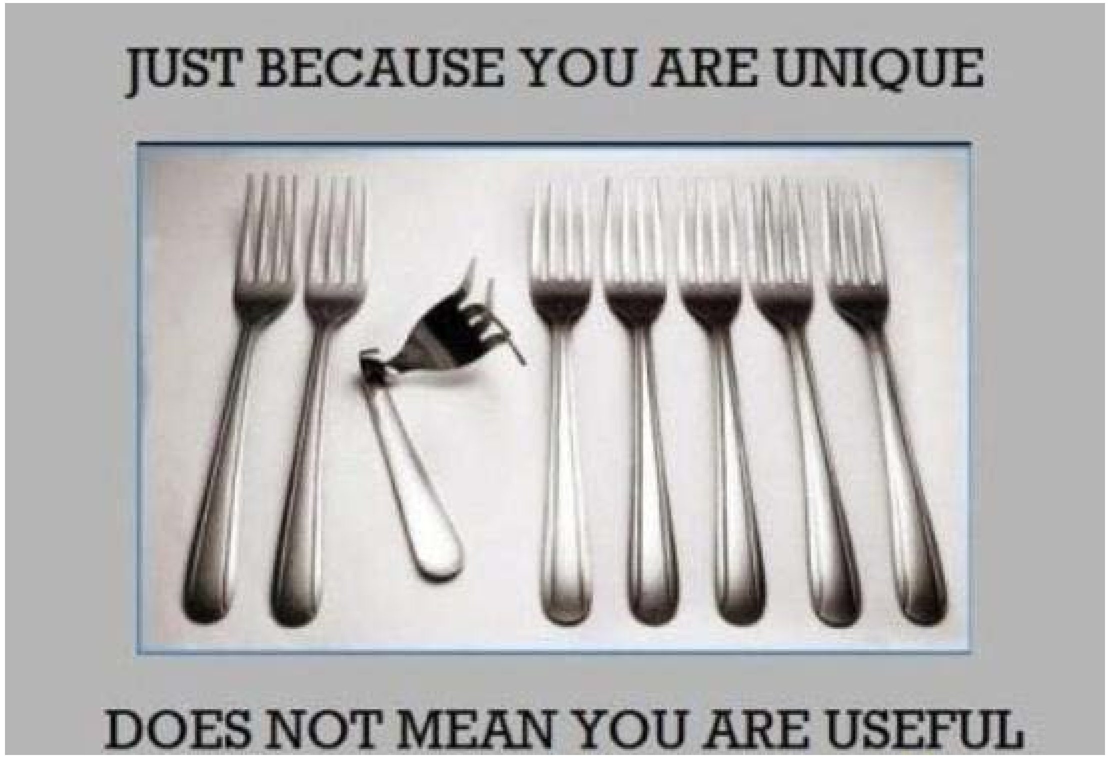
You are good…

but so are the others

You can't change your track record,
but there is more to a project proposal

How to make your project stronger?

How to stand out?



TIP 1: BE RELATABLE

In traditional project proposals, it’s about the TEAM.

In an ERC grant, it’s about the I

Shed your (Belgian) modesty

- Use ‘I’ instead of ‘We’, or ‘my team’
- Tell your own story, not just the numbers
  (Why are you the best person for this project?)
- Weave your skills into the project description:
  Relate project objectives to your personal experience
- You are more than a researcher

