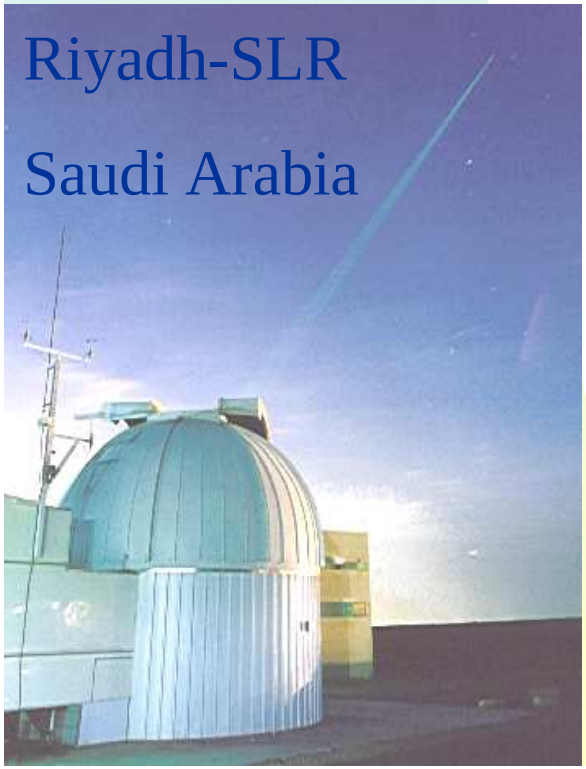
12 years

Saudi Space Geodesy (SSG):

Road Map for Fundamental Station



By: Attieh Alghamdi

King Abdulaziz City for Science and Technology (KACST), Riyadh Saudi Arabia

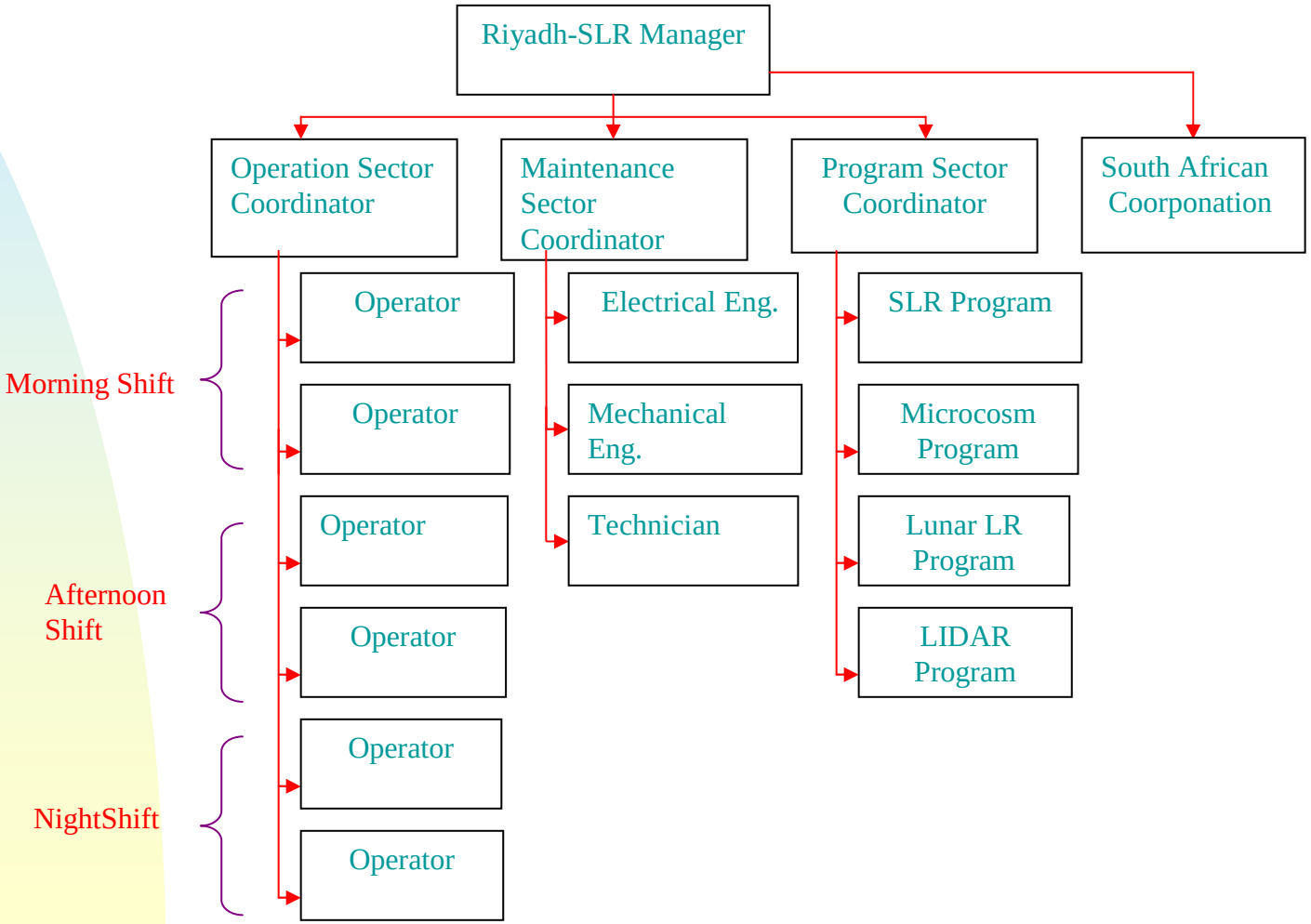
Presented in

Space Geodesy Workshop,

Matjiesfontein, South Africa

Nov. 2007

12 years


Riyadh-SLR Manager
Operation Sector Coordinator
Maintenance Sector Coordinator
Program Sector Coordinator
South African Coorponation
Operator
Operator
Operator
Operator
Operator
Operator
Electrical Eng.
Mechanical Eng.
Technician
SLR Program
Microcosm Program
Lunar LR Program
LIDAR Program
Morning Shift
Afternoon Shift
NightShift

