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ÚRAD PODPREDESEDU VLÁDY
SLOVENSKEJ REPUBLIKY
PRE PLÁN OBNOVY
A ZNALOSTNÚ EKONOMIKU



MINISTERSTVO
ŠKOLSTVA, VÝSKUMU,
VÝVOJA A MLÁDEŽE
SLOVENSKEJ REPUBLIKY

VÝSKUMNÁ
AGENTÚRA

Ing. Martin ŠMIHÁL

RESPECTATOM

09I05-03-V02-00028

Research on hybrid spectrometric methods for the identification of atoms and molecules at the ppb level using sensor fusion and machine learning technologies

Project Meeting – Technical Aspects

University of Žilina
Novo s.r.o.
NT Research s.r.o.

February 19, 2025



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Meeting Agenda

1. Project Introduction
2. Project Plan
3. Teams and Their Roles



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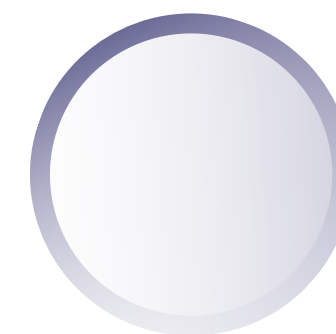
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RespectATOM brings faster, more affordable, and highly accurate molecular analysis, making advanced diagnostics and environmental monitoring more accessible.





Our Goals

✓ Machine Learning Integration

- AI-driven data processing for mass and optical spectroscopy
- Automated molecule and atom identification at ppb levels

✓ Sensor Fusion Optimization

- Combining mass spectrometry & optical spectroscopy for higher accuracy
- Real-time multi-sensor data interpretation for improved reliability

✓ Cost-Effective Spectrometry

- Lower operational costs compared to GC-MS
- Minimal sample preparation while maintaining high sensitivity

✓ Wide Industrial Adoption

- Scalable AI-driven spectroscopy system for multiple applications
- Real-time medical, industrial, and environmental analysis



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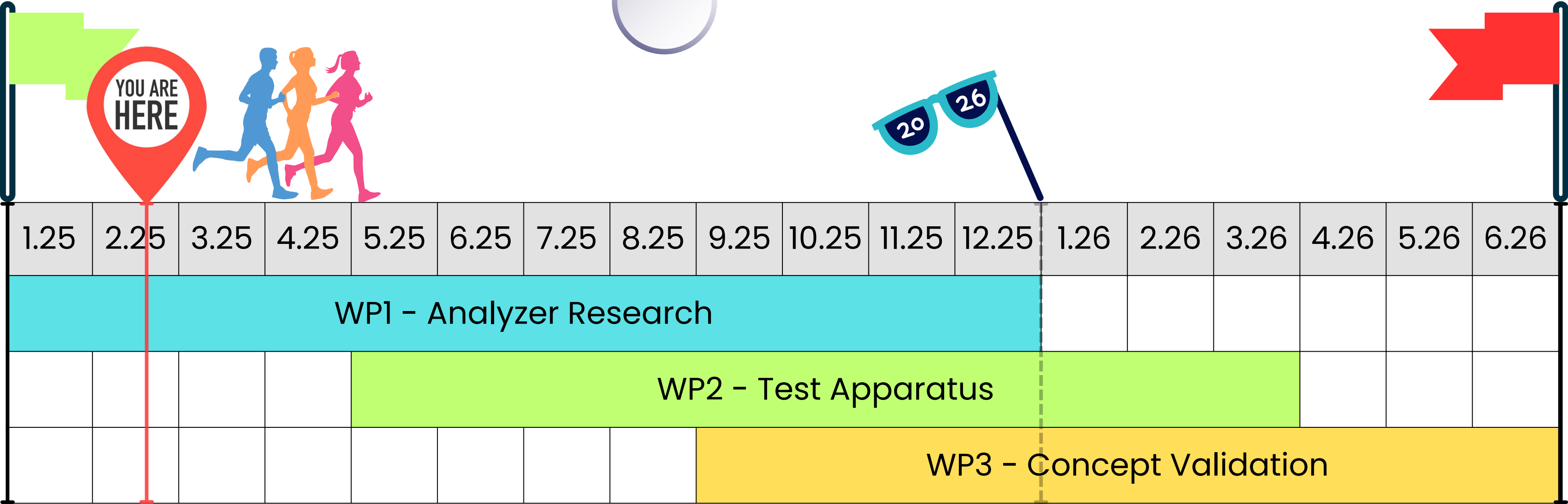


