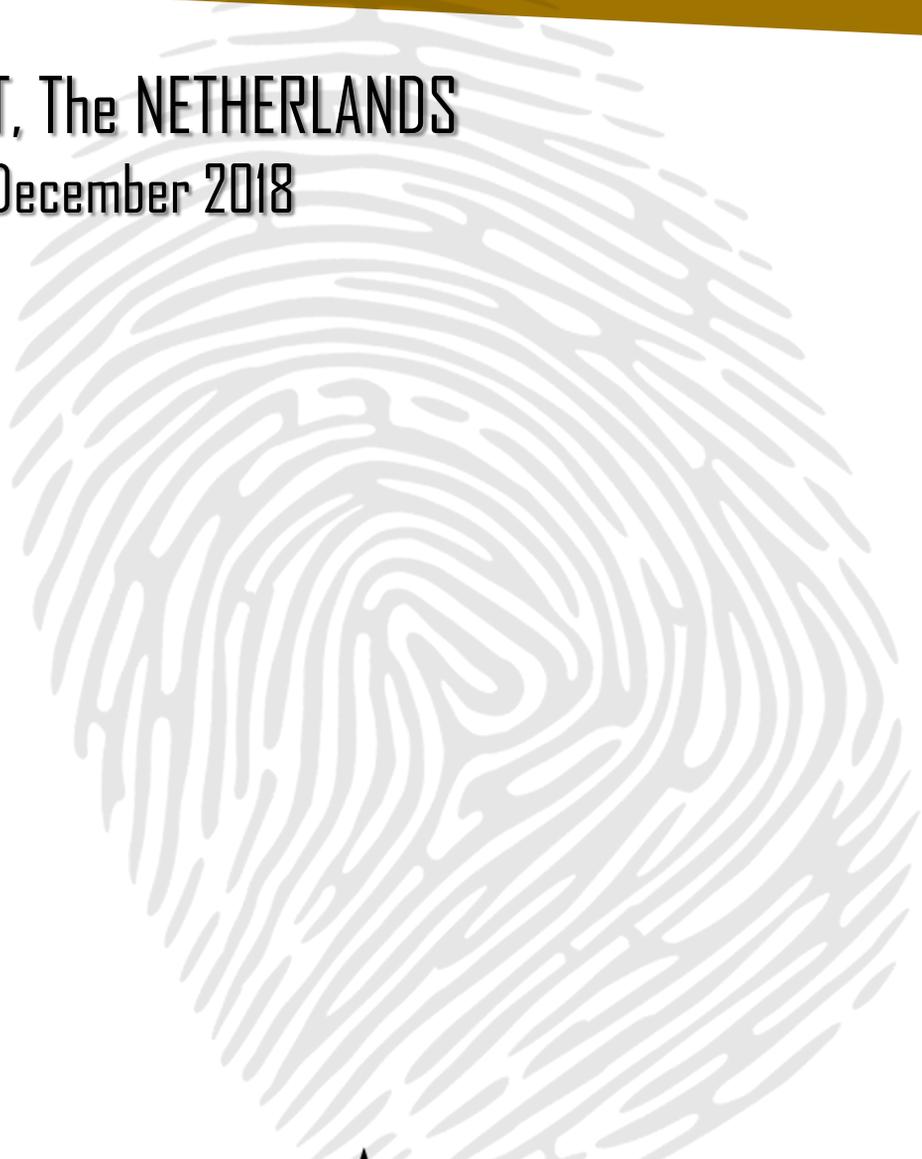


II MULTIFORESEE CA16101 TRAINING SCHOOL

Molecular imaging in Forensics

MAASTRICHT, The NETHERLANDS

10th to 13th of December 2018



Notes

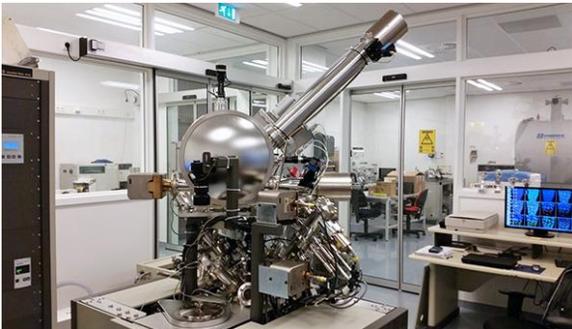
M4I is a high-end research environment with a unique knowledge infrastructure. Its goals are aligned with Kennis-As Limburg (Knowledge Axis, Province of Limburg), a strategic programme designed for the sustainable economic development of Limburg. M4I contributes to innovative patient care, the education of knowledge workers for the job market and collaborative research and knowledge transfer with regional partners from business and government.



WELCOME at M4I

One Institute, Two Divisions

M4I is a state-of-the-art molecular imaging institute that brings together a powerful palette of high-end, innovative imaging technologies. The mission of the institute is to perform fundamental, instrumentation and applied studies in molecular imaging as a part of a translational, synergistic, interdisciplinary research programme in a leading international center relevant for science, education, economy and society.



Division of Imaging Mass Spectrometry