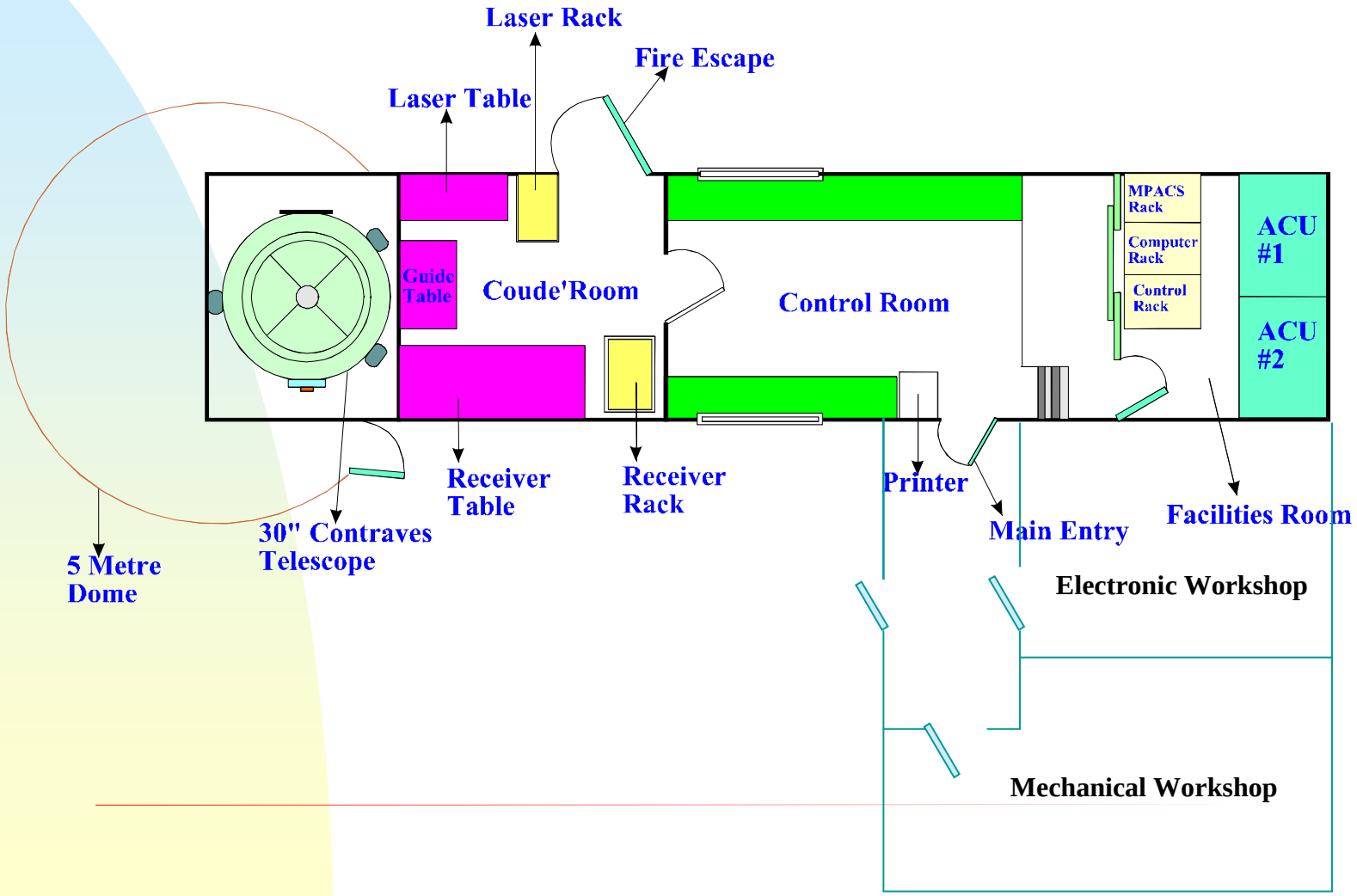
12 years

Space Geodesy STAFF

NO	Position	Name
1	**Space Geodesy Manager**	Dr. Attieh A Al-ghamdi
2	**Maintenance Sector Coordinator**	Abdulaziz Ben Shiehwyyn
3	Electrical Eng.	Roy
4	Mechanical Eng.	Dany
5	Technician	Mohammed Al-Sultan
6	**Operation Sector Coordinator**	Eng. Khalid S. Al-ghamdi
7	Operator	Saud Al-harkan
8	Operator	Sultan Al-masowd
9	Operator	Beby
10	Operator	Alex
11	Operator	Bander Al Aqeel
12	Operator	Naeef Al Sayeed
13	**Program Sector Coordinator**	Sami Al-Juhani
14	For → SLR program & Ganet	Abdullah Al-ghamdi
15	For → Microcosm Program	Salman Al-ghamdi
16	Lunar LR	----------
17	LIDAR Specialist	----------

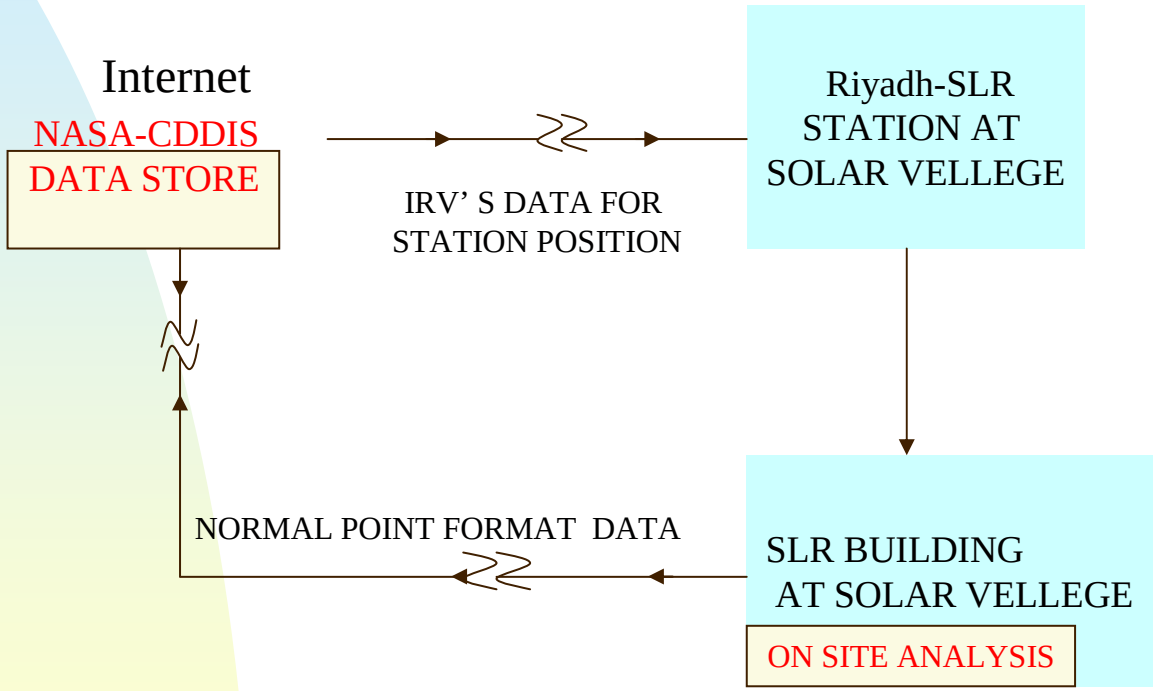
12 years

Schematic diagram of Riyadh-SLR system
An Overall view



12 years

Satellite laser ranging data procedure at Riyadh-SLR



12 years

Applications

- MANY GEODTIC PARAMETERS CAN BE DETERMINED
  WE MEASURE THE TIME OF FLIGHT OF PHOTON

- WE ARE ABLE TO DETERMINE:
  - ROTATION OF THE EARTH
  - TECTONIC MOTION
  - THE ORBIT OF SATELLITES
  - OUR OWN POSITION RELATIVE TO EARTH'S CENTER OF GRAVITY TO MANY APPLICATIONS OF SLR

12 years

"Riyadh-SLR" CONTRIBUTION TO EARTH SCIENCE

- *Riyadh-SLR with the rest global Satellite Laser Ranging (SLR) network:* have evolved into a powerful source of data for studies of the solid Earth and its ocean and atmospheric systems

