Experiments on ECWs Scattering

01.07.2019

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Debriefing

June 27th 2019

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PLASMA TARGET

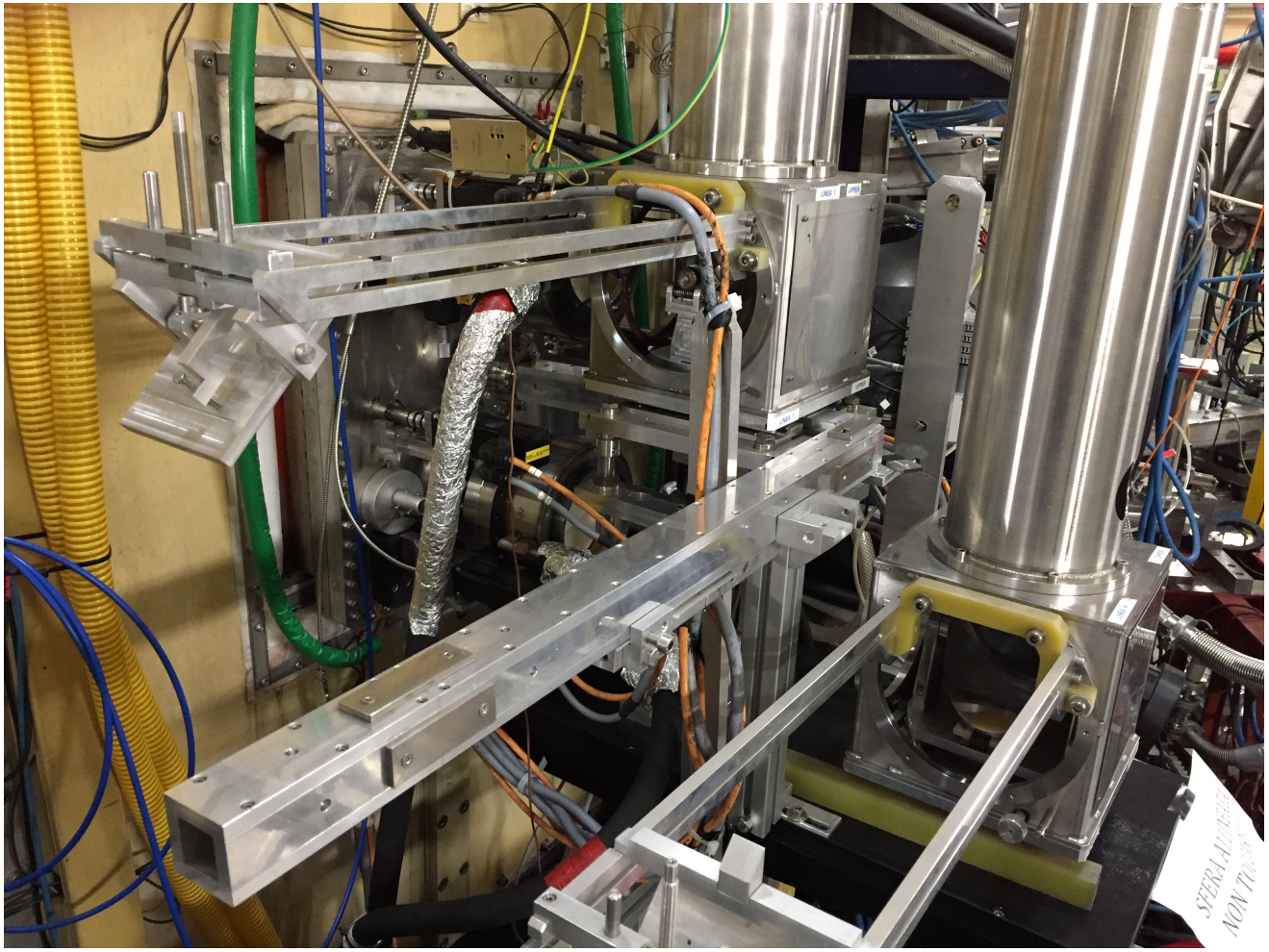
- **5.2 T - 500 kA**
- Rotating **m:n=2:1 tearing modes** stimulated by:

Pellet injection + Free density ramp-down

to induce fast rotation of the mode typically followed by slowing down, **even down to hundreds of Hz**.

Vacuum Leak on the Launching Line (Gy #4)

A **vacuum leak** was found on the vacuum feed-through of the driving shaft for toroidal steering of the launching line in the ECRH/Scattering antenna.



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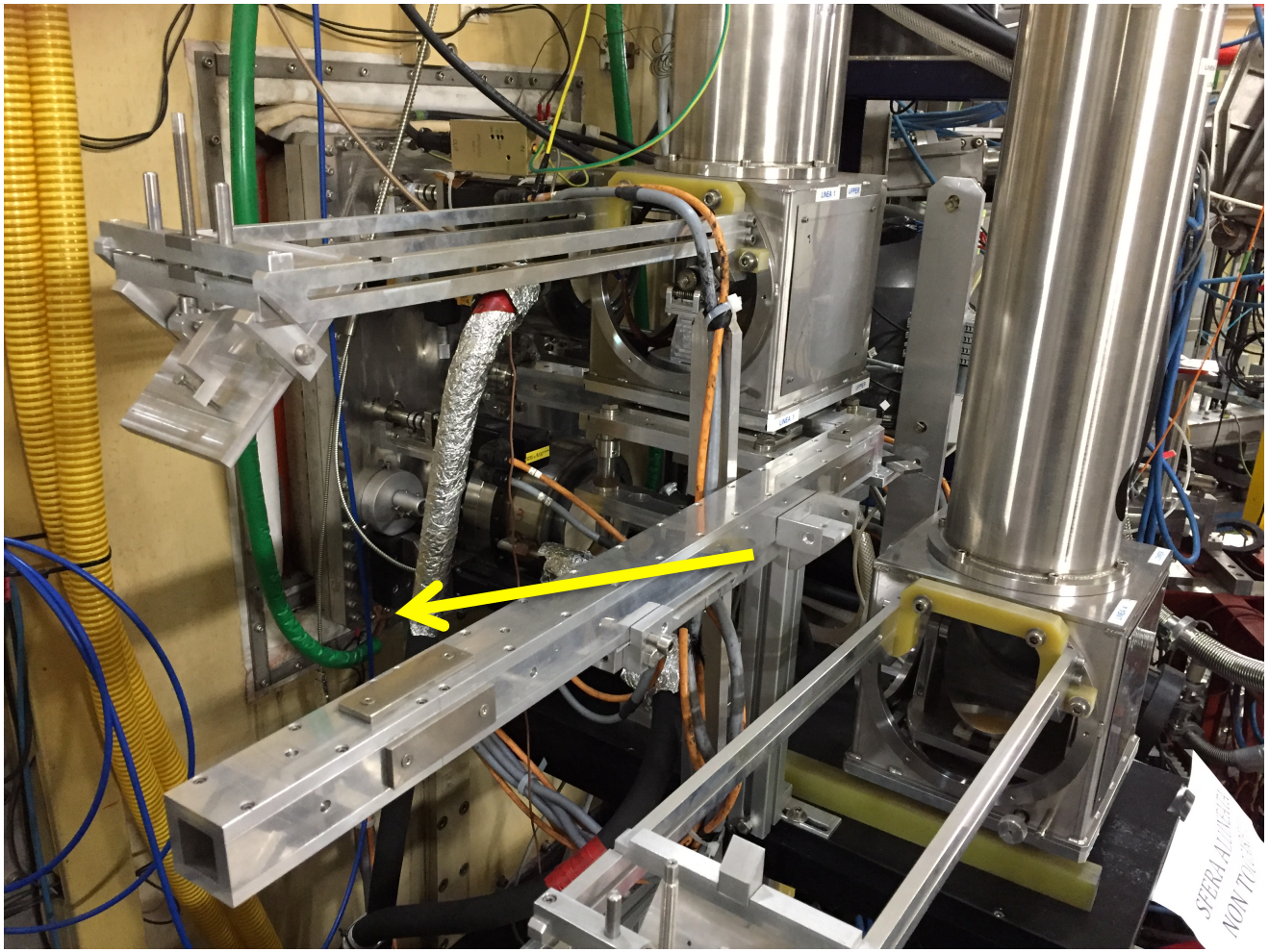

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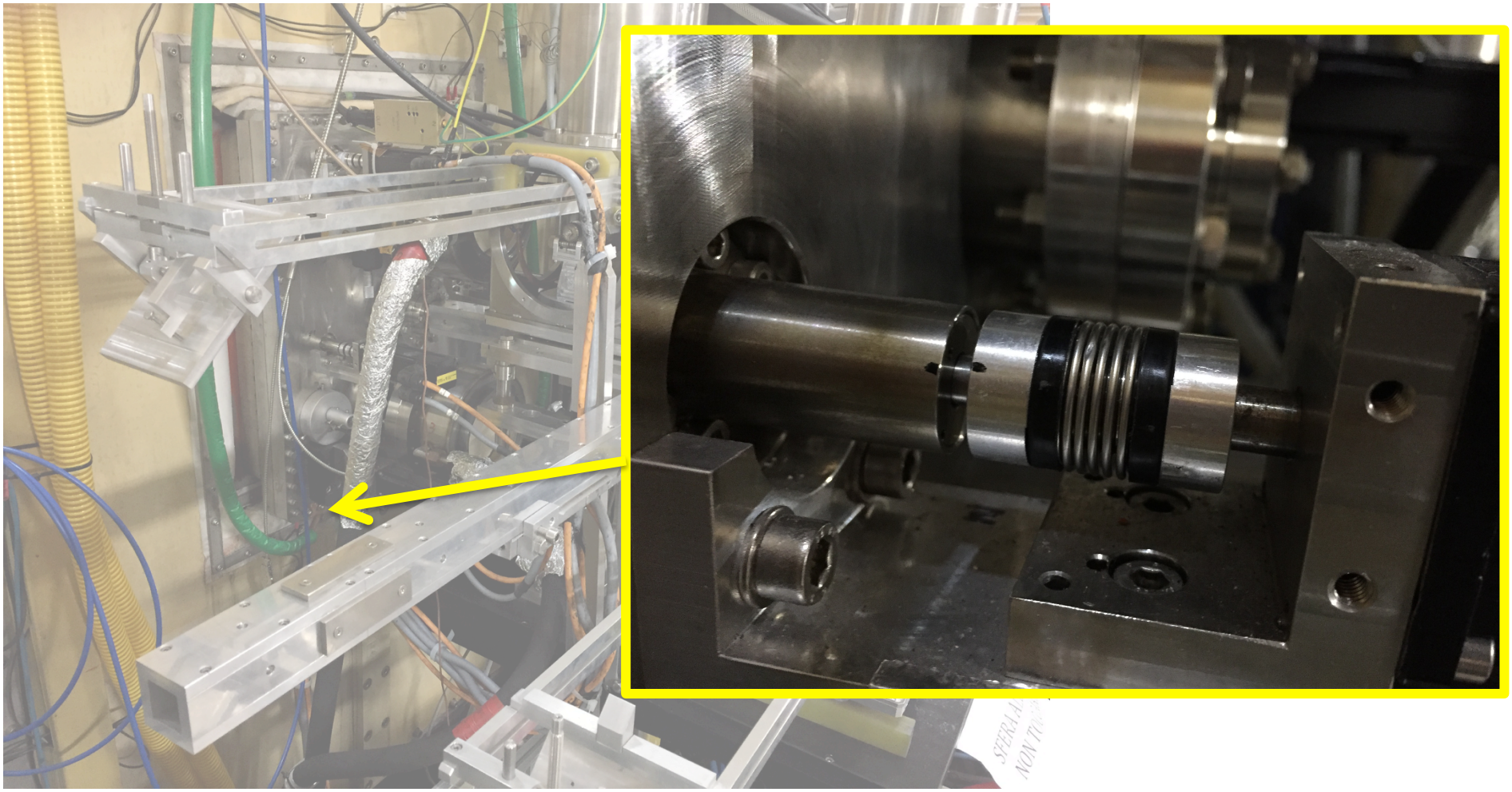

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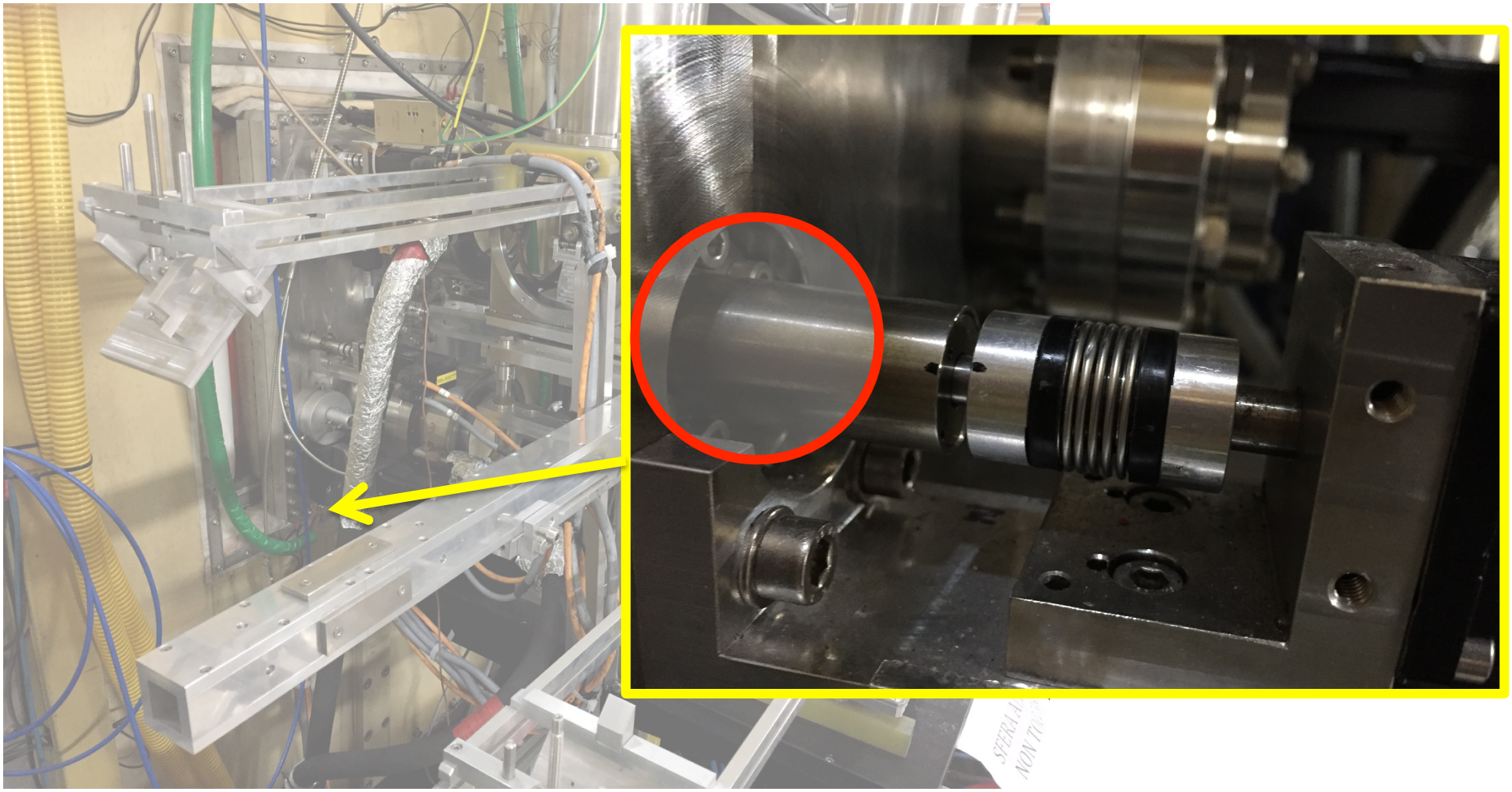

Theoretical Expectations

Low-power threshold (LPT) non-linear phenomena, such as Parametric Decay Instability (PDIs) of a pump wave, can be found in the presence of **a finite-width beam**, **either ordinary or extraordinary polarized**, reaching a locally non-monotonic density profile (e.g. large magnetic islands, central density pump-out, blobs, filaments...).