The M4I Division of Imaging Mass Spectrometry, under supervision of university professor Ron Heeren, is one of the world leaders in high resolution molecular imaging of biological surfaces. The division targets the development and application of state-of-the-art mass spectrometry based molecular imaging approaches for nanomedicine and biomedical research.

Heeren's research group is among others well-known for the application of Mass Spectrometry Imaging (MSI) to molecular histology, the study of functional molecules within living tissues. The main research aim for the coming years is to develop and apply mass spectrometry as a diagnostic and prognostic tool for personalized medicine in e.g. oncology, neurology and cardiovascular medicine, three important fields of expertise of Maastricht University.

The Division of Imaging Mass Spectrometry is part of M4I, the largest molecular imaging centre in Europe, and is embedded in the Faculty of Health, Medicine and Life Sciences of Maastricht University. The division operates in close collaboration with the M4I Division of Nanoscopy (of Prof. Peter Peters) and the departments of General Surgery and Pathology of Maastricht University Medical Centre.

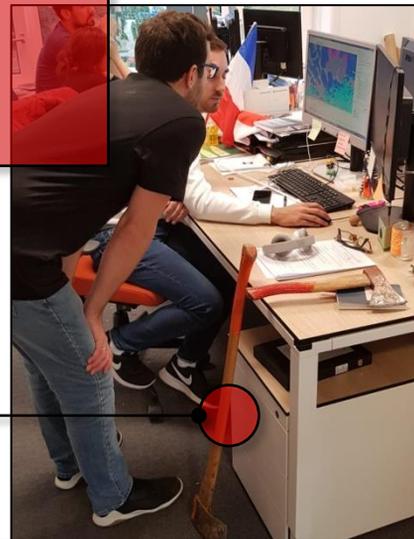
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ONCE UPON A TIME...