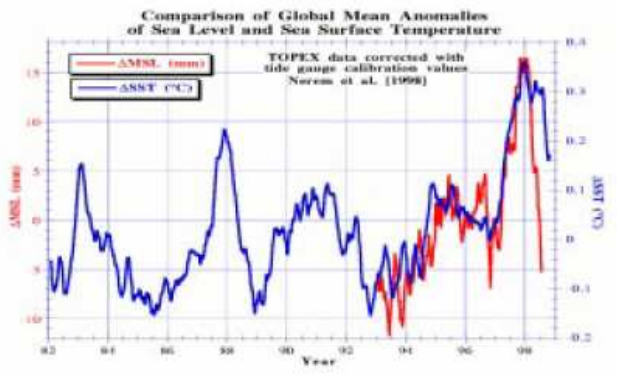
- *Riyadh-SLR with the rest global Satellite Laser Ranging (SLR) network:* provides precise orbit determination for spaceborne radar altimeter missions mapping the ocean surface (which are used to model global ocean circulation), for mapping volumetric changes in continental ice masses, and for land topography

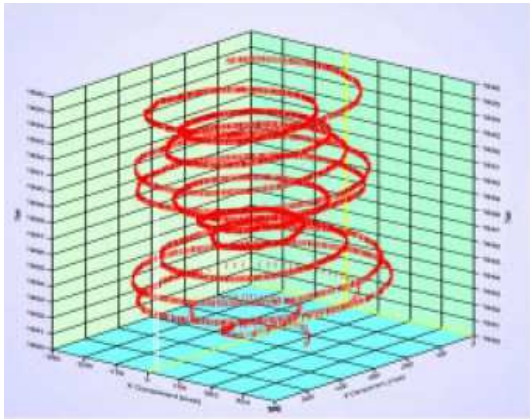
- *Riyadh-SLR with the rest global Satellite Laser Ranging (SLR) network:* provides a means for subnanosecond global time transfer, and a basis for special tests of the Theory of General Relativity

12 years

Riyadh-SLR Contributions

- SLR SUPPORTS DIRECT SENSING OF SURFACE ELEVATIONS
- SLR CONTRIBUTES TO SEA AND ICE LEVEL MONITORING
- SLR Measures the Long Term Dynamics of the Solid Earth, Oceans and Atmosphere



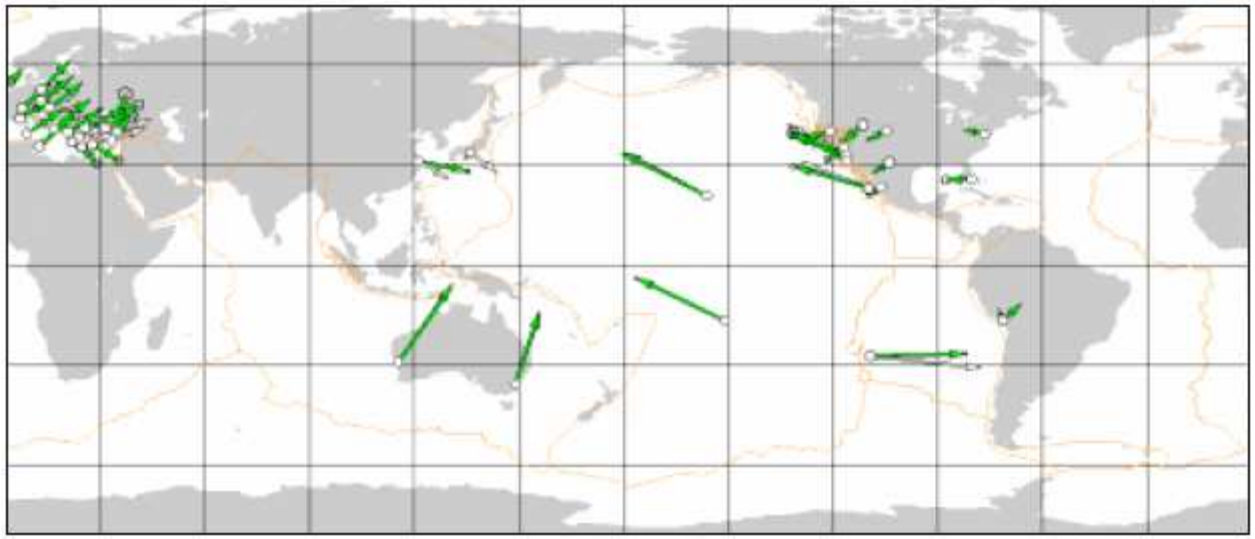


12 years

Riyadh-SLR Contributions

- SLR SUPPORTS STUDY OF TECTONIC MOTION

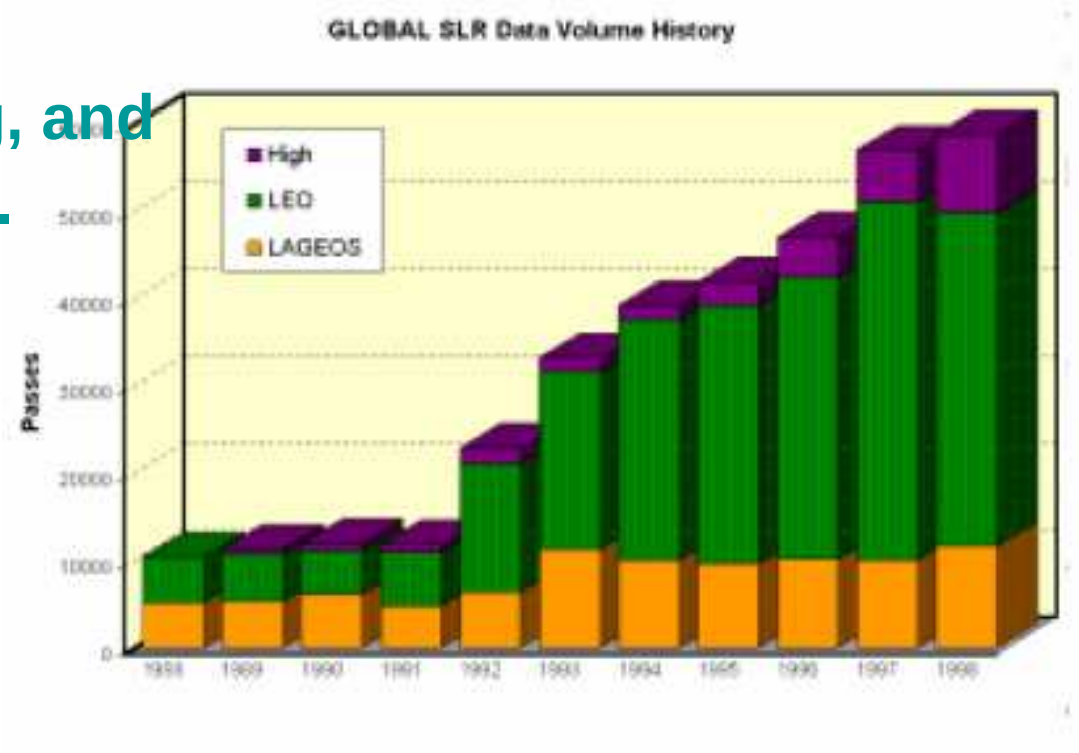
- SLR SUPPORTS RESEARCH IN FUNDAMENTAL PHYSICS



