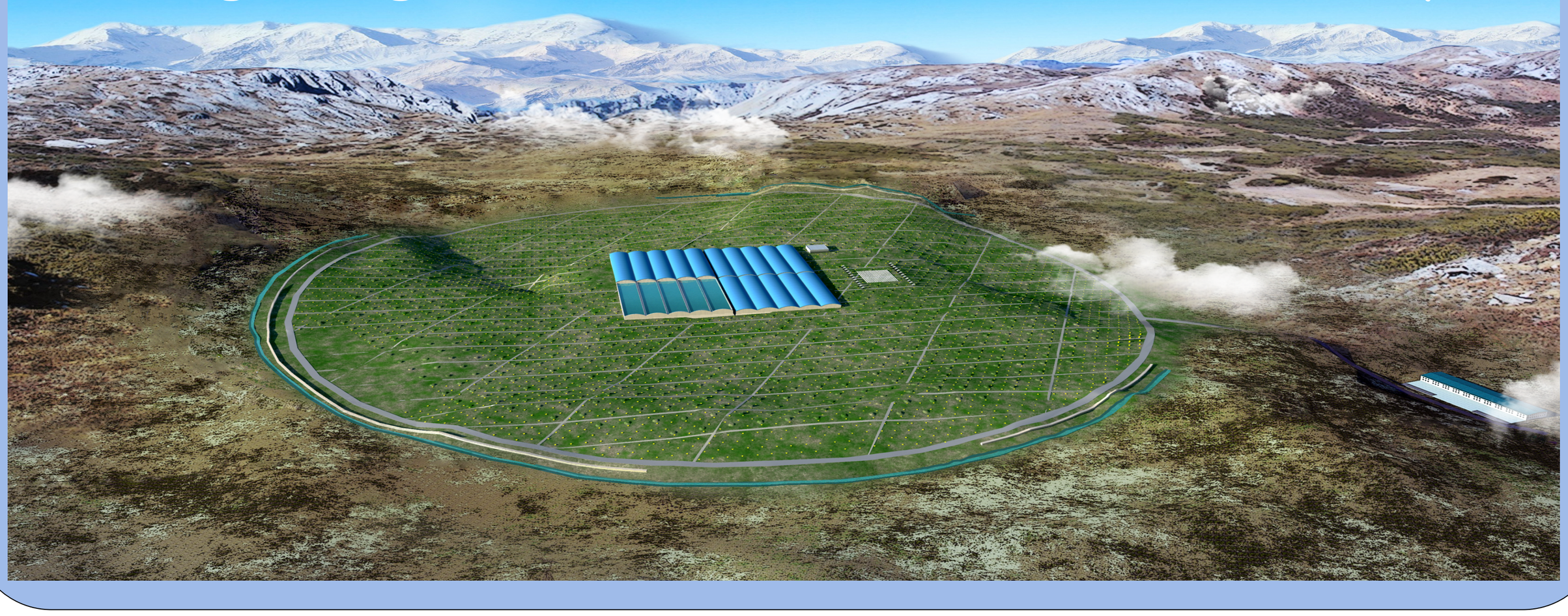
# Large High Altitude Air Shower Observatory



