The Center for Astrochemical Studies at the Max Planck Institute for Extraterrestrial Physics.

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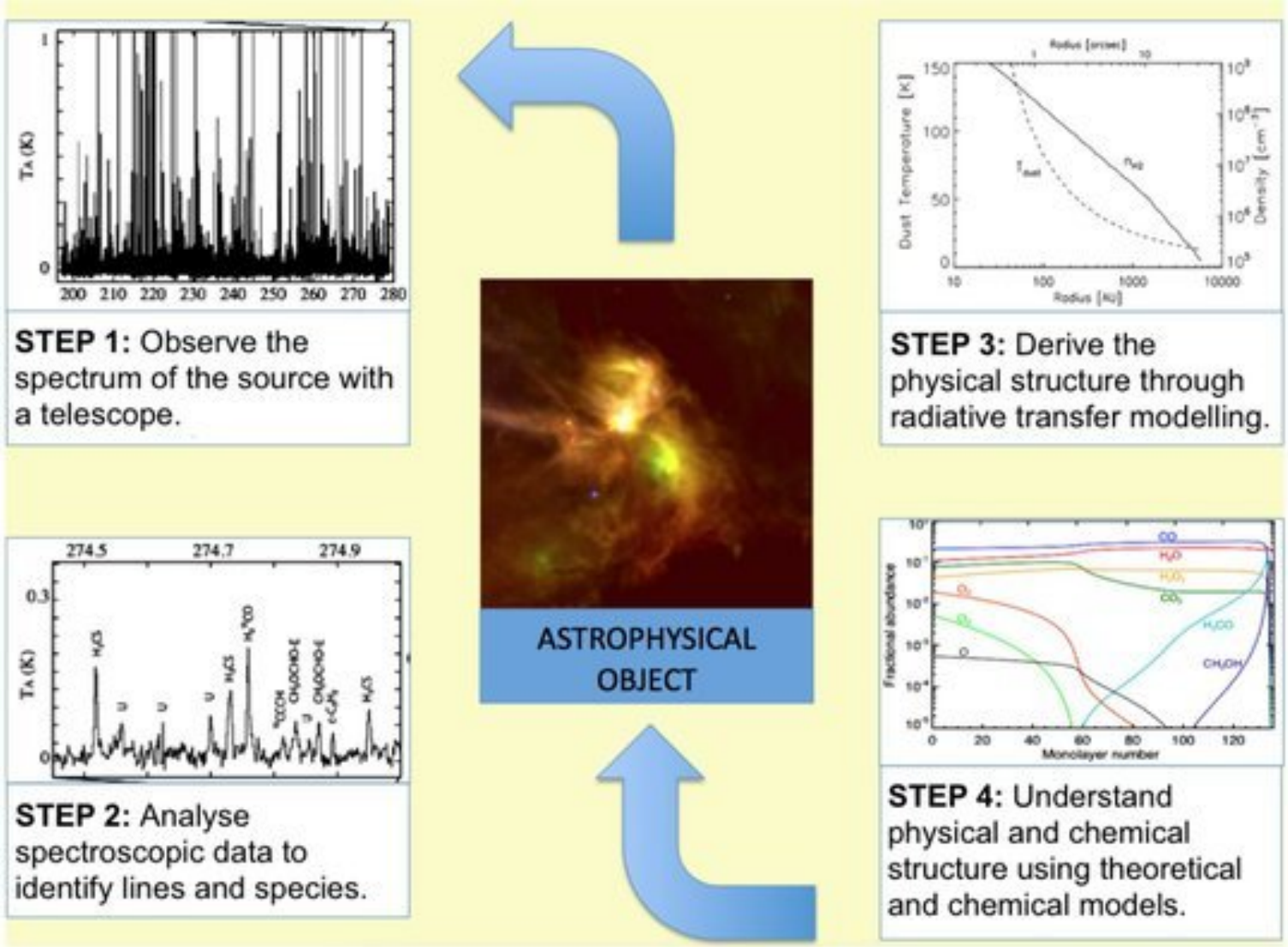
CAS@MPE
Garching (Germany)

