

# MATERIAL R&D FOR HIGH-INTENSITY PROTON BEAM TARGETS



## PROGRESS REPORT

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May 5, 2006

# R & D Overview

**PHASE I-a:** 24 GeV beam on targets and beam windows

**PHASE I-b:** Irradiation Damage Assessment of Super-Invar  
(plus Inconel-718)

**PHASE II: Target Material Irradiation – Expanded Matrix**

- 3D-weaved Carbon-Carbon Composite
- Toyota “Gum Metal”
- Graphite (IG-43)
- AlBeMet
- Beryllium
- Ti Alloy (6Al-4V)
- Vascomax
- Nickel-Plated Aluminum

**PHASE II-a:** Irradiation effects on 2D-weaved CC composite

**PHASE III: Current activity – Receiving protons since 11 AM,  
May 4, 2006 .....**

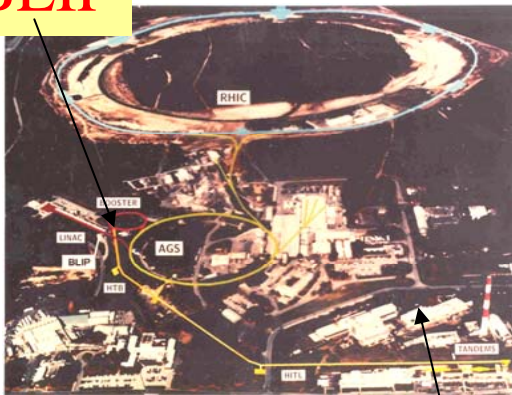
# PHASE III Overview

**All of it put together in 6 weeks**

- **3D-weaved Carbon-Carbon Composite**
- **2D-weaved Carbon-Carbon**
- **Toyota “Gum Metal”**  
(90% cold-worked plus typical grade tested during Phase II)
- **Various Graphite Grades (IG-43; IG-430; amorphous)**
- **Ti Alloy (6Al-4V)**
- **Pure Copper (annealed)**
- **Glidcop (axial orientation and transverse orientation)**
- **Bonded graphite to Titanium and Copper**  
(45 degree bond orientation and 90-degree orientation)
- **Tungsten**
- **Tantalum**
- **Super-Invar (most challenging of all materials in matrix!)**
  - **Re-introduction of irradiated material into the assembly including annealed and non-annealed specimens**
- **Miscellaneous materials (AlBemet; Vascomax)**
- **Nickel-Plated Aluminum of the NuMI horn**

# The Overall Process

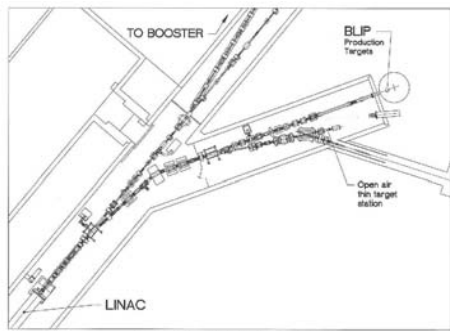
## BLIP



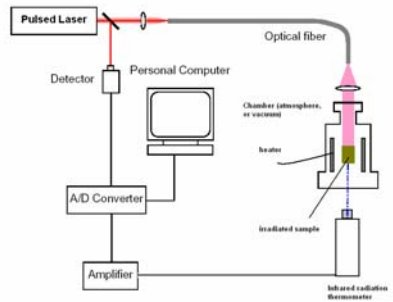
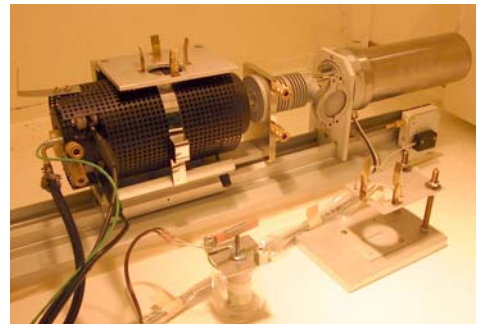
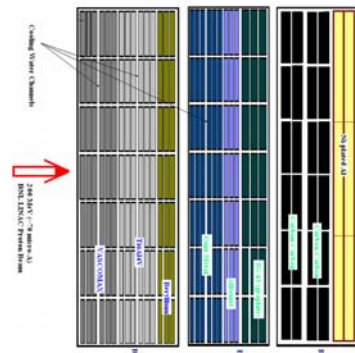
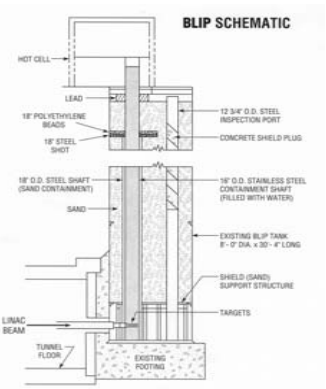
BLIP Parameters

