Beam Test Facilities at LBNL

ILC Detector Test Beam Workshop

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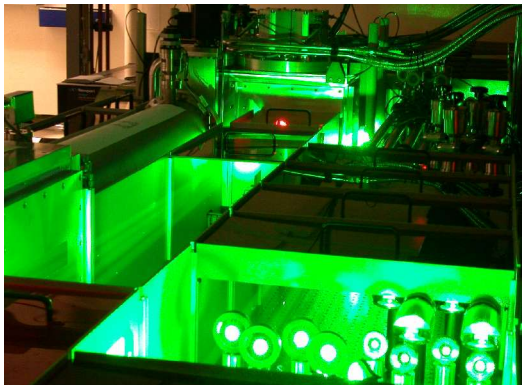
Introduction: beam facilities at LBNL

Advanced Light source (ALS)

- X-ray light from 1.9 GeV electrons in 200 m storage ring
- 35+ beamlines for physics, material science and biology experiments
- Beam test line extracted from injection booster

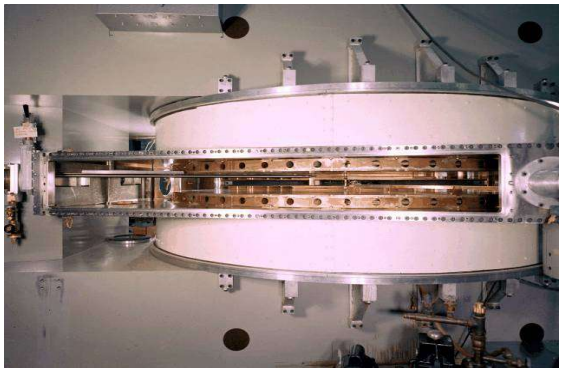


Laser Optics and Accelerator Systems Integrated Studies (LOASIS)

- Electron acceleration up to 1 GeV using TW laser wakefields in plasma
- Plans for upgrade up to 10 GeV

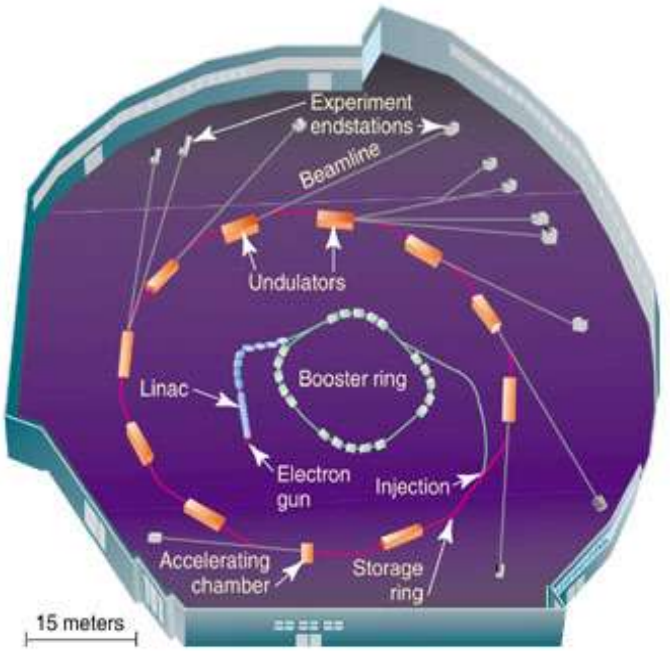
88-inch cyclotron

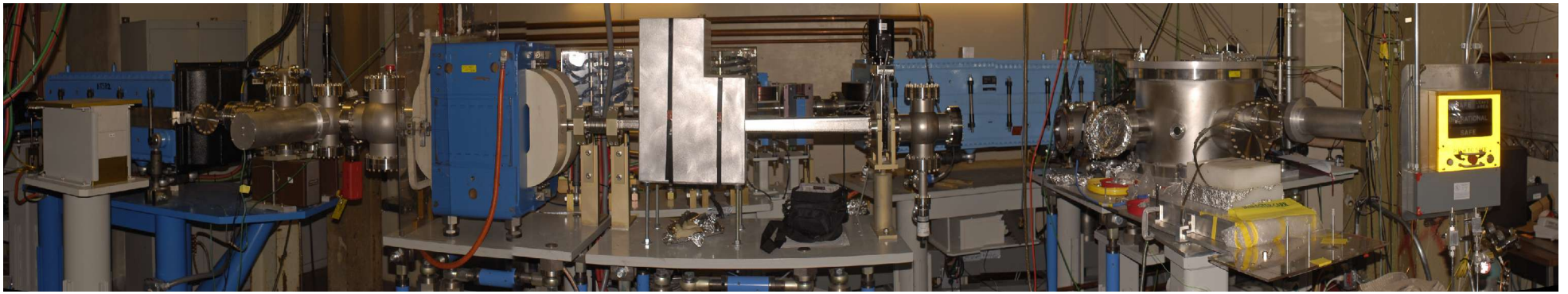
- Beam lines for proton, heavy ion and neutron irradiation