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O-wave → **LH ($-q_x$, ν)**

O-wave → **UH (q_x, ν_E)**
n-mode

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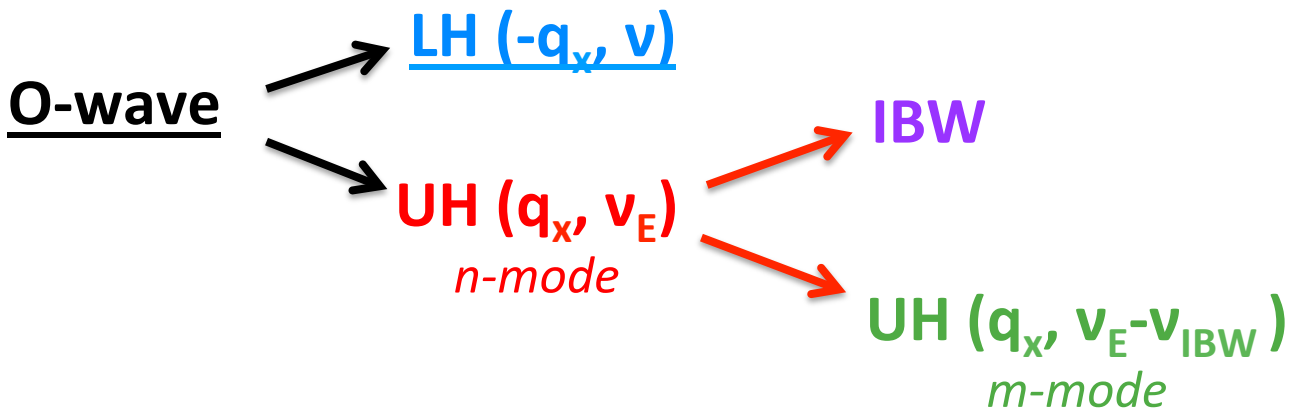

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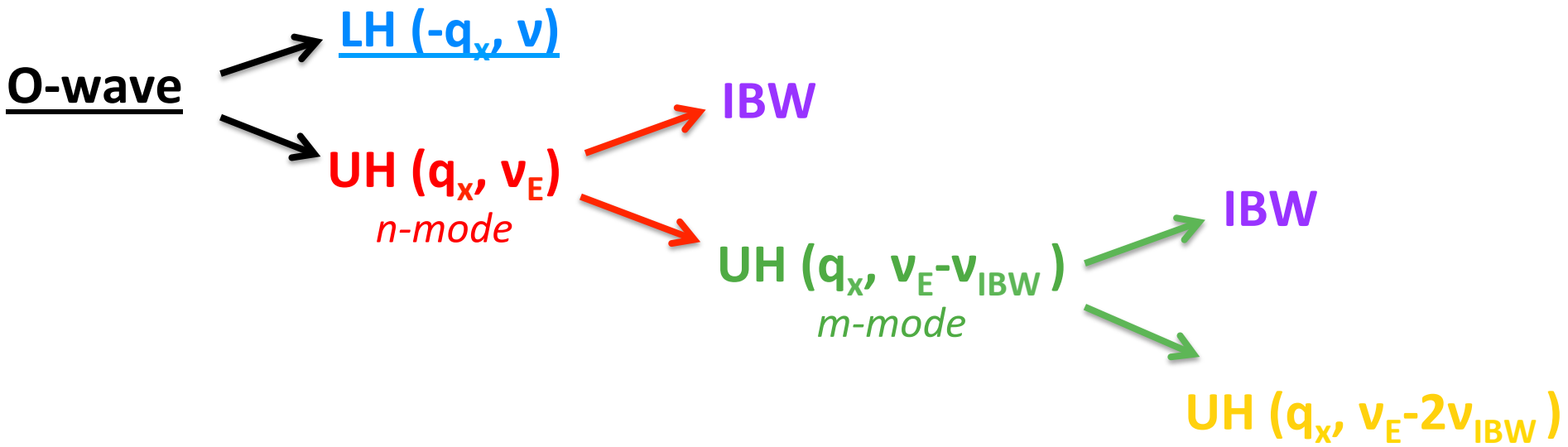

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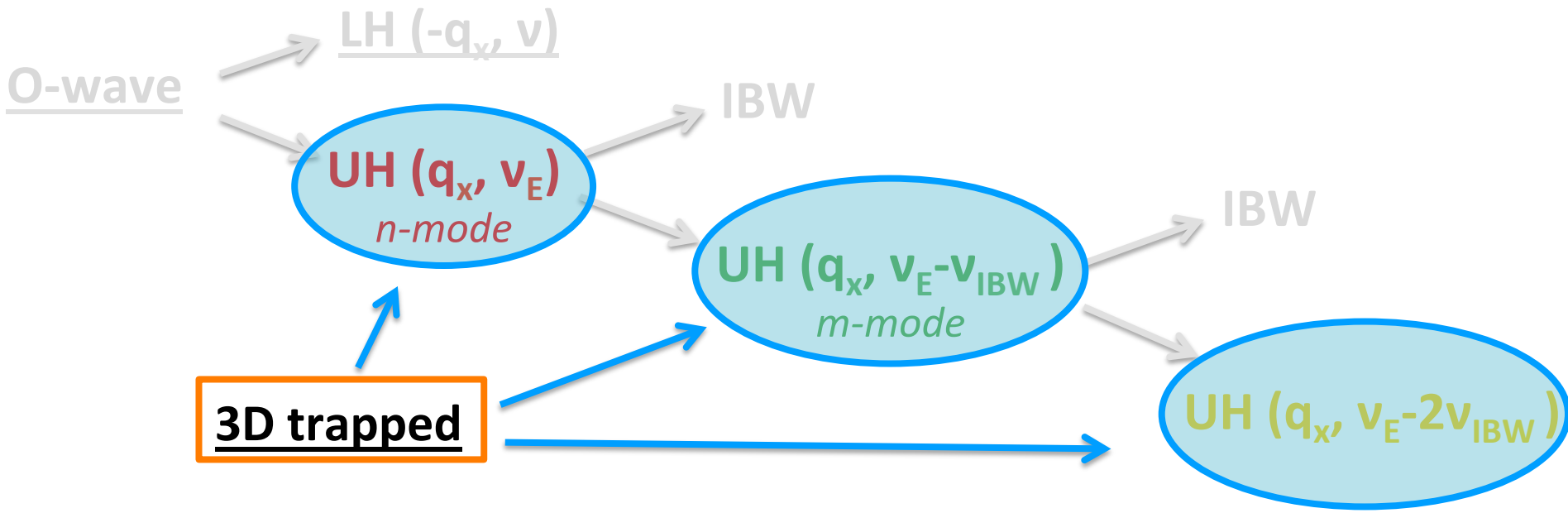
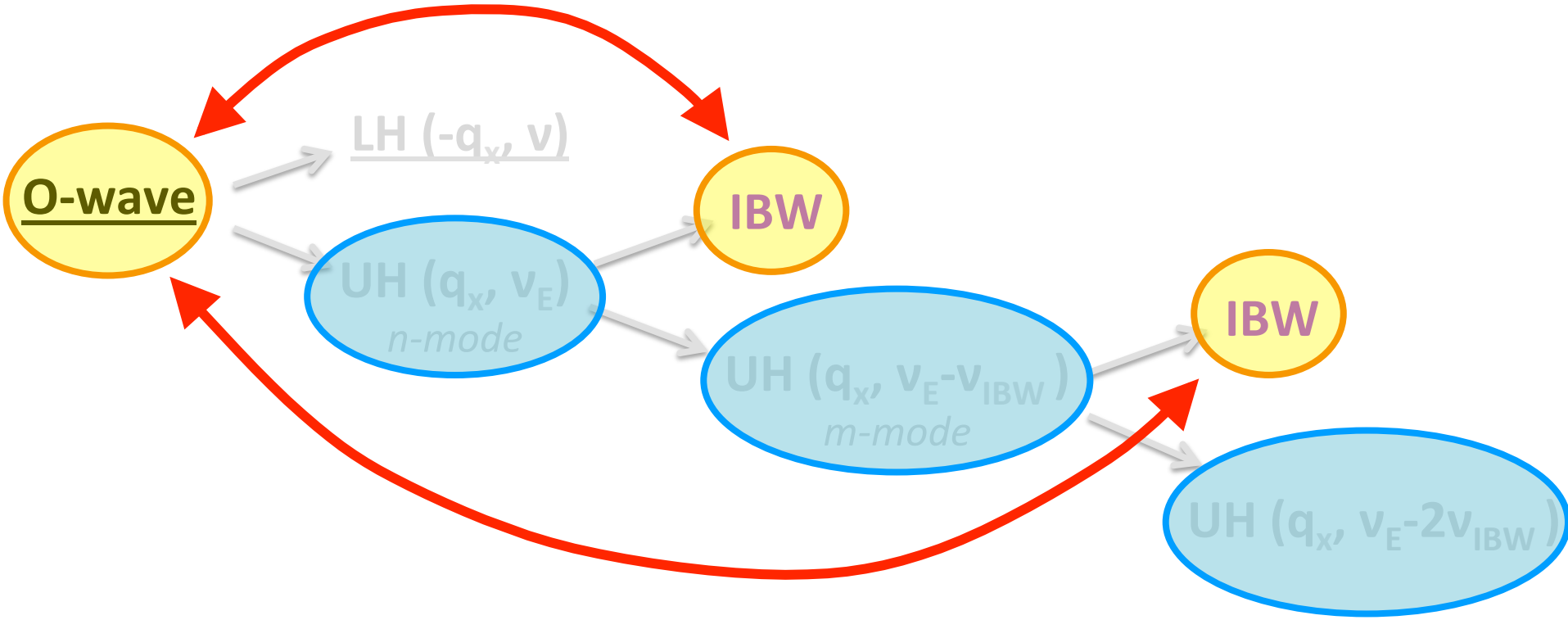


What We Want to Measure

The **non-linear coupling of the daughter IBWs with the pump O-wave** can lead to the excitation of the **anomalous scattering** signal, down-shifted in frequency



Fixed Probe Beam Injection

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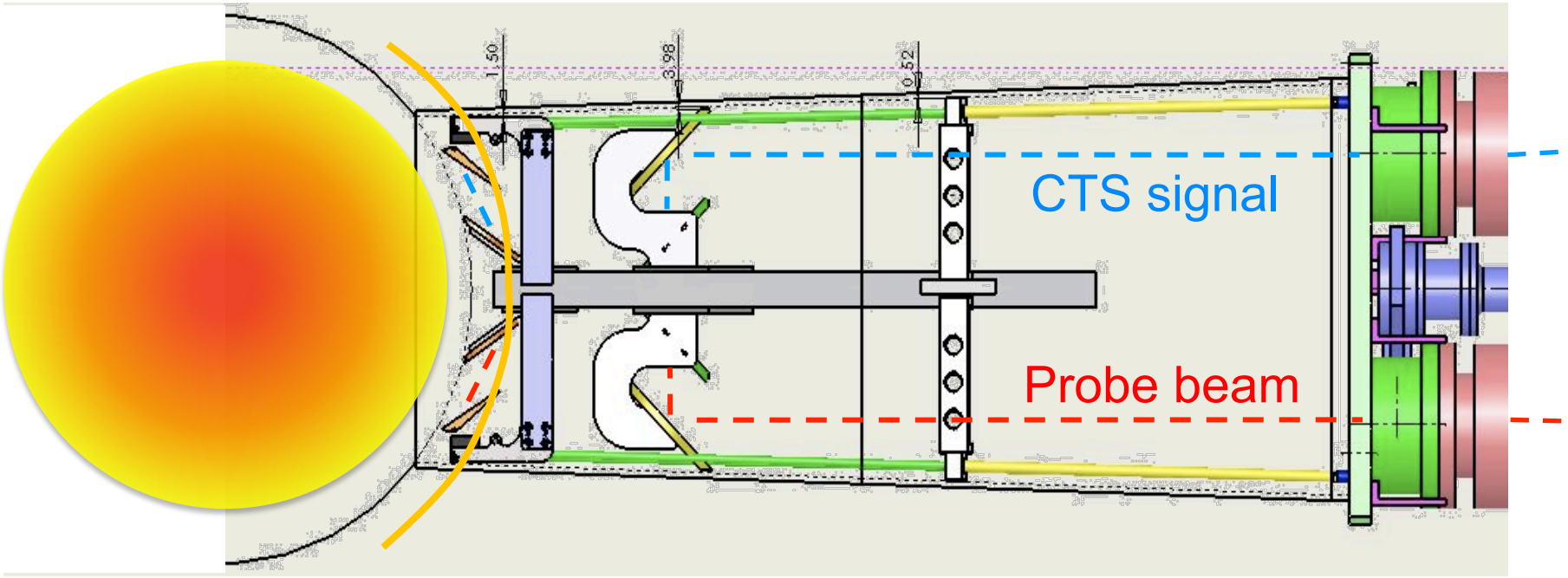

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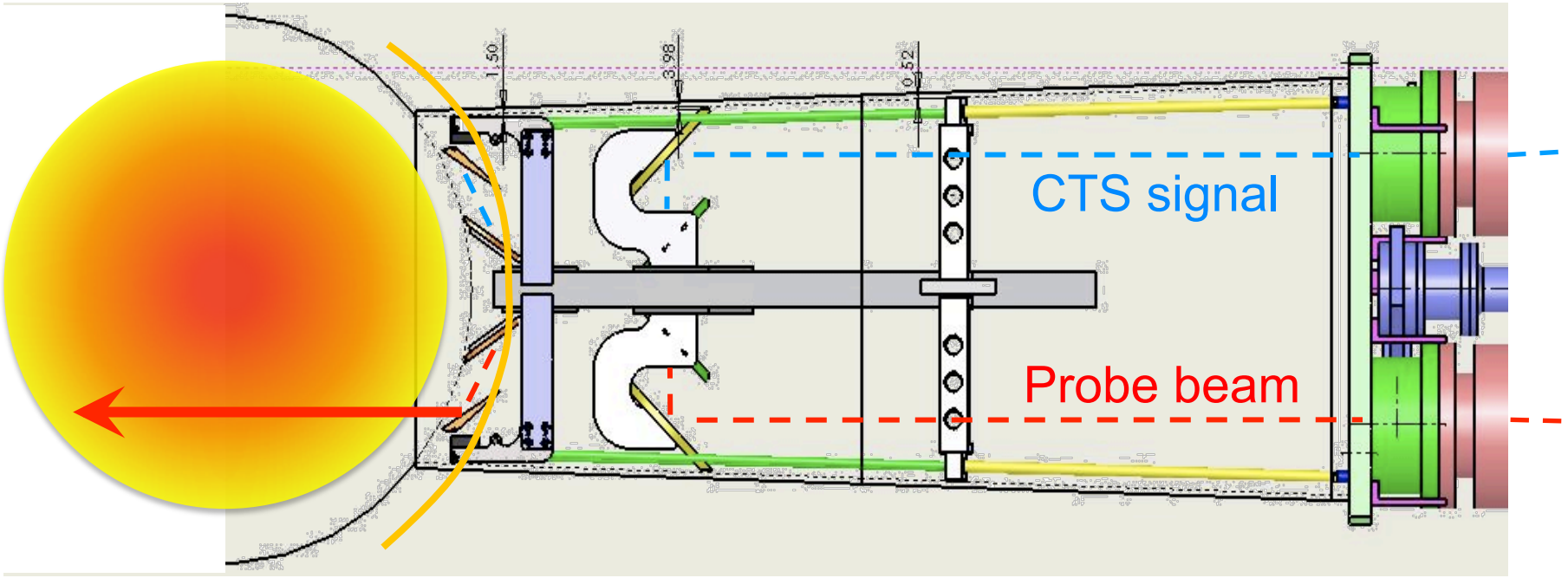