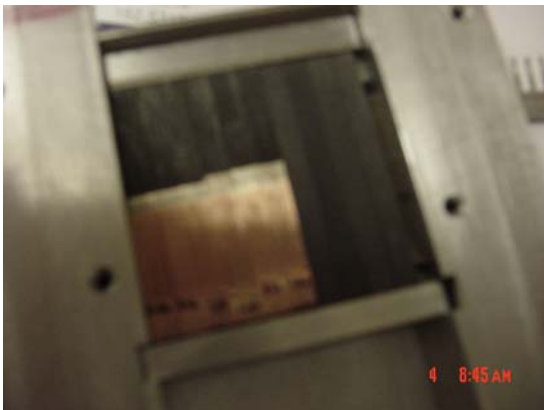
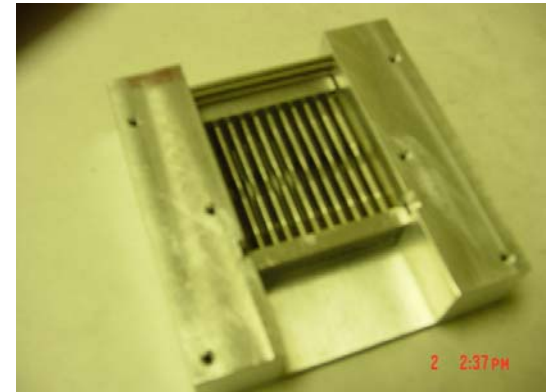
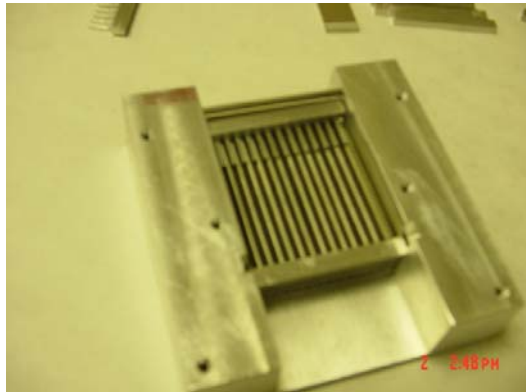
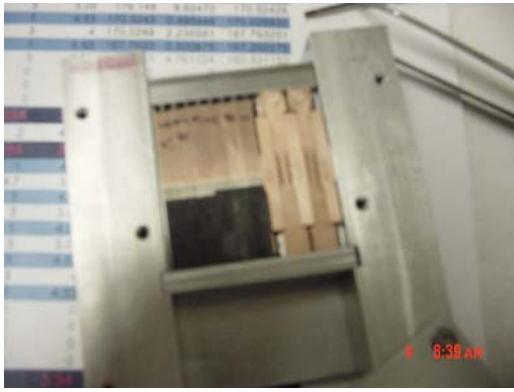
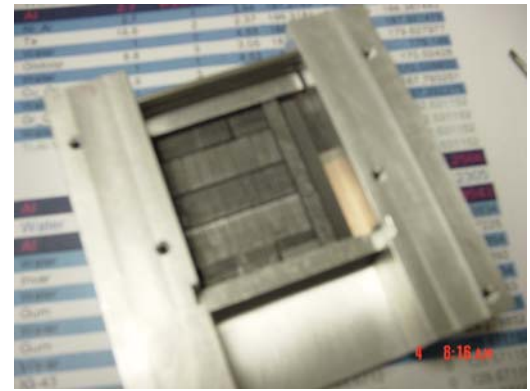
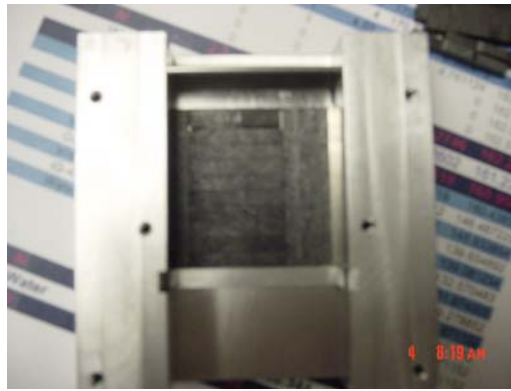
Parameter	Past	Present
Proton Energy (MeV)	200	66-200
Pulse Current	25 mA	37 mA
Pulse Rate	5 Hz	7.5 Hz
Pulse Width	450 μs	525 μs
Maximum Current	56 μA	146 μA
Typical Current	48 μA	80 μA
Beam Lines	1	1
Target Capacity	8-12	8-12

\*Parasitic operation with high energy physics program  
 \*\*Dedicated operation without high energy physics program

