

Coherently-enhanced Raman One-beam Standoff Spectroscopic TRacing of Airborne Pollutants

CROSS TRAP



An EU FP7 ICT FET STREP Project

The Consortium



MenloSystems
GmbH



RUPRECHT-KARLS-
UNIVERSITÄT
HEIDELBERG



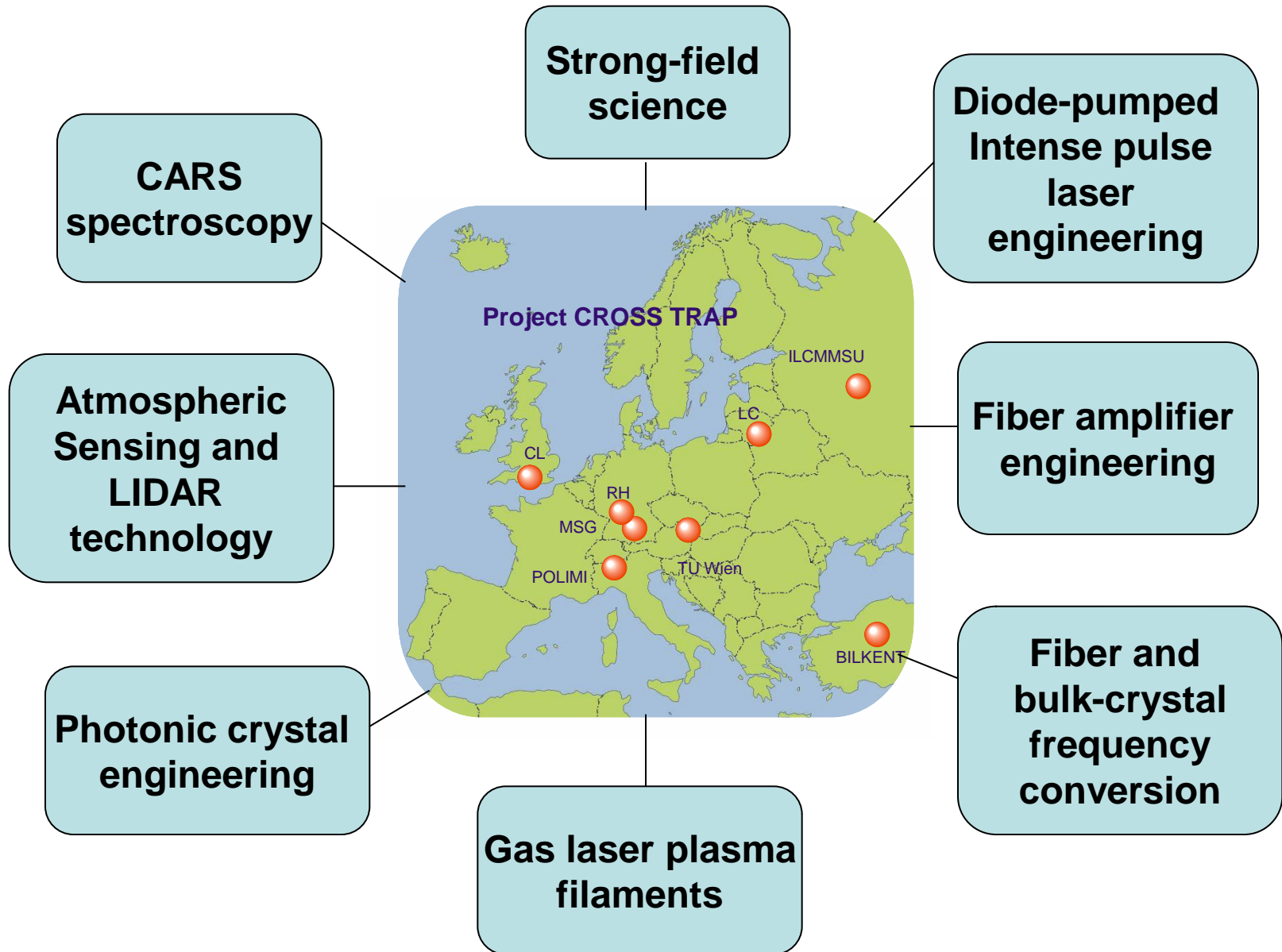
