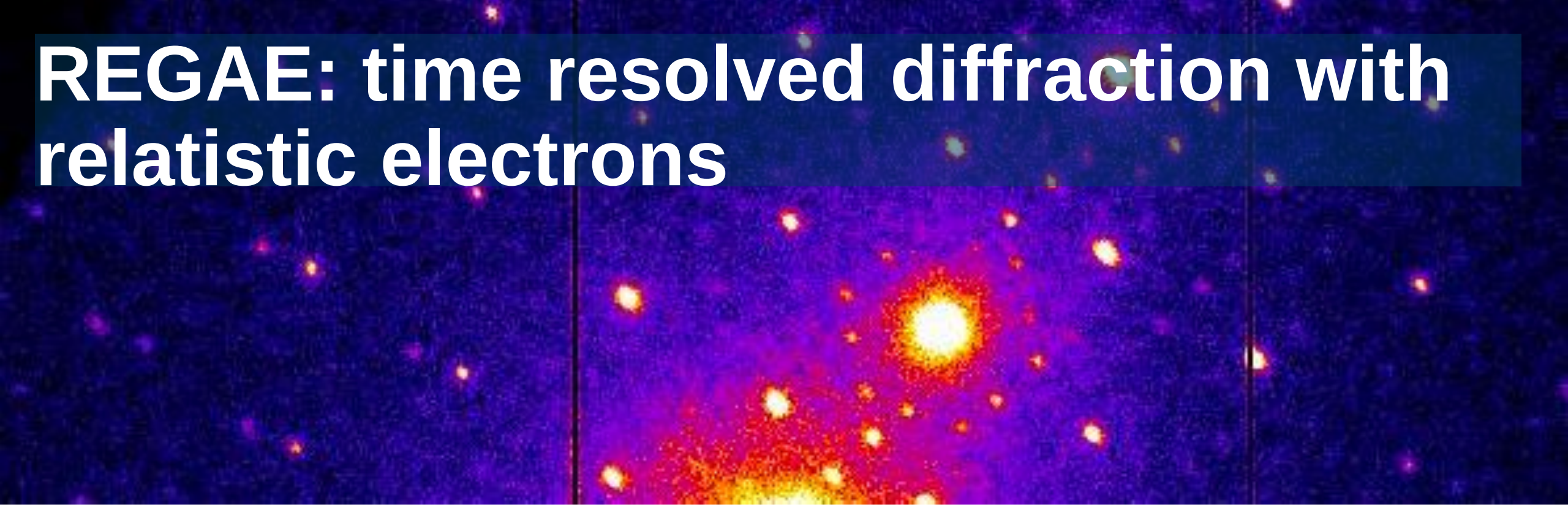
REGAE: time resolved diffraction with relatistic electrons