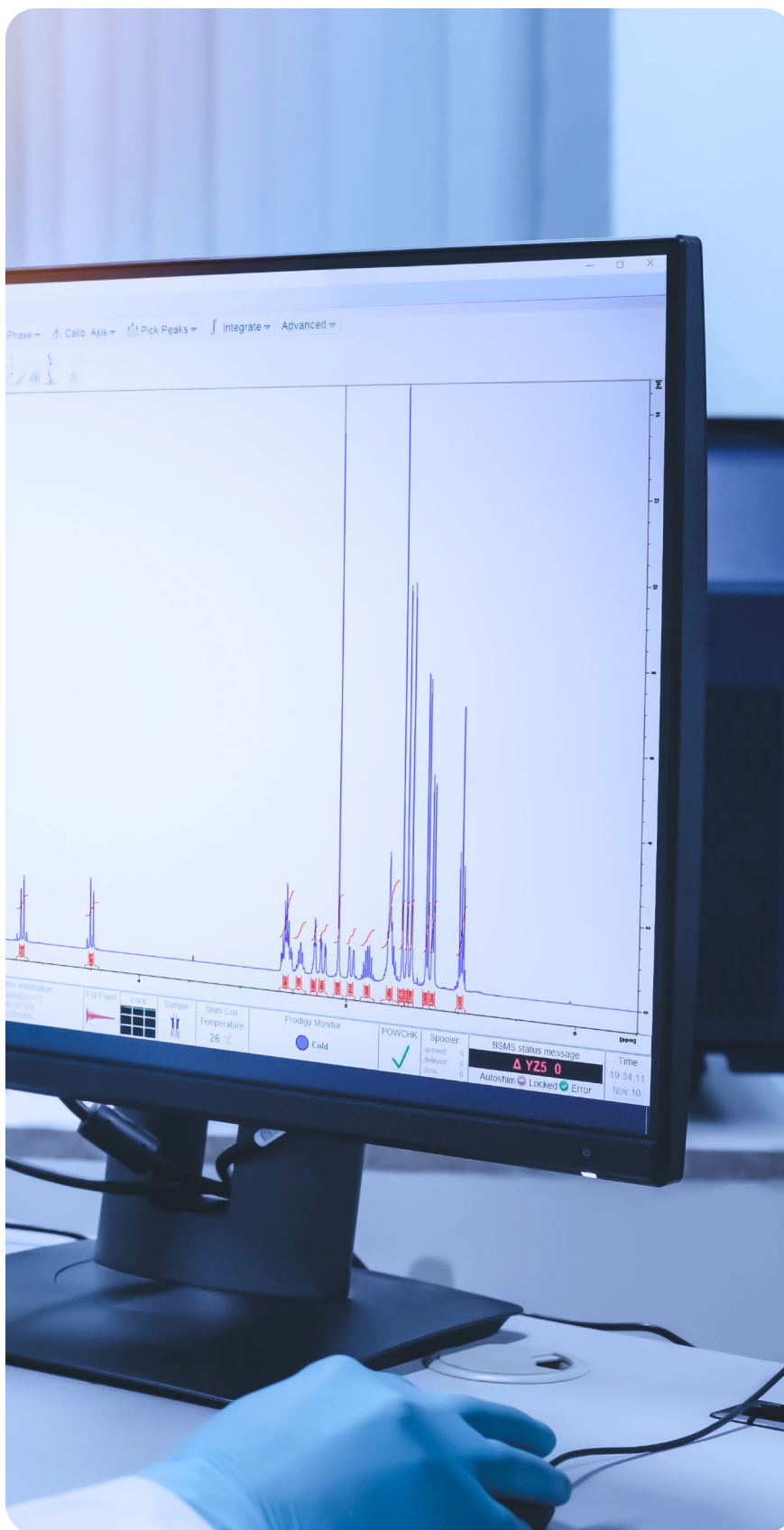
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RESPECTATOM

