

A centrifugal lab-on-a-disc device for the *in situ* determination of dissolved reactive phosphate in water



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Contents

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- Centrifugal microfluidics
- Analytical method on disc
- Detection system
- Integrated system

Phosphorus in water

- Growth limiting nutrient:
 - algal bloom
 - hypoxic waters
 - death of aquatic animals
 - toxic blooms



http://sites.duke.edu/biology217_01_s2011_mkg14/ecological-impacts/eutrophication/

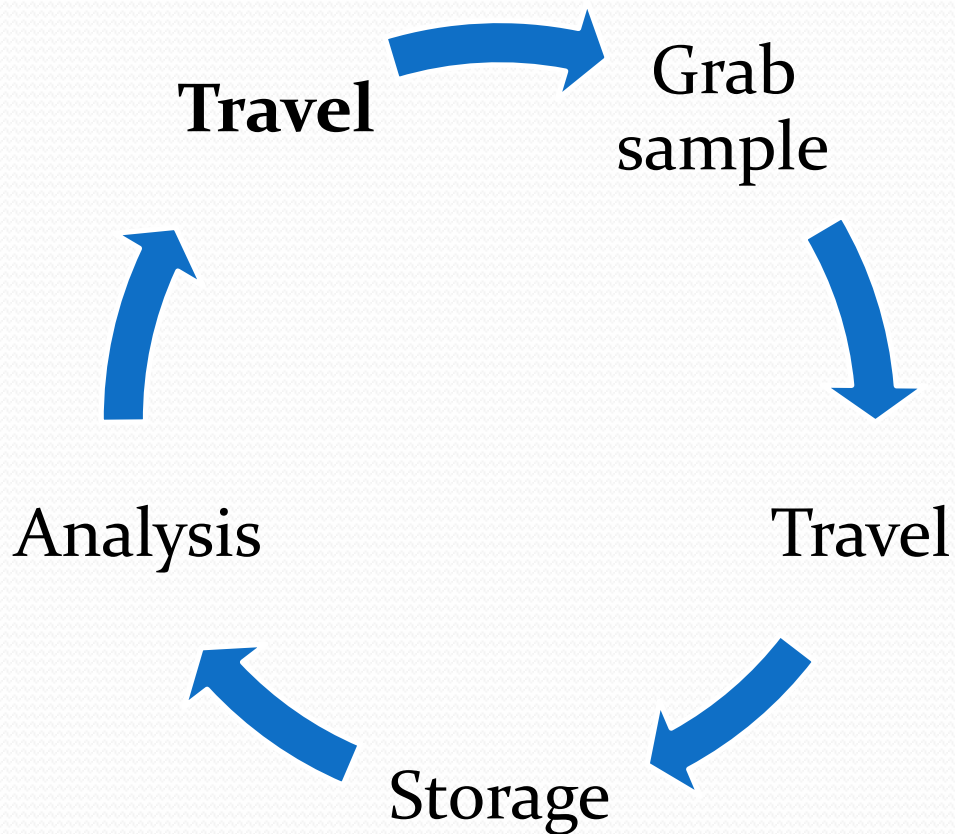


<http://www.natureworldnews.com/articles/15693/20150717/toxic-algae-expected-lake-erie-potentially-worst.htm>