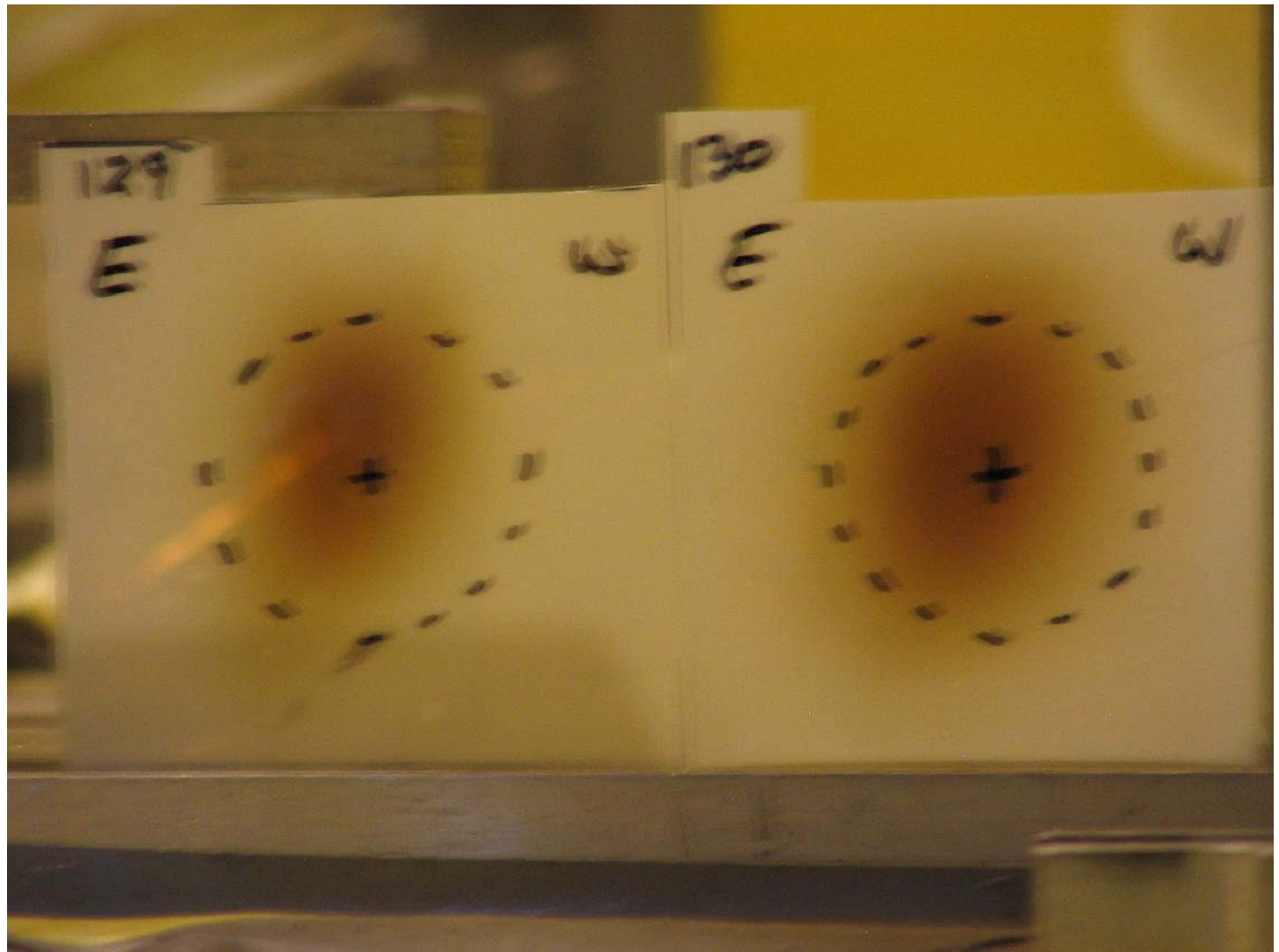


Schematic of BLIP Beam Line





The Beam is ON !!!!



Nick

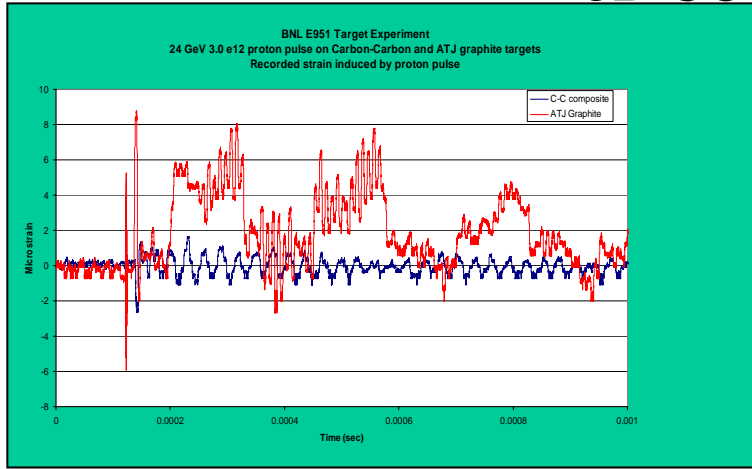
You got your first 1000 uA-hrs last night.