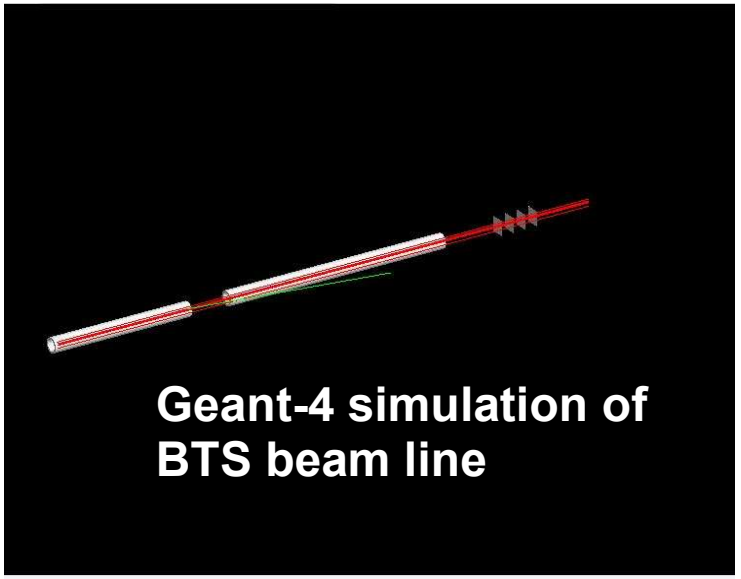
The BTS facility at the Advanced Light Source

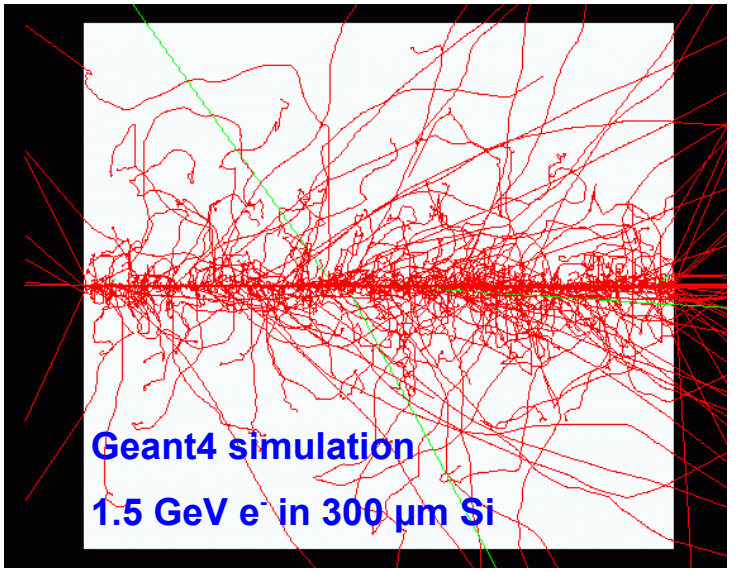
- BTS beam line extracted from the ALS booster ring
  - single/multiple bunch of primary 1.5 GeV e^-
  - 1 Hz repetition rate
  - tunable particle flux
- Several CMOS pixel prototypes tested by LBNL ILC and STAR groups
- Test area being equipped with 4-plane beam telescope based on thinned CMOS pixel sensors for particle tracking studies with extrapolation resolution<10 μm

