



A.P.E



# APE

## Applied Physics & Electronics Gr

- APE manufactures devices for the **Characterization, Modification, and Improvement** of ultra-short laser pulses
- APE devices are used worldwide in industrial and research applications





# APE History - 28 Years

Thomas Lindemann



Design Engineer

Jan Popien



Electronics

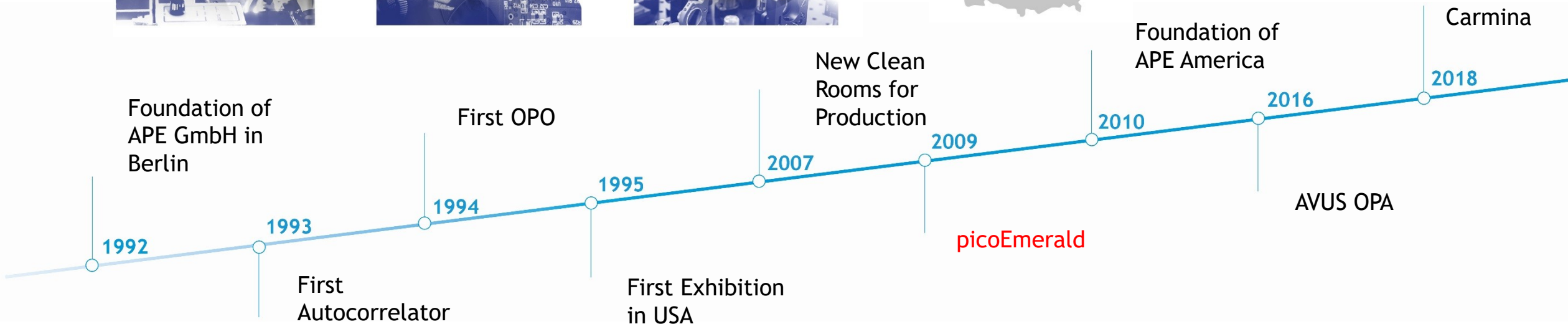
Edlef Büttner



Physics



Headquarters  
Berlin -  
Germany



# APE Numbers & Facts (I)

## Work Force & Infrastructure

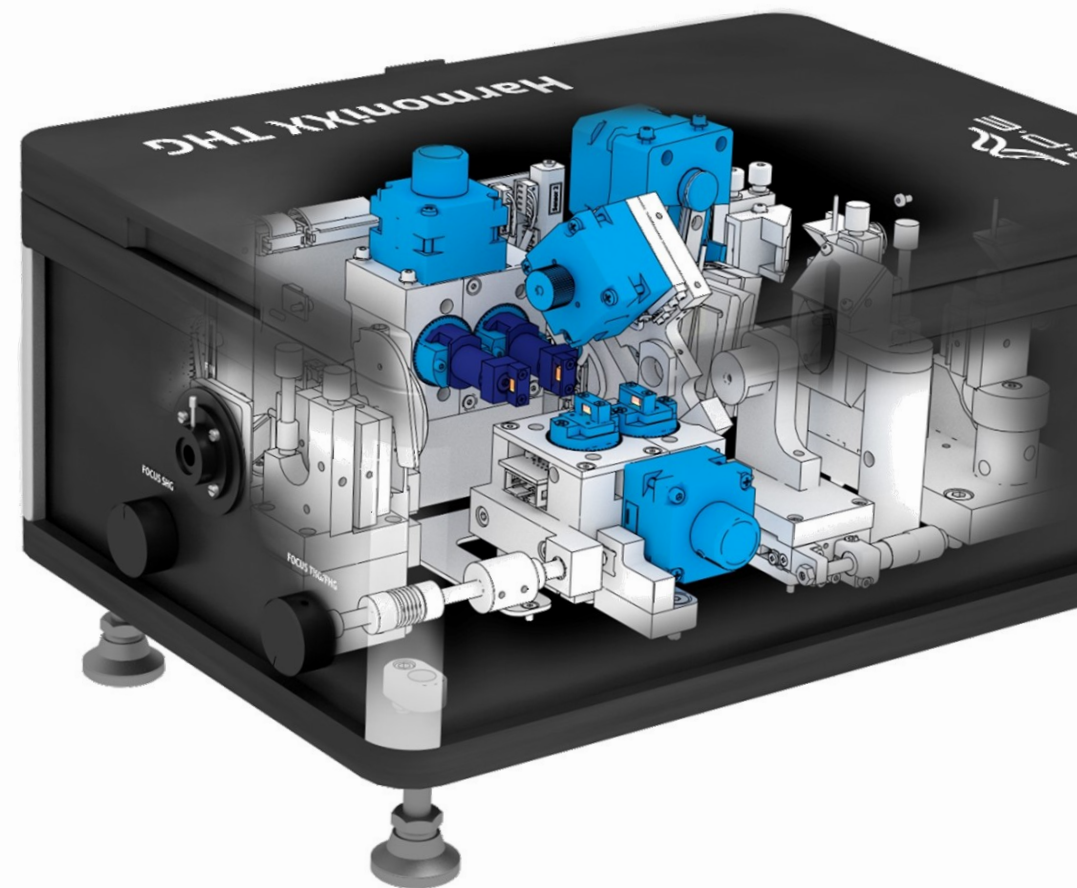
- > 60 Employees,
- 13 R&D and Production Labs,  
3 Clean Rooms