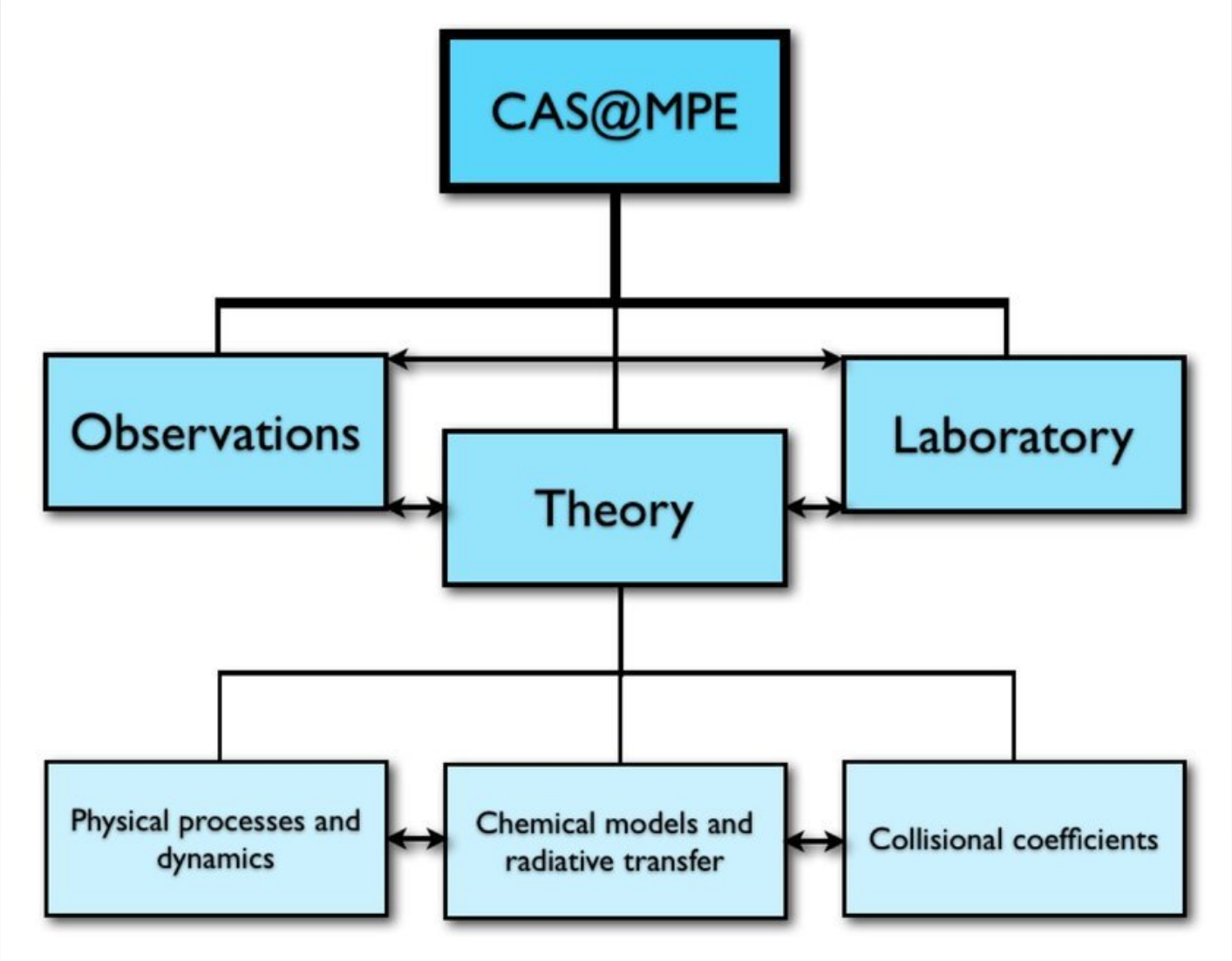
June 23, 2016

Motivations



(Caselli & Ceccarelli, 2012)

Motivations



▸ http://mpe.mpg.de/CAS

CAS – Lab Personnel

- Luca Bizzocchi
- Jake Laas
- Christian Endres
- Barbara Michela Giuliano
- Silvia Spezzano
- Domenico Prudenzano (PhD student)
- Thomas Schamberger (Master student)

CAS – Laboratories

- CAS Absorption Cell (CASAC)
- Chirped Pulse Fourier Transform Spectrometer (CP-FTS)
- THz Time Domain Spectrometer (TDS)
- Fourier Transform Infrared spectrometer (FTIR)

CASAC Experiment

- Schottky-based multiplier chain (AMC, Virginia Diodes Inc.)
  - 80 GHz – 1.1 THz frequency range
- Long-pathlength glass tube (3m-long x 5cm-diameter)
- DC discharge (2kW) & solenoid (up to 350 Gauss)
- N_{2L} cooling of the cell
- Single and double–pass arrangement
- Cryogenic InSb and Schottky diode detectors
- Diffusion (VHS-6 Agilent) & mechanical pump (Edwards E2M40)

