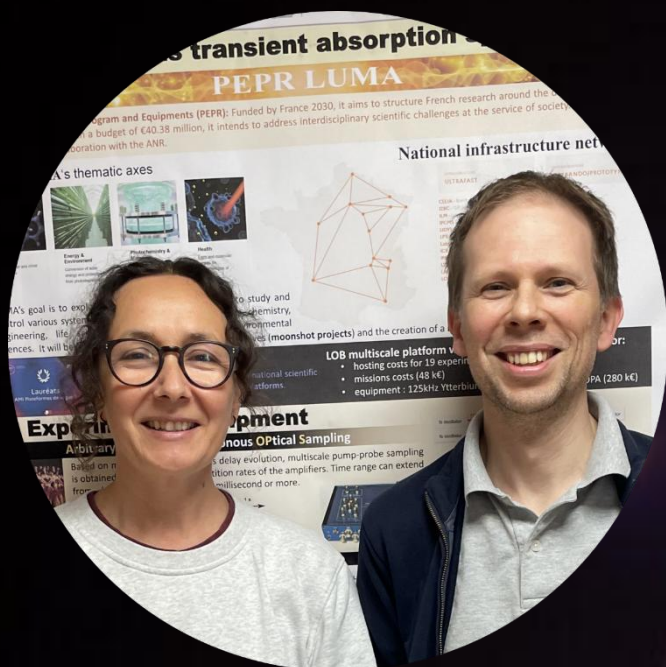


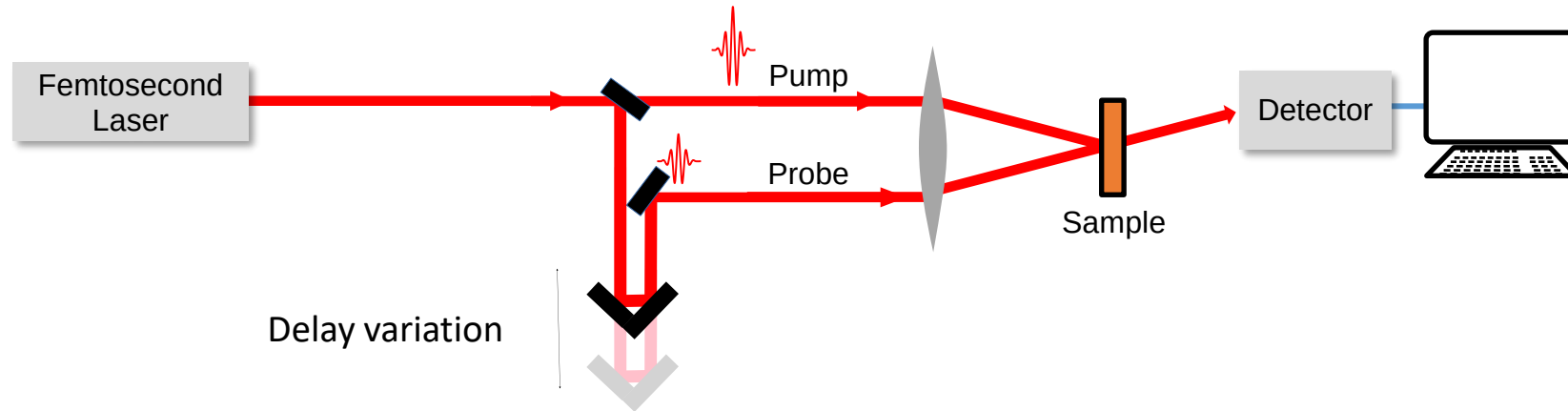
Spectroscopies et dynamiques ultrarapides.



Laura Antonucci / Michel Sliwa LOB PEPR LUMA Ultrafast Platform Polytechnique, Palaiseau

■ Spectroscopie d'absorption transitoire femtoseconde

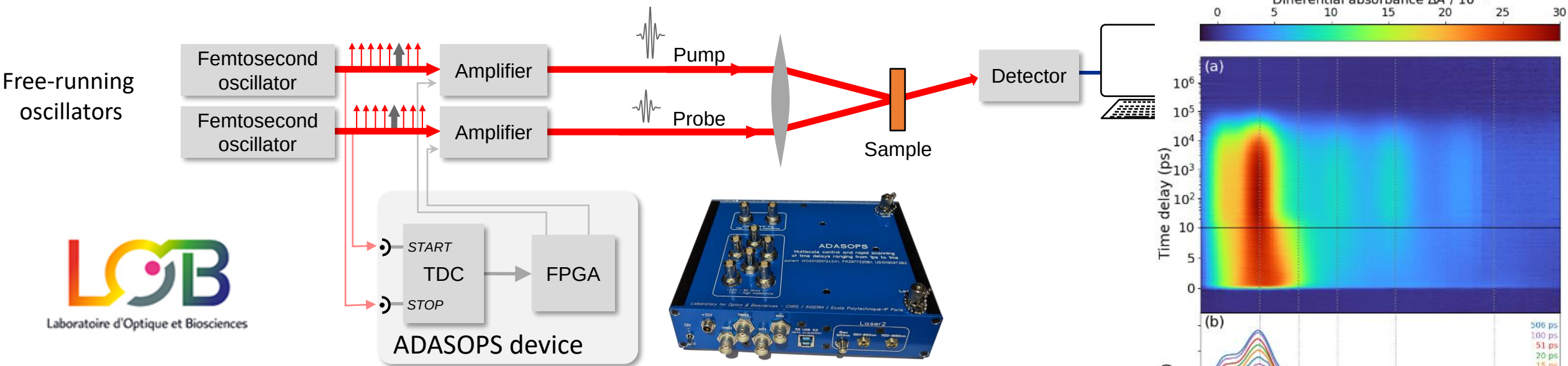
Delay line



Method	Range	Pointing stability	Defocusing	Rapid scanning	Versatility	Implementation
Delay line	fs-ps-ns- <u>us</u> -ms	●	●	●	●	●