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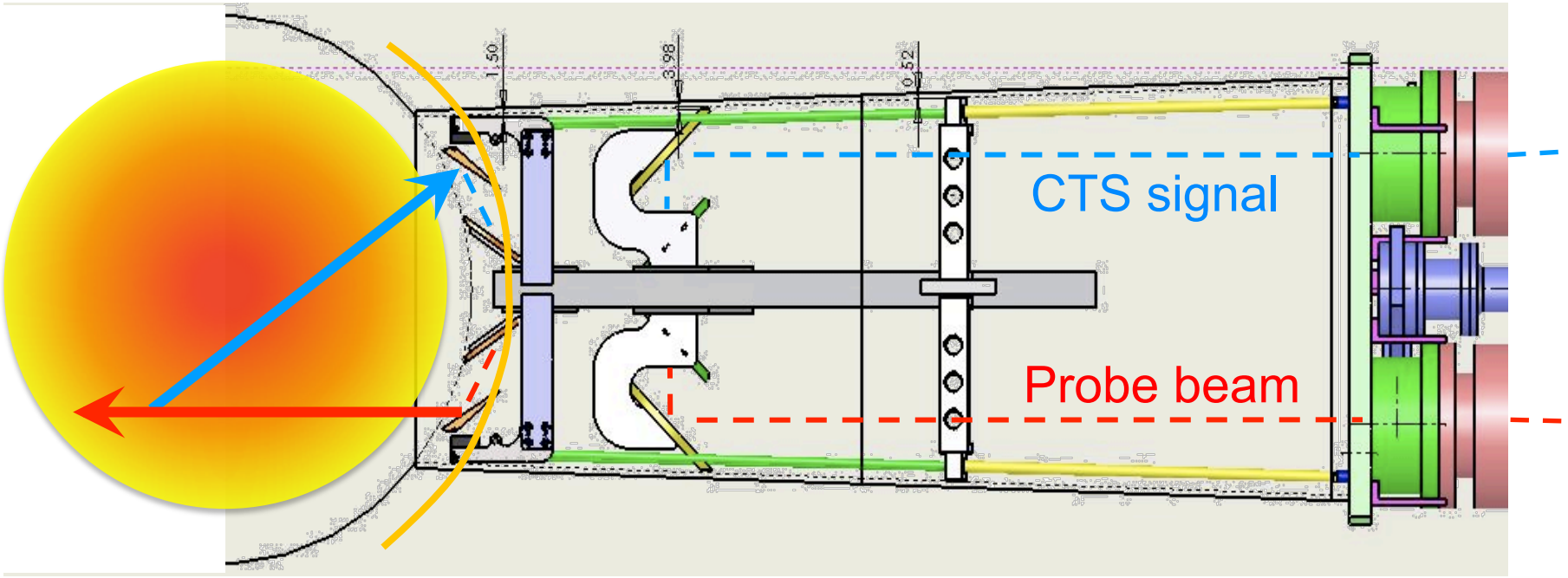

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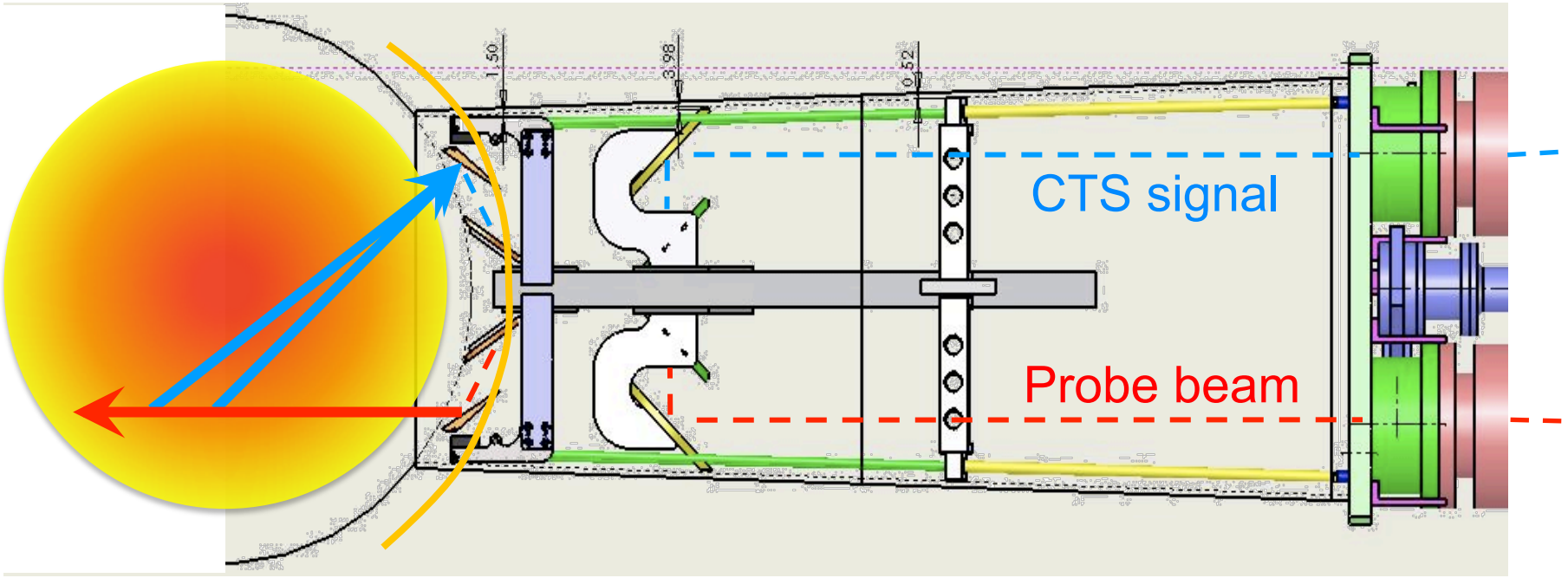

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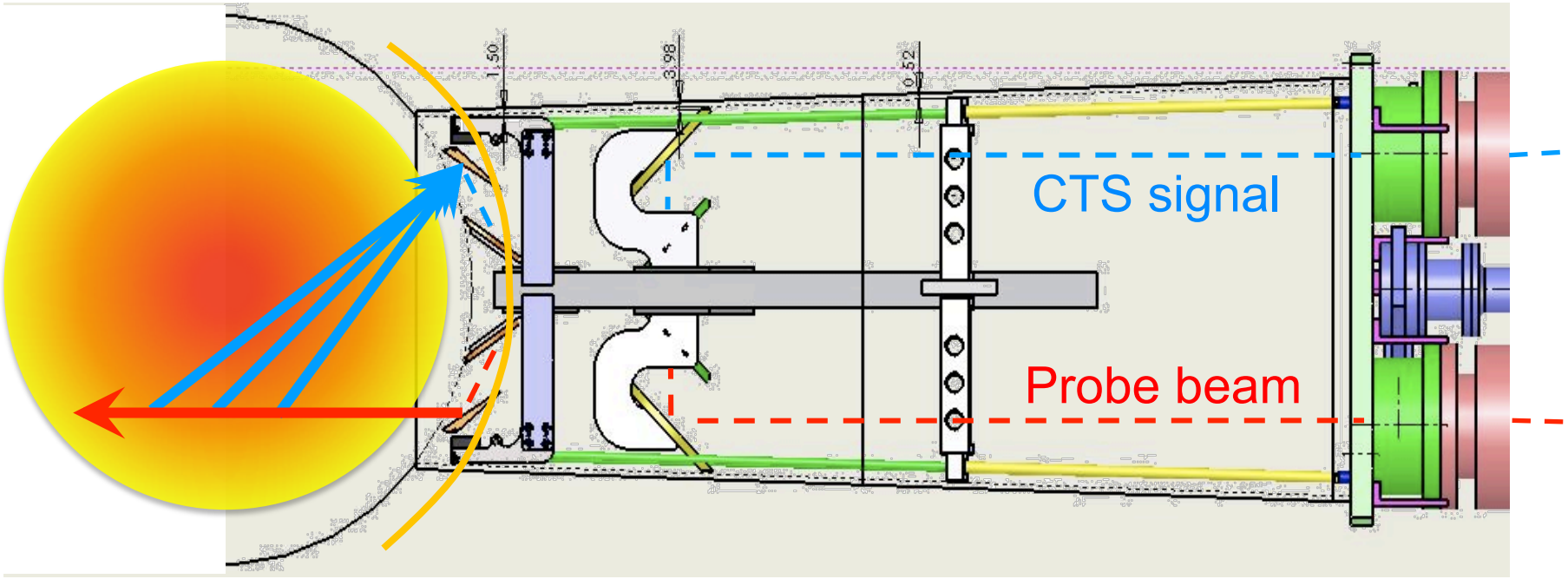

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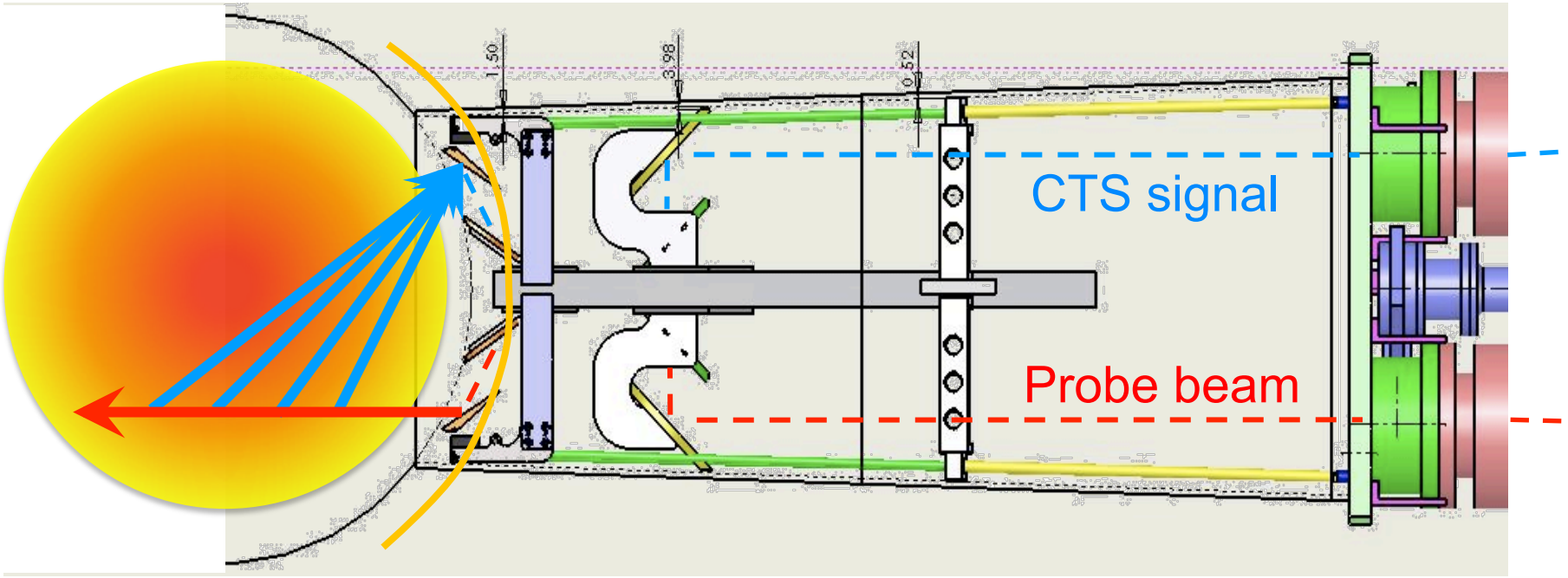

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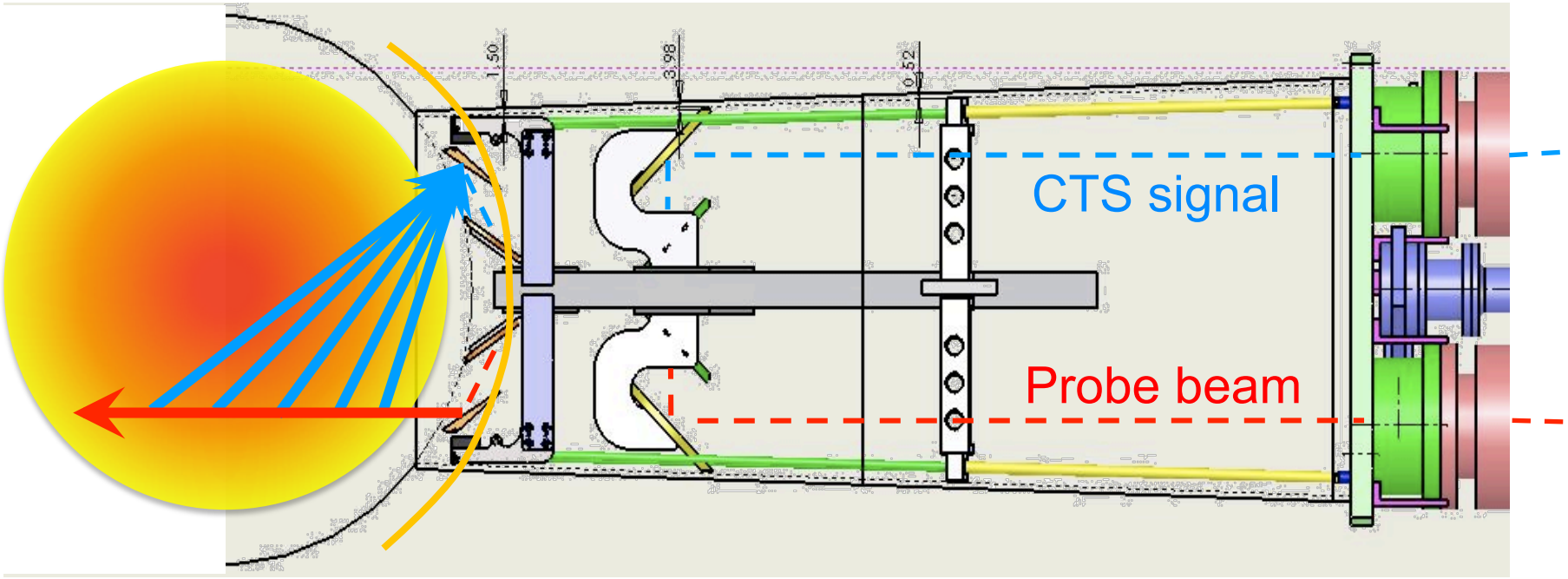

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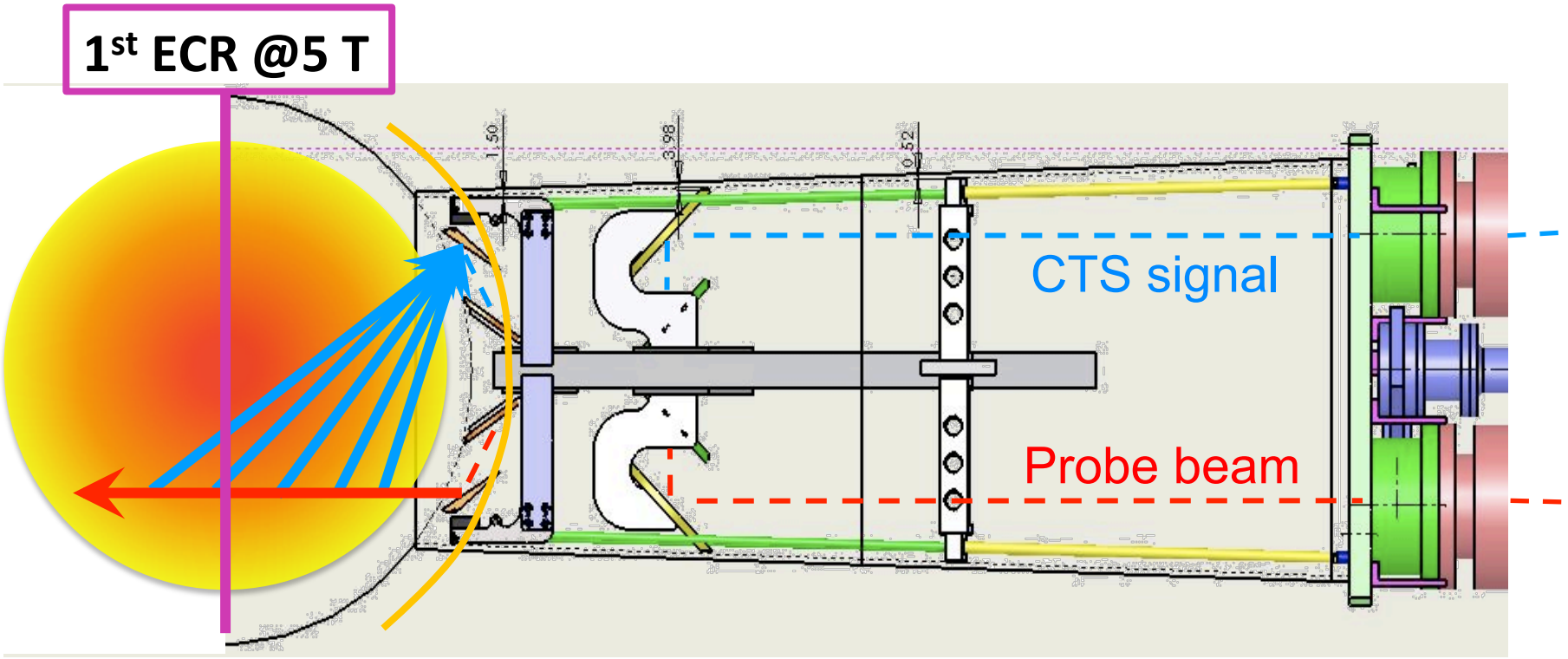

