APPLICATION FOR THE
JANUARY 2009 – MAY 2009
EXPERIMENTAL CAMPAIGN
AT THE NEVADA TERAWATT FACILITY
USING EITHER THE “ZEBRA” OR “LEOPARD”
equipment

JANUARY 2, 2009 – MAY 29, 2009

REQUESTS DUE AT NTF BY
OCTOBER 13, 2008)
Nevada Terawatt Facility

Application for Experimental Time on the Zebra / Leopard Equipment

January 2, 2009 – May 29, 2009

Title:

Date:

Lead Scientist:

Student Participation:

Contact Information (Phone # & e-mail):

Collaborating Scientists and Affiliations:

Requested number of Zebra / Leopard shots:

Requested number of days to complete experiment:

Scientific Theme:

Dates not available:

Requested Core Diagnostics:
Guidelines

1) See http://www.ntf.unr.edu/core_diags.php for a list of available Core Diagnostics.

2) Indicate Zebra / Leopard operating parameters, and port requirements anticipated for diagnostic instruments.
   a) Load measurements (standard or custom)
   b) Pulse duration – Long or Short
   c) Chamber Requirements – (ports, location of diagnostics equipment)
   d) Screen Box requirements

3) Describe any special needs that are relevant, such as equipment, cables, fast or slow triggers signals, tools.

4) A clear statement of scientific importance; why are NTF facilities needed and if so what characteristics are most important. Include scientific deliverables, and a clear path for achieving these deliverables (including both experimental and theoretical components, graduate student participation, collaborations with other institutions such as national laboratories or universities, and a statement of participant’s responsibilities). Provide a description of prior work including publications.

5) Mechanical drawing: Electronic or manual drawings are acceptable. The design should be as complete as possible. Technical team members will work with the experimenter(s) to assure compatibility with zebra and the goals of the experiment.

6) Vacuum test certification: All instruments intended for attachment to the Zebra load chamber must be certified in advance for vacuum integrity. Technical staff members will work with the experimenter(s) to assure compatibility.

7) Previous users: Short paragraph explaining results and outcome.
Abstract
Anticipated Outcomes
Equipment, Materials & Engineering Needs

**Engineering Requirements**
(Mechanical drawing, Vacuum test certification)
1) 

2) 

3) 

**Materials**
(Disclosure all materials comprising loads and diagnostics instruments. Experiments that require the use of certain hazardous materials will be sampled and/or monitored so that non-exposure documentation can be complied).
1) 

2) 

3) 

**Equipment**
1) 

2) 

3)
Leopard Laser

Laser parameters

- Pulse energy – up to 14 J;
- Pulse duration - 350 fs;
- Wavelength - $\lambda_0=1056$ nm, $\Delta \lambda = 6$ nm;
- Beam diameter - 8.6 cm;
- Rate of shots (disk amplifier cooling) - 1/40 min;
- Contrast ratio (ASE) - $10^3$.

Alignment beam (from the regenerative amplifier)

$\lambda_0=1056$ nm, $\nu = 100$ Hz

Laser beam diagnostics

- Energy
- Near Field;
- Far Field (with parabola, F=15 cm) - since October 2008;
- Pulse duration (FROG) - since November 2008;
- Contrast ratio - since November 2008.

Vacuum beampaths from the compressor to vacuum chambers

Experimental areas
(supported by the principal experimentalist)

Phoenix vacuum chamber

Lens focusing system, F=30-100 cm
Al parabola mirror, F=15 cm
Targeting system

- Training is offered by Dr. R. Presura

Zebra vacuum chamber

Lens focusing system, F=80-110 cm
Targeting system

- Training is offered by Dr. R. Presura
**Zebra**

**Load current**

<table>
<thead>
<tr>
<th>Regime</th>
<th>Maximum current intensity</th>
<th>Current rise time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short pulse</td>
<td>1 MA</td>
<td>100 ns</td>
</tr>
<tr>
<td>Long pulse</td>
<td>0.6 MA</td>
<td>200 ns</td>
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</tbody>
</table>

The Zebra current depends on load characteristics. The maximum current intensities cited are measured with standard short-circuit loads. Their geometry is available upon request.

