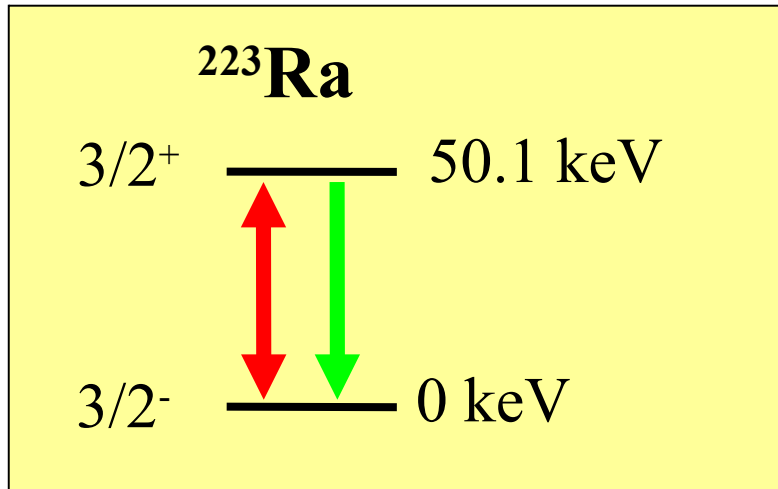


STIRAP – stimulated Raman adiabatic passage

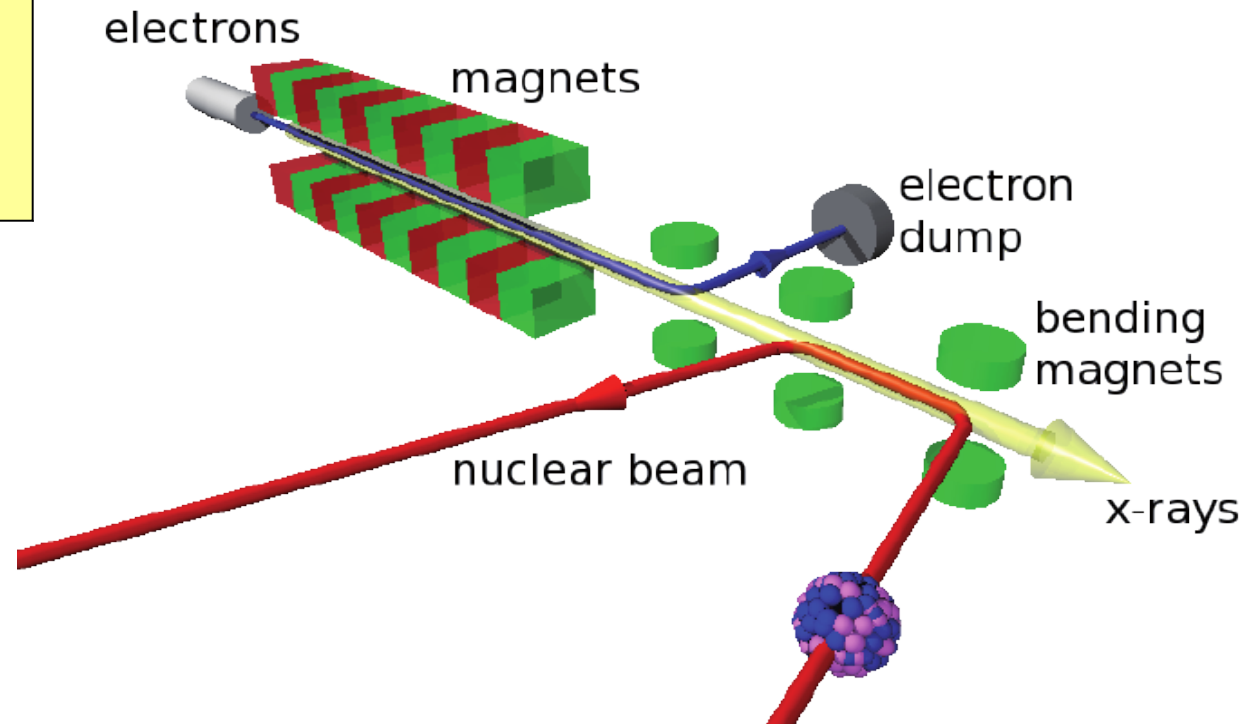
Nuclear excitations and the XFEL

bridge the gap between nuclear excitation and photon energies...



