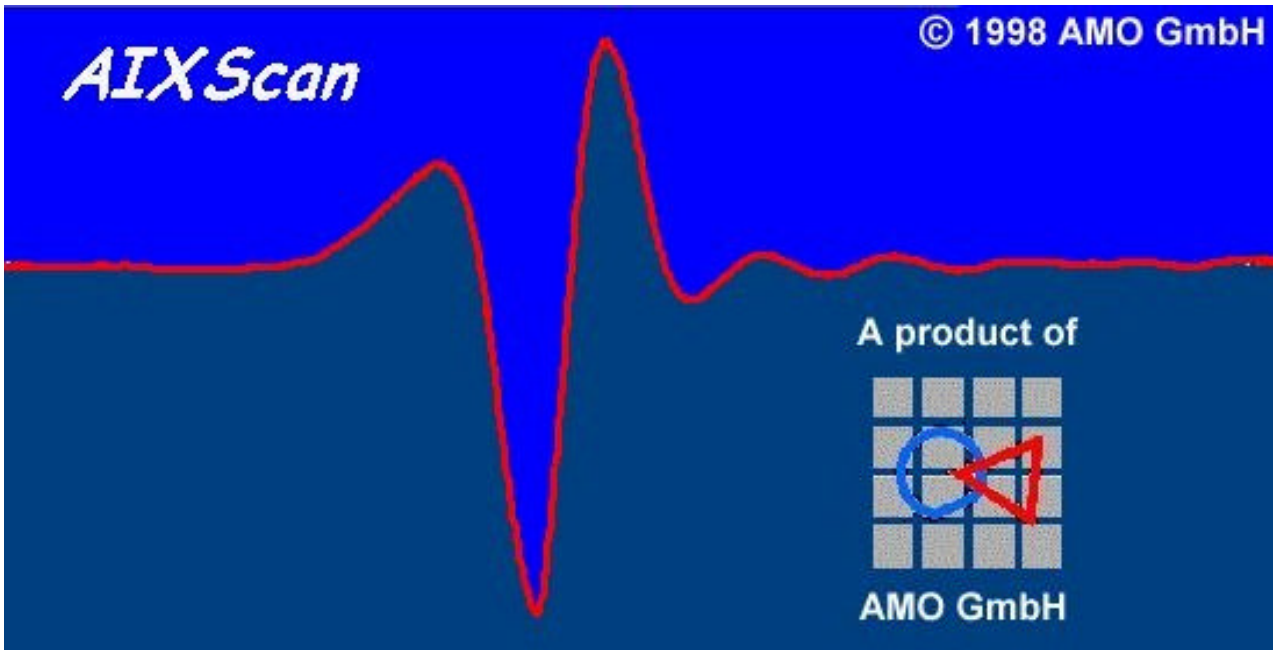
AIX*scan*â



Features of the* AIX*scan*â *System

- realtime detection of sub-ps phenomena on picosecond timescale
- short measurement times compared to Lock-In based detection
- typical SNR of 10^6 to 10^9 reached within minutes e.g. for semiconductor pump-probe measurements
- sampling rate up to 50 MHz
- on-line optimization of optical alignment possible while watching the signal on the monitor
- real-time autocorrelation measurements
- applications with high repetition rate fs laser sources:
  pump-probe, four-wave mixing and other time resolved optical measurements
- user friendly Labview program running under Windows 2000 ® to have full control over the measurement and the stepper movement
- further stepper controls on request
- fully automatic calibration of the time axis to account for the exact shaker motion
- possibility of subtracting a background signal (e.g. a modulation due to stray light)
- standard file management for loading and saving data files

