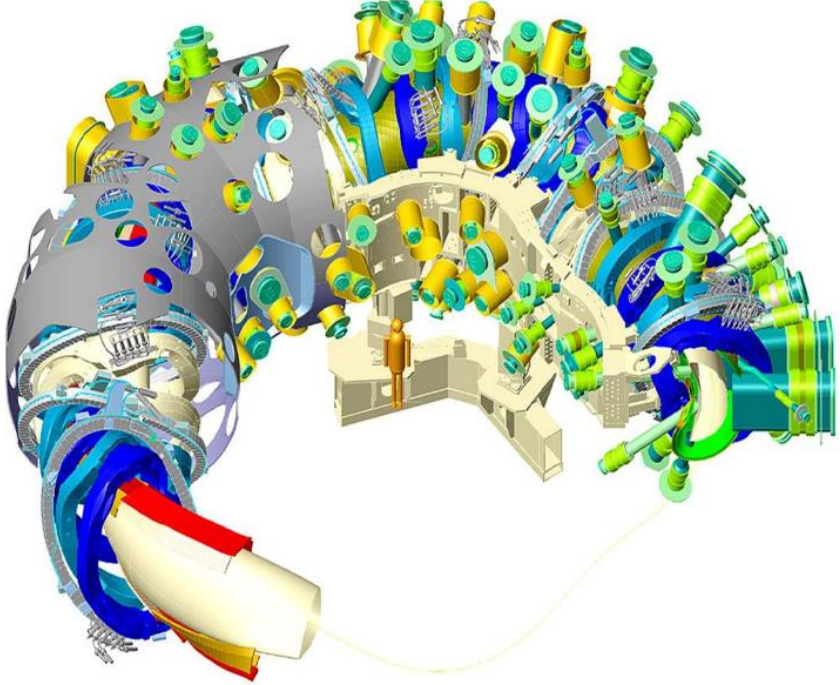


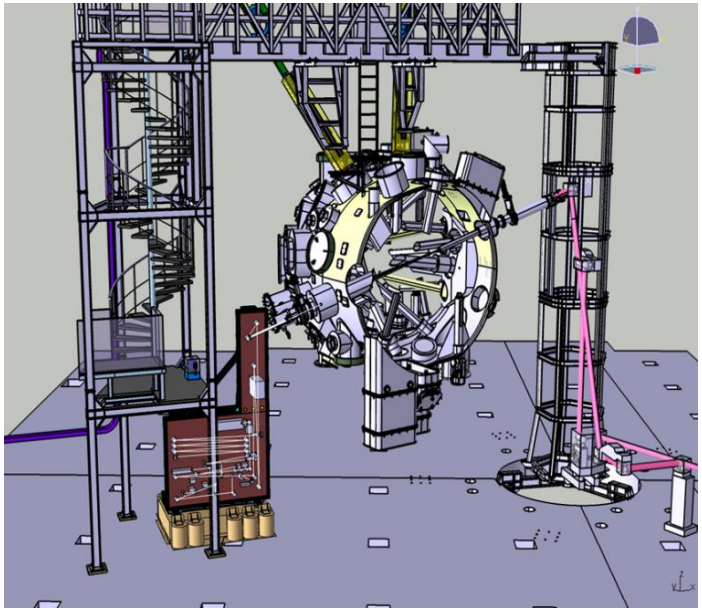
W7-X Dispersions Interferometer's Current Signal Processing and Future Bayesian Model Data Analysis.

Humberto Trimiño Mora

The Dispersion Interferometer

The dispersion interferometer (DI) diagnostic:

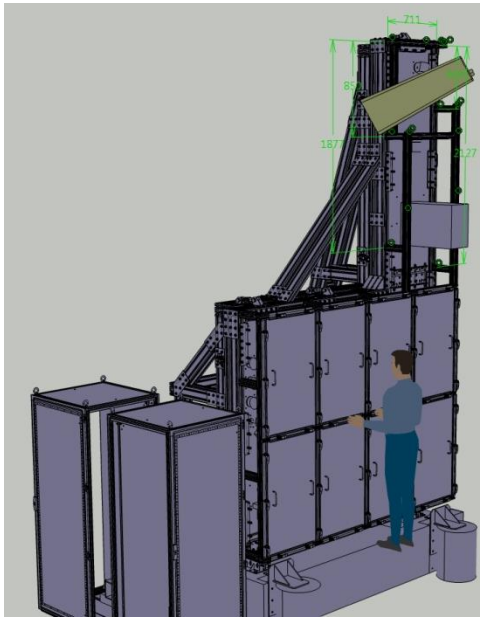
- Can be used to measure line integrated electron density.
- Performs data acquisition and processing with an FPGA.