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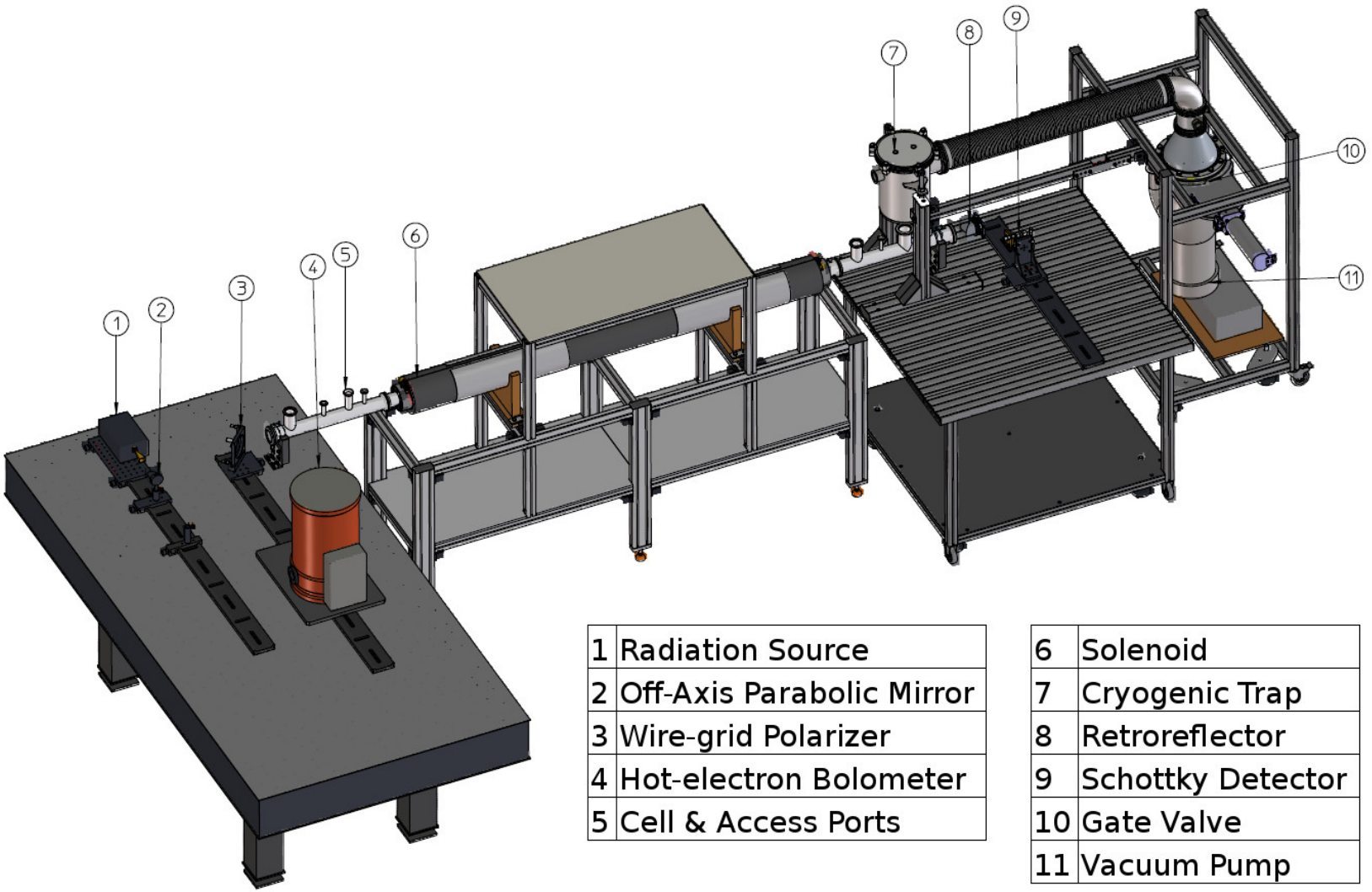
- Reactive species (ions and radicals)
- Isotopologues characterization
- THz extension of low-frequency experiments

