COLOURATION & FLUORESCENCE EMISSION IN NATURAL PHOTONIC STRUCTURES

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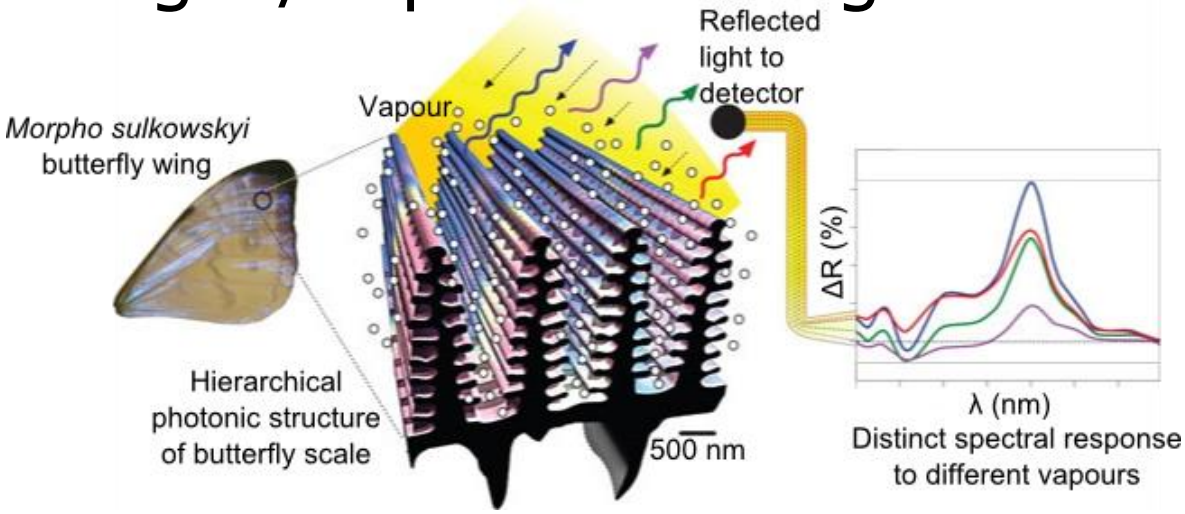
UNIVERSITY OF EXETER

Structural colours in living organisms

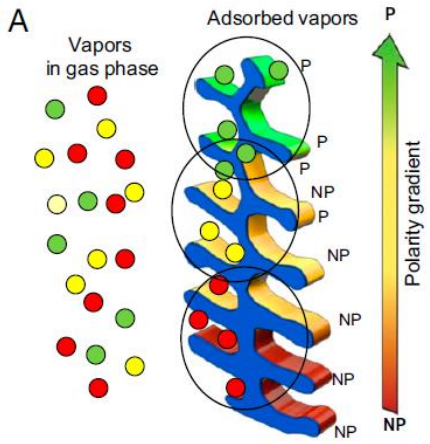
Kinoshita, *Structural Colors in the Realm of Nature*, 2008

In the biological world, many structural colours produced by the interaction between light and photonic structures

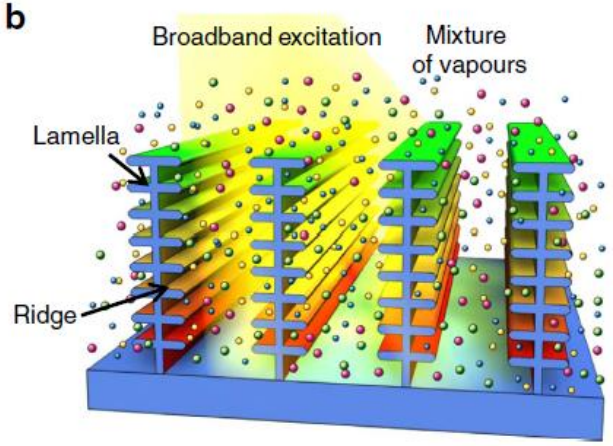
Fluid-induced colour changes in photonic structures & gas/vapour sensing