Advantages over 2-Color Interferometer:

- Less sensible to vibrations of optical components.
- Reflection reduced and less sensible to base length changes.

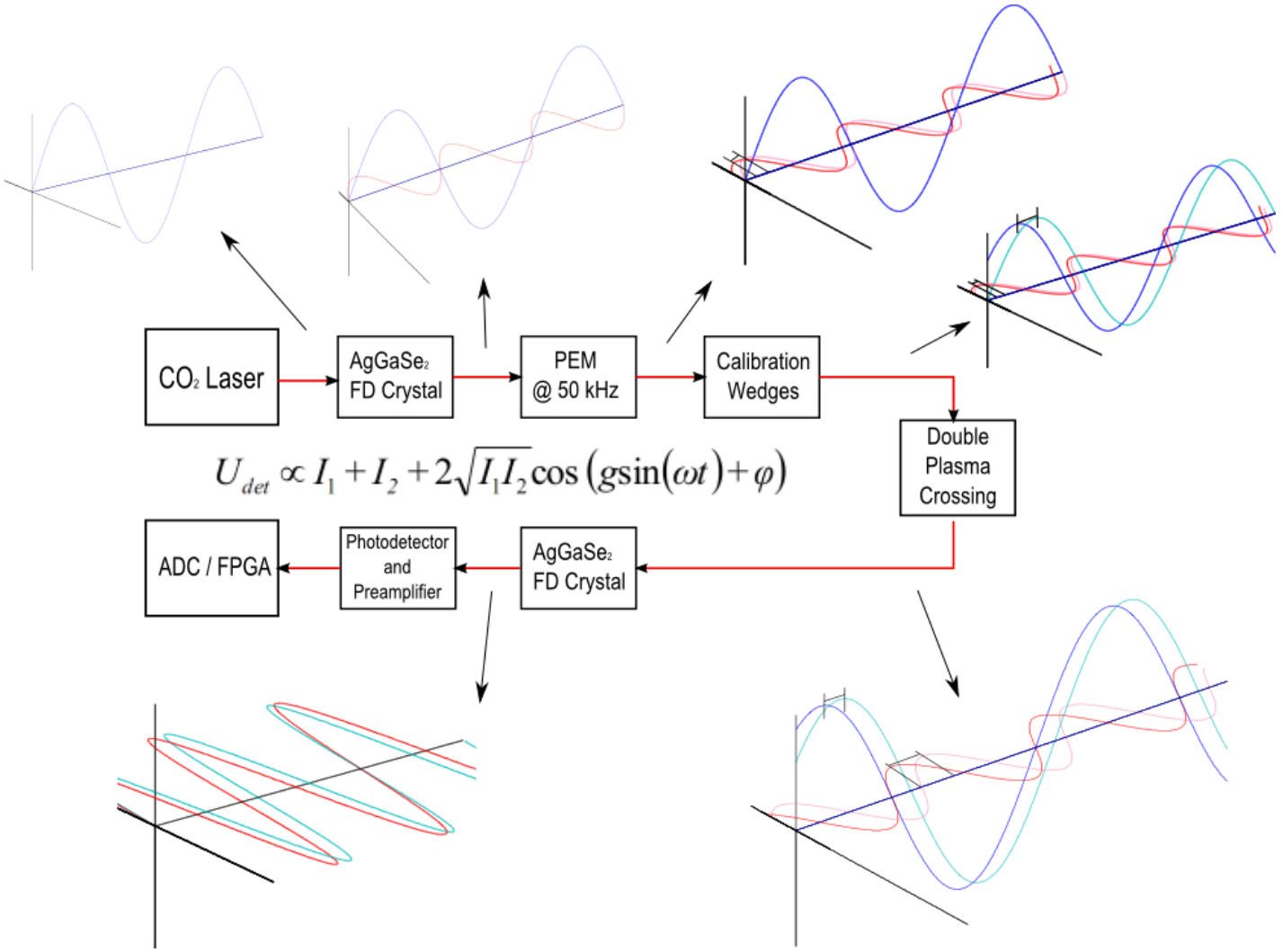
$$V_p = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos(2m * \sin(\omega t) + \varphi)$$



For Wendelstein 7-X (W7-X)

