

Preparing for the SKAO

Alexandre Refregier (ETH Zurich)



HIRAX

Hydrogen Intensity and Real-time Analysis eXperiment

- Interferometric array up to 1024 6m dishes operating at 400–800 MHz
- Scalable array built in stages: 2 (qualification), 8, 128 (funded), 256 then expand to 1024 and operate full array for 4 years
- SARA0 Karoo site co-located with SKAO
- Dishes stationary and tiltable
- 15,000 deg² Neutral Hydrogen survey with redshifts between 0.8 and 2.5

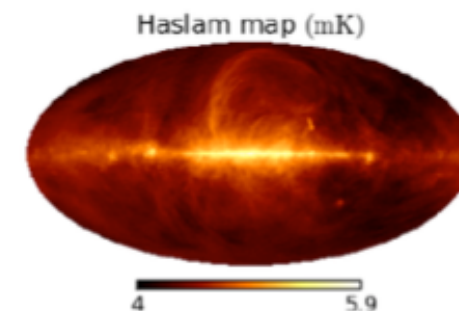
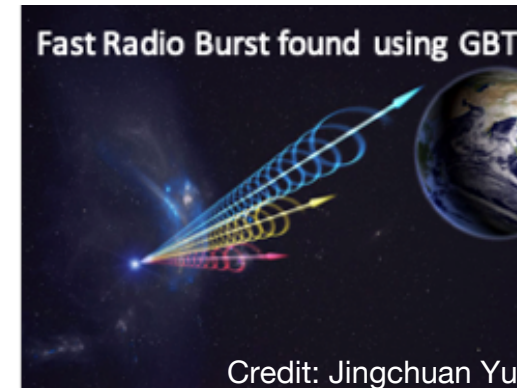
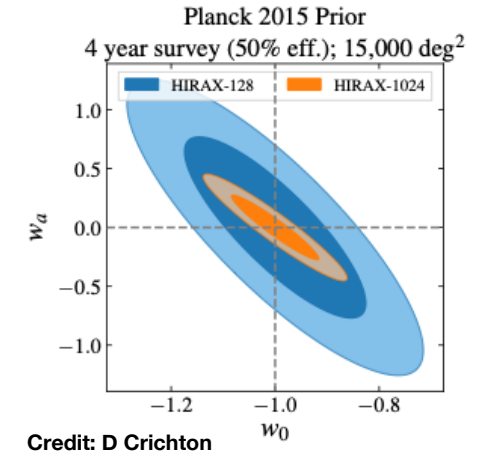
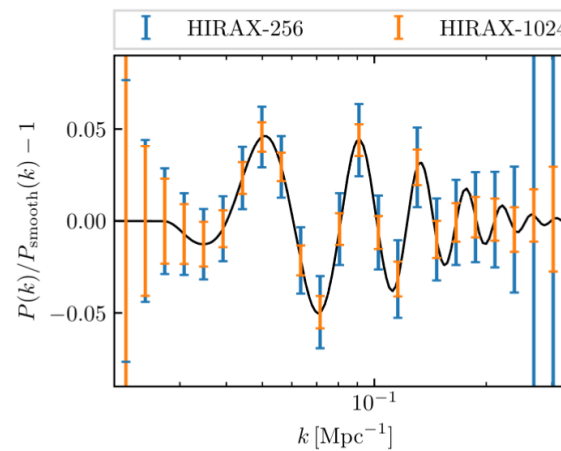
Dish diameter	6 m
Dish focal ratio	0.21
Collecting area	7200 m ²
Frequency range	400–800 MHz
Frequency resolution	1024 channels, 390 kHz
Field of view	5°–10°
Resolution	0.2°–0.4°
Target system temperature	50 K

Crichton+ (2022)



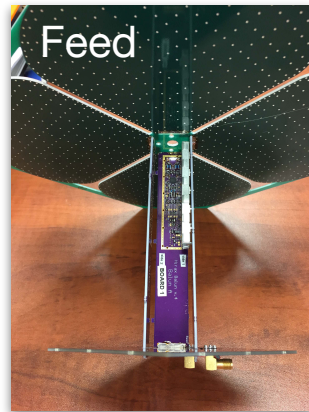
Science Goals

- Measure baryon acoustic oscillations with 21cm intensity mapping: characterise dark energy
- Cross-correlation with other cosmological surveys
- Radio transient searches, fast (FRBs) and slow
- Pulsar searches: 15 uJy/scan - search in each of 10-20 beams, galactic centre searches
- Neutral hydrogen absorbers: up-res frequency in beam-formed data (FFTs on GPUs)
- Diffuse galactic polarization

