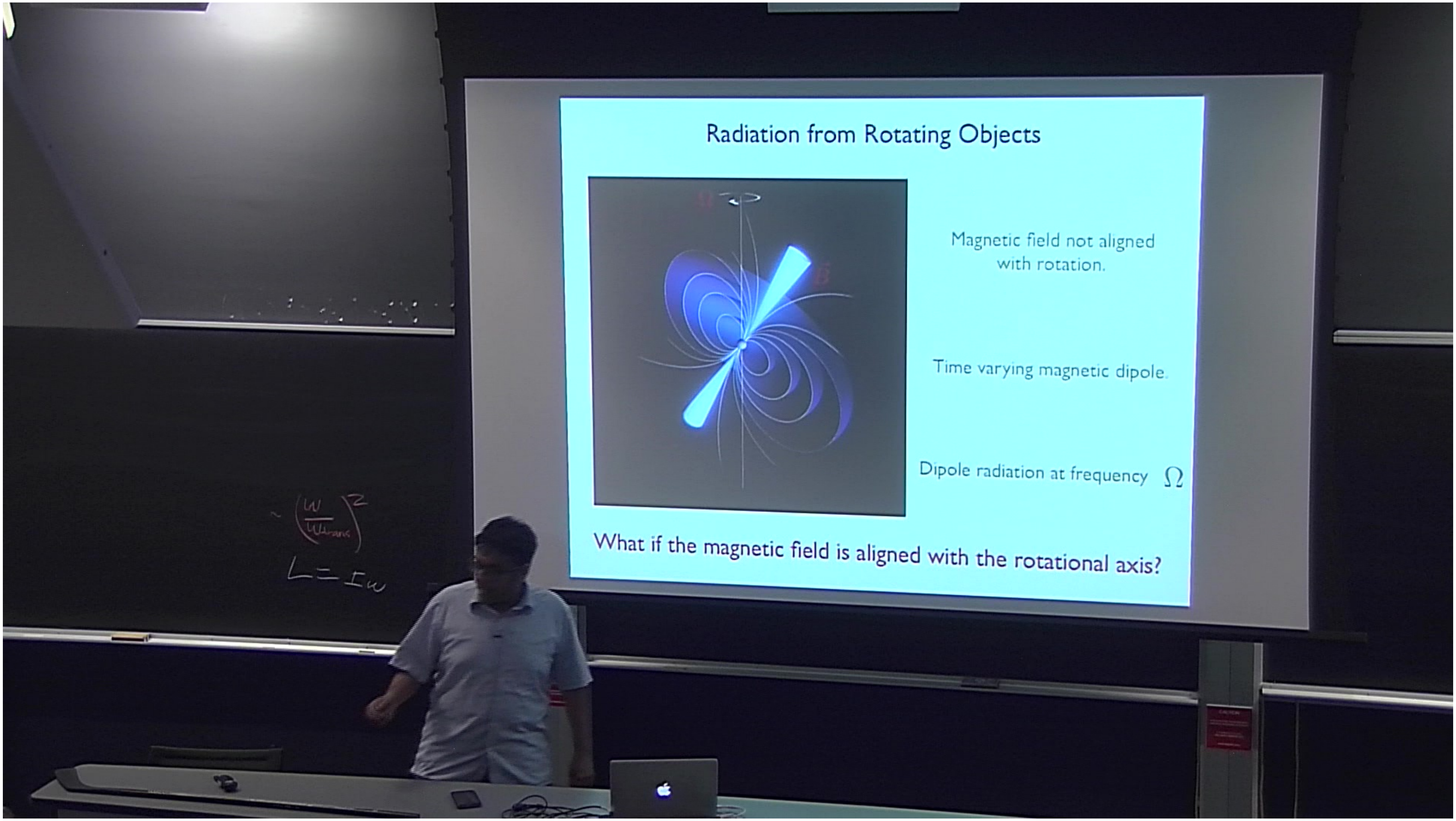