Tip 1: Be Relatable

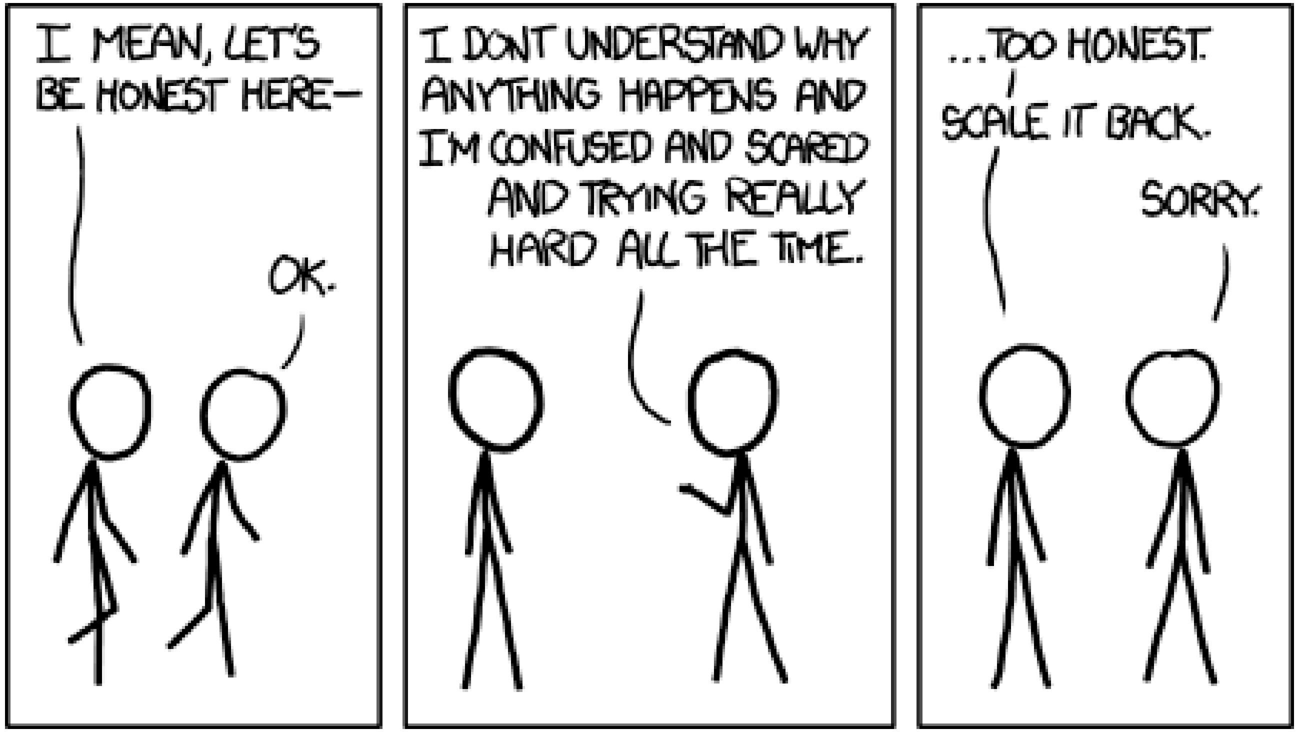
It's about you, and about **your project**

Branding: create an identity

- Nice visual logo (use on the front page)
- Good name:
    - should be pronounceable
    - acronym should be meaningful
- Use the acronym instead of 'the project' throughout the text.
- Make it stand out in the text (e.g. SMALLCAPS)

Tip 2: Be Honest

- about yourself
- about your goals
- about the strengths of the project (but also about the weaknesses)