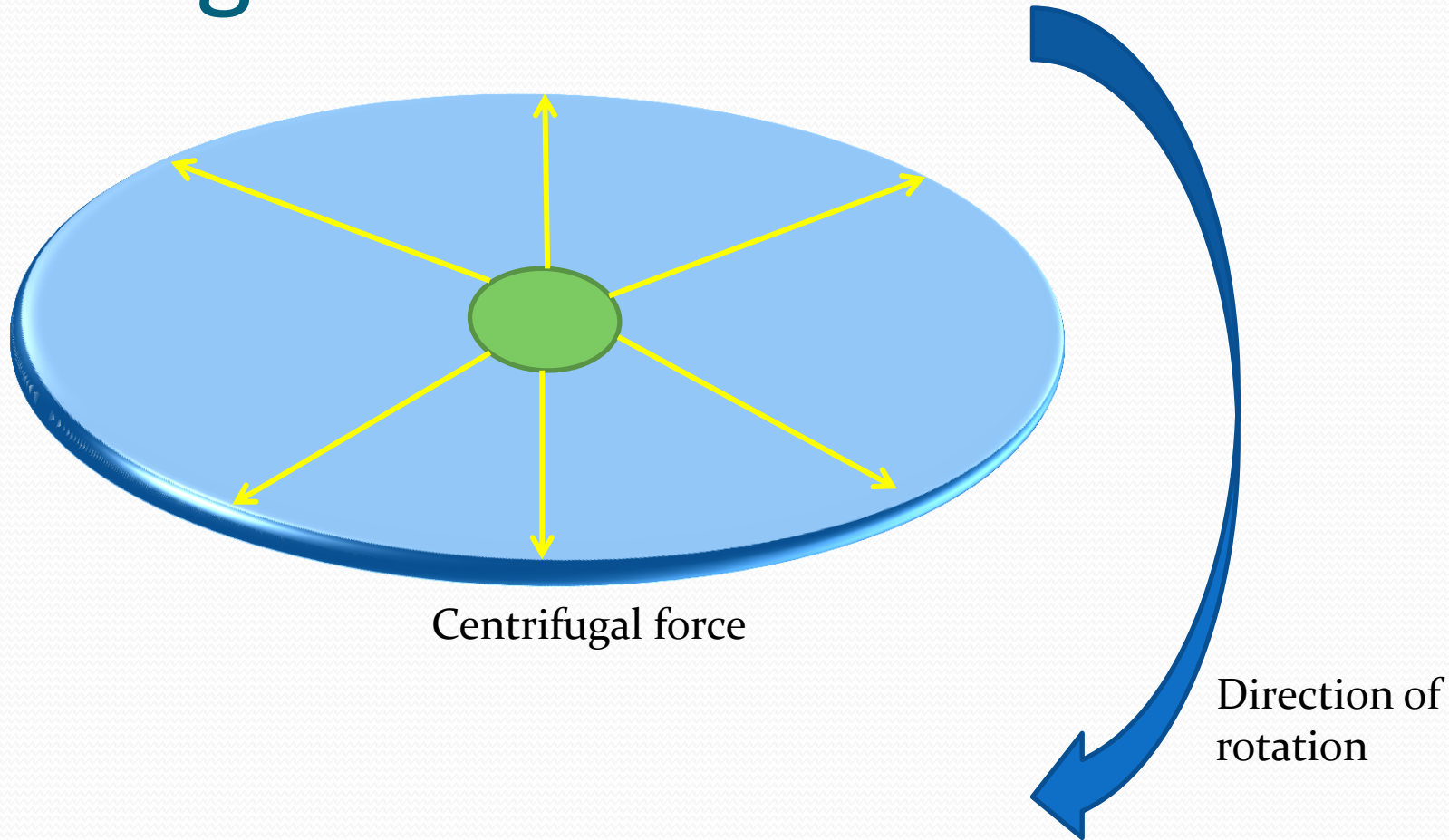
<http://serc.carleton.edu/microbelife/topics/redtide/general.htm>

Traditional analysis



- Time intensive
- Labour intensive
- Expensive instrumentation
- Low sampling frequency
- Contamination