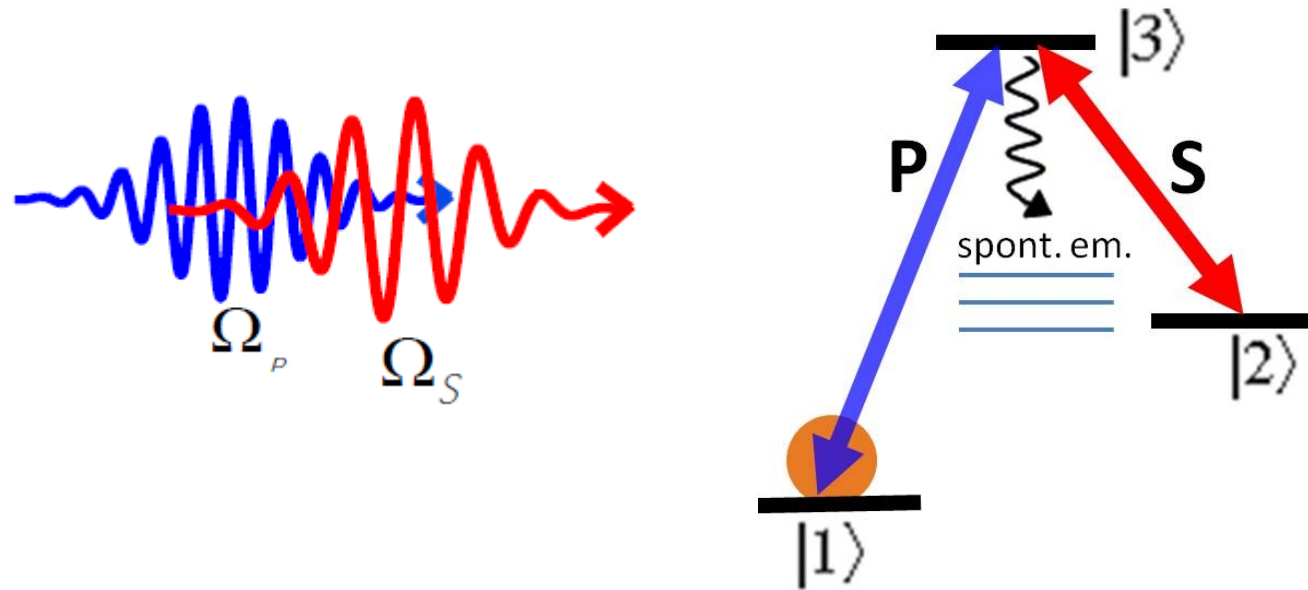
Doppler shift

$$E_n = (1 + \beta)\gamma E_L$$



STIRAP and the coherent XFEL

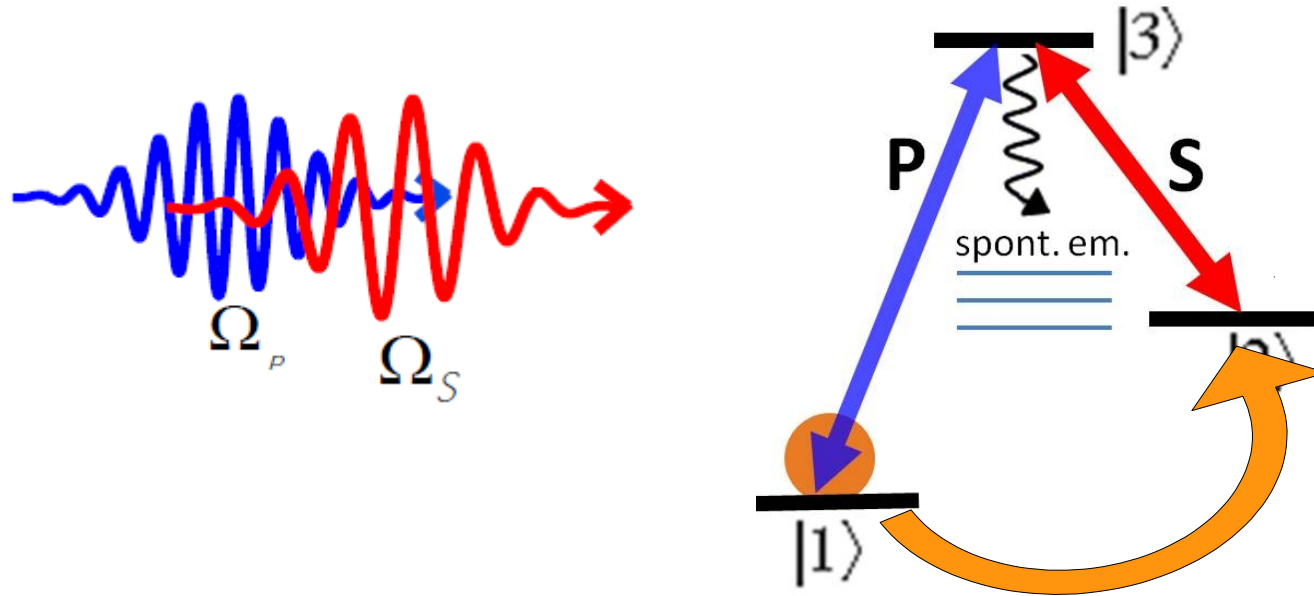
STImulated Raman Adiabatic Passage



$$|D\rangle = \frac{\Omega_s}{\sqrt{\Omega_p^2 + \Omega_s^2}} |1\rangle - \frac{\Omega_p}{\sqrt{\Omega_p^2 + \Omega_s^2}} |2\rangle$$

