Science driven requirements for seeded FEL

C. Masciovecchio

Elettra Sincrotrone Trieste

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Why Free Electron Lasers ?

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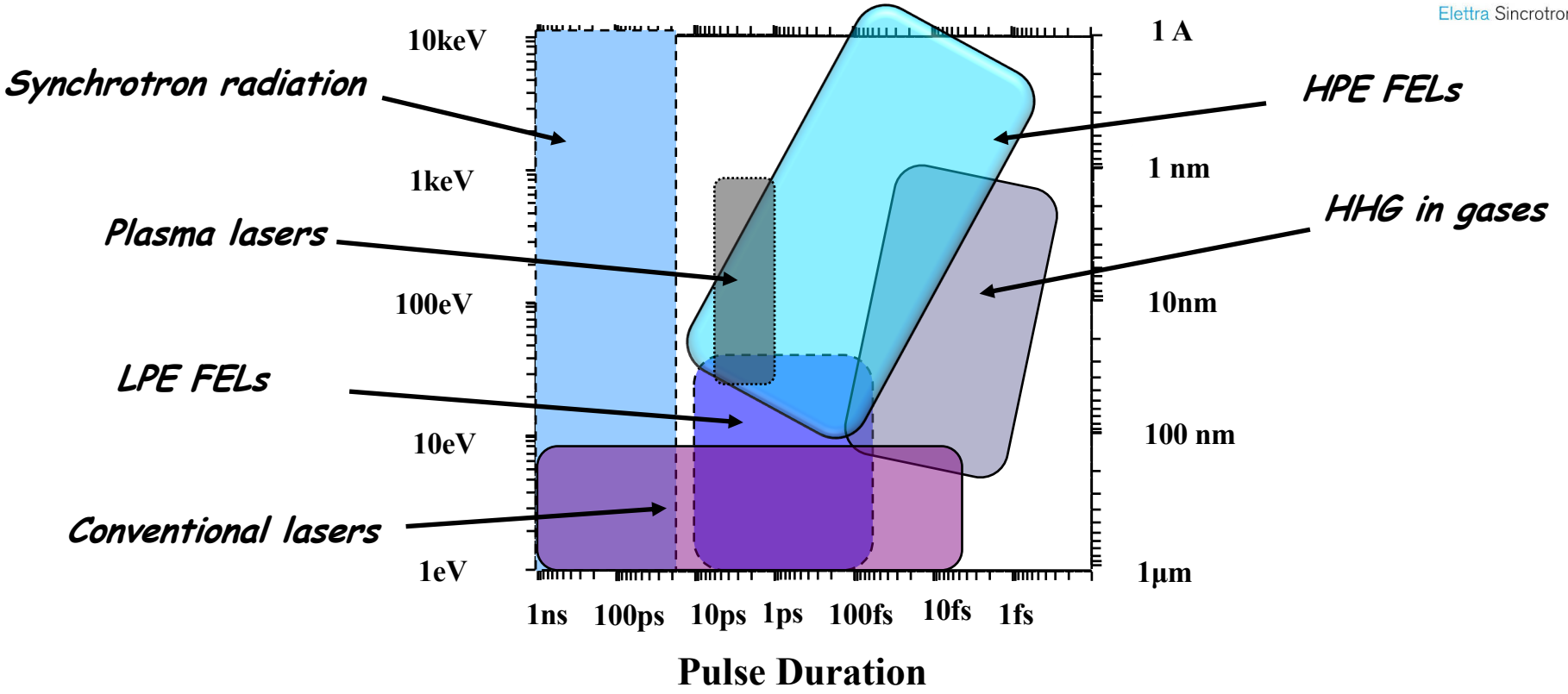
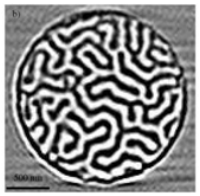
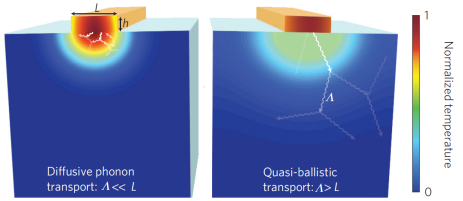