Multi-timescale Transient absorption spectroscopy

ADASOPS : Arbitrary Detuning Asynchronous Optical sampling

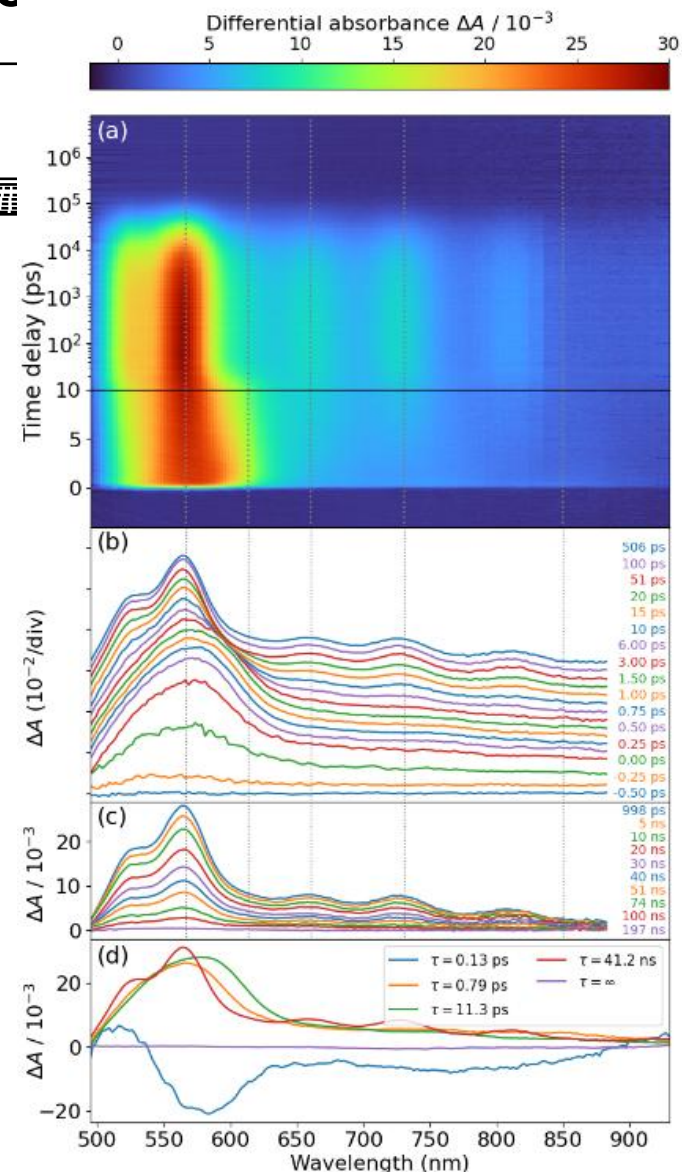


Oscillator monitoring and delay evolution calculation

TDC measurements
Precision ~10 ps RMS



Delay calculation
Precision ~ 500 fs RMS



Ecole Polytechnique - CNRS US Patent 10190972B2

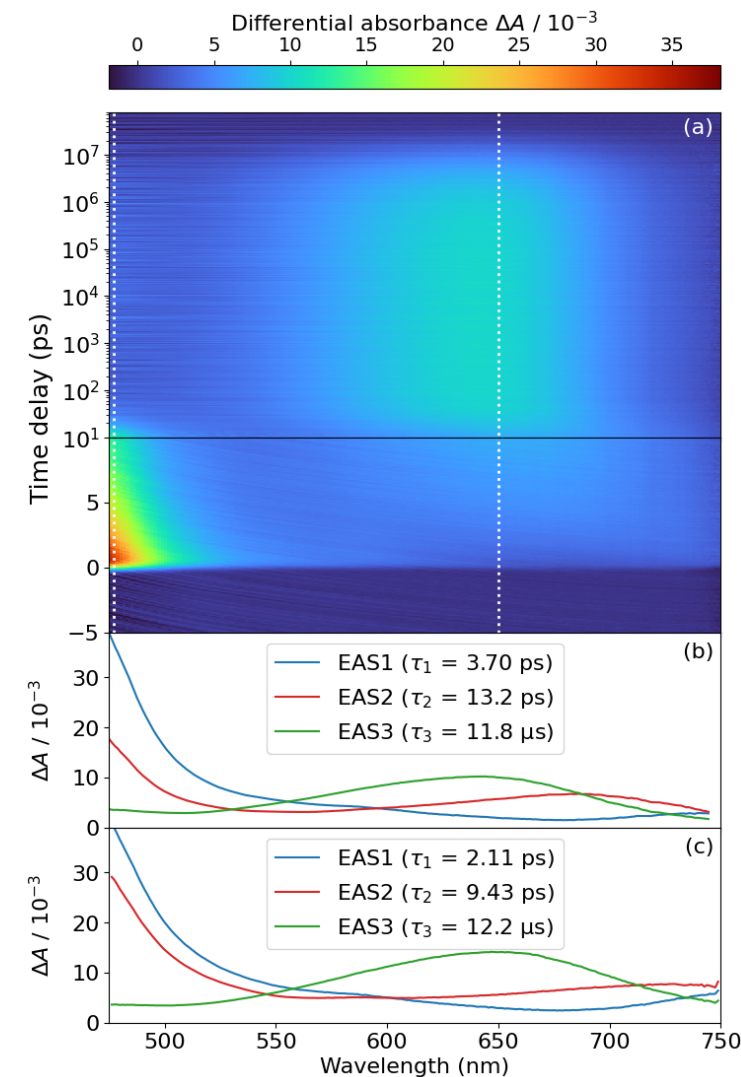
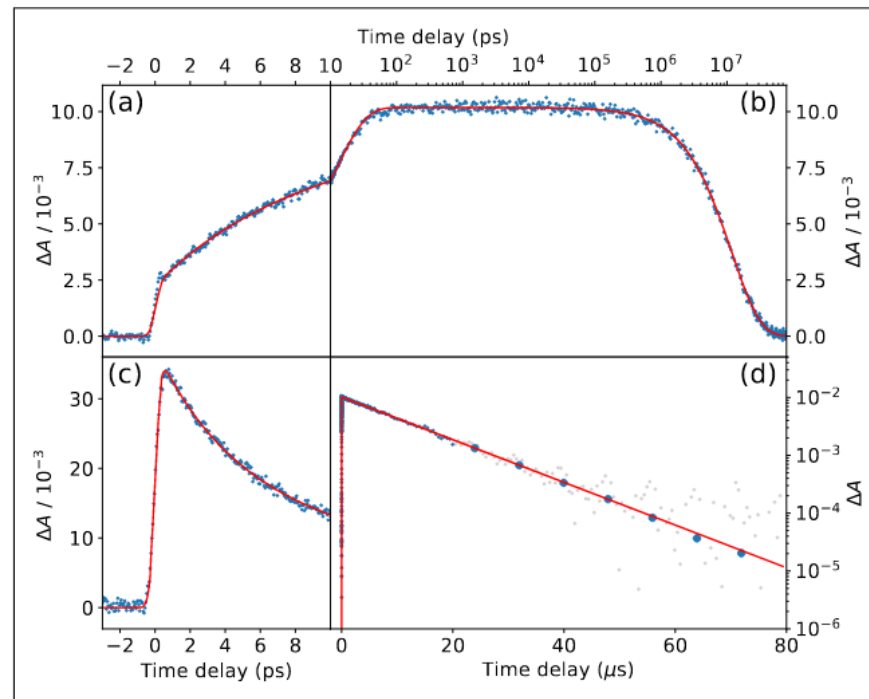
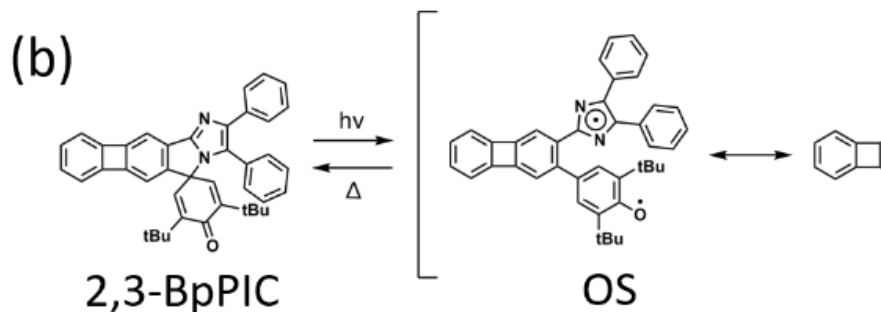
L. Antonucci, X. Solinas, A. Bonvalet, M. Joffre, *Opt. Express* **28**, 18251 (2020)

X. Solinas, L. Antonucci, A. Bonvalet, M. Joffre, *Opt. Express* **25**, 17811 (2017)

J. Helbing, P. Hamm, *The Journal of Physical Chemistry A*, **127**, 6347 (2023)

Multi-timescale Visible Transient absorption spectroscopy

anr[®]
ChirADASOPS



800 target delays in less than **one second** to achieve continuous visible-near infrared (**470-1000 nm**) transient absorption measurements from **100 fs to 100 μ s** with the ability to measure absorbance differences down to **10^{-5}** .

E. Balanikas et al., Revealing photochemical processes using multiple-timescale multiple-probing visible transient absorption spectroscopy with two independent femtosecond amplifiers, 2026, <https://hal.science/hal-05565471>

■ Spectroscopie d'absorption transitoire multi-échelle femto-milliseconde



ULTRAFast project
<https://lob.ip-paris.fr/ultrafast>



UV(370)-Vis(730) kHz
Few pump, Project:
Tunable Pump

MIR kHz
Mid 2027: MIR 125kHz
Vis 125 kHz

Vis 125kHz
Project JRA:
UV(250)-Vis (1000) 200kHz

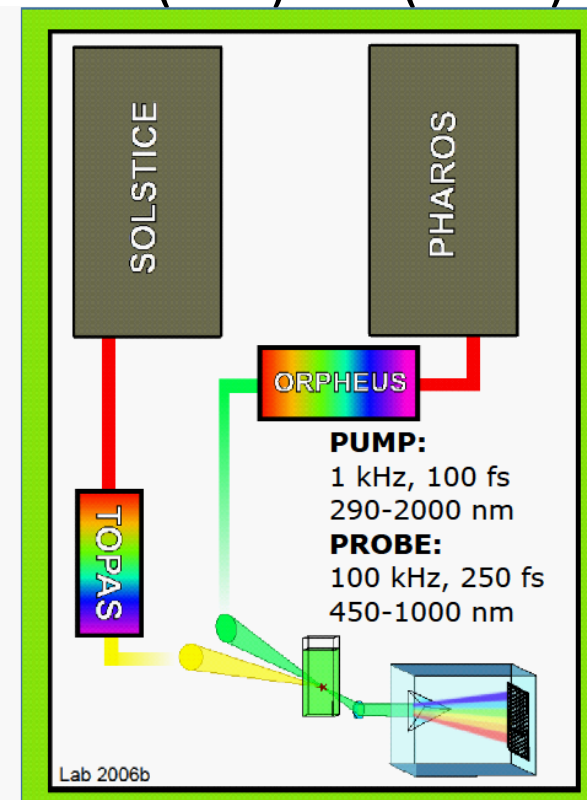
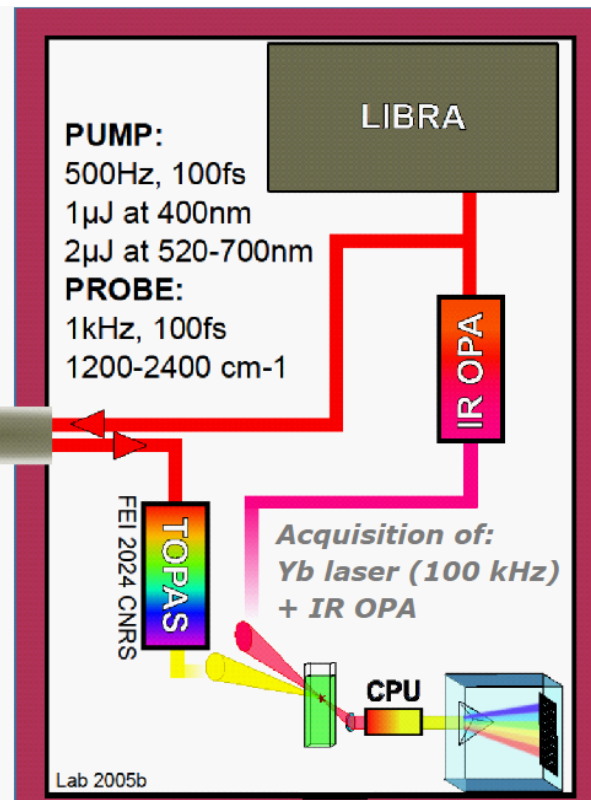
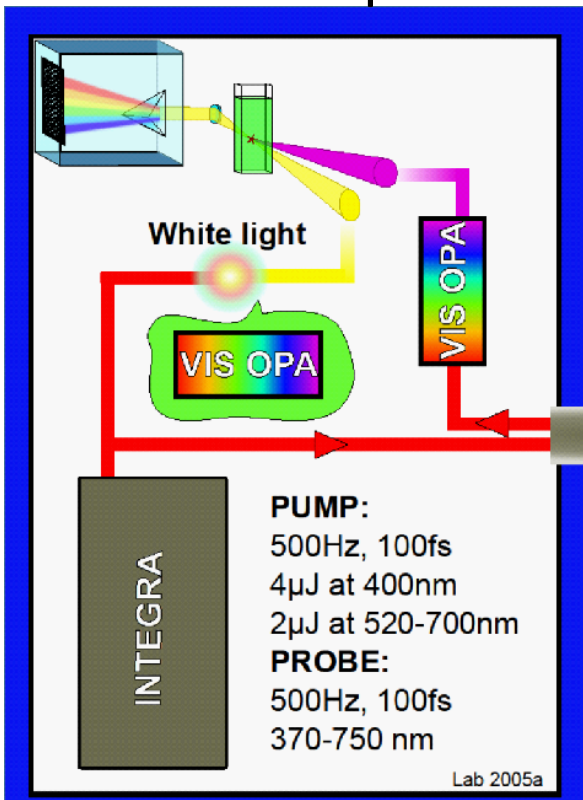
Platform staff: A. Bonvalet, P. Changenet, M. Joffre, J.-C. Lambry, X. Solinas, M. Vos