CASAC Experiment



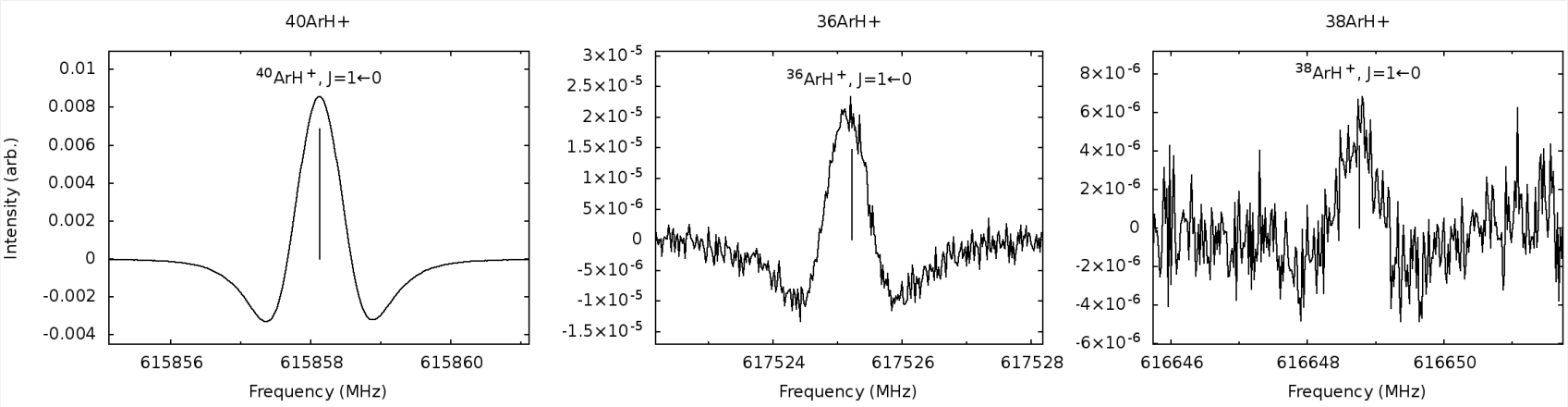
1	Radiation Source
2	Off-Axis Parabolic Mirror
3	Wire-grid Polarizer
4	Hot-electron Bolometer
5	Cell & Access Ports

6	Solenoid
7	Cryogenic Trap
8	Retroreflector
9	Schottky Detector
10	Gate Valve
11	Vacuum Pump

CASAC Experiment

CASAC – "Science Verification"

- ^{40}Ar (99.60%) – ^{36}Ar (0.34%) – ^{38}Ar (0.06%)