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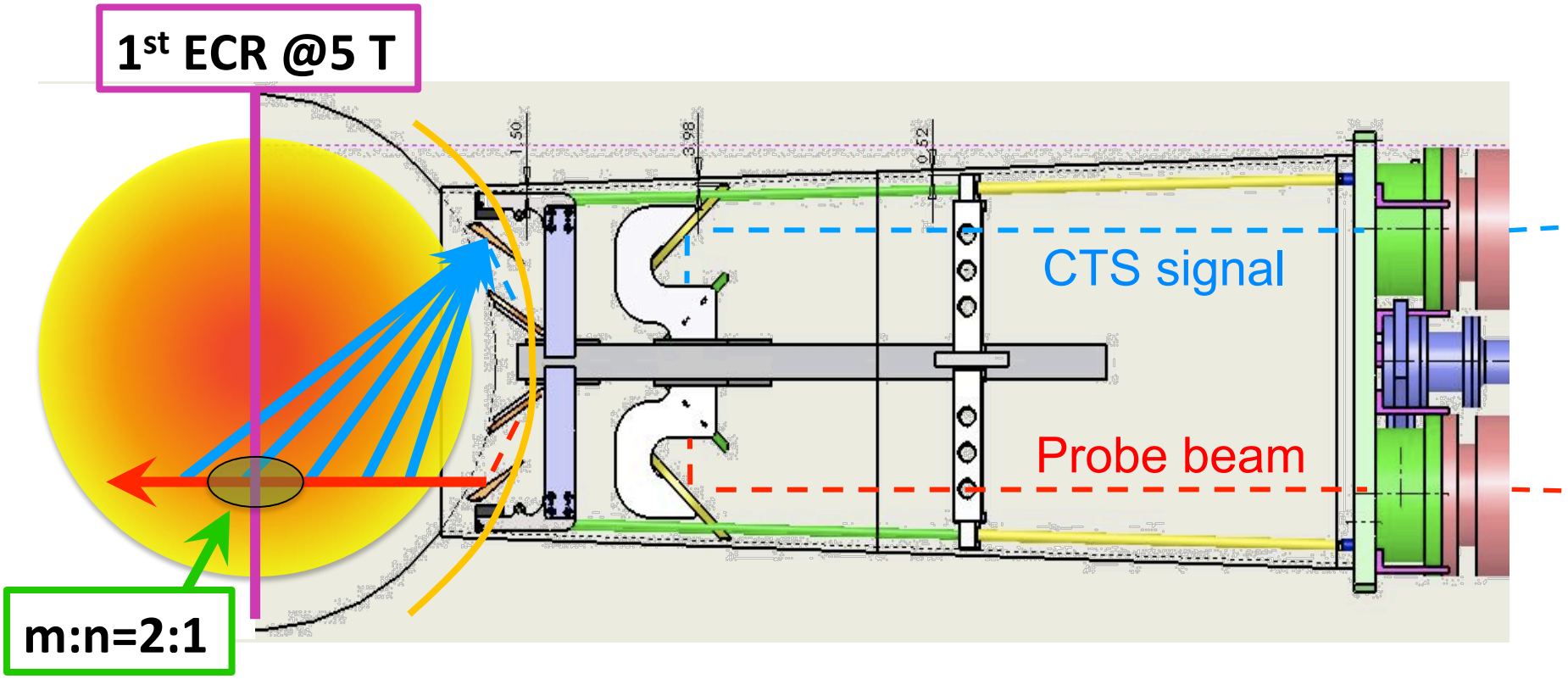

Scattering Layout in the Plasma

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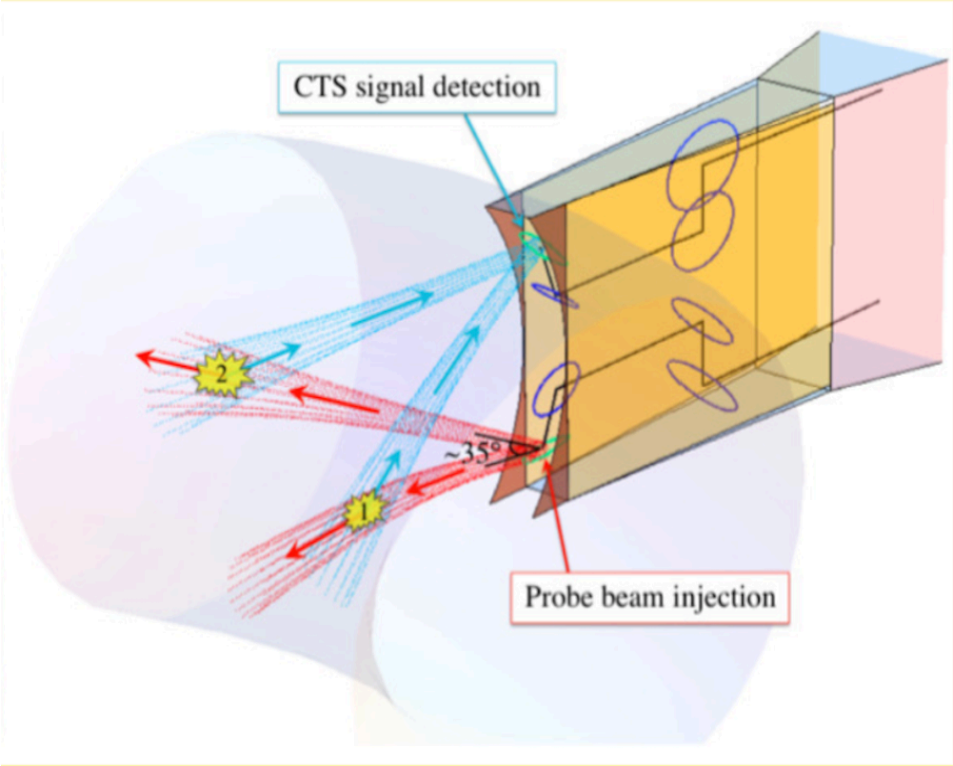

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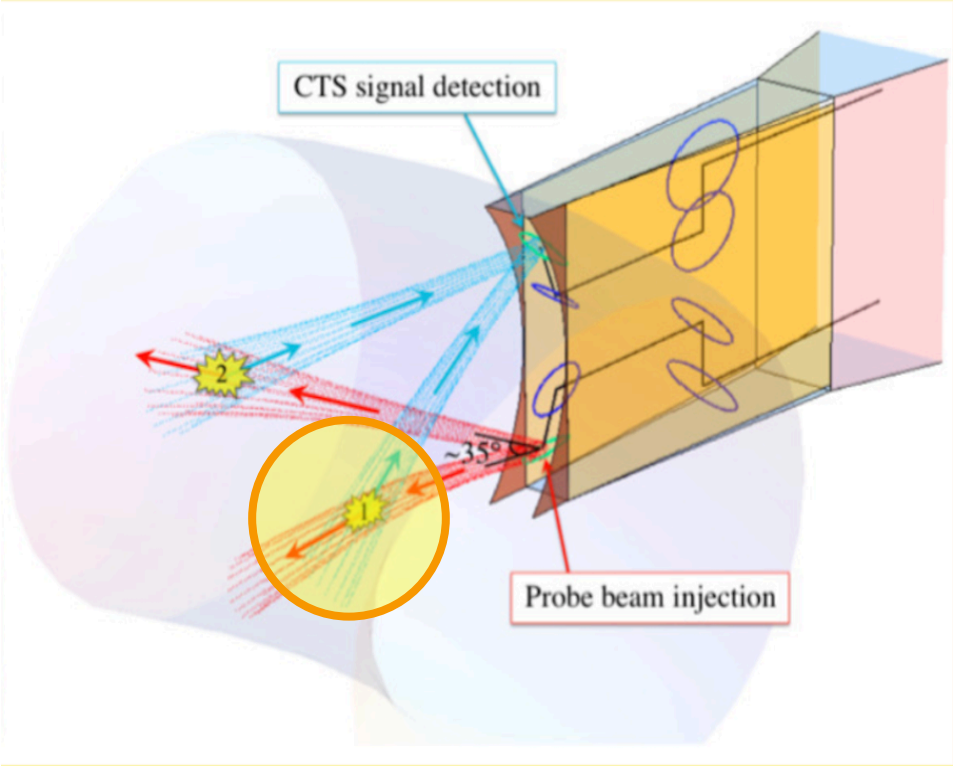

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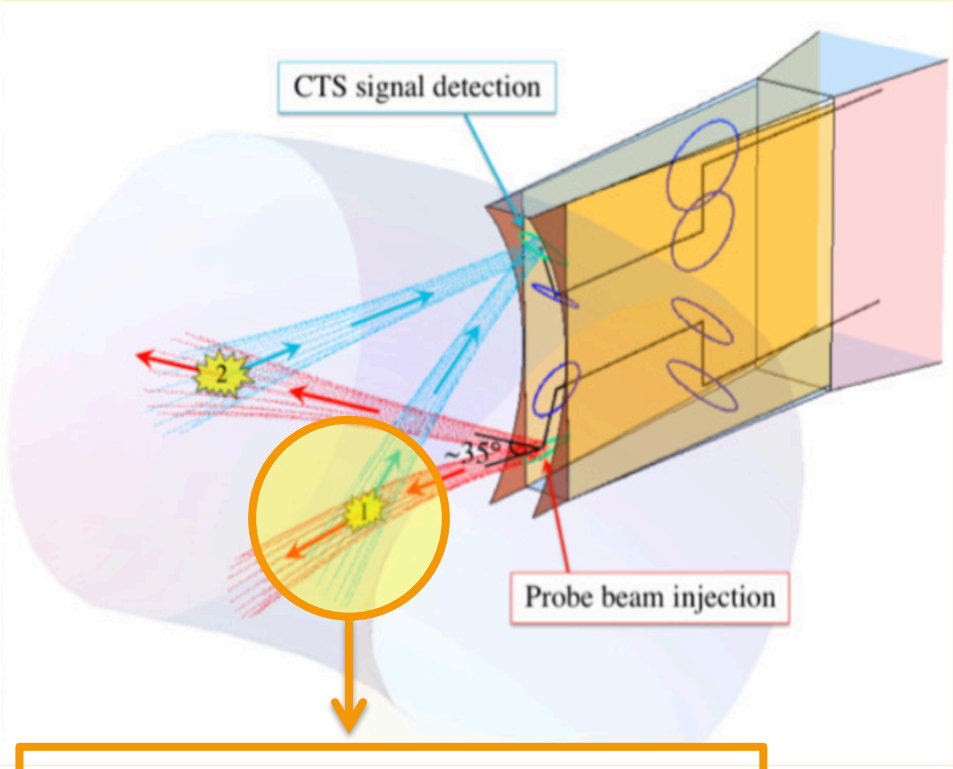

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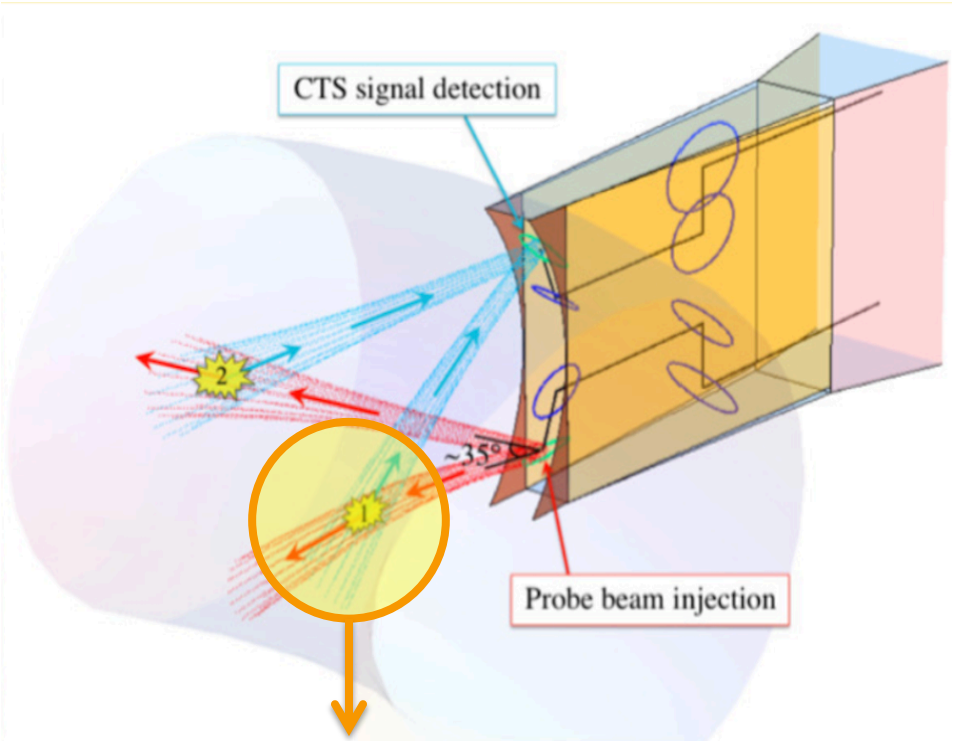

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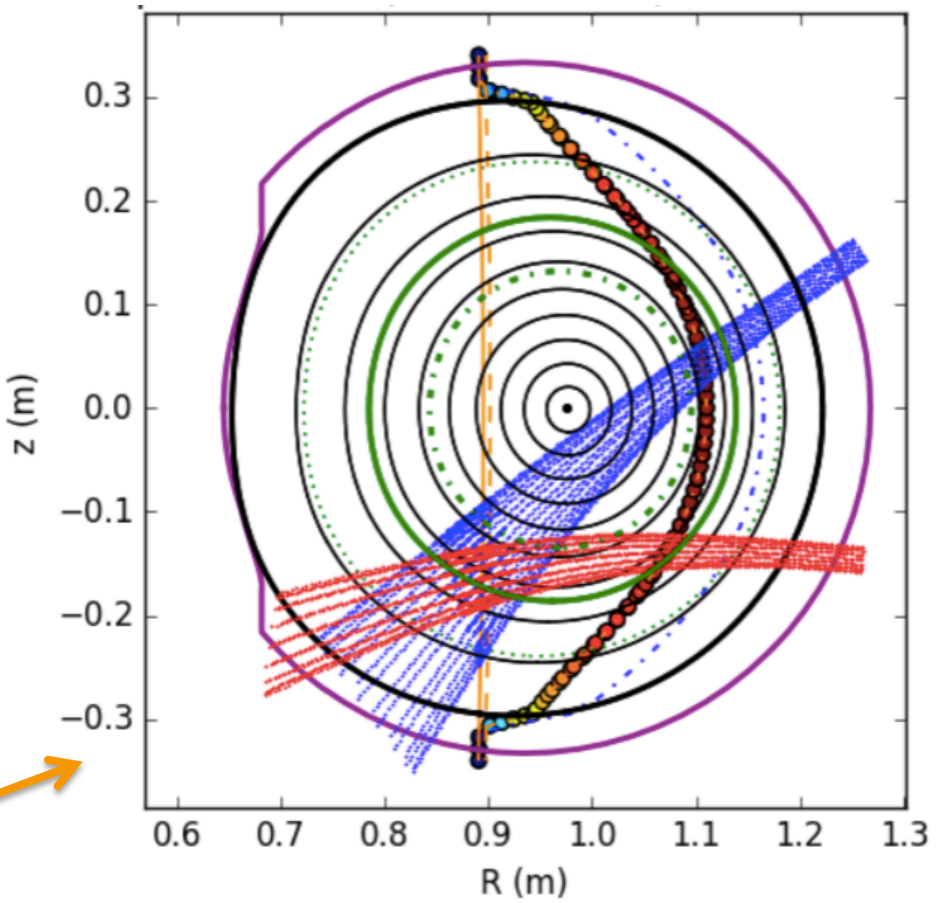