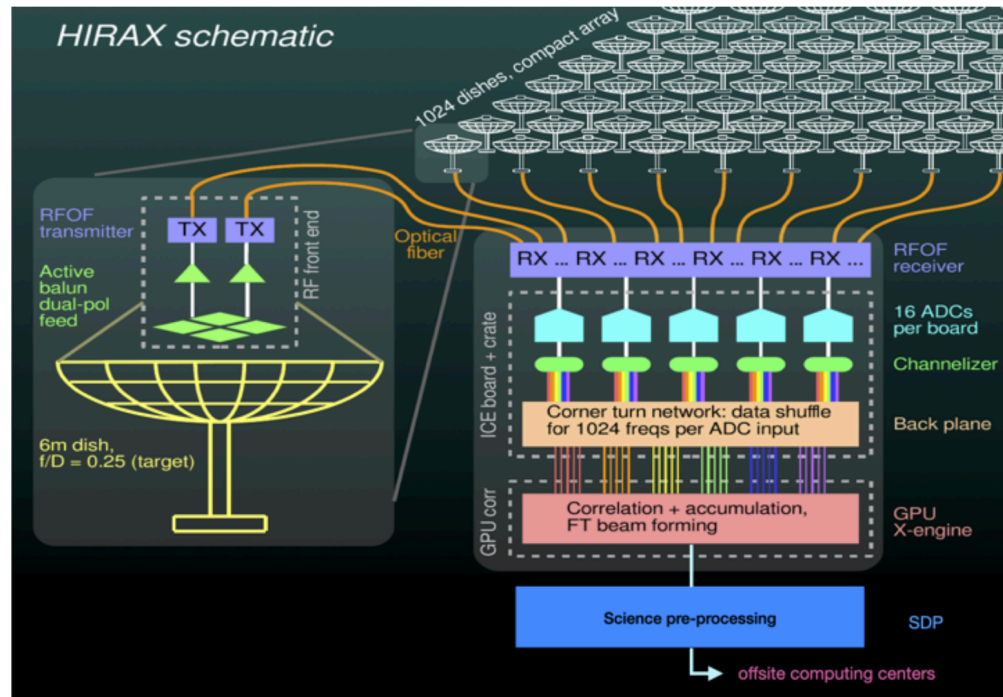


HIRAX Instrument

RFoF transmission



Feed



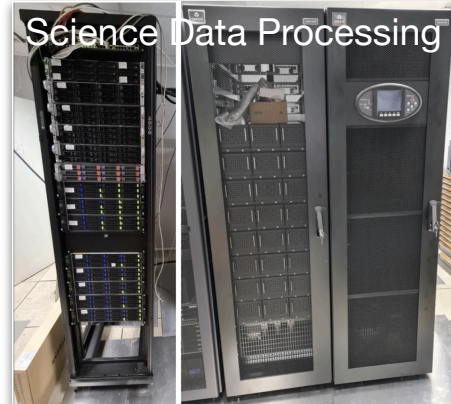
ICE Boards



X-engine



Science Data Processing



Dish



HIRAX Status

- Funding is secured for the 128-dish array
- NRF strategic research equipment (SRE) funding. Swiss SNF funding for the X-engine (GPU correlator), Science Data Processing system and Dish metrology. Canadian (McGill) funding for F-engine (ICE boards). Recent funding from the Simons Foundation.
- The telescope mechanical assembly (TMA) are being produced under a partnership between HIRAX (UKZN), Advance Fiber form (AFF) and the National Research Council of Canada (NRC)
- Two qualification dishes have recently been installed at the Klerefontein test site: first light
- Construction of the primary array will start soon at the Swartfontein site: first 8-dish array followed by 32-dish array by end of 2025



