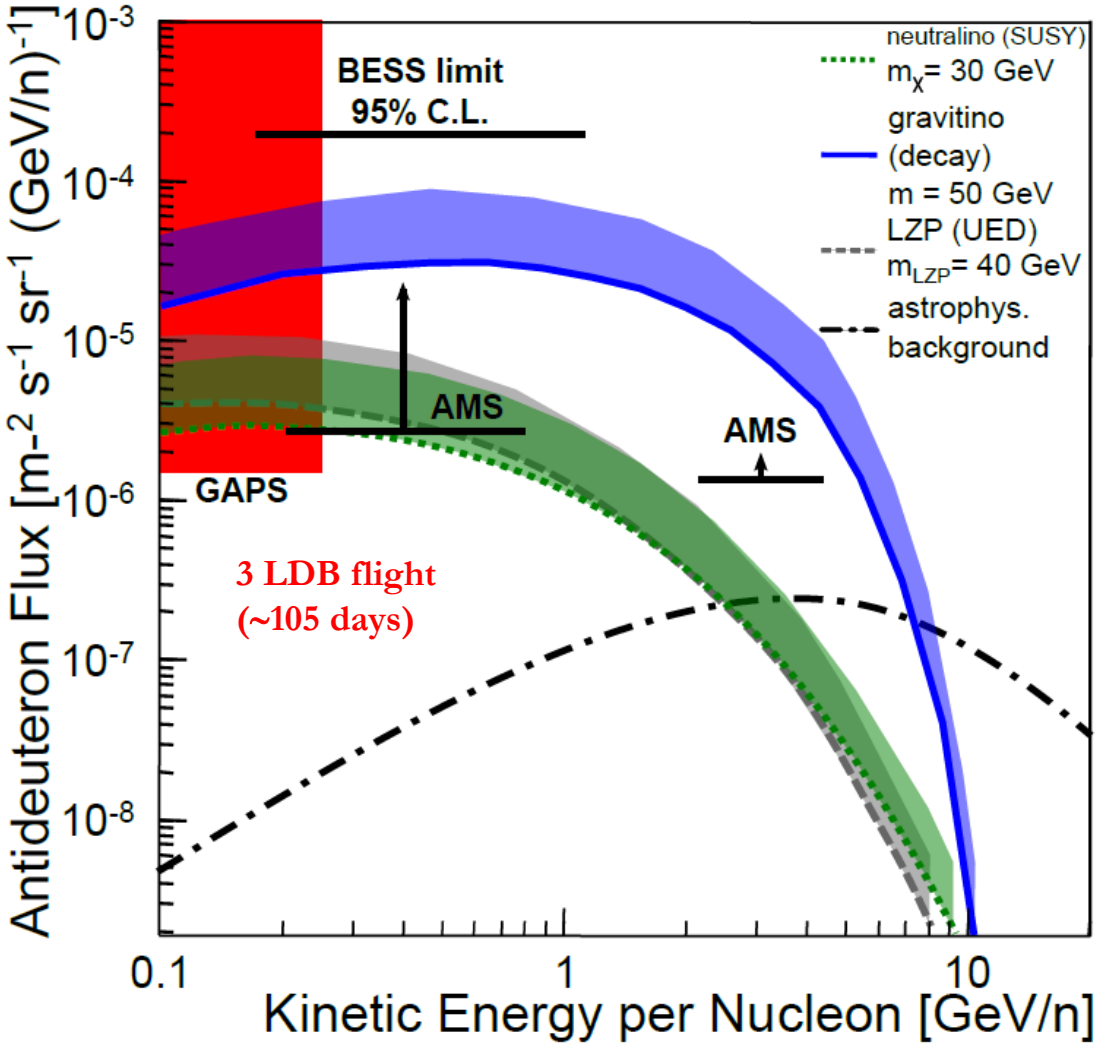
GAPS
General Antiparticle Spectrometer

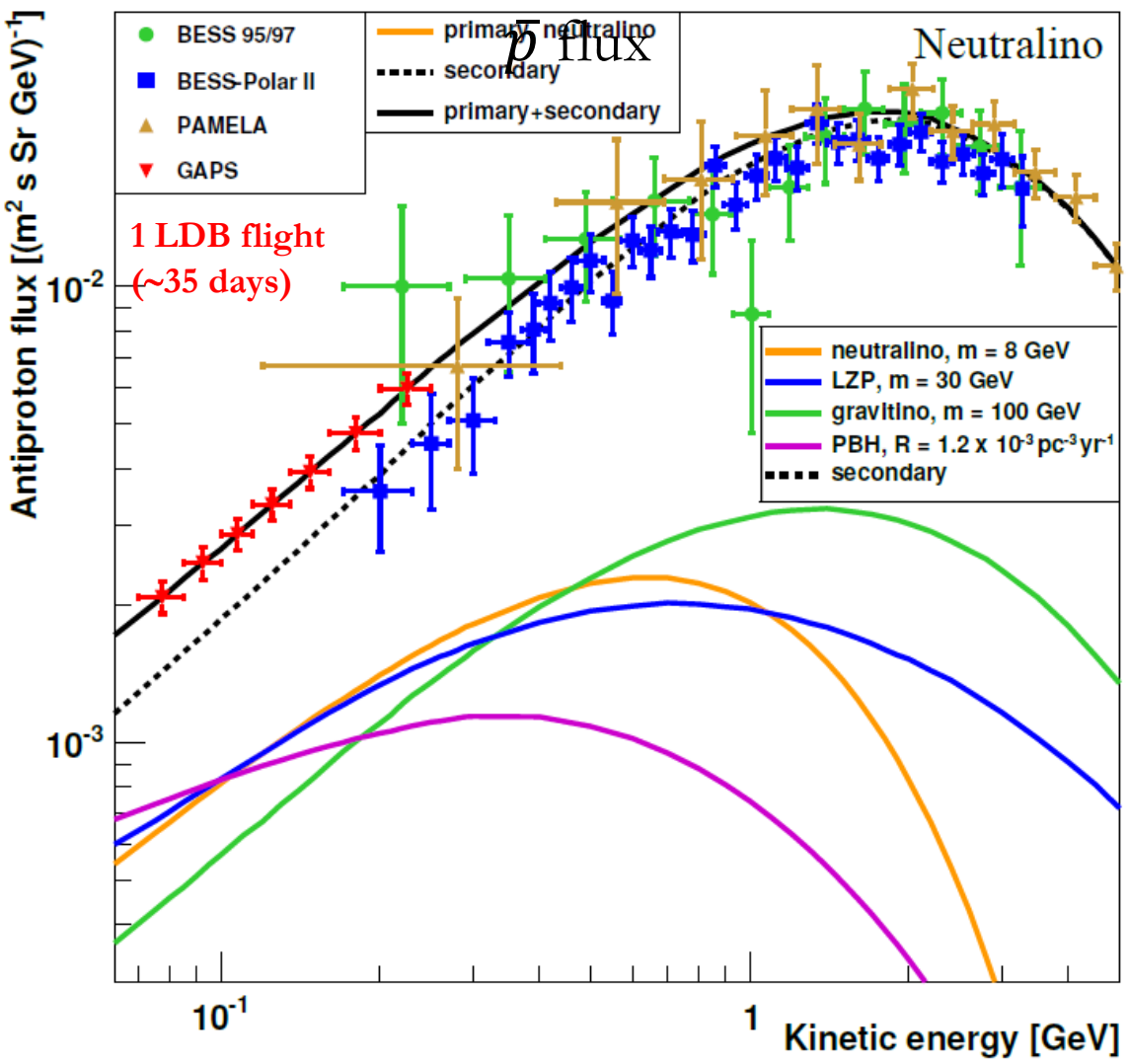


The science

Indirect DM search

$\bar{D}$ measurement :

- **Low astrophysical background** → secondary $\bar{D}$ from CR interaction with ISM
- **Sizable** primary $\bar{D}$ signal from several DM models
- **Complementary** to other searches:
  - Collider exp.
  - direct underground exp.
  - other indirect methods