12 years

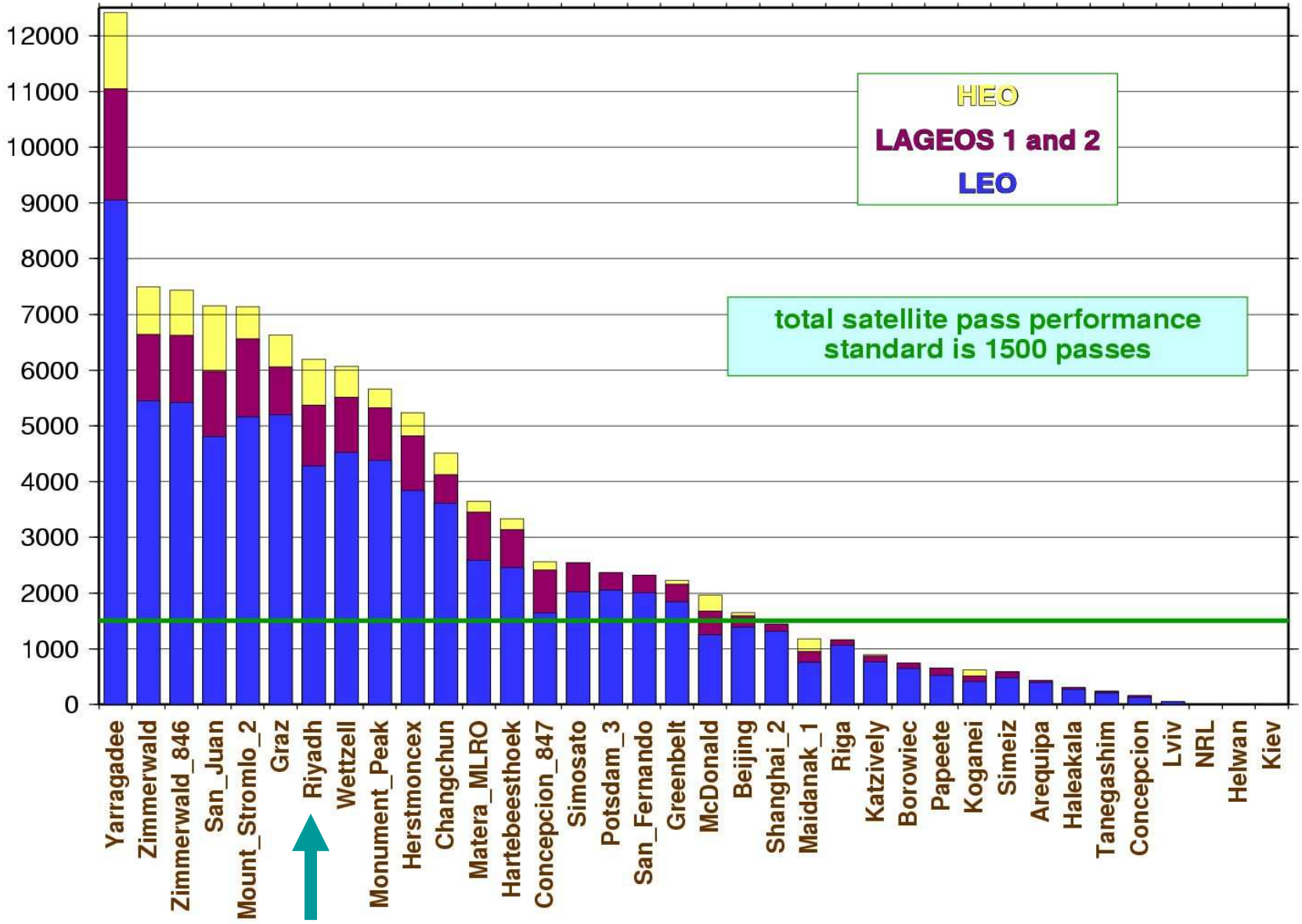
SLR OPERATIONS ARE STEADILY IMPROVING

- **SLR data yield has improved through:**
  - **Real-time data processing,**
  - **Satellite pass interleaving,**
  - **System upgrades,**
  - **Additional operating, and**
  - **Additional Satellites.**



12 years

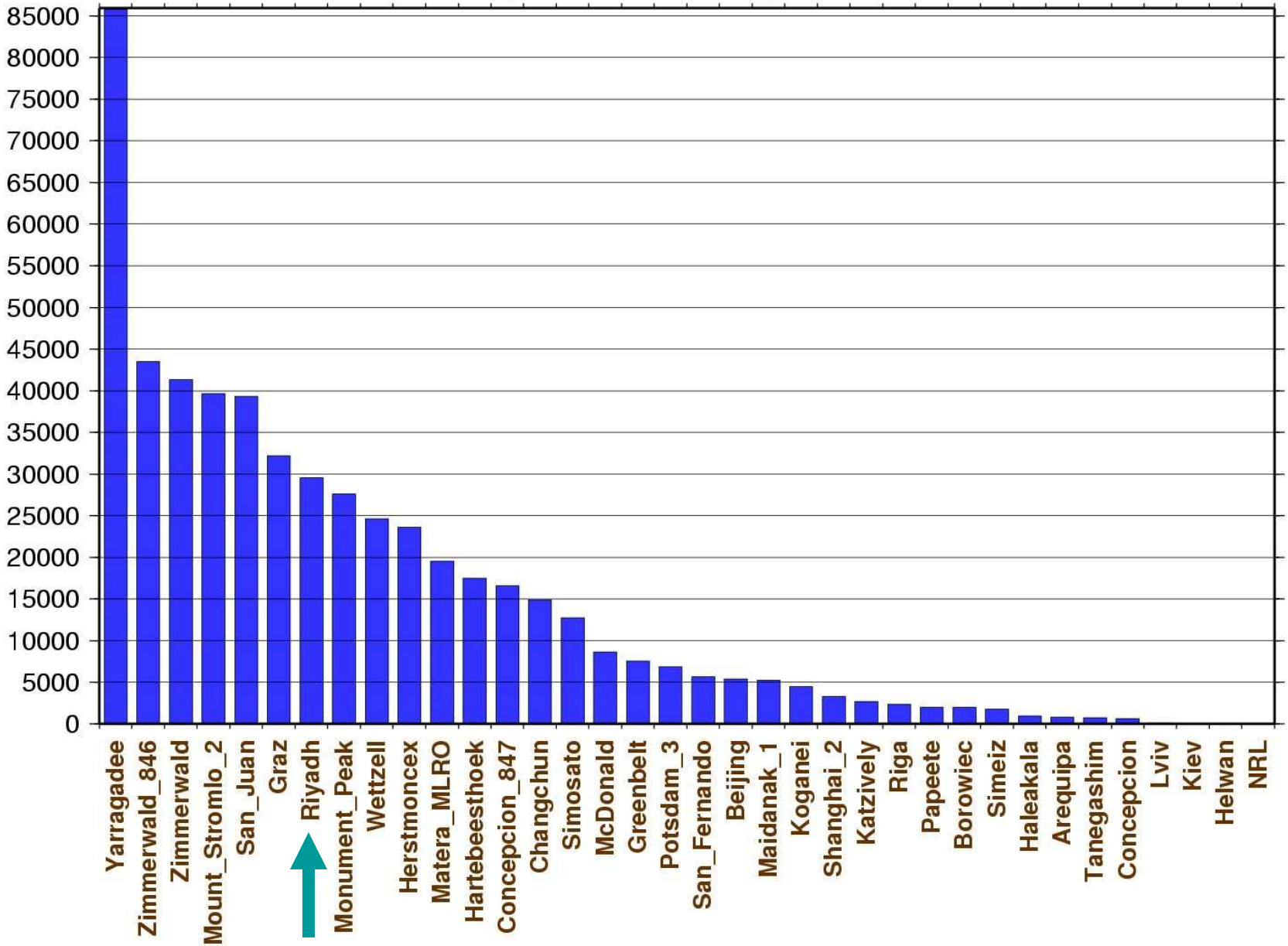
total passes
from April 1, 2006 through March 31, 2007