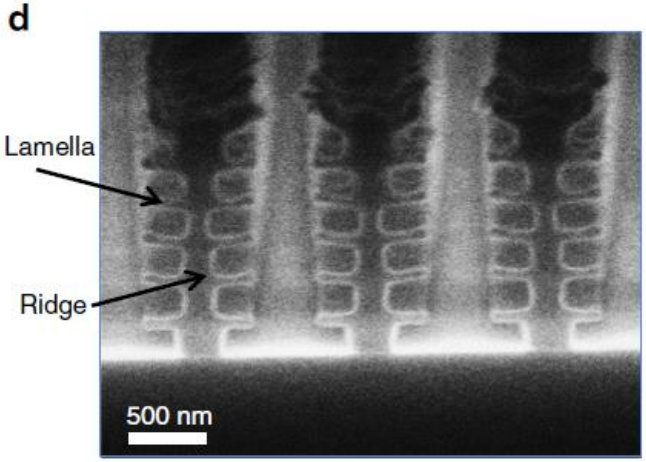


Potyrailo *et al.*, Nat. Photonics 1, 2007



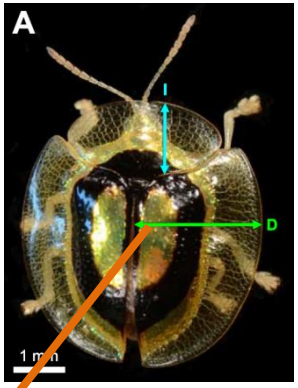
Potyrailo, Starkey, **Vukusic** *et al.*,
PNAS 110, 2013

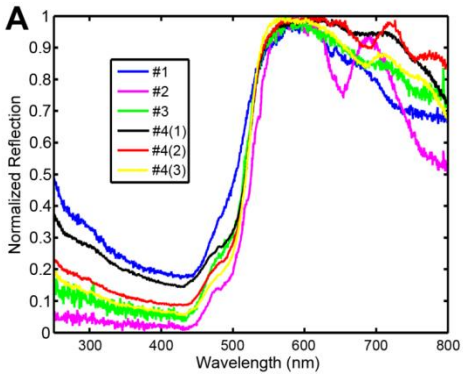


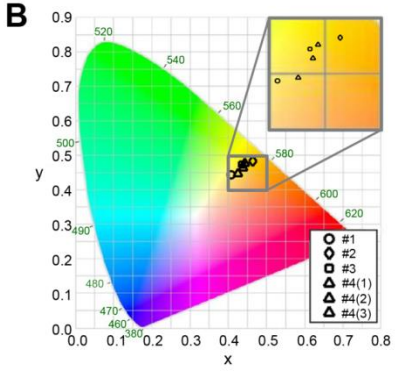


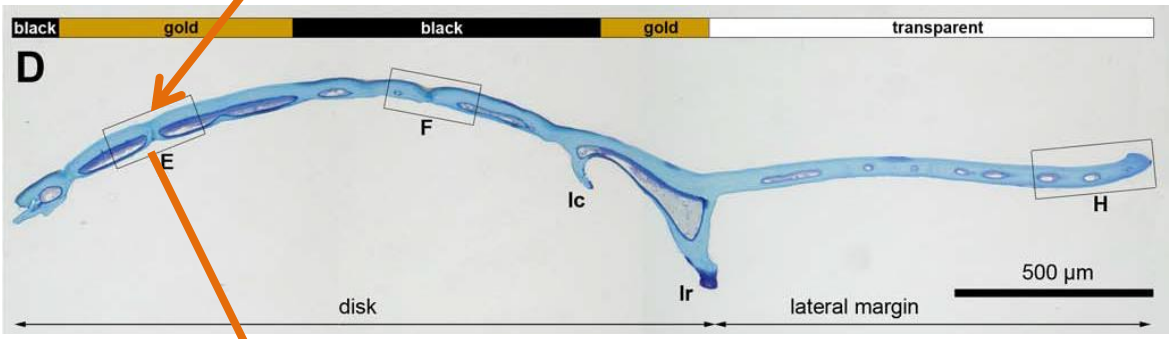
Potyrailo ,…, **Vukusic** *et al.*, Nat. Comm. 6, 2015
Poncelet, Tallier, **Mouchet** *et al.,* Bioinspir. Biomim. 11, 2016

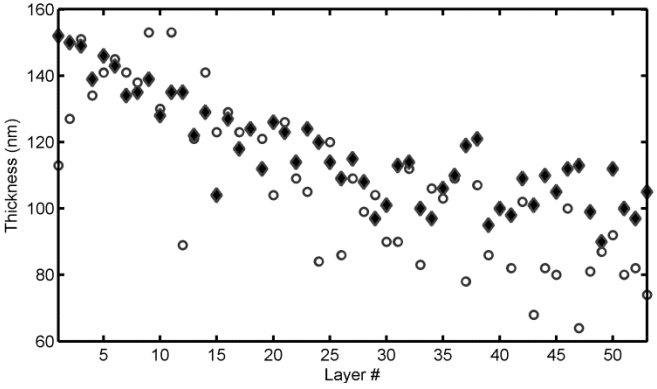
Chirped multilayer in the endocuticle of *Charidotella ambita*