AI-Enhanced Hybrid Spectrometry

Time schedule

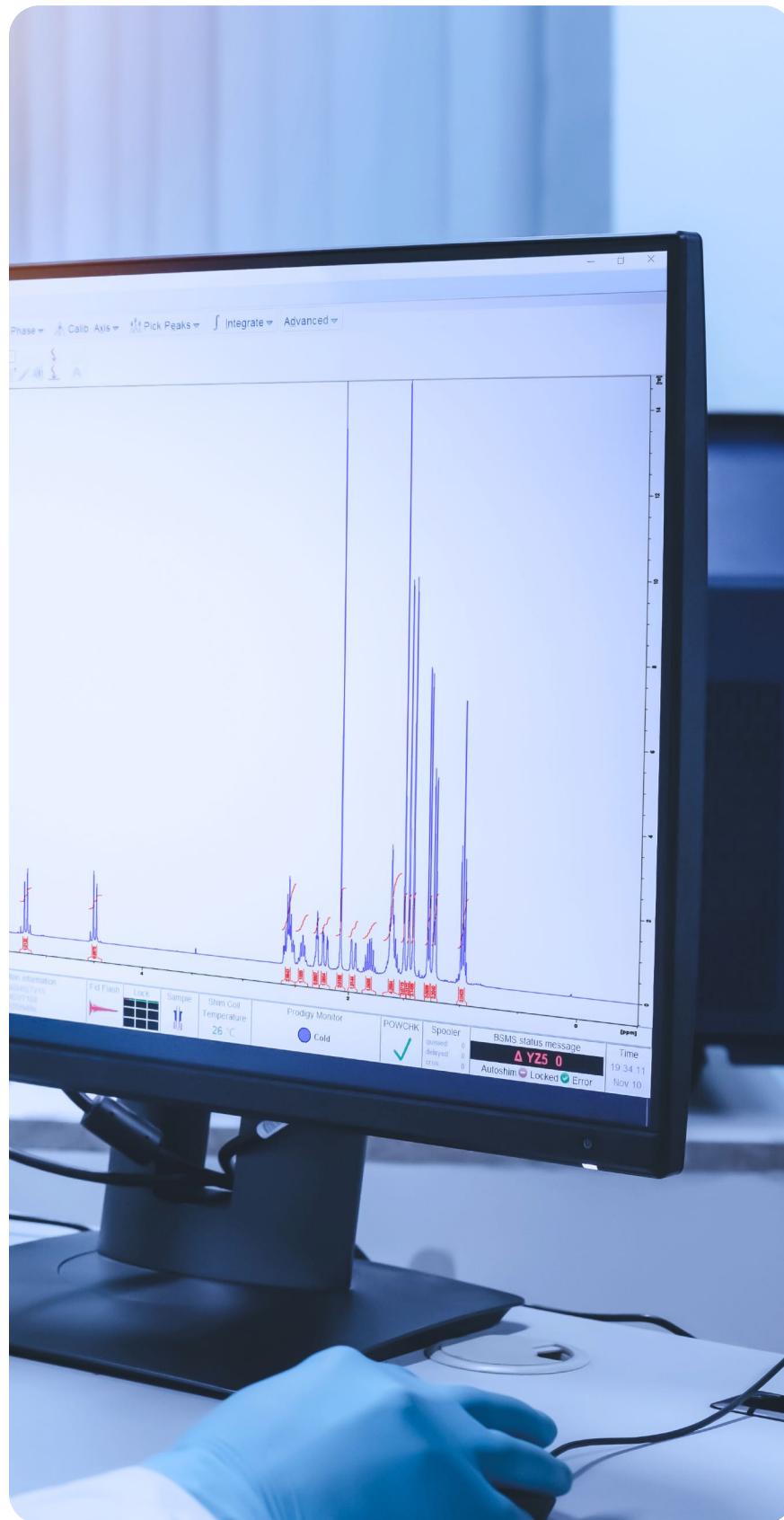




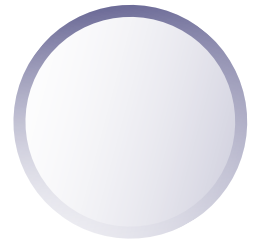
WP1 – Analyzer Research

Objective

- ✓ **Research hybrid analytical spectrometric methods**
to detect atoms and molecules at 10 ppb levels
- ✓ **Explore sensor fusion techniques**
to enhance measurement accuracy



WP1 – Analyzer Research



Key Activities

- **UNIZA:** Collect, analyze, and summarize existing research on optical and mass spectrometry
- **NOVO & NTR:** Study sensor fusion models and their applicability to analytical methods