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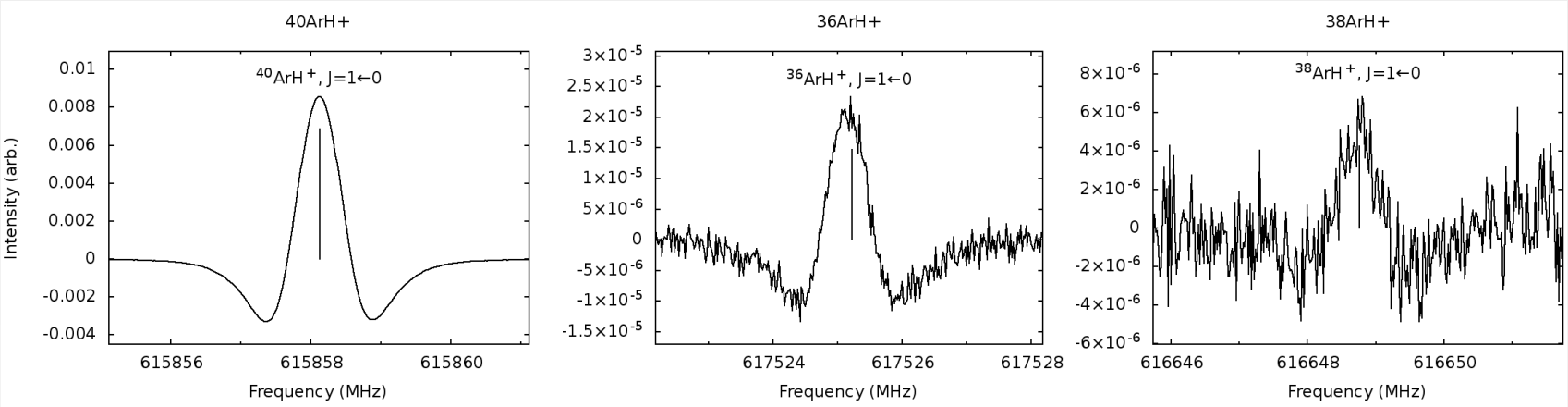
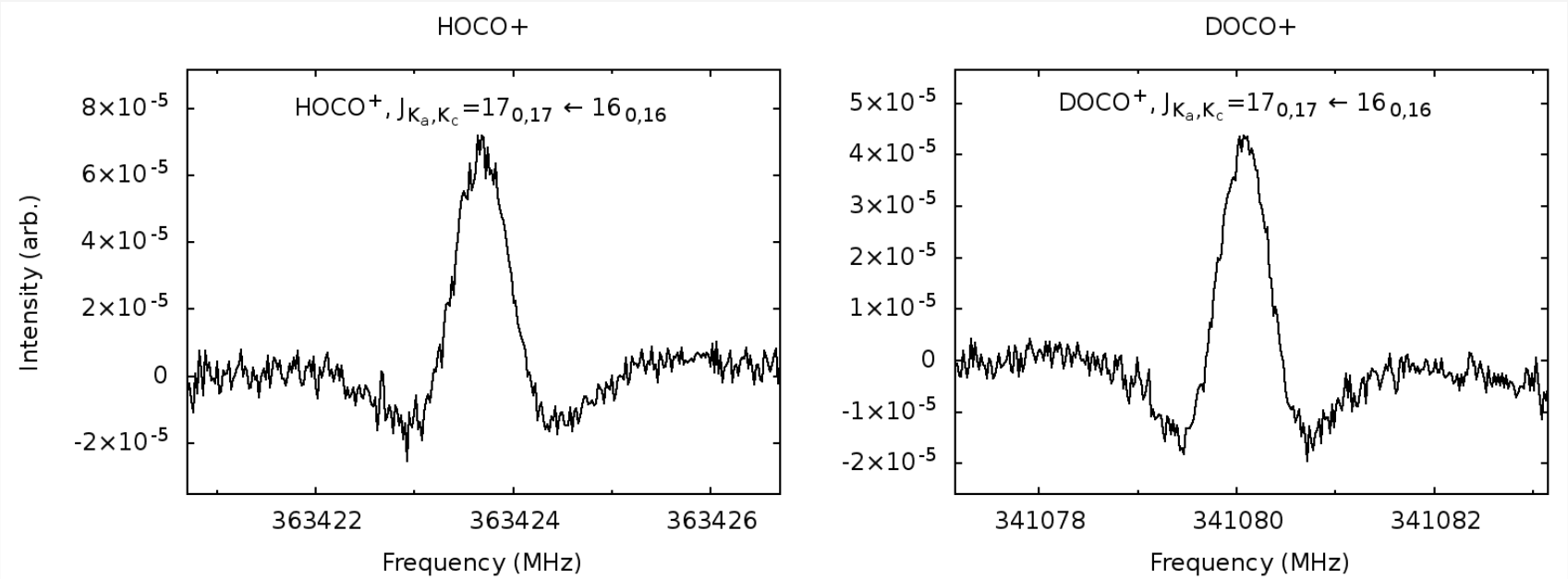
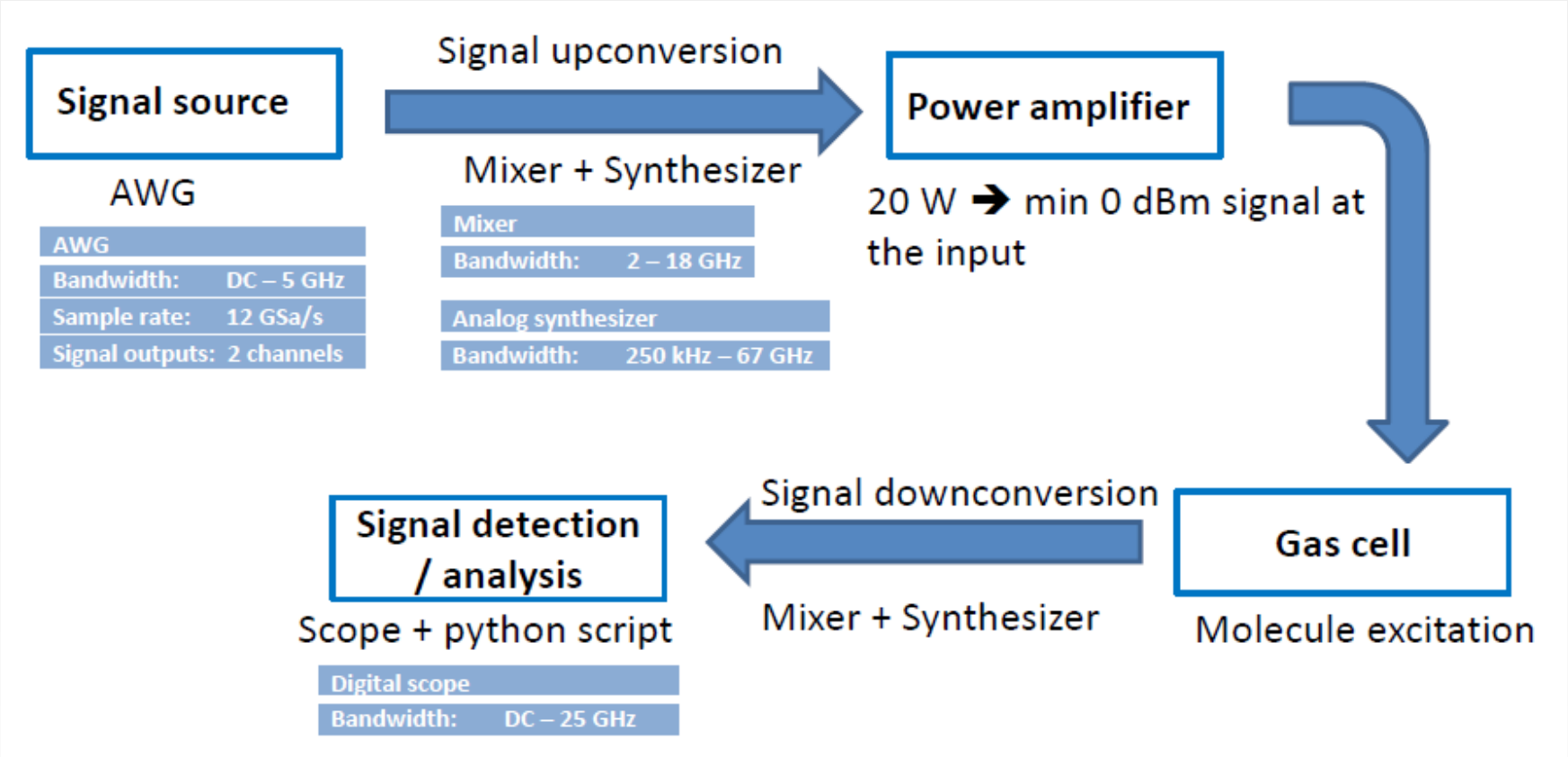