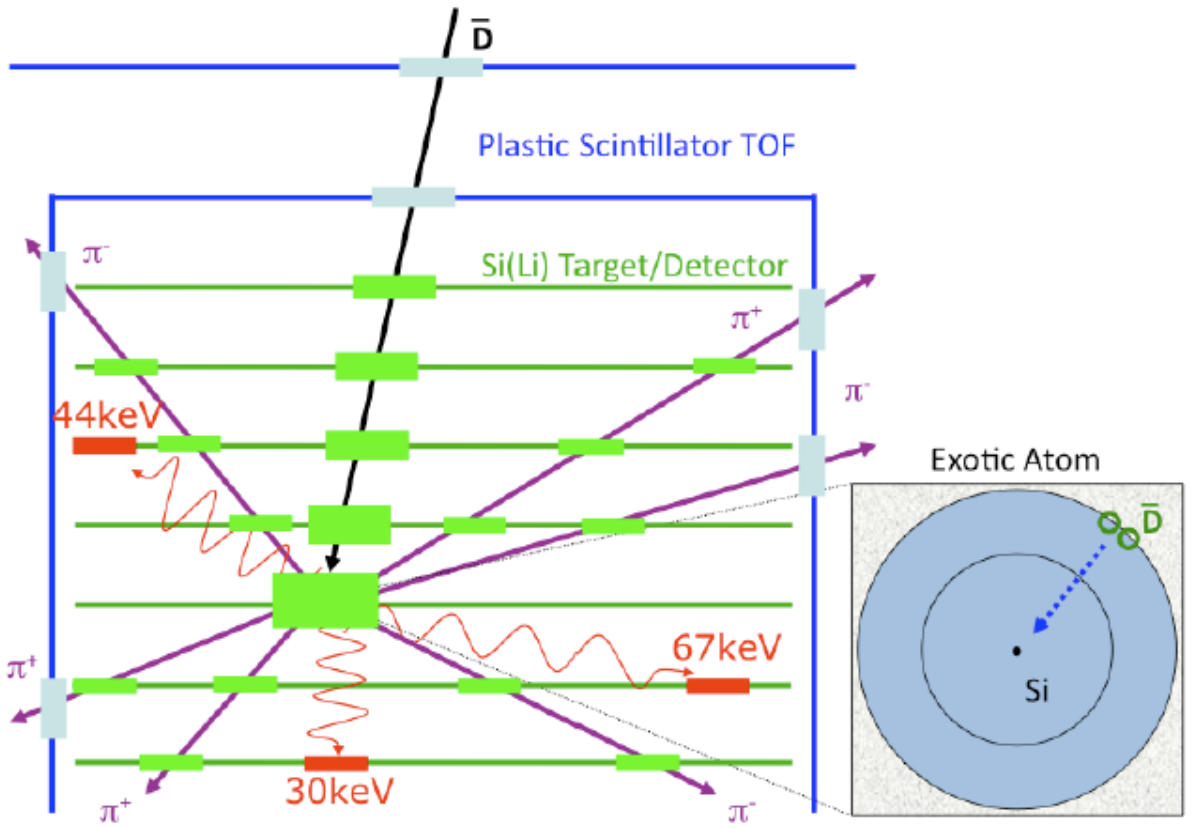


The science

Indirect DM search

$\bar{p}$ measurement :

