Inspiral Hardware Injections

Steve Fairhurst

University of Wisconsin-Milwaukee

Inspiral Working Group

LIGO Scientific Collaboration

LIGO-G030618-00-Z

S2 Hardware Injections

- Set of 18 inspiral events injected at various times throughout S2, masses from 1.0, 1.0 to 10, 20 M$_{SUN}$, distances from 15 to 500 kpc.

- Focus here on March 25 injections (2 sets), 1.4, 1.4 and 1.0, 1.0 solar mass inspirals.

- Results
  » Inspiral pipeline produces triggers in all 3 interferometers.
  » Triggers detected at expected time; time agrees (to one sample point) for all 3 instruments.
 » Measured distances are within 25% of injected distances.

Distance Measurements – L1

- Distances in L1 accurate to within 10%.

- Changing calibration time within data chunk has little effect on distances.

Accuracy in measuring distances to hardware injections at GPS time 732690416 sec
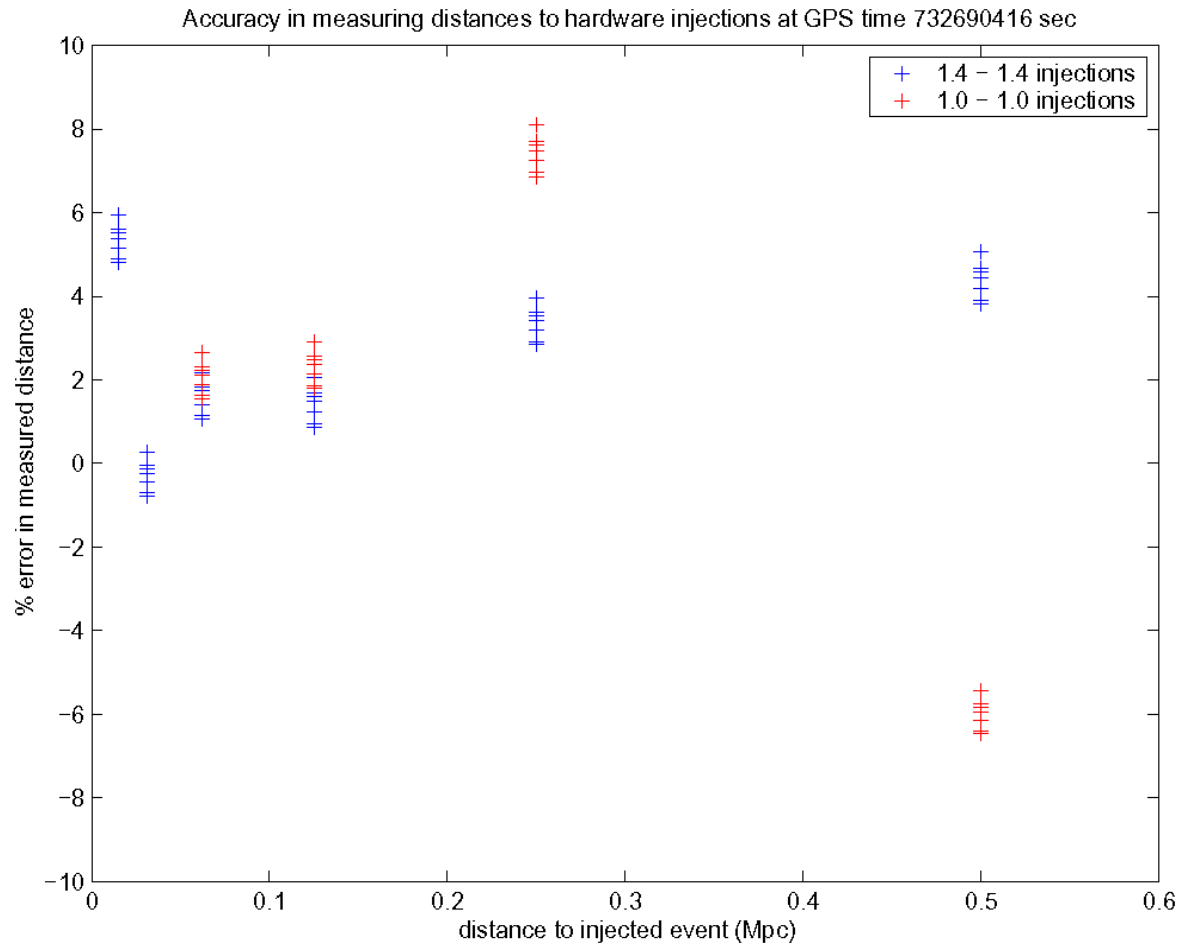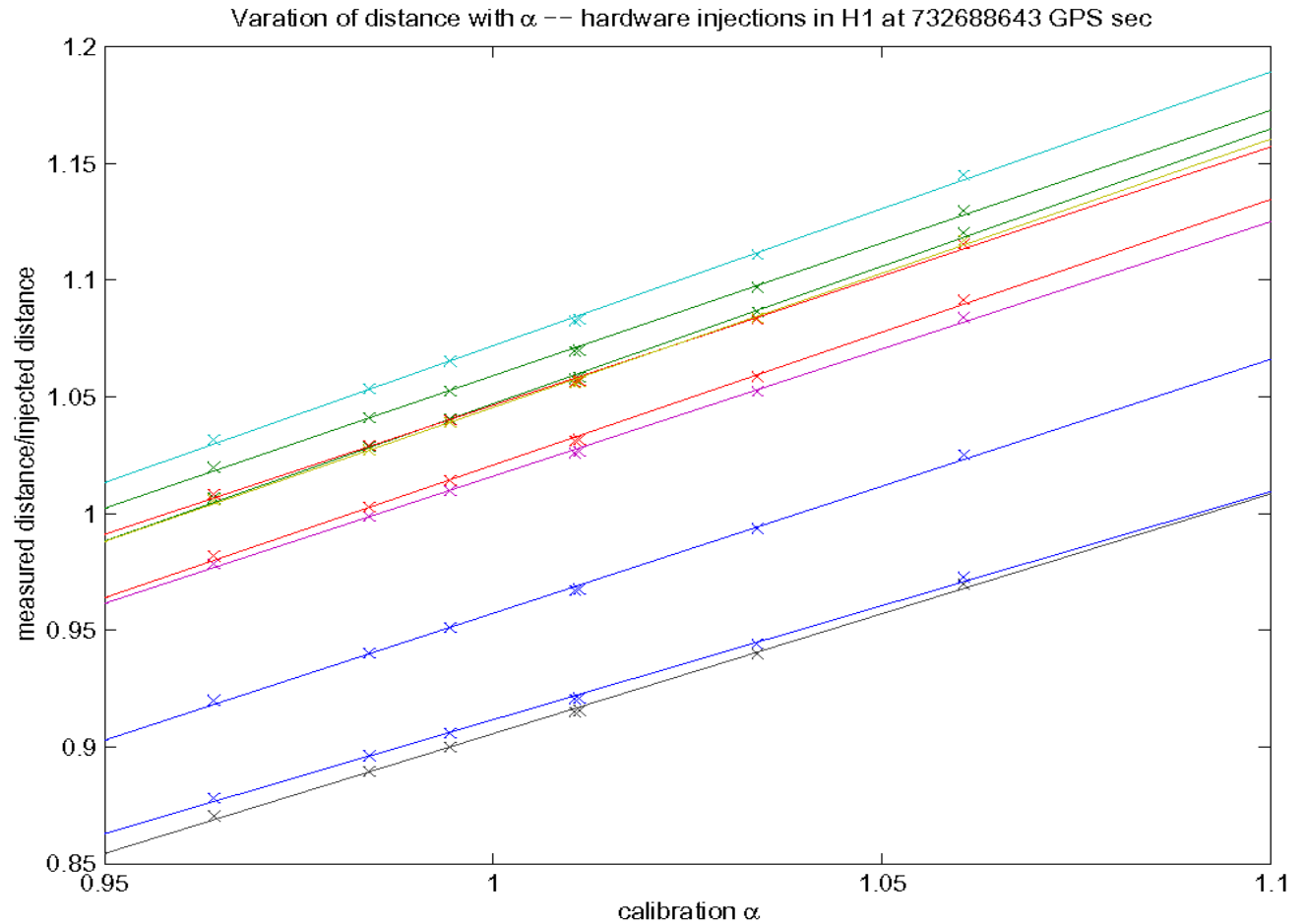
Distance Measurements – H1

- Distances accurate within 25%.

