# Synchrotrons in the world

#### EUROPE

Germany

**ANKA (Karlsruhe) BESSY (Berlin) DELTA** (Dortmund) ELSA-II (Bonn) **HASYLAB** (Hamburg)

Denmark

LSB (Barcelona)

Frence **ESRF** (Grenoble) LURE (Orsay) SOLEIL

Holy

**DAFNE (Frascati) ELETTRA (Trieste)** 

# Long Term Strategy at the ESRF and **Detector Developments** ASTRID (Aarhun) Spain E-urope and the World

SES (Daresbury)

Sweden MAX (Lund)

Switzerland SLS (Villigen)

### Scientific Infrastructure and Experimental Programme

- Example: DETECTORS (.... all happening after the sample)
  - Systematic under-funding:
    - ESRF: ~50M€/1000M€=0.05
    - CERN: ~0.33
  - Large Angular Collection
  - Time Resolution
  - Integration with Optics and Software Developments
  - It does not necessarily require new technology

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## What is the ESRF doing?

#### Read-Out < 0.3 ms

#### 16 Gbit/s



How efficient are we? Incident flux (spectral):  $\Delta \lambda / \lambda$  1<sup>st</sup> harmonic = 10<sup>-2</sup> ♦ Δθ/θ Si (111) = 10<sup>-4</sup> • IXS  $\Delta\lambda/\lambda = 10^{-7}$ ♦ Total power generated = 10<sup>3</sup> Watt ◆ Total power on sample = 10<sup>-3</sup> Watt Emitted signal (spatial): ◆ Fluorescence: 10<sup>-4</sup> covered ♦ Powder diffraction: 10<sup>-7</sup> covered

### Faster, Better, and New Science rew. acc dec. exp readout 300 msee seconds close open 5msec 5msec shutter time

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Detection threshold above  $k\alpha$  Cu

#### Ring integration spectra



#### **Benefits :**

Elimination of fluorescence background reduces image noise allowing to more easily detect weak scattering features

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Direct conversion of X-rays to electrical signal **Si, GaAs, Cd(Zn)Te,...** best spatial resolution

ASICS with <u>intelligent pixels</u>: Auto correlator per pixel

3D connectix for **<u>4-side buttable</u>** 

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Head = APD + Pre-amplifier

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- Faster and Better Macromolecular Crystallography, by continuous rotation.
- Better Macromolecular Crystallography, by low noise, energy discrimination.
- SAXS with micro-second time resolution, example: muscle diffraction.
- 2D X-ray Photon Correlation Spectroscopy.
- Faster Nuclear Resonance scattering.
- Faster and better X-ray magnetic scattering.
- $4\pi$  fluorescence detection.

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### Scientific Infrastructure and Experimental Programme

- Example: DETECTORS
  - Identify New Science (see ESRF UM Workshop)
  - Identify Large Gains:
    - ⊙ X-ray Fluorescence
    - ☺ Diffuse X, SAX,... Scattering
    - ☺ Inelastic and Nuclear Scattering
    - ☺ Combine to X-ray Imaging

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### - Identify Pilot Programmes

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