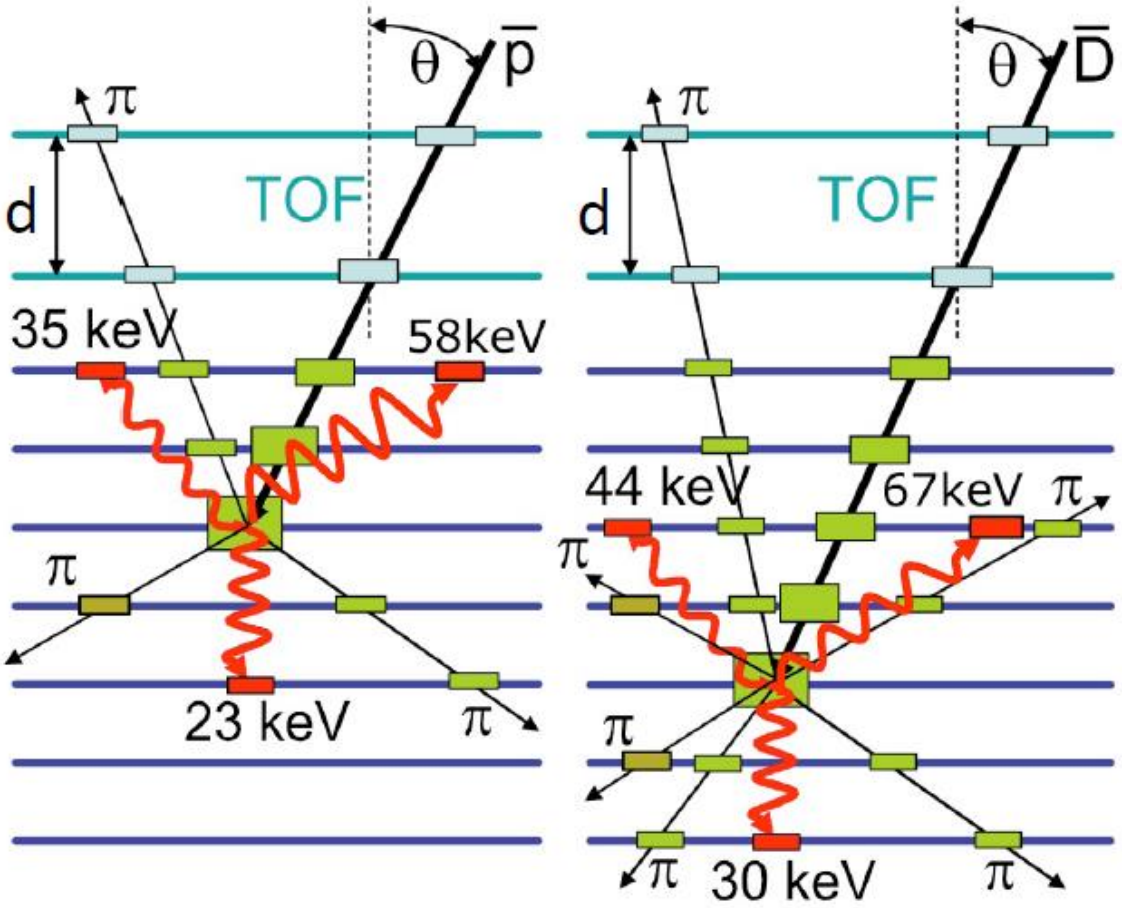
- Precise flux measurement at low energy
  - 1 LDB flight → 10 time more statistics @0.2GeV compared to BESS and PAMELA



T. Aramaki et al., AstroPh 74 (2016) 6, arXiv: 1506.02513

Detection concept

1. Low-energy antiparticles ($\bar{p}$, $\bar{D}$) slow-down and stop in the medium, forming an **exotic atom** in its **excited** state
2. The atom de-excites via emission of **X-rays**
3. The antiparticle undergoes **annihilation** with atomic nucleus, emitting **pions** and **protons**



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$\bar{D}$ vs $\bar{p}$ identification

Based on:

- Time-of-light measurement along antiparticle trajectory
- Multiple dE/dx measurements
- X-ray energies
- Pion/proton multiplicity

TOF plastic scintillators

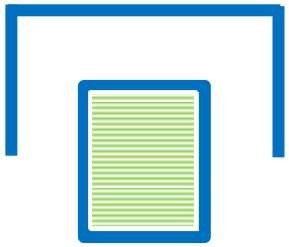
- outer TOF: 3.6×3.6m^2, 2m height
- inner TOF: 1.6×1.6m^2, 2m height
- **1m** b/w outer and inner TOFs
- **500 ps** timing resolution
- 16.5 cm wide plastic paddles
- PMT on each end

