

# Today

- **4/12/11 Physics 262 Lecture 11**
- **Homework**
  - Review your exams and review practice exam again.
- **Lab: Continue project**
  - Opto-electronics lab post-poned to allow time to finish projects.
  - Finish up projects and get your movies into laser show.
- **Lab grading rubric**
- **Lecture**
  - Laser Safety
  - Project grading

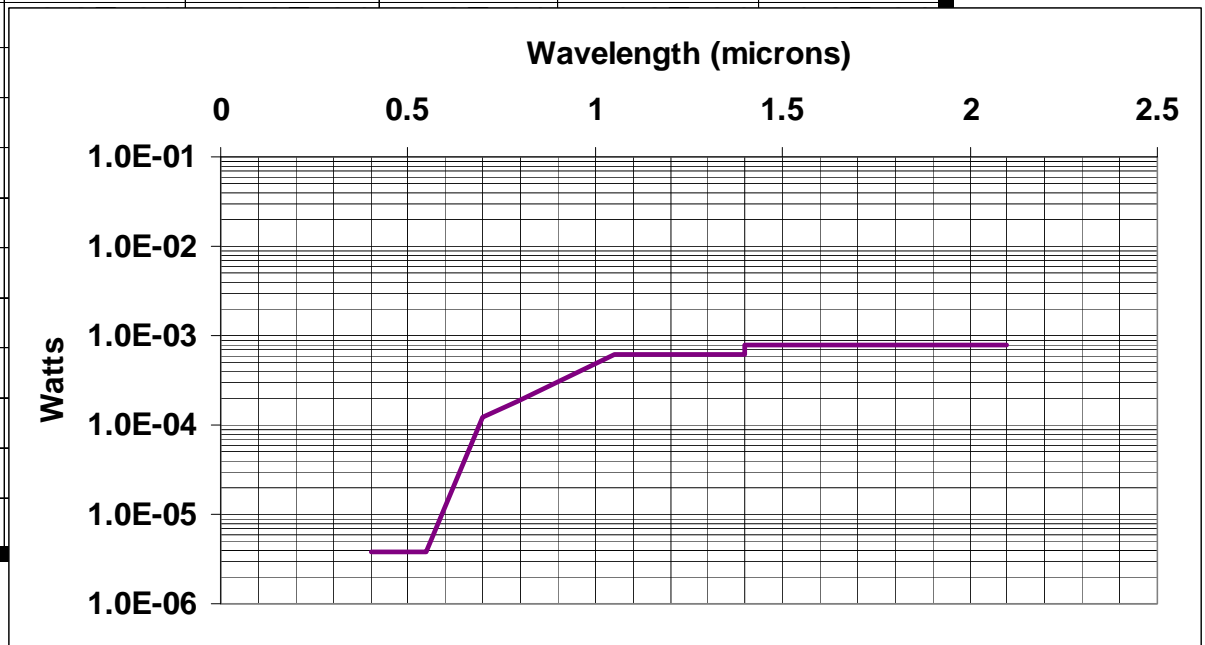
# Laser Danger

- The two main hazards for the lasers we use are:
  - *Eye Damage and Electrocution.*
- Lasers are classified from Class I (safe) to Class IV (very dangerous).
- Red HeNe Lasers with output powers over 1mW are class IIIB lasers.
- Class IIIB lasers can cause permanent retinal damage if an undiverged beams enters your eye.
- If the beam is diverging, lasers up to 25mW will likely not cause permanent damage (assuming the subject blinks before a significant amount of energy enters the eye and the subject isn't purposely staring into the beam).
- Undiverged beams can cause eye damage at low powers.
- Laser power supplies operate at up to several thousand volts.
- The Argon laser and Ti:Sapphire lasers are class IV!!!!

# Laser Safety – Class I Lasers

**A class 1 laser is safe under all conditions of normal use:  
The maximum permissible exposure (MPE) cannot be exceeded.**

duration	t	1.0E+03	sec	t>10-9	t<30000	for Density		
					t<1000	for energy/power		
Eye MPE for direct ocular Exposure (ANSI Z136.1-1980 table 5)								
μm	μm	cm	J/cm2	W/cm2	J	W		
lambda range	lambda	d	energy den	power den	energy	power		
.4-.55	0.4	0.7	1.0E-02	1.0E-05	3.8E-03	3.8E-06	3.8E-06	
.4-.55	0.55	0.7	1.0E-02	1.0E-05	3.8E-03	3.8E-06	3.8E-06	
.55-.7	0.55	0.7	1.0E-02	1.0E-05	3.8E-03	3.8E-06	3.8E-06	
.55-.7	0.7	0.7						
.7-1.051	0.7	0.7						
.7-1.051	0.79	0.7						
.7-1.051	1.051	0.7						
1.051-1.4	1.051	0.7						
1.051-1.4	1.4	0.7						
1.4 -100	1.4	0.1						
1.4 -100	1.53	0.1						
1.54	1.54	0.1						
1.4 -100	1.55	0.1						
1.4 -100	2.1	0.1						



# Laser Safety – Class 2 Lasers

**A Class 2 laser is safe because the blink reflex will limit the exposure to no more than 0.25 seconds. It only applies to visible-light lasers (400–700 nm).**

**Class-2 lasers are limited to 1 mW continuous wave (or more if the emission time is less than 0.25 seconds) (or if the light is not spatially coherent).**

**Intentional suppression of the blink reflex could lead to eye injury. Many laser pointers are class 2.**

	A	B	C	D	E	F	G	H
1	duration	t	2.5E-01	sec	t>10-9	t<30000	for Density	
2						t<1000	for energy/power	
3	Eye MPE for direct ocular Exposure (ANSI Z136.1-1980 table 5)							
4	μm	μm	cm	J/cm <sup>2</sup>	W/cm <sup>2</sup>	J	W	
5	lambda range	lambda	d	energy den	power den	energy	power	
6	.4-.55	0.4	0.7	6.4E-04	2.5E-03	2.4E-04	9.8E-04	3.8E-06
7	.4-.55	0.55	0.7	6.4E-04	2.5E-03	2.4E-04	9.8E-04	3.8E-06
8	.55-.7	0.55	0.7	6.4E-04	2.5E-03	2.4E-04	9.8E-04	3.8E-06
9	.55-.7	0.7	0.7	6.4E-04	2.5E-03	2.4E-04	9.8E-04	1.2E-04

# Laser Safety Rules

- 1) Do not view any laser beams directly.
- 2) Do not operate HeNe lasers without the beams being well controlled.
- 3) Do not add mirrors or other optics to set-up.
- 4) Keep shiny objects out of way of beam.
- 5) Do not operate laser with cover off or with wires exposed or disconnected.
- 6) Keep beams controlled at a uniform height and block spurious beams.
- 7) Don't sit with eyes at beam level.
- 8) Beware of stray reflections, especially when aligning optics. Warn other in room of any realignments.
- 9) Take off watches, bracelets and shiny rings to prevent accidental reflections.
- 10) Alert all visitors to the potential dangers and precautions