**LOB multiscale platform
financial support**

- hosting costs for 50 days/year from 2025 to 2030
- missions costs

laura.antonucci@polytechnique.edu
michel.sliwa@polytechnique.edu



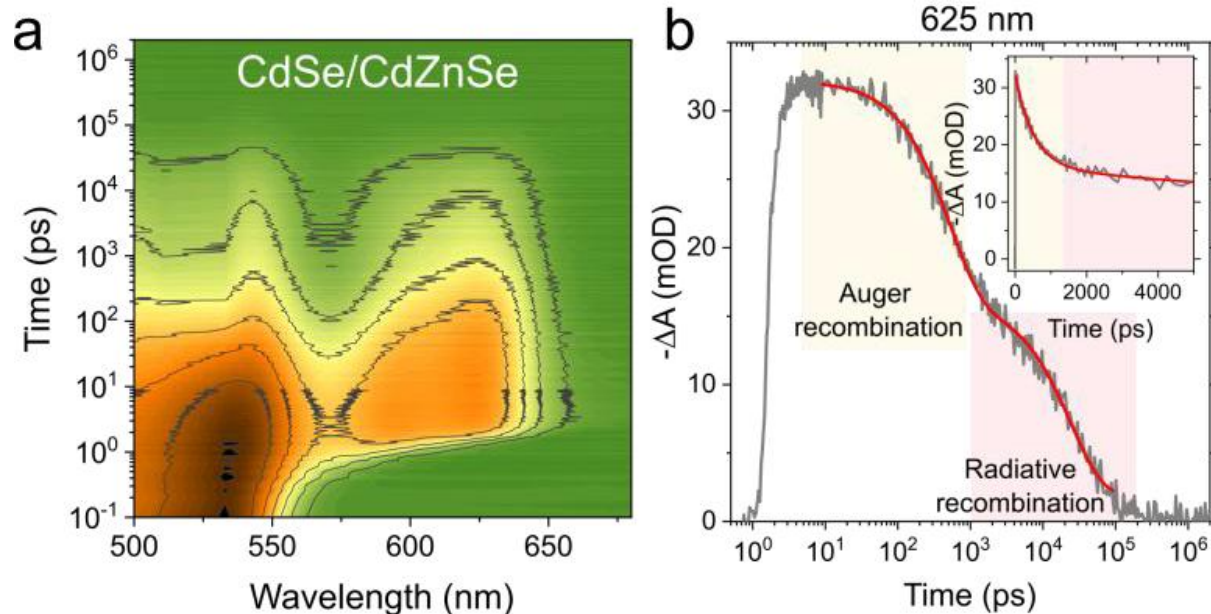
■ Spectroscopie d'absorption transitoire multiscale Visible et MIR

C. Livache, Laboratoire de Physique de la Matière Condensée

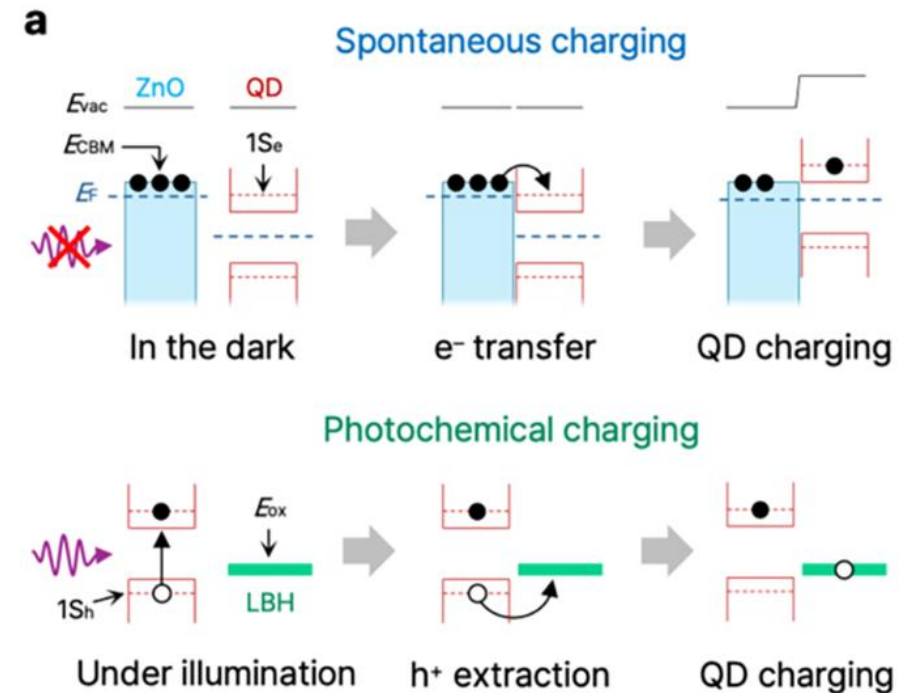
Wan-Ki Bae at SKKU (Korea) + Post Doc Korea

Philippe Guyot-Sionnest from the University of Chicago (Professeur Invité 2 mois)

Visible and infrared optical gain in quantum dots: 9 days

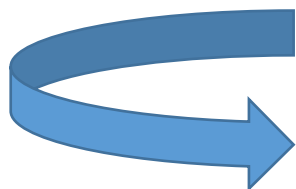
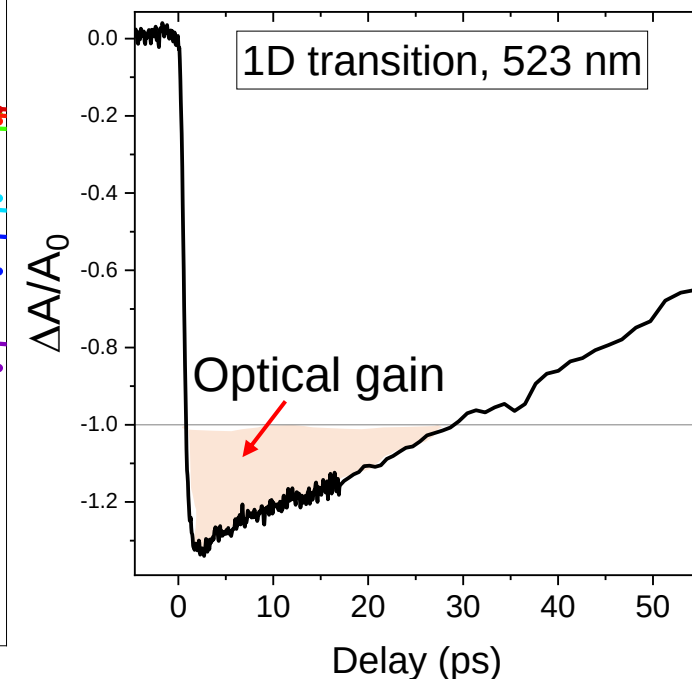
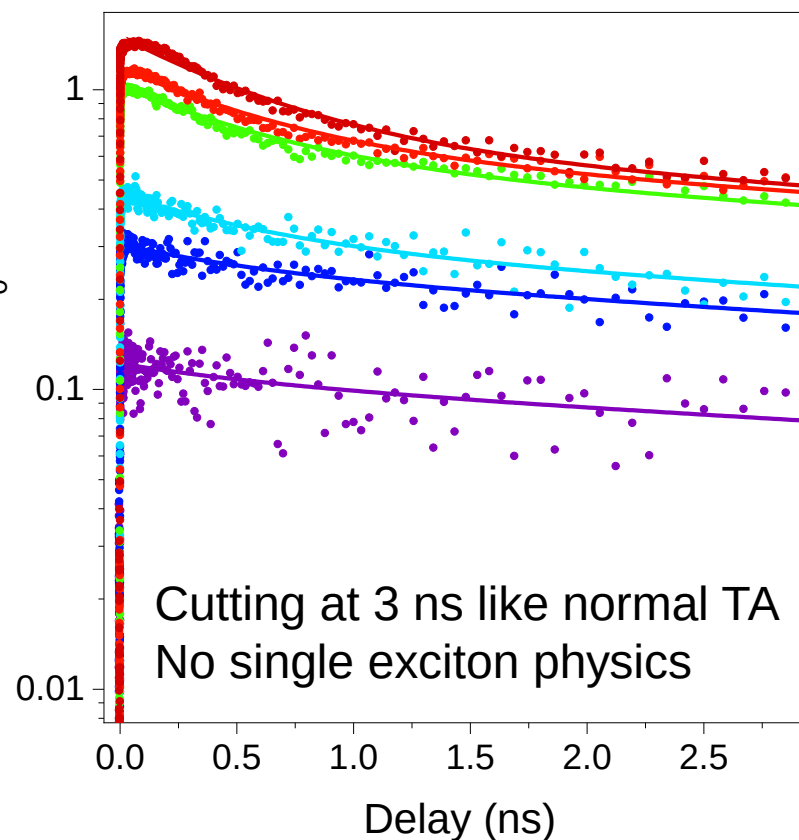
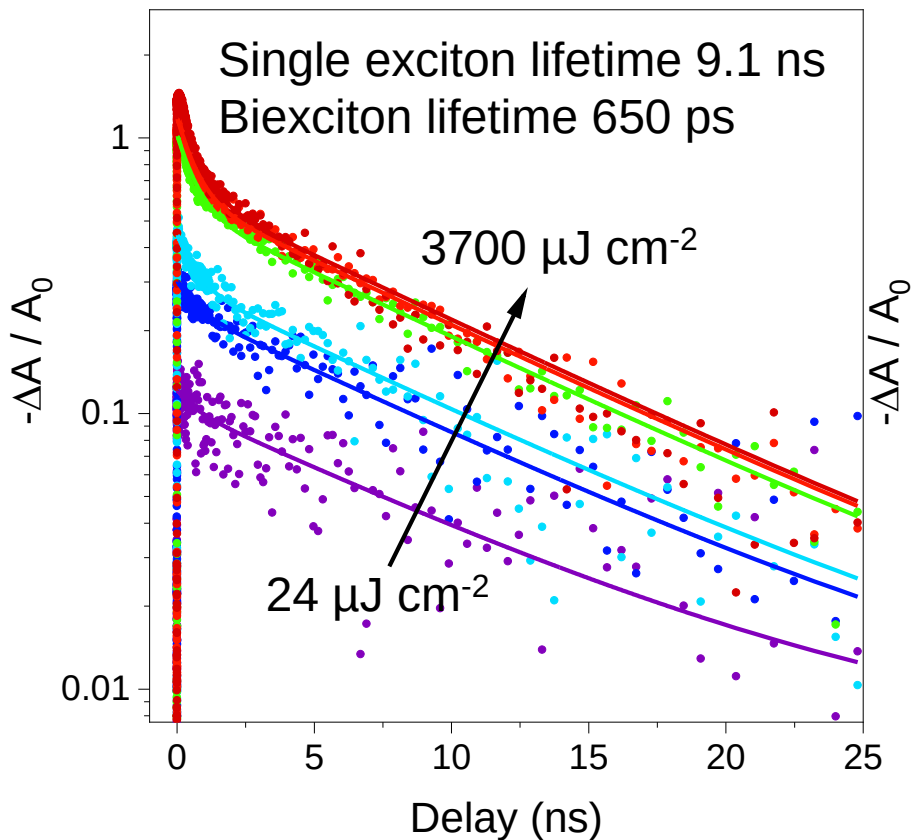