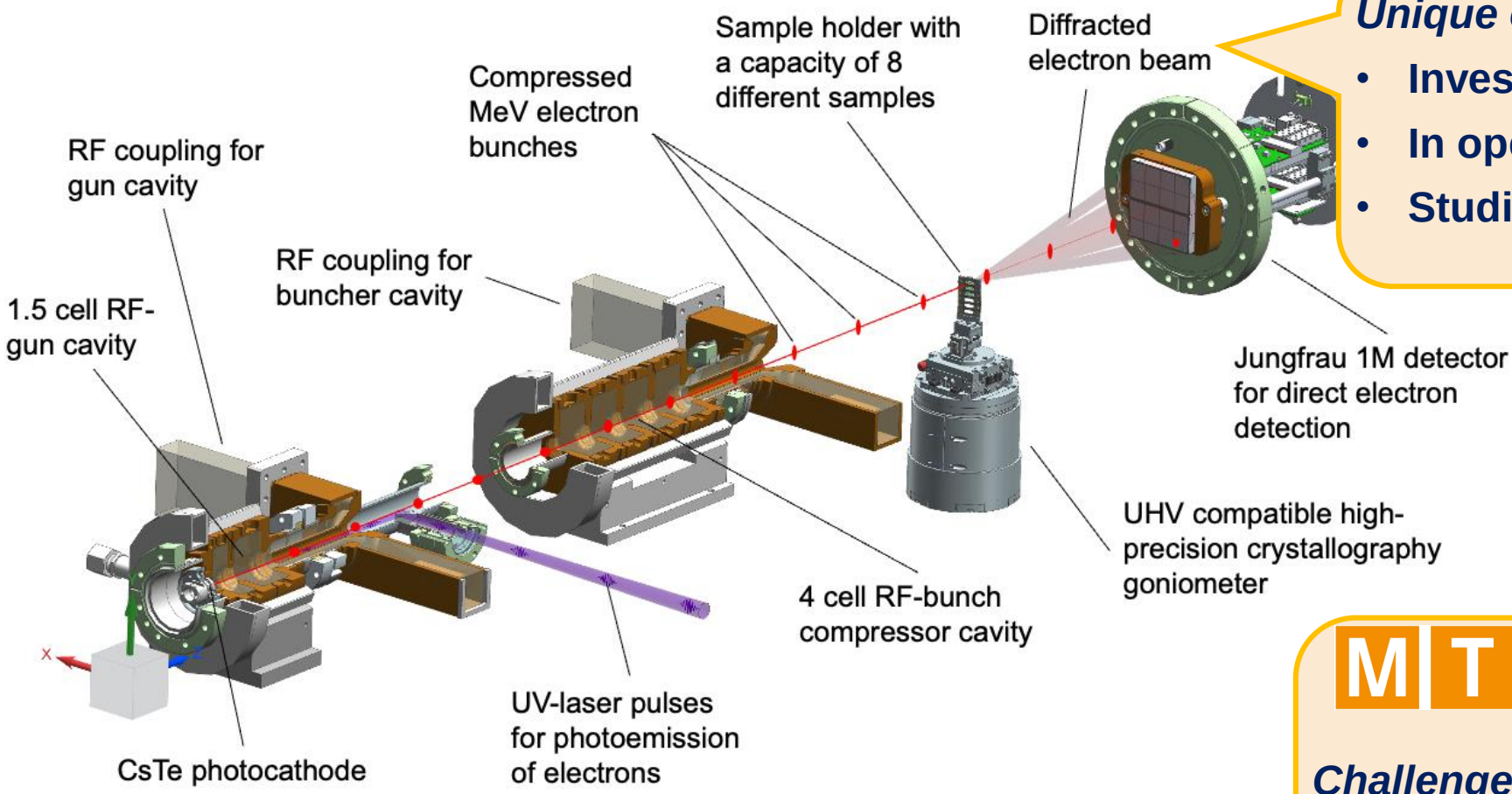
M.K. Czwalinna , H. Schlarb A. Meents, and K. Flöttmann

HELMHOLTZ

REGAE MeV diffraction setup

…on its way to become a user facility

Time resolved diffraction experiments with fs time resolution



Unique opportunities at REGAE:

- **Investigation of dynamical processes,**
- **In operando studies,**
- **Studies with societal impact.**

MTARD → (ST3)

