

Syllabus

Nuclear Warfare Physics 20061

The course on Nuclear Warfare PHYS20061 is offered by the Physics Department and the Center for Social Concerns as an introductory course for non-science majors to provide an overview about the broad range of topics and aspects of nuclear weapons and warfare in the 20th century.

Class Content

The course will start with the history and emergence of weapons of mass destruction technologies as a consequence of World War I and World War II, culminating in the development and use of the nuclear bomb. The historic development will be complemented by a discussion of the underlying physics principles. This will provide the necessary background for a basic understanding of nuclear weapons techniques and nuclear weapons effects as well as the decay radiation driven consequences. These consequences will be discussed in terms of short-range, atmospheric, biological, and medical effects as demonstrated by Hiroshima, Nagasaki and the results of the US bomb test series. Also discussed will be the implications and consequences for social groups and societies. Several lectures will be given by non-physics faculty to present the legal, political, and ethical implications of possession and use of nuclear weapons and nuclear warfare. The class will cover the following topics but not necessarily in the here listed order:

1. *History of Nuclear Bomb development*

- History of nuclear physics
- Mindset for WMD technology emerging in WW I and WW II
- Technological break through by development of military industrial complex
- Building the bomb as national effort, the US Manhattan project and the Arzamas-16 Russian bomb project

2. *Physics of Nuclear Bomb*

- Nuclear physics principles
- Nuclear energy release
- Nuclear decay and radiation
- Nuclear fission processes
- Nuclear fusion processes

3. *Technology of Nuclear Bomb*

- Design technology
- Efficiency concept
- Neutron bomb
- Bunker Busters
- Dirty Bomb

4. *The consequences of Nuclear Bombs*

- Shock and blast effects
- Fall out effects and radiation level
- Atmospheric impact
- Nuclear Winter

5. Nuclear Radiation Effects

- Natural radiation
- Man-made radiation
- Hiroshima and Nagasaki
- Biological impact
- Medical consequences

6. The legal aspects of Nuclear Weapons

- The legality of Nuclear Weapons
- Nuclear Arms Control
- Nuclear Disarmament
- Non-proliferation Policy

Grades

The final grade will be determined on the basis of class participation, four homework sets on the physics background, and the results of the research work and presentation.

Contact Information

Lecturer: Michael Wiescher, NSH181, Tel: 1-6788, e-mail: Wiescher.1@nd.edu,
office hours: Thursday 2:00-4:00pm

T.A.: James de Boer, Tel: 1-6754; NSH113b, e-mail: deBoer.12@nd.edu,
office hours: Monday 6:00-8:00pm

Research Projects

The goal of the student research project is to demonstrate and highlight the direct implications of nuclear weapon development and technology on society and on small communities. These projects will focus on a variety of political, economic, and civil consequences of nuclear technology development and the development of nuclear weapons industry. These class projects are designed to explore how these developments are visible in the South Bend Mishawaka community. The projects not only address the narrower realm of nuclear weapon technologies but also the broader aspect of exposure of the average citizen to an increasing man-made nuclear radiation level. The projects require some research within the community. The results should be summarized in a 10 page report and should be presented in a 10 minute power-point talk during the last two class sessions. The following projects are offered to study groups of not more than 3 students.:

Physics Aspects

1. Natural and medical radiation exposure in the South Bend Community
2. Design principles and efficiency of a dirty bomb

Historical, ethical, and legal Aspects

1. Fritz Haber: ethical conflict in weapons research
2. Explore the historic involvement of the ND nuclear facilities and the connection with the Manhattan project
3. Origin and Consequences of the Einstein Russell Manifesto
4. Legal and political aspects of nonproliferation in terms of international agreements and treaties
5. Comparative view of WMD distribution and nonproliferation

Social and Economic Aspects

1. View on nuclear warfare and nuclear testing reflected in the South Bend press (1950-1970)
2. Business response, development of bomb shelter industry
3. The industrial military complex in South Bend – present and past involvement with WMD production
4. Local community response preparations
5. Case study on the possibility of nuclear winter and the potential impact on local economy

Literature

There is no specific text book covering the entire class topic. For the more technical and physics aspects of the class I will use as textbook: Paul P. Craig & John A. Jungerman, "Nuclear Arms Race", McGraw Hill 1986, 1st edition and 1990, 2nd edition. This book is out of print but I purchased a sufficient number of used copies which will be made available for \$ 35.-. I intend to buy the book back at the end of the semester (to a slightly reduced price). Next to the book, class notes will be made available through the web. For more extensive information about the different topics and subjects covered in the class I recommend the following book, web-page, and video list:

History of Weapon Development:

Kai Bird, Martin J. Sherwin, "American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer", A. Knopf Publisher, 2005

Andrew Grossman, "Neither Dead nor Red", Routledge, 2001

Gregg Herken, "Brotherhood of the Bomb", Holt & Co, 2002

Robert Jungk, "Brighter than a Thousand Suns", Harcourt, 1986

Alexei Kojevnikov, "Stalin's Great Science", Imperial College Press, 2004

Richard Rhodes, "The Making of the Atomic Bomb", Simon & Schuster, 1986

Kenneth Rose, "One Nation Underground", New York University Press, 2001

Gerhard Weinberg, "A World at Arms", Cambridge University Press, 1999

www links: <http://www.firstworldwar.com/weaponry/>
<http://www.teacheroz.com/wwi.htm>

<http://www.aip.org/history/exhibits.html>
<http://nuclearhistory.tripod.com/>
<http://www.globalsecurity.org/wmd/world/germany/nuke.htm>
<http://www.fas.org/nuke/intro/nuke/heavy.htm>
[http://www.archiv.uni-leipzig.de/heisenberg/Vom Frieden zum Krieg/Von Haigerloch nach Farm Hall/von haigerloch nach farm hall.htm](http://www.archiv.uni-leipzig.de/heisenberg/Vom_Frieden_zum_Krieg/Von_Haigerloch_nach_Farm_Hall/von_haigerloch_nach_farm_hall.htm)
<http://www.dannen.com/decision/>

The Physics of Nuclear Weapons:

Ramesh Chandra, "Nuclear Medicine Physics", Williams & Wilkins, 1992

Paul P. Craig & John A. Jungerman, "Nuclear Arms Race", McGraw Hill 1986, 1990

David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics, Part 5", Wiley & Sons, 2001

John Lilley, "Nuclear Physics", Wiley & Sons, 2001

www links: <http://www.lbl.gov/abc/>
<http://nucleardata.nuclear.lu.se/database/masses/>
<http://www.pbs.org/wgbh/aso/tryit/atom/#>

Technology of Nuclear Weapons:

Brian Alexander, "Tactical Nuclear Weapons", Brassey's Inc, 2003

Richard Meserve et al, "The Nuclear Weapons Complex", National Academy Press, 1989

www links: <http://www.science.uwaterloo.ca/~cchieh/cact/nuctek/fusionbomb.html>
<http://www.fas.org/nuke/intro/nuke/>
<http://www.cdi.org/nuclear/>

Effects of Nuclear Weapons:

John Auxier et al., "Radiological Effluents Released from U.S. Continental Tests 1961 through 1992", U.S. DOE 1996; <http://www.nv.doe.gov/news&pubs/publications/historyreports/doenv209&317/317cover.pdf>

Paul P. Craig & John A. Jungerman, "Nuclear Arms Race", McGraw Hill 1986

Samuel Glasstone & Philip Dolan, "The Effects of Nuclear Weapons", Department of Defense 1977 (out of print);

www versions: <http://www.cddc.vt.edu/host/atomic/nukeffct/enw77.htm>,
<http://www.princeton.edu/~globsec/publications/effects/effects.shtml>

Lionel Johns et al., "The Effects of Nuclear War", Office of Technology Assessment, 1979

www version: <http://www.fas.org/nuke/intro/nuke/7906/>

Jeffrey Koplan, "A Feasibility Study of the Health Consequences to the American Population of Nuclear Weapons Tests", Report to Congress, 2001

www version: <http://www.cdc.gov/nceh/radiation/fallout/report.pdf>

Richard Miller, "The US Atlas of Nuclear Fallout 1951-1962, Vol. I-V", Legis Books, 2001

Richard Miller, "Under the Cloud", Two-Sixty Press, 1991

Frederic Salomon & Robert Marston, "The Medical Implications of Nuclear War", National Academic Press, 1986

Susan Thaul & Heather O'Maonaigh, "Potential Radiation Exposure in Military Operations", National Academy Press 1999

United Nations Reports on the Effects of Atomic Radiation: <http://www.unscear.org/>

Tom Vanderbilt, "Survival City", Princeton Architectural Press, 2002

www links on Hiroshima & Nagasaki:

http://www.trumanlibrary.org/whistlestop/study_collections/bomb/large/index.php

<http://www.fas.org/nuke/intro/nuke/effects.htm>

<http://www.cddc.vt.edu/host/atomic/hiroshim/>

http://www.cddc.vt.edu/host/atomic/hiroshim/hiro_med.htm

<http://www.yale.edu/lawweb/avalon/abomb/mpmenu.htm>

<http://www-sdc.med.nagasaki-u.ac.jp/n50/start-E.html>

www links on US Bomb Test Results:

<http://nuclearweaponarchive.org>

<http://www.stardestroyer.net/Empire/Science/Nuke.html>

www links on Medical Aspects:

<http://www.rerf.or.jp/eigo/titles/radtoc.htm>

<http://www2.nci.nih.gov/>

Legal Aspects and Non-Proliferation Issues:

Brian Alexander, "Tactical Nuclear Weapons", Brassey's Inc, 2003

Helen Caldicott, "The New Nuclear Danger", New Press, 2002

Paul P. Craig & John A. Jungerman, "Nuclear Arms Race", McGraw Hill 1986

Siegfried Hecker et al., "High Impact Terrorism", National Academic Press, 2002

John Holdren et al., "The Future of US Nuclear Weapons Policy", National Academy Press, 1997

Richard Meserve et al., "Protecting Nuclear Weapons Materials in Russia", National Academy Press, 1999

www links:

<http://www.yale.edu/lawweb/avalon/lawofwar/hague02.htm#art1>

<http://www.wslfweb.org/nukes.htm>

<http://www.fas.org/nuke/control/index.html>

http://www.wordiq.com/definition/Nuclear_Non-Proliferation_Treaty

<http://www.globalissues.org/Geopolitics/ArmsControl/Nuclear.asp>

<http://www.icrc.org/Web/Eng/siteeng0.nsf/iwpList167/42F64C9A4212EA07C1256B66005C0BF1>

Movies and Videos of Interest:

Dr. Strangelove or: How I Learned to Stop Worrying and Love the Bomb (1964)

[e.g. <http://www.indelibleinc.com/kubrick/films/strangelove/>]

The Atomic Café (1982) [e.g. <http://www.publicshelter.com/main/tac.html>]

Trinity and Beyond (1995) [<http://www.vce.com/trinity.html>]

Hiroshima (1995) [http://movies2.nytimes.com/gst/movies/movie.html?v_id=151837]

Hiroshima: Why the Bomb Was Dropped (1996)

[http://movies2.nytimes.com/gst/movies/movie.html?v_id=245840]

Atomic Journeys (1999) [<http://www.vce.com/trinity.html>]

Nukes in Space (1999) [<http://www.vce.com/nukes.html>]

History Of Nuclear Weapons – The Ultimate Weapons (2005)

[<http://www.crookedcreekproductions.us/Descriptions/nuclear%20weapons%20description.htm>]

Nuclear Warfare Tuesday, Thursday 12:30-1:45 pm			
Date	Subject Topic	Lecturer	class contribution
22-Aug-06	<i>Introduction and Overview</i>	<i>Wiescher</i>	
24-Aug-06	<i>Modern Warfare in the 20th Century</i>	<i>Wiescher</i>	
29-Aug-06	<i>The Development of Nuclear Science 1900-1939, Nuclear Physics for Pedestrians</i>	<i>Wiescher</i>	<i>Fritz Haber</i>
31-Aug-06	<i>Accelerator and Detector Tour and Demonstration</i>	<i>Stech & Wiescher</i>	
5-Sep-06	<i>The Dawn of the Nuclear Age 1939-1944</i>	<i>Wiescher</i>	
7-Sep-06	<i>Fission and Fusion Technology</i>	<i>Wiescher</i>	
12-Sep-06	<i>The Manhattan Project, the first Race for Supremacy</i>	<i>Wiescher</i>	<i>Notre Dame involvement</i>
14-Sep-06	<i>Hiroshima and Nagasaki, the Reasons</i>	<i>Wiescher</i>	
19-Sep-06	<i>The Law of Arms Control and Disarmament</i>	<i>Reydams (Pol.Sci.)</i>	
21-Sep-06	<i>Nuclear Weapons and the Law</i>	<i>Reydams (Pol.Sci.)</i>	
26-Sep-06	<i>Hiroshima and Nagasaki, the Consequences</i>	<i>Wiescher</i>	
28-Sep-06	<i>Transition to the Cold War</i>	<i>Wiescher</i>	<i>Russell Einstein manifesto</i>
3-Oct-06	<i>The Cold War, the second Race for Supremacy</i>	<i>Wiescher</i>	
5-Oct-06	<i>Proliferation and Non-Proliferation Attempts</i>	<i>Wiescher</i>	<i>Legal aspects of nonproliferation</i>
10-Oct-06	<i>Monitoring Proliferation</i>	<i>Wiescher</i>	
12-Oct-06	<i>Non-Proliferation Cases: North-Korea, Iran, Iraq</i>	<i>Reydams (Pol.Sci.)</i>	<i>Comparative views</i>
17-Oct-06	<i>fall break</i>		
19-Oct-06	<i>fall break</i>		
24-Oct-06	<i>Hunting the White Stag: The Impact of Nuclear Weapons During the Cold War</i>	<i>LtdCol Jordan (ROTC)</i>	
26-Oct-06	<i>The US Bomb Test Program, Cultural and Sociological Aspects</i>	<i>Wiescher</i>	<i>Tests in the press</i>
31-Oct-06	<i>The US Bomb Test Program, Scientific and Technical Aspects</i>	<i>Wiescher</i>	<i>Nuclear shelters</i>
2-Nov-06	<i>The Nature and Argument of Nuclear Weapon Tests</i>	<i>Wiescher</i>	
7-Nov-06	<i>The Effects of Nuclear Weapons, Shock and Heat</i>	<i>Wiescher</i>	
9-Nov-06	<i>The Effects of Nuclear Weapons, short and long-term Radiation</i>	<i>Wiescher</i>	
14-Nov-06	<i>Biological and Medical Effects of Radiation</i>	<i>Wiescher</i>	<i>Natural, medical exposure</i>
16-Nov-06	<i>Consequences of Nuclear War: Radiation Fall-Out and Distribution</i>	<i>Wiescher</i>	<i>Community preparations</i>
21-Nov-06	<i>Consequences of Nuclear War: Nuclear Winter</i>	<i>Wiescher</i>	<i>Nuclear winter & economy</i>