**POLITECNICO
DI MILANO**



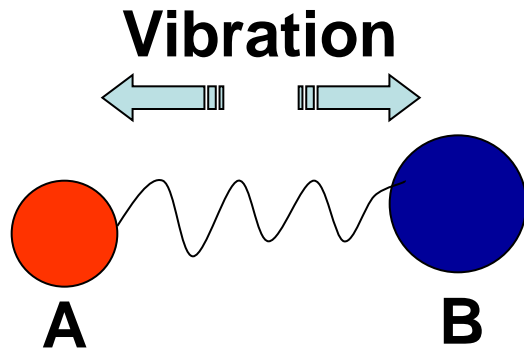
TECHNISCHE
UNIVERSITÄT
WIEN
Vienna University of Technology



Crossroads of Expertise



Optical Fingerprint of a Chemical Bond

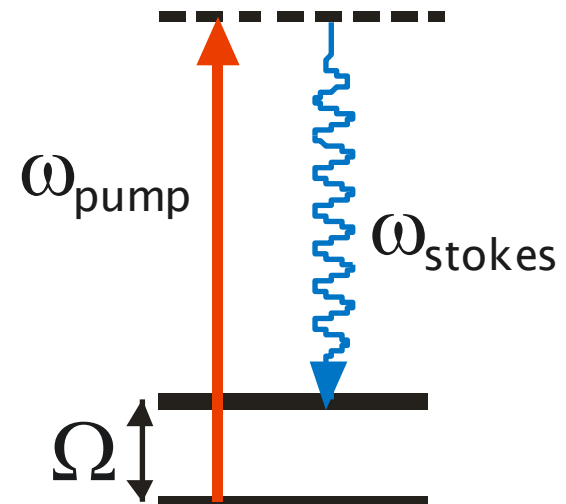


Chemically-sensitive:

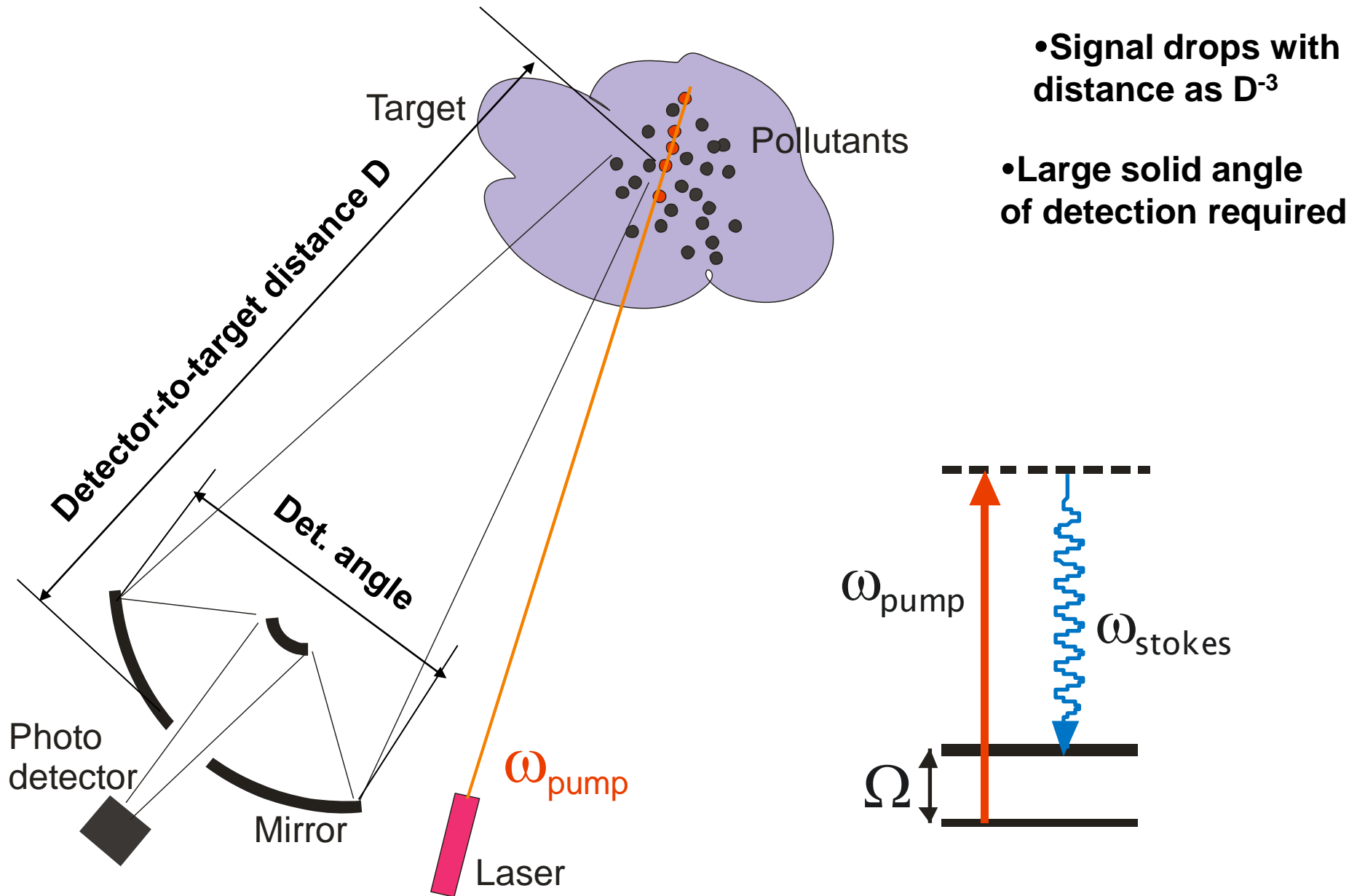
a) Sensitive to individual atoms/ions
but not revealing chemical structure
(e.g. atomic fluorescence/absorption lines)