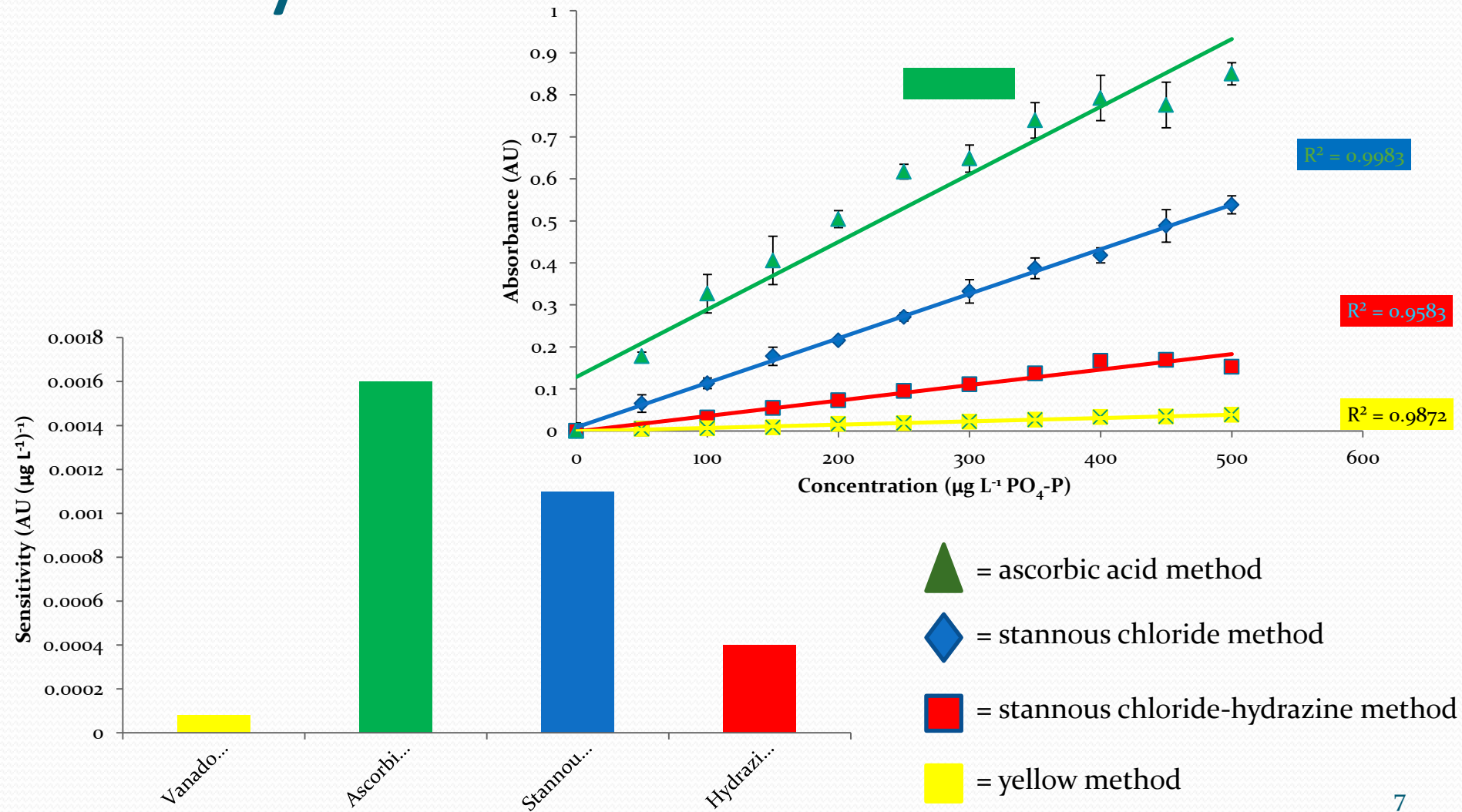
Centrifugal microfluidics



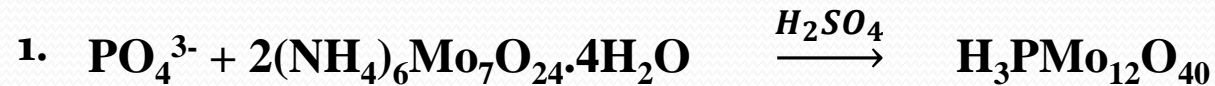
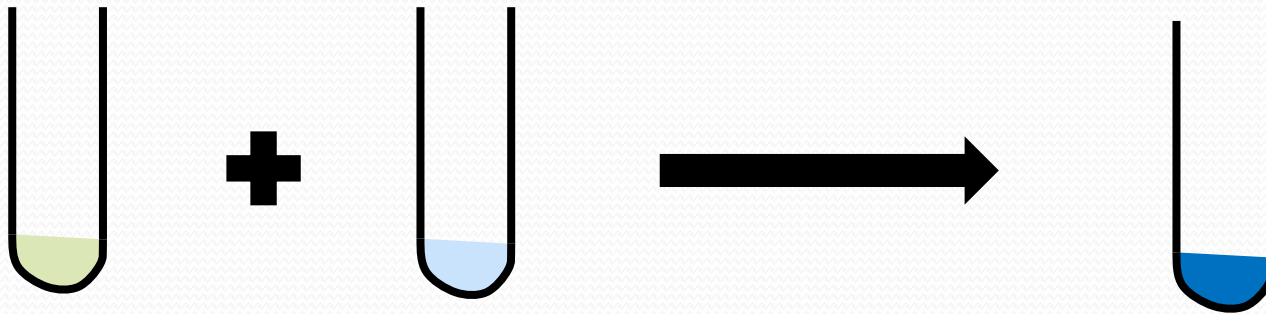
Analytical method