Multi-time scale experiments allow to explore all the regimes in QDs, from extreme high energy multiexciton processes to slow single-exciton physics



■ Spectroscopie d'absorption transitoire multiscale Visible 125 kHz

CdSe/ZnSeZnS QDs emitting at 590 nm, excited at 420 nm, power dependence studies



On-Demand Charged States in Quantum Dot–ZnO Nanoparticle Assemblies toward Sub-Excitonic Optical Gain

[Hyeonjun Lee *](#); [Amira Gharbi](#); [Benjamin Shu](#); [Clément Marchat](#); [Alessandro Rotondi](#); [Sejong Min](#); [Mehdi Mouissat](#); [Thierry Gacoin](#); [Michel Sliwa](#); [Donghyo Hahm](#); [Clément Livache *](#)

+ Author & Article Information

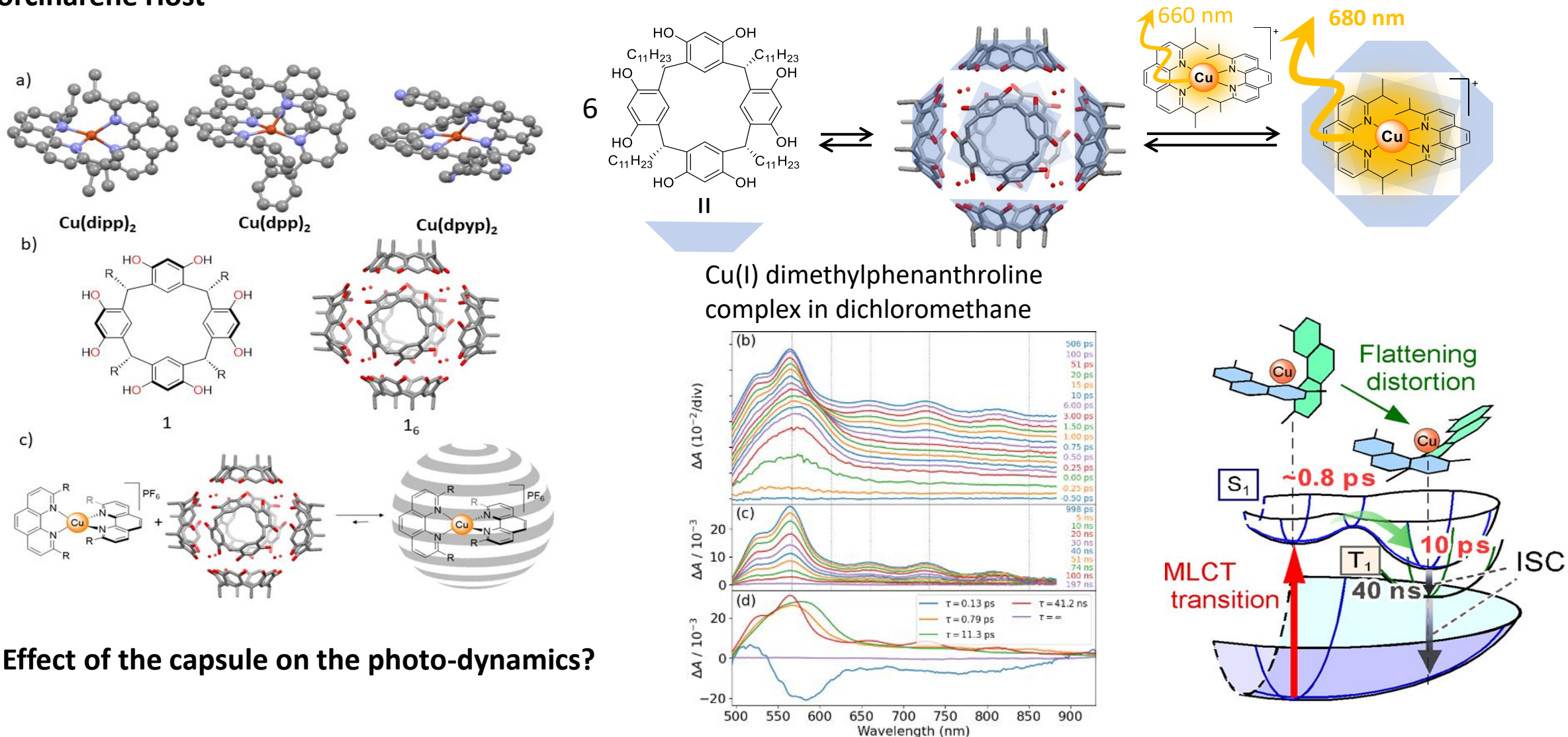
ACS Nano (2026) 20 (36): 25041–25052.

<https://doi.org/10.1021/acsnano.6c11137>

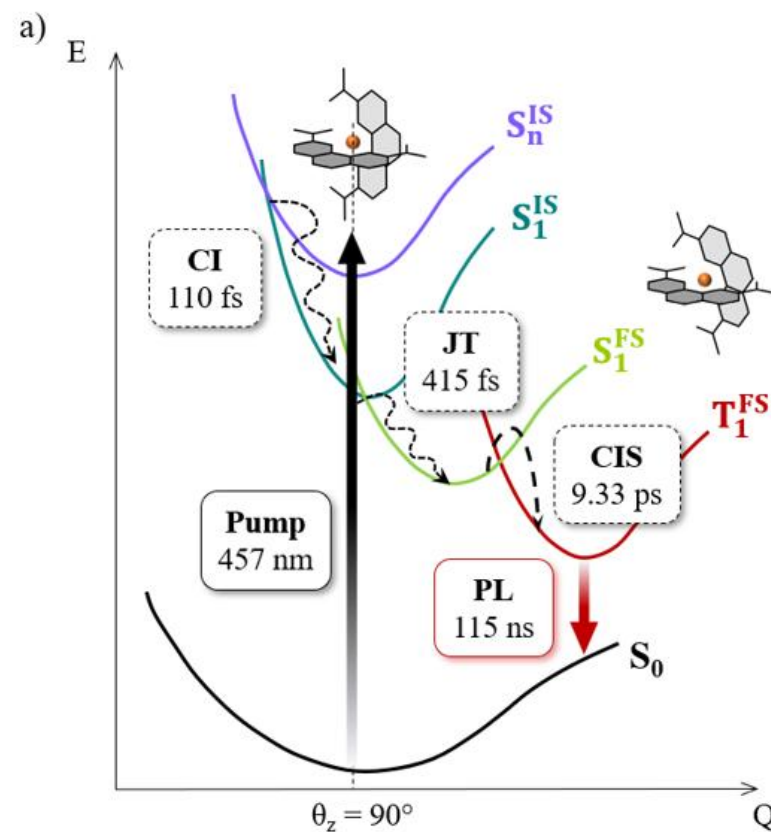
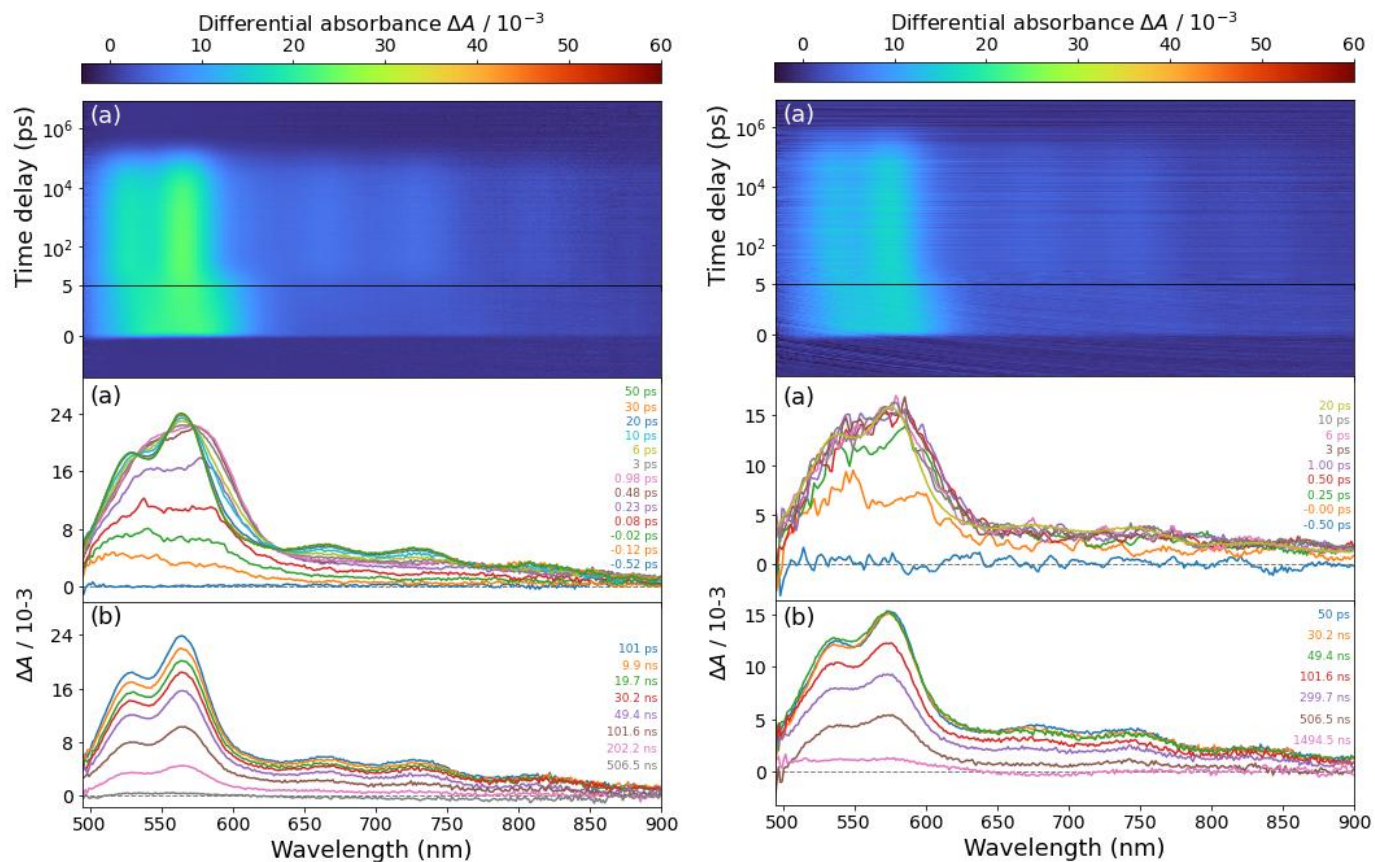
Article history

