

# Integrated microfluidic cell lysis and plasmonic assay for detecting circulating tumor genetic biomarkers in liquid biopsies

Giuseppe Spoto

Pillar Health – Spoke 1/WP 4

## SAMOTHRACE 2<sup>nd</sup> Year: Experimental Prototypes Demo Showcase

SAMOTHRACE PROJECT ECS00000022

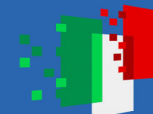
March 10th 2025



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## Limitations

Invasive approach

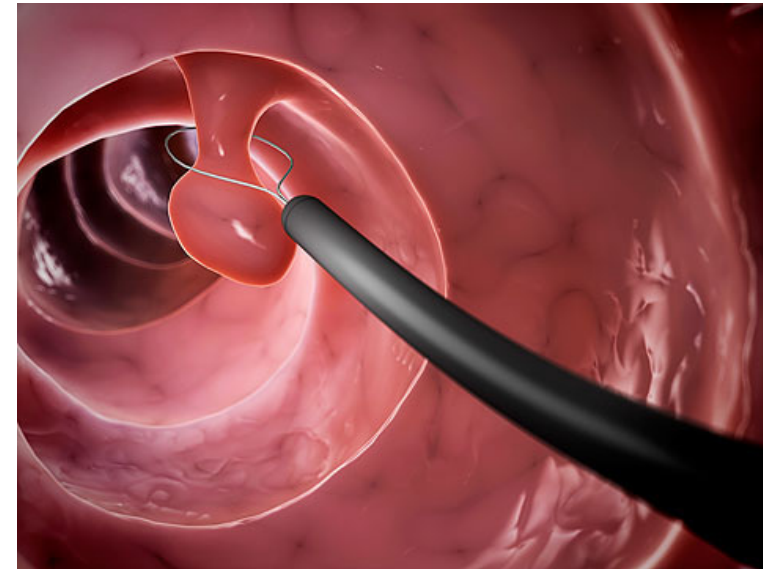
Potential clinical complications

Subject to tumor accessibility and patient condition

No frequent monitoring

Costly

Snapshot: difficulty in accounting for tumor heterogeneity



2.6 million  
breast and prostate  
biopsies per year  
in the U.S.\*



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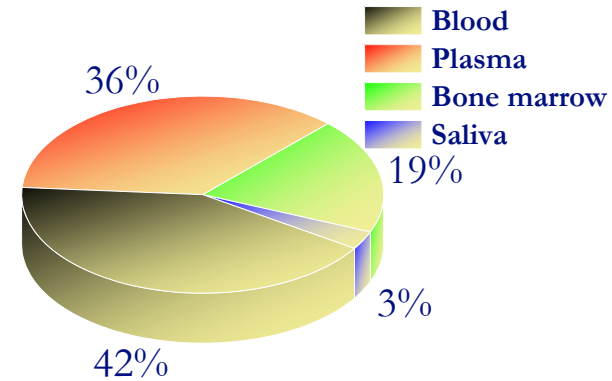
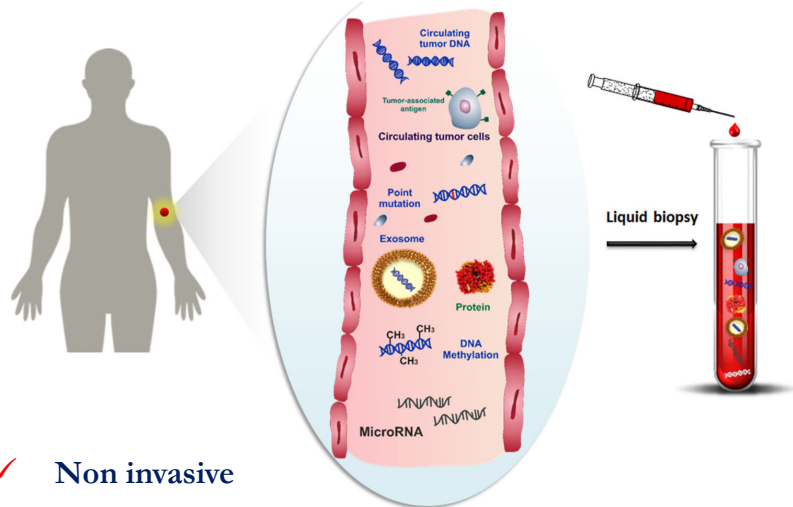