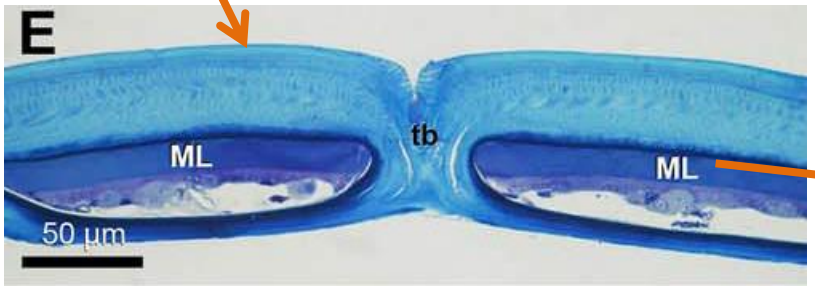


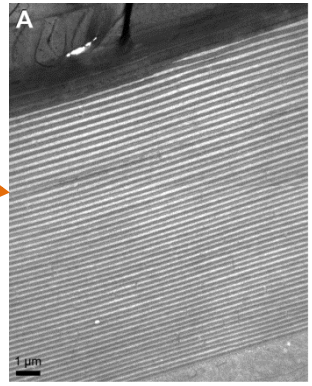








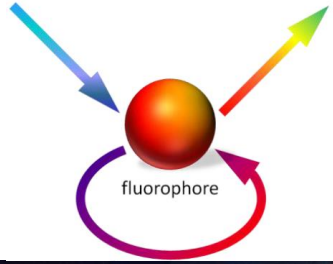




- Metallic gold colour due to chirped multilayer in endocuticle
- Its development coincides with the start of mating behaviour, suggesting a signaling function

Pasteels, Deparis, **Mouchet** *et al*., Arthropod. Struct. Dev. 45, 2016.

Fluorescence from living organisms



Jewel anemone, *Corynactis viridis*

White spotted jelly, *Phyllorhiza punctata*

Moon jelly, *Aurelia aurita*

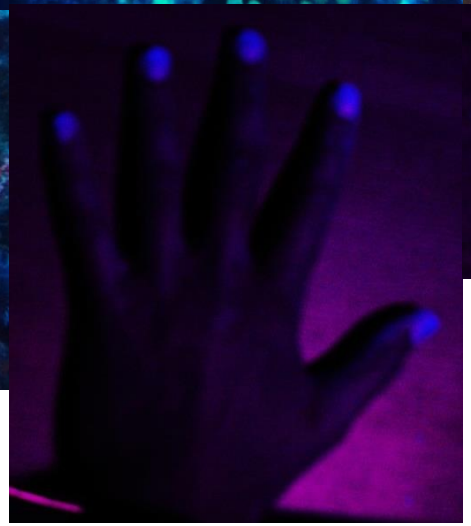
National Marine Aquarium, Plymouth, UK, 19/11/2016

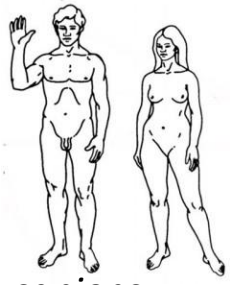
Striped bark scorpion, *Centruroides vittatus*

