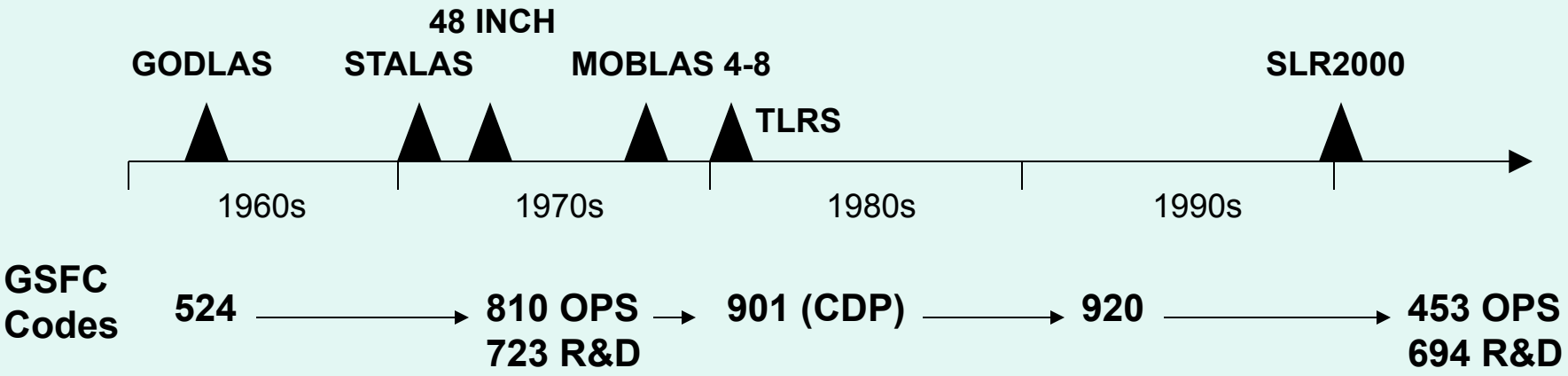
SLR at GSFC



GSFC invented and developed Satellite Laser Ranging and continues to advance SLR R&D, however, there have been many contributors to SLR over the years, including SAO & U.Texas in U.S. and many international groups.

NASA/GSFC Satellite Laser Ranging (SLR) Network

GSFC Firsts (a 40+ year history!)

- **1964: First successful demonstration of SLR to Beacon Explorer 22-B satellite at GSFC (3 m ranging)**
- **1968-1976: NASA, CNES, and SAO SLR systems carried out first meter level global geodetic and gravity field measurements using reflectors on remote sensing satellites**
- **1969: NASA Apollo 11 mission places first retroreflector array on Moon to begin international Lunar Laser Ranging (LLR) effort.**
- **1975-1976: CNES and NASA launched first passive satellites dedicated to SLR (Starlette and LAGEOS) to begin modern space geodetic era**
- **1975-1979: NASA builds up SLR network for POD support of GEOSAT and SEASAT ocean altimetric missions (10 - 20 cm ranging).**
- **1979-1993: NASA Crustal Dynamics Project (CDP) provides focus for further technology development (1 cm ranging) and international cooperation in defining contemporary tectonic plate motions, regional crustal deformation, Earth Orientation Parameters, Earth gravity field etc.**

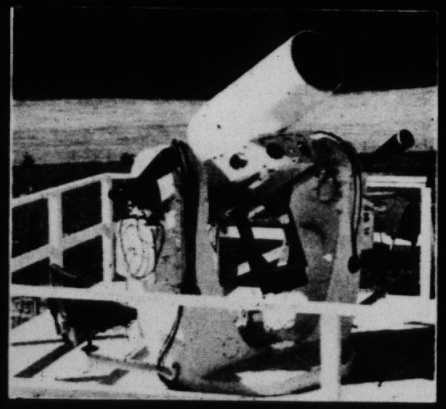
- **1992-present: Various US and European remote sensing missions (e.g. ERS-1 & 2, TOPEX/Poseidon, GFO) rely heavily on centimeter orbits provided by SLR. NASA provides the world's data most precise data and until budget cuts in 2003, provided half of the global SLR data.**

- **1998-present: GSFC selected as the Central Bureau (CB) for the new International Laser Ranging Service (ILRS). The CB is responsible for overseeing global operations of 40 international stations providing cm-accuracy orbits for 20 artificial satellites (and the Moon) and ensuring that all ILRS stations, operations, data, and analysis centers adhere to ILRS standards.**