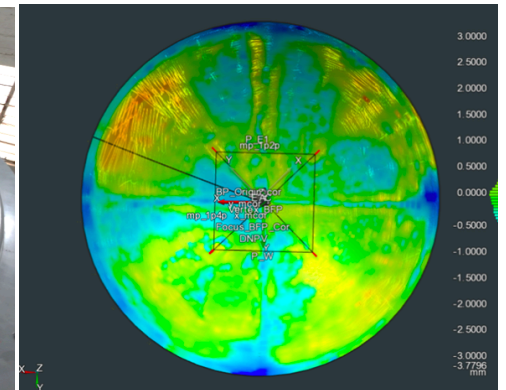
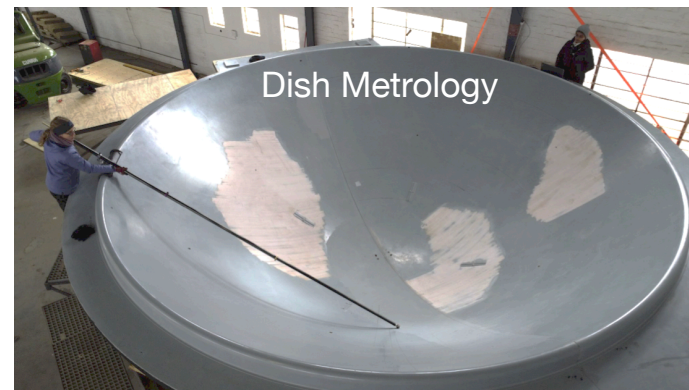
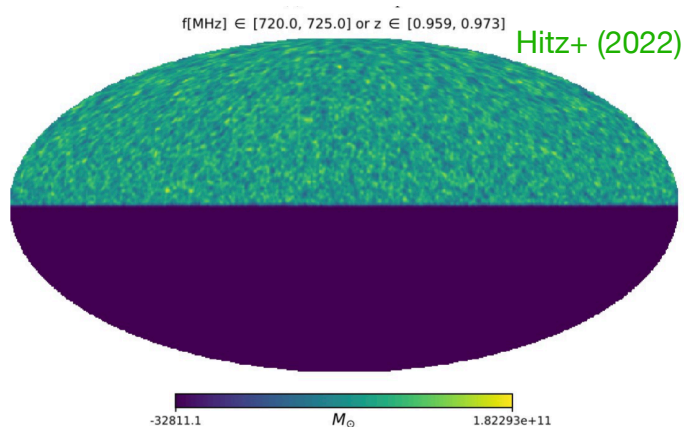
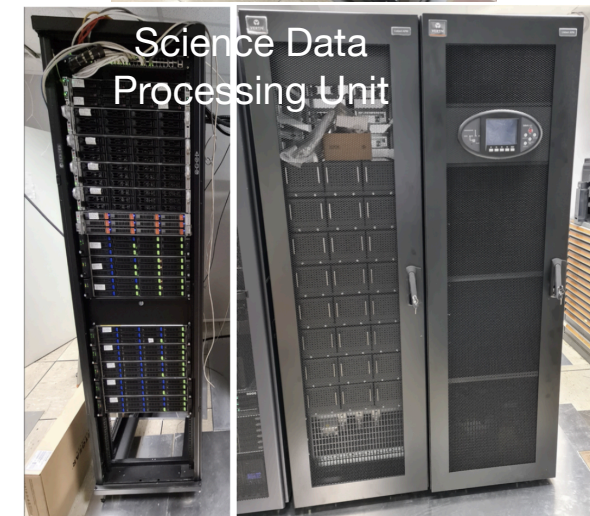
First Light!