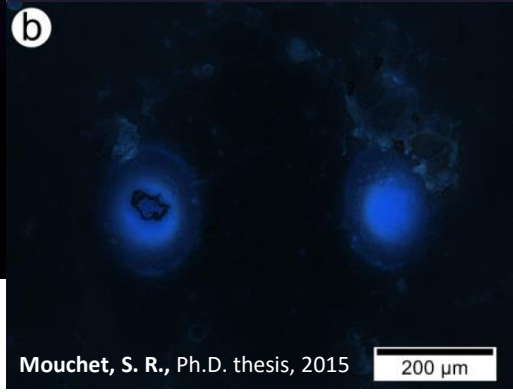
Van Hooijdonk, E., Ph.D. thesis, 2012

Various species of sea anemones

Birch Aquarium, La Jolla, CA, 05/05/2016





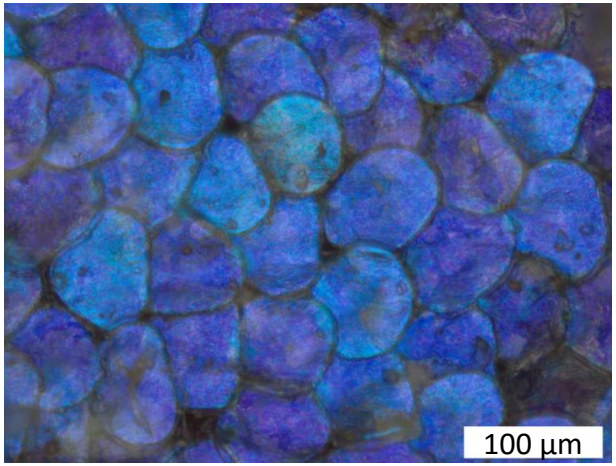


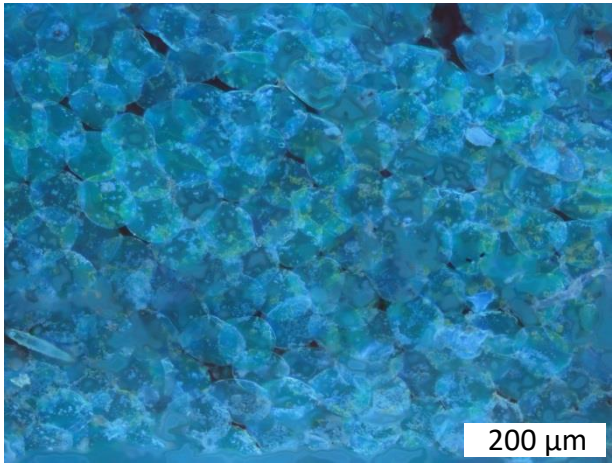
Mouchet, S. R., Ph.D. thesis, 2015

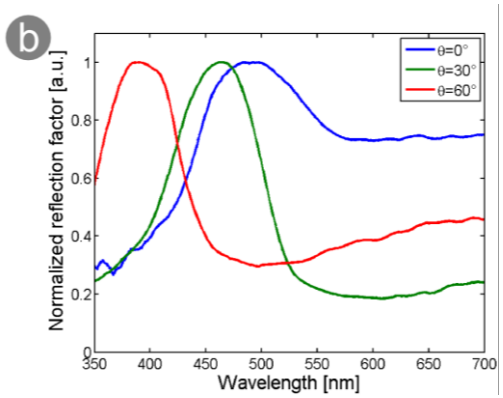
Human being, *Homo sapiens*

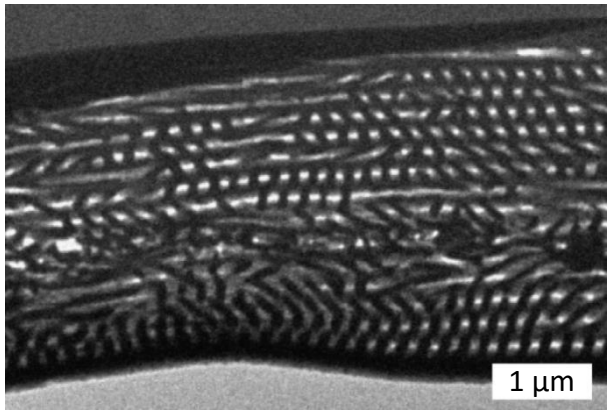
Namur, Belgium, 09/2015

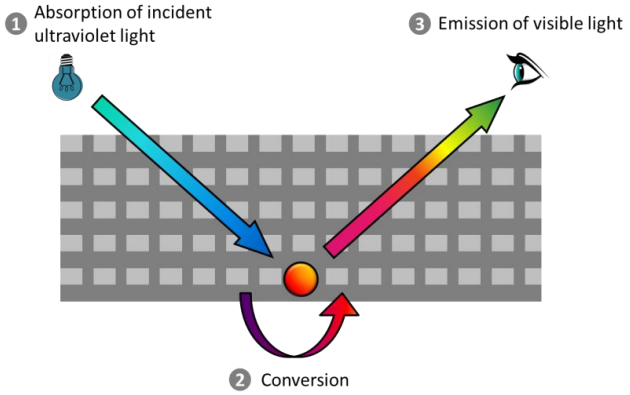
Confined fluorescence in natural photonic structures