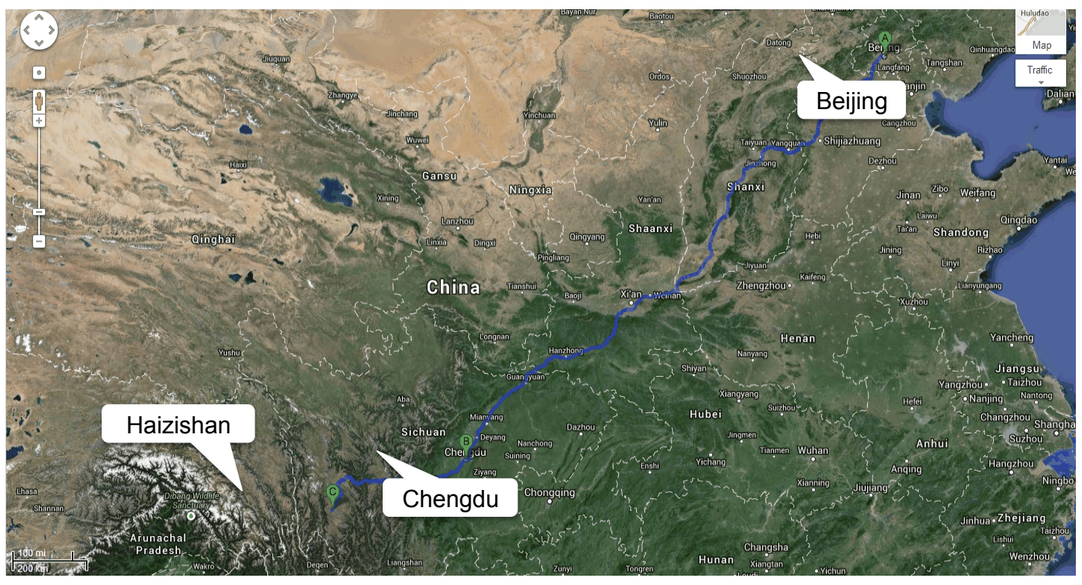
## Introduction

The Large High Altitude Air Shower Observatory (LHAASO)experiment is a new generation instrument with the aim to study with unprecedented sensitivity the spectrum, the composition and the anisotropy of cosmic rays in the energy range between $10^{12}$ and $10^{18}$ eV, as well as to act simultaneously as a wide aperture, continuosly operated gamma ray telescope in the energy range between $10^{11}$ and $10^{15}$ eV. The remarkable sensitivity of LHAASO in cosmic rays physics and gamma astronomy would play a key role in the comprehensive general program to eplore the High Energy Universe. The first phase of LHAASO will consist of three major components:

- 1 km2 array (KM2A), including 5195 1 m2 scintillator detectors, with 15 m spacing, for electromagnetic particle detection.
- An overlapping 1 km2 array of 1171 36 m2 underground water Cherenkov tanks with 30 m spacing, for muon detection (total sensitive area ~40,000 m2 ).
- A close-packed, surface Water Cherenkov Detector Array(WCDA) with a total area of about 78,000 m2.
- 18 wide field-of-view air Cherenkov (and fluorescence) telescopes (WFCTA).