■ Spectroscopie d'absorption transitoire multiscale Visible 125 kHz

Iris Sanchez, Benoit Colasson, U. Paris Cité, Laboratoire de Chimie et Biochimie Pharmacologiques et Toxicologiques, 9 days
Enhanced Emission and Stability of Copper(I)-Bisphenanthroline Complexes via Encapsulation in a Self-Assembled Hexameric Resorcinarene Host



■ Spectroscopie d'absorption transitoire multiscale Visible 125 kHz



	τ_1 (ps)	τ_2 (ps)	τ_3 (ps)	τ_4 (ns)
Cu(dipp)₂(PF₆)	0.11	0.45	9.3	115
Cu(dipp)₂(PF₆)@1₆	0.197		7.3	473
Cu(dpp)₂(PF₆)	0.12	1.37	9.8	118
Cu(dpp)₂(PF₆)@1₆	0.2	1.10	11.4	248

Encapsulation slow down (or suppress) flattening step & no influence on ISC

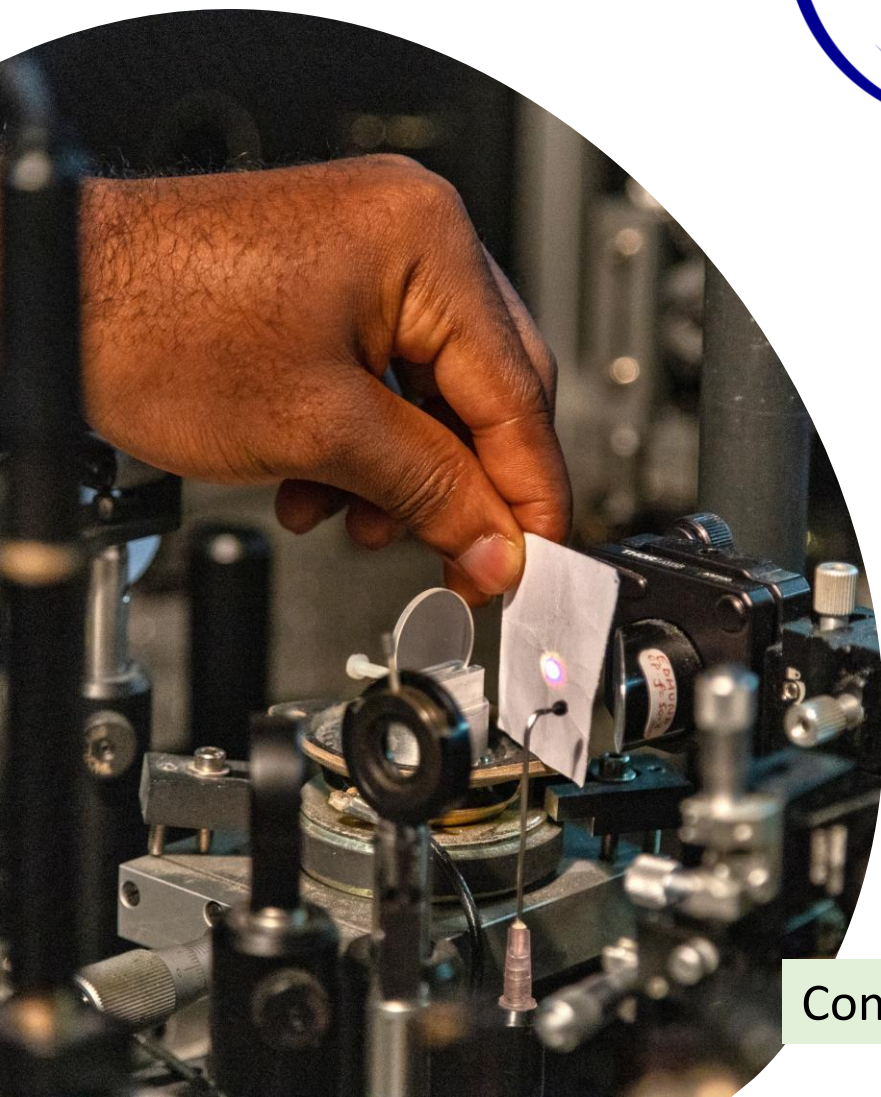
Increase the lifetime of triplet state (protection from dioxygen and exciplex quenching with solvent)

Journées Annuelles PEPR LUMA



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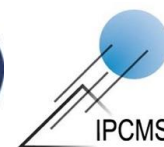


User facility “Ultrafast” at IPCMS Strasbourg

funded by PEPR LUMA

Contact: stefan.haacke@ipcms.unistra.fr

Université
de Strasbourg



Outline

Ultrafast Magnetisation Dynamics

valerie.halte@ipcms.unistra.fr

Ultrafast Molecular Photochemistry

BIODYN team: A. Boyer, J. Léonard, S. Haacke

Femtosecond transient absorption &
fluorescence

“Beam time” projects since march 2024

Conclusions

Ufast Photo-Chemistry: Trans. Absorption UV/VIS/NIR

Pump laser pulses

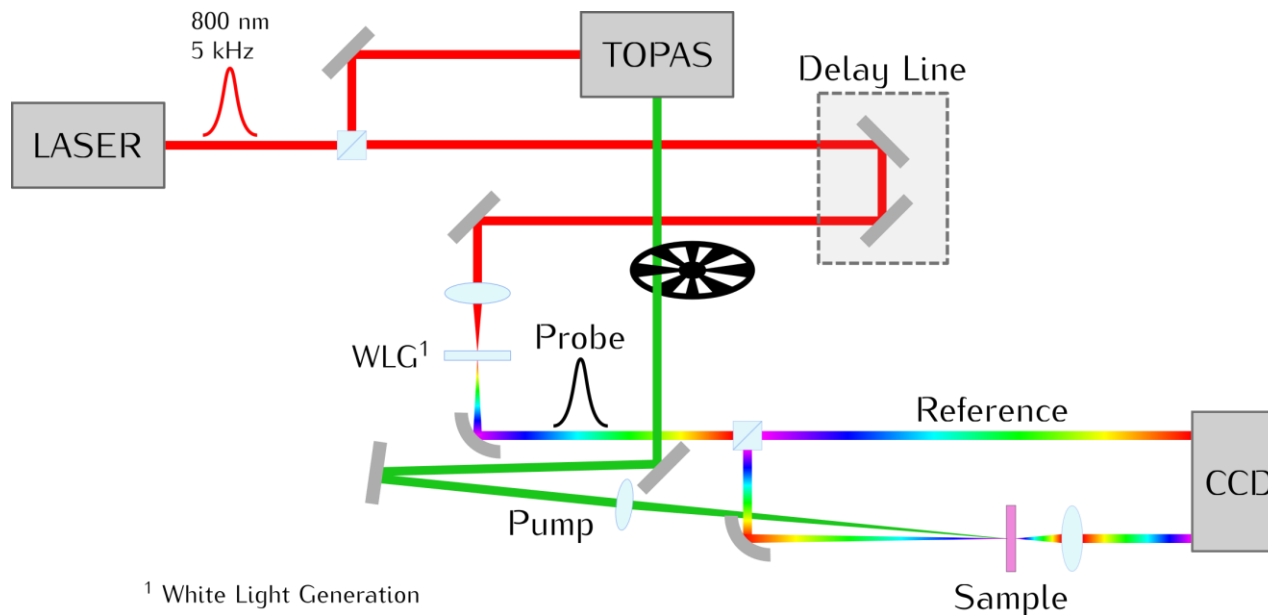
- (i) TiSa 400 or 800nm, <10fs, 1 kHz
- (ii) tuneable OPA 280nm to NIR, 60-80fs, 5kHz