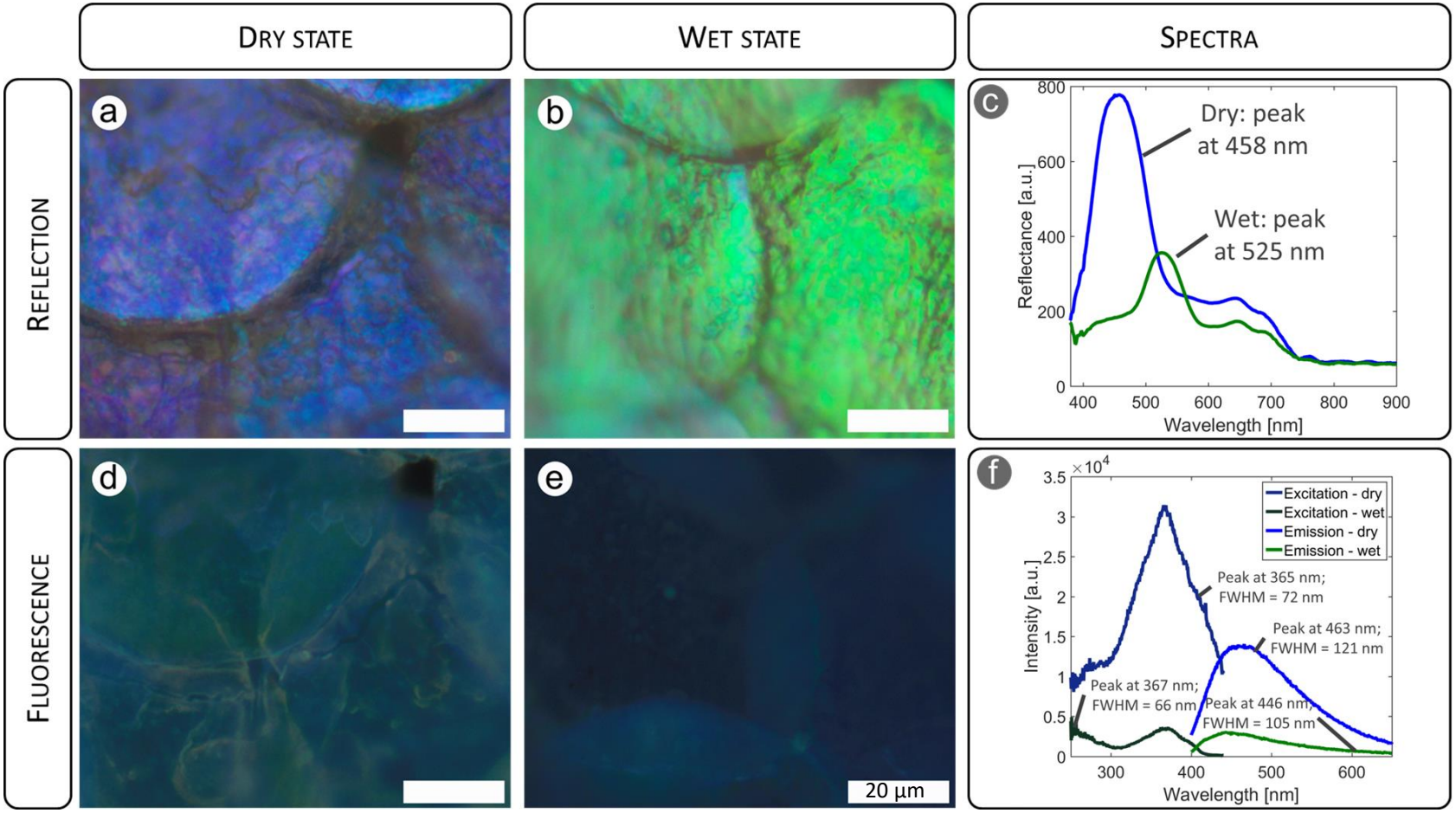




Fluorophores naturally embedded in photonic structure

Mouchet,…, **Vukusic** *et al.*, Mater. Today: Proc., accepted (A)