Never lie

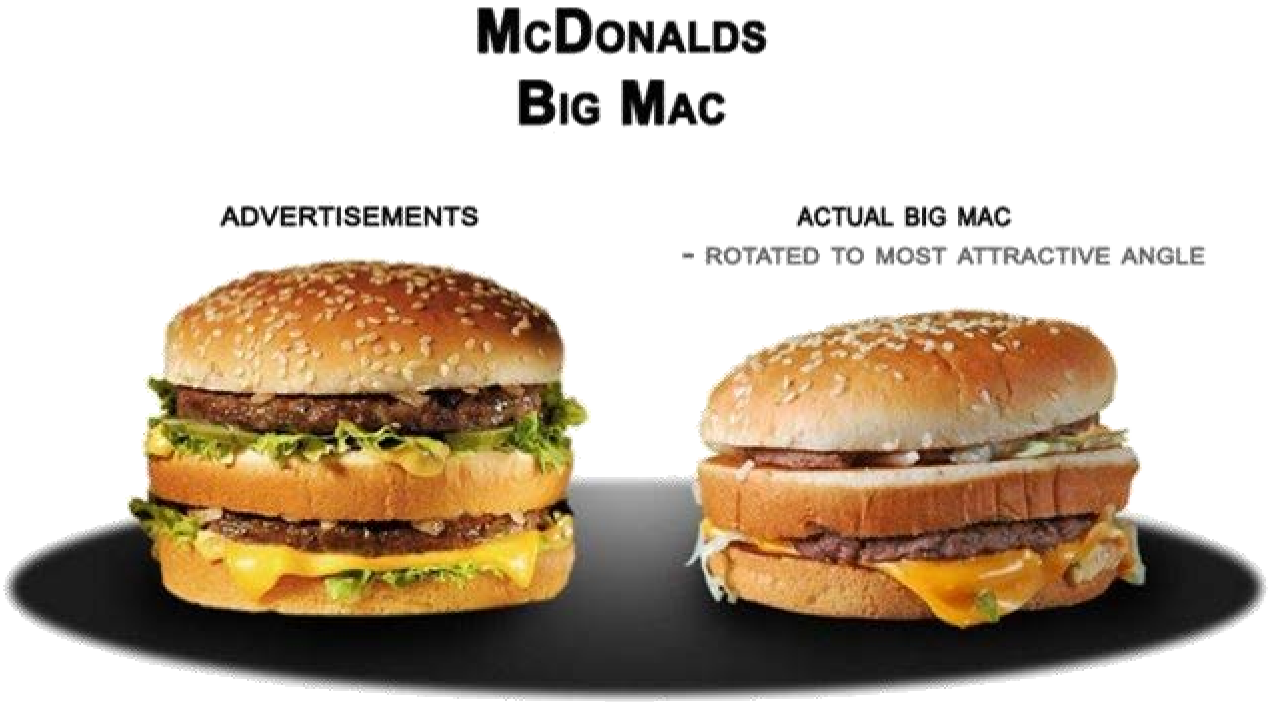
- outright
- by exaggeration
- by omission

Reviewers are not naive. They have also written project proposals, they are more experienced that you, and can read between the lines.

Tip 2: Be Honest

know your weaknesses, and your project's.

- do not try to hide them (lie by omission)
- be open about them,
  explain mitigation strategies
- acknowledge work of competition
  (they might be in the reviewer panel)



limit scope

- do not promise to do everything (because you can't deliver)
- clearly state what you will NOT do, where the limits of your work lie
- tell where you will work together with others, even competitors

Tip 3: Be Accessible

Reviewers should not struggle to read your proposal: make it easy to read

Address **visual** learners

- Clear figures
- Consistent visual style
- Figures take a prominent place
- Page layout: not too packed. (tip: use LaTEX)

Address **auditory** learners

- Good English (have it proofread)
- Consistent narrative (tell a story)
- No overly long sentences
- Repeat the important points

GHENT UNIVERSITY · imec

These three aspects cannot be considered independently to realize distributed PICs that go beyondthe state-of-the-art of single-path PICs. In the sections a.1-a.2 I discuss them in more detail. To make sure that the overall objective is not lost in the detailed research, In section a.4 I propose a numberof concrete demonstrators for distributed, reconfigurable PICs.

figure and fonts are too small

a.1 New waveguide architectures

Optical circuits guide light in optical waveguides, similar in concepts to optical fibers: the light is confined in a core of higher refractive index. In silicon photonic circuits, the wave... into a silicon layer, surrounded by glass. Because these materials have a very high contrast ... he waveguide core can become submicrometer in size [31, 7, 32]. In silicon photonics, there is a large toolbox of functional waveguide blocks: 1 x 2 and 2 x 2 beam couplers [33, 34], waveguide crossings [35, 36, 3... that can be used to couple to and from external optical _bers ... combining splitter/combiner functions with waveguide delay lines, wavelength filters can be constructed [42, 33, 27]. There has been an enormous amount of work on these building blocks, and their operation is generally well understood. To make fully functional photonic circuits, there is also the need for electro-optical functionality: generation, modulation and detection of light. The lack of e_cient integrated light sources is a weakness of silicon photonics: this is usually addressed by bringing in the light from the outside [41]. However, the bene_ts of on-chip light sources is extremely large, and there is a lot of research to integrate other materials on chip to make efficient integrated laser sources [43, 44, 45]. Electrically modulating or tuning the optical response of a waveguide can be done in di_erent ways [46, 47]. The ones I will use in PhotonicSwarm are discussed further in section a.2. For converting optical signals to electrical signals di_erent types of photodetectors are used [48, 49, 50, 51, 52]. These will also be essential for PhotonicSwarm, and are also discussed in section a.2. Today's PICs connect building blocks in a linear topology that follows the intended path of the signal. For example, an optical link follows a path from laser) modulator) wavelength combiner) waveguide) wavelength splitter) photodetector. In PhotonicSwarm I will explore topologies where light is distributed over many paths, or even over a continuum of paths, similar to free space. There are di_erent waveguide architectures to realize this distribution. I will focus on the following, illustrated in Fig. 1:

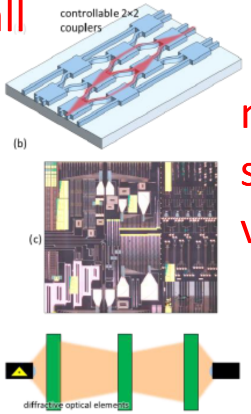


Figure 1: Waveguide architectures for distributed photonic integrated circuits. Light ows through the circuit along many paths. The distribution and phase delay of the di_erent paths is controlled in a granular way so the light interferes constructively at the desired output(s). Possible sites for actuatorsare indicated i. yellow.

no consistent style and no visual alignment

Waveguide meshes: The simplest implementation consists of simple mesh networks of couplers and optical delay lines: These can be used to build recon_gurable switches, adaptive coupling structures, wavelength _lters or construct arbitrary linear transformations [13, 30]. One step further is to use recon_gurable meshes to dynamically synthesize wavelength _lters, as proposed in [53]. I have recently demonstrated the first silicon photonic implementation of a 4 x 1 beam combiner [14]. Larger meshes will also provide ... active modulation can be used to make extremely accurate sens...

Text structure is not clear

Figure is squeezed between text

Phased waveguide arrays consist of waveguide bundles with a controlled relative phase [54, 33]. When cascaded together and including active tuning or modulation in the ind... can perform complex signal processing. I already demonstrated a most simple reconFIgurable ... array in silicon [57].

Lateral Leakage is the phenomenon where waveguides can exchange light through an intermediate guiding layer, behaving as on-chip antennas beaming signals over a long rang... des [58, 59]. This effectively breaks the restrictions of a planar topology, and enables circuit with higher connectivity. With active tuning, this effect can be switched on or off in a continuous way [60].Ring resonators are cavities that capture and release light when the wavelength fits a whole number of times inside the cavity [61]. 1-D chains of rings are used for complex spectral filters and to slow down light [62, 63]. I want to scale up these coupled-resonators to 2-dimensional networks, that behave more like molecules and nanocrystals in solid-state-physics. [64, 65]. In larger lattices, the larger-scale topology can also create 'protected' modes that are insensitive to local variations [66, 67]. The roundtrip length and the coupling between resonators can be well controlled (and actively tuned) in such 2-D resonator lattices, which allows reconfiguration.

In-plane diffraction gratings are already used for simple wavelength demultiplexing [33], but these concepts consisting of arrays of scatterers/reectors can also be cascaded. Geometries like this can be used as on-chip equivalents to image processing with di_ractive elements [68].

