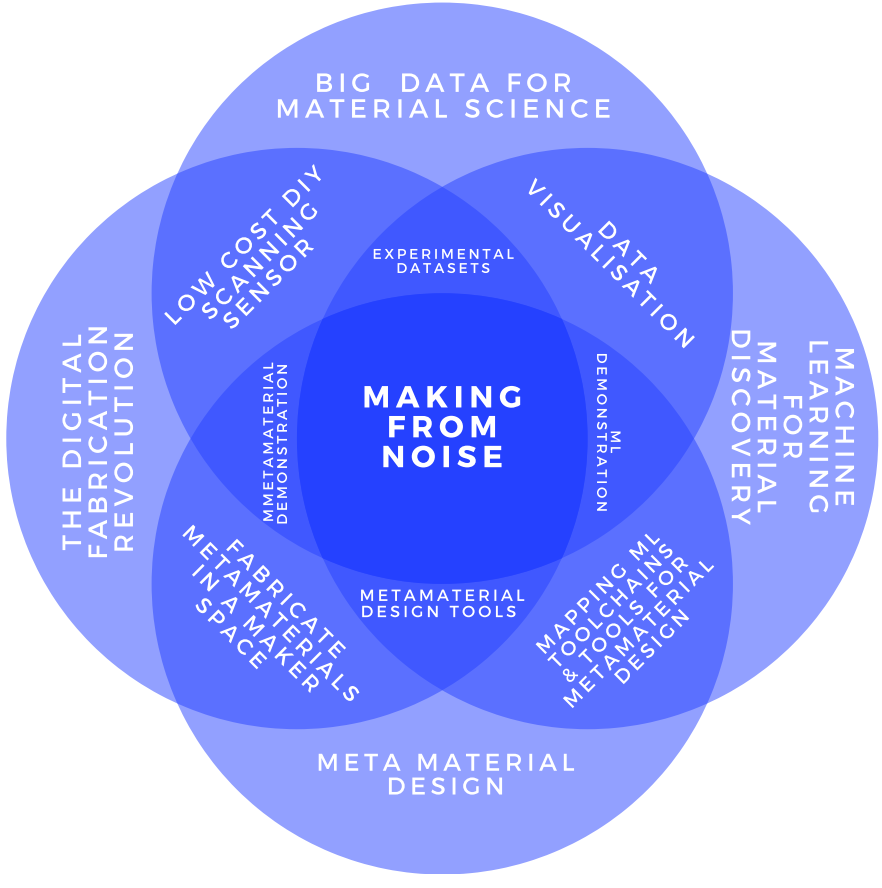


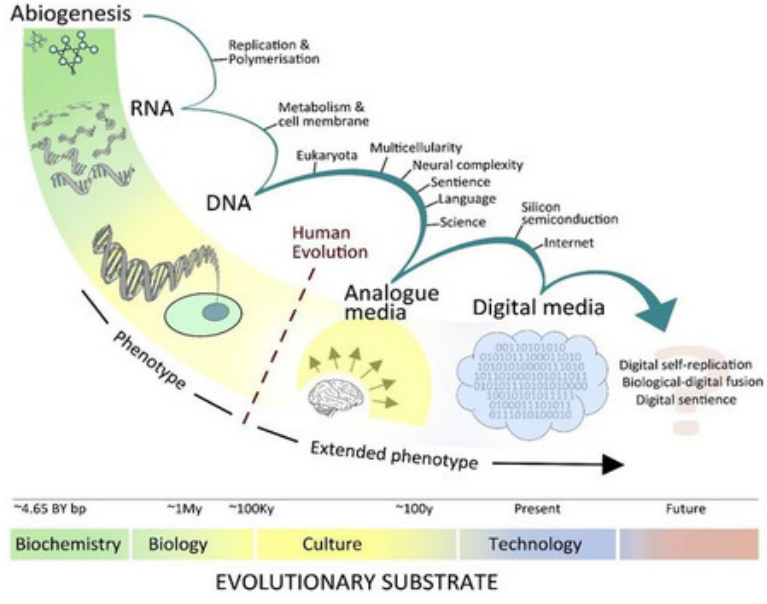

# FROM DATA TO METAMATERIALS IN A MAKER SPACE

SCROLL DOWN FOR OVERVIEW

# OVERVIEW

## MAKING

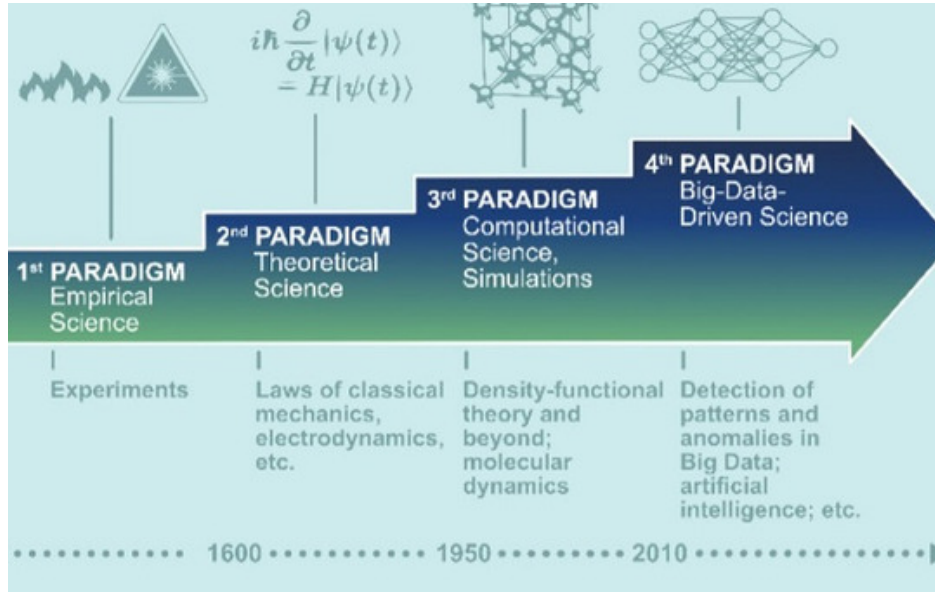
Humans have made material things from as far back as we have been human. The things we make all contain information and making material things can be seen as a kind of coding of materials or inversely a materialisation of information. Making things helps us to construct meaningful knowledge and enables us to put information back into our environment so that we can influence it. We now make materials that produce, transfer and store *bits* (binary units of data) and we are living in an age when these technologies have blossomed and evolve with us.




Schematic timeline of information and replicators in the biosphere from Michael R. Gillings, Martin Hilbert, Darrell J.Kemp (2016)

# DATA DRIVEN MATERIAL DESIGN

Today bits are being produced, shared and stored in amounts and formats that can seem like meaningless noise but advancing processing techniques such as machine learning are revealing new patterns of information about the material world. Data driven methods of finding materials to match properties are a opening a new paradigm in material science.



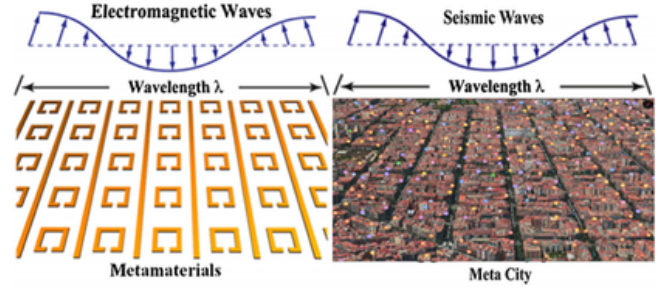

The Development of the paradigms (new modes of thought) of materials science and engineering' - Claudia Draxl and Matthias Scheffler (2018)