- Large variation from changing calibration time within chunk.

- Best results by averaging calibration over data chunk.

HW inj in H1 at 732690416 GPS sec
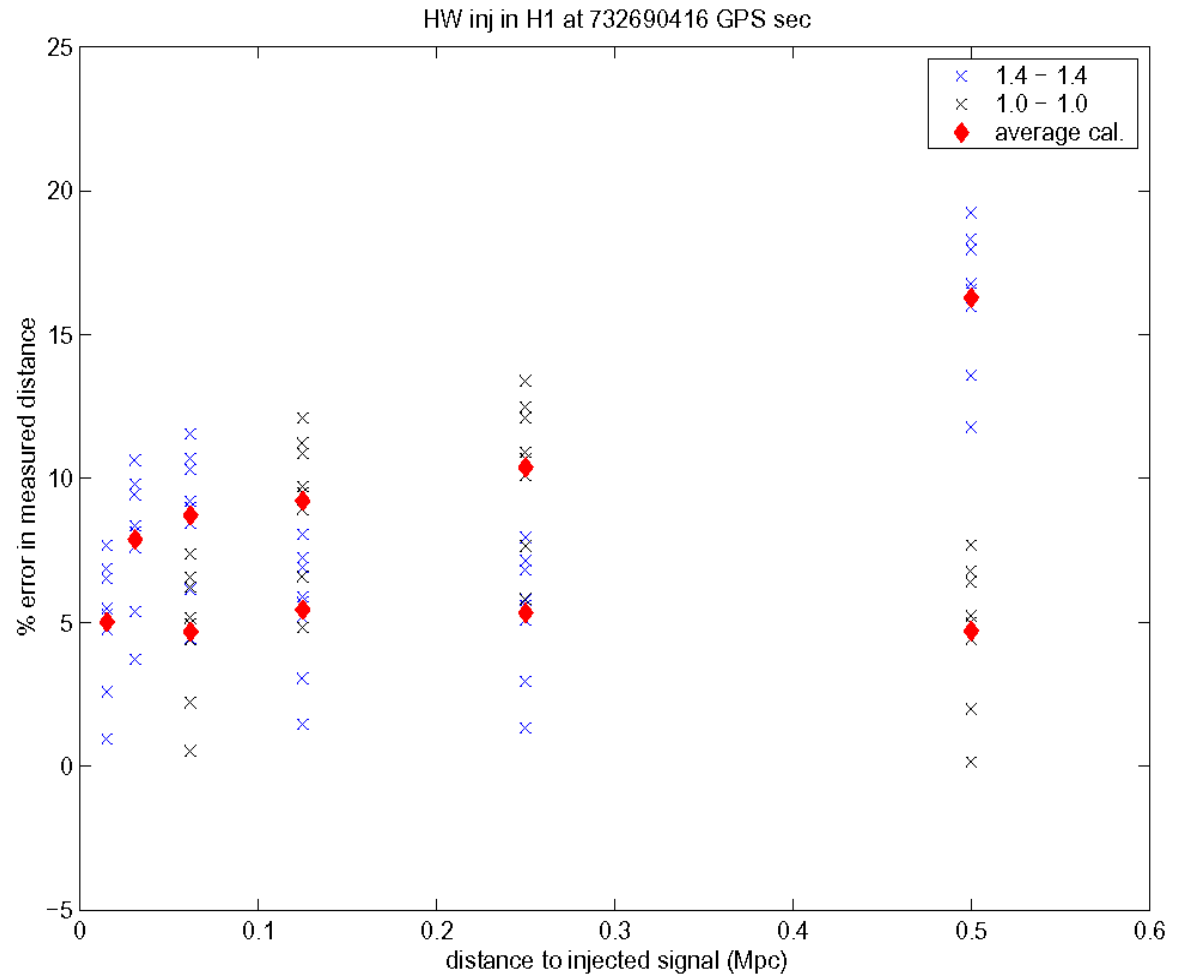
Variation of distance with a

- **Distance varies linearly with a, as expected.**

Variation of distance with α -- hardware injections in H1 at 732688643 GPS sec

Ending the Injection

- Recorded excitation in agreement with expectation.