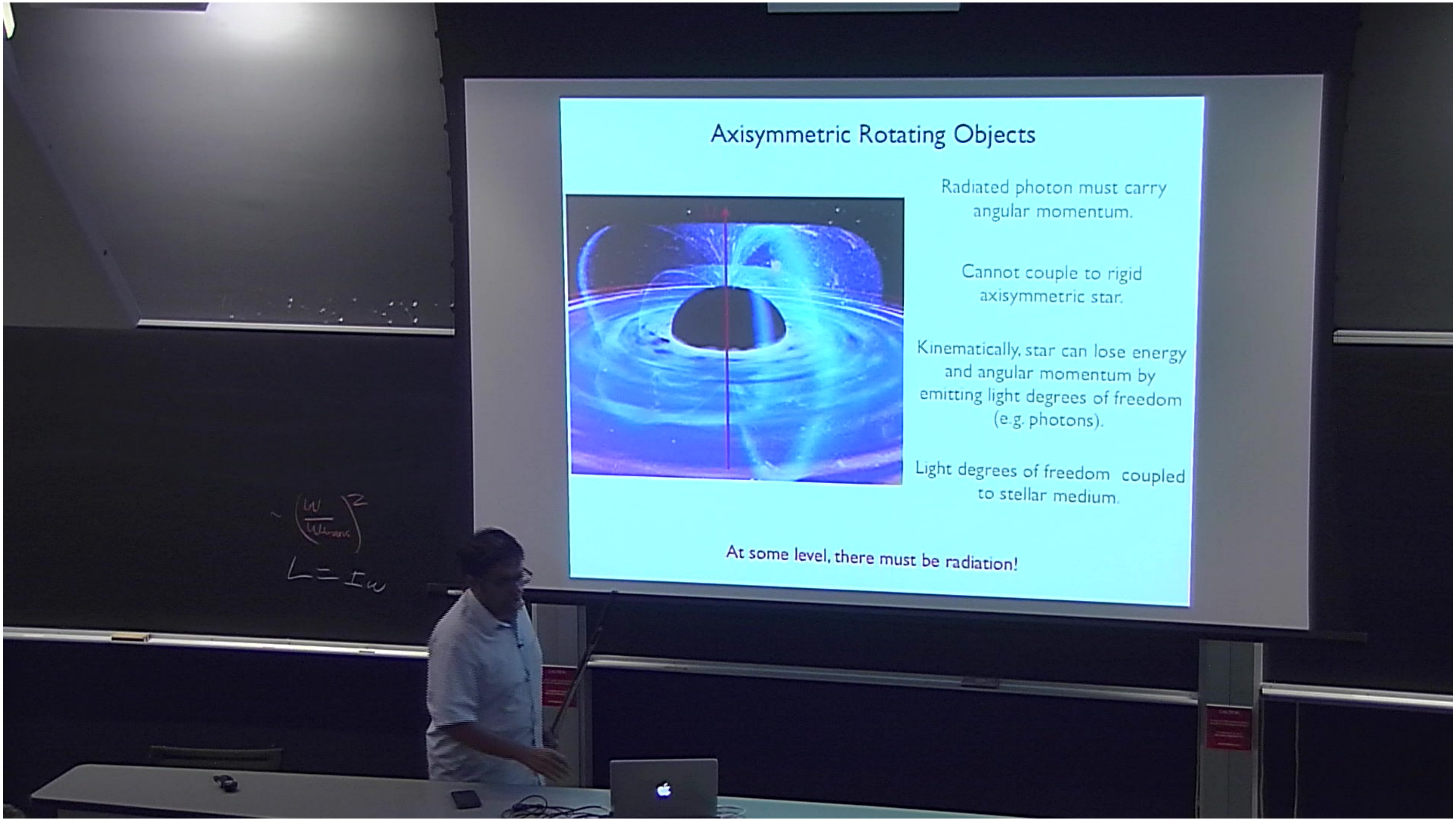
Title: Free Discussion