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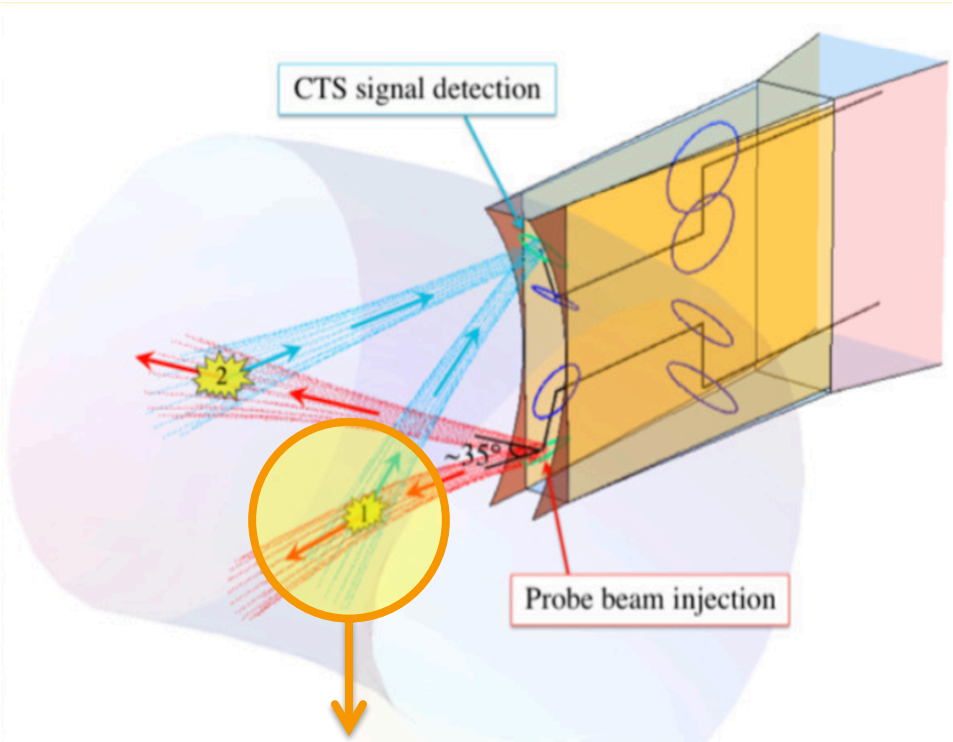

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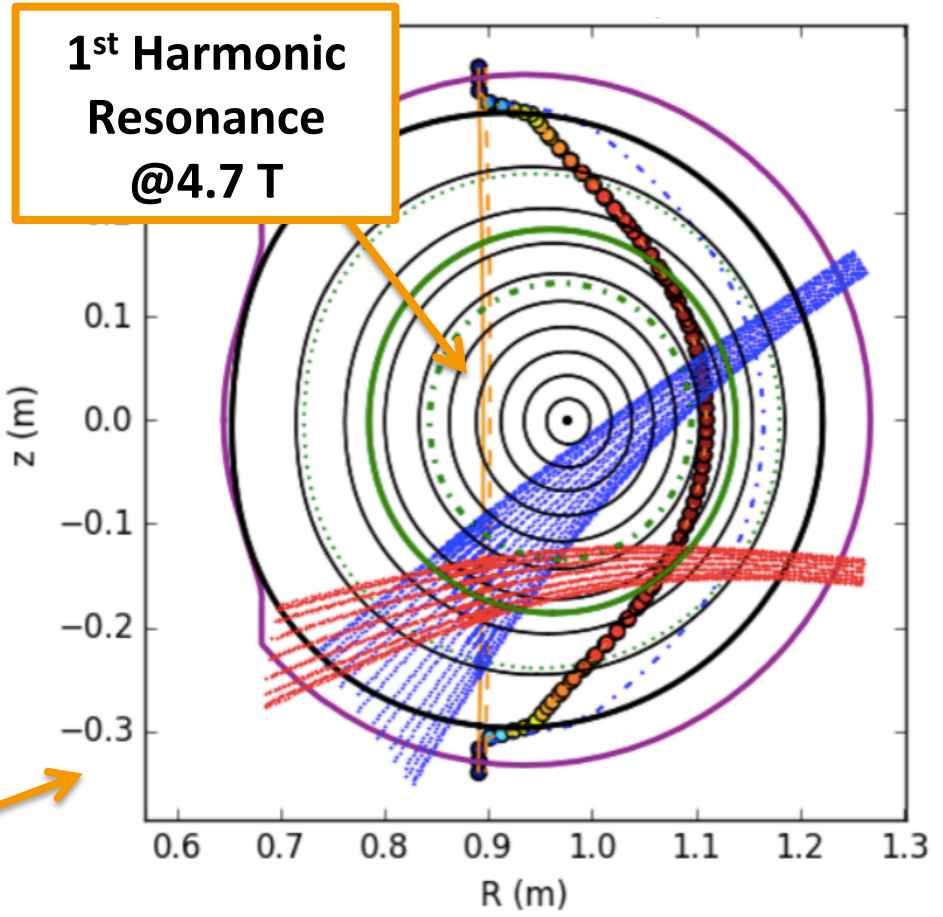

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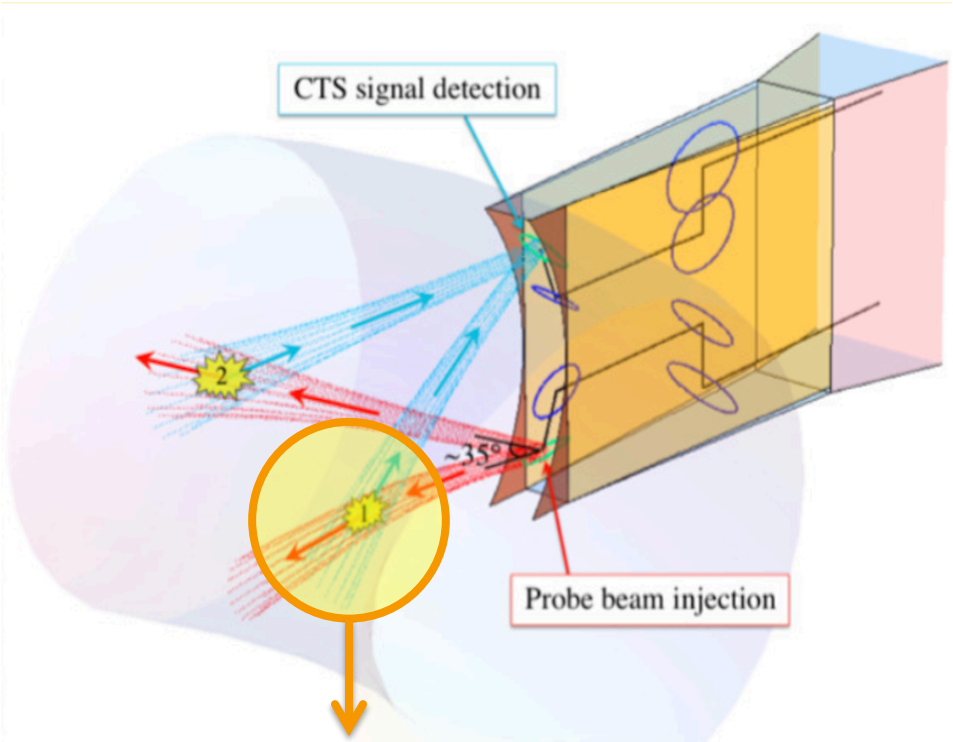

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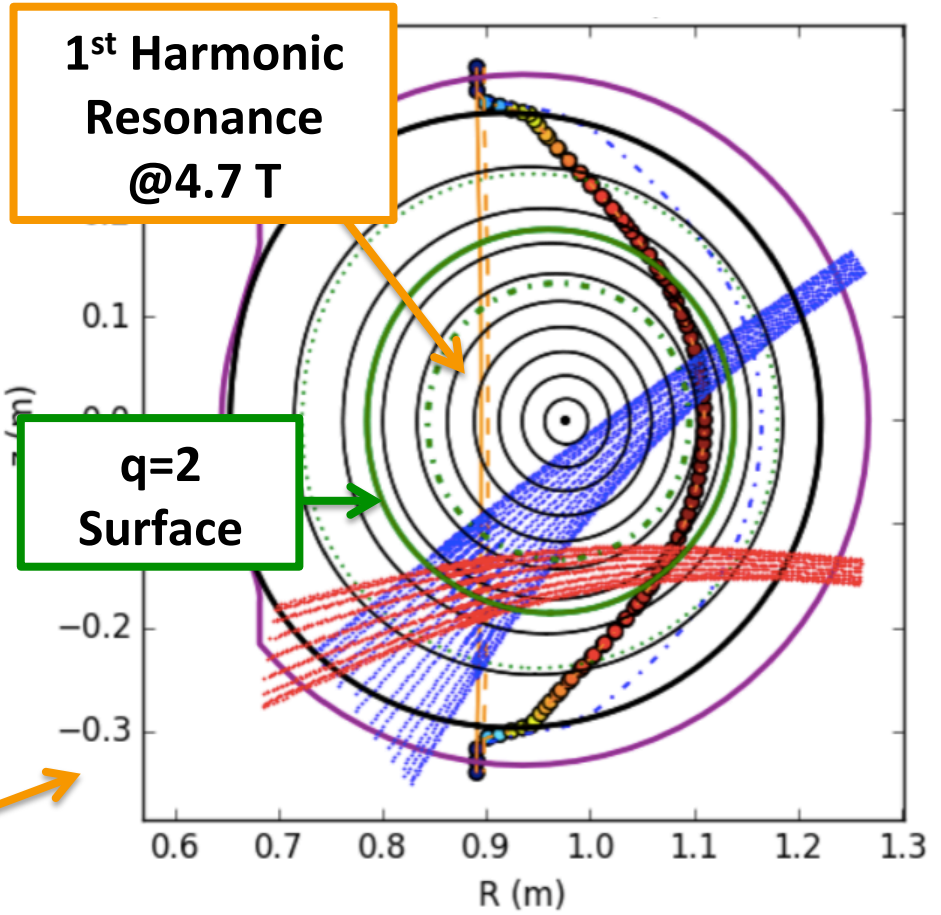

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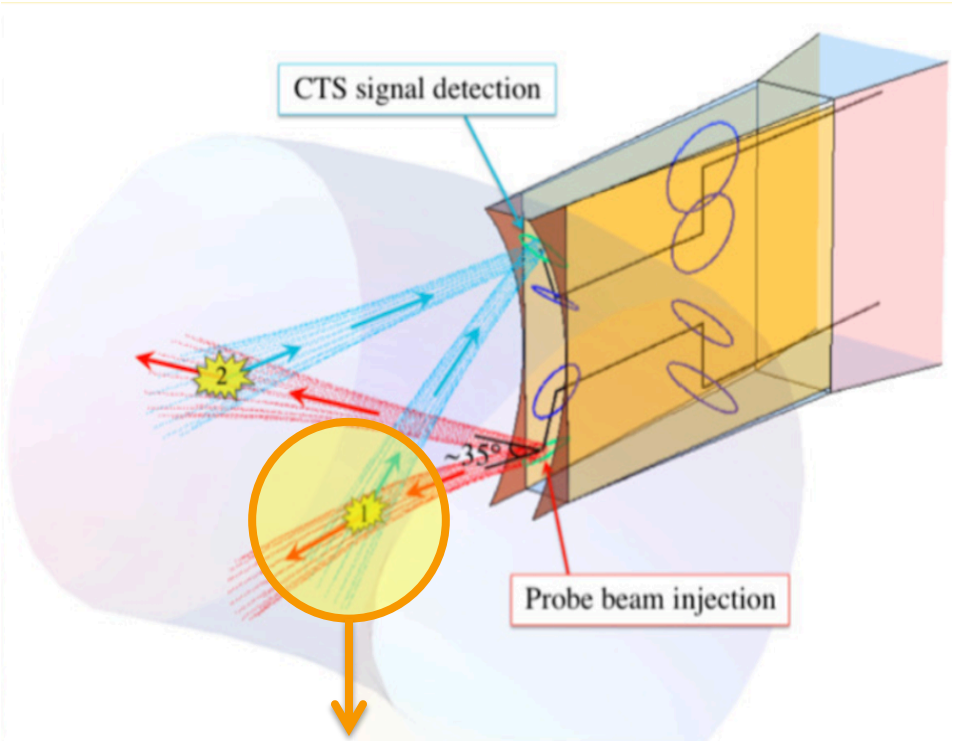