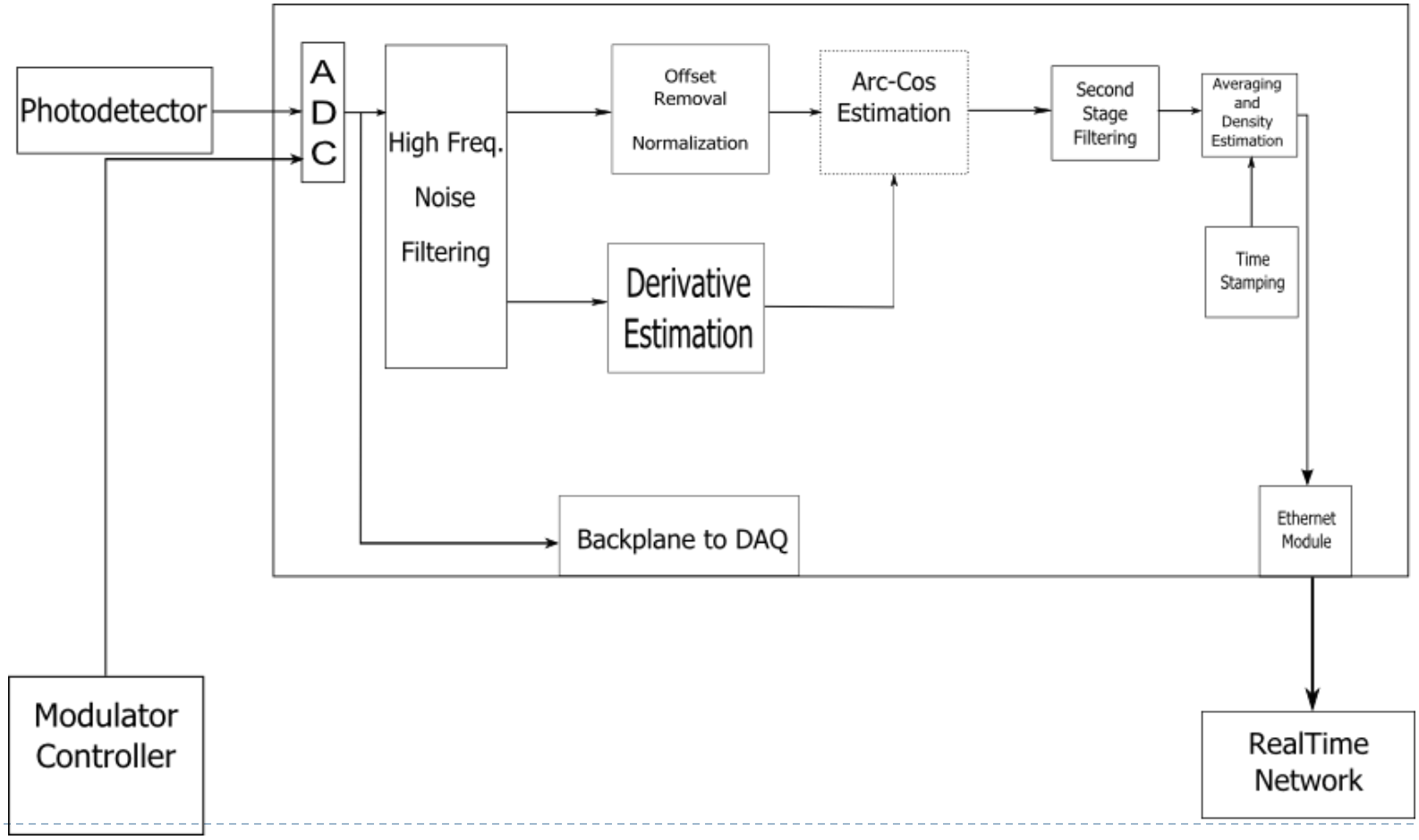
- A fast/real time variant of this analysis is desired.
- An acceleration of the modeling and the inversion through multi-core and/or FPGA system.