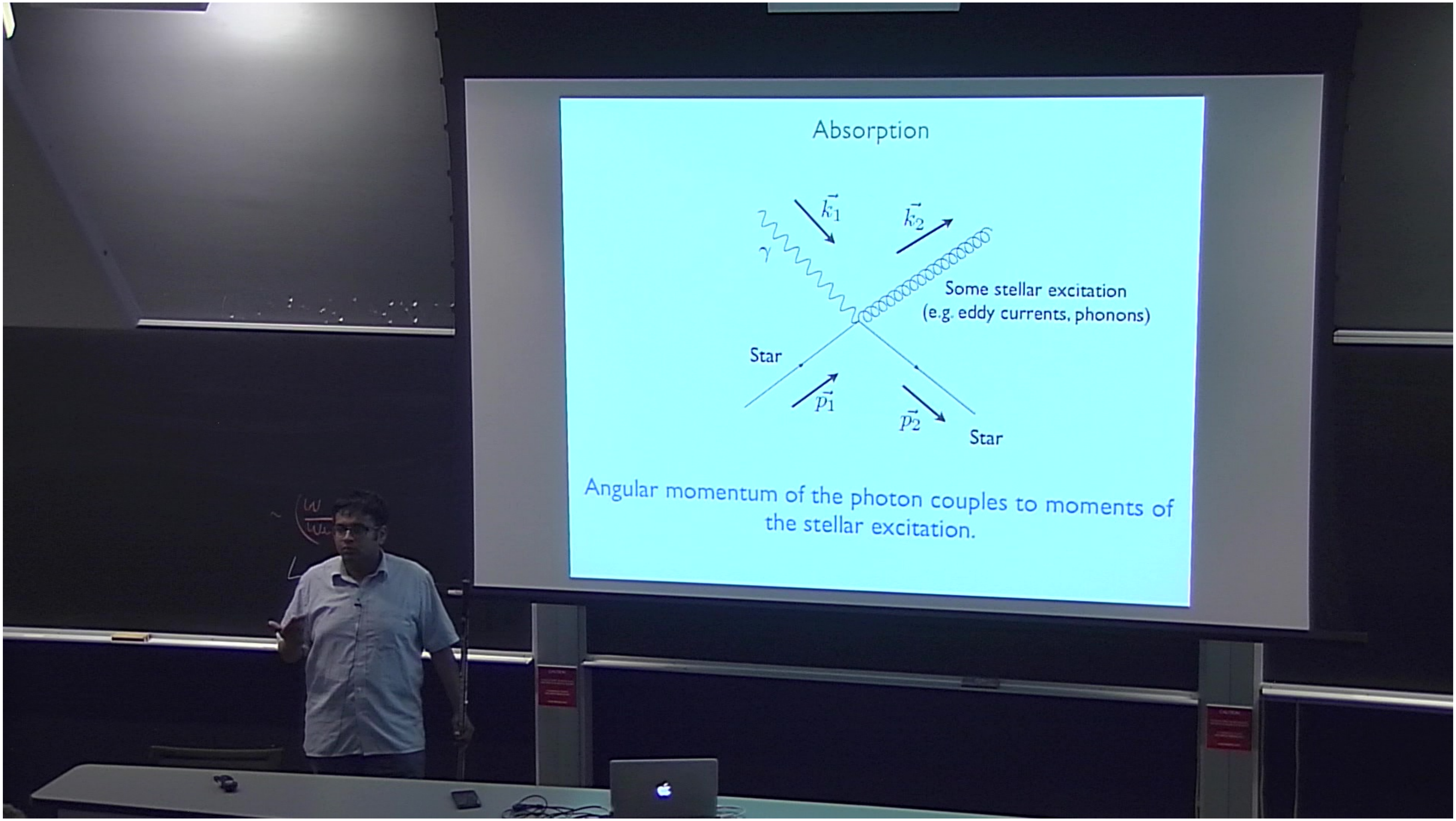
Date: Jun 18, 2014 05:30 PM

URL: http://pirsa.org/14060031

Abstract:


Radiation from Rotating Objects
Magnetic field not aligned with rotation.
Time varying magnetic dipole.
Dipole radiation at frequency Ω
What if the magnetic field is aligned with the rotational axis?
L = Iω