3/29/2005

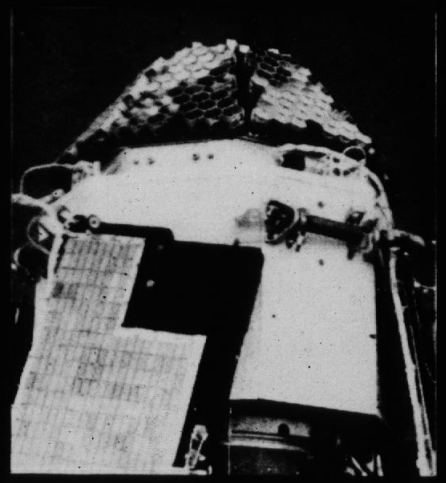
GSFC records first SLR returns ever on Oct 31, 1964
(GSFC team lead by Henry Plotkin)

SATELLITE LASER RANGING - 1964



TRANSMITTING LASER AND RECEIVING TELESCOPE, MOUNTED ON A MODIFIED NIKE-AJAX RADAR PEDESTAL.

GODLAS

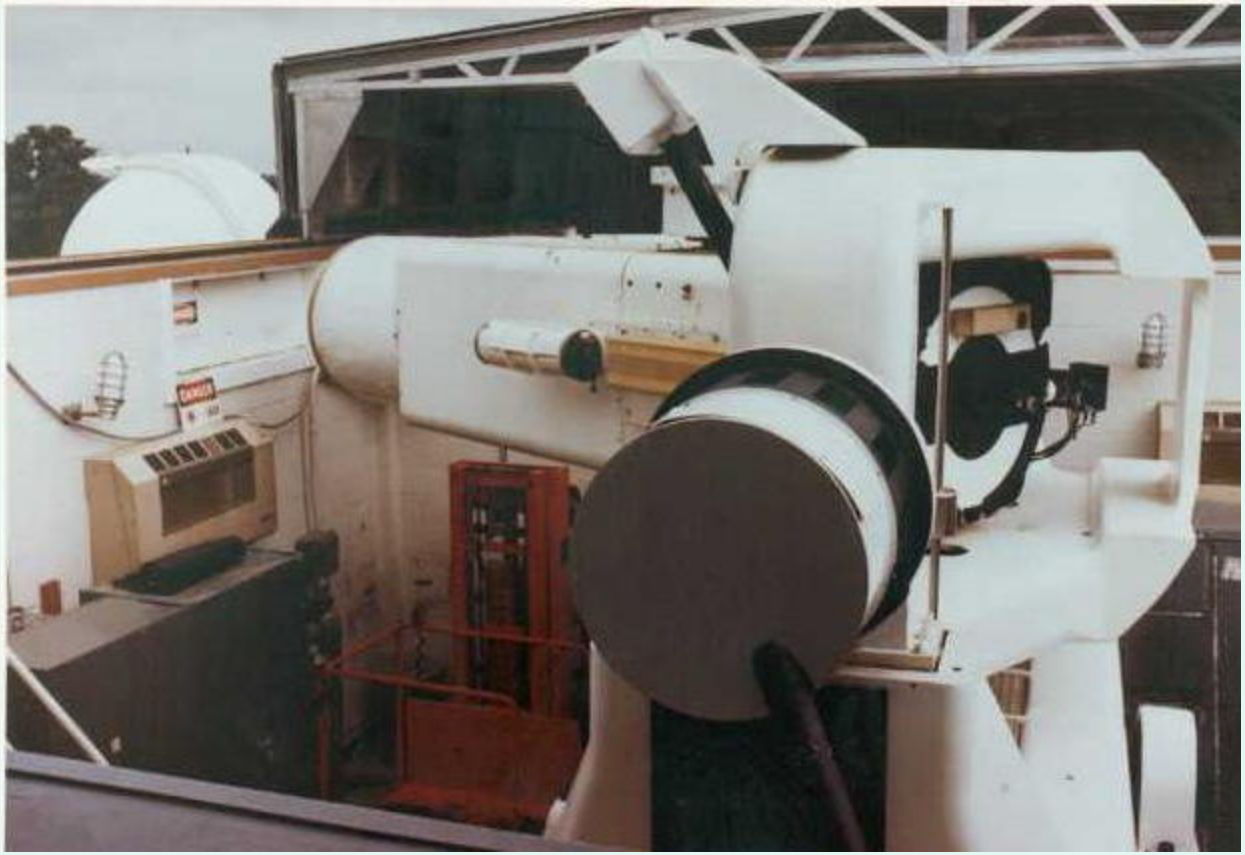


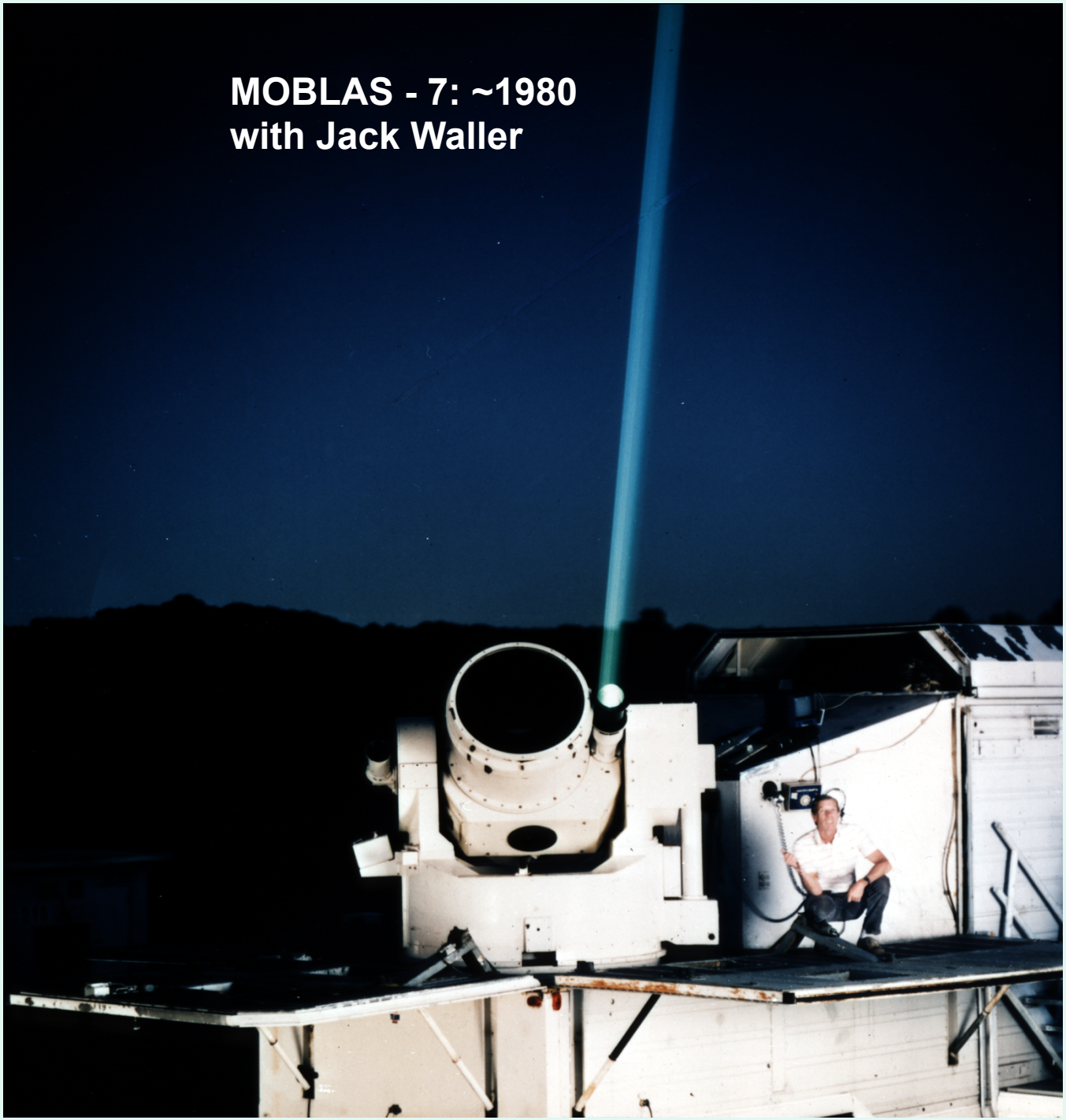
THE BEACON EXPLORER-B SATELLITE WITH ARRAY OF CUBE-CORNER REFLECTORS.

BE-B: first satellite with retro-reflectors

STALAS

- Developed in early 1970s as a “stationary laser” system at GORF.
- X-Y mount with 61cm (24”) telescope.
- Initial system had 1 Hz ruby (694nm) laser.





-Systems built in 1978 by Contraves (telescope & mount), and BFEC (electronics).