Joe

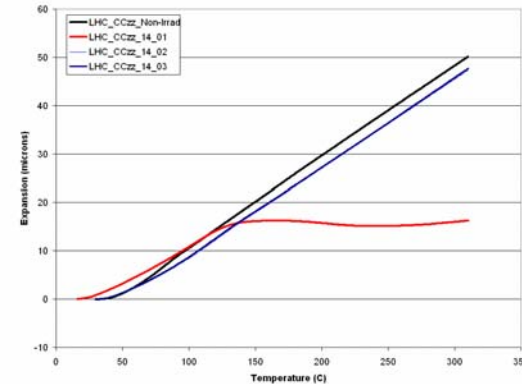
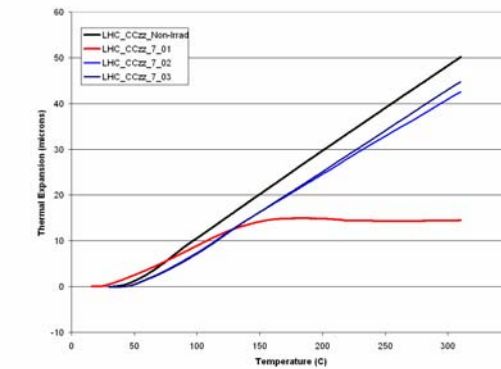
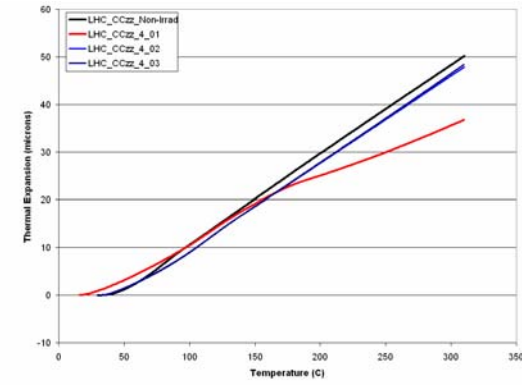
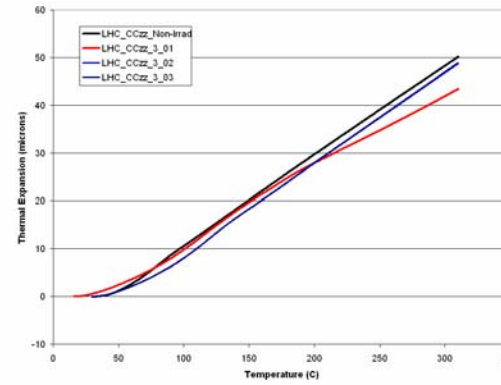
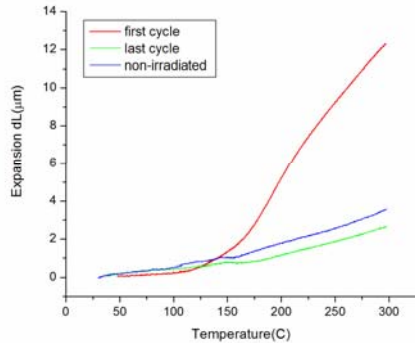
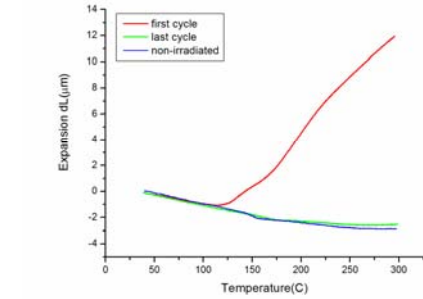
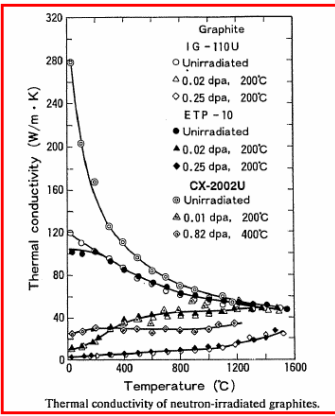
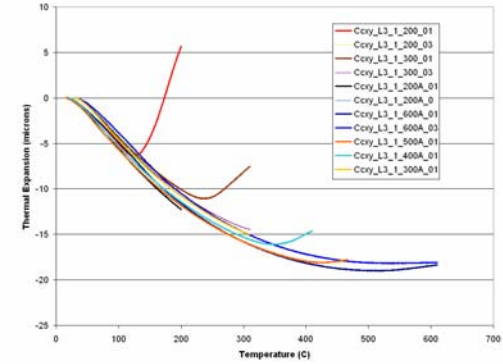
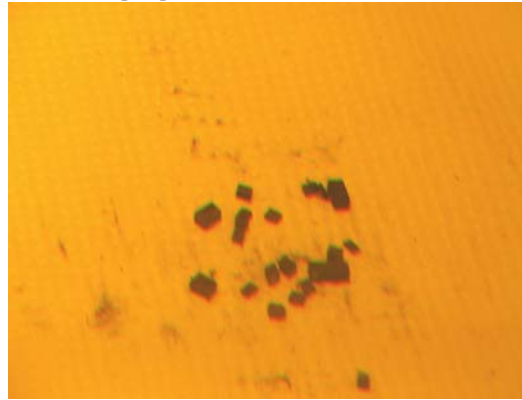
Some Background .....