## R&D

- Development expenditures  
of 30 % of total revenues

## Manufacturing

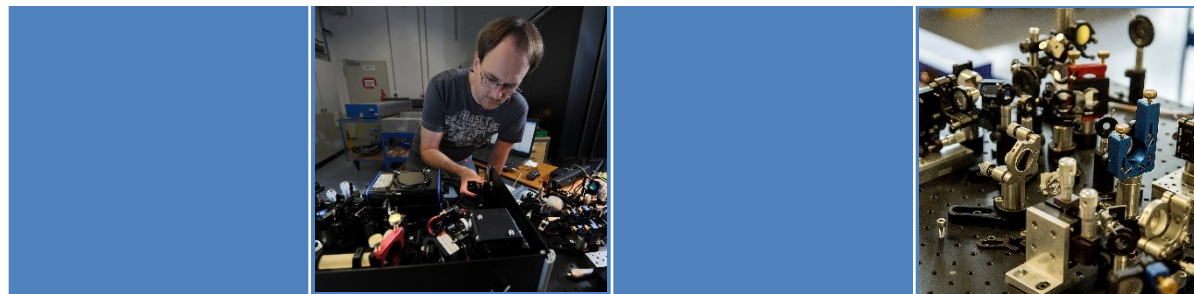
- All devices are manufactured,  
assembled, and tested at APE  
Berlin