Imaging with high Spatial Resolution (~ λ)





Dynamics: wave mixing (nanoscale) & extreme conditions

Resonant Experiments: XANES & XMCD

X-ray Absorption

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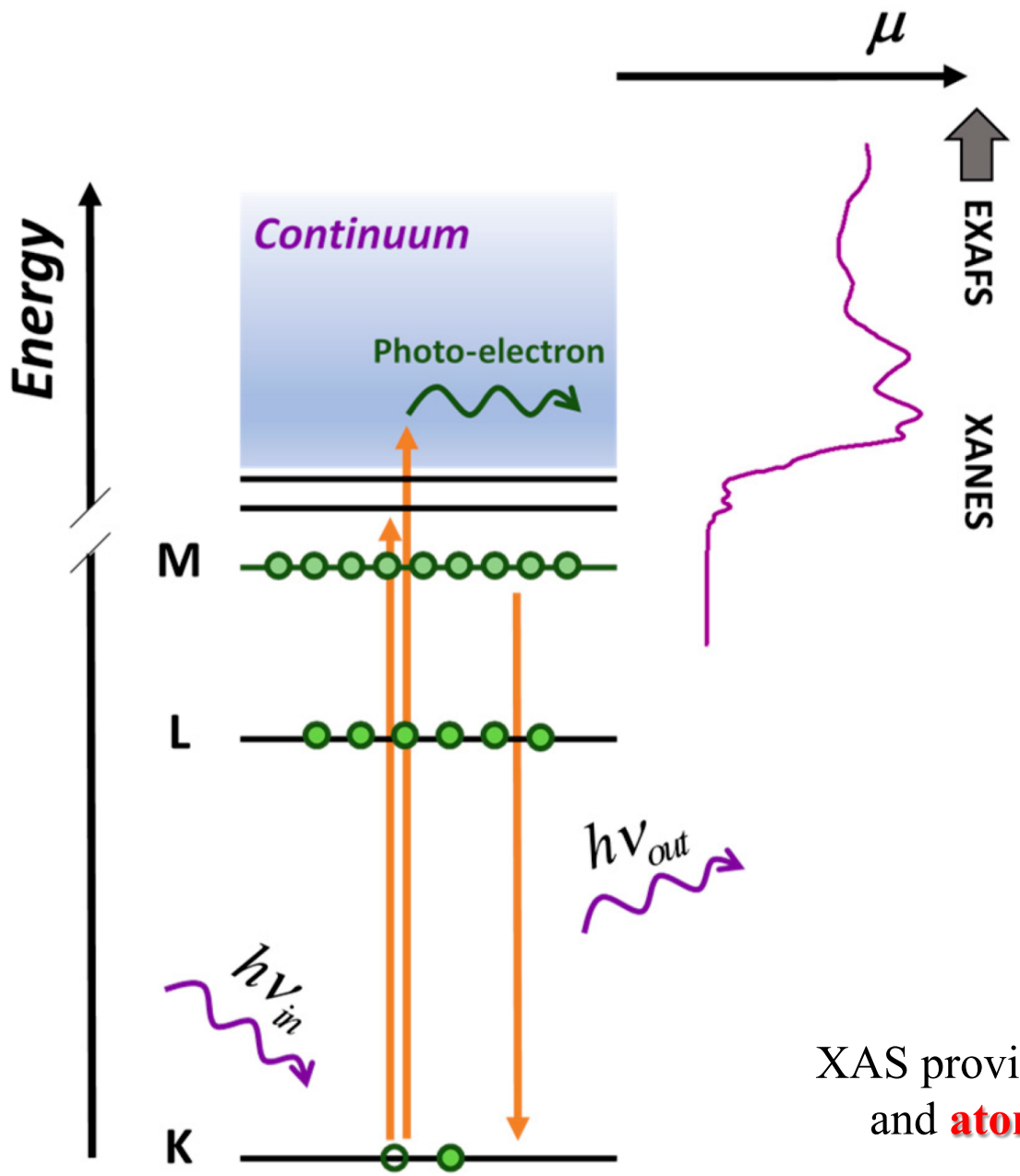