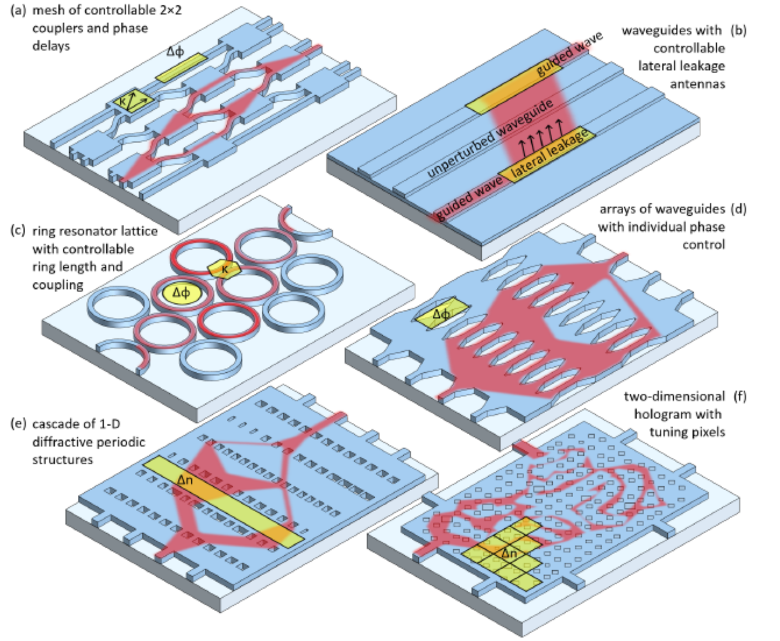


Figure 2: Waveguide architectures for distributed photonic integrated circuits. Light flows through the circuit along many paths. The distribution and phase delay of the different paths is controlled in a granular way so the light interferes constructively at the desired output(s). Possible sites for actuators are indicated in yellow.

Lateral Leakage is the phenomenon where waveguides can exchange light through an intermediate guiding layer, behaving as on-chip antennas beaming signals over a long range and bypassing intermediate waveguides [58, 59]. This effectively breaks the restrictions of a planar topology, and enables circuit with higher connectivity. With active tuning, this effect can be switched on or off in a continuous way [60].

Ring resonators are cavities that capture and release light when the wavelength fits a whole number of times inside the cavity [61]. 1-D chains of rings are used for complex spectral filters and to slow down light [62, 63]. I want to scale up these coupled-resonators to 2-dimensional networks, that behave more like molecules and nanocrystals in solid-state-physics. [64, 65]. In larger lattices, the larger-scale topology can also create 'protected' modes that are insensitive to local variations [66, 67]. The roundtrip length and the coupling between resonators can be well controlled (and actively tuned) in such 2-D resonator lattices, which allows reconfiguration.

In-plane diffraction gratings are already used for simple wavelength demultiplexing [33], but these concepts consisting of arrays of scatterers/reflectors can also be cascaded. Geometries like this can be used as on-chip equivalents to image processing with diffractive elements [68].

In-plane holograms are similar to volume holograms: light is free to propagate in the plane of the chip, and scattered by a very large number of distributed scatterers [69]. I have already successfully applied this principle in a 1-D waveguide to make an arbitrary wavelength filter [70], but the extension to 2 dimensions in high-contrast silicon photonics will be challenging.

Tip 4: Believe

You must believe in your project

- that you can make it work
- that you really want to do this
- that it is meaningful

If you* don’t believe

- your motivation
- your technical plan

how will you convince reviewers?

* and your peers

GHENT UNIVERSITY imec

Tip 4: Believe

To make a convincing story, you need to answer

- What?
- How?
- Why?

What researchers think

- Why?
- What?
- How?

What funding agencies think

Tip 4: Believe: Why?

The motivation of your work should not be an afterthought

Start with **a single driver**

- **An observation**: “The current situation is like this (and not good enough)”
- **A need**: “The world needs … to make it better”

Break down drivers into subdrivers (for each workpackage) that relate to the main driver.

Drivers should sound realistic; don’t be overly dramatic.

If you can convince the reader of your driver, you are more than halfway.

Tip 4: Believe: What?

What is your Key (technical) idea to tackle the driver?

Without a good idea, it will not work.

Refining the idea

- brainstorm
- break down your idea / project into bullets / pictures.
- strip nonessential sidetracks (or use as risk mitigation)
- try pitching it for a critical audience
- **repeat**

Postpone the actual writing:

Once you start writing text, you will lock your train of thought. Rewriting is tough

TIP 4: BELIEVE: HOW?

Make your project real!