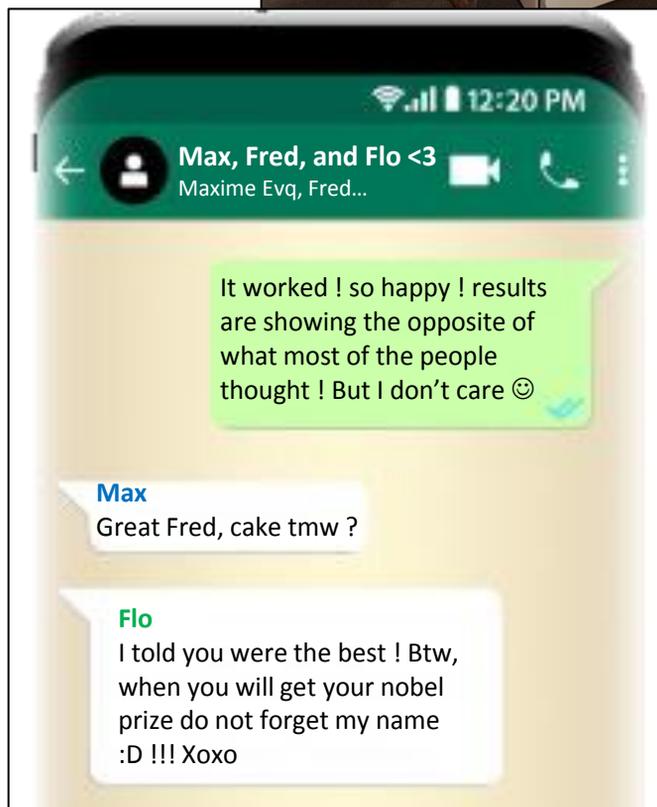
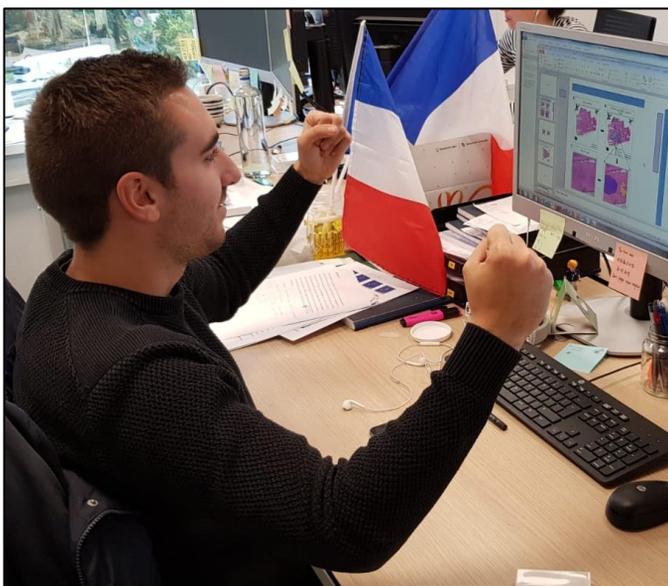
November 2018, 23rd

Fred, one of the M4I PhD students, was having trouble working on a challenging project. His collaborator visited him to understand why things were going so slow. Apparently, according to Pierre (Fred's officemate), the collaborator made it clear that he needed the data ASAP...