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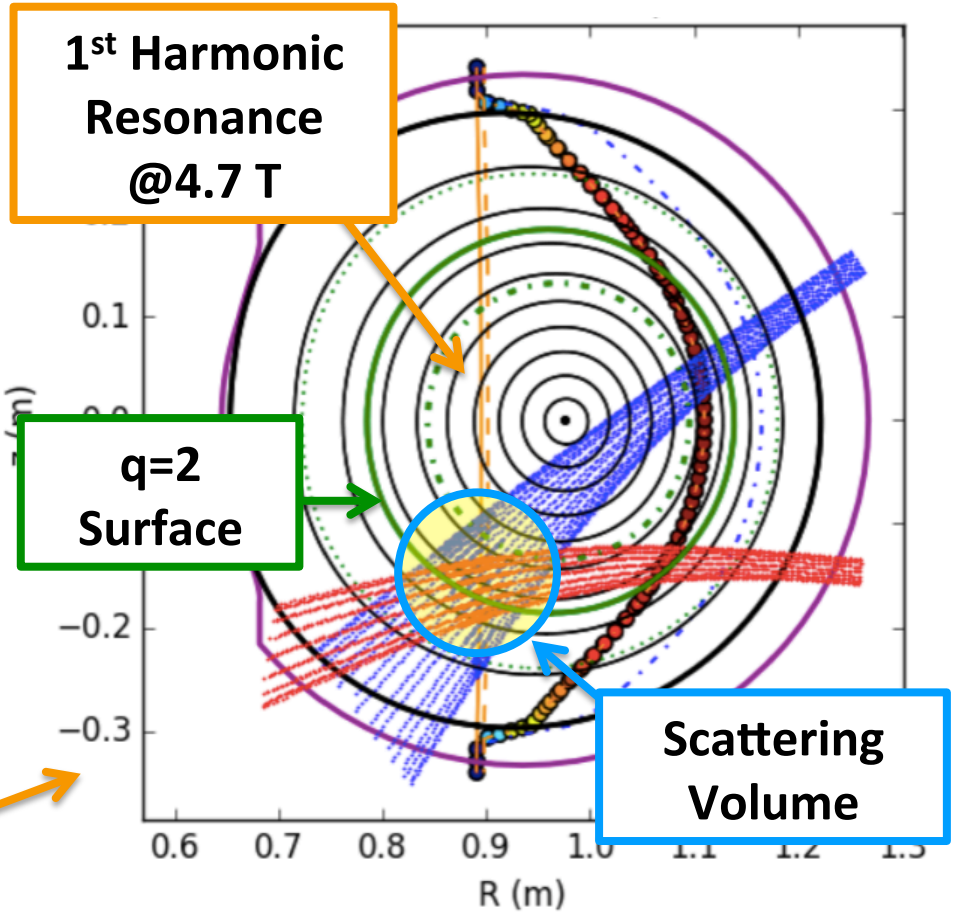
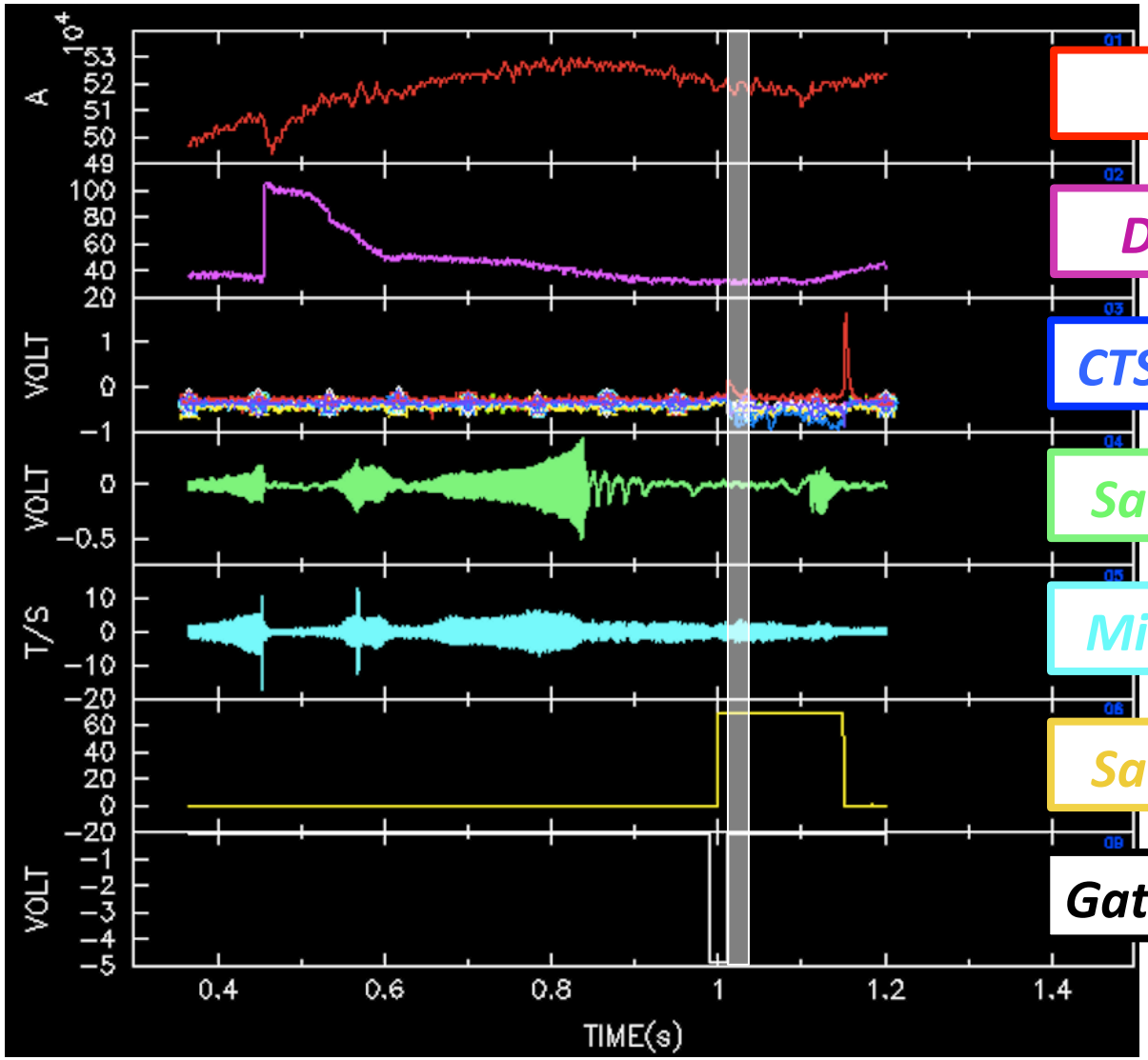


Scattering Volume

Some Measurements – Timing *wrt* m:n=2:1 TM

#43055



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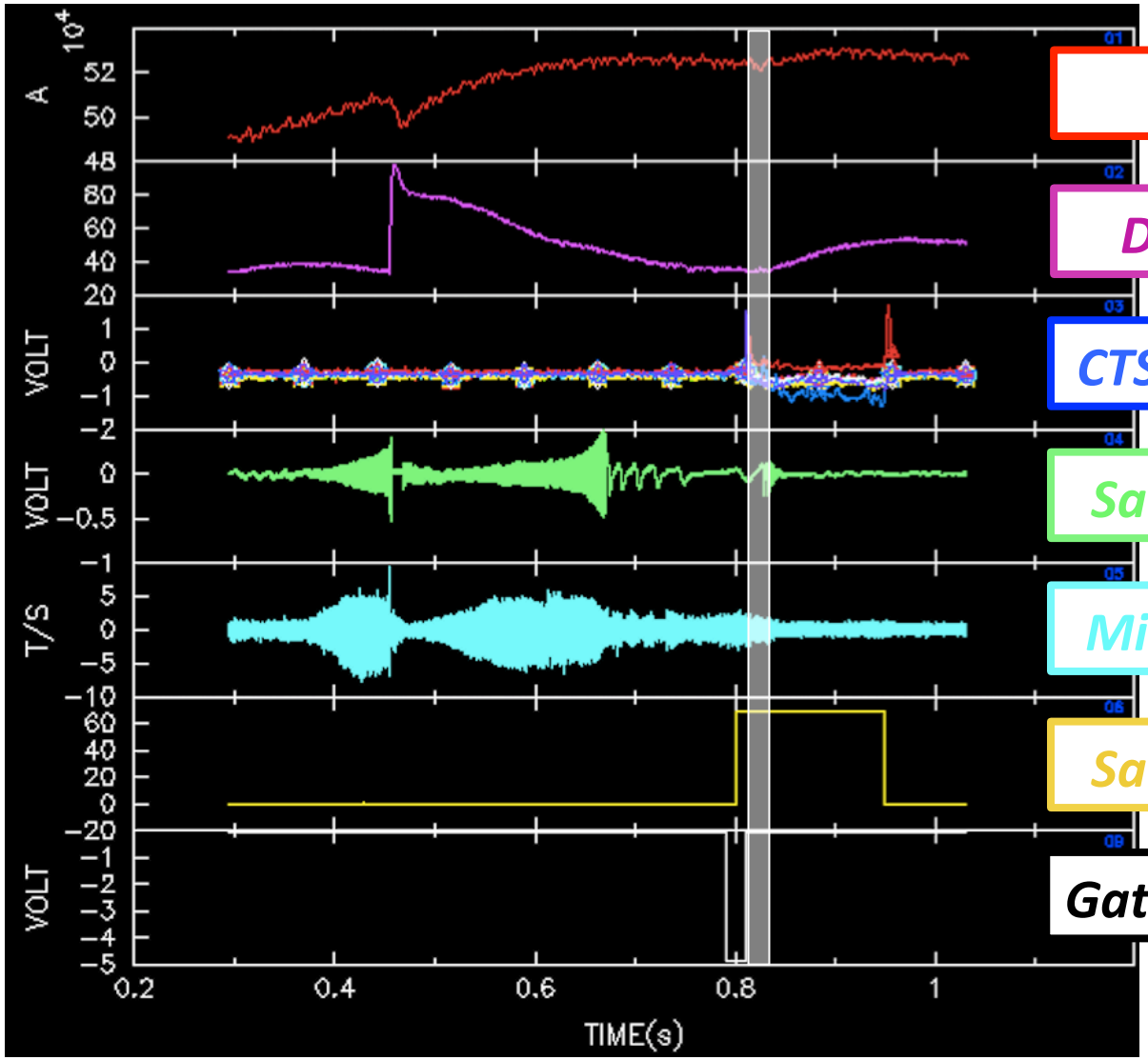

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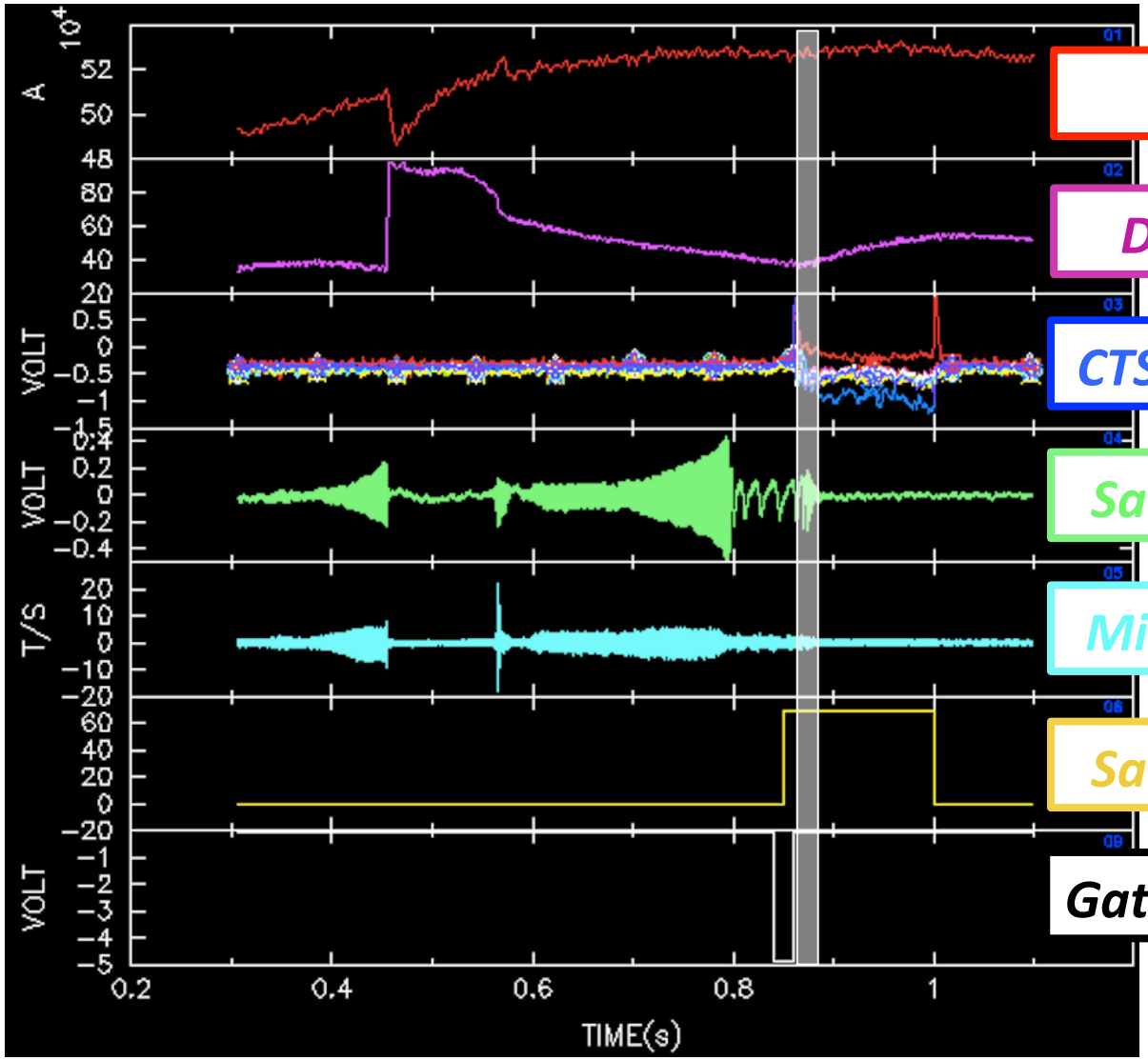
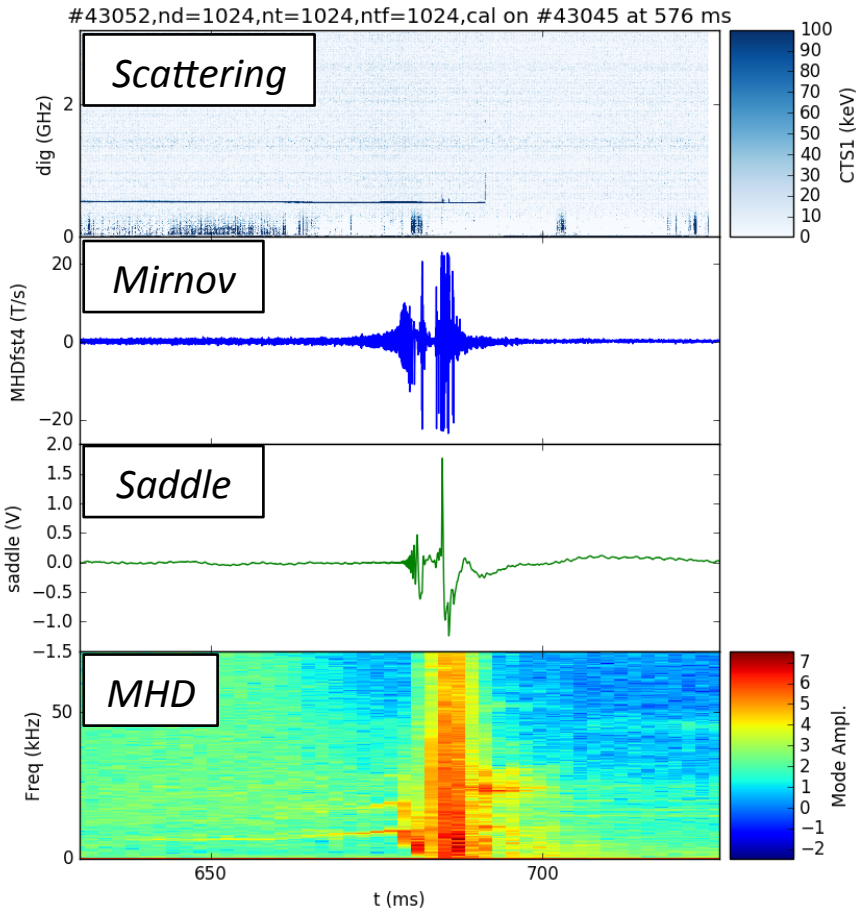
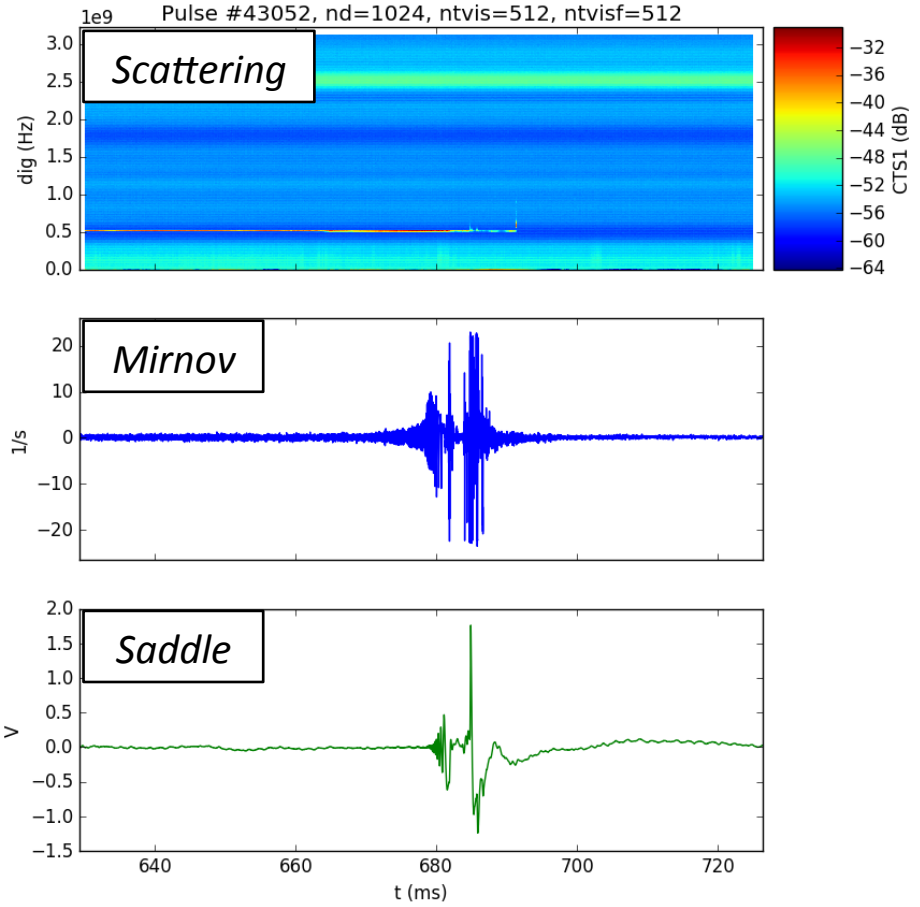


