Basic questions:

What is our definition of success?

- Near term impact: a peer-reviewed paper combined with a compelling story, in a presentation format suitable for non-experts
- Longer term: sustained track record of publication; attraction of new scientists to the field; altering the approach adopted by others

What is the ***minimum*** collection of measurements needed?

- Focus on minimum needed to ensure solid reliable results, then expand into new arenas

What might go wrong and how can we avoid it?

What capabilities are needed?

How should we communicate our results?

- AAS summer meeting typically includes special sessions
- IAU workshop
- HEAD
- AAS maintains a list of specialized meetings
- Distinguished lecturer series
- University colloquia and seminars

White Dwarf photosphere objectives, status, strategy:

Objectives:

Relative line shape measurements of Hβ, Hγ, Hδ at T_e=0.8 - 1.5 eV, n_e=10^{16} – 10^{18}
Direct comparison with new line-broadening models

Status, achievements:

Reached white dwarf photospheric conditions of T and ρ on the Z-platform
Produced a macroscopic plasma that is uniform (at some level)
Produced a plasma that is stable over long times (300—400 ns)
Demonstrated we can measure up to Hα, Hβ, and Hγ

Strategy for impact:

measure full set of lines, possibly including Hδ and Hε
characterize T and n_e independently, or semi-independently
- Improve modeling
- Introduce trace elements
- Implement something like Roberto's "charge state analysis"
- Dream of optical Thomson Scattering

Publish paper characterizing platform
Publish paper constraining/comparing line broadening theories
Analyze observed WD spectra with new line-broadening, empirically constrained, models

Photoionized plasma objectives, status, strategy :

Objectives:

Measure charge state distribution for two different photoionized elements and as a function of photoionization parameter

Strengthen the newly identified line ratio temperature diagnostic by extending it to another element and by comparing with radiative recombination temperature diagnostic (using fluorine)

Status, achievements:

Re-established the ability to do photoionized plasma experiments at Z

Measured photoionized neon charge state distribution as a function of gas density

Identified a new temperature diagnostic suitable for laboratory photoionized plasmas

The inferred temperature confirms production of photoionized plasmas

Strategy for impact:

Extend absorption measurements to sulfur

Perform simultaneous measurements with gas cells at different distances and different pressures to evaluate the approach to equilibirum

Resonant Auger Destruction / Black Hole Accrestion objectives, status, strategy :

Objectives:

Measure Kα satellite fluorescence from photoionized Si or S

Measure relative Kα satellite intensities as a function of column density

Status, achievements:

Photoionized Si data recently obtained by RCM group confirms the correct charge states can be produced on Z

Experiment definition is in progress

Strategy for impact:

In near term (CY11) use existing target possibilities: either Si_3N_4 (with CH tamping) or SF_6 filled gas cell

In CY12 consider feasibility of Silane or other Si-bearing gases

Measure charge state distribution with absorption spectroscopy

Measure self emission with XRS^3 (spherical crystal spectrometer)

Measure temperature with Radiative Recombination Continuum

Stellar Interior Opacity objectives, status, strategy :

Objectives:

Measure iron plasma transmission at conditions corresponding the base of the solar convection zone

Status, achievements:

The 2007 Z data reproduced iron charge states found at the base of the solar convection zone, but the density was an order of magnitude lower

The 2007 comparisons should inspire concern for calculations, but higher density/temperature measurements are needed

Recent experiments demonstrated the we can reach the conditions found at the base of the solar convection zone

Strategy for impact:

Measure transmission in thick iron and thin iron samples using sample design that produces the CZ base conditions

Exploit the data to perform Beer's Law scaling tests

Infrastructure needs:

- Z is a "collaborative facility", not a user facility. Need a written description of how we do business. Standing operating procedure
- Handbook: capabilities, platforms, diagnostics, training, access requirements
- Checklist to ensure visitor logistics run smoothly
- Assistance with housing, establishing a community atmosphere for visitors/students
- Office space, lab space; computer access
- External web: description of ongoing projects; solicitation schedule for Z time
- Need closure after experiments: outbrief soon after experiment, annual report of collaborative experiments and research

Physics measurement gaps and diagnostics needed to fill gaps:

- Electron temperature in x-ray driven gas
  - Optical Thomson scattering
  - Radiative recombination continuum
  - Line ratios
- High accuracy drive spectrum
  - XUV spectrometer
- Electron density in x-ray driven gas
  - Interferometry
  - Optical Thomson scattering
  - Line ratio or absolute spectral intensities
- Self emission from photoionized plasma
  - Spherical crystal spectrometer
- High resolution XUV spectroscopy (15-100 Angstroms)
  - Variable line space grazing incidence spectrometer
- Multiple simultaneous optical spectra
  - Multiple optical spectrometer systems at Z
- Gas cell initial conditions
  - Pressure transducer, temperature gauge

Capability needs:

Magnetic fields in 2x10 cm scale cells (1-10 T)

Ability to field sealed gas cells filled with Silane or other Si bearing gas

New ideas:

1. Magnetic fields have been identified in many White Dwarfs and the relatively simple structure makes it more feasible to quantify the impact on important phenomena, such as energy transport through the convection zone.
However, the field observations depend on interpreting photosphere spectra in the presence of both Stark broadening and Zeeman splitting.
This is a challenge for spectral synthesis models and motivates experimental benchmarks.

2. Chandra spectra contain unidentified lines in the 20-50 Angstrom range that may arise from photoionized argon.
This motivates XUV studies of photoionized argon plasmas.

3. Resonant enhancement of Auger electron production from high Z nanospheres may lead to new possibilities for cancer treatment. However, the realization of this goal depends on efficient monochromatic x-ray sources and a thorough understanding of Auger production.