December 2018, 9th, 11.52PM

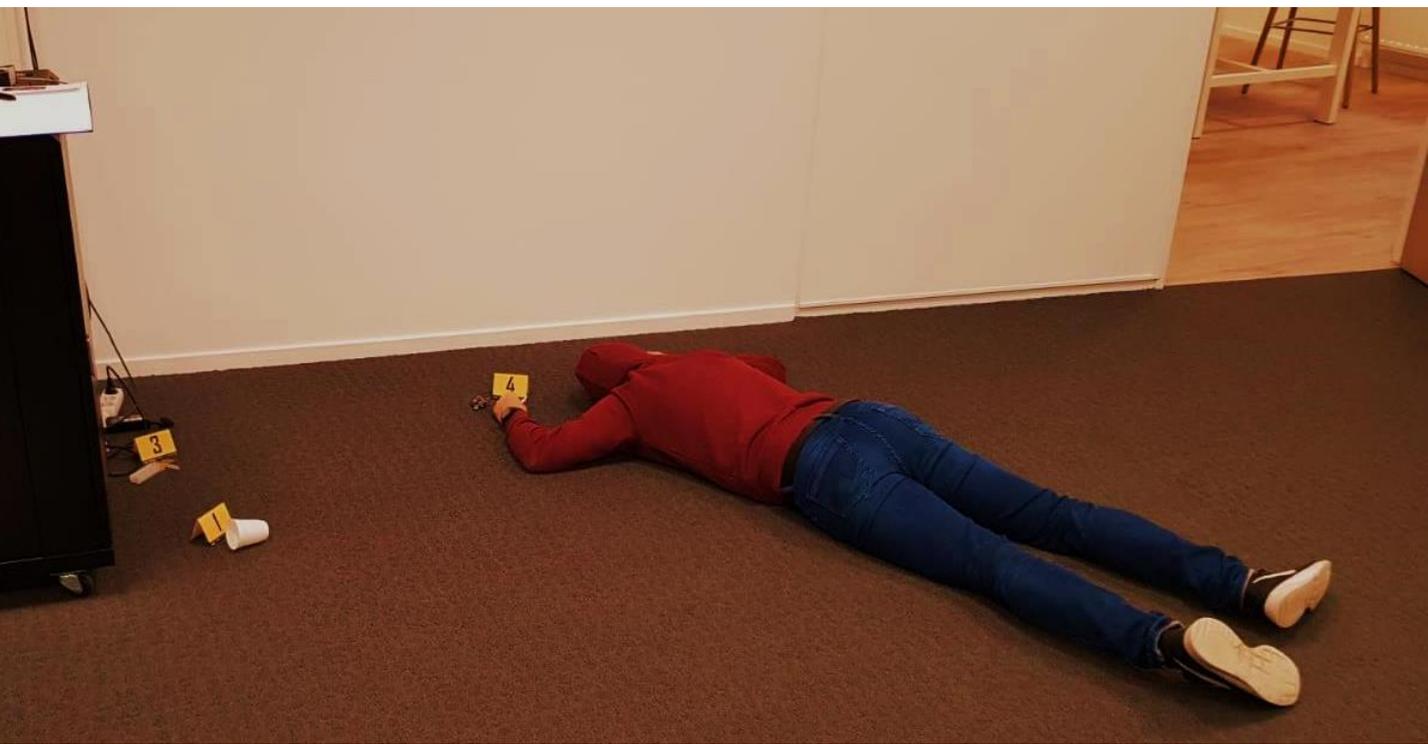
Fred was working on Sunday... when he finally got his results and a wonderful discovery which could lead to big changes in the mass spectrometry imaging field! Fred took his phone and wrote a text to Florian and Maxime (his favourites colleagues)...



Unfortunately, the day after...

DO NOT CROSS

Ron Heeren, Director of M4I, found Fred's body in the meeting room. Before posting a new job vacancy online, Ron guessed that Fred wanted to upload his data to present them at the Forensic training...



By chance, this training was full of talented scientists ready to solve this mystery and to help the M4I institute to find the person who did this to our poor Fred...

CRIME SCENE

*"Hum... clean glass slides...
Maybe he wanted to repeat
the experiments..."*



*"A cup of coffee
was on the crime
scene... Weird,
Fred is not a
coffee drinker..."*



*"A long hair
has been
found on the
laptop..."*

*"It looks like Fred tried to
protect his data until the
end... we should have a closer
look... and lets not forget the
notebook..."*



SUSPECTS

The staff just met, and they came up with a list of 3 suspects based on people who were working on the same topic as Fred. Here are the suspects with some details about their lifestyle in the office and lab...

Jianhua

Just arrived in NL

Smoker

Uses hand-cream

Currently sick and uses paracetamol

Loves ice creams

Kung-Fu Master



Lieke

PhD representative

Coffee lover

Taking Carbamazapine

Vegan

Works late

Hates French people



Britt

Just started her PhD

Coffee and alcohol drinker

Dyed hair

Uses hand-cream

Loves festivals



EXPERTS TO HELP YOU

To help you to find the murder, experts of the field will be available and will teach how to get the most out of the found evidences.



Prof. Bela Kubat
Maastricht UMC+



Dr. Jaap van der Weerd
NFI



Prof. Maarten Honing
M4I



Dr. Bryn Flinders
DSG



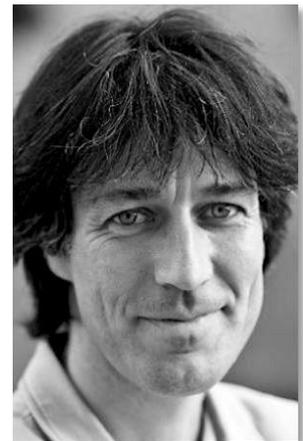
Prof. Martina Marchetti-Deschmann
ICTA Vienna



Dr. Tiffany Porta
M4I



Prof. Ron Heeren
M4I



Prof. Maurice Alders
UvA



Prof. Simona Francese
Sheffield Hallam University

Do not forget that this week is yours, M4I staff are also available to answer your questions, and you know sometimes people have a lot to say when looking for a murderer...