STIRAP and the coherent XFEL

STImulated Raman Adiabatic Passage



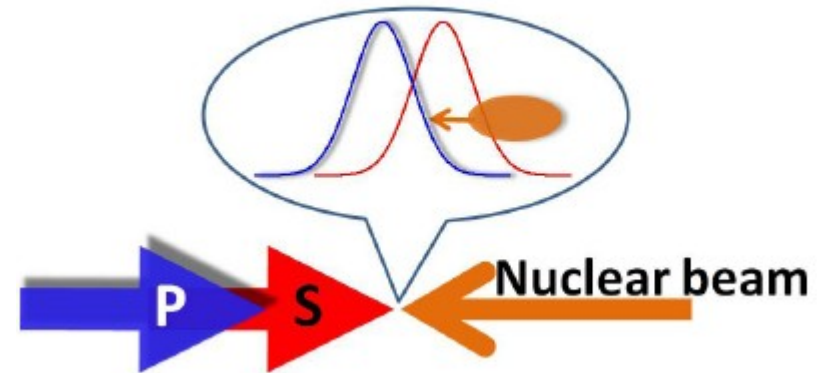
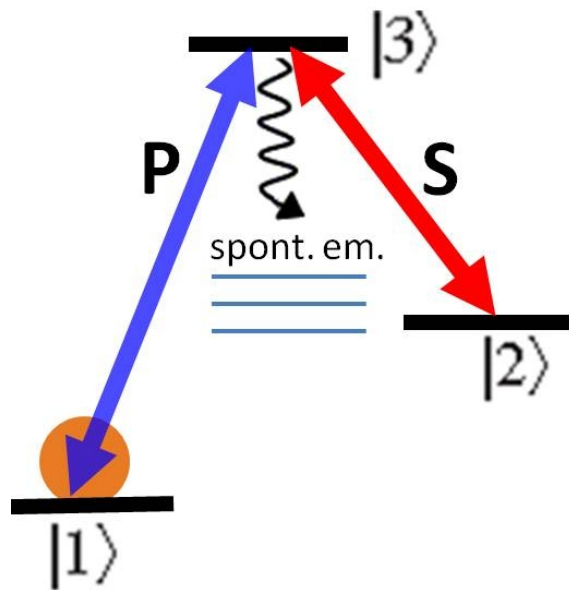
Robust coherent population transfer



ISOMER TRIGGERING?

$$|D\rangle = \frac{\Omega_s}{\sqrt{\Omega_p^2 + \Omega_s^2}} |1\rangle - \frac{\Omega_p}{\sqrt{\Omega_p^2 + \Omega_s^2}} |2\rangle$$

STIRAP and the coherent XFEL



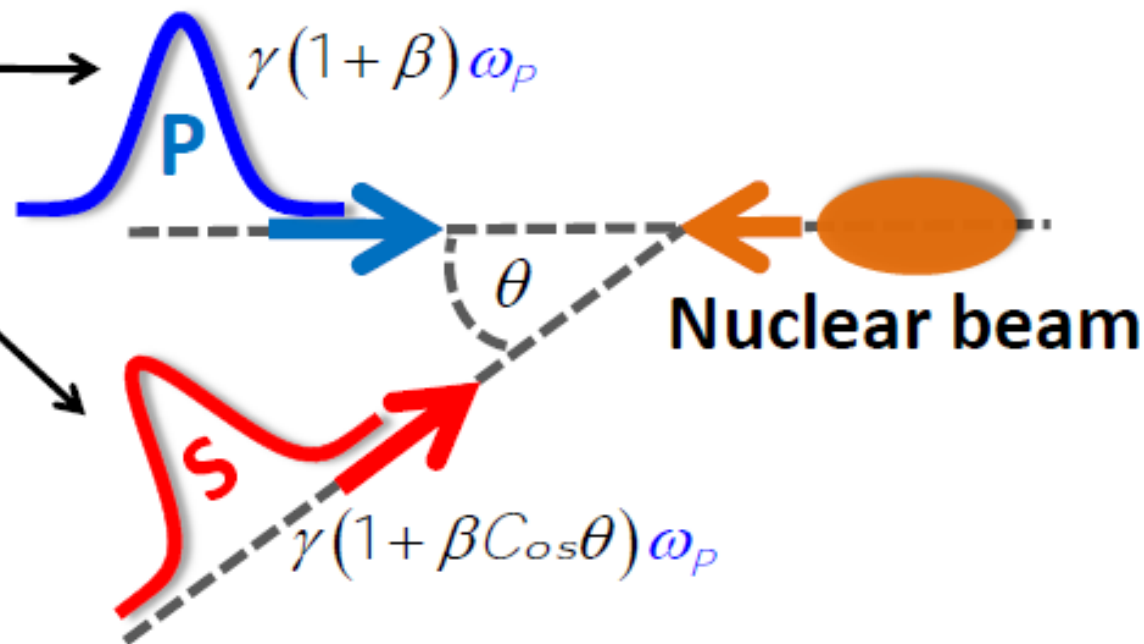
$$|D\rangle = \frac{\Omega_s}{\sqrt{\Omega_p^2 + \Omega_s^2}} |1\rangle - \frac{\Omega_p}{\sqrt{\Omega_p^2 + \Omega_s^2}} |2\rangle$$