# APE Numbers & Facts (II)

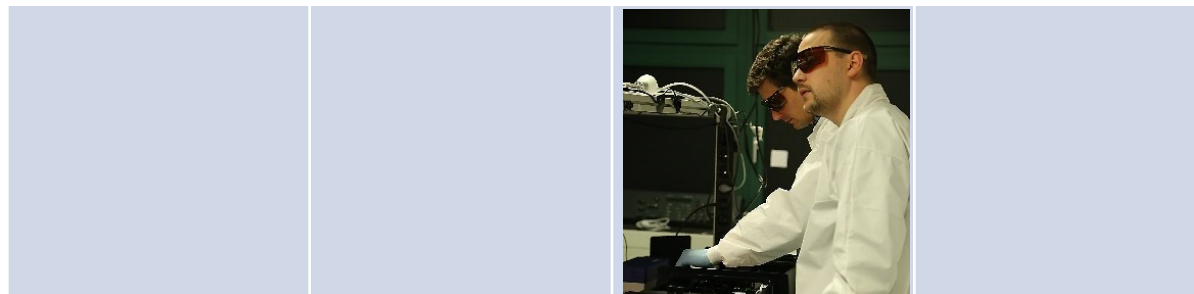
## Customization

- APE also offers customized unique solutions and series OEM products



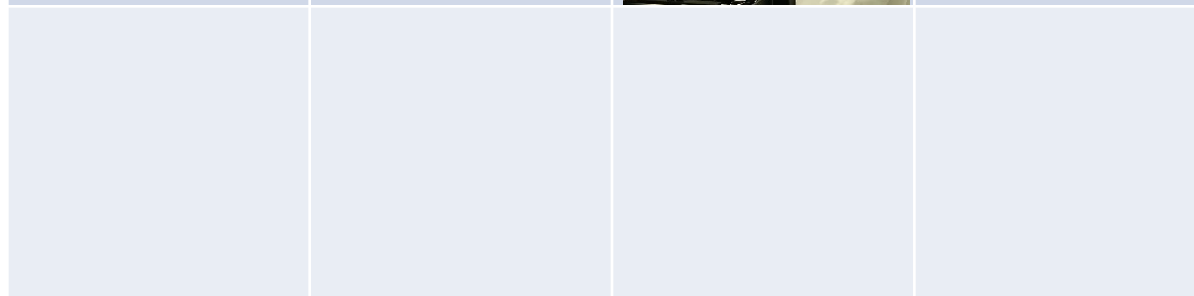
## Service

- Worldwide service network



## Global Distributor Network

- Trained specialists around the world



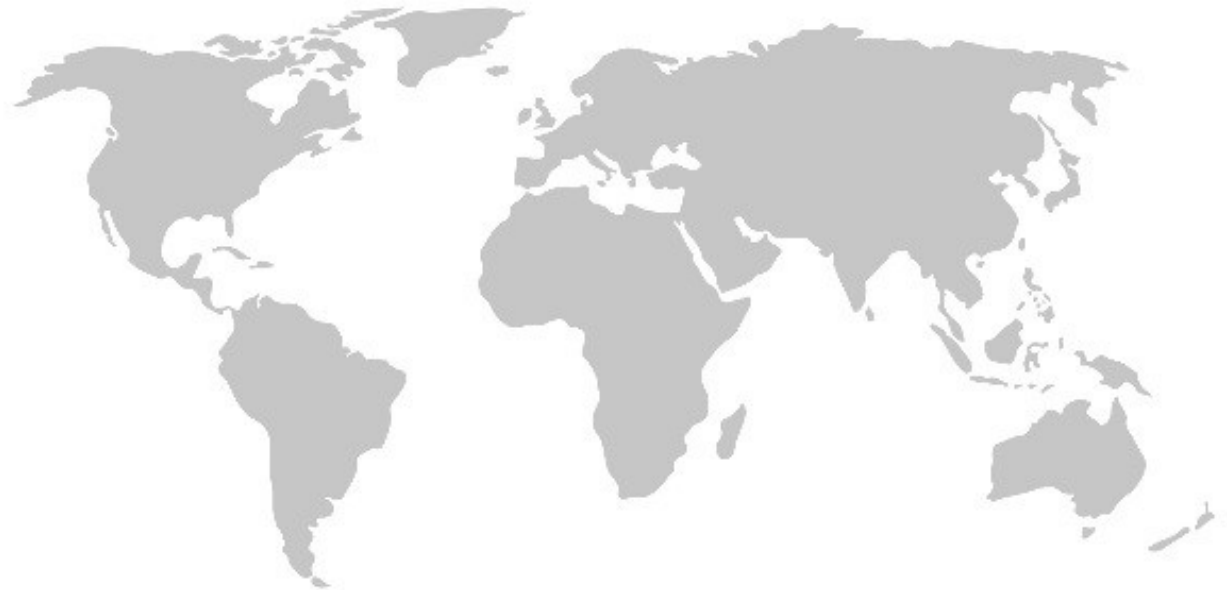
# APE Markets

## Science

- Universities & Research Labs

## Industry

- Trusted OEM partner for industrial companies
- e.g. Coherent, Spectra Physics, Amplitude, Bruker, ...