To find the murderer, you have access to the majority of our platform including chemicals and sample preparation instruments. See the lists below.

CHEMICALS

Ethanol
Methanol
Chloroform
Acetonitrile
Distilled water
Trifluoroacetic acid (TFA)
Formic acid (FA)

SAMPLE PRERATION

TM-Sprayer
Suncollect
Sublimation
Dessicator
Nitrogen gas line
Hair cutting device

MATRICES

2,5-Dihydroxybenzoic acid (DHB)
Norharmane
2,6-dihydroxyacetphenone (DHA)
9-Aminoacridine (9AA)
 α -Cyano-4-hydroxycinnamic acid (CHCA)

MS-INSTRUMENTS

RapifleX from Bruker
SolariX from Bruker

BENCH TOOLS

Pipettes, tubes, beakers, sonicator,
tape, syringes, ...



Do not forget to collect samples from the suspects to link them to the evidences found on the crime scene.

PRACTICAL GUIDELINES

On **Tuesday** and **Wednesday** you will generate data on our instruments based on your sample preparation protocol and analyse your data with our help.

On **Thursday** you will have to present your work in a small **presentation** (PowerPoint, 15 min max) including:

- The sample preparation and process of evidences
- The results generated during the data analysis session
- One conclusive slide on this work

Afterwards the goal will be to join forces with the other teams to find out who is the M4I murderer!

During this week if you have any question, do not hesitate to ask people around you 😊

Have fun!



PROGRAMME

	Monday	Tuesday	Wednesday	Thursday
9.00		General imaging MS introduction Dr. Tiffany Porta	Blood Prof. Martina Marchetti-Deschmann	Discussion on Innovations in MSI
10.00		10.00-10.30 Coffee	Blood spectroscopy Prof. Maurice Aalders	9.45-10.15 Coffee
11.00		Hair Analysis Dr. Bryn Flinders		
12.00		Fibers and spectroscopy Dr. Jaap van der Weerd	Forensic pathology Prof. Bela Kubat	Who is the killer ???
13.00		12.30-13.30 Lunch	12.00-13.00 Lunch	12.30-13.00 Course wrap-up, evaluation and closure
14.00	Arrival & Coffee 14.30 Course Objectives Prof. Ron Heeren			Lunch and Closure
15.00	15.00 - 15.45 Basic Analytical Chemistry for Forensic research Prof. Maarten Honing	13.30-17.00 Practical MSI	13.00-17.00 Data analysis and report	
16.00	16.15-17.00 MALDI MSI of fingerprints Prof. Simona Franscese			
17.00	17.00-18.00 Networking Activity			
18.00	Free evening	Free evening	19.00-22.00 Joint course networking dinner	

TEAMS

Team	Name
IA	Heaton Cameron
IA	Cuypers Eva
IA	Virginia Donadeo
IA	Brajković Marko
HA	Bejatt Ravell
HA	Antic Igor
HA	Nihad Archetib
HA	Osina Izle
FP	Vella Joanna
FP	Bartolic Dragana
FP	Pawlaczyk Aleksandra
FP	Zivancev Jelena

HEADQUARTERS:

Team Hair analysis (HA): Meeting room in front of the lab

Team Fingerprints (FP): Meeting room 5.467

Team Ink analysis (IA): Meeting room in the back

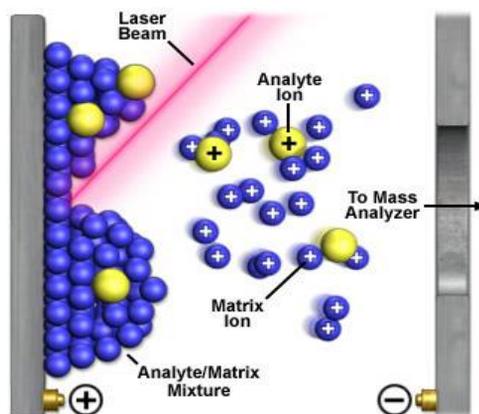
Matrix Assisted Laser Desorption/Ionization