Wave changes



DSP Requirements of the DI

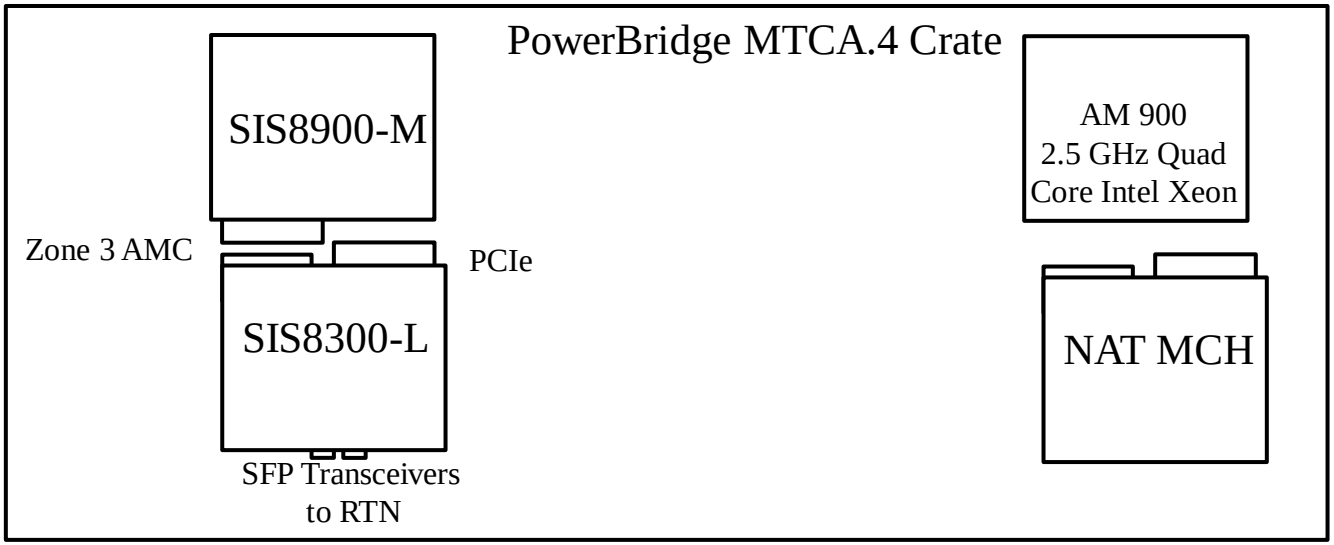
$$V_p = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos(2m * \sin(\omega t) + \varphi)$$



Current Setup and Implementation

Data Acquisition: SIS8900 digitizer with connection to SIS8300-L

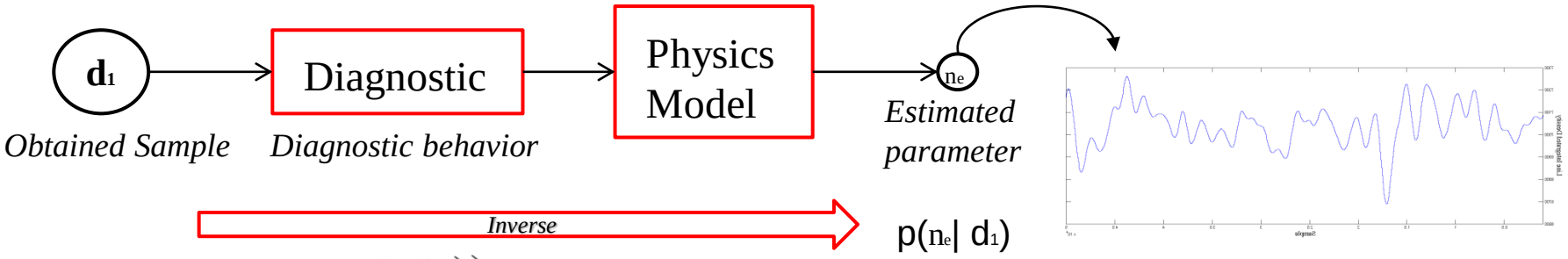
Raw Data Storage: Currently handled through PCIe backplane communication.

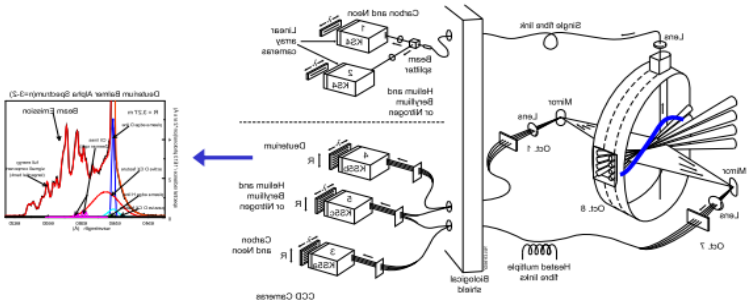


Real-time Data Transmission: Connection to Real time network using 1000BASE-SX transceivers at 1ms time resolution.

DSP Control/ Configuration: Possible through PCIe access to register bank.