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# Challenges to apply liquid biopsies for personalized medicine in oncology



- ✓ Non invasive
- ✓ Assessment of tumor heterogeneity
- ✓ No subject to tumor accessibility and patient condition
- ✓ Frequent monitoring
- ✓ Simpler and cheaper than tissue biopsy

Bellassai et al. *Frontiers in Chemistry* 2019, 7, 570

US is the market leader (market forecast over \$7 billion in 2025)\*

Prominent players:

Exact Sciences, Roche, and Guardant Health

Europe LB market is forecast to grow at a CAGR of 9.5% to reach US\$ 2.2 billion from 2020 to 2027\*\*

\*Frost & Sullivan (2022)

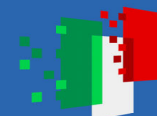
\*\*[www.theinsightpartners.com/reports/toc/europe-liquid-biopsy-market](http://www.theinsightpartners.com/reports/toc/europe-liquid-biopsy-market)



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# How can we currently investigate genomic alterations in clinics using liquid biopsy?



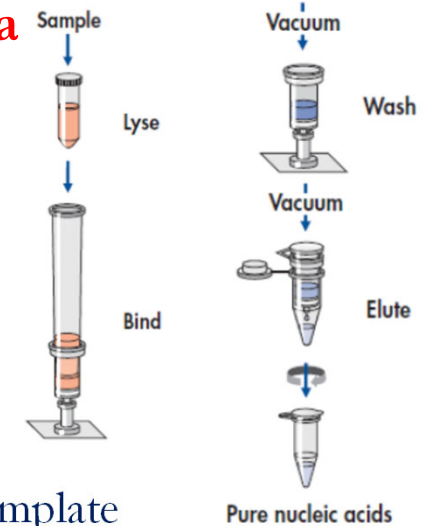
Next generation sequencing



Digital PCR

## DNA isolation from patient's plasma

- ✿ Input 1-3 mL
- ✿ Blood waste
- ✿ Time, costly
- ✿ Risk of sample contamination



## Polymerase chain reaction (PCR)

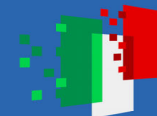
- ✿ Prone to sample contamination
- ✿ Preferential amplification of short template sequences
- ✿ Artifact generated by recombination between homologous regions of DNA
- ✿ Subject to errors ( $\sim 1:10^6$  bp)



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# How our plasmonic method improves cancer diagnostics based on liquid biopsy?

No PCR amplification

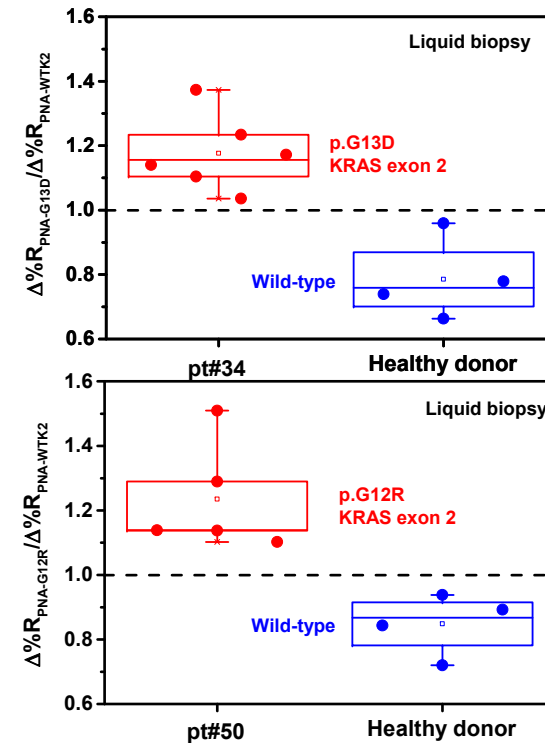
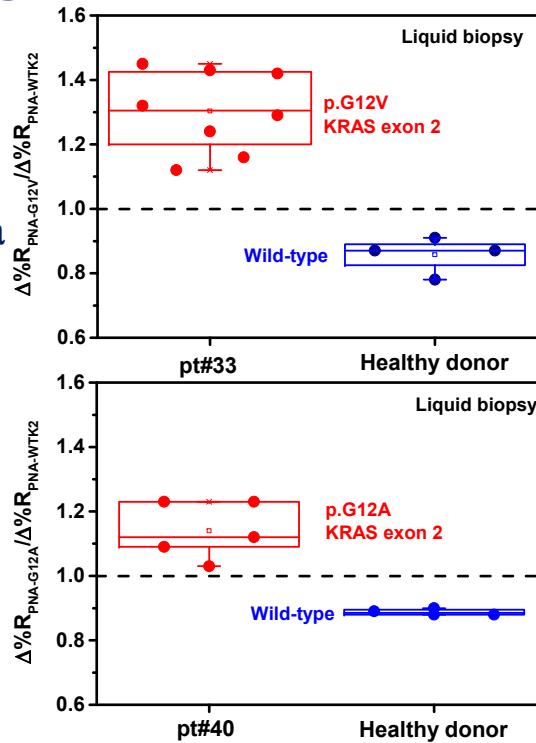
No DNA isolation from plasma