Requirements:

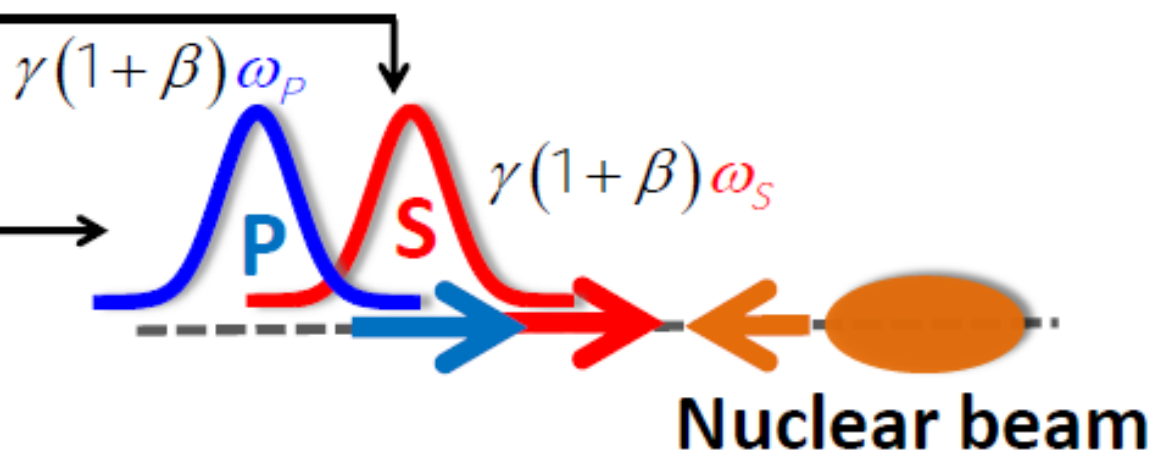
- accelerated nuclei
- two-color
- full temporal coherence

STIRAP and the coherent XFEL

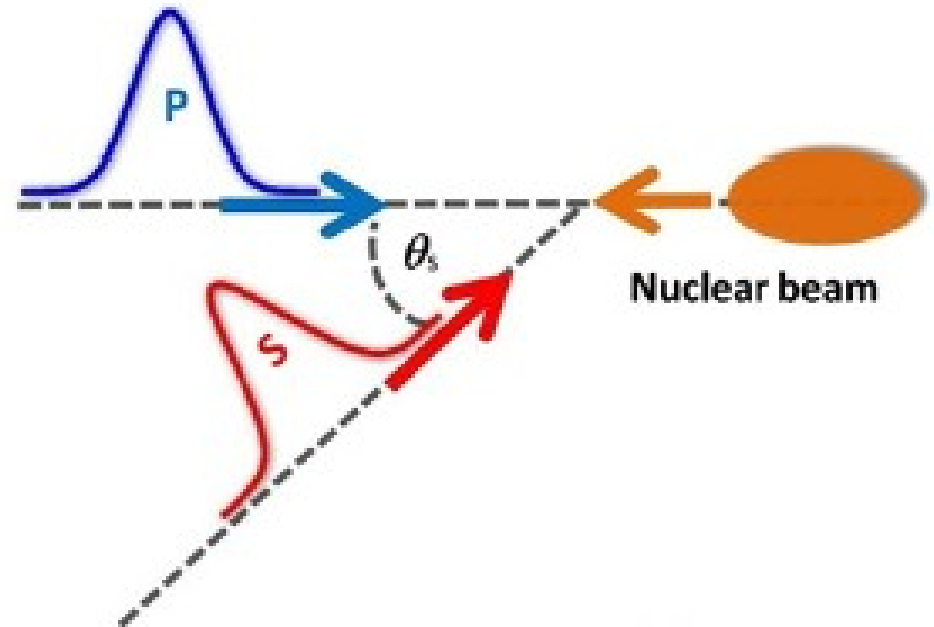
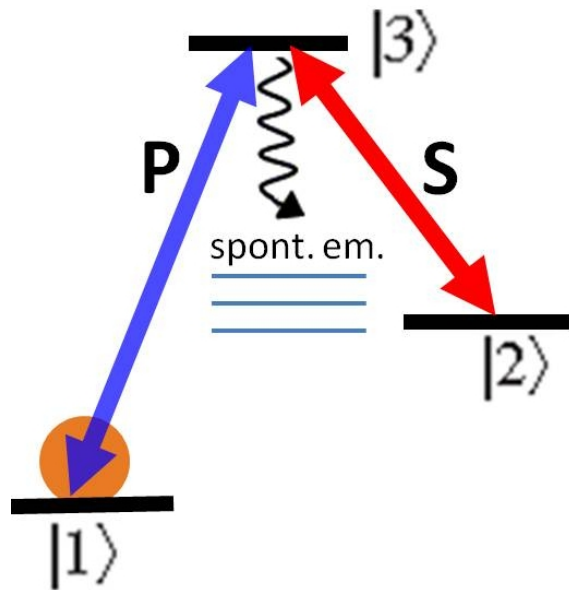
Cross One Color
Scheme
Central frequency of
P and **S** are the same.