Detection:

- White-light continuum 300-1500 nm; sensitivity $\Delta OD_{\min} \approx 5 \times 10^{-4}$

Samples

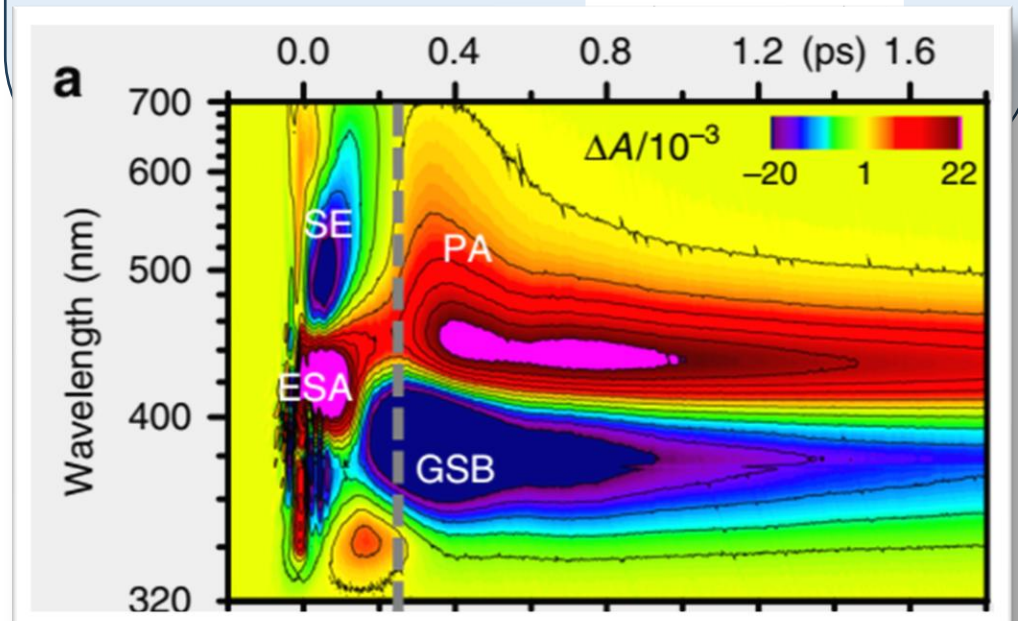
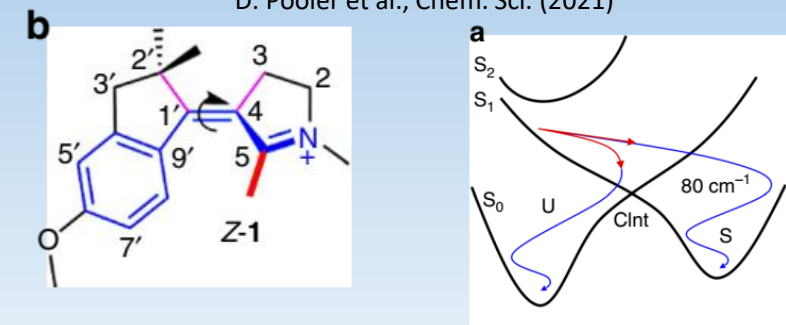
- Liquid or films, 300 K



Sub-picosecond photo-isomerisation with vibr. coherences

M. Gueye et al., Nat. Comm. (2018)

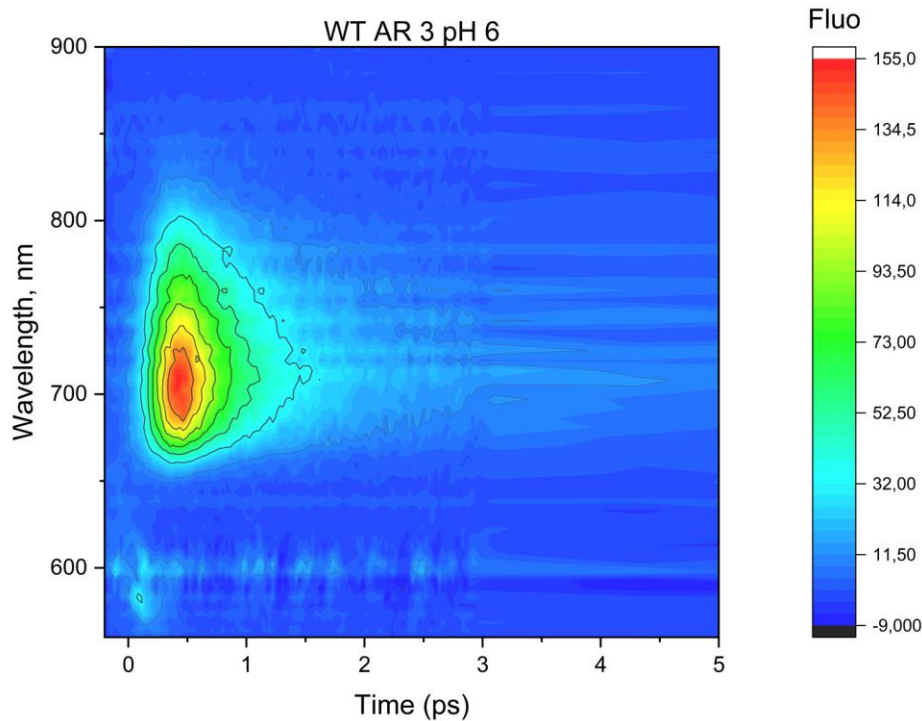
D. Pooler et al., Chem. Sci. (2021)



Ufast Photo-Chemistry: Fsec Fluorescence

Special feature: Broadband operation – full spectra

coll. N. Ernstring (HU Berlin)

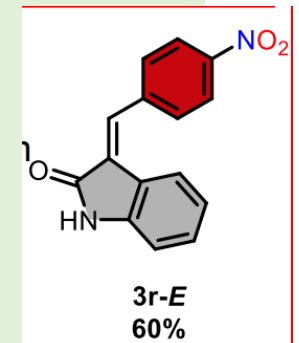
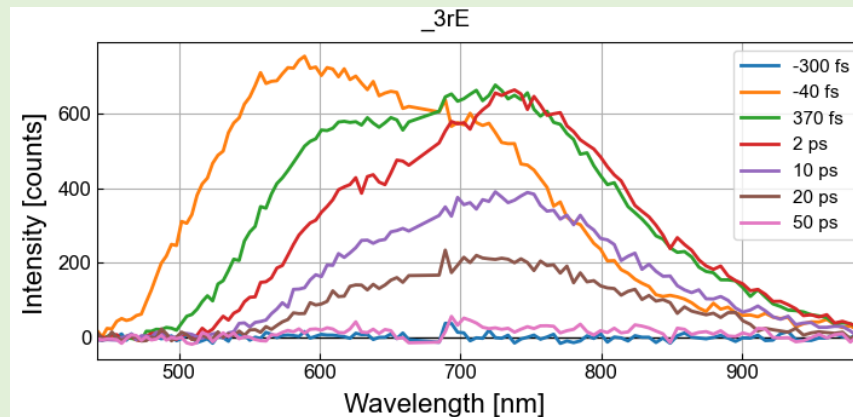


Retinal isomerization in AR-3
0.30 ps fluo lifetime

Recent improvements:

- Temporal Resolution (≈ 100 fs)
- Bandwidth > 100 nm (@500 nm)
- Sensitivity $\uparrow 3$ x

Oxindole photo-switch, 15 ps isom. time



The benefit of combining TAS & fluorescence

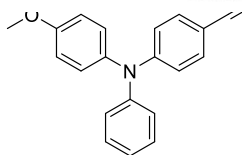
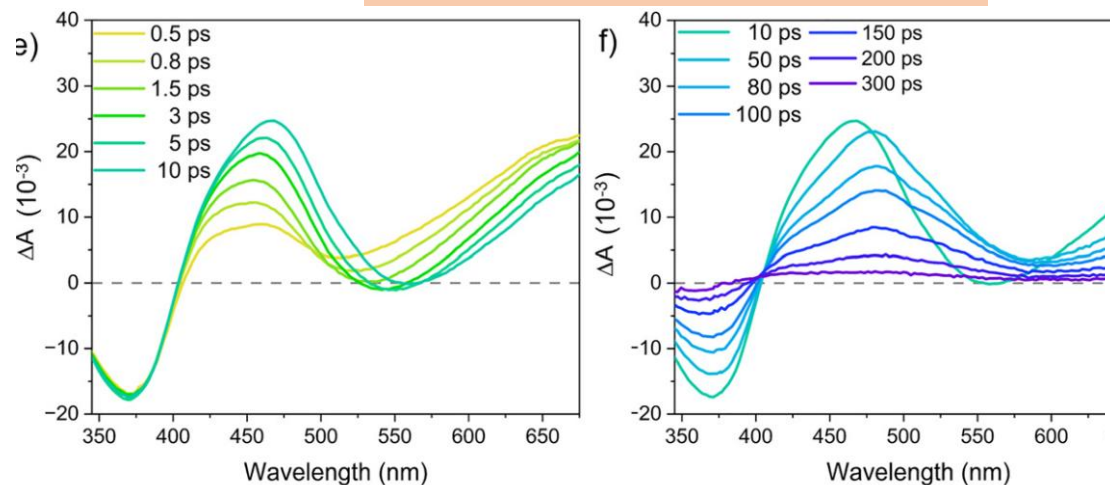
Excited state dynamics leading to photoisomerisation of molecular rotors