Human plasma input 40  $\mu$ L

No blood waste

1.5 hours (10-12 min. hands-on)

Reduced risk for sample contamination



R. D'Agata et al. *Biosensors and Bioelectronics*. 170, 2020, 112648.

Bellassai et al., *ACS Sens.*, 2021, 6, 6, 2307–2319



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### Less time and effort in the liquid biopsy analytical workflow

From circulating tumor cells to genomic material ready for molecular detection in one single step.

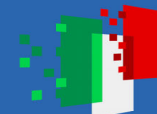
From circulating tumor cells to tumor genomic alteration plasmonic detection with a two steps workflow.



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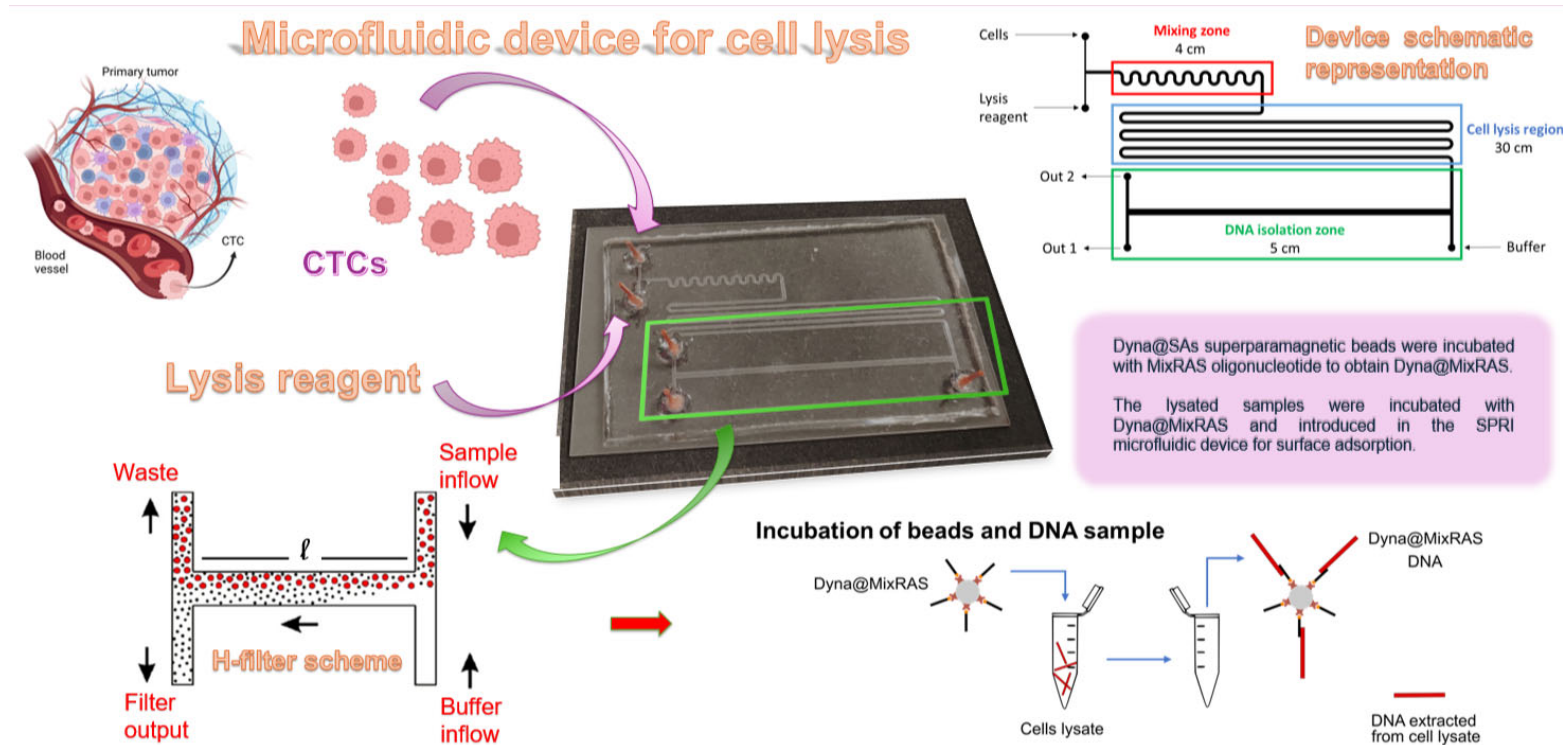