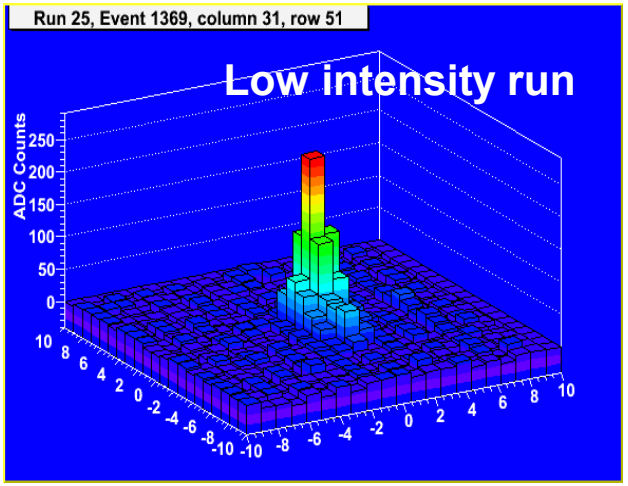


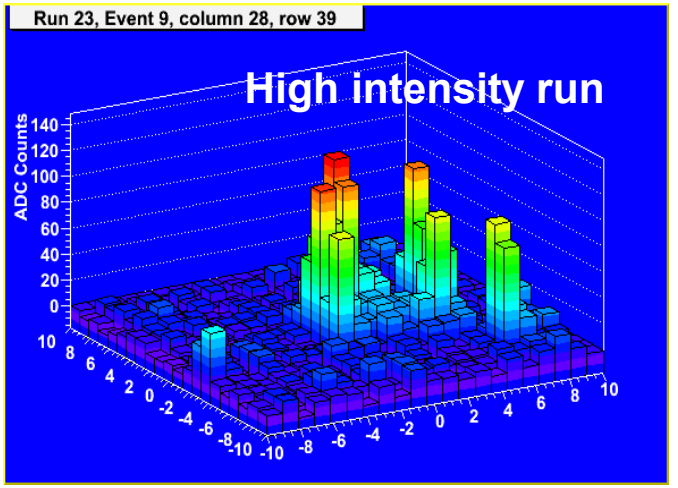


The BTS facility at the Advanced Light Source (2)