b) bond-selective =
vibrational Raman optical response

$$T_{\text{period}} = 2\pi/\Omega \approx 10\text{fs} - 1\text{ps}$$

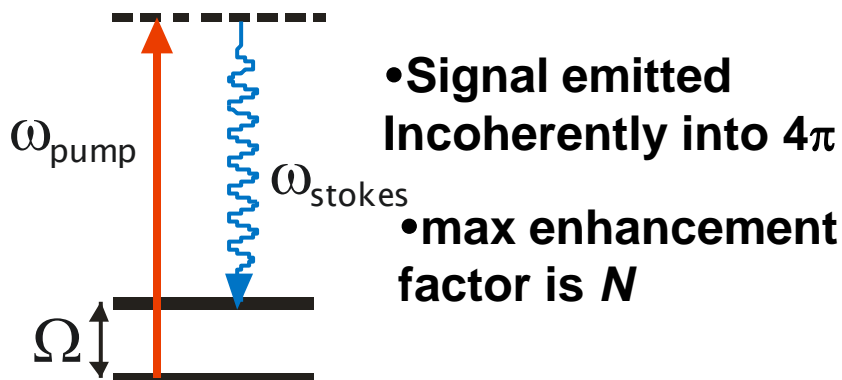
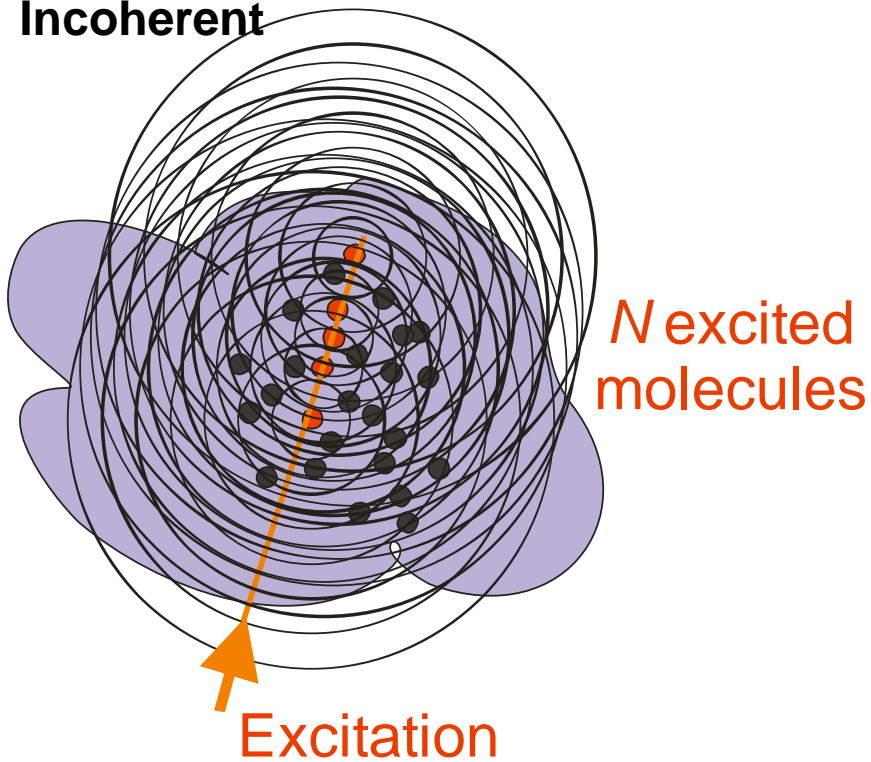


Conventional Raman LIDAR

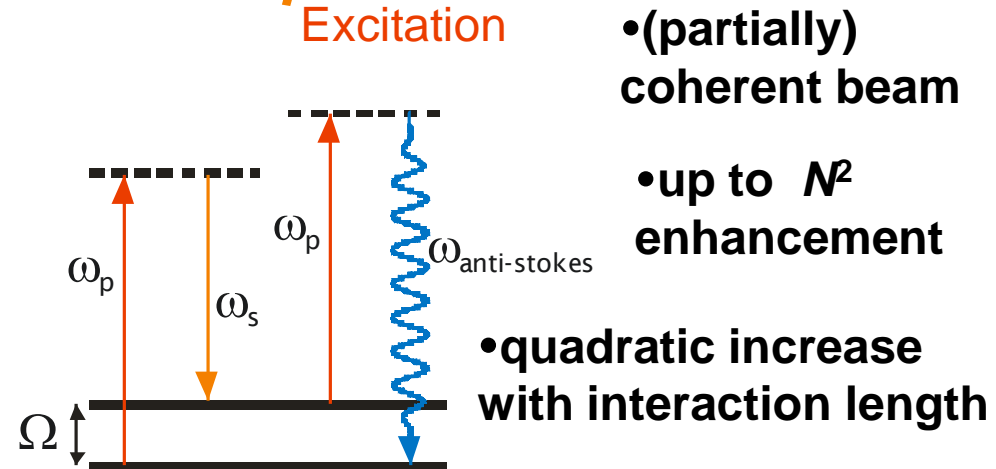
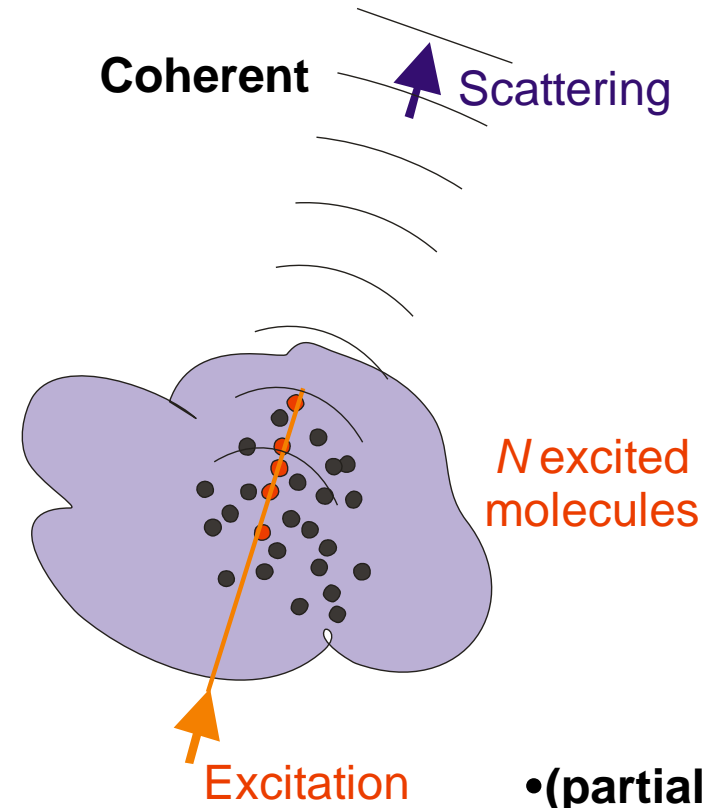