The **post-edge** part of the spectrum gives information about interatomic distances and bond angles

The **main edge** features are used for the determination of the local geometry around an absorbing atom (can be shifted due to bonding characteristics) and the position reveals the oxidation state

XAS provides information on the local **electronic** and **atomic structure** of a selected element

Resonances

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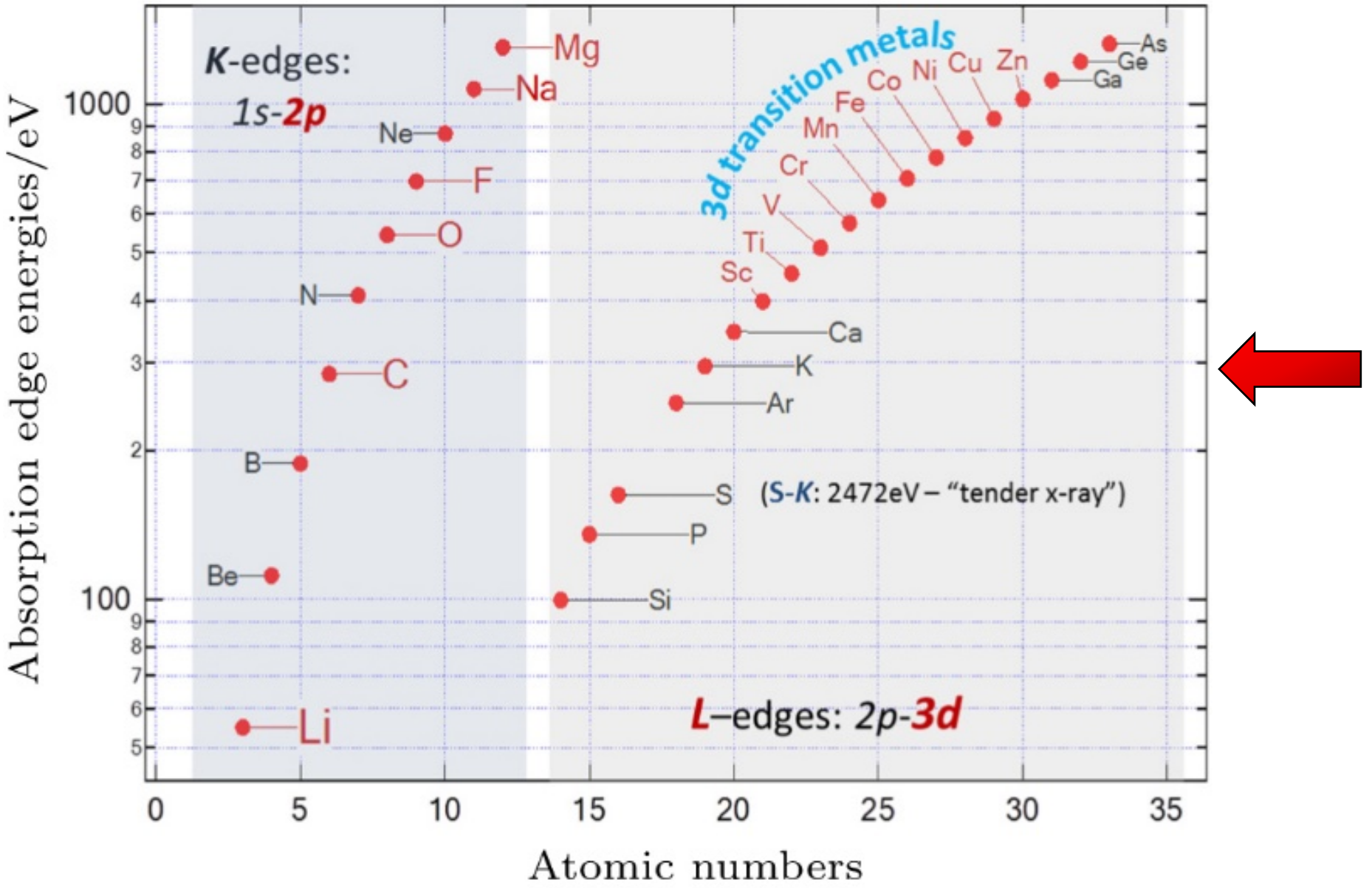