Parallel Two Color
Scheme
Central frequency of
P and **S** are different.



STIRAP and the coherent XFEL

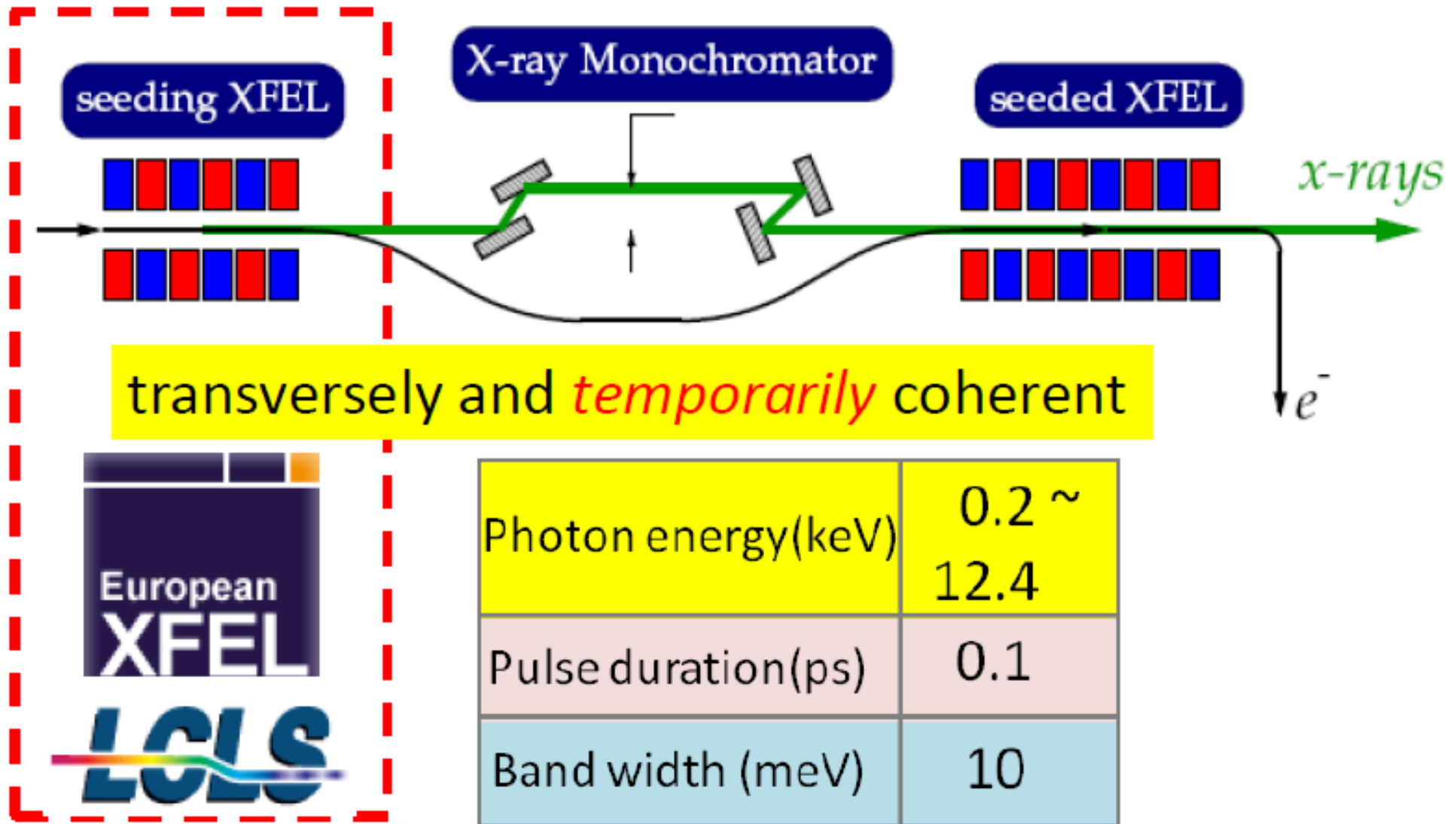


$$|D\rangle = \frac{\Omega_s}{\sqrt{\Omega_p^2 + \Omega_s^2}} |1\rangle - \frac{\Omega_p}{\sqrt{\Omega_p^2 + \Omega_s^2}} |2\rangle$$