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# The prototype: cell lysis device



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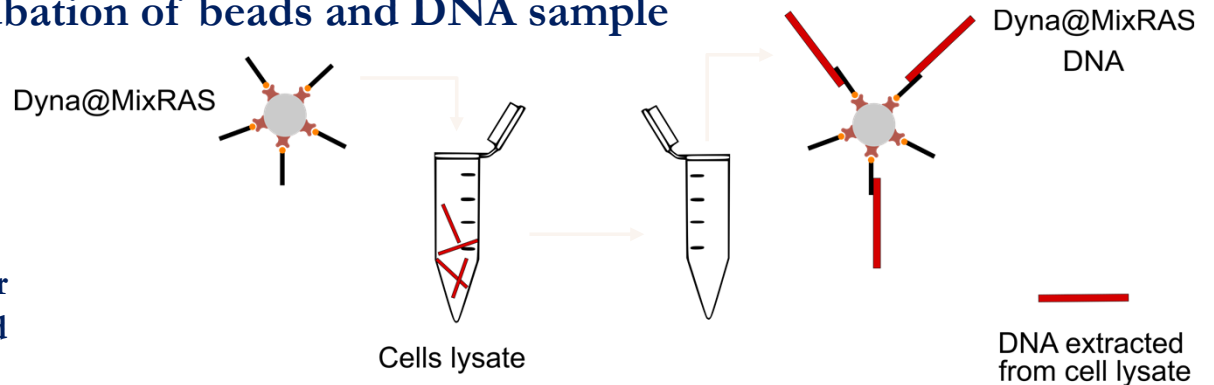


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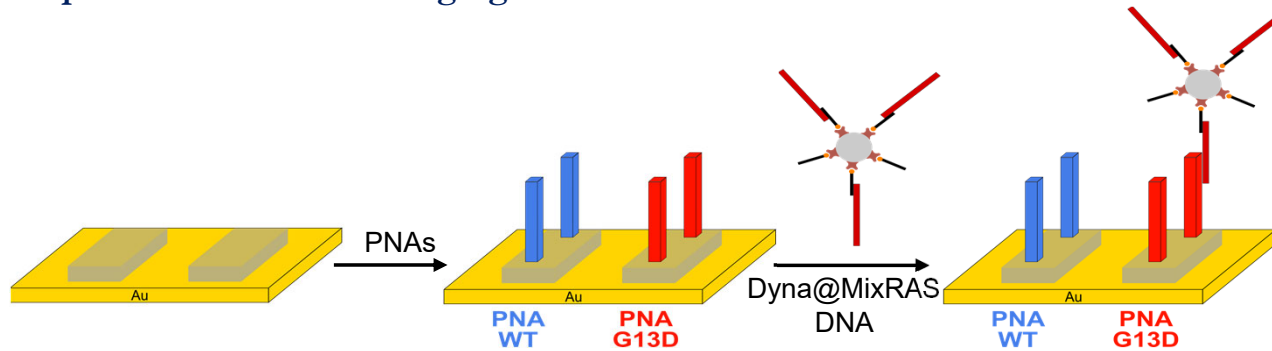