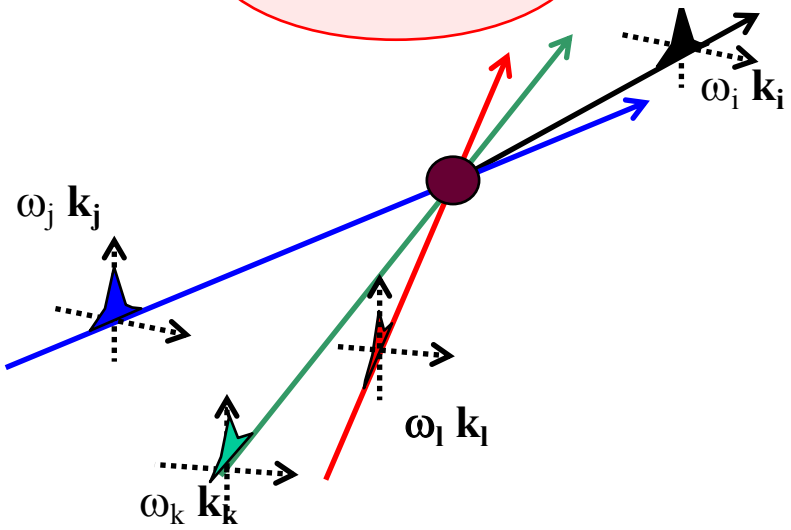
Nonlinear Optics

N. Bloembergen 1981

$$Pi = \chi_{ij}^{(1)} E_j + \chi_{ijk}^{(2)} E_j E_k + \chi_{ijkl}^{(3)} E_j E_k E_l + \ldots$$

ω_i is a **combination** of ω_j, ω_k, and ω_l

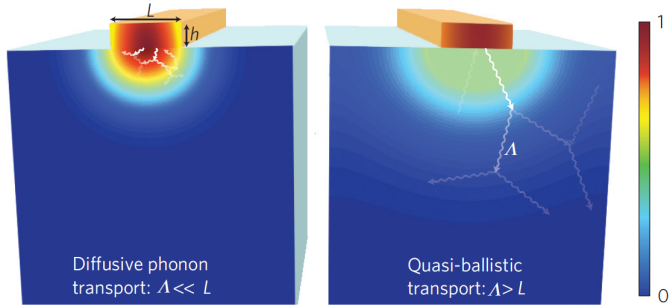
Transient Grating → $\omega_j = \omega_k$



SCIENCE ADVANCES | RESEARCH ARTICLE

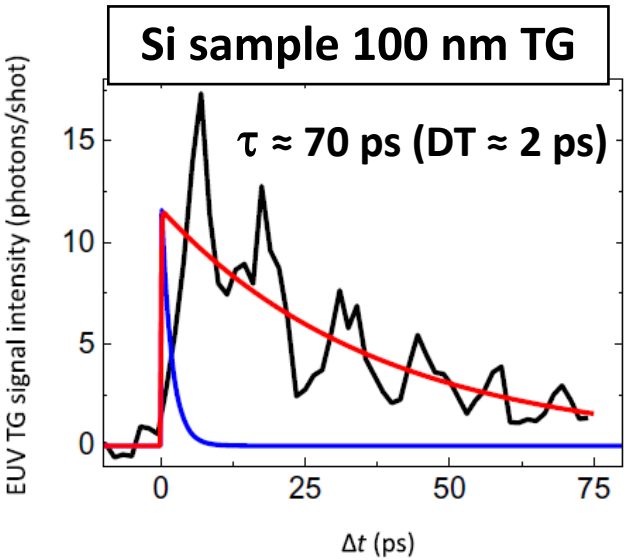
OPTICS

Nanoscale transient gratings excited and probed by extreme ultraviolet femtosecond pulses



