Summary of Special Relativistic Effects

	Space Interval	Time Interval	Power
Rods & Clocks	$L = \frac{L'}{\gamma}$	$\Delta t_e = \Delta t_e' \gamma$	$P = P'$
Photons	$\Lambda = L' \delta \sin\theta$	$\Delta t_a = \frac{\Delta t_e'}{\delta}$	$P = P'$

K → Lab frame
K' → Rest frame
subscript "a" → arrival
subscript "e" → emission

Other important transformations:

Solid angle

$$d\Omega = \frac{d\Omega'}{\delta^2}$$

Specific Intensity

$$I_\nu = I_\nu' \delta^3$$

Intensity

$$I = I' \delta^4$$

Energy

$$E = E' \delta$$

Summary of Radiation Properties: Continuum

	Thermal	Blackbody	Bremsstr.	Synchrotron	Inverse Compton	Curvature Radiation
Optically thick	–	YES	NO	–	–	–
Maxwellian distribution of velocities	YES	YES	–	NO	–	NO
Relativistic speeds	–	–	–	YES	YES	YES
Main Properties	Matter in thermal equilibrium	Matter AND radiation in thermal equilibrium	Radiation emitted by accelerating particles	Radiation emitted by accelerated particles in **B** field.	Relativistic electron/photon collisions	Radiation emitted by accelerated particles along the parallel B field component

Summary of Radiation Properties: Lines

	Absorption	Emission	From
Atomic transition	Hydrogen (e.g., Balmer lines)	H_α, $Fe\ K_\alpha$	Accretion Disks
Gamma-decay	–	Al-26, Fe-60, Co-56, Ti-44	Supernovae
Matter-antimatter annihilation	–	511 keV line + continuum	e-/e+ pair annihilation (direct, oPs, pPs)

Summary of Timing Properties in X-Ray Binaries

Accretor	QPOs	Fastest Variability	Slow Variability
Neutron Star (LMXBs, HMXBs)	Yes	kHz QPOs	NBO, HBO, FBO
Black Hole (LMXBs, HMXBs)	Yes	High-Frequency QPOs	Low-Frequency QPOs (type A, B, C)

Summary of Supernovae

Type	Mechanism	Hydrogen lines	Compact Object Formation
Ia	Single-degenerate (WD accretion) or double-degenerate (WD-WD merger)	No	None
Ib	Core-collapse	No/Very weak	NS/BH. Possible relation to GRBs
Ic	Core-collapse	No	NS/BH. Possible relation to GRBs
II	Core-collapse	Yes	NS/BH

Summary on Supernova Remnants

	Ambient medium	Ejecta	Shock	Duration
1. Free Expansion	Mass swept up by forward shock << ejecta mass	supersonic expansion	Forward shock – Reverse shock formation	~few hundreds years
2. Adiabatic Expansion	Mass swept up by forward shock > ejecta mass	supersonic expansion	Reverse shock disappears	~10,000 years
3. Radiative Phase	significant cooling	deceleration	forward shock significantly decelearates	~100,000 years
4. Dispersion to ISM				~ millions of years