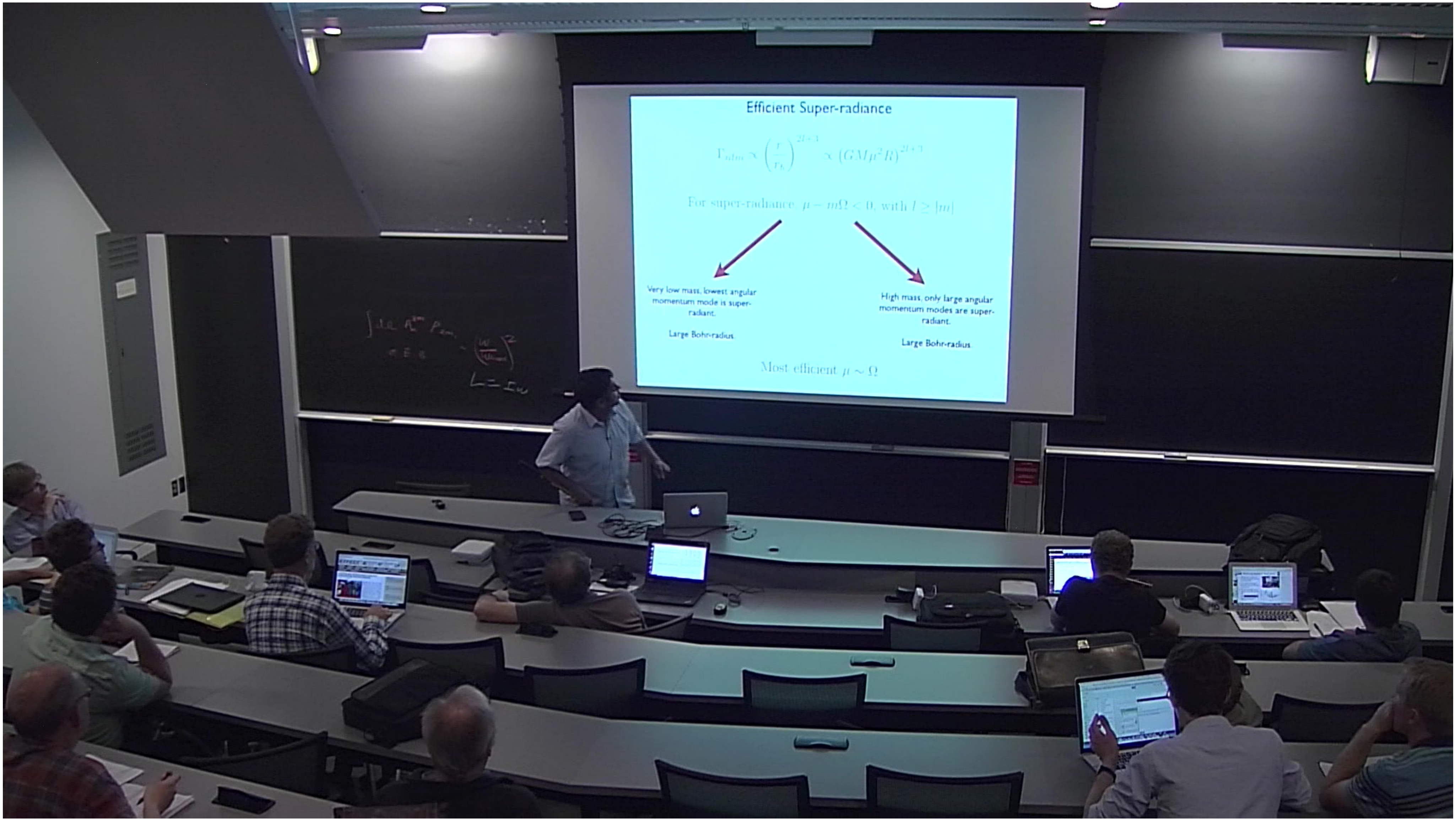

Axisymmetric Rotating Objects
Radiated photon must carry angular momentum.
Cannot couple to rigid axisymmetric star.
Kinematically, star can lose energy and angular momentum by emitting light degrees of freedom (e.g. photons).
Light degrees of freedom coupled to stellar medium.
At some level, there must be radiation!


Absorption
$\vec{k}_1$
$\vec{k}_2$
γ
Some stellar excitation
(e.g. eddy currents, phonons)
Star
$\vec{p}_1$
$\vec{p}_2$
Star
Angular momentum of the photon couples to moments of the stellar excitation.


Massive Particles and Massive Stars
Particle of mass μ, star of mass M.
Gravitationally bound states at $r_b \sim \frac{1}{GM\mu^2}$
Bose enhancement => exponential amplification!

Region of Growth
$\psi_{nlm} \sim \left(\frac{r}{r_h}\right)^l \sim r^l \left(GM\mu^2\right)^l$
$\Gamma_{nlm} \propto \left(\frac{r}{r_h}\right)^{2l+3} \propto \left(GM\mu^2 R\right)^{2l+3}$


Extremal Objects
Most efficient $\mu \sim \Omega$
Largest M, R consistent with Ω
Relativity $\Omega R \lesssim 1$
Given μ, need extremal object at μ.


Efficient Super-radiance
$\Gamma_{nlm} \propto \left(\frac{r}{r_b}\right)^{2l+3} \propto (GM\mu^2 R)^{2l+3}$
For super-radiance, $\mu - m\Omega < 0$, with $l \geq |m|$
Very low mass, lowest angular momentum mode is super-radiant.
Large Bohr-radius.
High mass, only large angular momentum modes are super-radiant.
Large Bohr-radius.
Most efficient $\mu \sim \Omega$


Extremal Objects
$\Gamma_{atm} \propto \left(\frac{r}{r_h}\right)^{2l+3} \propto (GM\mu^2 R)^{2l+3}$
Most efficient $\mu \sim \Omega$
Largest M, R consistent with Ω
Relativity $\Omega R \lessapprox 1$
Given μ, need extremal object at μ.