Identify performance gaps and challenges in current analytical techniques

Define research priorities for developing the test apparatus in WP2



WP1 – Analyzer Research

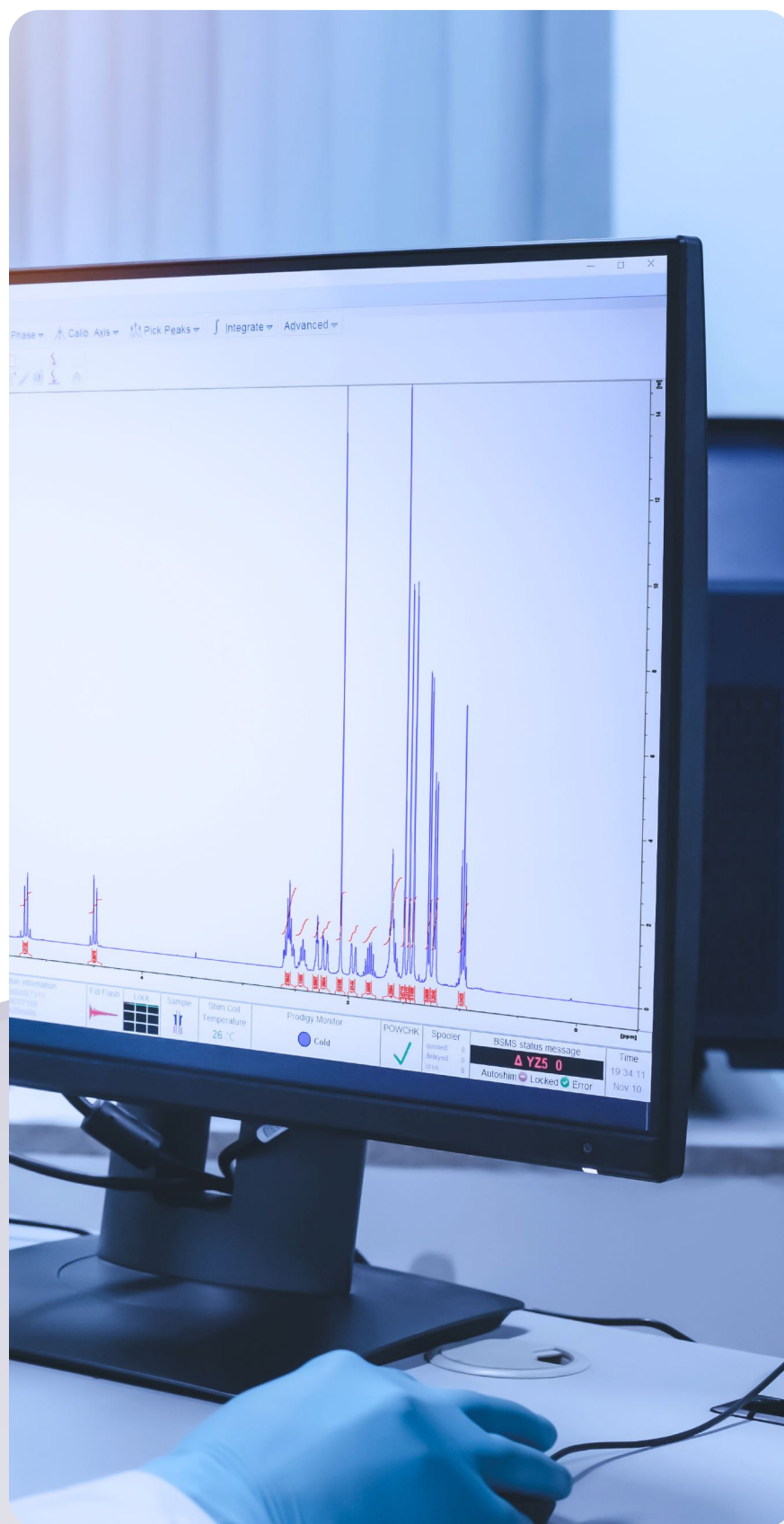
Deliverables

O1.1 – Literature Review Report

(Overview of optical & mass spectrometry integration)

O1.2 – Summary Report

(Findings, trends, and recommendations for further research)





WP2 – Test Apparatus

Objective

- ✓ **Design and construct a test apparatus**
to validate hybrid spectroscopic methods
- ✓ **Develop sensor fusion algorithms**
for analytical spectroscopy



WP2 – Test Apparatus

Key Activities

- **Develop and construct a prototype integrating mass & optical spectrometry**
- Test plasma activation for both solid and gas samples
- Combine spectroscopy methods to enhance detection precision

UNIZA: Leads the design and theoretical framework for the test apparatus

NOVO: Optimize sensor fusion models for multi-sensor data interpretation

NTR: Provides expertise in cold plasma technology.



WP2 – Test Apparatus

Deliverables

- 📌 O2.1 – Prototype Measurement System
- 📌 O2.2 – Publication on Solid Sample Analysis
- 📌 O2.3 – Publication on Gas Sample Analysis
- 📌 O2.4 – Publication on Hybrid Spectrometry
- 📌 O2.5 – Optimized Sensor Fusion Model
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WP3 – Concept Validation

Objective

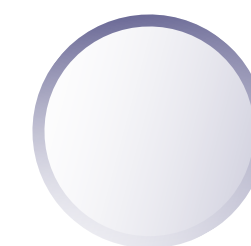
- ✓ **Validate the hybrid spectrometry**
- ✓ **Benchmark results**