Some Spectrograms - #43052





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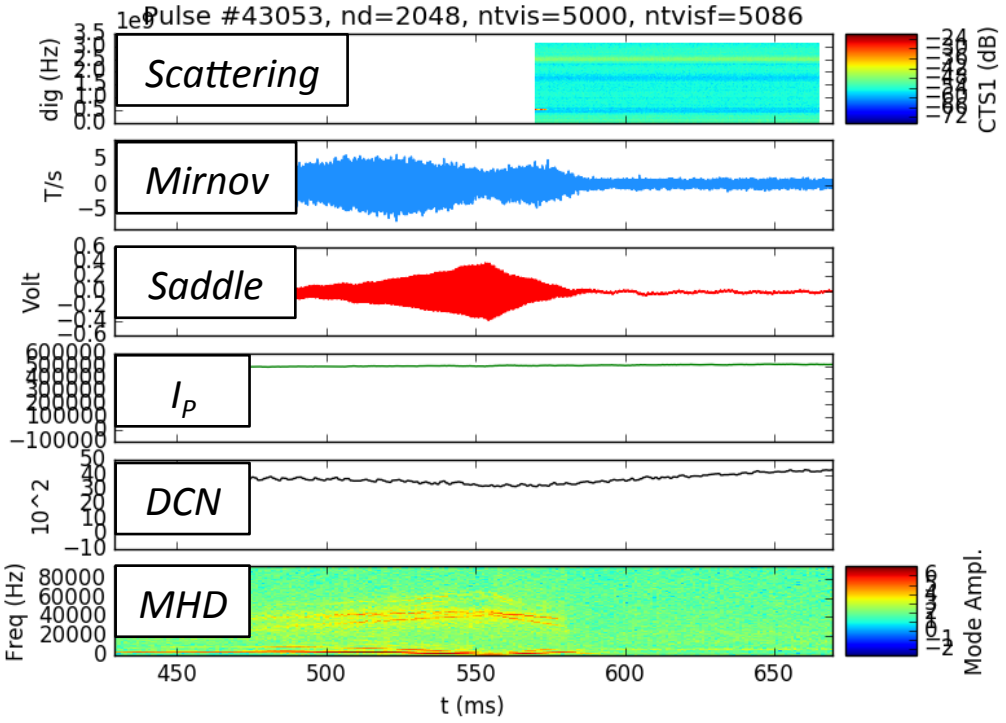

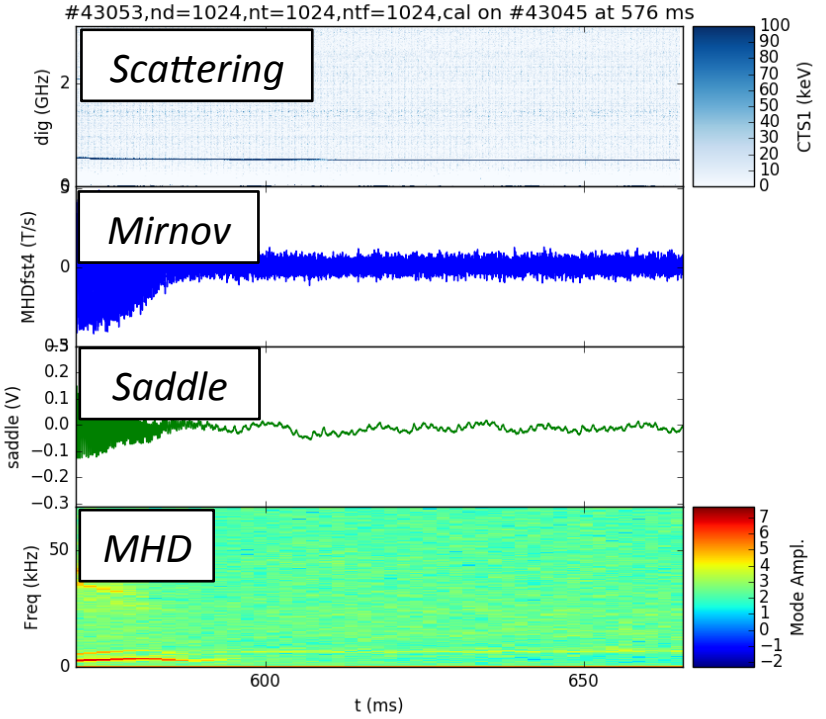

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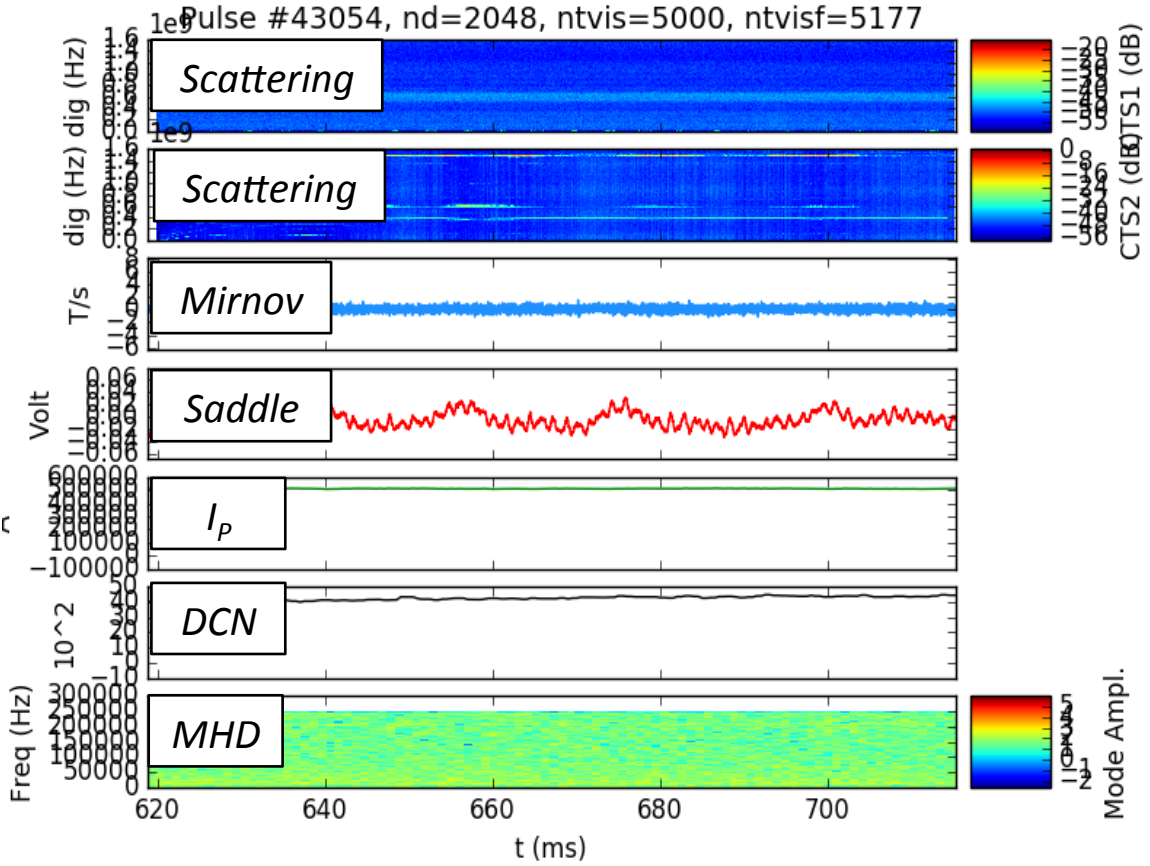

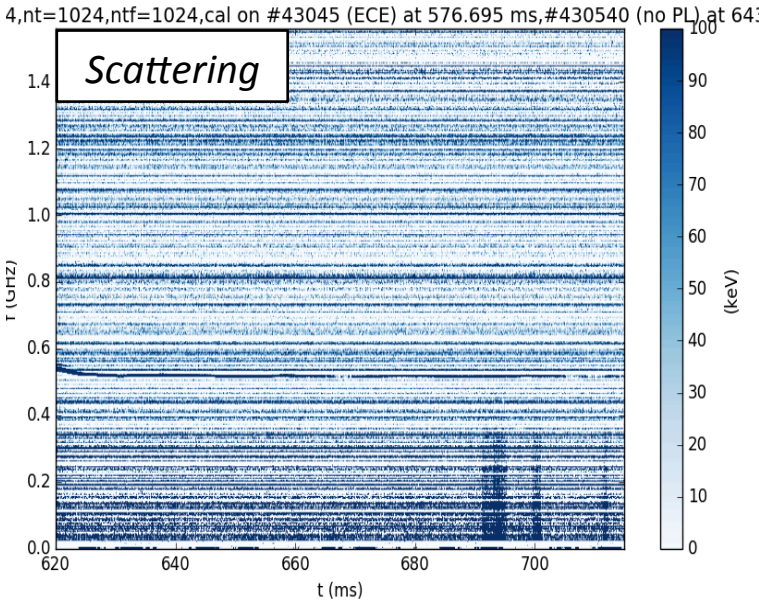

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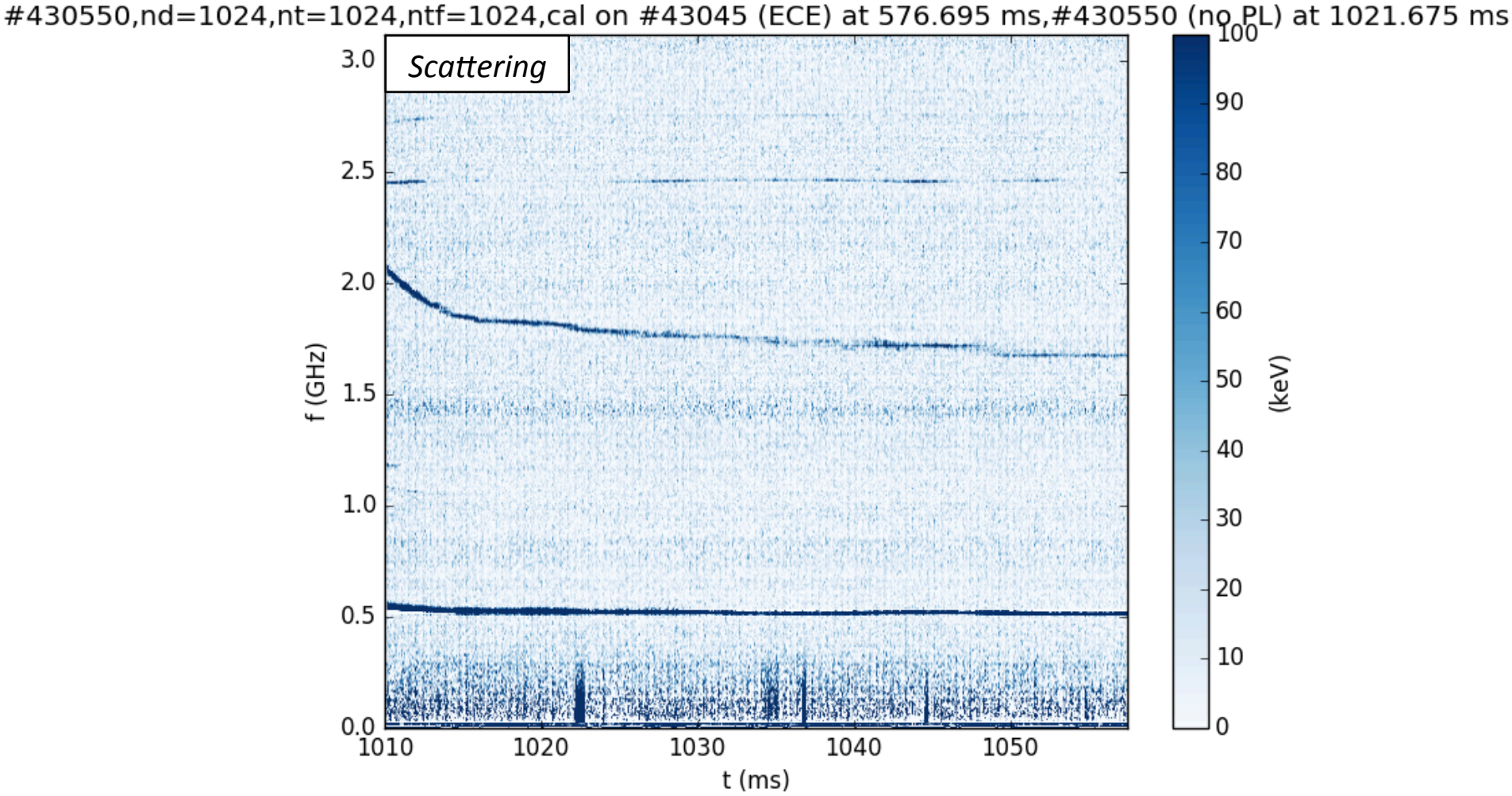

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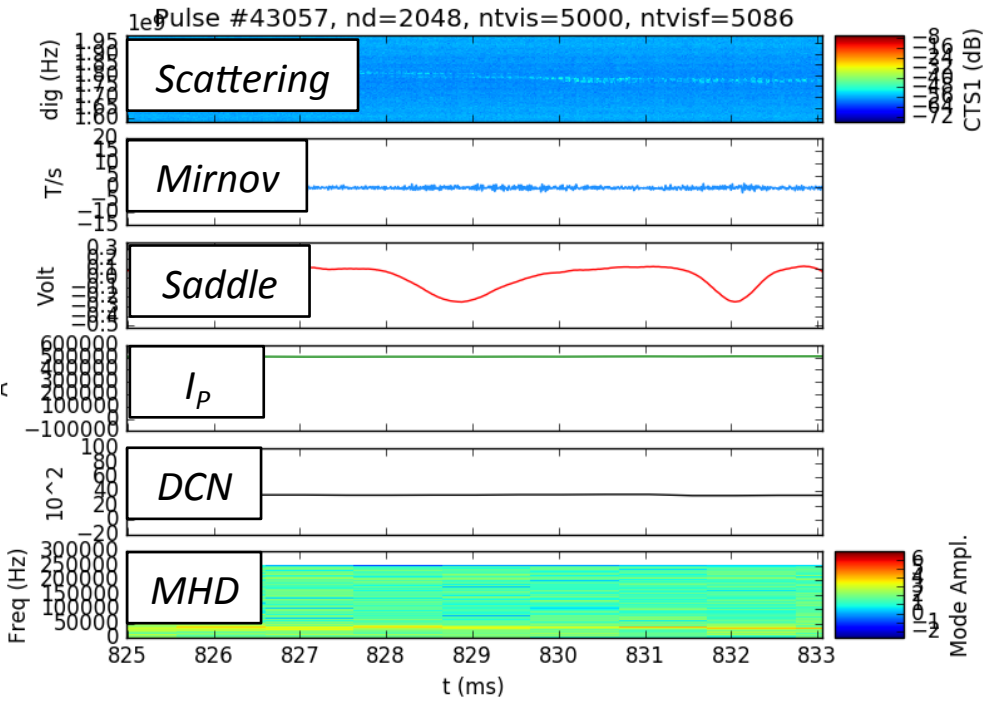