# Graphite vs. Carbon-Carbon

## 3D CC

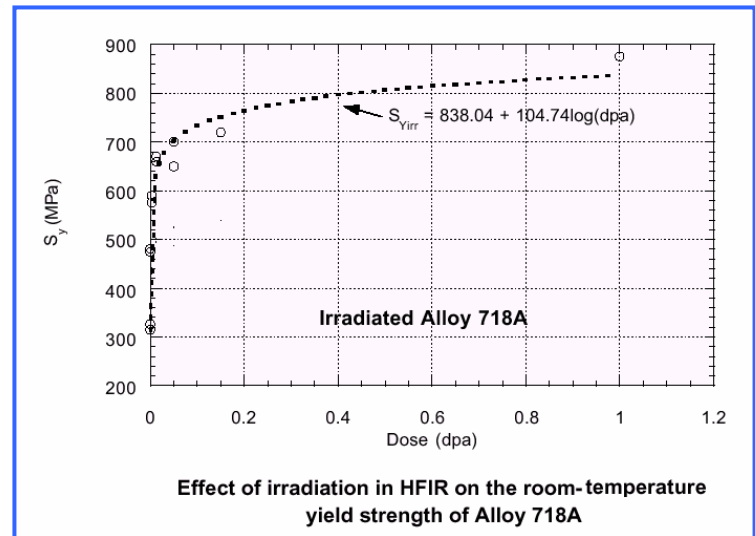
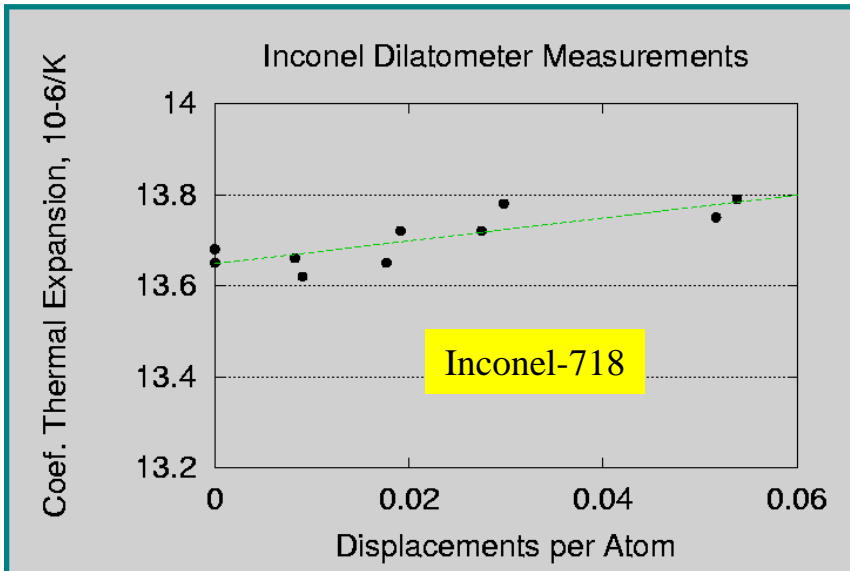
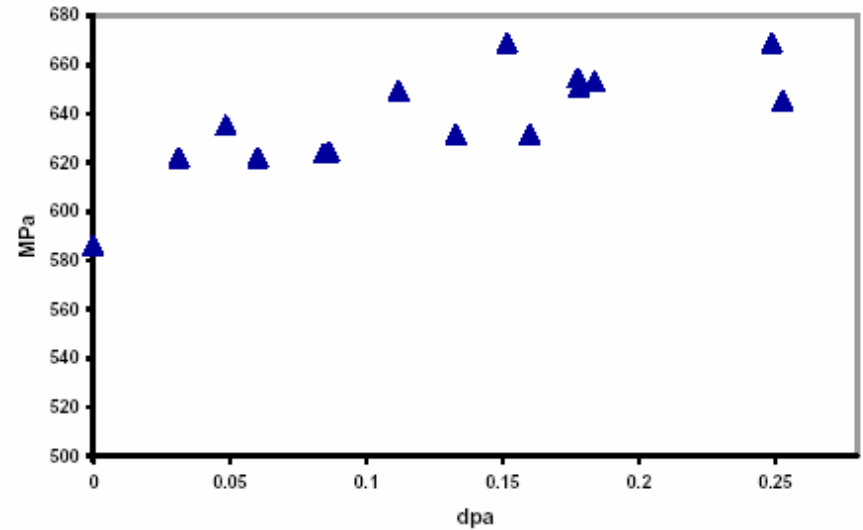
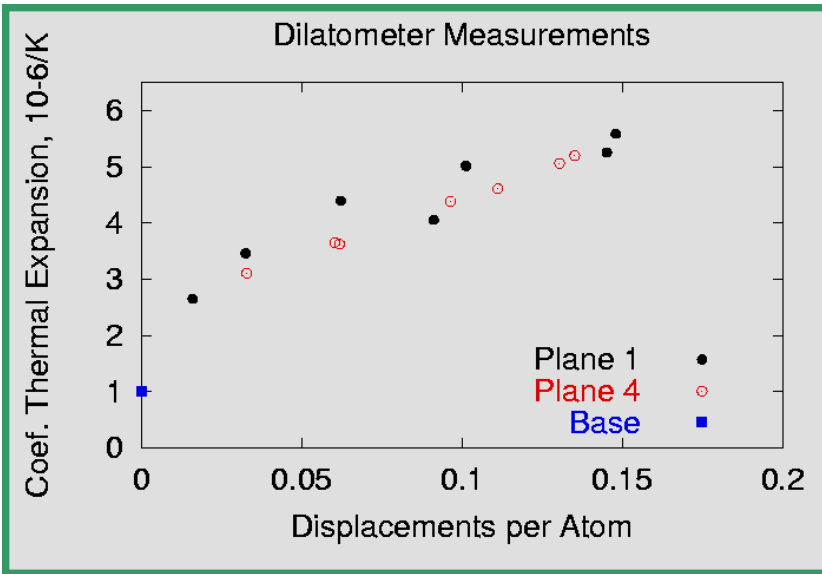