Si(Li) detectors

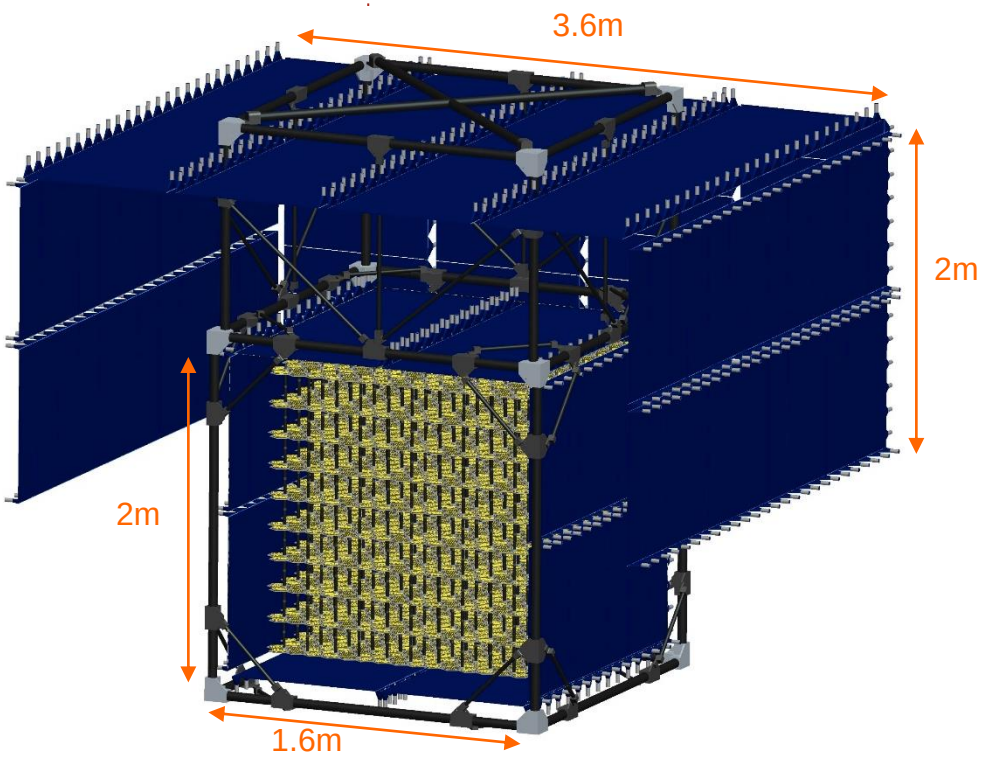
- 12×12 **Si(Li)** wafers
  - **4 inch** diameter
  - **2.5mm** thickness
  - segmented into **4 strips**
- **10 layers** with 20 cm spacing

→ 3D particle tracking

- 100 ns timing resolution
- **3 keV** energy resolution
- dual channel electronics
  - X-ray: 20 - 80 keV
  - charged particles: 0.1 - 100 MeV



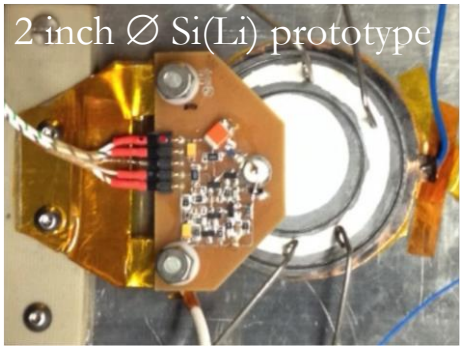
The instrument

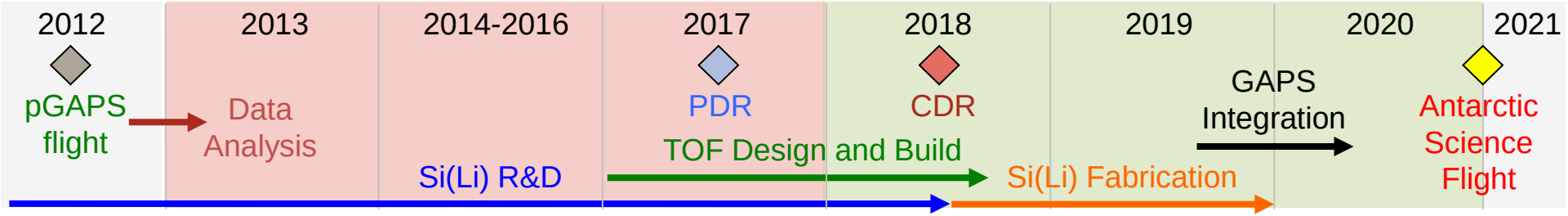


operation temperature: -35°C
Cooling system: oscillating heat pipe (OHP)

Project history and status

- Proposed in 2002
- Detection concept (X-ray yelds) validated in accelerator beam-test at KEK in 2005
- Final instrument design finalized in 2009
- Prototype flight (pGAPS) at JAXA/ISAS balloon facility in 2012 (first time for Si(Li) operated on balloon)
- Project submitted to NASA several times, rejected for budget reasons
- New submission in 2016 with INFN participation
  - Waiting for NASA answer (late september)!!!