# METAMATERIALS AND DIGITAL FABRICATION

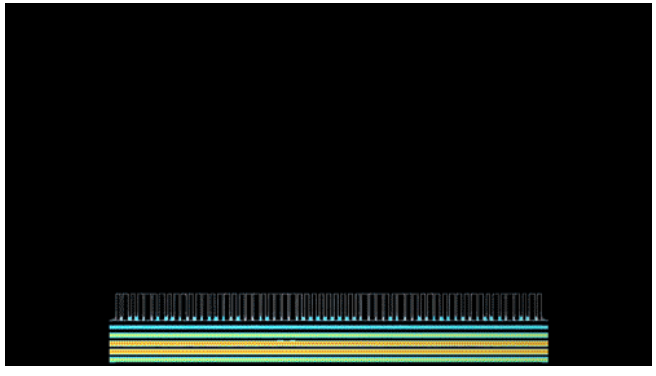
Increasingly we are also making atoms from bits - using computers to design and fabricate material things in new ways.

Since the 1990s, the increasing affordability of digital fabrication tools has enabled researchers to fabricate more easily a class of materials called metamaterials. These materials exhibit properties rarely found in nature as a result of their repetitive fabricated structures rather than their molecular structures.

These rare properties include transforming waves of all scales (electromagnetic, acoustic, seismic) in ways we don't see normally and some of their applications (invisibility cloaking, black holes, and passive energy harvesting from sound) have been the stuff of science fiction until now.




Analogies between electromagnetic (nano-scale) metamaterial and (decameter scale) metacity
- Brulé, et al.(2017)



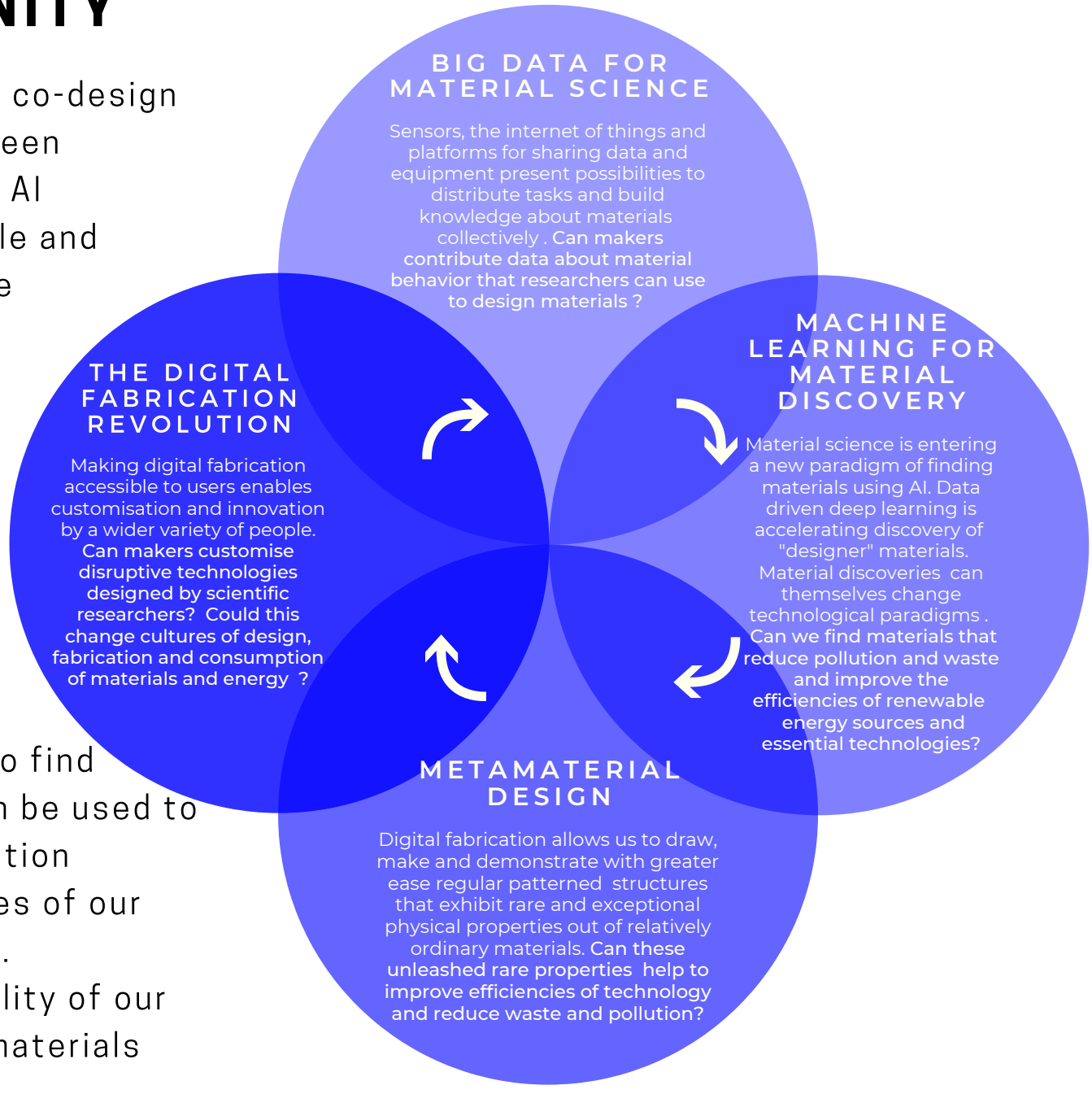
Light passing through a flat metamaterial 'meta-lens' is focused by millions of nano structures
Khorasaninejadet al (2016)