## 2D CC

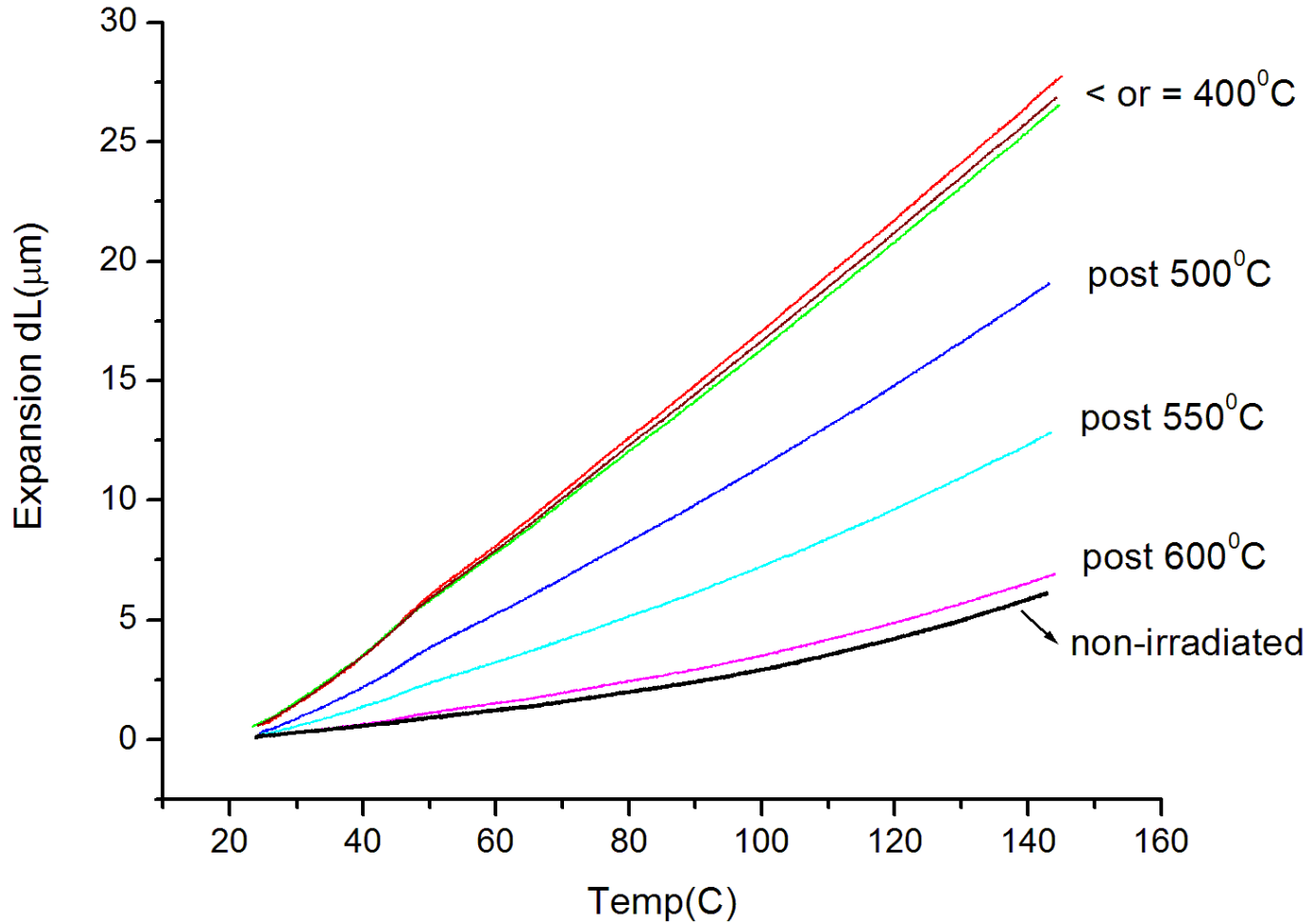




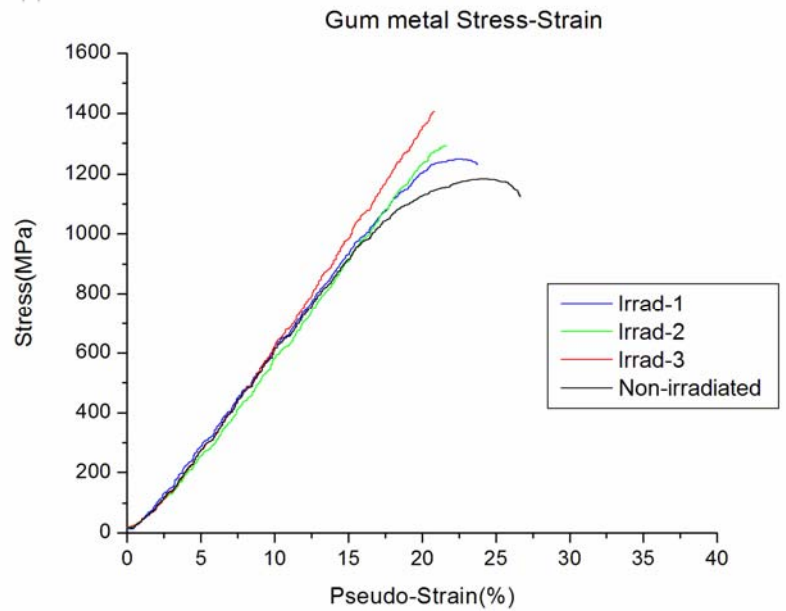
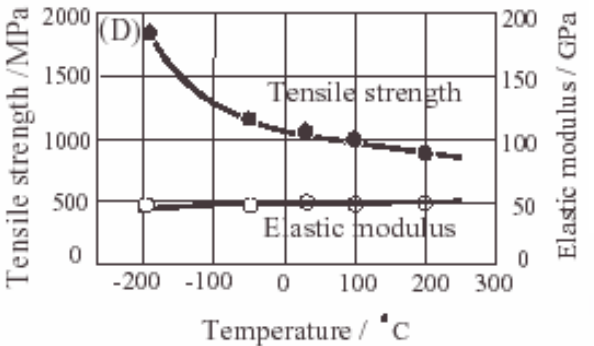
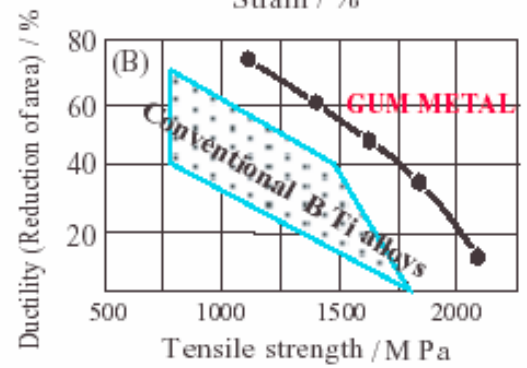
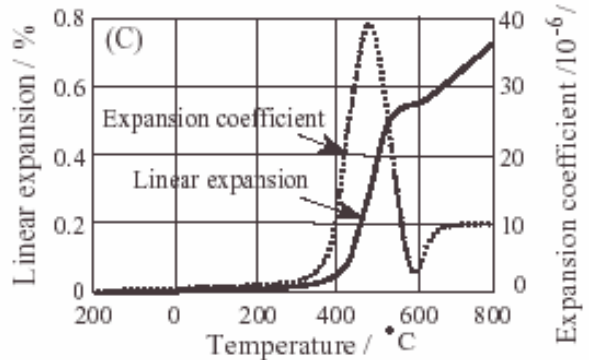