The collaboration

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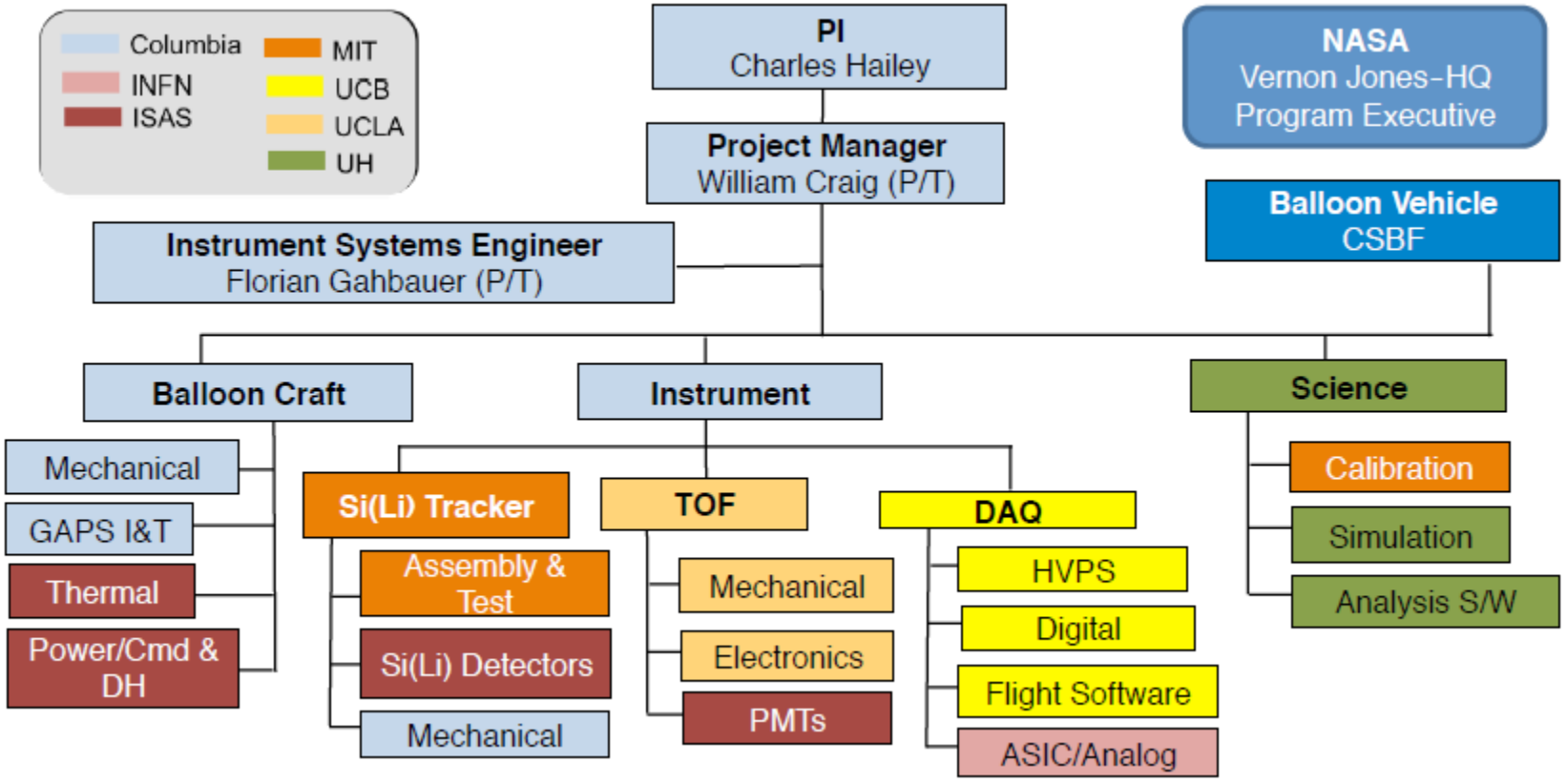
Team responsabilities and workflow



Ruolo italiano

- Contributo alla realizzazione degli ASIC per il DAQ dei rivelatori Si(Li)
  - INFN Trieste (V.Bonvicini, B.Gobbo, G.Zampa)
  - INFN Pavia – Uni.Bergamo (V.Re, M.Manghisoni, +1)
- Partecipazione allo sviluppo del software di simulazione e analisi
  - INFN Trieste (M.Boezio +1)
  - INFN Firenze (E.Vannuccini, S.Bottai)
  - INFN RomaII (R. Sparvoli)
- Interpretazione dei dati
  - INFN Torino (N.Fornengo, F.Donato)