Water-induced fluorescence change in natural photonic structures

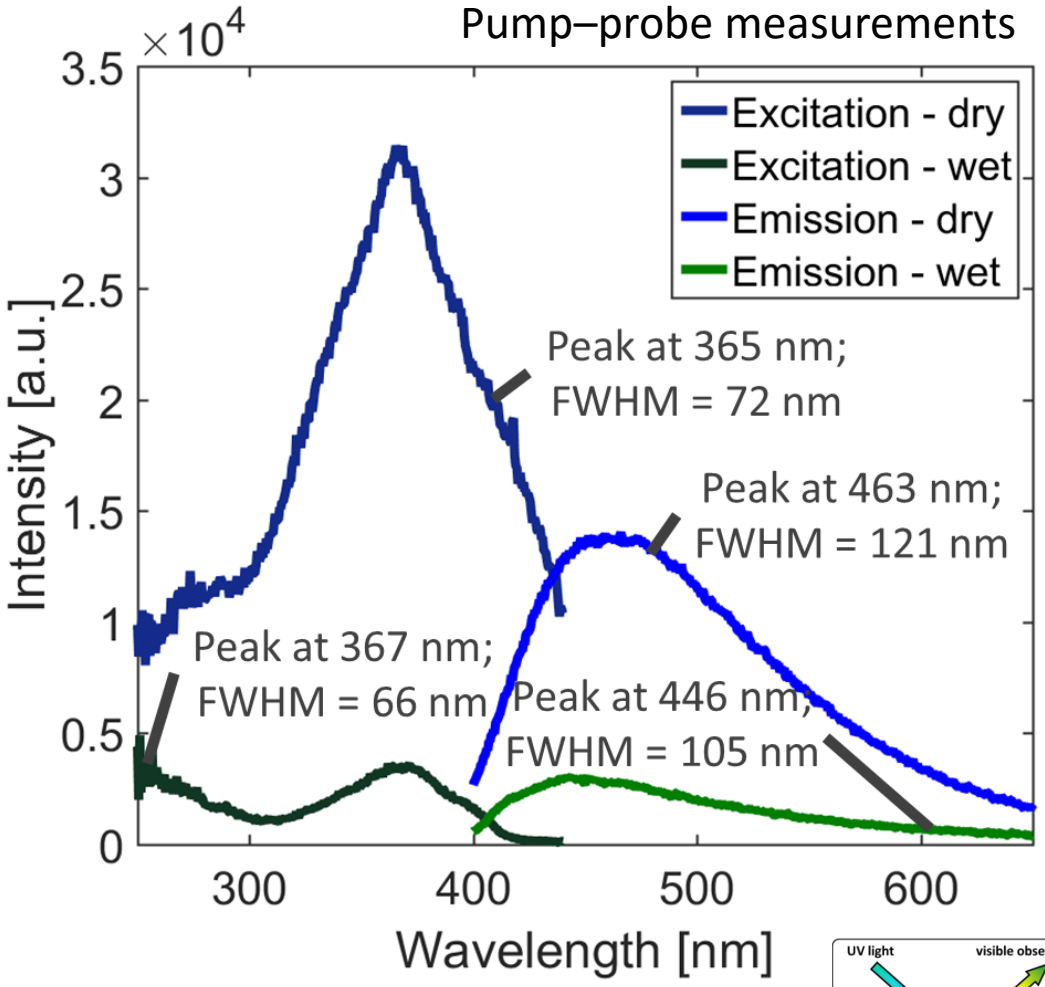


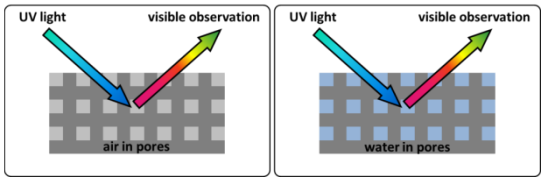
Mouchet *et al.,* Sci. Rep. 6, 2016
Mouchet,…, **Vukusic** *et al.,* Proc. Roy. Soc. B 283, 2016
Mouchet,…, **Vukusic** *et al.*, Mater. Today: Proc., accepted (B)

Reflectance: red-shift
Fluorescence: blue-shift

Water-induced fluorescence change in natural photonic structures

Pump–probe measurements





Mouchet,…, **Vukusic** *et al.,* Proc. Roy. Soc. B 283, 2016

Mouchet,…, **Vukusic** *et al*., Mater. Today: Proc., accepted (B)

Conclusion

- **Natural photonic structures** are **sophisticated materials** displaying a **large variety of optical effects**
- This field has strong **interdisciplinary aspects**
- In addition to the development of new concepts and technological applications through a **bioinspiration** approach, their study allows to **understand the related biological functionalities**
- Willing to **collaborate with local partners** in order to investigate **optical effects of marine species**

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