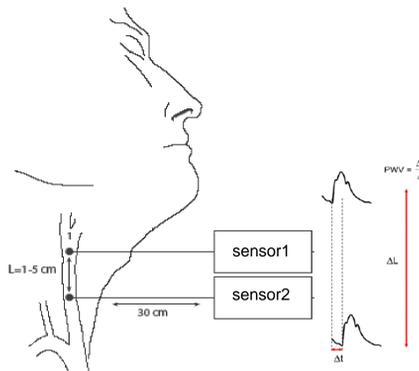


## Background



The non-invasive measurement of the aortic pulse wave velocity (PWV) is the current gold standard of arterial stiffness. The PWV is defined as the ratio of the travelled path length and the Pulse Transit Time (PTT). A larger value of PWV indicates a greater arterial stiffness and thus a higher risk of cardiovascular events.



In the CARDIS project, our target is to develop a mobile, low-cost point-of-care device used for screening and assessing the risk of CVD in the individual through assessment of PWV.

The PTT of the pulse is measured by a non-invasive technique called the **laser Doppler vibrometry (LDV) based on silicon photonics**.



This technique can also do different jobs:

- (a) measure aortic and local pulse wave velocity;
- (b) detect vibrations induced by turbulent blood flow in stenosed arteries;
- (c) pick up cardiac contraction abnormalities via measurements on the chest.

**Advantage:**  
Silicon photonics – Low cost and Compact size

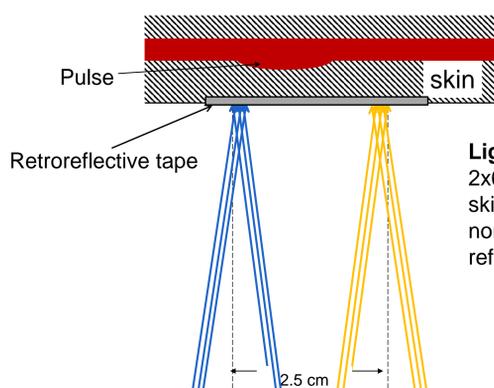
The key part of the device is a silicon photonic circuit with integrated LDV arrays.



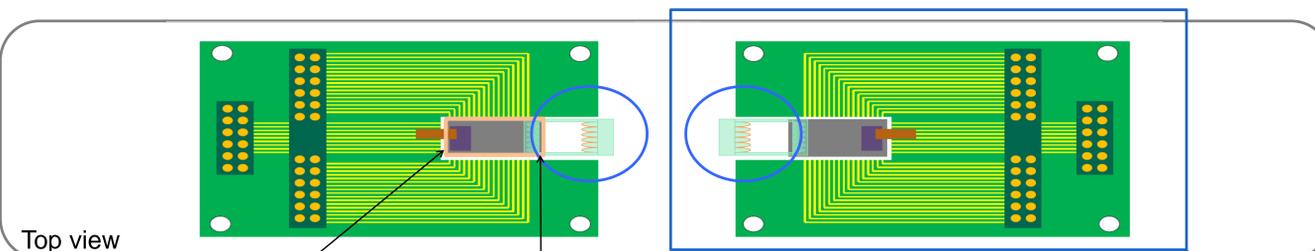
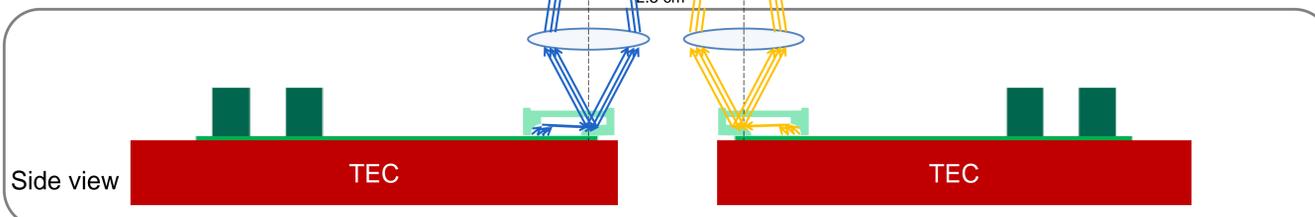
The silicon photonics ensures a compact LDV chip. E.g. full-size of a 1x6 LDV chip (including wire-bonding) is 2.5x5 mm.

Fabrication cost of silicon PICs is very low for high volume production.

## The photonics head

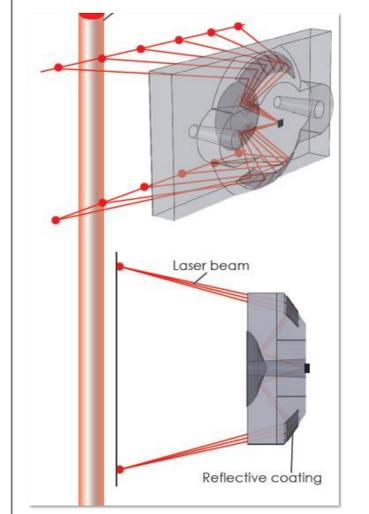


**Light beams in free space:** The device sends 2x6 beams to their corresponding locations on the skin at the same time. A retroreflective tape is normally attached to the skin to increase the reflection of those measurement beams.



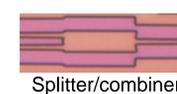
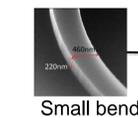
**Advantage:**  
2x6 laser beams – Easy to use

By using more beams, it is easier to find the best position of the measurement.

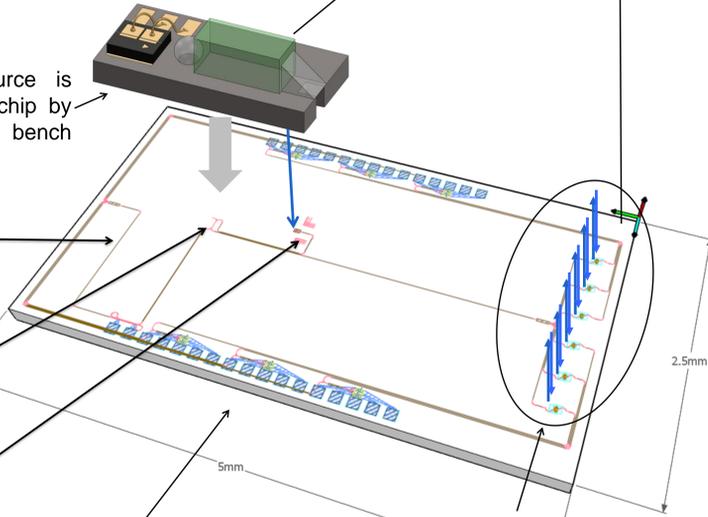


## Photonics integrated circuit

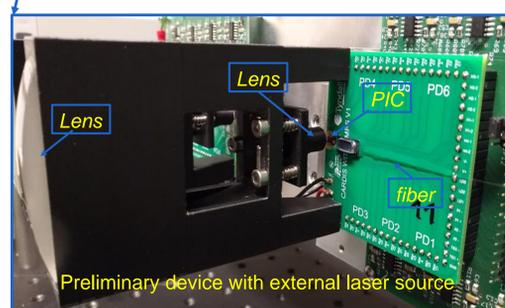
**Source:** The laser source is integrated with the SOI chip by bonding a micro-optics bench (MOB) on top.



**Detectors:** Germanium photo-detectors (PDs) are also integrated on the photonic chips.



**Transmit-receive antennas:** Light beams are coupled out of the chip from surface grating couplers. Reflections from the skin are coupled to the chip again via similar grating couplers.



## Working mechanism and preliminary measurement results