# Product Groups

## Wavelength Conversion

- Providing exactly the wavelength needed



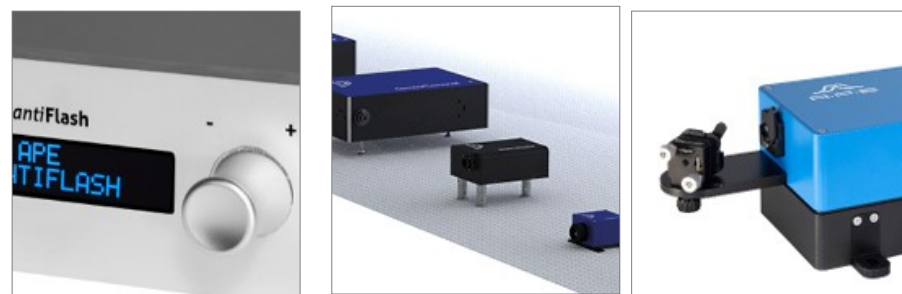
## Pulse Diagnostics

- Measuring the characteristics of ultra-short pulses



## Pulse Manipulation

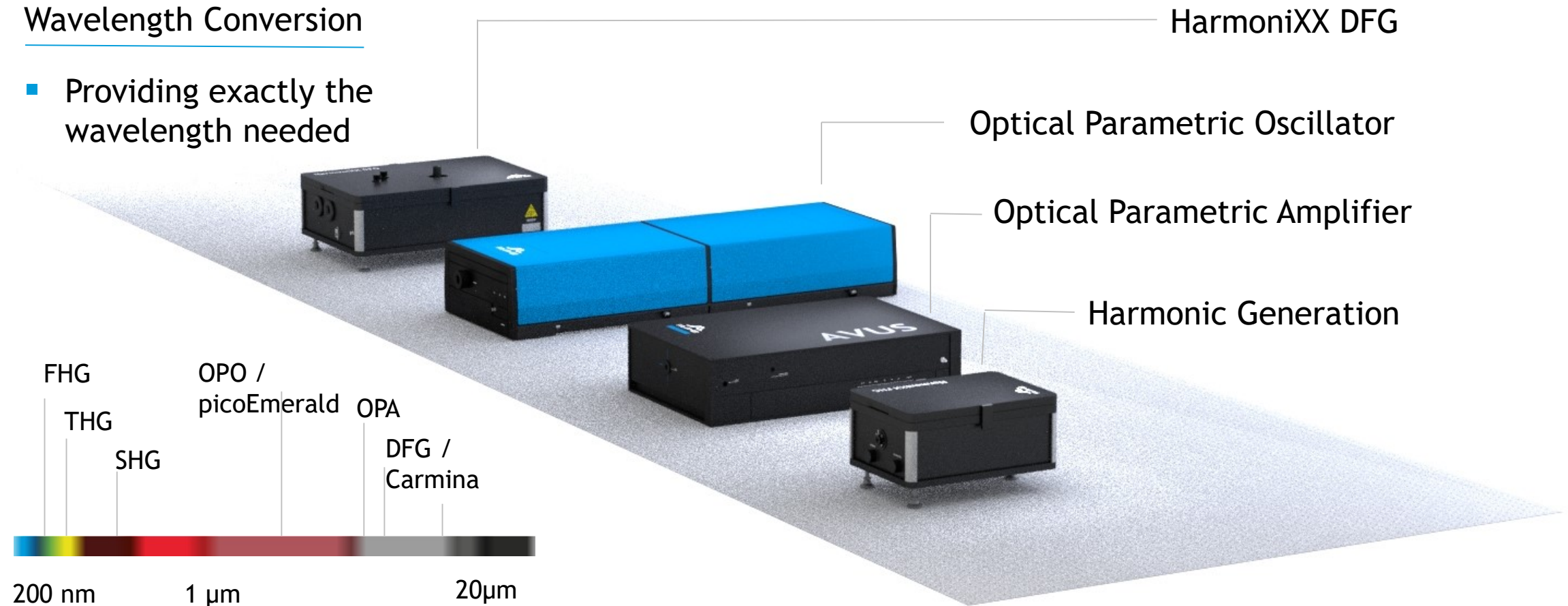
- Modifying pulses as required



# Products Wavelength Conversion

## Wavelength Conversion

- Providing exactly the wavelength needed