20070423

12 years

minutes of data
from January 1, 2007 through March 31, 2007



20070423

Next

HartRAO and KACST Cooperation

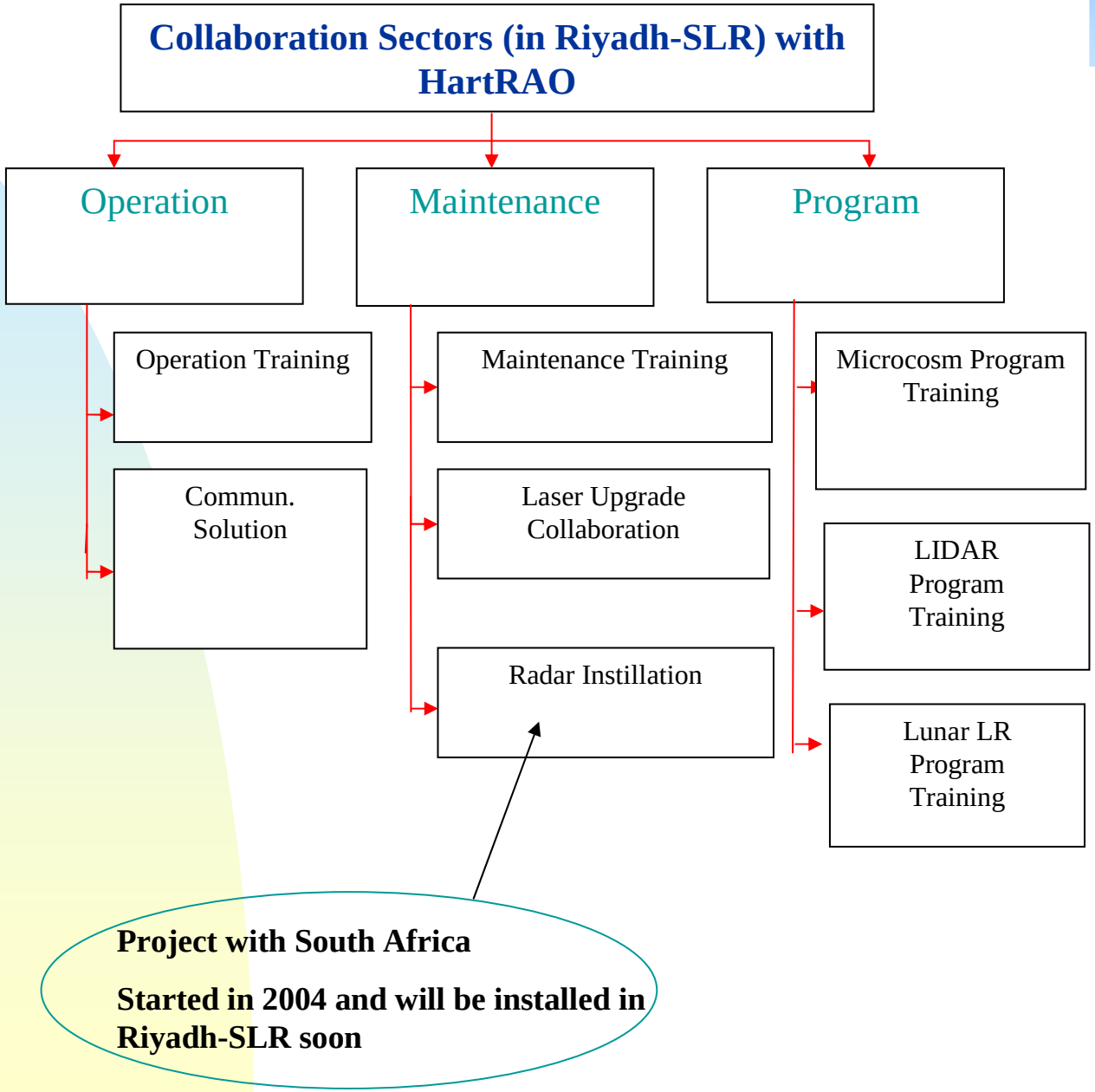
- Riyadh-SLR maintenance & Operation
- Microcosm Program
- Tie References:
  - GPS,
  - SLR,
  - DORIS

Next

SAUDI SPACE GEODESY PROGRAM

- Satellite Laser Ranging (SLR)
- Luner Laser Ranging (LLR)
- Doppler Orbitography and Radio-positioning Integrated by Satellite (DORIS)
- Navigations
  - GPS
  - Galilleo
  - GLONASS

Next


Collaboration Sectors (in Riyadh-SLR) with HartRAO
Operation
Maintenance
Program
Operation Training
Commun. Solution
Maintenance Training
Laser Upgrade Collaboration
Radar Instillation
Microcosm Program Training
LIDAR Program Training
Lunar LR Program Training
Project with South Africa
Started in 2004 and will be installed in Riyadh-SLR soon

Collaboration Time Frame

TITLE OF EVENTS	2008							2009											2010											
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Site Survey Collaboration																															
Riyadh-SLR Electronic Log-Book Collaboration																															
Telescope Inspection Collaboration																															
Operation Training Collaboration																															
Communication solution Collaboration																															
SLR RADAR Installation Collaboration																															
SLR Program Training Collaboration																															
MICROCOSM Pro. Training Collaboration																															
LIDAR Pro. Training & Project Collaboration																															
LUNAR Pro. Training & Project Collaboration																															
LASER Upgrade Collaboration																															
SLR Conference at KACST Collaboration																															

Next

MicroCosm analysis Program

- Microcosm Program has been installed in KACST main Offices in Riyadh last month
- There going to be a training in Feb. 2008 on microcosm program in Riyadh for both SA's staff

  (*This will be arranged later*)

Next

Riyadh-SLR System Development

PURPOSE

- To finesse system works to avoid catastrophic failures, minimise downtime, and therefore cost of ownership.
- To provide KACST with a state-of-the-art KHz SLR system, and therefore, a technology transfer.
- To involve KACST engineers in system development
- System (HP1000, Continuum YG501, Contraves MPACS, EOS CAMAC timing system, WeatherTronics mets etc) becoming difficult to reliably maintain due to component age and limited spares availability.
- To categorise component failures according to their impact on the system and budget.