- **Four methods:**
 - High sensitivity
 - Selectivity
 - Simplicity
 - LOD and LOQ
 - Linear range

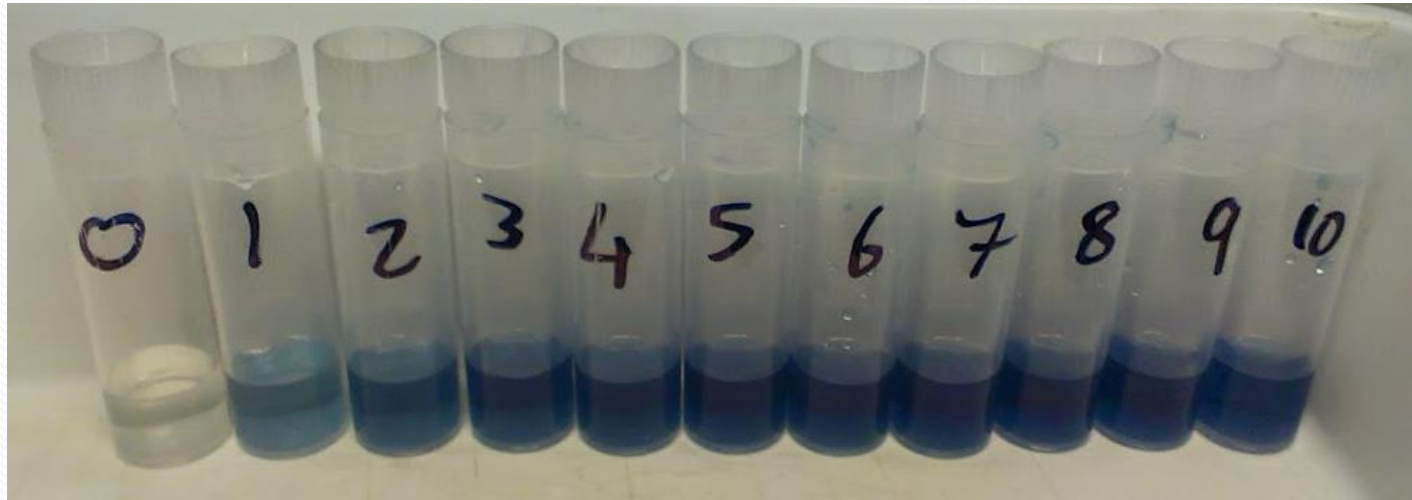
Analytical method



Analytical method