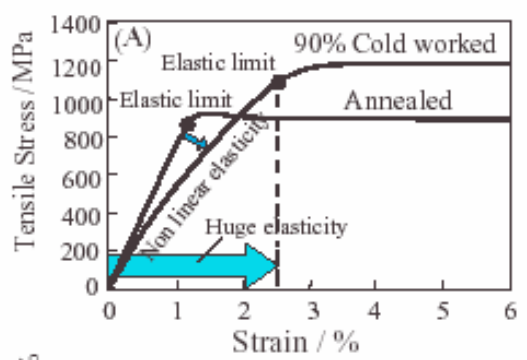
# Re-considering Super-Invar



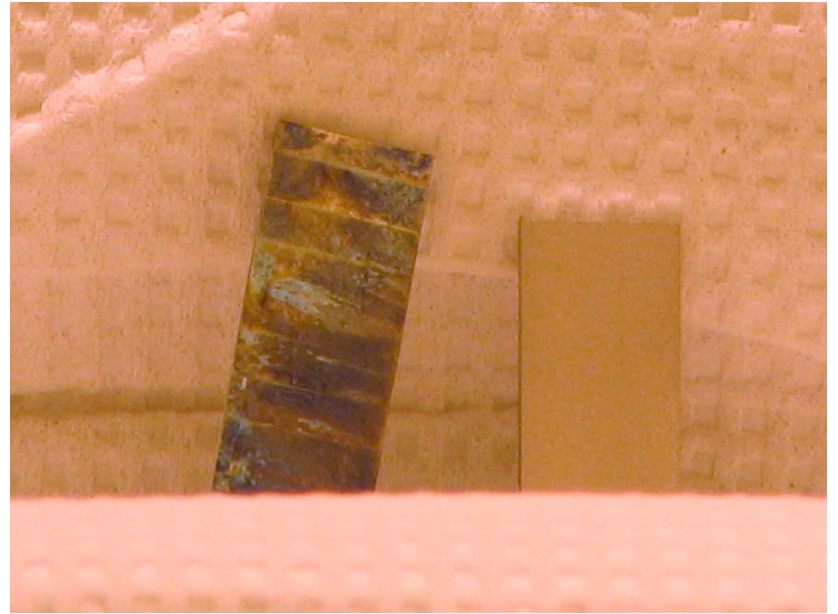
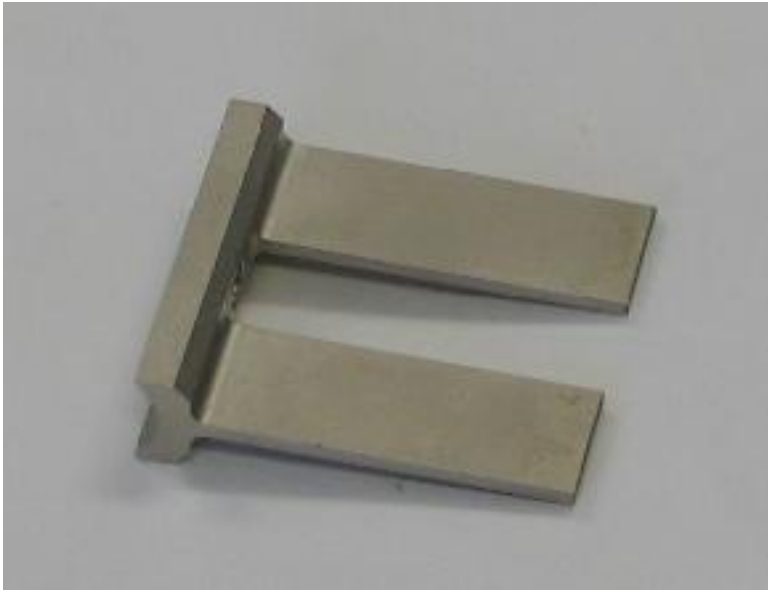
# Expansions of Super-Invar