At $\lambda \approx$ to MFP of thermal phonons

Fourier law breaks down



Transient Grating on Disordered Systems

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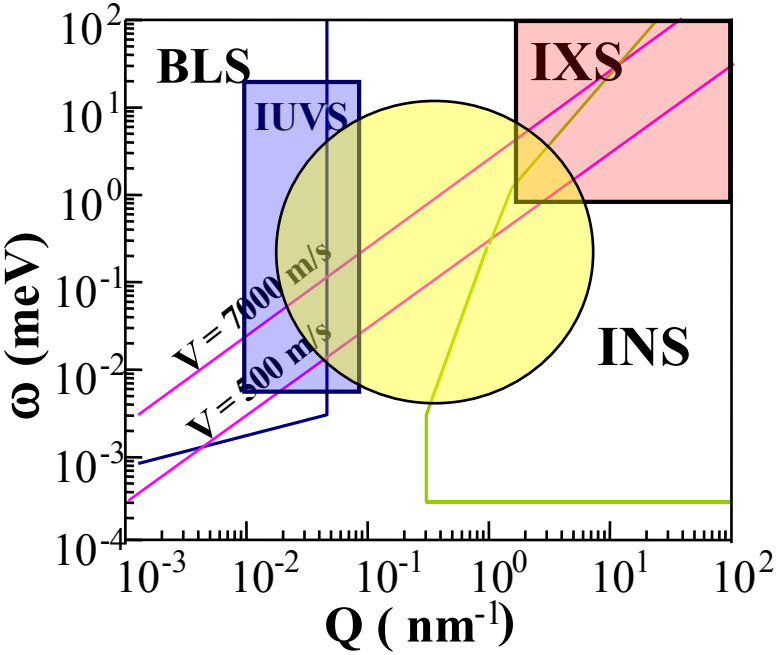

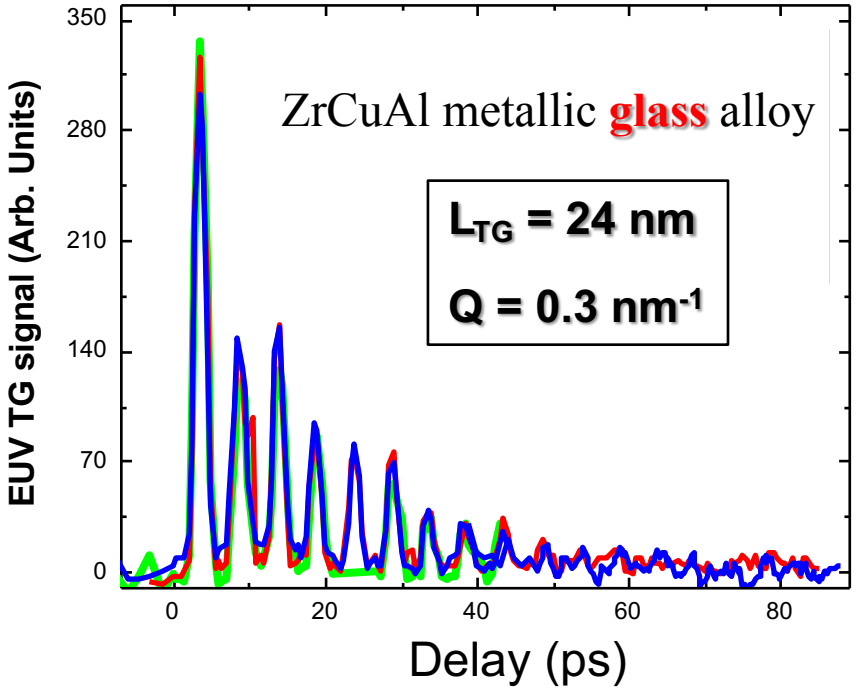

IXS @ Brookhaven (5 M €)

BRISP @ ILL (5 M €)

T-REX @ ESS → 20 M€

IXS @ XFEL (in progress)

IXS @ SLS (in progress)

Phonon decay (~ 30 ps → ~ **0.1 meV**)

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Enjoy FUSEE workshop!!!