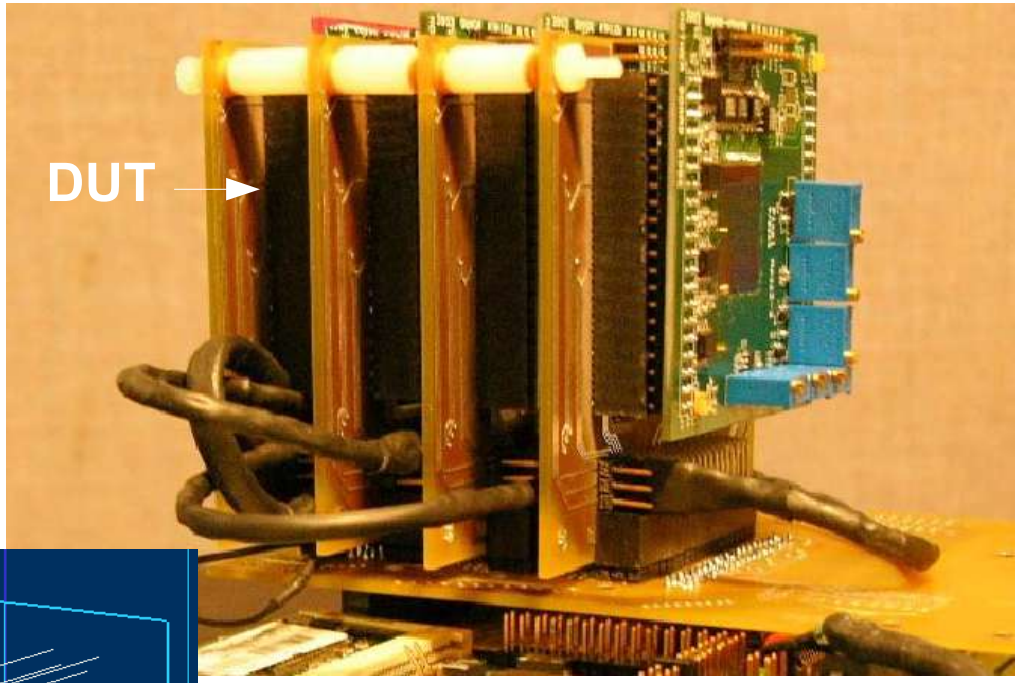


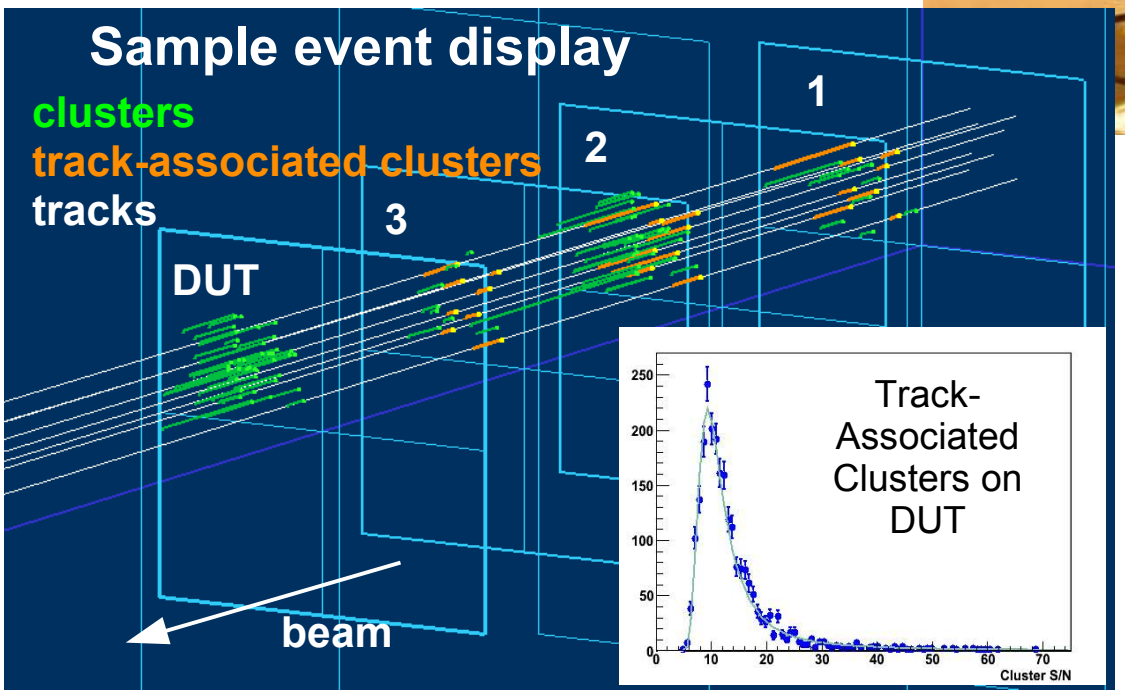


Example event displays from tests performed with LBNL LDRD-1 CMOS pixel prototype

The Thin Pixel Pilot Telescope

- Layout: 3 layers of thin MIMOSA-5 sensors (40 μm + 50 μm + 50 μm) + reference detector
- Pixel pitch 17 μm, sensor spacing 1.7 cm
- Common trigger/readout board, on-line cluster search and data sparsification



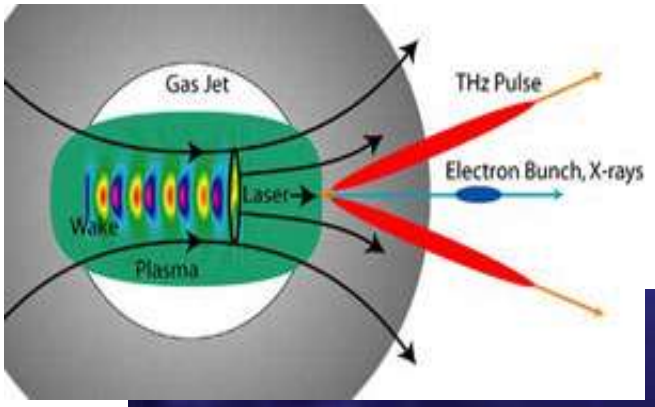


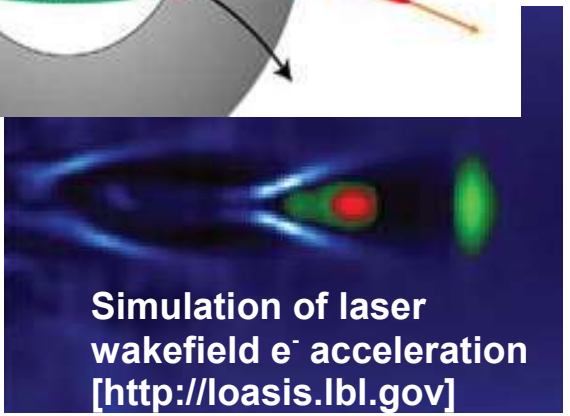
- First prototype fully assembled and tested in Fall '06, improved version with 4 thin layers being commissioned (more details in M. Battaglia's talk)
- Pilot project for CMOS pixel beam telescope for use at FNAL MBTF