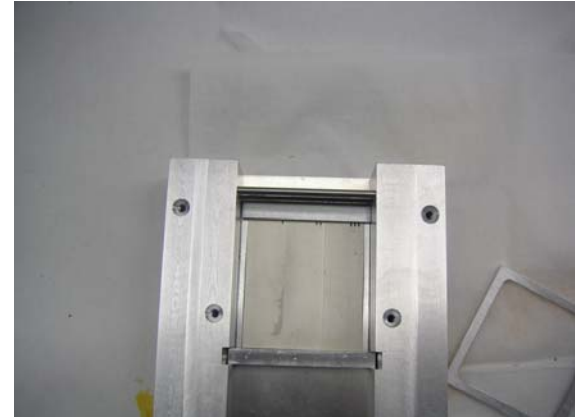
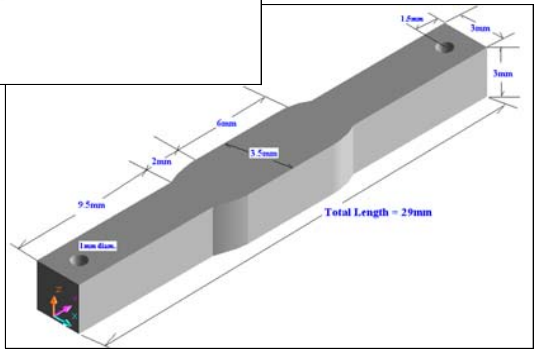
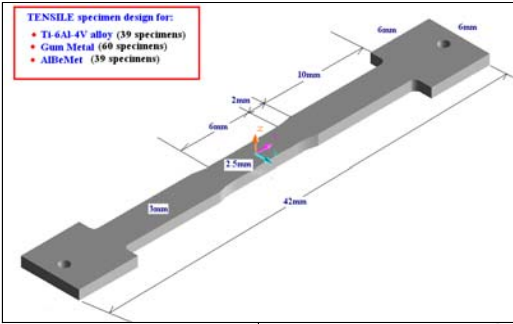
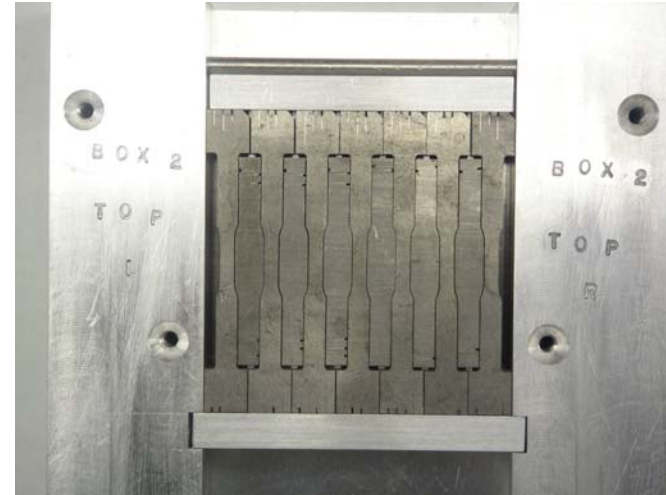
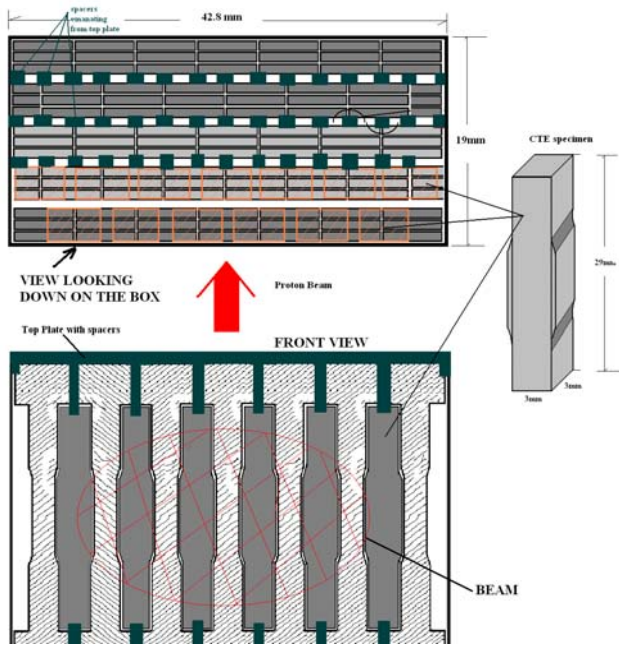
# The wonders of Gum Metal



Horn, horn, horn .....



# Irradiation Assembly



# Activation Measurements