- ✓ **Optimize sample identification**



WP3 – Concept Validation

Key Activities

- **Conduct laboratory testing** of the developed hybrid spectrometric system
- **Compare measurement**
- **Train and optimize machine learning** models for data interpretation
- **Analyze performance**, identify limitations, and refine methodologies





WP3 – Concept Validation

Deliverables

- 📌 **O3.1 – Acquired Datasets**
(Optical Spectroscopy + GC-IMS reference data)
- 📌 **O3.2 – Interpretation Report**
(Findings, model accuracy, and improvements)
- 📌 **O3.3 – Benchmark Study**
(Comparison with existing methods)
- 📌 **O3.4 – Final Research Report**
(Comprehensive project results and recommendations)



Teams and Their Roles

University of Žilina (UNIZA) – Lead Applicant

- Leads theoretical research, data analysis, and validation
- Designs the test apparatus and experimental framework
- Ensures scientific integrity and methodology alignment

Novo s.r.o. – Technology Partner

- Develops machine learning models for data interpretation
- Optimizes sensor fusion techniques for spectroscopy
- Constructs and tests the prototype measurement system

NT Research s.r.o. (NTR) – Plasma Technology Expert

- Provides cold plasma technology for sample activation
- Supports spectroscopic analysis and system integration
- Ensures effective plasma-spectroscopy interaction



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“Just keep moving forward.”

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