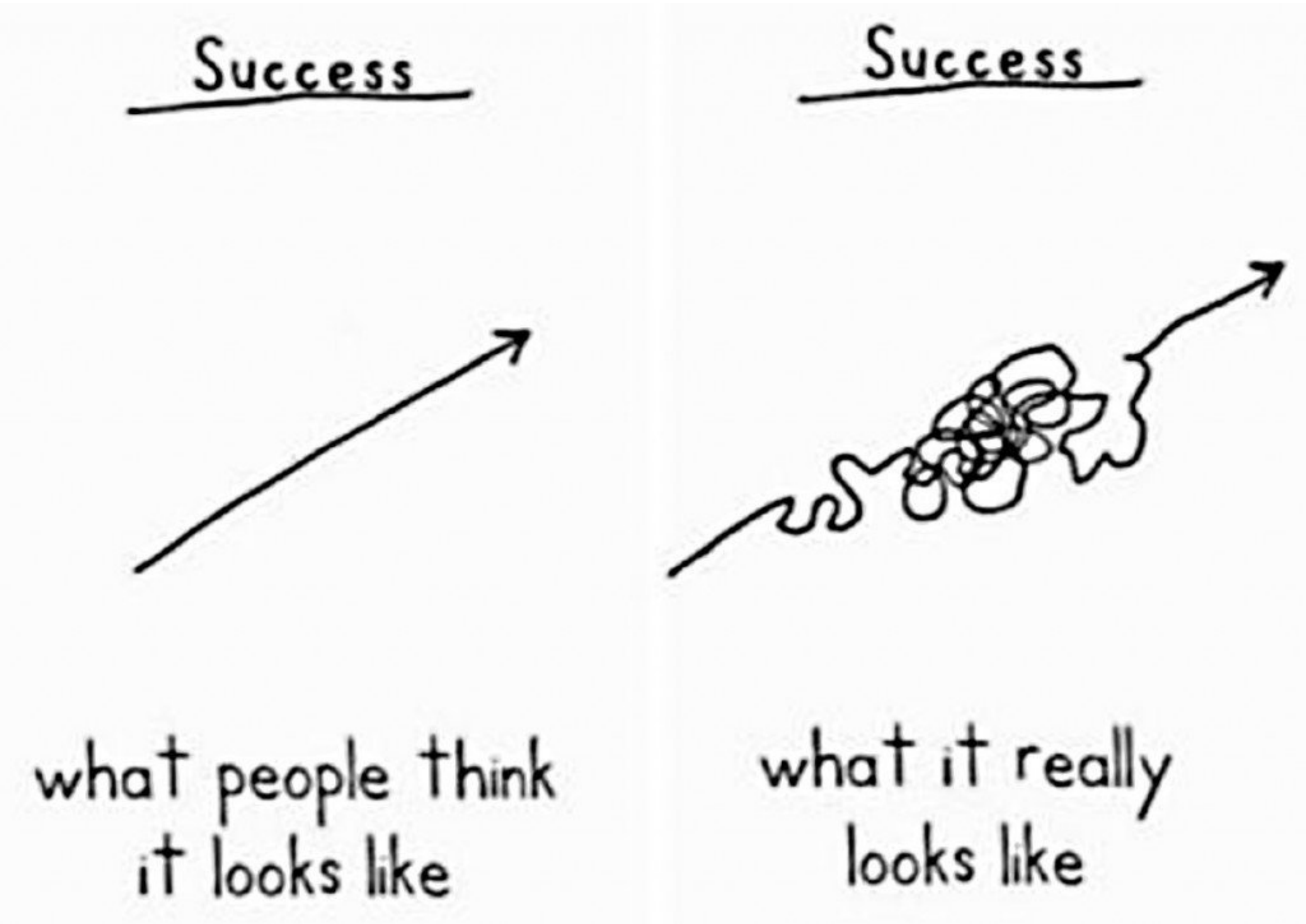
- write as if the project is already approved (plan of action instead of a proposal)
- “I will”
- do not use the word ‘proposal’
- use “can” and “will”, rather than “could” and “would”

Be Relatable

Be Honest

Be Accessible

Be lieve



PHOTONICS RESEARCH GROUP

Wim Bogaerts

Professor in Silicon Photonics

E wim.bogaerts@ugent.be

T +32 9 264 3324

@PhotonicsUGent

www.photonics.intec.ugent.be

GHENT UNIVERSITY

imec embracing a better life

FACULTY OF ENGINEERING AND ARCHITECTURE

nb-photonics Center for Nano- and Biophotonics Ghent University

erc European Research Council