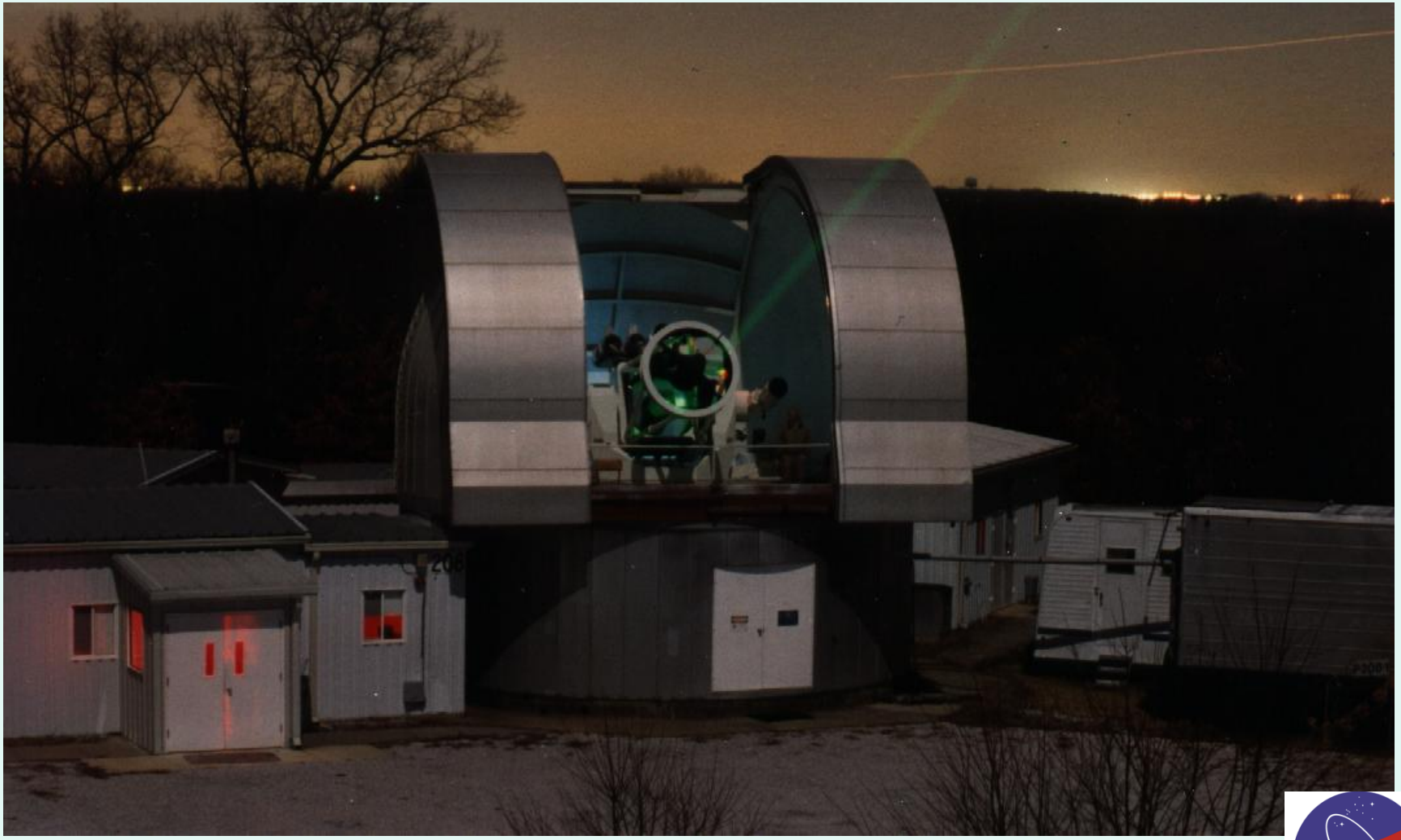
- 76 cm (30”) diameter telescope.

- Laser (now): 5Hz, 532nm, 100mJ.

-5 systems, all still operating, now located in:

California (Mon.Peak)
Australia
South Africa
Maryland (GGAO)
Tahita.