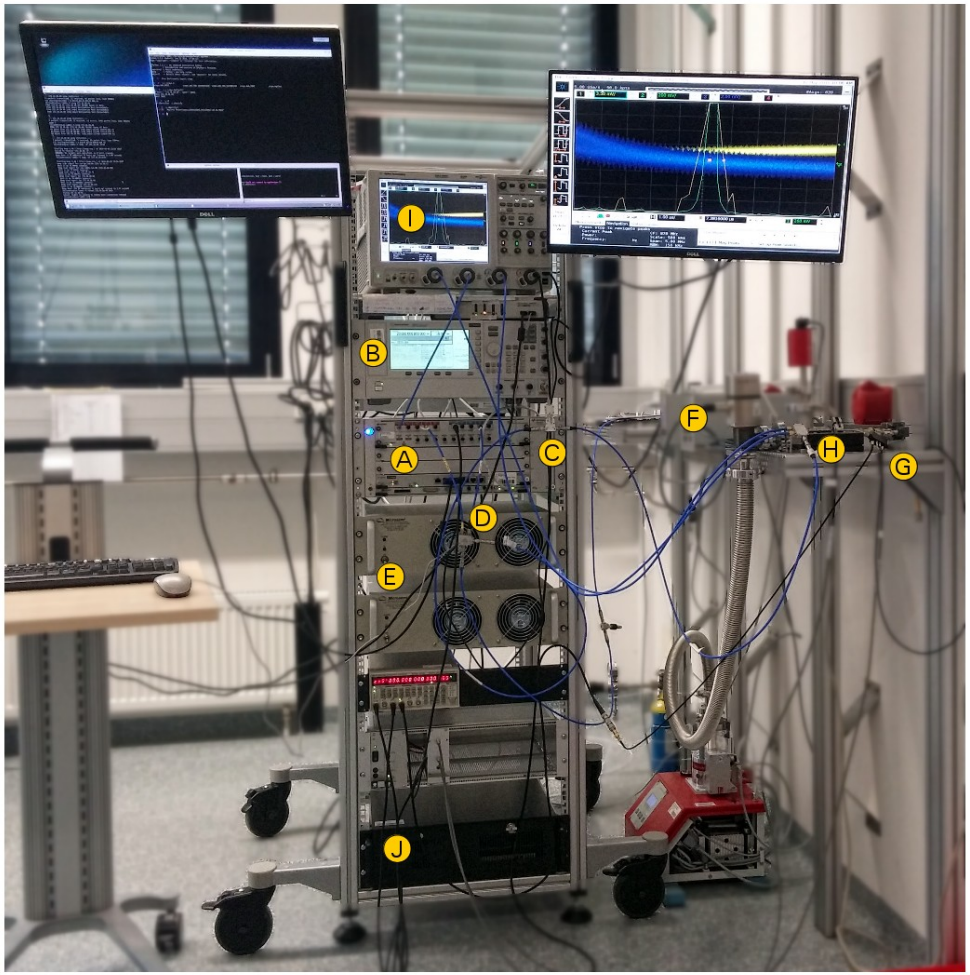
CP-FTS

- 6-18 GHz (20W) / 18–26 GHz (4W), 7 GHz instantaneous bandwidth
- extension to 80-110 GHz in progress



- Heavy molecules (e.g COMs)
- Collision dynamics (pulse-probe)