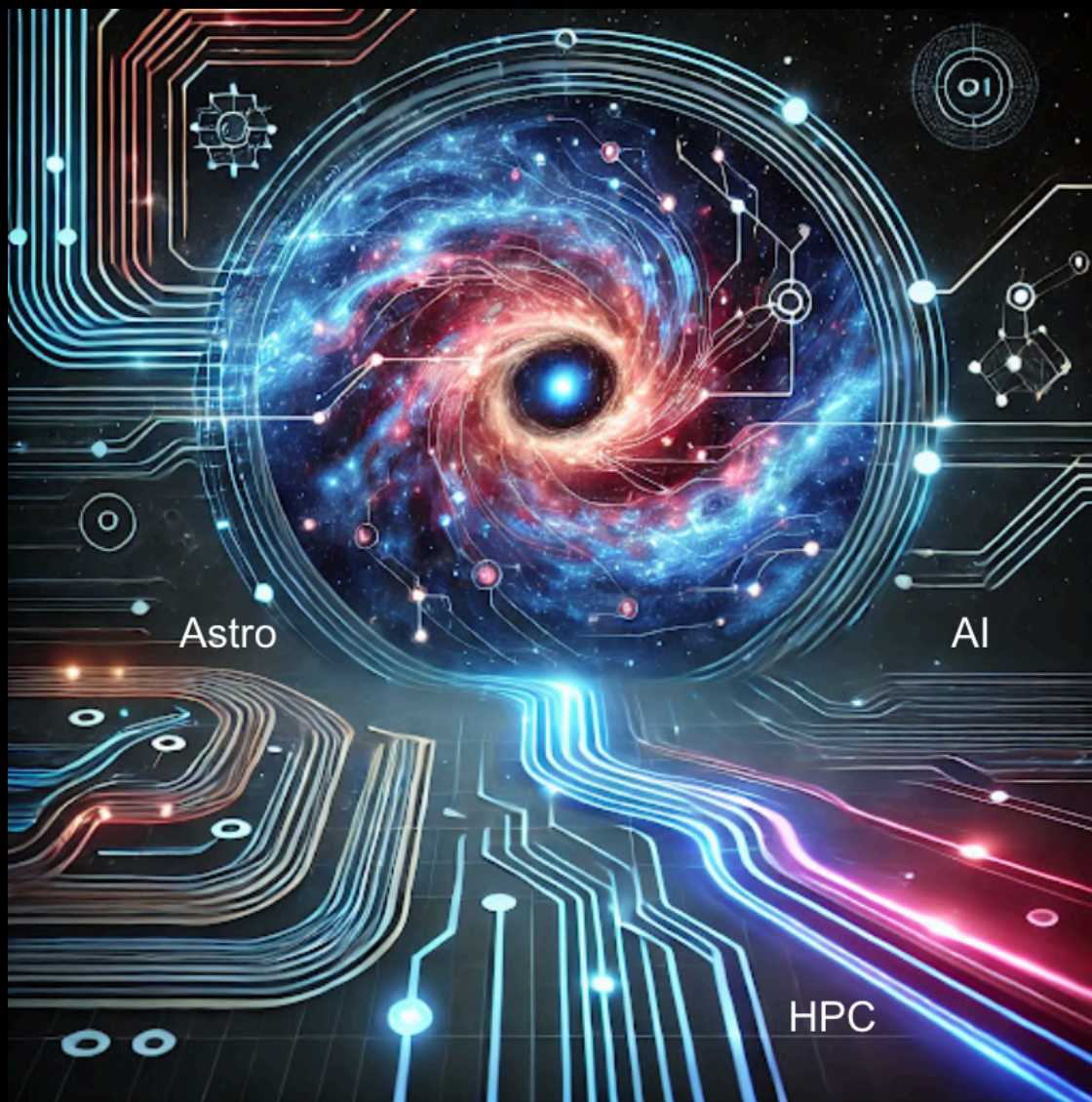


Swiss HIRAX Contribution

Swiss contributions include:

- Design, construction and testing of Digital correlator (X-engine) with Canada (earlier FLARE)
- Design, construction and testing of Science Data Processing Unit (earlier FLARE)
- Beam calibration R&D using holography (earlier FLARE) and drone with tests at Bleien Observatory
- High precision dish metrology (ongoing FLARE)
- Co-coordinators of the HIRAX Simulation, Post-Processing, Theory, and Correlator Working Groups. Members of the HIRAX Management Team and Executive Management Committee
- Science: sky and telescope simulations, analysis pipeline, systematics





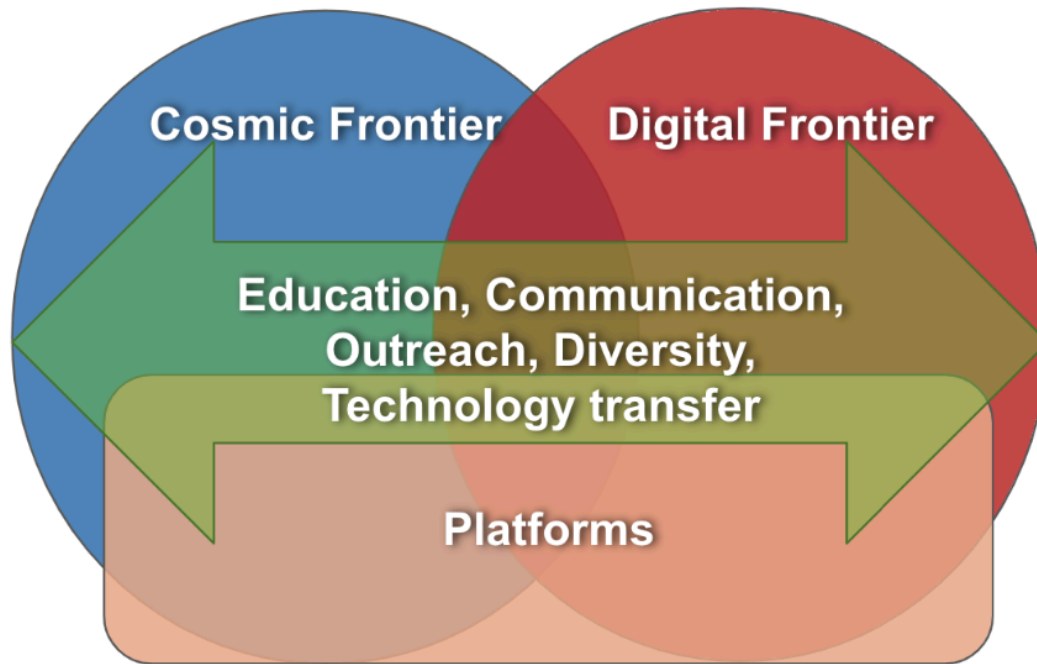
Proposal for a
National Center of
Competence in
Research (NCCR)
under review by the
Swiss National Science
Foundation (SNSF)



D+Cosmos

Decoding
the Universe

D+Cosmos



Consortium of 11 institutions, including federal universities, cantonal universities, universities of applied sciences and arts, and national platforms:

ETH Zurich, EPFL, U. Geneva, CSCS, FHNW, HES-SO, ISSI-Bern, SDSC, U. Basel, U. Zurich, and ZHAW