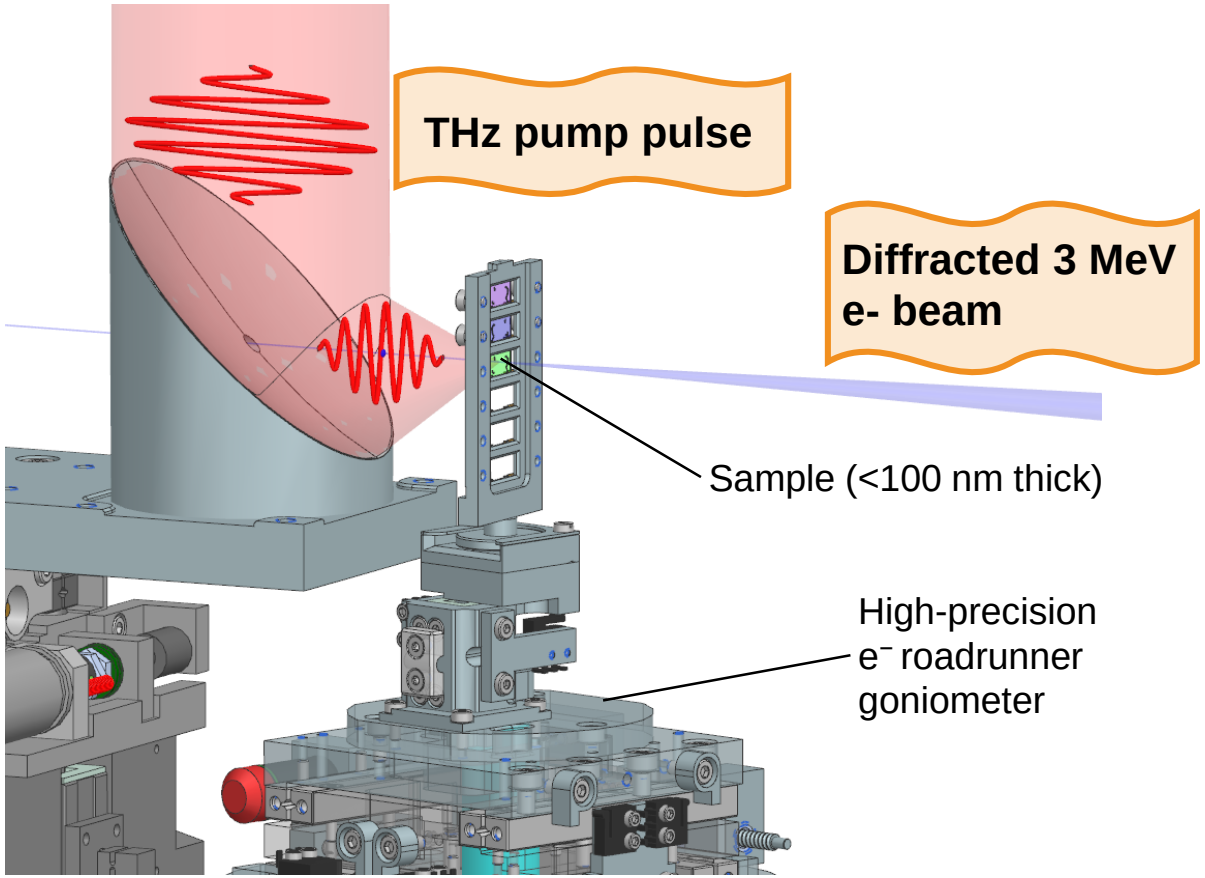
Challenge for new beam diagnostics

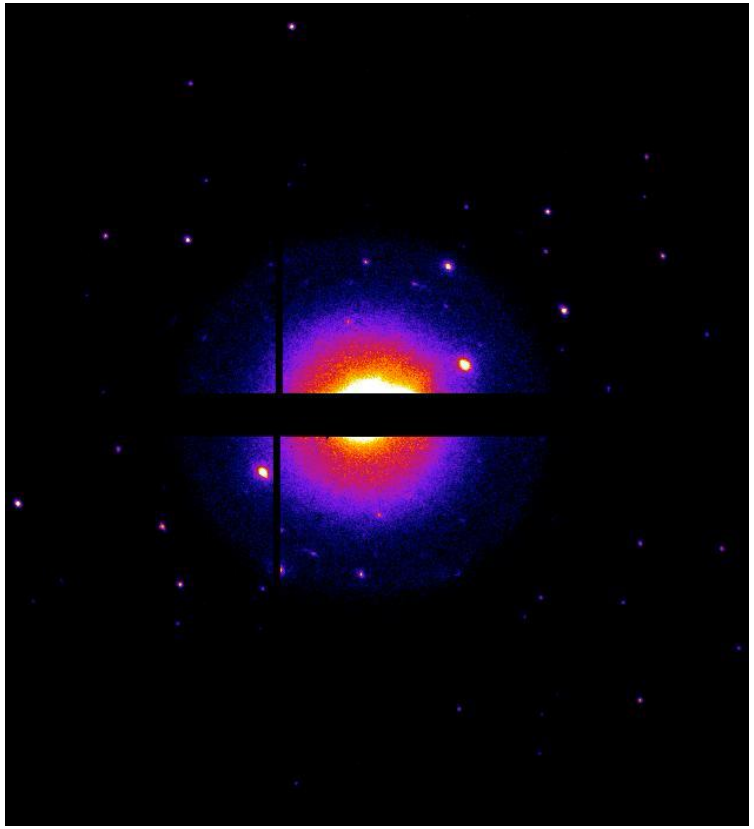
- ***Sub-pC bunches:***
  Highly sensitive, preferably non-invasive methods needed