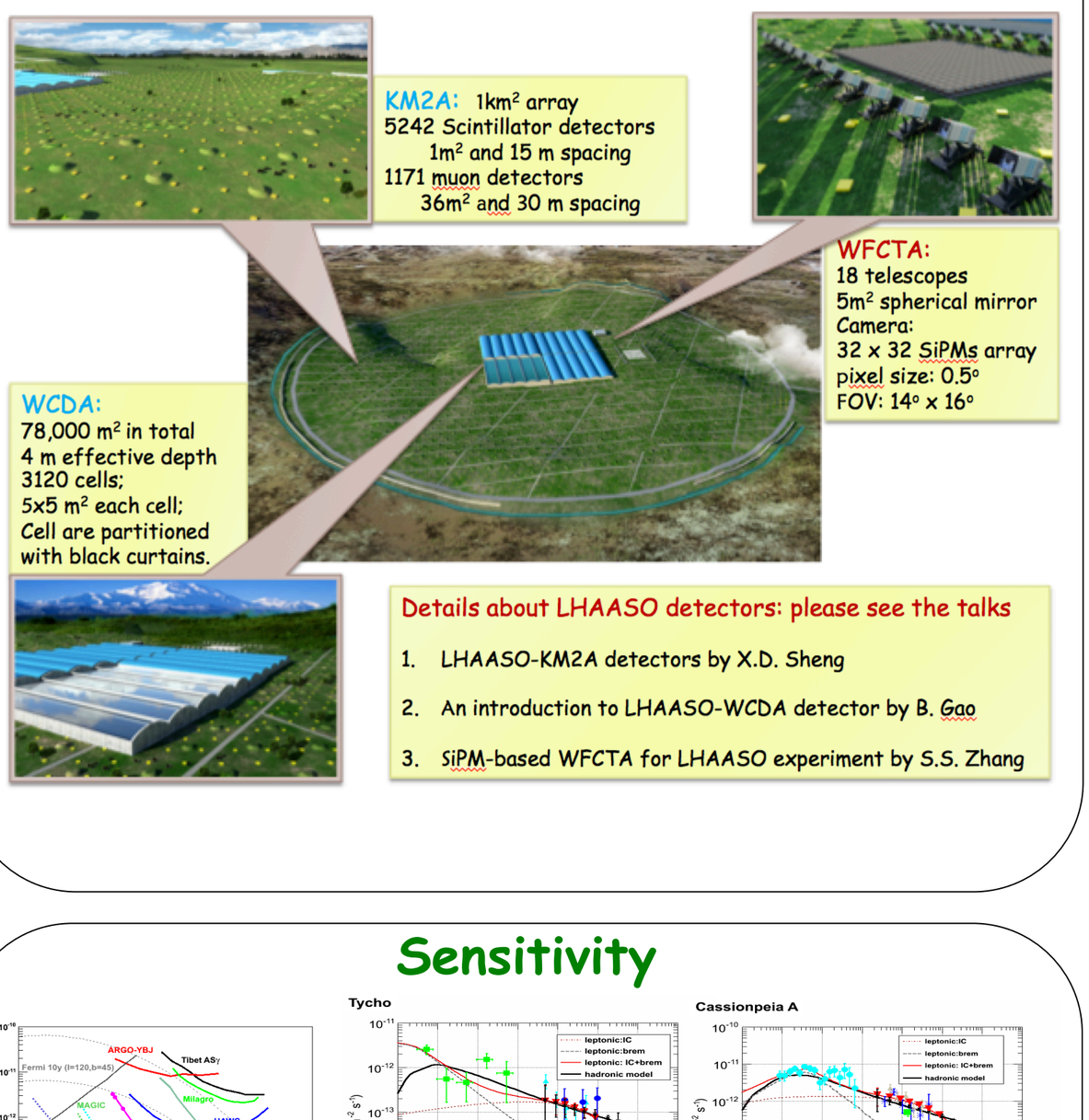
Construction of the infrastructures started in 2015. The commissioning of the first pond and of a quarter of the KM2A array is expected in 2018. The conclusion of installation in 2021.

## Site




LHAASO is located at high altitude (4410 m asl, 600 g/cm2, 29◦ 21′ 31″ N, 100◦ 08′15″ E) in the Daochen site, Sichuan province, P.R. China.

## Layout




Details about LHAASO detectors: please see the talks

1. LHAASO-KM2A detectors by X.D. Sheng
2. An introduction to LHAASO-WCDA detector by B. Gao
3. SiPM-based WFCTA for LHAASO experiment by S.S. Zhang

## Scientific targets

- LHAASO will perform an unbiased sky survey of the Northern sky with a detection threshold of ~0.01 Crab unit in the energy range 2 TeV and ~0.1 Crab around 100 TeV in one year. This unique detector will continuously survey the γ-ray sky for steady and transient sources from 100 GeV to 1 PeV.
- LHAASO will study in detail the high energy tail of the spectra of most of the γ-ray sources observed at TeV energies, opening for the first time the PeV range to the direct observations of the high energy cosmic ray sources.
- LHAASO will map the Galactic diffuse gamma- ray emission above few hundreds GeV and thereby measure the cosmic ray flux and spectrum through- out the Galaxy with high sensitivity.
- LHAASO will allow to reconstruct the energy spectra of different mass groups in the $10^{12}$ – $10^{18}$ eV with unprecedented statistics and resolution, directly measuring the knees for the spectra of Protons, Irons and other species of cosmic rays.
- LHAASO will allow to measure, for the first time, the CR anisotropy across the knee separately for light and heavy primary masses.
- LHAASO will explore for new physics, such as DM or quantum gravity
- LHAASO will be one of the major infrastructural instruments in HE astroparticle physics together with CTA, IceCube and AUGER

## Sensitivity




Integral sensitivity of LHAASO to a Crab-like point gamma ray sources. WCDA will reach 1% of the Crab Flux at 3 TeV, KM2A will reach 2% of the Crab flux at 30 TeV and 10% at 100 TeV.