The LOASIS accelerator facility

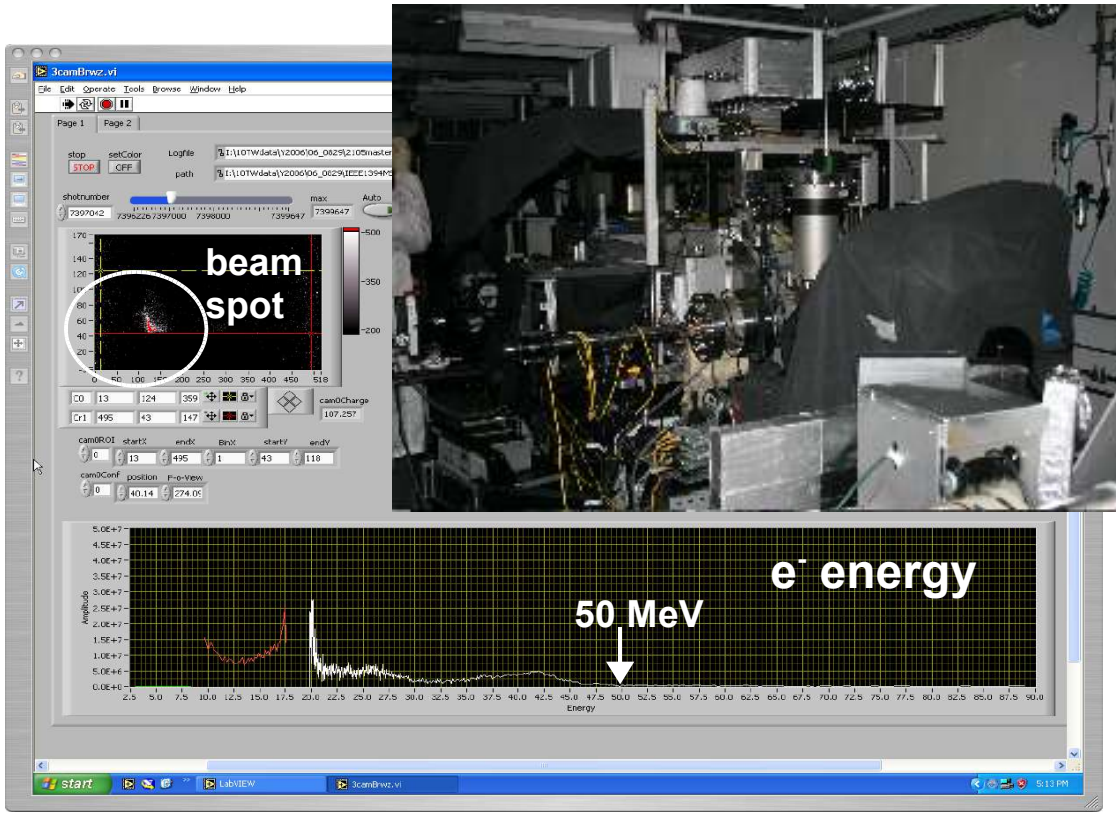
- Electron acceleration by means of TW laser wakefields in plasma: 1 GeV e^- achieved with 40 TW Ti:Sapphire laser in 3.3 cm

- Possibility for tuning beam energy (~50 MeV to 1 GeV): opportunity for studying detector response to low momentum particles, e.g. from pair background





Simulation of laser wakefield e^- acceleration [http://loasis.lbl.gov]