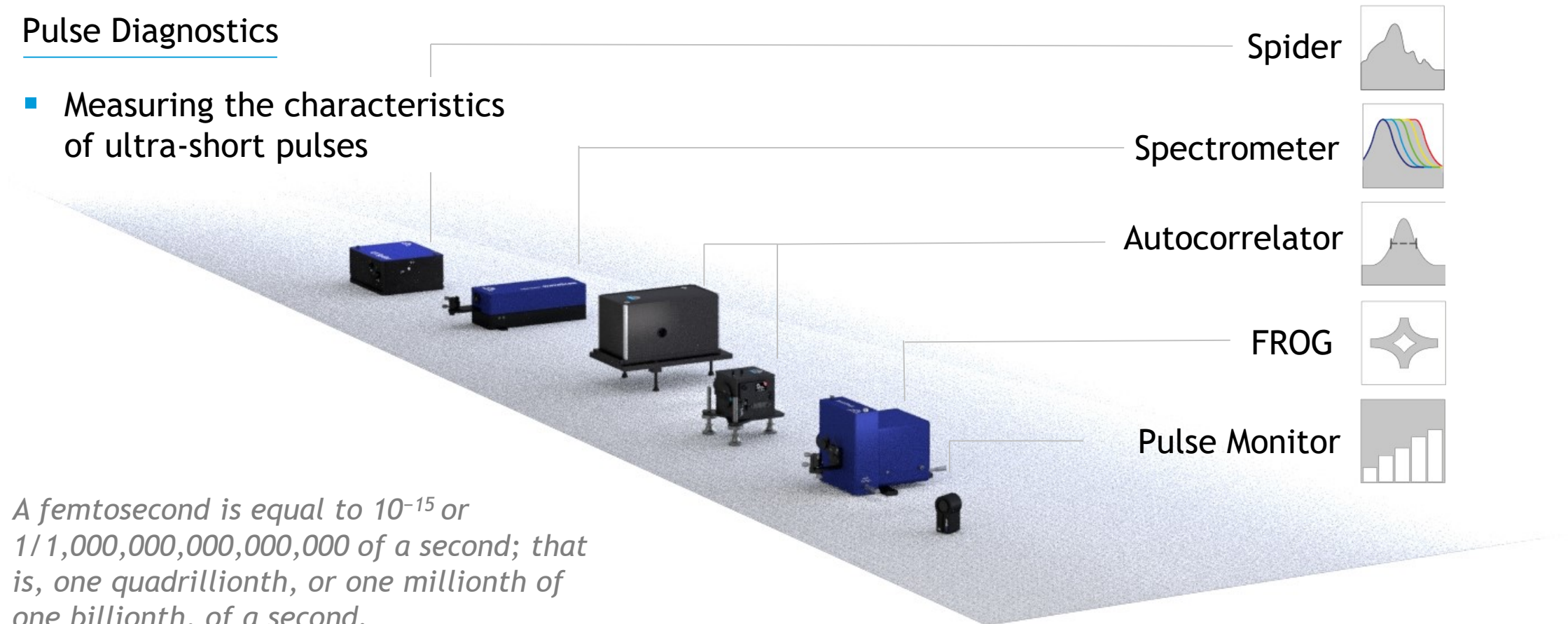




# Products Pulse Diagnostics

## Pulse Diagnostics

- Measuring the characteristics of ultra-short pulses

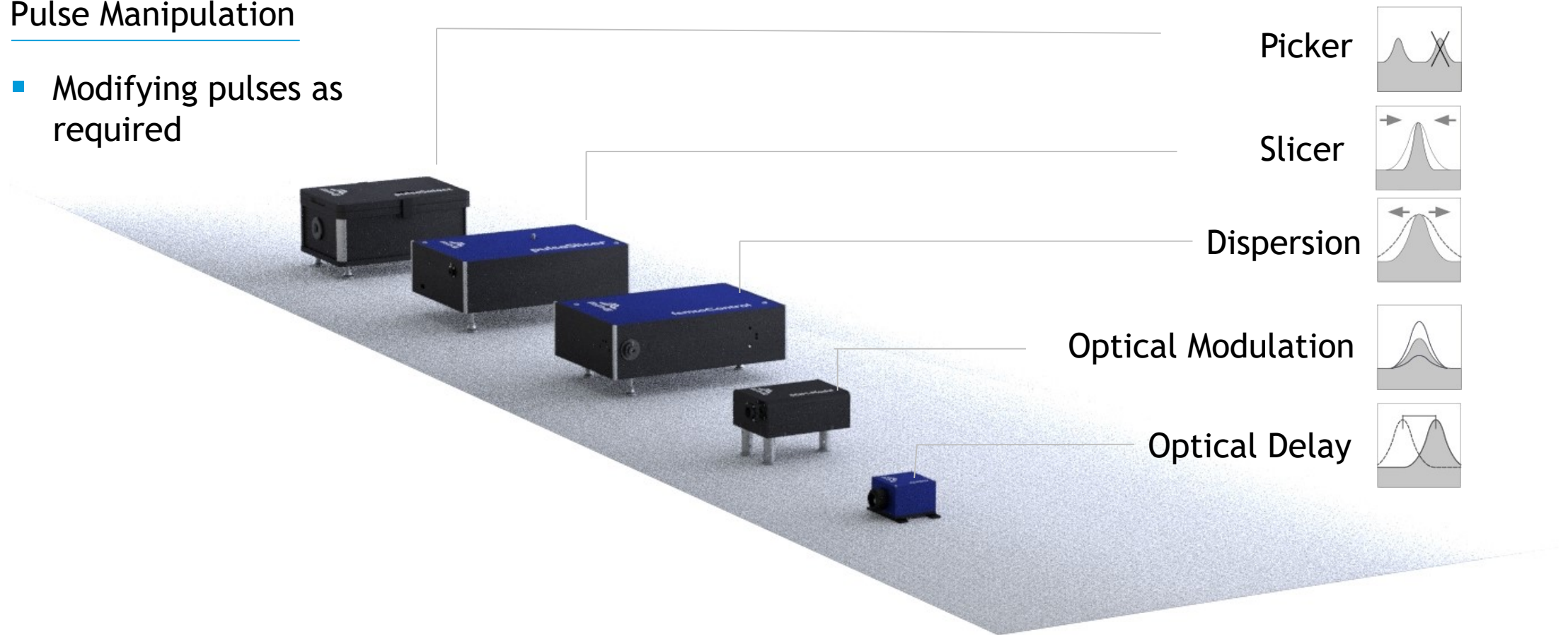


*A femtosecond is equal to  $10^{-15}$  or  $1/1,000,000,000,000,000$  of a second; that is, one quadrillionth, or one millionth of one billionth, of a second.*