- Sudden end of injection leads to low frequency excitation of AS_Q.

Comparison of excitation channel and AS_Q
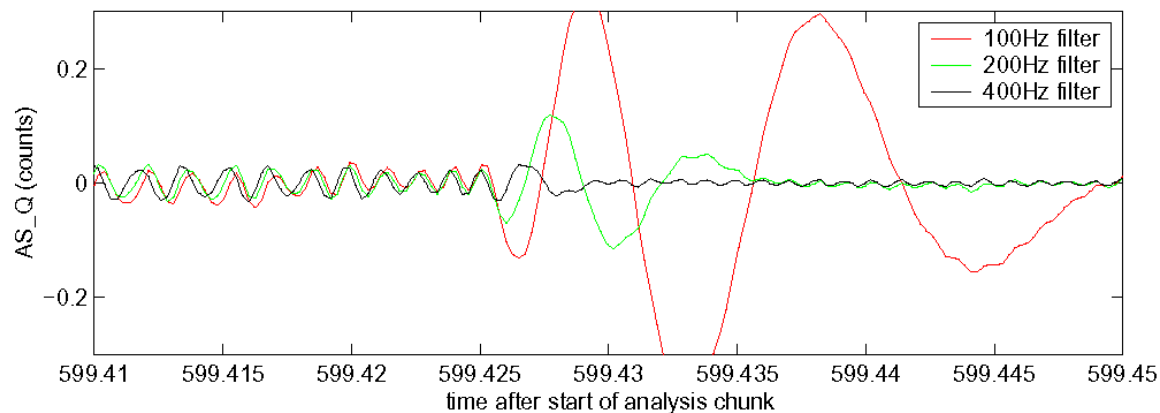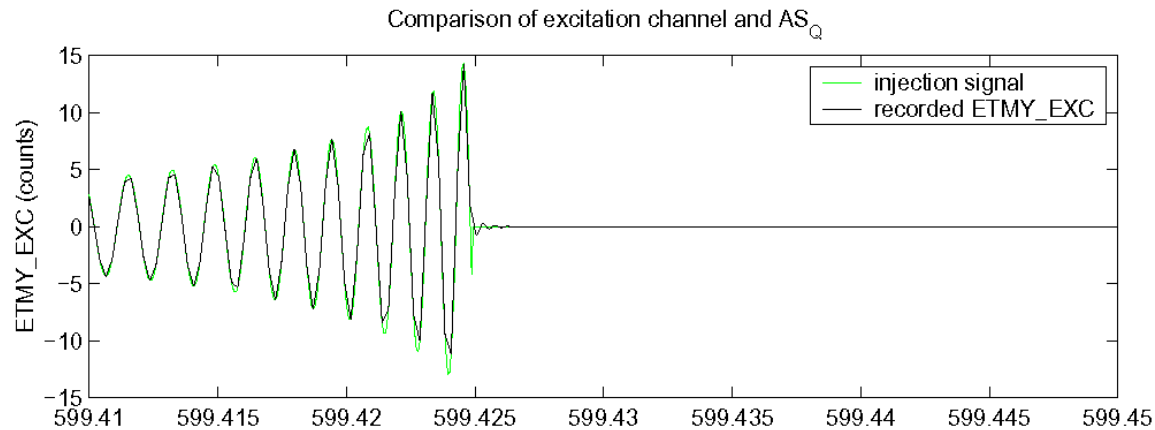
AS_Q excitations

- Excitation not seen in software injections.