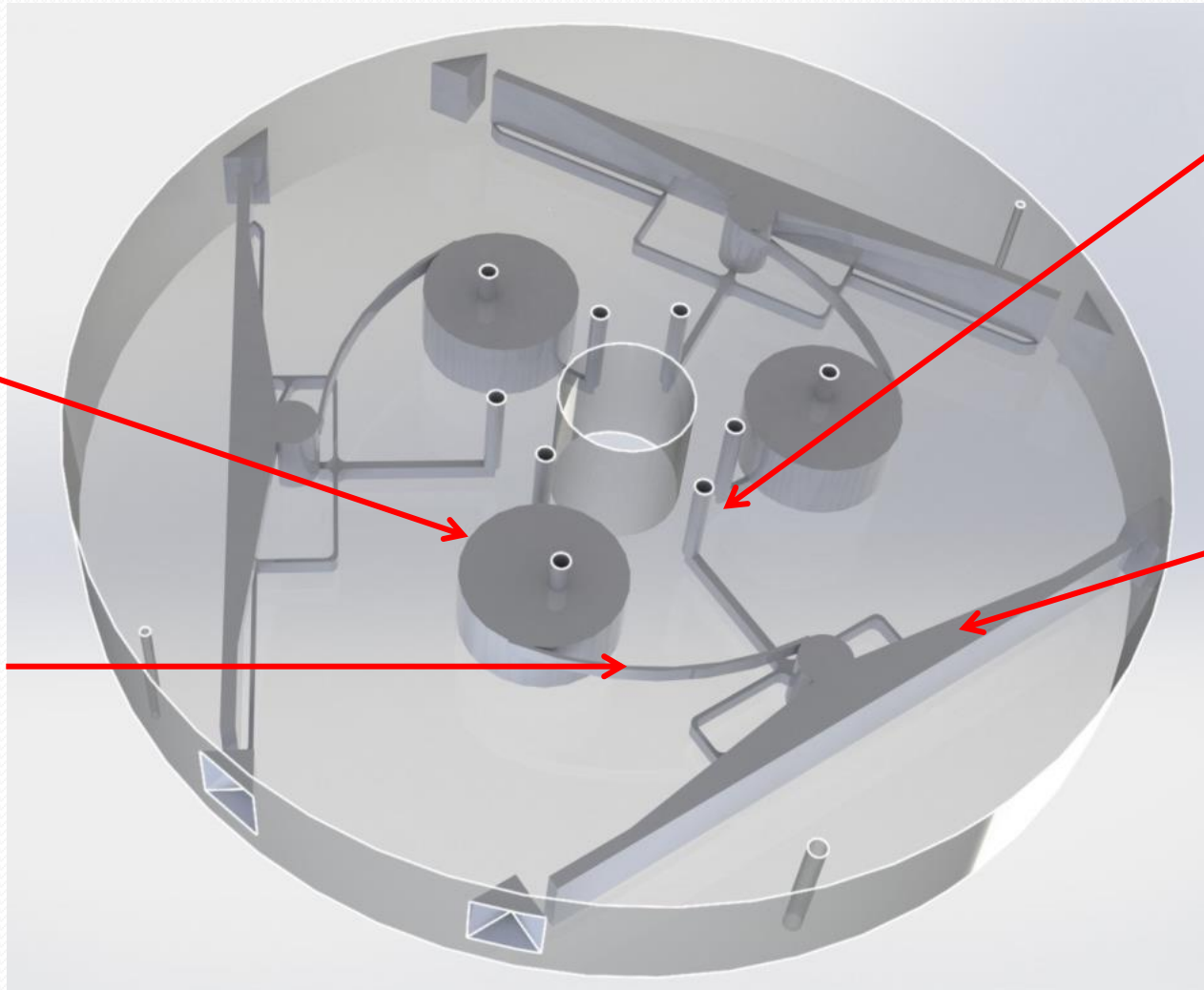


Detection system



$$A = \epsilon C l \uparrow \text{increase}$$

Microfluidic disc



Reservoir

Air vent

Detection chamber