In the short pulse regime, the current has a pedestal that increases approximately linearly for about 100 ns to about 50 kA.

**Load vacuum chamber**

The walls of the vacuum chamber function as current return path. It is not recommended to place any component in the high-field region. The minimum safe distance for diagnostics is 30 cm from the chamber axis.

Sixteen diagnostics ports, equally spaced at 22.5 degrees, with alternating diameters of 7.6 cm and 4.4 cm are available. Diagnostics access along the z axis and at 9 degrees to the axis is also available.

**Synchronization**

Trigger pulses with jitter lower than 5 ns rms with respect to the maximum load current intensity are available for diagnostics that require delay time shorter than 350 ns. If the delay required is longer, the trigger pulse available has 25 ns rms jitter.

**Other information**

Residual gas pressure (vacuum) lower than $4 \times 10^{-5}$ Torr is required for Zebra operation.

The anode-cathode gap shrinks with 1 mm during vacuum pump down.

In the short pulse set-up, the load region is accelerated to more than 300g during the shot.

The feasibility of any proposed modification of the Zebra set up must be discussed timely with the technical team (point of contact Dr. Radu Presura).
Diagnoses

**Laser diagnostics**

Diagnostics: shadow and/or schlieren diagnostics along two lines of sight at 22.5 degrees from each other; two pulses separated by variable delay along each line of sight. Total pulse train duration: 9 ns or 34 ns.

Laser parameters: 532 nm wavelength, 150 ps pulse duration.

Training in the operation of the laser diagnostics is offered by Dr. Vladimir Ivanov. Setting up the delay lines and the magnification are performed by Dr. Ivanov. Other features of the laser diagnostics are available by collaboration with Dr. Ivanov.

**Visible-light diagnostics**

Time-gated CCD camera (iCCD) with exposure time longer than 2 ns (3 ns 1-σ jitter).

Streak camera (30 ns 1-σ jitter).

**X-ray diagnostics**

Time-gated pinhole camera (film detection)

Time-gated spectrometer (convex KAP crystal, film detection)

Time-integrated spectrometer (convex KAP crystal, film detection)

Bolometer (Ni or Au)

Filtered Photoconductive detectors (PCD)

Filtered X-ray diodes (XRD)

The bolometer and a combination of PCDs and XRDs installed in 5-channel heads. Two such detector heads are available.

Support with installing and operating theses devices (including setting delays, applying biases, filter replacement and film development) is offered by the technical team (point of contact Dr. Radu Presura). The technical team also trains the experimental team on these tasks.

Dr. Victor Kantsyrev (victor@physics.unr.edu) offers specific training in x-ray diagnostics.

Other x-ray diagnostics are available by collaboration with Dr. Victor Kantsyrev (victor@physics.unr.edu).

**Instrumentation**

Oscilloscopes

Delay generators (DG 535, BNC 500, Quantum)

Low voltage power supplies

High voltage power supplies

**Other information**

Magnetic protection of several diagnostics beam lines is available upon request. Installation of any other diagnostics instruments must be coordinated timely with the technical team (point of contact Dr. Radu Presura).
Operations

Hours of Operation

Zebra operation: Monday through Friday
To Be Determined

Requests to extend the schedule considered.
Training of the experimental teams in operations tasks (e.g. chamber set up, safety operator) is available.

For more information, contact

Dr. Radu Presura, presura@physics.unr.edu.
Dr. Vladimir V. Ivanov, ivanov@unr.edu

Updates and answers to frequently asked questions regarding Zebra, diagnostics and operations will be posted on the NTF website http://www.ntf.unr.edu/.