AIX*scan*® measurement system and basic optical setup

AIX*scan*® *measurement system*

The common experiment for time-resolved measurements on ultrashort time scales is a pump-probe setup. The response of the sample (e.g. change of reflectivity or transmission) to a pump pulse is probed by a second pulse variably time-delayed with respect to the pump pulse. The classic approach is to use a Lock-In amplifier and a chopper to measure the pump induced signal changes for different time delays achieved with a motorized delay stage.
The main advantage of the AIX*scan*® system is to use a fast scanning delay generator for the time delay and accumulating the signal with a fast A/D converter without chopping one of the laser beams. This technique - first introduced in the 80`s [1] - allows to average thousands of scans within minutes. In the 90`s the ultrafast optics group of H. Kurz at the Technical University of Aachen (or AIX-la-Chapelle) developed a specialized VME-Bus based computer hardware, which allows Megasample A/D conversion rate and on-line data processing. Using scan frequencies up to hundred Hz, well above low frequency noise of the laser, a signal-to-noise ratio of 10^6 to 10^9 is achieved within minutes [2,3].
AIX*scan*® makes this technique available for everybody working in the field of ultrafast spectroscopy. The system features up-to-date PC-based hardware and software.

[1] M.J. Rosker, F.W. Wise, and C.L. Tang; Physical Review Letters 57(3); 321(1986)
[2] G.C. Cho, W. Kütt, and H. Kurz; Physical Review Letters 65(6); 746(1990)
[3] A. Bartels, T. Dekorsy, H. Kurz; Optics Letters 24; 996 (1999)

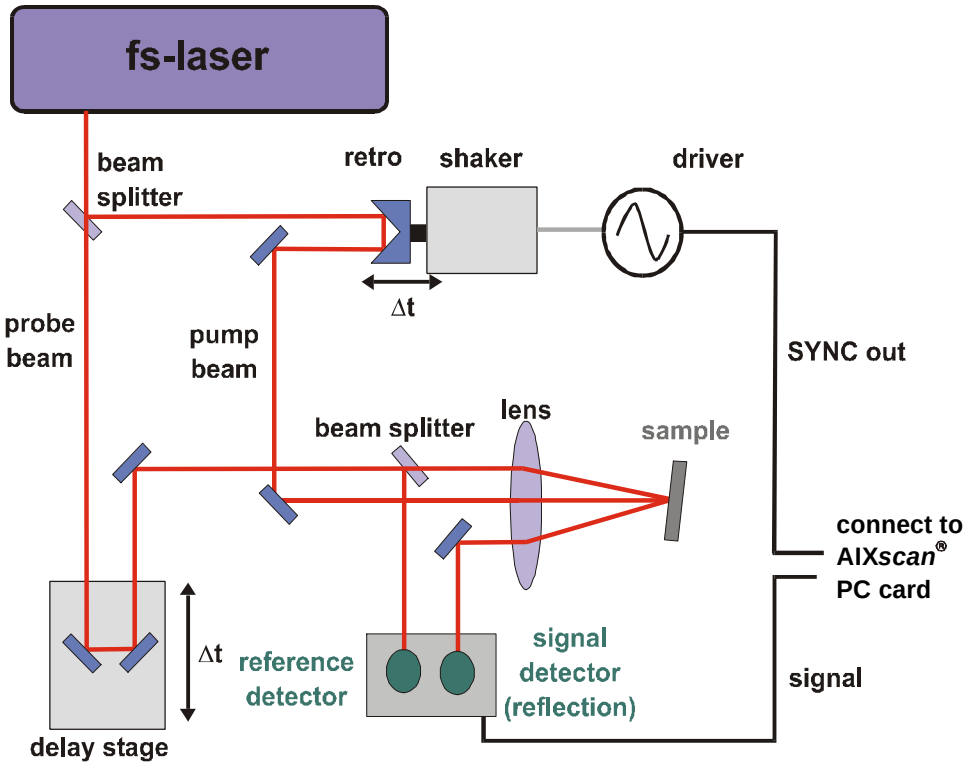


figure 1: Schematic sketch of a pump-probe set-up.

1) Fast scanning pump-probe set-up

Fig. 1 shows a basic pump-probe set-up. In the AIX*scan*® basic system, you are provided with the rapid delay line based on a retroreflector mounted onto the shaker. If your optical set-up is already complete, you have to change it by placing the shaker into one of the beam paths. The stepper motor for adjusting time-delay zero has to be placed into the other path. For a pump-probe set-up the recommended arrangement is to place the stepper into the probe beam and the shaker into the pump-beam. In general the stepper should be placed in that beam path which requires the most stable beam position, since this arm is static during the measurement. The other beam where the shaker is placed may - in case of stray light from this beam - introduce an undesired modulation of your signal with the shaker frequency. This modulation can be subtracted by the software during the measurement.