Microchannel

Detection system



Roithner 880 nm laser

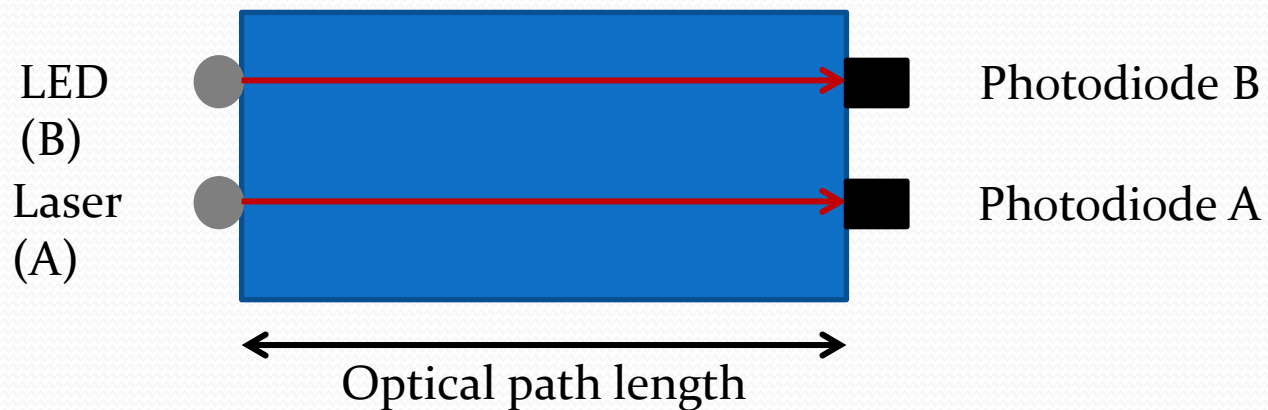
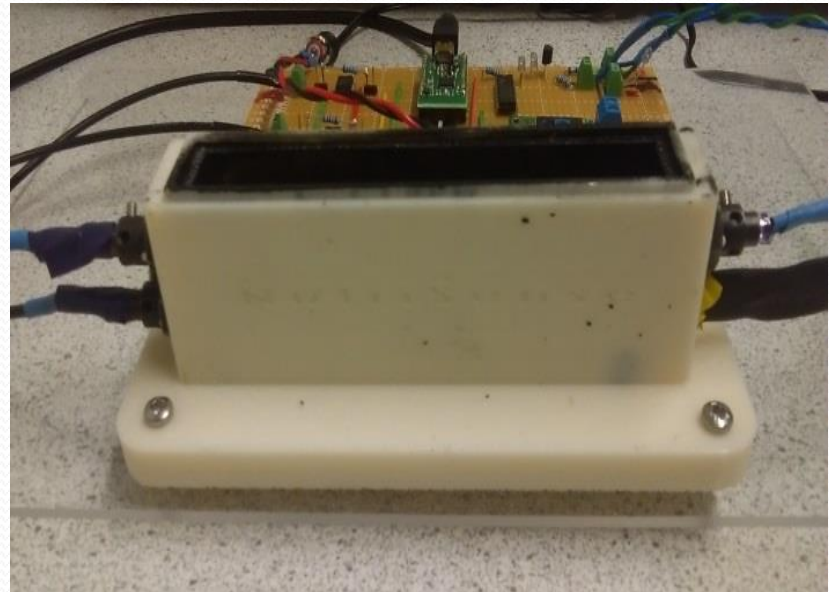
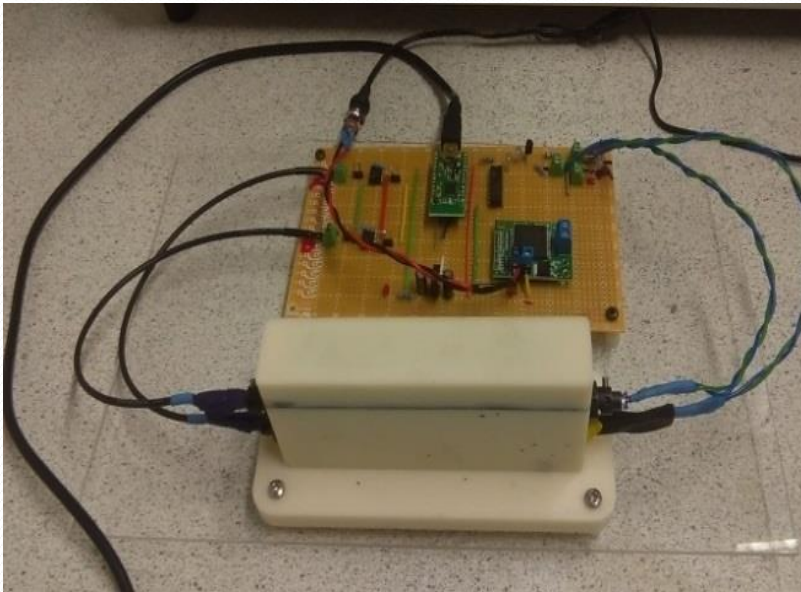