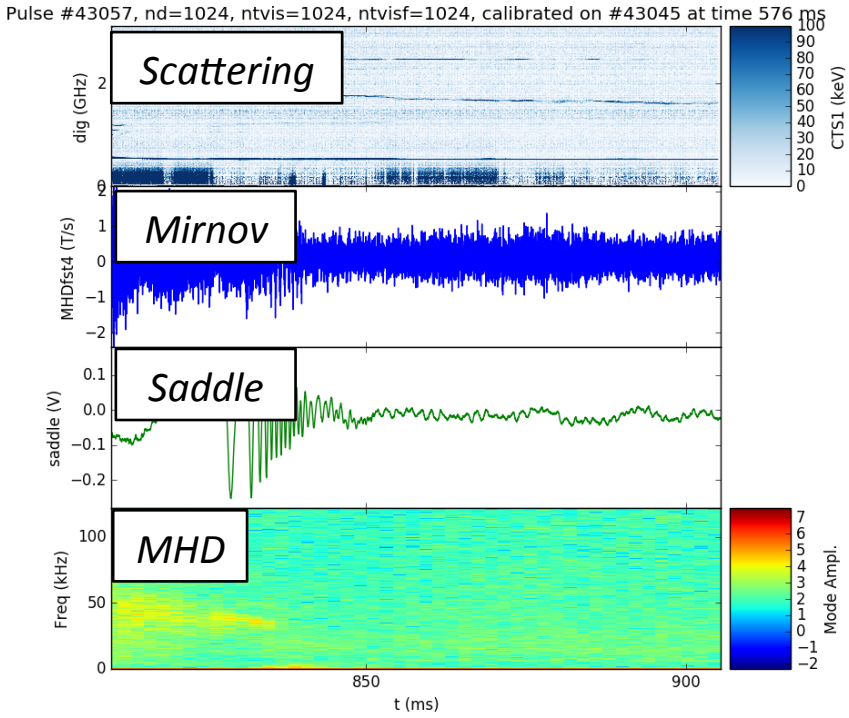

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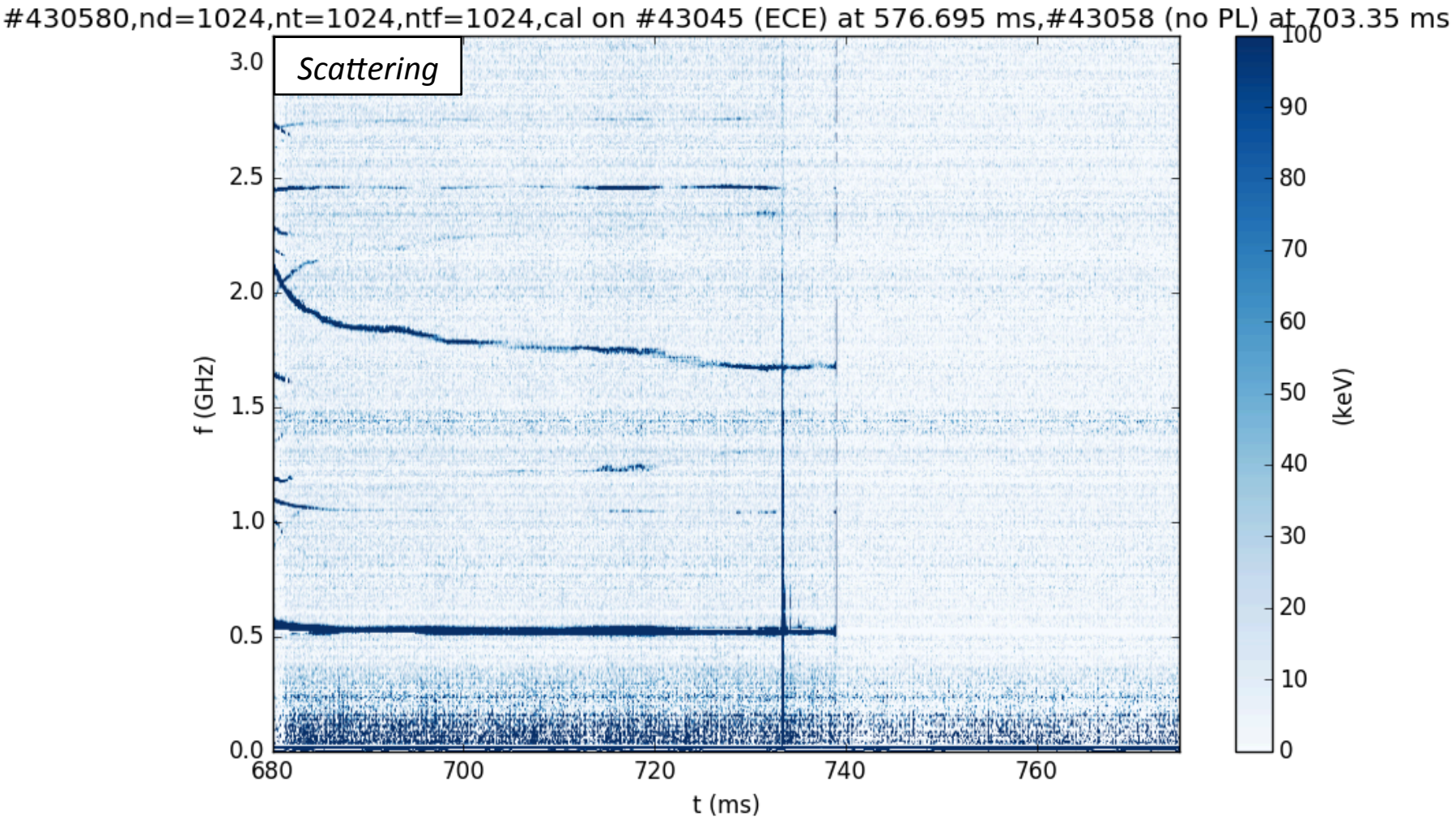


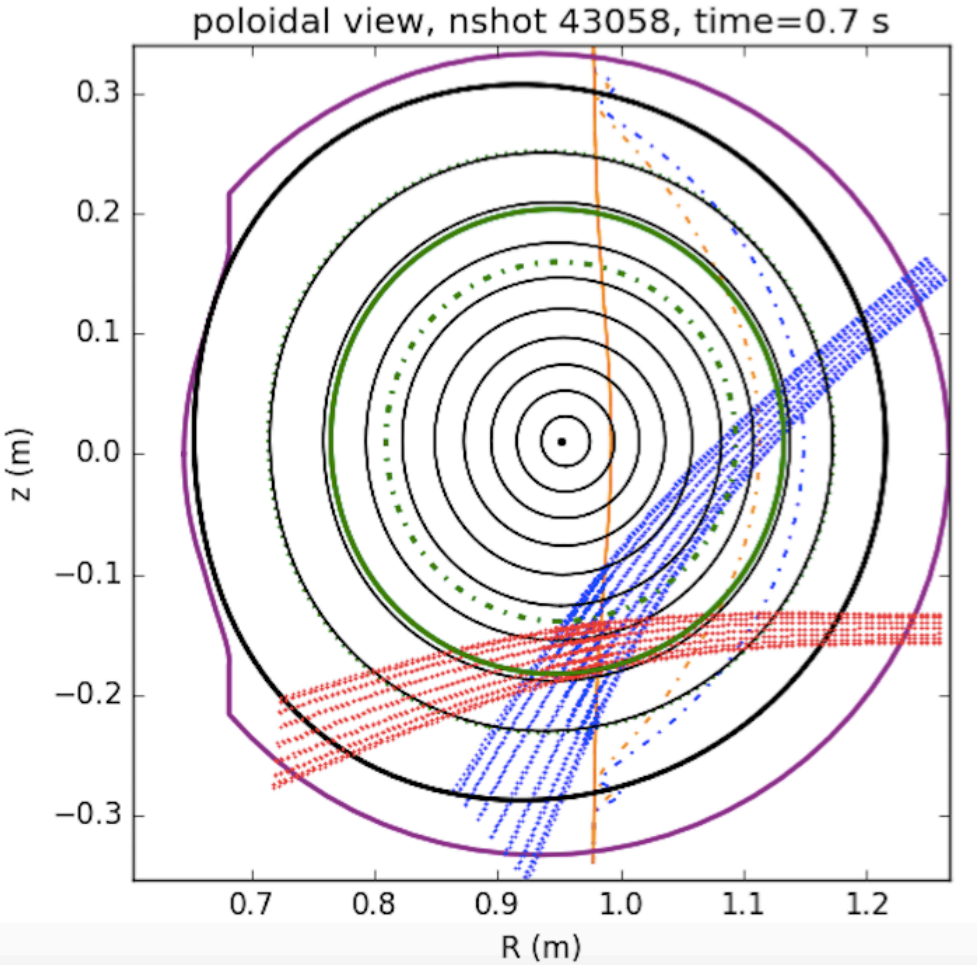
One Possible Reason for Absence of Emissions

The spectrograms seem not to evidence significant anomalous emissions in the time and frequency ranges measured in the shots (work is still in progress in this sense).

Forced to inject the probe at:

$(\alpha, \beta) = (0°, 0°)$

we were probably crossing the beams in an inner radial position wrt the q=2 position.



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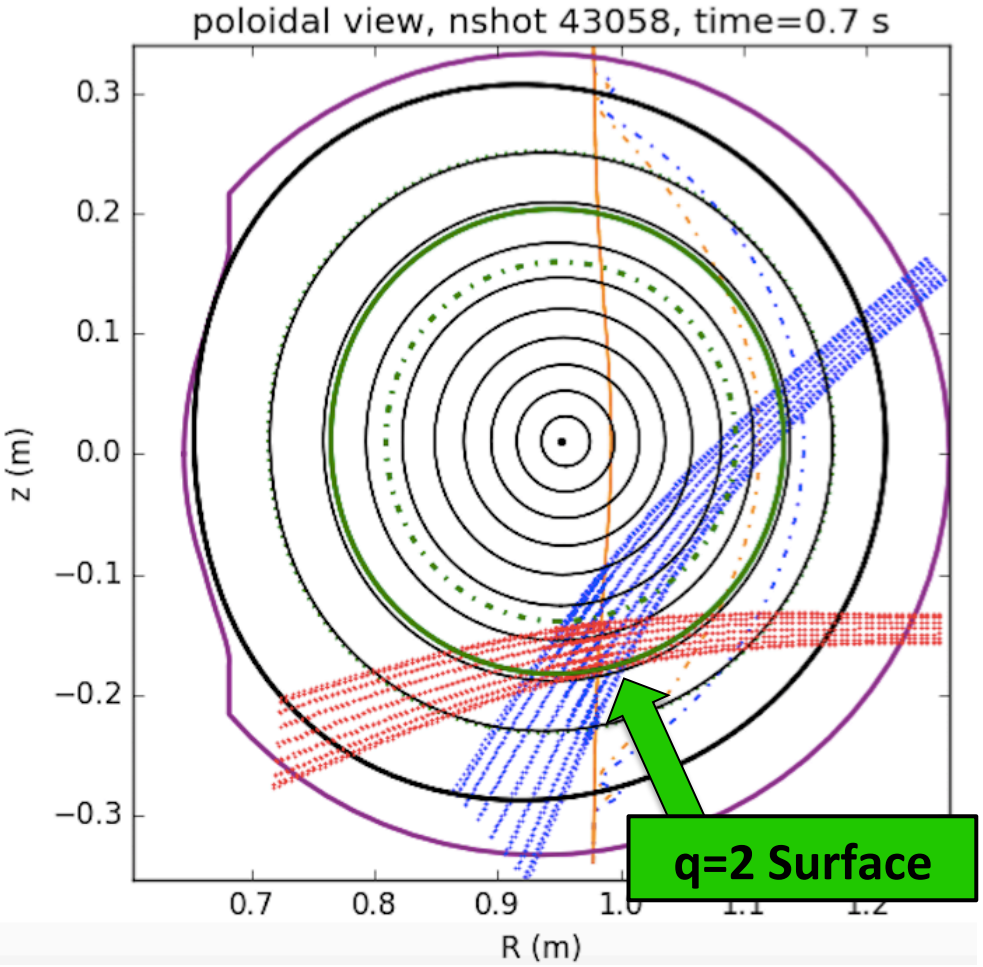

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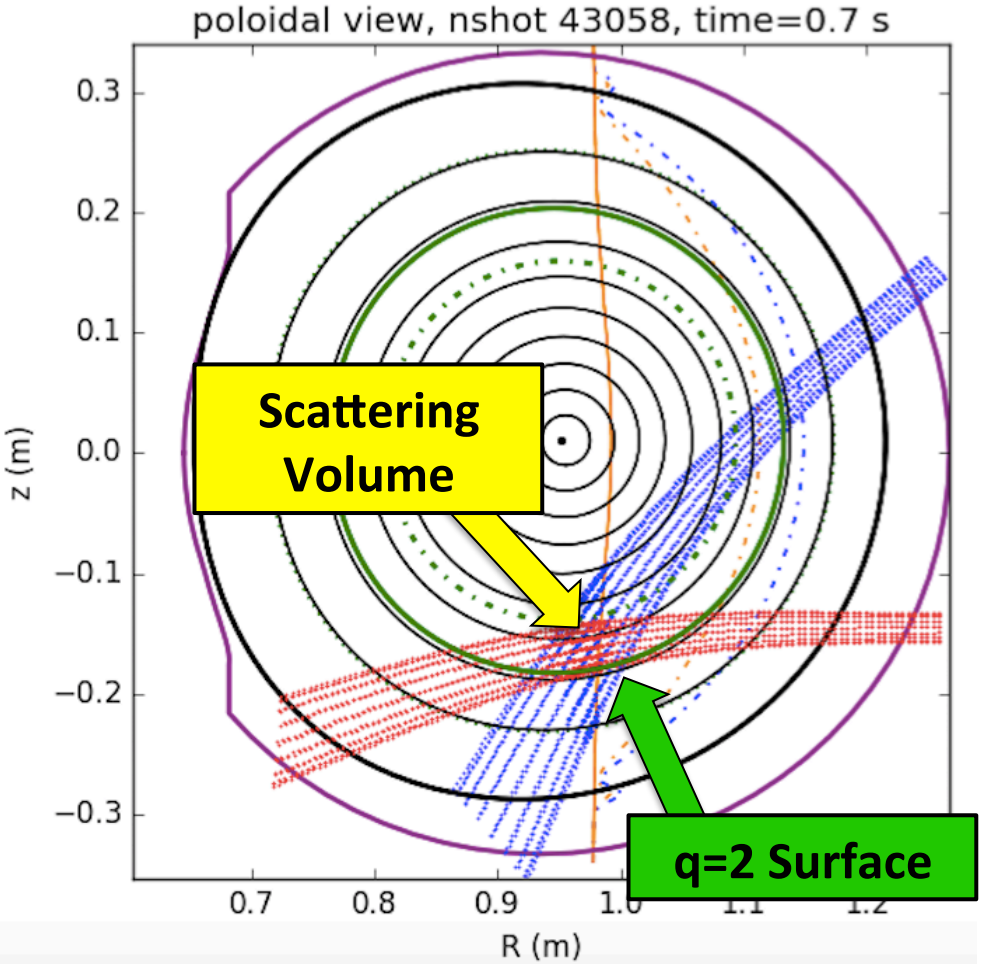

Another Possible Reason for Absence of Emissions

A crucial factor to expect PDIs due to trapped waves in non-monotonous local density profiles with a finite-width O-mode pump scenario consists of a **small (but still finite) electric field component perpendicular to the magnetic field** of the trap, which, according to theory, **would provide the pump wave non-linear coupling to the quasi-perpendicular IB and UH waves**.

See, for instance: *E.Z. Gusakov and A.Yu. Popov, Phys. Plasmas **25** (2018)*

In our scenario **such perpendicular field component was absent**, due to the fixed toroidal steering angle of line #4 which forced non-oblique probe injection.

Next Sessions on Scattering Experiments

1- **Demonstrate the recently envisaged low power threshold Parametric Decay Instabilities of EC waves at non-monotonous density profile locations**

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PLASMA TARGET

- **7.2 T - 500-700 kA**
- **In a first phase**: NO ROTATING ISLANDS, in order to demonstrate a Collective Scattering measurement.
- **In a second phase**: in case of success of the first phase → possible request of islands, still with Pellet injection + Free density ramp-down, to investigate the effects on CTS signals.