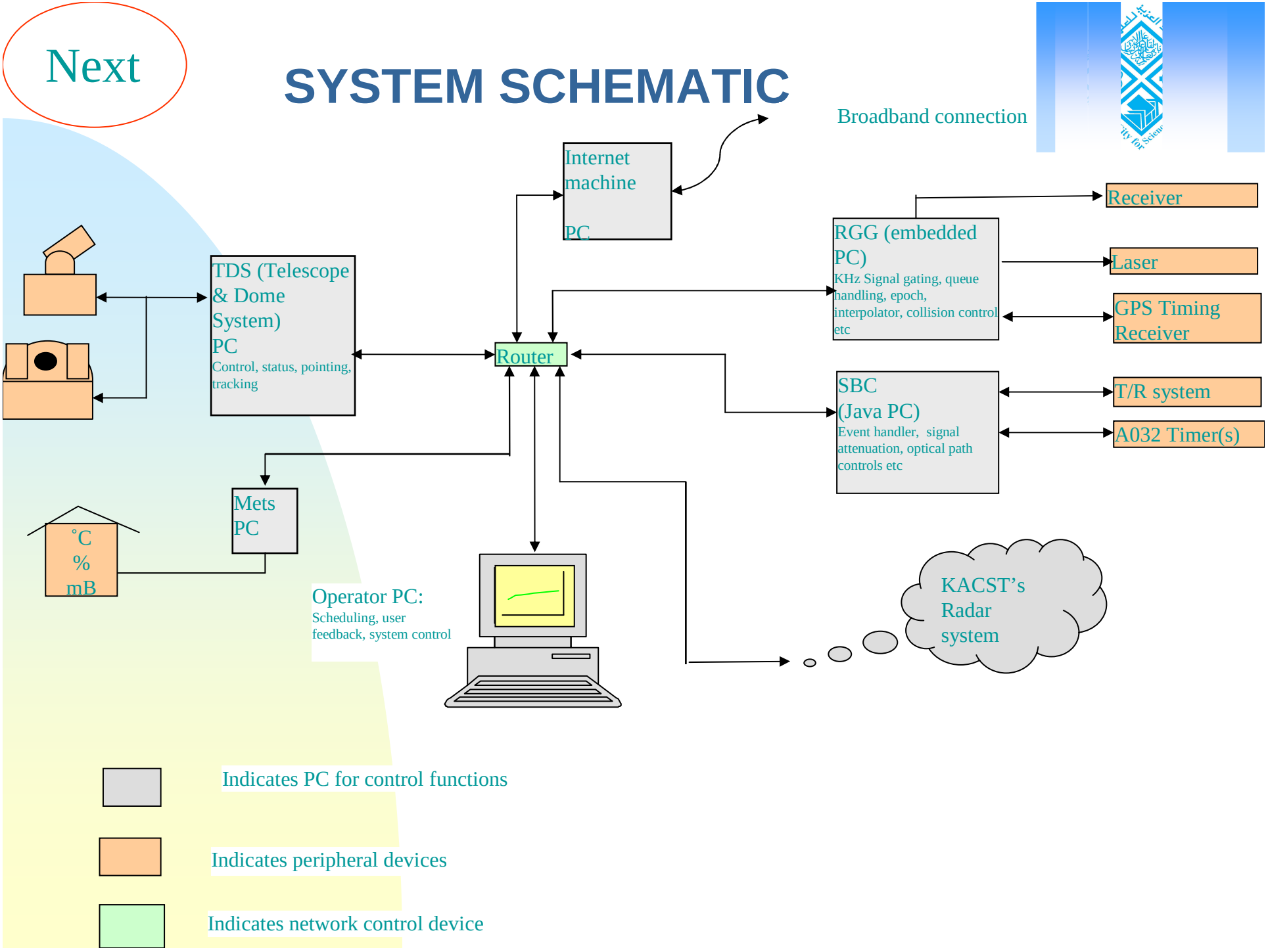
Next

Major challenges facing KACST at present

- How to migrate the system to the modern KHz regime (higher productivity, millimetre accuracy).
- How to build internal expertise necessary for controlling the project, from a technical point of view.
- How to avoid catastrophic failures from occurring in the elderly system that's currently operational.
- How to transfer system knowledge to KACST personnel.

Next

SYSTEM SCHEMATIC



Glossary

A032-ET	Of-the-shelf event timer, product of Technical University of Riga, Latvia.
Brashear	new name for Contraves Goerz Corp, Pittsburgh PA, telescope/mount and MPACS manufacturer
Cable wrap	long cables for transmitting power and signal across an axis. (Another way is to use slip rings.)
Collision	where a shot is to be transmitted within n microseconds of the gate being opened for an expected return.
LAN	local Area Network
MCP	Micro-Channel Plate (detector - multiple-stop)
RGG	Range Gate Generator (KHz sampling and control device)
SBC	Single Board Computer (PC controller for the A032-ET timers and T/R system)
SLR	Satellite Laser Ranging
SPAD	Single Photon Avalanche Diode (detector – single stop)
TBD	To Be Determined
TDS	Telescope & Dome System
TLR	Terrestrial laser ranging

Next

Doppler Orbitography and Radio-positioning Integrated by Satellite (DORIS)

KACST- IGN Agreement

The object of this Agreement is to define the mutual responsibilities of

the King Abdulaziz City for Science and Technology(KACST), and

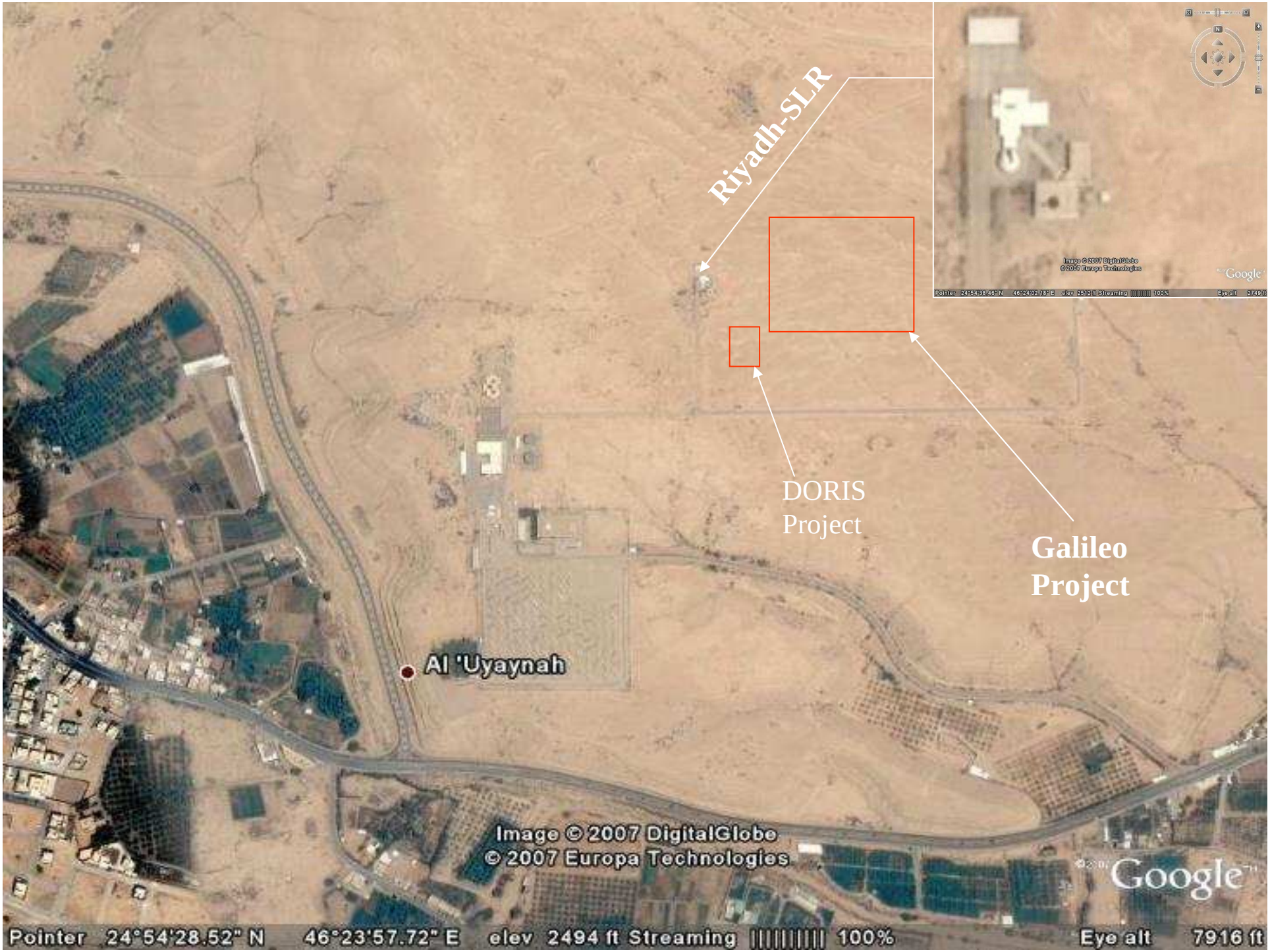
the Institut Géographique National (IGN),

for the establishment and maintenance of a DORIS orbitography station in the premises of the King Abdullah City for Science and Technology (KACST), Saudi Arabia.