These properties open up new possibilities to improve efficiencies of existing essential technologies and reduce waste and pollution.

Today's desktop computation enables metamaterial structures to be drawn and modeled and fabricated relatively easily compared to natural materials. This helps to generate datasets for machine learning and the design of metamaterials using intelligent, data-driven methods.

# THE OPPORTUNITY

- Strengthen cultures of co-design and collaboration between makers, scientists and AI
- Inclusion of more people and perspectives in the use and development of these disruptive technologies
- Development of data driven metamaterial design tools that are accessible and useful to scientists and makers
- Use machine learning to find metamaterials that can be used to reduce waste and pollution and improve efficiencies of our essential technologies.
- Improve the sustainability of our cultures sourounding materials



# QUESTIONS OF FOCUS

***HOW ACCESSIBLE TO A NOVICE ARE THESE NEW TOOLS AND METHODS OF DATA-DRIVEN MATERIAL DESIGN AND DIGITAL FABRICATION?***

***HOW CAN A NOVICE 'MAKER' DESIGN METAMATERIAL DEVICES FROM THE NOISE OF DATA THAT SURROUNDS US?***

# RESEARCH METHODS

**From an outsiders point of view**, this research project tries to:

- find and organise information about metamaterials and ways to fabricate and test them.
- replicate metamaterials designed by scientific researchers in a maker space.
- construct a scanning sensor using low cost hardware and opensource/ free information.
- find and collate documented tools and toolchains needed to design a metamaterial using data-driven methods.

In doing so it follows the journey of noisy bits generated by sensors in a maker space, through datasets and algorithms that may be designed using opensource tools, to replicable metamaterial design drawings to finally the transformation of bits to atoms using digital fabrication.

By tagging, clustering and diagramming information it structures scientific knowledge from published research papers and first hand practical knowledge from making.

# OUTPUTS SO FAR

***Metamaterial taxonomy***

***A review of machine learning tools and methods in metamaterial design***

***Bibliography***

coming soon..
Making metamaterials in a maker space
Making a low cost scanning sensor
Metamaterial Zoo

# FUTURE GOALS

***Produce a resource of tested metamaterial fabrication methods for makers***

***Demonstrate an opensource data driven metamaterial design tool***

***Demonstrate a low-cost, low-tech method of producing experimental datasets usable by a metamaterial design algorithm***

Please contact **saira.raza@iaac.net** if you would like to collaborate