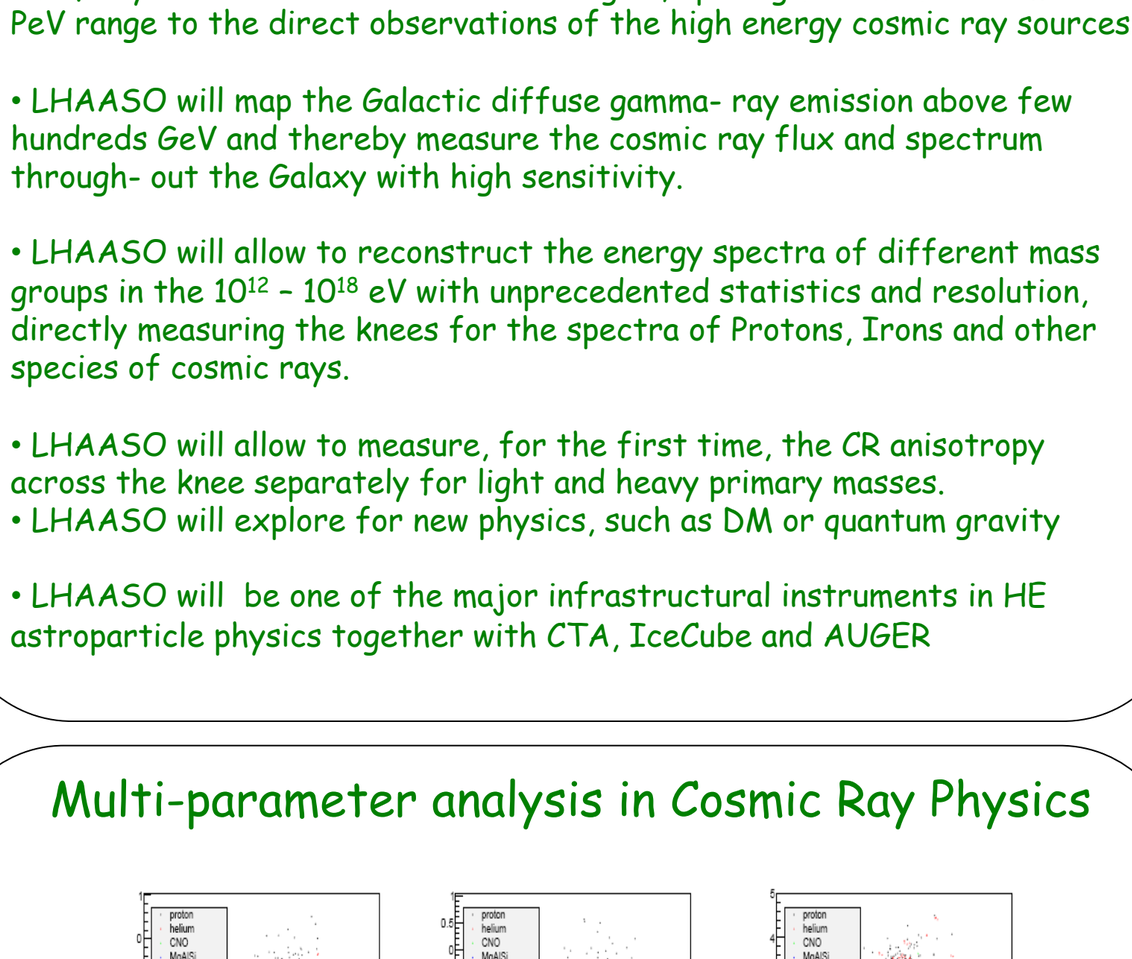
Statistic error ~10% @100TeV, LHAASO is capable to distinguish leptonic and hadronic sources

### Expected AGN observation with LHAASO




- 30-40 Blac objects with redshift available in Fermi 2LAC sources will be detectable by LHAASO in TeV;
- ~100 AGNs is expected considering another half of 2LAC BL sources have no measured redshift

## Multi-parameter analysis in Cosmic Ray Physics




Expected proton, light component, all particle and iron energy spectrum observation with LHAASO at knee region , sub-EeV region.