Next

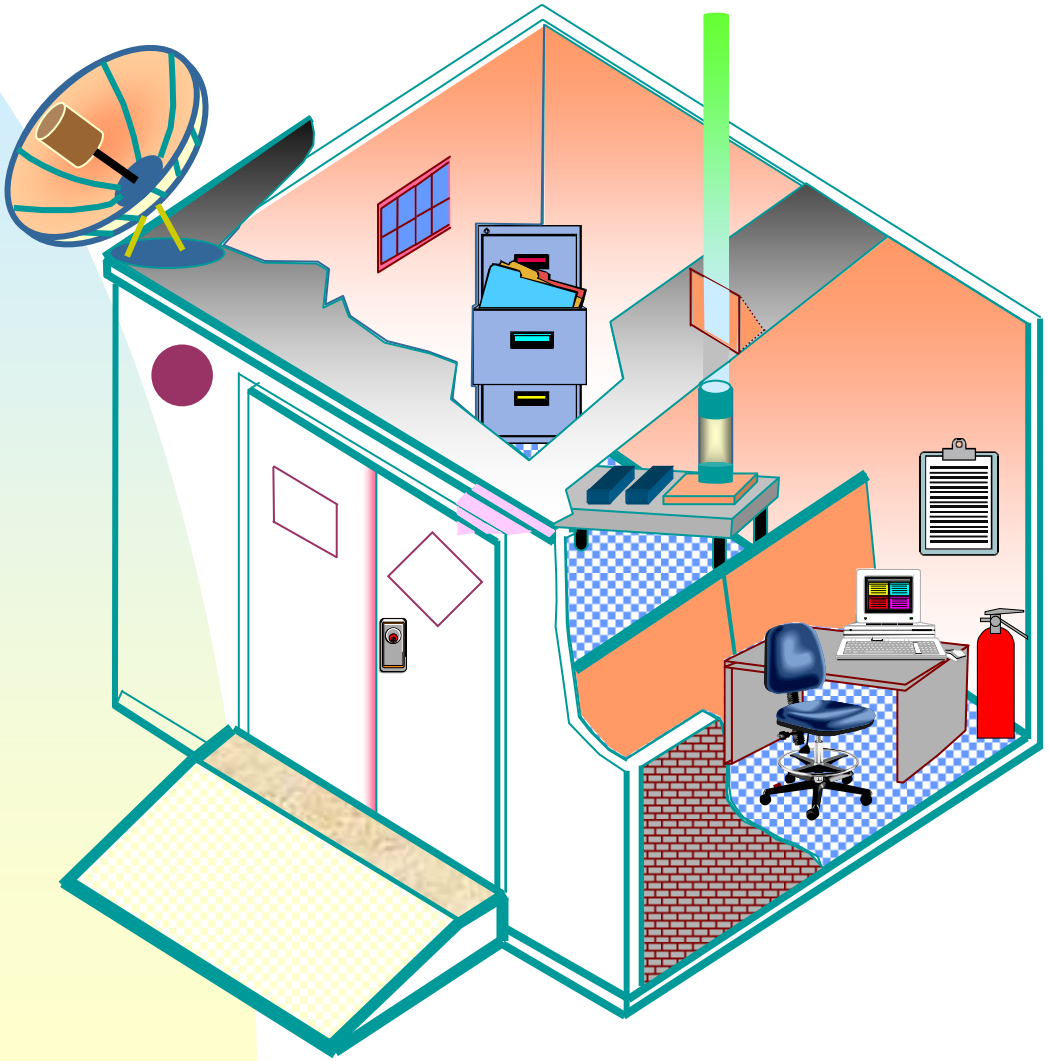
Doppler Orbitography and Radio-positioning Integrated by Satellite (DORIS)

- Centre National d'Etudes Spatiales (CNES) and the Institut Géographique National (IGN), IGN is responsible for the installation and the maintenance of the DORIS orbitography network.
- uplink radio system whose main goals are the precise determination of the orbit of low altitude satellites, and the precise positioning of ground beacons.
- It is composed of on-board satellite receivers and of a dense, permanent network of transmitting stations distributed evenly throughout the world.
- Each DORIS station is composed of the following elements:
  - beacon;
  - an external antenna;
  - an Uninterrupted Power Supply unit;
  - a weather station measuring temperature, pressure and humidity;
  - cables and accessories.

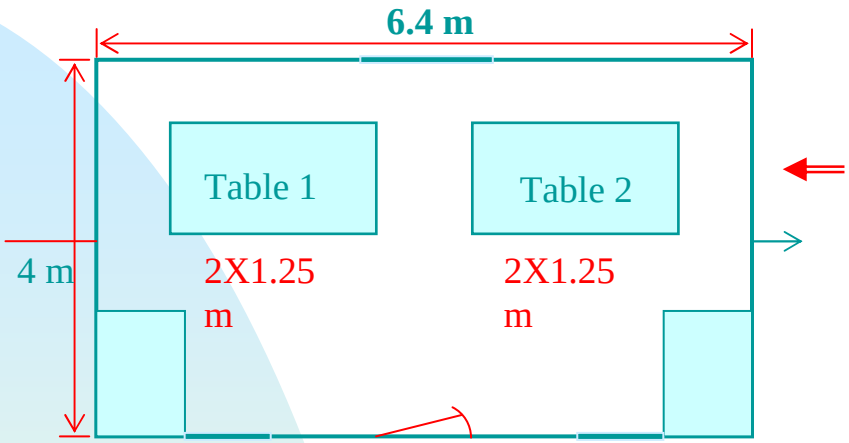

Riyadh-SLR
DORIS
Project
Galileo
Project
Al 'Uyaynah
Image © 2007 DigitalGlobe
© 2007 Europa Technologies
Google
Pointer 24°54'28.52" N 46°23'57.72" E elev 2494 ft Streaming 100% Eye alt 7916 ft