M. Seinfeld, T. Le Baher, C. Andrau & C. Monnereau (ENS Lyon) et al.

Exp. Period: 11 – 22/11/2024, **10 jours**

2 papers : PCCP (2026) 28, 8937–8948 & J. Mat. Chem. B (2026) in press

Transient absorption

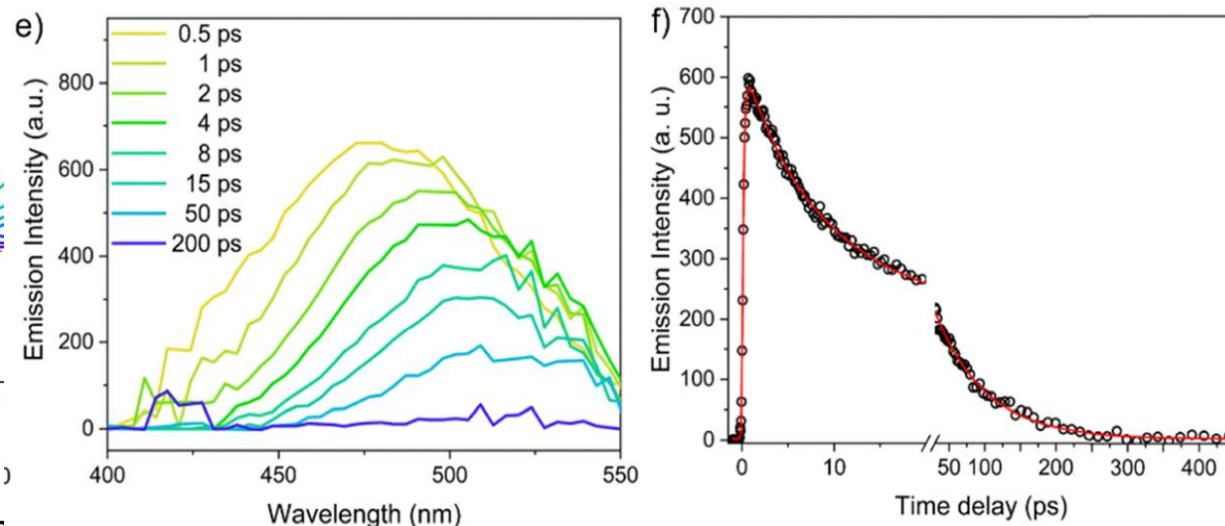


Z-TPE - TPA

sub-ps exc. state relaxation
& isomerisation

Emission masked by
exc. state absorption

Femto fluo



slow isomerisation (82 ps) from
a weakly fluo state

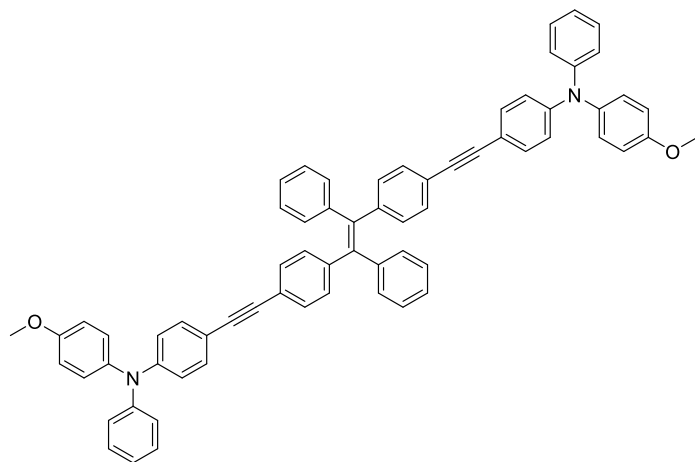
The benefit of combining TAS & fluorescence

Excited state dynamics leading to photoisomerisation of molecular rotors

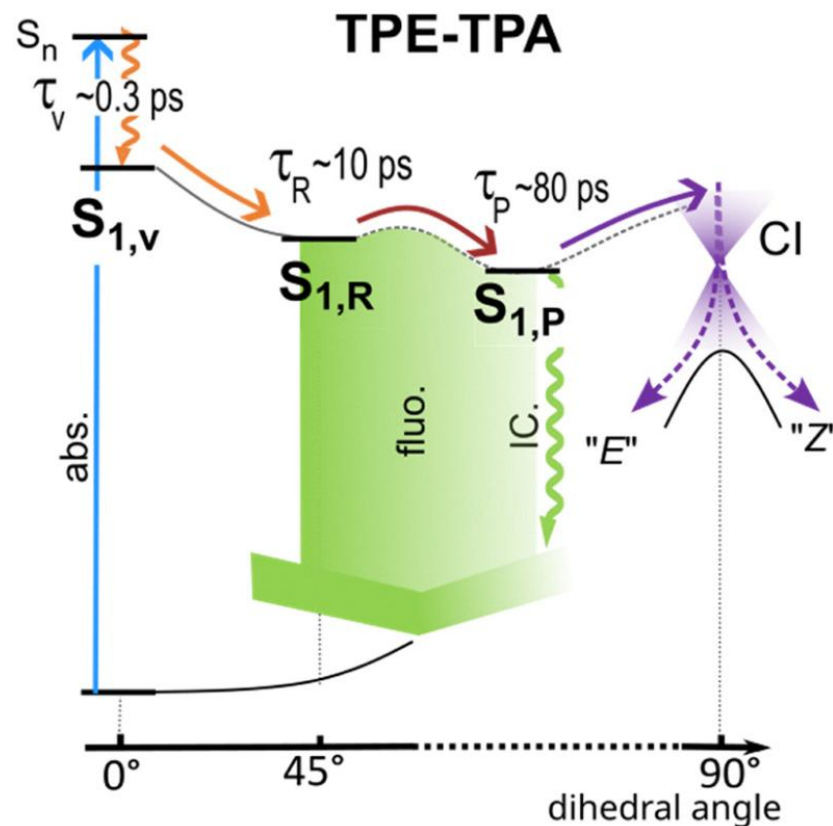
M. Seinfeld, T. Le Baher, C. Andrau & C. Monnereau (ENS Lyon) et al.

Exp. Period: 11 – 22/11/2024, **10 jours**

2 papers : PCCP (2026) 28, 8937–8948 & J. Mat. Chem. B (2026) in press



Z-TPE - TPA



Coord:

S. Haacke

Support every day:

X. Fu (post-doc),

O. Crégut (IR)

8 +1 projects since March 2024

71 days out of 100 possible

ELEXIC: Elucidation of fluorescence quenching by azoic photochromes in organic nanoparticles

Porteur: E. Ishow (CEISAM Nantes), PhD: F. Zizzi

Period: 6 – 17/01/2025 & 12-16/01/2026 **15 days**

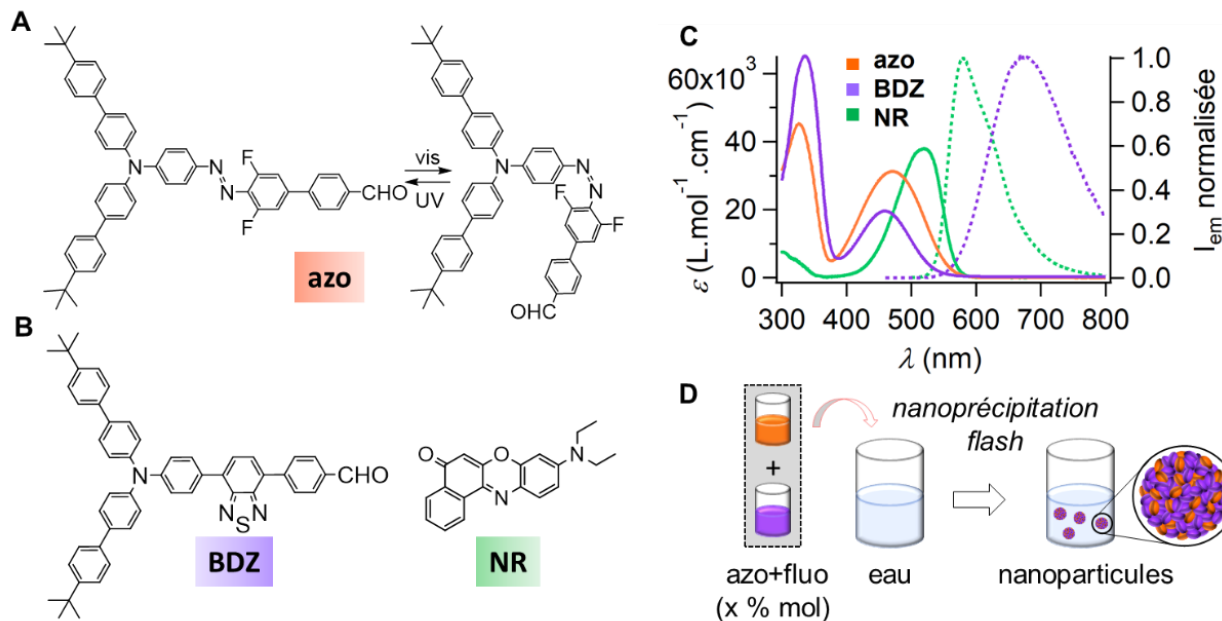
Accueil:

Coord – S. Haacke

Support & Training:

Post-Doc or PhD student

O. Crégut (IR)



New molecular designs & Photochem:

Thermopolymerisation (C. Monari, Mulhouse)

Fe(II) complexes (Y. Canac, Toulouse)

Molecular rotors (B. Schmaltz, Tours)

El. transfer (M. Ha-Thi, Saclay)

Di-cationic xanthenes (N. Ferré, Marseille)

MOFs & COFs (F. Odobel, Nantes)

NiO Photocathodes (SYNFLUX-LUMICALS)

Conclusions

- PF & Moonshots boost femto spec at IPCMS
- Protocol for Hosting & Training of teams is established
- Some set-ups are unique in France
- User facility relatively well known
- Moonshots and other LUMA projects will use $\approx 50\%$ beam time