Current Approach

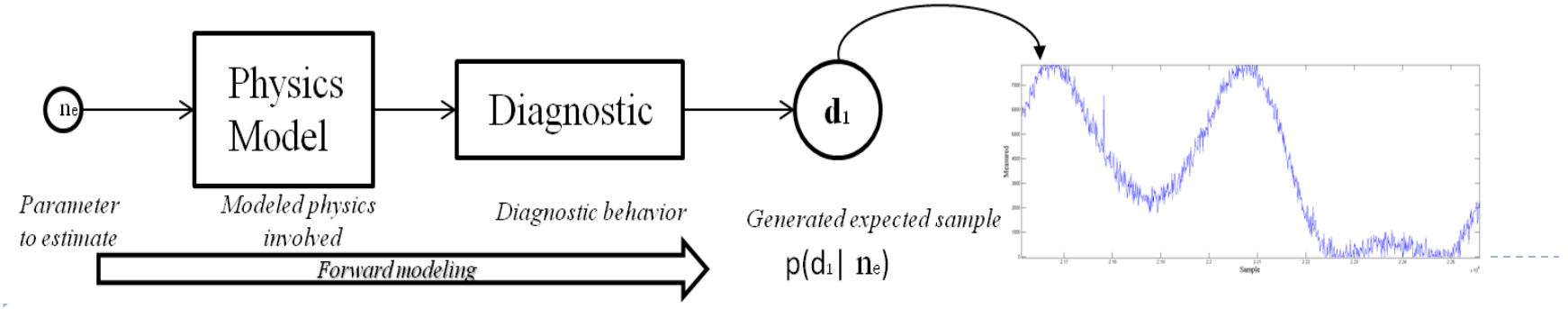




How can we effectively introduce our knowledge into the estimation process?

Forward Modeling and Bayesian Inference.

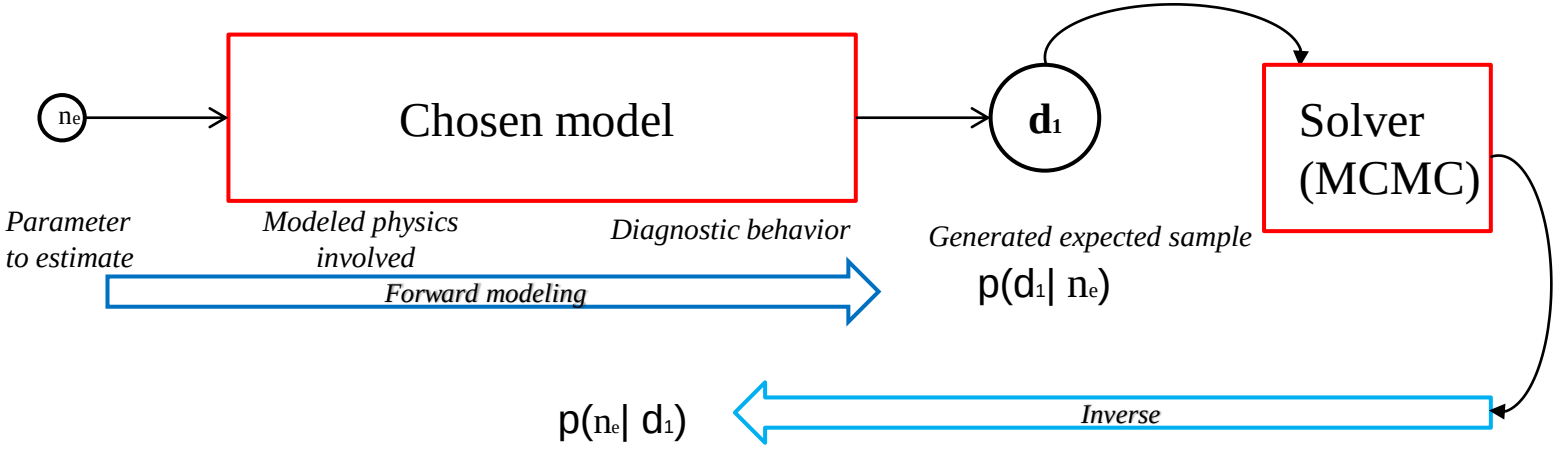
$$prob(H \mid D, I) = \frac{prob(D \mid H, I) * prob(H \mid I)}{prob(D \mid I)}$$



Future Approach: Model Based Data Analysis

Hardware + Forward modeling + Bayesian Inference:

- Find hardware analogue of components in a model for a proper modeling.
- Standard optimizers as solvers.
- Solve the inversion problem for many complete forward models.



If implemented in real time the approach could be useful for diverse applications

- Generating signals for control loops.
- Local hardware determination of required parameters.
- Would considerably benefit multiple signal analyses of different systems.
- Can be improved by swapping model due to its modularity and standard solvers.

Future Requirements

Possible challenges:

- Limitations in parallelism feasibility.
- Solvers or optimizer slowing processing.
- Inversion of highly non-linear models.

Solution approach and requirements:

- Hardware/Software solution combined with FPGA.
- Requires fast communication between FPGA/Software.
- GPU or multicore processing of inversion.

Vielen Dank für Ihre Aufmerksamkeit