Commonly, MALDI is used with one of two different laser types, the N2 (337 nm) or neodymium-doped yttrium aluminum garnet (Nd:YAG; 355 nm) lasers, with repetition rates of 200–1000 Hz and typical pulse lengths of ≤ 3 ns. Over time the laser spot size was reduced from 100–150 to 20 μm and then 1 μm , allowing the direct imaging of single cells and tissues at subcellular spatial resolution using a transmission geometry configuration. In addition to spatial resolution, breakthroughs in acquisition speed have recently been made. For example, the rapifleX MALDI Tissuetyper™ (Bruker) enables acquisition rates up to 50 pixels/s with a 10-kHz laser and two scanning mirrors that allow the laser beam to be rapidly moved across the sample. Several studies have demonstrated the potential of MALDI for imaging specific peptides and protein compounds; these include the distribution of neuropeptides, tumor delineation in the pituitary gland, molecular phenotyping of CNS glial cells and endogenous peptide markers for Usher's and Parkinson's diseases.

Mass Spectrometry Imaging in Nanomedicine: Unraveling the Potential of MSI for the Detection of Nanoparticles in Neuroscience F PY Barre, R MA Heeren, N Ogrinc Potocnik
Current pharmaceutical design 23 (13), 1974-1984

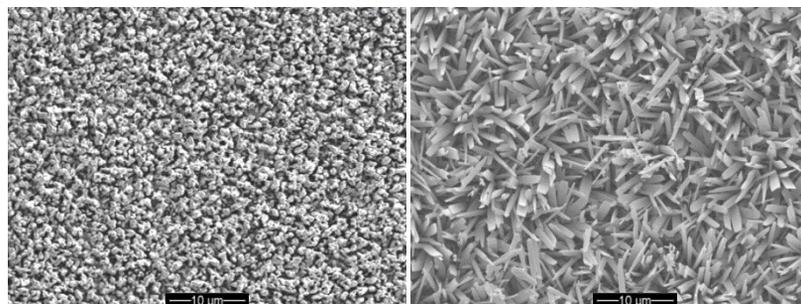
Matrix

Matrix application is the key of MALDI. The role of the matrix is to absorb the energy of the laser thereby facilitating the desorption and ionization of molecules.



<https://nationalmaglab.org/user-facilities/icr/techniques/maldi>

Matrix crystals
Courtesy of Lennart Huizing



PRACTICAL

MAASTRICHT, The NETHERLANDS

10th to 13th of December 2018



HAIR ANALYSIS



Notes

HAIR ANALYSIS

Your team will be responsible for studying the hair which has been found on the crime scene. Bryn Flinders, expert in the field, will guide and help you during this practical.



Bryn, helped by Maxime, will present you the different instruments you can use during the practical but ... will you find the right protocol?

