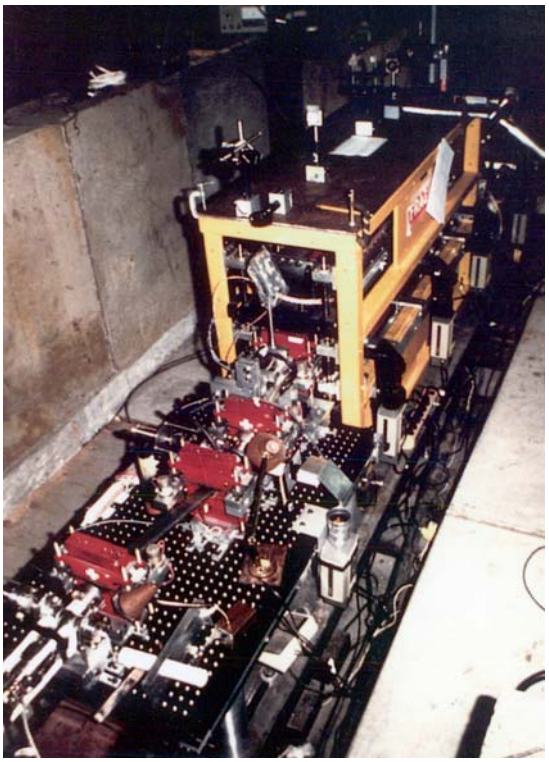
# Free Electron Lasers

The UH physics department Free Electron Laser group is led by John Madey, the inventor of the FEL, and includes faculty members Luis Elias, Pui Lam and Eric Szarmes. The group's research is centered around the MOPA III infrared laser and the THz terahertz laser.

### The MOPA III Free-Electron Laser



The undulator section of the MOPA III FEL

The Physics Department of Physics is currently installing an infrared, rf-linac-based FEL. The MOPA III FEL, originally developed by Madey at Stanford University, is a continuously tunable, mid-IR laser source that delivers a diffraction-limited beam of phase-locked, picosecond optical pulses of extremely high peak power and spectral brightness for fundamental and applied research, including:

- ultra-sensitive lidar and remote sensing
- high-resolution excited state spectroscopy
- generation of tunable, high brightness single-mode radiation by optical phase-locking techniques
- Doppler-free nonlinear spectroscopy and Doppler limited absorption spectroscopy
- compact x-ray sources
- studies of the non-classical nature of FEL light
- optical pulse compression and pulse shaping
- photo-chemistry and surface science
- novel FEL configurations including multiple inverse-tapered undulators
- medical research; hard- and soft- tissue-laser interactions

Current research activities of the group include remote sensing and excited state spectroscopy, cavity electrodynamics, the fundamental theory of free-electron lasers, novel configurations of FELs for coherent multicolor spectroscopy, the design of optical resonators for the production of coherent optical pulse trains and tunable x-rays, and novel techniques for linear and nonlinear optical spectroscopy.

### Terahertz Free Electron Laser Group

The Terahertz free electron laser is based on an electrostatic Van-de-Graf accelerator using a novel recirculating beam system that was developed by Elias. This device has been transported from the University of Central Florida to the UH where its installation is pending

construction of a facility that will house it. The FEL will be operate as a user facility generating high power, highly coherent output in the range 0.6 – 1.3 THz.

The THz FEL group is working closely with the UH FEL group. The research plans for this activity includes:

The recirculating CW THz FEL as it will look after assembly.

- Study the interaction of THz radiation with molecular, biological and solid-state systems
- Develop solid state sensors and devices in the THz region
- Develop plasma gating techniques which can be used to generate short THz pulses
- Use the Lienard-Wiechert to conduct theoretical studies of the generation of coherent FEL radiation in the time domain.
- Development of CW FELs
- Development of a short pulse THz FEL based on the Mark III thermionic RF gun.
- Detection of THz signals from hazardous substances.