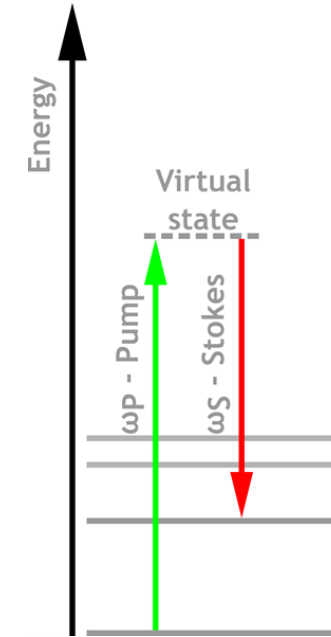
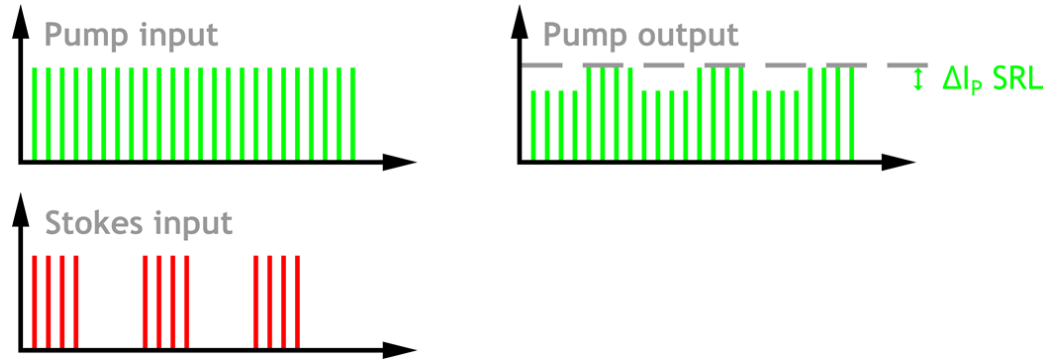
# Products Pulse Manipulation

## Pulse Manipulation

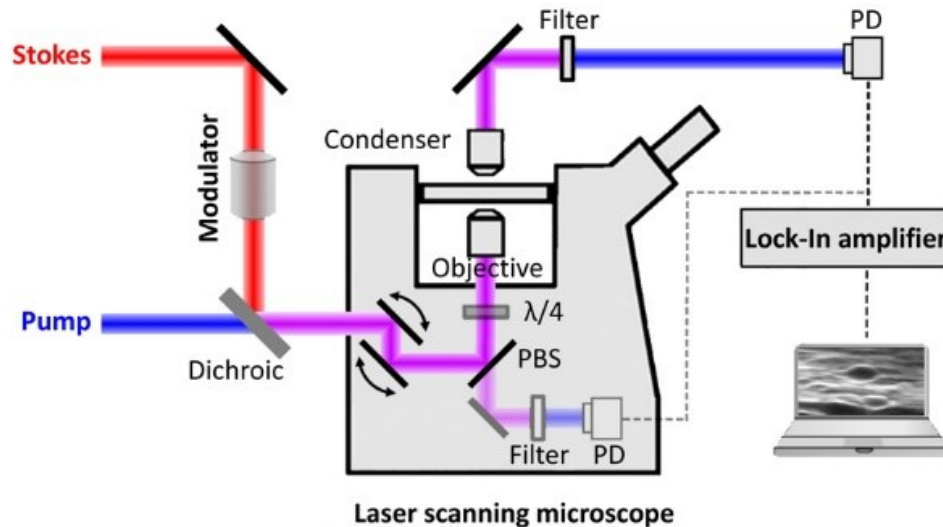
- Modifying pulses as required



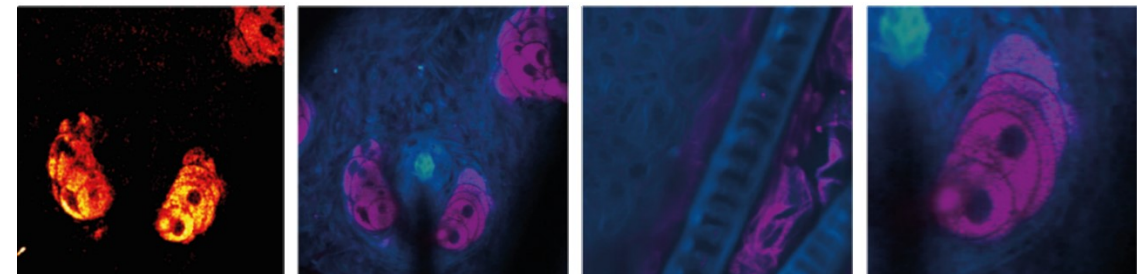
# Stimulated Raman Scattering (SRS) microscopy (SRS)