23-Nov-06	<i>Ecologic & Economic Considerations, the Military Industrial Complex</i>	<i>Wiescher</i>	<i>Military industrial complex</i>
28-Nov-06	<i>Nuclear Terror</i>	<i>Wiescher</i>	
30-Nov-06	<i>Nuclear Fear</i>	<i>Wiescher</i>	<i>Dirty bomb design</i>
2-Dec-06	<i>The Moral and Ethical Aspects of Nuclear Warfare</i>	<i>tba</i>	

Project Assignments:

Date	topic	student 1	student 2	student 3
29-Aug-06	Fritz Haber: ethical conflict in weapons research	<i>Elizabeth Barron</i>	<i>Eric Jones</i>	<i>Alejandro Humbert</i>
12-Sep-06	The historic involvement of the ND nuclear facilities with the Manhattan project.	<i>John Furrey</i>	<i>Allan Johnston</i>	<i>Mason Perkins</i>
28-Sep-06	Origin and Consequences of the Einstein Russell Manifesto	<i>Nicole Dorner</i>	<i>William Strew</i>	<i>Jonathan Metallo</i>
5-Oct-06	Legal and political aspects of nonproliferation in terms of international agreements and treaties	<i>Curtis Ballard</i>	<i>Elizabeth Kunkel</i>	<i>Anne Shreiner</i>
12-Oct-06	Comparative view of WMD distribution and nonproliferation...	<i>Alice Ciciora</i>	<i>Ryan Eggenberger</i>	<i>Katherine Kennifer</i>
26-Oct-06	View on nuclear warfare and testing reflected in the South Bend press	<i>Ashley McConnell</i>	<i>Stephen Simeonidis</i>	<i>Nicole Eggenberger</i>
31-Oct-06	Investigate the development and distribution of private and public nuclear shelters within South Bend and Mishawaka communities	<i>Dennis Hughes</i>	<i>Nicholas Sabella</i>	<i>Justin White</i>
14-Nov-06	Natural and medical exposure in the South Bend community	<i>Jennifer Fedyna</i>	<i>Obiora Idigo</i>	<i>Daniel Kiesa</i>
16-Nov-06	Investigate local community information policy and preparation for nuclear emergency case	<i>Erin Ramsey</i>	<i>Corey Sinclair</i>	<i>Paul Taskaldos</i>
21-Nov-06	Case study on the possibility of nuclear winter and the potential impact on local economy	<i>Amelia Gillespie</i>	<i>Scott Meier</i>	<i>Elizabeth Stevens</i>
23-Nov-06	The industrial military complex in South Bend-past and present involvement with WMD	<i>Brian Donoghue</i>	<i>Kevin Martin</i>	<i>Angela Sutton</i>
30-Nov-06	Design principles and efficiency of a dirty bomb in terrorist warfare.	<i>Anthony Ashley</i>	<i>Brian Blacker</i>	<i>Brian Riese</i>