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## Incubation of beads and DNA sample



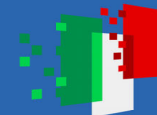
PCR-free plasmonic detection of the cancer genetic alteration by using beads-enhanced surface plasmon resonance imaging



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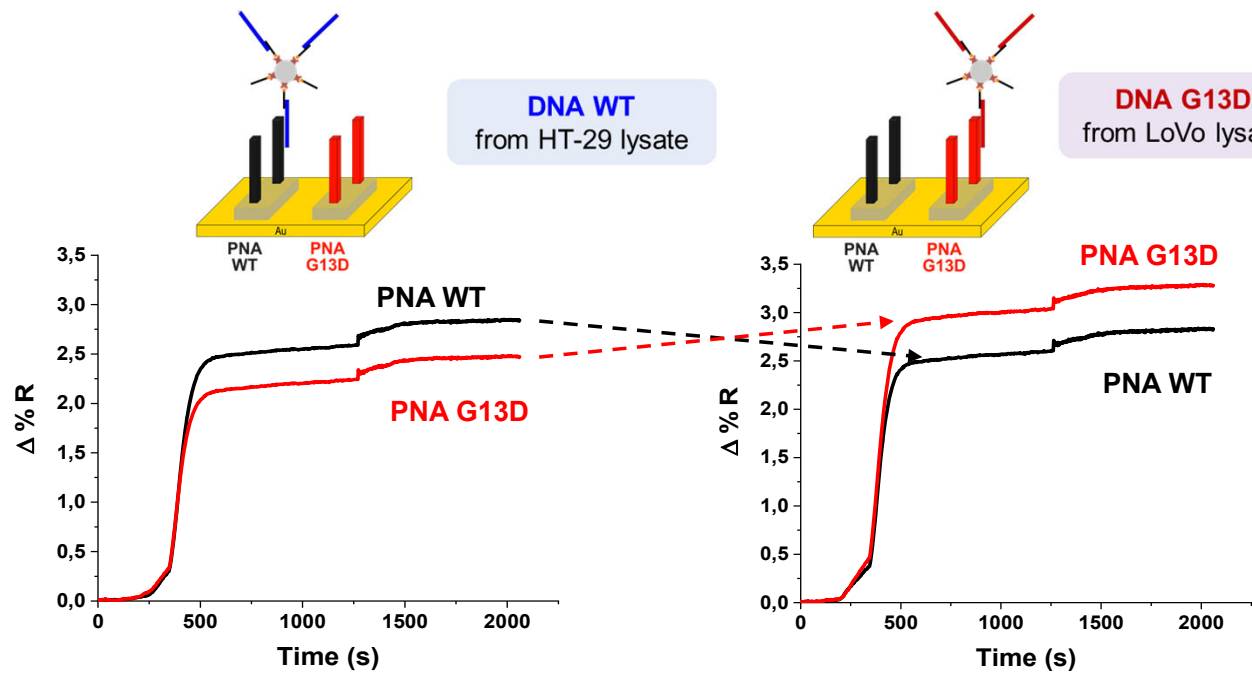
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## PNA/DNA hybridisation



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## DEVELOPMENT PLAN UNDER SAMOTHRACE ECOSYSTEM

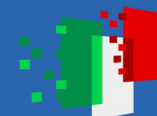
- Starting point: initial TRL 2
- Current TRL 4 thanks to: dedicated personnel, eco-system interactions (prototype fabrication, tests, clinical applications)



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## NEXT STEP UNDER SAMOTHRACE ECOSYSTEM

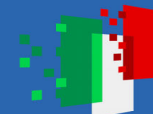
- Next key milestones to be reached by the end of the project.
- Target TRL: 5
- Advancements planned: final assay optimization. Additional mutations may be investigated (e.g. in hematological malignancies)



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[www.samothrace.eu](http://www.samothrace.eu)



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# THANK YOU

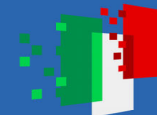
## VISIT OUR DEMO AT BOOTH N. 28



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