- Pulsed laser beams, one of them tunable
- Temporal and spatial overlap of pulses at sample site
- Modulation of one beam (for instance Stokes)
- Lock In Detection technique to detect low intensity modulation in output Pump beam



Source: Xie group, Harvard University



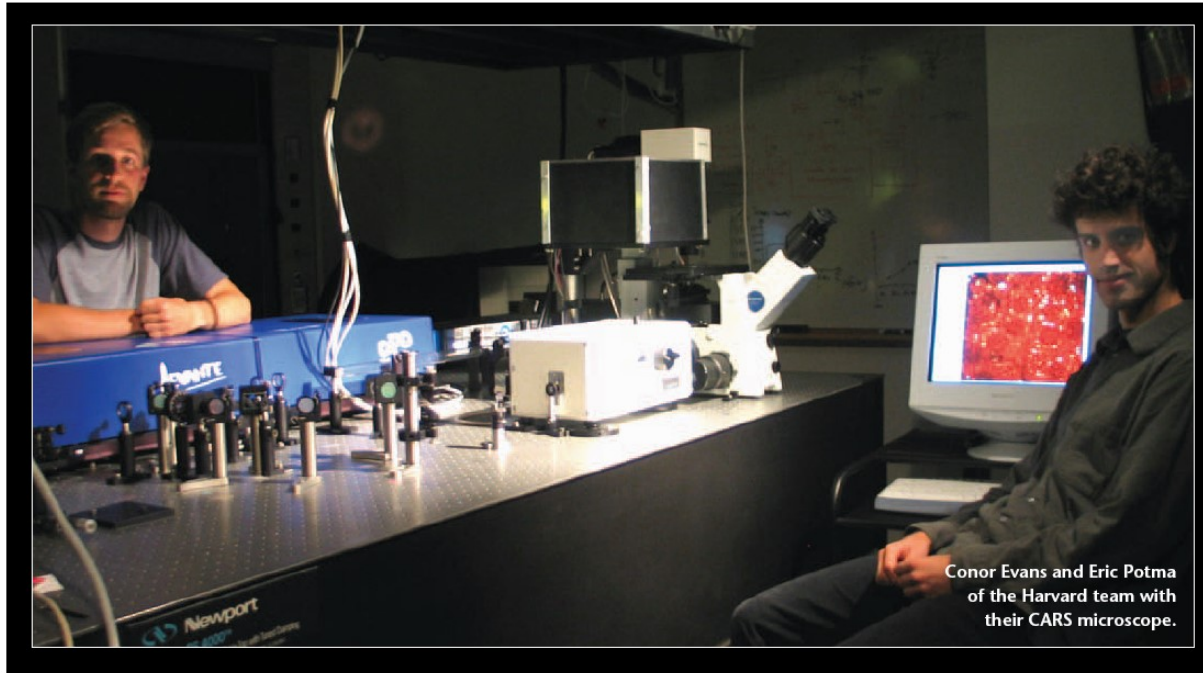
SRS pic: on sebaceous gland and epidermis layer

Source: Prof. Wei Min | Columbia University

# APE and Coherent Raman Microscopy



- Start in 2004 with 1064 nm - Levante Ring OPO together with Sunney Xie / Harvard



- APE is market leader for coherent Raman light sources with more than 150 installed light sources and several hundred publications
- Current picoEmerald-S is APE's 4<sup>th</sup> generation of Coherent Raman light sources, turn key and fully automated

# APE goals for nanoVIB

Light source for Coherent Raman Imaging as well as MINFLUX and 2PE-Fluorescence

TRL9 for a fast tuning light source

TRL7 for femto-pico pulse length conversion



	Current status	goal	improvement
Repetition rate	80 MHz	40 MHz	2x higher SRS signal / 4x higher CARS signal
Modulation frequency	¼ of Laser rep rate	½ of Laser rep rate	3dB better S/N in SRS
Tuning speed	typ. 60 s	~3s (<5s)	>10x faster tuning
Pulse length	2 ps	<2 ps / ~300 fs switchable	CRS and multi-photon imaging / photo-activation