Future direction: Pump–probe experiments

Providing sub-atomic spatial resolution with femtosecond temporal resolution

- Unique buncher cavity for <20 fs time resolution
- Various pumping schemes including **THz, IR, Vis, UV**



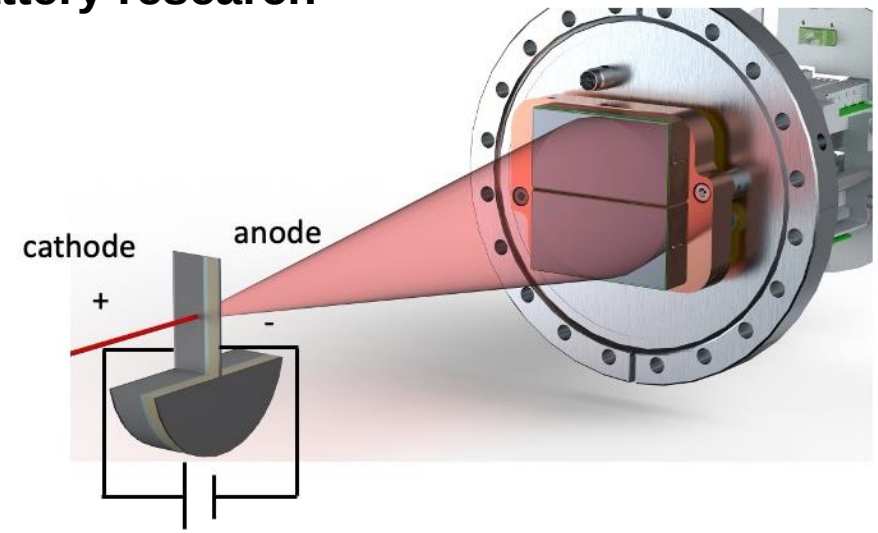


Series of diffraction images of TaS_2 recorded at REGAE with 3.48 MeV electrons, 50 um beamsize, < 15 fC charge per pulse

Operando electron diffraction

Utilizing the higher penetration power of MeV electrons in combination with 3 GHz microbeam mode

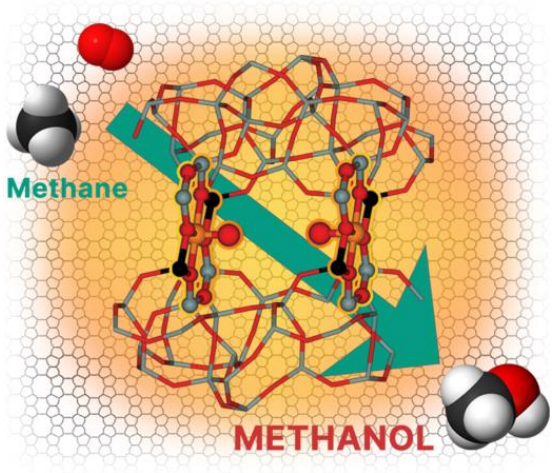
Battery research

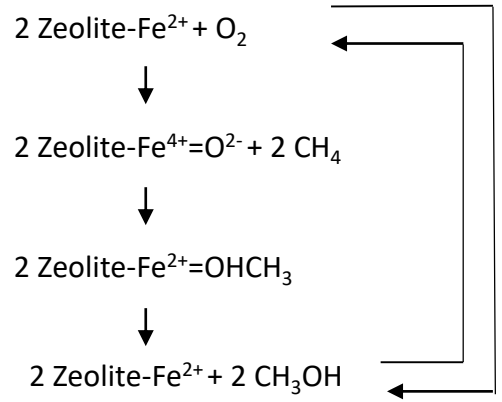


- operando investigation during cycling of battery
- MeV electron diffraction in microbeam mode will allow studying Li^+ incorporation / distribution, defect formation, and phase transitions at high spatial resolution.

(collaboration with J. Hadermann (Uni Antwerpen, Belgium) and A. Hardy (Uni Hasselt, Belgium.)

Catalysis





- Catalyst particle size of 1 um ideally suited for MeV electron diffraction
- Catalytic hydrogen transfer mechanism not fully understood yet
- MeV electron diffraction ideally suited for operando experiments due to better visibility of hydrogen and higher penetration power

(collaboration with Juri Dedecek (CAS Prague, Czech republic))