Hardware injection at 15 kpc

Software injection at 10.4 kpc
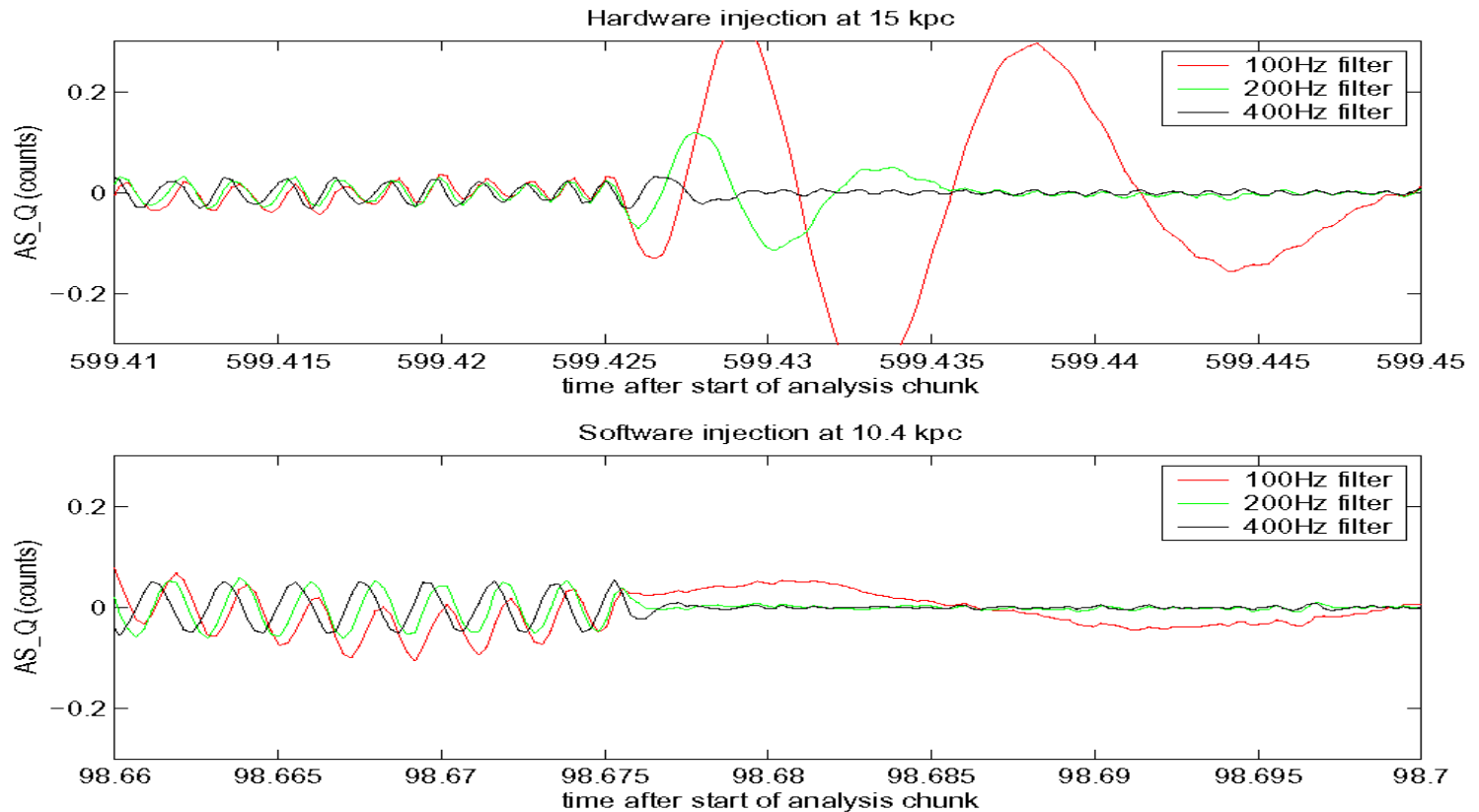
Plans for S3

- Inject signals at distances more appropriate to improved sensitivities. Distances between 100 kpc and 3 Mpc.

- Use more accurate actuation function, provided by calibration team.

- End injections more smoothly to eliminate excitation of AS_Q at end of injection.