Next

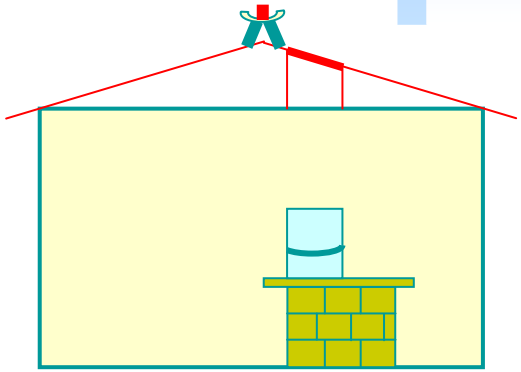
SCHEMATIC DIAGRAM OF THE LIDAR ROOM



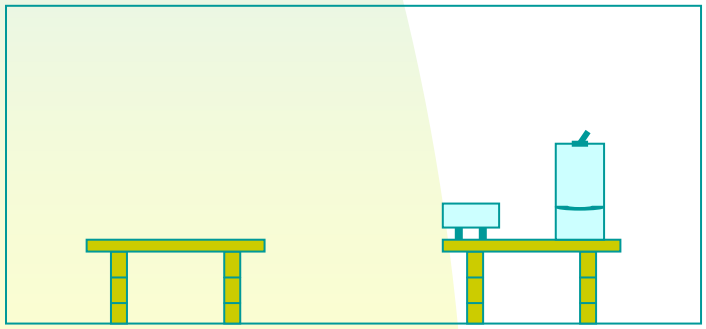
Next



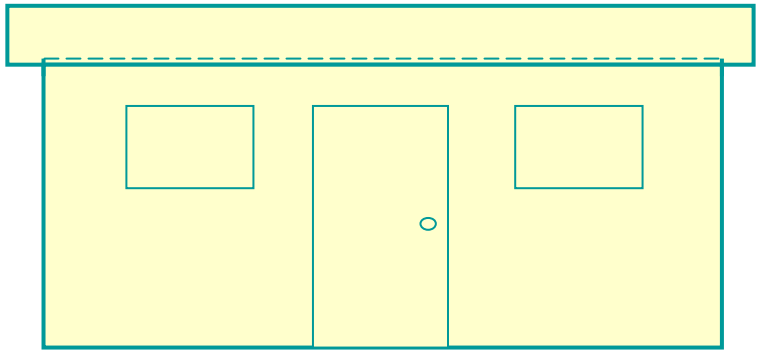
Upper view



Side View

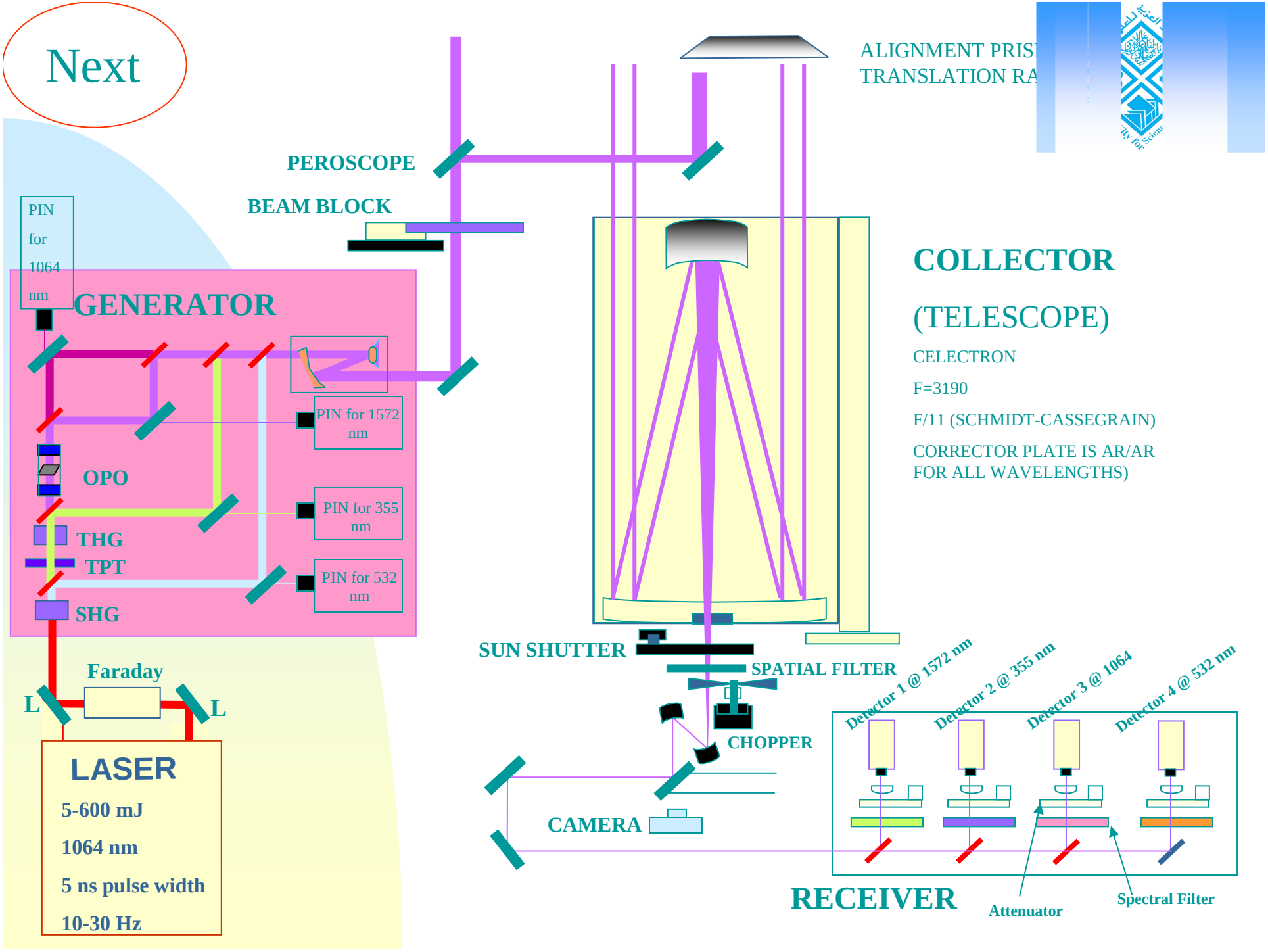


Inside View



Front view

Next


ALIGNMENT PRIS
TRANSLATION RA
PEROSCOPE
BEAM BLOCK
PIN for 1064 nm
GENERATOR
PIN for 1572 nm
OPO
PIN for 355 nm
THG
TPT
PIN for 532 nm
SHG
Faraday
L
L
LASER
5-600 mJ
1064 nm
5 ns pulse width
10-30 Hz
COLLECTOR
(TELESCOPE)
CELECTRON
F=3190
F/11 (SCHMIDT-CASSEGRAIN)
CORRECTOR PLATE IS AR/AR FOR ALL WAVELENGTHS)
SUN SHUTTER
SPATIAL FILTER
CHOPPER
CAMERA
Detector 1 @ 1572 nm
Detector 2 @ 355 nm
Detector 3 @ 1064
Detector 4 @ 532 nm
RECEIVER
Attenuator
Spectral Filter

Next

SPECIFICATIONS

Laser:

equipped with modulized laser system to ease the laser maintenance.

Our Nd:YAG laser has

5-600 mJ @ 1.064 ,
5ns pulse width,
ppr 10-30 Hz

SHG @ 0.532 , 200 mJ
THG @ 0.355 , 150 mJ
OPO @ 1.572 , 35 Mj

Telescope

type Celestron C14, F=3190, F/11, Schmidt-Cassegrain

Receiver

PMT	**detector for**	**1.064**
SPAD	**detector for**	**0.532**
SPAD	**detector for**	**0.355**
AD PIN	**detector for**	**1.572**

Continued…...

- **SOFTWARE**

  Advanced software driver to give the user more control over the printing quality

- **THE CONTROL SYSTEM**

  The control system is operated by a PC computer under a window environment

- **RADAR SYSTEM**

  Radar system for Aircraft Safety, a standard marine radar is adapted

- **ROOM DESIGN**

  The LIDAR system is housed in a room with fixed range window at zenith.

Thank you