CP-FTS


I
B
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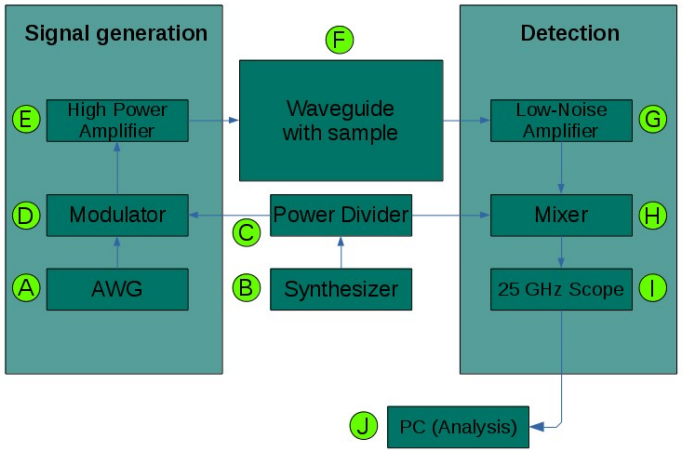
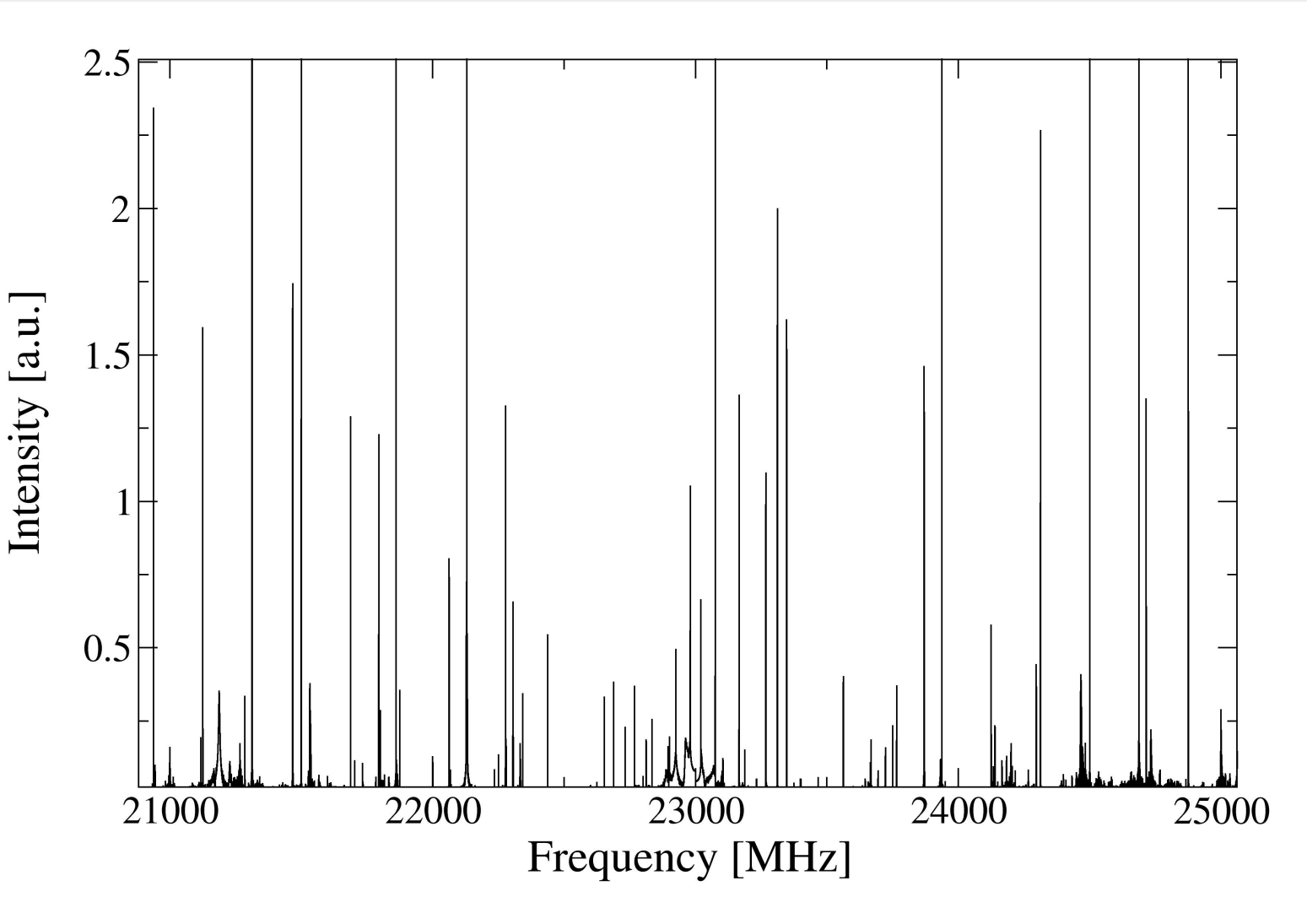
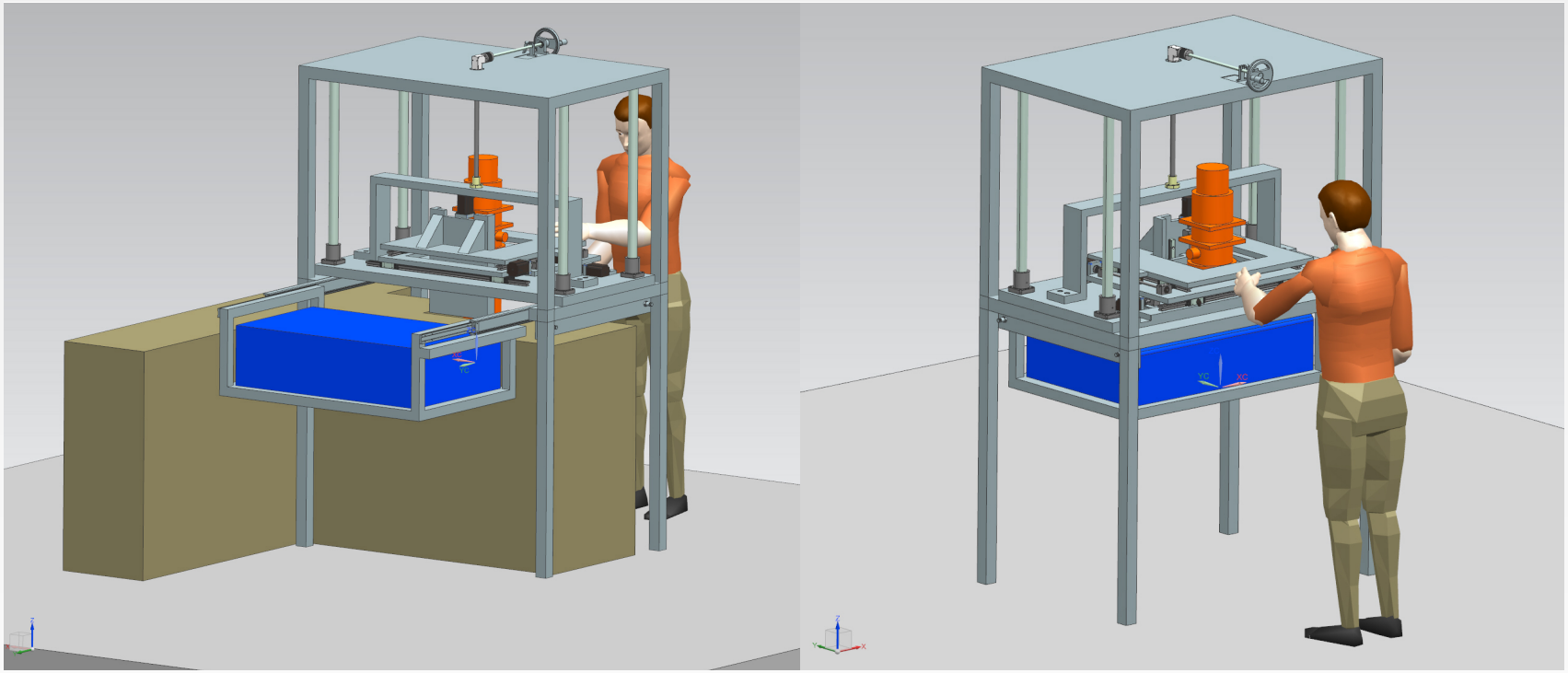

Signal generation
F
Detection
E
High Power Amplifier
Waveguide with sample
Low-Noise Amplifier
G
D
Modulator
C
Power Divider
Mixer
H
A
AWG
B
Synthesizer
25 GHz Scope
I
J
PC (Analysis)

CP-FTS – First light



The FTIR/THz Time Domain Spectrometer

- Cryostat coupled to the FTIR (left) or THz-TDS (right)
  - Cryocooler (4K, high vacuum)
  - FTIR: full IR coverage (2–400 μm band, res = 0.004 cm^{-1})
  - THz TDS: Broadband (1–5 THz)



- Physical properties of astrophysically relevant solids

Next?

- Molecular-jet experiment in the mm-wave currently in development
  - first light late 2016/early 2017 (hopefully!)
  - rotationally cold molecular beam (few K)
  - ions, radicals, heavier species
  - discharge
- Explore more powerful sub-mm sources (CASAC)
- Test alternative ways to produce molecular plasma (CASAC)
- Complete first-tests and extend frequency coverage (CP-FTS)
- Couple the CP-FTS with other system
- Assemble the cryo + THz TDS system
- FTIR in few weeks