Incoherent vs Coherent

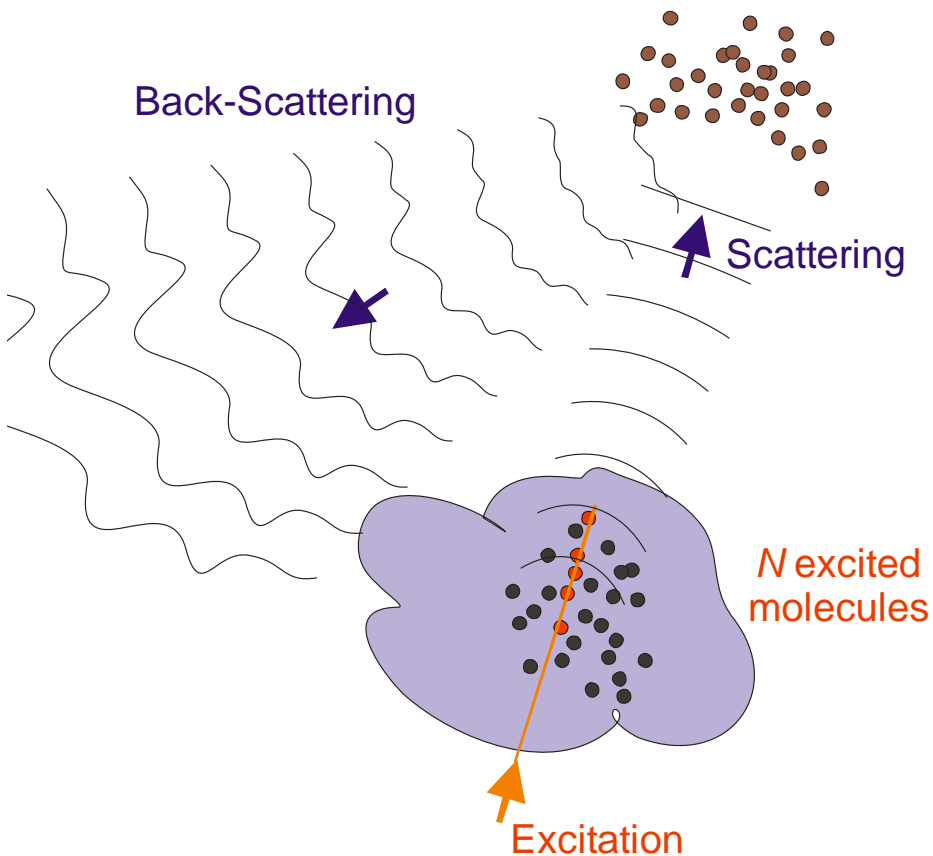
Incoherent



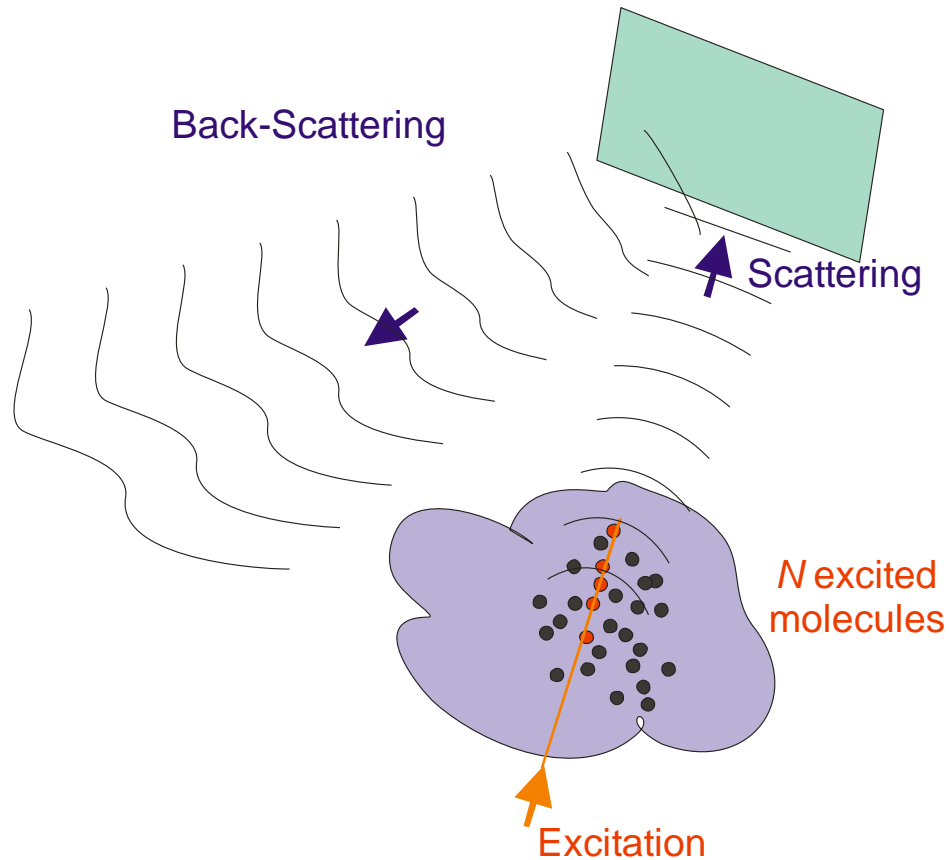
Coherent



Backscattering

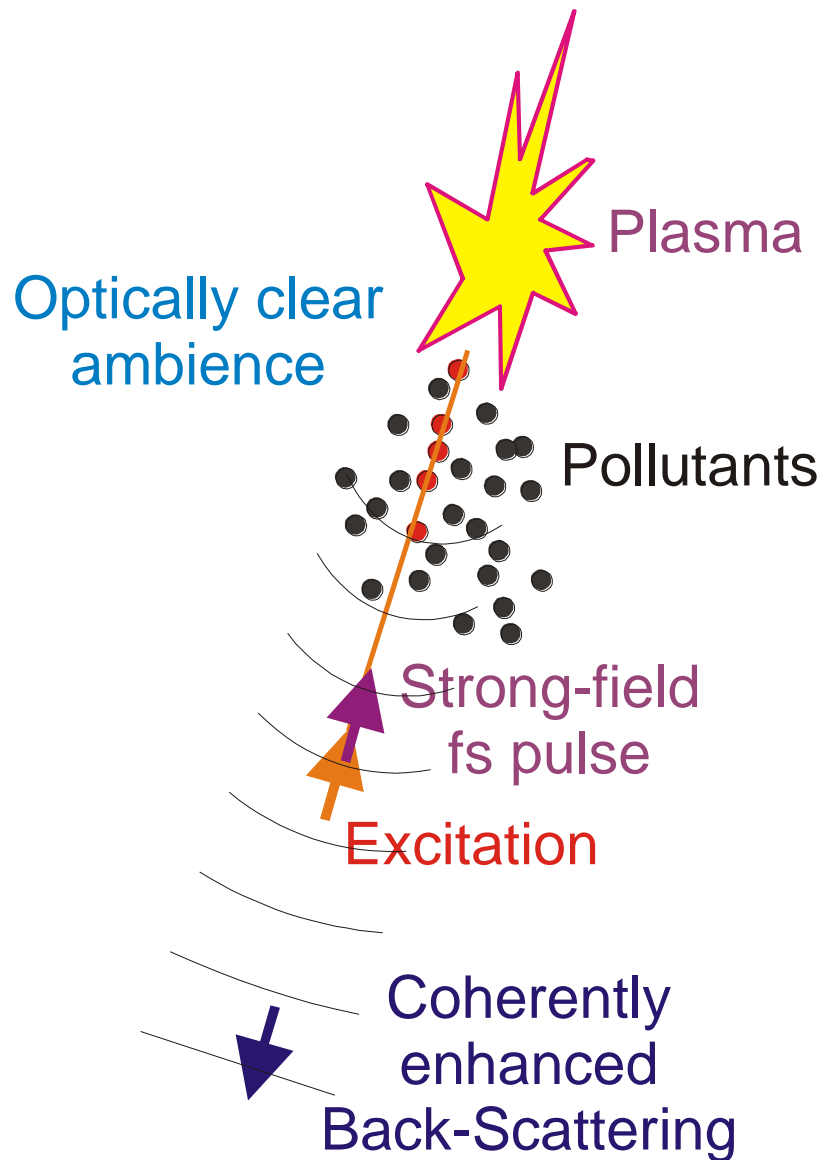


- from atmosphere:
wipes out advantages
of coherent enhancement



- specular reflection off hard surfaces
(e.g. road signs, walls)
proven to work for $D_{\text{standoff}}=0 - 3 \text{ km}$

CROSS TRAP Aim



•combine two lasers:

- 1) Intense femtosecond source to control plasma reflector
- 2) Tunable dual-frequency picosecond source to read out CARS signature of molecules

CROSS TRAP Challenges

- **Plasma control**

- Low plasma density
- Plasma lifetime
- Control of spatial pattern
- Phasing of multiple filament cores
- etc.

- **Backward CARS phase-matching**

- not fully (anti-) collinear to the pump field direction
- may require loss of I_{pump}^2 scaling factor
- background signal suppression
- etc.

- **fs and ps laser combination**

- pulse timing and laser synchronization
- coupling into small filaments
- mutual beam pointing stability
- etc.

Cross-Fertilization

Topic in CROSS TRAP

- **fs filaments in gas**
- **fs pulse wakefield**
- **CARS**

Implications for other research fields

- intense THz pulse generation and delivery
- radar marking
- LIBS
- ranging
- etc.
- particle acceleration
- vibrational/rotational molecular dissociation
- molecular alignment/orientation
- etc.
- novel single-beam approach
- help build up molecular sensing databases
- unexplored phase-matching possibilities
- etc.