SECRET FILE CODES

10.1007/978-1-4939-7051-3_12
10.1007/s13361-017-1766-0
10.1002/dta.1812



BRYN FLINDERS – HAIR ANALYSIS EXPERT
MAXIME EVEQUE – MSI EXPERT

Notes

PRACTICAL

MAASTRICHT, The NETHERLANDS

10th to 13th of December 2018

FINGERPRINTS



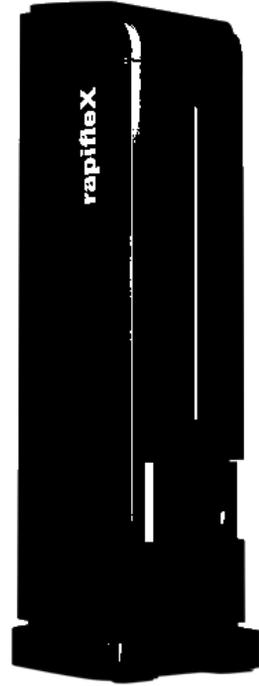
Notes



FINGERPRINTS

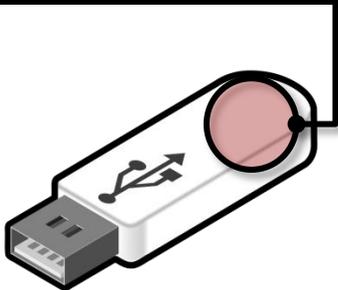
Now it is time to learn what these fingerprints have to tell us... Your team will be analysing the fingerprints that were found on the glass slides. Are they corresponding to one of the suspects? What can we learn about the lifestyle of the murderer?

Unfortunately, our expert Simona Francese had to fly to LA to help the NCIS department. Instead, there are some MSI experts on site that we can use to help you find out who killed Fred.



SECRET FILE CODES

Bradshaw 222 (2012) 318-326
Wolstenhome 2009; 23: 3031-3039



ANTON SKRIBA – MSI EXPERT

SILVIA MAS – MSI EXPERT

Notes

PRACTICAL

MAASTRICHT, The NETHERLANDS

10th to 13th of December 2018

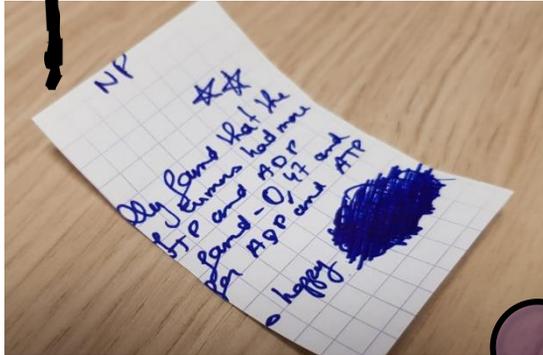


INK ANALYSIS



Notes

INK ANALYSIS



LAST MINUTE EVIDENCE

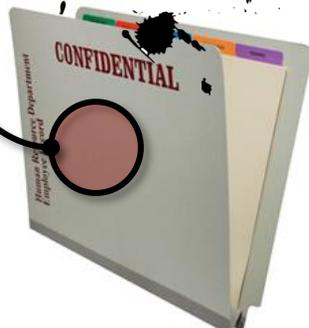
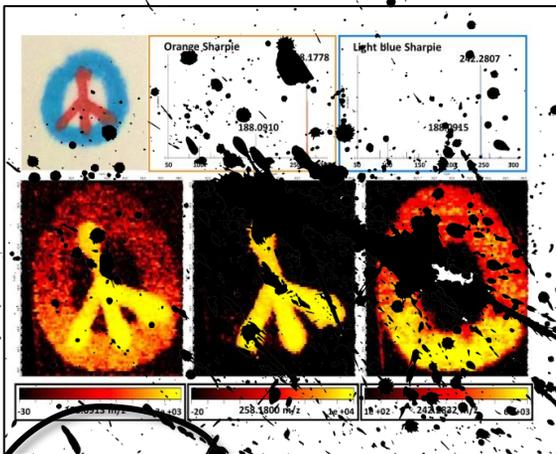
Ron found this in the notebook and would like to know if we can get something from this.

On the crime scene we just found some interesting things on Fred's notebook...

Another piece of paper has been found in Fred's hand, it seems like he wanted to protect this till the end...

We are sure you will find a way to get the best out of it.

In order to help you, Naomi and Klara will guide you through the process.



Sorry, something went wrong with the printer... or maybe the killer sabotaged it



KLARA SCUPAKOVA – *MSI expert*
NAOMI VOS – *MSI expert*

**LOCKED IN A
LAB WITH A
MURDERER**



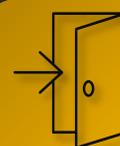
Die dig die



**WORK AS
A TEAM**



**FIND THE
CLUES**



**ESCAPE
THE
KILLER**

M4I

NEED