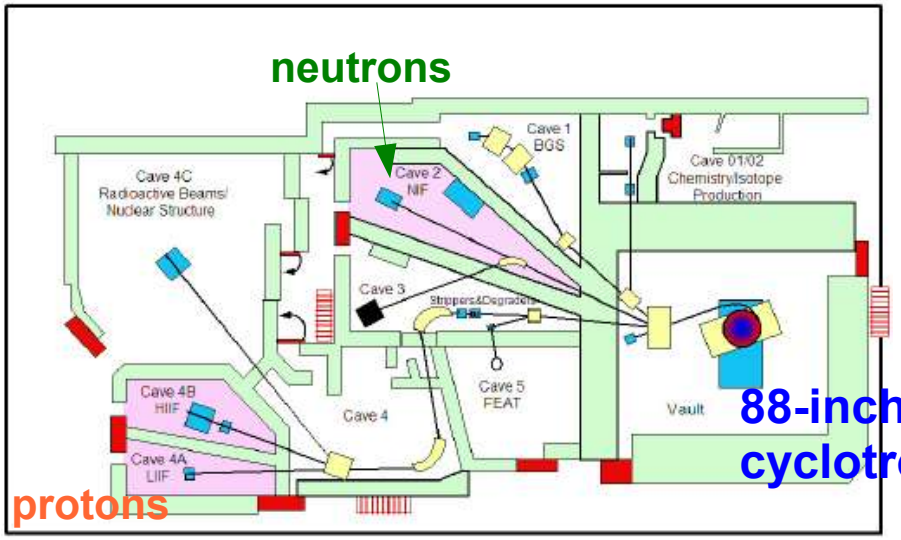


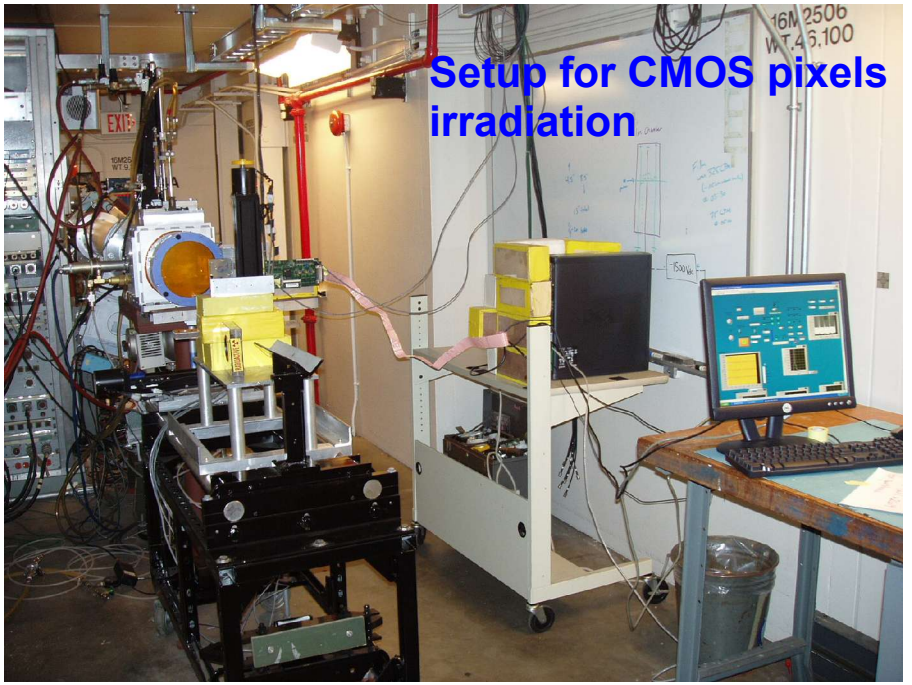
- First tests with CMOS pixels last summer (E≤50 MeV)

- Plans to extend beam line for decreased intensity and to allow testing at different incident angles

Irradiations at the 88-inch Cyclotron

- Dedicated beam-lines for proton (heavy ions) & neutron irradiations at the BASE facility
- E_p up to 55 MeV, $E_n \leq 30$ MeV, tunable flux, typical ~$1 \times 10^8/cm^2/s$
- Proton line provides user control of beam on/off periods and accurate dosimetry; possibility for mounting and cabling equipment for online monitoring outside the cave
- Neutron line recently developed and commissioned, provides similar capabilities
- LBNL ILC group: several irradiations with 30 MeV p of CMOS and DEPFET pixel prototypes; first n irradiation in Fall 2006
- Facility available to external users





Conclusions & Outlook

- Several test facilities available on-site at LBNL, offering opportunities for various testing conditions

- ALS 1.5 GeV e^- beam extensively used in test of CMOS pixel prototypes; beam-line being equipped with 4-plane beam telescope with 50 μm thin CMOS pixel sensors, allowing tracking studies with position resolution<10 μm

- Plans for tests with low momentum particles and tunable beam energy at LOASIS plasma accelerator facility

- Consolidated user facilities at 88-inch cyclotron for proton and neutron irradiation

- More information:
  - www-als.lbl.gov
  - loasis.lbl.gov
  - cyclotron.lbl.gov