2) The shaker

The shaker is mounted onto the provided specially damped holder. The retroreflector mounted onto the shaker is a triple mirror retro and has an aperture of 1/2 inch. Use two mirrors or a reflecting 90° prism to couple the beam into the retro. If you use further optical components for determination of the beam polarization, place them behind the shaker into the beam path, since the retro is not fully polarization maintaining. Position the shaker holder at the right fine position on the table in order to have equal pump and probe beam path lengths. Tighten the holder to the optical table with the provided clamps.

3) The frequency generator

The shaker is driven by an internal D/A-converter combined with an amplifier also available from AMO GmbH. It produces a maximum amplitude larger than 3 mm peak-to-peak and results in a time delay of more than 20 picoseconds. The "right" frequency and amplitude settings are determined by your experiment.

4.) The software

With the software included in the basic system (programmed in Labview 6.1) users can make use of the full power of AIX*scan*® measurements. It supports the stepper delay stage which is attended to the basic system. Further stepper controls can be attended on request. The software is delivered as Labview Source and as Runtime Library so that no Labview is needed. For users competent in Labview programming it is possible to adapt the software to their personal needs.

Basic components

Hardware:

AIX*scan*® measuring plug-in card to perform the data aquisition

- A/D converter for data aquisition
- D/A converter for shaker control
- shaker providing a fast optical delay stage
- amplifier to drive the shaker
- retroreflector mounted on the shaker

Optional:

- computer including necessary peripheral devices
- stepper control unit
- translation stage incl. connection cable
- optical pump-probe setup including detector

Software:

- Labview program for main control of data acquisition and control of the stepper
- Labview software simulation of a measuring signal and a stepper for testing purpose
- Dynamic link library to control the AIX*scan*® plug-in card
- user friendly configuration
- supporting further stepper controls on request

Requirements for AIX*scan*â*:*

A Pentium 200 MHz computer system with at least 64 MB RAM is required for this measuring system. The operation system has to be Windows 2000 or higher. For an adequate display of the Labview-frontpanel, it is recommended that the display has a resolution of at least 1024 x 786 points. The labview control program has been developed in Labview 6.1. It is not compatible to earlier versions of Labview.

Features of the AIX*scan*â *System*

- **short measurement times compared to Lock-In based detection**
- **typical SNR of 10^6 to 10^9 reached within minutes** e.g. for semiconductor pump-probe measurements
- sampling rate up to **50 MHz**
- **D/A converter** with max. amplitude of **+/- 10V** and frequencies up to **100 MHz**
- **additional amplifier** for shaker driving, also available by AMO GmbH
- **on-line optimization** of optical alignment possible while watching the signal on the monitor
- **user friendly Labview program running under Windows 2000** â to have full control over the measurement and the stepper movement
- **integration of every** stepper or dc-based **motor system** possible
- **fully automatic calibration** of the time axis to account for the exact shaker motion
- possibility of subtracting a background signal (e.g. a modulation due to stray light)
- standard file management for loading and saving data files

typical applications for the AIX*scan*â *System*

- **optical pump – probe setup with femtosecond laser pulses** for analyzing sub – ps phenomena e.g. phonon relaxation in semiconductors, liquids and other material systems
- **pump-probe, four-wave mixing and other time resolved optical measurements**
- applications with high repetition rate fs laser sources (> 1GHz)
  - real-time **autocorrelation** measurements
  - quick detection of **coherently generated THz – pulses** for e.g. material characterisation
    - analysis of doping in semiconductors
    - imaging applications in tomography or transillumination
    - analysis of biological samples (e.g. DNA)
    - sensitive analysis of humidity (e.g. in human dermis, in drying processes)
  - general usage of the AIXScan – measurement card for **fast data acquisition** (up to 50 MHz) and preprossesing (e.g. averaging)