48 Inch Telescope Facility at GGAO



48” Telescope Facility (aka 1.2 m Telescope) Located at GGAO

- **Built in 1973-74 by Kollmorgen Corporation as multi-user facility**

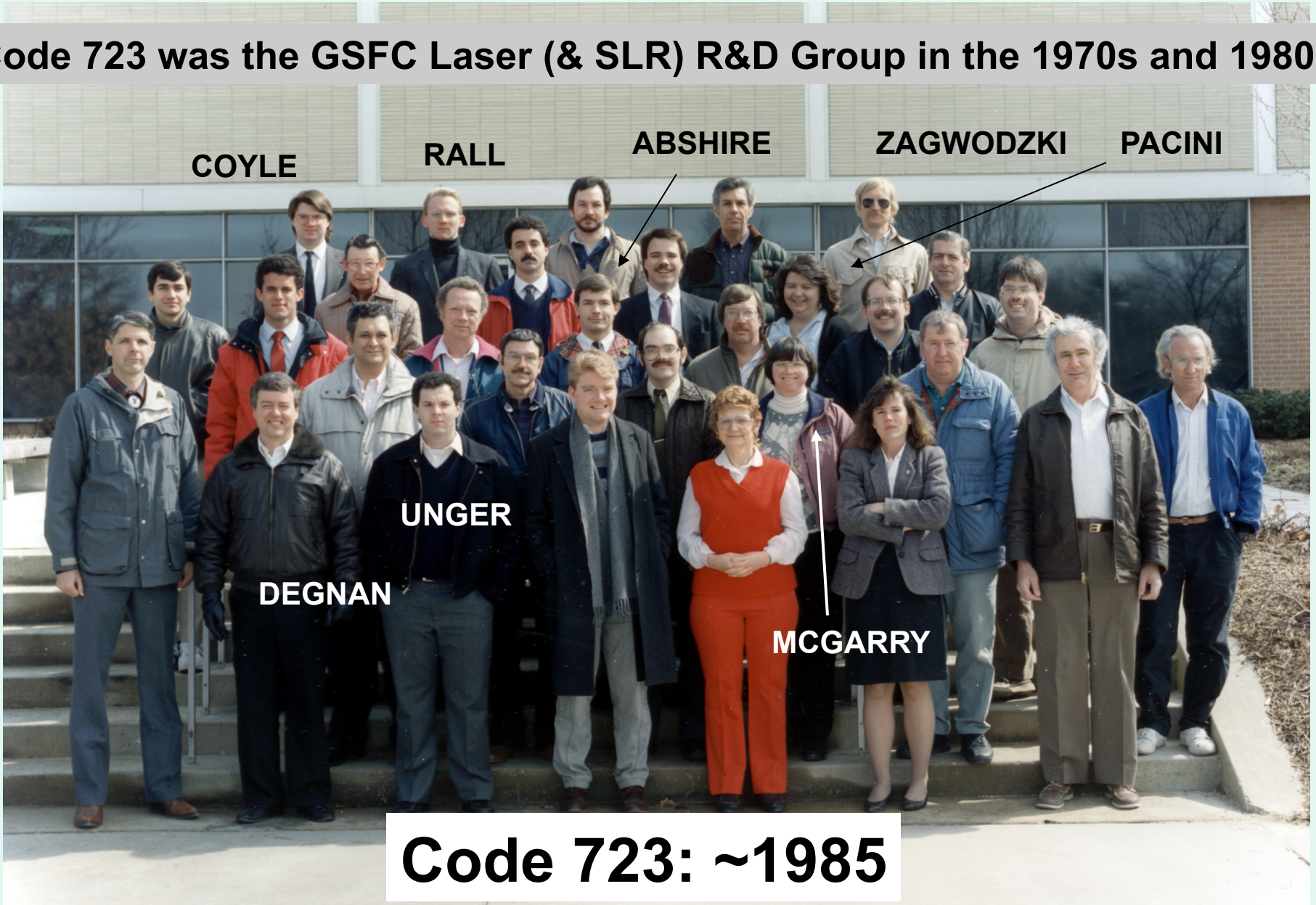
- **Arcsecond precision tracking**

- **R&D Facility used by many groups:**

  • Field testing of bread board for optical heterodyne spectrometers in 1970s & 1980s (M.Mumma & colleagues)
  • Automated guiding and two-color refractometry (D. Currie/UMd, D. Wellnitz/UMd): 1970s.
  • Lunar laser ranging test facility (C. Alley/UMd): 1980s.
  • Comparison of one way propagation times of laser pulses (East-West vs West-East) by C. Alley and R. Nelson in 1983.
  • Single and two-color satellite laser ranging test bed (Zagwodzki, Degnan, McGarry): 1980s & 1990s.
  • **MLA Earthlink Calibration Experiment: May 2005.**

  and many others…

Code 723 was the GSFC Laser (& SLR) R&D Group in the 1970s and 1980s



Code 723: ~1985

Who are these people and why do they look so young?