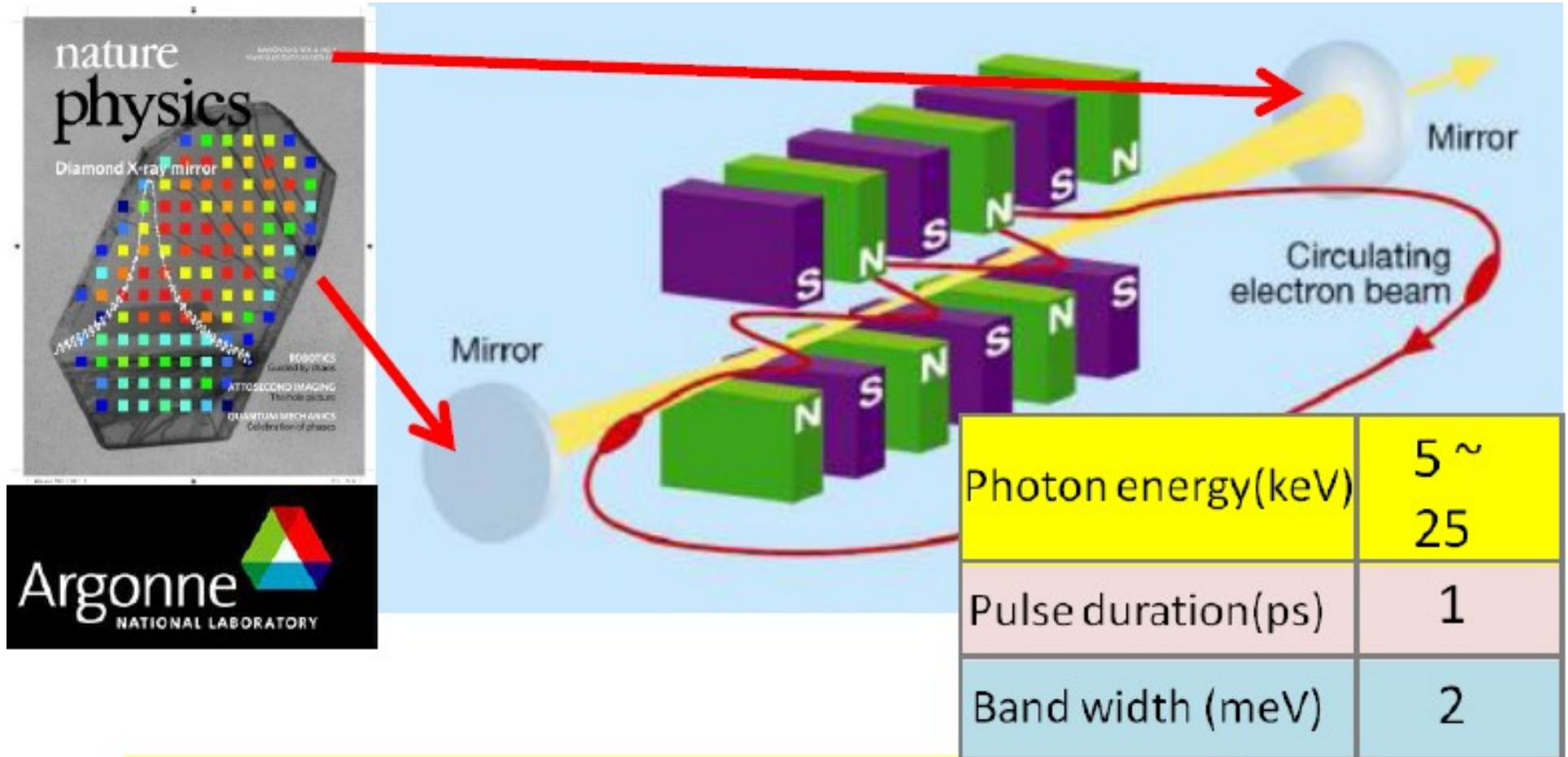
Requirements:

- accelerated nuclei
- ~~two color~~
- full temporal coherence

... seeded XFEL



... XFEL oscillator

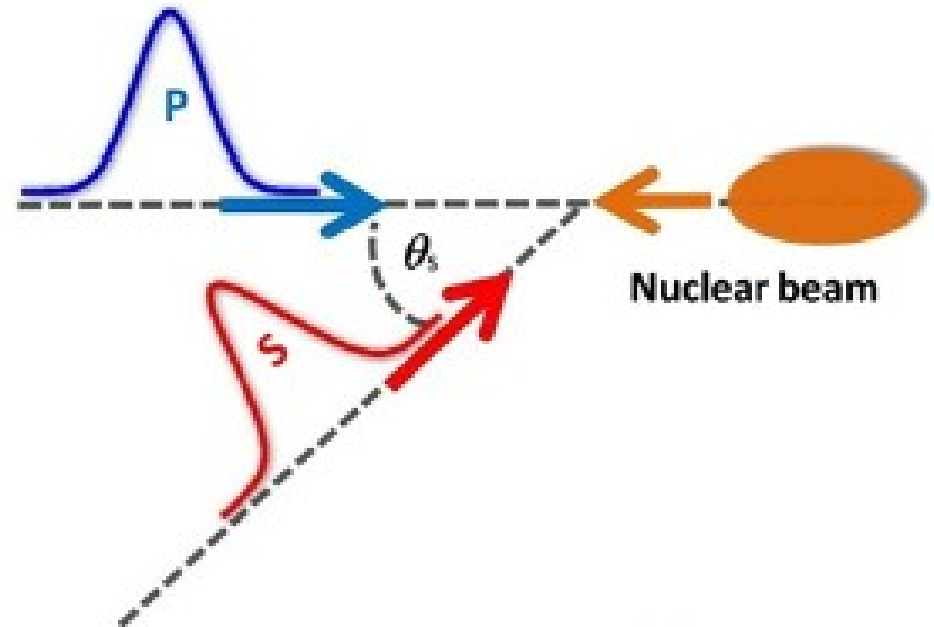
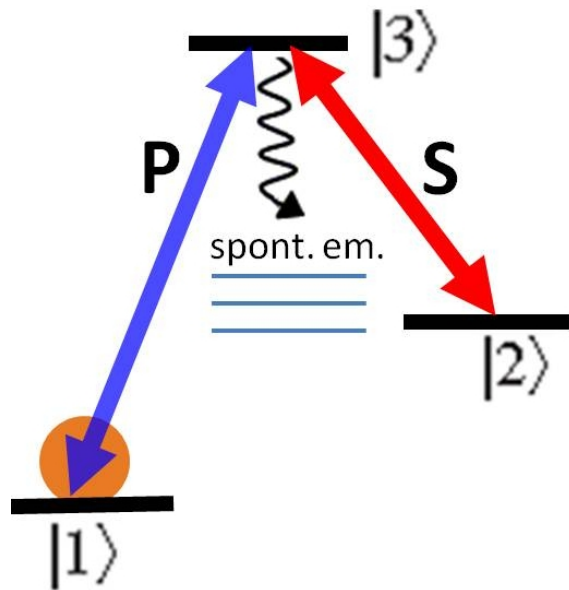


transversely and *temporarily* coherent

K.-J. Kim, Y. Shvyd'ko and S. Reiche, **PRL100, 244802 (2008)**

Y. Shvyd'ko et al., **Nature Phys. 6, 196 (2010)**

STIRAP and the coherent XFEL



$$|D\rangle = \frac{\Omega_s}{\sqrt{\Omega_p^2 + \Omega_s^2}} |1\rangle - \frac{\Omega_p}{\sqrt{\Omega_p^2 + \Omega_s^2}} |2\rangle$$

Requirements:

- accelerated nuclei
- ~~two color~~
- Coherence: SXFEL, XFELO

STIRAP and the coherent XFEL

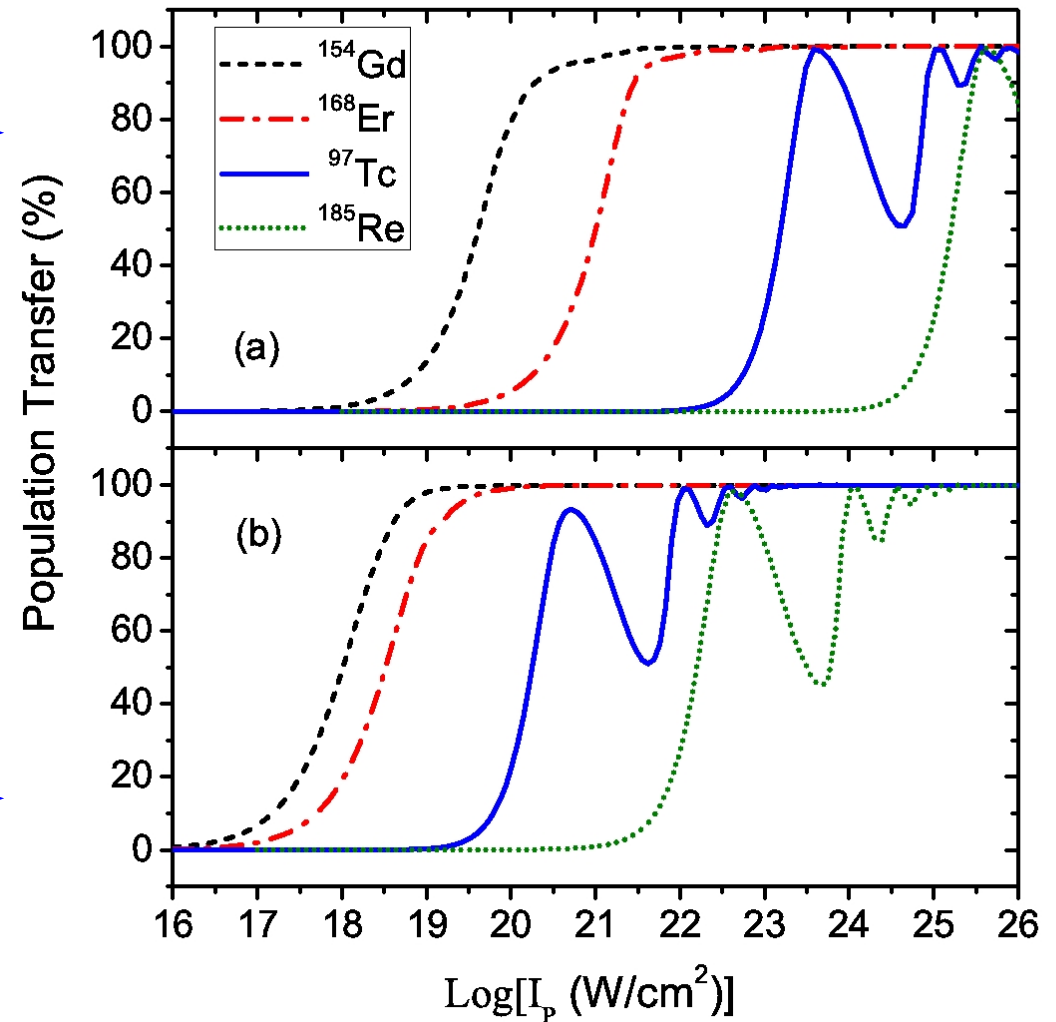
Seeded XFEL



TABLE I. The nuclear data.

Element	Line width of $ 3\rangle$ (meV)	E_3 (keV)	E_2 (keV)	E_1 (keV)
^{185}Re	0.04	284.200	125.359	0
^{97}Tc	0.60	656.900	324.476	96.57
^{154}Gd	300.00	1241.291	123.071	0
^{168}Er	130.00	1786.123	79.804	0

XFELO



STIRAP and the coherent XFEL

TABLE II. The nuclear data.

Element	(a) Seeded XFEL				(b) X-FELO			
	γ	Stokes angles (rad)	$\frac{I_p^{\text{eff}}}{I_p}$	$\frac{I_S^{\text{eff}}}{I_S}$	γ	Stokes angles (rad)	$\frac{I_p^{\text{eff}}}{I_p}$	$\frac{I_S^{\text{eff}}}{I_S}$
^{185}Re	11.482	1.45440	0.085	0.048	5.728	1.45963	0.211	0.118
^{97}Tc	22.605	1.38357	2.710	1.608	11.229	1.38482	6.722	3.988
^{154}Gd	50.057	0.64069	2963.200	2669.410	24.836	0.64079	2465.290	2000.670
^{168}Er	72.025	0.42598	1876.080	1792.260	35.730	0.42601	4652.680	4444.800

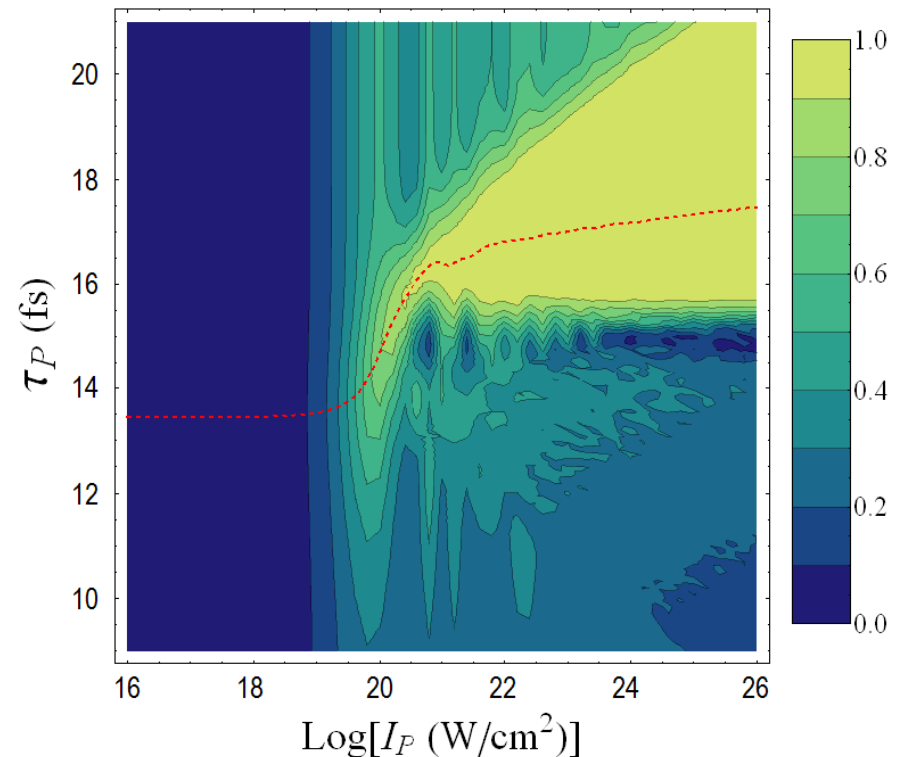
ISSUES:

geography

ion beam

resolution

ion beam focus



STIRAP and the coherent XFEL

Seeded XFEL



TABLE I. The nuclear data.

Element	Line width of $ 3\rangle$ (meV)	E_3 (keV)	E_2 (keV)	E_1 (keV)
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^{168}Er	130.00	1786.123	79.804	0

XFELO