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ité
Strasbourg



Transient Magneto Optics (TMO): Kerr effect VIS

Dynamics of phase transition: ferro $\leftrightarrow$ paramagnetic
transition metal $\leftrightarrow$ isolator (Verwey)

électrons, spins, p

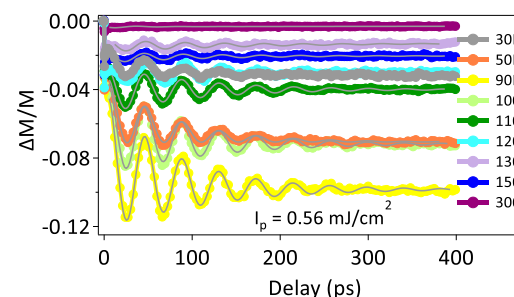
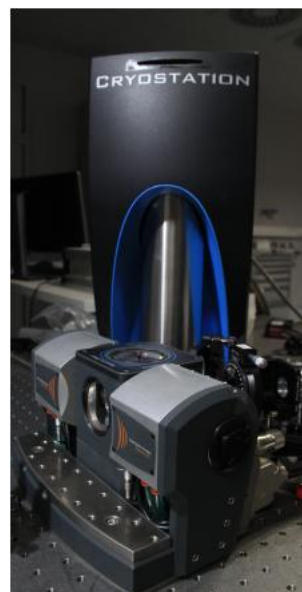
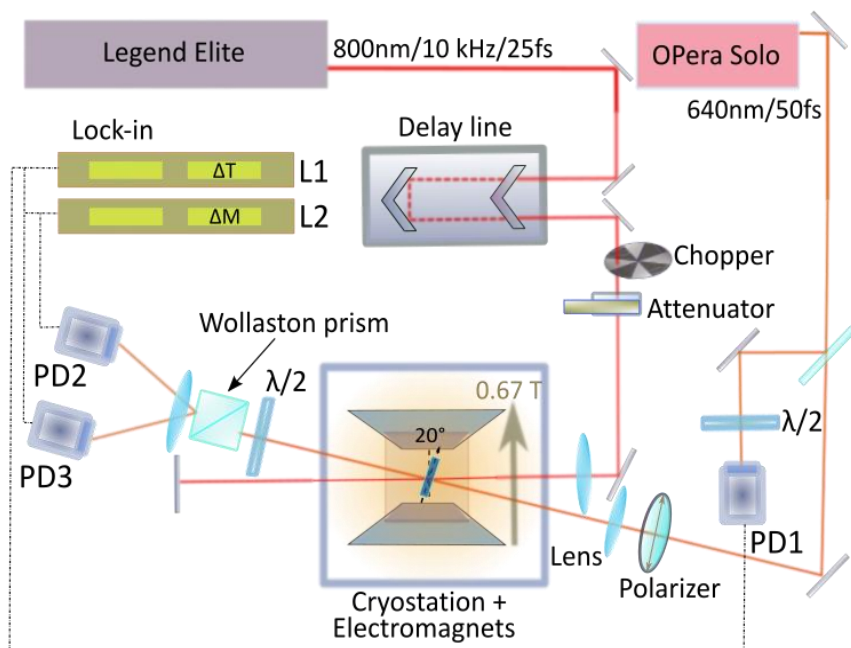
Laser source: TiSa 10kHz, 25 fs, 1mJ @ 800nm, few μ J @ 400 nm, OPA: 500-750 nm

Sample environment: Cryostat "He free" 3K-350K, Electroma

Detection : Pump-probe in Kerr or Faraday configuration

Ultrafast dynamics of magnetization

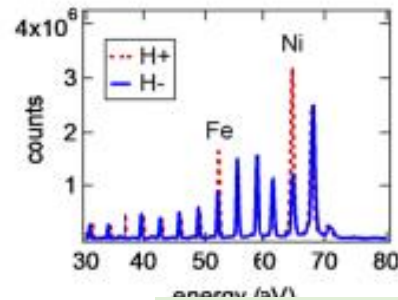
in a Fe_3O_4 film at valerie.halte@ipcms.unistra.fr



Transient Magneto-Optics: **Kerr Effect** HHG-XUV

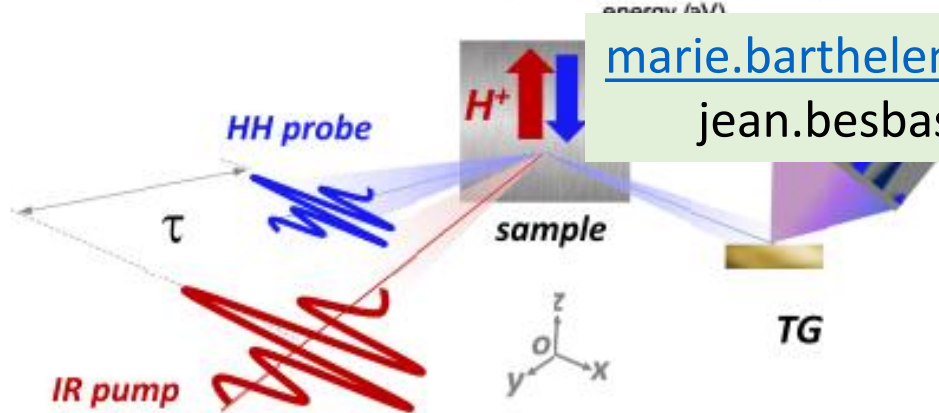
Element-selective : Ni, Fe, ... probe ultrafast spin transitions

Pump: TiSa, 1kHz, 25 fs, 8mJ @ 800nm Probe: High harmonics 20-70 eV, Sample: 300 K, $B \leq 0.45$ T

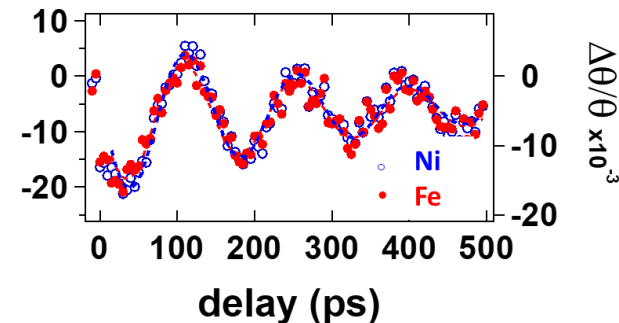
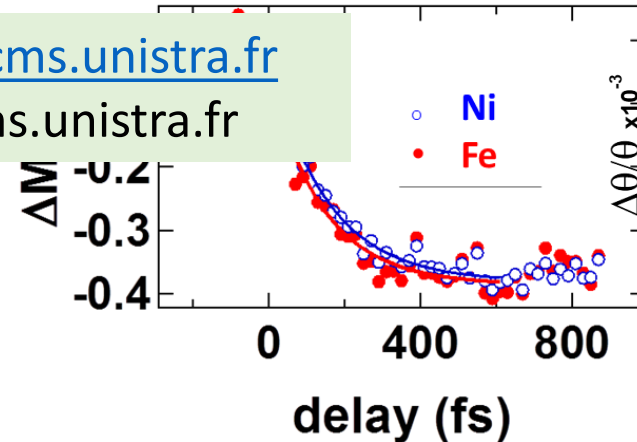


Role of intersublattice exchange interaction in ultrafast longitudinal and transverse magnetization dynamics in **permalloy**. Maghraoui et al PRB 107, 134424 (2023)

marie.barthelemy@ipcms.unistra.fr
jean.besbas@ipcms.unistra.fr



Transverse MOKE geometry. Inset: reflected XUV spectra of a 10nm thick $\text{Ni}_{20}\text{Fe}_{80}$ film for 2 orientations of magnetic field in the plane of the sample.

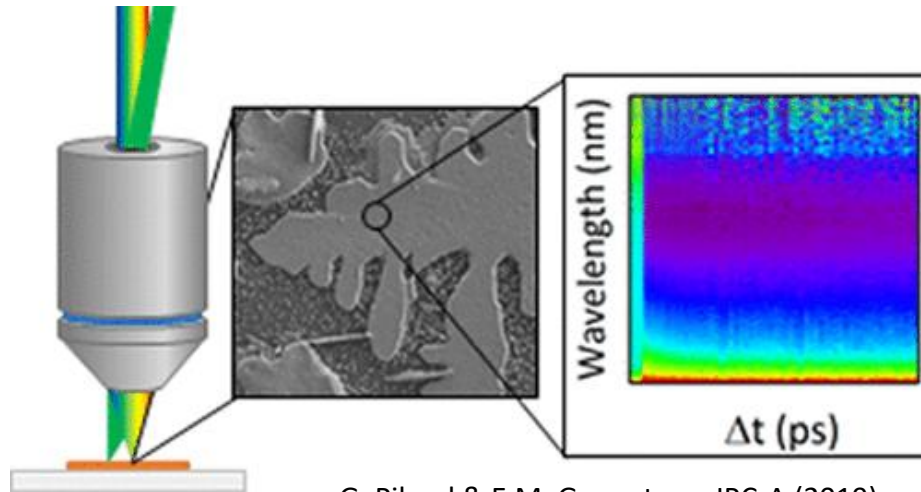


Time resolved MOKE signals integrated over harmonics h35 and h43 corresponding respectively to M edge of Fe (red) and Ni (blue).

Investissements vague 2

Améliorations - Nouveaux développements/installations

A) **Microscopie** magnéto-optique,
pompe-sonde sous microscope confocale et basses T



G. Piland & E.M. Grumstrup, JPC-A (2019)

Moonshot TORNADO: Dynamique électronique dans des hétérostructures de Van der Waals à base de TMD twistés

Expression d'intérêt: T. Jaouen et J.-C. Le Breton, IPR Rennes & S. Beaulieu CELIA Bordeaux

Pertinent pour **PEPR SPIN**