# APE work packages and time line



X Deliverables, ☆ Milestones

	Year 1				Year 2				Year 3				Year 4			
	03	06	09	12	15	18	21	24	27	30	33	36	39	42	45	48
<b>WP4 (APE) Laser for MINFLUX and SRS operation</b>																
T4.1: Develop ultra-fast targeting of arbitrary wavelengths for ps SRS-lasers				X				X								
T4.2: Development of pulse-length switching between ps and fs regimes									X		X					

## Deliverables

**D4.1:** Loan picoEmerald to bridge the gap until the prototype is finished to LLG for Task 2.2 (M13);

**D4.2:** Fast tunable SRS-light source to IF-Nano (M22);

**D4.3:** Femto-pico conversion upgrade of SRS-light source to IF-Nano (M25);

**D4.4:** Fast tunable femto-pico SRS-light source to KTH (M31)

# APE first work package and time line



## Optics:

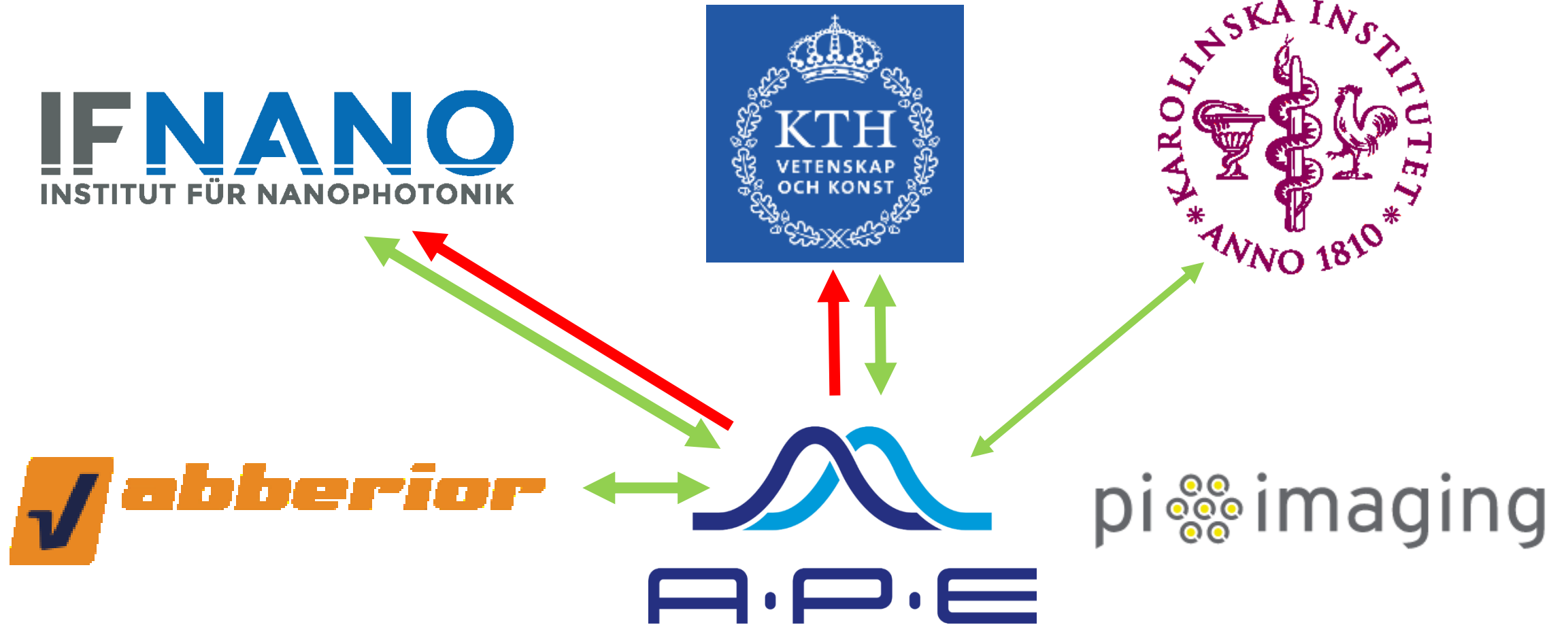
- Characterization of 40 MHz Laser and pulse compression to  $<2\text{ps}$
- SHG generation for OPO pumping
- Breadboard setup
- OPO resonator design for 40 MHz
- Nonlinear optical interaction scheme (choice of nonlinear crystal, size of crystal)
  - Test and validation of scheme
  - Concept for automated tuning
- → to be finished until M6

Mechanical design / electronics design of fully integrated light source

Software integration

→ first prototype to IF-Nano in October 2022 (D4.2 in M22)

# APE interaction with the NanoVIB partners





# APE project team contact data



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