Radionics 880 nm LED

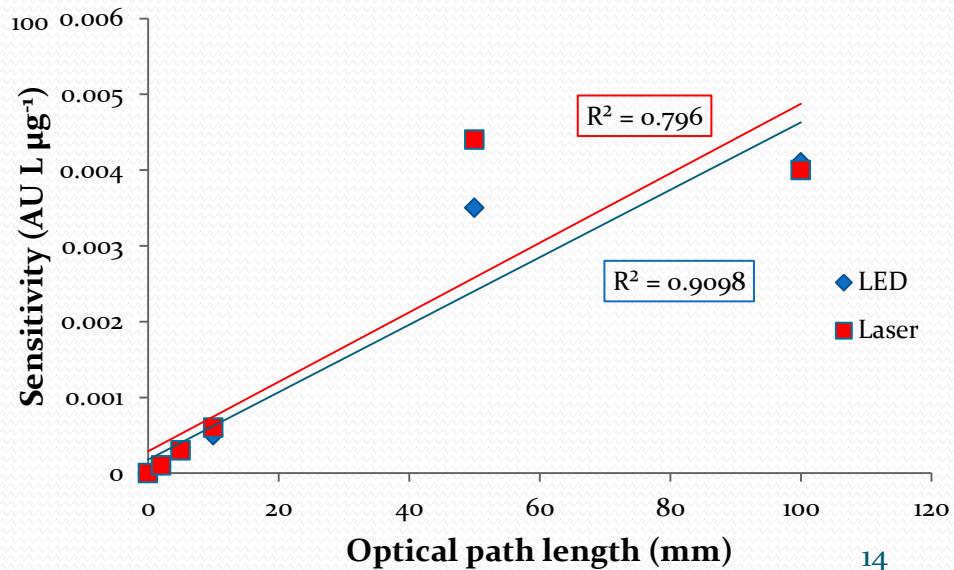
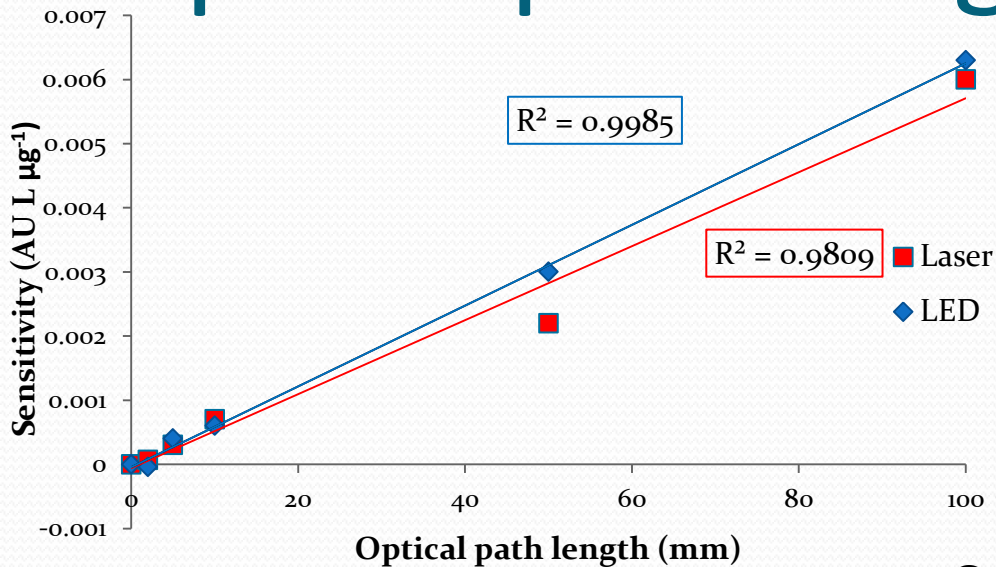


Radionics photodiode

Optical path length study



Optical path length study



Integrated NutriSense system



Black 3D printed container

Motor to be incorporated for disc rotation

Optical detection system is aligned on the stage

Electronics stored beneath, away from wet chemistry

Conclusion

- Analytical method
- Disc design optimised
 - Mixing
 - bubble formation
 - Optical path length
- Integrated system designed – first prototype fabricated

Future work

- Incorporate motor into system
- Investigate system robustness *in situ*
- Adapt disc design for other analytes for water quality analysis

Acknowledgements

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- Ivan Maguire
- Prof. Fiona Regan



Water
Institute





Thank you!